GENERAL L&L KILN TROUBLESHOOTING GUIDE

TABLE OF CONTENTS

GENERAL L&L KILN TROUBLESHOOTING GUIDE

CAUTION - ELECTRICITY CAN KILL

Many of the tests described in here are performed under power. They should be done ONLY by someone who is familiar with electrical safety such as an electrician or trained maintenance person. We identify any test that is live with a **CAUTION** statement. We describe these tests in detail so that an electrically trained person who doesn't specifically understand kilns can do the troubleshooting - the level of simplicity described is not meant as an invitation to harm the untrained. **AS LONG AS THE KILN IS UNPLUGGED YOU ARE SAFE.**

GET A DIGITAL MULTIMETER!

If you want to do much of the troubleshooting described here and not be dependent on a kiln service person then get this tool. It is not hard to use! Without it you are only guessing at the origin and severity of an electrical problem based on how the kiln is acting. A slow-firing kiln may just have old elements, or the elements could be fine but the incoming voltage from your power supply could be low, or fluctuating. Unless you test with a multimeter, you could purchase new elements and run the risk that you might be wasting money and time without solving the problem. Be forewarned however: Testing electrical circuits is very dangerous and potentially deadly if you do it incorrectly. It could result in electrocution! If you don't feel comfortable doing this hire an electrician or get someone to do it who is qualified. That being said - many of the tests described in here just require testing for resistance - which is done with the kiln unplugged. **AS LONG AS THE KILN IS UNPLUGGED YOU ARE SAFE.**

Radio Shack or any good hardware store will carry inexpensive digital multimeters for around $40-$50. The meter shown below was purchased at Home Depot for about $120 and includes an amp probe to measure amperage. The meter you buy should be digital simply because the analog type is not very accurate. You must be able to see ohm (resistance) readings to the first decimal place. Being able to see that ".7" on the meter is the difference between "I think it may be your elements…" and "I know it is your elements…".

GENERAL L&L KILN TROUBLESHOOTING GUIDE

TROUBLESHOOTING GUIDE

This manual is meant to assist and educate kiln owners and service technicians. This is mostly specific to Jupiter, DaVinci and Doll kilns. For older L&L kilns see our more general troubleshooting guide: *hotkilns.com/trouble.pdf.* The Easy-Fire kilns have their own separate troubleshooting instructions (*easy-fire-trouble.pdf*) and so does the Liberty-Belle (*liberty-belle-trouble.pdf*)

Please email or fax any corrections or suggestions that you have so that we may incorporate this information into our next revision. We have gone into great depth in many areas and, while some of this may seem overwhelming, much of this is geared towards helping customers who want to be as self-sufficient as possible. Our basic philosophy at L&L is to make kilns that last. No small part of having a reliable well-firing kiln is good maintenance. This information is provided as a service and is believed to be accurate. However, it is the reader's sole responsibility to interpret and use this information correctly. Please visit our web site to download the latest versions of all our instructional and technical information.

RELATED L&L GUIDES

CAUTION INSTRUCTIONS

See *cautions.pdf* in the OPERATION section of your Instruction Manual. THIS IS SOMETHING YOU MUST READ.

REGULAR KILN MAINTENANCE

See *maintain.pdf* in the OPERATION section of your Instruction Manual. THIS IS SOMETHING YOU MUST READ.

BASIC ELECTRICITY FOR TROUBLESHOOTING

See troubleshoot-electricity.pdf in the TROUBLE-SHOOTING section. Also see *hotkilns.com/volts.pdf* for more in-depth information about electricity for kilns.

TROUBLESHOOTING BRICK PROBLEMS

See *troubleshoot-brick.pdf* in the TROUBLE-SHOOTING section for information on firebrick problems and instructions on how to repair firebrick problems.

TROUBLESHOOTING ELEMENT PROBLEMS

See *troubleshoot-elements.pdf* in the TROUBLE-SHOOTING section for information on elements problems and instructions on how to install elements and element holders.

TROUBLESHOOTING FIRING PROBLEMS WITH CONE PACKS

See *troubleshoot-cones.pdf* in the LOG, CONES, TIPS section.

THE CERAMIC PROCESS

See *ceramic-process.pdf* in the LOG, CONES, TIPS section.

REPLACEMENT PARTS

See *parts.pdf* in the PARTS section. .

SERVICE

See *service.pdf* in the SERVICE section.

GENERAL TROUBLESHOOTING TOOLS AND METHODS

BASIC TOOLS REQUIRED

The minimal toolkit necessary for effective troubleshooting and fixing of electric kilns contains a digital multi-meter to measure ohms and AC voltage, and an assortment of screwdrivers, nutdrivers, wrenches, pliers, cutters, wire strippers and wire terminal crimpers. As you work on your kiln you will see what types of tools you need, like a 3/8" nut-driver, needle-nose pliers without the cutting part so the tips will close all the way. wire cutters heavy enough to cut the element terminals, wire strippers and wire terminal crimpers. No special tools are required for maintenance on L&L kilns.

KEYS TO GOOD TROUBLESHOOTING

SAFETY FIRST
Pay attention to electrical safety. Don't get electrocuted and don't guess.

DEFINE THE VARIABLES
Define all variables of the situation, and how they could potentially interact with and affect each other in each unique case you come across.

ELIMINATE VARIABLES ONE AT A TIME
Eliminate variables one by one to expose the problem variable(s). Asking questions can do this to some degree. Electrical testing, examining shards of ware or cone, or examining the interior of the kiln usually can supply the rest of the story. Good troubleshooting is based on logic.

TROUBLESHOOTING CHECKLISTS

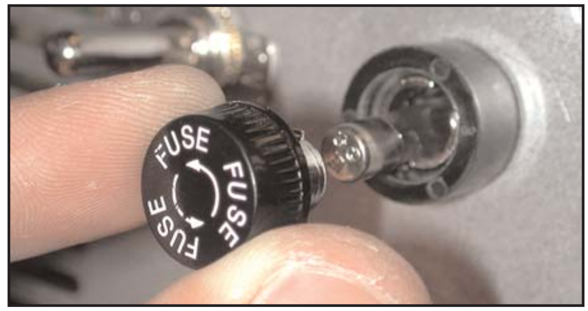
TROUBLESHOOTING CHECKLIST
The following checklists are shorthand methods for troubleshooting your kiln. Much of what is in here is also covered more extensively in the rest of this troubleshooting guide but in a more theoretical and in-depth way. These checklists can help simplify the process.

CONTROL DISPLAY DOESN'T SHOW ANYTHING (AUTO KILN)

On/Off Switch
1) Make sure the On/Off Switch is turned on. Turn it on and off.

Control Fuse
1) Check control fuse in side of control box. Twist open the fuse holder and physically check the little fuse. You can see if the metal element inside is melted if it is blown. You can also use your digital multimeter to check continuity across the fuse.

Picture of the on/off switch and fuse holder opened.



Branch Fusing
1) Check the branch element circuit fuses inside the control box. All kilns with more than 48 amps and many 3 phase kilns have branch fuses.

Plug & Cord (if you have one)
1) Make sure the power cord is plugged into the receptical. Reseat plug.

2) With power off examine the electrical cord. Look for burned or melted areas and breaks or pinched sections. Look closely at the head of the plug. If there is an internal problem with the wires and the plug parts you won't be able to see it but you may detect a softening or melting of the plastic at the plug head.

3) With power turned on and panel open check voltage at the Power Terminal Block. If you see no voltage there then you know something is wrong with the power source. **CAUTION: This test should only be done by an experienced person familiar with electricity and its dangers.**

Circuit Breaker / Power Source
1) Check voltage at the receptical. **CAUTION: This test should only be done by an experienced person familiar with electricity and its dangers.**

A Fused Disconnect Switch:

2) Check circuit breaker or fused disconnect switch to make sure they are turned on. Sometimes circuit breakers need to be turned on and off to reset them.

3) If you have a fused disconnect check the fuses with your voltmeter for continuity. **CAUTION: This test should only be done by an experienced person familiar with electricity and its dangers.**

4) Make sure fuses or circuit breaker is the proper amperage and type. See wiring diagram for details.

5) Test for voltage at the main power supply as close to the kiln as possible. **CAUTION: This test should only be done by an experienced person familiar with electricity and its dangers.**

6) **CAUTION**: If you have a 208 volt rated kiln and are trying to run this on 240 volts you will create a dangerous situation. **This is dangerous because the kiln will draw more amps than it is rated for which will overload the power wires and other components and could cause a fire.** Chances are the circuit breaker will trip or the fuses will blow first.

7) Check voltage to the kiln. MAKE SURE YOU ARE NOT USING A 3 PHASE KILN ON A SINGLE PHASE CIRCUIT.

Internal Wiring

1) Unplug kiln or turn off at circuit breaker or fused disconnect and open up panel. CHECK VOLTAGE TO BE SURE. Make sure that all the wires inside the control panel are connected. See photograph on page 2 and also the Wiring Diagram. Specifically look at the wires that go from the power connection block to the on/off switch, then to the control fuse and then to the control transformer.

Short Circuits

Do all the following with the kiln unplugged.

1) Check for short circuits. Look for any signs of burnt wires. This might indicate a short circuit. A way this might happen, as an example, is that frayed wires at the end of a wire connector might touch each other.

2) Check for worn wires that may have shorted against the case. Examine wire insulation. If the wire insulation has become frayed or deteriorated from heat, the wires could short to the metal casing which is electrically grounded.

3) Look for dirt. Some dirt (such as carbon compounds) are electrically conductive. This is generally not the case with ceramic materials but some can be. Vacuum out if you see dirt.

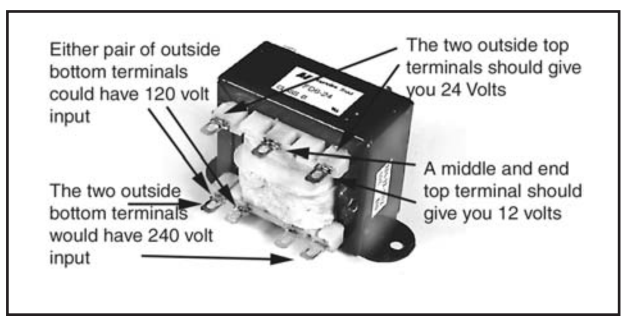
NOTE: Usually a short circuit will trip the circuit breaker for the kiln or the fuses in the fused disconnect switch if you have one. You will then not see any display on the DynaTrol. Turn your circuit breaker on and off, and check fuses on the fused disconnect and control fuse.

Control Transformer

CAUTION: These tests should only be done by an experienced person familiar with electricity and its dangers.

1) If none of these solve the problem then you could have a bad control transformer. To check the transformer operation test with your digital multimeter. It should read 240 volts across terminals 4 & 7 and 24 volts across terminals 5 & 8. This is a live test so be very careful not to touch any of the wires - remember there is 240 volts in the panel and this can electrocute you. If you are not getting proper voltage (or any voltage from the transformer and you are getting it to the transformer then you need to replace the transformer.

Control Transformer:



2) If there is 240 (or 220 or 208) volts coming into the control transformer (terminals 4 & 7) and there is no voltage coming from the transformer (across terminals 5 & 8) then you have a bad control transformer and it needs to be replaced.

3) If there is no voltage coming into terminals 4 & 7,

then test for it at the Power Terminal Block where the power cord comes in. If there is power there then look for a bad connection or wire between the power connection block and the transformer, i.e. a bad toggle switch, wire, or ½ amp fuse holder. If power is not there then go further back on the line and measure the voltage. Keep going until you find voltage, then look for the problem between that point with the voltage and the last point checked that had no voltage.

Control Board

1) If the transformer is OK and you know you have voltage going to the control board but the control still shows no display then the control board needs to be replaced.

THE KILN DOESN'T HEAT AT ALL (MANUAL KILNS)

1) Check many of the same things in the above section on Automatic kilns - power supply, branch fuses, short circuits, cord, etc.

2) Make sure the infinitely variable zone input switches are turned on (if included on your kiln). There is a "click" in the "off position at "12 O'clock". Full on is the "click" position just to the right of this (1 O'clock).

3) Infinitely Variable Zone Input Switches may have failed.

4) Check to see if Dawson Timer is set properly. (If it is at "0" the kiln will not fire.

5) Check to see if the Dawson plunger is not pushed into place.

DISPLAY READS FAIL (AUTO)

1) Usually **FAIL** will be seen flashing along with a **tC1**, **tC2** or **tC3** indicating which thermocouple has failed.

2) Remove the offending thermocouples connection wires from the Terminal and bind the red and yellow wires together with electrical tape. The control should read room temperature for that thermocouple (approximately 130°F because of the thermocouple offsets).

3) If it does read room temperature then the thermocouple is probably bad and needs to be replaced. If the control does not read room temperature then there is either a bad thermocouple extension wire or the control is bad.

4) Redo the test by putting a small jumper like a paperclip across the thermocouple terminals directly on the Dynatrol board. If the control now will read room temperature then you have a bad thermocouple wire. If it does not read room temperature then the control is definitely bad and needs to be replaced.

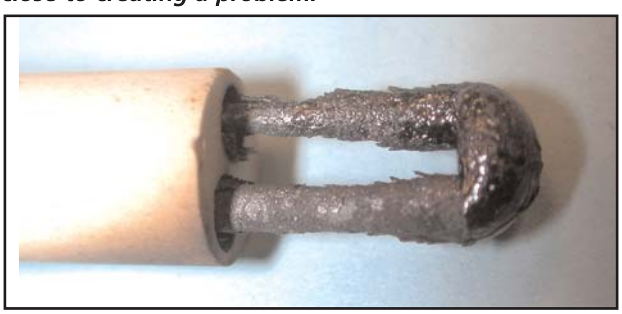
DISPLAY READS 2400 or CPLt WHEN IT STARTS UP (AUTO)

Even though you know the kiln is not that hot. This indicates thermocouple circuit failure.

TECHNICAL NOTE: This is called thermocouple upscale protection. If the control senses a lack of millivoltage (an open circuit) it interups this as the highest temperature the control could reach. This automatically ensures that the control will not call for power.

1) Check thermocouple end. Examine end carefully. Sometimes there can be a crack that opens up while the kiln is hot but appears to be normal when the kiln is cold. If the end of the thermocouple looks severely corroded and you are getting Error codes then it is best to replace the thermocouple.

A thermocouple end that will still work but is getting close to creating a problem:



2) Check thermocouple circuit. For instance check to make sure that all the thermocouple lead wires are firmly connected. Check where the thermocouple lead

wires go into the ends of the thermocouples. Are the wires loose? Tighten the screws on the ends of the thermocouples to be sure you have a tight connection. Check for corrosion. Check where the thermocouples connect to the Dynatrol. Try pulling off each connection and reseating it. This can scrape away corrosion that may have built up. Check for melted wires.

3) A very easy check is to check resistance (ohms) . Remove the thermocouple lead wires from the thermocouple head and check resistance with your meter. If the thermocouples and circuit is normal then you will see a resistance of about .9 or 1.0. If you see an **OL** in your meter then you have an open circuit somewhere which is probably a bad thermocouple.

DISPLAY IS NORMAL BUT KILN WON'T HEAT UP (AUTO)

Programming

1) Make sure you have programmed the kiln properly and it is supposed to be firing. Do you have a **Delay Time** or a **Preheat Time** in your program? (Hit **Review Prog** button to find out).

Wiring

1) Unplug kiln or disconnect from live power by turning off circuit breaker or fused disconnect switch. Open panel. Check all power wires for firm connections.

2) Visually inspect the power wires coming from the Power Terminal Block to the inputs of the Power Relays. Reseat all the spade connectors to rub off any oxides and to ensure a good connection.

Control Board Outputs

1) It is possible that the the internal switches on the control board could be bad. You can test that by checking to see if you find voltage (12 volts DC) between any of the output contacts on the control board to ground (any green wire). **CAUTION: This test should only be done by an experienced person familiar with electricity and its dangers.**

Bad Power Relays

1) You should be able to hear contactors going on and off with a clicking noise when you first turn on the kiln and it is supposed to be heating up. If not try turning the kiln off and then back on again and restarting the program. Of course if you don't hear the relays it only tells you that they aren't firing. The problem could be in the control for instance not telling the relays to fire. If you do hear relays and the kiln is not heating then you know the problem is in the power circuit AFTER the relays.

2) With power on and panel open check voltage before and after each of the contactors while the kiln is firing. **CAUTION: This test should only be done by an experienced person familiar with electricity and its dangers.**

Bad Elements

See *troubleshoot-elements.pdf* in the TROUBLE-SHOOTING section.

KILN FIRES UNEVENLY

Peepholes

1) Plug up Peephole holes in the kiln to prevent drafts.

Lid Seal

1) Check to make sure that door/lid is sealing properly. If door/lid is not sealing against top brick correctly a bright red glow will be visible around the door/lid seal when kiln is operating. (A little of this is OK). Also excessive heat loss can be felt around seal. Rub seal high points down with sandpaper until no more than l/l6 of an inch gap is found at any point along seal. Note that the gap at the top will definitely appear larger than any gap you see between the kiln sections. This is partly because the lid actually bows down in the center of the lid when it heats up and the edges consequently rise slightly. Just check for an UNEVENESS in this gap which will cause an excessive heat loss.

2) If door/lid is excessively cracked or worn or has holes in it this may cause drafts in the kiln. Replace door/lid.

GENERAL L&L KILN TROUBLESHOOTING GUIDE

This shows a crack in a lid that is OK. Cracks are a natural event with refractory slabs. As long as the crack does not create a large pathway for heat to escape and remains stable it is OK to leave as it. See the section in the back called CRACKS IN THE TOP & BOTTOM:

Elements

1) Elements may have differentially changed in resistance. Check element resistance (see *troubleshoot-elements.pdf*).

2) Empty the kiln. Then turn kiln on using a fast program like FAST GLAZE until elements are red. Open the door carefully and observe the elements to see if they all seem to be glowing about the same amount. **CAUTION: The power does not turn off when you open the lid. Be careful not to put your hand inside the kiln while it is on. Dangerous electric shock could result if you touch an element.**

3) There is a neat diagnostic program within the Dynatrol. This is handy to use when your kiln is first delivered and set up to make sure it was done properly. It can also be useful in seeing if an element has burned out. To use this diagnostic program enter the following sequence when the display says **IdlE**.

4) Press **OTHER, 4, 4, 3**

5) Keep pressing **OTHER** to cycle through the menu options until you get to **dIAG** and then press **ENTER**.

6) Open the lid of your kiln. You will see each zone of the kiln turn on for one minute each, starting with zone #1, the top zone. The control will display **OUt1**, then **OUt2**, then **OUt3** as it cycles through this sequence. **CAUTION: The power does not turn off when you open the lid. Be careful not to put your hand inside the kiln while it is on. Dangerous electric shock could result.** This will tell you if the kiln sections are in the wrong order or if the wires are somehow crossed in the control panel. If this is the case the zones will not turn on in the proper 1, 2, 3, order.

Loading

1) The Dynamic Zone Control of the EASY-FIRE kilns can compensate for many uneven loading situations. However, if you are having a problem with uneven firing try to vary the way you load it to match the firing characteristics of the kiln. For instance if it typically fires hot at the top them put more weight in the top to absorb that heat.

2) Be sure to put posts under the bottom shelf. The bottom shelf should be at least 1/2” to 1-1/2” above the floor of the kiln.

Firing with Cones

1) Try using cone packs in all sections (top, center, bottom) of the kiln and keep records of what happens. See *troubleshoot-cones.pdf* in the LOG, CONES, TIPS section of your Instruction Manual.

Thermocouple Offsets

Thermocouples can drift in in their accuracy over time and this can happen at different rates for each thermocouple. If one thermocouple reads at a different temperature than another thermocouple this can cause uneveness in the kiln. Read about Thermocouple Offset in section 4.3.1.8 in the DynaTrol Reference Manual (*dynatrol-instruct-blue.pdf* in the CONTROL section) and the Calibration section in the *dynatrol-basic-operation.pdf* in the OPERATION section of your Instruction Manual.

Vent System

1) Is your vent system on and pulling air? You can check this with a source of smoke in a cold kiln. (If you burn a small piece of paper near the holes on the bottom of the kiln with the vent on and THE KILN OFF you can see if the smoke is being drawn into the holes. You can also check this by feeling the output of the vent when the kiln is at high temperatures. The air coming out should be quite warm to the touch (about

110 Deg F to 140 Deg F). The Vent-Sure will aid in keeping your kiln uniform by drawing hot air from the top of the kiln towards the bottom. It counteracts the natural rising of the heat. If you want to increase draw first close the Bypass valve on the Bypass Collection Box under the kiln. See the Vent-Sure vent instructions. You can also increase the size of the vent holes in the bottom of the kiln. You can also try taking out the top peephole plug. See *ventsure-instruct.pdf* in the OPTIONS section of your Instruction Manual.

LAG & AUTOLAG SETTINGS

Check the LAG setting (see information in these instructions under "KILN FIRES SLOWLY". To get the kiln to fire more evenly you may want to decrease the LAG setting and perhaps turn the AUTOLAG OFF.

CONTROL ERROR CODES (Auto)

See the control instructions and the explanation later in these instructions.

THE KILN FIRES UNEVENLY (MANUAL)

1) Many of the above issues for automatic kilns also apply to manual kilns.

2) Multi section kilns like our J Series, X or T Series DaVinci, older G Series Colorado and SQ Series Dyna-Kilns have infinite control over the input to each section or zone. Firing chamber uniformity depends upon how a kiln may be loaded and how the input to each zone is adjusted. Normally a kiln is on "low" for a period of time, then set to "medium" for the next period of time, and finally on "high" until shut-off by either Dawson kiln sitter or other control device such as a program control. Often firing as above may end up with a difference in temperature in various sections of the fired load or zone. To correct this without the use of a pyrometer system requires a trial and error method, such as using multiple cones in various zones of the kiln. After shut-off carefully note the temperature variations and by small adjustments to the sectional input controls when on "high" attempt to tune this difference out. Since cones only indicate end of firing temperature one has no idea of how the uniformity is developing as the temperature is increasing. We recommend a TRU-VIEW multi-thermocouple pyrometer system which indicates the temperature of each zone. (These are available from L&L). The system includes a thermocouple located in each kiln section. A switch allows the operator to switch from zone to zone very rapidly and thereby indicating each zone temperature. Adjustments to the infinite control will then be indicated. This method indicates zone temperature at all times and is also a great help in cooling a kiln. Often a kiln should cool slowly requiring a period on "low" heat. In such a procedure the Dawson Kiln Sitter is reset carefully to "on" position (ignore the cone which has initially shut this kiln off) but make absolutely certain you are on "low" heat to prevent overfiring. Do not leave your kiln; keep checking. CAUTION: Such a procedure requires knowing the temperature of the kiln and kiln sections and requires manual shut-off of the kiln. Simply shut-off power manually (by turning off the various input/zone switches) and cause the Dawson to manually shut-off by depressing the weight of the Dawson Kiln Sitter.

KILN FIRES TOO HOT OR COLD

Firing with Cones

1) On the next firing make up "cone packs", one for each thermocouple. A cone pack is a set of three cones, standing in a line. The target cone is the cone number you are firing to and is in the middle. The one in front of it is one cone number lower, and the one behind it is one cone number higher. Use Large Self-Supporting Cones. You can purchase these through your ceramic supply distributor. They come 25 cones per box and are quite inexpensive. See *troubleshoot-cones.pdf* in the TROUBLESHOOTING section of your Instruction Manual.

Easy-Fire vs Vary-Fire (Auto)

Keep in mind that the Easy-Fire programs feature Orton software that adjusts the final temperature based on the speed of firing. This in effect adjusts the heat-work and hence the actual cone that the kiln fires to. This feature is not in the Vary-Fire programs. You have to input the final set point temperature in a Vary-Fire program.

Hold Times

Be very careful with hold times. Even a fairly short hold time of 10 minutes can dramatically increase the amount of heat work and hence the cone that the kiln fires to. On the other hand you can use the hold time to increase the heat-work to compensate for under-fired work. Just test this in small increments. There is a great program available for free from Orton's web site that allows you to calculate this with some precision.

Control Settings

1) The ceramic thermocouple protection tubes introduce a known error into the system. This is covered in the Operational Instructions but bears repeating here. The temperature that is measured by the tip of the thermocouple is approximately 70 Deg F cooler than the actual kiln temperature. We have found through extensive testing that the best way to compensate for this is to put in a Thermocouple Offset of + 50 Deg on each thermocouple (setting is **0050**) and a Cone Offset of of -20 (setting is **9020**) for EACH cone that you fire to (on the Easy-Fire Programs or **9030** on cones 022 to 017). We have already programmed the control with this information so that you don't have to do it. However, we also provide step-by-step instructions on how to do it in the Operational Instructions. If you are using the VARY-FIRE programming then use a Thermocouple Offset of plus 70 (setting is **0070**).

Thermocouple Drift

Thermocouples drift in their accuracy with time. You may have to make further adjustments in the Thermocouple Offset or Cone Offset settings over time.

KILN STALLS

1) If for some reason the thermocouple wires touch the hot kiln case they may melt and fail. The result of this is that the kiln can "stall out", say **CPLt** prematurely or display any other number of other random error codes. It may refuse to increase in temperature, and the kiln will just run on and on. If it is re-started it may work fine for a while. What happens is that the millivolt signal in the TC wire goes to ground, or the two wires in the TC wire are "electrically" connected by the stainless steel melting through the insulation and the "temperature" is then taken right there, not in the kiln. However, the signal received can be so foreign to the microprocessor that the kiln will just stall. The specific Thermocouple Lead Harness needs to be replaced.

2) Thermocouples close to end of their useful life can cause some of these same problems.

3) Sometimes excessive ambient temperatures (over 125°F) around the control can cause stalling too.

4) Corroded connection points can also cause stalling.

KILN FIRES SLOWLY

Bad or Wrong Voltage

1) Check your voltage. Do this at the kiln at the Power Terminal Block with the control panel open or check it at your fused disconnect box. **CAUTION: This test should only be done by an experienced person familiar with electricity and its dangers. You need to see what the voltage is when the kiln is firing.** Low voltage will make the kiln fire considerably slower. For instance a kiln designed for 240 volts will have 25% less power when operated on 208 volts. Check voltage at your panel and where the kiln is connected. Check the voltage when the kiln is firing and when it is not firing. Sometimes the high amperage draw of the kiln will cause a voltage drop at the kiln. A voltage drop of 5 to 10 volts is not uncommon and is to be expected. If your voltage drop is more than that then you may have a problem with your electrical supply.

2) Make sure no other large electrical appliances such as a clothes dryer or electric oven are on when you are operating your kiln. This may cause a voltage drop which would slow the kiln down.

3) Voltage may vary in your area depending on season and time of day. Frequently there are "brown outs" during the summer months in some areas. This is when the electric utility reduces the voltage. Try firing

at night after peak electrical use hours. You can use your Delay feature to do this easily. Find out from your local utility company when the end of the peak period of electrical use is. Some utilities offer preferential rates for using electricity at night because it is cheaper for them.

Element Aging
See *troubleshoot-elements.pdf.*

Power Relays
1) Power Relays may cause poor transfer of power to elements when they have been used for a long period of time. It is not always a total failure - which is of course harder to troubleshoot. If these are suspected replace them.

Bad Wiring
1) Have an electrician check your wiring. We have seen aluminum wire cause intermittent problems with allowing enough voltage through. We do not recommend aluminum wiring although some electricians will swear by it. The problem with it is that aluminum oxide, which is formed from heat, is a resistor while copper oxide is not a resistor. With kilns you will often develop some heat in the electrical lines. If all connections are perfect and the wire is oversized you probably will not have a problem - but why take that chance? Make sure your wires are of the proper size and that all connections are good.

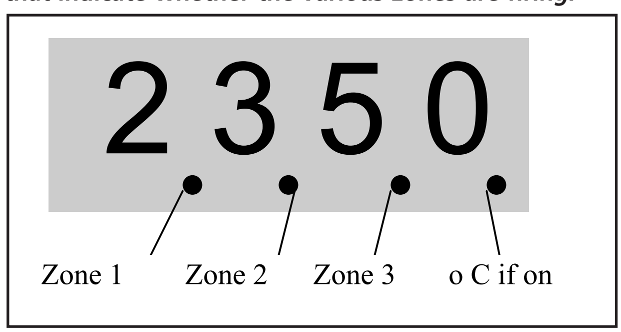
WIRES WILL GET HOT
Unlike many other appliances that use electricity (like motors) kilns are called a "resistive load." This means that there will be a continuous pull of steady electrical power for many hours. Even with properly sized wire this will generate SOME heat in the wires. This is one reason we recommend against using aluminum wire for a power feed. If you look carefully you will see that we have OVERSIZED our internal power wires far in excess of their rated capacity. In addition all our power wire is rated for very high temperatures. The larger the wires the less resistance in the wires and the cooler they will operate.

2) Check your circuit breaker for proper operation. These sometimes go bad over time.

3) If all the elements are firing and the kiln is still firing too slow check the amperage draw of the kiln under a full load. **CAUTION: This test should only be done by an experienced person familiar with electricity and its dangers. You need to see what the voltage is when the kiln is firing.**

4) You can tell if all zones are firing by pressing the number **8** on the control numeric pad. You will see one little light per zone under the numbers on the control display. If you see two dots on an e23S or e28S then you are firing at full load. If you see three dots on an e23T or e28T then you are firing at full load. See if the amperage drawn is the same as what the kiln is rated for. See the product literature and/or data nameplate on the kiln for the rated amperage draw. There is also a complete table of this information in the Installation Instructions part of this manual. For instance, a model e23T rated for 240 volts, Single Phase should draw 48.0 amps. If it is substantially less than the rated amperage draw and your voltage is within 5% of the rated voltage (for instance 230 volts for a 240 volt unit), then chances are the elements have changed in resistance. This will require element replacement.

Pressing the number "8" will turn on 2 or 3 small LEDs that indicate whether the various zones are firing.



Wiring in the Kiln
1) Unplug kiln.

2) Trace wiring for missing or bad connections.

3) Check wiring against wiring diagram.

4) Check for corroded connectors or connectors that have frayed wires. Replace if you see this.

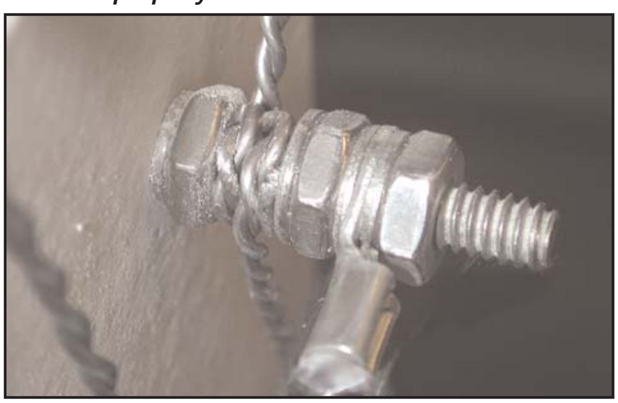
5) Make sure all kiln sections are plugged in (if applicable to your model). Make sure ALL plug connections are good and not oxidized.

Element Connections

1) The holes where the elements go through the firebrick walls are too large. This could cause too much heat to escape from the kiln thereby overheating the element terminals. This can be remedied by lightly stuffing non-RCF ceramic fiber in the element holes. (See the Parts List for for non-RCF fiber). You can stuff this in from the inside of the kiln using a sharp tool like a very small screw driver.

2) Check to see if the element ends are twisted properly. They should be twisted clockwise around the terminal screw. If the twist is too loose this could generate extra heat at the element ends. Check for corrosion on the terminal. If there is corrosion sometimes you can remove it with a wire brush.

Photo of element terminal with element end twisted around it properly:



3) The element connection hardware may not be tight enough. A loose connection can generate heat and cause oxidation of the hardware which in turn will cause a worse electrical connection (because of resistance) and more heat. Replace with new hardware.

Heat Leakage & Vents

1) Make sure peephole plugs are in.

2) Make sure hole for vent is proper. Check Vent-Sure instructions for proper hole sizes.

3) If you are using a different brand of vent make sure it is the appropriate size for your kiln. Check with the vent manufacturer and tell them how many cubic feet are in your kiln.

4) If your lid or bottom is cracked check to see if it seems to be leaking much heat at high temperatures. Patch or replace if extreme. (SOME IS OK).

Single vs Three Zone Control

1) Three zone control will slow a kiln down. It helps even out the temperatures in a kiln by shutting off one or more zones while firing. In addition zone control introduces other issues like **LAG** that sometimes complicate a firing. **The first thing to try if you are getting a slow firing is to switch the kiln to single zone operation.** That may get you back into operation quickly. Then, if that makes the problem go away you can fine tune the specific issue within the zone system that is causing the problem.

2) Normally Jupiter and DaVinci kilns are programmed to be either two or three zones. You can easily change this to be single zone operation.

3) Press **OTHER, 4, 4, 3**

4) The display says **notC** This stands for “number of thermocouples”.

5) To run the kiln using only one thermocouple press **ENTER** at the **notC** prompt**.** You will then see **0003** or **0002** (depending on whether it is currently programmed for three zones or two zones). Then press **1**, then **ENTER.** The display will then say **StOP.** All the zones of the kiln will turn on and off simultaneously when you program the Dynatrol to use only one thermocouple.

6) To run the kiln using only two thermocouples press **ENTER** at the **notC prompt.** You will then see **0003** or **0001** (depending on whether it is currently programmed for one zone or three zones). Then press **2**, then **ENTER.** The display will then say **StOP.** When you program the Dynatrol to run using only two thermocouples the bottom zone and the middle zone go on and off simultaneously. If you have a three section kiln the bottom section and the middle section will work off the middle (#2) thermocouple and they will fire together. This configuration can be an interesting option to help speed up the kiln but still

get some advantage from the zone system.

7) To run the kiln using three thermocouples press **ENTER** at the **notC prompt.** You will then see **0002** or **0001** (depending on whether it is currently programmed for one zone or two zones). Then press **3**, then **ENTER.** The display will then say **StOP.** If you choose to do this thermocouple #1 must be in the top zone, thermocouple #2 in the middle, and #3 in the bottom. All three zones will operate independently, tied to their respective thermocouples.

8) To exit the **OTHER-4-4-3** series of menus without doing anything press **OTHER** until you come to **PCt**. Then press **ENTER** twice. You will then see **CPL**, and then **IdLE**, **tC2**, and the current temperature cycling in the display again.

LAG Setting

1) **LAG** is the zone control setting that determines the temperature differential allowed between zones.

2) The lower the **LAG** number the more even the firing. However, this can slow the kiln down considerably. It is somewhat like a convoy - the kiln can only move as fast as its slowest zone (although of course it is more complicated than this because the faster zones help heat the slower zones).

3) The default **LAG** setting is **25**. If you increase this to **50** or even **75** is allows the kiln to fire its zones with a greater differential which will speed the kiln up.

4) Press **OTHER** until you see **LAG**.

5) Hit **ENTER**.

6) You will see **LAG** and a number such as **0025** flash.

7) Input a new number (from 5 to 99) with the keypad and hit **ENTER**. We do not recommend less than **25** unless you have a very critical process and where speed is not an issue like on low fire. A very low number like **0005** could really slow the kiln down. If you want lower than **0025** try **0015** or **0010.**

8) **AUL6** (Autolag) will now display, flashing with either **On** or **OFF**. See next section.

Autolag Setting

1) **Autolag** automatically disables the **LAG** control until the end of the firing.

2) Having **Autolag** turned **On** speeds up the firing considerably. Most ceramics applications do not require exceptional uniformity until the end of the firing. With **Autolag On** the **LAG** feature is disabled until the last 45°F of the firing when it comes back on to it's programmed setting. Basically this allows the faster sections to help pull the slower sections along.

3) However, for glass and other industrial applications turning **OFF** Autolag is probably recommended.

4) Press **OTHER** until **LAG** appears.

5) Press **ENTER**.

6) As soon as you press **ENTER** after entering the **LAG** setting (you can leave it as is - just press **ENTER**) you will see **AUL6** for approximately two seconds, and then see either **On** or **OFF**.

7) Press **1** to toggle between **ON** and **OFF**.

8) Then press **ENTER**

ShtO (Shut-Off) Setting

1) This option is used to shut off the automatic feature in the Dynatrol that holds the hottest part of the kiln at each segment's set point until the average of the three (or two) thermocouples reaches that set point. This can have a dramatic effect on speed of firing and is worth trying to see if it helps you if you are having a problem.

2) When you press **OTHER, 4, 4, 3**.

3) Press **OTHER** until **ShtO** is displayed.

4) Pressing **ENTER** here allows you to toggle, using any number key, between **On** and **OFF**.

5) **On** means that as soon as the hottest zone gets to the segment's set point the entire kiln switches to either the "hold time" or the next segment. This will result in a quicker firing.

6) **OFF** means that the Dynatrol will not let the hottest zone's temperature rise until the average temperature of the three zones reaches that segment's set point. Then the kiln can begin the "hold time" or

the next segment. This will result in more even firing.

7) When you have the setting you want shown in the display (**On** or **OFF**) press **ENTER**. **CPL** will display for a few seconds and then **IdLE** , **tC2** and **current temperature**.

PId Setting

1) This setting generally should be left at its factory default because it is hard to predict the changes that it will create in your firing. However, a full explanation is given for more advanced users who want to experiment with this.

2) This setting comes pre-programmed at the factory for 65%. Basically this setting determines how much help the middle zone of the kiln gives the bottom zone of the kiln when the bottom zone is lagging behind during heating. This comes into play when the bottom zone is on 100% of the time. With this feature, the middle zone of the kiln will come on the programmed percent (PId) of the time that the TOP zone comes on, if the bottom zone is on all the time. Tests showed that if the bottom was on 100% of the time, the top zone was generally on 90% of the time, but the middle zone was on only about 40% of the time. By programming a higher percent you can greatly speed up your firings. (you will have to experiment, try the factory setting 65% then try maybe 100% and compare your results). Basically the higher the **PId** setting the faster the firing at the potential price of uneveness.

3) As your elements age firing by firing, this setting will activate earlier and earlier in the firing because the bottom will be working at 100% earlier and earlier. This will allow the artificial inflation of the center's temperature sooner and sooner. Because this center is heating based on mathematics now and not it's own thermocouple's reading, it will have a longer and longer period of time to get hotter than the top and the bottom. In some cases this can lead to gross uneveness. You may find yourself dialing down the PId to something like 50% or 60%. Remember that if it is set around 40% (it's normal operating percentage) or below, the thermocouple's reading then will be the control for that section, not the mathematics of the **PId** feature.

4) When display flashes **IDLe**, **tC2** press **OTHER** see **rSEt.** Press **4, 4, 3.** See **notC**

5) Keep pressing **OTHER** to cycle through the menu options until you get to **PId**.

6) Press **ENTER**. See **PCt**, **0085** cycling.

7) Press any number from **0** to **150**, see the number you have entered preceded by a zero like **0120** if you entered **120**. Press **ENTER**, see **CPL** or **StOP** for a few seconds, then **IDLE**, etc.

8) Pressing **ENTER** here allows you set another percent setting that can help a slow, heavily loaded kiln fire faster.

Adding More Insulation

1) In L&L's top loading kilns an additional bottom may be placed under the original bottom. This will improve the insulation in the kiln, thereby slowing heat loss and speeding the firing time. You can also put a 2” layer of calcium silicate on top of the stand beneath the bottom of the kiln.

2) Also try raising the height of the kiln from the floor or putting a reflective stainless steel or aluminum sheet under the kiln. All these things keep the floor from absorbing the radiant energy from the kiln and will improve heat up times (as well as bottom of the kiln uniformity).

3) Put a 1” layer of non-RCF ceramic fiber on the lid. This is completely non-hazardous which is important in this application because you will be releasing fibers into the air when you move it while loading. While this is a somewhat extreme measure we have found that a disproportionate amount of the heat loss from a kiln is through the top. Non-RCF ceramic fiber is soluble in the body and is considered totally safe. (See the Parts List).

4) Whatever you do be sure NOT to put the kiln directly on the floor. If the floor is cement or other hard non-flammable material it will absorb the heat from the kiln. If the floor is wood or other flammable material you will create a very DANGEROUS situation which could cause a serious fire.

KILN HEATS TOO FAST

Voltage

1) Check your voltage. Some people may have high voltage like 245 volts where you should nominally have 240 volts.

2) Make sure you don't have a 208 volt kiln hooked up to a 240 volt circuit. **This is dangerous because the kiln will draw more amps than it is rated for which will overload the power wires and other components and could cause a fire.**

Elements

1) Check element ohms and compare with factory values. (See CHECKING ELEMENT OHMS).

THE KILN FIRES SLOWLY (MANUAL)

1) Check many of the same things as you would for an automatic kiln like element resistance, wiring, etc.

2) Switches are sometimes defective.

3) Relays or contactors may cause poor transfer of power to elements when they have been used for a long period of time. Examine contacts for wear. Replace contactors if contacts are worn or pitted.

4) Make sure all elements are firing. You can do this by simply looking inside the kiln while the elements are on. They should all be glowing a similar color red. CAUTION: In most kilns the power does not turn off when you open the lid. Be careful not to put your hand inside the kiln while it is on. Dangerous electric shock could result.

12) If all the elements are firing and the kiln is still firing too slow check the amperage draw of the kiln under a full load, i.e. with all Infinitely Variable Zone Input Switches on 100%. See if the amperage drawn is the same as what the kiln is rated for. See the product literature and/or data nameplate on the kiln for the rated amperage draw. For instance, a model J230 rated for 240 volts, Single Phase should draw 43.93 amps. If it is substantially less than the rated amperage draw and your voltage is within 5% of the rated voltage (for instance 230 volts for a 240 volt unit), then chances are the elements have changed in resistance. This will require element replacement. You can check element resistance by disconnecting the elements and checking the elements with an ohmmeter. See your instructions or check with factory for proper resistance.

TROUBLESHOOTING VARIABLES

For most L&L kiln problems the variables can be organized into these categories:

1) The Kiln Body
a) firebrick
b) element holders
c) lid and floor
d) metal case
e) stand
f) hardware

2. Elements
a) elements
b) element connections
c) element configurations
d) element replacements.

3) Atmosphere
a) atmosphere in the kiln while firing.

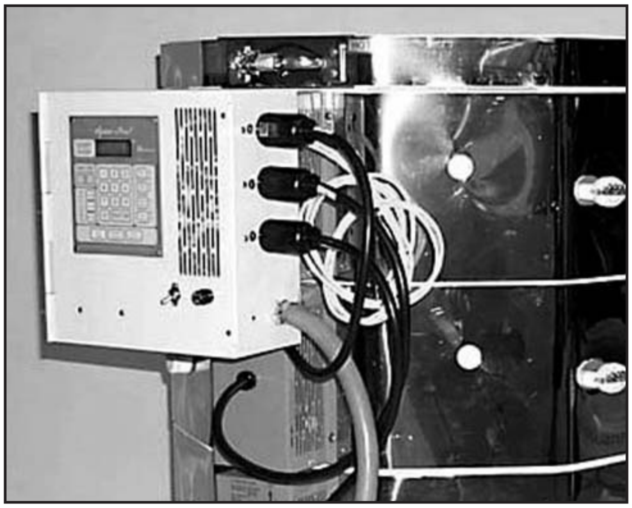
4) The Control
a) switch box
b) automatic control
c) kilnsitter
d) cones
e) thermocouples and pyrometers.

5) The Power Supply:
a) main power cord and receptacle
b) or the powerblock
c) wire and breakers.

Nearly all kiln related problems stem from one or more of these variables. We will go in-depth, starting with “The Kiln Body”

THE KILN BODY

The top of a JD230 showing the three sections that sit on top of each other and the control box mounted.



From the floor up most L&L kilns have a metal stand, a firebrick floor (sometimes containing an bottom element), a firebrick body containing ceramic element holders in grooves, heating elements in the holders and a firebrick lid. Either an automatic or manual control and various accessories (such as vents and pyrometers) are used as well.

Layout and Configurations

In sectional, polygonal kilns, the kiln body rests on the upper-outer edge of the kiln floor. It should sit flat, but if it does not, you can carefully slide it back and forth on the kiln floor, sanding the high spots away until it does sit flat. The kiln body should also be level, particularly if the Dawson kilnsitter is being used. The kiln body is typically made of 9" high sections on the polygonal (J and K Series) and DaVinci (X & T Series) L&L kilns. In the past we have made 14" high and 6-1/2" high sections for J models. We continue to make 4-1/2" unheated sections for Jupiter kilns. The sections are stacked on top of each other up to 5 high (and for some special units even higher).

The bricks are not cemented together in these models, but are cut to fit exactly together to form a very stable, multi-sided (polygon), or gently curved, symmetrical shaped (DaVinci). No latches are used to connect the sections but these can be added if required. The new "Easy-Lift, Easy-Load" Jupiter hinge does allow you to attach up to three sections rigidly together.

Firebrick

The firebrick used on almost all top loading electric kilns is very soft and fragile. It is typically K-23 firebrick either 2 ½" thick or 3" thick. This brick is used because of its remarkable insulating efficiency. It is much greater than some of the harder firebricks available. All L&L kilns have a special compound called brick facing applied to the inside surface of the firebrick to harden it once it is fired. It is a good idea to reapply this coating every so often over the years. A very thin coating is recommended for deep penetration of the compound into the brick.

Over the years, the brick will achieve a fine network of cracks throughout its body. This is caused by the expansion and contraction of heating and cooling. The geometry of polygon kilns is such that their shape (and the stainless steel bands) will hold them together long after the brick itself would normally fall apart.

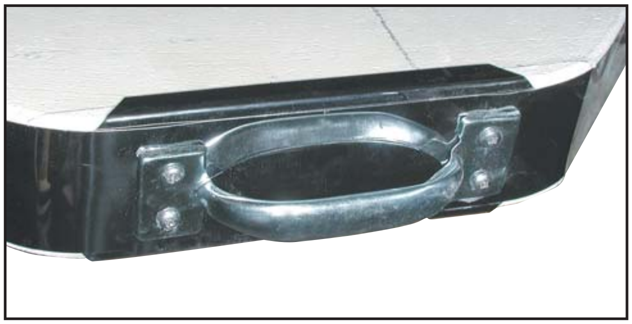
Firebrick Problems and Repair

See *troubleshoot-brick.pdf* for information on firebrick problems and instructions on how to repair firebrick problems.

Lids and Floors

The bricks in the lid and floor of the polygon and DaVinci kilns are cemented together, dried, cut and sanded flat. Then they are bound around the outside edge with a stainless steel band. These bands, like the ones surrounding the sections, have worm gear clamps attached to them which allow them to be tightened or loosened. These do get loose over time and need to be tightened periodically. The lids come with stainless steel "clips." which help to hold the lid in place. There are metal plates with a small 90° bend that are pinched between the stainless steel band and the brick to screw handles, door chains/supports and hinges into. The 90° bend on the clips also helps support the lid during lifting and lowering.

This shows typical clips that hold top firebrick to the stainless steel band, keeping the brick from slipping out of a band that becomes slightly loose.

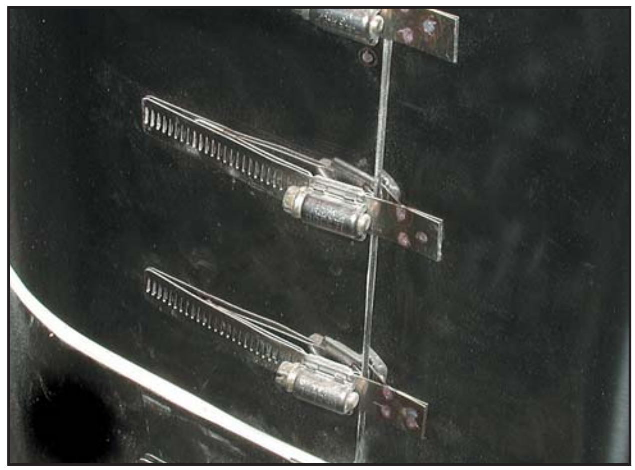


Cracking in lids and floors is common in kilns, even new ones. It is almost unavoidable and mostly does not matter a great deal. The geometry of the lid or floor, the tightness of the stainless steel band and the fact that firebrick expands as it heats up and fills the cracks combine to render a cracked lid or floor almost a non-issue. In fact, L&L's largest kiln lids (for the T3400 Series) are made in two halves to allow for the heat expansion. The only concerns may be if the stainless steel band cannot be tightened (in which case long metal shims may be needed between the stainless steel band and the brick) or if the crack is letting tiny chips fall into the ware. Two good solutions for the latter problem are either a shelf on posts placed over the ware to protect it or a very thin mixture of “brick facing” allowed to penetrate into the lid or floor around the crack to harden the brick. Too much brick facing on the lid can spall or flake off and cause problems.

Stainless Steel Bands

Each kiln section and the top and bottom have a stainless steel band wrapped tightly around them. This is how the kiln sections retain their shape. The steel has holes punched in it to locate peepholes, thermocouple holes, Dawson kilnsitter holes, etc. The bands are the same on the top section of the kiln as they are on the bottom section; different holes are used in different places and the firebrick may not be drilled through even though there is a corresponding hole in the stainless steel band. Worm gear clamps tighten the bands so that they fit snugly around the shaped bricks. Hinges are screwed into flat, galvanized or aluminized metal stiffening plates located behind the stainless steel bands.

Photo of the worm gear clamps used on L&L kilns. Sometimes welds holding these onto the case can fail. You can screw them on in most cases or, if all else fails you can screw the two ends of stainless steel together to make a repair. We recommend using a stainless steel screw. Keep in mind that, if you do screw the case together, that you may have to redo the repair at sometime in the future because it will not be adjustable.



Kiln Stand

The kiln stand is usually galvannealed or aluminized steel (on Jupiter and Doll kilns), or painted angle iron(on DaVinci kilns). **It should be leveled before putting the kiln on it.** This can be done by placing metal shims under the legs of the stand, but not between the kiln floor and the stand. Be sure to use a level when doing this. Some older stands that L&L made were not galvanized or aluminized. These may have rusted over the years particularly under the corrosive conditions of kiln firing. You should replace a corroded stand because you could have a major disaster if the kiln were to fall over while it was firing.

Once the stand is level, place the kiln floor on it. If it wobbles at all you must shim the stand legs to correct this. If you fail to do this you may crack the kiln floor prematurely. It is imperative to use a proper stand. Without it, the non-flammable concrete/brick/tile floor will act as a "heat sink," transferring heat from the bottom of the kiln throughout the floor; this will result in cooler bottom zones and uneven slow firings and could also result in a fire.

If you want to add more insulation to the bottom (something we recommend in the case of slow firing) you can put another kiln bottom under your new kiln bottom (people often have old kilns around that can be cannibalized for this purpose) or you can put a layer of calcium silicate under the kiln stand. See our parts list for information on this.

Jupiter Stands with Vent Collection Box

New stands have mounting studs in place around a hole in the middle of the stand for the attachment of L&L's venting system. See the section in this guide on “Venting” for more information as well as the vent system instructions for the specific requirements pertaining to size and number of exhaust holes for each different size kiln. Sometimes the studs on the stand do not quite line up with the holes in the vent system's “by-pass collection box”. If this is the case try to determine which studs are not correct and either enlarge the holes in the bypass collection box (with a drill), or put a nut on the stud and tap it with a hammer, bending it slightly to go into the hole.

Hardware

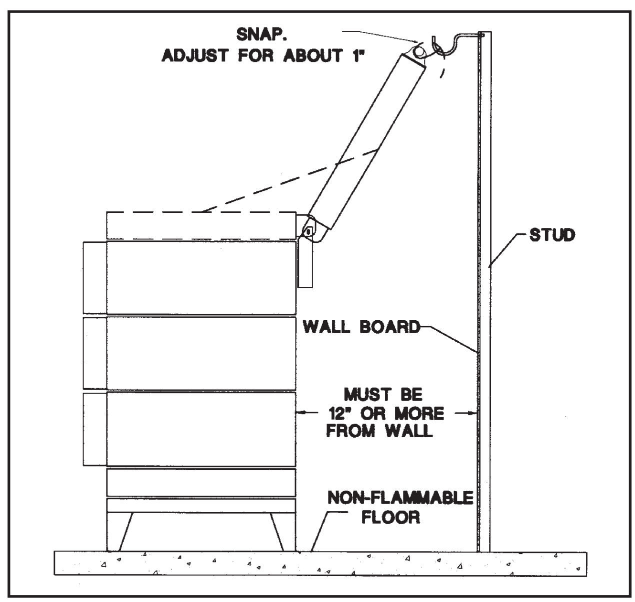
The older L&L kilns had zinc plated steel hardware on the kiln case. The newer models use much more expensive stainless steel hardware because it will not rust like zinc plated steel. Old hardware can always be replaced with stainless steel hardware of the same type. (Also, the electrical hardware that we used to use before 2000 was nickel plated rather than all stainless steel).

Econo/Jupiter Standard Lid Hinge

The hinge for the lid has a pin connecting the lid to the kiln body. When the kiln is cool, it is critical that the pin pass through the bottom of the oval-shaped holes on the part of the hinge that is mounted to the kiln body. If the pin passes through the middle or top of these holes the lid may not sit properly, will rise up as the kiln heats up, and might crack. The firebrick expands as the kiln heats. The oval-shaped holes allow for this expansion by giving the hinge pin room to rise up as the bricks expand. If the pin cannot rise, brick will continue to push upward, and the back edge of the lid will suddenly become a pivot point that will mangle the brick and force all the lid’s weight to ride on that point, possibly cracking it. Check this hinge pin position occasionally! To adjust it, loosen the mounting screws on the kiln body's part of the hinge assembly (not the lid's section) and slide that part of the assembly up or down. The mounting holes here are oval shaped as well.

Close-up of a hinge assembly. It is important to have the hinge bar rest on the bottom of the oval hole in the hinge when the kin is cold. This allows the lid to move up when the kiln expands.

The standard J Series lid (on J14 through J245 kilns) is meant to be used with door chains to stop the door from opening too far; a safety chain from the door handle to a hook secured in the wall keeps the lid from accidentally closing.



Older J2900 (29” diameter) Econo and Jupiter kilns have a tall metal backstop protruding from the hinge to keep the lid from opening too far. These have no door chains, but still use the safety chain to the wall hook system. This has been replaced with the new "Easy-Lift, Easy-Load" spring loaded hinge system as standard on all 29" diameter Jupiter kilns as of April 2001.

Jupiter "Easy-Lift, Easy-Load" Spring Loaded Hinges

In April 2001 L&L started using spring loaded hinges as standard equipment on the twelve-sided (29") Jupiter kilns. These hinges are available as an option on the ten- and eight-sided Jupiters as well. They make opening the lid considerably easier, especially on the larger kilns. Do not consider using these hinges if you rely on being easily able to remove sections of your kiln to load it. These hinges cover about 20 inches of the height of the kiln body, or about two and one quarter sections of the kiln, and complicate the simplicity of removing the individual kiln sections. The 12- sided Jupiters already use a hinge that covers two sections, so the simplicity of removing sections on these models is not really compromised by the use of this better hinge. These new hinges also feature the ability to tie together up to three sections (or two sections and the bottom on 2 section kilns). The hinge itself is made from galvannealed steel for corrosion resistance and is then powder coated.

There is no easy way to retro-fit an older kiln with one of these hinges, but it can be done. When these are installed at the factory, we use aluminized metal backing plates tapped in behind the stainless steel bands to give the hinge mounting screws something to latch onto.

DaVinci Lid Hinge and Counterbalance

The DaVinci hinges include a pole mounted counterbalance. These hinges still have the oval-shaped holes for the hinge pin to accommodate the expansion of the hot brick. The difference is a spring-loaded pole(s) and cable(s) that pulls up on the front of the lid. Normally these lids are maintenance free and quite safe when used with the safety chains that are attached to the pole(s).

A DaVinci with lid up and safety chains on

However, the lids are very heavy and the counter-balance will NOT keep them from closing on their own. They can be adjusted to do so, but this usually results in the lid lifting up during firing. There may be a fine line where the lid will not raise up during firing, and also may not fall down right away from its upright position. This fine line will be different for every kiln; even two identical kilns built at the same time will not act exactly alike. Always adjust the tension on the lid so it will not open up during firing, and ALWAYS use the safety chains when the lid is up.

The easiest adjustment points are the threaded connectors between the eyebolts on the front of the lid and the cable that connects to that point from the counter balance. A longer cable adjustment will mean a heavier lid, a shorter one will mean a lighter lid. A more crude adjustment would be to lengthen or shorten the entire cable itself. Do not try to shorten the springs or make adjustments to the cable inside the counter balance poles. Be sure to read the DaVinci Set-Up instructions that came with your kiln. (*davinci-setup.pdf*).

Element Holders

Each kiln section has a number of heating elements in it. These elements sit in ceramic element holders or channels that are set in the brick. They go all the way around the kiln.

A J2900 Brick set which includes two bricks and three rows of holders.

Elements are held in place by two small flanges on the back of the element holder that slide into specially routed channels in the brick. These eliminate the need for pins to hold the elements in place. These holders also help to retain the heat in the kiln during firing. The harder ceramic holders reflect the radiant heat of the elements back into the kiln better than the firebrick. When ordering replacement element holders it is best to measure their length and include that along with the kiln model number. There are "old-style" element holders in kilns built before January 1996. After January 1996 the element holders were made with a slightly larger channel for the elements. We recommend replacing the “old-style” holders with the more recent version. The reason for the “new- style” element holders was to accommodate the larger diameter of the “Heavy Duty” elements, which are still available for SQ, B, J and JD model kilns only if they were built after January 1996, or have had all their element holders replaced since that date. Note that the new and the old style holders fit into the exact same milled slot that we have always put in our brick. Therefore you can put new holders in your old kiln. There is a slight offset between the two styles when you mix them but this won’t cause any problems for the elements.

DaVinci kiln element holders (gray-colored) are rated for a higher temperature than the J model element holders. They are interchangeable in terms of their composition for most uses. It is the lengths which are different. They can be custom cut using a wet diamond saw if necessary. The DaVinci element holders will not slump together in the event of an over-fire as soon as the J model holders will, which is at about 2450°F. The DaVinci element holders are rated for about 3000°F, but are not quite as impervious to heat shock as the J model holders. Very sudden changes in temperature will cause them to crack sooner than the J model holders would. Since 2350°F is the maximum temperature for any L&L kiln, the higher-rated DaVinci holder would never see its temperature rating of 3000°F. In the event of an over-fire, however, the cost of repair is considerably less if the element holders have not slumped.

Element Holder Replacement

See *troubleshoot-brick.pdf* for instructions on how to replace element holders.

HEATING ELEMENTS

If you are having a problem heating your kiln up first look at the following issues:

CIRCUIT

Make sure the elements are wired according the wiring diagram. Some elements are in series, other kilns have parallel circuits. This makes a HUGE difference in how the kiln fires. See the explanation of circuits in *troubleshoot-element.pdf* in the TROUBLESHOOTING Section.

POWER SUPPLY

With the digital multimeter, the voltage to the kiln can be tested. The condition of the power supply lines and connections can be determined visually.

INSULATION

Another variable is the condition of the insulation. Are there significant leaks? Large cracks in the lid or bottom? Do you fire with the peephole plugs open? The condition of the firebrick can be determined visually.

ELEMENTS

The elements are the least stable variable and should be examined before anything else. Use the multimeter to test the elements' resistance (ohms). Note that element resistance changes over time, the hotter and more often you fire the quicker they change. As the resistance goes up the kiln will slow down because it is getting less power.

You may not need to replace any elements, but you must eliminate or implicate them as a potential source of the problem.

ELEMENT TROUBLESHOOTING

See *troubleshoot-elements.pdf* in the TROUBLE-SHOOTING section of your instruction manual for more information on element problems, how to change elements and how to change element holders. See the section later in these instructions for a complete "walkthrough" of how to check elements in a manual kiln.

KILN ATMOSPHERE & VENTING

An electric kiln atmosphere rich in oxygen will make elements, kilnsitters, and thermocouples last as long as possible. All the materials used in L&L kilns like to be in oxygen. Fumes are generated by carbonaceous materials in clay, china paints and glazes containing oils, glue from decals, and certain glazes and other miscellaneous products. Fumes include carbon monoxide, sulfur oxides, hydrogen fluoride and metal vapors. These fumes are unhealthy and can adversely affect your work.You MUST VENT YOUR KILN if you are doing ceramics.

INSTALLATION CODES

See *install.pdf* in the INSTALLATION section for more information on venting and codes.

GENERAL ROOM VENTILATION

Your kiln room should be dry and well ventilated. Never operate in an enclosed space unless you have good ventilation. Aside from issues of ventilating the fumes from the firing, the heat build up in an enclosed room could present a significant fire hazard. We recommend room ventilation of at least 10-25 times the cubic feet of the kiln per hour. For example, if a kiln has 10 cubic feet then 250 cubic feet per hour (about 4 cubic feet per minute) should be adequate. Our suggestion is to get a variable speed fan for ambient room ventilation and keep a thermometer on the wall. That way you can vary the ventilation to suit the needs of ambient heat conditions in the room. Grainger is an excellent source for ventilation equipment. (See www.grainger.com)

MANUAL VENTING

For many years people only vented their kilns by propping up the lids for the first part of the ceramic firing and taking out peepholes. You can still do this if you want. However, be sure to have proper room ventilation at least to get rid of the fumes that get vented to the room. Also be sure

POWER VENTING

We recommend our VENT-SURE downdraft kiln vent system. This will do most of the venting of the fumes of the kiln, will help cool the kiln, will improve uniformity of firing in the kiln, and will help maintain the oxygen level in the kiln (which is important for certain glaze effects). See our catalog for more information as well as hotkilns.com/vent.pdf. The complete installation instructions are at *ventsure-instruct.pdf.*

With a downdraft vent system air is pulled from tiny holes in the bottom of the kiln, which creates a slight negative pressure in the kiln. Just enough fresh air is drawn into the kiln to continuously replace the air being sucked out.

The heat in the kiln is then forced to move about. The slight downdraft effect of the vent system counteracts the tendency of heat to rise in the kiln (which would otherwise lead to uneven temperatures top to bottom in the kiln). The amount sucked out should not be enough to compromise the rate of temperature climb, but must be enough to suck out all impurities (i.e. carbon, fluorine, water vapor etc.). L&L's Vent-Sure system only requires between one ¼” hole and four 5/16” holes, depending on the size of the kiln. Too many holes can cause slower firings and a lower maximum temperature. In addition, the vent system ductwork could get too hot, and potentially melt, if there are too many holes. The Bypass Collection box (included with the Vent-Sure vent system) allows to adjust the amount of air being sucked from the kiln. Basically you want it to just vent the fumes.You may need to turn the vent off near the end of the firing especially if you are having a hard time reaching final set point.

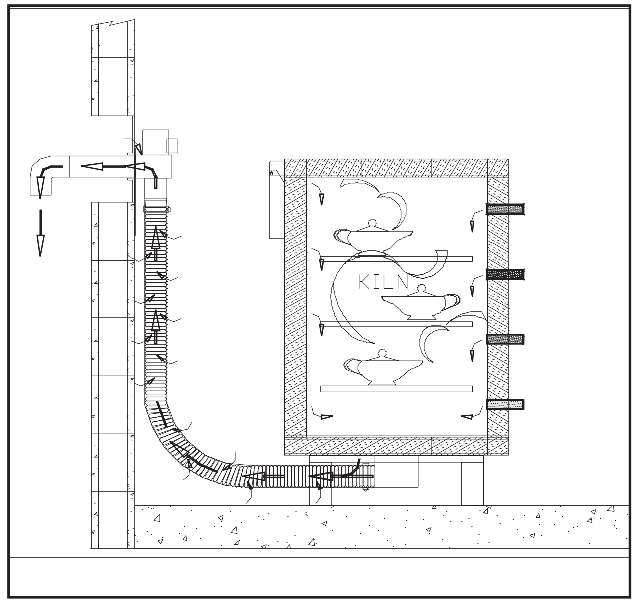
One thing to keep in mind about venting at high temperatures is that you are actually venting less air the higher in temperature the kiln goes. This is because the air in the kiln expands with temperature so less molecules of air (which hold the heat) are being removed from the kiln the hotter the kiln gets.

Keep in mind that even the best vent systems cannot handle lots of smoke from newspaper or a lot of wax resist, and still let the kiln reach its highest temperature. To be sure you have not created an unsafe situation, you should check the temperature of the flexible ductwork while the kiln is at its maximum temperature. Most flexible aluminum ductwork is rated for at least 350°F, so if it is hotter than the rating you must plug up at least one hole. High Temperature Cement (available from L&L) works well for this. Kao-wool and other high temperature fiber products can work too. However, the fibers may get stuck in the fan motor, and potentially burn it out.

Other residue, particularly wax resist, can build up on the fan motor and the inside of the ductwork. A periodic cleaning will help. CAUTION:Be careful if you are doing wax resist. The wax will condense on the inside of the aluminum ductwork and this could be dangerously flammable. Check this periodically if you are doing this.

It is not necessary to put air-intake holes in the lid on sectional L&L kilns, although you can if you prefer. If the kiln is not sectional, or fits together extraordinarily well, you will want to drill air intake holes in the lid. The number and size of these holes should never exceed the number and size of the air exhaust holes.

A schematic drawing showing the Vent-Sure:



THE CONTROL

There are two basic types of control systems on L&L kilns.

MANUAL CONTROL

One is a “manual”control. The “manual” control refers to the siwtches which need to be adjusted during the firing. Even in a “manual” kiln the actual shut-off device is a simple automatic pyrometric device (the Dawson Kiln Sitter-timer). The manual control system consists of the switch box with either Hi-Med-Low switches or infinite type switches, one for each zone of the kiln, the Dawson Kiln-sitter, and possibly branch fuses and contactors (in larger kilns).

AUTOMATIC CONTROL

An “automatic” kiln consists of the switch box, an electronic temperature control, thermocouples, contactors and branch fuses in larger kilns. The electronic temperature control both automatically turns up the heat based on a program and shuts off the kiln when it reaches the correct final temperature. The thermocouples measure the temperature in the kiln.

SERVICEABILITY

L&L has designed their controls to be as far from the heat as possible, easy to repair on site and simple to remove and return to the factory if factory service is required or preferred.

SAFETY WARNING

In the United States and Canada, most electric kilns use high-voltage electricity, either 208 or 240 volts. Some small ones (such as our Doll-Baby kilns) use just 120 volts. Most non-US voltage supplies are either 220 single phase or 380 three phase. Kilns need a lot of power to run and being around that much electricity can be dangerous. Always physically disconnect what you are working on from the power supply. If it is not possible to disconnect physically, be sure to turn off the power supply and take a voltage reading to ensure there is no power on. Ideally you would be able to see the power disconnect closest to you and monitor it to make sure no one turns it on while you are working. Lock-out-tag-out padlock type devices are available if you cannot see the power disconnect. (This is required for commercial, industrial and institutional users). These allow you to lock a power supply while you are working on the kiln. Once the kiln is unplugged, all the parts are safe to handle, provided they are not too hot. See *cautions.pdf* in the CAUTIONS Section.

GENERAL INFORMATION

See *troubleshoot-electricity.pdf* in the TROUBLESHOOTING section for a good simple explanation of how electricity works in a kiln.

Making visual comparisons between circuits in the control or between sides of the same circuit will often point to the problem.

Electricity travels in a circle, hence the word “circuit”. It is easiest to visualize your kiln circuitry in terms of a circle. Electricity always chooses the easiest path, as well. It always tries to go to “ground” before anything else, but if this is not possible, it will flow into your circuit as soon as you turn the circuit breaker on. Think of the kiln elements as part of the “circle”. They are termed the (electrical) load. Everything else in the control box just provides the route for the electricity to travel on; this is termed the (electrical) line. Like a wall receptacle in a house, the electricity just sits at the edge of your circuit breaker until you turn it on. As soon as you turn it on, the electricity will rush into the kiln circuitry, stopping at a turned-off switch, or a turned-off kiln-sitter; once you turn the switch or kiln-sitter on, then the electricity goes further, until it hits the elements. The nature of the material that the elements are made of provides a consistent amount of resistance per unit of measurement, depending on the thickness of the wire gauge and length of element wire. Good element design is complicated by the need to balance coil diameter, wire diameter, total resistance needed, stretch ratio, watt density and other variables to create an optimal design. Basically, however, the resistance provides the heat, the special alloy withstands the high temperatures, and the engineering of the kiln can maximize these and other variables by providing the correct ingredients to create the whole system.

REPLACING WIRE TERMINALS

When you replace any electrical component there will be wires with terminals on each end connecting the component to the circuit. If you just replace a component such as the switch, and not the terminals that attach the wires to the switch, your new switch may not last very long. Replacing both the "male" and the "female" parts of any electrical connection is the best way to repair it. For this you will need a good wire crimper. Do not use pliers except in an emergency repair. You must have total contact between the wire and the terminal or you will create a resistance which will heat up the terminal, wire and component and cause an eventual failure.

MANUAL KILN SWITCHBOX

L&L sectional kilns make visualizing kiln circuitry easy. K, J, JD and DaVinci models -- as well as most kilns on the market -- are all just parallel branch circuits stacked on top of each other. There is one power source coming in and it branches out into two to six (or more) branch circuits in L&L kilns. Each branch circuit has two or three elements in it and these are wired in parallel or in series. “Current proportioning” can change the element configuration from series to parallel to achieve low, medium, and high. . They were used on the old K models and other old models, and on some newer manual kilns. Manual Davinci, Doll and Jupiter kilns, and the older Econo J kilns use “time proportioning switches” (also called Infinite or INF switches). These time proportioning switches sometimes (in smaller J Series kilns up to 15 amps per circuit) control power directly. On higher amperage models, like the J236, J245, J2900 Series and the DaVinci kilns, the switches control power contactors. These switches give the operator more control, as one may set them for low, medium or high and anything in-between. They also allow the resistance of a branch circuit to be measured easily (to diagnose element problems). There is no different resistance at low, medium or high like there is with a current proportioning switch. It will be the same reading regardless of what the switch is set for (except Off), depending, of course, on where you are reading the resistance from. (Note: our use of the phrase “current proportioning” here refers to fact that the actual wattage of the whole element circuit is changed by the switch; it does not imply the use of an industrial device known as an SCR which incrementally changes the current in a circuit).

DIAGNOSE A SLOW-FIRING MANUALLY CONTROLLED KILN & GENERAL TACTICS

Manually controlled L&Ls without electronic controllers are set up for easy measurement of resistance and voltage. Most other manually controlled kilns are set up in a similar fashion. The following steps will outline the process of diagnosing one of these kilns with, say, a slow-heating problem.

#1) Look for the nameplate data

Every kiln should have a nameplate containing model number, voltage, phase and amperage needed, as well as the watts that it will produce. This is the key and is often the only information you may have on how much power to make available when hooking the kiln up, and how the kiln should act. Plug the Amps and Volts labeled here into Ohms Law to see what the resistance for the whole kiln should be. There is a photograph of a typical nameplate later in this troubleshooting guide.

If the nameplate is missing you can call or email the factory to try and figure out what model it is. Measure the inside dimensions of the kiln, take whatever resistance readings you can, let us know whether it has Hi-Med-Low switches on infinite type switches and describe anything else you can about the kiln. A digital picture emailed to us can be very helpful.

#2) Measure the total resistance of the kiln

Always unplug the kiln or turn off the power if you cannot unplug it when measuring resistance in these circuits. Now turn all switches to high, and turn the kiln-sitter on. Measure the ohms from the prongs on the main powercord -- from the two 'hot” blades, not from the ground or neutral. The reading should match within about 9% of what you calculated it should be from the nameplate data.

A) If there is no reading, or a reading that makes no sense like .031 ohms or any reading that has KOhms (Kor MOhms after it then;

1) The meter is not set to the correct setting or is low on batteries. Change the batteries and set it for either “auto-range”, or 0-200 Ohms , or a similar setting.

2) Kilnsitter or switches are not ON (turn infinite switches to 100% on)

3) Kiln is equipped with an automatic control or there are contactors with open contacts between your measurement point and the elements.

4) There is a short to ground somewhere. Part of the circuit is in contact with ground.

5) All the elements have failed.

6) There is a break in the powercord, kiln-sitter connections or in the main power line somewhere before the point where the branch circuits begin.

7) There is a chance that different or the same components in the branch circuits could all fail at the same time. Although the chances of this happening are pretty slim, it should be considered if none of these

other factors are applicable.

B) If there is a reading, it should be within 9% of what you mathematically determined from the nameplate label. If it is not, the reading will almost always be higher than what you calculated. Only if the wrong elements were installed in the kiln - or if the elements are so old that they are squashed into each corner all the way around the kiln (old elements expand in size) - can the resistance be lower than what the nameplate calculations would indicate. Low resistance is very bad because it means more electricity is being pulled in through your components than they were designed to handle. Look for overheated connection points if this situation continues for any length of time and replace elements immediately. With a high resistance reading, you want to see how much higher it is and what the relationship between the calculated resistance and the actual resistance really means.

1) If the reading is just a bit more than 9% over the calculated resistance, the elements are probably all still connected but are badly oxidized. Check the actual voltage from where the kiln was plugged in or connected to power. Divide the resistance you have measured into that number and compare the result to the amperage on the nameplate. It will be lower. Problems can also arise if the actual voltage is considerably different than the nameplate voltage. A 240 volt kiln running on 208 volts will have about 25% less power. A 208 volt kiln running on 240 volts will burn up the elements and the switches quickly.

2) More testing is needed if the readings are considerably higher.

3) The meter is properly set but there is a considerably high ohms reading at the powercord.

C) Double check your math. Be sure that your calculated resistance for the whole kiln is a result of the nameplate voltage divided by the nameplate amperage.

D) Know the kiln's history. Were the elements just replaced? If so, check the rewiring. You will need a wiring diagram for the kiln and a switch schematic if it is a four position switch (Low, Medium, High, Off). There is also a chance that the wrong elements were installed.

#3) Measure the resistance of each branch circuit

Turn the switches OFF. The switches must be off or else the meter will read all the branch circuits at once. What this does is reads the resistance of just the elements in each circuit, not the entire kiln. On a many L&L kilns there are plug and receptacle connections between the elements and the switches or contactors. Measure branch circuit resistance with the kiln power OFF from the two flat prongs (not the ground) of the plug-heads of each kiln section. On other kilns you want to determine how many elements are in each circuit and how the elements in each circuit connect together and to each circuit's power wires. Take the branch circuit resistance reading at the point where the power wires connect to the element(s).

#4) Determine Series or Parallel

Look to see if the elements are wired in series or in parallel with each other. Even in L&L's latest kilns you would still have to either take the element box off or look at the kiln's wiring diagram to determine this. See *troubleshoot-element.pdf* in the TROUBLESHOOTING Section.

#5) Check individual element resistance

Try to get a single element's resistance reading by either calculating it if they are in parallel or by measuring it with the meter if they are in series. You may need to disconnect wires to isolate as much as possible each element. Keep in mind that on some kilns, like our B Series kiln and many other kilns currently on the market, elements can be graded from top to bottom and may have different resistances.

#6) Take a voltage reading in each branch circuit

Do this either at the element connection to the power wires or at the control box receptacles on later L&Ls.

A) Usually a kiln with 240, 220, or 208 volts supplied to it will still have 240, 220, or 208 volts at the elements. Sometimes, though, the "240" volts will be split using a Neutral line (this comes in with the main power line in K18, and K18R kilns only. Some other kiln companies make use of this as well. Usually they would be labeled "220/110 VAC"). This happens right at the point where the branch circuits begin. By using the Neutral line, the "220" volts are split into two 110 volt circuits. When plugging each branch circuit resistance into Ohms Law you must calculate using the actual voltage in the branch circuit, not just what the nameplate says.

B) Another reason to test the branch circuit voltage is that corroded element connections (and corroded connection points in general) will cause a slight - or not so slight - voltage loss, in the form of heat. The voltage can drop considerably as it goes through the control to the elements if there are too many corroded connection points. Measure the voltage at the main power supply. Then measure it at the element connections to the power wires. If there is a considerable voltage drop then you have a corrosion or connection problem. Kilns in general corrode easily, even the "stainless steel". Heating and cooling, baking off moisture, and all sorts of fumes and particle matter combine to create a corrosive environment. Using a down-drafting vent system combats this. Badly corroded connections need to be replaced immediately. Both parts of a connection should be replaced at the same time. It is possible to "clean up a connection" by using an emery board or a gentle file to remove corrosion. But once corrosion starts, it generates heat, which in turn generates further corrosion, and more heat, etc, - this vicious cycle will continue until you smell something awful, trip your breaker, or possibly start a fire. In particular check your plug and receptacle connections, especially the main powercord and receptacle.

#7) Add it all up

Note and compare what the whole kiln's resistance is, what the branch circuits' resistance is, what an individual element's resistance is, and whether the branch circuits' elements are wired in series or parallel. If the branch circuit voltage is different from the whole kiln's voltage supply (220/110), then it will be easier to compare the numbers of each branch circuit individually like you would for the whole kiln if the voltage was the same all the way through. Draw and label a picture of the wiring and the elements. Check yourself using the different formulas in Ohms Law.

#8) By now you have determined if the elements are the problem or if the components or connections are the problem.

A) If this kiln had a calculated resistance of, say, 7 ohms, and an actual resistance of 8 ohms, you have determined that you need elements if none are broken and no circuits are out. The ohms are a bit more than 9% over the calculated resistance and this correlates with the problem (slow kiln), considering the fact that no circuits or elements are out. Ideally you should replace all the elements; at least replace those with readings that are too high. If you do not replace them all at once, the kiln may heat unevenly. (However, with the zoned design twith ungraded elements his is much less of a problem than with kilns that have graded elements).

B) If this kiln had a calculated resistance of, say, 7 ohms, and an actual resistance of 15 ohms, you would have to assume that either the elements are really far gone or a circuit is out. When going through the steps above you will establish (for the sake of this example) that this kiln has three equal parallel branch circuits and each branch circuit contains two elements wired in series. With a calculated resistance of 7 ohms and the knowledge that the kiln is made up of three equal parallel branch circuits, you know that each branch circuit's resistance should be 21 ohms. Because your actual resistance reading is 15 ohms, you should be able to see that the relationship between one branch circuit and 21 ohms, and three parallel branch circuits and 7 ohms (21/3=7), would point you to the fact that 15 ohms is about what only two branch circuits would measure; hence, one is probably not working. The extra ohm is here because nothing ever comes together that perfectly. The other elements are probably aged also, or the small percentage of error inherent in even the most precise measurements can be blamed for this extra ohm.

#9) What if the element ohms are OK?

Lets say it turns out the element ohm readings taken at the elements come up fine. However, the whole kiln resistance is 15 ohms, not 7 ohms, as it should be. The problem must be in a branch circuit because the kiln will work partially, so we know the main power wire is not the source of the problem. The element ohms are all OK, so the problem must lie somewhere between the two. To determine why a branch circuit is not working:

A) With the kiln on, run a voltage test on the receptacles or at the connections to the elements in each branch circuit to see which it is the bad one.

B) Making sure the power is off, open the control panel and visually inspect the branch circuits. Check branch fuses if the kiln has them.

C) Locate the two wires that begin the bad branch circuit from the bunch that come from L1 and L2 on the main powerblock.

D) Follow those wires to where they connect to the first component in line, probably either a fuse block, a relay or a switch.

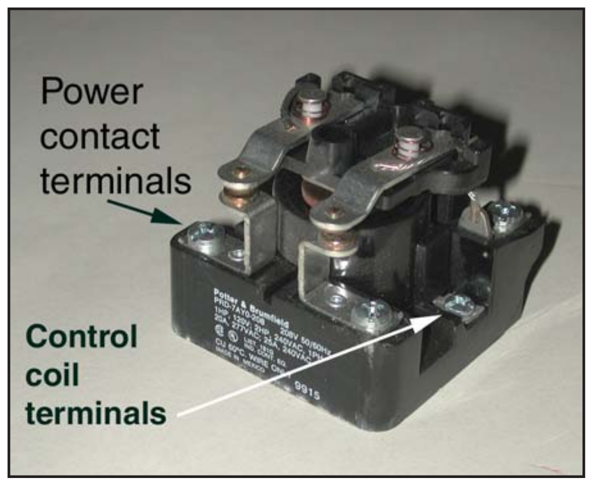
E) With the power ON, and any kiln-sitters or switches on High (so that the elements would come on if they could), take a voltage reading at the point where these two wires connect to the first component in line. The reading normally should be the same as what it is at the main powerblock. If it is not, one of the wires between the main powerblock and the first component is bad. Replace it.

F) If there is voltage there then take another reading after the first component at the point where the two wires continue onto the next component or to the element connection. If there is voltage after the component then the component is working.

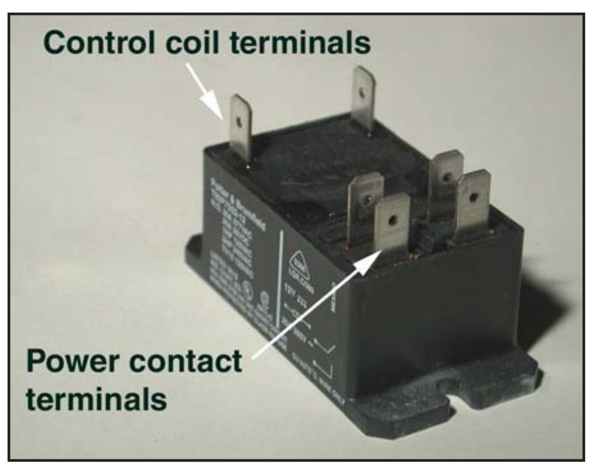
1) Note: Low/ Medium/ High switches in some L&Ls and in other kilns have three wires running from them to the element connections. With these switches on High, take your voltage reading at any two of the three connections. Take all three readings, though. (for example: the two left connections, the two right connections, and the two outside connections).

2) Note: If the component is a relay or a contactor, the switch controlling it would have to be on High for voltage to be able to be read after this component. There are contactors connected by infinite switches in all L&L manual kilns with sections that draw more than 15 amps. L&L's infinite switches can only handle up to 15 amps, so contactors must be used for larger loads. If you cannot read the voltage after a contactor even if the switch controlling it is on High and there is voltage before the contactor, the problem could be either the switch or the contactor. The contactors L&L uses contain what is essentially an electromagnet, called a coil. The coil in the contactor completes the circuit that is being controlled by the switch. When the coil is activated by turning on the switch, it creates a magnetic field which pulls the contacts together in the contactor, allowing electricity to pass through to the elements. This allows the higher-rated contactor to handle the power to run the elements, while the lower-rated switch just handles the very minor amount of power necessary to energize the coils of the contactors.

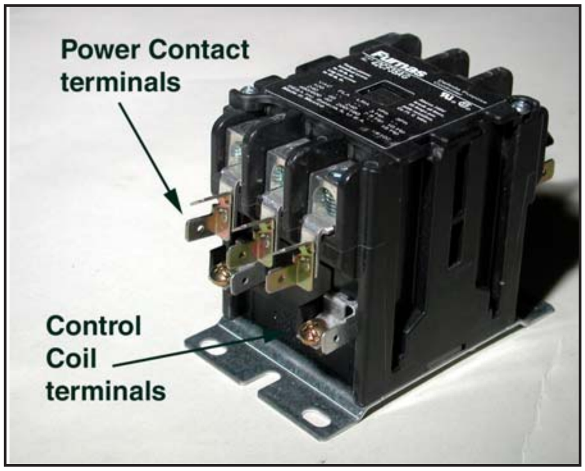
Picture of a PRD-7AYO relay used on most J Series manual kilns that require contactors.



Picture of an enclosed 25 amp relay that we currently use on most Jupiter automatic kilns and some manual kilns.



Picture of a 50 amp contactor used on DaVinci kilns.



a) To determine whether the contactor or the switch is bad, first follow the wires from the load side of the switch to the contactor.

b) With the power all on and the switch on high, take a voltage reading where the two wires from the switch to the contactor connect to the contactor. Normally there will be the same voltage before the switch (on the switch's line side, or at the main powerblock) as at the test point. If these voltage readings are the same, then the contactor is bad.

c) If there is no voltage present, then follow those two wires back up to the load side of the switch and measure the voltage there. If the voltage reading is the same, then one of the wires is bad.

d) If there is no voltage present at the load side of the switch (power all on, switch on high), then be sure voltage is coming to the switch; if it is, then the switch is bad. Replace the switch and if the problem still persists then repeat the test; you will most likely have to replace the contactor as well.

e) If there is no voltage after the first component in line and it is not a relay/contactor, then just replace it. If it is a fuse holder, just replace the fuse (usually a bad fuse means there is a short somewhere in the circuit). Use a “continuity” tester to test for bad fuses. Always check tightness of connections in a questionable circuit.

f) If there is voltage after the first component then move along the circuit from the main powerblock towards the element connections, testing for voltage before and after every component until you isolate the problem. Do not bother taking voltage readings at the element connections anywhere other than where the power wires connect to the elements. Voltage readings taken from between the elements (and from between resistors in general) give a reading that reflects voltage which is half the supply voltage with two elements in series, and either one-third or two-thirds the supply voltage with three elements in series (depending on which side of the middle element in the series the test lead is placed).

MANUAL DAWSON KILN SITTER

See the Dawson Kiln Sitter Instruction Manual in the CONTROL section of your Instruction Manual.

BASICS

L&L has used the W.P. Dawson company's kiln-sitters and sitter/timers for many years. A “kiln-sitter” is a device that incorporates spring-loaded electrical contacts coupled with a mechanical start-up and shut-off assembly. This assembly uses a long ceramic tube that extends through the wall of your kiln and protrudes about 1-1/2” into the firing chamber. A small pyrometric cone or bar is placed in the mechanism at the end of this tube in the kiln. When the pyrometric cone melts enough to bend, the mechanism moves and sets off a spring-loaded lever whose movement allows the contacts to pop apart, cutting power to either the kiln or the branch circuits' contactor coils. Timer models incorporate a timer into this assembly. The timer uses a fixed stop to essentially push the spring-loaded lever (see "How the Kiln-Sitter/Timer Works" in this manual for more information and see also the Dawson instruction manuals). Dawson models such as the model P and K have no timers and are still available from L&L. We use the model P on the automatic kilns as an optional back up safety device. The LT-3 and the LT-3K have timers in addition to the shut-off mechanism; they are now used on all L&L manually controlled kilns. The P and the K are essentially the same except the P is housed in its own metal box. The LT-3 has a 240 volt AC timer motor and the metal box to house it, and the LT-3K has a 120 volt AC timer motor and no metal box (this is the one we use in the Doll-Baby kilns). Both the K and the LT-3K were designed to be attached directly into an existing control panel, while the P and the LT-3 mount in their own box and are connected electrically to the switch box or other control. Any of these four models can be housed in the metal box or attached directly to an existing box.

The kiln-sitters are used either as a safety backup or as the primary turn-off control.
Many people who are using manual kilns will want to pay great attention to the end of the firing. These people will be adjusting switches throughout the firing to even out the heat top to bottom, and will have self-supporting cones that can be seen through the peepholes to know at the end of the firing that all the sections are even in temperature. The kiln-sitter will turn off the kiln once its cone has melted, with no regard to the temperature in the rest of the kiln. What this means is that there is the potential for the ware in the bottom of the kiln to be under-fired if the kiln-sitter is in the top of the kiln, or over-fired if the kiln-sitter is in the bottom of the kiln. You will also be able to turn off the entire kiln yourself when you see the target cone slump over. In this scenario, you would have the kiln-sitter cone be one or two cones higher than the cone you are firing to. Of course, if you are not very fussy about the final result you can have the kiln sitter do the shut off automatically. Just be sure to be near the kiln when it is supposed to stop. Kiln Sitters are not fool-proof devices! REMEMBER: They need periodic cleaning and adjustment.

Safety Note: Unplug/ disconnect the kiln from power if you are working with it!

How the Kiln-Sitter/Timer works

A) The timer

A) The timer is a limit timer, counting down the hours you set it for until it reaches zero, at which point it turns off the kiln regardless of what is happening with the cone device. This part of the device is usually thought of as a back-up for the shut-off part. (Note: some people do not like this feature and disable it by removing the wires that power the timer motor)

B) The shut-off mechanism

This is a bit more complicated. There is a set of contacts similar to those in a power contactor except there is no electro-magnetic coil to be energized. There is a spring-loaded button with a slot cut around it on the outside of the kiln-sitter that, when pressed, pushes the electrical contacts together. This allows electricity to pass through to the elements. There is a spring-loaded, sliding, flat piece of metal that is forced into the button's slot once it is pressed in, which keeps the button from popping back out.

There is a hinged weight hanging off of the front, directly over the button. When the weight hangs all the way down, the button will not stay in when pressed because a small piece of the weight is now holding the flat piece of metal out of the buttons' slot. When you raise the weight, the button will stay in if pressed. If you raise the weight all the way up you will find it will not stay up on its own. There is a small claw-like piece at the end of a long rod which sits directly above the weight when it is in the up position. This is called the "claw" and the rod is called the "sensing rod". The sensing rod moves easily up and down and raises the claw up and down with it. When the weight is all the way up, the claw can be lowered to trap the weight under its edge; this keeps the weight up and allows the button to stay in.

CAUTION: You should not press the button in until you are ready to fire the kiln. Setting the kiln-sitter requires you to have your hands inside the kiln. If the power is on, there is a risk of electrocution with the kiln-sitter button pressed in.

CAUTION: If the power is on and there is a "fused contactor" (a condition in which a contactor has essentially failed by welding its contacts together in the intense heat of electrical arcing between dirty contacts), some or all of the elements will be on even if the kiln-sitter and all the switches are off. So be sure the power is turned off at the main disconnect or circuit breaker.

Now the weight is up, you are holding the claw down to keep the weight up, the button is out and the power is off.

There is a ceramic tube going from the back of the kiln-sitter through the wall of the kiln, ending with an oval-shaped hole, the other end of the sensing rod and two angled, flat pieces of metal called “cone supports”. In order to use this kiln-sitter, a small pyrometric cone or pyrometric bar must be slid in place here. The cone lays flat across the tops of the cone supports. The sensing rod rests in the middle, on top of the cone. When the cone is in place the weight should still be up, trapped behind the claw. The cone will melt and bend at a specific temperature (actually after a specific amount of what is known as heat-work) and there are different cones for different temperatures or different amounts of heat-work. As the cone begins to melt, the sensing rod resting on top of the cone begins to force its way down, slowly bending the cone. As the sensing rod moves down on the inside of the kiln, it is slowly moving up on the outside. The claw attached to the outside end of the sensing rod moves up and eventually the weight is freed. It falls if the kiln is level and the device is operating properly (dirt or corrosion can impinge on proper operation). In falling, it knocks the spring-loaded metal plate out of the button's slot, allowing the button to pop out, which turns off the kiln. If this does not work, the timer will run down, and the timer motor will push the spring-loaded metal plate out of the button’s slot, thus turning off the kiln.

With all this cause and effect there are many ways this device could not work properly. With a maintenance schedule, though, it can work well for years. The user’s manual from Dawson is excellent for maintenance and troubleshooting. Usually, the biggest problem we see is either the button not staying in or the kiln-sitter not turning off the kiln.

Potential Problems with the Dawson

A) If the button will not stay in, the weight is up, and the kiln-sitter is relatively new, there is probably a wire pressed against the spring-loaded, flat metal piece; this keeps the piece from sliding into the button's slot. Or maybe the spring has come out of its tiny hole in the flat piece of metal. If the flat piece is older, corrosion may also keep it from sliding.

B) If the kiln-sitter does not shut off the kiln but the timer does, then usually either the wrong cone was used, the weight or the claw are out of adjustment, or the kiln is not level and the weight cannot fall once it is released.

C) If neither the kiln-sitter nor the timer shut off the kiln then either the corrosion inside is so bad that nothing moves easily, or the contacts behind the button are fused together. This can be fixed with a wire brush and some lubricant or with a new contact block, but it may be time to replace the whole Dawson kiln sitter or, at the very least, the tube assembly.

D) The tube assembly can get filled with condensed glaze residue or other debre. It may be possible to clean it out but most likely you will need to replace it.

E) The actuator rod can become so corroded that it does not work properly. This will typically require a change in the tube assembly.

FOR MORE INFORMATION

The Dawson instruction manuals have very good diagrams that are important to have.

dawson-LT3.pdf
dawson-pk.pdf

AUTOMATIC CONTROL BOX

General Information

The similarities between the automatic controls and the manual controls are most easily seen in the power circuits. Just like in a large manually-controlled kiln with contactors controlled by switches, all the automatic kilns contain contactors which are controlled by the automatic controller. Early controls just had one output which turned all the contactors (as well as the elements) on and off together. Later controls (used after September 1998) typically have 3 inputs and outputs, which allows each contactor, and the element circuit connected to it, to be turned on and off individually as needed, based on the the various inputs. (See *dynatrol-instruct-blue.pdf* in the CONTROL section of your Instruction Manual for more information on the DynaTrol).

DaVinci Control Panel. This shows branch fusing.

The control knows when to turn the contactors on and off because of the signals it receives from the inputs. The inputs are the thermocouples (TCs), also known as the temperature sensors. In early controls only one TC was used. The micro-processor (the brain) in the control compared the TC reading to the map of the programmed firing it was following and decided whether to activate the output to turn on all the elements or not. The later versions of these controls, like our DynaTrol, have three of these thermocouples inputs. Each is connected to its own part of the processor and has its own separate output.

The thermocouples are meant to be positioned in the wall of the kiln near the middle of the zone whose temperature they are reading; the tips should be about 1” to 1-1/2” in. A zone is the area in a kiln controlled by just one of the controllers outputs. For example, a model JD230 has three zones, each controlled by one of the three main outputs. In its control panel there are three branch circuits, each containing a contactor. Branch circuit number one's contactor is controlled by output number one from the DynaTrol controller. Output number one comes on or off depending on readings from thermocouple number one (input number 1), which is located in the top (#1) section of the kiln. The electricity in branch circuit number one feeds the elements in the top section (number one zone). Number two zone is the middle section and number three zone is the bottom section; each is individually controlled by their respective contactors and thermocouples. Essentially, each zone is like its own kiln, with its own temperature sensor and power supply. When stacked on top of each other the zones operate independently, yet they all follow the same path and more or less do the same thing by comparing the actual temperature in each zone to what is on the program map and then either leaving the elements on or turning them off accordingly.The DynaTrol computer-controlled kilns use calculations to determine some functions. These calculations are performed in the micro-processor with data fed from: A) your choices in programming; B) the thermo-couples; C) the internal clock. The various calculations performed throughout the firing result in the complex firing programs, uniformity and the consistent automatic shut-off or controlled cooldown.

A) Your choices in programming fill in the blanks on the map of the firing (i.e. how fast the kiln will climb in temperature and to what temperature, if there is a hold, a preheat, a delay, etc). The Easy Fire programs have most of these settings pre-programmed. The Vary Fire programs can be completely programmed and altered as you wish.

B) The thermocouples measure the temperature in the kiln by emitting a specific linear millivolt signal for each degree of temperature. The microprocessor equates this milivolt signal to a specific temperature in °F or °C. The location of each thermocouple is important because the signal emitted will reflect the temperature in that part of the kiln. The DynaTrol takes these signals (typically one from the top zone in the kiln, one from the middle zone, and one from the bottom zone) and compares each in turn to the “process variable” or “setpoint”. This is the temper-ature that the kiln is supposed to be at any particular point in the firing program. This “point in time” is constantly being modified as time passes. Based on where the firing map says the kiln should be, the appropriate corresponding outputs to the TC inputs are activated. In other words, when each TC reading is compared to the firing map, a decision is made by the micro-processor to either turn on the elements in that particular thermocouple's section, or to turn them off. In this way, the kiln temperature closely follows the programmed rises, holds and ramp-downs.

C) The internal clock is really never seen except when the control is counting down hours and minutes during a hold time, a preheat or a delayed start. However, its information is used in nearly every calculation.

D) The Orton Firing Institute has devised and patented a way to calculate a final temperature for a firing, based on the relationship between how many degrees the kiln is climbing per hour, and what temperature is presently in the kiln. This calculated final set point temperature is the temperature at which the pyrometric cone that the firing has been programmed to go to will melt, given that specific rate of climb and current temperature. Near the end of firing, the DynaTrol slows the kiln's rate of climb down proportionally in order to avoid an overshoot. This means that the calculated final temperature is constantly being adjusted at the end of the firing to account for the slowing down of the kiln. This is only used in the “Easy-Fire” mode. It is an elegant way for the control to measure heat-work that is so important for ceramic firing and consistently and accurately fire correctly even given different loading conditions and the changing character of the kiln itself.

Needless to say, these controllers are more complicated than the older infinite or Hi-Medium-Low switches. In order to properly control the kiln, they also need a lot of self-diagnostics. If a thermocouple is burned out there needs to be a way to alert the user. If the kiln is climbing so slowly that the calculations reach an impossible scenario, there must also be a way to alert the user. All the error codes are explained in Appendix G of the DynaTrol Instructions (*dynatrol-instruct-blue.pdf*). They all refer to a specific situation, but the reasons that the situation exists is often due to more than one different cause.

E) Calibrating the control: See the section on calibrating the control in *basic-dynatrol.pdf* in the OPERATION section of your Instruction Manual. There is a good explanation of the thermocouple offsets and how to change them.

This is a handheld DynaTrol control - standard on the DaVinci automatic kilns. Normally the DynaTrol is directly mounted in the control box of a Jupiter kiln. This handheld box plugs into a special receptical mounted on the top of the DaVinci control box or on the front of the special optional Jupiter control box. There is a6 foot cable and typically it is hung on a hook on the wall.

Diagnosing Error Messages

Error codes can appear at any time during the firing. They always refer to a problem that, if allowed to continue, could end with unknown or even disastrous results. **Errd, Err1, ErrP** and the **FAIL** message seem to make the most frequent appearances. Errd means there is a temperature difference of more than 100 degrees between the zones. **Err1** indicates that the kiln is climbing too slowly in an Easy-Fire program to calculate what the final temperature should be, based on what cone you have programmed it to fire to. **ErrP** indicates that there was either a very quick power outage (**ErrP** will flash along with the temperature and the kiln will still be heating), or there was a longer power outage (**ErrP** will be the only thing in the display and the kiln will not be heating). **FAIL** refers to a specific thermocouple failure. It will appear after displaying a “**tC**” (thermocouple) number 1, 2 or 3.

Can you restart the kiln?

You can try to restart the kiln after getting an error code. Some messages, like flashing **ErrP** and **FAIL**, will not necessarily turn off the kiln. Depending on the problem though, re-starting it may or may not let it finish the firing, or even start up again. An Errd will usually not re-start easily because the temperature top to bottom is drastically different. An **Err1** at the end of the firing will re-start but will probably re-occur in about 22 minutes. A **FAIL** message will not go away even if the problem is fixed during the firing. The kiln can still be firing with the **FAIL** message flashing along with the number of the TC that failed. Stopping and then re-starting the kiln after fixing the problem with the TC circuit is the only way to erase the **FAIL** message. **ErrP** flashing with the temperature means that the kiln is still firing, after just a short power outage or interference. Just press any number to clear the **ErrP**. An **ErrP** which is not flashing must be re-started.

Worst Case Scenario for Restarting After an Error Code

Keep in mind that you run the risk of over-firing if you re-start while the kiln is very close to the final temperature. A pyrometric cone melts with the proper combination of time and temperature. Add more time and you don't need as high a temperature, go to a higher temperature and you don't need as much time. When an error code shuts down the kiln near your final temperature (within about 50 degrees) and you do not know exactly how long it has been cooling, or what temperature it reached before the error code appeared, you run the risk of having too much unaccounted for time in your time-temperature equation. The DynaTrol calculates this equation automatically after determining how many degrees per hour the kiln is climbing (time) and to what temperature it is climbing to (temperature). However, it cannot do this accurately after a high temperature re-start.

If you have cones in the kiln that you can see through the peepholes, then use these after you re-start and turn off the kiln manually when the target cone bends over.

If you do not have cones visible then you can gamble and estimate a final temperature based on how many degrees per hour the kiln has risen, including the time it was off.

For example, you come in and the control says tC 2, 2200 (degrees F) and everything seems fine in your slow glaze to cone 6 firing. But twenty-five minutes later you come back and see Err1.

The first thing you want to do is press #1 to clear the error code. Look for tC 2's temperature and write it down. It might be 2175. You have no cones in the kiln but you really need these pieces fired.

Wait a few seconds until you see "**IdLE, tC 2, 2175**". Press Start to re-start the program and note the time on your watch. Note the 25 minutes the kiln was "holding" from the last time you saw it at 2200°F until this time, where it says **2175**. It must have continued to climb somewhat, but because the **Err1** will appear after 22.5 minutes of holding when the kiln is programmed to be climbing, it probably never got over 2210°F. So the kiln has held at an average of about 2195°F for about 25 minutes, instead of continuing on to 2232°F (cone 6) to finish the firing.

The relationship between time and temperature allows you to estimate how much hold time to add to get the same amount of heat work as the kiln would have achieved by climbing to 2232°F. Assuming a 108°F per hour temperature rise, a good rule of thumb is to add about a 20 minute hold to the maximum temperature; this will allow you to lower the final temperature by about 20°F. An hour hold time would mean a final temperature of about 40°F lower. A two hour hold time would be about 60°F lower. (This same information and more about time and temperature is in the section on pyrometric cones)

In this example, the kiln has already held at about 35 degrees lower than the final temperature for 25 minutes. It would need another 25 minutes of holding to give the ware the same amount of heat work that 2232°F (cone 6) would have.

In reality, however, an **Err1** that close to the end of a firing probably means you need new elements. So re-starting the kiln will probably not enable it to climb much higher in temperature. Keeping track of the time, let it run, and when it shows **Err1** again just keep re-starting it until the firing finishes. Meanwhile call and order new elements.

Be very careful if you try this method. On loads that are very important always use cones you can see through the peepholes in case of a failure of some kind. If you have to use this method without the cones, remember that almost all your calculations are based on estimates and the results could be disastrous to your ware and/or the kiln if you are not accurate enough. The further away the temperature that the kiln is holding at is from the cone that the firing was trying to get to, the less accurate an estimated amount of time will be to achieve the amount of heat work necessary. If you can wait and re-fire from room temperature, you should. If you depend in any way on your kiln you should keep spare parts around for it. You could replace the elements easily yourself after the kiln cools and then re-load it and re-fire it to the proper cone without losing much time at all. Or consider that most glazes have an entire cone's temperature range that they can mature within. Weigh your options and decide.

In general though, Error Codes mostly appear after the kiln has been disassembled and set back up improperly, has had its power supply altered (like moving to a new studio with different voltage), or has had an element or a thermocouple burn out.

Errd

If the kiln was just re-assembled and **Errd** is the error code, then double-check that the kiln sections are plugged into their appropriate receptacles and the thermocouples are in the proper zones:

-Two section kilns: Top ring is in #1 receptacle on the control, bottom is in #2. Top ring gets TC1, bottom ring gets TC2.

-Three section kilns: Top is in #1 receptacle, middle is in #2, bottom is in #3. Top ring gets TC1, middle ring gets TC2, bottom ring gets TC3.

-Four section kilns: Top is in #1 receptacle, next section down is in #3, next is in #4, the bottom is in #5 (the cords and numbers go 1,2,3,4, but the second receptacle down on the control box is skipped; there are five circuits on the control, but only four sections. The top ring gets TC1. Either the upper-middle or the lower-middle section can have TC2 in it. The bottom ring gets TC3. All five circuit controls have the center three circuits tied into TC2. Therefore, skipping #2 receptacle with the four ring kilns would be the same as skipping the #3 or the #4 receptacle. TC1 must always be in the top section and TC 3 must always be in the bottom section. TC2 can be in either of the middle sections.

-Five section kilns: Top is in #1 receptacle, upper-middle is in #2, middle is in #3, bottom-middle is in #4, bottom is in #5 receptacle. The top ring has TC1 in it. The middle ring has TC2 in it (receptacles #2,#3,#4 go on and off together), the bottom ring has TC3 in it.

If you are sure the kiln is set up properly, nothing is out of place and none of the thermocouples are partially out of the kiln, then one of the following situations may apply:

-You were firing with the lid open and you got Errd either while the lid was open or right after you closed it. For drying with the lid open, only about two inches is needed to adequately vent off water vapor. This is plenty if all the peep holes are open. The DynaTrol will attempt to compensate for the heat loss, and it usually can. The trouble may happen when you close the lid. The elements in the top of the kiln are already much hotter than the ones nearer the bottom due to their need to compensate for the heat loss from the top. When you close the lid it can take as long as eight seconds for the DynaTrol to respond to the rise in temperature in the top of the kiln, and shut off those elements. This can quickly cause an uneven temperature in the kiln, which will usually result in **Errd** (possibly an **Err2** in a smaller kiln **-Err2** is when the entire kiln temperature is more than 50°F over the hold time's temperature for longer than 18 seconds).

-There was a lot of air being exhausted from your kiln when **Errd** appeared. If a vent system pulls too much air from just one point in the kiln, say, to down-ramp the load very quickly to a lower hold time for crystal formation, an uneven temperature can result. The firing will go slowly as it will be difficult to compensate for the heat loss; eventually, however, the

Errd (or **Err1**) can appear.

-**Errd** just appeared, the middle TC reads about 130°F lower than the other TCs. In order of most likely to least likely;

1) Something is too close to, or is touching, TC2 in the kiln. Allow almost an inch between everything for thermal expansion. Fix and re-fire the kiln.

2) A TC wire has melted against the kiln case (the yellow TC lead wire can melt and send weird signals to the DynaTrol). The wire must be replaced, which is cheap and easy to do.

3) A TC is about to fail. Perform a physical inspection if possible, or just re-start the kiln and monitor it carefully.

4) Element(s) just burned out. Perform an ohms test for more information.

5) A relay has just failed. Perform a voltage test.

6) There is a bad connection point somewhere. This will become more of a possibility as the kiln ages. Examine all points carefully for melting, corrosion, discoloration and/or bad smell.

Err1

If **Err1** is the error code on the screen when you check on the firing, then for some reason the kiln could not generate enough heat to counter the heat loss. If the kiln can get no hotter (even though all the elements appear to be on and the program is not holding), then **Err1** is what you will see. If one of the elements or one of the circuits in the control fails while the kiln is at a high enough temperature then it will probably display an **Err8** code (which means temperature is falling when it should be rising) **Err1** or **Err8** can mean either you need new elements or a new component in one of the circuits. An ohms test and a voltage test can tell you which it is. If you recently changed locations, power supplies, elements, or did any repairs, then closely examine what changed between your last successful firing and this one. There may be some other issue besides bad elements or a bad component.

-A new location can mean a 208 volt power supply rather than a 240 volt supply (about 25% less power).

-In re-wiring the power supply you may not have used thick enough copper wire (line, conduit and connection points will be very hot).

-The elements you got from some other supplier who said "these'll work fine" have too much resistance, or you did not hook them up properly (leaving the jumper wire out of a J230 section will double the resistance in that circuit and only one of the two elements will be used. Always use an ohms meter on the element and on the circuit)

-If you rewire anything improperly or incorrectly the potential for anything from a blown breaker to just no power at all is possible. (Using wire with a temperature rating of less than 150°F can seriously limit the life of the circuitry and can be dangerous as well, especially when the wires are close to the kiln. Use a wire diagram and trace every wire to check yourself). You can buy high temperature wire from L&L.

FAIL

If, upon inspection, the error code **FAIL** turns out to be a burned out TC then the solution is simple. Change the thermocouple. You should not mix unsheathed thermocouples with sheathed ones. (because their response rates are slightly different). A spare on hand is a good idea as well.

Sometimes the code **CPLt** will be displayed. This code is always displayed after a successful firing to mean “complete”. If it appears after you attempt to re-start the kiln after a **FAIL** message, or at any other time except for the end of the firing to mean “complete”, then it will have a different meaning. If **CPLt** appears randomly it means either your TC wires are burning against the kiln case or your TCs are so close to failing that they are giving a reading that is so high that the DynaTrol thinks the firing is over.

If the TCs are not bad (you just replaced them and they worked fine for at least one complete firing) but the **FAIL** message still appears, it may be that the TC wire is bad (melted or broken at a point) or the electronics have partially failed. If you are not electrically inclined then call the factory and send the entire control panel in for service. If you are electrically inclined then try the following:

GENERAL L&L KILN TROUBLESHOOTING GUIDE

A) Turn OFF the power, unplug or (if it is hardwired) turn the breaker off.

B) Open the cover of the control. On controls without hinged cover plates you want to loosen the TC clamp on the bottom or side of the control to give the TC wires inside some slack.

C) Number the TC wires inside so you will know which sets of screws they attach to. Then remove the TC wires from the TC connections on the electronic board.

D) In their place put tiny jumper wires. A paper clip cut into three “U” shaped pieces works well. Insert one “U” per TC circuit tightening the screws down as you go. You are simply completing each TC circuit without using the TC wire or the TC. Do not let the “U”s touch anything other than the TC connection points. Note: the fact that a paperclip is not the proper type of metal to use in a Type K TC circuit is not an issue for a test like this.

E) Cover (with electrical tape) the loose TC wires so they will not short anything out if they touch connection points and carefully close up the control.

F) Turn the unit on. If it still says **FAIL** then the electronic board has failed. If it reads room temperature then the TC wire or the TC has failed.

G) If it reads room temperature with these jumpers in, and you are not sure if it is the TC or the TC wire, just re-attach TC2's wire to TC3 and re-attach TC3's wire to TC2. If the **FAIL** message is still on TC2 then it is the wire, not the TC. If it says that the **FAIL** is now at TC3, then you know it is the TC, not the wire (there are many other ways to determine this as well).

There are many other trouble scenarios that are unique to computerized kilns. Understanding how the DynaTrol and other controls work will give the user some insight into why there is a problem. Two major trouble scenarios and their solutions are as follows:

No display (power) at all, even after 15 seconds.

1) Turn on any other control devices like switches to HIGH, Kiln-sitters ON, limit timers ON.

2) On SQ and some G models, and on a few custom L&Ls check the operation of the open door shut-off switch. Re-form the flexible metal trip bar if necessary.

3) Examine the electrical cord and its connection points coming to the kiln. Look for burned or melted areas and breaks or pinched sections.

4) Reset the your circuit breaker in your house, studio or factory.

5) Make sure toggle switch is ON.

6) Check the control fuse next to the toggle switch. Turn power off, push the knob in and then turn it to remove the fuse.

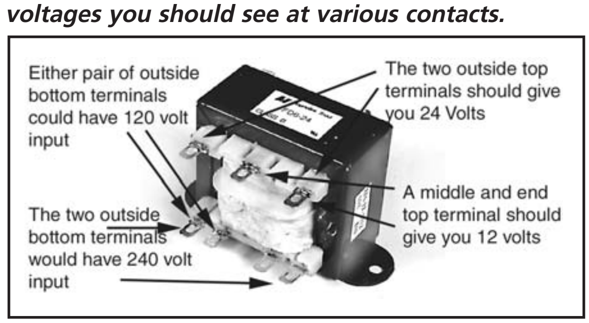
7) If none of these possibilities fixes it then there is definitely a problem. Test for voltage at the main power supply as close to the kiln as possible.

8) Unplug or disconnect the kiln from power.

9) Open the control, check for potential short circuits because the front is hanging open and then carefully apply power to the control.

10) Locate the control circuit transformer and measure the voltage at the two bottom, outside terminals for 208/240 vac kilns, and at the two bottom left, or bottom right for 110/120 vac kilns. Look for either the 208/240 power supply or the 110/120 power supply.

Picture of typical control transformer showing what voltages you should see at various contacts.



Note: If there is no voltage there, then test for it at the Power Connection Block where the power cord comes in. If there is power there then look for a bad connection or wire between the power connection block and the transformer, i.e. a bad toggle switch, wire, or ½ amp fuse holder. If power is not there then go further back on the line and measure the voltage. Keep going until you find voltage, then look for the problem between that point with the voltage and the last point checked that had no voltage.

11) There probably will be voltage at the bottom of the transformer, so test for voltage at the top two outside terminals of the transformer. On L&L THP and DynaTrol controls the voltage here should be about 21 to 25 vac (older units that used the Perfectfire control will have transformer readings of about 12 vac because they use a different type of transformer). Look for half of the 21 to 25 vac with one test lead on the top center terminal of the transformer. Test both outer terminals with the center terminal. The DynaTrol will still work with one of these two 10.5 to 12.5 vac circuits not working, but keeping an extra transformer on hand will be a good idea. Probably there will be no voltage at the top here. Usually, if everything else (including the power) is OK then the transformer is at fault. There may be a broken or loose wire that connects from the transformer windings to the connection points on the transformer. You can try to resolder it. However, it is usually easier to just replace the transformer.

11) If there is the proper voltage at the top of the transformer then follow the wires from the top of the transformer to the DynaTrol. To eliminate the wires as culprits, take another voltage reading the same way as before, just at the other end of the same wires. If there is still voltage, but still no display, then the DynaTrol board itself is bad. If the unit is still under warranty for service or replacement, then contact L&L. If the unit is older you can still have it repaired or replaced by L&L.

Seems like the kiln is under-firing or over-firing slightly

See *troubleshoot-cone.pdf* in the TROUBLESHOOTING section of your Instruction Manual.

Calibrating the DynaTrol

See the section on calibrating the control in *basic-dynatrol.pdf* in the OPERATION section of your Instruction Manual. There is a good explanation of the thermocouple offsets and how to change them.

Stalling caused by shorting of thermocouples

L&Ls JD and DaVinci computer-controlled kilns have the thermocouple(s) mounted away from the control, making them simple to replace. The downside to this arrangement is that TC wire must be used to route the signals from the TCs to the DynaTrol. These wires will melt and fail if allowed to touch the kiln case when it is hot. The result of this is that the kiln can “stall out”, say **CPLt** prematurely or display any other number of other random error codes. It may refuse to increase in temperature, and the kiln will just run on and on. If it is re-started it may work fine for a while. What happens is that the millivolt signal in the TC wire goes to ground, or the two wires in the TC wire are “electrically” connected by the stainless steel melting through the insulation and the “temperature” is then taken right there, not in the kiln. However, the signal received can be so foreign to the microprocessor that the kiln will just stall. You can cut out the bad section in the wire and crimp or solder the wires together (making sure red goes to red and yellow to yellow) as a temporary fix. Note that thermocouples close to end of their useful life can cause some of these same problems.

Prevention and education is the best way to keep this possibility to a minimum. The yellow wires come zip-tied and more can be used to keep them away from the side of the kiln. It is not recommended to tie them to the kiln powercords or any wires carrying higher voltage. The magnetic field in high voltage wires can transmit voltages into the thermocouple wires if they run parallel next to the high voltage wires. The problem will not happen as long as everyone who uses the kiln understands about the TC wires. It may be good to keep some wire on hand just in case.

Note: Sometimes excessive ambient temperatures (over 125°F) around the control can cause stalling too. Corroded connection points can also cause stalling.

PYROMETERS

Pyrometers are very useful for monitoring manually fired kilns. L&L used to sell only analog pyrometers (now we sell only digital pyrometers). An analog pyrometer has a needle and a printed scale under the needle to interpret the needle's position. Most clay and glazes will mature over at least two cone numbers and these pyrometers are at least that accurate. In time however, they loose their accuracy. They can be calibrated by using a large cone visible in the kiln. Compare the pyrometer reading when the cone melts to a cone table temperature equivalent for that cone number and adjust the calibration screw on the front of the pyrometer accordingly. We now only sell digital pyrometers now because of their superior accuracy.

Picture of an older Tru-View Pyrometer system. All new pyrometers sold are digital because of their greater accuracy.

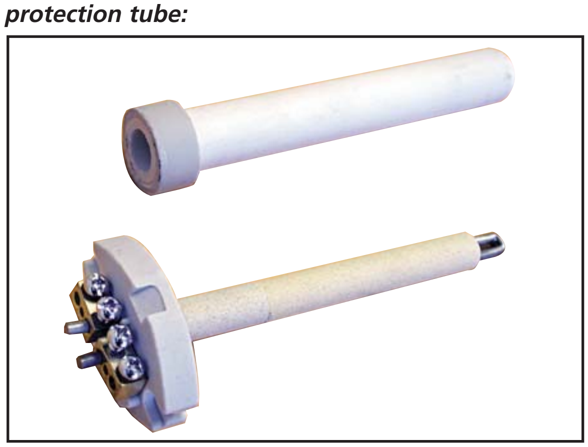
Tru-View Pyrometer System

L&L's TRU-VIEW pyrometer systems can have as many as five thermocouples connected to them. The pyrometer can only read one at a time, though, so a thermocouple selector switch is wired into the yellow side of the TC circuits. The TC selector switch that was originally used was replaced by the one currently in use. The new one is a simple 12 position switch. The trick when working on these is to use a continuity tester to match the lead in question on the inside to the position of the knob on the outside. For example, the knob may point to "TC 1" on the label. On the inside there is only one lead from the switch that corresponds to TC 1. If you do not connect that lead to TC 1, then when the knob points to "TC 1" on the label it may be reading some other TC besides TC 1. Note: the common wire comes from the center of the switch. See *truview-instruct.pdf* for more information.

THERMOCOUPLES

The pyrometers and all of the electronic kiln controllers for L&L kilns work with a "Type K Thermocouple". (Although we do make available a Type S platinum thermocouple. See stc.pdf). There are all different "types" in the entire range of thermocouples available to the consumer and to industry. Type K is just one type covering the temperature scale from 32°F to 2500°F (0°C to 1372°C). Type K thermocouple circuits are made of one kind of wire on one side if the circuit, and another kind of wire on the other side of the circuit. The point at which the two kinds of wire meet is right at the end of the sensor - the thermocouple probe's tip in the kiln. This is where the temperature is read. All types of thermocouple circuits are set up this way, with two dissimilar metals making up each half of the circuit. In the case of the Type K the metals are called Alumel and Chromel. They are usually either 14 awg (American wire gauge) or the thicker 8 awg wire. The thickness of the wire is only important inside the kiln. Thicker wire lasts longer, but is more expensive and more difficult to work with. Our standard Type K thermocouples in the Easy-fire, Jupiter, DaVinci and Doll kilns now come with a ceramic thermocouple protection tube. (These last longer because they are protected from the kiln atmosphere).

An 8 gauge Type K thermocouple next to a ceramic protection tube:



Metal Sheathed Type K Thermocouples

These have a metallic sheath on the outside of the thermocouple and are 1/4” OD. See *tc-metallic.pdf* for more information on these. If you retrofit these into a kiln with larger diameter thermocouples be sure to plug up the larger hole around the thermocouple especially if a venting system is in use. Otherwise they could read cooler than the real temperature of the kiln and this could result in a disastrous firing.

Type S Platinum thermocouples

Type S thermocouples are also available with the DynaTrol. This option must normally be ordered with the kiln as the millivolt signals from a Type S thermocouple are different than the millivolt signals from a Type K thermocouple and the DynaTrol must be preprogrammed to recognize the different signals.

A Type S thermocouple will last considerably longer than a Type K thermocouple. However, it does cost considerably more money to replace it when it does fail or break. The dissimilar metals that make up a Type S are Platinum/Rhodium and Platinum. It is these precious metals that makes the type S thermocouple cost so much more.

Over time the difference in the money spent using Type K vs. Type S is negligible. Type K will burn out faster than Type S but they are inexpensive to replace. Performance of one over the other is not an issue (except that the Type S will not drift as much when the kiln is fired to high temperatures). See *stc.pdf* for more information.

For More Information on Thermocouples

ktc.pdf
ktc-14 gauge.pdf
stc.pdf
tc-metallic.pdf
tc-protect.pdf

Thermocouple extension wire

From the TC to the pyrometer there is insulated Type K thermocouple wire containing one very thin alumel wire, one very thin chromel wire and usually an uninsulated ground wire with aluminum foil wrapping the three wires together with the thicker plastic type insulation over that. The entire circuit needs to keep this same type of wire from the pyrometer to the thermocouple. There can be no sections containing other types of wire (like copper, or alumel where chromel should be). There is a polarity as well. The chromel side is generally referred to with the color yellow and a "+" positive designation. The alumel side is referred to with the color red and a "-" negative designation. If the polarity is reversed the pyrometer will read in reverse -temperatures will decrease when they should be increasing. Accidentally doing this will not damage anything if the problem is fixed promptly. Note that we use a special high temperature TC extension wire inside the Easy-Fire control cabinet.

Cones measure heat-work

Cones are not temperature measuring devices. They measure how much heat has been absorbed by the ware in the kiln, which is the result of the combination of time and temperature. A particular piece of clay needs a certain amount of time at a specific temperature to properly fire it, lower temperature if the time is longer, higher temperature if the time is shorter. An example of this would be if you added about a 20 minute hold to the maximum temperature of a cone 6 firing, you would be able to lower that final temperature by about 20°F. An hour hold time would mean a final temperature of about 40°F lower. A two hour hold time, about 60°F lower.

See *troubleshoot-cones.pdf* in the LOG, CONES, TIPS Section of your Instruction Manual.

THE POWER SUPPLY

This consists of the main power cord, receptacle, powerblock, wire, and breakers.

Safety Warnings

NOTE: If you are not sure about some part or procedure in creating or testing a power supply line for a kiln, DO NOT GUESS! If you wire something improperly, you might just blow the circuit breaker, or burn the place down. Get an electrician or someone who knows.

NOTE: There are many different ratings on the wire and components that make up the supply line that need to be considered (along with proper and safe installation) when creating or testing a kiln power supply. It is beyond the scope of this manual to properly educate someone to fully understand the potential variations and variables involved in this. Often a building like a school or a recreation facility (or even a home) will be inspected for electrical code and fire code enforcement. If you do not own the building, or if the kiln is in anything other than a free standing private workshop for yourself, get permission to do what you want to do from the owner and get an electrician to properly wire the circuit so you are not liable.

The Data Nameplate

A typical data nameplate:

Every kiln has a data nameplate, usually a sticker on the side of the control box, that specifies model number, serial number, voltage required, phase required, amperage required, watts produced and the recommended maximum temperature. This is the information to get from L&L for your particular kiln if you do have not received it yet or if it has no data nameplate. If you have the information from the data nameplate, then that is what you show to your electrician, or use to procure the proper wire and components to create the power supply line. Here are some things to keep in mind if you are the "electrician":

If you are the electrician:

-As of January 2001, National Electric Code Handbook says that a resistive heater this size, on for more than three hours at a time, should be provided a circuit that is rated for 125% of the total amperage drawn by the unit when it is on High. So a kiln drawing 43.98 amps would require a service of no less than 54.98 amps. As wire and components for power supply lines are usually rated in increments of 10, the next higher rating is 60 amps. Therefore everything in the line must be rated at least for 60 amps.

Note about the 50 amp power cord used on kilns with up to 48 amps: the cord is built to take at least 60 amps, (6AWG wire for the hot leads - good per NEC table 310-16, 8 AWg for the ground, plus oversize copper blades on the plug, and high temp. rating.) In addition this configuration has been examined by UL and approved for use not only with L&L kilns but most other UL listed kilns on the market. Do size the rest of the circuit for 60 amps (i.e. the wires, circuit breaker, etc.).

-Most L&L kilns require a specific voltage to operate properly. The Data Nameplate will say in the voltage column either 120, 208, 220, 220/110, 240, 380/220, or 480. Most of the USA is residential- 240 vac, with schools and industry- sometimes having 208 vac. Often, however, residential can be 208 (downtown NYC, south-central Idaho etc). There are usually no issues with 120 volts. 220 and 380/220 are usually found overseas. 480 is sometimes available for schools or industry. The biggest problem we see is the issue of 208 vs. 240: The kiln that says 208 volts will overheat the elements and burn them out quickly if it is run on 240 volts. Older 208 volt kilns have 208 volt switches also. They will burn out quickly if run on 240 volts. If the kiln is made for 240 volts then it will have about 25% less power and a maximum temperature of about cone 5 (maybe) if run on 208 volts. You should only run a kiln on the voltage that the Data Nameplate specifies if you are to expect the best results. Plus or minus six or seven volts is OK, but keep in mind that the higher the actual voltage is over the recommended voltage, the higher the surface temperature of the element is at any given time, and therefore it is more likely to burn out early. Likewise, the lower the actual voltage is below the specified voltage, the lower the maximum temperature will be.

Voltage is specific to the building and to time of day. It will probably be a bit lower during the day, and higher at night. You can carefully test it to see what it is with your multi-meter. It is costly to change the voltage, but this can be done with a transformer. You'll definitely need a good electrician, though. The cheapest way to fix the problem is to replace the elements (and possibly the switches) with the proper voltage ones. The switches are marked INF 240, INF 208, INF 120 or something similar. You will probably need to remove one to see the markings. The computerized controls will work on either 208 or 240 unless 120, 380/220 or 480 is specified. (Note that we use 240 volt INF switches now on 240 and 208 volt kilns. 208 volt INF switches have slightly different timing because of the way the voltage affects the internal heater in the switch).

Use copper wire

Always use copper wire with the highest temperature-rated insulation you can find. 150°C is what the internal wiring up next to the kiln is rated for, so hook-up wire with that rating would be excellent; however, 105°C is adequate. Note: our power cords, which are approved by UL, are rated for 105°C. Keep in mind that for different amperage services, different thickness of copper hook-up wire is required. The following chart should give an idea of what is necessary:

Chart of wire and amperage

Service required	**Gauge of wire required (american wire gauge)**
15 amp	14 awg copper
20 amp	12 awg copper
30 amp	10 awg copper
40 amp	8 awg copper
60 amp	6 awg copper
70 amp	4 awg copper
80 amp	3 awg copper
90 amp	2 awg copper
100 amp	1 awg copper
125 amp	1/0 awg copper
150 amp	2/0 awg copper
175 amp	4/0 awg copper
200 amp	250mcm copper (1000 circular mils)
225 amp	350mcm copper
250 amp	350mcm copper

Voltage is not really an issue here. Usually wire like this is rated for at least 300vac if not 600vac. Look for the wire specifications on the insulation or ask the supplier to be sure. The voltage rating is based on the electrical resistance of the wire insulation (to prevent voltage leak).

Voltage Drop over distance

Running power for your kiln over a long distance will result in a drop in voltage. The amount is about:

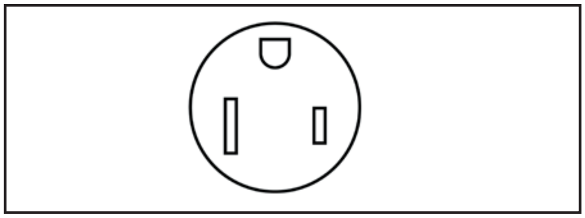
7 volts per 100 feet with 10 awg wire
21 volts per 300 feet with 10 awg wire
6 volts per 100 feet with 6 awg wire
18 volts per 300 feet with 6 awg wire
3 volts per 100 feet with 1 awg wire
9 volts per 300 feet with 1 awg wire

These estimates are dependent on the kiln operating at 50% to 100% of its capacity, with the temperature of the wire no more than 167°F. Be sure to test the voltage before the run has been installed so you know what you are working with.

Power cords

The industry name for the supplied power cord on many L&L kilns is: Nema 6-50P for all single phase 208, 220, and 240 models drawing less than 50 amps. A few exceptions are the later G models (GD, GT, GQ, and GS) with the 30 amp, four-prong plug. This is a Nema 14-30P plug. The Doll kilns and other 120 vac kilns use Nema 5-15P plugs for up to 15 amps, and Nema 5-20P plugs for 15 to 20 amps. The three phase Easy-fire kilns use a 15-50P cord. Various types of 30 amp plugs are used on the Libery-Belle kilns. To get the appropriate receptacle just substitute the “P” at the end of the Nema code for an “R”. P for plug, R for receptacle.

Diagram of a NEMA 6-50 receptical. The hole shown at the top is the ground.



TROUBLESHOOTING AN EXISTING POWER SUPPLY

Circuit breakers
Circuit breakers that have tripped and have been reset continually will be more apt to trip at a lower amperage than they are rated for. They get worn out. Also, a breaker in a small kiln room will trip sooner because of the higher ambient temperature. An inductive amp meter will indicate whether the kiln is pulling more amperage than the breaker allows. Remember to size it for 125% of the total amp load.

Wire size too small
Using a wire size that is too small for the amperage draw will cause the wire and conduit to heat up and either the voltage to the kiln will drop (some voltage will be lost in heat) or the breaker will trip from the local heat. Without a properly sized breaker, the connection points will start to corrode and this may cause an electrical fire.

Corrosion
Any visible corrosion - especially on a plug and receptacle connection - will result in heat generated at that point. Heat leads to corrosion, which leads to more heat and eventually the melting of the component or connection point. This could start a fire if the breaker fails to trip.

Dedicated circuit
The kiln should be on its own circuit. If anything else is on the circuit the voltage will drop when the other device is turned on. The circuit breaker must be rated for the combined amperage of all the devices if the kiln must share a circuit.

Melting power cord
Look for the power cord melting if it is close to the kiln. Also look at the receptacle that it plugs into (there is often oxidation there). Look for signs of overheating; these include bulging, discolored, swollen or flattened insulation (like a slice from the side of the cord). If the cord is only slightly melted it may be OK to use if the situation that caused the melting is rectified. If the cord appears to be getting worse, replace it. If the insulation on the cord has deteriorated it is possible that the power wires could short out and cause a fire.

CONCLUSION AND REMINDERS

Remember, SAFETY FIRST. Always assume the circuit is live until you check it, the wiring is wrong until you trace it out, and that there is always more going on than what someone tells you. Slow and methodical, step-by-step with an overview of the entire situation is the best way to deal with any problem.

In most cases, your local distributor can replace parts and repair your kiln. A good electrician may also be able to diagnose and repair your kiln. L&L's technical service department can handle any type of inquiry pertaining to the kiln's theory and design, construction and use. We can also repair or retro-fit most older controls if they are sent back to the factory.

FEEDBACK

PLEASE send us your feedback and questions. We are particularly responsive to email because it allows us to research problems, questions and concerns at a less hectic pace. We will get back to you. We want to make this Troubleshooting Guide and all our documentation the very best in the industry. You can send your email to service@hotkilns.com. You can email the president of the company direct at steve@hotkilns.com. Although we like email don’t hesitate to call or fax. We are here to help.