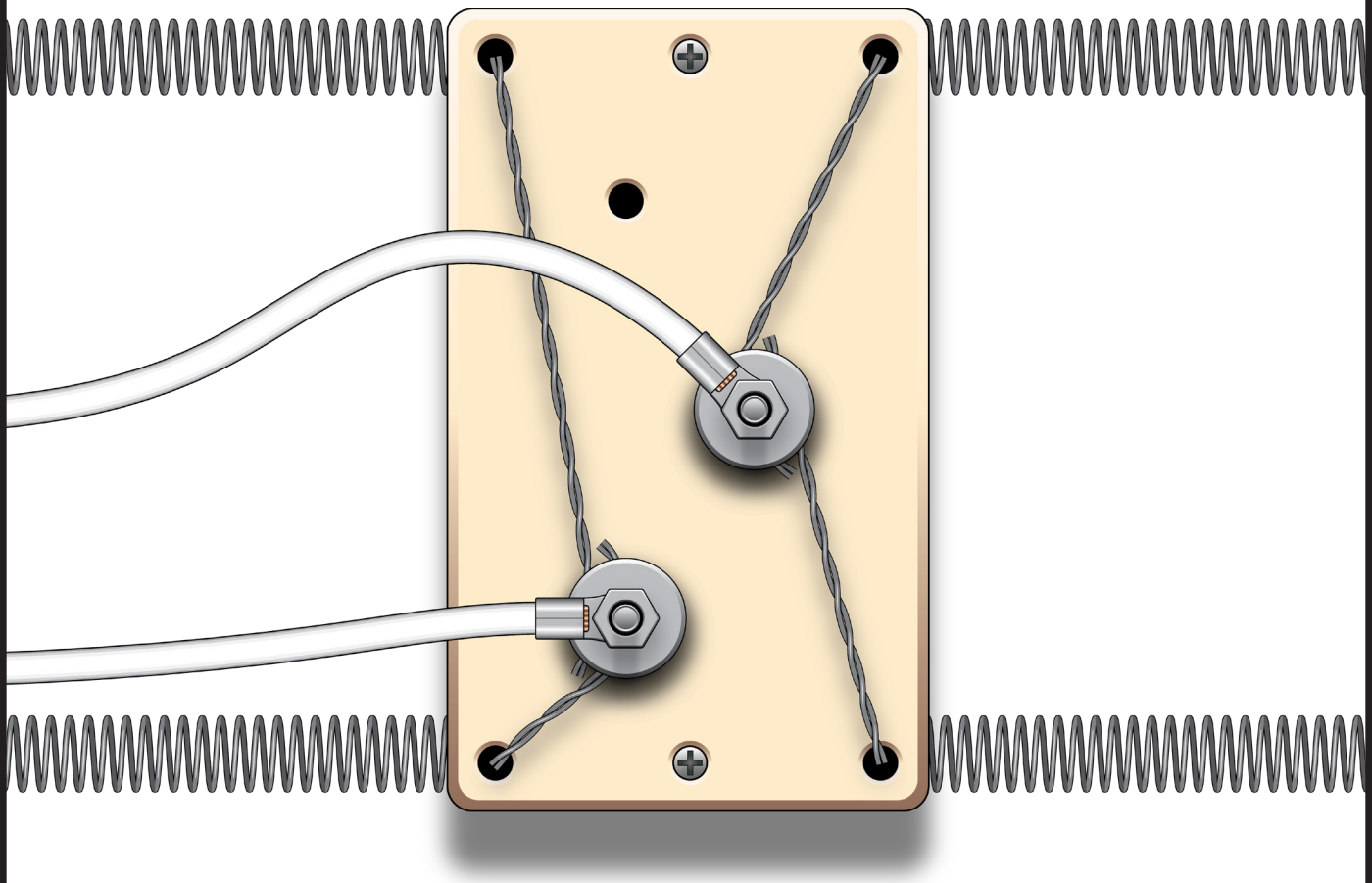
# ELEMENTS:

## Troubleshooting & Installation



**Instructions for L&L Kilns**

# ELEMENTS: TROUBLESHOOTING & INSTALLATION

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# ELEMENTS: TROUBLESHOOTING & INSTALLATION

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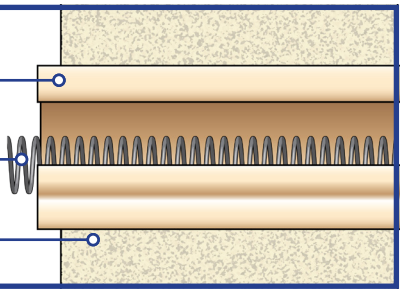
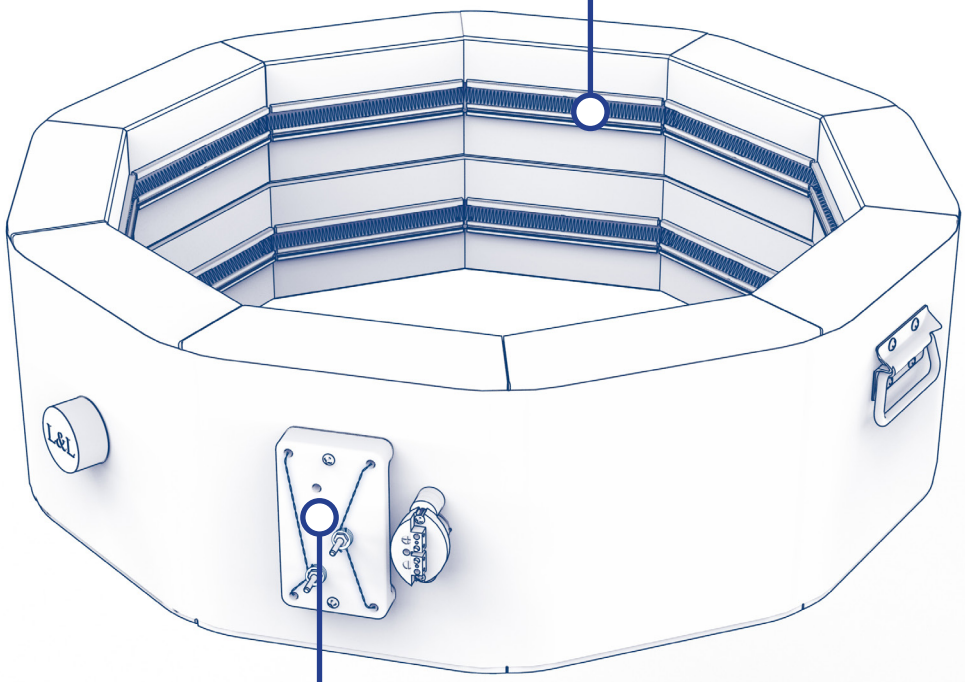
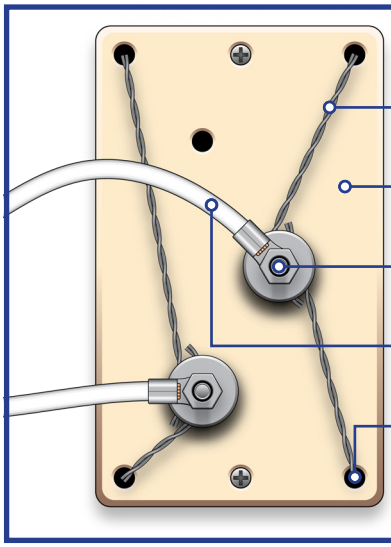






**Element Tail**
*Twisted ends of the element coils*

**Element Terminal Block**
*Ceramic block that mounts the terminal hardware*

**Terminal Hardware**
*Stainless steel bolts, washers, and nuts connecting the elements and power wires*

**Power Wire**
*Supplies power to the elements*

**Element Through-Hole**
*Small hole allowing the element tail to pass through the kiln wall*

## ELEMENT TROUBLESHOOTING

### Error 1

If your controller shows an Error 1, E1, E-1, or Err1 error code, it means that your kiln is slowing down and can no longer reach temperature. There are three leading causes of this in order of likelihood:

1. Your elements have aged and need to be replaced. This is most likely when you notice the kiln gradually slowing down.
2. One or more contacts or relays have failed. This is most likely if you notice a sudden change.
3. You have a low voltage problem. This is most likely if you find this happening in the summer.

### Why does an older kiln slow down?

Aging elements will be slowly eaten away by the atmosphere in the kiln. They will also increase in their resistance, which decreases the amount of amperage and, ultimately, the amount of heat given off by the elements. This is why older kilns sometimes fire slowly and may not reach their maximum temperature. Periodic element resistance readings using the multimeter will allow you to check the "health" of your elements. Of course, a slow-firing kiln is the first indication that you have an element problem.

### Elements expand and grow with age

If you use low-fire clay and glaze (never firing above cone 4) or only bisque fire, your elements will last a long time. This is good to an extent, but you will encounter another problem over time. Elements expand as they age, increasing in length and coil diameter. Although resistance usually increases as the elements age, this expansion can decrease it. As the element expands, it binds up in the corners, pushing individual coils together. This creates shortcuts for the electricity and reduces the material it must pass through. In turn, the resistance in the whole element is reduced. Only the parts of the wire that don't contact the coils on either side of them will emit heat. If there is a lot of element material jammed in the corners, there won't be enough material left in the coil to radiate the heat generated by the increased amperage and decreased resistance. More amperage through the electrical components in the controller could cause damage if the situation continues or the resistance drops far enough. Additionally, the expanding diameter of the elements can make them challenging to remove from the holders

This won't typically happen to those firing at higher temperatures because increases in resistance quickly compromise the kiln's maximum temperature, requiring the elements to be changed long before they can jam up in the corners. High temperatures and glaze firings are also more prone to eating through the element, causing it to fail before the element can expand enough to cause the problems mentioned above. Occasionally, use a multi-meter and visually inspect your elements.

### What if I see charred and blackened corners?

When the coils bunch up in the corners, they may not always touch each other. However, they could be close enough to allow electricity to 'arc' across the gap. This arc can generate extreme temperatures. Charred and blackened corners of the kiln are clear warning signs of this potential problem.

Do not confuse this with randomly sized sections of the coils glowing more quickly than other sections. This is normal and can even be observed with new elements. The wire's annealing process causes this and does not adversely affect the elements' operation in the kiln.

### Factors shortening element life

- Contamination such as glaze or kiln wash. Silica, a main ingredient of both, attacks the element wire.
- Tightly wound areas on element coils. The elements must be stretched evenly. If the element coils are bunched up along the length of the element it can overheat. See the section below on stretching elements.
- Glaze rubbing off onto the holders and elements when loading the kiln. If this occurs, thoroughly vacuum the element holders immediately.
- Exploding bisque ware. This can blow bits of clay into the element holders. Temperatures are much higher next to the elements and may exceed the clay melting temperature. If not removed, the clay may melt, contaminating the element. To avoid this, only fire bone dry clay. For thick pieces, fire on low for an extended period or use the preheat feature on your controller. If you hear a "pop" when firing such pieces, stop firing and cool the kiln. If an explosion has occurred, thoroughly vacuum all element holders.

- Firing pieces too close to the elements. We recommend at least a 1-1/2" gap between pieces and elements, further if large flat surfaces are parallel to the kiln wall.
- A reducing atmosphere. This will destroy elements. Iron-chrome-aluminum elements require an oxidizing atmosphere. Do not use wood chips, oils, or other materials to generate a reduction firing. Rapid element failure may result. NOTE: Reducing atmospheres are the opposite of oxidation atmospheres (i.e. normal air). The name comes from the ability of a reducing atmosphere to "reduce" oxides.
- Various fumes from oils, waxes, carbon, fluorine, or lead glazes are present. The aluminum in the Iron-chrome-aluminum elements forms a protective oxide coating. This coating is attacked by many things, including oils, carbon from wax burnout, free carbon, halogens such as chlorine or fluorine, halogen salts, the salts of alkali metals, nitrates, silicates, borax compounds, iron oxides, and molten metals such as zinc, aluminum, copper, lead, and their oxides. Use a kiln vent if you use lead glazes (or cause any of these problems). Fire frequently with a noncorrosive load, such as a bisque firing. This will help the elements restore their protective oxide coating. Note that clay almost always has organics, sulfur, and fluorine. This is one reason why proper venting is critical for your kiln's long, trouble-free life and operation.
- Excessive soaking time. The higher the temperature, the longer the soak, the sooner the element will increase in resistance and decrease in life. Usually, short soaks work fine.
- Using 3rd party elements. A number of people sell "replacement elements" for kilns without the proper design information. It is easy to make an element with the same wattage as an L&L element but without the other qualities contributing to a long life. Designing an element is a complicated process that balances things like voltage, wire diameter, watt density, stretch ratio, etc.
- Make sure all elements are heating. If all elements are not doing their share of the work, then the other elements will not last as long.

### Terminal Burn-out

Sometimes, the ends of the elements can burn out at the terminal hardware connections. This can be due to any or all of the following causes:

- The element tails are not twisted properly. Extra heat could be generated at the element's end if the twist is too loose.
- The element through-holes are too large. This could cause too much heat to escape from the kiln, thereby overheating the terminal connections. This can be remedied by lightly stuffing ceramic fiber (we have non-RCF ceramic fiber available) in the through-holes
- The terminal hardware may not be tight enough. A loose connection can generate heat and cause the hardware to oxidize, which in turn will cause a worse electrical connection and more heat. Replace it with new hardware and tighten it properly.
- The terminal hardware should be stainless steel. Check to see if it is in good shape. If not, replace it with stainless steel hardware, or if need be, replace the whole terminal block assembly with one of our new ones.

## MEASURING ELEMENT OHMS

### Why measure your element Ohms?

Aging elements generally increase in electrical resistance. When resistance (Ohms) increases, current and power (Amps and Watts) decrease, assuming Voltage remains constant. Without enough power, your kiln will fire slowly and may not reach the desired temperature. This makes measuring your element Ohms the best way to identify when elements need replacing.

By measuring resistance in Ohms (Ω), we can tell how much power your kiln has lost throughout the element's life. For example, a brand-new section on an e23T 240V kiln would read about 14.5 Ω. If you measured this same kiln section after many cone 6 firings, you might get a reading of 16.5 Ω. Divide the current reading by the original reading to calculate the increase in resistance.

16.5/14.5=1.1379, or close to a 14% increase in resistance, which means a decrease in power.

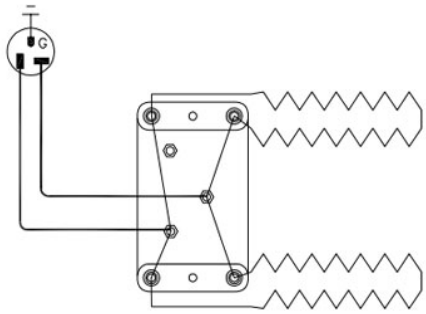
We recommend changing elements after a 10% increase in resistance, as this is when most kilns will slow down. This will vary based on your kiln, your voltage, and the types of firing you do. People doing low-fire work will get by longer on lower power than those firing at higher temperatures (cone 6+).

## Ohms Per ELEMENT VS Ohms Per SECTION

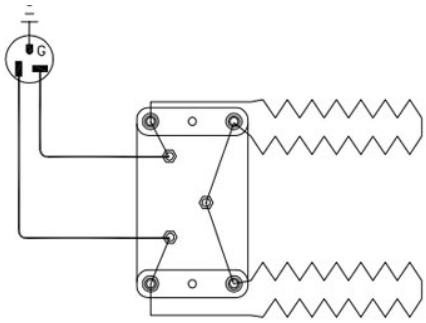
Remember that the Ohms listed on the wiring diagram are per ELEMENT, while your readings will be per SECTION. How you figure out the ideal ohms per section depends on whether the elements are wired in Parallel or Series. Most kilns are wired in Parallel except for JD230V and most 18" kilns like the e18T.

For a parallel kiln, divide the per-element Ohms listed by the number of elements per section. For a series kiln, multiply the per-element Ohms listed by the number of elements per section.

**Example 1 (2 Elements in Parallel):** e23T 240V 1 Phase: Elements are 28.9 Ohms each. Divide by two and you will get a reading of 14.5 Ohms per section.




**Example 2 (2 Elements in Series):** e18S 240V 1 Phase: Elements are 9.6 Ohms each. Multiply by two and you will get a reading of 19.2 Ohms per section.




## Measuring Ohms in Easy-Fire, eQuad-Pro, Liberty Belle, Doll, School Master, and EFL Series kilns

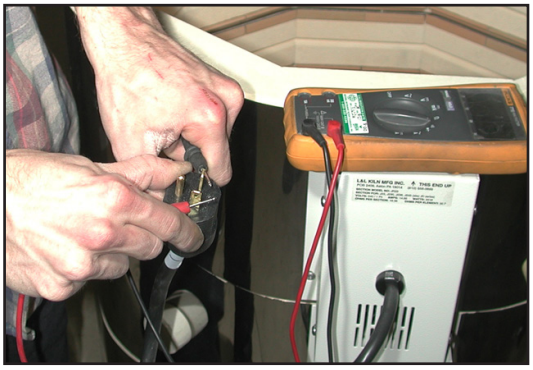
In these series of kilns, a piggy-backed control panel covers up the element terminal blocks.

1. Power-OFF the kiln and unplug it. Turn off all power at the disconnect switch or circuit breaker if it is directly wired.
2. Open the outermost control panel by unscrewing it from the element cover box in the case of Easy-Fire, eQuad Pro, School Master, and Liberty Belle kilns, or from the kiln body in the case of older Doll kilns.
3. Once you open the control panel, you will see the power wire terminal strip. It has numbered wires coming from the element terminal blocks and wires connecting to the power relays. There are two wires per kiln section/ring, so in a three-ring kiln, numbers 1 & 2 are for the top section, 3 & 4 for the middle, and 5 & 6 for the bottom.
4. Set your multimeter to Ohms (Ω), and place one lead between the two tabs with #1 wires connected. The lead fits into a small circular divot (see picture). Put the other lead on the #2 tabs and note the reading. Repeat the process for 3 & 4 and 5 & 6. Remember that each pair of wires represents one section.
5. Compare your readings to those on the wiring diagram in your instruction manual. Remember that the ohms on the wiring diagram are per ELEMENT, while your reading will be per SECTION. See above for more info on understanding the readings.

### Measuring Ohms in Jupiter and Davinci kilns

In these series of kilns, the control panel is separated from the kiln body, and the element terminal blocks are connected to the control panel via external jumper cords.

1. Power-OFF the kiln and unplug it. Turn off all power at the disconnect switch or circuit breaker if it is directly wired.
2. Unplug the first jumper cord from the control panel.
3. Set your multimeter to Ohms (Ω), and using your testing leads, place one lead on each of the "hot" prongs—they will be the flat ones.
4. Make note of the reading and move on to the next one.
5. Compare your readings to those on the wiring diagram in your instruction manual. Remember that the ohms on the wiring diagram are per ELEMENT while your reading will be per SECTION. See above for more info on understanding the readings.

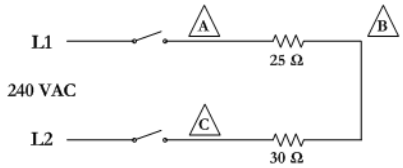


## HOW ELEMENTS ARE WIRED

### Why is this important?

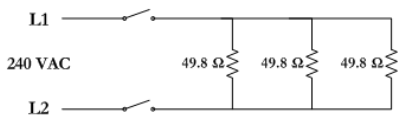
The way the elements in a kiln are wired is vital because different wiring schemes with elements of the same resistance will yield drastically different results. For example, if a kiln section or group of elements is out, and the kiln is made up of series circuits, you would first check the elements because even one burned-out element in a series circuit can make all the elements appear burned-out. If this same kiln had parallel circuits, you would first check the switch or relay. This is because in a parallel circuit, if one element is out, the others will still light, so for all the elements in the parallel circuit to be out would mean that whatever controls the circuit (i.e., the switch or the switch by way of a relay, or the wires in-between) would be suspect. CAUTION: Accidentally wiring a kiln with parallel element circuits will make it heat up incredibly fast until the breaker trips. For instance, an e18S-3 kiln wired correctly, in series, draws 23 amps at 240 volts. Wired in parallel it would draw around 90 amps at 240 volts, which would be disastrous.

#### Series Circuits



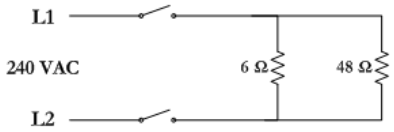

In a series circuit, power flows through one element and then another. We can see this in how it is wired. Think again of power coming in one wire and out the other.

#### Parallel Circuits




Parallel circuits meanwhile allow power to flow through both elements simultaneously in no order. The power is applied to the beginning and end of ALL the elements at once. Thus the resistance of the entire circuit is the number of elements in the circuit divided into the factory resistance value for one element.

#### Series-Parallel




Sometimes element wiring can be termed series-parallel. Both series circuits get power at the same time, making them series-parallel circuits.

### Specific to non-sectional kilns:

In non-sectional kilns, it can be difficult to tell the element circuits apart since the element connection board runs the entire length of the kiln and covers all the circuits. Trace the connecting wires to discover the beginning and end of each element circuit on the element connection board. Ideally, you would draw a picture of each element circuit before dismantling it. If you are just replacing the elements, it is not necessary to know if they are wired series or parallel; it is imperative, though, that they go back together exactly how they came apart.

For a more in-depth description of Series, Parallel and Series-Parallel circuits, along with descriptive diagrams see BASIC ELECTRICITY TROUBLESHOOTING FOR L&L KILNS in the TROUBLESHOOTING Section for more information on circuit wiring. If you want more information about electricity for kilns see hotkilns.com/volts.

## POWERED BOTTOMS

The elements on the powered bottoms are typically the same as those in the kiln with some exceptions. Series elements cannot be used by themselves in a powered bottom, so a parallel element must be used in smaller, series-wired kilns like the JD230V-PB.

## OTHER TYPES OF ELEMENTS

### Heavy-Duty elements

If your kiln was made after January of 1996 it will have larger element holders. These new holders can hold elements of a larger diameter and heavier gauge. These high-grade, heavy-duty elements feature lower watt density than standard elements, which, coupled with the heavier gauge wire, results in longer element life. You should try these heavy-duty elements if you are experiencing short element life because of your duty cycle (frequent firing, high-temperature firing, long soak times). They have the same resistance as the standard elements, so the power rating of the kiln does not change. It also means that you can use them alongside standard elements. One consideration with mixing the standard and heavy-duty elements is that the heavy-duty elements will age more slowly which may influence uniformity in the kiln. Dynamic Zone Control will automatically compensate for this problem. We do suggest, however, that you put newer elements in the bottom ring where temperatures tend to be cooler and need as much power as they can get. L&L cannot keep track of which elements you have and that you must specify heavy-duty elements when ordering. If you don't specify heavy-duty elements, you will get standard elements.

### APM Elements

APM is a special version of the Kanthal A-1 alloy used in kilns. It is sintered and resists the crystallization that normal Kanthal-type alloys experience. As a result, it makes sense to use this when you are doing processes that require long holds at high temperatures (like crystalline glaze, for instance). On the other hand, these elements are very expensive and subject to the same problems, such as glaze contamination, that any element can experience. See hotkilns.com/apm for more information.

### Quad Elements

The quad-element option gives you four rows of heavy-duty elements to maximize element life and heating power. Double the element surface area means that quad elements will degrade at a slower rate than ordinary elements which is great for those firing to high temperatures. More surface area also means more radiated heat for faster and more even firings. Quad elements are also typically made from thick gauge element wire further increasing their durability. Note: Quad-element designs use extra-long elements to wrap around the kiln twice each, meaning that the electrical specs are kept the same. Because of the need to have more element holders in the brick, quad elements are not interchangeable with regular elements. See hotkilns.com/quad-elements for more information.

### Increasing Power in Your Kilns

If you have a JD230 you can retrofit the new Easy-Fire e23T elements in that specific model and increase the power rating of the kiln. That will give you about 10% more power to start with and therefore, as elements age, the lowering power will have less impact on your firings. See hotkilns.com/jd230-ez as an example. These elements can be retrofitted into older kilns.

## CHANGING ELEMENTS

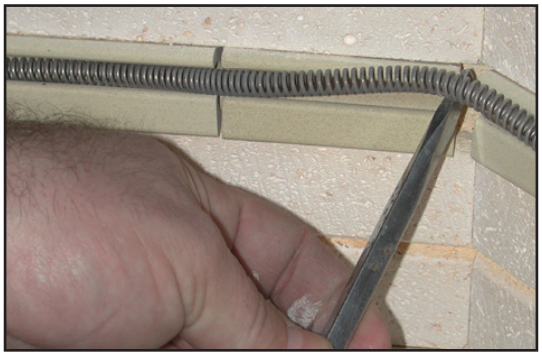
When ordering new elements, contact L&L or your local distributor. Provide them with your kiln's model number, serial number, voltage, and phase – all of which can be found on the nameplate, typically on the control panel. This step is essential to ensure you receive the correct elements for your kiln. In addition to new elements, you may want to consider getting new terminal hardware, as these can corrode over time even though we use stainless steel.

**Before performing any maintenance, always make sure your kiln is unplugged or the circuit breaker or fused disconnect switch is turned off and locked out.**

### Removing old elements

1. Remove the control and element boxes from the kiln. On most L&L polygonal kilns, you will open the control box by removing two screws on the top, remove the thermocouple and power wires (that come from the element box) from the terminal strip, then remove the screws on the right-hand side of the element box and swing it open. Before undoing wires, label how they are configured (take pictures if needed).
2. Inside the element box, you will find the element terminal blocks. Their exact configuration may differ depending on your kiln's model. In this example, we use standard terminal blocks with parallel wiring, the most common configuration. If your kiln has a different configuration, consult the terminal block diagrams below. Using an adjustable wrench or a 3/8" nut driver, remove the nuts, washers, power wires, and element tails from the terminal bolts. Keep them in the correct order and photograph them before removal. The last washer and nut fastening the bolt to the ceramic block can remain in place if they are in good condition.

   **FOR OLDER NON-CERAMIC TERMINAL BOARDS:** Remove all the old tails from the element connection bolts and re-tighten these bolts to the element connection board. You may have to remove the element connection board from the kiln to do this. If the bolts are corroded, replace them with new stainless steel terminal bolts, nuts, and washers. If the terminal board itself is burnt or broken, replace it as a complete unit with new hardware.
3. Clip off the element tails close to the through holes so they can slide through the kiln wall for removal.
4. Remove the old elements from the inside of the kiln. Use a sharp tool like a screw driver to lift the elements out of the ceramic grooves at the corners. You can slide the holder over to make enough of a gap to get the tool under the element. As long as the element holders are intact and the elements weren't fired beyond their lifespan, the element coils should come out of the holders with ease. Very old elements can sometimes become wedged in the element holders, making it necessary to pry/twist/ break them out carefully using needle nose plyers. If need be, a propane torch will soften the element wires and make them easier to remove. **BE CAREFUL NOT TO BURN YOURSELF IF YOU DECIDE TO USE THIS METHOD. Use heat-protecting gloves.**

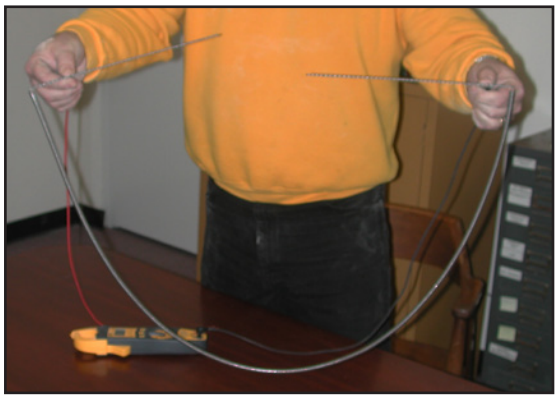


5. From the inside of the kiln, pull the element tails through the kiln wall. Be careful not to enlarge the hole in the soft firebrick.

   **FOR OLDER NON-CERAMIC TERMINAL BOARDS:** There are usually ceramic insulator bushings on the outsides of the through holes that the elements pass through. Some models (particularly older J2900 kilns and DaVinci kilns) have spacers to keep these insulators in place. These may fall out and break if you are not careful. Be sure not to lose these spacers when replacing elements. Note how they are positioned so you can replace them the same way. The newer ceramic terminal blocks have no bushings or spacers - it is all one integrated piece.

6. With the elements removed, vacuum out the element holders of any dust or debris. Check them for evidence of glaze or material contamination. Contaminated holders can lead to the rapid failure of new elements. Chip or scrape carefully to remove the contaminant or replace the affected element holders. To replace them, refer to the Replacing Element Holders section.

## Checking new elements



Thoroughly inspect your new elements. Ensure the wire thickness is similar to that of the old ones. Verify that the coils per inch and the diameter of the coils are also similar. Use your multimeter to check the resistance of your new element. Place the probes on the element tail about 3" away from the beginning of the coil. Compare it to your kiln's elements' factory resistance value(s). Your reading should be no more than one Ohm off (less for elements with Ohm readings of less than 10 Ohms). If you have received the wrong element in error, don't hesitate to call the factory to get it exchanged. This is the time to address any issues. DO NOT WAIT UNTIL YOU STARTED THE JOB, STRETCHED THE ELEMENT, OR EVEN INSTALLED IT BECAUSE, AT THAT POINT, YOU COULD NOT RETURN IT.

## Pre-stretched elements

Most replacement elements come pre-stretched. All elements are slightly under-stretched and can settle during shipping, requiring adjustment for the final fit. If that is the case, stretch out the element until it is the correct length. It is better to gently stretch out the whole element instead of aggressively stretching a small section, which could lead to deformation or bunching.

## Stretching unstretched elements

1. To determine the total length to stretch an element, measure the total length of element grooves.
2. Mark the floor with two marks for the stretched length. Have a helper stand on the tail of one element and pull the other tail until the element is the proper length. The assistant must stand very firmly because a flying element could cause severe injuries. WEAR SAFETY GLASSES WHEN YOU DO THIS. Alternately, clamp the end to something with vice-grips.
3. Examine for evenness of stretch. Selectively stretch tightly wound sections to provide uniformity of stretch.
4. Repeat this procedure several times.
5. You will have to pull the elements beyond the last mark to obtain full stretch.
6. If overstretch occurs, insert a metal rod or small-diameter dowel into the element coil and compress it with needle-nose pliers.
7. Stretch uniformity is necessary for satisfactory element life.

## Installing new elements

We highly recommend getting all-new element terminal hardware when you replace your elements, as these can strip or corrode over time, even though we use stainless steel. When you buy elements, we offer a 50% discount on element terminal hardware.

Besides a few exceptions, such as our Schoolmaster line, most L&L kilns will use identical elements throughout, so you don't need to worry about installing them in a specific order. The description on the website of each element will alert you if this is the case.

Replace the elements in one section at a time so you don't make a mistake with the wiring.

1. Insert one element tail through the kiln wall and terminal block. At this point, the element ends should be straight.
2. Feed the element coils into the holders, working your way around the kiln. Note that the unfired element will have some springiness. You may need to use a screwdriver to press the element into the holder. No pins are required.
3. Insert the other element tail through the kiln wall and terminal block.

4. Pull the coils up tight to the wall of the kiln by pulling the tails from the outside.

   FOR KILNS WITH NON-CERAMIC TERMINAL BLOCKS OR RETROFITTED KILNS WITH CERAMIC TERMINAL BLOCK BUT STILL NEED BUSHINGS: Be sure to replace the insulators and spacers over the element tails.

5. Ensure the element is securely seated in the holders and not popping out of any corners. If it doesn't stay seated in a corner, stretch it a little more so there's less tension.
6. Repeat this process with the rest of the elements in the section.
7. Be sure to install the elements and hardware in the correct order. Consult the diagram for your specific configuration. For a standard terminal block with parallel wiring (the most common configuration), the correct order will be as follows:
   A. The first washer.
   B. A hex nut. Tighten to secure the bolt to the terminal block.
   C. A second washer.
   D. The first element tail. When you wrap the element tails around the bolt, wrap them tightly, only halfway around, making a "U" shape. This ensures that they remain flat and make complete contact with the washers. You do not want to wrap them all the way around, having the elements overlap. That would create a gap preventing complete contact with the washers.
   E. A third washer.
   F. The second element tail.
   G. The final washer.
   H. The power wire.
   I. A final hex nut. A tight connection is vital for proper contact. If you under-tighten, the element tails may not make complete contact and could overheat. But if you overtighten and twist the element on the bolt too far, you could break the element or bolt.

   Repeat this process with every terminal bolt.

   Note: Over the years we have changed the order of terminal hardware to simplify the process. Your older kiln may be using a different order, but this is our current recommended order and will be what you receive when ordering new hardware (for a standard terminal block in parallel)

8. Once the tails are all connected and tightened, you can clip off any excess element wire from the tails.
9. Once you have completed the above steps in all kiln sections, reattach the element box and the ground wires if the kiln has them. DANGER: DO NOT FORGET GROUND WIRES; EACH KILN SECTION SHOULD BE GROUNDED
10. Test the ohms as described in the measuring element Ohms section.
11. Reattach the control box, plug the kiln in, turn it on, and ensure all the elements come on.

## First firing with new elements

We recommend running our first firing program to ensure everything is working correctly, to form a protective oxide layer on the elements, and to seat the new elements into the holders. NOTE: You may experience some smoking from the kiln on its first firing with new elements. This is normal and due to residual oil left on the element wire from manufacturing.

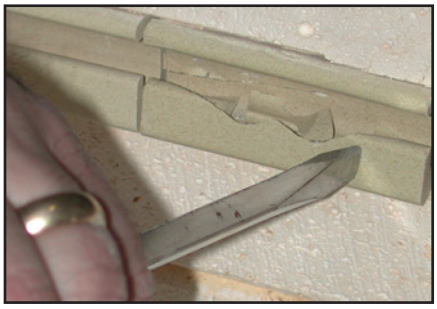
## REPLACING ELEMENT HOLDERS

When ordering a new element holder, provide the kiln's model number and the holder's length. For this information, see the Parts List. Note that if the holder has melted badly, you may need to either replace the brick that holds it or at least patch the brick with our Brick Repair Kit.

### Method #1

This method leaves the kiln intact. You break up the holder, remove it in pieces, and then modify the new holder to snap into the groove.

1. Using a chisel or large screwdriver and a hammer, carefully crack the holder that needs to be removed. Break it into little pieces that can be removed. Take your time with this. And try not to damage the soft firebrick.



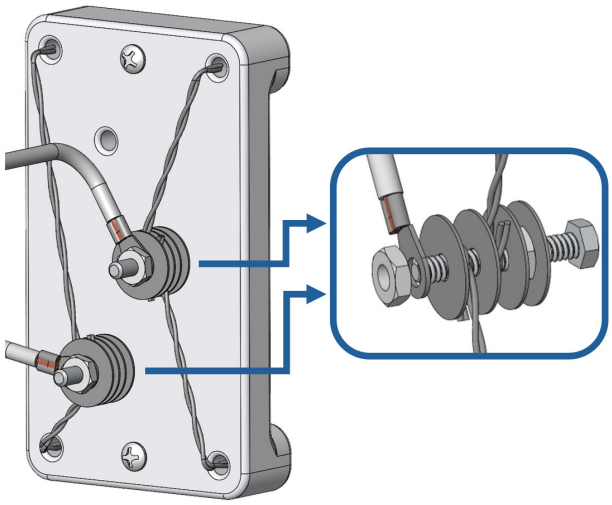
2. Use Linemen's Pliers to snap off the BOTTOM edge of the holder.


### Method #2

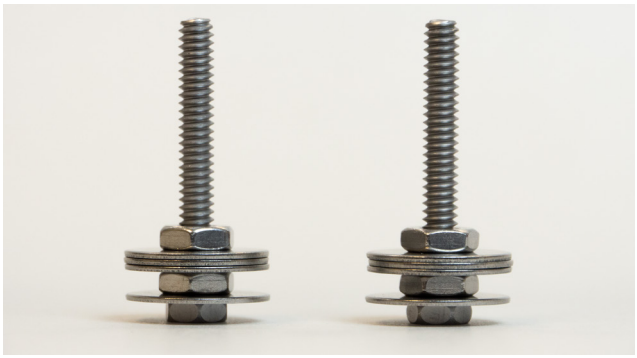
This method requires you to take the kiln sections apart.

1. Remove the section with the bad holder from the kiln and place it on a flat surface like a floor or table.
2. Carefully pull the elements out of the holders and allow them to hang loose. Take great care not to break the elements, as they are very brittle after firing.
3. Loosen the hose clamps holding the stainless-steel band just enough to allow the brick to slide out with slight pressure (so that the other bricks stay in place). NOTE: If you don't have the section on a flat surface, the bricks will all come out of proper alignment.
4. Pull up the brick just enough to slide out the defective element holder and replace it with a new one. Be sure the element holder lines up with the others on either side. Element holders have a top and a bottom, so be sure to correct the orientation.
5. Retighten the hose clamps on the band. Alternately tighten the bottom and top clamp so that you don't cock the stainless casing.

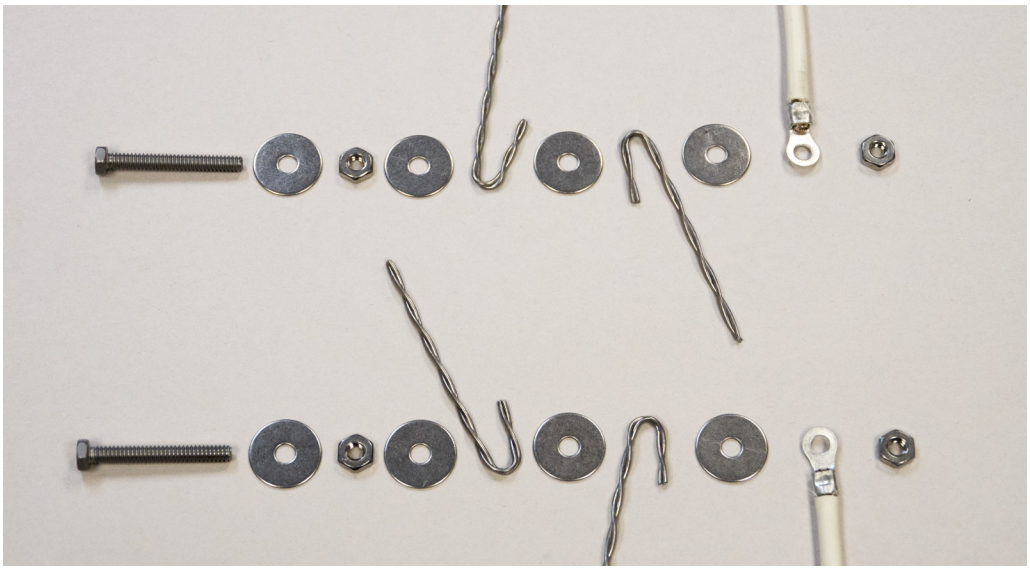
## STANDARD TERMINAL BLOCK WITH PARALLEL WIRING



Hardware Stacked:



Hardware Exploded:

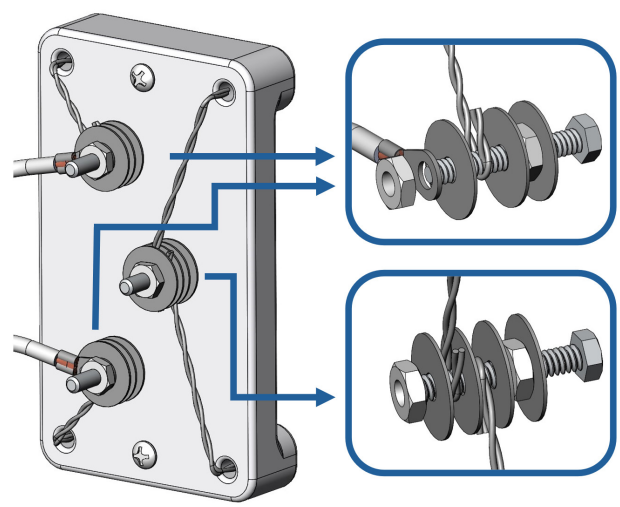


The Standard Terminal Block with Parallel Wiring is the most common configuration and what you are most likely to find on your kiln.

This configuration features two terminal bolts with identical hardware stacked onto each bolt in the following order:

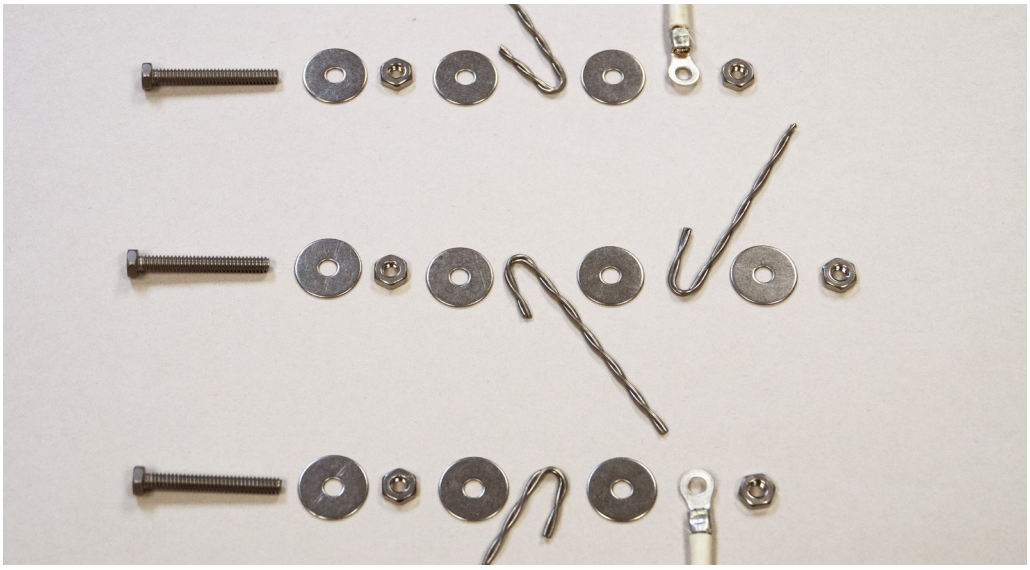
1. Washer
2. Hex Nut
3. Washer
4. Top element tail
5. Washer
6. Bottom element tail
7. Washer
8. Power Wire
9. Hex Nut

## STANDARD TERMINAL BLOCK WITH SERIES WIRING



Hardware Stacked:

Hardware Exploded:



The Standard Terminal Block with Series Wiring is found on the JD230V and most 18" kilns, such as the e18T.

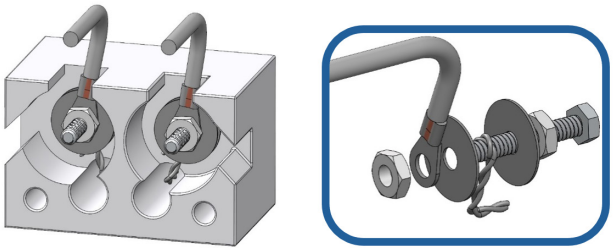
This configuration features three terminal bolts. The two left-side bolts on the top and bottom have identical hardware stacked onto each bolt in the following order:

1. Washer
2. Hex Nut
3. Washer
4. Top or bottom element tail
5. Washer
6. Power Wire
7. Hex Nut

The single right-side bolt in the middle has hardware stacked in the following order:

1. Washer
2. Hex Nut
3. Washer
4. Bottom element tail
5. Washer
6. Top element tail
7. Washer
8. Hex Nut

## M-SERIES TERMINAL BLOCK



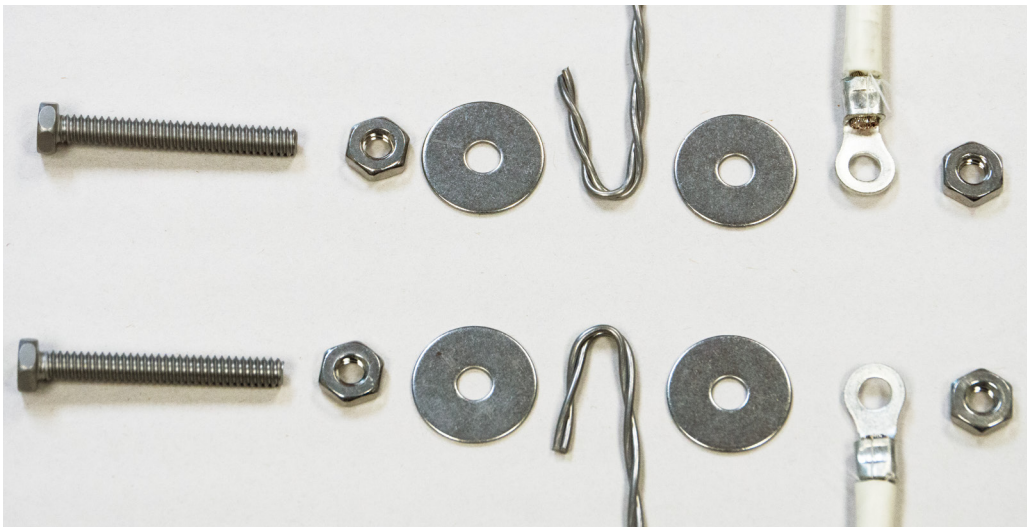
The M-Series Terminal Block is found on the M-Series (middle section) Easy-Fire Kilns.

This configuration features two terminal bolts with identical hardware. This hardware is stacked onto each bolt in the following order:

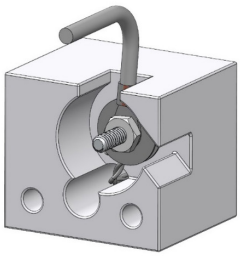
1. Hex Nut
2. Washer
3. Element Tail
4. Washer
5. Power Wire
6. Hex Nut

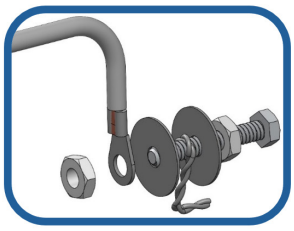
Hardware Stacked:

Hardware Exploded:



## EASY-LOAD TERMINAL BLOCK





The Easy-Load Terminal Block is found in Easy-Load kilns.

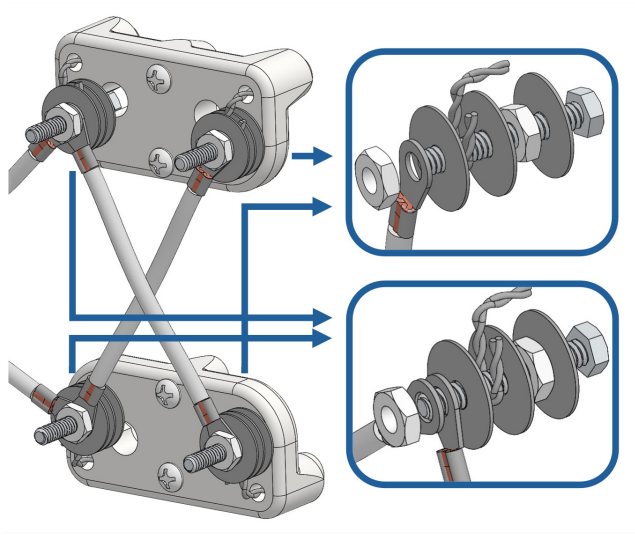
These blocks feature a single Terminal bolt. However, there will be multiple Terminal blocks per section. The hardware is stacked onto this bolt in the following order:

1. Hex Nut
2. Washer
3. Element Tail
4. Washer
5. Power Wire
6. Connection wire (depends on configuration)
7. Hex Nut

Hardware Stacked:

Hardware Exploded:

## UNIVERSAL TERMINAL BLOCK WITH PARALLEL WIRING



The Universal Terminal Block is our new design and will eventually replace the Easy-Load, M-Series, and Standard terminal blocks.

The Universal terminal block with Parallel Wiring will become our most common configuration.

This configuration features four terminal bolts (one for each element tail)

The two left-side bolts have hardware stacked in the following order:

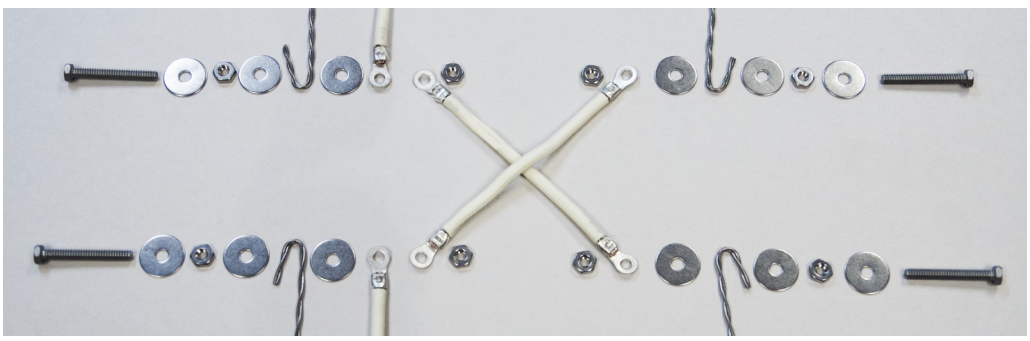
1. Washer
2. Hex Nut
3. Washer
4. Element Tail
5. Washer
6. Jumper Wire (top left to bottom right, bottom left to top right)
7. Power Wire
8. Hex Nut

Hardware Stacked:

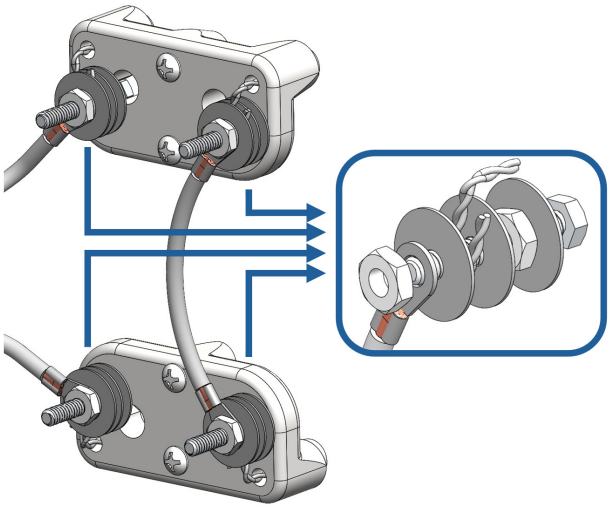
The two right-side bolts have hardware stacked in the following order:

1. Washer
2. Hex Nut
3. Washer
4. Element Tail
5. Washer
6. Jumper Wire (top right to bottom left, bottom right to top left)
7. Hex Nut

Hardware Exploded:



## UNIVERSAL TERMINAL BLOCK WITH SERIES WIRING



The Universal terminal block with Series Wiring will replace the Standard terminal block with Series Wiring and will be found on the JD230V and most 18” kilns, such as the e18T.

This configuration features four terminal bolts (one for each element tail)

The two left-side bolts have hardware stacked in the following order:

1. Washer
2. Hex Nut
3. Washer
4. Element Tail
5. Washer
6. Power Wire
7. Hex Nut

Hardware Stacked:

The two right-side bolts have hardware stacked in the following order:

1. Washer
2. Hex Nut
3. Washer
4. Element Tail
5. Washer
6. Jumper Wire (top right to bottom right)
7. Hex Nut

Hardware Exploded: