SUPPLEMENTAL INSTRUCTIONS FOR FIELD REPLACEMENT OF ELECTRICAL COMPONENTS IN A HEATER OR CONTROL PANEL

This document provides supplemental instructions to assist with the replacement of heater electrical components. Refer to owner's manual for detailed installation, operation, and maintenance instructions.

WARNINGS

PLEASE READ ALL INSTRUCTIONS CAREFULLY BEFORE BEGINNING WORK.
FAILURE OF THE REPAIR TO RETURN THE HEATER OR PANEL TO IT'S ORIGINAL FACTORY CONDITION MAY VOID THE WARRANTY AND/OR ANY 3RD PARTY AGENCY APPROVALS.

WARNING: Potentially lethal voltages are present. Be sure to lock the branch circuit disconnect switch in the off position and tag the circuit "Out for Maintenance" before working on this equipment.

CAUTION: It is strongly recommended this product be maintained by qualified personnel familiar with the NEC and/or CEC requirements as well as any local codes. It is the responsibility of the installer to verify the safety and suitability of the installation.

REFERENCE DATA

(Sources for additional information where applicable):
Heater or Panel User Manual – refer to instructions provided with equipment or can be found on our website
Field Replacement of Heater Bussing – ENM-3069
Field Replacement of Resistance Coil – ENM-2149

SECTION 1 General Instructions

Note – this section provides general instructions that will apply to all components being replaced. Refer to Section 2 for component specific instructions.

1.1. For heaters, verify that heating elements are in good working order before proceeding with any repairs. Inspect for any damage to the element, it's electrical terminals, and it's supports. Verify test ohms of each element circuit, if zero or infinity, further investigation and potential element replacement may be required. If available, check individual element circuit dielectric strength to ground using a hypot meter or megohm meter to verify proper electrical isolation to ground. Refer to separate instruction sheet for element replacement if necessary. Refer to the owner's manual for the heater for additional instructions.

1.2. Before removing the electrical components or wiring being replaced, locate the wiring diagram provided with the equipment and mark up the specific items being replaced. Review the actual wiring compared to the diagram. Take clear pictures of the components and wiring and take note of typical terminal hardware arrangement. Mark any power wires going to the component with temporary markers to remember where they go if not already provided with wire markers. Mark up the wiring diagram with the temporary wire markings to ensure wiring will be reconnected properly. Inspect any power wires for damage such as discoloration, brittleness, or cracking when bent. Replace any damaged power wires per instructions below. (If a wiring diagram cannot be located, contact the factory for a replacement copy)

1.3. Remove damaged or burnt wiring and the component(s) being replaced. Carefully review the new component against the one(s) removed to ensure it is a correct match with the same electrical ratings.

Warning – **never substitute a component having different ratings without consulting the factory**.

1.4. Where wires are terminated with ring tongue, fork, or quick connect termination and can be reused, inspect for signs of corrosion or heat damage. Clean up the terminals as best as possible prior to re-installing or replace them if they are overly damaged. It is not recommended to substitute an insulated terminal for an uninsulated terminal or the other way around without carefully reviewing the connection. Terminations at heating elements and some components are expected to be very hot and an insulated terminal will melt. Also, insulated terminals may be necessary in other cases due to electrical clearance requirements. See table below for required electrical clearances.

1.5. Before reinstalling the new component, please read Section 2 for component specific instructions.

Before installing the new component part, compare the part number and ratings to the one being replaced. It is acceptable to substitute a part from an alternate vendor if the ratings match unless specifically noted below in Section 2 that any substitution should be reviewed with the factory.

When mounting a new component, ensure it is tightly secured to subpanel. Failure to do so could result in a component coming loose and causing an electrical short and significant equipment damage.

1.6. Rewiring instructions:
If replacing wire or terminations with non-factory provided materials – Be sure they are the same material type and size (or larger). Wire gauge and insulation must be the same or greater than was previously provided. Only use terminations that are properly rated for the amperage and temperature. Do not substitute aluminum wires, all wires are sized for copper.

When routing wire, consider bend radius of the wire to prevent damage to the conductor. The typical rule of thumb is a minimum bend radius of 8 times the overall conductor diameter including the insulation. Also consider clearance to HOT components, and strain on electrical connections. Use wire ties as needed. Where wires attach to moving doors or similar, ensure proper clearance and movement is allowed.

All supply connections to the resistance element terminals or their bussing lugs must be reconnected exactly as they were originally installed. Refer to document "Field Replacement of Heater Bussing" noted above if removing buss connections to replace wire. It will list required torque and assembly details.

CAUTION – to prevent overheating of power wires it is very important to not bundle more than 6 wires together and to only loosely clamp them with wire ties as necessary. Tightly bundling with wire ties will prevent wires from dissipating heat and result in wire failure or potentially a fire.

Verify electrical clearances for all live and uninsulated terminations.

Required Clearances

Panel/Heater Voltage	Between Live parts and **Ground ****	Between Live Parts of **Different Phases**
0-300	1/2	1/4
301 - 600	1/2	3/8

**** GROUND** means the enclosure, or any metal part such as an electrical component that is grounded to the enclosure.

CAUTION - All electrical connections must be properly torqued to prevent loose connections. It is very important to note that <u>over-tightening can cause component or conductor damage</u> resulting in a failure.

Refer to the torque value requirements documented on the product. They will be noted either on the wiring diagram or on a label provided with the heater or panel. Consult the factory if unable to locate torque guidelines.

1.7 After the installation of new components and re-wiring has been completed, make a thorough visual inspection of the heater or panel. Ensure that all electrical connections are tight, electrical clearances are per the table above, hardware properly installed, all supply connections and wiring match the wiring diagram, and that all foreign materials such as temporary wire tags, old terminal hardware, old elements, etc., are removed from the terminal box. A resistance check of each stage should be made insuring that each has equal continuity and that there are no shorts to ground. - If available, a hypot tester should be used applying a voltage equal to : 2 x Line volts +1000 volts (ex. 240v power : 240x2 + 1000= 1480V) to ground at each supply connection for a duration up to 1 minute. **Caution**: prior to applying the hypot voltage it is recommended to disconnect the wires to the primary of the transformer in order to protect the control circuit from possible damage. If any electrical arcing or breakdown occurs, the heater or panel must be carefully examined and the fault determined and corrected before energizing the heater.

NOTE: ASPEQ Heating Group assumes no liability for workmanship or cost incurred by field repair of heaters.

SECTION 2 Component Specific Instructions

2.1. **Disconnect Switch** (DS)

The disconnect switch is used to break power for maintenance. In order to repair or replace it, power ahead of the panel must be disconnected and locked out to remove power from the line side of the switch. The DS must be rated for the total amperage of the equipment. The switch is provided with a finger safe shroud over the line side lugs to protect against contact when power upstream is on but the DS is off. It must be reinstalled when the repair is complete. The DS is not normally able to be repaired other than replacing line or load side lugs.

Prior to replacing the DS, compare the part number of the new DS to the one removed. If the new switch is not an exact match, carefully review markings for suitability.

To replace the DS, review if any instructions from the manufacturer were provided and read for any specific detailed instructions. Use tape to temporarily mark the wires L1, L2, L3 to ensure that phases do not get crossed. Loosen wires, remove mounting screws, and set the old switch aside.
The shaft may be used or replaced if a new one is provided. If a new shaft is used, it will need to be cut to the proper length by comparing to the old one or by fitting it up to the handle in the enclosure door.

If bolt on electrical lugs are included, verify they are properly tightened and aligned to maintain electrical clearance.

Mount the new DS in the existing mounting holes. If the new DS does not mate up with the existing holes review to ensure the DS is the correct replacement. Verify the shaft properly aligns with the handle. If it does not properly align, the DS may not properly engage when the enclosure door closes. Adjust alignment if needed.

Note, for wires on the load side of the DS, if more than one wire is installed into a single lug, the wires will have an aluminum ferrule crimped around them. DO NOT remove the ferrule during the repair.
Reinstall wires into the lugs, and properly torque to the specified value.

2.2. **Contactors** – Magnetic and Mercury

Contactors are used to break the power circuit providing power to a heater. The contactor is normally open (NO) with no power applied. 24 or 120VAC is applied to the contactor coil to close the circuit. Mercury contactors function in the same method. Mercury contactors must be mounted with the orientation arrows on the device pointing up in order to work properly.

Contactors come with 1, 2, or 3 poles for breaking power. If all hot power lines are opened by the contactor it is a “disconnecting” device. If only 1 line of a single phase or 2 lines of a three-phase power source are broken the contactor is a “deenergizing” device. Do not substitute a deenergizing device in place of a disconnecting device without consulting the factory.

Troubleshooting a contactor - if signs of overheating or if the electrical contacts of the contactor are fused in the closed position, the contactor needs to be replaced. If the contactor is still functioning but is experiencing chattering when pulling in, try using electrical contact cleaner. Also verify the control voltage to the contactor is the required voltage within +/-10%. Low voltage will reduce the magnetic field used to pull in the contactor.

When replacing a contactor, ensure that the replacement part’s ratings match the one being replaced and that the **resistive** amperage rating is equal or greater than old part. Also verify that the control voltage matches – typically 24 or 120V. **WARNING – failure to confirm ratings could result in a failure and potential fire.** Please note that contactors may also include inductive ratings for amperage. Since electric heaters are a resistive load, the correct rating to use is its resistive rating.

To replace the contactor, first apply temporary markers on all of the wires to identify them. Remove the old contactor and inspect the wires as noted in the General Instructions above. Remove and reinstall. Reattach all wires and properly torque the power wires per the specified values.

2.3. Fuse & Fuse block

When replacing fuses first investigate what caused the fuse to blow. Fuses for resistive loads are sized at 125% of the nominal amperage and rounded up to the next available standard fuse. Fuses should not blow except when exposed to an abnormal condition such as a short to ground or significant voltage spike.

WARNING - Always check for an electrical short to ground before replacing a fuse. This is done best with a hypot or megohm meter as noted in the General Instructions above.

When replacing a blown fuse, always ensure that the fuse class, voltage, and amp rating match the fuse being replaced and as noted on the heater or panel wiring diagram.
WARNING - **Never substitute a higher amperage rated fuse because it will not properly protect the wire and other components down-stream of the fuse**.

If the fuse block is damaged due to a circuit failure or loose connection, ensure the block is of the same class, voltage, and amperage rating. Inspect power wires to the fuse block and replace them if damaged as noted in Section 1 above. Remove and replace the fuse block and reattach the wiring. Properly torque to the specified value.

2.4. Transformer

Control transformers are used to drop the incoming power voltage down to typically 24VAC or 120VAC for the control circuit. Transformers rated 24VAC and 75VA or lower are typically Class 2 self-limiting devices which do not require additional fusing. Transformers not marked Class 2 require primary fusing sized to protect them from an overload.

Troubleshooting transformers – blown primary fuses, signs of overheating, or melted wires at the transformer are all potential indications of a bad transformer.

If blown primary fuses, inspect for an electrical short to ground as noted above in the “Fuses & Fuse block” instructions above. If no sign of the cause for the blown fuse, replace and monitor for proper operation.

Note that transformers are an inductive load and fuse sizing is per the NEC.
Warning -Replace transformer fusing only with the same Class, voltage, and amperage fuse as noted on the heater or panel wiring diagram.

If no sign of damage but the heater is not operating, a trained electrician can measure the voltage at the primary and secondary terminals of the transformer to confirm if it matches the heater ratings.

In some cases, Class 2 transformers contain a reset button which will reset the internal limiting device, however most Class 2 transformers contain a single blow internal fusible link.

Replacing a transformer – if the transformer must be replaced, carefully compare the voltage and VA rating against the one being removed. A higher rated VA may be substituted but never a lower VA. Provide temporary tags on the primary and secondary wires.

NOTE: some transformers are multi-voltage units that can be used for more than one primary or secondary voltage. These will be marked with each applicable voltage. If the transformer being removed is a multi-voltage transformer and has the same lead wires or terminals as the replacement, make note of the connection arrangement to help ensure the new transformer is properly connected.

WARNING – failure to properly connect the correct terminals of the transformer can result in a potential fire or equipment damage.

Inspect the connecting wires as noted in the General Instructions above. Remove and reinstall. Reattach all wires and properly torque per the specified values.

2.5. SCR

SCRs are used to modulate the power to the heater in order to provide proportional control. For further information on function, and troubleshooting, refer to the owner's manual for the specific model of SCR provided in the heater or panel.

If SCR replacement is required- follow all the general guidelines in Section 1 above as well as specific instructions in the owner's manual of the SCR model provided. Confirm the ratings of the new part match the SCR being replaced. When installation is finished, ensure all connections are properly torqued to the specified value.

2.6. Airflow Switch

An airflow switch is a safety device to disable the heater if airflow is not present. It measures the pressure differential between the air duct and the surrounding room. If sufficient differential, the switch contact will close.

Troubleshooting an airflow switch – a trained electrician is needed to measure the contacts across the switch with airflow and without to determine if the airflow switch is closing. If the contact is not closing, inspect the pickup tubes for damage, blockage, and to ensure they are properly connected. Refer to the owner's manual for proper connections for positive and negative pressure installations.

Airflow switch replacement – if replacement is required, follow all the general guidelines in Section 1 above as well as specific instructions in the owner's manual of the airflow switch model provided. When installation is finished, ensure all connections are properly torqued to the specified value (if not ¼" quick connect terminals).

2.7. Relays, Pilot Devices, Terminal Blocks, and Power Blocks

If it becomes necessary to replace any of these items in the control circuit due to failure from cycling or signs of overheating, follow all the general guidelines in Section 1 above. Ensure the replacement is identical with the same item number and ratings. Review wiring diagram and carefully tag all wires before removing them from the device being replaced. When installation is finished, ensure all connections are tight. For Power Blocks properly torque them to the specified value.

2.8. Thermal Cutout or Thermostat

Thermal cutouts and thermostats are used to disable a heater when it is operating at a temperature above its design limit or thermostat set point. The cutout type, mounting arrangement, and temperature setting have been carefully matched for each individual heater construction. Thermal cutouts are either automatic resetting once the temperature drops, or manual resetting which requires pushing a button on the cutout to allow it to reset. Most are normally closed when the temperature is below the set point and will open when the set point is exceeded.

WARNING – potential fire or equipment damage – never disable or remove a thermal safety device from a heater and always replace any thermal cutout only with an exact replacement from the factory.

Types of thermal cutouts used in heaters:
Bi-metal cutout – these are typically used for sensing air. The metal surface of the device will expand when heated and open the contact when the set point is reached.

Bulb and Capillary cutout or thermostat – the capillary and bulb are filled with a thermal liquid which expands when heated. If the Bulb is exposed to a temperature above it's set point, the fluid expands and opens the contact.

Linear Limit – this is similar to bulb and capillary but there is no bulb. If any 5" length of the capillary is heated above the set point it will cause the fluid to expand and trip the contact.
Images:

Bi-metal

bulb & capillary thermostat

bulb&capillary cutout

linear limit

Troubleshooting a thermal cutout – a trained electrician is needed to measure the contacts across the cutout to determine if it is not working properly. With the power off, a cutout can be tested with an ohm meter to determine if it is closed. Then with power applied and the heater operating, it should remain closed which can be verified if voltage passes through the device.

If it is determined that the cutout is open without heat and cannot be reset, it will need to be replaced.

If a cutout is closed with no power but opens up while heating, it is important to investigate what may be causing the heater to be running above the intended temperature. Some potential causes are: low fluid flow, blocked flow, heater temperature set point above its rated value, or other possible issues. Refer to the heater owner's manual for additional information.

Thermal Cutout and Thermostat Replacement - if replacement is required, follow all the general guidelines in Section 1 above as well as specific instructions in the owner's manual of the heater.

WARNING – RISK OF EXPLOSION - cutouts for heaters used in hazardous atmospheres must only be replaced by trained factory personnel. Do not attempt to replace without factory assistance.

Ensure the replacement item is identical to the original with the same item number, temperature setting, and ratings. Review wiring diagram and carefully tag all wires before removing them from the device being replaced.

Document the orientation, installation, and mounting of the cutout or thermostat including photos.

SPECIAL INSTRUCTIONS for BULB and CAPILLARY and LINEAR LIMIT CUTOUTS or THERMOSTATS:

For Linear Limit and Bulb and capillary construction, carefully observe the routing and arrangement of the capillary tube. Also make note if a sleeving material is installed over the capillary to provide electrical clearance.

CAUTION – failure of the replacement cutout or thermostat could occur if not properly handled - for Bulb and Capillary or Linear Limit construction it is critical to handle the capillary with care. If it is bent on a small radius, kinked, or pinched, it will cause the capillary tube to break.

When routing the capillary of a Linear Limit or Bulb and Capillary, you must be gentle when handling and straightening the capillary that was provided coiled for shipment. Straighten it by hand and only bend on a generous radius to avoid damaging it. Do not let it be stepped on, kinked, or otherwise exposed to physical damage or it will not function once installed.

When bulb and capillary cutouts or thermostats have the bulb clamped directly to a heating element, it is very important to ensure the replacement is properly clamped in the identical location previously provided and that it remains in contact with the element to function properly.

WARNING - potential fire or equipment damage- for Linear Limits or Bulb and Capillary cutouts and thermostats mounted inside of a terminal enclosure, the copper capillary must be protected from coming in contact with live electrical terminals. Ensure that sleeving is installed where needed or mechanical clamps are used to prevent contact with live parts.

When installation is finished, ensure all connections are tight. For load carrying cutouts or thermostats in the power circuit, properly torque them to the specified value.