



NX Series
Main-Standby Transmitter
System

All India Radio (AIR)

APPENDIX B

SODA LOAD AND DRY COOLER

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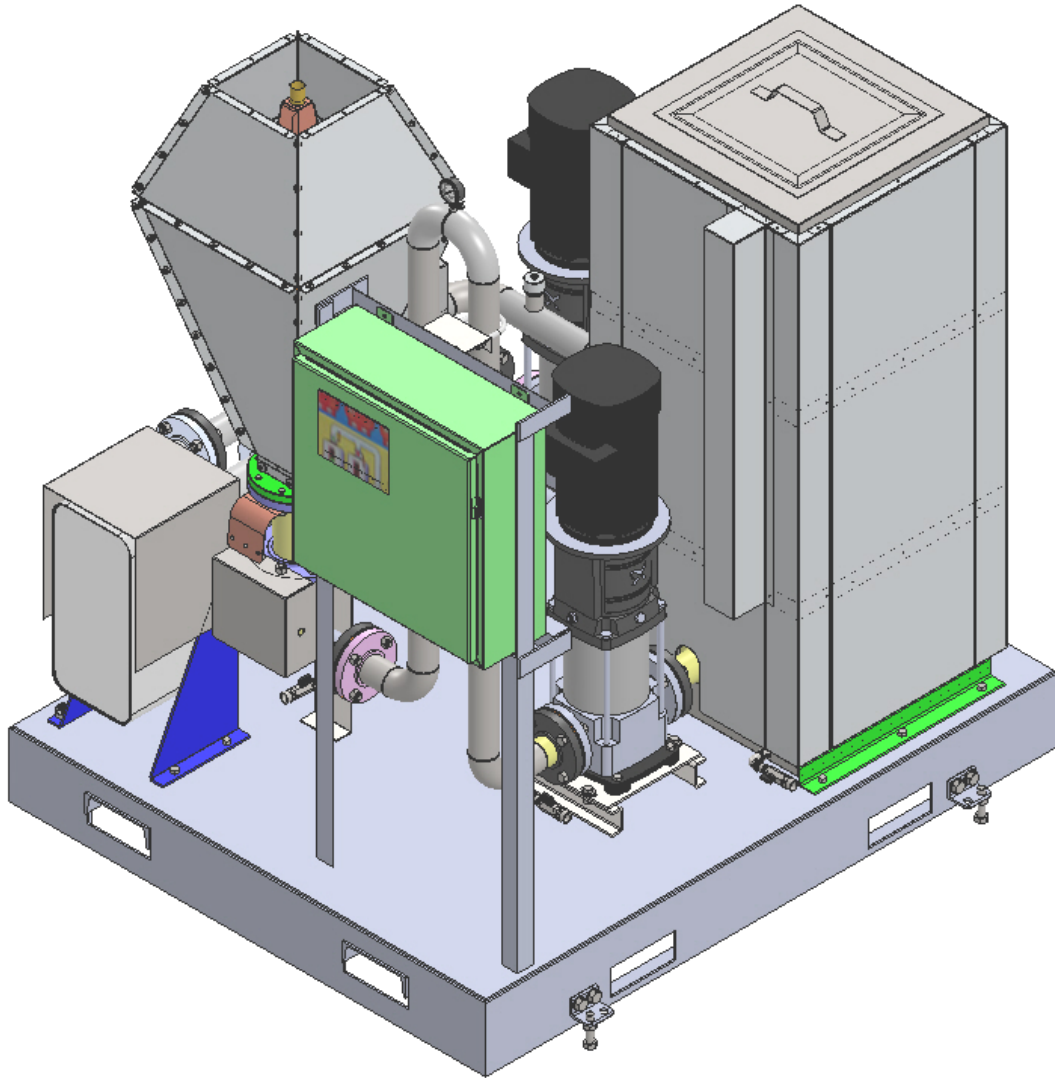
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PRELIMINARY MANUAL

MODEL 40400 / 40500 / 120 Ω

SODA LOAD





MODEL 40400 & 40500
120 Ω SODA LOAD
400/500 KW

LIMITED TWO-YEAR WARRANTY

We take pride in manufacturing products of the highest quality and we warrant them to the original purchaser to be free from defects in material and workmanship for the period of two years from date of invoice. Additionally, products of our manufacture repaired by us are warranted against defects in material and workmanship for a period of 90 days from date of invoice, with the provisions described herein.

Should a product, or a portion of a product of our manufacture prove faulty, in material or workmanship, during the life of this warranty, we hereby obligate ourselves, at our own discretion, to repair or replace such portions of the product as required to remedy such defect. If, in our judgment, such repair or replacement fails to be a satisfactory solution, our limit of obligation shall be no more than full refund of the purchase price.

This warranty is limited to products of our own manufacture. Equipment and components originating from other manufacturers are warranted only to the limits of that manufacturer's warranty to us. Furthermore, we shall not be liable for any injury, loss or damage, direct or consequential, arising out of the use, or misuse (by operation above rated capacities, repairs not made by us, or any misapplication) of the equipment. Before using, the user shall determine the suitability of the product for the intended use; and the user assumes all risk and liability whatsoever in connection therewith.

The foregoing is the only warranty of Altronic Research Incorporated and is in lieu of all other warranties expressed or implied.

Warranty returns shall first be authorized by the Customer Service Department and shall be shipped prepaid. **Warranty does not cover freight charges.**

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PRECAUTIONS

!!!DANGER!!!

Do not attempt any service or parts replacement without first disconnecting all AC power and RF power. Failure to do so may result in serious or *fatal electrical shock*.

!!!WARNING!!!

Before operating equipment insure interlock is operating properly. Not doing so can result in a dangerous, possibly lethal condition.

WARNING

Do not expose open tank to flames or sparks. The contents of the tank might be explosive.

WARNING

Ethylene Glycol may cause permanent damage to the kidneys, liver and other organs if ingested. Avoid excessive contact with skin or eyes. See the Material Safety Data Sheet for the specific precautions and first aid measures prescribed by the manufacturer.

WARNING!

USE OF ANYTHING OTHER THAN PURE POTABLE OR DISTILLED WATER OR A MIXTURE OF HIGH QUALITY PASSIFIED ETHYLENE GLYCOL (i.e. SR1) AND POTABLE WATER, OR USE OF A MIXTURE MORE CONCENTRATED THAN 50% ETHYLENE GLYCOL WILL VOID THE WARRANTY!!!

CAUTION

Operating without interlock will void the warranty.

INTRODUCTION

This handbook is for skilled technical personnel as an aid in understanding and performing installation, service and maintenance procedures for the OMEGALINE® Model 40400 & 40500 Soda Load. Personnel are considered to be skilled if they have the necessary knowledge and practical experience of electrical and radio engineering to appreciate the various hazards that can arise from working on radio transmitters, and to take appropriate precautions to ensure the safety of personnel.

SECTION I

DESCRIPTION AND LEADING PARTICULARS

- 1-1. Purpose and Application of Equipment.** The OMEGALINE® Model 40400 & 40500 Soda Loads are designed to safely dissipate a maximum of 400kW or 500 kW watts of electrical energy, respectively.
- 1-2. Sequence & Theory of Operation.** In preparation for operation, the soda load system is energized with AC Mains power (not RF power). A liquid heater is then switched on to warm the soda solution to a set point. This set point is usually 75°C to allow the system to work at high ambient temperatures. The set point temperature may be altered in the field to compensate for different soda mixture concentrations and/or lower ambient temperatures. When the soda solution has reached the set point (or sooner if transmitter is used to heat tank), RF power may be applied.

There are two isolated liquid loops in this system:

- The soda solution loop is an open (i.e. at atmospheric pressure) system that receives solute from the Tank. The Primary Pump directs it to the Resistor, thence to the Heat Exchanger and back to the Tank. There is no flow control valve in this loop.
- The water coolant loop is a closed (i.e. sealed and pressurized) system that receives water-based coolant from the Dry Cooler. The Secondary Pump directs the coolant to a 3-Way Valve, which divides the stream and sends a portion of it through the Heat Exchanger as necessary to maintain the Set Point. Excess coolant is combined with the Heat Exchanger discharge and returned to the Dry Cooler. There is no flow control valve in this loop.

Temperature measurements are made on the inlet and outlet ports of the soda cell. The temperature difference between these points is mathematically combined with the flow and specific heat of the soda solution and this calculation yields the applied power:

$$\text{Power in KW} = \text{Temperature Difference}(^{\circ}\text{C.}) \times \text{Flow(GPM)} \times 0.268$$

As applied RF power heats the soda solution flowing through the resistor, the inlet temperature must be decreased proportionally to maintain the average temperature in the load. Precise temperature control is achieved by using a 3-way valve controlled by a programmable logic controller. This valve mixes the hot water from the heat exchanger

with colder water from the cooler and maintains the required temperature to the coolant side of the heat exchanger. The position of this valve is proportional to a signal which is generated by the calorimetry/controller module. This signal is based on calculations derived from measurement of the cold-solute inlet of the load. This control process is augmented by a look-ahead algorithm based on projected power.

1-3. Digital Calorimetry. Digital calorimetry is included in the soda load package. This operates at both high and low power block settings with accurate and repeatable measurements. A programmable logic controller utilizes this high-speed calorimetric data and provides totally automatic control of the soda load system. Additionally, it adapts to changing environmental conditions. The program continuously scans for fault conditions and protects the soda load and transmitter in fault conditions whenever transmitter power is applied to the load. Safety points monitored include soda solution flow, temperature and soda solution tank level.

1-4. Resistive Components. The resistive element is constructed using two non-conductive tubes; one smaller tube is placed inside a larger tube. The cross-sectional area of these tubes is selected to provide the required fluid flow rates while minimizing pressure drops. The tubes are mounted on a dual sweep elbow. The soda solution flows into the smaller tube up to a housing cap at the top. It is diverted down through the cavity between the small OD and the large ID tubes. When it reaches the outlet elbow, it is directed to the system heat exchanger for heat removal.

The top housing cap is metallic. The RF energy is applied at this point. The dual sweep elbow serves as ground and the termination point for RF signals. The complete resistive element assembly is enclosed in a semi-log tapered outer shield. The spacing at the RF end is dimensioned to match the source impedance. The shape tapers as it approaches the ground end. This matches the impedance of the solution as it approaches ground.

There are many factors that determine the resistive component of the load. The liquid cross-sectional area, length and metal surface contact area are fixed by the design. The concentration and temperature of the soda solution (solute) are variable and controlled by the operator.

SECTION II

DRY COOLER INSTALLATION

WARNING: The Dry Cooler weighs approx. 3,000 pounds / 1,361 kilograms. Use caution when unpacking and lifting.

- 2.1 **Inspection Prior to Unpacking.** Inspect outer carton for evidence of damage during shipment. The Dry Cooler is pressurized to 14 psi/97kPa at the time of shipment. This pressure should be checked **prior to unpacking**. [There is a Shrader valve installed in one of the blind coolant flanges on the Dry Cooler. Use an ordinary tire pressure gauge to check the pressure at this point.] If the pressure is below 14 psi/97kPa, the Dry Cooler may be damaged. Appropriate investigation of the condition of the unit should be initiated at once. We suggest that the user collect and preserve all documentation such as Bills of Lading, Manifests, etc. *Claims for damage in shipment must be filed promptly with the transportation company involved. Altronic Research Inc. is not responsible for damage incurred in transportation.*
- 2.2 **Unpacking.** Remove crating. The cooler and leg assemblies are mounted to the shipping platform with lag bolts. All of these bolts must be removed. The expansion tank has to be removed from the shipping platform and installed after the Dry Cooler is assembled and placed in position in some configurations.

Special Equipment Required: Crane—Adequate capacity with lifting slings.

Attachment A – Installation, Operation and Maintenance contains detailed sling, spreader bar and lifting instructions. Personnel who are to perform the task of lifting the unit should read and follow these directions to avoid damage to the coil assembly.

Site Plan. The final plan for this installation must be developed on-site and is beyond the scope of this manual. **See Attachment B: Dry Cooler Foundation Dimension Plan for dimensions.** We recommend placing the Dry Cooler and Soda Load on level ground with no more than 2 feet (.61 meter) above the plate exchanger base on a 4-inch (10.2 cm) concrete reinforced pad with a leak containment basin. If used within 1 mile (1.6 km) of a seashore, the Dry Cooler coils should be coated with Herrisite SP.

- 2.3 **Assembly.** The manufacturer of the Dry Cooler has prepared detailed plans for assembly and installation of the Dry Cooler. They are included in this manual as Attachments A through C. Be certain that these instructions are read and understood before beginning the installation work. The basic steps are summarized below:
- Prepare footing for placement.
 - Lift cooler coil assembly and install mounting legs (on some units).
 - Position Dry Cooler in installation spot and securely bolt it in place.
 - Install expansion tank if not installed prior to shipment. The required fittings are provided to plumb the tank to the Dry Cooler.

- 2.4. **Plumbing Installation Tasks.** Plumb the glycol-water coolant lines (supply & return) to the load.

Equipment Required: Steel Pipe Threading machine with capacity up to 3-inch/7.62cm dies.

1. Connect 2 ½-inch/6.35cm source and drain lines.
 - a. Fabricate pipe and assemble to fittings.
 - b. Install in accordance with site plan.

MATERIALS LIST

QTY	ITEM
TBD	2 ½ in./6.35cm Flange seal sets
TBD	2 ½ in./6.35cm Flange seal sets
TBD	2 ½ in./6.35cm to 3 in./7.62cm threaded reducers steel
TBD	2 ½ in./6.35cm Elbows steel
TBD	2 ½ in./6.35cm Flange 150lb./68kg. threaded w/nuts & bolts
TBD	2 ½ in./6.35cm Flange 150lb./68kg. threaded w/nuts & bolts
As required	2 ½ in./6.35cm steel pipe - Schedule 40
As required	Thread sealer
As required	Pipe wrenches
As required	Large socket set and wrenches to connect flanges

NOTES FOR THE DESIGNER/ENGINEER

When designing and installing piping for coolant, it is necessary to provide fill valves, air-purge valves and drain valves at appropriate points in the piping.

FILL VALVES because filling must be done by using a pump and hose to supply coolant to the system. This valve must be fitted with a nipple and suitable connector for pressurized coolant.

AIR PURGE VALVES because air must be purged from the usually closed system during coolant filling operations. These valves must be located at the highest point of the piping.

DRAIN VALVES because it is necessary to drain coolant from the system for long term storage and/or for maintenance.

Ordinary black pipe is adequate for coolant piping. Plastic pipe is not recommended due to the temperature of the coolant and the effect of ultraviolet radiation on plastic. We recommend that all piping be painted white with an oil-based or alkyd-based exterior paint in order to limit corrosion and heat gain.

PLUMBING PURGING AND CLEANUP

Prior to pressure testing and initial fill, the new plumbing must be cleaned of any debris, metal cuttings, oils, etc. Remove any debris on the air inlet side of the finned tubes by shutting off the fans and blowing air or a water spray in the reverse direction. Straighten any fins that may have been bent during cleaning. See the Dry Cooler Maintenance section in Attachment A for more detailed instructions.

Charging of the water coolant fluid system and leak tests will be performed after installation of soda load. See Section V for instructions.

2.5. Electrical Installation Tasks. Connect the AC Mains and control cables.

1. Route high voltage wiring from AC Mains service to Dry Cooler. Ensure that the supply voltage matches the specified motor voltage.
2. Route control wiring from Dry Cooler to Soda Load Electrical Interface Control Box. This cable should be installed in site-appropriate conduit (~ ½ inch/12.7mm diameter) for appropriate 8-conductor control cable.
3. Once all cables are installed, ensure that the Dry Cooler does not have a RUN signal from the Soda Load and then energize AC Mains power to the Dry Cooler.
4. Check motor rotation by momentarily starting fans. This is accomplished by manually depressing the armature of any fan motor contactor for a few seconds while another person checks the direction of airflow from that fan.
5. The proper airflow direction is bottom to top. If the airflow is incorrect, reverse two wires of the input power at the AC Mains connection and recheck.

SECTION III

SODA LOAD INSTALLATION

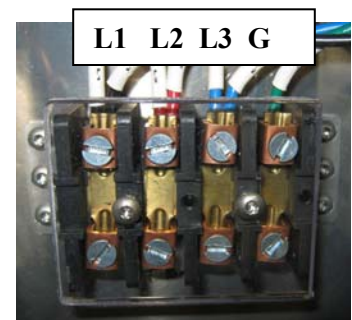
- 3.1. **Inspection.** Inspect for damage. Compare packing list with shipment.
- 3.2. **Unpacking.** Remove packaging and crating. The Soda Load was shipped partially disassembled. Place in prepared area with an adequate drain or basin to catch any possible liquid leakage.
- 3.3. **Hopper Assembly.** Refer to assembly instructions included in shipping documents.
- 3.4. **Leveling.** Four leveling and anchoring bolts are built into the soda frame assembly. They must be adjusted to level the Soda Load assembly. Holes are provided for anchoring.
- 3.5. **Equipment and Materials Required:**

1. Analyzer to monitor impedance and phase of load with plotter/printer data recording device.
2. Provided: Sodium Carbonate powder (Na_2CO_3) (also known as Potash) 4 liters.
3. Safety Equipment: Safety Goggles, Face Shield & Rubber Gloves.
4. Spectrum analyzer to look for harmonics. (OPTIONAL)

3.6. **Install Additional Earth Ground:**



Bottom of Resistor



- 3.7. **Connecting AC Mains.**
1. Connect L1, L2, L3 from 400 VAC 50 Hz Delta AC Mains supply to terminal block.
 2. Connect safety ground.

- 3.8. **Verify Pump Rotation.** Manually close each pump contactor momentarily to check proper rotation.
NOTE: There are arrow markings on the top of the pump indicating direction of proper rotation.

IF WRONG ROTATION:

Disconnect and lock out AC Mains power to Electrical Interface Control Box.
Exchange 2 wires of the AC Mains supply at terminal strip.
Reconnect AC Mains supply.

Turn on the main circuit breaker in the Electrical Interface Control Box and verify proper pump rotation.

IF CORRECT ROTATION:

Set breaker to OFF.

Install all safety covers for AC terminal strip.

Proceed to next step.

3.9 Soda Load Operation

1. Set Control Breaker to ON.
2. Verify Soda Load operation.
3. Temperature indicators indicate proper temperature.
4. Flow meter indicates proper flow.
5. Alarm status indicators green.
6. Communications operational: CPU, Display, Sensors, and Controls.

3.10 Transmitter Interlock Relay

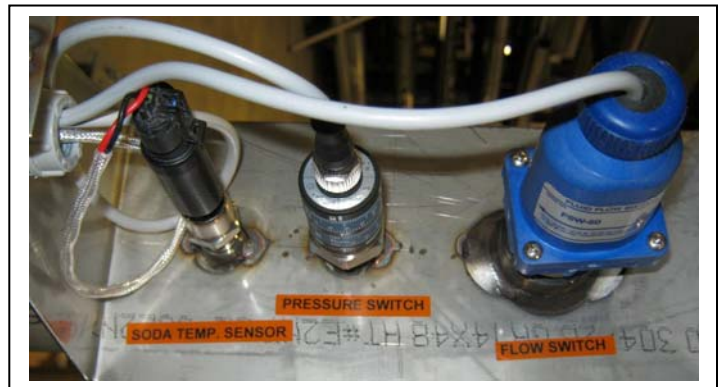
There are five (5) mechanical switches wired in series providing power to the relay. The PLC provides a ground. Loss of any switch closure will disable the transmitter.



NOTE: The interlock relay contacts are isolated. The enabled condition has a closure across the NO contacts. This is wired in a fail-safe arrangement.

Following are the switches in the interlock relay circuit:

- Water Coolant (Secondary) Flow Switch
- Soda Flow Switch
- Soda Pressure Switch
- Solute Tank Low Level Switch
- Soda PLC/Flow-meter Low Flow
(part of control system)



3.11 Interlock Connection and Verification

1. Install interlock and hook up to transmitter. (See schematic diagram)
2. Insure transmitter will not run.
3. Insure the transmitter has received an enable signal.

3.12 Charging and Leak Test

1. Fill soda tank with hot distilled water to 2-6 inches (5.1-15.2 cm) above the pump suction input from the tank. **NOTE:** Filling with hot water will speed up testing, but is otherwise unnecessary.
2. Set breaker to the ON position.
3. Open the bleeder valve on the pump.
4. Vent until liquid comes out, then close the valve.
5. Momentarily depress the pump starter relay (<1 second)
6. Open the bleeder valve on the pump.
7. Vent until liquid comes out, then close the bleeder valve.
8. Press and hold the starter contact on the pump relay for 5 seconds. The pump will change sounds as it primes and the pressure gauge should indicate ~ 10-15 PSI within 5 seconds.
9. Release the starter contact. If the pump does not prime, repeat steps 3 through 7.
10. Look for leaks and correct, if necessary.
11. Fill the tank with hot water to 2 inches (5.1cm) below the upper level sensor section in the tank. **NOTE: *Bleed the soda pump air bleed port after the tank is filled and before starting the pump. Failure to accomplish this will result in damage to the pump.***
12. The heaters may automatically turn on if the temperature is below the programmable temperature.
13. Change the display to the control screen by pressing the menu button.
14. Press the "Soda Pump ON" button. The pump should start.
NOTE: If there is a fault, i.e.: no flow, low liquid level in tank, low pressure, no communications between PLC and display, the pump will automatically shut down within 15 seconds. Look for the fault, correct it and repeat step 14.
15. Look for leaks.

IF a leak is detected:

16. Press the Red Emergency Switch button IN.
17. Press the "Pump OFF" button.
18. Fix leaks.
19. Twist the Emergency Push Button to Reset. Repeat step 14.

IF there are no leaks the Soda System is operational.

20. Connect the facility cooling water to the soda system.
21. Pressurize and look for leaks on the secondary side of the plumbing system.
22. Monitor the interlock circuitry and verify that a transmitter enable signal is enabled.
23. Press the red Emergency Push Button on the front of the load.
24. Monitor the interlock circuitry and verify that the transmitter enable signal is removed.
25. Twist the Emergency Push Button to reset.
26. Set set-point temperature to 70°C. This is the approximate operational temperature of the system at this point.
27. Connect the "N" cables to the loads using the adapters.
28. Calibrate the analyzers.
29. Connect the cables to the adapter.
30. **NOTE:** The measured data at this time is just water. It will not be a usable impedance but plot it anyway for future reference.
31. Record and install new paper.
32. Put on the below-described Personal Protective Equipment.

NOTE: Liquid-proof safety glasses, face shield and rubber gloves should be used for the following steps in the commissioning procedure. The addition of sodium carbonate to water may cause bubbling/splashing of the hot solution.

When the solution has reached approximately 75° C, slowly pour the sodium carbonate (soda) into the water through the top of the tank. Pouring small portions and distributing the soda across the boundaries of the tank prevents the mixture from clotting and dropping to the bottom of the tank. The soda is shipped in a separate container. Begin by mixing about 1 liter of the soda into the water. The end mixture will vary with the type of water used, so start with less soda than you think will be needed. Use a network analyzer or RX meter to measure. **NOTE: The impedance will decrease about 2 ohms per °C. increase in temperature. The approximate impedance at this point should be 140 ohms.**

33. The final adjustment will be made later when RF is applied and the mixture is heated to 75° C by the applied RF. Low level RF power may be applied until the set point of 75° C is reached. At this time, additional soda may be added as the reflected power is observed. The time delay between adding soda and the impedance changing is about 1 minute. Add small amounts of soda, i.e., less than 10ml, as the mixture approaches the desired level as indicated by a low reflected signal. The reflected power will drop to zero when the proper impedance is achieved. **NOTE: The exact impedance of the load is temperature sensitive. The required RF conductance is 120 ohms @ 75° C. For operation at 50° ambient, lower set point for lower ambient conditions.**

3.13 Preparation for Reshipment

Prior to shipment, drain fluids and use air to blow out any excess fluids. It is not required to clean or flush the unit.

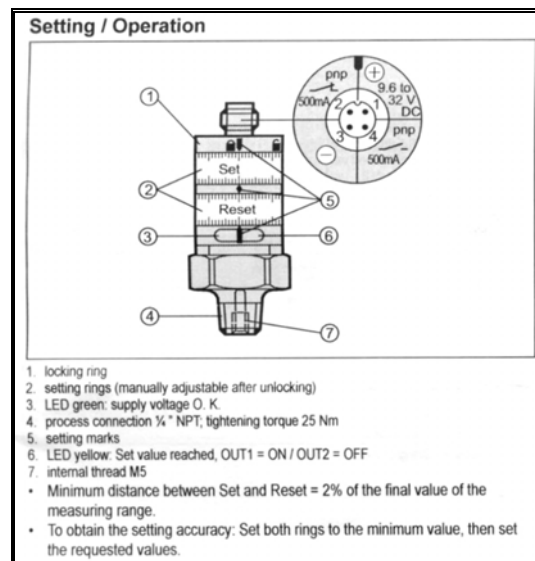
3.14 Long-term Storage

Soda Load can be stored with soda and glycol mixtures in place for extended periods, i.e.: 4 to 6 months. The pumps should be run periodically as a maintenance activity. Adjustments (add water or soda) may need to be made after long-term storage. It is recommended to allow several hours of run time after long periods of storage to allow soda to remix with water prior to adding any ingredients.

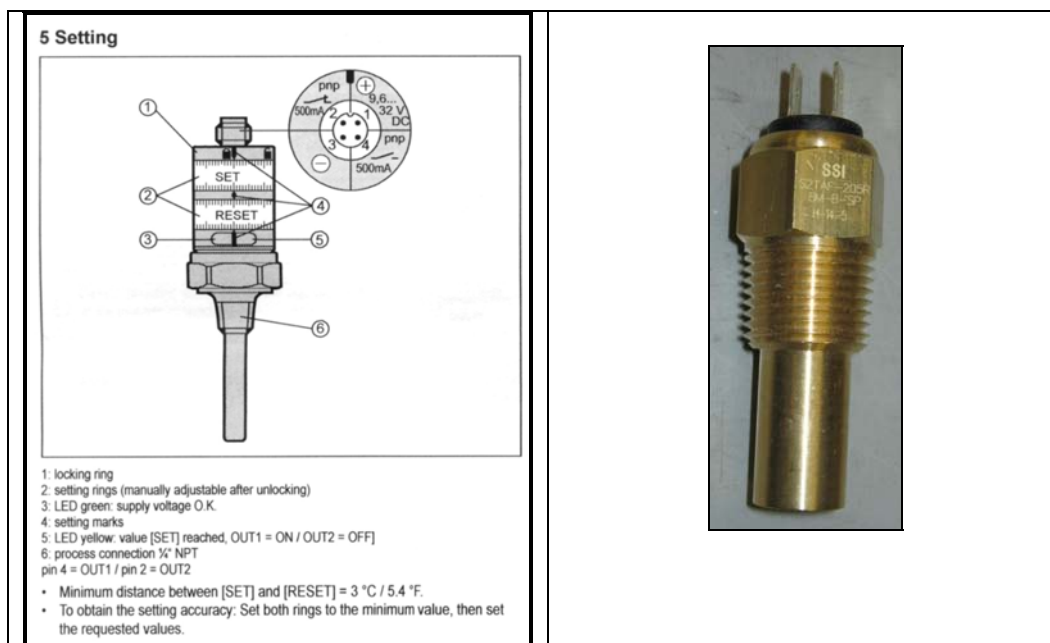
SECTION IV

CALIBRATIONS

- 4.1. **Testing and Calibration.** To start soda load verification, calibrate the soda flow meter as follows: With low power (<50kW) out of the transmitter, adjust the flow gain parameter in the offsets screen of the program until the displayed power matches the applied RF power. This parameter will be adjusted at high power levels for final calibration.
- 4.2. **Soda Pressure Switch Adjustment.** The switch is adjusted at the factory to close at the standard flow and to open if the pressure drops. (see below)



- 4.3. **Temperature Sensors.** The temperature sensors are set at the factory and no adjustments are required. (see below)



- 4.4. **Soda Flow Switch.** The flow switch is set by the factory and no adjustment is required.
- 4.5. **Water Coolant Flow Switch.** The flow switch is set from the factory and no adjustment is required.
- 4.6. **Emergency Stop Verification.** When the system is operating, press the E-Stop Button. All heaters, valves and pumps should stop and transmitter enable signal must be automatically removed.
- 4.7. **High and Low Liquid Level Switch Verification.** There are no adjustments for these items. If either fails to work, remove and replace.

NOTE: The transmitter will have to be reset when an interlock trip condition has existed. Apply minimum power. Verify calorimetry in accordance with Para. 4.2.

4.8 **Medium Power Testing.**

- a. Apply medium RF power, high setting, no modulation.
- b. Monitor calorimetry indications for accuracy.
- c. Record the VSWR as displayed by the transmitter control panel.
- d. Remove RF power and record the time required for the coolant temperature stabilization. Record these times.

4.9 **High Power Testing.**

- a. Apply about 2/3 full power.
- b. Note VSWR and calorimetry reading.
- c. After the temperature control loop has stabilized, the power may be increased slowly to full power. **The hot temperature must not exceed 90 degrees C. or the transmitter will shut down.**
- d. If VSWR and calorimetry are within acceptable limits, the RF may be applied in ramp or stepped operation.
- e. Full power without modulations may be applied for about 30 seconds. This allows the coolant loop to lower the cold inlet temperature. After it is lowered, the full modulation may be applied.

4.10 3-Way Valve Initial Programming. The valve controller is programmed from the factory to operate in the analog mode. If this program is lost or changed, the controller will need to be programmed before operation:

Programming – Change of control signal & PWM pulse setting

1. Remove power and put all dip switches "OFF" (default setting).
2. Apply power and, **within 10 seconds**, press and release the reset button. The LED should be blinking.
3. Select the control signal with dip switches:

	Digital or Analog Modes	PWM Mode
Move switch No1 "ON" and then "OFF".	Digital (On/Off or 3 point floating)	5 sec. pulse (default setting)
Move switch No2 "ON" and then "OFF".	Analog (Default)	25 sec. pulse

Stroke adjustment

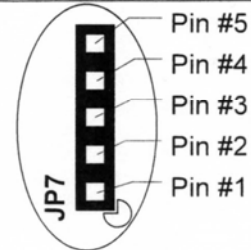
see the stroke adjustment section above.

Enabling or disabling PWM mode

1. Remove power supply to actuator
2. Install jumper between pin 3 & 4 of JP7
3. Select the desired action using the dipswitches (DS1):

DS1-1	DS1-2	Action
OFF	ON	Enable PWM Mode
ON	OFF	Disable PWM Mode

4. Re-apply power supply to actuator
5. **Wait 5 seconds**
6. Remove power supply to actuator
7. Remove jumper between pin 3 & 4 of JP7, re-install it between pin 4 & 5.
8. Re-apply power supply to actuator
PWM is factory preset at 5 sec. pulse, refer to programming section above to change pulse setting.



When not used for programming, jumper is placed between pin 4 & 5

SECTION V

WATER COOLANT CHARGING AND LEAK TEST

PLUMBING PURGING AND CLEANUP

Prior to pressure testing and initial fill, the new plumbing must be cleaned of any debris, metal cuttings, oils, etc.

5-1. Water Coolant System Leak Check.

There are valves on the sight gage that must be opened when sight gage is utilized and a 1 atm pressure relief valve in the top of the expansion tank

- a. Apply 14psi/97kPa dry air pressure to the water coolant system. Pressure may be applied at any accessible point on the system. Close off the filling valve and allow 30 minutes for leaks to appear. The system has a large volume. After the prescribed time, observe the pressure reading. If there is a drop in pressure, leak isolation must be performed. A spray bottle filled with a soap mixture aids in isolating leaks.
- b. After a leak-free system is verified, vent the air pressure applied for testing and open the isolation valve to the surge tank.

- 5-2. Water Coolant System Coolant Charging. The water coolant system may be charged at the drain at the inlet side of the secondary pump. The vent valve located at the top manifold of the Dry Cooler may be opened to vent air from the system. **NOTE:** The system volume is varied by the length of connecting pipe. Consult site drawings.

WARNING!

DO NOT USE ANY STOP LEAK, SEALANTS, OR AUTOMOTIVE ANTIFREEZE IN COOLANT. USE OF ANYTHING OTHER THAN PURE POTABLE/DISTILLED WATER OR A MIXTURE OF HIGH QUALITY PASSIFIED ETHYLENE GLYCOL (i.e. SR1) AND POTABLE WATER, OR USE OF A MIXTURE MORE CONCENTRATED THAN 50% ETHYLENE GLYCOL WILL VOID THE WARRANTY!!!

- a. Prepare a 10-40% solution (depending on lowest ambient temperature) of corrosion inhibited ethylene glycol (Dow SR1 or equivalent) and distilled and/or potable/drinking water suitable for human consumption in an appropriate container. The U.S. Environmental Protection Agency has established standards for potable water at a maximum of 500 ppm of dissolved solids. The coolant mixture must be pumped into the system at the water coolant charging port with a small pump such as a Wayne utility transfer water pump. Connect water + glycol source to Dry Cooler liquid lines. Pump this mixture into the cooling system. Charge to proper level. **NOTE: Bleed the water coolant pump vent port after the water coolant system is charged. It will be air-locked. Failure to accomplish this will result in damage to the pump.**
- b. The air will have to be bled at the Dry Cooler vent port and at the high points of the plumbing.

- c. As the system approaches the proper level, the air will have to be bled at the water coolant charging port.
- d. Bleed air from all vents.
- e. The water coolant pump will have to be bled and allowed to prime the pump cavity.
- f. Close the water coolant charging port valve.
- g. Momentarily press the water coolant motor starter to verify proper pump rotation.

The initial start up of the pump is a repeated process. The vent plug on the pump has to be bled until the air is out, closed, and the pump run again using the manual button on the motor starter contact. When the system is free from air, the pump will run evenly and the pressure will be constant up to a maximum TBD psi.

- 5.3. **Soda System Drains.** The soda system may be drained at the valve located near the bottom of the tank. There is a hose connection located below the AC control box. This connection is plumbed to the low points of the soda system. There are 3 valves that must be repositioned to drain the soda side. **NOTE:** After the system is drained, these valves must be closed prior to recharging the system.

HEATER WARNING

**DISCONNECT AND LOCKOUT AC MAINS POWER TO THE
SODA LOAD BEFORE DRAINING SODA SYSTEM TANK.
OPERATION OF THE SODA TANK HEATERS WHEN THEY ARE
NOT COMPLETELY COVERED IN LIQUID WILL RESULT
IN IMMEDIATE FAILURE!**

- 5.4. **Water Coolant Drains.** All water-cooling drains are required to fully drain. The Dry Cooler side of the system may be partially drained at the fill port. There are valves located at the low points of the water coolant plumbing. **NOTE:** Be sure to close drain valves prior to recharging the system.

SECTION VI

RESISTOR DESCRIPTION

The Altronic 400/500 KW Soda Load Resistor consists of three sections combined to absorb RF power and to act as a cooling medium for removal of heat from the load. Section one is a 4-inch diameter segment of polypropylene tube. Section two is a 2 ½ -inch piece of polypropylene tube, with the same length and position inside the housing as section one. The last section is the outer conductor, which is a tapered sheet metal housing. Water enters from the flanged connection at the bottom of the load, and flows up through the center of the 4-inch tube. After reaching the top of the 4-inch tube, water flows down between the 2 ½ -inch and 4-inch tube. Water leaves the resistor through the flanged connection on side two of the load. The shape of the outer conductor is used to set the VSWR of the dummy load.

WARNING!!!

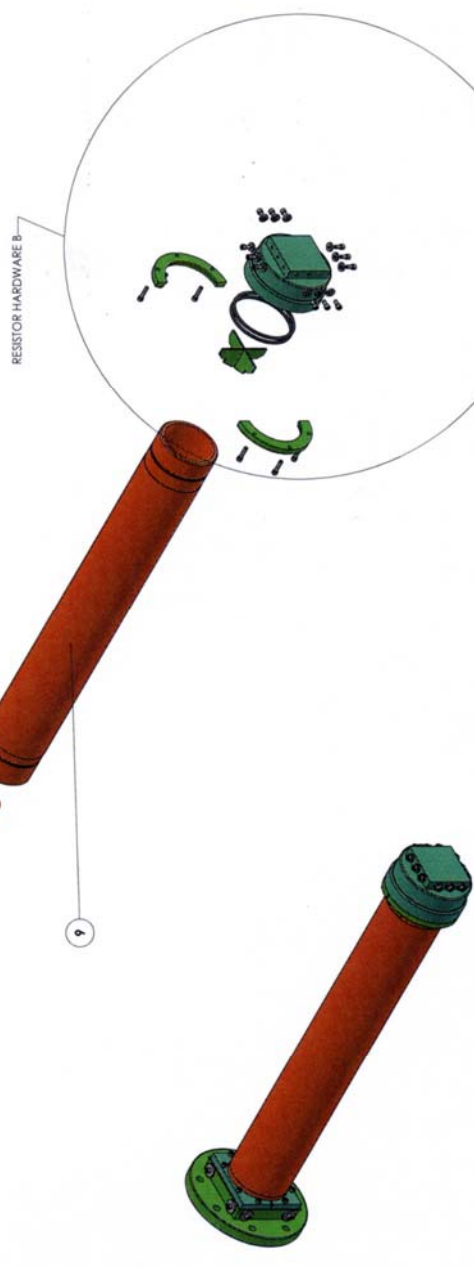
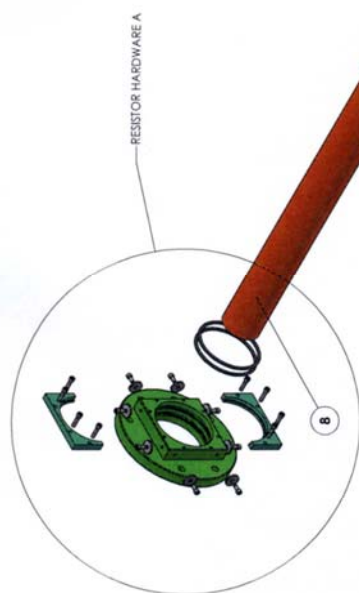
OPERATION OF THE DUMMY LOAD WITHOUT THE RESISTOR HOUSING IN PLACE COULD CAUSE FATAL INJURIES AND DAMAGE THE LOAD.

RESISTOR MAINTENANCE

The Altronic 400/500 KW Soda Load Resistor will require little in the way of maintenance. Components located inside the resistor assembly other than the resistor element are not subject to field maintenance. The resistor is field replaceable in those instances where there is no extensive damage to the resistor contacts or rupture of the water jacket, due to improper operation of the load. In the event of mechanical damage to the unit, operational difficulty, or information concerning a desired unusual application of the load, contact the factory.

Minor repairs can be accomplished without removing the resistor from the load. If it is found that the 4-inch polypropylene tube has to be replaced, the resistor must be removed from the load. Please contact the factory for instructions. The following page shows the resistor assembly.

ITEM NO.	Part No	DESCRIPTION	QTY.	MATERIAL
1	000-40500-0209	LOCATING CROSS PART A	1	BRASS(IN) BAR (2X.125")
2	000-40500-0210	LOCATING CROSS PART B	1	BRASS(IN) BAR (2X.125")
3	000-40500-0203	OUTER TUBE RETAINER	2	1/2" X 5' 3/40 BRASS BAR
4	000-40500-0201	CAP RETAINER RING	1	BRASS(IN) ROD 6" DIA.
5	000-40500-0201	CAP RETAINER RING	1	BRASS(IN) ROD 6" DIA.
6	000-40500-0204	OUTER TUBE FLANGE	1	BRASS(IN) 10" SOLID
7	000-40500-0202	RESISTOR CAP	1	6" BRASS FULL ROUND
8	000-40500-0206	INNER TUBE	1	PIPE(IN), 2-1/2" POLYPROPYLENE NAT SCH 80
9	000-40500-0205	OUTER RESISTOR TUBE	1	PIPE(IN), 4" POLYPROPYLENE NATURAL SCH 80
10	010-01420-100	25-20 X 1.0 BOLT	6	304 SS
11	010-01420-012	.28IN-20 X .50IN SCREW	20	304 SS
12	000-40500-0223	25 X Ø 1.00 SILVERPLATED WASHER	8	BRASS(IN) ROD 1 1/16 DIA
13	021-EP348-000	ASS68-348 ORING	4	EPDM
14	010-01420-100	25-20 X 1.0 BOLT	8	304 SS
15	000-40500-0222	25 X Ø .625 SILVERPLATED WASHER	12	BRASS(IN) ROD 11/16 DIA



NOTES

DATE	DESCRIPTION	BY	CHK	DATE
	UPPER RESISTOR			

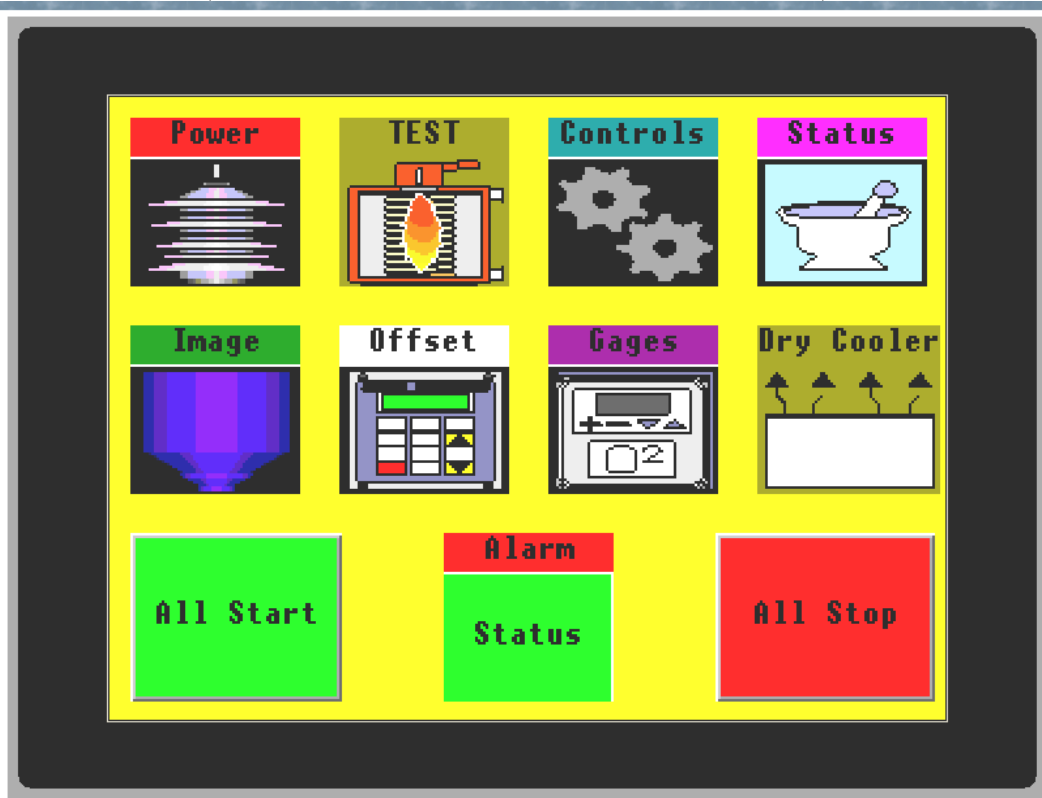
Altronic Research, Inc.
 7101 W. Highway 7187, U.S.A.

ITEM NO.	DESCRIPTION	QTY.	UNIT
1	UPPER RESISTOR	1	

SCALE: 1:1
 SHEET 1 OF 15

SECTION VII

PROGRAM INSTRUCTIONS (MAY VARY FROM ILLUSTRATIONS)



When power is applied this screen is displayed. Each of the squares are touch switches and will advance to the selected screen. The Hard key located in the lower left of the screen area will cause the program to always return to this menu screen.

Power switch to small monitor screen.

Test switch to large monitor screen.

Control switch to manual control screen.

Status switch to status display screen.

Image switch to picture control screen.

Offset switch to system constants screen.

Gage switch to Gage view power indicator.

Dry Cooler switch to dry cooler indicators.

All Start will turn on the pumps, heaters and the dry cooler.

All Stop will turn off the pumps, heaters, and the dry cooler.

Alarm Status will display the alarms and allow reset of manual alarms.

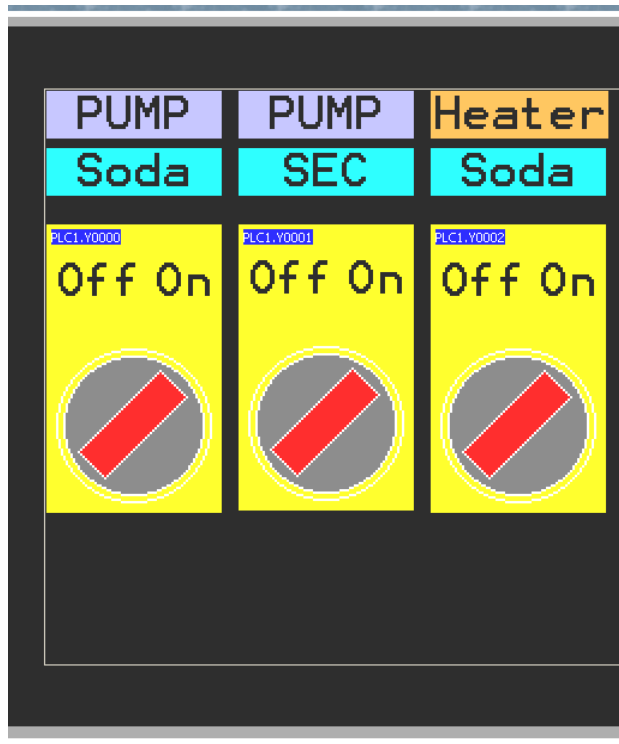


- The Power 1 screen displays the applied power.
- The temperature of the soda solution exiting the load.
- The temperature of the cold soda solution entering the load.
- The difference between the Hot and Cold Ports.
- The flow in Gallon per Minute of the soda system.
- The temperature of the cold solution from the Dry Cooler.
- The Soda Heater On; Dry Cooler Fans currently in operation; 3-way valve position.



- The Power 2 screen displays the applied power.
- The temperature of the soda solution exiting the load.
- The temperature of the cold soda solution entering the load.
- The difference between the Hot and Cold Ports.
- The flow in Gallon per Minute of the soda system.
- The temperature of the cold solution from the Dry Cooler.
- T Temp is measuring the soda tank temperature.

This screen displays the same information as the Power 1 screen with the power portion of the display being enlarged for distant viewing.



**The control screen allows the switches for power control.
The soda pump may be started or stopped.
The water coolant pump may be started or stopped.
The heaters may be turned on or off.**



The status display shows the real time operation of the monitored points.

The indicators will be green if conditions are acceptable.

They will be red if a fault exists.

REFER TO TROUBLESHOOTING SECTION for more information.

Automatic faults will clear when the required condition is met.

Manual faults will flash the letters until the condition is accepted on the reset screen.

Soda pressure indicates that sufficient pressure is not present in the soda system.

Sec pressure indicates that sufficient pressure is not present in the water coolant system.

Temp switch soda indicates the outlet solution has exceeded 90 deg C.

Sec Pump Hot indicates the water coolant pump motor has overheated.

The Flow Switch soda indicates that the soda flow is low.

The Flow Switch water coolant indicates that the water coolant flow is low.

The water coolant over current switch indicates that the water coolant motor starter has tripped from overload.

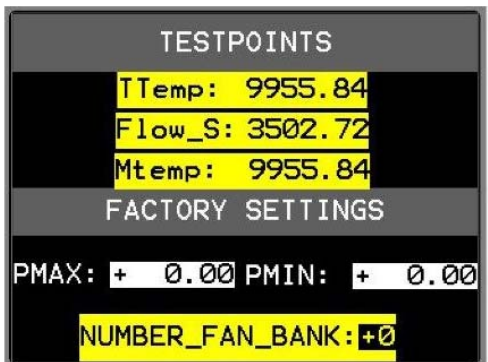
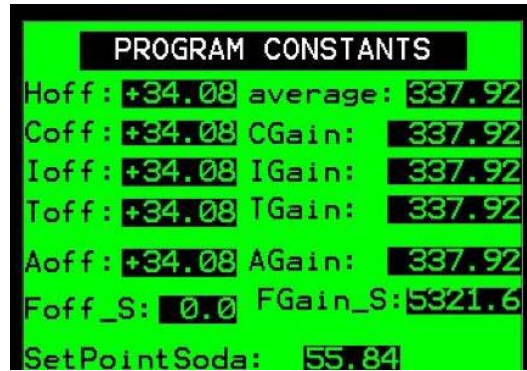
The Tank low switch indicates the soda solution in the tank is low.

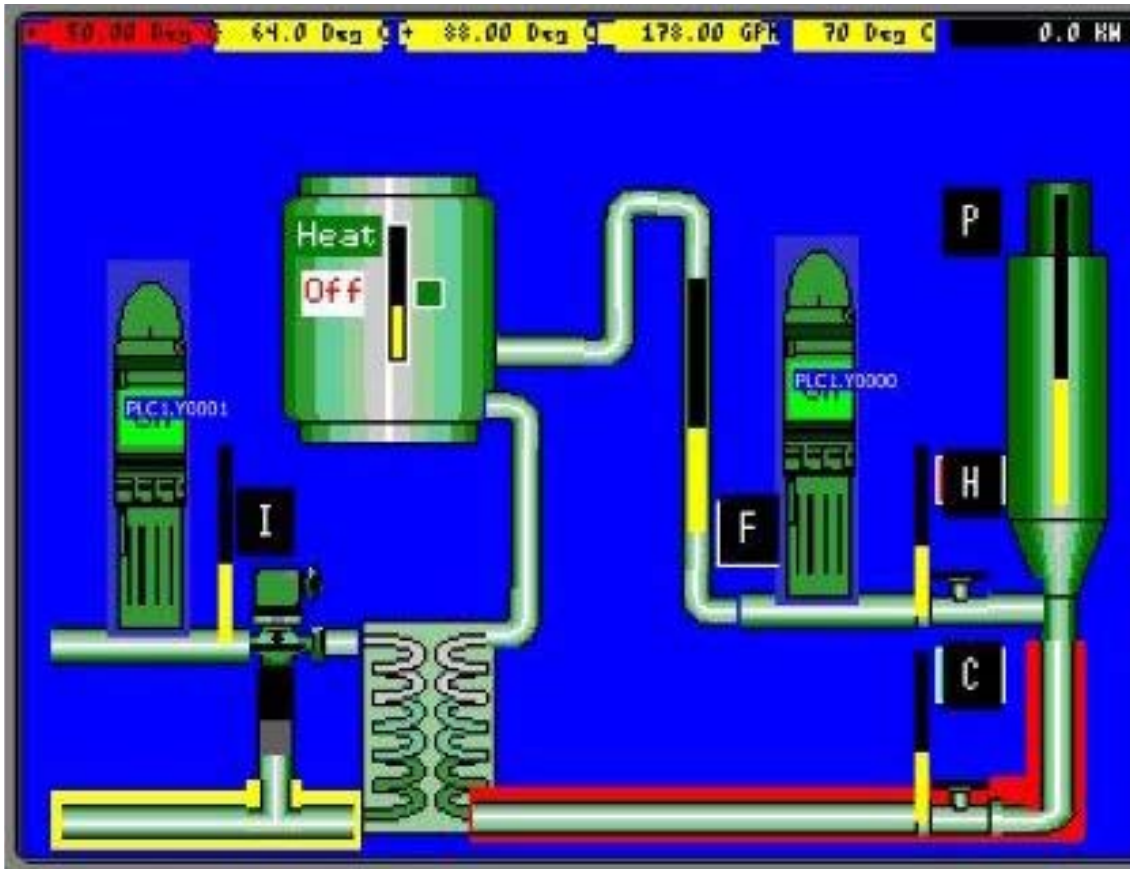
The Tank high switch indicates the soda solution in the tank is high.

The e-Stop indicates that the e-stop is pressed.

The Dry Cooler power indicates the main power for the dry cooler is off.

(Additional example screens)





The picture screen shows a schematic view of the Soda load.
 Pressing the color squares will display the information at the top of the screen.

Dry Cooler operation is not included in this screen.

The following calibration table indicates typical data:

**TYPICAL PROGRAM CONSTANTS
 LOADED AT CALIBRATION**

(To be completed at start-up)

Hoff:	HGain:
Coff:	CGain:
Ioff:	IGain:
Toff:	TGain:
Aoff:	AGain:
Foff_S:	FGain_S:
SetPointSoda:	

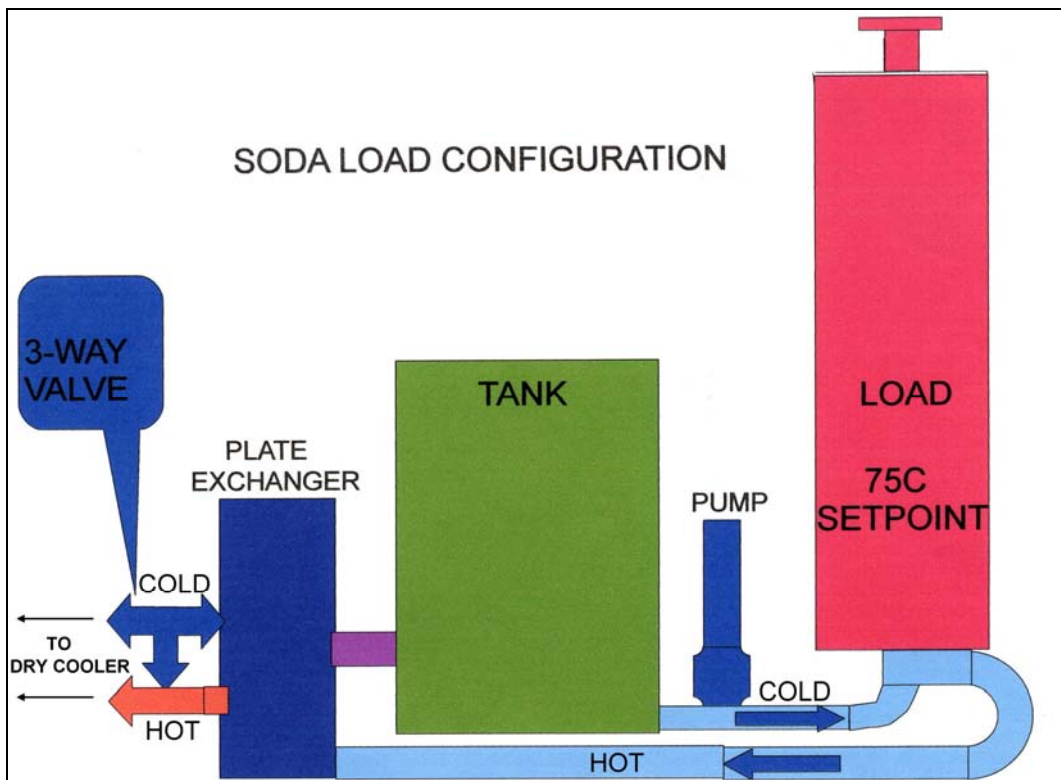
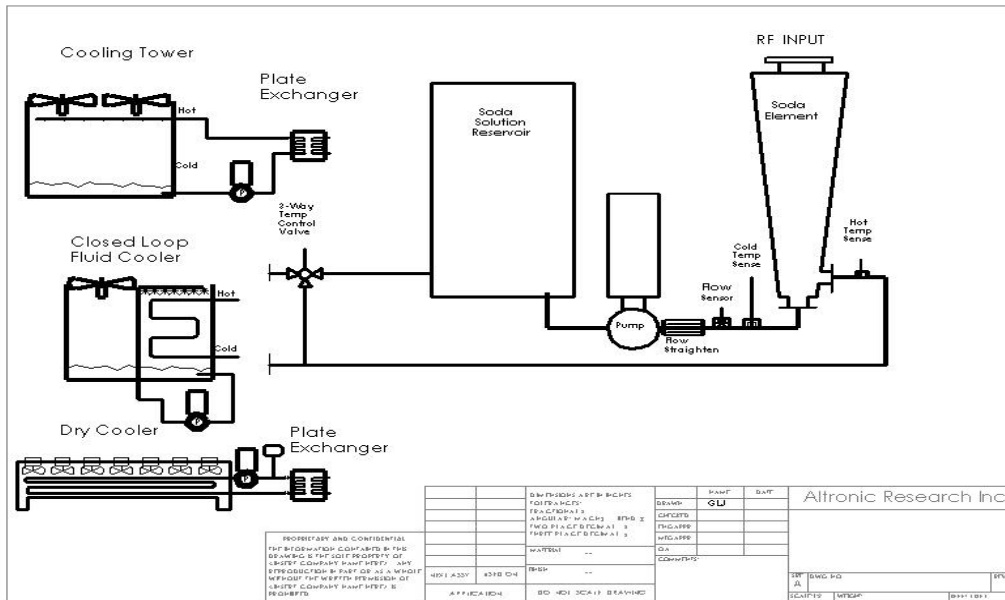
SECTION VIII

CONTROL COMPONENT REPLACEMENT

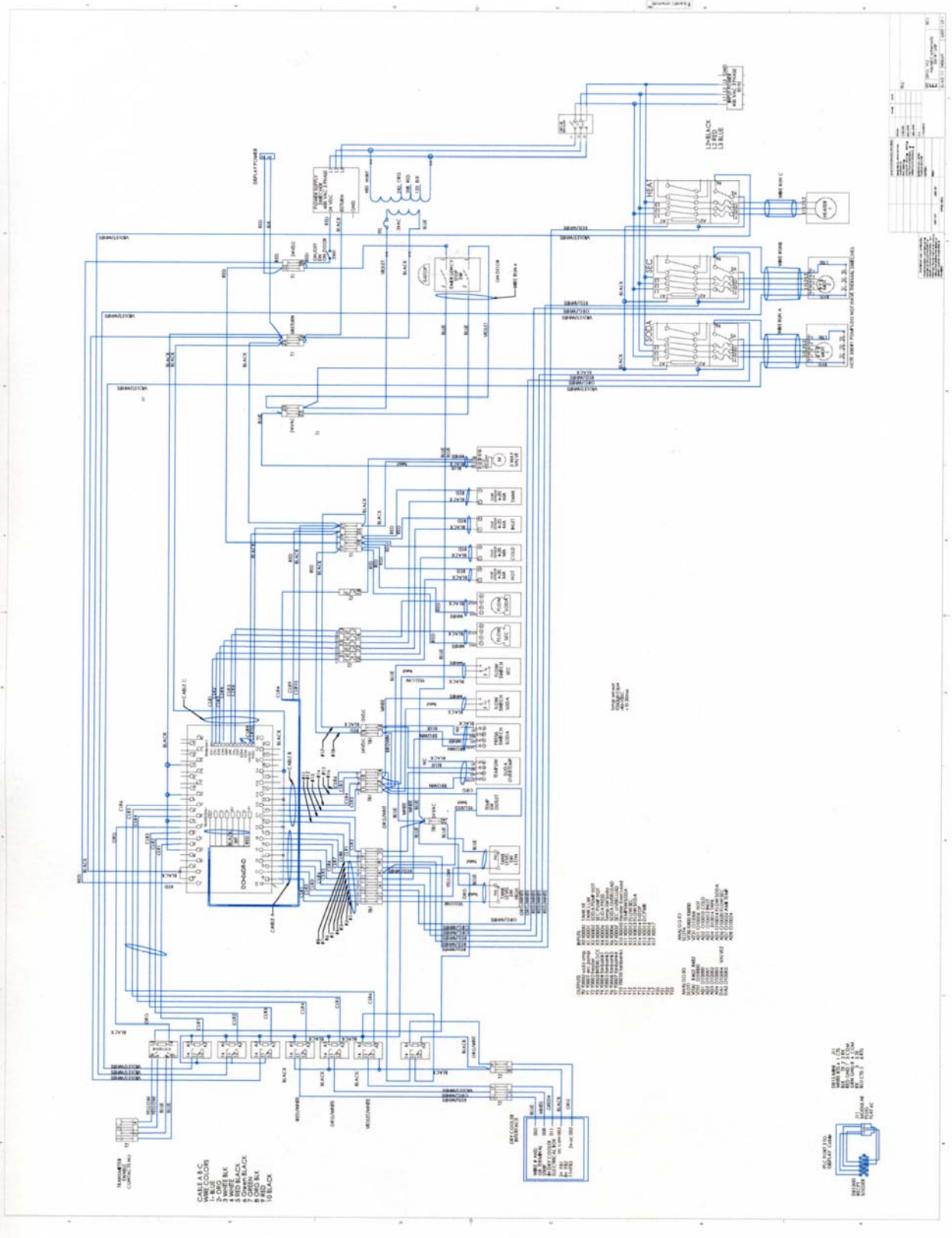
The control electronics consist of two major components: (1) the PLC and (2) the Display. A row of LED indicators located on the right upper section of the PLC housing indicates communications are occurring. The Display provides all the decision-making capabilities of the system. If there is a failure in either of these components, they will have to be replaced with programmed replacements.

- (1) The PLC may be replaced by loosening the screws attaching the terminal strip top and bottom. The terminal strips will unplug from the PLC. The PLC is affixed to the back panel with DIN rail hardware. The release point is located on the bottom and may be snapped down to release. The plug-in circuit assemblies on the PLC may be removed and replaced individually. This must be accomplished when the power is off. These devices are slot-specific and must be installed in their respective slot positions. The PLC has two add-on circuit assemblies that provide I/O interface. The voltage output card is located in slot two (2). This card provides a 0 to 10 VDC signal controlling the position of the three-way valve. The input card located in slot three (3) provides 4-20MA interface to the temperature and flow sensors. There is a 3-position switch located on the right side of the PLC. This switch must be in the middle position for normal operation.
- (2) The Display may be changed by removing the attaching wiring and cables and the mounting screws located around the edge of the display.

OUTLINE DRAWINGS



SCHEMATIC DIAGRAM



REPLACEMENT PARTS LIST

MODEL 40400 & 40500

(TYPICAL)

<u>Item</u>	<u>Qty.</u>	<u>Description</u>	<u>Part Number</u>
1	2	Pump-40500 Pump-40400	900-10000-001 900-10000-002
2	3	Motor Starter DC	313-10000-270
3	1	3-Way Valve	100-10000-005
4	1	3-Way Valve Control/Actuator	100-10000-006
5	1	PLC "Programmed"	700-10000-020
6	1	8-Channel I/O Card	700-10000-007
7	1	2-Channel I/O Card	700-10000-009
8	1	Display "Programmed"	313-10000-269
9	1	Heater Element	087-10000-024
10	3	Overload Relay	313-10000-271
11	1	Power Supply DC	313-10000-272
12	1	AC Transformer	354-5041C-000
13	1	Pressure Switch	700-10000-017
14	1	Flow Switch	674-10000-017
15	1	Flow Meter	674-10000-009
16	1	Temperature Switch	700-10000-016
17	3	Temperature Sensor/Transmitter	889-10000-013
18	2	Switch, Level	578-10000-126
19	1	Dry Cooler Fan	
20	1	Dry Cooler Fan Hub	
21	1	Dry Cooler Motor Starter	

TECHNICAL CHARACTERISTICS:

Model 40400 & 40500

Impedance: 120 ohms nominal
Frequency Range: 50 Hz to 2 MHz (including full load for harmonics 2 and 3)
Resistive Type: Soda Solution (Sodium carbonate + Water)
Max Power: 400/500 KW
200/300 KW Carrier Power + 125% Peak Modulation
RF Input: Box Line 10 ½" x 10 ½" square line
Stabilized VSWR: 1.05:1
Accurate Power Measurement: Digital Calorimetric Range 10 to 100% FSR
Accuracy ±< 4% FSR
Dimensions: 60 in. W x 72 in. L x 82 in. H
(Nominal) (152.4cm x 182.9cm x 208.3cm)
Weight: 2800 lbs/1270kg (with crate)
AC Power Requirements: Load Module 40 Amp. ; Dry Cooler 30 Amp.
400 VAC, 3 Phase, 50 Hz

System Protection:

MECHANICAL PROTECTION:

LOW FLOW
LOW TANK LEVEL
OVER CURRENT: fans, pumps and control
OVER TEMPERATURE

COMPUTER CONTROLLED PROTECTION:

LOW FLOW
OVER TEMPERATURE

Water Coolant Circuit:

Dissipation: 400/500KW
Cooling medium: SR1 10-40% + distilled water
Flow rate of cooling medium: 115/150 GPM
Cooling air temperature: -10°C to 40°C

Load rating based on optimum clean system conditions.

Load derates @ less than optimum conditions.

RF module must remain above freezing temperature.

Serial No. _____ Frequency MW _____ Resistance Ω _____

Model _____ Inspected by _____ Date _____ Software Revision 40xxx.1.4

CRAFTED WITH PRIDE IN ARKANSAS, U.S.A.

TROUBLESHOOTING:

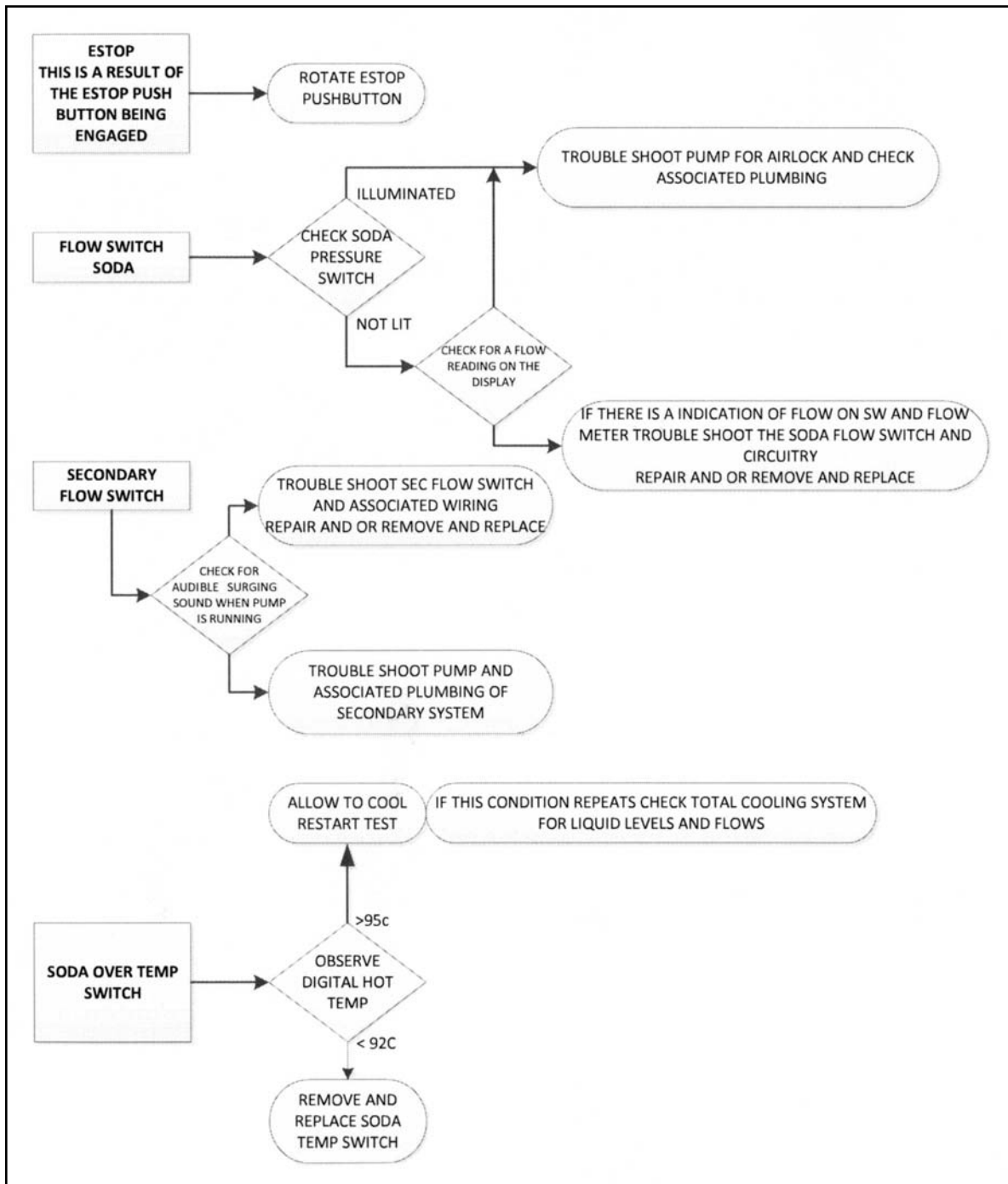
The wiring configuration of the Soda Load control circuitry provides redundant fail-safe protection. Mechanical switches are wired in series along with a Programmable Logic Controller (PLC) to enable the transmitter interlock relay. The fluid flows of the soda and secondary loops are monitored by individual mechanical switches along with the outlet temperature of the resistor. These signals are combined with redundant sensors that are monitored and controlled by the PLC. This insures the integrity, reliability and safety of the Soda Load system and protects personnel and equipment. In addition to transmitter enable controls, there are individual protection mechanisms on the pumps, heater and Dry Cooler. Fault indications on these are displayed on the monitor screen.

<u>Fault Condition</u>	<u>Recommended Solution(s)</u>
TANK HI	Open soda tank lid and see if liquid is above top sensor. If it is, drain to below sensor. If not above sensor, troubleshoot tank Hi Level switch and wiring.
TANK LOW	Open soda tank lid and see if liquid is below bottom sensor. If it is, fill until above sensor. If not below sensor, troubleshoot tank low level switch and wiring.
SODA PUMP OVER CURRENT	Reset overload on contactor. If fault repeats, measure current on each leg of power. If current high, troubleshoot pump motor. If current within limits, remove and replace contactor.
SEC PUMP OVER CURRENT	Reset overload on contactor. If fault repeats, measure current on each leg of power. If current high, troubleshoot pump motor. If current within limits, remove and replace contactor.
HEATER OVER CURRENT	Reset overload on contactor. If fault repeats, measure current on each leg of power. If current high, troubleshoot heater. If current within limits, remove and replace contactor.
DRY COOLER POWER	Check AC Mains is applied to Dry Cooler. Measure 24VAC on secondary of transformer in Dry Cooler. If present, troubleshoot interconnect wiring and circuitry. If absent, troubleshoot Dry Cooler circuitry.
ESTOP	This is not a fault, but all other sensors will show fault if this is engaged. Rotate ESTOP switch to reset.

The following faults must be evaluated in sequence as they are wired in series:

**FLOW SWITCH SODA
 FLOW SWITCH SECONDARY
 TEMP SWITCH SODA
 FLOW SODA SWITCH
 (See chart following page)**

Troubleshooting Flow Chart



ATTACHMENTS

- A. Dry Cooler Assembly & Installation Instructions**
- B. Dry Cooler Foundation Dimension Plan**
- C. Dry Cooler Electrical Schematic**
- D. Material Safety Data Sheets**



When you want Quality, specify COLMAC!

**Installation, Operation,
and Maintenance**
ENG00018621



**Air Cooled
Fluid Coolers**

Contents

1. SAFETY INSTRUCTIONS	1
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3. GENERAL DESCRIPTION	4
4. INSTALLATION	4
5. OPERATION	7
6. MAINTENANCE	8



1. SAFETY INSTRUCTIONS

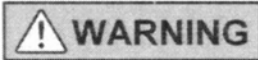
To avoid serious personal injury, accidental death, or major property damage, read and follow all safety instructions in the manual and on the equipment. Maintain all safety labels in good condition. If necessary, replace labels using the provided part numbers.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.



DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.



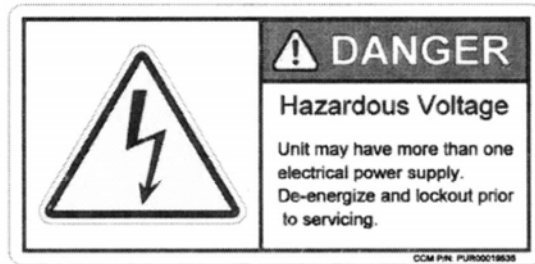
WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.



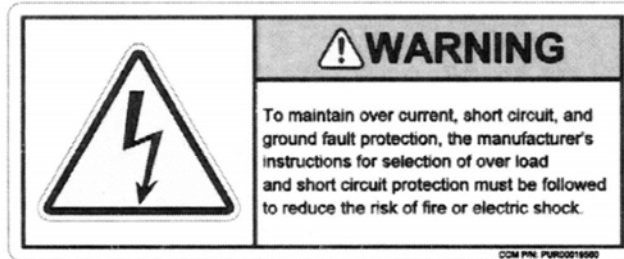
CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



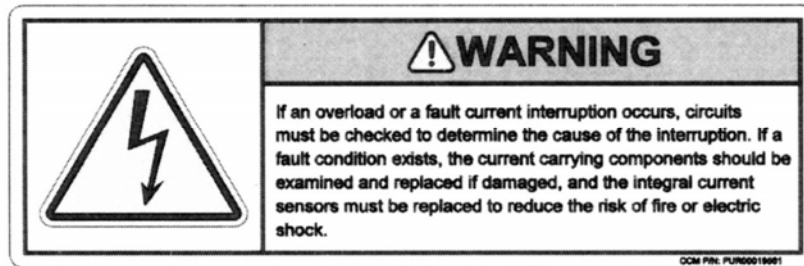
NOTICE indicates instructions that pertain to safe equipment operation. Failure to follow these instructions could result in equipment damage.



PUR00019535



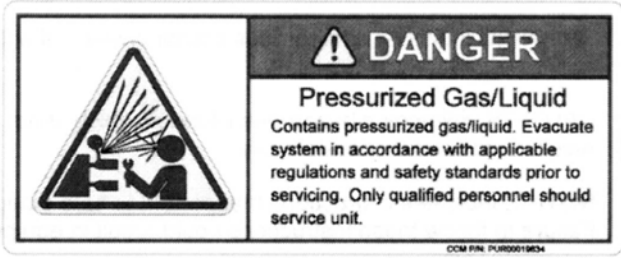
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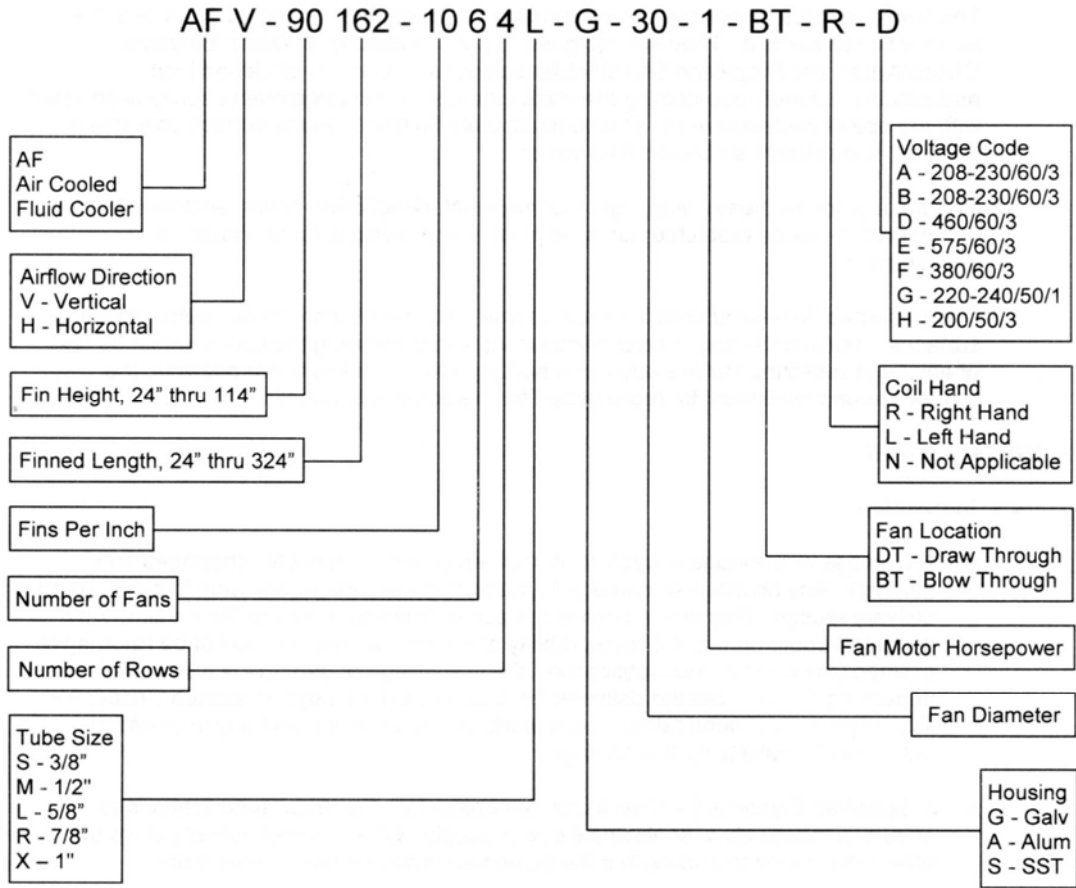


PUR00019536



PUR00019634

2. MODEL NOMECLATURE



3. GENERAL DESCRIPTION

- 3.1. Colmac Fluid Coolers are multiple row compact finned tube coolers with direct drive fans. The fluid circulates in multiple passes through the tubes and cooling air flows over the exterior finned surface. They are designed to provide cooling of Water, Ethylene Glycol/Water, and Propylene Glycol/Water solutions in a variety of closed loop applications. Closed loop cooling eliminates the cost of fluid treatment usually associated with the use of cooling towers. The compact plate fin heat transfer surface provides a compact and efficient air cooled fluid cooler.
- 3.2. The fan motors are heavy-duty, rigid foot mounted, direct drive, totally enclosed fan motors with moisture protected rain shields (slingers) suitable for an industrial environment.
- 3.3. The published fan sound level is based on free field conditions with no sound reflecting surfaces. If the cooler sound level is important, avoid installing the cooler within 30 feet of any large reflecting surface such as a building or wall. If this is not possible, the installed sound level must be recalculated for the actual site condition.

4. INSTALLATION

4.1. Inspection

- 4.1.1. Damage or Shortage – Upon receipt of equipment, inspect for shortages and damage. Any shortage or damage found during initial inspection should be noted on delivery receipt. This action notifies the carrier that you intend to file a claim. Any damaged equipment is the responsibility of the carrier, and should not be returned to Colmac Coil without prior notification. If any shortage or damage is discovered after unpacking the unit, call the deliverer for a concealed damage or shortage inspection. The inspector will need related paperwork, delivery receipt, and any information indicating his liability for the damage.
- 4.1.2. Specified Equipment – Check unit nameplate for: Electrical specifications to ensure compatibility with electrical power supply. Check model nomenclature and other information to ensure that the equipment matches the original order.

4.2. Mounting & Rigging

- 4.2.1. **NOTICE: In no circumstances should coil headers or return bends be used in lifting or moving condensers.**
- 4.2.2. **NOTICE: Use shipping container, or use hangers to lift unit into mounting position.**
- 4.2.3. The fluid coolers are fitted with lifting eyes on the top face of the cooler. Use lifting beams as illustrated in Figures 1 and 2.
- 4.2.4. All lifting must be done perpendicular to top of coil face with lifting straps attached to the lifting brackets in a vertical configuration as illustrated in Figures 1 and 2.
- 4.2.5. **NOTICE: Do not lift units with lifting straps attached to the lifting brackets in an A-frame configuration.**

4.3. Mechanical

- 4.3.1. Level the fluid cooler and install steel shims to fill any gaps under the support feet.

4.3.2. **NOTICE: The fluid inlet must always be connected to the header on the air outlet side for counterflow operation.**

4.3.3. After the flange bolts are installed, tighten snug but do not torque. Next install the mechanical anchors at all support lets and tighten down and then tighten the flange bolts.

4.3.4. **NOTICE: Do not force flanges to come together.** If flanges are not parallel, they will require adjustments with either application of heat to the nozzle or by removal and re-welding. Contact Colmac for instructions.

4.4. Electrical

4.4.1. Each Colmac AFV/AFH fluid cooler is factory wired for single-point connections in the field to the weatherproof terminal box on each cooler or to each individual motor at each fan bay depending on customer specification. Fan motors greater than 1 Hp do not have internal thermal overload protection controls; they must be provided by others. Fan Motors 1 Hp and smaller do have internal thermal overload protection. Standard construction does not include fan cycling and fused disconnects which must be supplied by others. Individual motor protection and fan cycling controls are available as optional extras.

4.4.2. All field wiring must comply with National Electrical Code and all other state and local regulations. This includes providing proper and safe motor protection, fusing, disconnects, and other basic equipment.

4.4.3. Check that the supply voltage matches the motor rated voltage. After the motors are connected, jog them to check for fan clearance and for proper fan rotation. Rotation can be reversed by swapping two of the three incoming line conductors on a three phase system. Operate all the fan motors for several hours to allow the motors to dry.

4.4.4. For fluid coolers equipped with FC (fan cycling) controls, refer to the wiring diagram included with the unit for control and connection details.

4.5. Location

4.5.1. Colmac fluid coolers have been designed primarily for outdoor installations. When locating the unit on a roof, it must be mounted on support beams which span load-bearing walls. Failure to do so may lead to excessive vibration on a resilient roof and possible damage to the unit. Refer to unit weights indicated on the submittal drawing or shipping documents and to the refrigerant line weights referenced below.

4.5.2. Locate the fluid cooler no closer than the unit's width from a wall or other obstruction. When two or more units occupy the same area, space them apart by a minimum distance of one unit's width to allow free air circulation around the coils.

4.5.3. The fluid cooler must be installed level and be securely anchored to the building structure or concrete pad.

Table 1

Weight of Ethylene Glycol in Type L Copper Lines

Line Size O.D.	Pounds per 100 Lineal Ft, Ethelene Glycol		
	0% Glycol	20% Glycol	40% Glycol
	100°F / 135°F	100°F / 135°F	100°F / 135°F
5/8	10.0 / 10.0	10.3 / 10.2	10.6 / 10.5
7/8	20.3 / 20.1	20.8 / 20.7	21.4 / 21.2
1 1/8	35.5 / 35.2	36.5 / 36.1	37.1 / 36.7
1 3/8	54.1 / 53.6	55.5 / 55.0	57.0 / 56.5
1 5/8	76.5 / 75.9	78.6 / 77.9	80.7 / 79.9
2 1/8	133.1 / 132.0	136.8 / 135.5	140.4 / 139.0
2 5/8	205.3 / 203.6	210.9 / 209.0	216.5 / 214.4
3 1/8	293.1 / 290.6	301.0 / 298.3	309.1 / 306.0
3 5/8	396.4 / 393.1	407.2 / 403.5	418.0 / 413.9
4 1/8	515.3 / 511.0	529.3 / 524.5	543.4 / 538.1

Table 2

Weight of Propylene Glycol in Type L Copper Lines

Line Size O.D.	Pounds per 100 Lineal Ft, Propylene Glycol		
	0% Glycol	20% Glycol	40% Glycol
	100°F / 135°F	100°F / 135°F	100°F / 135°F
5/8	10.0 / 9.9	10.2 / 10.1	10.4 / 10.3
7/8	20.3 / 20.1	20.7 / 20.5	21.0 / 20.7
1 1/8	35.5 / 35.2	36.1 / 35.8	36.7 / 36.3
1 3/8	54.1 / 53.6	55.1 / 54.5	55.9 / 55.2
1 5/8	76.5 / 75.9	77.9 / 77.1	79.1 / 78.2
2 1/8	133.1 / 132.0	135.6 / 134.2	137.6 / 136.0
2 5/8	205.3 / 203.6	209.1 / 207.0	212.2 / 209.7
3 1/8	293.1 / 290.6	298.4 / 295.4	302.9 / 299.3
3 5/8	396.4 / 393.1	403.6 / 399.5	409.7 / 404.9
4 1/8	515.3 / 511.0	524.7 / 519.4	532.6 / 526.3

4.6. Filling

- 4.6.1. Clean water is suitable for flushing and testing in warm weather, but when the temperature is below freezing, a glycol/water solution is required.
- 4.6.2. All system piping must be flushed before connecting it to the fluid cooler.
- 4.6.3. **NOTICE: Do not flush the system through the fluid cooler as dirt and welding debris from the piping can cause fowling of the internal surfaces of the tubing and potentially block the tubes.**
- 4.6.4. Vent all air from the piping and cooler during filling.

- 4.6.5. When the air is all vented, pressurize the system, and check all of the flange joints for leaks, and retighten flange bolts where necessary.
- 4.6.6. After testing, drain the flushing fluid and replace with clean demineralized water and glycol solution of the specified ratio prior to operation.

4.7. Storage

- 4.7.1. If the fluid coolers are to be stored or not operated for an extended period of time, the fan motors may ingress moisture if they are not protected or operated regularly. In severe cases, the moisture will reduce the insulation level of the windings or cause rusting of the bearings necessitating removal for repairs at a motor repair facility. This is a common problem with large generating installations when the coolers are often ready but commissioning of the main turbine-generator is delayed for several months.
- 4.7.2. The simplest remedy for installed coolers is to operate the fan motors for a few hours every week during the downtime period until regular operation resumes. The fan motors on stored coolers must be protected from the elements by covering them with waterproof tarps.

5. OPERATION

5.1. Before Startup

- 5.1.1. Make sure unit voltage agrees with supply voltage.
- 5.1.2. Make sure system is wired correctly and in accordance with the guidelines laid out in this IOM, as well as local and national standards that may apply.
- 5.1.3. Check torque on all electrical connections.
- 5.1.4. Make sure all piping is done completely and in accordance with the guidelines laid out in this IOM, as well as in accordance with standard good practice.
- 5.1.5. Make sure unit is mounted securely using all hangers, and is level.
- 5.1.6. Make sure that all fan set screws are tight.

5.2. After Startup

- 5.2.1. Check fan rotation of all fans to make sure air is moving in proper direction.

5.3. Fan Cycling Setup Checklist

- 5.3.1. Heating/Cooling Mode Adjustment: As shipped from the factory, the fan cycling controller is set up for cooling mode.
- 5.3.2. Setpoint Adjustment: Set point is defined as the temperature setting at which the temperature controller output relay will de-energize.
- 5.3.3. Differential Adjustment: Differential is defined as the change in sensor temperature between energization and de-energization of the relay. In cooling mode, the temperature controller will energize the output relay at a temperature equal to the

setpoint plus the differential. The temperature controller will de-energize the output relay at a temperature equal to the setpoint.

5.3.4. Offset: On temperature controllers with offset functionality, the offset adjustment sets the temperature offset from the control module setpoint, at which the stage module's output relay will de-energize.

5.3.5. Temperature Sensor

- For sensing fluid temperature: Insert sensor into sensor well in outlet header utilizing thermal paste to ensure good heat transfer.
- For sensing ambient temperature: Attach sensor to unit leg away from fan induced air flow and out of direct sunlight.

5.3.6. Control Settings

Master Setpoint & Differential Table
(Values supplied by sales and/or engineering)

Type F.C Controls			
Setpoint 1		Differential 1	
Bulb Location			
Cond. Leaving Fluid Temp.			
Ambient Air Temp.			

Stage Differential & Offset Table
(Values supplied by sales and/or engineering)

Type F.C Controls			
Offset 1		Differential 1	
Offset 2		Differential 2	
Offset 3		Differential 3	
Offset 4		Differential 4	
Offset 5		Differential 5	
Offset 6		Differential 6	
Offset 7		Differential 7	
Offset 8		Differential 8	
Offset 9		Differential 9	

6. MAINTENANCE

- 6.1. The direct Drive fan motors are provided with double sealed shaft bearings. Periodic lubrication is not required.
- 6.2. Check the fan blades annually and remove any accumulations of dirt.
- 6.3. **Cleaning inside:** When the glycol/water solution is maintained in its original condition, the inside of the tubes will not require regular cleaning. If the glycol/water solution is allowed to deteriorate, the inside of the tubes may become corroded or fouled and

require cleaning. Disconnect the cooler from the pipe connections and fill with chemical cleaners suitable for copper tubes. Drain and flush with clean water after cleaning.

- 6.4. **Cleaning Outside:** Remove any debris that collects on the air inlet side of the finned tubes as this will reduce the airflow. The debris can often be removed by shutting off the fans and blowing air or a water spray in the reverse direction. A soft bristled brush with a water-detergent solution may be required to remove oily deposits followed by rinsing with clean water. Straighten any fins that may have bent during cleaning.

6.5. Replacement Parts

- 6.5.1. Replacement parts which are covered under the conditions of Colmac Coil's warranty (see Limited Warranty) will be reimbursed at the part cost only. For replacement parts, warranted or otherwise, contact Colmac Coil directly. When contacting Colmac Coil with the explanation of failure, have the complete model number, serial number, date of installation, and date of failure at hand.

FIGURE 1
Vertical Fluid Cooler
Rigging

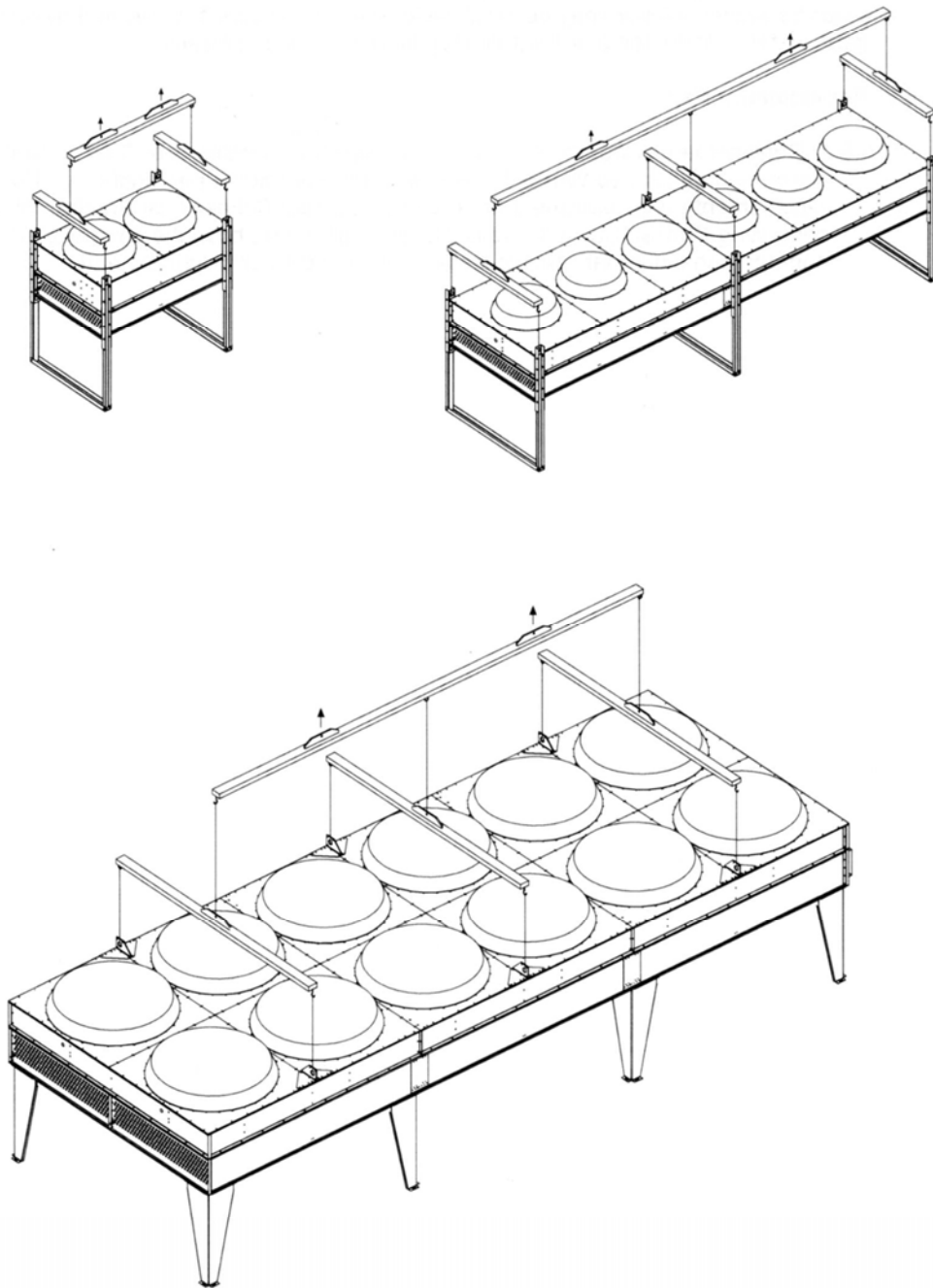
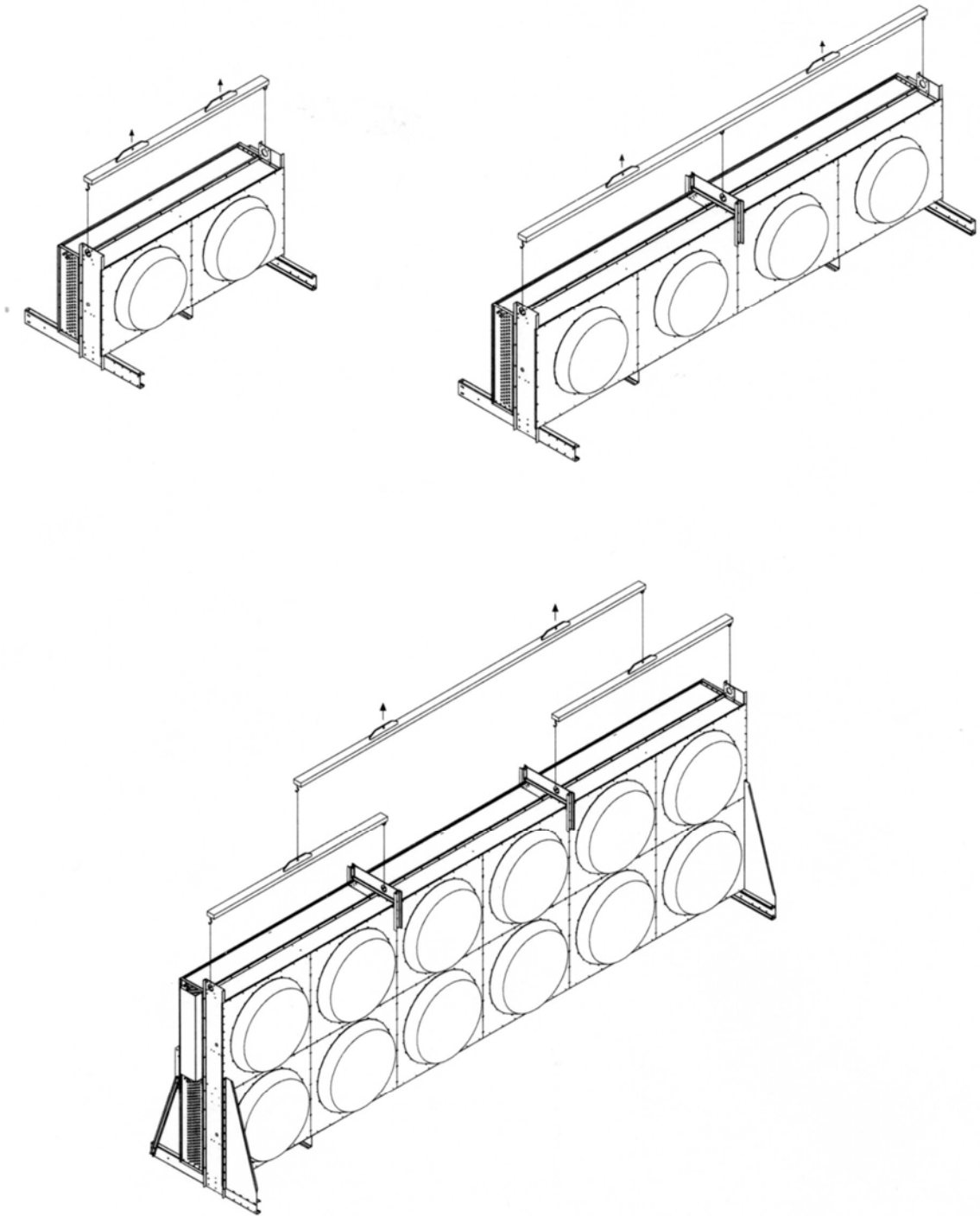


FIGURE 2
Horizontal Fluid Cooler
Rigging



NOTICE OF CONFIDENTIAL INFORMATION

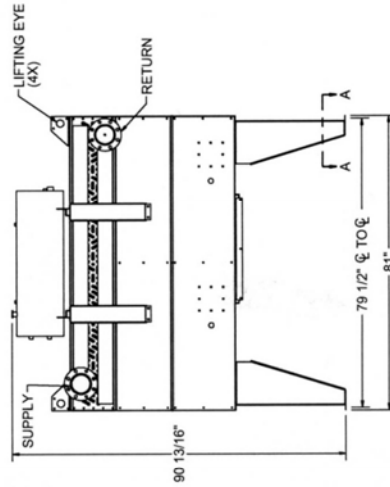
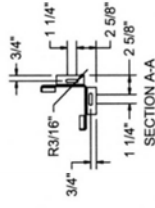
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UNIT SPECIFICATIONS:

DRAFT: BLOW-THRU
 QTY. - DIA FANS: 4 - 30"
 FAN SPEED: 1150 RPM
 FAN SPEC. COMP. TYPE: CAPACITIVE
 MOTOR QTY.: HP - 8 1/2 HP
 MOTOR VOLTAGE: 400/50/3
 MOTOR FLA: 6.1A EA (EST)
 (Table 50.1 of UL 508a Procedure)
 MOTOR TYPE: TEFC
 MOTOR S.F.: 1.25
 INT. THERMAL OIL PROT.: NO
 ULL LISTED: NO
 DRY WEIGHT: 2,473 LBS
 INTERNAL VOL.: 6.01 FT³
 FAN GUARDS: NO

NOTES:

1. NEMA 3R ENCLOSURE FOR MOTOR PROTECTION WIRING.
2. 20 GALLON SURGE TANK
3. PROTECTIVE SCREEN AIR ENTERING SIDE OF UNIT.
4. COIL TAG:
5. SHIPPING CHARGE: 14 PSI

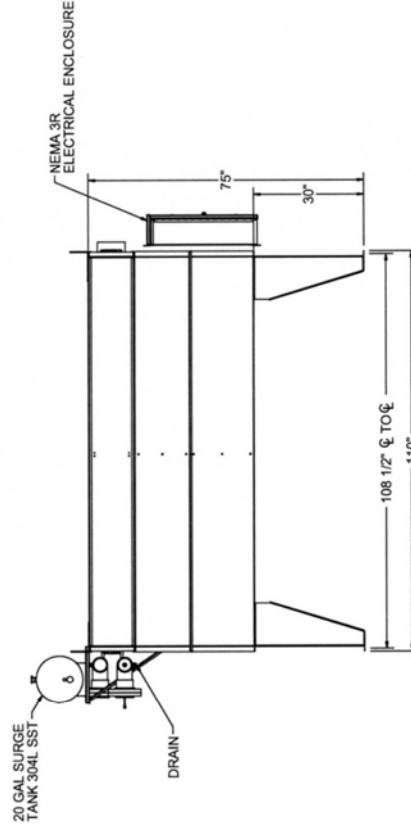
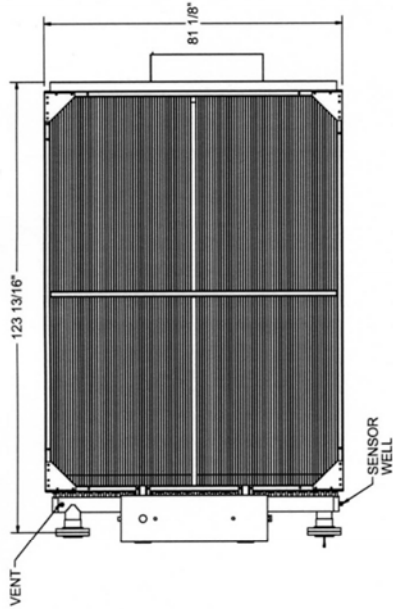


COIL SPECIFICATIONS:

CONNECTION SIZE: 4" 150# RF&O STEEL FLANGE SUPPLY/RETURN
 HEADER SIZE: 4 1/8" OD 150# STEEL COPPER
 TUBE PATTERN: 15 X 1,299 STAGGERED
 FINS 0.006 THICK: ALUM.
 FIN PATTERN: WAFFLE/RIPPLE
 HOUSING: GALV.
 FERRULES: NO
 FIN HEIGHT: 78"
 FIN LENGTH: 107"
 ROWS DEEP: 5
 FINS PER INCH: 14
 FACE AREA: 57.96 FT²

UNIT PERFORMANCE:

TOTAL CAPACITY: 1,519,629 BTUH
 AIRFLOW: 40,400 CFM
 FACE VELOCITY: 697 FPM
 ELEVATION: 1,000 FT AMSL
 ENT AIR DRY BULB: 122° F
 LVG AIR DRY BULB: 161.6° F
 ENT FLUID TEMP: 174° F
 LVG FLUID TEMP: 145.6° F
 FLUID FLOW RATE: 115 GPM
 AIR PRESS DROP: 0.88 INWG
 FLUID: ETHYLENE GLYCOL 50%
 WATER 50%
 CIRCUITING: 32 FEET/ 8 PASS/ 4 DROP
 MAWP: 250 PSIG
 MOMT: 300° F



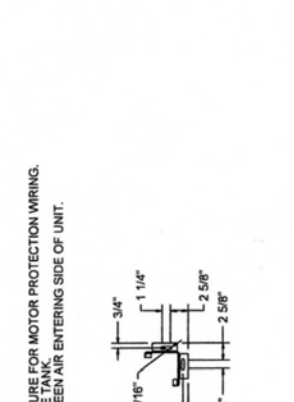
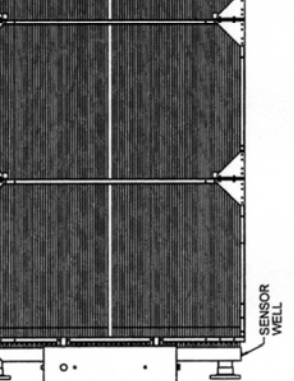
ECO #17815	REVISION		
A	3/21/2013	DLS	CHK
SCALE:	NO SCALE	THIRD ANGLE PROJECTION	
DWG. TITLE: AFV-78 x 107-1445L-C-G-30-3-BT-I CUSTOMER: ALTRONIC RESEARCH, INC TAG: 400kW			
UNLESS OTHERWISE SPECIFIED DIMENSIONS AND TOLERANCES ARE: FRACTIONS ± 1/4 ANGLES 45°			
DRAWN BY: GWW	CHECKED BY: DLS	DATE: 9/26/2012	ENG APPR: DLS
DATE: 9/26/2012	DATE: 9/26/2012	DATE: 9/26/2012	DATE: 9/26/2012
SUB00022527			SHEET 1 OF 1

NOTE: Due to the 400/50/3 voltage, the fan speed needed to change. All temps and BTU's stay the same. Increase in water pressure drop. Please let Dave Smith know if this represents any problems.

CUSTOMER APPROVAL SECTION
 Please check appropriate box, sign & date
 APPROVED
 SIGNED: *[Signature]* DATE: 10/25/12
 Approved AS NOTED

Sign & Date here

NOTICE OF CONFIDENTIAL INFORMATION
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UNIT SPECIFICATIONS:
 DRAFT BLOW-THRU: 30"
 FAN SPEED: 1,450 RPM
 FAN TYPE: COMPOSITE
 MOTOR QTY.: HP - 2HP
 MOTOR VOLTAGE: 400/50/3
 MOTOR TYPE: 3A EA (EST)
 MOTOR TYPE: 3A EA (EST)
 MOTOR S.F.: 1.25
 INT. THERMAL OIL PROT.: NO
 U.L. LISTED: NO
 DRY WEIGHT: 3,478 LBS
 INTERNAL VOL.: 5.94 FT³
 FAN GUARDS: NO

NOTES:
 1. NEMA 3R ENCLURE FOR MOTOR PROTECTION WIRING.
 2. 20 GALLON SURGE TANK.
 3. PROTECTIVE SCREEN AIR ENTERING SIDE OF UNIT.

UNIT PERFORMANCE:
 TOTAL CAPACITY: 1,904,833 BTUH
 AIRFLOW: 52,800 CFM
 FACE VELOCITY: 698 FPM
 ELEVATION: 1,000 FT AMSL
 ENT AIR DRY BULB: 122.4 F
 ENT AIR WET BULB: 74.4 F
 ENT FLUID TEMP: 17.4 F
 LVG FLUID TEMP: 145.7 F
 FLUID FLOW RATE: 150 GPM
 AIR PRESS DROP: 0.85 INWG
 FLUID PRESS DROP: 10.01 FT H₂O
 CIRCUITING: 52 FEED/8 PASS
 MAWP: 250 PSIG
 MDMT: 300 F
 MDMT: 30 F

COIL SPECIFICATIONS:
 CONNECTION SIZE: 4" 150# RFSSO STEEL FLANGE SUPPLY/RETURN
 HEADER SIZE: 4 1/8" OD TYPE 'L' COPPER
 TUBES: 3/8" OD X 1/2" WALL COPPER
 FIN PATTERN: 3/8" STAGGERED
 FIN PATTERN: WAFFLE/RIPPLE
 HOUSING: GALV.
 FERRULES: NO
 FIN LENGTH: 146"
 ROWS DEEP: 6
 FINS PER INCH: 14
 FACE AREA: 79.08 FT²

REV.	DATE	CHK	DLS
A	10/23/2012		

COLMAC COIL
 Manufacturing Inc.
 P.O. Box 571
 COLVILLE, WASHINGTON 98114

AWG. TITLE
 AFV-78 x 146-1466L-C-G-30-2-BT-1
 CUSTOMER: ALTRONIC RESEARCH, INC
 TAG: 500KW

SCALE: NO SCALE
 THIRD ANGLE PROJECTION
 UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
 TOLERANCES ARE:
 FRACTIONS 1/16
 ANGLES ±5°

REV.	DATE	CHK	DLS
A	10/23/2012		

ECO#17095
 REVISION

DRWN BY GWM
CHECKED BY DLS
DATE 9/28/2012
END APPR DLS
DATE 9/28/2012

SUB00022535

ITEM	STATUS	M-QTY	M-UM	QTY	UM	PART NUMBER	DESCRIPTION
1	P			1	EA	PUR00013533	Electrical Enclosure, 30 x 30 x 12, NEMA 3R
2	P			1	EA	PUR00013534	Back Panel, 27H x 27W, Sheet
3	P			2	AR	PUR00020388	DIN Rail
4	P			1	AR	PUR00013979	Wire Duct
5	P			3	AR	PUR00020388	Wire Duct
6	P			6	EA	PUR00020385	End Stop for ABB Terminal Block
7	P			4	EA	PUR00020421	Ground Terminal Block, M4x6 Yellow & Green
8	P			21	EA	PUR00020388	LPCF Fuse Block
9	P			1	AR	PUR00020388	DIN Rail
10	P			5	EA	PUR00020423	Terminal Block, End Section
11	P			19	EA	PUR00020412	Terminal Block, M4x6 Grey
12	P			2	AR	PUR00020413	1/2" Bar, M4x6, 10 Pole
13	P			1	EA	PUR00018505	Ground Lug
14	P			1	EA	A1550110	Temperature Switch, Johnson Controls, 90 to 250 deg F
15	P			2	EA	A1550105	Temperature Switch, S350 (Slave), Johnson Controls, 1 to 30 deg F
16	P			1	EA	B1536912	Transformer, 100VA, 208/240/277/304/60/12/24V
17	P			2	EA	B1539002	Fuse, 1A, UL Class CC
18	P			1	EA	B1536008	Fuse, 6A, UL Class CC
19	P			3	EA	B1537511	Fuse, Class J, 25A
20	P			6	EA	D1538101	Overload Relay, 2.5-4A, Class 20
21	P			6	EA	D1538140	Contactor, JEC, BA, 24 V
22	P			18	EA	B1538013	Fuse, 12A, UL Class CC
23	P			1	EA	B1547301	Fused Disconnect, 30A, UL Class J

		COLMAC COIL Manufacturing Inc. P.O. Box 571 CO. VALLE, WASHINGTON 99114	
USE ONLY CONFORMING SPECIFIED DIMENSIONS TO THE FOLLOWING STANDARDS: & 1/16" XX 1/8" 008 ANSIS 100 1/8" 008 IT 100 1/8" 008	SCALE: NOT SCALE THIRD ANGLE PROJECTION 	DRAWN BY: [] CHECKED BY: [] DATE: [] 10/11/12	DESIGNED BY: [] DATE: [] 10/11/12
REV: [] DATE: [] ECN: [] REVISION: []		DRAWING TITLE: Wiring Diagram 6 Fan, 2HP, 400/50/3, FC DRAWING NO.: [] FAB00021781	
SHEET 1 OF 2		SHEET 2 OF 2	



Material Safety Data Sheet

SODA ASH LITE

Date Prepared: 8/04/00

Supersedes Date: 5/20/96

1. PRODUCT AND COMPANY DESCRIPTION

RHODIA INC.
RHODIA SPECIALTY PHOSPHATES
CN 7500
259 Prospect Plains Road
Cranbury NJ 08512-7500

Emergency Phone Numbers:
For Product Information: (800) 243-5052

For Product Information:
(800) 243-5052

Chemical Name or Synonym:
DISODIUM CARBONATE; SODA ASH; CARBONIC ACID, DISODIUM SALT

Molecular Formula:
Na₂CO₃

2. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS Reg Number	OSHA Hazard	Percentage
SODIUM CARBONATE	497-19-8	Y	100

3. HAZARDS IDENTIFICATION

A. EMERGENCY OVERVIEW:

Physical Appearance and Odor:
white granules solid, odorless.

Warning Statements:
WARNING!! CAUSES EYE IRRITATION. MAY CAUSE SKIN IRRITATION.

B. POTENTIAL HEALTH EFFECTS:

Acute Eye:

Causes irritation.

Acute Skin:

May cause redness, swelling.

Acute Inhalation:

May cause upper respiratory tract irritation, lung irritation.

Acute Ingestion:

Low acute oral toxicity. May cause nausea, vomiting, diarrhea, irritation, corrosion.

Chronic Effects:

This product does not contain any ingredient designated by IARC, NTP, ACGIH or OSHA as probable or suspected human carcinogens.

4. FIRST AID MEASURES

FIRST AID MEASURES FOR ACCIDENTAL:**Eye Exposure:**

Hold eyelids open and flush with a steady, gentle stream of water for at least 15 minutes. Seek immediate medical attention.

Skin Exposure:

In case of contact, immediately wash with plenty of soap and water for at least 5 minutes. Seek medical attention if irritation develops or persists. Remove contaminated clothing and shoes. Clean contaminated clothing and shoes before re-use.

Inhalation:

Remove victim from immediate source of exposure and assure that the victim is breathing. If breathing is difficult, administer oxygen, if available. If victim is not breathing, administer CPR (cardio-pulmonary resuscitation). Seek immediate medical attention.

Ingestion:

If victim is conscious and alert, give 1-2 glasses of water to drink. Do not give anything by mouth to an unconscious person. Seek immediate medical attention. Do not leave victim unattended. To prevent aspiration of swallowed product, lay victim on side with head lower than waist. Vomiting may occur spontaneously. If vomiting occurs and the victim is conscious, give water to further dilute the chemical.

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE:

Inhalation of product may aggravate existing chronic respiratory problems such as asthma, emphysema or bronchitis. Skin contact may aggravate existing skin disease.

NOTES TO PHYSICIAN:

All treatments should be based on observed signs and symptoms of distress in the patient. Consideration should be given to the possibility that overexposure to materials other than this product may have occurred.

5. FIRE FIGHTING MEASURES

FIRE HAZARD DATA:**Flash Point:**

Not Applicable

Extinguishing Media:

Not combustible. Use extinguishing method suitable for surrounding fire.

Special Fire Fighting Procedures:

Firefighters should wear NIOSH/MSHA approved self-contained breathing apparatus and full protective clothing. Dike area to prevent runoff and contamination of water sources. Dispose of fire control water later.

Unusual Fire and Explosion Hazards:

Not combustible.

Hazardous Decomposition Materials (Under Fire Conditions):

carbon dioxide

6. ACCIDENTAL RELEASE MEASURES

Evacuation Procedures and Safety:

Ventilate closed spaces before entering. Wear appropriate protective gear for the situation. See Personal Protection information in Section 8.

Containment of Spill:

Follow procedure described below under Cleanup and Disposal of Spill.

Cleanup and Disposal of Spill:

Scrape up and place in appropriate closed container (see Section 7: Handling and Storage). Collect washings for disposal. Decontaminate tools and equipment following cleanup. Clean up residual material by washing area with water. Avoid creation of dusty conditions.

Environmental and Regulatory Reporting:

Do not flush to drain. If spilled on the ground, the affected area should be scraped clean and placed in a appropriate container for disposal. Prevent material from entering public sewer system or any waterways. Large spills should be handled according to a predetermined plan. For assistance in developing a plan contact the Technical Service Department using the Product Information phone number in Section 1.

7. HANDLING AND STORAGE

Minimum/Maximum Storage Temperatures:

Not Available

Handling:

Do not get in eyes. Do not breathe dusts. Avoid direct or prolonged contact with skin.

Storage:

Store in an area that is cool, dry, well-ventilated.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ATAQ GRAJAH BRP

Introductory Remarks:

These recommendations provide general guidance for handling this product. Because specific work environments and material handling practices vary, safety procedures should be developed for each intended application. While developing safe handling procedures, do not overlook the need to clean equipment and piping systems for maintenance and repairs. Waste resulting from these procedures should be handled in accordance with Section 13: Disposal Considerations.

Assistance with selection, use and maintenance of worker protection equipment is generally available from equipment manufacturers.

Exposure Guidelines:

Exposure limits represent regulated or recommended worker breathing zone concentrations measured by validated sampling and analytical methods, meeting the regulatory requirements. The following limits apply to this material, where, if indicated, S=skin and C=ceiling limit:

PARTICULATES NOT OTHERWISE REGULATED RESPIRABLE FRACTION

OSHA	Notes	TWA	STEL
		5 mg/cu m	

Engineering Controls:

Where engineering controls are indicated by use conditions or a potential for excessive exposure exists, the following traditional exposure control techniques may be used to effectively minimize employee exposures.

Respiratory Protection:

When respirators are required, select NIOSH/MSHA approved equipment based on actual or potential airborne concentrations and in accordance with the appropriate regulatory standards and/or industrial recommendations.

Under normal conditions, in the absence of other airborne contaminants, the following devices should provide protection from this material up to the conditions specified by the appropriate OSHA, WHMIS or ANSI standard(s):
Air-purifying (half-mask/full-face) respirator with cartridges/canister approved for use against dusts, mists and fumes.

Eye/Face Protection:

Eye and face protection requirements will vary dependent upon work environment conditions and material handling practices. Appropriate ANSI Z87 approved equipment should be selected for the particular use intended for this material.

It is generally regarded as good practice to wear a minimum of safety glasses with side shields when working in industrial environments.

Skin Protection:

Skin contact should be minimized through use of gloves and suitable long-sleeved clothing (i.e., shirts and pants). Consideration must be given both to durability as well as permeation resistance.

Work Practice Controls:

Personal hygiene is an important work practice exposure control measure and the following general measures should be taken when working with or handling this material:

- (1) Do not store, use, and/or consume foods, beverages, tobacco products, or cosmetics in areas where this material is stored.
- (2) Wash hands and face carefully before eating, drinking, using tobacco, applying cosmetics, or using the toilet.
- (3) Wash exposed skin promptly to remove accidental splashes or contact with this material.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical and Chemical properties here represent typical properties of this product. Contact the business area using the Product Information phone number in Section 1 for its exact specifications.

Physical Appearance:

white granules solid.

Odor:

odorless.

pH:

11.3 at 1 wt/wt%.

Specific Gravity:

2.53 at 20 C (68 F).

Water Solubility:

soluble 7 Wt/Wt% at 25 C (77 F).

Melting Point Range:

851 C (1564 F)

Boiling Point Range:

Not Available

Vapor Pressure:

Not Available

Vapor Density:

Not Available

Molecular Weight:

105.99

10. STABILITY AND REACTIVITY

Chemical Stability:

This material is stable under normal handling and storage conditions described in Section 7.

Conditions To Be Avoided:

extreme heat

Materials/Chemicals To Be Avoided:

aluminum
fluorine
humid air
moisture
sulfuric acid
acids

magnesium
phosphorus pentoxide

Decomposition Temperature Range:
400 C (752 F)

The Following Hazardous Decomposition Products Might Be Expected:

Decomposition Type: thermal
carbon dioxide

Hazardous Polymerization Will Not Occur.

Avoid The Following To Inhibit Hazardous Polymerization:
not applicable

11. TOXICOLOGICAL INFORMATION

Acute Eye Irritation:

Toxicological Information and Interpretation:
eye - eye irritation, 50 mg, rabbit. Severely irritating.

Acute Skin Irritation:

Toxicological Information and Interpretation:
skin - skin irritation, rabbit. Mildly irritating.

Acute Dermal Toxicity:

No test data found for product.

Acute Respiratory Irritation:

No test data found for product.

Acute Inhalation Toxicity:

Toxicological Information and Interpretation:
LC50 - lethal concentration 50% of test species, 2300 mg/cu m/2hr, rat.

Acute Oral Toxicity:

Toxicological Information and Interpretation:
LD50 - lethal dose 50% of test species, 4090 mg/kg, rat.

Chronic Toxicity:

This product does not contain any substances that are considered by OSHA, NTP, IARC or ACGIH to be "probable" or "suspected" human carcinogens.

No additional test data found for product.

12. ECOLOGICAL INFORMATION

Ecotoxicological Information:

No data found for product.

Chemical Fate Information:

No data found for product.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Method:

Chemical additions, processing or otherwise altering this material may make the waste management information presented in this MSDS incomplete, inaccurate or otherwise inappropriate. Please be advised that state and local requirements for waste disposal may be more restrictive or otherwise different from federal laws and regulations. Consult state and local regulations regarding the proper disposal of this material.

Container Handling and Disposal:

Rinse containers before disposal.

EPA Hazardous Waste - NO

14. TRANSPORTATION INFORMATION

Transportation Status: IMPORTANT! Statements below provide additional data on listed DOT classification.

The listed Transportation Classification does not address regulatory variations due to changes in package size, mode of shipment or other regulatory descriptors.

US Department of Transportation

Shipping Name:
NOT REGULATED

15. REGULATORY INFORMATION

Inventory Status

Inventory	Status
UNITED STATES (TSCA)	Y
CANADA (DSL)	Y
EUROPE (EINECS/ELINCS)	Y
AUSTRALIA (AICS)	Y
JAPAN (MITI)	Y
SOUTH KOREA (KECL)	Y

Y = All ingredients are on the inventory.

E = All ingredients are on the inventory or exempt from listing.

P = One or more ingredients fall under the polymer exemption or are on the no longer polymer list. All other ingredients are on the inventory or exempt from listing.

N = Not determined or one or more ingredients are not on the inventory and are not exempt from listing.

FEDERAL REGULATIONS

Inventory Issues:

All functional components of this product are listed on the TSCA Inventory.

SARA Title III Hazard Classes:

Fire Hazard	- NO
Reactive Hazard	- NO
Release of Pressure	- NO
Acute Health Hazard	- YES
Chronic Health Hazard	- NO

STATE REGULATIONS:

This product does not contain any components that are regulated under California Proposition 65.

16. OTHER INFORMATION

National Fire Protection Association Hazard Ratings--NFPA(R):

2	Health Hazard Rating--Moderate
0	Flammability Rating--Minimal
0	Instability Rating--Minimal

National Paint & Coating Hazardous Materials Identification System--HMIS(R):

2	Health Hazard Rating--Moderate
0	Flammability Rating--Minimal
0	Reactivity Rating--Minimal

Reason for Revisions:

Regulatory Review and Update.

Key Legend Information:

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
TLV - Threshold Limit Value
PEL - Permissible Exposure Limit
TWA - Time Weighted Average
STEL - Short Term Exposure Limit
NTP - National Toxicology Program
IARC - International Agency for Research on Cancer
ND - Not determined
RPI - Rhodia Established Exposure Limits

Disclaimer:

The information herein is given in good faith but no warranty, expressed or implied, is made.

**** End of MSDS Document ****



Health	1
Fire	1
Reactivity	0
Personal Protection	C

Material Safety Data Sheet Dowtherm SR1 MSDS

Section 1: Chemical Product and Company Identification

Product Name: Dowtherm SR1

Catalog Codes: SLD4267

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Ethylene glycol; Water; Potassium phosphate dibasic

CI#: Not available.

Synonym: Dowtherm* SR-1 Heat Transfer Fluid; Dowtherm* SR-1

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Ethylene glycol	107-21-1	>95
Water	7732-18-5	<3
Potassium phosphate dibasic	7758-11-4	<3

Toxicological Data on Ingredients: Ethylene glycol: ORAL (LD50): Acute: 4700 mg/kg [Rat]. 5500 mg/kg [Mouse]. 6610 mg/kg [Guinea pig]. VAPOR (LC50): Acute: >200 mg/m 4 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:

Hazardous in case of ingestion. Slightly hazardous in case of skin contact (irritant, permeator), of eye contact (irritant). Severe over-exposure can result in death.

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: Classified A4 (Not classifiable for human or animal.) by ACGIH [Ethylene glycol]. **MUTAGENIC EFFECTS:** Mutagenic for mammalian somatic cells. [Ethylene glycol]. Non-mutagenic for bacteria and/or yeast. [Ethylene glycol]. **TERATOGENIC EFFECTS:** Not available. **DEVELOPMENTAL TOXICITY:** Not available. The substance may be toxic to kidneys, liver, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs

damage. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.

Skin Contact:

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation: Not available.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion:

Medical Conditions Aggravated by Exposure: Persons with pre-existing kidney, respiratory, eye, or neurological problems might be more sensitive to Ethylene Glycol. Notes to Physician: 1. Support vital functions, correct for dehydration and shock, and manage fluid balance. 2. The currently recommended medical management of Ethylene Glycol poisoning includes elimination of Ethylene Glycol and metabolites. Elimination of Ethylene Glycol may be achieved by the following methods: a. Emptying the stomach by gastric lavage. It is useful if initiated within < 1 of ingestion. b. Correct metabolic acidosis with intravenous administration of sodium bicarbonate, adjusting the administration rate according to repeated and frequent measurement of acid/base status. c. Administer ethanol (orally or by IV (intravenously)) or fomepizole (4-methylpyrazole or Antizol) therapy by IV as an antidote to inhibit the formation of toxic metabolites. d. If patients are diagnosed and treated early in the course with the above methods, hemodialysis may be avoided if fomepizole or ethanol therapy is effective and has corrected the metabolic acidosis, and no renal failure is present. However, once severe acidosis and renal failure occurred, however, hemodialysis is necessary. It is effective in removing Ethylene Glycol and toxic metabolites, and correcting metabolic acidosis.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: The lowest known value is 398°C (748.4°F) (Ethylene glycol).

Flash Points: CLOSED CUP: 111°C (231.8°F). (Tagliabue.)

Flammable Limits: LOWER: 3.2% (Ethylene Glycol)

Products of Combustion: These products are carbon oxides (CO, CO₂). Some metallic oxides.

Fire Hazards in Presence of Various Substances: Slightly flammable to flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions:

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SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards:

Explosive decomposition may occur if combined with strong acids or strong bases and subjected to elevated temperatures. (Ethylene glycol)

Section 6: Accidental Release Measures

Small Spill:

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of acetic acid. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:

Poisonous liquid. Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Neutralize the residue with a dilute solution of acetic acid. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, acids, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection: Safety glasses. Synthetic apron. Gloves (impervious).

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

Ethylene glycol STEL: 120 (mg/m³) [Australia] TWA: 100 (mg/m³) from ACGIH (TLV) [United States] CEIL: 125 (mg/m³) from OSHA (PEL) [United States] CEIL: 50 (ppm) from OSHA (PEL) [United States] TWA: 52 STEL: 104 (mg/m³) [United Kingdom (UK)] Inhalation TWA: 10 (mg/m³) [United Kingdom (UK)] SKINConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Glycol like

Taste: Not available.

Molecular Weight: Not applicable.
Color: Colored
pH (1% soln/water): Not available
Boiling Point: 163°C (325.4°F)
Melting Point: May start to solidify at -13°C (8.6°F) based on data for: Ethylene glycol.
Critical Temperature: Not available.
Specific Gravity: 1.1295 (Water = 1)
Vapor Pressure: 0.3 kPa (@ 20°C)
Vapor Density: >1 (Air = 1)
Volatility: Not available.
Odor Threshold: Not available.
Water/Oil Dist. Coeff.: Not available.
Ionicity (in Water): Not available.
Dispersion Properties: See solubility in water, diethyl ether, acetone.
Solubility:
Soluble in cold water, hot water, acetone. Partially soluble in diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.
Instability Temperature: Not available.
Conditions of Instability: Excess heat, incompatible materials
Incompatibility with various substances: Reactive with oxidizing agents, acids, alkalis.
Corrosivity: Non-corrosive in presence of glass.
Special Remarks on Reactivity:
Hygroscopic. Absorbs moisture from the air. Avoid contamination with materials with hydroxyl compounds. Also incompatible with aliphatic amines, isocyanates, chlorosulfonic acid, and oleum (Ethylene glycol)
Special Remarks on Corrosivity: Not available.
Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Ingestion.
Toxicity to Animals:
Acute oral toxicity (LD50): >8200 mg/kg [Rat]. Acute dermal toxicity (LD50): >2000 mg/kg [Rabbit].
Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A4 (Not classifiable for human or animal.) by ACGIH [Ethylene glycol]. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. [Ethylene glycol]. Non-mutagenic for bacteria and/or yeast. [Ethylene glycol]. May cause damage to the following organs: kidneys, liver, central nervous system (CNS).
Other Toxic Effects on Humans:
Hazardous in case of ingestion. Slightly hazardous in case of skin contact (irritant, permeator), of inhalation.
Special Remarks on Toxicity to Animals:

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Lowest Published Toxic Dose/Conc: TD_L [Man] - Route: oral; Dose: 15gm/kg Lethal Dose/Conc 50% Kill LD₅₀ [Rabbit] - Route: dermal; Dose: 9530 ul/kg (Ethylene glycol)

Special Remarks on Chronic Effects on Humans:

May cause adverse reproductive effects and birth defects (teratogenic) based on animal test data. No human data has been reported at this time. May affect genetic material (mutagenic) (Ethylene glycol)

Special Remarks on other Toxic Effects on Humans:

Section 12: Ecological Information

Ecotoxicity:

Ecotoxicity in water (LC₅₀): 41000 mg/l 96 hours [Trout]. 46300 mg/l 48 hours [water flea]. 34250 mg/l 96 hours [bluegill fish]. 34250 mg/l 72 hours [Goldfish]. (Ethylene Glycol)

BOD₅ and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:

California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: No products were found. California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: No products were found. Illinois toxic substances disclosure to employee act: Ethylene glycol Illinois chemical safety act: Ethylene glycol New York release reporting list: Ethylene glycol Rhode Island RTK hazardous substances: Ethylene glycol Pennsylvania RTK: Ethylene glycol Minnesota: Ethylene glycol Massachusetts RTK: Ethylene glycol Massachusetts spill list: Ethylene glycol New Jersey: Ethylene glycol Louisiana spill reporting: Ethylene glycol California Director's List of Hazardous Substances: Ethylene Glycol TSCA 8(b) inventory: Ethylene glycol; Water; Potassium phosphate dibasic TSCA 4(a) proposed test rules: Ethylene glycol SARA 313 toxic chemical notification and release reporting: Ethylene glycol 95.95% CERCLA: Hazardous substances.: Ethylene glycol: 5000 lbs. (2268 kg);

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):

R22- Harmful if swallowed. S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 1

Reactivity: 0

Personal Protection: C

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Synthetic apron. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

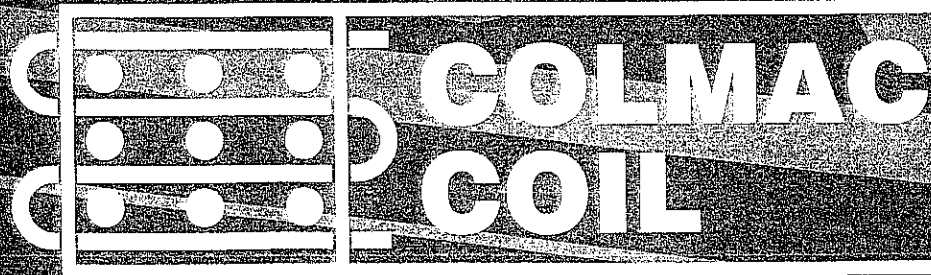
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**COMPONENT MANUFACTURER'S
DOCUMENTS**

CONTRACTOR'S INSTALLATION INFORMATION



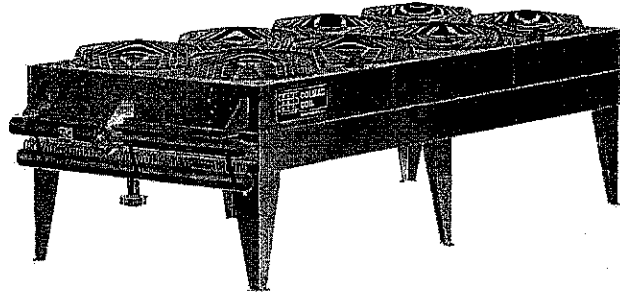
Manufacturing Inc.

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When you want Quality, specify COLMAC!

**Installation, Operation,
and Maintenance**
ENG00018621



**Air Cooled
Fluid Coolers**

Contents

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1. SAFETY INSTRUCTIONS

To avoid serious personal injury, accidental death, or major property damage, read and follow all safety instructions in the manual and on the equipment. Maintain all safety labels in good condition. If necessary, replace labels using the provided part numbers.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.



DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.



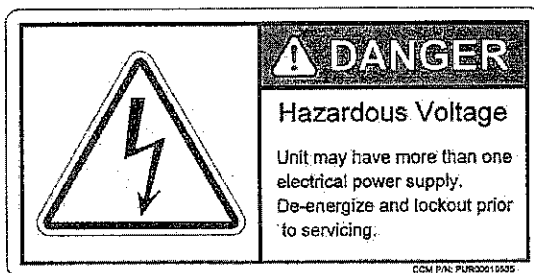
WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.



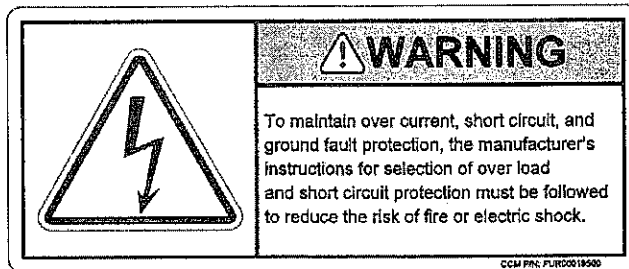
CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



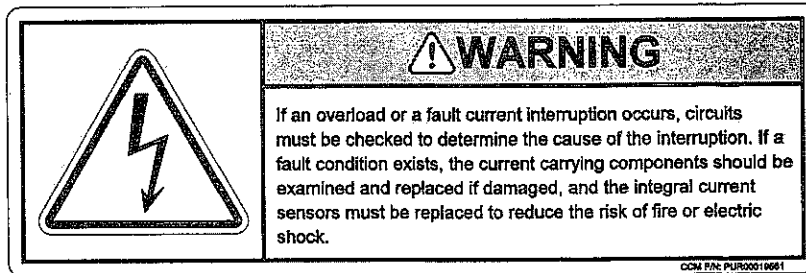
NOTICE indicates instructions that pertain to safe equipment operation. Failure to follow these instructions could result in equipment damage.



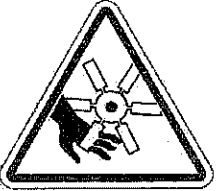
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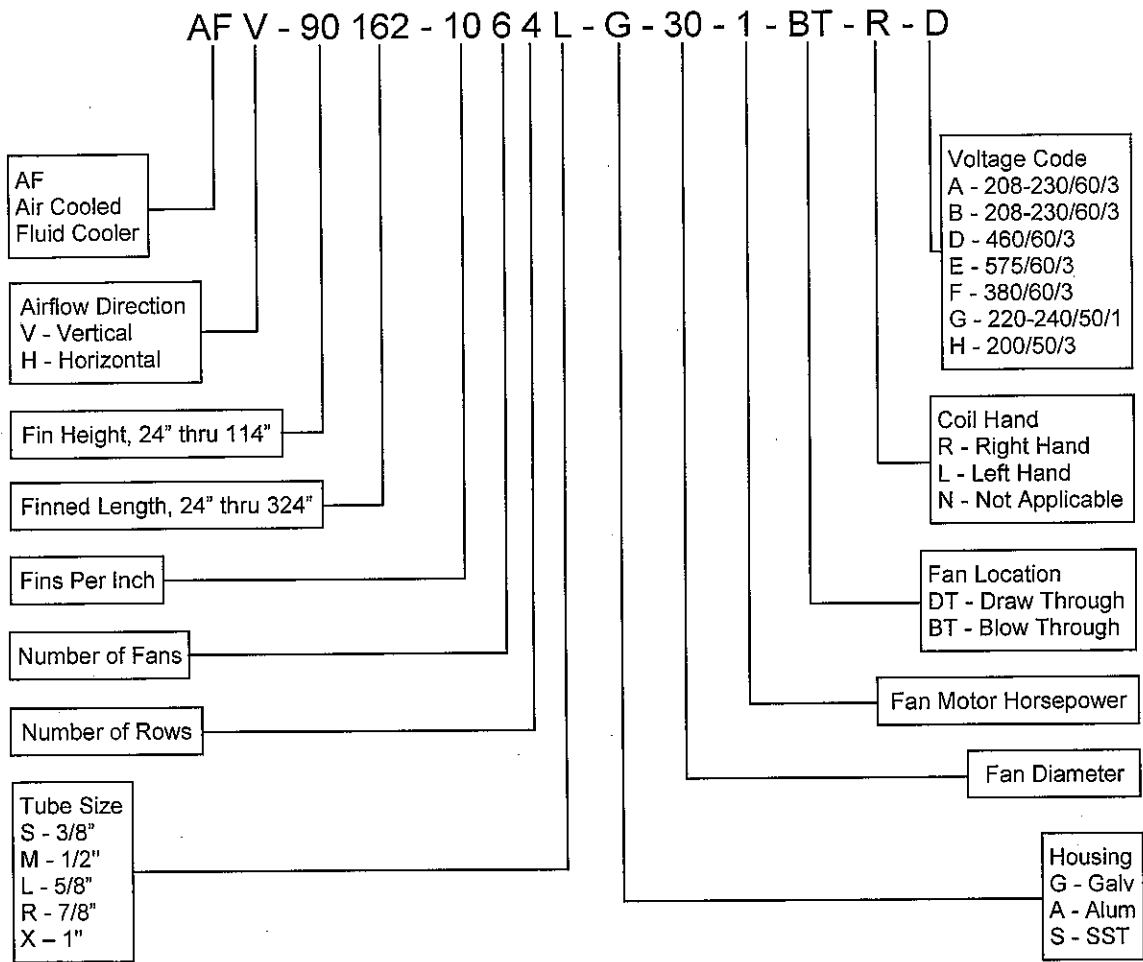
	⚠ DANGER
	Rotating Machinery Equipment may start and stop without warning. Do not operate with guards removed. Lockout prior to servicing. <small>CCM P&E PUR00019536</small>

PUR00019536

	⚠ DANGER
	Pressurized Gas/Liquid Contains pressurized gas/liquid. Evacuate system in accordance with applicable regulations and safety standards prior to servicing. Only qualified personnel should service unit. <small>CCM P&E PUR00019634</small>

PUR00019634

2. MODEL NOMECLATURE



3. GENERAL DESCRIPTION

- 3.1. Colmac Fluid Coolers are multiple row compact finned tube coolers with direct drive fans. The fluid circulates in multiple passes through the tubes and cooling air flows over the exterior finned surface. They are designed to provide cooling of Water, Ethylene Glycol/Water, and Propylene Glycol/Water solutions in a variety of closed loop applications. Closed loop cooling eliminates the cost of fluid treatment usually associated with the use of cooling towers. The compact plate fin heat transfer surface provides a compact and efficient air cooled fluid cooler.
- 3.2. The fan motors are heavy-duty, rigid foot mounted, direct drive, totally enclosed fan motors with moisture protected rain shields (slingers) suitable for an industrial environment.
- 3.3. The published fan sound level is based on free field conditions with no sound reflecting surfaces. If the cooler sound level is important, avoid installing the cooler within 30 feet of any large reflecting surface such as a building or wall. If this is not possible, the installed sound level must be recalculated for the actual site condition.

4. INSTALLATION

4.1. Inspection

- 4.1.1. Damage or Shortage – Upon receipt of equipment, inspect for shortages and damage. Any shortage or damage found during initial inspection should be noted on delivery receipt. This action notifies the carrier that you intend to file a claim. Any damaged equipment is the responsibility of the carrier, and should not be returned to Colmac Coil without prior notification. If any shortage or damage is discovered after unpacking the unit, call the deliverer for a concealed damage or shortage inspection. The inspector will need related paperwork, delivery receipt, and any information indicating his liability for the damage.
- 4.1.2. Specified Equipment – Check unit nameplate for: Electrical specifications to ensure compatibility with electrical power supply. Check model nomenclature and other information to ensure that the equipment matches the original order.

4.2. Mounting & Rigging

- 4.2.1. **NOTICE: In no circumstances should coil headers or return bends be used in lifting or moving condensers.**
- 4.2.2. **NOTICE: Use shipping container, or use hangers to lift unit into mounting position.**
- 4.2.3. The fluid coolers are fitted with lifting eyes on the top face of the cooler. Use lifting beams as illustrated in Figures 1 and 2.
- 4.2.4. All lifting must be done perpendicular to top of coil face with lifting straps attached to the lifting brackets in a vertical configuration as illustrated in Figures 1 and 2.
- 4.2.5. **NOTICE: Do not lift units with lifting straps attached to the lifting brackets in an A-frame configuration.**

4.3. Mechanical

- 4.3.1. Level the fluid cooler and install steel shims to fill any gaps under the support feet.

4.3.2. **NOTICE:** The fluid inlet must always be connected to the header on the air outlet side for counterflow operation.

4.3.3. After the flange bolts are installed, tighten snug but do not torque. Next install the mechanical anchors at all support lets and tighten down and then tighten the flange bolts.

4.3.4. **NOTICE:** Do not force flanges to come together. If flanges are not parallel, they will require adjustments with either application of heat to the nozzle or by removal and re-welding. Contact Colmac for instructions.

4.4. Electrical

4.4.1. Each Colmac AFV/AFH fluid cooler is factory wired for single-point connections in the field to the weatherproof terminal box on each cooler or to each individual motor at each fan bay depending on customer specification. Fan motors greater than 1 Hp do not have internal thermal overload protection controls; they must be provided by others. Fan Motors 1 Hp and smaller do have internal thermal overload protection. Standard construction does not include fan cycling and fused disconnects which must be supplied by others. Individual motor protection and fan cycling controls are available as optional extras.

4.4.2. All field wiring must comply with National Electrical Code and all other state and local regulations. This includes providing proper and safe motor protection, fusing, disconnects, and other basic equipment.

4.4.3. Check that the supply voltage matches the motor rated voltage. After the motors are connected, jog them to check for fan clearance and for proper fan rotation. Rotation can be reversed by swapping two of the three incoming line conductors on a three phase system. Operate all the fan motors for several hours to allow the motors to dry.

4.4.4. For fluid coolers equipped with FC (fan cycling) controls, refer to the wiring diagram included with the unit for control and connection details.

4.5. Location

4.5.1. Colmac fluid coolers have been designed primarily for outdoor installations. When locating the unit on a roof, it must be mounted on support beams which span load-bearing walls. Failure to do so may lead to excessive vibration on a resilient roof and possible damage to the unit. Refer to unit weights indicated on the submittal drawing or shipping documents and to the refrigerant line weights referenced below.

4.5.2. Locate the fluid cooler no closer than the unit's width from a wall or other obstruction. When two or more units occupy the same area, space them apart by a minimum distance of one unit's width to allow free air circulation around the coils.

4.5.3. The fluid cooler must be installed level and be securely anchored to the building structure or concrete pad.

Table 1

Weight of Ethylene Glycol in Type L Copper Lines

Line Size O.D.	Pounds per 100 Lineal Ft, Ethelene Glycol		
	0% Glycol	20% Glycol	40% Glycol
	100°F / 135°F	100°F / 135°F	100°F / 135°F
5/8	10.0 / 10.0	10.3 / 10.2	10.6 / 10.5
7/8	20.3 / 20.1	20.8 / 20.7	21.4 / 21.2
1 1/8	35.5 / 35.2	36.5 / 36.1	37.1 / 36.7
1 3/8	54.1 / 53.6	55.5 / 55.0	57.0 / 56.5
1 5/8	76.5 / 75.9	78.6 / 77.9	80.7 / 79.9
2 1/8	133.1 / 132.0	136.8 / 135.5	140.4 / 139.0
2 5/8	205.3 / 203.6	210.9 / 209.0	216.5 / 214.4
3 1/8	293.1 / 290.6	301.0 / 298.3	309.1 / 306.0
3 5/8	396.4 / 393.1	407.2 / 403.5	418.0 / 413.9
4 1/8	515.3 / 511.0	529.3 / 524.5	543.4 / 538.1

Table 2

Weight of Propylene Glycol in Type L Copper Lines

Line Size O.D.	Pounds per 100 Lineal Ft, Propylene Glycol		
	0% Glycol	20% Glycol	40% Glycol
	100°F / 135°F	100°F / 135°F	100°F / 135°F
5/8	10.0 / 9.9	10.2 / 10.1	10.4 / 10.3
7/8	20.3 / 20.1	20.7 / 20.5	21.0 / 20.7
1 1/8	35.5 / 35.2	36.1 / 35.8	36.7 / 36.3
1 3/8	54.1 / 53.6	55.1 / 54.5	55.9 / 55.2
1 5/8	76.5 / 75.9	77.9 / 77.1	79.1 / 78.2
2 1/8	133.1 / 132.0	135.6 / 134.2	137.6 / 136.0
2 5/8	205.3 / 203.6	209.1 / 207.0	212.2 / 209.7
3 1/8	293.1 / 290.6	298.4 / 295.4	302.9 / 299.3
3 5/8	396.4 / 393.1	403.6 / 399.5	409.7 / 404.9
4 1/8	515.3 / 511.0	524.7 / 519.4	532.6 / 526.3

4.6. Filling

4.6.1. Clean water is suitable for flushing and testing in warm weather, but when the temperature is below freezing, a glycol/water solution is required.

4.6.2. All system piping must be flushed before connecting it to the fluid cooler.

4.6.3. **NOTICE: Do not flush the system through the fluid cooler as dirt and welding debris from the piping can cause fowling of the internal surfaces of the tubing and potentially block the tubes.**

4.6.4. Vent all air from the piping and cooler during filling.

4.6.5. When the air is all vented, pressurize the system, and check all of the flange joints for leaks, and retighten flange bolts where necessary.

4.6.6. After testing, drain the flushing fluid and replace with clean demineralized water and glycol solution of the specified ratio prior to operation.

4.7. Storage

4.7.1. If the fluid coolers are to be stored or not operated for an extended period of time, the fan motors may ingress moisture if they are not protected or operated regularly. In severe cases, the moisture will reduce the insulation level of the windings or cause rusting of the bearings necessitating removal for repairs at a motor repair facility. This is a common problem with large generating installations when the coolers are often ready but commissioning of the main turbine-generator is delayed for several months.

4.7.2. The simplest remedy for installed coolers is to operate the fan motors for a few hours every week during the downtime period until regular operation resumes. The fan motors on stored coolers must be protected from the elements by covering them with waterproof tarps.

5. OPERATION

5.1. Before Startup

5.1.1. Make sure unit voltage agrees with supply voltage.

5.1.2. Make sure system is wired correctly and in accordance with the guidelines laid out in this IOM, as well as local and national standards that may apply.

5.1.3. Check torque on all electrical connections.

5.1.4. Make sure all piping is done completely and in accordance with the guidelines laid out in this IOM, as well as in accordance with standard good practice.

5.1.5. Make sure unit is mounted securely using all hangers, and is level.

5.1.6. Make sure that all fan set screws are tight.

5.2. After Startup

5.2.1. Check fan rotation of all fans to make sure air is moving in proper direction.

5.3. Fan Cycling Setup Checklist

5.3.1. Heating/Cooling Mode Adjustment: As shipped from the factory, the fan cycling controller is set up for cooling mode.

5.3.2. Setpoint Adjustment: Set point is defined as the temperature setting at which the temperature controller output relay will de-energize.

5.3.3. Differential Adjustment: Differential is defined as the change in sensor temperature between energization and de-energization of the relay. In cooling mode, the temperature controller will energize the output relay at a temperature equal to the

setpoint plus the differential. The temperature controller will de-energize the output relay at a temperature equal to the setpoint.

5.3.4. Offset: On temperature controllers with offset functionality, the offset adjustment sets the temperature offset from the control module setpoint, at which the stage module's output relay will de-energize.

5.3.5. Temperature Sensor

- For sensing fluid temperature: Insert sensor into sensor well in outlet header utilizing thermal paste to ensure good heat transfer.
- For sensing ambient temperature: Attach sensor to unit leg away from fan induced air flow and out of direct sunlight.

5.3.6. Control Settings

Master Setpoint & Differential Table
(Values supplied by sales and/or engineering)

Type F.C Controls			
Setpoint 1		Differential 1	
Bulb Location			
Cond. Leaving Fluid Temp.			
Ambient Air Temp.			

Stage Differential & Offset Table
(Values supplied by sales and/or engineering)

Type F.C Controls			
Offset 1		Differential 1	
Offset 2		Differential 2	
Offset 3		Differential 3	
Offset 4		Differential 4	
Offset 5		Differential 5	
Offset 6		Differential 6	
Offset 7		Differential 7	
Offset 8		Differential 8	
Offset 9		Differential 9	

6. MAINTENANCE

- 6.1. The direct Drive fan motors are provided with double sealed shaft bearings. Periodic lubrication is not required.
- 6.2. Check the fan blades annually and remove any accumulations of dirt.
- 6.3. **Cleaning inside:** When the glycol/water solution is maintained in its original condition, the inside of the tubes will not require regular cleaning. If the glycol/water solution is allowed to deteriorate, the inside of the tubes may become corroded or fouled and

require cleaning. Disconnect the cooler from the pipe connections and fill with chemical cleaners suitable for copper tubes. Drain and flush with clean water after cleaning.

6.4. Cleaning Outside: Remove any debris that collects on the air inlet side of the finned tubes as this will reduce the airflow. The debris can often be removed by shutting off the fans and blowing air or a water spray in the reverse direction. A soft bristled brush with a water-detergent solution may be required to remove oily deposits followed by rinsing with clean water. Straighten any fins that may have bent during cleaning.

6.5. Replacement Parts

6.5.1. Replacement parts which are covered under the conditions of Colmac Coil's warranty (see Limited Warranty) will be reimbursed at the part cost only. For replacement parts, warranted or otherwise, contact Colmac Coil directly. When contacting Colmac Coil with the explanation of failure, have the complete model number, serial number, date of installation, and date of failure at hand.

FIGURE 1
Vertical Fluid Cooler
Rigging

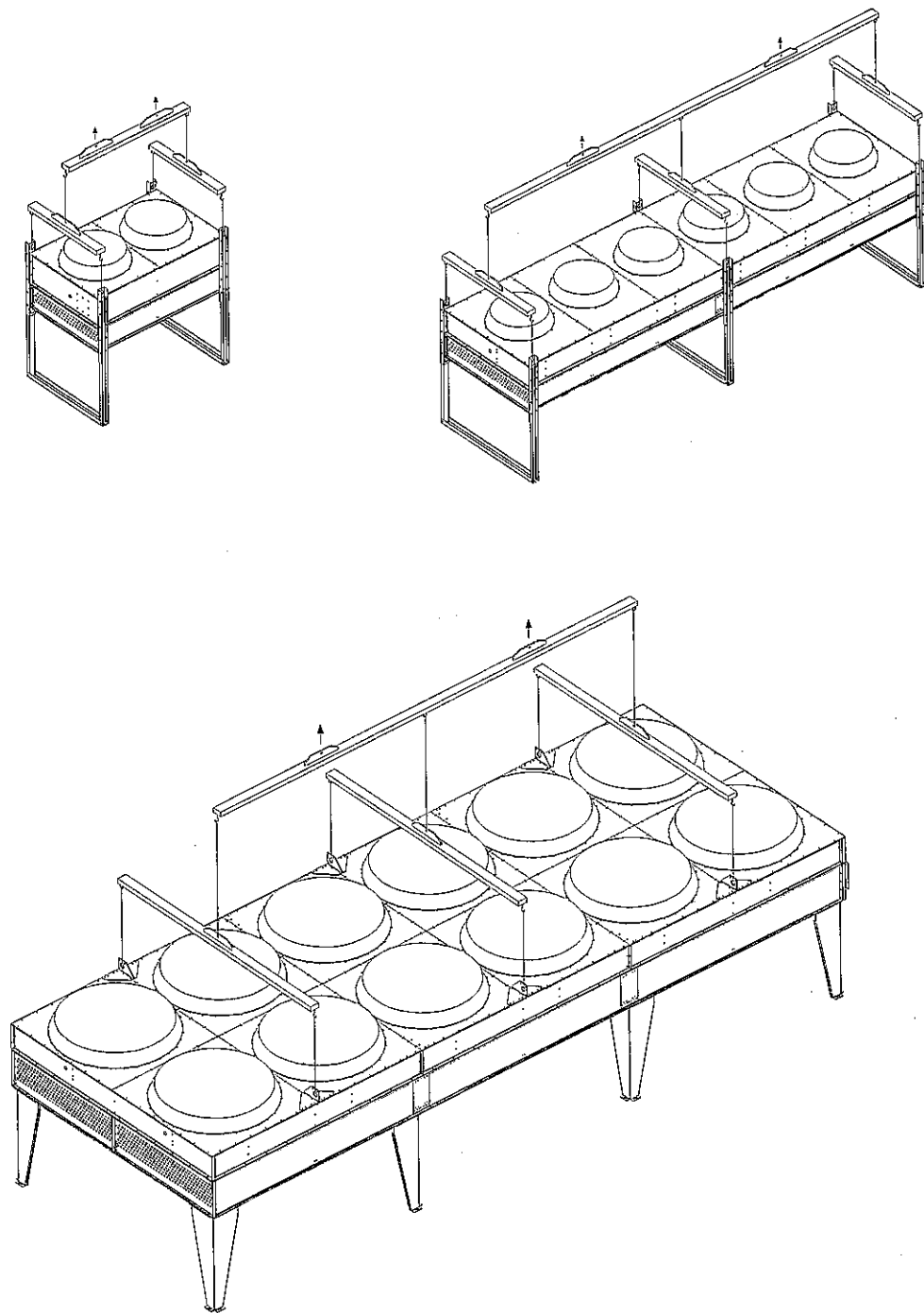
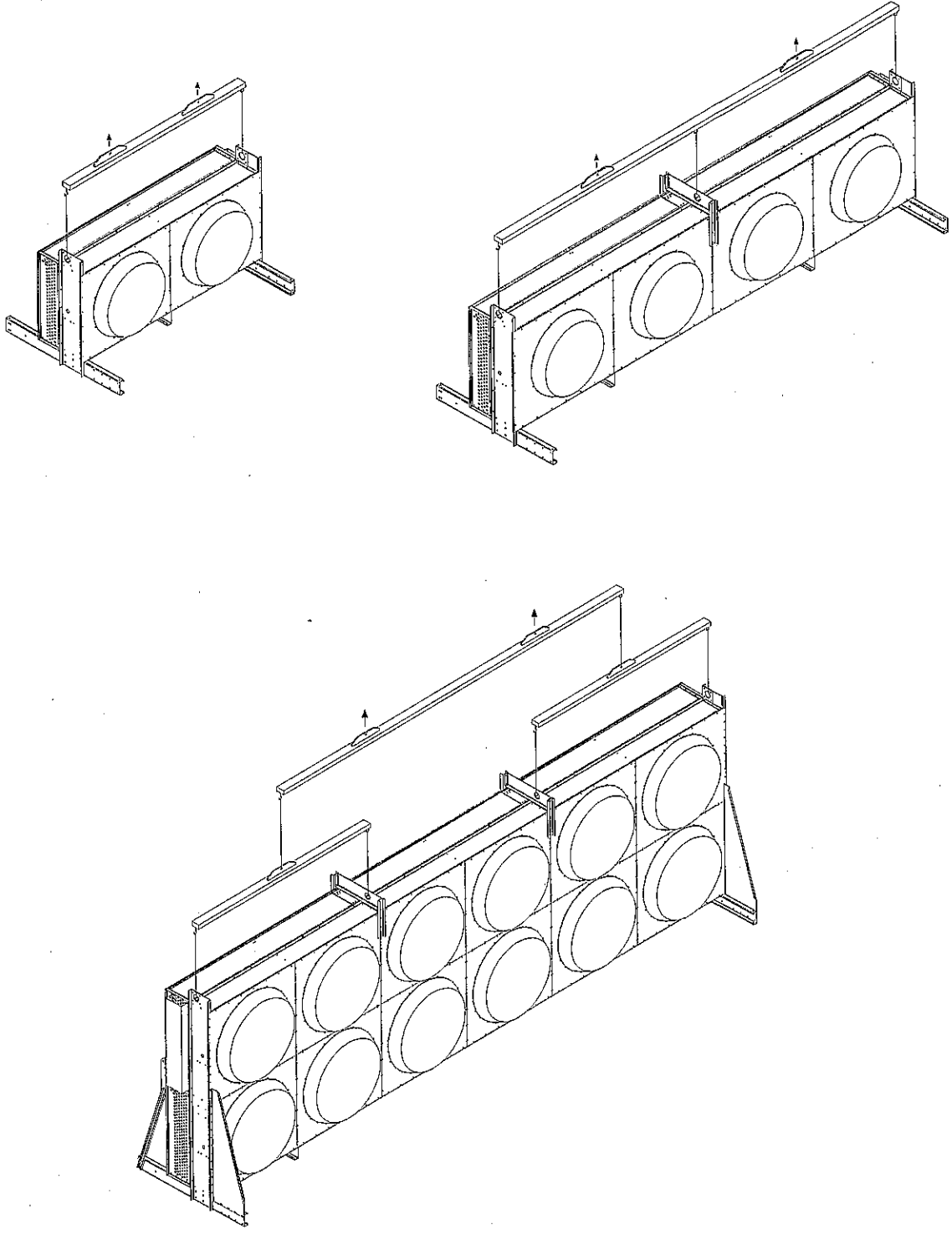


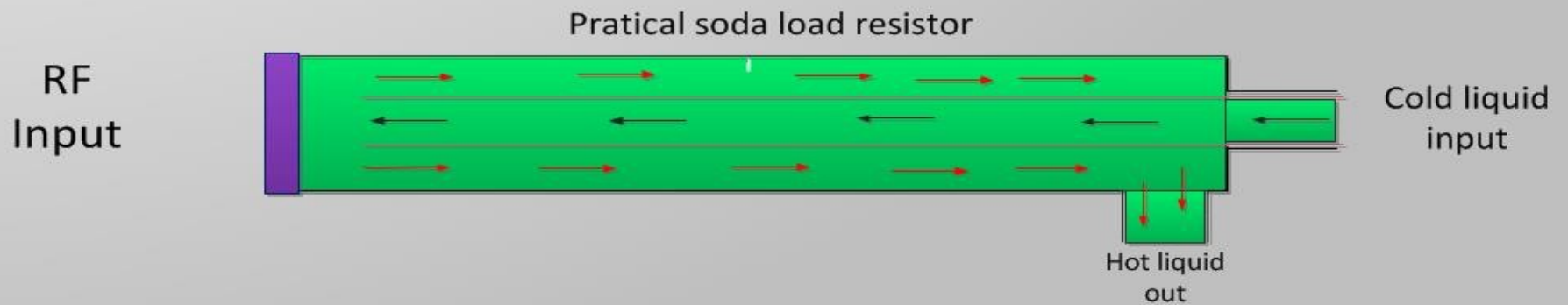
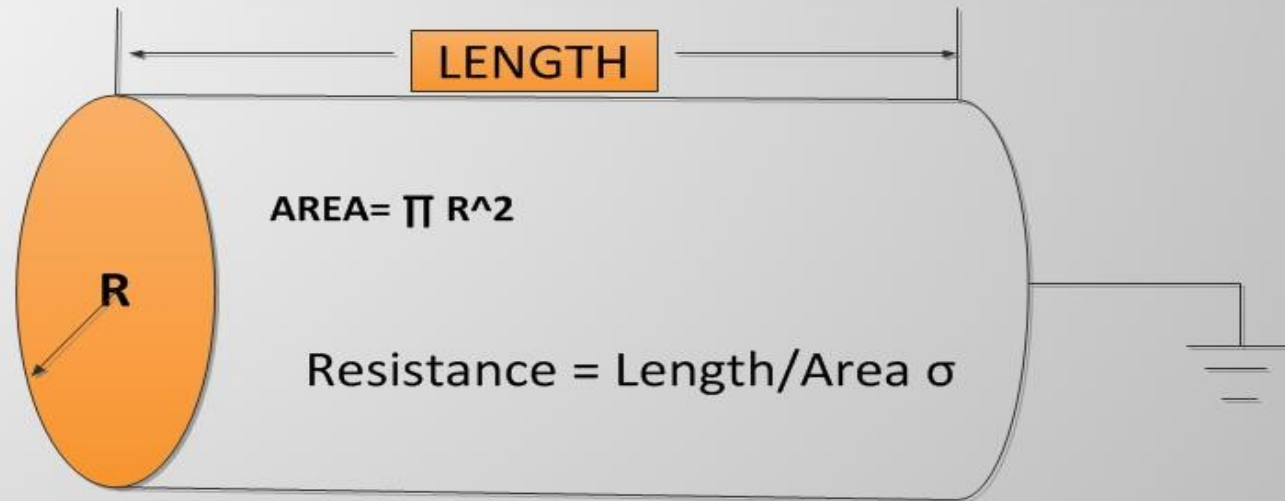
FIGURE 2
Horizontal Fluid Cooler
Rigging

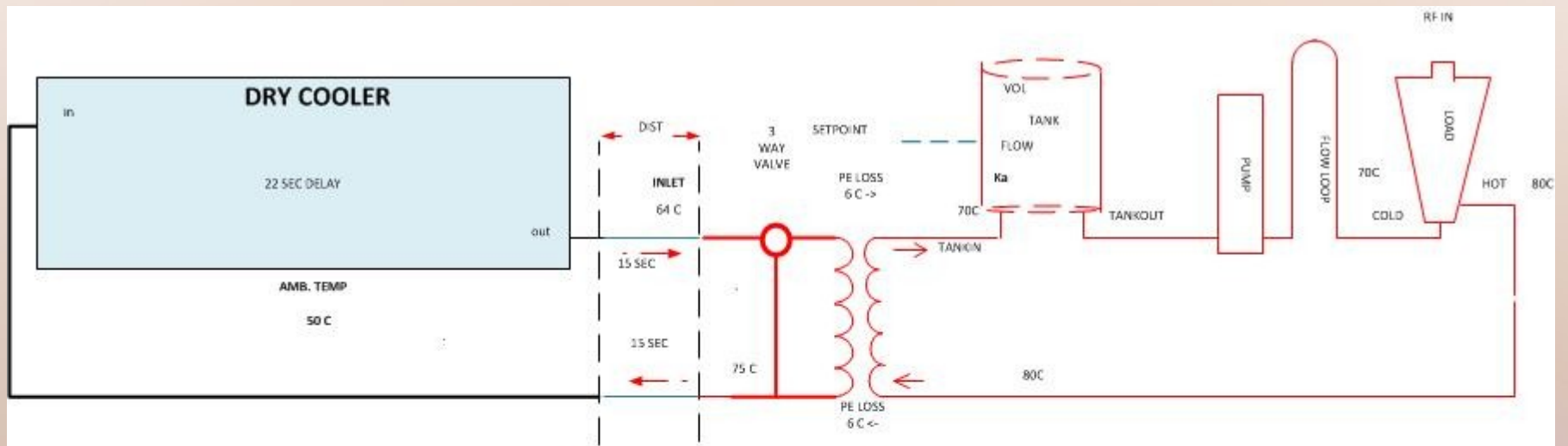


SODA ELEMENT

Title Basic Soda Element

June 6, 2013





$$\text{SETPOINT} = \text{AMB} + 15 + 6 + (\frac{1}{2} \text{ DELTA TEMP})$$

AMB TEMP	REQ. SETPOINT
55	80
50	75
45	70
40	65
35	60

DELAY THROUGH SYSTEM
 15 SEC OUT
 22 SEC COOLER
 15 SEC BACK
 52 SEC TOTAL

Dry Cooler

Inspection: The Dry cooler was pressurized when shipped verify that there is still pressure on the air valve located in the center of the flange cover.

Note:

If there is no pressure refer to the Soda Load Manual for specific instructions.

Installation: Position In Accordance with Site Drawings

Plumbing: Progressive torque in alternating sequence all Flange Connections to 100 FtLBS

Electrical:

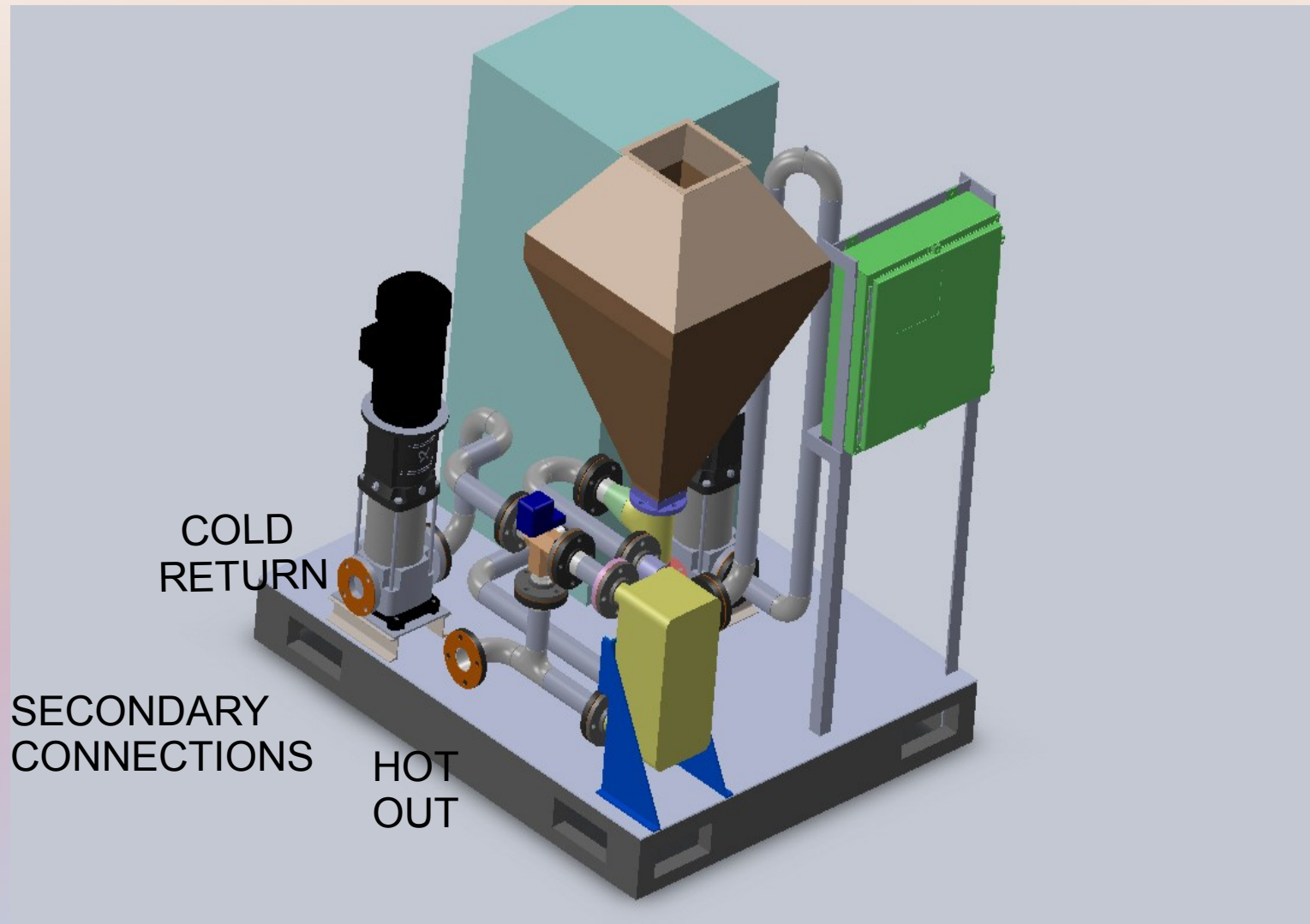
Power: Connect facility power 400 VAC 3 Phase to mains input of dry cooler

Controls: Connect control wiring to Dry Cooler Control terminals

Note:

Refer to Dry Cooler Interface Drawing for specific connection points

SECONDARY VIEW



Soda Load

Installation: Position in accordance with site Drawings

Plumbing: Progressive torque in alternating sequence all Flange Connections to 100 Ft Lbs

Electrical:

Power: Connect facility power 400 VAC 3 Phase to mains input of dry cooler

NOTE: There is a safety ground on the bottom of the frame.

Controls: Connect control wiring to Soda Load Dry Cooler Control terminals

Note:

Refer to Dry Cooler Interface Drawing for specific connection points

Transmitter Interlock Connect Transmitter enable to Soda load TB2-X,

RF Connect box line in accordance with site installation procedures

NOTE:

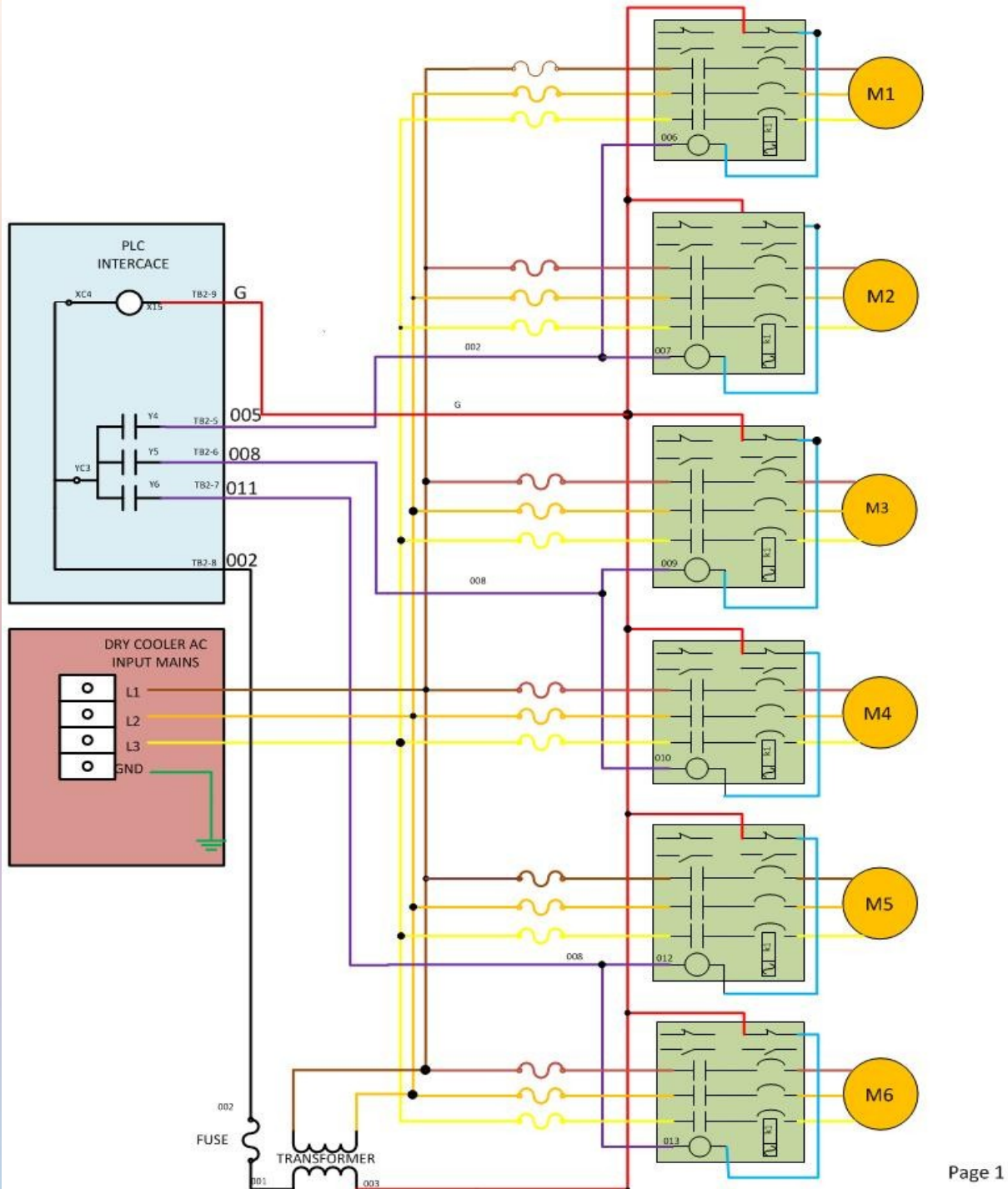
DO NOT OPERATE SYSTEM WITHOUT TRANSMITTER INTERLOCK CONNECTED

CHECKING PHASE ROTATION

- APPLY POWER TO THE SODA SYSTEM
 - NOTE:
 - TWO (2) PERSONEL ARE REQUIRED TO PERFORM THIS TASK.
- WHILE OBSERVING THE MOTOR THROUGH THE TOP OF THE PUMP MOMENTARLY PRESS THE CONTACTOR RELAY FOR THE SODA PUMP AND NOTE ROTATION. IF ROTATION IS NOT CORRECT REMOVE POWER TO THE SODA SYSTEM AND SWAP TWO WIRES ON THE INPUT TO THE SODA ELECTRICAL PANNEL. REAPPLY SODA LAOD INPUT POWER AND VERIFY PROPER ROTATION.
- REMOVE POWER TO THE SODA LOAD SYSTEM

DRY COOLER CONFIGURATIONS

- THE DRY COOLERS HAVE A DIFFERENT NUMBER OF FANS BASED ON THERE COOLING CAPACITY.
- 500 KW 3 BANKS OF 2 FANS
- 400 KW 2 BANKS OF 2 FANS
- 200 KW 2 BANKS OF 1 FAN
- A HARDWARE JUMPER STRAP SELECTION IN INSTALLATION CONFIGURATION CHANGES CONTROL POINTS THROUGH SOFTWARE
- THE NUMBER FANS WILL AUTOMATICALLY OPERATE BASED ON APPLIED POWER.



Soda Charging Procedure

Power should be removed from the soda system for this procedure.

NOTE:

A small pump is required to charge the system.

Connect the output of the priming pump to the soda tank drain

Connect the input side of the priming pump to the water source .

Actuate the source pump and fill the system to 8 cm below the tank high level switch.

The Lid on the tank will have to be removed to view the level.

Apply power to the soda load system.

From the Display screen select menu-> controls> press the soda pump on

The pump will run for about 5 second and shut off if there is no flow.

Open the bleed valve on the soda pump and remove air. Close when liquid start to come out. Bleed the air out of the valve at the top of the flow loop. Repeat these procedures starting the pump until the pump stays running. Top off the level in the tank to 8 cm below the tank high switch level. And disconnect pump from soda tank drain valve.

Remove power from the soda system and perform secondary charging procedures.

Secondary Charging Procedure

Performed after soda charging procedure

Power should be removed from the soda system for this procedure.

NOTE:

A small pump is required to charge the system.

Connect the output of the priming pump to the input side of the secondary pump.

Insert the input side of the priming pump into the supplied containers of glycol/water mix. Actuate the source pump and fill the system to $\frac{3}{4}$ capacity per site specific documentation.

There are two air bleed points in the secondary system One is in the top of the piping from the secondary pump to the plate exchanger. The other is on the secondary pump. These points will have to be repeatably accessed to remove all air from the system. The general operation is to open the bleed port until liquid comes out then close the port.

Apply power to the soda load system.

From the Display screen select menu-> controls> press the sec pump on

The pump will run for about 5 second and shut off if there is no flow.

Open the bleed valve on the sec pump and remove air. Close when liquid start to come out. Bleed the air out of the valve at the top of the flow loop. Repeat these procedures starting the pump until the pump stays running. Fill the secondary system until level $\frac{1}{4}$ of sight gage on dry cooler. Depending on the installation the air may have to be bleed at the dry cooler inlet port. Note if the solution becomes air saturated the pump may have to be set off and the air allowed to separate from the liquid this may take up to one hour. When the secondary system is charged the pump may be removed.

FAN ROTATION

- INSURE POWER TO THE SODA LOAD IS OFF
- INSURE POWER TO DRY COOLER IS OFF
- OBTAIN A 4”(10 CM) INSULATED #14 OR BIGGER WIRE AND STRIP BOTH ENDS
- INSERT ONE END INTO TERMINAL 002 AND SCREW DOWN INSURE THE OTHER END IS NOT CONTACTING A CONDUCTIVE SURFACE.
- TWO PERSONELL ARE REQUIRED TO PERFOR THIS OPERATION
- APPLY POWER TO THE DRY COOLER
- MOMENTERLY TOUCH THE FREE END OF THE JUMPER WIIRE TO TERMINAL 003 “THE FAN SHOULD ROTATE” VERIFY THAT THE FAN IS BLOWING UP THROUGH THE COILS
- IF FANS ARE BLOWING IN THE WRONG DIRECTION
 - REMOVE POWER TO THE DRY COOLER AND SWAP TWO OF THE AC INPUT WIRES. REAPPLY POWER AND REPEAT TEST
 -
- REMOVE POWER TO THE DRY COOLER

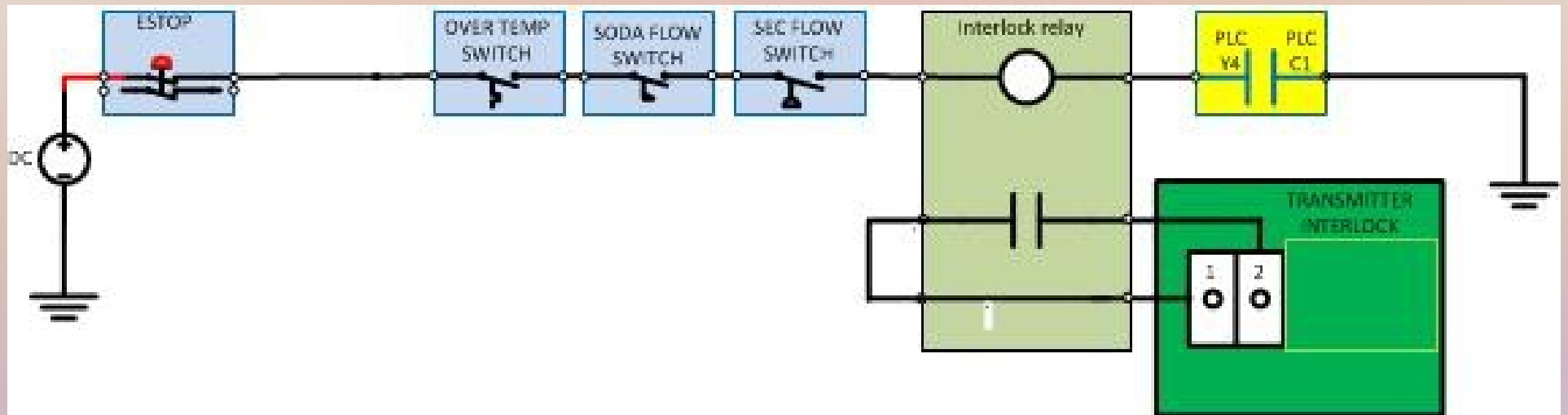
SETTING IMPEDANCE 1

- PRESS MENU ALL START
- PRESS MENU-> OFFSET-> SETPOINT SODA → 75->ENTER
- PRESS MENU->CONTROL-> HEATER ON
- THIS WILL START THE HEATING OF THE LIQUID IN THE TANK AND WILL TAKE O FEW HOURS TO REACH SETPOINT TEMPERTURE
- THE AMOUNT OF SODA REQUIRED DEPENDS ON THE SYSTEM SIZE.
- VERIFY THE TRANSMITTER INTERLOCK IS OPERATIONAL
- THIS MAY BE TESTED BY PRESSING THE ESTOP PUSH BUTTON
- IF IT IS OPERATIONAL ROTATE THE E STOP PUSH BUTTON TO RESET
- WHEN THE SYSTEM HAS REACHED 45 DEGREES C THE TRANSMITTER MAY BE POWERED ON AT A MED POWER SETTING. THERE WILL BE A HIGH REFLECTION AT THIS POINT AND THE TRANSMITTER WILL FOLD BACK.
- POUR SODA IN TO THE TANK A COUPLE OF LITERS MAY BE INITALLY INTRODUCED.
- READ THE IMPEDANCE ON THE TRANSMITTER THIS SHOULD START TO COME DOWN AND POWER WILL BE ABSORBED BY THE LOAD. ALLOW THE SODA TEMP TO HEAT UP TO 75 C.

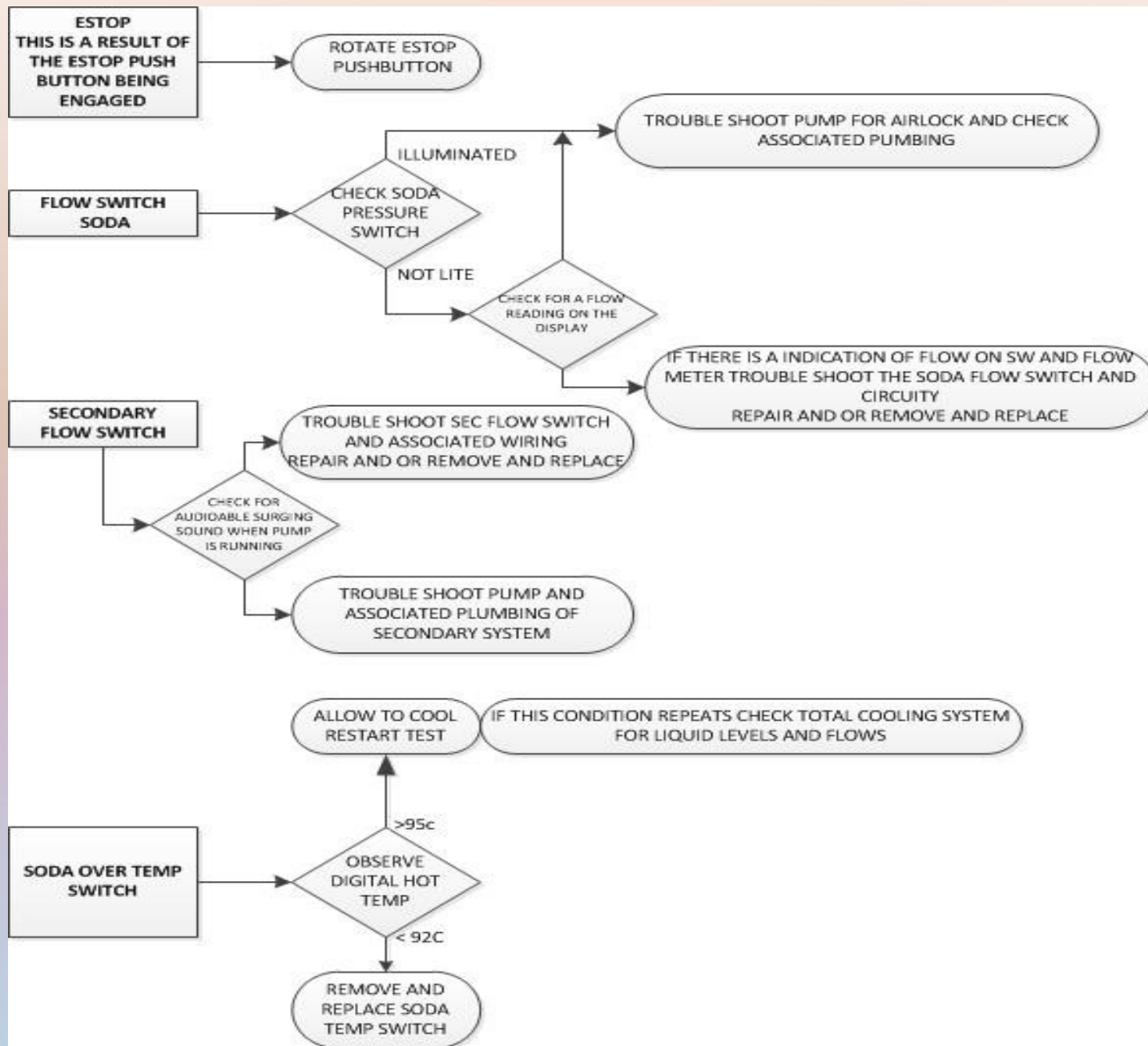
SETTING IMPEDANCE 2

- AS THE IMPEDANCE APPROACHES 50 OHMS APPLY SMALLER AMOUNTS OF SODA AND WAIT ABOUT 1 MINUTE FOR THE READING TO STABLIZE BEFORE ADDING ADDITIONAL SODA. THE IMPEDANCE SHOULD BE SET TO 50 OHMS AND A VSWR READING OF BETTER THAN 1.05 SHOULD BE ACHIEVED.

TRANSMITTER INTERLOCK



TRANSMITTER INTERLOCK TROUBLE SHOOTING



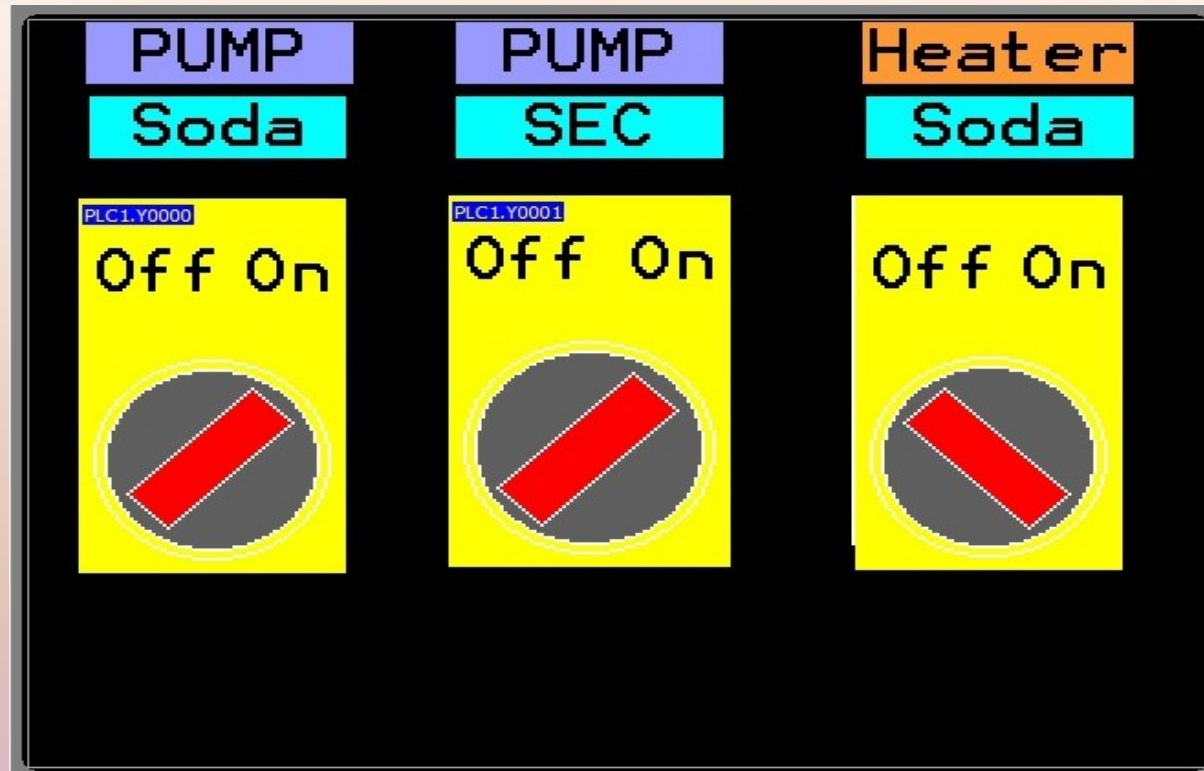
Start screen



This screen only pops up at power on.
The button by the exit must be pressed to advance.

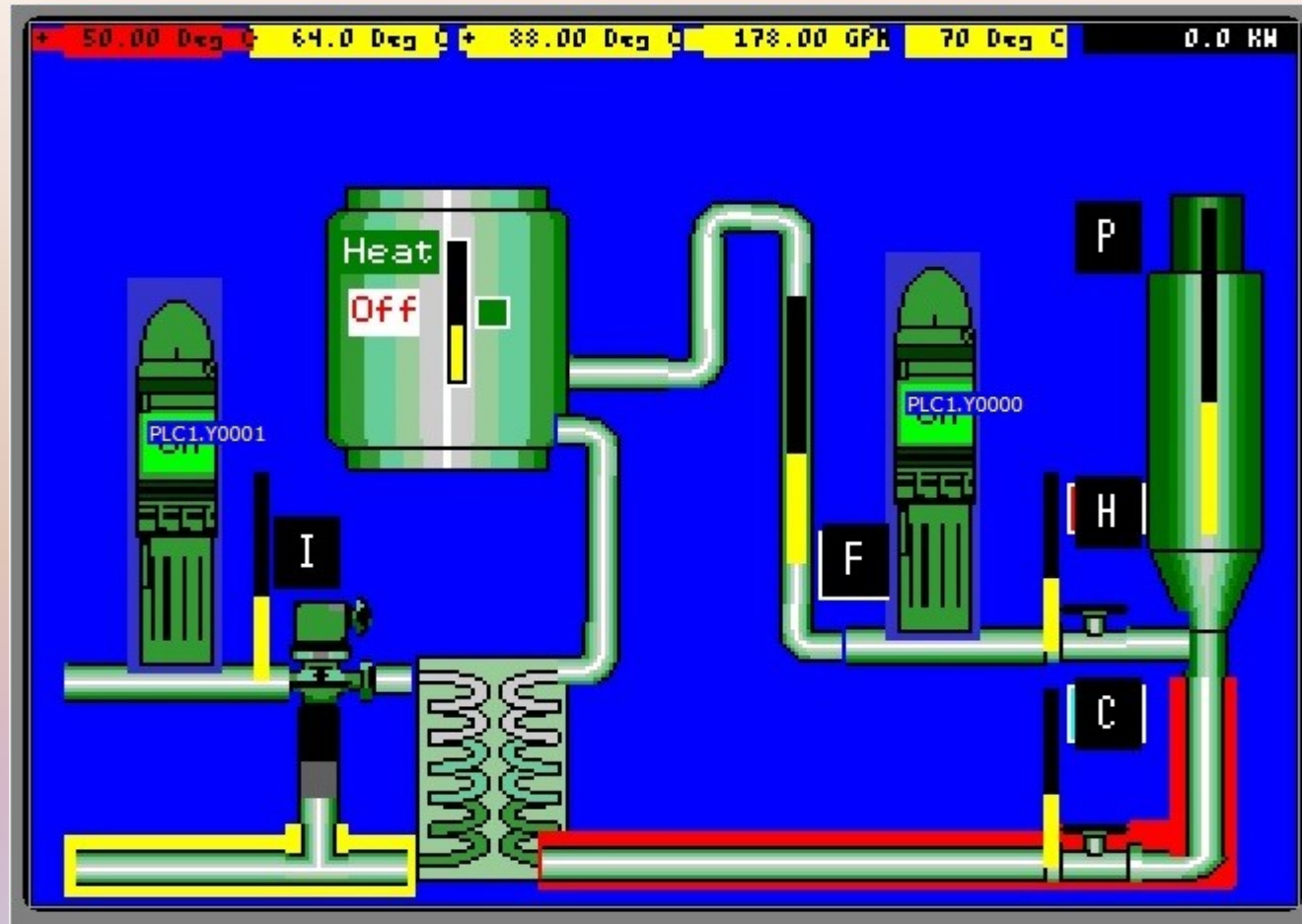
NFB SHOWS NUMBER FANS JUMPER CONFIGURATION

Controls



- Manual Control TOUCH RED AREA TO TOGGLE SWITCH
- Soda Pump
- Sec Pump
- Heater
- Note:
 - The heater will automatically turn on and off to maintain the tank Temp to Soda Offset temp when the heater switch is on

Image1



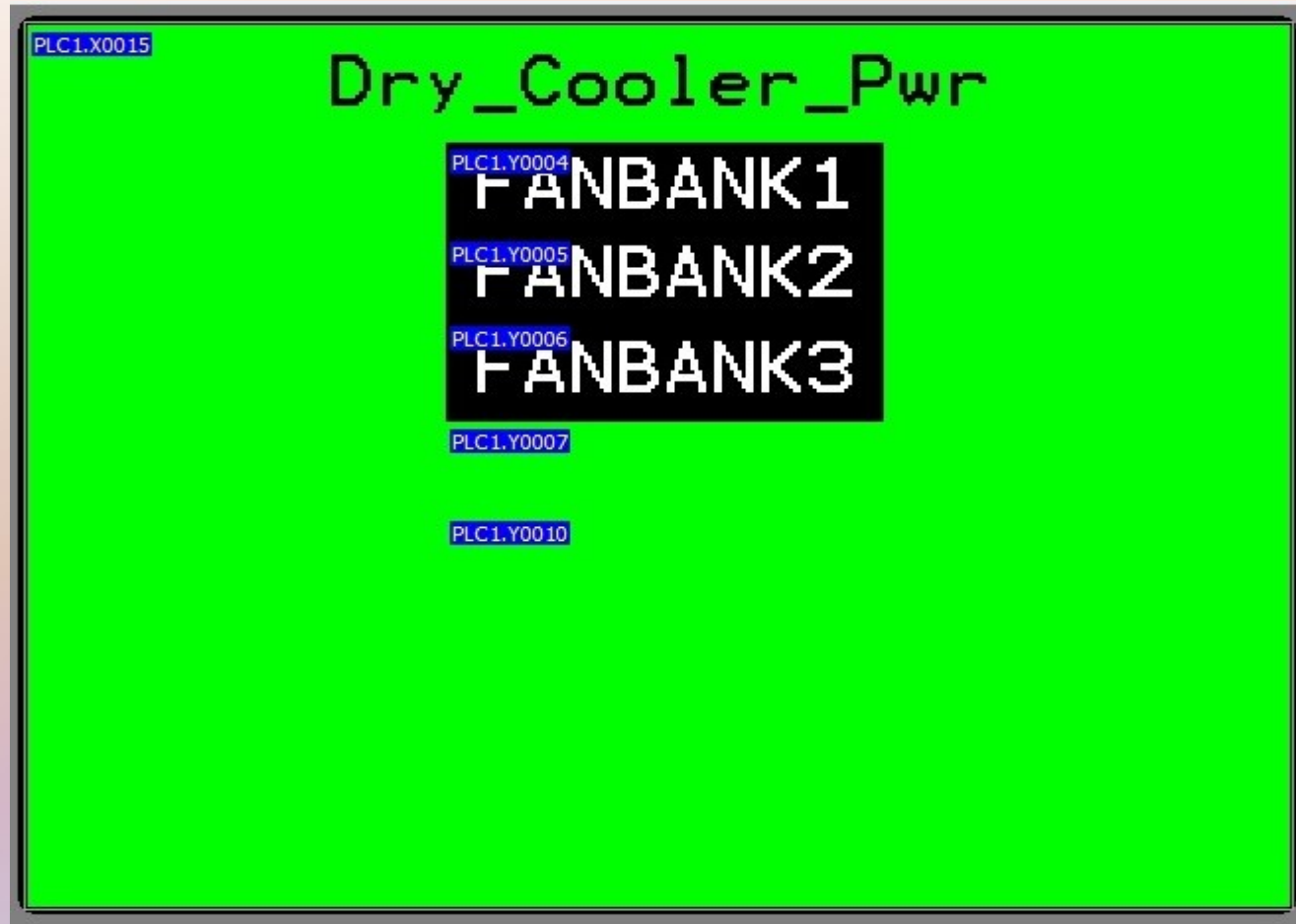
- Press high lighted button for operation and display

Power



- Averaged Information main screen
 - The bottom row of indicators reflect system operation

Dry Cooler Status



- Display Status of Dry Cooler Fans
- When the fans are on indicators are illuminated

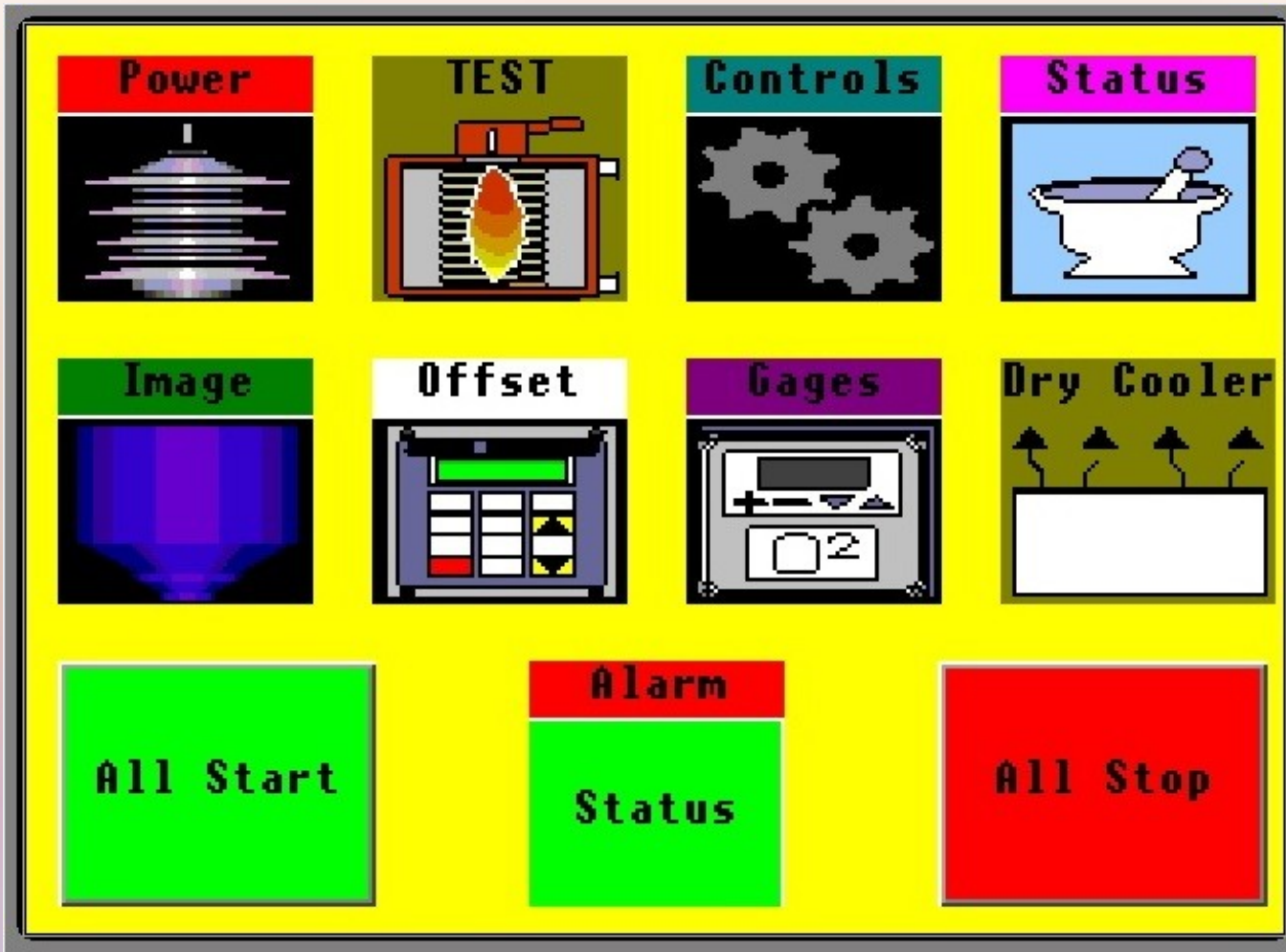
OFFSET

VALUES IN SCREEN
DO NOT APPLY
FOR DEMO ONLY

PROGRAM CONSTANTS			
Hoff :	+34.08	HGain :	287.04
Coff :	+34.08	CGain :	3287.04
Ioff :	+34.08	IGain :	3287.04
Toff :	+34.08	TGain :	3287.04
Aoff :	+34.08	AGain :	3287.04
Foff_S :	0.0	FGain_S :	5779.2
SetPointSoda :	55.84		

- **OFFSETS INITIAL SETTINGS**
 - Hoff 40.00 HGAIN 374
 - Coff 40.00 CGain 374
 - Ioff 40.00 Igain 374
 - Aoff 40.00 Again 374
 - Foff_S 00.00 FGAIN 3120
 - SetPointSoda 75.00

MAIN



SELECTION SCREEN DISPLAYED WHEN MENU PRESSED

TEST DATA

TEST DATA RAW			
POWER:			600.00 KW
HTemp:	+	88.00	Deg C
CTemp:	+	70.00	Deg C
DTemp:		20.00	Deg C
ITemp:	+	64.0	Deg C
TTemp:	+	74.00	Deg C
Flow_S:			178.00 GPM

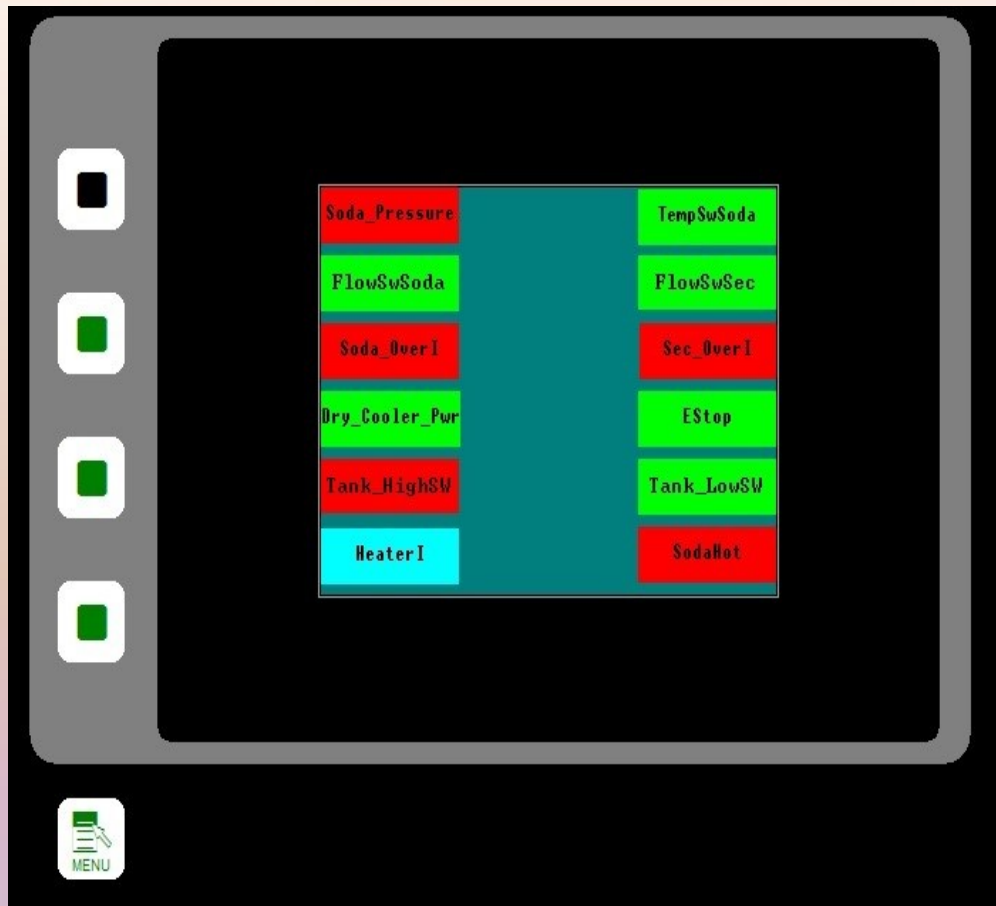
- RAW DATA USED FOR TRENDING REVIEW
- THIS IS REAL TIME NO AVERAGING DATA

Sensor Calibration

- Apply power to soda load system
- Set SetPoint to 85 C
- Turn on Pumps and heater
- Allow Fluid temperature to reach 75C
- This may take several hours depending on the starting temperature of fluid.
- If no transmitter power is available the system may be left on over night
- The process may be accelerated by using RF Power to heat the liquid.
- When the temperature of the Cold water is 75 ± 1 Turn off the transmitter and heater
- Allow the system to stabilize for 15 minutes.
- Record Cold And Hot temperatures . Using the Hot offset adjust the hot temp to match the cold temp
- When they match and DeltT is zero record the Hot offset on the inside of the electrical box door
- Set the soda Set point to 75C
- Allow 3 minutes before removing power to display for permanent memory to be stored

When the transmitter is at full power observe the power displayed on the soda load. Using the Fgain setting in the offset screen adjust the Displayed power to match the transmitter power.

- Record the information on the label inside the door and wait 3 minutes for the data to get stored in memory before removing power to display

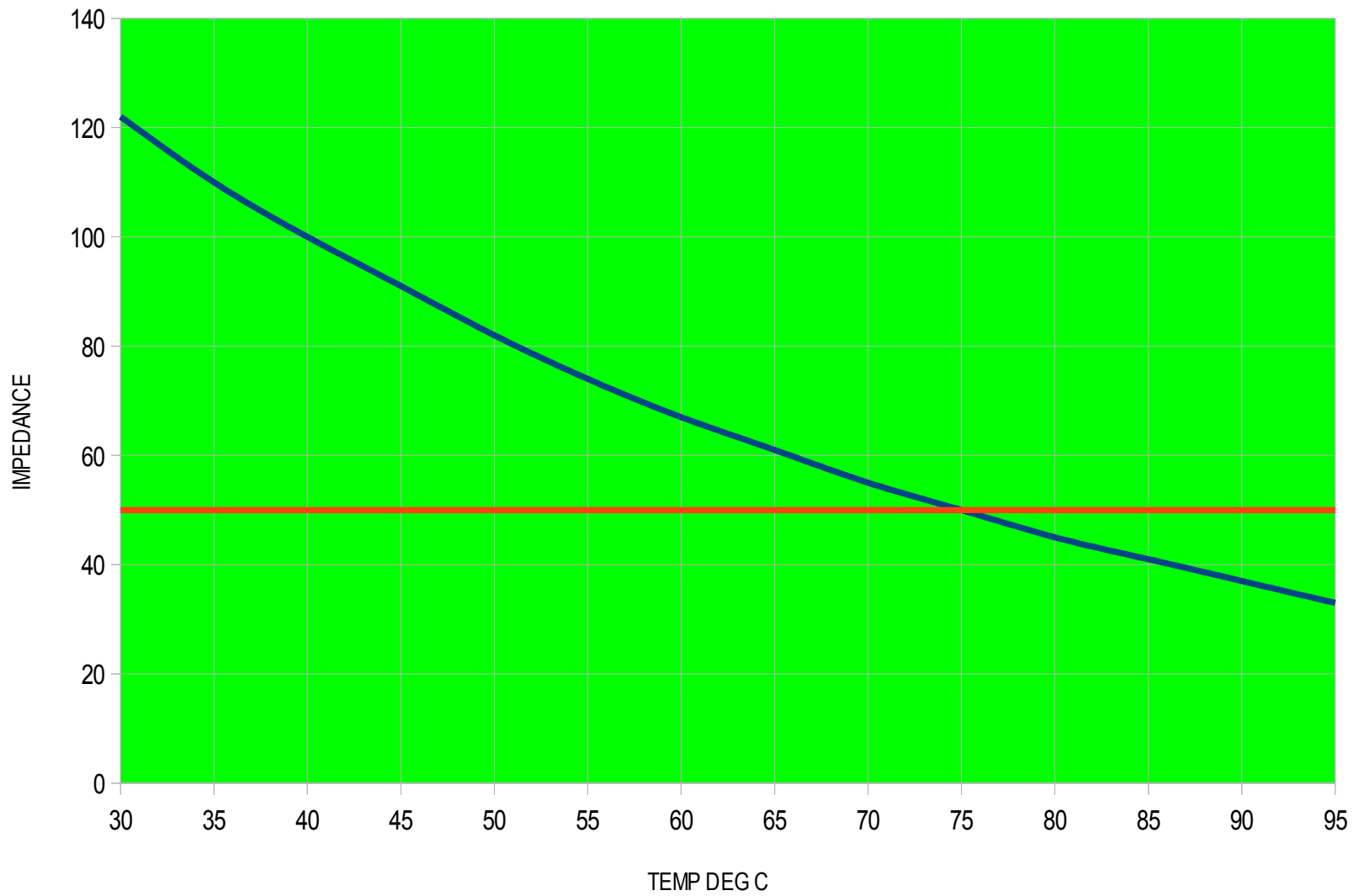


Status Screen

This screen displays the status of sensor monitor points Red is a fault condition
The heater is controlled by the PLC to maintain tank temperature and is fault indication it show if the heater is on or off

IMPEDANCE VS TEMP

NORMILIZED TO 75 C



3 Way Valve

- It is necessary for the 3 way valve to move a full 90 Degrees in operation and this should be confirmed.
- Display->MENU->Power
- The reading on the lower right of the display is the valve command word. A reading of 4095 is fully open and the mechanical pointer should point to 0 degrees. A reading of 820 is fully closed and the mechanical pointer should point to 90 degrees.
- The valve command word may be temporary changed from the display screen
 - Turn the secondary pump off
 - Display->menu->offsets soda set point
 - Set Set point soda to a value well below the tank temperature ie.10 C
 - The valve should go to 0 Degree and the valve command word should be 4095
 - Set set point soda to a value well above tank temperature ie 90C.
 - The valve should go to 90 Degree and the valve command word 820
- If the valve spans the full 90 degree range
- Set the set point soda to 75 C
- Do not turn off power to the display for 3 minute to insure the data is stored to memory.
- Turn the secondary pump on
- If the valve fails to travel the 90 Degree span perform Zero and Span Calibration procedure in the valve data sheet

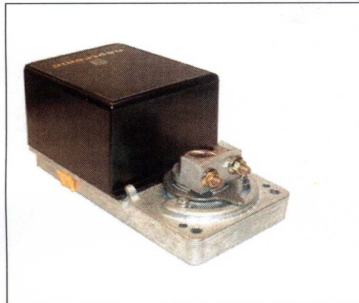
3 way valve continued

- If the valve moves in the wrong direction when commanded to move. Change the DIP switch 1 to the opposite position on the valve circuit board

neptronic®

Actuator

Specification & Installation Instructions



Features:

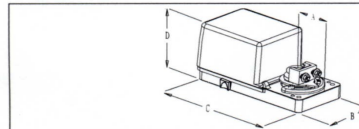
- Mounts easy on round & square shaft (with option -8).
- External clutch for manual adjustments.
- Maintenance free.
- Position indicator.
- Control signal fully programmable.
- The fastest actuator of the world (model BM__FF).
- Fail safe by *Enerdrive System*¹ (on model 060 & 080).
- Auxiliary switches (on model 020 & 080).

Old Number

BBM2000A	BM000
BBM2021A	BM020
BBM2060A	BM060
BBM2080A	BM080
BBMF2000A	BM000F
BBMF2021A	BM020F
BBMF2060A	BM060F
BBMF2080A	BM080F
BBMFF2000A	BM000FF
BBMFF2021A	BM020FF
BBMFF2060A	BM060FF
BBMFF2080A	BM080FF

Technical Data	BM000	BM060	BM000F	BM060F	BM000FF	BM060FF	BM020	BM080	BM020F	BM080F	BM020FF	BM080FF
	BBM 2000A	BBM 2060A	BBMF 2000A	BBMF 2060A	BBMFF 2000A	BBMFF 2060A	BBM 2021A	BBM 2080A	BBMF 2021A	BBMF 2080A	BBMFF 2021A	BBMFF 2080A
Fail safe - Enerdrive	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Power consumption	6 VA	15VA Peak,6VA	15 VA	24VA Peak,15VA	15 VA	24VA Peak,15VA	6 VA	15VA Peak,6VA	15 VA	24VA Peak,15VA	15 VA	24VA Peak,15VA
Torque	50 in.lb. [5,6 Nm] at rated voltage		35 in.lb. [3,9 Nm] at rated voltage		25 in.lb. [2,8 Nm] at rated voltage		50 in.lb. [5,6 Nm] at rated voltage		35 in.lb. [3,9 Nm] at rated voltage		25 in.lb. [2,8 Nm] at rated voltage	
Running time through 90°	20 to 30 sec torque dependant		3.5 to 4.5 sec torque dependant		1.5 to 2.5 sec torque dependant		20 to 30 sec torque dependant		3.5 to 4.5 sec torque dependant		1.5 to 2.5 sec torque dependant	
Auxiliary switches	No						Yes (2)					
Ingress protection	IP22 equivalent to Nema type 2, IP54 equivalent to Nema type 3R if water tight inlet bushings (not supplied NEP617) are installed						IP22 equivalent to Nema type 2					
Feedback	4 to 20 mA or 2 to 10 Vdc adjustable											
Power supply	22 to 26 Vac or 28 to 32 Vdc											
Electrical connection	18 AWG [0.8 mm ²] minimum											
Inlet bushing	2 inlet bushing of 5/8 in [15.9 mm] & 7/8 in [22.2 mm]											
Control signal	Analog, Digital or Pulse with modulation (PWM) programmable (factory set with Analog control signal)											
Angle of rotation	0 to 90 degrees, mechanically adjustable (factory set with 90° stroke)											
Direction of rotation	Reversible, Clockwise (CW) or Counterclockwise (CCW) (factory set with CW direction)											
Ambient temperature	-22°F to 122°F [-30°C to 50°C]											
Storage temperature	-22°F to 122°F [-30°C to 50°C]											
Relative Humidity	5 to 95 % non condensing.											
Weight	3 lbs. [1.4 kg]											
Warning	Risk of malfunction: Do not press the clutch when actuator is powered.											
	Risk of malfunction: When adjusting limit screws a stroke adjustment must be performed. Refer to stroke adjustment section.											

Dimensions



Dimension	Imperial (in)	Metric (mm)
A	1.50	38.1
B	3.26	82.8
C	6.60	167.5
D	model 000 & 060	3.01
	model 020 & 080	3.72

Caution

We strongly recommend that all Neptronic® products be wired to a separate transformer and that transformer shall service only Neptronic® products. This precaution will prevent interference with, and/or possible damage to incompatible equipment.
When multiple actuators are wired on a single transformer, polarity must be observed. Long wiring runs create voltage drop which may affect the actuator performance.

¹ Enerdrive System U.S.A. Patent #5,278,454



Mechanical Installation

MOUNTING BRACKET

CLUTCH

1. Manually close the damper blades and positioned the actuator at 0° or 90°.
2. Slide the actuator onto the shaft.
3. Tighten the nuts on the "U" bolt to the shaft with a 8mm wrench to a torque of 60 in.lb. [6,7 Nm].
4. Slide the mounting bracket under the actuator. Ensure free movement of the slot at the base of the actuator. The bracket pin must be placed in the mid distance of the slot.
5. Fix the bracket to the ductwork with #8 self-tapping screws.

⚠ Risk of malfunction: When adjusting limit screws a stroke adjustment must be performed. Refer to stroke adjustment section.

Wiring Diagrams

<p>Analog</p> <p>COMMON (-)</p> <p>SUPPLY (+)</p> <p>2 to 10 VDC</p> <p>FEEDBACK 4 to 20 mA</p> <p>FEEDBACK 4 to 20 mA</p> <p><i>For 4 to 20 mA control signal</i> Connect one of the supplied 500 ohm resistors between pins 1 and 3.</p>	<p>PWM</p> <p>COMMON (-)</p> <p>SUPPLY (+)</p> <p>PWM CONTROL SIGNAL</p> <p>FEEDBACK 4 to 20 mA</p> <p>FEEDBACK 4 to 20 mA</p>
<p>Digital – 3 wire / 2 position</p> <p>COMMON (-)</p> <p>DRIVE CW</p> <p>DRIVE CCW</p> <p>SUPPLY (+)</p> <p>FEEDBACK 4 to 20 mA</p> <p>FEEDBACK 4 to 20 mA</p> <p><i>Special consideration for Digital control</i> In this mode, actuator is sensitive to induced electrical voltages from other sources. To prevent such interference, wire one 2.2k ohm 0.5W resistor between pins 4 and 1 and a second 2.2k ohm 0.5W resistor between pins 3 and 1. These resistors are supplied.</p>	<p>Digital – 4 wire / 3 point floating</p> <p>COMMON (-)</p> <p>DRIVE CW</p> <p>DRIVE CCW</p> <p>SUPPLY (+)</p> <p>FEEDBACK 4 to 20 mA</p> <p>FEEDBACK 4 to 20 mA</p>
<p>For 2 to 10 VDC output feedback For any of above wiring configurations, connect one of the supplied 500 ohm resistors between pins 1 and 5.</p>	

PC Board

<p>Potentiometer</p> <p>Terminal</p> <p>LED</p> <p>Reset button</p> <p>Dip switch</p> <p>1 2 3 4 5</p>	<p>Dip switch settings</p> <p>Rotation: CW</p> <p>Fail safe return at 0°</p> <p>PWM: 25 sec.</p> <p>Rotation: CCW</p> <p>Fail safe return at 90°</p> <p>PWM: 5 sec.</p>
--	--

Stroke Adjustment – No control signal change

1. Apply power and, **wait for at least 10 seconds**.
2. Press and release the reset button to start the auto-stroke process.
The LED should be illuminated.
 - First option:
The actuator will then travel in both directions to find it's limit and position itself according to the demand.
The LED will extinguish, the process is complete.
 - Second option:
When the desired end position is reached, press and release the reset button. The actuator will now return back to its original position. (you can also press and release the reset button when it's reaches the original position)
The LED will extinguish, the process is complete.

Programming – Change of control signal

1. Remove power and put all dip switches "OFF". (factory preset).
2. Apply power and, **within 10 seconds**, press and release the reset button. The LED should be blinking.
3. Select the control signal with dip switches:
 - **Digital** (On/Off or 3 point floating)
move switch **No1** "ON" and then "OFF".
 - **PWM**
move switch **No2** "ON" and then "OFF".
 - **Analog** (factory preset)
move switch **No3** "ON" and then "OFF".
4. **Stroke adjustment**
see the stroke adjustment section above.

Note, If PWM mode is selected:

- Time base : When programming is done,
if switch No3 is "on" time base is 0.1 to 5 sec. (resolution 20 msec.)
if switch No3 is "off" time base is 0.1 to 25 sec. (resolution 100 msec.)
* For 5 sec. time base, we strongly recommend a switch common connection for better position stability.
- Switch 24 VAC: Triac or dry contact, 40mA maximum switching current.
- Switch common: NPN transistor, SCR, Triac or dry contact 75mA maximum switching current.

Feedback Selection (CCW direction)

To select CCW direction put switch No1 "ON".

In Analog or 3 point floating mode you can program the feedback control.

If switch No3 is "OFF":

The feedback control is automatically reverse to 4 to 20 mA for 90 to 0 degrees.



If switch No3 is "ON":

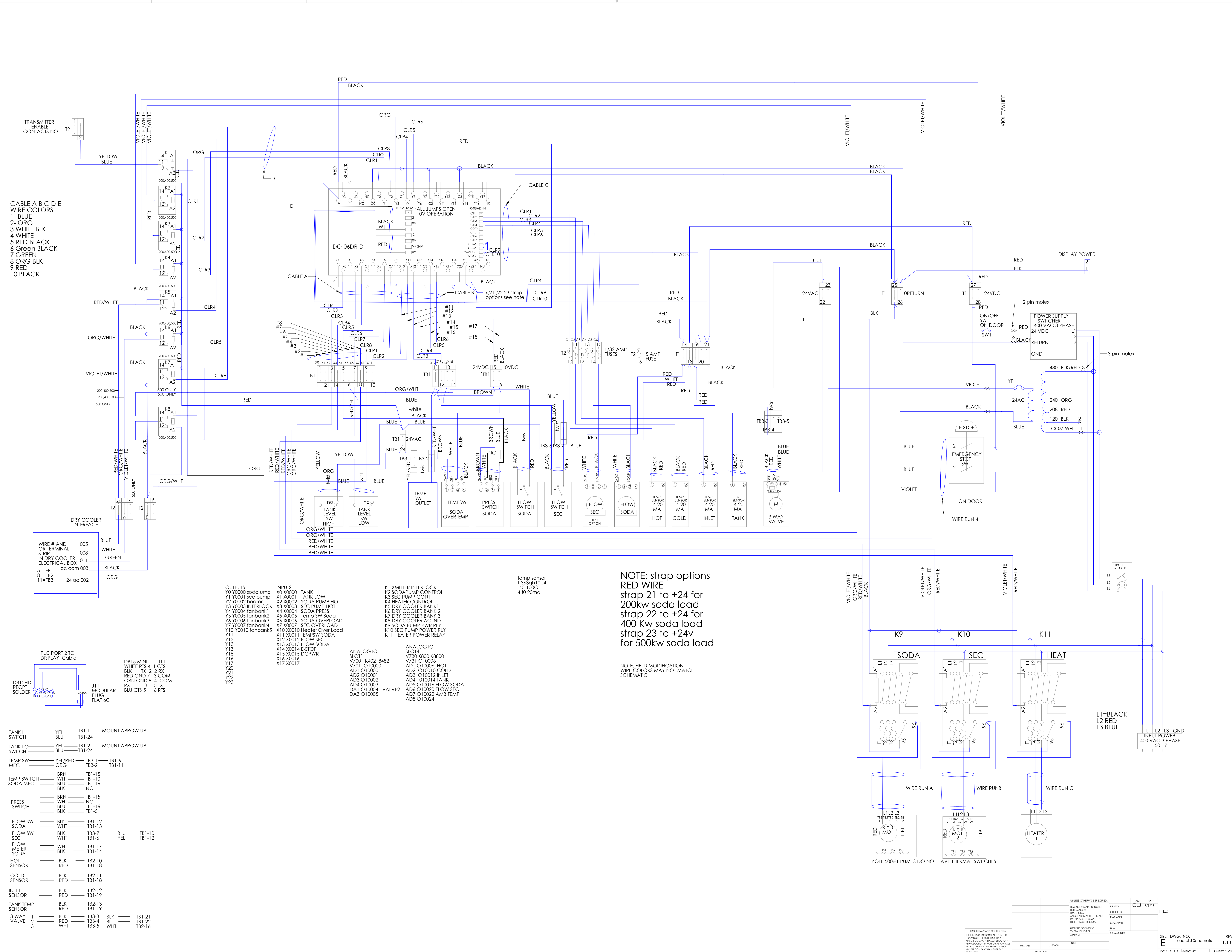
The feedback control is to 20 to 4 mA for 90 to 0 degrees.

**Zero and Span Calibration**

This feature is applicable to analog control signal only.

1. Remove power and put all dip switches "OFF". (factory preset).
2. Apply power and, **within 10 seconds** press and hold the reset button until the LED blinks once.
The Zero and span calibration process then start.
3. Release the reset button. The LED is now constantly illuminated.
4. Apply new minimum voltage.
It can be any value between 0 to 7 VDC, with an external 0 to 10 volt supply (ex: MEP).
5. Press and release the reset button to memorize the new minimum voltage. The LED blinks once.
6. Apply new maximum voltage.
It can be any value between 3 to 10 VDC, this value should be greater than the new minimum value.
7. Press and release the reset button to memorize the new maximum voltage. The LED blinks once.
The Zero and span calibration process is complete.

Note: To reset zero and span to 2 to 10 VDC (factory value). You just have to re-select the analog control signal mode, see Programming.



CABLE A B C D E
 WIRE COLORS
 1- BLUE
 2- ORG
 3- WHITE BLK
 4- WHITE
 5- RED BLACK
 6- GREEN BLACK
 7- GREEN
 8- ORG BLK
 9- RED
 10- BLACK

WIRE # AND OR TERMINAL STRIP IN DRY COOLER ELECTRICAL BOX
 5= FB1
 8= FB2
 11=FB3
 24 ac 002

OUTPUTS
 Y0 Y0000 soda ump
 Y1 Y0001 sec pump
 Y2 Y0002 heater
 Y3 Y0003 INTERLOCK
 Y4 Y0004 fanbank1
 Y5 Y0005 fanbank2
 Y6 Y0006 fanbank3
 Y7 Y0007 fanbank4
 Y10 Y0010 fanbank5
 Y11
 Y12
 Y13
 Y15
 Y16
 Y17
 Y20
 Y21
 Y22
 Y23

INPUTS
 X0 X0000 TANK HI
 X1 X0001 TANK LOW
 X2 X0002 SODA PUMP HOT
 X3 X0003 SEC PUMP HOT
 X4 X0004 SODA PRESS
 X5 X0005 Temp SW Soda
 X6 X0006 SODA OVERLOAD
 X7 X0007 SEC OVERLOAD
 X10 X0010 Heater Over Load
 X11 X0011 Temp SW SODA
 X12 X0012 FLOW SEC
 X13 X0013 FLOW SODA
 X14 X0014 E-STOP
 X15 X0015 DCPWR
 X16 X0016
 X17 X0017

ANALOG IO
 SLO1
 V700 K402 8482
 V701 010000
 AD1 010000
 AD2 010001
 AD3 010002
 AD4 010003
 DA1 010004 VALVE2
 DA3 010005

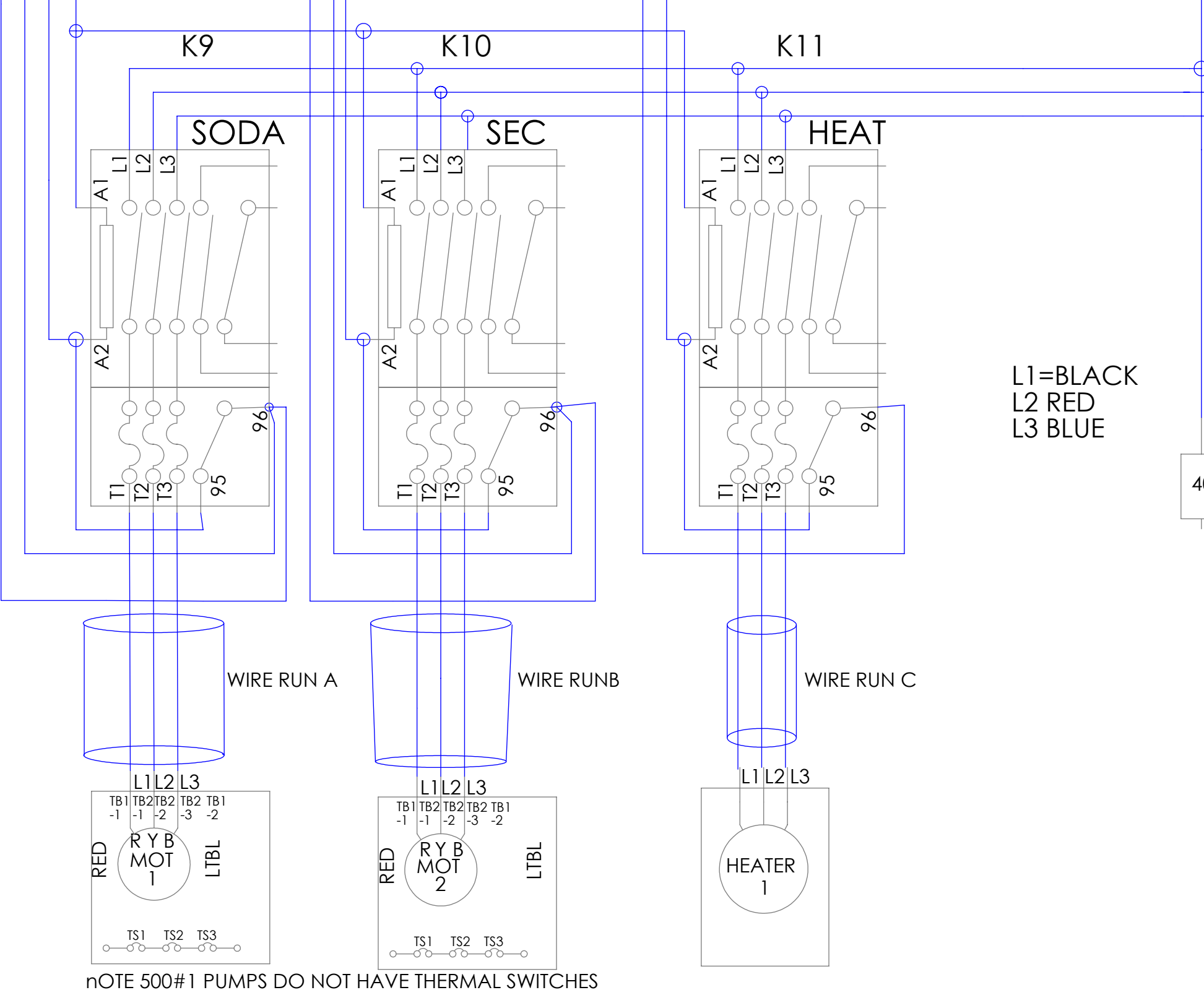
K1 XMITER INTERLOCK
 K2 SODAPUMP CONTROL
 K3 SEC PUMP CONT
 K4 HEATER CONTROL
 K5 DRY COOLER BANK1
 K6 DRY COOLER BANK 2
 K7 DRY COOLER BANK 3
 K8 DRY COOLER AC IND
 K9 SODA PUMP PWR RLY
 K10 SEC PUMP POWER RLY
 K11 HEATER POWER RELAY

temp sensor
 #363gh10p4
 -40-100C
 4 10 20ma

NOTE: strap options
 RED WIRE
 strap 21 to +24 for 200kw soda load
 strap 22 to +24 for 400 Kw soda load
 strap 23 to +24v for 500kw soda load

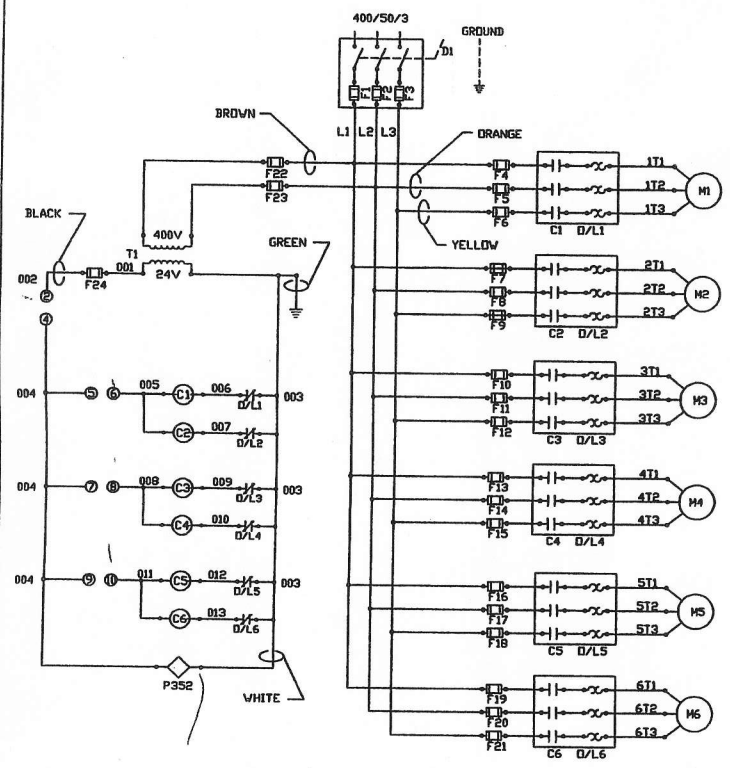
NOTE: FIELD MODIFICATION
 WIRE COLORS MAY NOT MATCH SCHEMATIC

TANK HI SWITCH — YEL — TB1-1 MOUNT ARROW UP
 TANK HI SWITCH — BLU — TB1-24 MOUNT ARROW UP
 TANK LO SWITCH — YEL — TB1-2 MOUNT ARROW UP
 TANK LO SWITCH — BLU — TB1-24 MOUNT ARROW UP
 TEMP SW — YEL/RED — TB3-1
 MEC — ORG — TB3-2 — TB1-11
 TEMP SWITCH — BRN — TB1-15
 SODA MEC — WHI — TB1-10
 — BLU — TB1-16
 — BLK — NC
 PRESS SWITCH — BRN — TB1-15
 — WHI — NC
 — BLU — TB1-16
 — BLK — TB1-5
 FLOW SW SODA — BLK — TB1-12
 SODA — WHI — TB1-13
 FLOW SW SEC — BLK — TB3-7 — BLU — TB1-10
 SEC — WHI — TB1-6 — YEL — TB1-12
 FLOW METER SODA — WHI — TB1-17
 SODA — BLK — TB1-14
 HOT SENSOR — BLK — TB2-10
 — RED — TB1-18
 COLD SENSOR — BLK — TB2-11
 — RED — TB1-18
 INLET SENSOR — BLK — TB2-12
 — RED — TB1-19
 TANK TEMP SENSOR — BLK — TB2-13
 — RED — TB1-19
 3 WAY VALVE 1 — BLK — TB3-3 — BLK — TB1-21
 2 — RED — TB3-4 — BLU — TB1-22
 3 — WHI — TB3-5 — WHI — TB2-16

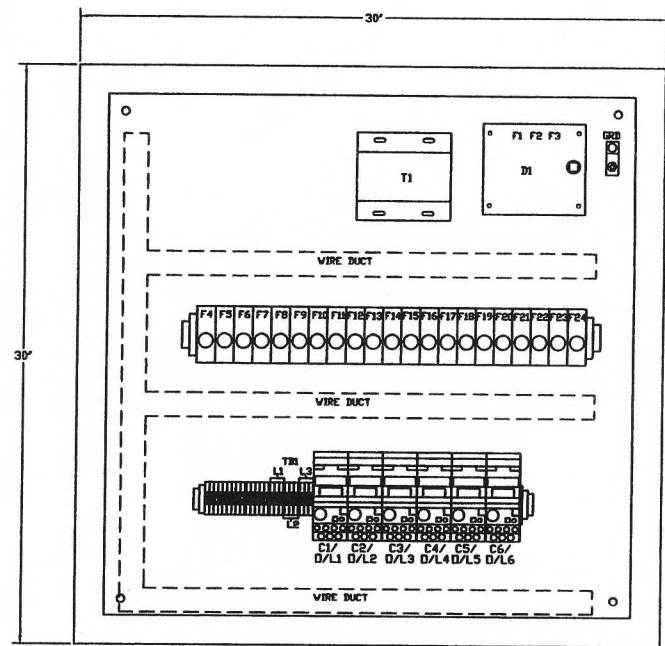


NOTE 500#1 PUMPS DO NOT HAVE THERMAL SWITCHES

UNLESS OTHERWISE SPECIFIED:	<p>DIMENSIONS ARE IN INCHES FRACTIONS 1/8, 1/4, 3/8, 1/2, 5/8, 3/4, 7/8 DECIMALS .0005, .001, .002, .005, .010, .015, .020, .030, .040, .050, .060, .070, .080, .090, .100, .125, .150, .175, .200, .250, .300, .375, .450, .500, .625, .750, .875, 1.000, 1.250, 1.500, 1.750, 2.000, 2.500, 3.000, 3.500, 4.000, 4.500, 5.000, 5.500, 6.000, 6.500, 7.000, 7.500, 8.000, 8.500, 9.000, 9.500, 10.000</p>	<p>DRAWN: GLJ CHECKED: [] ENG APPR: [] MFG APPR: [] QA: [] COMMENTS: []</p>	<p>DATE: 7/17/13 TITLE: []</p>
<p>PROPERTY AND CONFIDENTIALITY INFORMATION CONTAINED HEREIN IS THE PROPERTY OF [] AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE WRITTEN PERMISSION OF []</p>	<p>DATE: 7/17/13 SCALE: 1:1 WEIGHT: []</p>	<p>REV: 1, 1, J</p>	<p>SHEET 1 OF 1</p>



- NOTES:
- TOTAL AMPACITY OF PANEL IS 20.06 AMPS.
 - INCOMING LINE CONDUCTORS WILL BE COPPER WIRE WITH 75°C INSULATION.
 - TERMINALS 2 & 4 ON TBI ARE PROVIDED FOR A RUN PERMISSIVE SUPPLIED BY OTHERS., IF NO RUN PERMISSIVE REQUIRED ACROSS 2 & 4.
 - CONTROL POWER CIRCUIT TAPS ARE TO BE #14 AWG WIRE. MOTOR BRANCH CIRCUIT TAPS ARE TO BE #10 AWG ((1) CIRCUIT). D1 - TBI USE #10 AWG WIRE.



ELECTRICAL ENCLOSURE LAYOUT

LEGEND.

- M1 THRU M6 - MOTOR, 2HP, 400/50/3 (4.3 FLA EA) (Table 50.1 of UL 508a Procedure) WITHOUT INTERNAL THERMAL OVERLOAD PROTECTION.
- C1 THRU C6 - CONTACTOR V/ 24V CONTROL.
- TBI - TERMINAL BLOCK
- F1 THRU F3 - 35A, TIME DELAY, U.L. CLASS J FUSE
- F4 THRU F21 - 15A, TIME DELAY, U.L. CLASS CC FUSE
- F22 THRU F24 - 1A, TIME DELAY, U.L. CLASS CC FUSE
- T1 - TRANSFORMER, 100 VA, 300/480-24V
- D1 - FUSED DISCONNECT, 30A CLASS J
- D/L1 THRU D/L6 - OVERLOAD RELAY 4-6A
- F24 - 6A TIME DELAY, U.L. CLASS CC FUSE

UL 508 LISTED

REV	DATE	CHK	REVISION	REV	DATE	CHK	REVISION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:

FRACTIONS	DECIMALS
1/16	.0005
ANGLES	30X .0005
31°	300X .0005

Sign & Date h

id needed to change. All

by problems.

NOTICE OF CONFIDENTIAL INFORMATION

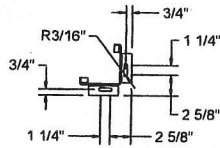
INFORMATION CONTAINED HEREIN IS CONFIDENTIAL AND IS THE PROPERTY OF COLMAC. WHERE FURNISHED TO A CUSTOMER FOR EVALUATION, WHERE FURNISHED TO A CUSTOMER FOR INSTALLATION OR MAINTENANCE, WHERE FURNISHED TO A SUPPLIER, IT SHALL BE USED SOLELY IN THE PERFORMANCE OF WORK CONTRACTED FOR BY THIS COMPANY. THIS INFORMATION SHALL NOT BE USED OR DISCLOSED BY RECIPIENT FOR ANY OTHER PURPOSE.

UNIT SPECIFICATIONS:

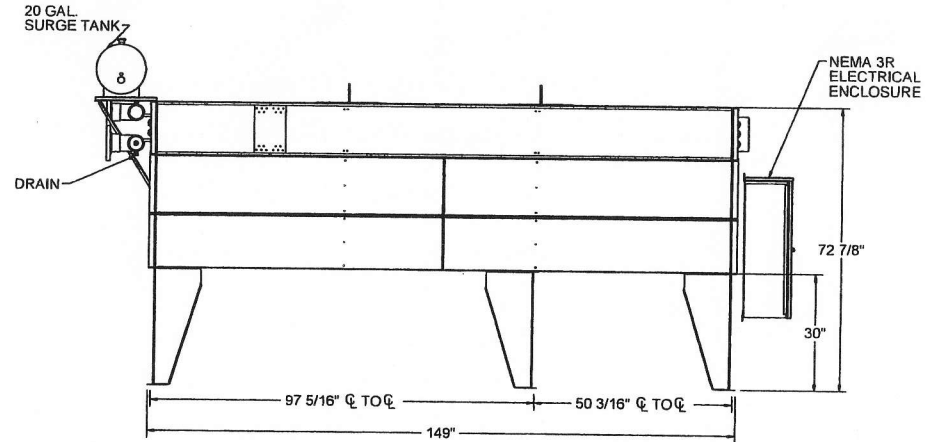
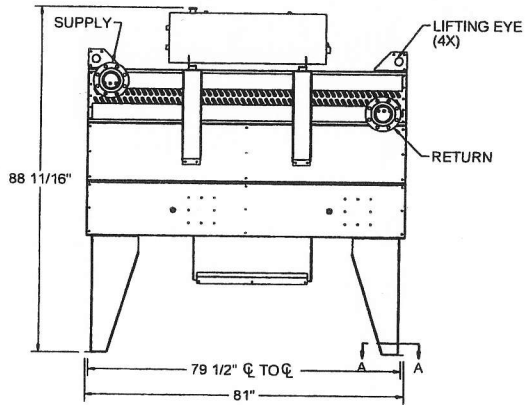
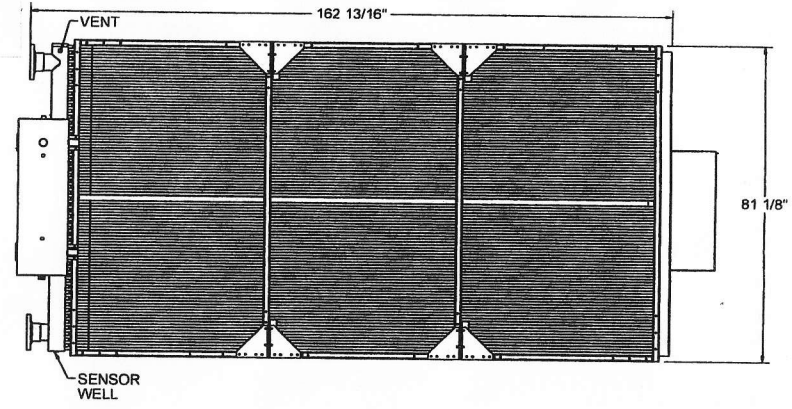
DRAFT: BLOW-THRU
 QTY. - DIA FANS: 6 - 30"
 FAN SPEED: 1,450 RPM
 FAN TYPE: COMPOSITE
 MOTOR QTY. - HP: 6 - 2HP
 MOTOR VOLTAGE: 400/50/3
 MOTOR FLA: 4.3A EA (EST)
 MOTOR TYPE: TEFC
 MOTOR S.F.: 1.25
 INT. THERMAL O/L PROT.: NO
 U.L. LISTED: NO
 DRY WEIGHT: 3,478 LBS
 INTERNAL VOL.: 8.94 FT³
 FAN GUARDS: NO

NOTES:

1. NEMA 3R ENCLOSURE FOR MOTOR PROTECTION WIRING.
2. 20 GALLON SURGE TANK.
3. PROTECTIVE SCREEN AIR ENTERING SIDE OF UNIT.



SECTION A-A



A	10/23/2012	DLS	ECO#17095
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NOTICE OF CONFIDENTIAL INFORMATION

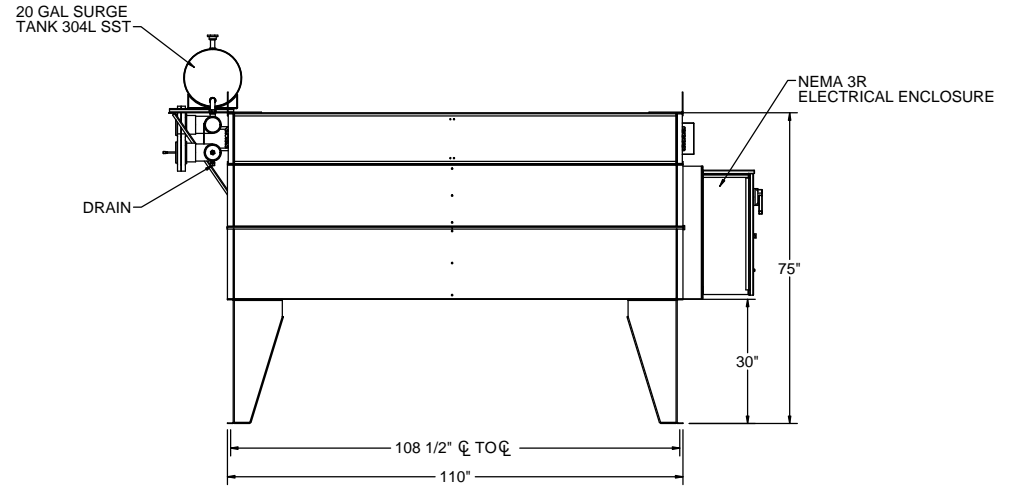
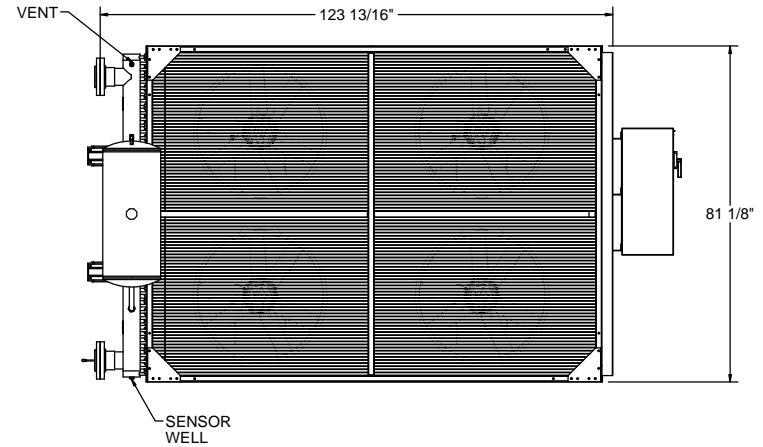
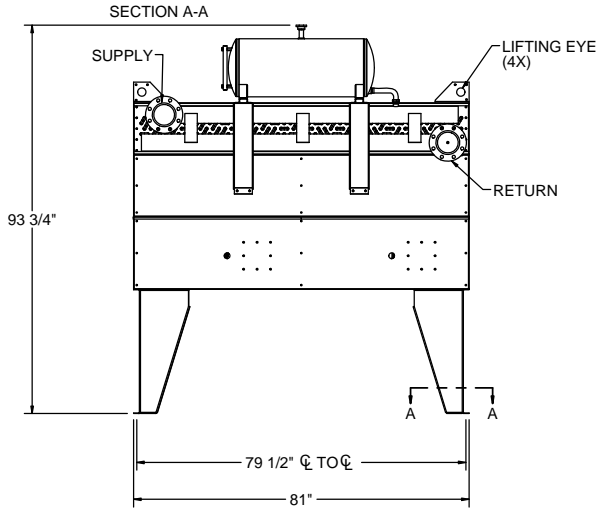
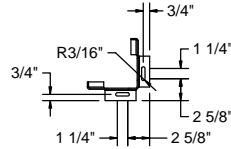
INFORMATION CONTAINED HEREIN IS CONFIDENTIAL AND IS THE PROPERTY OF COLMAC. WHERE FURNISHED WITH A PROPOSAL, THE RECIPIENT SHALL USE IT SOLELY FOR EVALUATION. WHERE FURNISHED TO A CUSTOMER, IT SHALL BE USED SOLELY FOR PURPOSE OF INSPECTION, INSTALLATION, OR MAINTENANCE. WHERE FURNISHED TO A SUPPLIER, IT SHALL BE USED SOLELY IN THE PERFORMANCE OF WORK CONTRACTED FOR BY THIS COMPANY. THE INFORMATION SHALL NOT BE USED OR DISCLOSED BY RECIPIENT FOR ANY OTHER PURPOSE.

UNIT SPECIFICATIONS:

DRAFT: BLOW-THRU
 QTY. - DIA FANS: 4 - 30"
 FAN SPEED: 1450 RPM
 FAN TYPE: COMPOSITE
 MOTOR QTY. - HP: 4 - 3HP
 MOTOR VOLTAGE: 400/50/3
 MOTOR FLA: 6.1A EA (EST)
 (Table 50.1 of U.L.508a Procedure)
 MOTOR TYPE: TEFC
 MOTOR S.F.: 1.25
 INT. THERMAL O/L PROT.: NO
 U.L. LISTED: NO
 DRY WEIGHT: 2,473 LBS
 INTERNAL VOL.: 6.01 FT³
 FAN GUARDS: NO

NOTES:

1. NEMA 3R ENCLOSURE FOR MOTOR PROTECTION WIRING.
2. 20 GALLON SURGE TANK.
3. PROTECTIVE SCREEN AIR ENTERING SIDE OF UNIT.
4. COIL TAG: 440-10000-002
5. SHIPPING CHARGE: 14 PSI



COIL SPECIFICATIONS:

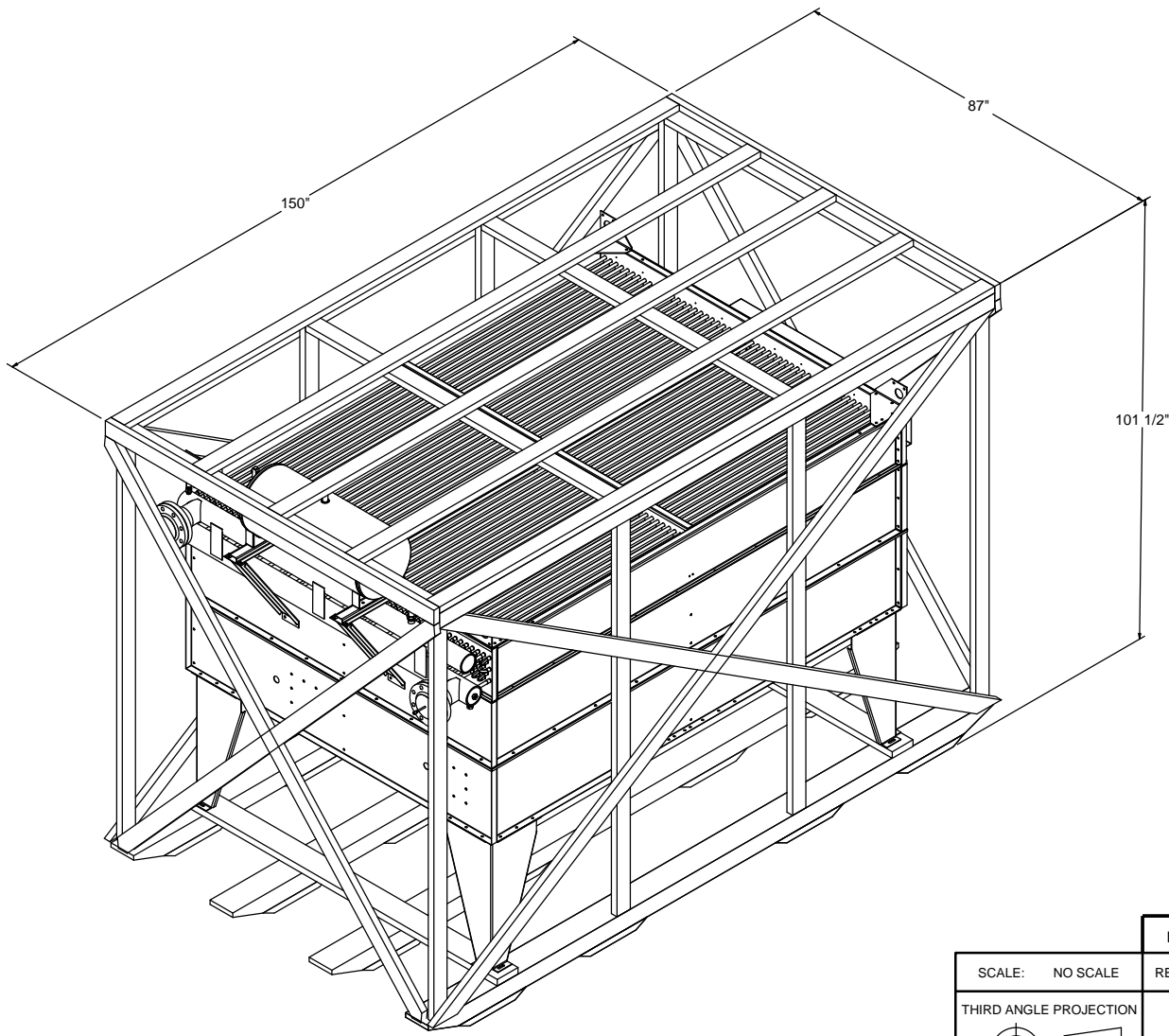
CONNECTION SIZE: 4" 150# RFSO STEEL FLANGE SUPPLY/RETURN
 HEADER SIZE: 4 1/8" OD TYPE "L" COPPER
 TUBING: 5/8" x 0.025 WALL: COPPER
 TUBE PATTERN: 1.5 x 1.299 STAGGERED
 FINS 0.006 THICK: ALUM.
 FIN PATTERN: WAFFLE/RIPPLE
 HOUSING: GALV.
 FERRULES: NO
 FIN HEIGHT: 78"
 FIN LENGTH: 107"
 ROWS DEEP: 5
 FINS PER INCH: 14
 FACE AREA: 57.96 FT²

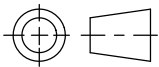

UNIT PERFORMANCE:

TOTAL CAPACITY: 1,519,629 BTUH
 AIRFLOW: 40,400 CFM
 FACE VELOCITY: 697 FPM
 ELEVATION: 1,000 FT AMSL
 ENT AIR DRY BULB: 122° F
 LVG AIR DRY BULB: 161.6° F
 ENT FLUID TEMP: 174° F
 LVG FLUID TEMP: 145.6° F
 FLUID FLOW RATE: 115 GPM
 AIR PRESS DROP: 0.88 IWG
 FLUID: ETHYLENE GLYCOL 30%
 FLUID PRESS. DROP: 11.3 FT H2O
 CIRCUITING: 32 FEED/ 8 PASS/ 4 DROP
 MAWP: 250 PSIG
 MAWT: 300° F
 MDMT: 30° F

REF: 51552B-A06

SCALE: NO SCALE	REV. B	DATE 5/10/2013	CHK DLS	ECO #18075
THIRD ANGLE PROJECTION	REV.	DATE	CHK	REVISION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± 1/4 ANGLES ±5°			P.O. Box 571 COLVILLE, WASHINGTON 99114	
DRAWN BY GWW		CHECKED BY DLS	ENG APPR DLS	DWG. NO. SUB00022527
DATE 9/28/2012		DATE 9/28/2012	DATE 9/28/2012	SHEET 1 OF 2



SCALE: NO SCALE		B	5/10/2013	DLS	ECO #18075		
THIRD ANGLE PROJECTION		REV.	DATE	CHK	REVISION		
				P.O. Box 571 COLVILLE, WASHINGTON 99114			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS $\pm 1/16$.XX ± 0.030 ANGLES .XXX ± 0.010 $\pm 1^\circ$.XXXX ± 0.005		DWG. TITLE AFV-78 X 107-1445L-C-G-30-3-BT-I CUSTOMER:ALTROMIC RESEARCH,INC TAG:400KW				DWG. NO. SHEET 2 OF 2	
		DRAWN BY	CHECKED BY	ENG APPR	SUB00022527		
		< NAME >	< NAME >	< NAME >			
		DATE	DATE	DATE			
		< DATE >	< DATE >	< DATE >			