THE EASTERN SPECIALTY COMPANY

USER MANUAL

HOT SOCKET SIMULATOR

PRODUCT:

Catalog # 3100-L

LIMITED WARRANTY & LIMITATION OF LIABILITY

TESCO warrants to the original purchaser that it will correct all defects in material and/or workmanship in the Instrument, test equipment or software covered by this warranty (herein called **"PRODUCT"**), provided that TESCO is notified of such defect within the warranty period (set forth below) in accordance with paragraph four of this Warranty.

WARRANTY PERIOD. The warranty period shall begin on the date of shipment of the PRODUCT or the date of the issuance of this warranty certificate, whichever is later. If no warranty period is specified below and signed by an authorized DISTRIBUTOR of TESCO, the Warranty Period shall be one (1) year. In no event shall this Warranty remain in effect for more than the stated Warranty Period plus two (2) months after the date of shipment. TESCO's sole obligation and the purchaser's sole remedy under this Warranty is limited to repair or replacement, at TESCO's option, free of charge, F.O.B. TESCO's factory at Bristol, PA of any workmanship and/or part which in TESCO's sole judgment displays evidence of defect. On-site Warranty repairs will be made when in TESCO's judgment the PRODUCT cannot practically be shipped to TESCO's factory. Any modifications, additions or upgrades made to the PRODUCT or control software after this warranty becomes effective shall not extend the term of this warranty.

COVERAGE. The warranty set forth above shall be applicable only if the PRODUCT:

1. Is used for the specific purpose for which it was intended;
2. Is operated in accordance with instructions, if any, supplied by TESCO;
3. Has not been modified, neglected, altered, tampered with, vandalized, abused or misused, or subjected to accident, fire, flood or other casualties;
4. Has not been repaired by unauthorized persons;
5. Has not had its serial number altered, defaced or removed;
6. Has not been connected, installed or adjusted other than in accordance with the instructions, if any, furnished by TESCO.

The warranty set forth herein DOES NOT APPLY to defects resulting from ordinary wear, tear and usage, or any cause, similar or dissimilar, not resulting solely from defective material and/or workmanship.

The Warranty set forth herein shall NOT be effective unless:

1. Notice of defect is given to TESCO by phone, fax, email or mail as soon as the defect is discovered.
2. Notice of defect contains the following information: PRODUCT serial number, PRODUCT model number, date of original installation, and an accurate and complete description of the defect including the exact circumstances leading to the defect.
3. The defective PRODUCT or part is returned only upon authorization from TESCO as evidenced by the issuing of a Return Merchandise Authorization (RMA) number, and that the transportation charges are prepaid (except that TESCO may, at its option, appoint a qualified DISTRIBUTOR to make field inspections of the PRODUCT for which purpose the purchaser shall permit such DISTRIBUTOR to enter upon its premises and examine the PRODUCT).
4. The Return Merchandise Authorization (RMA) number is written on the shipping label and all paperwork defective PRODUCT or part.
5. The defective PRODUCT or part is returned in the original packing or packing approved by TESCO

TESCO is not responsible for drayage charges, damages or labor costs incurred in conjunction with failure, removal or reinstallation of any PRODUCT, all of which shall be at the purchaser's expense. TESCO is not responsible for special, incidental or consequential damages, whether resulting from breach of warranty, negligence or any other reason.

TESCO manufactured parts will be available for a minimum period of at least two years after the manufacture of a PRODUCT has been discontinued.

TESCO will provide original purchaser during the Warranty Period, unlimited telephone consulting time for the purpose of PRODUCT trouble shooting/servicing and for the first thirty (30) days of the Warranty Period, unlimited telephone consulting time for the purpose of PRODUCT/software application.

THE WARRANTY CONTAINED HEREIN IS IN LIEU OF ALL OTHER WARRANTIES AND TESCO MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, WARRANTIES OR CONDITION, DESIGN, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR ANY OTHER MATTER.

No other Warranty, express or implied, is authorized by TESCO, and no DISTRIBUTOR of TESCO or any other person has any authority to amend, extend, modify, enlarge or otherwise alter the foregoing warranty and disclaimers in any way whatsoever, except as provided for in an Extended Limited PRODUCT Warranty Agreement.

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Introduction

The Hot Socket Simulator – Catalog # 3100-L, is used to simulate hot socket events in the lab. This unit has the ability to simulate a hot socket on the line and load jaws through controlled arcing (with adjustable frequency). It can also be used to determine internal temperature parameters that can be used to remotely sense hot sockets without destroying the internals of the meter due to arcing by using a controlled heating test (using a cartridge heater and thermocouple feedback for temperature control).

The Simulator has one 2/12S socket (5 jaws). The arcing mechanism has the ability to arc either of the line side jaws and the heating block can be easily placed on any of the 5 jaws. The Arcing and Heating tests should be performed independently. And while it is possible to run Arcing and Heating tests simultaneously, it is not recommended.

Non-contact temperature reading is performed though a Raytek pyrometer with digital temperature display and 0-10Vdc analog output. The pyrometer must be focused on the hot meter stab. The heating test is controlled through a thermocouple in the heater block. There is an additional thermocouple provided for the customer to measure temperature anywhere in the socket cabinet.

!!! WARNING !!! – There are safety hazards within this unit! High temperatures and high electrical loads can exist in the meter socket enclosure. Though the machine is well protected with safety circuits, care MUST be taken in handling of the meters under test and the associated equipment

System configuration, set-up, and control are provided to the user via an Operator Interface Panel (OIT) comprised of push-buttons, indicators, and touch-screen.

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1. Operator Interface Panel (OIT)

1.1. The Operator Panel push-buttons & indicators

- ***Illuminated "E-Stop" Push-button (Latching, Red)***

Red indicator lamp illuminates Red LED whenever the E-Stop push-button is activated (depressed). Since the E-Stop push-button is a latching push-twist/pull type, it maintains either an active (depressed) or inactive (pulled out) state, and once it is manually activated it must then be manually twisted and pulled back out before Control Power can be restored. When the E-Stop is not activated, it provides normally-closed contacts in the 24Vdc safety interlock circuit to the safety relay. Pressing the E-Stop opens the safety circuit which then removes 240Vac Control Power from the socket and the meter. Resetting the safety circuit, however, does not automatically re-enable the control power (see below).

- ***Illuminated "Reset" Push-button (Momentary, Blue, then Red when power is enabled)***

Blue indicator lamp illuminates the Red LED whenever Control Power is ON. The "Reset" push-button is of a momentary type and provides normally-open contacts in the 24Vdc Reset circuit to the safety relay. When pressed, the safety relay is reset (so long as there is no other safety interlock circuit violation) and thereby enables the system. If the control power is not reset, the unit will not be able to power the meter or perform any tests.

1.2. The Operator Panel touchscreen

The Operator Panel touchscreen consists of a "Main" screen (Figure 1, below), and a series of sub screens located along the bottom edge of the OIT.

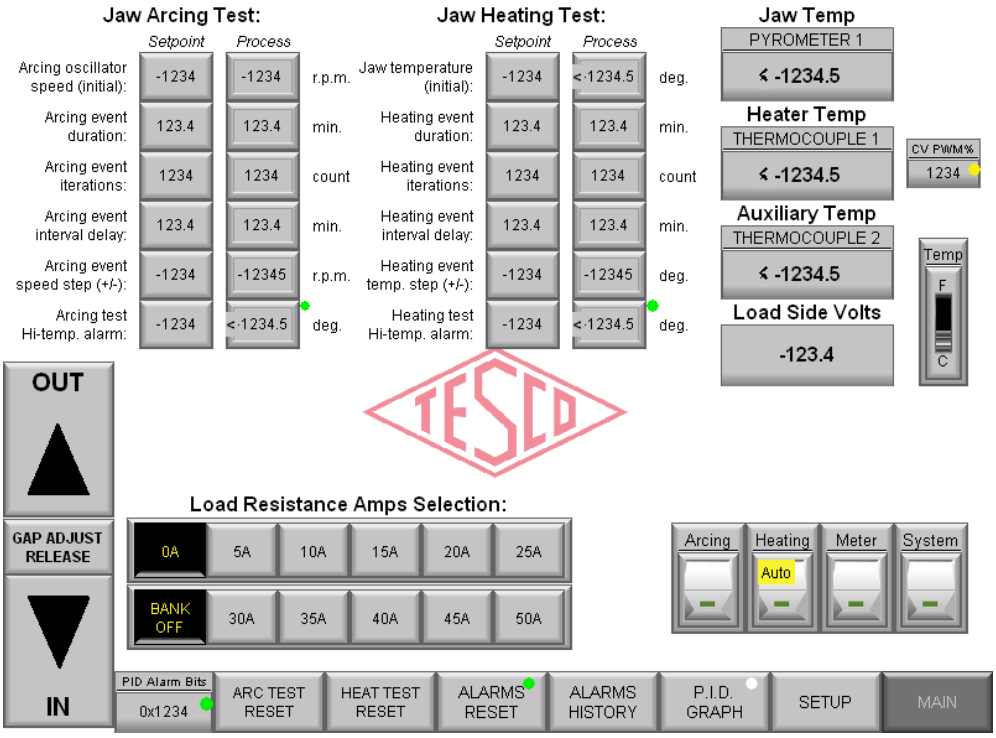

Figure 1 - Operator Panel Touch-screen consists of a "Main" screen and a series of sub screens

Input for any numeric entry is provided to the user via a pop-up Numeric Entry Keypad.

A pop-up Numeric Entry Keypad gets activated whenever the user presses any of the Set-point push-buttons on the Operator Panel Touch-screen. The Numeric Entry Keypad displays the current numeric value for the given set-point, along with applicable high and low limits. Invalid entries generate an error message and such out-of-range values will be rejected.

- ***"System" Toggle***

  Overall system operation is turned on/off through a toggle push-button switch labeled "System" on the Operator Panel Touch-screen (Figure 2, below).

Figure 2 - System Enable, OIT Toggle Switch (Off and On states)

An indicator on the "System" toggle switch provides indication as to whether system operation is enabled (On/Run) or disabled (Off/Pause). System control power must be ON in order for the "System" toggle switch to enable overall (master) system operation.

When "System" toggle is switched OFF, all active/enabled processes are suspended/paused and all outputs for heating and arcing tests are forced off. When "System" toggle is switched back to ON again, all active/enabled processes that were paused now resume, picking up right where they left off. Integrity of accumulated values for duration timers and interval counters is preserved, however only the interval delay timers are allowed to tick down even while the "System" toggle is switched OFF.

- ***"Meter" Toggle***

  Meter socket power is turned on/off through a toggle push-button switch labeled "Meter" on the Operator Panel Touch-screen (Figure 3, below).

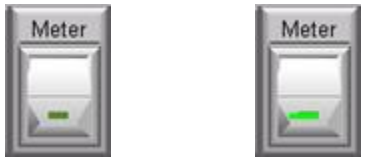

Figure 3- Meter Socket Power Enable, OIT Toggle Switch (Off and On states)

An indicator on the "Meter" toggle switch provides indication as to whether meter socket power is enabled (On) or disabled (Off). System control power must be ON in order for the "Meter" toggle switch to enable meter socket power.

- ***"Arcing" Toggle***

  The Arcing Test is turned on/off through a toggle push-button switch labeled "Arcing" on the Operator Panel Touch-screen (Figure 4, below).

Figure 4 - Jaw Arcing Test Enable, OIT Toggle Switch (Off and On states)

An indicator on the "Arcing" toggle switch provides indication as to whether jaw arcing testing is enabled (On) or disabled (Off). System control power must be ON in order for the "Arcing" toggle switch to enable jaw arcing operation.

When "Arcing" toggle is switched OFF, all active/enabled processes specific to the *Jaw Arcing Test* are suspended/paused and all outputs for *arcing* tests are forced off. When " Arcing " toggle is switched back to ON again, all active/enabled processes specific to the *Jaw Arcing Test* that were paused now resume, picking up right where they left off. Integrity of accumulated values for duration timers and interval counters is preserved, however only the interval delay timers are allowed to tick down even while the "Arcing" toggle is switched OFF.

- ***"Heating" Toggle***

  The Jaw Heating Test is turned on/off through a toggle push-button switch labeled "Heating" on the Operator Panel Touch-screen (Figure 5, below).

Figure 5- Jaw Heating Test Enable, OIT Toggle Switch (Off and On states)

An indicator on the "Heating" toggle switch provides indication as to whether jaw heating testing is enabled (On) or disabled (Off). System control power must be ON in order for the "Heating" toggle switch to enable jaw heating operation.

When "Heating" toggle is switched OFF, all active/enabled processes specific to the *Jaw Heating Test* are suspended/paused and all outputs for *heating* tests are forced off. When "Heating" toggle is switched back to ON again, all active/enabled processes specific to the *Jaw Heating Test* that were paused now resume, picking up right where they left off. Integrity of accumulated values for duration timers and interval counters is preserved, however only the interval delay timers are allowed to tick down even while the "Heating" toggle is switched OFF.

- ***Arcing Test RESET***

  Pressing this push-button turns off the Jaw Arcing toggle push-button and resets the interval counter to begin a new Jaw Arcing test.

- ***Heating Test RESET***

  Pressing this push-button turns off the Jaw Heating toggle push-button and resets the interval counter to begin a new Jaw Heating test.

- ***Gap Adjustment***

  Throughout a Jaw Arcing Test it is necessary to monitor the arcing conditions and make adjustments to the gap size. This unit has the capability to vibrate both of the line side jaws, and the gap adjustment is defined as the distance between either vibrating jaw and its corresponding meter blade. This gap is controlled using a stepper motor located to the left of the oscillator assembly inside the testing cabinet. Primarily, the user will make gap adjustments using the pushbuttons on the OIT (see Figure 6 below). Note the "Out" button moves the vibrating jaw(s) away from the meter blade and the gap adjust release button releases the stepper motor so that manual one time gap adjustments can be made.

Figure 6- Gap Adjust in/Out, OIT Pushbutton Switches

Alternately, the gap can be adjusted using the rocker switch enclosure located on the left side of the 3100-L (Figure 7, below).

Figure 7 – Rocker switch enclosure that controls gap adjustment

The enclosure on the left side of the unit contains rocker switches labeled “On/Off” and “Out/In”. The “On/Off” switch allows the user to disengage the stepper motor should they choose to make manual gap adjustments. The “Out/In” switch allows the user to bring the testing jaw out away from the arcing meter stab as well as bring it back in. For a fine adjustment, one press of the rocker switch sends one pulse for a set shaft rotation. For larger adjustments, pressing and holding the rocker switch sends a series of pulses at rapid intervals.

- ***Load Resistance Amps***

The load current to the meter socket is selectable through a series of radio-button switches labeled "Load Resistance Amps Selection" on the Operator Panel Touch-screen (Figure 8, below).

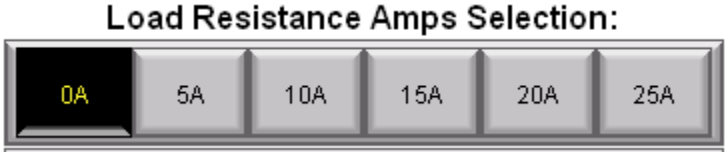

Figure 8 - Load Resistance Amps, OIT Radio Buttons (0A selected)

Available load currents are 0-100A in 5A increments, if all auxiliary loads are plugged into the unit. The rows of this control will only show up if that auxiliary bank is installed and the safety circuit is satisfied. Load current selection is mutually exclusive so that only one load current can be selected at a time, and selecting a new value automatically de-selects the previous setting.

The load cycling function can be enabled during the Heating testing by pressing the top button of that button group. “# of cycles” will determine the number of times the load is turned on and off. The “Delay” is the time that the load is on and off (50% duty cycle).

1.3. Jaw Arcing Test

Jaw Arcing is turned on/off through a toggle push-button switch on the Operator Panel Touch-screen (see Figure 4, in section "Arcing Toggle").

Arc event periods can be set via a control on the Operator Panel Touch-screen. The duration of the arc event, as well as the time delay between consecutive events, and the total number of events in the test, are all Jaw Arcing test parameters that can be set (Figure 9, below).

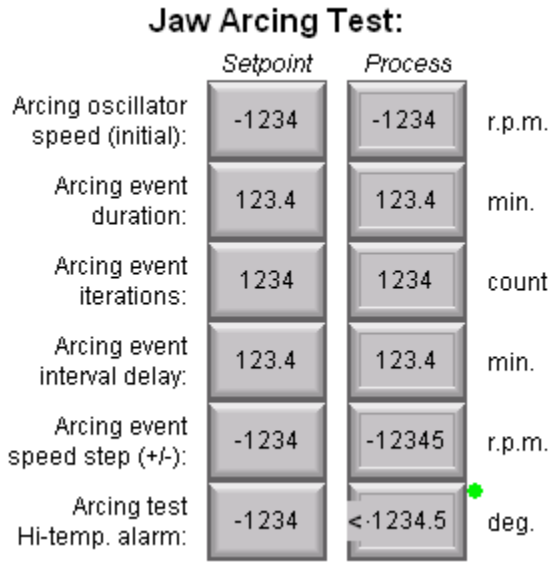

Figure 9 - Jaw Arcing Test Parameters & Settings

Jaw Arcing Test parameters are set-up using the following Operator Panel Touch-screen controls:

Arcing oscillator speed - The "Setpoint" item sets the rpm (frequency) of the oscillator motor, which is the same as #arcs-per-minute. The "Process" column shows the resulting actual programmed speed.

Arcing event duration - The "Setpoint" item sets the duration (in minutes) to run the oscillator motor which generates each arcing event. The "Process" column shows the amount of time (in minutes) that remains for this event step (arcing event) while it is active.

Arcing event iterations - The "Setpoint" item sets the number (iterations) of arcing events to execute. The "Process" column shows a countdown of the number of iterations (events) that remain for the current test undergoing. When this value is one, it means the current event is the last event of the test undergoing, then the "Arcing" toggle switch will automatically become disabled immediately after this last arcing event is finished.

Arcing event interval delay - The "Setpoint" item sets the delay time (in minutes) to wait after each arcing event before starting the next arcing event. Note that no delay is applied after the last arcing event of the test, since the "Arcing" toggle switch automatically becomes disabled immediately after the last arcing event is finished. The "Process" column shows the amount of time (in minutes) that remains for this event step (interval delay) while it is active.

Arcing event speed step (+/-) - The "Setpoint" item sets the interval step (in rpm, a.k.a. frequency) to increase or decrease the oscillator motor speed (frequency) which generates the arcing event. The new

value will be relative to the value from the previous interval (or the original setpoint if this is the first interval). Positive numbers increase the speed, negative values decrease the speed. The "Process" column shows the current resulting value for motor speed setpoint after applying resultant ('step size' * 'current step'). Note that resultant ('Arcing event speed step (+/-)' * 'Arcing event iterations')must be greater than zero yet less than the maximum speed of 3000 rpm, otherwise results will be unpredictable!

Arcing Test Hi-Temp Alarm – The “Setpoint” item sets the temp level above which the Arcing Test will fault out. The indicator next to this item will be green when the temperature is less than the setpoint and red when it is greater than the setpoint.

1.4. Jaw Heating Test

Alternative jaw heat is offered from a cartridge heater element affixed to one of the jaws of the meter socket. Temperature output from this heating element is controlled by a PID controller and PWM output generated by the PLC.

Jaw Heating is turned on/off through a toggle push-button switch on the Operator Panel Touch-screen (see Figure 4, in section "Jaw Heating Test Enable").

Heat event periods can be set via a control on the Operator Panel Touch-screen. The duration of the heat event, as well as the time delay between consecutive events, and the total number of events in the test, are all Jaw Heating test parameters that can be set (Figure 10, below).

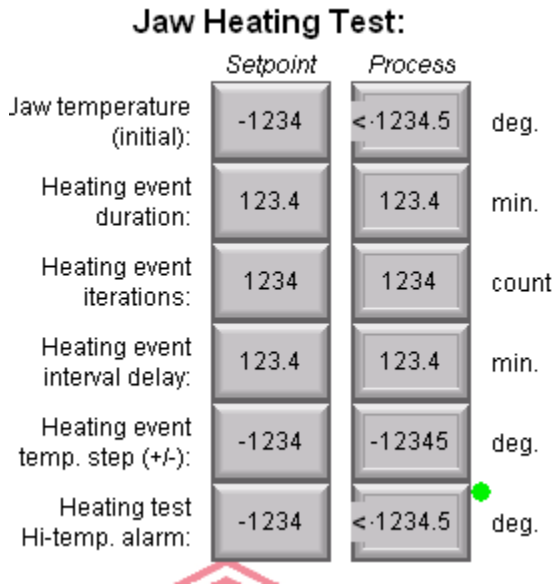

Figure 10 - Jaw Heating Test Parameters & Settings

Jaw Heating Test parameters are set-up using the following Operator Panel Touch-screen controls:

Jaw temperature - The "Setpoint" item sets the Temperature setpoint (in degrees-C) of the temperature PID controller in the PLC. The "Process" column shows the actual process temperature being read by the PLC at the analog input. The base frequency of the PWM output signal is always 1.0 second (1-Hz.).

Heating event duration - The "Setpoint" item sets the duration (in minutes) to run the cartridge heater PID and PWM output which generates each heating event. The "Process" column shows the amount of

time (in minutes) that remain for this event step (heating event) while it is active.

Heating event iterations - The "Setpoint" item sets the number (iterations) of heating events to execute. The "Process" column shows a countdown of the number of iterations (events) that remain for the current test undergoing. When this value is one it means the current event is the last event of the test undergoing, then the "Heating" toggle switch will automatically become disabled immediately after this last heating event is finished.

Heating event interval delay - The "Setpoint" item sets the delay time (in minutes) to wait after each heating event before starting the next heating event. Note that no delay is applied after the last heating event of the test, since the "Heating" toggle switch automatically becomes disabled immediately after the last heating event is finished. The "Process" column shows the amount of time (in minutes) that remains for this event step (interval delay) while it is active.

Heating event temp step (+/-) - The "Setpoint" item sets the interval step (in degrees-C) to increase or decrease the temperature setpoint which generates the heating event. The new value will be relative to the value from the previous interval (or the original setpoint if this is the first interval). Positive numbers increase the temperature, negative values decrease the temperature. The "Process" column shows the current resulting value for temperature setpoint after applying resultant ('step size' * 'current step'). Note that resultant ('Heating event temp. step (+/-)' * 'Heating event iterations') must be greater than zero yet less than the maximum speed of 3000 rpm, otherwise results will be unpredictable!

Heating Test Hi-Temp Alarm – The “Setpoint” item sets the temp level above which the Heating Test will fault out. The indicator next to this item will be green when the temperature is less than the setpoint and red when it is greater than the setpoint.

1.5. Alarms History

The system constantly monitors and reports the status for alarm conditions and reports each alarm status in the Alarms History sub screen located along the bottom edge of the OIT (Figure 11, below).

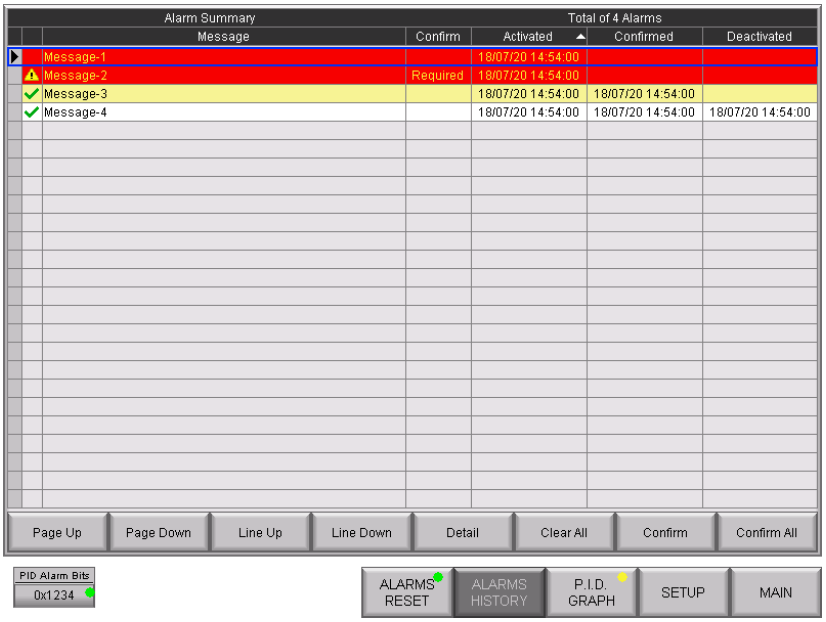

Figure 11 - Alarms History sub screen

The following is a description of the cause and remedy for each of the alarms:

(C60) Process temp. exceeds Heating Test alarm setpoint – The temperature read by the thermocouple in the heating block exceeds the maximum temperature in the alarms setup. This could be caused by an overshoot of the PID control, or a failure of the hardware components. To correct this problem, stop the heating test and reduce the setpoint temperature (or adjust the step amount or number of steps in the Heating Test) if it is a PID control issue, or check the main display to make sure that the thermocouple is outputting the proper temperature and check to make sure that the heater in the heater block is getting hot if it is a hardware problem.

(C61) No temp. rise detected in response to Heat Test output – The Heating Test has started and the controls have sent a signal to the Heater, but there is no corresponding temperature rise for a certain amount of time. Check the main display to make sure that the thermocouple is outputting the proper temperature. Also, check to make sure that the heater in the heater block is getting hot. If not, replace the damaged component.

(C62) Process temp. exceeds PID target overshoot limit – In the process of getting to the setpoint temperature, the control has overshot the setpoint by a value greater than the value set in alarm settings. This is typically due to a change in the PID settings. To correct this, return the PID settings to their original values, or press the "Reset to Factory Default Settings" button on the Setup screen.

(C63) TS1-ALM Temp Sensor 1 Fault Detected – This fault is the result of an input from the Raytek pyrometer controller. It indicates that the input signal from the pyrometer has exceeded the value for maximum input set in the Raytek controller. To correct this, replace the pyrometer sensor as it is the most likely cause.

(C64) Heat step event setup resulted in an invalid SP value – The cause of this fault is that the combination of the heating event iterations x heating event temp. step + the initial temperature exceeds the high temperature alarm value. To correct this, reset the parameters of the heat test (either reduce the number of iterations, the initial temp, or the temp step amount).

(C66) PID1 PV Dev. Alarm (error > dev. band, for > time preset) - This fault is caused by either a slow reaction or an overreaction of the heating test PID control. It means that the thermocouple feedback is falling outside of a temperature band. To correct this, again check the thermocouple and heater operation, and if any changes to the PID parameters had been made, reverse them or go back to the original settings by pressing the "Reset to Factory Default Settings" button on the Setup screen.

(C70) Process temp. exceeds Arcing Test alarm setpoint – The temperature read by the pyrometer exceeds the maximum temperature in the alarms setup. This is likely caused by a failure of the hardware components. To correct this problem, stop the arcing test and check the main display to make sure that the pyrometer is outputting the proper temperature. Replace the pyrometer head or Raytek controller to correct the problem

(C71) No temp. rise detected in response to Arc Test output– The Arcing Test has started and the controls have started the arcing, but there is no corresponding temperature rise for a certain amount of time. Check the main display to make sure that the pyrometer is outputting the proper temperature. If not, replace the damaged component.

(C73) SC1-ALM Vibrator Motor Fault Detected – This fault is caused by a fault in the vibrator motor control or the motor itself. To correct this, replace the motor or controller.

(C74) Arc step event setup resulted in an invalid SP value - The cause of this fault is that the combination of the arcing event iterations x arcing event temp step + the initial rpms exceeds the high rpm alarm value. To correct this, reset the parameters of the arcing test (either reduce the number of iterations, the initial rpm, or the arcing step amount).

C76 CTRIO configuration error to run gap stepper motor – This fault is caused by the PLC stepper controller card (CTRIO). This fault should never occur unless the PLC code has been changed. To correct this, revert to the original PLC code.

(X10) Open safety circuit alarm – This is caused by the safety relay output being de-asserted. This could be caused by the estop button being pressed or the door being opened. To correct this, reset the e-stop, close the door, and restore the control power (blue button).

(X11) Open E-Stop safety circuit alarm – This is caused by the estop button being pressed. To correct this, reset the e-stop and restore the control power (blue button).

2. Resistor Bank Cooling Fan

The resistor bank cooling fan is controlled by a thermostat located near the top inside in the resistor bank housing. The fan will continue to run until internal temperature within the resistor bank housing falls below the thermostat set-point, so long as Control Power is on. Removing Control Power by pressing the E-Stop or opening the chamber door also shuts the fan off as a matter of safety.

3. System Venting

3.1. Exhaust blower

The 3100-L comes equipped with a xxxCFM exhaust blower mounted above the unit designed to vent unwanted fumes from the socket chamber.

3.2. External port

The customer is responsible for venting the output of the exhaust blower away from the operator. 4" flexible duct is recommended. The ducting should be the shortest, straightest routing to the outside of the building.

Duct sealant, caulk, or tape should be applied to all seams, including around the opening in the wall or ceiling on the interior and around exterior building penetrations, to prevent air leakage and maximize air performance.

4. Operations

4.1. Loading Meter into Socket

The socket that is mounted to the back panel of the system is not unlike any standard commercial or residential socket. The main difference is the moveable jaw that is part of the arcing process. Depending on the test that you are going to perform, there are different precautions

- ***Arc Testing***

Take care in this situation to ensure that the stabs of the meter are properly aligned, since the moveable jaw is only one-sided and it is sometimes difficult to get all 4 jaws to line up. You must also ensure that there are no flammable materials in the meter chamber as during arc testing, hot material and sparking will likely occur.

- ***Heat Testing***

The heater block that generates the controlled high temperature is attached to the jaw that you want heated (can be any meter stab). The process to switch over the system from arc testing to heat testing and vice-versa will be addressed later in this document. The care that needs to be taken here in particular is to make sure that after the heater block is installed, make sure that it is pushed onto the meter stab as far as possible so that it will not be touching the meter socket base. Touching the meter socket base with the heater block could cause damage.

4.2. Converting from Arc Testing to Heater testing

If the heater testing is going to be placed onto a meter stab other than the one that was setup of arc testing, simply remove the socket jaw that the heater testing is going to be done to by first removing the meter from the socket, then removing the side of the socket base that will be use for the heating test. Then locate the nut that is holding the jaw in question in place and remove it, keeping it close by. Then replace the meter base side on the panel (Figure 12, below).

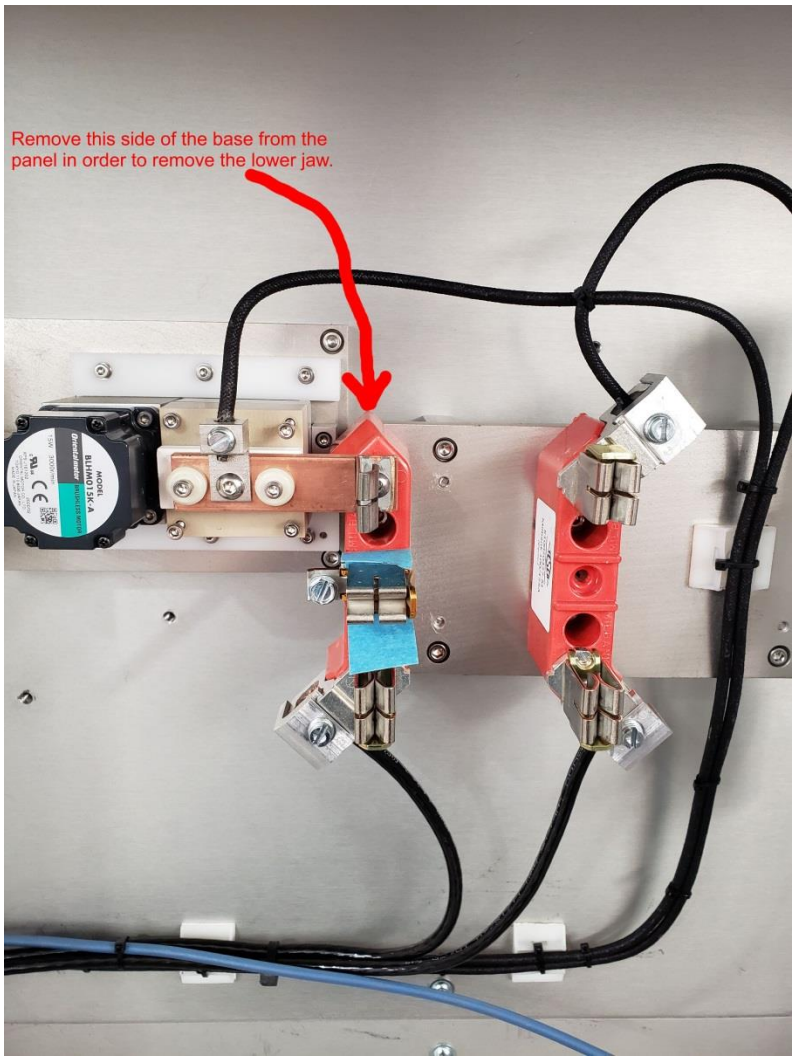

Figure 12 - Socket Base Removal

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If you are applying the heater block to the meter stab that is currently being used for arc testing, rather than removing the jaw from the back of the socket base, first remove the vibrating jaw assembly by removing the four mounting screws (Figure 13, below).

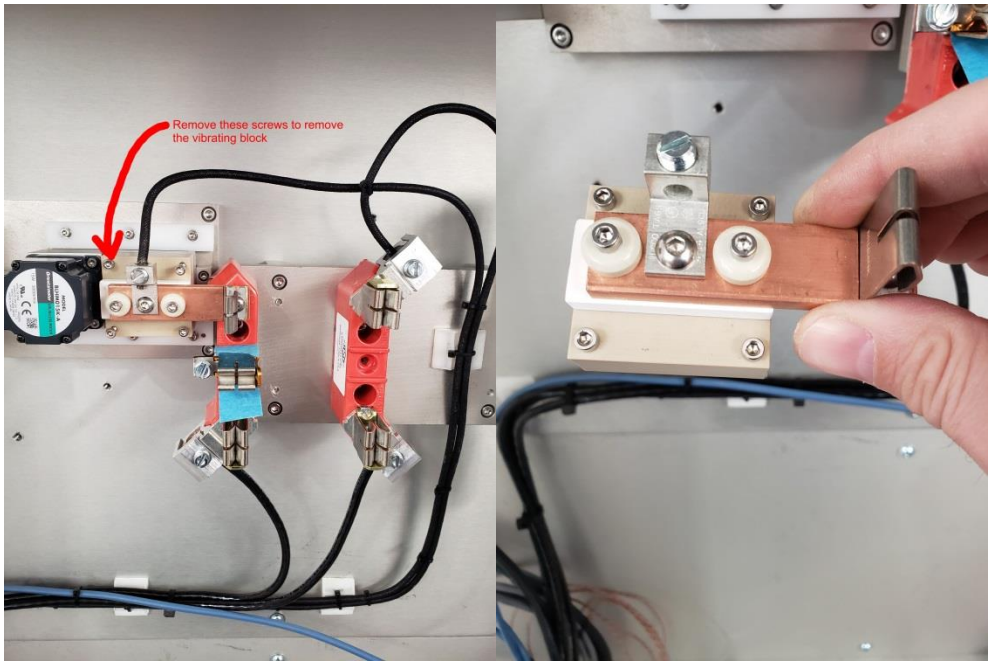

Figure 13 –Vibrating Jaw Removal

Next, remove the power wire from the jaw that was removed and insert that wire into the terminal on the heater block (Figure 14, below).

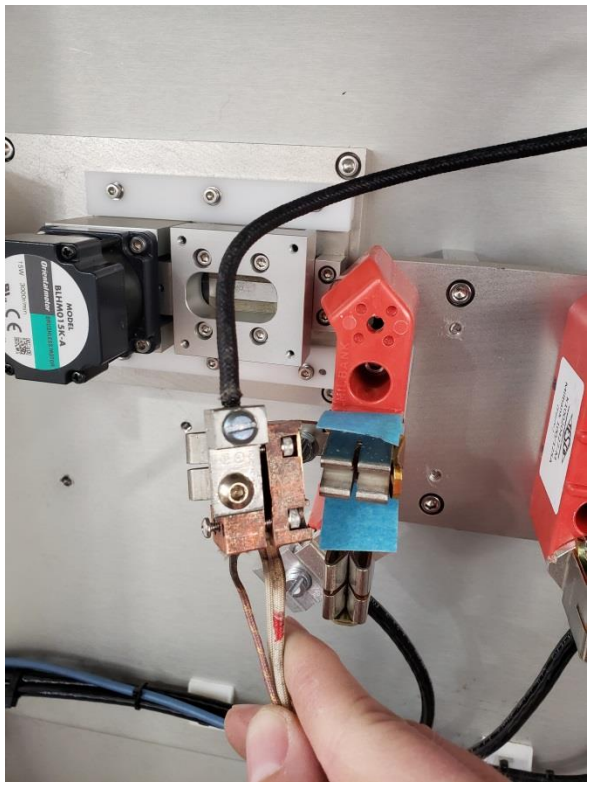

Figure 14 –Wiring Heater Block

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Finally, attach the heater block to the meter stab and seat the meter into the remainder of the socket jaws (Figure 15, below).

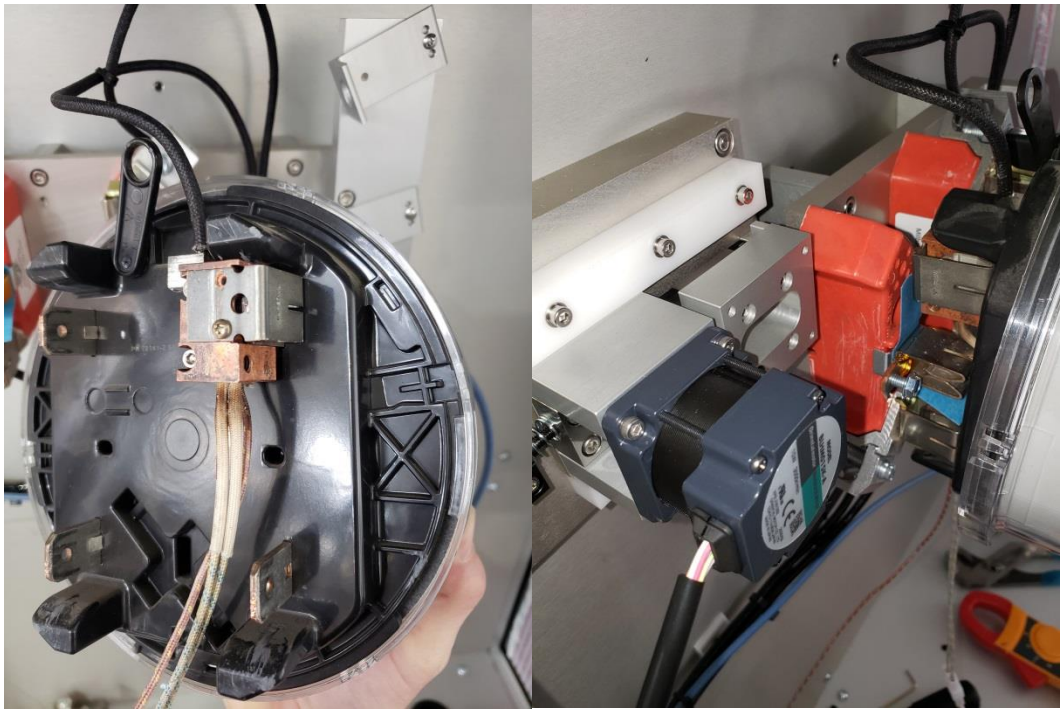

Figure 15 – Mounting Heater Block