QUICK START

INSTALLERS

1. If you need to assembly the kiln read the ASSEMBLY section.

2. If you need to hook up the kiln red the INSTALLATION section. The Wriing diagram is located in the WIRING section.

3. Read the CAUTION section for installation cautions.

USERS

1. Read and understand the CAUTIONS section

2. Read the Operation section. This is all you need to know to operate the kiln.

3. If you want to know more about how to operate the control read the CONTROL section. This is very detailed and can be overwhelming. Use it as a reference and for more sophisticated programming and configuration instructions.

4. For ongoing routine kiln maintenance read the MAINTENANCE section. This is something that the kiln operator is responsible for.

5. For more background information on Ceramics process, Cones, and a Log Sheet see the LOG, CONES, TIPS, CERAMIC PROCESS section.

MAINTAINERS

1. Read the TROUBLESHOOTING section, the WIRING section, the PARTS section and the SERVICE & WARRANTY section.

ADMINISTRATORS

1. See the Safety Data Sheets section if you have any questions about materials used in the kiln.

CAUTION INSTRUCTIONS FOR L&L KILNS

CAUTION INSTRUCTIONS

KILNS THESE CAUTIONS APPLIES TO

CURRENT PRODUCTION KILNS

- Easy-Fire Kilns (e Series)
- School-Master Kilns (SM Series)
- Jupiter Automatic Kilns (JD Series)
- eQuad-Pro Production Kilns (eQ Series)
- JH Crystalline Kilns (JH Series)
- Easy-Load Front-Loading Kilns (EL Series)
- DaVinci Automatic Kilns (X and T Series)
- Doll/Test Kilns (DL and DLH Series)
- Fuego Kilns

OBSOLETE MODELS

- Easy-Fire XT Kilns (eXT Series)
- Liberty-Belle Kilns (LB Series)
- Jupiter Manual Kilns (J Series)
- Econo Kilns (K Series and J Series)
- Programmatic Kilns (B Series)
- Robin Kilns
- Dyna-Kilns (C & H Series)
- Dyna-Kilns (SQ Series)
- Dura-Fire Kilns (D Series)
- Enameling Kilns (E48, E49, R Series)
- Oval Kilns (OV Series)
- Genesis Kilns (G Series)
- Most other L&L kilns

RESELLERS ARE NOT AUTHORIZED TO MODIFY CAUTION INSTRUCTIONS

Distributors and installers of L&L kilns are not authorized by L&L to make modifications or contradict these Caution Instructions (or our Installation Instructions). If L&L's instructions are not followed, L&L specifically disavows responsibility for any injury or damage that may result.

DATED INFORMATION

The information in these Caution Instructions is believed to be correct to the best of our knowledge at the time of publication (see the date at the bottom of this sheet). You can view the most recent update from our web site at ***hotkilns.com/cautions*** at any time.

SAFETY NOTICE

1. All cautions and requirements recommended by L&L Kiln Mfg. Inc. are meant to assist users to properly and safely operate their kilns. Many of these cautions apply to kilns and ceramic processes in general. Other process and materials are outside the scope of these Cautions. If you are firing other materials than ceramics there may be issues such as outgassing or explosive hazards that you need to carefully investigate before firing in a kiln.

2. By making use of, and/or downloading from, this web site, user acknowledges that process and manufacturing systems improperly installed, maintained, or operated can pose serious and dangerous threats to worker safety, environmental integrity, and product/process quality.

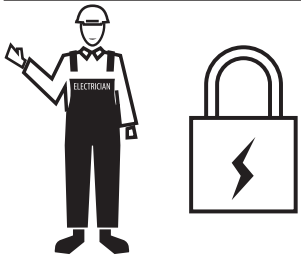
3. Kilns operate at high temperatures and make use of high voltages/amperages and if improperly installed, maintained, or used, can cause serious personal or property damages.

4. Commercial kilns are provided with various safety, performance, and operating limits, designs and devices which, if disconnected, altered, tampered with, or changed by user, user's employees, user's agents, or others acting on user's behalf or with user's knowledge, will become user's sole risk and responsibility.

5. User also has the sole responsibility for assigning properly trained persons to operate the kilns who have demonstrated common sense and a general aptitude for such work.

6. It is user's sole responsibility to understand and assure adherence to all safety notices and installation, operating, and maintenance instructions provided by L&L Kiln Mfg., Inc.

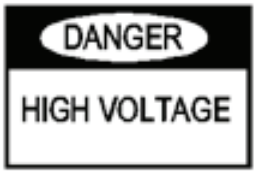
ELECTRICAL SAFETY



GENERAL

Electricity can be dangerous if not approached carefully. There are three basic hazards that cause injury or death – shock, arc-flash, and arc-blast. It is important to remember that even a small amount of current passing through the chest can cause death. Most deaths occurring for circuits of less than 600 volts happen when people are working on "hot," energized equipment – **PLEASE DISCONNECT AND LOCK OUT ALL ELECTRICAL POWER BEFORE ATTEMPTING KILN REPAIRS!**

ELECTRICAL HAZARDS



SHOCK

An electrical shock is a current that passes through the human body. Any electrical current flows through the path of least resistance towards ground; if an external voltage contacts a human body, e.g. by touching a live wire with the hand, the voltage will try to find a ground, and a current will develop that flows through the body's nervous system or vascular system, and exit through the closest part of the body to ground (e.g., the other hand which may be touching a metal pipe.) Nerve shock disrupts the body's normal electrical functions, and can stop the heart or the lungs, or both, causing severe injury or death.

ARC-FLASH

An arc-flash is an extremely high temperature conductive mixture of plasma and gases, which causes very serious burns when it comes into contact with the body, and can ignite flammable clothing. Arc temperatures reach up to 35,000°F – which is 4X the temperature of the sun's surface.

ARC-BLAST

Arc-blast is a pressure wave resulting from arcing, which can carry molten metal fragments and plasma gasses at very high speeds and distances. This can not only carry very hot shrapnel to injure a person, but can actually be strong enough to destroy structures or knock workers off ladders.

SAFETY PRINCIPLES

Be safe! Make sure any equipment that is being installed or serviced is disconnected from all sources of power. In industry, it is important to have 'Lockout and tagout' procedures in place to make sure that power stays disconnected while people are servicing equipment. It is just as important in residential and commercial sites – DO NOT

WORK ON LIVE EQUIPMENT UNLESS ABSOLUTELY NECESSARY!

Use the right tools for the job – do not improvise. For instance, use a proper fuse puller; don't use a screwdriver to pry out an open fuse.

Protect the person; use proper gloves, shoes, and clothing. In industry it is recommended to wear safety goggles or face shields to prevent arc-flash or arc-blast injuries. Wear rubber soled shoes.

Make sure the environment around the equipment being serviced is safe. For instance, when working around electricity, **it always very dangerous for the floor to be wet.** Make sure there is adequate space to work safely.

Be aware that current flow across your chest can be fatal. If possible, use only one hand to manipulate test leads when conducting any necessary measurements on live equipment. Use a clamp for one lead, and use one hand to guide the other test lead. Keep the other hand as far as possible from the live circuit components.

INSTALLATION CAUTIONS

USE A QUALIFIED ELECTRICIAN

1. Have electrical installation performed by an licensed electrician or other qualified technician.

2. There is danger of electric shock.

3. There is danger that an improperly sized or installed circuit could cause a fire.

CLEARANCES AND FLAMMABLE SURFACES

1. Make certain floor is not flammable.

2. Install kiln so that the hot surface of the kiln is no closer than 12" (30 cm) to any wall. 18" (46 cm) is preferable.

3. Be careful about enclosed spaces: In general, it is not a good idea to install a kiln in a small confined space (such as a closet).

4. Maintain a minimum of 36" (91 cm) between the hot surfaces of two adjacent kilns, especially if they are going to be used at the same time. (The kilns will heat each other).

5. The essential issue with kiln clearance is to keep excessive heat from flammable surfaces. Remember, even when you follow clearance and ventilation recommendations, the kiln is giving off heat. Try not to place the kiln near things that can be affected by elevated temperatures. An example would be an electrical fuse panel which you do not want to overheat.

CHECK TEMPERATURES AROUND KILN

1. Check temperatures around the kiln when it is at high fire to be sure that you are not creating an unsafe condition.

2. Combustible surfaces that stay below 71°C (160°F) are generally considered safe from the point of view of starting a fire.

LEVELING THE KILN

1. Level the kiln while you are installing it.

2. Use thin metal shims under the legs to accomplish the leveling (never wood or other combustible materials).

3. Make sure that the base will not wobble.

4. Leveling is important because the kiln sitter (in older manual kilns) is affected by gravity. If the kiln is not properly leveled the kiln sitter might be either too reactive or too sluggish.

5. You do not want your ware to be unstable in the kiln. It might fall over.

6. If kiln is not leveled this could lead to the cracking of the bottom and the top. In particular, the bottom could easily crack when you first set the weight of the kiln on the bottom while setting up the kiln for the first time.

ADJUSTING THE HINGE PROPERLY

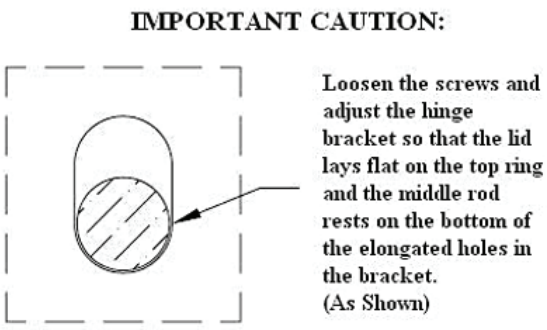
1. See the assembly instructions for your specific kiln. (Assembly instructions are available at ***hotkilns.com/assembly-instructions***)

2. **CAUTION: DO NOT attempt to disengage the spring hinge without first reading the detailed assembly instructions.** The spring is under great pressure and could cause severe injury if it is removed under pressure. **RELIEVE ALL SPRING TENSION BEFORE REMOVING! OPEN LID COMPLETELY!**

3. The hinge of any kiln must be adjusted so that expansion caused by the heating process has room to expand up and down. (L&L includes expansion slots in the hinges.)

4. An improperly adjusted hinge can damage the top kiln rim and/or lid by compressing and breaking the brick near the hinge.

5. CAUTION: It is critical that the hinge bar sits in the bottom of slot. This is to allow the lid to rise and fall slightly as the kiln heats and expands without putting stress on the lids connection points and potentially damaging the lid.



THERMOCOUPLES

1. Thermocouples (in automatic kilns) must be inserted into the kiln at least 1” (2.5 cm) in from the inside surface of the kiln.

2. They must protrude into the kiln itself because, if the measuring tip of the thermocouple is buried inside the insulation, the thermocouple will measure a lower temperature than the actual temperature in the kiln.

3. This could cause an overfire of the kiln.

4. Replace thermocouples once they are no longer reasonably accurate. (Note: Type K thermocouples last about the same as kiln elements so it is recommended to change thermocouples when you change elements.)

USE THE SUPPLIED KILN STAND

1. **Do not use kiln without the factory supplied stand.**

2. Never set a kiln on a floor without significant air space circulating under the kiln.

3. L&L stands typically raise the floor of the kiln by 8” (20 cm).

4. Using a proper stand is critical because, without a kiln stand that moves the radiant heat of the kiln away from the floor, some flooring could catch on fire. For instance, over time the radiant heat from the kiln can cause wood to lose its moisture and lower the autoignition temperature. (The autoignition temperature is the specific temperature at which a substance ignites and causes a fire.)

DON’T USE AN EXTENSION CORD

1. Never use an extension cord with your kiln. The extra length of the wire could cause the cord to overheat and catch on fire.

2. Extension cords, with their multiple connections and potentially mismatched wire gauge for the load, could cause a fire when used with a continuous resistive load like a kiln.

3. Locate the outlet close enough to the kiln to plug directly into it with the kiln’s supplied power cord.

4. Kilns that pull over 48 amps and some three phase kilns generally will not have a power cord. These kilns need to be direct-wired in to the power supply.

POWER CORD MUST BE PROPERLY RATED

1. All L&L power cords are rated for 105°C (221°F).

2. Any cord temperature rating less than 105°C can cause a malfunction and possible fire where the power leads connect to the control box.

3. It is OK, and will not void the warranty, to remove the plug that comes with the kiln and direct wire the kiln. However, the connection wires must be rated for a minimum of 105°C (221°F).

USE COPPER WIRE FOR HOOK UP

1. Do not use aluminum wire on the final connection to the kiln.

2. The specific reason particular to kilns is that the wire tends to get hotter near the kiln than it might going into some other types of appliance.

3. Being a resistive load, there is constant heat being generated by the conductors for quite a few hours. When aluminum wire gets hot it accelerates oxidation. Aluminum oxide is a resistor; copper oxide is not as much. If the connection at the terminal board gets oxidized it will really heat up - to the point where it could cause a fire.

4. Note: Depending on local codes it may be OK to use aluminum wire to your subpanel - as long as that wire is not exceeding its temperature rating while kiln is firing on full power for an extended period of time.

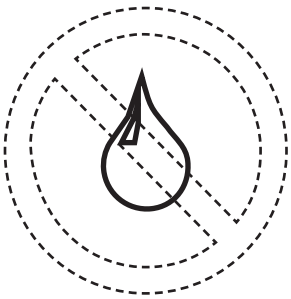
PROTECT POWER CORD FROM KILN CASE

1. Route Power Cord (or electrical connection wires) away from kiln in such a way that the wires can not touch the hot case of the kiln.

2. Secure the cord so it can not move.

3. If the cord touches the hot case it could melt and cause a short circuit and/or fire.

KEEP KILN DRY & IN PROTECTED SPACE



1. The kiln must be kept dry.

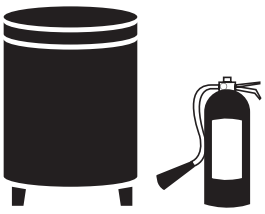
2. It is best to keep it in an enclosed room away from inclement weather. See specific details in the INSTALLATION INSTRUCTION section of your instruction manual or on-line at: ***hotkilns.com/easy-school-install*** or: ***hotkilns.com/general-installation-instructions.***

3. Note that warranty does not cover damage from corrosion and electrical damage caused by inclement weather.

4. Water in contact with a kiln can cause an electrocution hazard.

5. If you keep a kiln outside (even in a very dry environment) and cover it with a tarp to protect it from rain you could still cause corrosion from the dew that forms on the cold metal surface of the kiln in the morning.

KEEP A FIRE EXTINGUISHER NEAR KILN



1. Keep an adequate fire extinguisher near the kiln and check it on a regular basis.

2. Check with your local fire authorities to see if there are any specific requirements concerning sprinkler systems, automatic foam extinguishers, etc.

3. Use a fire extinguisher that is rated for electrical fires (ABC rating is recommended).

SPRINKLER CAUTIONS

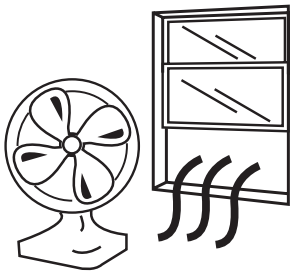
1. If you have a sprinkler system be careful to check the temperature rating and location of the heads so that you do not inadvertently cause them to actuate under normal firing conditions.

2. Be sure to monitor temperature while the kiln is at its highest firing temperature and conditions are at their worse (for instance when the door to the kiln room is closed or the ventilation fan is turned off). **Serious damage to the kiln and your premises can take place if the sprinkler system goes off when the kiln is at high temperature** - especially if no one is in the building when it happens.

3. See the following web page for guidance on how to calculate ventilation requirements for a kiln room: ***hotkilns.com/calculate-kiln-room-ventilation***

GENERAL ENVIRONMENT CAUTIONS

VENTILATION IS ESSENTIAL



1. Kilns generate harmful fumes when firing ceramics.

2. Fumes include carbon monoxide, sulfur oxides, hydrogen fluoride and metal vapors (all of which can be very toxic).

3. Install kiln in well-ventilated area.

4. Never operate in an enclosed space such as a closet unless you have good ventilation in that space. See the following web page for guidance on how to calculate ventilation requirements for a kiln room: ***hotkilns.com/calculate-kiln-room-ventilation***

5. Aside from issues of ventilating the fumes from the firing, the heat build up in an enclosed room could present a significant fire hazard. See the INSTALLATION cautions.

6. Severe corrosion can be caused by kiln fumes, salt air or other environmental conditions.

7. Good venting can minimize these problems.

8. Ventilation must be to the outside.

9. Be careful not to locate the outlet of the vent near an open window.

AMBIENT TEMPERATURES

1. The kiln should operate in an environment that is between -18°C (0°F) and 38°C (100°F).

2. Note that the control, if set up for degrees centigrade, may give you an error code if room temperature drops below 0°C (32°F). The DynaTrol and most other controls do not handle negative numbers.

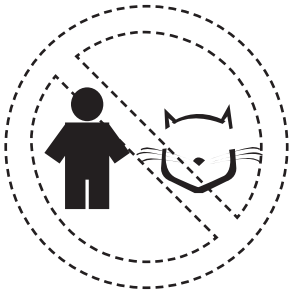
SURFACE IS HOT AND CAN CAUSE BURNS

1. Kiln surface can be extremely hot: up to 260°C (500°F).

2. You can be severely burned if you touch the hot surface.

3. Display a sign near the kiln that specifically warns everyone of how hot the kiln is.

KEEP CHILDREN/ANIMALS AWAY FROM KILN

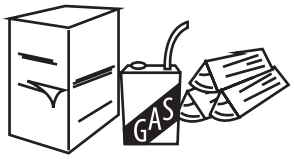


1. Protect any children, animals, and unqualified adults (anyone who is not able to understand these cautions) that may be near the kiln.

2. Aside from fumes that must be ventilated, and flammability concerns, they must be protected from the heat of the kiln and the electrical dangers.

3. Ideally, the kiln should be secured in a space away from any children (especially in a schoolroom situation where children might not always follow safety precautions).

KEEP FLAMMABLES AWAY FROM KILN



1. Do not put sealed containers or combustible materials such as solvents, paper, rags, kerosene, paints, cesium, magnesium, aluminum powder, calcium, sawdust, plastic dust, coal, flour and powdered metal, in or near kiln. An explosion or fire could result.

2. The kiln elements could act as an ignitor of flammable fumes when hot.

PRACTICE GOOD HYGIENE

1. Clay contains silica dust which can be harmful (see silica caution) and some glazes contain heavy metals such as lead, cadmium and copper.

2. While this caution is outside the scope of kiln safety it is worth mentioning here.

3. Keep your room clean and your kiln clean.

PROPER USE OF KILN WASH

1. Make sure the floor of the kiln and the tops of the shelves are coated with kiln wash.

2. This will protect these surfaces from melting glaze and ceramics.

3. Do not coat the undersides or sides of the shelves.

4. Do not apply kiln wash to the brick sides or element holders. (Damage to the elements could result).

5. If you have a kiln sitter, put kiln wash on the cone supports (not the sensing rod) for accurate cone action.

6. Clean off the old wash and reapply new wash each time you fire or when it begins to chip away.

7. Be aware of any hazardous warnings on your kiln wash. Most kiln wash contains silica.

TRIPPING HAZARDS

1. Be sure to remove tripping hazards near the kiln.

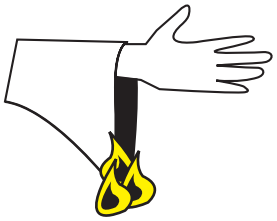
2. In particular be sure to keep the kiln cord out of traffic areas.

CLOTHING TO AVOID

1. When working around a hot kiln be careful of the kinds of clothes you are wearing.

2. Some clothes could potentially catch on fire if they touch the hot surface of a kiln.

3. Also avoid loose fitting clothes that could catch on the kiln.



PREFIRING CAUTIONS

KILN WASH CONTAINS SILICA

1. Long term exposure to silica dust could cause lung damage.

2. Exercise proper caution when mixing the dry powder and when removing it from your shelves.

4. Use a NIOSH approved particulate respirator for dust and use proper ventilation. You can buy these from safety supply houses. (NIOSH_approval #TC-21C-132 is an example).

5. L&L does not sell kiln wash but you can obtain it from your ceramic distributor where you buy clay.

DO NOT USE SILICA SAND

1. Do not use silica sand in the kiln.

2. Some people like to use this as a work support medium.

3. The silica sand will attack the elements and thermocouples.

4. It can migrate in the kiln from expansion and movement due to heat.

5. If you must use sand to support or stabilize your load try alumina oxide or zirconia oxide sand.

NEVER FIRE MOIST GREENWARE

1. Never load moist greenware or pots in your kiln.

2. The expanding water vapor in the ware could cause the ware to explode, damaging your kiln interior.

3. We recommend using a dry out segment in your bisque program at 66°C (150°F). (Note that, because of the thermocouple offset programmed into our DynaTrol when we use the ceramic protection tubes, the display temperature will read 93°C (200°F) when the real temperature is 66°C (150°F)).

4. Remember that there may be water trapped in the work even if you can't always see it. If you place a piece of greenware next to your wrist and it feels cool to the touch it probably has too much moisture in it to fire.

CAUTION WITH USE OF WAX

1. When you heat wax (in wax resist and lost wax processes) it will volatilize and potentially condense in the cooler ventilation ducts.

2. Over time this can cause a fire hazard because the wax is flammable.

3. Depending on how the vent motor is mounted, the wax can also gum up the vent motor.

4. If you use these processes it is entirely up to you to engineer and monitor the safety of the installation.

5. The use of wax will void the warranty of the vent system.

DO NOT FIRE TEMPERED GLASS

1. Tempered glass can explode when fired.

STORE SHELVES IN A DRY LOCATION

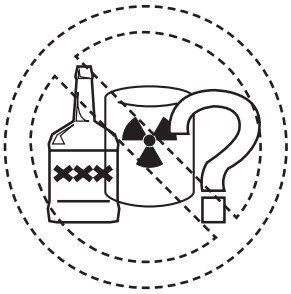
1. Shelves can absorb moisture.

2. This can cause them to explode when fired. (This is especially true of nitride bonded silicon carbide shelves).

DO NOT USE CRACKED SHELVES

1. Cracked shelves can fail in the middle of a firing causing the whole load in your kiln to collapse.

DO NOT FIRE TOXIC, FLAMMABLE, OR UNKNOWN MATERIALS



1. Plastics, organic materials, bakeable modeling clay, mothballs and a large variety of materials can decompose under heat causing the release of highly toxic fumes or rapid uncontrollable combustion.

2. Rocks, marbles, cement and other materials may explode under high temperatures.

3. Before firing anything but ceramics, glass and metal (obtained from a known reputable source) in a kiln carefully investigate what happens under heat.

4. This is the sole responsibility of the user.

5. The kiln is not designed to be used for firing hazardous materials. Doing so will void kiln warranty.

6. Adding propane, wood, charcoal or other materials intended to produce a reduction atmosphere can be hazardous if the volume is sufficient. Note that these materials can cause an explosion under certain conditions (just the right amount of air and flammable gasses at just the right temperature) which could cause injury or death. Moreover, a reducing atmosphere can cause premature element failure by reducing the protective oxide coating on the elements. Also note that carbonaceous materials will produce poisonous carbon monoxide and highly flammable hydrogen as they decompose at high temperatures. Also note that the “auto-ignition” temperature of flammable gasses is generally above 1400° F.

LOADING & UNLOADING CAUTIONS

TURN OFF POWER WHILE LOADING

1. Turn off power to the kiln when loading or servicing.

2. If power is on when you are loading or unloading the kiln it is possible to touch the elements and get electrocuted.

3. We recommend having the kiln attached to a fused disconnect switch with a lockout device (in any institutional or industrial installations where someone could turn on the kiln while someone else was working on it).

KEEP LID CLOSED WHEN KILN IS NOT IS USE

1. Keep lid closed when not operating the kiln.

2. Otherwise the weight of the lid over time may force the hinge and stainless wrap to move down.

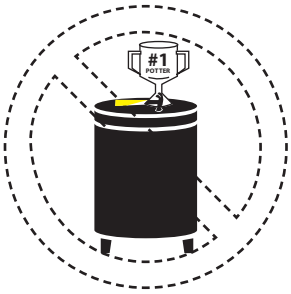
3. This will affect the way the lid closes and may cause the lid to crack.

4. It will also keep the kiln cleaner by keeping dust out.

5. In addition, if the kiln somehow gets turned on accidentally, an open kiln could present a fire hazard.

CAUTION INSTRUCTIONS FOR L&L KILNS

DO NOT STORE ANYTHING ON LID

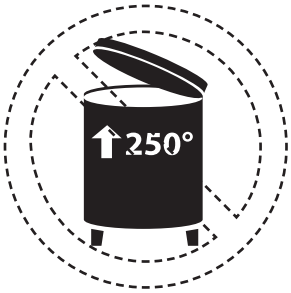


1. Do not use the lid as a storage shelf.

2. The lid could crack.

3. Also - this practice could lead to a fire if you accidentally leave combustible materials on the lid.

DO NOT OPEN THE DOOR ABOVE 250°F



1. Do not open the kiln door until the kiln has cooled down to 250°F (120°C).

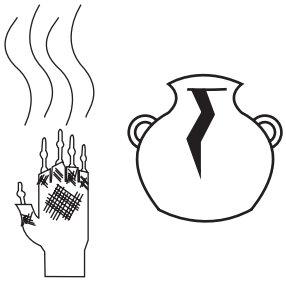
2. You could burn your hand on the handle and/or the radiant heat from the kiln.

3. Be careful when you do open the door at this temperature because you can still get burned.

4. Use heat resistant gloves when opening the door. (These are available from L&L).

5. For ventilation purposes, some people fire with the lid slightly propped open 1" to 3" during the beginning phase of the firing (if they do not have a downdraft vent system). **Be aware of the potential dangers of doing this (heat, live electricity, fumes and potentially cracking the lid) and take appropriate measures to protect yourself, the kiln, and the kiln room.**

DO NOT UNLOAD KILN WHILE HOT



1. You may burn yourself

2. You may harm your work.

BE CAREFUL OF SHARP OBJECTS & GLAZE

1. Stilt marks and other sharp protrusions can cut you.

2. Remember that glaze is like glass.

3. Wear safety glasses while grinding or knocking of stilt marks.

4. Check the shelves for broken bits of glaze which may have attached to the shelves. These can be like shards of glass that can cause a serious cut.

SECURE LID WHILE LOADING OR UNLOADING IF YOU HAVE A SPRING-LOADED EASY-LIFT HINGE

1. Be sure to LOCK THE LID IN PLACE with the spring-loaded plunger pin located on the side of the hinge.

IF YOU HAVE A DAVINCI COUNTERBALANCED LID

1. Be sure to LOCK THE LID IN PLACE with the safety hooks when in the up position.

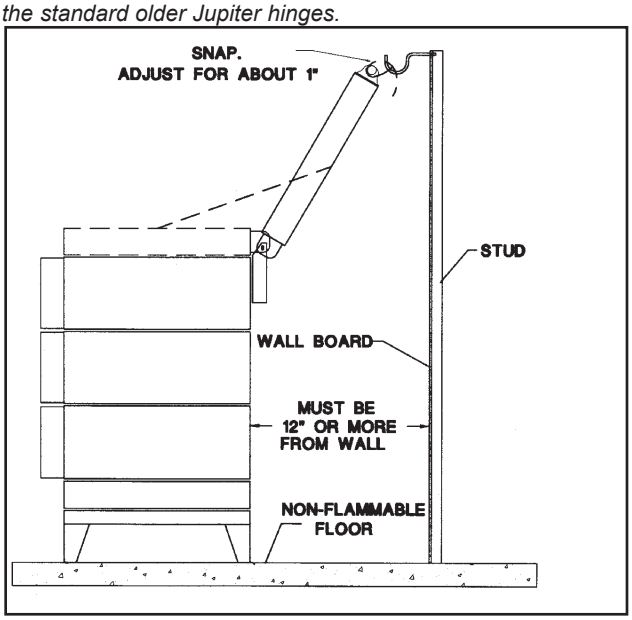
2. There is one on each side of a DaVinci kiln. Use both chains.

IF YOU HAVE A BASIC HINGE WITH CHAIN SUPPORTS

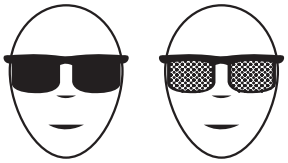
1. A special safety system is supplied with your Fuego, e18S-3, e18M-3, e18T-3, J18-3, or J18X-3 kiln (and some other older models). This is a door safety chain.

2. It secures the lid in an open position when you are loading or unloading the kiln and ensures that the lid can not accidentally come down on you. You must install and use this for your safety's sake.

This drawing shows the safety chain installation and use for the standard older Jupiter hinges.



VIEWING INTO THE KILN



1. Use dark glasses (shade number 1.7 to 3.0) to view inside the kiln through the peepholes when firing. These will protect you from the radiant infrared radiation and will also protect your eyes in case the ceramic ware explodes. Do not use regular sunglasses for this - they are not designed to protect your eyes from this type of radiation.

2. Use heat resistant gloves when opening peephole plugs. They are very hot and can burn you.

3. Do not open the kiln lid unless the kiln is turned off (except for carefully controlled troubleshooting tests). There is danger from electrocution. Cracks caused by propping open the lid are not covered by the warranty.

4. Use heat resistant gloves when opening a hot lid.

5. Do not open the lid when the kiln is above 121°C (250°F).

FIRING CAUTIONS

ATTEND THE FIRING

1. We recommend attending the kiln while firing.

2. **NO AUTOMATIC SAFETY DEVICE IS FOOLPROOF!** Be especially careful about attending the kiln when it is supposed to shut off. (The Delay feature in automatic kilns gives you control over this).

3. If you have a manual kiln with a Kiln Sitter PLEASE BE EXTRA CAREFUL! Kiln sitters can be very unreliable because of the moving parts, dirt or clay that can get into the tube, the way cones are placed on the tube, corrosion, etc. **DO NOT FIRE THIS KILN UNATTENDED WHEN THE KILN IS SUPPOSED TO TURN OFF AND LEARN HOW TO USE THE TIMER BACK UP.** Neither L&L Kiln Mfg., Inc. nor Edward Orton Jr. Ceramic Foundation warranty the kiln or kiln sitter against damage caused by overfiring. ***We highly recommend firing all manual kilns with witness cones that you can see through the peephole and/or a pyrometer so you have some idea of what is happening inside the kiln.***

4. The controller is used to control temperature; it is not a safety device.

5. For industrial applications, or for situations where firing high value loads, we recommend the use of a high limit back up control with back up contactors. This available as an option on certain model kilns.

MAKE SURE YOUR KILN SITTER IS ADJUSTED

1. If you have a manual kiln (or the Kiln Sitter backup on an automatic kiln) be sure it is properly adjusted.

2. See the Kiln Sitter instructions.

3. Overfiring could result.

4. Note that the kiln sitter could have gone out of adjustment during shipment. Do NOT assume that it is adjusted when first firing the kiln.

5. The tube assembly should be replaced if gets overly corroded or contaminated with condensed glaze or other materials. Dawson recommended checking the pivot point for corrosion and sluggishness every 6 to 12 months.

USE KILN WASH ON THE CONE SUPPORTS

1. If you have a kiln sitter, put kiln wash on the cone support (but not the sensing rod) for accurate cone action.

2. This will keep the cones from sticking when they bend.

3. We recommend cleaning off the old wash and reapply new wash each time you fire.

UNDERSTAND YOUR CONTROL

1. Become familiar with either the control (if you have an automatic kiln) or the Kiln Sitter (if you have a manual control or have that as your backup control).

2. Do this before operating the kiln.

PROGRAM REVIEW ON AUTOMATIC KILNS

1. Review the current program before firing to ensure the correct profile is programmed.

2. You may pick up an important mistake and save a whole load.

3. Hit **Review Prog** after you have done your programming and the control display will scroll through the program. It only takes a minute or less.

DO NOT CONFUSE CONE NUMBERS

1. Cone ratings are not intuitive. Cones with an “0” in front of them (like cone 05) are lower in temperature rating and the higher the number the lower the temperature rating. On the other hand cones with no “0” in front (like Cone 5) raise in temperature as the number gets higher.

2. For instance, Cone 05 is a much lower temperature than Cone 5 for instance. If you fire Cone 05 clay to Cone 5 you could cause a serious overfiring of the material which could melt in your kiln and cause severe damage to the kiln interior.

3. See the Orton cone chart. ***(hotkilns.com/orton-cone-chart)***

USE THE PROPER THERMOCOUPLE

1. Never use a different type of thermocouple with your controller unless it has been set up from the factory (or unless you carefully go through the process of changing from one type to another).

2. For instance if you used a Type S thermocouple on a control set up for Type K you would overfire your kiln.

3. On some controls (like the newer DynaTrols) it is possible to change thermocouple types. However, this involves both a programming change and a jumper change on the control. It also requires you to change out all the thermocouple lead wire to properly calibrated wire for the new thermocouple type. (See: ***hotkilns.com/change-thermocouple-type***)

CHECK THERMOCOUPLE CALIBRATION

1. Thermocouples will drift in reading over time.

2. This could potentially lead to an overfiring before the thermocouple actually fails.

3. Although you can not easily check thermocouple calibration, the general accuracy of the entire kiln system can be checked by firing with witness cones. See the LOG, CONES & CERAMIC FIRING section or ***hotkilns.com/troubleshooting-cones***. Also see this video: ***hotkilns.com/firing-kiln-witness-cones***.

4. L&L recommends changing your Type K thermocouples when you change your elements.

SHUT OFF KILN AT DISCONNECT OR CIRCUIT BREAKER

1. It is possible for electrical contacts on contactor relays to fuse together.

2. If this happens power will continue to flow to the elements and your kilns could overfire even though everything on the kiln is shut off.

3. You should turn kiln off from the circuit breaker or fused disconnect switch after turning off the kiln itself.

DO NOT FIRE KILN ABOVE 2350°F (1290°C, Cone 10)

1. Most L&L kilns are rated for use to 2350°F (1290°C, Cone 10).

2. The rating of the kiln is listed on its data nameplate normally affixed to the control panel.

3. **DO NOT FIRE ANY HIGHER THAN THIS** or hold for extended periods of time at those temperatures.

4. The elements, element holders and firebrick could melt.

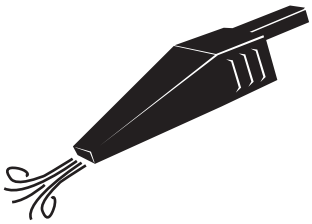
POST FIRING CAUTIONS

CHECK FOR GLAZE AND CERAMIC CHIPS

1. Check element holders and walls for glaze, clay chips or anything that could melt at a high temperature.

2. If melted clay or glaze comes in contact with an element, a rapid failure could result. The molten material traps the heat radiating from the element and subsequently raises the surface temperature of the wire. The temperature will quickly pass the maximum recommended temperature for the wire and burn it.

3. To clean holders, a good shop vacuum **with a HEPA filter** will handle dust and loose crumbs. A very gentle chisel or grinder may help with glaze contamination on element holders, but remember that the elements themselves are quite brittle when they are cool.



4. Replace the contaminated holder if you can not clean it.

5. Remove any glaze that has splattered on the firebrick or shelves. **(USE SAFETY GLASSES WHEN DOING THIS BECAUSE GLAZE CAN BE LIKE BROKEN GLASS).** Vacuum afterward. Note about vacuuming: it is possible to build up a strong static electricity charge when you are vacuuming. If this somehow manages to discharge into the control it can ruin the electronic circuit. Make sure vacuum is grounded and periodically touch some grounded metal surface away from the kiln to discharge the energy.

GENERAL MAINTENANCE CAUTIONS

ELECTRICAL SAFETY

1. Shut off kiln when servicing it. Use an approved lock out/tag out procedure to make sure that no one servicing the kiln gets injured or killed.

2. **The elements carry high voltage and can electrocute you.** Many of the tests described in the troubleshooting manual 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.

3. As long as the kiln is unplugged or turned off at the fused disconnect switch or circuit breaker (and checked with a reliable meter to be sure) you are safe.

4. When checking element resistance, disconnect kiln from power by unplugging kiln or turning off at the fused disconnect switch or circuit breaker. Lock out if appropriate.

CHECK WIRES & TERMINALS

1. Check wires for deterioration or oxidation or burns.

2. Replace any that seem brittle or where the wire insulation has deteriorated, fallen off or burned off.

3. Check terminals for oxidation (discoloration).

4. If you are near salt air or if you notice corrosion on the stainless exterior of the kiln for whatever reason (like certain fumes generated by your work) then do this far more frequently.

5. Check power connection terminals in the kiln and control box for tightness. Be sure to do this with the power disconnected (unplugged) for the kiln. If these terminal connections get loose heat can be generated (because the electrical resistance gets greater) and this can cause a fire.

6. Check thermocouple connections for corrosion, tightness and oxidation as well. A bad thermocouple connection can change the accuracy of the temperature reading which could cause an overfiring.

CHECK TEMPERATURE OF CORD

1. Occasionally check temperatures of the main power cord at the main receptacle and the main kiln breaker while the kiln is at its hottest.

2. If these are hotter than normal, it could be a sign of a loose or corroded connection, or possibly the wire gauge used in the power hook-up is the wrong size for the amount of current being drawn by the kiln.

3. Immediately diagnose and fix this because it could cause a fire.

4. Also check temperature of any other cords on the kilns (such as element jumper cords).

CHECK FOR CORRODED CONNECTIONS

1. When replacing infinite zone switches (and other electrical components), replace the electrical connectors.

2. At the very least check for discoloration (an indication of oxidation).

3. Electrical connectors will typically oxidize over time where there is heat and this can cause further overheating of the part at the connection point. This can in turn lead to early failure of the part, wire and connector.

4. Make certain that the new connectors are firmly crimped onto the wire.

THE WRONG PARTS CAN BE HAZARDOUS

1. Non-L&L elements can present a potential hazard to the kiln or cause a fire (by drawing too much amperage).

2. The wrong type of fuse, relay, switch or other component can cause a fire or other hazardous condition.

3. An improperly rated cord can cause a fire.

VIDEO ABOUT GENERAL MAINTENANCE

See this video for some general maintenance tips: ***hotkilns.com/maintaining-kiln***

KILN MODIFICATIONS CAUTIONS

COATINGS

1. We can not at this time recommend any coatings for the elements.

2. Use of ceramic coatings will void the warranty on the elements and potentially the firebrick or element holders if it contaminates them.

3. Some people have reported success with ITC coating and some people seemed to have caused problems with this coating.

4. We have not adequately tested these coatings so we can only say, at this time, that any trouble that results from the use of ITC and other coatings must be at the risk of the user.

5. We do use a proprietary coating on all our firebrick that improves firebrick life and reduces dusting.

OTHER MODIFICATIONS

1. All customer modification is made solely at the risk of the customer.

2. Modifications will void the warranty.

3. L&L takes no responsibility for hazardous conditions created by unauthorized modifications.

4. Any authorization for an engineering change must be in writing from the factory.

DO NOT OVERINSULATE KILN

1. You may add insulation to the bottom, and to some extent the top.

2. If you put too much insulation on a lid it may weaken because it relies on the cooling of the lid to maintain its structural strength. This could lead to cracking or potentially a collapse of the lid.

3. See the various troubleshooting guides for information about this.

4. However, never wrap insulation around the perimeter of a typical sectional kiln.

5. You could trap heat in the wiring boxes and cause an electrical fire.

6. Also the stainless steel wrap that hold the kiln together will expand and loosen the structure of the kiln.

DOLL INSTRUCTION MANUAL

L&L Kiln's patented hard ceramic element holders protect your kiln.

FIRST FIRING FOR L&L KILNS WITH A DYNATROL OR GENESIS

WHEN TO DO A FIRST TEST FIRING?

Once your kiln is set up, leveled properly (very important), control panel hooked up to the kiln correctly, and all the power wired properly, you are ready for your first firing. Read these instructions and plan your time accordingly.

VIDEO ON HOW TO PROGRAM

See this video for help in programming your DynaTrol for the first firing:
hotkilns.com/programming-first-firing

WHY DO A TEST FIRING?

The test firing is done very slowly, about 16 to 19 hours total to minimize the inner and outer surface temperature differences in the kiln while it goes through its maiden firing. Also this will slowly steam off any moisture absorbed by the firebrick during construction, shipping, and storage.

The test firing is done to cone 5 (about 2167°F) to vitrify the special coating on the inside on the firebrick and to allow an “aluminum oxide” coating to form on the element’s surfaces.

The coating on the top and bottom helps to strengthen the surface of the firebrick, and helps prevent dusting in the kiln.

The oxide layer on the elements helps to protect them from the many contaminants found in many materials fired in a kiln. This aluminum oxide layer will rejuvenate itself every time there is an oxygen rich firing to a high temperature. Going to cone 5 may also point out any problems with your electrical service - like low or incorrect voltage or wrong supply line wire size.

The elements will also seat themselves in the ceramic holders - and any springiness you see when you first get your kiln will be alleviated.

NOTE: Normally bisquing is done to cone 05. Do not be confused by how the test firing uses **SLOW BISQUE** to cone 5, even though normally you would use a **SLOW BISQUE** to cone 05. The Slow Bisque program is used for the test firing BECAUSE it is a long program. We want this to be slow.

The test firing is done with the operator present as much as possible. This is to be sure the kiln is heating up safely, and that the heating kiln affects nothing else in the room or the room itself. As for the operator being present, logistically this may be difficult as the test fire is designed to take about 16 to 19 hours.

To deal with this a “Delayed Start” can be added to the test fire program, allowing you to press **START** at say 5PM, the kiln to start at say 8PM in order to turn off at 3PM the following day while you are there. More detail on this a little further on. You can also split it into two firings (see instructions at the end of this sheet).

> **NOTE:** The test fire is done with the kiln furniture. We highly recommend putting kiln furniture in the kiln because firing an empty kiln can sometimes lead to an error code (E-D) on two or three zone kilns. Anything else in the kiln (clay) will produce contaminants to some degree, and the elements in the kiln have not yet achieved this all important aluminum oxide coating before being subjected to these contaminants.

VENTING

Leave the Vent-Sure downdraft vent system on while the kiln is heating and cooling. Keep the peephole plugs in and the lid closed. If you have no vent system then leave the top peephole plug out during the first test firing.

> **NOTE:** it is best for the evenness and speed of the firing to keep all the peepholes closed. However, for longevity of things like the elements, and thermocouples, as well as for better colors in clays and glazes, it is best to have as much air as possible moving through the kiln, without compromising the speed and evenness of the firing (this is a trade-off). Open peepholes can be an OK way to vent, except that uneven drafts through the kiln can affect thermocouple readings, or “freeze” cones, leading to uneven or slow firings.

WHAT TO EXPECT

ELEMENT SMOKING

Brand new elements may have lubricant still on them and may smoke a little initially the first time they are heated. A fan in a window is more than adequate to deal with this. If you have the Vent-Sure vent on this should also be adequate.

NOISES IN AN AUTOMATIC KILN

A **Beep** when you press a button on the DynaTrol keypad.

FIRST FIRING FOR L&L KILNS WITH A DYNATROL OR GENESIS

Clicking noises from inside the control box as the unit heats. This will happen throughout the firing until it shuts off. Sometimes it will happen more frequently than other times. It is the result of the relays opening and closing as the control tells them to, turning the electricity on or off to the elements, working to heat the kiln evenly. (On manual kilns with contactors you will also hear contactors clicking).

Hum. Whenever kiln elements come on they are accompanied by a humming sound from electricity in the elements. This is normal. The natural properties of electricity and the dynamics of the shape of the element combine to create a slight vibration in the element.

WHAT HAPPENS AS THE KILN HEATS UP

All the materials used in the kiln's construction expand incrementally as they are heated. First the inside materials- i.e. the elements, holders, and inside surfaces of the walls, floor, and lid heat and expand slightly. Then, the heat moves slowly through the walls, lid and floor until it begins to heat the outer surface of the kiln. The greater the difference in temperature is between the inside surface vs. outside surface, the more stress there is on the material itself.

Walls, lids and floors can sometimes develop hairline-cracks on the surface or in the some cases, all the way through. Really this is normal and to be expected sooner or later to some degree. If you tighten the stainless steel bands that surround the floor, lid, and walls of the kiln every so often, the fact that the firebrick expands as it heats will mean that the cracks are actually closing up while the kiln is heating, expanding against the cooler outer shell. The geometry of the kiln and the tightness of the stainless steel bands are what holds everything together, whether the brick is in a few pieces or all one piece should not matter a whole lot, although cracked floors should be fully supported as they are with our full-support stands.

See the ***maintain.pdf*** and ***troubleshoot-brick.pdf*** for more information. See this for how to repair hairline cracks: ***hotkilns.com/repairing-hairline-cracks-firebrick-video***).

VISIBLE RED HEAT

Another thing to expect is to see the "red heat" through the seams, between the sections of the kiln, beginning around 1000°F. This is normal. The seam between the lid and the top section will probably appear the largest. This is partly because, when the top heats up, it becomes slightly concave and the edge lifts up.

IMPORTANT NOTE: It is important for this gap between the lid and the rest of the kiln to be even all the way around throughout the firing. If it is more open in the front when hot, then the hinge is out of adjustment and must be raised up. Your kiln's Assembly instructions detail the hinge adjustment. The danger of this condition is that all the weight of the lid is now resting on the inner upper edge of the back firebricks on the top section. They will crack off in a firing or so and probably damage the lid too.

> **CAUTION**: The outer metal and brick surfaces of the kiln will get very hot, as hot as 450°F - easily hot enough to burn you.

The interior of the kiln will look white hot at the highest temperatures.

> **CAUTION**: Be sure to always use rated dark safety glasses when looking through the peepholes to protect your eyes from infrared radiation. See **Kiln Cautions** for details.

CONTROL DISPLAY ON DYNATROL

Acronyms on the DynaTrol's display screen stand for important messages, they are its way of communicating with the user. The DynaTrol display is limited to four letters or numbers at a time. So for example, **TCOS** is the acronym the DynaTrol uses for "thermocouple offset".

Once it hits its target temperature, it will shut off with a **CPLT** (complete) message. Once this message is seen the kiln is no longer running. It is safe to shut off the power to it. If no controlled cool-down was programmed, the kiln will cool quickly at first, then more and more slowly. As it is cooling it will display the **CPLT**, the **amount of time it took to complete the firing**, the **TC2**, and **the current temperature** over and over again.

The temperature will normally be displayed from **TC2**, which is thermocouple number two. Press **1** to see the temperature in the top section- **TC1**. Press **3** to see the temperature in the bottom section of a three or more section kiln. The DynaTrol is checking all three thermocouples every eight seconds even though just one thermocouple's temperature is displayed. The displayed temperature will rise as the kiln heats up, cycling from **TC2** to current temperature inside the kiln over and over again. (A kiln with just one thermocouple will just show the temperature reading, no **TC number**).

FIRST FIRING FOR L&L KILNS WITH A DYNATROL OR GENESIS

DYNATROL CONTROL: STEP BY STEP

1) Turn on power to the kiln with the toggle switch. Display reads WAIT then IDLE.

2) Press **ENTER** and wait until you see IDLE, TC2, and the current temperature cycling over and over again.

3) Press **SLOW BISQUE** and see S-bC.

4) Press **ENTER** and see CONE, and a number (which represents the cone number currently programmed in the control) flashing back and forth.

5) Press **5**, and see the number **5** in the display. .

6) Press **ENTER** and see HOLd, 00.00 flashing back and forth.

7) Press **ENTER** and see IDLE, TC2, and the current temperature cycling over and over.

8) Press the **Preheat** button in the **Easy-Fire Options** section.

9) See HLd, 00.00 flashing back and forth.

10) Press **300** so the display reads 3.00.

11) Press **ENTER** and see IDLE.

12) Press **START/STOP** to begin the test firing.

You have just entered an “Easy-Fire Slow Bisque” Program to cone 5 with a three hour preheat, the combined total of which will take roughly 16-19 hours. The preheat part increases the heat in the kiln at 60°F per hour from room temperature up to 200°F where the hold time comes on, the timer appears, and it holds at 200F for the set amount of time. Once the timer runs out, the rest of the program follows.

Now you must figure out how to be around for the end of the 16-19 hour firing. This is where the Delay Start feature may come in handy. It is a digital hours and minutes timer you can add to the beginning of any program. You tell the timer how many hours and minutes to count down before the DynaTrol turns up the kiln and runs the rest of the program.

> **NOTE**: It is critical for someone to be present for, and especially at the end of, each firing. This is particularly true for this first firing. Even if you have a high limit control - no safety device is entirely foolproof.

DO YOU NEED A DELAYED START?

Picture a clock-face and count forward 16 hours from when you planned to press **START/STOP** to begin this program. Will you be present for at least the last few hours? If “YES” then you do not need a delayed start time and you can start the firing when you planned to, skip the rest of step 6 and step 7. If “NO” then you do need a delayed start time, continue on here.

CALCULATING THE DELAY START

Picture the same clock-face, and see when the firing would have ended if you had pressed **START/STOP** when you planned (i.e. 16 hours from when you want the firing to begin). Now picture how many hours later the firing would have to end, in order to have someone there for the last few hours of this 16-19-hour firing. That “number of hours later” is what to program in for the **Delay Start**.

An example

You are planning to start the program at 7 pm. Your program is going to take minimum 16 hours. 16 hours from 7 pm is 11 am the following day. You plan to get into the kiln room at 9 am. 9 am to 11 am is only two hours. You would need to get there one hour earlier to be there for the last three hours, OR start the program one hour later than 7 pm so that the program completes at 12 pm the following day. You will need to program a one hour delayed start. First you will enter the program, then the preheat, then the delayed start. You will press **START/STOP** at 7 pm, but now a timer will appear and count down the one hour before the rest of the program begins.

ADDING A DELAYED START

1) Press **DELAY** and see dELA, 0.00 flashing over and over.

2) Enter the number of hours and minutes to delay the start for. For example: For a two hour delay press **2**, **0, 0** so it says **2.00**. For a 1 hour and thirty minute delay press **1, 3, 0** so it says **01.30**. Numbers in the display to the right of the decimal represent minutes. Numbers to the left of the decimal represent hours.

3) When the correct number of hours and minutes has been keyed in, press **ENTER**, see **IDLE**

START FIRING

When the correct time to begin the firing arrives, press **START/STOP**. The display will say -ON-, then it will cycle through a sequence showing TC2, and the current temperature in the kiln over and over as it heats. Here is what to expect the kiln will do based on what you have programmed, after you press **START/STOP**.

FIRST FIRING FOR L&L KILNS WITH A DYNATROL OR GENESIS

If you programmed a delayed start, there will be an hours and minutes timer displayed along with the TC2, current temperature message. It will be displayed until the timer runs out.

It will climb at about 60°F per hour until it reaches 200°F, then the timer will appear again and the three hour preheat will begin counting down on the display with the TC2, current temperature message. It will sit around 200°F until the timer runs out.

Now it will begin to climb at about 80°F per hour up to 250°F

Once the hottest thermocouple reading reaches 250°F, the kiln will begin climbing at 200°F per hour until it reaches 1000°F

Once the hottest thermocouple reading reaches 1000°F, the kiln will begin climbing at 100°F per hour until it reaches 1100°F

Once the hottest thermocouple reading reaches 1100F, the kiln will begin climbing at 180°F per hour until it reaches 1915°F

Once the hottest thermocouple reading reaches 1915°F, the kiln will begin climbing at 80°F per hour until it reaches somewhere between 2100-2190°F

Once the hottest thermocouple reading reaches around 2165°F, the kiln display will say CPLT, a time like 17.47, the **TC2**, and the current temperature in the kiln as it is cooling.

Once CPLT is seen the firing is complete. We recommend shutting all power to the kiln off.

You can also leave the display on with the current messages cycling over and over, or you can press **START/STOP** to get back to IdLE, TC2, current temperature and leave it there.

NOTE: If the first firing ended in an error code please make note of which one it was; i.e. E-1 or E-d etc. See this first:

hotkilns.com/list-all-error-codes-dynatrol

GENESIS CONTROL

Refer to the instructions in the Genesis Control Manual on page 5 and 6. However instead of firing to Cone 04 fire the kiln to Cone 5 on a Slow speed.

Now you must figure out how to be around for the end of the 16-19 hour firing. This is where the Delay Start feature may come in handy. It is a digital hours and minutes timer you can add to the beginning of any program. You tell the timer how many hours and minutes to count down before the DynaTrol turns up the kiln and runs the rest of the program.

NOTE: It is critical for someone to be present for, and especially at the end of, each firing. This is particularly true for this first firing. Even if you have a High Limit Back-up - no safety device is entirely foolproof.

DO YOU NEED A DELAYED START?

Picture a clock-face and count forward 16 hours from when you planned to press **STRT** to begin this program. Will you be present for at least the last few hours? If “YES” then you do not need a delayed start time and you can start the firing when you planned to, skip the rest of step 6 and step 7. If “NO” then you do need a delayed start time, continue on here.

CALCULATING THE DELAY START

Picture the same clock-face, and see when the firing would have ended if you had pressed **START/STOP** when you planned (i.e. 16 hours from when you want the firing to begin). Now picture how many hours later the firing would have to end, in order to have someone there for the last few hours of this 16-19-hour firing. That “number of hours later” is what to program in for the **Delay Start**.

An example

You are planning to start the program at 7 pm. Your program is going to take minimum 16 hours. 16 hours from 7 pm is 11 am the following day. You plan to get into the kiln room at 9 am. 9 am to 11 am is only two hours. You would need to get there one hour earlier to be there for the last three hours, OR start the program one hour later than 7 pm so that the program completes at 12 pm the following day. You will need to program a one hour delayed start. First you will enter the program, then the preheat, then the delayed start. You will press **START/STOP** at 7 pm, but now a timer will appear and count down the one hour before the rest of the program begins.

ADDING A DELAYED START

1) Press **DELAY** and see dELA, 0.00 flashing over and over.

2) Enter the number of hours and minutes to delay the start for. For example: For a two hour delay press **2**, **0, 0** so it says **2.00**. For a 1 hour and thirty minute delay press **1, 3, 0** so it says **01.30**. Numbers in the display to the right of the decimal represent minutes. Numbers to the left of the decimal represent hours.

3) When the correct number of hours and minutes has been keyed in, press **ENTER**, see **IDLE**

START FIRING

When the correct time to begin the firing arrives, press **START/STOP**. The display will say -ON-, then it will cycle through a sequence showing TC2, and the current temperature in the kiln over and over as it heats. Here is what to expect the kiln will do based on what you have programmed, after you press **START/STOP**.

If you programmed a delayed start, there will be an hours and minutes timer displayed along with the TC2, current temperature message. It will be displayed until the timer runs out.

It will climb at about 60°F per hour until it reaches 200°F, then the timer will appear again and the three hour preheat will begin counting down on the display with the TC2, current temperature message. It will sit around 200°F until the timer runs out.

Now it will begin to climb at about 80°F per hour up to 250°F

Once the hottest thermocouple reading reaches 250°F, the kiln will begin climbing at 200°F per hour until it reaches 1000°F

Once the hottest thermocouple reading reaches 1000°F, the kiln will begin climbing at 100°F per hour until it reaches 1100°F

Once the hottest thermocouple reading reaches 1100F, the kiln will begin climbing at 180°F per hour until it reaches 1915°F

Once the hottest thermocouple reading reaches 1915°F, the kiln will begin climbing at 80°F per hour until it reaches somewhere between 2100-2190°F

Once the hottest thermocouple reading reaches around 2165°F, the kiln display will say CPLT, a time like 17.47, the **TC2**, and the current temperature in the kiln as it is cooling.

Once CPLT is seen the firing is complete. We recommend shutting all power to the kiln off.

You can also leave the display on with the current messages cycling over and over, or you can press **START/STOP** to get back to IdLE, TC2, current temperature and leave it there.

SPLITTING TEST FIRING INTO TWO FIRINGS

This is done by entering in the standard program for the test fire on Day 1, first thing in the morning. Turn this on as early on Day 1 as possible and let it run all day until you go home in the afternoon. Before you go home Press **START/STOP**, then turn off the kiln.

On day 2, first thing in the morning, program in a **SLOW GLAZE** to cone 5, no hold or preheat is necessary. Regardless of how hot it still may be in the kiln, turn this program on as early as possible in the morning on Day 2. It will run up to somewhere between 2100°F and 2190°F in about 7-8 hours. If it is still not done when you go home, as long as 8 hours have passed since you turned it on, you can press **START/STOP** and turn the toggle switch off and go home. Otherwise when it is done it will give the CPLT message and it is then safe to Press **START/STOP**, turn the toggle switch off and go home.

FREQUENTLY ASKED QUESTIONS

There are ceramic washers in between the elements and the element holders in the corners of my kiln - what are these for?

1. This is done on some kilns - particularly DaVinci kilns. The discs are placed in the element holders to keep the elements from coming out during shipment.
2. It is a good idea to keep them in place during at least the first firing.
3. Once the elements heat up they will seat themselves in the element holders properly and they can be removed.

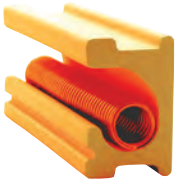
Can you fire to a higher cone than cone 5 on the first firing?

The Cone 5 temperature target is somewhat arbitrary. We want to accomplish three things with the first firing:

1. Fuse the hardening coating we apply to the surface of the tops and bottoms
2. Seat the elements in the holders
3. Put an initial oxide coating on the elements (which protects them from contaminants in the atmosphere form clay and glazes). A higher temperature is not a problem.

DOLL INSTRUCTION MANUAL

CONTROL



L&L Kiln's patented hard ceramic element holders protect your kiln.

BASIC OPERATION OF L&L KILNS WITH A DYNATROL 700

*Press the **START/STOP** Button to start firing the program you have selected. You can also stop a program from firing.*

*The **Vary-Fire** section is for advanced users.*

*Press **Review Prog** to see what program you are running and to make sure you have entered the proper cone number.*

***Review Seg** allows you see what segment of the program you are on.*

*The **Other** section is for entering options such as cone offsets. thermocouple offsets, etc.*

***Delay** allows you to enter a countdown time to start the program automatically.*

The display area provides lots of information such as temperatures, program prompts, etc.

Enter the cone number and other numeric information like delay time using the number keypad.

Choose one of the four Easy-Fire programs. The control will prompt you for cone number and hold time.

***Preheat** allows you to enter a set time for the kiln to fire at 150°F to dry out your work*

***Alarm** sounds an audible signal at whatever temperature you set. The normal setting of **9999** means it will not go off. Hit **ENTER** to turn off buzzer.*

HOW YOUR KILN WORKS

The DynaTrol automatic program control automatically adjusts power to evenly heat up the kiln according to the program you are firing. The four EASY-FIRE programs make firing most ceramics simple. The programs vary the ramp rates and final temperature reached based on time-proven methods. You do not have to adjust anything once you start firing.

DYNAMIC ZONE CONTROL

The DynaTrol uses one, two or three separate thermocouples to measure temperature in the top, middle and bottom of the kiln (top and bottom in a two section kiln or, if set up one one thermocouple just one zone). Each zone of control adjusts power to each heated zone in the kiln to maintain even temperatures from top to bottom.

FIRST TEST FIRING OF THE KILN

See the **dynatrol-first-firing.pdf** sheet for detailed instructions on this process.

USING YOUR KILN

TURNING ON THE KILN

1) Make sure your circuit breaker or fused disconnect switch is turned on.

2) Turn on kiln with the toggle On/Off switch on the left side of the control box.

WHEN YOU FIRST TURN ON THE KILN

1) When the kiln is turned on you will see **WAIT** in the DynaTrol display. Wait until you see **IdLE**, **TC2**, and the current temperature cycling over and over in the display.

2) This cycling **IdLE** message means that the DynaTrol is on, ready to be programmed, but the kiln is not firing yet.

3) The current temperature is measured at the tip of the three thermocouples (**TC1**, **TC2**, **TC3**). The default thermocouple reading is **TC2**. In other words unless you specifically ask the control to show you the temperature at **TC1** or **TC3** then it will only show you the temperature at **TC2**. Press the #1 button to see the temperature at **TC1**, or the #3 button to see the temperature at **TC3,** or press the #2 button to toggle back to **TC2**.

IF YOU HAVE A TWO SECTION HIGH KILN

If your kiln has only two thermocouples you will not be able to find **TC3** as there is no third thermocouple. The DynaTrol comes pre-programmed from the factory for your kiln's particular specifications. (Note: if you programmed the control as a single zone control you will only see one temperature and no **TC1**, **TC2** or **TC3** in the display.)

EASY-FIRE OPERATION

1) The EASY-FIRE mode allows you to fire to a CONE NUMBER at one of four different speeds. These are the four preset EASY-FIRE programs that have been designed to do most typical ceramic firing cycles. They are "Fast Bisque", "Slow Bisque", "Fast Glaze" and "Slow Glaze". These preset programs have specific ramps and speeds built into them. (You can find out how these are written in the Appendix of the DynaTrol Reference Section). You can enter any cone number from 022 up to cone 10.

CAUTION: Follow the recommendations of the clay and glaze manufacturer for proper cone to fire to - and keep in mind that if you don't fire to the proper cone you can cause a major meltdown of your work).

FIRING OPTIONS

1) You can enter a **HOLD TIME** at that final cone setting. (Be careful because you will add heat-work to load when you add soak time).

2) You can enter a **DELAY TIME** (to prevent the program from starting for a while)

3) You can enter a **PREHEAT TIME** to "candle" the load at 180°F to 200°F to help dry the load out and reduce internal trapped moisture.

4) You can enter a **CONTROLLED COOLING** segment, or other custom segments to the end of the Easy-Fire program.

5) The above "Easy Options" allow for some degree of customization while still keeping the programming simple and easy.

PATENTED ORTON TECHNOLOGY

The EASY-FIRE mode uses the Orton Foundation's patented method to achieve the correct heat work making these programs ideal for firing ceramics. The advantage of using the EASY-FIRE method is that a complicated firing profile may be chosen with just a few keystrokes.

The DynaTrol actually calculates when it should shut off based on what cone number was programmed, and how many degrees per hour the kiln was rising at the end of the firing. The DynaTrol actually adjusts the final set point using Orton's patented formula in these Easy-Fire preset programs. (**NOTE**: This is not always true for the Vary-Fire programs where you can set an absolute final temperature set point).

These program's final temperature set points are based on large Orton self-supporting cone (rather than the small Orton cones or regular large Orton cones).

WHAT IF YOU MAKE A MISTAKE?

NOTE: If you make a mistake while programming (like entering the wrong hold time) and you have already pressed **ENTER**, you must continue to enter the rest of the program. Once you see **IdLE** (meaning programming is complete) you must then go back and re-enter the program again.

FIRING THE KILN

1) Make sure **IdLE**, **TC2**, and the temperature are flashing. This means that the control is not running a program.

2) Press one of the four easy firing profile buttons: **SLOW BISQUE** or **FAST BISQUE** or **SLOW GLAZE** or **FAST GLAZE**.

3) Press **ENTER**. The display will flash **CONE** and a number representing a cone number (like **06**).

4) Enter the cone number you want to fire to (for instance cone **5**). You can enter any cone number from **022** up to cone **10**. It will not let you put cone numbers in outside of this range. If you type a wrong number, press **0/ 0/ ENTER** and the previous cone number will reappear in the display. Then type the correct cone number.

BE CAREFUL TO ENTER THE PROPER CONE NUMBER. DO NOT CONFUSE CONE 05 WITH CONE 5 FOR INSTANCE BECAUSE YOU COULD MELT YOUR CONE 05 CLAY.

5) Press **ENTER**. **HOLD** and **0.00** will flash.

6) Enter a hold time or leave at **0.00**. Numbers to the left of the decimal are hours, to the right are minutes.

IMPORTANT NOTE ABOUT HOLD TIMES: Be careful with hold times - this will add to the heat work and will actually fire the work to a higher cone which will not be compensated by the Easy-Fire program. In general we do not recommend using a hold time unless you are carefully monitoring the kiln performance with actual cones.

7) Press **ENTER**. then **IdLE**, **TC2** and the current temperature will flash in the display.

8) Press **START/STOP** to begin firing or read on to enter an optional Preheat or Delay Start time.

9) When firing is complete the display will flash **CPLT**, the total firing time in hours and minutes (for instance **07.34)** and current temperature inside kiln.

ENTERING AN OPTIONAL PREHEAT TIME

With any of the EASY-FIRE modes, a preheat stage is available. During the preheat stage the temperature is automatically increased at a rate of 60°F per hour until 180°F is reached; the 180°F temperature is then held for the programmed amount of time.

Preheat is automatically set to **0.00** during EASY-FIRE programming and at the end of each firing, so if a preheat stage is wanted, it must be reprogrammed for each EASY-FIRE firing.

1) To preheat the kiln for a specific amount of time you must first program an EASY-FIRE program. Once this is done you can add the preheat option to it.

2) Press the Preheat button in the Easy-Options Section at the bottom of the control. See **HOLD** and **0.00** cycling over and over.

3) Press the number keys to input how long you want the preheat time to be. Numbers to the LEFT of the decimal in the display are hours, i.e. 3 hours of preheat time would look like **03.00**. Numbers to the RIGHT of the decimal in the display are minutes, i.e. 75 minutes of preheat time would look like **00.75**.

4) Press **ENTER** and see **IdLE** meaning that programming the preheat option is complete.

5) Press **START/STOP** to begin firing or read on to enter an optional Delay Start time.

ENTERING AN OPTIONAL DELAY START TIME

This feature makes it easy for you to be present at the end of a firing. You can delay the start of the program by up to 99 hours and 99 minutes.

To program a delay time you need not have programmed any firing profile yet. You can enter a Delay Time at any time the control is not firing the kiln. It will apply to the next program you run when you hit **START/STOP.**

1) When the display cycles **IdLE**, **TC2**, current temperature over and over. (Control is not firing)

2) Press the Delay button in the Easy-Options Section at the bottom of the control. See **dELA** and **0.00** cycling over and over.

3) Press the number keys to enter the amount of delay time desired. Numbers to the RIGHT of the decimal in the display are minutes, i.e. 75 minutes of delay time would look like **00.75**. Numbers to the Left of the decimal in the display are hours, i.e. 14 hours 30 minutes of delay time would look like **14.30**.

4) Press **ENTER** and see **IdLE**, meaning programming the delay option is complete.

5) This delay will appear in the display like a timer counting down when you press **START/STOP** to begin firing. The firing will begin once the timer reaches zero. It will remain set as is until you change it.

ENTERING AN OPTIONAL ALARM TEMP

You can make the control sound an audible sound at some specific temperature. This can be useful to alert you to do something like pay attention to the end of the firing. It is not very loud.

1) You can enter an Alarm Temperature at any time the control is not firing the kiln. It will apply to the next program you run when you hit **START/STOP**.

2) Press the Alarm button in the Easy-Options Section at the bottom of the control. See **ALRM** and **9999** cycling over and over. A high value like that means the control will not sound an alarm.

3) Enter a four digit number like **2000**. (This represents 2000°F).

4) Hit **ENTER**

5) The display will go back to flashing **IdLE**, **TC2** and current temperature.

When you fire now, the alarm will sound at 2000°F. Once it starts to beep, press **ALARM** or **ENTER** to turn it off.

REVIEWING THE PROGRAM

1) Reviewing your program before you start (or just after) is very important. It can prevent a serious mistake. In particular check the cone number you are firing to. Also it is useful for obtaining the temperature that you reached on your last firing.

2) In the Review Section hit **Review Prog** button.

3) The program will scroll. You will see, in the following order, various aspects of the program.

a) The program name (like **S-bC** for Slow Bisque, **F-bC** for Fast Bisque, **S-GL** for Slow Glaze and **F-GL** for Fast Glaze)

b) **PRHT** followed by its value in time (like **3.00** for 3 hours)

c) **CONE** followed by its value (like **05**)

d) **°F (or °C)** followed by a value like **1888**.

e) **CNOS** followed by **9020** or some other number which could also be **0000**. The **9020** represents the Cone Offset that may be preprogrammed into the control.

f) **HLOd** followed by the value in time like **0.00** of the Hold Time programmed into the control.

g) **dELA** followed by the value in time like **02.30** if the Delay Start Time is programmed into the control.

h) **ALRM** followed by the value in temperature like **2000**

i) **ERCd** followed by **ON** or **OFF** (See in-depth **dynatrol-700.pdf** if you want an explanation of this.) Typically Error Codes should be ON.

j) **FIRE** followed by the number of firings the kiln has done.

4) If you are using the VARY-FIRE programs it will be similar except it will scroll through all the segments, ramps and holds for USER programs.

5) If you have added controlled coolings or 16-step options there will be a reference to these steps in the Review Program sequence as well. (See the Reference Manual for more information).

VARY-FIRE OPERATION

With the Vary-Fire mode you may program six different programs. Each program can have up to eight segments. Each segment has a ramp rate (set in degrees Fahrenheit or Centigrade, heating or cooling, per hour), a set point temperature (the temperature that ramp rate will heat or cool to) and an optional hold time at that temperature for up to 99 hours and 99 minutes. (As a contrast, in the Easy-Fire mode, the number of segments and the firing profile are preset. In fact you can find these profiles in the Appendix of the **dynatrol-700.pdf**. They make a good starting point for creating your own Vary-Fire programs). When the DynaTrol comes to you new it has programs already in place in these six program slots. You can program over them with your own programs or simply use the ones in there. These pre-set programs are outlined in the Reference Manual in Appendix I. In short, they are a glass slumping program, a glass tack fuse program, a glass full fuse program, a glass bead annealing program, a lost wax burnout program, and a slow cooling cycle for cone 6 that can be added to an existing program. Even if you program over these programs, you can get them back from memory any time. Unfortunately any programs you have in there that you have made will be lost if you recall the original default programs.

When programming your programs, the ramp portion of a segment need not always be increasing in temperature. You can program a decrease in temperature at a specific rate also. If you wish to use the more sophisticated features and options of the DynaTrol refer to the **dynatrol-700.pdf**. There are various samples and great detail about options, troubleshooting and theory.

CONTROLLED COOLING

1) If your kiln is cooling too rapidly for good glaze results, or if the cooling is so rapid that cracking occurs on certain large pieces, it is recommended to cool under power. This is accomplished using the following instructions.

2) The Easy-Fire to Vary-Fire feature allows you to fire an Easy-Fire program and then automatically start a Vary-Fire program at the end of the Easy-Fire program. The Vary-Fire to Cone feature allows you to enter a sophisticated Vary-Fire program that fires to a cone number, not to a specific temp.

3) There are complete sections on these subjects along with a step-by-step examples, in the **dynatrol-700.pdf**.

CHECKING TEMPERATURE & TIME REACHED

1) When an Easy-Fire program is complete it will tell you how long it took to finish the program, and what the temperature is as the kiln cools off.

2) At the end of the program the control will flash **CPLT** and a number like **7.34**. The 7 stands for hours and the 34 stands for minutes. This is how long it took for the kiln to reach final set point. It will also show you the temperature inside the kiln as it cools off.

3) Hit **START/STOP**. You will then see **STOP**.

4) Press **REVIEW PROGRAM**. The display will scroll through the entire program and will show you the actual temperature reached.

CALIBRATING THE CONTROL

Some people say their new kiln does not get to temperature during the test firing. There are generally two reasons for this. One reason is that the kiln is empty. Another reason is that the kiln cannot be calibrated until it has reached temperature and melted a cone so someone can see how close it really is, and then adjust it accordingly. (We do not

fire the kiln before it ships). The thermocouples can be +/- 10°F when they are brand new.

EMPTY KILN VS. FULL

One difference between an empty and full kiln is that an empty kiln cools a lot quicker which will freeze the cone very quickly. In a full kiln there is a lot of mass in the kiln that is just as hot as the kiln around it. It is this mass (the load in the kiln), radiating it's heat as well, that will continue to melt the cone for a little longer after the kiln has been shut down. Once the kiln is fine-tuned, it is this variable - how you have loaded the kiln- that will account for many of the variations you will see from firing to firing. Another difference is the speed of firing - an empty kiln will fire differently than a full one. Although the control does compensate for this that compensation is not totally perfect.

FINE TUNING THE KILN

You can fine-tune how hot the kiln gets by adjusting the thermocouple offset.

If you can tell the cone bent at all during the first firing, but no more than a little bit, then you can start by reducing the thermocouple offset setting by 5°F.

If you can tell the cone did not bend at all, then you can start by reducing the thermocouple offset setting by 10°F

If it bend more than a little bit, you might wait and see how it does with a load, or start by reducing the thermocouple offset settings just 5°F and then see.

If the cone bent too much you should start by increasing the thermocouple offset by 5°F.

REMEMBER THIS: Adding thermocouple offset lowers the temperature in the kiln, subtracting thermocouple offset raises the temperature. We suggest tuning the kiln for your glaze firings which are more critical and then using cone offsets to adjust bisque temperatures (if you need to).

CONE OFFSETS

Tune your kiln using the thermocouple offset for your most critical firing (typically glaze firings). Then use the cone offset to adjust for other cones that you fire to to get them just right (if they are critical). Typically bisque firings are not very critical.

FOR MORE INFORMATION

See the DynaTrol Instructions for detailed step-by-step programming. See section 9.9 for Thermocouple Offsets. See section 9.6 for Cone Offsets.

See ***https://hotkilns.com/calibration***

See our various instruction sheets about cones, specifically **troubleshoot-cones.pdf.**

For older kilns (pre Sept 2020)

For kilns (and protection tubes) made before August 15, 2004 the offsets are as follows:

The thermocouple offset was 0050 (+50°F) when it left the factory. In addition the Cone Offsets came preprogramed. From cone 022 to cone 017 the cone offsets were set at 9030. All other cones were preset at 9020.

For kilns (and protection tubes) made AFTER Oct 1, 2004 until September 2020 the offsets are as follows:

The thermocouple offset is 0018 (+18°F) when it leaves the factory. In addition the Cone Offsets come preprogramed. From cone 022 to cone 017 the cone offsets are set at 9020. There are no cone offsets for other cones.

MISC NOTES AND OVERVIEW

The DynaTrol controls your kiln by firing programs you choose from a bank of available programs in its memory. It has four preset programs: Slow Bisque, Fast Bisque, Slow Glaze and Fast Glaze for any cone number; cone 022 through cone 10. In addition it has six specialized programs for glass and jewelry which can be replaced by your own custom programs, or recalled at any time

To any of these four pre-set programs, you have the option of including a **PREHEAT** to the beginning (for drying). You also have the option of adding a **DELAY** time to delay the start time of the entire program as well. Both of these options are things that you add to a program.

You cannot erase something you have entered. You can only program over it. Say you enter the wrong program, a Slow Glaze instead of a Slow Bisque. You must go ahead and program the whole wrong program with any cone numbers etc, then go and enter the correct program right over top of the wrong one. A preheat must be entered with the regular program every time you want one. The DynaTrol will not remember that you always/never use a preheat with that particular program. Delayed Starts will stay in effect regardless of what else is programmed, until you actually press **DELAY** and change it.

Always press **REVIEW PROGRAM** to see what program is ready to be fired.

OBTAINING FIRING INFORMATION

There are a number of keys that you can push while the control is operating to get information.

Press "**1**", "**2**" or "**3**" while firing to change which thermocouple reading you see in the LED display.

Press 8 while firing to turn On/Off the ability to see which zones are firing by the LED display dots. Dot on the left is the top zone, dot in the center is the center zone, and the dot on the right is the bottom zone. Don't forget that the dot on the very far right is only on if you are running in Celsius temp scale.

Press 5 while firing and see the current rate of climbing in degrees per hour. This is useful to look at near the end of the program so you can look on a cone chart to accurately see what temperature your kiln will shut off.

Press 0 while firing to see how much time has elapsed since the program began.

Press Review Prog - The information displayed when Review Program is pressed varies depending on whether you are using EASY-FIRE or VARY-FIRE. When Review Program is pressed, each of the steps in the current firing profile is displayed one after another.

When a firing is complete, Review Program is used to see the final temperature reached during the firing.

Press Review Seg - to view the current firing segment or to skip from the current segment to the next segment. When **Preview Seg** is pressed during a firing the current stage of the firing is displayed. If it is pressed in between firings, **STOP** will flash and then the current temperature will be displayed. When you press **Preview Seg** twice you will see the program set point temperature. When you press it three times you will see the control board temperature.

ERROR CODES & DIAGNOSTICS

See Appendix E in the **dynatrol-700.pdf** for a list of error codes and their meanings.

The best place to look for Error codes is on our website at ***hotkilns.com/error-codes***

UNDERSTANDING THE DISPLAY

See Appendix D in the **dynatrol-700.pdf** for a list of all the displays and their meanings.

DYNATROL REFERENCE INSTRUCTIONS
With the 700 Series Processor

Congratulations! You have just purchased one of the new DynaTrol automatic temperature controls with "Dynamic Zone Control". This is an easy to use control which should give you many years of service.

Suggestions? Firing Tips? Corrections? Please email us with your suggestions, firing tips, unique uses, applications, or corrections. The DynaTrol is a truly great control. However, we want to keep improving both the control and the instructions. Please help us and our other customers.

What Control this manual applies to: This manual is for all DynaTrols with the 700 Series processor. These are used in most kilns manufactured after Jan 1, 2005.

Note: One easy way to tell whether you have a 700 level control is to look at the display. Each of the four characters on the display have 14 segments in the character, allowing a for a more legible display. The older controls had 7 lighted segments in each character.

When L&L started using the 700 Processors: The 700 processor is used on L&L Kilns made after Jan 1, 2006 (The serial number on the kiln will have an "06" in it (for instance 012806A) or of course a later year.

TYPE CONVENTIONS USED IN THIS MANUAL

BUTTON = This type font equals a button that you hit on the face of the control

DISPLAY = This type font equals what the display shows

URL = References to L&L web help

VIDEO INSTRUCTIONS

Check out all of our troubleshooting and instructional videos on our website including many on DynaTrol programming! Look for video links throughout this instruction manual.

hotkilns.com/videos

WEB LINKS

There are many web links throughout this instruction manual. In addition almost all the web links that pertain to First Firing, Programming, Calibrating, Troubleshooting, Process and Fixing are in Appendix K at the end of the manual.

DYNATROL 700 INSTRUCTIONS FOR L&L KILNS

1. CONTROL CAUTIONS

- The controller is used to control temperature, it is not a safety device.
- Do not operate the controller in temperatures above 125°F or below 32°F (NOTE: The board components are rated for 50°C below zero so the control (and kiln) can be stored outside in a covered area).
- Never leave your kiln unattended at the end of a firing. (The Delay feature gives you control over this).
- The controller contains electronic components which are sensitive to static electricity. Before handling the controller dissipate any static charge you may have by touching metal or a screw on the controller panel, the electrical box, the kiln lid, or some other grounded object.
- Be sure that the kiln has been set up properly. For **EASY-FIRE**, LIBERTY-BELLE, and EQUAD-PRO kilns see the their specific Assembly Instructions. **For Davinci and Jupiter kilns:** the kiln sections are numbered with a small sticker on the end of each section's powercord. The top section on any L&L kiln is section #1. The #2 section is always the section directly under the #1 section on any sectional L&L kiln. On three section kilns section #3 is the bottom section. On kilns with more than three sections, sections are numbered 1 through 4 or 1 through 5, top to bottom. Likewise, the top thermocouple is labeled #1 and should be in the top section of the kiln. The #2 thermocouple is the bottom thermocouple in a two section kiln. The #2 thermocouple is the middle thermocouple on three or more section kilns. The #3 thermocouple is always in the bottom section of the kiln. It is imperative that your kiln is set up like this. Be sure to double-check this even if you set up the kiln yourself.
- When hooking up the thermocouple wires to the thermocouples on the kiln be sure to follow these color codes:

THERMOCOUPLE WIRE COLOR CODING

In the USA and non-European countries with Type K Thermocouples: The RED wire goes to the NEGATIVE side of the thermocouple connection block and the YELLOW wire goes to the POSITIVE side of the thermocouple connection block. The external sheathing of the extension wire is YELLOW.

In the USA and non-European countries with Type S Platinum Thermocouples: The RED wire goes to the NEGATIVE side of the thermocouple connection block and the BLACK wire goes to the POSITIVE side of the thermocouple connection block. The external sheathing of the extension wire is GREEN.

In European Countries with Type K Thermocouples: The WHITE wire goes to the NEGATIVE side of the thermocouple connection block and the GREEN wire goes to the POSITIVE side of the thermocouple connection block. The external sheathing of the extension wire is GREEN.

In European Countries with Type S Platinum Thermocouples: The WHITE wire goes to the NEGATIVE side of the thermocouple connection block and the ORANGE wire goes to the POSITIVE side of the thermocouple connection block. The external sheathing of the extension wire is ORANGE.

NOTE: The 700 control can be switched between Type K and Type S. This requires a software configuration as well as a jumper change. See more about this is section later in manual. **NOTE: THIS CAN BE DANGEROUS IF NOT DONE PROPERLY. IF YOU USE A TYPE S THERMOCOUPLE BUT HAVE THE CONTROL SETUP FOR TYPE K YOU MAY RUIN YOUR KILN BY OVERFIRING IT.**

- Always check the position of the thermocouple probe on the inside of the kiln before starting a firing. The `current temperature` displayed on the controller is measured at the end of the thermocouple. NOTE: If the thermocouple tip (where the temperature is measured) is back inside the brick insulation of the kiln (even a little bit) it will make the control think that the kiln is not as hot as it really is. That could lead to an overfiring!
- Always review the current program before firing to ensure the correct profile is programmed.
- We recommend having your kiln shut off by a manual fused disconnect switch located near the kiln. That way you can turn off all electricity to the kiln when you are not using it. This would prevent any sort of accidental turning on of the kiln by an electrical surge.
- Follow the other precautions listed in your Kiln Instructions and in the Troubleshooting Guide.

2. DISPLAY AND KEYBOARD

The front panel of the controller has seven distinct parts:

- **START/STOP** Key
- **LED** Display
- **VARY-FIRE PROGRAMMER** Section
- **REVIEW AND SPECIAL OPTIONS** Section
- **NUMBER KEYS** Section
- **EASY-FIRE** Section
- **EASY OPTIONS** Section

LED DISPLAY - four digit display showing times and temp-eratures. Indicate Deg F or C

Number keys section for entering temperatures and times. Change which thermo-couple you are reading. Turn On/Off ability to see which zones are firing. Reprogram the number of zones of control.

START/STOP button for starting and stopping firings.

"Vary Fire" Programmer for setting and saving your own firing profiles.

REVIEW section to review the selected program, view the current segment, view the board temperature, view the program set point, or skip to the next firing segment.

OTHER button to look up cone temperatures, set the cone offset to adjust cone temperatures, set thermocouple offsets, Identify Control, Turn On/Off 16 segment program capability, Reset default values, or change the temperature scale (°F/°C).

EASY OPTIONS section for setting Delay Time, PreHeat Time, and Alarm Temperature.

EASY FIRE section for choosing one of four preset Easy Fire profiles.

2.1 START/STOP Key

Starts the firing or, if there is a firing in progress, stops the firing.

NOTE: This key has no function during programming.

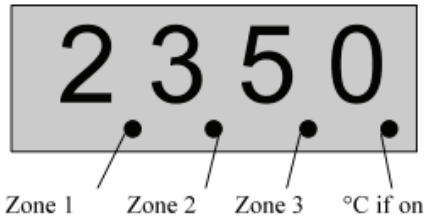
2.2 VARY-FIRE PROGRAMMING SECTION

2.2.1 Program your own firing profiles and recall them for use.

Enter Prog - This button allows you to initiate programming. Up to 6 profiles (programs) may be programmed and saved.

Recall Prog - Allows one step recall of one of the programmed profiles (programs).

2.3 LED DISPLAY



Displays temperatures, times, and messages. The LED (Light Emitting Diode) has room for four digits or letters in the display.

When the decimal point is displayed between the middle 2 digits, a time is being displayed.

If there is a decimal to the right of the last digit, the temperature is being displayed in degrees Celsius (Centigrade). By pressing #8 on the numerical Keypad while you are firing a profile you can turn on and off the ability to see which zones are firing. The little LED lights under the numerals in the display act as indicators of the zones firing. There are three of these little indicators and all three will blink on and off even if your kiln only has two or one heating zones.

2.4 REVIEW SECTION

REVIEW PROGRAM- The information displayed when **Review Prog** is pressed varies depending on whether you are using **EASY-FIRE** or **VARY-FIRE**. When **Review Prog** is pressed, each of the steps in the current firing profile is displayed one after another.

When a firing is complete, **Review Prog** is used to see the final temperature reached during the firing.

REVIEW SEGMENT - It is used to view the current firing segment or to skip from the current segment to the next segment. When Review Segment is pressed during a firing the current stage of the firing is displayed. If it is pressed in between firings, `STOP` will flash and then the `current temperature` will be displayed. When you press **Review Seg** twice you will see the program set point temperature. When you press it three times you will see the control board temperature.

2.5 OTHER (OPTIONS)

Cone Offset, Thermocouple Offset, Identify Control for KISS software, Set 16 Segment Program, View Cone Table, and change between °F and °C. There are several "**Other**" options. (See Section 7 for more details).

Reset feature RSET

Cone Lookup Table CONE

Controller ID Id

16 step program 16-S (only comes up if you have **VARY-FIRE** Program #5 in active memory or if you have an **EASY-FIRE** program in active memory)

Cone temperature offsets CNOS

Temperature scales °F or °C CHG°

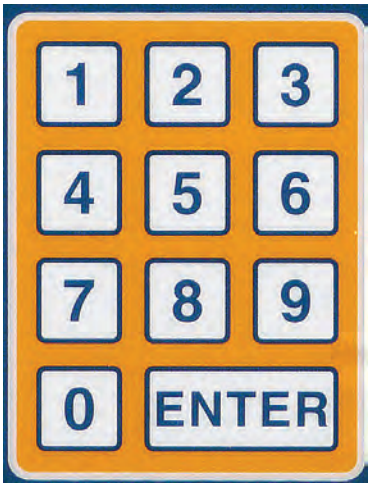
Error codes ON or OFF ERCd

Thermocouple offset TCOS

Board temperature bd T

2.6 NUMBER KEYS

Contains the **ENTER** key and the number keys.



Numeric keys - Used for entering times, temperatures and other numbers. The number "**1**" is also used to acknowledge the ErrP error signal when you first turn the kiln on. Press "**1**", "**2**" or "**3**" while firing to change which thermocouple reading you see in the LED display.

-Press **5** while firing and see the current rate of climbing in degrees per hour. This is useful to look at near the end of the program so you can look on a cone chart to accurately see what temperature your kiln will shut off.

-Pressing the **7** key will run the amperage diagnostic routine displaying the amperage rating for each section of the kiln. If the kiln is not equipped with the optional current sensor all amperage readings will be zero.

-Press **8** while firing to turn On/Off the ability to see which zones are firing by the LED display dots. Dot on the left is the top zone, dot in the center is the center zone, and the dot on the right is the bottom zone. The dot on the very far right is only on if you are running in Celsius temp scale.

-Press **0** while firing to see how much time has elapsed since the program began

ENTER Key – Used to enter or acknowledge numbers and programs

2.7 EASY-FIRE Section

Choose the EASY-FIRE mode you want to use.

Slow Bisque - Used for setting a slow bisque firing profile. Approximately 13 hours to fire to cone 04.

Fast Bisque - Used for setting a fast bisque firing profile. Approximately 10 hours to fire to cone 04.

Slow Glaze - Used for setting a slow glaze firing profile. Approximately hours to fire to cone 04.

Fast Glaze - Used for setting a fast glaze firing profile. Approximately hours to fire to cone 04.

2.8 EASY-OPTIONS Section

Choose the EASY options (**Delay Time, Preheat Time, Alarm**)

Alarm – Sound an audible alarm at a temperature you specify. Pressing the Alarm key while firing allows the reprogramming of the alarm to a low or high temperature alarm.

Preheat – Used to put in a preheat time at 200°F to allow the ceramic work to dry out completely.

Delay – Used to delay firing until you want the program to start

3. DYNATROL SPECIFICATIONS

Thermocouple Input: Type K or Type S (software/jumper switchable)

Accuracy: +/- 10°F

Cold Junction Compensation: Electronic

Power Input: 24 Volt Center Tap Transformer / 50 Hz or 60 Hz

Outputs 1 & 3: 150mA at 12 VDC, one 12 volt relay with 80 ohm coil per output

Output 2: 600mA at 12 VDC, one to three 12 volt relays with 80 ohm coil per output

Output 4: 150mA at 12 VDC, one optional 12 VDC relay with 80 ohm coil per output

Output 5: 150mA at 12 VDC, one optional 12 VDC relay with 80 ohm coil per output

Operating Temperature Range: 0°F to 125°F, 0°C to 52°C (See FAQ Section concerning "What Ambient Temperature Conditions do I need for control?")

High Side Switching: High side switching which allows the relay's return wire to be connected to ground (if the return wire shorts to ground it will have no effect).

Safety Transistor: A safety transistor powers the other output transistors giving multiple ways to turn off the output for increase safety.

Capacitor-Couple Output: The microprocessor is connected to the output transistor through a capacitor so that the output turns off if the microprocessor latches up.

4. OVERVIEW: HOW THE DYNATROL WORKS

4.8.1 GENERAL

When electrical power is connected to the DynaTrol, the display will be lit , and WAIT will be displayed for about 5 seconds then, IdLE, TC2, and the current temperature will be cycling over and over in the display. This cycling IdLE message means that the DynaTrol is on, ready to be programmed, but the kiln is not running yet.

The current temperature is measured at the tip of the three thermocouples (TC1, TC2, TC3). If the thermocouple wires are connected to the thermocouples and if the tips of the thermocouples are inserted inside the kiln, the current temperature displayed is the temperature inside the kiln. The default thermocouple reading is TC2. In other words unless you specifically ask the control to show you the temperature at TC1 or TC3 then it will only show you the temperature at TC2. This is done by simply pressing the #1 button to see the temperature at TC1, or the #3 button to see the temperature at TC3.

When the **START/STOP** button is pressed after either a **EASY-FIRE** (also sometimes called “Cone-Fire) or a **VARY-FIRE** profile has been selected, the DynaTrol starts to increase the temperature in the kiln towards the first set temperature at the programmed rate of rise. The kiln will be cycling (clicking) on and off to accomplish the exact rate of temperature rise. When the displayed temperature reaches the first set temperature in the first segment, the first hold phase can begin. If there is a hold time programmed in this segment, the DynaTrol will hold at the first set temperature for the programmed amount of hold time until the ending of the first segment of the firing. The second segment ramp stage then begins with the temperature increasing toward the second set temperature at the second ramp rate. Once it reaches the second set temperature it will hold there if there is a hold time programmed for the second segment (if there is no hold time then it simply goes on to the next segment). The control keeps going through this sequence until the end of the firing profile.

With the **VARY-FIRE** mode you may program six different programs with up to eight segments in each program. **VARY-FIRE** programs can be changed to whatever you need them to be. Each segment in a given program has a ramp rate (set in degrees Fahrenheit or Centigrade, heating or cooling, per hour), a set point temperature or cone number (the temperature that ramp rate will heat or cool to) and an optional hold time at that temperature for up to 99 hours and 99 minutes.

In the “**EASY-FIRE**” mode, the number of segments and the firing profile are preset according to the **EASY-FIRE** Temperature Profiles shown in the Appendix section. The ramp portion of a segment need not always be increasing in temperature. You can program a decrease in temperature at a specific rate also. **EASY-FIRE** programs can have preheat segments and cooling segments added to them, or they can stand alone.

4.8.2 WHEN YOU HAVE LESS THAN THREE THERMOCOUPLES

If your kiln has only two thermocouples you will not be able to find TC3 as there is no third thermocouple. The DynaTrol comes pre-programmed from the factory for your kiln’s particular specifications.

If your kiln only has one thermocouple many of the features in the DynaTrol are not used. Rather than seeing IdLE and a TC1, TC2, or TC3, you will only see IdLE and a temperature flashing on and off. Likewise any menu choice which controls relationships between the different “zones” in the kiln will either not even appear in the menu or will not affect the DynaTrol’s operation.

5. PROGRAMMING

5.1 EASY-FIRE

The **EASY-FIRE** mode allows you to fire to a CONE NUMBER at one of four different speeds and then hold at that final temperature if you desire. **EASY-FIRE** also allows you to add a preheat time to the beginning of the program, and/or, a slower cooling time or a more complex program to the end of it. These are the four preset **EASY-FIRE** programs that have been designed to do most typical ceramic firing cycles. They are **Slow Bisque** (very slow; approximately 13+ hours heating time only), **Fast Bisque** (slow; approximately 10+ hours heating time only), **Slow Glaze** (medium; approximately 6-1/2+ hours heating time only) and **Fast Glaze** (fast; approximately 3+ hours heating time only). These preset programs have specific ramps and speeds built into them. You can enter any cone number up to cone 10 *(see note below) as the hottest set point. This allows for some degree of customization while still keeping the programming simple and easy.

The **EASY-FIRE** mode uses the Orton Foundation's patented method to achieve the correct heat work making these programs ideal for firing ceramics. The advantage of using the **EASY-FIRE** method is that a very complicated firing profile may be chosen with just a few key strokes (see Appendix F for these firing profiles). These program's final temperature set points are based on a 108°F temperature rise per hour for a large Orton self-supporting cone (rather than the small Orton cones or regular large Orton cones). Your real rate of climb may be different in the end; depending on a lot of different variables. **Expect to see a lower final temp if the kiln goes slower, or a higher one if it climbs faster.**

NOTE: Some L&L Kilns are not designed to go to cone 10 or 2350°F. Consult your kiln's control panel label for the maximum operating temperature.

5.1.1 To use EASY-FIRE:

Press	Display	Comment
	IdLE and TC(#)	Make sure IdLE and TC(#), and the current temperature are flashing. Note: If you only have one thermocouple enabled then you will not see TC(#)
Press one of the four easy firing profile buttons: **SLOW BISQUE** or **FAST BISQUE** or **SLOW GLAZE** or **FAST GLAZE**.	You will see S-bC, F-bC, S-GL or F-GL.	This is where you choose the Easy-fire program you want to run
Press **ENTER**	See CONE and Cone Number flashing	This can be any cone from **022** to **10.** If you type a wrong number here, press **0000** until all zeros appear in the display, press **ENTER,** then type the correct cone number.
Type the cone number you want to fire to (for instance **05**)	See HOLd and 0.00 flashing	You are now about to enter a hold time (if any). Type the hold time or leave at 0.00. Numbers to the left of the decimal are hours, to the right are minutes. (Note that adding hold time will add heat-work to ceramics and thus increase the cone that you are firing to. The **EASY-FIRE** programs will NOT compensate for this)
Press a number if you want a hold time like **0.05** and then **ENTER**. If you want the hold to be 0.00 then just press **ENTER.**	IdLE and TC2 and the current temperature will be flashing in the display.	You are done programming. Note: If you see RA 8 then you have the Controlled Cooldown turned on. See **Section 6.4** for more information.
Press **START/STOP**	--ON--	This will begin firing.
Review Prog		Do a program review to make sure the program is what you want. See **Section 8.1** for details on what you should see.

5.1.2 EASY-FIRE Example 1

Slow Bisque Firing Profile to Cone 04, **Pre-heat of 1 hour, 2 minute Hold** - Use the following steps for a bisque firing to cone 04, a 2 minute temperature hold at the peak temperature, and a preheat stage with 1 hour hold time. THIS IS JUST AN EXAMPLE…You can change the firing profile, cone number, hold time, or preheat time to fit your specific needs.

To begin programming the display must be reading IdLE, TC(#), and the current temperature. Note: If you only have one thermocouple enabled then you will not see TC(#)

Press	Display	Comment
Slow Bisque	S-bC	If you press the wrong button, before pressing **ENTER**, simply press the correct button.
ENTER	Alternately flashing: CONE and #	The Slow Bisque profile is now selected. The word CONE and the last entered cone number will alternately flash on the display. Now enter the cone number - **04**.
04	04	
ENTER	Alternately flashing: HOLd and 0.00	The cone number has been accepted. Now enter the 10 minute hold time.
0010	00.10	Numbers to left of decimal point are hours, to the right of decimal point are minutes. If you type a wrong number, press **0000**, then type the correct number.
ENTER	IdLE and TC(#) flashes, then the current temperature	The 10 minute hold time is accepted. IdLE indicates the firing profile has been completed. Note: If you see RA 8 then you have the Controlled Cooldown turned on. See **Section 6.4** for more information. Note: If you only have one thermocouple enabled then you will not see TC(#)
Preheat	Alternating flashing: HLd and 0.00	Preheat has been selected and the hold time is to be entered now.
100	1.00	Numbers to left of decimal point are hours, to the right of decimal point are minutes. NOTE: For a 1 hour hold time you could also enter **60** for 60 minutes; the display would show .60. If you type a wrong number, press **0000**, then type the correct number.
ENTER	IdLE and TC(#) flashes, then current temperature	Accepts a hold time of 1 hour, then IdLE indicates the preheat stage has been completed. Note: If you only have one thermocouple enabled then you will not see TC(#)
START STOP	-ON-	After -On- is displayed for several seconds, the heating elements of the kiln will cycle on and the current temperature in the kiln will be displayed. If a time is displayed instead of the current temperature, then a delay start is in effect. If you do not want to delay the start. Press **START/ STOP** button, then **DELAY,** then **0000,** then **ENTER**. When the current temperature and IdLE are again flashing in the display, press **START/ STOP** to re-start the program.
Review Prog		Do a program review to make sure the program is what you want. See **Section 8.1** for details on what you should see.

5.1.3 EASY-FIRE Example 2

Fast Glaze Firing Profile to Cone 06, 10 minute Hold, Delay start of 2 hours. Use the following steps for a glaze firing to cone 06, a 10-minute temperature hold at the peak temperature, and a 2-hour delay before the start of the firing. THIS IS JUST AN EXAMPLE. You may change the firing profile, cone number, hold time, delay time, or even add a preheat to this program to fit your special needs.

Press	Display	Comment
Fast Glaze	F-GL	If you press the wrong button, before pressing **ENTER,** simply press the correct button.
ENTER	Alternately flashing: CONE and #	Fast Glaze is selected. The word CONE and the last entered cone number will alternately flash on the display.
06	06	If you type a wrong number, press **0000**, then type the correct number.
ENTER	Alternately flashing: HOLd & 0.00	The cone number has been accepted and the hold time is entered now. Note: If you see RA 8 then you have the Controlled Cooldown turned on. See **Section 6.4** for more information.
0010	00.10	The Hold time is displayed. Numbers to left of decimal point are hours, to the right of decimal point are minutes. If you type a wrong number, press zero 4 times, then type the correct number.
ENTER	IdLE and TC(#) flashes, then the current temperature	Accepts a hold time of 10 minutes and then IdLE indicates the firing profile has been completed. Note: If you see RA 8 then you have the Controlled Cooldown turned on. See **Section 6.4** for more information. Note: If you only have one thermocouple enabled then you will not see TC(#)
Delay	Alternately flashing: dELA and 0.00 (or the last programmed delay time)	Either 0.00 or the last programmed delay time will flash alternately with dELA.
200	02.00	Numbers to left of decimal point are hours, to the right of decimal point are minutes. If you type a wrong number, press zero 4 times, then type the correct number.
ENTER	IdLE and TC(#) flashes, then current temperature	The 2 hour delay time is accepted. IdLE indicates the job is completed. Note: If you only have one thermocouple enabled then you will not see TC(#)
START/ STOP	-On- then 2.00	Starts the countdown of the delay time toward zero, at which time the kiln will start to heat. The display will show the amount of time left until the firing is to start.
Review Prog		Do a program review to make sure the program is what you want. See **Section 8.1** for details on what you should see.

6. EASY-FIRE OPTIONS SECTION

6.1 Delay Button

This button's function is used to delay the start of a firing.

NOTE: DELAY OPTION With any **EASY-FIRE** or **VARY-FIRE** program an optional Delay for the start time of the program is available. **This feature makes it easy for you to be present at the end of a firing.** Appendix F has the estimated times that the **EASY-FIRE** Programs take for selected cone numbers. By using this appendix, and adding however many hours you need, up to 99 hours and 99 minutes, to the delay timer you can ensure your presence at the end of the firing.

To program a delay time you need not have programmed any firing profile yet. When the display cycles `IdLE`, `tC(#)`, `current temperature` over and over. Note: If you only have one thermocouple enabled then you will not see `TC(#)`:

Press **Delay** and see `dELA` and `0.00` cycling over and over.
Press the number keys to enter the amount of delay time desired. Numbers to the RIGHT of the decimal in the display are minutes, i.e. 75 minutes of delay time would look like `00.75` or `0.75` or `.75`. Numbers to the Left of the decimal in the display are hours, i.e. 14 hours 30 minutes of delay time would look like `14.30`.
Press **ENTER** and see `IdLE/ TC(#)`, - that's it. Note: If you only have one thermocouple enabled then you will not see `TC(#)`

Now once you program any **EASY-FIRE** or **VARY-FIRE** program this delay will appear in the display like a timer counting down when you press **START/STOP** to begin firing. The firing will begin once the timer reaches zero. It will remain set as is until you change it.

Example: Program a one hour delay to the start of a firing. You can change the one hour delay to as much as 99 hours and 99 minutes of delay time.

Press	Display	Comment
Delay	Alternately flashing: `dELA` and `0.00`	The controller is ready to accept the delay time of 1 hour.
100	`1.00`	Displays the selected time. Numbers to left of decimal point are hours, to the right of decimal point are minutes. If you type a wrong number, press **0000**, then type the correct number.
ENTER	`IdLE`, `TC(#)` flashes then the `current temperature`	`IdLE` indicates the 1 hour delay has been accepted. The `current temperature` then flashes in the display. Note: If you only have one thermocouple enabled then you will not see `TC(#)`

6.2 Preheat Button

- Preheat can be used with the **EASY-FIRE** mode only. When Preheat is in use, the temperature ramps up at 60°F/hour to 200°F and then holds at 200°F for the amount of time programmed. After which the **EASY-FIRE** program begins. Preheat is automatically set to zero at the end of each firing, so if a preheat stage is wanted, it must be reprogrammed for each **EASY-FIRE** firing.

To preheat the kiln for a specific amount of time you must first program an **EASY-FIRE** program. Once this is done you can add the preheat option to it:
Press **PREHEAT** and see `HLd` and `0.00` cycling over and over.
Press the number keys to enter the amount of Preheat time desired. Numbers to the LEFT of the decimal in the display are hours, i.e. 3 hours of preheat time would look like `03.00` or like `3.00`. Numbers to the RIGHT of the decimal in the display are minutes, i.e. 75 minutes of preheat time would look like `00.75` or like `0.75`.
Press **ENTER** and see `IdLE`, `TC(#)` flashes then the `current temperature`. Note: If you only have one thermocouple enabled then you will not see `TC(#)`

Preheat Example: Set a preheat time of 3 hours.

Remember: You must choose and program an EASY-FIRE profile first, before you set the preheat time.

IdLE and TC(#) and the temperature must be flashing to start the programming. Note: If you only have one thermocouple enabled then you will not see TC(#)

Press	Display	Comment
Preheat	Alternately flashing: HLd and 0.00	If you see IdLE when you press Preheat then it means that you have a **VARY-FIRE** program entered. You can not use preheat with a **VARY-FIRE** program.
ENTER	Alternately flashing: HLd and 0.00	Preheat has been selected; enter the time you want to hold the temperature at 200°F (in this example 3 hours)
300	3.00	Displays the selected time of 2 hours. Numbers to left of decimal point are hours, to the right of decimal point are minutes. If you type a wrong number, press **0000**, then type the correct number.
ENTER	IdLE TC(#) flashes then the current temperature	IdLE and TC(#), and the current temperature then cycles in the display. Note: If you only have one thermocouple enabled then you will not see TC(#)

6.3 Alarm Button

This button's function enables you to program an audible temperature alarm. (Note: it is not very loud)

NOTE: If the alarm is desired, it must be set with the Alarm Button for each firing when an **EASY-FIRE** program is chosen. When a **VARY-FIRE** program is chosen the DynaTrol will automatically use the alarm setting that can be programmed with that **VARY-FIRE** program (It is done within the **VARY-FIRE** program). Once the Alarm Button is pressed, if no alarm setting is entered within 10 seconds, the display will return to IdLE, TC2 and the current temperature.

The alarm may be set before or *during* a firing. When the alarm temperature is reached, a beeper will sound. Turn off the sound by pressing **ENTER**. This is very useful for alerting you to specific critical temperatures in a program - for instance just before the kiln is going to reach maturing temperatures or when to close the peepholes during natural venting.

Example: Before or during a firing, set the alarm temperature to go off at 600°F.

Press	Display	Comment
Alarm	Alternately flashing: ALRM and #	The word ALRM and the last entered alarm temperature will alternately flash on the display. The controller is ready to accept the alarm temperature. If no alarm is entered within 10 seconds, the display will return to IdLE and TC 2 and the current temperature. Note: If you only have one thermocouple enabled then you will not see TC(#)
600	600	Displays the selected temperature of 600°F. If you type a wrong number, press **0000**, then type the correct number.
ENTER	IdLE and TC 2 flashes then the current temperature	The IdLE and TC2, and the current temperature then cycles in the display. Note: If you only have one thermocouple enabled then you will not see TC(#)

6.4 Downramping/Controlled Cooling with EASY-FIRE

If your kiln is cooling too rapidly for good glaze results, or if the cooling is so rapid that cracking occurs on certain large pieces, it is recommended to cool under power. A kiln with a light load or a large firing chamber will cool more quickly than a kiln with a heavy, dense load or a small firing chamber assuming the same thickness of the insulation. So you may want to test your kiln to see how quickly it cools at high temperatures and at low temperatures to see what type of cooling segment(s) you need. There are two methods to add a controlled cool to an **EASY-FIRE** program. Method #1 allows you to add a simple one segment controlled cooldown to the end of your **EASY-FIRE** program. Method #2 allows you to add a more complex **VARY-**

FIRE program to the end of your **EASY-FIRE**. Use method #2 if you need a cooling sequence with more than one segment.

Video on controlled cooling with an **EASY-FIRE** program: ***hotkilns.com/adding-controlled-cool-easy-fire-program***

6.4.1 Method #1 Using the simple Easy-Fire method

Access the hidden menu by pressing **OTHER** followed by **443**
Use the **OTHER** key to scroll through the options until you reach COOL and press **ENTER.** (Note - COOL is towards the end of the options)
Press **1** on the keypad to toggle this option ON/OFF and press **ENTER** to confirm your selection.
Now with the COOL option turned on, extra parameters will be added to the typical **EASY-FIRE** programming options. (RA8, F*8, Hld8)
Simply input your rate of cooling for RA8 and the temperature to controlled cool down to for F*8. You can add a hold at that final temperature as well.
As long as COOL is enabled, these parameters will be shown to you. After each firing these options will default back to 0. Leave RA8 at 0 if you don't want a controlled cool for this program.

6.4.2 Method #2 using the more sophisticated Vary-Fire method

First you enter the cooling segment. (NOTE: If your kiln is brand new this cooling segment is already entered in your DynaTrol. If you are not sure that it is in there, it will not hurt anything to re-enter it.
Start by pressing the **ENTER PROG** button in the **VARY-FIRE** Section
Press **6** and then press **ENTER** to program USER 6.
Program USER 6 with the desired cool down program. 150 degrees F per hour down to 1400 F is a good cooling program. Once we finish these steps, USER 6 will start when your **EASY-FIRE** program reaches complete (CPLT). If you do not know how to program a **VARY-FIRE** program, see Section 7. **NOTE:** Segment 1 of USER 6 is utilized by the controller and cannot be used for the program. Therefore the number of segments you input for the program will need to be one greater than the number of segments that are really being used for the cooling. Once you begin programming USER 6; when the display asks for RA1 press **ENTER, ENTER, ENTER** and begin the cool-down part of the program with segment 2.
Press the desired **EASY-FIRE** program button (i.e. **Slow Bisque, Fast Bisque, Slow Glaze or Fast Glaze**).
Program the **EASY-FIRE** portion for the program. Do this just as you would for any **EASY-FIRE** program.
To tell it to join the cooling program to the **EASY-FIRE** program, press the **Other** button until 16-S appears in the display. Press **ENTER**.
Press the **1** key until the desired condition is displayed. On will allow **EASY-FIRE** program to flow into **VARY-FIRE** USER 6 program and OFF will disable this option.
Press the **ENTER** button. Programming is now complete. If 16-Segment is On then the controller will complete the **EASY-FIRE** program and, upon finishing it, will run the **VARY-FIRE USER 6** program.
NOTE: 16-S will appear in the Program Review when you press the **Review Prog** button. Once the USER 6 is programmed with the controlled cooling segment you do not need to enter it every time. In place of steps 1-3; do the following: 1) Press **Recall Prog**. 2) Press #**6**. 3) Press **ENTER**. Then follow with steps 4-8 above.

Note: It does not matter whether COOL is the Hidden Menu is turned on or off for the second method.

6.4.3 EASY-FIRE Example 3 with a controlled cooldown (using Vary-Fire method)

Slow Glaze Firing Profile to Cone 6, 5 minute Hold, Controlled Cooldown.

Press	Display	Comment
Enter Prog	Alternately flashing: USER and #	You FIRST have to program the cooldown program BEFORE you program the **EASY-FIRE** program. Otherwise the control thinks you are going to use **VARY-FIRE** program #6 as your main program.
6	6	You are going to program **VARY-FIRE** program No. 6
ENTER	Alternately flashing: SEGS and 2 (or some other number 2-8)	This is the number of segments you will need. In most cases you will want 2 segments. **The first segment IS NOT USED and it doesn't matter what it says**.
2	2	This tells the control you will be programming two segments
ENTER	Alternately flashing: RA 1 and 0500 (or some other number)	This is the ramp of segment 1. It doesn't matter what the value is because it will be ignored.
ENTER	Alternately flashing: oF 1 and 0200 (or some other number)	This is the temperature set point of segment 1. It doesn't matter what the value is because it will be ignored.
ENTER	Alternately flashing: HLd1 and 0200 (or some other number)	This is hold value of segment 1. It doesn't matter what the value is because it will be ignored.
ENTER	Alternately flashing: RA 2 and 0000 (or some other number)	This is asking you what ramp value to put in for segment 2. This will be our cooldown rate in degrees F (unless you are operating in deg C)
150	150	This means we will cool at a rate of 150 deg per hour.
ENTER	Alternately flashing: oF 2 and 0000 (or some other number)	This is asking you what temperature value to put in for segment 2. This will be our cooldown setpoint, i.e. the target temperature to cool down to. After we reach this temperature the kiln will stop firing and it will cool down without any power. (Note: Must be lower than final cone temperature)
1400	1400	We will have a controlled cooldown to 1400 Deg F
ENTER	Alternately flashing: HLd2 and 0000	This is asking you for a hold time.
0000	00.00	Hold of zero
ENTER	Alternately flashing: ALRM and 9999	This is asking you for an alarm temperature. 9999 keeps it turned off.
ENTER	IdLE, TC(#) flashes then the current temperature	The cooling segment is complete. Now we must enter the heating part of the program. Note: If you only have one thermocouple enabled then you will not see TC(#)
Slow Glaze	S-GL	If you press the wrong button, before pressing **ENTER,** simply press the correct button.
ENTER	Alternately flashing: CONE and #	**Slow Glaze** is selected. The word CONE and the last entered cone number will alternately flash on the display.
6	Alternately flashing: CONE and 6	The word CONE and the entered cone number will alternately flash on the display. If you type a wrong number, press **0000,** press **ENTER**, then type the correct cone number.
ENTER	Alternately flashing: HOLd and 0.00	The cone number has been accepted and the hold time is entered now.

05	.05	The Hold time is displayed. Numbers to left of decimal point are hours, to the right of decimal point are minutes. If you type a wrong number, press zero 4 times, then type the correct number.
ENTER	IdLE, TC(#) flashes then the current temperature	Accepts a hold time of 5 minutes and then IdLE indicates the heating part of the program is complete. Note: If you only have one thermocouple enabled then you will not see TC(#)
Other, Other, Other, Other	16-S	This means “16 segment”. This is how we add the two programs to each other.
ENTER	OFF	The 16 segment feature is turned off as the default setting.
1	On	Pressing **1** turns the 16 segment feature on. You can toggle between OFF and On by pressing **1** again.
ENTER	IdLE	You have now activated the 16 segment feature which will start **VARY-FIRE** Program No 6 when the **EASY-FIRE** program finishes
START/ STOP	-On-	Starts the program..
Review Prog		You will see 16-S at the end of the displays that scroll. This tells you that **VARY-FIRE** Program #6 will start when your **EASY-FIRE** program ends.

7. VARY-FIRE CUSTOM PROGRAMMING

7.1 GENERAL CONCEPT

The **VARY-FIRE** mode allows you to program exactly how you want the kiln to fire. It provides a very broad range of programming possibilities designed to allow these kilns to be used in many different ways. The DynaTrol allows you to permanently store **6 separate programs with up to 8 ramp/hold segments in each program**.

There is one cooling or heating ramp, a temperature setpoint, and an optional hold time at that setpoint, per segment.

These programs are stored in a non-volatile memory bank, which means that they will stay in memory even when all power is turned off.

The DynaTrol allows you to hold at a low temperature for a long time (i.e. you can have an automatic drying period similar to the Preheat option in the **EASY-FIRE** mode). Then it can automatically ramp up to your final temperature, switching to different heating or cooling rates along the way. You can ramp slowly through critical periods or soak at any temperature within, or at the end of a firing, for more consistent maturing of work. Your program can include a controlled cool down to avoid heat shock.

Many of these options are permanently programmed into the **EASY-FIRE** programs to maximize their ability to properly fire your ceramics. However, with the **VARY-FIRE** programs you have complete control over nearly every aspect of the firing so you can adjust the kiln performance to your exact needs. **This can allow the kiln to be used for non-ceramic applications such as glass slumping, annealing, enameling, growing crystals, jewelry, heat treating, testing, and other industrial uses.**

In the **VARY-FIRE** mode your saved programs are called USER1, USER2,… USER6. These are the names that will define your programs and make them easy to recall in order to use them to fire the kiln.

These six programs slots; USER1, USER2,… USER6, etc. come with generic programs already in place. These programs can be replaced with your own custom programs, and at any time in the future the original programs can be recalled. If they are recalled however, they will replace any of your custom programs that you have saved under USER1, USER2,… USER6.

7.1.1 Factory Loaded VARY-FIRE Programs

The six factory loaded programs in the **VARY-FIRE**'s custom program slots are as follows:

USER1 is a glass slumping program

USER2 is a glass tack fuse program

USER3 is a glass full fuse program

USER4 is a glass bead annealing program

USER5 is a lost-wax burnout program

USER6 is a slow cooling cycle that can be added to a CONE 6 firing (or can be altered to add to any firing) but only when the 16-S option is selected

NOTE: See the Appendix H section in this manual for exactly what each of these programs will do.

7.1.2 VARY-FIRE Chart Concept

VARY-FIRE programs in general are best thought of in the terms of a chart. For example: a three segment program with a maximum set point temperature of 1575°F, a one hour hold time, and a controlled cooldown. In segment 1, ramp rates are at first only 100°F per hour until the entire kiln's temperature reaches 200°F. Then, with no hold time in segment 1, the control automatically switches to segment 2, which will allow the kiln to rise at 500°F per hour until its maximum setpoint at 1575°F. Then it will hold for one hour at 1575°F. Then, in segment 3, it will cool from 1575°F to 1000°F at 143°F per our. Once the kiln temperature cools to 1000°F the firing is complete and the kiln heaters will turn off.

Segment	Rate °F/hour	Temperature	Hold
1	100°F/Hour	200°F	0
2	500°F/hour	1575°F	1 hour (01.00)
3	143°F/hour	1000°F	0

NOTE: The Appendix K has a blank form for writing your firing programs. Photo-copy this form as needed.

7.1.3 VARY-FIRE Example

The following steps are used to enter a program under USER1 for the firing profile in the above example.

You can follow along with this video on our website: ***hotkilns.com/programming-vary-fire-dynatrol***

NOTE: You can change the program's name (the USER number), change the number of segments, and change the ramping rates, segment setpoints and hold times within each of the segments. You can even add a DELAY time to ensure that you will be around for the end of the firing, all to fit the program to your own specific needs.

Press	Display	Comment
Enter Prog	Alternately flashing: USER and #	The display alternates between USER and the last selected firing profile number.
1	1	Selects user (USER) profile number 1. Only choose USER 1 if you wish to program over the program that is already there.
ENTER	Alternately flashing: SEGS and #	The displays flashes between SEGS and the number of segments which were previously selected for this profile.
3	3	This is the number of segments needed for our example profile.
ENTER	Alternately flashing: RA 1 and #	The display flashes between RA1 and the heating rate per hour of the previously selected for this profile.
100	100	Displays the selected rate/hour.

ENTER	Alternately flashing: °F 1 and #	The display flashes between °F1 and the temperature which was previously selected for this profile.
200	200	Displays the selected temperature
ENTER	Alternately flashing: HLd1 and #	The display flashes between HLd1 and the hours and minutes which were previously selected for this profile.
0	00.00	No hold time.
ENTER	Alternately flashing: RA 2 and #	The display flashes between RA2 & the heating rate previously selected for this profile.
500	500	Displays the selected rate/hour.
ENTER	Alternately flashing: °F 2 and #	The display flashes between °F2 & the temperature which was previously selected for this profile
1575	1575	Displays the selected temperature.
ENTER	Alternately flashing: HLd2 and #	The displays flashes between HLd2 & the previously selected hold time.
0100	1.00	One Hour hold time at 1575°F. (Normally with pottery you would rarely hold at the top temp/cone. Holding here adds heat work… an hour hold can make it 2-3 cones hotter. Type **0000** for no Hold))
ENTER	Alternately flashing: RA 3 and #	The display flashes between rA3 and the heating rate previously selected for this profile.
143	143	Displays the selected rate/hour.
ENTER	Alternately flashing: °F 3 and #	The display flashes between °F3 and the temperature which was previously selected for this profile
1000	1000	Displays the selected temperature.
ENTER	Alternately flashing: HLd3 and #	The displays flashes between HLd3 and the previously selected hold time.
0	. 0	No hold time.
ENTER	Alternately flashing: ALRM and #	The display alternates between ALRM and the previously used alarm setting.
9999	9999	Enters the temperature at which the alarm will sound. The alarm will be turned off with a setting of 9999.
ENTER	CPL flashes then IdLE, TC(#),current temperature	CPL flashes indicating the program has been completed. IdLE then the current temperature flashes in the display. Note: If you only have one thermocouple enabled then you will not see TC(#)

7.2 Preheating (Candling) with VARY-FIRE

There is no actual **Preheat** option in the **VARY-FIRE** mode. You must include another segment in your program in order to "Preheat". To preheat in the **VARY-FIRE** mode you would make your first segment as follows:

rA1 = 60 , °F1 = 200 and HLD1 (time you wish to preheat for)

7.3 Downramping, or Controlled Cooling with VARY-FIRE

To have the kiln cool at a prescribed rate, slower than it's natural rate, within a program or at the end of a firing, first consider the following. A kiln with a light load or a large firing chamber will cool more quickly than a kiln with a heavy, dense load or a small firing chamber assuming the same thickness of the insulation. So you may want to test your kiln to see how quickly it cools at high temperatures and at low temperatures to see what type of cooling segment(s) you need.

When using just **VARY-FIRE** programming, treat a cooling segment the same as a heating segment when programming the DynaTrol. While programming, you must initially add an extra segment. Then, when you input the RA number in this segment (ramp or rate of rise or fall in °F or °C per hour), this number will be the number of degrees per hour that you want the kiln to COOL. Next, input a number to be the set point temperature in °F (or °C). This number will be the temperature *to which* the kiln will cool, at the rate you have just programmed. You can then program a hold (if you need one here) at this temperature. The program can then end (this was your last segment) or it can continue on cooling or go back to heating in the next segment.

All that the DynaTrol knows, is that to be a cooling segment, the set point must be *LOWER* than the previous segment's set point. It will treat the ramp rate the same for either heating or cooling, just moving the temperature along at the prescribed rate. (See the previous example for the **VARY-FIRE**).

NOTE: When programming a firing with a controlled cooling, be sure to put at least one heating segment before the cooling segment as the kiln cannot cool first. It must heat first before cooling.

7.4 Using VARY-FIRE to fire to a CONE number

You can write a **VARY-FIRE** Program, and rather than have to set a *temperature* as the hottest point, you can set a *Cone Number* as the hottest point. This is very useful when you want your glazes fired to say "cone 6". The **VARY-FIRE** program will actually adjust the final temperature in the segment where you programmed a cone number as the set point. All subsequent set points in later segments must be lower in temp than the Cone segment.

In order to do this; while you are programming the **VARY-FIRE** program and you come to the point where you would normally enter the hottest *temperature,* press **Other** instead of entering a top temperature. Now enter in the appropriate cone number, then press **ENTER** and continue on with that segment's hold time and any later cooling segments etc…

If you change your mind, pressing **Other** before you enter a cone number will take you back to where you can input a temperature rather than a cone number for that segment.

See this video here (skip to 4:45): ***hotkilns.com/programming-vary-fire-dynatrol***

7.5 Adding Two VARY-FIRE Programs Together

The USER 6 program can be added to any **EASY-FIRE** or to **VARY-FIRE** program USER 5. USER 6 comes pre-programmed as a slow cooldown from a Cone 6 firing. It can be adapted to be a slow cooldown from a different cone number or temperature, or with a few adjustments it can be it's own program, or it can be the second half of a sophisticated 16 segment crystalline glaze program for example.

To add whatever is programmed in USER 6 to whatever you program in USER 5 you must first put USER 5 in active memory by recalling it. Then turn on the 16-S feature- located under the **Other** key so the control knows to join those two programs together and run first USER 5, then immediately follow it with USER 6. Think of the first segment of USER 6 following right after the end of USER 5.

7.6 The UNDO/GO-BACK Button

The **Review Prog** (Review Program) button acts as the Go-Back button during **VARY-FIRE** Programming only. If you are programming a segment of a **VARY-FIRE** program, you can go backwards to change something if you need to by pressing **Review Prog**. Once you reach the ALRM, 9999 part of the programming you can no longer go backwards.

If you cannot go back, just continue on and finish programming like nothing was wrong. Then when you get back to IdLE, go back in and program it correctly.

You cannot go backwards in the **EASY-FIRE** programming at all. Just finish programming as if no mistake was made, then once you are back to IdLE, re-program it correctly.

7.7 The RECALL PROG (RECALL PROGRAM) Button

This button is used to call up one of your six previously programmed USER firing profiles in order to use that program to fire the kiln.

Check out this video on the topic: ***hotkilns.com/recalling-vary-fire-program-dynatrol-ll-kiln***

Example: To recall USER profile #4, do the following. First enter your program into User Profile #4, then:

Press	Display	Comment
Recall Prog	Alternately flashing: USER and 1	The controller is ready to accept the desired user number.
4	4	Indicates the user program selected.
ENTER	CPL flashes then IdLE, TC(#),current temperature	CPL flashes indicating the program has been completed. IdLE then the current temperature flashes in the display. Note: If you only have one thermocouple enabled then you will not see TC(#)

7.8 The SKIP-STEP Feature

The Skip Step function is performed using the **Review Seg** (Review Segment) button. The Skip Step feature is only available in a **VARY-FIRE** firing profile. It is used when enough heat work has been done at the current segment and you want to immediately go the next segment. To skip to the next segment, press **Review Seg**, then within 2 seconds, press **ENTER**, and **ENTER** a second time. If you press **View Seg** and do not press **ENTER** within 2 seconds, the current segment (e. g., rA1) will continue to be displayed. Simply wait until the temperature is again displayed and press **Review Seg**, then **ENTER** within 2 seconds, and **ENTER** again. If you press **Review Seg,** then **ENTER,** then decide not to skip to the next ramp stage, simply do not press any key; after about 10 seconds the display will return to the current temperature.

If you are currently in the ramping part of the segment and you skip step you will jump over any hold time in that segment and go directly to the ramp in the next segment. If you are currently in the hold part of a segment and you skip a step you will just go to the ramp in the next segment.

7.9 Full Power Ramp

A full power ramp will be enabled if a ramp rate of 9999 degrees per hour is programmed. At the start of a full power up ramp the elements will continuously be on until the soak temperature is reached. At temperatures 50 degrees less than the programmed soak temperature the elements will begin to cycle to minimize overshoot. A full power ramp is the quickest way to reach a specified temperature. You can also use full power ramp for troubleshooting purposes forcing the elements on so that you can test them with a multimeter.

8. VIEW/ REVIEW AND SPECIAL OPTIONS

8.1 Review Prog (Review Prog)

This feature is useful to be sure that the program that you have just selected to fire, either one of the preprogrammed **EASY-FIRE** programs or one of your six USER programs, is the one that you think it is.

You can use the Review Prog. Button to verify that you have a delay or preheat or any other options. It will also tell you how many firings have been completed on the kiln.

Example - If you have selected a Slow Bisque "**EASY-FIRE**" profile to cone 04 with a 20 minute hold, the following will be displayed, each for about 1/2 second when **Review Prog** is pressed:

Display	Comment
S-bC	Slow Bisque firing profile
PRHT	Indicates the next value will be the preheat hold time
0.00	No preheat hold time is selected
C0NE	Next value will be the selected cone number
04	Selected cone number
°F	next number will be the cone temperature
1926	DynaTrol's temperature for cone 04
CN0S	Indicates the next value will be the amount of offset applied to that cone number
0	There is no offset- Offset is degrees +/- you can add to a cone's temp equivalent
H0Ld	Next number will be the hold or soak time at the end of the firing
0.20	20 minutes hold selected
dELA	next number will be the delay time before the start of firing
0.00	No delay, firing will start when **START/STOP** is pressed
ALRM	Next number will be the high alarm limit setting
9999	This is as high as the alarm can be set and assures the alarm will be off
ERCd	Next message will indicate if the error codes are 0N or 0FF
0N	Error codes are 0N
FIRE	Next number is the number of times the kiln has been fired
25	Kiln has been fired 25 times (yours will most likely say a different number here)
IdLE	End of firing profile- it goes back to IdLE

8.2 Review Seg (Review Segment)

Pressing the **Review Seg** key during a firing will display several different pieces of information about the status of the firing.

Once pressed, this is what the DynaTrol is displaying:

First: The Current Segment

Next: The Rate of Rise (in degrees Fahrenheit per hour)

Next: The Traveling Temperature Set Point (This means that the set point temperature is moving with the program. The set point is the specific temperature the control is telling the kiln to achieve).

Last: The actual physical temperature of the DynaTrol's circuit board.

8.2.1 Examples of Review Seg:

If you press **Review Seg**, and the FIRST message that is displayed is…	It Means:
STOP	No firing is in progress, the controller is currently idling (IdLE and TC2, current temperature)
rA 4 , 500	Kiln firing, ramp stage in segment 4, 500 degrees per hour rate of rise. Then you will see SETP and the current traveling set point
rA 3 , 50	Kiln firing, ramp stage in segment 3, 50 degrees per hour rate of rise. Then you will see SETP and the current traveling set point
HLd2	Kiln firing, hold stage in segment 2
HLd6	Kiln firing, hold stage in segment 6
If you press Review Seg, the SECOND message that is displayed is…	**It Means:**
The Traveling Set Point: in the form of a temperature number (for instance 1749) in whatever temperature scale you are using. i.e. SETP and 200	This number is constantly changing based on how you have programmed the kiln. The DynaTrol looks at the entire program you have entered and then plots the course of the Traveling Set Point. Once the firing has started and the elements are heating, the thermocouples are registering the temperature in the kiln. These temperatures are constantly compared to the Traveling Set Point and their relationship is what determines whether or not the elements stay on or are turned off in each zone of the kiln.
If you press Review Seg, the THIRD message that is displayed is…	**It Means:**
The ambient temperature of the DynaTrol's electronics in the control panel. i.e. bd T and 100	This temperature can tell you if you are operating the kiln in a detrimental and possibly unsafe environment. The recommended maximum ambient temperature is 125°F. If your temperature reads hotter than that you could damage the DynaTrol over time. Something else to consider is the fire hazard issue (see the general kiln instructions for precautions on this)

9. THE 'OTHER' BUTTON

The **Other** button opens a menu which contains many of the different user-programmable settings. As you press **Other** again and again the menu will scroll by. You can press **Review Seg** to go backwards in the menu. NOTE: You can not access the **Other** menus while the control is firing a program.

9.1 The OTHER Menus Overview

Reset feature RSET
Cone Lookup Table CONE
Controller ID Id
16 step program 16-S (only comes up if you have **VARY-FIRE** Program #5 or an **EASY-FIRE** program in active memory)
Cone temperature offsets CNOS
Temperature scales °F or °C CHG°
Error codes ON or OFF ERCd
Thermocouple offset TCOS
Board temperature bd T

TO EXIT this menu without changing anything, press the START/STOP button.

9.2 Reset

RSET - Choosing this function will re-assign the default value (ON) to the Error codes only. Press **Other** until RSET is displayed. Then press **ENTER**. IdLE will be displayed indicating that the Error Checking is ON. This is also the screen where you can enter the "**Hidden Other Menu**" (See Section 10 for more information).

9.3 Cone Lookup Table

CONE – **This option allows you to type in a cone number and see what the DynaTrol's programmed temperature is for that cone number at a temperature climb of 108°F per hour.** This function is provided as a handy reference table to use while you are programming. There is a more complete cone table in "Logs, Cones, Tips" section of the Owners Manual or see here: ***hotkilns.com/orton-cone-chart***. Remember, however, that there is no absolute equivalent between cones and temperature.

9.3.1 Cone Table Example:

Press	Display	Comment
Other **Other**	CONE	The word CONE will appear on the display
ENTER	Alternately flashing: CONE and a cone number. This example: CONE and 07	The word CONE and a cone number will alternately flash on the display.
04	04	This is the cone we are looking up in this example
ENTER	1945	The cone temperature is displayed for 2 seconds then IdLE is displayed followed by the flashing current temperature

9.4 Identification

Id - **Used by KISS (Kiln Interface Software System) to identify the kiln when hooked to a personal computer.** This software is available from L&L. Normally this is set to 1. If you are not using the control in a KISS environment it doesn't matter what it says. Further info is provided in the KISS Instructions.

9.5 Sixteen Segment Program

16-S - **This option allows VARY-FIRE profile #5 or any EASY-FIRE program to be combined with USER 6 to make**

one profile with up to 16 segments. It shows up in the **Other** menu only when **VARY-FIRE** #5 Profile or any **EASY-FIRE** program has been programmed . To use it, first, program **VARY-FIRE** Profile #5 or an **EASY-FIRE** program. Note that the beginning segment of Profile #6 should be entered as if it was to start directly after the ending segment of the **EASY-FIRE** program or of **VARY-FIRE** profile #5.

To take advantage of this feature do the following:

Press	Display	Comment
		First, program **VARY-FIRE** Profile #6 Then **VARY-FIRE** Profile #5. Then…
RECALL PROGRAM	USER and 1	This is asking which program to recall, you can press **5**.
5	5	USER profile number 5 containing at least the first half of your program has been chosen, press **ENTER**.
ENTER	IdLE	The program USER 5 has been recalled
Other (4x)	16-S	Press **Other** until the 16-S appears. Press **ENTER** to accept the option.
ENTER	OFF	This option is currently off. Use any number key to toggle between ON and OFF
1	ON	This turns on the 16 segment programming – linking program #5 and program #6, press **ENTER**.
ENTER	IdLE	This activates and confirms the programming
START		The controller will fire **VARY-FIRE** Profile #5 until complete and then will fire **VARY-FIRE** Profile #6 until complete

NOTE: If you just want USER5 to fire without automatically being followed by whatever is programmed in USER6 double-check that this option is set to OFF. It will show up in the Program Review. If you have activated the 16-S feature and you press **Review Prog** it will only show you the first half of the program; USER 5 or the **EASY-FIRE** program. It will not show you the contents of USER 6 in the Review Program. It will show you 16-S as it scrolls through the Review Program. This is your clue that whatever is in USER 6 is going to follow your current program.

9.6 Cone Offset

CNOS **(Cone Offset) - Used to fine tune what the DynaTrol thinks the final cone temperature should be in EASY-FIRE programs.** The final cone temperature can be raised or lowered a maximum of 99°F (or 55°C). When entering the offset temperature the following code is used: the left two digits designate whether to raise (00) or lower (90) the cone temperature, that is, 00 means plus (+) and 90 means minus (-). The right two digits are the number of degrees the cone temperature will be raised or lowered. This offset will remain programmed only for the specific cone number until you reprogram the cone offset differently

9.6.1 Examples of Cone Offset:

Number	Meaning
0020	Raise the final cone temperature by 20°F
0040	Raise the final cone temperature by 40°F
0015	Raise the final cone temperature by 15°F
9030	Lower the final cone temperature by 30°F
9005	Lower the final cone temperature by 5°F
9045	Lower the final cone temperature by 45°F

NOTE: This option does not affect the VARY-FIRE (Ramp-Hold) mode but it will show up on the menu.

NOTE ABOUT PREPROGRAMMED CONE OFFSETS: The Cone Offsets come preprogrammed. From cone 022 to cone 017 the cone offsets are set at 9020. All other cones are preset at 0000. (Note on Blue DynaTrols made before Oct 1 2004 the cone offset was 9030 for cones 022 to 017 and 9020 for other cones. The offsets were changed when we switched to a more responsive thermocouple protection tube). You can always change this. The **RESET** option in **Other** menu will *NOT* reset these settings.

Check out the video here: ***hotkilns.com/change-cone-offset***

Cone Offset Example: Adjust cone 07 to shut off the kiln at 20°F below Orton's prescribed cone temperature.

Press	Display	Comment
Other several times until you see:	CNOS	If CNOS does not show on the display, press the **Other** key until CNOS displays.
ENTER	Alternately flashing: CONE and #	Cone Offset has been selected; the word CONE and the last entered cone number will alternately flash on the display. Now enter the cone number which you want to adjust (in this example cone 07)
07	Alternately flashing: CONE and 07	The word CONE and the entered cone number (07) will alternately flash on the display. If you type a wrong number, press **0** three times, press **ENTER**, then type the correct number.
ENTER	Alternately flashing: °FOS and 0	°FOS and the previous offset setting alternately flash. Enter the new offset temperature using the rules above, in this example, 9020
9020	9020	The selected offset temperature is displayed. If you type a wrong number, press **zero** 4 times, then type the correct number.
ENTER	IdLE, TC(#), current temperature	IdLE then the current temperature flashes in the display. Note: If you only have one thermocouple enabled then you will not see TC(#)

9.7 Change from Deg F to Deg C

CHG° **- Used to select degrees Fahrenheit (°F) or degrees Celsius (°C).**

Check out the video: ***hotkilns.com/change-deg-f-c***

9.7.1 Example: Change from °F to °C.

Press	Display	Comment
Other several times until you see:	CHG°	If CHG° does not show on the display, press the **OTHER** key until CHG° displays.
ENTER	°F	Indicates that the Fahrenheit (°F) scale is being used. You can toggle back and forth between °F and °C by pressing the **1** key.
1	°C	Displays °C . **The decimal point in the lower right corner means that the Celsius (centigrade) scale has been selected**.
ENTER	IdLE, TC(#), current temperature	IdLE appears indicating the temperature scale has been changed. The current temperature in °C then flashes in the display. There will be a decimal point in the lower right-hand corner of the display.

9.8 Error Codes (On/Off)

ERCd **- Used to turn ON or turn OFF the error codes.** When you receive your DynaTrol the error codes are turned on. In most cases, you will want the error codes on. They can be turned off if you are doing special firings, such as jewelry or glass firing where the kiln is opened while hot. Turning the error codes off turns off the dynamic zone control feature that keeps the temperature in the kiln even top to bottom. It eliminates nuisance shut downs but side also eliminates built in fail-safe measures that help prevent mistakes. See **Appendix E** for details on error codes.

Check out the video: ***hotkilns.com/turn-off-error-codes-video***

9.8.1 Example: Turn the error codes off.

Press	Display	Comment
Other several times until you see:	ERCd	If ERCd does not show on the display, press the **OTHER** key until ERCd displays.
ENTER	ON	Indicates that the error codes are turned on. You can toggle back and forth between on and off by pressing the **1** key.
1	OFF	Displays OFF indicating the error codes will be turned off.
ENTER	IdLE flashes indicating that the error codes have been turned off.	IdLE appears indicating that programming is complete. IdLE and TC2, and the current temperature then cycle in the display.

9.9 Thermocouple Offsets

TCOS – This is used to raise or lower the temperature indicated by any of the thermocouples. The maximum offset is 99°F (or 55°C). The format is the same as the cone offset: the left two digits designate whether to raise (00) or lower (90) the offset temperature, that is, 00 means plus (+) and 90 means minus (-). When TCOS is displayed, press **ENTER** and TC1 will be displayed. Press **ENTER** and the current offset for the top thermocouple will be displayed. Press **ENTER** when the correct offset for the top thermocouples is displayed and then TC2 will be displayed. Repeat the process for TC2 and TC3 only inputting the offset on the thermocouples that need it. **Raising the indicated temperature LOWERS the actual temperature in the kiln and therefore the amount of heat work. Lowering the indicated temperature RAISES the actual temperature in the kiln and therefore the amount of heat work.**

9.9.1 Thermocouple Offset Example

Entering this sequence of steps will make the TOP zone of the kiln fire cooler by 15°F than the rest of the kiln. To do this, the offset is performed on the top (#1) thermocouple only, however the rest of the thermocouples must be programmed as well. The other one or two thermocouples (depending on model of kiln) would be programmed for a zero offset.

Reminder: IdLE and TC(#), and the current temperature must be cycling before you begin programming. Note: If you only have one thermocouple enabled then you will not see TC(#)

Press	Display	Comment
Other several times until you see:	TCOS	Represents thermocouple offset, press **ENTER**
ENTER	TC1	Represents thermocouple #1. The top of the kiln contains TC1 so this is the thermocouple that we want to offset. Press **ENTER**.
ENTER	°FOS 00	The DynaTrol is asking how many degrees you wish to add to or take from that thermocouple's displayed reading. NOTE: If this number reads something other than **0000**, you already have an offset programmed here. Press **ENTER** if you wish to keep this offset, or, in this example we would press **15**
15	15	You have now programmed the top thermocouple to read 15°F hotter, therefore making the top of the kiln 15°F cooler, provided of course, that you program no offsets for thermocouples 2 or 3. Press **ENTER**
ENTER	TC2	Press **ENTER**, you must now enter offsets for thermocouples 2 and 3. In this example we are keeping these offsets set for zero.
ENTER	°FOS 0000	Keep at 0000. If this number reads something other than 0000, you already have an changed the default offset programmed here. Press **ENTER** if you wish to keep this offset.
ENTER	TC3	Press **ENTER**
ENTER	°FOS 0000	Keep at 0000. If this number reads something other than 0000, you already have an changed the default offset programmed here. Press **ENTER** if you wish to keep this offset.

ENTER	CPL or StOP	Thermocouple offset programming is complete.

NOTE: The thermocouple offset will affect the final temperature in that zone only for all **EASY-FIRE** and **VARY-FIRE** profiles. It will remain programmed until you reprogram it.

9.9.2 Board Temperature

bd t **-** You may press **ENTER** here to see what the ambient temperature of the DynaTrol's electronics are. This temperature can also be seen while the kiln is firing by pressing **Review Seg** three times. (125°F is an acceptable ambient operating temperature)

10. HIDDEN OTHER MENU

This menu contains the programmable settings for the rest of the features in the DynaTrol. To find this menu, first IdLE and tC(#)**, and the** current temperature **must be cycling in the display.** Note: If you only have one thermocouple enabled then you will not see TC(#)

Press	Display	Comment
OTHER	RSET	(this is the first option in the **Hidden Other Menu**)
4 and **4** and **3**	NOTC	This is the first hidden menu item. If you want to change this setting hit **ENTER** if you want to go to the next hidden menu item press **OTHER**
OTHER	Various options will show up (See below)	Press **Other** to scroll through the options.
START/STOP		Exits the Hidden Menu

10.1 NOTC: Number of Thermocouples

NOTC is used to change the number of zones in your kiln (essentially, the number of thermocouples used).

To run the kiln using only one thermocouple: When you see NOTC press **ENTER**, then **1,** then **ENTER**. If you choose to do this you must use only thermocouple number 2 in the kiln and we recommend putting it in the middle zone's thermocouple hole. All the zones of the kiln will turn on and off simultaneously when you program the DynaTrol to use only one thermocouple.

To run the kiln using two thermocouples: When you see NOTC press **ENTER**, then **2,** then **ENTER.** If you choose to do this you must have thermocouple #1 in the top zone of the kiln and thermocouple #2 in the middle zone or in the bottom zone. When you program the DynaTrol to run using only two thermocouples the bottom zone and the middle zone go on and off simultaneously.

To run the kiln using three thermocouples: When you see NOTC press **ENTER**, then **3**, then **ENTER**. 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.

NOTE: Kilns with only one thermocouple can be *programmed* to run with two or three thermocouples but because they physically only have one thermocouple the FAIL message will be displayed referring to the non-existent thermocouple. You must then re-program for just one thermocouple. Likewise, two section L&L kilns come with only two thermocouples. If you physically add a section to a two section kiln, you be able to add a third thermocouple. But if you program a two section kiln for three thermocouples you will receive the FAIL message referencing the non-existent thermocouple. You must then re-program for two thermocouples.

10.2 OP A: Option A

Used to control a vent (or other device using output 4). Output 4 can be programmed to be on or off during each segment of a **VARY-FIRE** program. During an **EASY-FIRE** program, output 4 comes on at the beginning of the firing and turns off after the kiln has cooled to 150°F.

10.3 OP B: Option B

Used to control a vent (or other device using output 4). Output 4 can be programmed to be on or off during each segment of a **VARY-FIRE** program. Output 4 comes on at the beginning of an **EASY-FIRE** program, off at 1450°F, back on after the firing is complete and the kiln has cooled to 1000°F and finally off again when the temperature is below 150°F.

10.4 OP C: Option C

For Vent Control: Output 4 can be programmed to be on or off during each segment of a Vary-Fire program. Output 4 is off during Easy-Fire programs.

For Powered Bottoms or other uses: This option can be used to enable a powered bottom, if installed.

When you press **ENTER** here all you will see is CPL (meaning 'Complete'). Now when you program in **VARY-FIRE** mode however, you will see an extra prompt in each segment called FAN1, FAN2,…FAN8. This will appear right before you see the rA1, rA2,…rA8 prompt. FAN, in this refers to the device being controlled (i.e. powered bottom or vent) and the number refers to the program segment. You can set the device to be either ON or OFF in each segment of programming in a **VARY-FIRE** program only by toggling between ON and OFF using a number key.

10.5 PCT: Percent

This option is used to turn on a powered bottom for a percentage of time, relative to that of the bottom zone. To set, enter a number from 0% to 150% using the number pad. i.e. Entering **100** here would turn the powered bottom on whenever the bottom zone came on. Entering **50** here would turn the powered bottom on for about eight seconds, then off for about eight seconds if the bottom zone of the kiln was on all the time. 150 is the maximum you can enter. This pretty much ensures the power bottom is on all the time. The bottom zone would have to be on less than about 66% of the time to have the power bottom cycle if **PCT** was set to 150.

NOTE: Setting the PCt setting to 0000 will turn off all powered bottom options.

10.6 Pid: PID Setting

This setting is not part of the powered bottom settings, It is always "on". Pressing **ENTER** here allows you to set another percent setting that can help a slow, heavily loaded kiln fire faster. This setting comes pre-programmed at the factory for 65%.

Basically you are determining 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 function automatically activates to your pre-programmed setting when the bottom zone is on 100% of the time. Without this feature, heat from the bottom zone will rise up and help to heat the other zones so generally the bottom of the kiln is on more than the other zones to compensate for this. Sometimes the slow bottom zone will slow the whole kiln down. With this feature, the middle zone of the kiln will come on the programmed percent of the time that the TOP zone comes on, if the bottom zone is on all the time. What was found during tests was 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 85% and compare your results).

10.7 dIAG: Diagnostics

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. Press **ENTER** when you see dIAG and open the lid of your kiln. When you are ready, press **ENTER** again and each zone of the kiln will turn on for 10 seconds starting with zone #1, the top zone. If you have a powered bottom it will be on last; when it says OUT4. **CAREFUL it can get hot and there is LIVE electricity – DO NOT TOUCH THE ELEMENTS!** This will tell you if all the power circuits are hooked up right and working; , or if kiln sections are plugged in to the wrong receptacles on the control panel (Jupiter & DaVinci kilns only). If this is the case the zones will not turn on in the proper 1, 2, 3, order.

10.8 ShTO: Shut-Off Averaging

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. Pressing **1** here allows you to toggle between ON and Off. ON meaning 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. OFF meaning 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. You may want to turn this setting to ON if you fire with the “Lag” set for say 15 and the “Autolag” OFF. ON can also help to speed up a slow firing as well.

10.9 ALR4: Alarm For…

This option controls “output 4.” This feature is activated by pressing **ENTER** when ALR4 is displayed. It energizes output #4 on the DynaTrol electronics board when the Alarm goes off. Since the alarm is a temperature alarm and can be set to go off at a specific temp, output 4 can be connected (for example) to a relay that governs the power for an auto-dialer to call your cell phone so you know it is time to come check the kiln. Or it could be connected to a really loud buzzer or light for the kiln room door. Contact the factory if you want to learn more.

NOTE: On kilns with powered bottoms DO NOT CHOOSE THIS OPTION. Your Powered Bottom is connected to output #4 and is best controlled by the ‘PCT’ option in the **Hidden Other Menu**. If this option is chosen, *and* you have a powered bottom, *and* you set the alarm, when the alarm goes off the powered bottom will come on- even if the program is off. The bottom of your kiln could get a bit hot if this happens. Just another reason why it is good to never leave a firing un-attended.

10.10 CYCL: Cycle Time

The cycle time is the length of time between an element turning on two consecutive times. Using a short cycle time may improve temperature control, while using a long cycle time may improve relay life. Cycle time can be programmed anywhere from 10 to 60 seconds. The default setting from the factory is 25 seconds

10.11 MAX: Maximum Temperature Setting

Maximum Temperature Setting controls how hot the kiln can be programmed to fire. This can be used to restrict firings to a certain cone, for example in a school. It can be set as high as 2400°F, although on any L&L the max temp in the warranty literature is “2350°F or Cone 10”. This is already set in the factory.

10.12 TYPE: Type of Thermocouple

The type of thermocouple can be either Type K or Type S. You must have the appropriate thermocouples and lead wire to switch from one to the other. In addition you must switch the software setting from “K-TH” to “S-TH”, or vise versa. Pressing any number key toggles you back and forth from K-TH to S-TH. For precaution, a small jumper must be moved on the circuit board when going from K to S. This jumper is located approximately in the center of the board under the marking “R97”. If the jumper is on only one of the prongs the control is set for Type K. If the jumper is on both of the two prongs the control is set for Type S. This precaution keeps you from accidentally having it set for K with S thermocouples or vise-versa. **(CAUTION: A SEVERE OVERFIRING CAN OCCUR IF YOU HAVE THE CONTROL PROGRAMMED FOR A TYPE S THERMOCOUPLE AND YOU ARE USING A TYPE K THERMOCOUPLE)**. If there is a mismatch between the jumper setting and the software setting you will get an error code: ERR9.

10.13 2KEY: Two- Key Start

Two-Key Start is a safety feature that makes you press **ENTER** after pressing **START/STOP** to begin a program. It keeps you from turning the kiln on by accident. If Two-Key Start is activated, when you press **START/STOP** you will see ----. Pressing **ENTER** now starts the program. By default we do not have this feature turned on.

10.14 E-bd: Error Board Temperature

This allows you to set how hot the room can be that the kiln is in before the DynaTrol shuts the elements off. A temp sensor right on the electronic board inside the control box senses temperature and can be used to trigger a power-off to the elements if the kiln room gets too hot. 250°F is the max. Remember it is a whole lot hotter that close to the kiln than it is in the rest of the room. Default setting is 200°F (93°C)

10.15 REST: Restore Default USER Programs

The DynaTrol comes preloaded with 6 special programs in the **VARY-FIRE** USER memory slots. **VARY-FIRE** has 6 memory slots for you to create and store your own custom programs. You may decide to keep these original programs or write over

them with your own programs.

If you ever want to get all of the original programs back again, you can go to RESТ in the **Hidden Other Menu** and press **ENTER**. If you do this however, any custom programs you made up and saved in the **VARY-FIRE** USER memory slots will be irretrievable. If you want to just get some of the original programs but not others, you will have to manually enter them in. **VARY-FIRE** TEMPERATURE PROFILES section in the Appendixes H contains the actual segment-by-segment program for each of the preset programs.

10.16 ERTF: Stores the Temp, Hours Past, and Rate of Rise when an Error Code occurs.

This feature stores the temp, number of hours that have passed in the program, and the rate of rise of the kiln when an error code occurs. If you come in to your kiln and see E-1 for example, it has shut off because it cannot climb faster than the slowest allowable temp:12 degrees per hour. You can press **ENTER** and then go to ERTF in the **Hidden Other Menu**, press **ENTER** there and see, the temperature at which the error code happened, then the number of hours and minutes that have passed since the program began, then the actual rate of rise in degrees F/ hour (or degrees C/ hour if yours is set for Celsius) when the error code occurred. This is a great diagnostic tool.

10.17 COOL: Cone-Fire Cooling Segment

This feature allows the user to toggle **ON** or **OFF** a cooling segment for any **EASY-FIRE** Program. OFF means that the **EASY-FIRE** Program will fire to it's maximum temperature, then shut off and cool naturally. ON means that once the max temp is reached the cooling segment will kick in. If ON is set, when a **EASY-FIRE** Program is chosen, like **Slow Bisque**, the control will prompt you to enter the cool down segment you want after you are done programming the **EASY-FIRE** Program.

With this feature turned on, the prompt while you are programming an **EASY-FIRE** program will be RA . When you see this enter a ramp rate. Then you will see °F (or °C). Enter a final set point temperature that you want the controlled cooldown to stop at. Then you will see HLd for a hold time (typically not used). An example of a good cool-down segment would be: Rate: 150 degF/hr, to: 1200F, hold: 0. See **section 6.4** for more info on EASY-FIRE controlled cooling.

10.18 VOLT: Voltage Measurement

This feature allows the line voltage to be tested by the DynaTrol safely. This will help diagnose firing problems where the kiln cannot reach temperature. When you see VOLT in the **Hidden Other Menu**, press **ENTER** and the display will flash NOLd; meaning that the next number displayed will be the "No Load Voltage". Press **ENTER** again and FLLd will flash meaning the next number to appear will be the "Full Load Voltage". The kiln's heating elements will be turned on for about 4 seconds while the full load voltage is displayed. After that, it will return to IdLE

To display voltage using the kiln controller a calibration must be done. Before calibration make sure the relays and elements are connected.

Press **Other** key one time.	The message RSET will be displayed.
Type in key sequence **4**, **4**, **3**	NOTC will be displayed.
Press **OTHER**	until VOLT is displayed.
Press **ENTER** key.	NOLD for no load will be displayed for two seconds. After NOLD, a number will be displayed until either **ENTER** is pressed or the **443** calibration code is entered. This number is the no load voltage. However, until after calibration this number is meaningless.
Type in key sequence **4**, **4**, **3**	CAL1 will be displayed. Measure the line voltage and enter this number now using the keypad. This number will be used to calculate no load voltage
Press **ENTER** key	CAL2 will be displayed. Measure the line voltage and enter this number now using the keypad. This number will be used to calculate full load voltage.
Press **ENTER** key	The voltage calibration routine is now complete. The controller will return to IdLE.

10.19 DTCT: Amperage Measurement Setting

This feature can only be used if your DynaTrol came with the optional current sensor. If equipped and properly installed, this

sensor allows the DynaTrol to read the amperage of the kiln in real time. This setting here only controls the maximum amount that the current sensor will measure. It is set in the factory for the proper amount and should not have to be changed. The amperage reading requires a current sensor that clips around one of the power cord's hot wires. The default range for the calibrated sensor is 50A. For larger kilns the controller can be adjusted for a higher range sensor.

10.19.1 Installing an optional current sensor:

1. The current sensor has two wires that need to be connected to the circuit board. One wire is black. One wire is white. On the top left corner of the circuit board is a terminal with inputs marked black and white.
2. Insert the white wire in the terminal that has been marked white.
3. Insert the black wire in the terminal that has been marked black.
4. Use a screwdriver to tighten the two screws on the terminals so that the wires will not come lose.
5. The circuit sensor clips around one of the power cord's hot wires.
6. The control is now able to measure the amperage draw using the controller's diagnostic routines.

6.1 Amperage Measurement

Amperage measurement can only be done if your kiln is equipped with a current sensor. If there is no sensor (or no amperage), your amp readings will be 0 when you run try this feature.

To run this feature first enter the **Hidden Other Menu**, then scroll through it until you come to dIAG. Press **ENTER** and see it say OUTS. Press "**1**", see it say AMPS. Press **ENTER** and see it say AMP1 -meaning the next number displayed will be the amps of Zone 1. Then AMP2 will be displayed- meaning the next number to appear will be the amps of Zone 2, and so on for Zone 3 if you have three zones.

7. APPENDIX A: OVERVIEW OF FEATURES

7.1.1 Dynamic Zone Control

The DYNATROL features Dynamic Zone Control. It measures temperatures in the bottom, middle and top of the kiln and automatically adjusts the heat output of three separate heating zones even as the kiln is heating up and during the final approach to maturing temperatures. Kiln temperatures are automatically evened out to within 1/2 cone or better top to bottom! There is no manual intervention with input switches to even out temperatures. There are separate thermocouples (heat sensors) and contactors (power controls) for each of the three zones. Dynamic Zone Control suspends firing on one or more zones if the other zones are lagging behind the faster zone(s)..TC1 (as displayed on the kiln) is the Top Zone, TC2 is the Middle Zone, TC3 is the Bottom Zone. **NOTE: It is absolutely necessary to match the proper section with the proper control box outlet and proper thermocouple** (Thermocouples, cords and receptacles are all marked for identification. If these are mismatched the kiln will not operate properly and you will get the Ed display showing that one of the zones is way off set point.

7.1.2 Programmable Number of Zones

The latest version of the DynaTrol allows you to program the number of zones. Typically there are three zones in a kiln. However, on our two section kilns the control will come programmed to operate as a two zone control. On GS1714 kilns we have the control programmed to be a single zone control. If you change the number of sections in a kiln (for instance, if you take one section off a three section kiln) you can reprogram the control to suit your needs. Another benefit of this new feature is that you can program the control to be a single zone control and avoid the complications of three zone control (i.e. LAG issues). When the control is programmed to be a single zone control outputs 1, 2 and 3 all work together. When programmed as a two zone control outputs 2 and 3 work together and output 1 is separate.

7.1.3 Four Easy Preset Programs

There are four preset **EASY-FIRE** programs that have been designed to do most typical ceramic firing cycles. They are **Fast Bisque, Slow Bisque**, **Fast Glaze** and **Slow Glaze**. These preset programs have specific ramps and speeds built into them (see Appendix A for details of what these ramps are). You can enter any cone number up to cone 10 (*see note below) as a final temperature, a hold time, a delay time and even a time as options. This allows a great deal of customization while still keeping the programming simple and easy. We recommend you start with these programs until you get some experience with the control and your kiln.

The **EASY-FIRE** mode uses Orton's patented method to achieve correct heat work so it is ideal for firing ceramics. The advantage of using the **EASY-FIRE** method is that a very complicated firing profile may be chosen with just a few key strokes. The **EASY-FIRE** method helps protect against over and under firing by carefully tracking and controlling the temperature at the end of the firing as the cone temperature is approached. The program is based on a 108°F temperature rise for a large self supporting cone (rather than the small Orton cones or regular large cones).

***Note:** Some L&L Kilns are not designed to go to cone 10. Consult your kiln's label for the maximum operating temperature.

7.1.4 Six User Defined Programs

If your needs are more sophisticated or involved there is a separate **VARY-FIRE** programmer mode. This allows you to have 6 separate, repeatable, storable programs with up to 8 segments. There is one cooling or heating ramp, a temperature setpoint and an optional hold time per segment. The programs are stored in non-volatile memory which means that they will stay in memory even when all power is turned off. The DYNATROL allows you to soak at a low temperature for a long time (i.e. you can have an automatic drying period) and then automatically ramp up to your high fire at different rates. You can ramp slowly through critical periods or soak at end point temperatures for more consistent maturing of work. It also allows a controlled cool down to avoid heat shock. Of course many of these valuable uses are available in the preset **EASY-FIRE** programs. However, with the **VARY-FIRE** programs you have complete control over ramp times and rates and so you can adjust the kiln performance to your exact needs. It also allows the control to be used for non-ceramic applications such as glass, enameling, heat treating and other industrial uses.

Note: VARY-FIRE programs fire the kiln to your specifically programmed temperature. **EASY-FIRE** programs will fire the kiln to your specifically programmed cone number.

7.1.5 Linkable Programs

You can link **VARY-FIRE** Program #5 and #6 to get a 16 segment program. You can also use this system to link **VARY-FIRE**

Program #6 to the end of an **EASY-FIRE** Program.

7.1.6 Delay Start

You can delay the start of the program by up to 99 hours, 99 minutes. This allows you to plan end of firing conveniently. This is also very useful for saving energy costs by firing kiln with night electric rates. If you want the kiln to mature at 2:00 PM the next day and you know your program will take 12 hours and you are starting your program at 4:00 PM today you would program in an 8 hour delay. NOTE: The delay start remains on or set for all programs (both **VARY-FIRE** and **EASY-FIRE**) until you turn it off.

7.1.7 Preheat (Candling)

You can “candle” the kiln for up to 99 hours, 99 minutes to dry ware thoroughly. “Candling” is a specific hold at 200°F which boils off the water in the clay slowly so that your work does not explode as the water expands rapidly to steam. This is highly recommended to do for most ceramics. We recommend overnight or for at least several hours depending on how dry your work is. NOTE: This is available as an optional step in the **EASY-FIRE** mode only. You can do the same thing with an added first segment in the **VARY-FIRE** mode.

7.1.8 Soak

The control will soak at Final Set Point for up to 99 hours, 99 minutes, and can be programmed to hold a temperature as long as 66 days before needing to be reset. This is a very useful feature and one of the great advantages of an automatic control. Most ceramics achieve their characteristics not so much by what temperature they reach but by how much “heat-work” is put into them. A long soak at a lower cone can often develop the bisque or glaze better. In addition a soak period almost always will improve the uniformity of the firing throughout the kiln. A soak period gives the entire load of ware time to absorb the radiant heat that is projected from the elements. If you simply rise to a certain temperature and then shut the kiln off (as is typical of a manual kiln sitter operation) then the center or the bottom of the kiln may not have had a chance to absorb as much heat as the ware around the perimeter. You may have experienced the fact that an older kiln with slow firing elements may in fact have given you better results. This is because the entire kiln has had a chance to even itself out as it approached final cone. We suggest experimenting with this feature. Try a soak of 10 to 20 minutes. The DynaTrol will automatically adjust the final temperature to compensate for the programmed Hold Time in the **EASY-FIRE** mode only. Be warned that element life is lessened by the amount of time the elements spend up at a higher temperature.

7.1.9 Audible Temperature Alarm

There is an easily settable audible temperature alarm. This can alert you at any point in program. For instance the control can alert you that the kiln is close to maturity so you can watch it reach final set point. You can use it to alert you when to close the lid if you are manually venting the kiln. You can disable this alarm by programming in `9999`. Press **ENTER** to turn off alarm when it is sounding.

7.1.10 Program Review

Press this button to see the entire program before or while running it. It will scroll through the programmed steps. We suggest hitting **Review Prog** at the beginning of your firing to see if the control is set up to do what you want it to. If the control shows error codes `0FF` when they should be `0n` or no `Hold` where one should be, you must first stop the program that is running in order to change anything. Most settings cannot be changed while running a program.

7.1.11 Segment Review

Press **Review Seg** once while you are firing to see which segment’s ramp or hold you are currently in, what the current set point is, and what the actual temperature of the DynaTrol’s electronics are.

7.1.12 Skip Segment

In the **VARY-FIRE** mode you can skip a segment to advance to a higher segment and speed the program along.

7.1.13 Set Point Indication

If you press **Review Seg** twice while the kiln is firing, the control will show you what your current set point is during the program as it is changing. This is useful to confirm that the temperatures of the thermocouples are where they are supposed to be.

7.1.14 Change of Program During Firing

When firing you can alter the program anytime. You must press **START/STOP**, then reprogram, then press **START/STOP**. The DynaTrol will automatically take the current temperature into consideration and start back up at that point in the program. If you attempt to do this right at the end of a firing, the amount of time it takes to reprogram is not accounted for by the DynaTrol. If more than a few minutes go by, the temperature displayed may not accurately represent the amount of heat work taking place in the kiln. Another reason to fire with witness cones.

7.1.15 Cone Offset

This is one tool you have to help you match the control to your real firing experience. It is important to fire the kiln with witness cones to find out what is really happening inside the kiln. Using these you can fine tune the overall performance of the kiln to match what is really happening to your ware. The cone offset is just one of the ways you have of making this adjustment. Keep in mind however that your firing speed and soak time will also have an effect on how the witness cones and ware perform. When you are making an adjustment try changing one variable at a time. For instance if you are firing to Cone 05 and your witness cones don't mature you could do a number of things. One is to use the cone offset to raise what the DynaTrol thinks is the temperature of cone 05 in an **EASY-FIRE** program. Another thing you could do is put in a soak/hold time at the end of the program in a **VARY-FIRE** program. Another thing would be to slow the kiln down towards the end of its firing cycle with a slower, longer final segment in a **VARY-FIRE** program. Try one thing at a time to find out what works best for you. The cone table that the DynaTrol uses are based on a 108°F temperature rise for a large self-supporting cone (not the small Orton cones or the regular large cones).

7.1.16 Thermocouple Offset

This allows you to individually change what the DynaTrol thinks the thermocouples are reading. Use this to adjust for thermocouple drift or kiln uniformity adjustments. It allows you to influence how the kiln "sees" the temperature in the kiln. For instance, if the center zone is consistently firing higher (as measured by witness cones) then you would change that thermocouple to read higher. This would trick the control into thinking that the center zone was hotter and it would keep the temperatures down. The difference between Cone Offset and Thermocouple Offset is that Cone Offset works in **EASY-FIRE** programs only and changes a specific cone's temperature for the whole kiln. Thermocouple Offset will affect temperatures in both **VARY-FIRE** programs and in **EASY-FIRE** programs. Basically it changes just that particular thermocouple's reading up or down to even out temperatures in an unevenly heating kiln no matter what cone number or temperature you are firing to.

NOTE: Thermocouples drift in their accuracy over time. The hotter you fire the quicker this will occur. This is another reason why it is important to check each firing (or at least every 5 or 10 firings) with witness cones. This is particularly important if you are firing at high temperatures like cone 6 or cone 10.

7.1.17 Last Temperature Reached Indication

When an **EASY-FIRE** program is complete it will tell you what the last temperature reached was. You press **Review Prog** at the end of the cycle to see this temperature. This is useful for logging and comparing to what happened with your ware. Compare this temperature to witness cones and make adjustments in your firing cycle or cone offsets to adjust the performance of the kiln.

7.1.18 Cone/Temperature Equivalent Look Up Table

Convert cone numbers to temperatures in degrees. The look up table is based on a ramp rate of 108°F. This table is provided as a handy reference table to use while you are programming. There is a more complete table in the Appendix J.

7.1.19 Dust Sealed Keypad

The keypad is dust tight so you don't need to worry if you have dirty hands that might get dust into the electronics.

7.1.20 Easy to Follow Graphic Design

It is graphically designed to be user friendly. **EASY-FIRE**, **VARY-FIRE**, OPTIONS and VIEW functions are grouped separately. The numeric keypad makes entering parameters like temperatures and cone numbers easy.

7.1.21 Error Checking Can Be Turned Off

There are various error codes in the control. These can be important diagnostic tools. They can also be somewhat confusing and alarming if you don't understand then. One of the most common ones is `E-1` which will stop the program if the kiln's temperature is rising too slowly. `ErrP` flashing or `PF` indicates a power outage to the control. `E d` indicates that one zone

is 100°F off set point. All these and more are explained in greater detail in **Appendix E**.

7.1.22 Reset Defaults Function

This function (available under **Options**, **Other** - see **Section 9**) resets most settings back to factory defaults. It does not affect the thermocouple or cone offsets. Turns Error Checking On.

7.1.23 Reads Control Board Temperature

This is a diagnostic tool. The control should not be operated when it is above 125°F (52°C) or below 32°F (0°C). This should not normally be a problem with the way L&L mounts these controls away from the heat. However, if you do get a reading that is higher than this temperature (for instance if you are operating in a particularly hot room) we recommend that you direct some cooling air at the control. This board temperature is displayed as follows: When you press the View Segment Button while firing, first the current segment is displayed, then the set point temperature and then the DynaTrol's board temperature. Ambient temperatures that are out of the suggested range can lead to either control failure or control inaccuracy.

7.1.24 Automatic Restart after Brief Power Interruption with Flashing Alert

This is the ErrP indication. If the power outage was brief the program will continue to fire and the ErrP message will flash with the temperature indication. By hitting the "1" button you can clear this alarm message. See **Appendix E** for all error code explanations

7.1.25 PID Tuning Control

PID stands for Proportional - Integral - Derivative. It is a sophisticated calculus algorithm that minimizes temperature overshoot. The control is able to anticipate the temperature set point and start to cut back power before it reaches actual setpoint. In standard On/Off control the power does not turn off until the actual set point is reached. Because of the inertia of the kiln this could result in temperature overshoot without the PID control. The values for the PID are hard programmed into the control and can not be changed. They are optimized for ceramics. If you are using the control for another application and you find that the control gives you some overshoot try a step in your **VARY-FIRE** program that is a very slow ramp for the last few degrees of the program. For instance if you wanted to get to 1800°F without overshoot, have the program go to 1775°F and then take 15 minutes to ramp to 1800°F. NOTE: As of April 2000 a second set of PID settings was added for temperatures below 500°F. This improved overshoot in the lower temperature range.

7.1.26 Thermocouple Burnout Protection

The kiln will shut down automatically if all thermocouples burn out. The kiln continues to fire if only one or two thermocouples burn out. This protects your firing in the event of failed thermocouples. Of course, if all three thermocouples FAIL then the control stops firing.

7.1.27 Digital Indication of Temperature in either Degrees F or C

You can switch between temperature readings in degrees Fahrenheit or degrees Centigrade.

7.1.28 See All the Zone Temperatures

You can scroll through all three thermocouple readings by pressing **1** to see TC1 (top zone), **2** to see TC2 (middle zone) and **3** to see TC3 (bottom zone). The default view is of TC2. You must specifically hit **1** or **3** to see the top and bottom zone temperatures. The reading will stay on the thermocouple that you last pressed.

7.1.29 See Which Zones are Firing

Press Number Key **8** while the kiln is firing. This toggles the LED display to show you which zones are firing. See the section under **DESCRIPTION OF KEY FUNCTIONS AND DISPLAY, Appendix C** for details. This is a great diagnostic tool to allow you to see which zones are firing. For instance if one zone is firing constantly and the other zones are not then you know that the constantly firing zone is the slow zone.

7.1.30 See the current rate of rise in degrees per hour:

Press Number Key **5.** See the section under **DESCRIPTION OF KEY FUNCTIONS AND DISPLAY, Appendix C** for details

7.1.31 See the elapsed time since the firing began

Press Number Key **0.** See the section under **DESCRIPTION OF KEY FUNCTIONS AND DISPLAY, Appendix C** for details

7.1.32 Cold Junction Compensation

The control automatically compensates for varying ambient temperatures. It can operate in ambient temperatures of 32°F to 125°F (0°C to 50°C). The **Review Seg** button lets you see ambient board temperature (press **Review Seg** three times). This is an electronic compensation.

7.1.33 Matches Pyrometric Cone Performance in EASY-FIRE Mode

This feature is licensed from Orton. (Patent #4,461,616 and 4,730,101). This feature is not controlled by the user. Basically it adjusts how the firing takes place towards the end so that the control approximates how cones work. The control sees how fast the kiln is rising and adjusts the final end point temperature higher or lower to achieve the proper amount of "heat-work". For instance, to mature your ware at the same cone number, a the kiln rising at 100°F per hour will require a lower set point temperature than a kiln rising at 200°F per hour. This feature is only used in the **EASY-FIRE** mode. Note: The control emulates the self supporting cones.

7.1.34 KISS Computer Interface System

The new DynaTrol is capable of being hooked up to a computer using special KISS Software. See separate instructions for details on this feature. Up to 10 separate kilns can be hooked up to one computer. This is available from L&L. See this for more information: ***hotkilns.com/kiss***

7.1.35 PID algorithm

The PID algorithm (in industrial, mathematical terms this is the proportional, integral, and derivative functions of the control) is how the controller decides what percentage of the kiln's total power is required to keep the temperature at the desired set point. The DynaTrol 700 board has a cycle time of 14 seconds (as the default setting) and will turn the relays on for a calculated number seconds to give the correct percent of power needed to keep the temperature near the traveling set point. For example, if the controller calculates that 25% of the power is required, the relays will be on for 3.5 seconds and off for 10.5 seconds.

Each part of the P (Proportional band), I (Integral) and D (Derivative) are calculated separately and added together to determine the correct percentage (control value) of power required. The proportional part of the control value is based on how far the temperature is away from the desired set point. It is the difference between the set point and the current temperature (also called the error) multiplied by the proportional gain.

The integral part of the control value is based on how long the temperature is taking to get to the set point. It is calculated by multiplying the error by the integral gain and summing this value over time. The integral value compensates for any long term error not taken care of by the proportional part.

The derivative part of the control value is based on how fast the temperature is moving towards or away from the set point. If the temperature is moving quickly towards the set point the derivative portion reduces the control value to prevent overshoot. If the temperature is moving away from the set point then the derivative portion increases the control value to get the temperature to start moving back towards the set point.

The constants for calculating the control value are fixed within the controller and can not be changed by the user. They do vary throughout the firing depending on the current temperature in the kiln. To prevent over and undershoot, the controller also has "approach control" to smooth the transition from a fast ramp to a hold.

7.1.36 Automatic Lag Function

With a zone control kiln there is always a trade off between speed and tightness of control . The series 700 automatic control LAG feature uses the programmed ramp rate to automatically set its "LAG" temperature setting to balance these two opposing needs. Sometimes the temperature of one or more kiln's sections "lags" behind one or more of the other sections. This is because the traveling set point of the control (based on the programmed ramp rate) is faster than one or more of those sections' can rise and have the temperature in the sections stay even. To effectively deal with this the 700 DynaTrol will automatically slow the ramp rate when a section of the kiln lags. The amount of "lagging" that is allowed before the firing rate will slow is determined by the ramp rate. Fast ramp rates (greater than 500 °F/hour) will allow the greatest temperature difference between sections. Slow ramp rates (below 70 °F/hour) will have the smallest temperature difference between sections. Therefore, when the controller is programmed to go fast it will sacrifice evenness to obtain speed. Likewise, when the controller is programmed to go slow, the controller will maintain tighter control. The controller will try to balance speed and tight control when a medium speed is programmed.

Here is the actual algorithm for those who are interested in knowing what is taking place (note that this is all transparent to

the user and is included in here to let you know how this works):

1. **If the programmed rate of rise is between 1˚F/hour and 70˚F/hour and -**

    1. All thermocouple readings are less than 3 degrees behind the traveling set point, the traveling set point moves at the programmed rate.
    2. The lowest thermocouple reading is between 3 and 6 °F behind, the traveling set point moves at 75% of the programmed rate.
    3. The lowest thermocouple reading is between 6 and 9 °F behind, the traveling set point moves at 50% of the programmed rate.
    4. The lowest thermocouple reading is between 9 and 12 °F behind, the traveling set point moves at 25% of the programmed rate.
    5. The lowest thermocouple reading is more than 12 °F behind, the traveling set point moves at 1 degree F per hour.

2. **If the rate of rise is between 71˚F/hour and 500˚F/hour and -**

    1. All thermocouple readings are less than 7 degrees behind the traveling set point, the traveling set point moves at the programmed rate.
    2. The lowest thermocouple reading is between 7 and 14 °F behind, the traveling set point moves at 75% of the programmed rate.
    3. The lowest thermocouple reading is between 14 and 21 °F behind, the traveling set point moves at 50% of the programmed rate.
    4. The lowest thermocouple reading is between 21 and 28 °F behind, the traveling set point moves at 25% of the programmed rate.
    5. The lowest thermocouple reading is more than 28 °F behind, the traveling set point moves at 1 degree F per hour.

3. **If the rate of rise is greater than 500˚F/hour and -**

    1. All thermocouple readings are less than 10 degrees behind the traveling set point, the traveling set point moves at the programmed rate.
    2. Lowest thermocouple reading is between 10 and 20 °F behind, the traveling set point moves at 75% of the programmed rate.
    3. The lowest thermocouple reading is between 20 and 30 °F behind, the traveling set point moves at 50% of the programmed rate.
    4. The lowest thermocouple reading is between 40 and 50 °F behind, the traveling set point moves at 25% of the programmed rate.
    5. The lowest thermocouple reading is more than 50 °F behind, the traveling set point moves at 1 degree F per hour.

8. APPENDIX B: TERMS AND ABBREVIATIONS

Celsius - a temperature scale in which 0° is the freezing point and 100° the boiling point of water. Also called centigrade.

Centigrade - a temperature scale in which 0° is the freezing point and 100° the boiling point of water. Also called Celsius.

Cone - a pyramid shaped ceramic composite which bends and melts in the kiln to indicate the amount of heat work which has taken place in the kiln. Also called a witness cone.

Default – (or default settings) These are the settings that the DynaTrol comes programmed with from the factory. Using the Reset feature will return the DynaTrol to it's default settings.

Final set point – in an all heating program with no cooling segments this would be the maximum temperature the kiln was programmed to reach. If there are programmed cooling or holding segments then the last segment's programmed set point is the final set point.

Profile - A series of segments which define how the kiln temperature is to proceed through the firing. This is sometimes referred to as a program.

Ramp-hold - A firing profile in which the temperature is programmed to increase to a specific temperature, hold for a period of time then repeat this sequence until a final temperature is reached.

Segment - One unit of programming. Each segment on this control has a ramp (Deg per hour), a final set point temperature and a hold time.

Set point – the target temperature within a programmed segment.

T/C or **t/c** - Abbreviation for thermocouple.

Thermocouple (abbreviated **T/C** or **t/c**) - Temperature measurement sensor made of two dissimilar metals which are joined at one end; the end where they are joined is the temperature measuring end.

9. APPENDIX C: DISPLAY MESSAGES (in alphabetical order)

ALRM - **Alarm**. When ALRM flashes in the display, an alarm temperature between 0° and 9999° may be entered. When the alarm is set to 9999°, it is turned off.

bd T **- Board Temperature**. Indicates the temperature of the DynaTrol's electronics (see Control Precautions).

°C1, °C2, °C3, through °C 8, Degrees Celsius temperature. In the **VARY-FIRE** Mode with the Celsius temperature scale selected, the controller is waiting for an end temperature to be entered for the segment. The numbers stand for the segment which is being programmed.

CHG° - **Change degrees -** When CHG° is displayed, press **ENTER** to select the temperature scale you would like to use, either Fahrenheit (°F) or Celsius (°C). The **1** key will toggle between °F and °C. When the scale you want to use is displayed, press **ENTER**.

CNOS - **Cone offset**. Press **ENTER** to adjust an individual cone shut off temperature of plus or minus 50°F maximum.

CONE - **Cone number**. When **CONE** is displayed, a cone number between 022 and 10 must be entered. This will be found in the Cone Table or the **EASY-FIRE** Mode.

°COS **–Degrees Centigrade offset** – seen when a Cone Offset or a Thermocouple offset is being programmed.

CPL - **Complete**. Indicates programming or some programming function is complete.

CPLT - **Complete**. Indicates a firing has been completed.

Decimal Point displayed in lower right-hand corner of display The temperature is displayed in degrees Celsius (°C).

Decimal Point displayed in center of display between 10's and 100's. A time in hours and minutes is being displayed.

dELA - **Delay**. Indicates the time in hours and minutes before the start of firing.

DIAG - **Diagnostic s**. Located in the **Hidden Other Menu**. Pressing **ENTER** here turns zone 1's elements on for a few seconds followed by zone 2's elements, then zone 3's elements. A powered bottom will stay on during all three zone's test. If the kiln is improperly put together it will become apparent now.

ERCd. **Error Codes**. When ERCd is displayed, press enter to turn the Error Code function on or off. This function is located by pressing **Other** in the **OPTIONS** Section.

E A **Error**. Indicates a software error has occurred. The error codes are listed in **APPENDIX E.**

E E. Software Error. Indicates a software error has occurred. Contact L&L Service. The error codes are listed in **APPENDIX.**

E 0, E 1, E 2 through E 8 means **Error**. An error has occurred; the error codes are listed in **APPENDIX E.**

ErrP (flashing)**- Power Outage Error**. This is displayed during a firing if power to the kiln has been interrupted for less than a couple minutes, depending how far along in the firing you are. The error codes are listed in **APPENDIX E.**

°F1, °F2, °F3 through °F8 In the **VARY-FIRE** Mode with the Fahrenheit temperature scale selected, the controller is waiting for an end temperature to be entered for the segment. The numbers stand for the segment which is being programmed.

°FOS **– Degrees Fahrenheit Offset** – seen when a Cone Offset or a Thermocouple offset is being programmed.

FAIL - **Thermocouple Failure**. The thermocouple is not connected to the controller or there may be a break in one of the thermocouple lead wires. If the thermocouple wire is broken, it must be replaced. When connecting the thermocouple, SEE THE COLOR CODING INFORMATION in **Section 1.0 (Control Cautions)**.

FAN1, FAN2, FAN3, through FAN8. This message will appear during programming in the **VARY-FIRE** mode only after OP C (option C in the **Hidden Other Menu**) has been chosen. FAN refers to your powered bottom (if you have one), and the number is the number of the segment you are currently programming. The powered bottom (FAN) can be programmed to be ON or OFF in each segment of the **VARY-FIRE** program.

F-bC **Fast Bisque**, One of the **EASY-FIRE** programs

F-GL **Fast Glaze**, One of the **EASY-FIRE** programs

HOLd or HLd - **Hold**. Indicates the holding time in hours and minutes at the end of a " **EASY-FIRE**" program. OR it may mean that you have just chosen the Preheat option and now the DynaTrol is asking how much hold time in the preheat setting you want to have.

HLd1, HLd2, HLd3 through HLd8 In the **VARY-FIRE** Mode the controller is waiting for a soak or hold time in hours and minutes to be entered for the segment. The numbers stand for the segment which is being programmed.

Id **– Identification.** Allows you to identify a particular control for use with KISS computer software.

IdLE **and** Temperature **– Flashing** The kiln is off, and the current temperature in the kiln is displayed. The DynaTrol is programmed to run using only one thermocouple.

IdLE**,** TC2**, and the** current temperature **flashing**- The kiln is off, and the current temperature in the kiln at thermocouple #2 is displayed. The DynaTrol is programmed to run using either two or three thermocouples.

NOTC **- Number of thermocouples.** Located in the **Hidden Other Menu**. Pressing **ENTER** here allows you to choose how many thermocouples (essentially how many zones) are in the kiln.

OFF. Press **ENTER** when displayed to turn the Error Codes, the Autolag, a Powered Bottom, or the "shut off" feature Off. Pressing the **1** key toggles between On and OFF.

ON (no dashes). Press **ENTER** when displayed to turn the function you are programming on. Pressing the **1** key toggles between On and OFF.

-On- (displayed with dashes). Displayed for about 10 to 15 seconds when the **START/STOP** button is pressed to begin a firing. The heating elements of the kiln will not begin heating until -On- disappears and the current kiln temperature is displayed. NOTE: Pressing any key besides **START/STOP** while -On- is displayed, will stop the firing. Pressing **START/STOP** after -ON- goes away will stop the firing.

OPA. **Option A**. Located in the **Hidden Other Menu**. Used for vent control. **(See Section 10.2)**

OPB. **Option B**. Located in the **Hidden Other Menu**. Used for vent control. **(See Section 10.3)**

OPC. **Option C**. Located in the **Hidden Other Menu**. used for Vent Control or Powered Bottom **(See Section 10.4)**

PCT. **Percent**. Located in the **Hidden Other Menu**. You can set how often your powered bottom comes on based on a percent of when the bottom zone comes on.

PF. **Power Failure**. PF indicates the power to the kiln has been interrupted for a long enough time to effect the current firing.

The kiln has shut down and the firing must be restarted.

PId. Located in the **Hidden Other Menu**. Pressing **ENTER** when you see this allows you to program a setting to help a heavily or unevenly loaded kiln fire faster.

RA1, RA2, RA3 through rA8 In the **VARY-FIRE** Mode the controller is waiting for an ramp temperature rise per hour to be entered for the segment. The numbers stand for the segment which is being programmed. The temperature is in °F/hr or °C/hr whichever has been selected. If °C has been selected, there will be a decimal point in the lower right-hand corner of the display.

RSET **Reset**. Press **Other** until RSET is displayed. Then press **ENTER**. IdLE will be displayed indicating that the Error Checking is ON. This is the Default settings.

16-S. **Sixteen step program option. VARY-FIRE** profile #5 must have been chosen, and now the DynaTrol must be told whether to automatically fire **VARY-FIRE** profile #6 immediately after the ending of #5 (16-S set to ON) or not (16-S set to OFF).

SAFT. **Safety option.** DO NOT PRESS **ENTER** HERE. This option is not used with L&L's kiln systems

S-bC **Slow Bisque**. One of the **EASY-FIRE** programs

S-GL **Slow Glaze**, One of the **EASY-FIRE** programs

SEG. **Segment**. When SEG is displayed, the number of desired segments for a **VARY-FIRE** program should be entered.

SHT0. Located In the **Hidden Other Menu**. Set to either ON or OFF. Lets you choose between firing styles where: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. 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.

STOP - **Stop**. Indicates firing has been stopped. Also may be displayed when the controller is first turned on. Also used like CPL with some functions.

USER. When USEr is displayed, one of the 6 user programs may be selected or programmed.

SSTP. **Skip Step**. Press **Review Seg, ENTER, ENTER** to skip to the next ramp segment in a **VARY-FIRE** program. Skip Step is not available with a **EASY-FIRE** program.

TCOS **Thermocouple offsets**. This is used to raise or lower the temperature indicated by any of the thermocouples. The maximum offset is 50°F. A positive offset is entered with 00 preceding the amount of offset and a negative offset is preceded with 90. This is the same as is done for entering cone offsets. When TCOS is displayed, press **ENTER** and TC1 will be displayed. Press enter and the current offset for the top thermocouple will be displayed. Press **ENTER** when the correct offset for the top thermocouples is displayed and then TC2 will be displayed. Repeat the process for TC2 and TC3.

Temperature **- Continuously displayed** The kiln is on (in either a **VARY-FIRE** or a **EASY-FIRE** program), and the current temperature in the kiln is displayed. The DynaTrol is programmed to run using only one thermocouple.

TC2 **and the** current temperature **flashing**- The kiln is on (in either a **VARY-FIRE** or a " **EASY-FIRE**" program), and the current temperature in the kiln at thermocouple #2 is displayed. The DynaTrol is programmed to run using either two or three thermocouples.

Time - Decreasing A delay start is in effect for a **VARY-FIRE** or a **EASY-FIRE** program. The time remaining before the kiln starts to heat is displayed.

Time - Temperature alternately flashing. The kiln is in either a hold phase of a **VARY-FIRE** segment or a hold phase at the end of an **EASY-FIRE** Profile. The numbers displayed are the remaining time and the current kiln temperature.

10. APPENDIX D EASY-FIRE TEMPERATURE PROFILES

These charts tell what the **EASY-FIRE** programs do to your kiln when you choose one of them. These charts will also be good reference points for writing your own programs in the **VARY-FIRE** mode. These charts are for cones 07 through 04 and cones 5, 6, 7, and 10. Other cone numbers will work as well in your own programs.

NOTE: No delays, preheats. or final soaks are shown. When these programs are fired the actual final temperatures will vary as the DynaTrol adjusts itself based on how quickly it is climbing to that final temperature. This would not be the case for **VARY-FIRE** programs that you develop and input yourself. Also note that all these programs end on segment 7 rather than start on segment 1. This is due to the way the Orton feature works in the **EASY-FIRE** mode and is not relevant to your own programming in the **VARY-FIRE** mode. (Segment #7 in the **EASY-FIRE** mode is a special segment that incorporates the Orton software and so it must be the last segment of every " **EASY-FIRE**" profile). Start your **VARY-FIRE** profiles on segment 1.

NOTE: All the programs shown are written to accommodate the fastest possible empty kilns. THE NUMBERS DO NOT REPRESENT TYPICAL KILN FIRING TIMES WITH A LOAD. Your kiln can take considerably longer (as much as 4 times) to fire than the times shown here.

You can download these profiles in Excell format: DynaTrol Easy-Fire Profiles in Deg F and Deg C (Excel Format) (***hotkilns.com/dynatrol-easy-fire-profiles-excel***)

10.1.1 CONE 07

Slow Bisque Firing Profile for cone			07	**1787°F**		**Slow Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	80	250		2.25	5	150	250		1.20
4	200	1000		3.75	6	400	1537		3.22
5	100	1100		1	7	120	1787*		2.08
6	180	1537		2.43					
7	80	1787*	0	3.13				0	
			Total	12.55				Total	6.50
	Fast Bisque Firing Profile					**Fast Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	120	250		1.50	6	570	1537		2.57
4	300	1000		2.50	7	200	1787*		1.25
5	150	1100		0.67					
6	180	1537		2.43					
7	108	1787*	0	2.31				0	
			Total	9.41				Total	3.82

*This final set point temperature is based on the specific rate of rise programmed for the last segment. If the rate of rise changes (for instance if the kiln goes slower than the programmed rate of rise because of a heavy load or aging elements) then the final set point temperature will be recalculated by the control. This maintains the "heat-work". The faster the rate of rise in the final segment, the higher the set-point temperature needs to be to get the same "heat-work". Inversely, the slower the rate of rise the lower the set-point temperature needs to be.

10.1.2 CONE 06

Slow Bisque Firing Profile for cone			**06**	**1819°F**		**Slow Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	80	250		2.25	5	150	250		1.20
4	200	1000		3.75	6	400	1569		3.30
5	100	1100		1	7	120	1819*		2.08
6	180	1569		2.61					
7	80	1819*	0	3.13				0	
			Total	12.73				Total	6.58
	Fast Bisque Firing Profile					**Fast Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	120	250		1.50	6	570	1569		2.63
4	300	1000		2.50	7	200	1819*		1.25
5	150	1100		0.67					
6	180	1569		2.61					
7	108	1819*	0	2.31				0	
			Total	9.59				Total	3.88

10.1.3 CONE 05

Slow Bisque Firing Profile for cone			**05**	**1891°F**		**Slow Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	80	250		2.25	5	150	250		1.20
4	200	1000		3.75	6	400	1641		3.48
5	100	1100		1	7	120	1891*		2.08
6	180	1641		3.01					
7	80	1891*	0	3.13				0	
			Total	13.13				Total	6.76
	Fast Bisque Firing Profile					**Fast Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	120	250		1.50	6	570	1641		2.75
4	300	1000		2.50	7	200	1891*		1.25
5	150	1100		0.67					
6	180	1641		3.01					
7	108	1891*	0	3.13				0	
			Total	10.81				Total	4

*This final set point temperature is based on the specific rate of rise programmed for the last segment. If the rate of rise changes (for instance if the kiln goes slower than the programmed rate of rise because of a heavy load or aging elements) then the final set point temperature will be recalculated by the control. This maintains the “heat-work”. The faster the rate of rise in the final segment, the higher the set-point temperature needs to be to get the same “heat-work”. Inversely, the slower the rate of rise the lower the set-point temperature needs to be.

10.1.4 CONE 04

Slow Bisque Firing Profile for cone			04	**1926°F**		**Slow Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	80	250		2	5	150	250		1
4	200	1000		4	6	400	1676		4
5	100	1100		1	7	120	1926*		2
6	180	1676		3					
7	80	1926*	0	3				0	
			Total	13				Total	7
	Fast Bisque Firing Profile					**Fast Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	120	250		2	6	570	1676		3
4	300	1000		3	7	200	1926*		1
5	150	1100		1					
6	180	1676		3					
7	108	1926*	0	2				0	
			Total	11				Total	4

10.1.5 CONE 5

Slow Bisque Firing Profile for cone			5	**2165°F**		**Slow Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	80	250		2.25	5	150	250		1.20
4	200	1000		3.75	6	400	1915		4.16
5	100	1100		1	7	120	2165*		2.08
6	180	1915		4.43					
7	80	2165*	0	3.13				0	
			Total	14.66				Total	7.44
	Fast Bisque Firing Profile					**Fast Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	120	250		1.50	6	570	1915		3.24
4	300	1000		2.50	7	200	2165*		1.25
5	150	1100		0.67					
6	180	1915		4.53					
7	108	2165*	0	2.31				0	
			Total	11.51				Total	4.49

*This final set point temperature is based on the specific rate of rise programmed for the last segment. If the rate of rise changes (for instance if the kiln goes slower than the programmed rate of rise because of a heavy load or aging elements) then the final set point temperature will be recalculated by the control. This maintains the “heat-work”. The faster the rate of rise in the final segment, the higher the set-point temperature needs to be to get the same “heat-work”. Inversely, the slower the rate of rise the lower the set-point temperature needs to be.

10.1.6 CONE 6

Slow Bisque Firing Profile for cone			**6**	**2199°F**		**Slow Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	80	250		2.25	5	150	250		1.20
4	200	1000		3.75	6	400	1949		4.25
5	100	1100		1	7	120	2199*		2.08
6	180	1949		4.72					
7	80	2199*	0	3.13				0	
			Total	14.85				Total	7.53
	Fast Bisque Firing Profile					**Fast Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	120	250		1.50	6	570	1949		3.30
4	300	1000		2.50	7	200	2199*		1.25
5	150	1100		0.67					
6	180	1949		4.72					
7	108	2199*	0	2.31				0	
			Total	11.70				Total	4.55

10.1.7 CONE 7

Slow Bisque Firing Profile for cone			**7**	**2228°F**		**Slow Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	80	250		2.25	5	150	250		1.20
4	200	1000		3.75	6	400	1978		4.32
5	100	1100		1	7	120	2228*		2.08
6	180	1978		4.88					
7	80	2228*	0	3.13				0	
			Total	15				Total	7.60
	Fast Bisque Firing Profile					**Fast Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	120	250		1.50	6	570	1978		3.35
4	300	1000		2.50	7	200	2228*		1.25
5	150	1100		0.67					
6	180	1978		4.88					
7	108	2228*	0	2.31				0	
			Total	11.86				Total	4.60

*This final set point temperature is based on the specific rate of rise programmed for the last segment. If the rate of rise changes (for instance if the kiln goes slower than the programmed rate of rise because of a heavy load or aging elements) then the final set point temperature will be recalculated by the control. This maintains the “heat-work”. The faster the rate of rise in the final segment, the higher the set-point temperature needs to be to get the same “heat-work”. Inversely, the slower the rate of rise the lower the set-point temperature needs to be.

10.1.8 CONE 10

Slow Bisque Firing Profile for cone			**10**	**2345°F**		**Slow Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	80	250		2	5	150	250		1
4	200	1000		4	6	400	2095		5
5	100	1100		1	7	120	2345*		2
6	180	2095		6					
7	80	2345*	0	3				0	
			Total	16				Total	8
	Fast Bisque Firing Profile					**Fast Glaze** Firing Profile			
Segment	Rate°F /hr	Temperature °F	Hold	Time in Hours	Segment	Rate°F /hr	Temperature °F	Hold	Time Hours
3	120	250		2	6	570	2095		4
4	300	1000		3	7	200	2345*		1
5	150	1100		1					
6	180	2095		6					
7	108	2345*	0	2				0	
			Total	13				Total	5

*This final set point temperature is based on the specific rate of rise programmed for the last segment. If the rate of rise changes (for instance if the kiln goes slower than the programmed rate of rise because of a heavy load or aging elements) then the final set point temperature will be recalculated by the control. This maintains the “heat-work”. The faster the rate of rise in the final segment, the higher the set-point temperature needs to be to get the same “heat-work”. Inversely, the slower the rate of rise the lower the set-point temperature needs to be.

11. APPENDIX E: ERROR CODES

See this web page for a more complete description of all error codes with links to how to fix the underlying causes:
hotkilns.com/error-codes

Error Code	Description	Quick View NOTE: “>” means greater than, “<” means less than
E 0 RPCN	Software Error. Recheck the selected program, and reprogram if necessary. You may have to contact the L&L for new software.	
E 1	The temperature is increasing less than 12 degrees per hour during a ramp segment, where the temperature is programmed to increase. This slow rate must persist for 22.5 minutes before the error is displayed. This can be caused by low power to the kiln, aged elements, etc. See the kiln Troubleshooting Guide to check for all the things that could cause slow heat up. It is one of the most common error codes. Try running the kiln with the error codes turned off. Note that Err1 is only a possibility during a ramp.	Ramp segment Temp. increase < 12°F/hr Persists > 22.5 min.
E 2	During a hold segment the temperature rises to greater than 50 degrees above the hold temperature which was set. The temperature must stay 50 degrees above this set temperature for 18 seconds before the error is displayed.	Hold segment 50°F above set temp. Persists > 18 sec.
E 3	During a hold segment the temperature is more than 50 degrees below the hold temperature which was set. The temperature must stay 50 degrees below this set temperature for 18 seconds before the error is displayed.	Hold segment 50°F below set temp. Persists > 18 sec.
E 4	The temperature is more than 50 degrees above the set-point during a ramp segment where the temperature is programmed to decrease. The temperature must stay 50 degrees above this set temperature for 18 seconds before the error is displayed.	Decreasing Ramp segment 50°F above last hold temp. Persists > 18 sec.
E 5	The temperature is more than 50 degrees below the local setpoint temperature during a ramp segment where the temperature is programmed to decrease. The temperature must stay 50 degrees below this set temperature for 18 seconds before the error is displayed.	Decreasing Ramp segment 50°F below local setpoint temp. Persists > 18 sec.
E 6	A Negative temperature is displayed. This generally indicates the thermocouple is connected incorrectly. To correct this situation, ensure the red and yellow wires are connected correctly to the controller and at all junctions. You can identify the red lead on an unmarked thermocouple with a magnet because a magnet will be attracted to the red lead.	(-) displayed
E 7	The temperature is more than 50 degrees above the local setpoint temperature during a ramp segment where the temperature is programmed to increase. The temperature must stay 50 degrees above this set temperature for 18 seconds before the error is displayed.	Increasing Ramp segment 50°F above local setpoint temp. Persists > 18 sec.
E 8	When using the **EASY-FIRE** Mode, the temperature is decreasing during the last ramp segment. This could indicate that (if provided on your kiln) that a kiln sitter has turned the kiln off or that the lid was up or the peepholes open or some other physical thing is causing the kiln to decrease in temperature.	Cone fire mode only Temp. decreasing during last ramp segment
E 9	There is a mismatch between the thermocouple type selected in the software and the jumper for the thermocouple type. See **section 10.12** to correct. (Also see **section 1.0** about thermocouple extension wire).	

E 22	E-22 appears if one of the thermocouple's connection wires is reversed- i.e. the red wire is where the yellow wire is, and the yellow wire is where the red wire is. When the wires are reversed on a thermocouple circuit the temperature it reads actually falls rather than rises as the thermocouple is heated. Eventually this leads to it's reading a negative number and this trips the error code. E-22 is the same as E--b. To fix it first look for which thermocouple reading is falling while the kiln is heating up. Press **1**, **2**, **3** while it is running to see the different thermocouple temperatures. **1** is always the top, **3** is the bottom. **2** is the bottom on a two section kiln. Then unplug the kiln and open the control cover and follow the wires for whichever thermocouple was falling. Look for where the wire's colors are reversed; at each connection it is red to red, and yellow to yellow. If all looks well, the thermocouple itself is probably flipped in the ceramic thermocouple connection block. Remove that thermocouple's mounting screws and washers. Loosen the two center screws on the thermocouple connection block. Pull the block off, turn the two heavy wires of the thermocouple itself over and slide the connection block back on. Re-tighten the two center screws and remount. Test it to see if that fixed it.	
PF	Continuous PF in display. Indicates a long term power outage. The kiln has been shut down. Press **1** to clear the display.	
ERRP	ErrP and the current temperature are alternately flashing. To clear the display, press the **1** key. If a firing was in progress, the kiln will continue to fire even though this message is flashing. This error can also happen as a result of RF noise that resets the microprocessor. If this is suspected, the control panel should be returned to L&L for testing and possible modification.	
E d	This is "Error Difference." Errd indicates that a difference of more than a 100 degrees has been detected between any of the thermocouples and the set point. When Errd is displayed the firing will be terminated. Errd will not be detected if the error codes (ERCd) have been turned off. The reason for having Errd is to insure against a case where, for instance, the top (TC1) and bottom (TC3) thermocouples have been inadvertently switched. In such a case the top thermocouple (TC1), while placed in the bottom section, could be calling for heat and the heat will be delivered to the bottom of the kiln causing a grossly uneven firing. The first thing to test, if you have this error code, is that the thermocouples are placed in the proper sections. To do this take each thermocouple out (while the kiln is cold) and heat it with a match while pressing the **1**, **2**, or **3** button on the control to read the appropriate thermocouple. Top should be #1, Middle should be #2 and Bottom should be #3. Another potential cause of this error code could be the sections stacked in the wrong order, or plugged into the control's receptacles in the wrong order. If not this, a bad element in one of the sections. Check to see if the elements are firing. Check resistance on the elements (see the troubleshooting guide or the general kiln instructions or contact L&L for information on this). Another possibility is a bad contactor or bad receptacle or loose wire. Using a digital multi-meter that allows you to test voltage in an outlet and resistance in a circuit (available from any good electronics or hardware store) you, your electrician, or your local kiln distributor can see whether a circuit is actually delivering power to the receptacles on the control box, and exactly what the resistance of your elements are.	
E E	A hardware error has been detected by the controller software. The controller must be returned for service.	Hardware error

12. APPENDIX F: ZONE CONTROL SPECIAL CASES

12.1 ZONE CONTROL ON A 2, 4 & 5 SECTION KILN AND WITH A POWERED BOTTOM

On kilns with four heating sections the center two heating sections are tied together as one center zone. On kilns with five heating sections the center three heating sections are tied together as one center zone. Each section still has its own separate contactor, but the center zone control output controls one contactor on a three section kiln, two contactors on a four section kiln and three contactors on a five section kiln. We suggest placing the center zone thermocouple (TC2) in either of the two middle sections on a four section kiln and in the center section on a five section kiln. You can of course experiment to achieve optimal results.

Kilns with two zones typically use inputs (thermocouples) and outputs (receptacles) 1 and 2 even though we usually have a third unused circuit on the control. If you add a section you may want to enable the three zone control (see the section on programming) and possibly add a thermocouple. On kilns with powered bottoms the powered bottom is controlled off the bottom zone control output. This would be the case of a kiln with three or more sections. In the case of a two section kiln with a powered bottom the powered bottom is controlled off the center zone control (TC2). This acts as a two zone kiln.

13. APPENDIX G: FREQUENTLY ASKED QUESTIONS

ALSO SEE APPENDIX K: HELPFUL WEB LINKS

13.1.1 During programming of a firing, I typed a wrong number. How do I correct this?

Before pressing **ENTER,** enter 0 until all zeros are displayed, then enter the correct number. If you have already pressed **ENTER,** you must continue to enter the rest of the program as you would have, then you must start over again to program properly, fixing your mistake this time around..

13.1.2 How do I clear the ErrP or PF from the display?

Press the **"1"** key. After several seconds the current temperature will be displayed. The amount of time the last firing took or STOP may be displayed before the current temperature. If the ErrP or PF message is flashing with the alternate display being the temperature then it means that the kiln is still firing after a brief power interruption.

13.1.3 I am getting the E d message. What is wrong?

More than likely the kiln was set up improperly. NOTE: It is absolutely necessary to match the proper ring with the proper control box outlet and proper thermocouple. If these are mismatched the kiln will not operate properly and you will get the E d display showing that one of the zones is way off set point. Thermocouples, cords and receptacles are all marked for identification. The top zone ring, outlet and thermocouple are all marked #1. In three ring kilns the middle zone is #2 and the bottom is #3. In four ring kilns the middle zone is #2 and #3; the bottom is #4. In five ring kilns the middle is #2, #3 and #4 and the bottom is #5. You can easily test to make sure the thermocouples are properly located by putting a match to one at a time and checking the temperature rise on the control for that thermocouple.

13.1.4 I am getting the E-1 message. What is wrong?

This is the most common error message. It means the kiln is rising in temperature too slowly and can be caused by a variety of things. In older kilns it is probably a result of elements being aged or one or more elements not firing for some reason. The first thing to check is element resistance and continuity. See our troubleshooting guide for details. If this happens in a newer kiln it is still a good idea to check the elements. One problem we have found is that the thermocouple lead wire was pinched and was creating a short circuit (meaning that the controls was reading whatever temperature was at the pinched point and so, as far as the control was concerned, the kiln wasn't heating up. The way to test for such a condition is first of all to observe that the control is showing a temperature that is greatly different than what you can tell is in the kiln. The other better way is to disconnect the thermocouple and see if the display says FAIL . If it does then it means there is no short circuit in the thermocouple circuit. This could also happen with a burned thermocouple connection wire (say if the yellow wire touched the kiln case and the wire insulation burned off). Note that Err1 is only a possibility during a ramp. A common problem is that one of the sections is lagging. Try to find out which section is lagging. If it is the bottom (fairly typical) you could try a 2" layer of calcium silicate under the kiln bottom (this is very inexpensive insulation that is quite hard and non-compressible) or even

another brick bottom. If you are using a vent try turning it off towards the high end of the firing cycle. (NOTE: This is OK to do on an L&L Vent-Sure but with some bottom mounted vents you are not supposed to do this or you will burn up the motor). Make sure your peepholes are closed at high fire.. Make sure kiln is loaded evenly, more in the bottom of the kiln than the top will make it fire very slowly also. One last thing to consider is the voltage available to the kiln when it is on and running. Get an electrician to check this at the kiln and be sure it comes pretty close to the kiln's label. Low voltage can cause slow heat ups and voltage lower than 208VAC can also cause problems with the microprocessor in the DynaTrol as well.

13.1.5 My kiln takes longer to fire than I think it should.

See suggestions above in E-1 troubleshooting. (***hotkilns.com/e1***)

13.1.6 My program takes longer to complete than I expected. What is happening?

The controller actually accomplishes the temperature rise by establishing what's called a traveling set point. The traveling set point is set by the controller at the initial kiln temperature, and it is increased (or decreased) at a rate equal to the ramp rate you have chosen. Anytime the kiln temperature is below this traveling set point the heating elements of the kiln are turned on. If the temperature is above the traveling set point the heating elements are turned off. When both the traveling set point and the average of the measured temperatures reach the first soak temperature, the hold phase begins or the next ramp rate begins. (That is called a guaranteed soak). It means that a program might take longer than the theoretical time you have programmed into it.

13.1.7 My kiln seems to be much hotter than the thermocouples indicate. Or the kiln seems to be going to slow (by the readings on the controller).

This could be serious. Check to see that the thermocouples are inserted at least 1 to 1-1/2" into the kiln. If the tips of the thermocouples are buried in the kiln wall insulation they will obviously read at a lower temperature than the inside of the kiln. **THIS COULD LEAD TO AN OVERFIRING OF THE KILN!** Another possibility is that there is a short circuit in the thermocouple lead wire. See the above Err1 question to check the thermocouple circuit.

13.1.8 Is there a guaranteed soak?

Yes. This means that if the kiln does not reach temperature in the time you assign in a ramp it will not start the hold portion of that segment until the kiln reaches the set point temperature. This also means that the actual time to fire may take longer than you have programmed into the kiln (if it takes longer to get to a particular temperature than you think it ought to take).

13.1.9 I turned on the controller and FAIL is displayed. What does this mean?

One or more of the thermocouples are not connected to the controller. When connecting the thermocouple, connect the negative wire (on Type K in non-European kilns this is RED) to the connector with the negative (minus) sign under it. Connect the positive wire (on Type K non-European kilns this is Yellow) to the connector with the positive (plus) sign under it. (See Section 1.0 for information on Type S and European kilns). Also there may be a break in one of the thermocouple lead wires, if so, the thermocouple lead wire must be replaced. Make sure all thermocouple connections are very secure and tight and that there is a direct touching of the thermocouple lead wire with the actual wire inside the thermocouple. (See I.21)

13.1.10 I keep burning out thermocouples. What is wrong?

Thermocouples, like elements are a consumable item. They will burn out over time. If you are firing to high temperatures (Cone 5 and above) you should consider either an 8 gauge thermocouple with a ceramic protection tube or Type S thermocouples. A reduction atmosphere (the lack of enough oxygen in the kiln to thoroughly burn off all impurities) attacks elements and thermocouples. Speedy firings especially as the kiln climbs to 1100°F, will not give enough time to burn out these impurities. This is made worse if there is no ventilation to the kiln. An open peephole or three may be enough, or a downdraft venting system like L&L's Vent Sure system may be what you need for a good, clean, oxidizing atmosphere.

13.1.11 How can I find out the final temperature which was reached during a cone firing?

At the end of an **EASY-FIRE** firing, the current kiln temperature and CPLT will be alternately flashing in the display. Press **ENTER** or **START/STOP**. Then press **Review Prog,** the final temperature will display. This final temperature will be retained until the next firing or until the controller is reprogrammed. In a **VARY-FIRE** program the DynaTrol will fire to the temperature programmed.

13.1.12 My kiln underfires, turns off before the DynaTrol reaches its set point .

If you have a Dawson Kiln Sitter as a back up safety device be sure that the cone in it is at least two to three cones higher than

your final set point temperature. Remember that, when using the DynaTrol control, the optional kiln sitter is only safety back up controls. You do not want it to actually actuate. If you have a Dawson Kiln Sitter/Timer, be sure the time is set higher than the expected length of your program. See above answer about the kiln sitter safety control. Also you may need to calibrate; to adjust the cone settings with the cone offset. Note that it is common for thermocouples to “drift” in their readings. As this happens the cone offset or the thermocouple offset can compensate for this. Sometimes fire with witness cones so you can compare what the control did to the actual performance of cones.

13.1.13 Why use a soak time or make the kiln go slow?

Most ceramics achieves its characteristics not so much by what temperature it reaches but by how much “heat-work” is put into it. A long soak at a lower cone can often develop the bisque or glaze better. In addition a soak period almost always will improve the uniformity of the firing throughout the kiln. A soak period gives the entire load of ware time to absorb the radiant heat that is projected from the elements. If you simply rise to a certain temperature and then shut the kiln off (as is typical of a manual kiln sitter operation) then the center of the kiln may not have had a chance to absorb as much heat as the ware around the perimeter. The same would be true for a thick piece of pottery if it was just heated to a temperature and then cooled. The middle of the piece would never get to the same temperature as the outside of the piece, and in extreme situations, if it was heated very quickly, could cause the piece to explode. You may have experienced the fact that an older kiln, with slow firing elements may in fact have given you better results. This is because the entire kiln has had a chance to even itself out as it approached final cone. A slow heat up will result in “cleaner” bisque. It will give the kiln time to burn out impurities like sulfur and carbon out of the clay. These impurities can cause pitting and other problems when you subsequently glaze the ware if they have not been given sufficient time to burn off during the bisque.

13.1.14 Can you change a program segment while running a program?

No. You must first Stop the program by hitting **START/STOP**. Then change the program. Then re-start the program. The control will automatically start from where you were previously. For instance if the kiln temperature is at 1200°F and this is segment No 2 it will restart from that point in the program. You can advance to the next segment (in a **VARY-FIRE** Program). See the directions in under Skip Step in the View Section.

13.1.15 When the control flashes TC2 alternating with a temperature does it read that until you toggle to a different thermocouple?

The control is continually reading the temperatures in all three zones. However it only displays one temperature at a time. It does not scroll automatically. To manually scroll to the different thermocouples hit either **1**, **2** or **3**. The default display is thermocouple #2.

13.1.16 Is there a lead zone?

No. Each zone is controlled independently with a separate input (each thermocouple), and a separate output (the signal from the DynaTrol to one of the contactors to send or not to send power to the elements. The output of the zones can be quite different. For instance the top zone (#1) may be calling for 75% output while the middle zone (#2) is calling for 35% output while the bottom zone (#3) is calling for 90% output. This percentage is the percent of time that a zone is on, out of the total time elapsed. This is a time proportioning control.

13.1.17 Is this a time proportioning control?

Yes. The control determines what the percent of output (0-100%) is required to properly heat the kiln. It then converts this into amount of time or and time off that the contactor should be firing. This is different than current proportioning which would send a proportional current to adjust an continually adjustable SCR power control for instance.

13.1.18 What happens when I turn off the Error Codes?

It is O.K. to do this. However, you will not get certain operator protections which might prevent you from getting a poorly fired kiln. They can be turned off if you are doing special firings, such as jewelry or glass firing where the kiln is left open. This will also turn off the Dynamic Zone Control, and the E d function when the Error Codes are turned off. This turns off most error functions so that kiln is not affected by these built in checks. It eliminates nuisance shut downs but side steps built in “fool proofing”. The only Error codes that this does not turn off are E b, FAIL, and ErrP or PF in both the **EASY-FIRE** and **VARY-FIRE** modes. In addition E 1 (indicating slow temperature rise) and E 8 (temperature falling) is not turned off in the last segment of an **EASY-FIRE** program. This is because the built in calculations would make no sense if the kiln were firing too slowly.

13.1.19 What happens when a thermocouple fails?

If the top (TC1) thermocouple fails then the top (TC1) and middle (TC2) work together from the TC2 thermocouple. If the bottom (TC3) Fails then the bottom (TC3) and middle (TC2) work together from the TC2 thermocouple. If the middle (TC2) Fails then the top (TC1) and middle (TC2) work together from the TC1 thermocouple.

13.1.20 One or more of the thermocouples reads FAIL. What is wrong?

One or more of the thermocouple circuits has failed. Chances are this is a bad thermocouple. Even if the thermocouple looks OK there might be a microscopic crack that could FAIL intermittently. A simple test to see if the problem is in the thermocouple itself or in the thermocouple wire is to do the following: Disconnect the thermocouple from the yellow lead/extension wire that attaches at the cold end of the thermocouple. Touch together the red and yellow leads coming out of the yellow lead/extension wire (note: this is very low milli-voltage and is not dangerous). This will complete the thermocouple circuit and eliminate the actual thermocouple from consideration. Now press the #**1** button, If the FAIL message goes away then you know it is a bad thermocouple. If the FAIL message does not go away then the next thing to check is make sure that the thermocouple is properly attached to the connection board on the control. If this looks OK then the yellow extension wire should be replaced or the DynaTrol might have a problem.

13.1.21 What is PID and can the PID settings be changed?

PID stands for “Proportional, Integral, Derivative” This is a mathematical calculus function built into the control that proportions the amount of power going to the output device (contactor) as the kiln approaches set point temperature. It is used to prevent overshoot which you would get if the control did not turn off until it reached the set point. The values are fixed and based on average kiln conditions. Because most kiln conditions are fairly similar and the ramps are very slow by most industrial standards not much flexibility needs to be built into the PID constants. There is no “adaptive tuning.” The values for the PID are hard programmed into the control and can not be changed. They are optimized for ceramics. If you are using the control for another application and you find that the control gives you some overshoot try a step in your program that is a very slow ramp for the last few degrees of the program. For instance if you wanted to get to 1800°F without overshoot have the program go to 1775°F and then take 15 minutes to ramp to 1800°F .

NOTE: Do not confuse the PID talked about here with the “PID” setting in the **Hidden Other Menu**.

13.1.22 Is there any way to know what the set point actually is?

Yes. Press **Review Seg** twice while the kiln is firing and the set point will appear.

13.1.23 What happens if there is a power outage?

If the power outage lasts for less than ½ hour the control should pick up where it left off unless the kiln temperature has dropped more than 250°F or, if it is within 100°F of the end of the firing then only a 100°F drop off is allowed. If the program automatically aborts based on the above logic then it must be manually restarted. If you restart the program, the control will find out where the temperature is and will start from there. If you get a power outage you will see an ErrP or PF error code. This must be reset by hitting any button on the key pad.

13.1.24 The display is jumpy. What about Thermocouple noise?

The negative lead of the thermocouples are automatically grounded to the safety ground. This typically is able to remove thermocouple noise from the system. Thermocouple noise is typically caused by stray electrical currents induced into the low voltage thermocouple circuits by the kiln elements. It shows up as “jumpy” temperature readings on the control. A little of this is OK but if the readings are very jumpy it can confuse the control. If you see this sort of “jumpiness” check all ground connections involved for tightness and continuity. If the ground is OK and the thermocouples are in the factory provided holes, in your kiln about one and one half inches, then contact L&L or a certified repairman for assistance. NOTE: thermocouples in homemade holes that may be positioned too close to the elements, could receive more of the inductive current generated by the elements, therefore receive more noise (NOTE: In extreme cases L&L can retrofit your control box with a noise suppressor and even wire the box so that the control voltage is feed through a separate 120 volt cord). (See this web page for a more detailed description with potential solutions: ***hotkilns.com/noise-fix***)

13.1.25 Do thermocouples need to be grounded or ungrounded?

They must be ungrounded thermocouples. Grounded thermocouples will cause problems with this control. The negative leads of the thermocouples are connected to the kiln ground. (See above section about electrical noise). Be sure there is only one ground to your kiln. This is normally through the plug or main power connection all the way to the “earth ground”.

The control is grounded and RF (radio frequency) noise generated in the thermocouples (from the element power and other sources) is drawn into the sheath ground and into the negative lead of the thermocouple and then ultimately out to earth ground.

13.1.26 Can I override the end of a firing to gain temperature?

Lets say you just fired a load and you can see through your peephole (looking at a witness cone) that your load did not fire to full maturity. Restart the program with a higher cone value and then manually shut off kiln when the witness cone starts to mature. Use the cone offset feature next time to eliminate this problem before it happens again.

13.1.27 I hear the contactors clicking on and off when the kiln is at a low temperature and even though my set point is way above the temperature readings. Why?

The control only allows power for about 1/3 of the time when the kiln temperature is below 500°F. This is because kilns are generally overpowered for these low temperatures and the control would constantly be overshooting any lower temperature set points without this feature.

13.1.28 What does it mean when the display flashes?

The DynaTrol is trying to give more information than can fit on just one displayed message. Either the message cycles over and over again, like `IdLE` and `TC2`, `current temperature`, or the messages continue to flash by quickly, as in the case of what happens when you press the **Review Prog** button.

13.1.29 What does CPL mean?

"**CPL**" means that programming an option or a sequence of steps has been completed.

13.1.30 How do you turn off the audible alarm?

The alarm is an audible signal. You can turn it off (after it turns on) by pressing **ENTER**. Set it for **9999** to disable it.

13.1.31 How do I get information about my firing?

When the program has completed it will flash `CPLT` and the time it took to get to temperature. After pressing **STOP** you can press **Review Prog** to get more information about the firing. The display will scroll through the following: the Cone you set it at, the actual temperature that the kiln achieved, what speed you had it set for, and hold time etc. This only works in the **EASY-FIRE** mode. In the **VARY-FIRE** mode, if you press **Review Prog** you see what you programmed only. This information will be retained in memory until the control is reprogrammed.

13.1.32 What ambient temperature conditions do I need for the control?

Do not operate the controller in temperatures above 125°F or below 0°F or 0°C. Actually a little hotter or colder will still be within tolerance of the components. The real component rating is near 160°F . If you are using the Celsius temperature scale 0°C is the lowest operating temperature possible as the DynaTrol thinks a negative temperature displayed is because of a thermocouple installed backwards, not because it could be cold outside. (NOTE: The board components are rated for 50°C below zero so the control (and kiln) can be stored outside in a covered area).

13.1.33 The kiln did not begin soaking when it should have.

The fact that the kiln did not start to soak when its seems like it should could be due to the fact that an average of all the process variables (TC readings) and the traveling set point have to reach set point temperature before the hold begins. Or the DynaTrol has computed a higher temp (than expected) to equate to the cone # fired to and the rate of climb… Once it gets to where it determines the cone is , it will begin the hold.

13.1.34 The thermocouples seem to be off according to the cones.

If you had an `ErrP` or `PF` message while firing, and the kiln temperature went down briefly, the cones may have misrepresented actual temperature for the following reason: If the temperature decreases in the kiln temporarily after the cone begins to form a glass (starts to mature even though it may not be visible) the decrease in temperature could "freeze" the cone and prevent it from operating properly. Cone temperatures also vary according to how quickly the kiln climbs in temperature. Thermocouples do age, sometimes rapidly, and may not read like they used to. Try a cone offset to raise or lower the entire kiln's final temperature for the cone you have programmed. Or try a thermocouple offset if it is just one or two zones that are consistently hotter or cooler than they should be.

13.1.35 How do I ramp down?

You must use the **VARY-FIRE** Mode. The control will change the path of the firing profile in the direction of the next segment's set point. In other words if the current segment has a set point of 500°F and the following segment has a set point of 1000°F then the control will ramp the set point in the "up" direction. Conversely if the current segment has a set point of 1000°F and the next segment has a setpoint of 500°F then the control will ramp the set point in the "down" direction. See the specific instructions in the Programming section under **VARY-FIRE**.

13.1.36 Does the control work on 50 HZ?

Yes. The control will work on either 50 Hz or 60 Hz. The electrical cycle does not affect any timing circuits in the control.

13.1.37 TEMPERATURE READINGS VS CONES

Automatic controls are great tools. *They are not complete tools, however.* They base what they do on electrical signals generated by the thermocouples that get interpreted by the electronic control as specific temperatures. There are four inherent problems with this. First, the thermocouples are only measuring temperature at the very tip of the thermocouple. Typically this is placed an inch or two in from the inside surface of the kiln. The thermocouple is usually not measuring the temperature in the middle of the kiln. Second, there is an inherent error in the thermocouple of a few degrees either way. Third, thermocouples drift in their accuracy over time. Fourth, and perhaps most important, thermocouples only measure temperature. For ceramics you are really interested in "heat-work" or the amount of heat that is absorbed by your ware over time. It is like baking a cake. Absolute temperature is only one factor in the successful baking. For all these reasons we highly recommend the use of witness cones in every firing. These will tell you what really happened in the kiln. We suggest using a set of three witness cones in each zone for the kiln. At the absolute minimum use one witness cone per firing to check basic performance of the kiln and control. Then using this accurate information you can use the many features of the DynaTrol to conform the performance of the control to your exact needs. You may want to try firing the kiln with all the preset programs with witness cones to see just how the type of program affects the cones you will be using. Keep good records and get to know your kiln, the DynaTrol and how the combination of these two things with the kind of ware that you fire all work together. **There is no substitute for experimentation and personal individualized documentation. See the following for more helpful information:**

hotkilns.com/firing-kiln-witness-cones (video) ***hotkilns.com/hold-times-and-heatwork***

hotkilns.com/calibrating-kiln ***hotkilns.com/fire-precisely-witness-cones***

hotkilns.com/promote-even-firing

14. APPENDIX H: VARY-FIRE DEFAULT PROGRAM'S

14.1.1 USER 1: Medium Speed Glass Slumping Profile

Segment	Rate	degF	Hold
1	500	250	00:12
2	500	500	00:12
3	500	750	00:12
4	600	1100	00:05
5	600	1220	00:05
6	9999	1000	01:00
7	90	970	01:00
8	120	750	00:01

14.1.2 USER 2: Medium Speed Glass Tack Fuse Profile

Segment	Rate	degF	Hold
1	500	250	00:12
2	500	500	00:12

3	500	750	00:12
4	600	1250	00:20
5	600	1350	00:10
6	9999	1000	01:00
7	90	970	01:00
8	120	750	00:01

14.1.3 USER 3: Medium Speed Full Fuse Profile

Segment	Rate	degF	Hold
1	500	250	00:12
2	500	500	00:12
3	500	750	00:12
4	600	1250	00:20
5	600	1480	00:15
6	9999	1000	01:00
7	90	970	01:00
8	120	750	00:01

14.1.4 USER 4: Glass Bead Annealing Profile

Segment	Rate	degF	Hold
1	9999	960	08:00
2	9999	960	00:40

14.1.5 USER 5: Lost Wax Burnout Profile

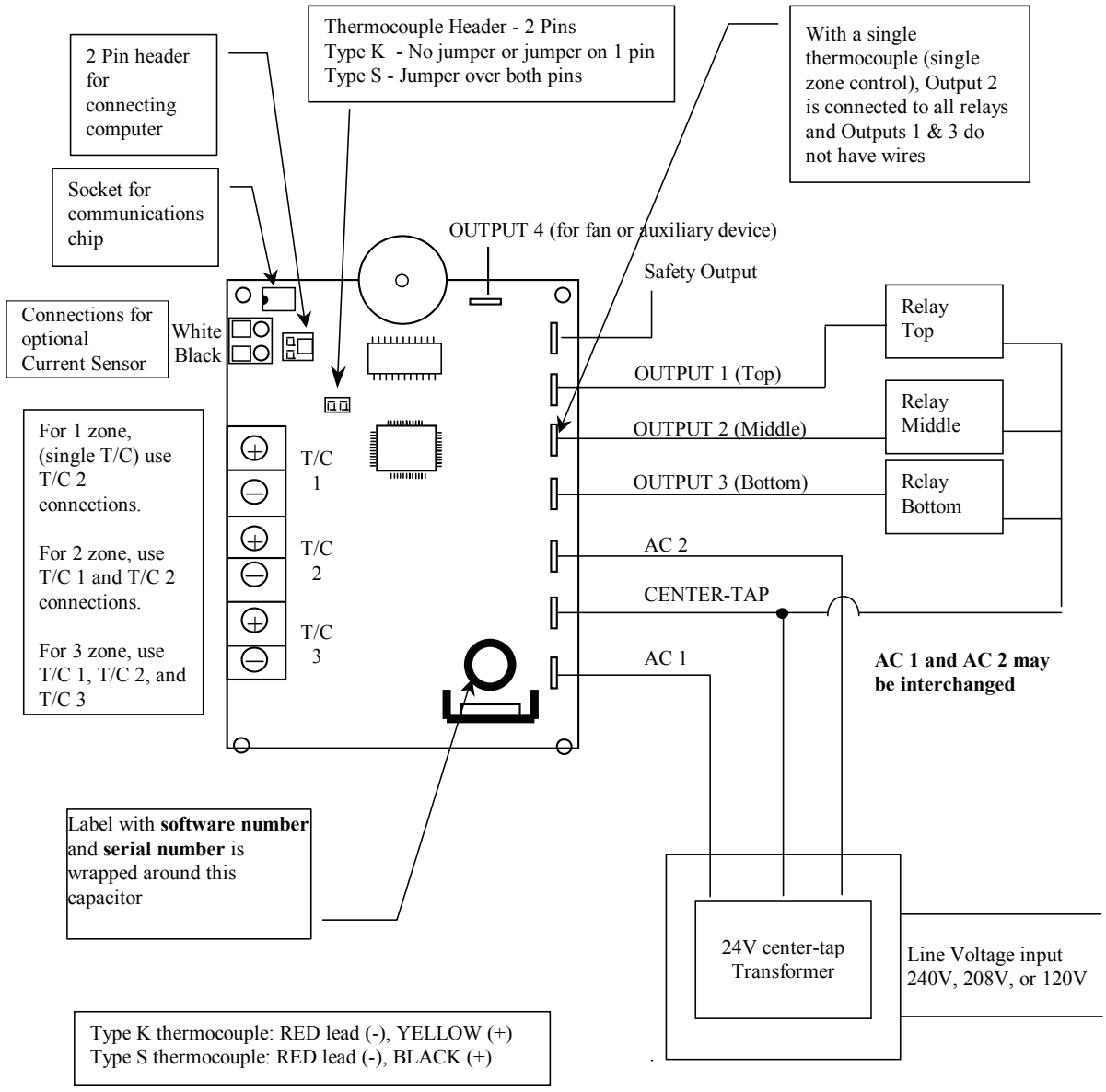
Segment	Rate	degF	Hold
1	9999	300	01:00
2	100	350	00:30
3	350	1350	01:30
4	300	900	99:99

14.1.6 USER 6: Slow Cooling Cycle for Cone 6 Glazes

Segment	Rate	degF	Hold
1	9999	2232	00:00
2	9999	1900	00:00
3	150	1500	00:00

15. APPENDIX I: HOOKUP DIAGRAM

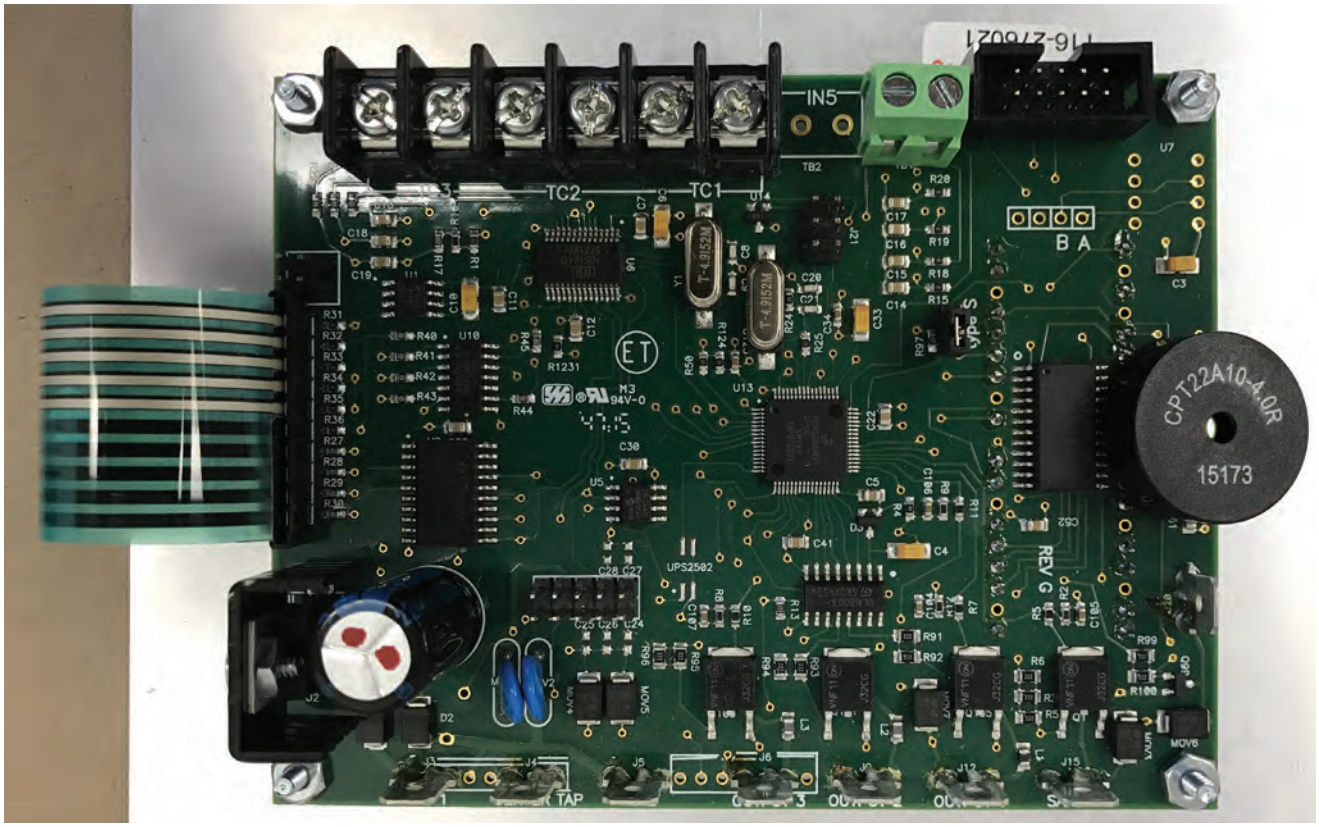
Connection Diagram - Series 700



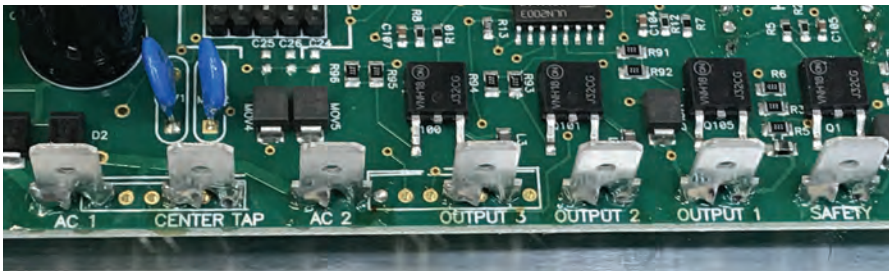
Revised: 12-21-05

16. APPENDIX J: PHOTOGRAPHS

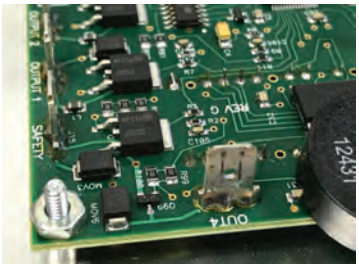
Back of the DynaTrol:



Inputs:

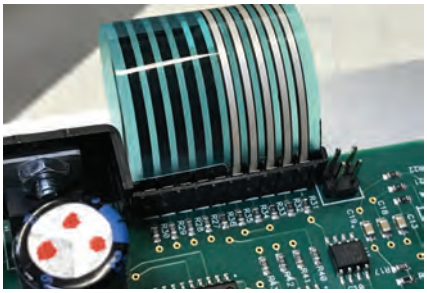


Output #4 is on the side



Software Version (on top) and Serial Number (on bottom):

Where Ribbon Connector connects board with panel:



Jumper for Type S Thermocouple. It is Type S when the jumper connects to the two prongs (right photo):

17. APPENDIX K: HELPFUL WEB LINKS

17.1 First Firing

First Firing Instructions for L&L Kilns with a DynaTrol (***hotkilns.com/first-firing***)

Programming your L&L DynaTrol for your first test firing (Video) (***hotkilns.com/programming-first-firing***)

How to do a split test fire on a new kiln with a DynaTrol - safest way to test fire. (***hotkilns.com/split-test-fire***)

What is the right temperature to fire to on the first firing? (***hotkilns.com/right-temperature-first-firing***)

17.2 Basic Firing and Programming

Turning on the DynaTrol on an L&L Kiln (Video) (***hotkilns.com/turning-dynatrol***)

How to Program Easy-Fire Programs for DynaTrol (***hotkilns.com/program-easy-fire***)

How to use the PreHeat feature in the DynaTrol (***hotkilns.com/preheat-dynatrol***)

Programming a Vary Fire on a DynaTrol (***hotkilns.com/programming-vary-fire-dynatrol***)

Recalling a Vary Fire Program on the DynaTrol (Video) (***hotkilns.com/recalling-vary-fire-dynatrol***)

How high can the DynaTrol be programmed to fire to? (***hotkilns.com/high-temp-dynatrol***)

How to Ensure that Kiln Has Been Programmed Correctly (***hotkilns.com/program-review***)

Reviewing a Program of a DynaTrol on an L&L Kiln (Video) (***hotkilns.com/review-program-dynatrol-video***)

DynaTrol Easy-Fire Profiles in Deg F and Deg C (Excel Format) (***hotkilns.com/dynatrol-easy-fire-profiles-excel***)

Adding a Controlled Cool to an Easy Fire Program (Video) (***hotkilns.com/controlled-cool-easy-fire***)

How to program a controlled cool down in the DynaTrol control? (***hotkilns.com/programmed-cool-down-dynatrol***)

How do I control the cooling with the DynaTrol? (***hotkilns.com/control-cooling-dynatrol***)

17.3 Advanced Programming and Configuration

How to add soak to or reprogram a DynaTrol during a firing (***hotkilns.com/add-soak-while-firing***)

How to create very long programs in the DynaTrol? (***hotkilns.com/very-long-programs***)

How do I enter a really slow program? (***hotkilns.com/really-slow-program***)

Setting OTHER options on the DynaTrol (Video) (***hotkilns.com/other-options-dynatrol***)

Changing Degrees F to C on a DynaTrol control (Video) (***hotkilns.com/change-deg-f-c***)

The Hidden Menu in the DynaTrol - what it does and how to make changes (***hotkilns.com/hidden-menu-dynatrol***)

How do I fire with fewer kiln sections on my Jupiter Kiln? (***hotkilns.com/fire-fewer-sections-jupiter***)

How do you find out how many firings the DynaTrol has performed? (***hotkilns.com/number-firings-dynatrol***)

Can the DynaTrol count the number of firings of the kiln? (***hotkilns.com/how-many-firings***)

How do I find out what the final temperature reached in a program on a DynaTrol? (***hotkilns.com/final-temperature-reached***)

Changing to Single Zone on a DynaTrol (Video) (***hotkilns.com/change-single-zone***)

Turning Off Error Codes on a DynaTrol control (Video) (***hotkilns.com/turn-off-error-codes-video***)

Changing contactor Cycle Time on a DynaTrol control (Video) (***hotkilns.com/changing-cycle-time-dynatrol***)

17.4 Process Questions

How do hold times and heatwork affect my work? (***hotkilns.com/hold-times-and-heatwork***)

What can I do to promote even kiln firings? (***hotkilns.com/promote-even-firing***)

Should I use the Fast Glaze or Slow Glaze or Fast Bisque or Slow Bisque? (***hotkilns.com/fast-vs-slow-firing***)

Why use slow bisque over fast bisque? Is it just a moisture issue? (***hotkilns.com/slow-bisque-vs-fast-bisque***)

How do I program a slump or tack or full fuse glass program into DynaTrol? (***hotkilns.com/program-slump-tack-fuse-glass***)

17.5 Error Codes

Kiln DynaTrol Control Error Codes (***hotkilns.com/error-codes***)

Error D (***hotkilns.com/e-d***)

How to fix E-1 or Err1 (***hotkilns.com/e1***)

How to fix PF, E- P, E-P, ErrP Error (***hotkilns.com/fix-errp***)

What to do when you see “FAIL”? (***hotkilns.com/error-fail***)

What’s the Worst thing that can Happen from Restarting After an Error Code? (***hotkilns.com/restarting-after-error-code***)

Can I Restart the Kiln after Getting an Error Message? (***hotkilns.com/restart-after-error-message***)

Turning Off Error Codes on a DynaTrol control (Video) (***hotkilns.com/turn-off-error-codes-video***)

17.6 Troubleshooting Control

Why does my kiln jump over the Preheat without holding at the Preheat temp? (***hotkilns.com/jump-over-preheat***)

Some of the buttons on the DynaTrol do not work. How do I fix this? (***hotkilns.com/buttons-do-not-work***)

The DynaTrol shows cone 05 after I program it for 5 or 06 after I program it for 6 (***hotkilns.com/program-different***)

How can the thermocouple wires get reversed on a Jupiter or DaVinci Automatic Kiln? (***hotkilns.com/thermocouple-wires-reversed-jupiter-davinci***)

What to do if there is no display on the DynaTrol (***hotkilns.com/no-display-dynatrol***)

How to interpret a garbled message on the DynaTrol (***hotkilns.com/interpret-display***)

Display Reads 2400 or CPLt When it Starts Up (***hotkilns.com/display-startup***)

Why does the temperature read-out on my hand-held pyrometer differ from the temperature shown on the DynaTrol? (***hotkilns.com/temperature-pyrometer-dynatrol-differ***)

My contactors / relays are wearing out too quickly - what can I do? (***hotkilns.com/contactors-wear-out-quickly***)

The controlled cooling on an Easy-Fire keeps changing. Why? (***hotkilns.com/controlled-cooling-easy-fire-keeps-changing***)

Control reads higher temperature than my studio. No error code. What is wrong? (***hotkilns.com/control-reads-high***)

17.7 Troubleshooting Process & Firing Issues

Change the cycle time of the DynaTrol Control (***hotkilns.com/change-cycle-time-dynatrol***)

Changing contactor Cycle Time on a DynaTrol control (Video) (***hotkilns.com/changing-cycle-time-dynatrol***)

What to do if the kiln fires slowly? (***hotkilns.com/slow-kiln***)

Electrical Supply Problems and slow kiln performance (***hotkilns.com/electrical-supply-problems***)

Why does my kiln seem like it overfires the pottery? (***hotkilns.com/overfire-pottery***)

The center of my kiln gets too hot compared to the top and bottom. (***hotkilns.com/center-kiln-hot***)

How do I fix pinholes and blistering in glazing? (***hotkilns.com/fix-pinholes-blistering***)

Why does my kiln stall or stop heating with lots of clicking (relays) and no error code? (***hotkilns.com/kiln-stall-no-error-code***)

17.8 Calibrating Control and Kiln

Changing Cone Offset on a DynaTrol on an L&L kiln (Video) (***hotkilns.com/change-cone-offset***)

Thermocouple Offset Setting and Cone Offset Setting (***hotkilns.com/thermocouple-cone-offset***)

Changing Thermocouple Offset on a DynaTrol control (Video) (***hotkilns.com/change-thermocouple-offset***)

Adjusting and Calibrating the DynaTrol or One-Touch for More Accurate Firing (***hotkilns.com/calibrating-kiln***)

Fire Kiln with Cones (***hotkilns.com/fire-kiln-cones***)

How to fire very precisely using witness cones (***hotkilns.com/fire-precisely-witness-cones***)

What are Thermocouples? (***hotkilns.com/what-are-thermocouples***)

17.9 Fixing and Changing Control

WHEN REPLACING A DYNATROL: CHECK THE CONFIGURATION OF THIS REPLACEMENT CONTROL TO MAKE SURE YOU DON'T MELT YOUR KILN! (***hotkilns.com/cautions-for-replacing-dynatrol***)

How to Change Thermocouple Type (Type S or Type K) on a DynaTrol (***hotkilns.com/change-thermocouple-type***)

Replacing a DynaTrol (Video) (***hotkilns.com/replace-dynatro***l)

Replacing Control (Text and photos) (***hotkilns.com/replacing-control***)

Checking a Relay in an L&L Automatic Kiln (Video) (***hotkilns.com/checking-relay***)

Check Power Relay (Text and photos) (***hotkilns.com/check-power-relay***)

Changing a Relay in an L&L Automatic Kiln (Video) (***hotkilns.com/changing-relay-video***)

Replacing Power Relay (Text and photos) (***hotkilns.com/replacing-power-relay***)

Checking Switches on the DynaTrol Control Board (Video) (***hotkilns.com/check-switches-dynatrol-board***)

17.10 Specifications and Options

Specification Sheet for DynaTrol Control (***hotkilns.com/specification-sheet-dynatrol-control***)

KISS Computer Interface & Datalogger for DynaTrol Control (***hotkilns.com/kiss***)

How to install KISS Chip on DynaTrol Board (***hotkilns.com/install-kiss-chip***)

Vent-Control for Vent-Sure (***hotkilns.com/vent-control-vent-sure***)

Genesis Touch Screen Control Retrofit Board Only (***hotkilns.com/retrofit-genesis***)

18. APPENDIX K: FIRING PROGRAM BLANK

Firing Program Number: _____

Segment	Rate	Temperature	Hold
1			
2			
3			
4			
5			
6			
7			
8			

Firing Program Number: _____

Segment	Rate	Temperature	Hold
1			
2			
3			
4			
5			
6			
7			
8			

19. TABLE OF CONTENTS

KILNS BUILT TO LAST
L&L Kiln Mfg. Inc. ♦ 505 Sharptown Rd.♦ Swedesboro, NJ 08085
Phone: 856.294.0077 ♦ Fax: 856.294.0070 ♦ Email: sales@hotkilns.com ♦ Web: hotkilns.com

BEFORE YOU BEGIN USING THE GENESIS CONTROL

1. Watch all the videos on the Gensis control at hotkilns.com/videos in the "Genesis Control" category.
2. Look through the Genesis instruction manual.
3. Get familiar with the control by using the menus.
4. Set up WiFi (See Setting Up WIFI on the Genesis Control) on how to do this on our website under the Genesis Control Videos.
5. ***Update the latest Firmware.*** This changes from time to time with no set schedule. We have found that many issues that customers have are fixed by new software: Menu > Configuration > Communications > Update Firmware

TIPS

In case you need to get into the Factory Configuration menu (to change the number of zones for instance, or to change offsets) use the code: 443

When updating firmware, you may get a blank screen due to a weak signal. Simply go back, reconnect to WiFi and select Update Firmware again. This may happen more than once, depending on your WiFi signal.

You may get a pop-up that says "Latest Firmware is Already Installed". You can then select cancel to skip redownloading the same update.

Operation Manual

Genesis
Model LT3140
Controller

Genesis 2.0

BARTLETT
INSTRUMENT COMPANY

1032 Avenue H
Fort Madison, IA 52627

319-372-8366

www.bartinst.com

Table of Contents

Introduction

This manual covers the operation of the Genesis 3140 & Genesis 1120 kiln controllers. The Genesis is a versatile touch screen controller that regulates the temperature in your kiln so you can fire a variety of products like ceramics, glass, jewelry, and more. The Genesis has preset ceramic programs with cone fire programming, preset glass firing profiles, and 30 custom programs, along with Wi-Fi capabilities for software updating, built in diagnostics, and maintenance logging among other new features.

Precautions

- The controller is used to control temperature; it is not a safety device.
- Do not operate the controller in temperatures above 160^{o} F.
- Always supervise your kiln during a firing.
- The controller contains electronic components which are sensitive to static electricity. Before handling the controller dissipate any static charge you may have by touching metal or a screw on the controller panel, the electrical box, the kiln lid, or some other grounded object.
- Always check the position of the thermocouple probe before starting a firing. The current temperature displayed on the controller is measured at the end of the thermocouple which must be in the firing chamber about 1" to 1-1/2". Seal the opening around the thermocouple with kaowool or similar material if necessary.
- Always review the current program before firing to ensure the correct profile is programmed.
- Ensure the kiln and the areas around the kiln are clear of combustible material. See kiln manufacturer's recommendation on required clearances.

Home Screen Overview

Start
Press to begin firing process.

Current Temperature
Displays the current temperature of the kiln.

Status
Displays the current status of the kiln.

Edit or View Menu
Press to edit or view (novice mode) the currently loaded program

Current Program
Displays the program currently loaded

Fire Time
The firing time in hours:minutes

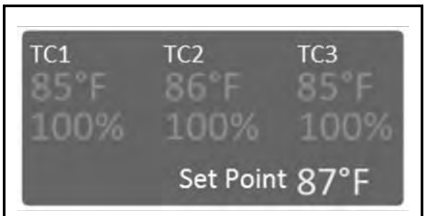
Load
Press to load a new or saved program

Set Point
Displays the temperature the kiln is trying to fire to

Menu Options
Data Menu
Diagnostics
Adjustments
Configuration
Restore Presets
Customization
Factory Config

Wi-Fi
Indicates the Wi-Fi signal strength. An Exclamation mark by the Wi-Fi symbol indicates connected to Wi-Fi but not to the internet

Segment
Displays the segment the firing currently is in and the total number of segments



Toggle Status
Press anywhere in the square to toggle status to see each thermocouples temperature, percentage of power to each element, and the set point. The single temperature is TC2' s reading

Figure 1: *Home Screen Overview*

Quick Start

Step 1: Load A Program (See Pages 7-13)

- Press the **Load** button.
- Select the type of program.
    - Ceramic (Bisc or Glaze)
    - Glass
    - Custom

Step 2: Review or Edit the Program (See Pages 7-13)

- Press the **Edit** or **View** button.
- Review and confirm the program selection.

Step 3: Start the Firing (See Page 13)

- Press the **Start** button.
- Enter the start code.
- Press **Start.**

First Firing of the Kiln

The purpose of the first firing is to put a protective oxide layer on the elements and thermocouple. The first firing is done without ware in the kiln that might give off fumes that contaminate the elements. Fire to Cone 5 with a Slow Speed.

Ceramics Programming (Bisc or Glaze)

Programming in Novice mode is the easiest method to program the controller to fire ceramics. Programming consists of choosing a cone number, firing speed, and a preheat time. The firing speed is chosen by the type of firing and thickness of the clay used. All 4 speeds below will calculate the firing rate at the end of a firing and adjust the final temperature for correct heat-work.

Ceramics Programming – Novice Mode ON:

Step	Display Shows	Key Press	What This Selection Means
1	Home Screen	Load	You're ready to load a different program into the controller memory.
2	What are you firing?	Ceramics	Choose from Ceramics, Glass, and Other. Choose Ceramics for a bisc or glaze firing.
3	Cone Number XX Temperature XXXX	Next	Use the scroll bar to choose the desired cone number for the firing. Remember, cone numbers starting with a 0 are a lower temperature than cone numbers not starting with a 0. For example, don't mistake a cone 6 for a cone 06!
4	What speed?		Choose the firing speed either Fast, Medium, MedSlo, or Slow.
		Fast	Fast is the fastest firing speed and is used for glaze firings on thin ware, china paint firings, and decal firings. Firing times range from 4 to 5 hours.
		Or Medium	Medium is used for firing glaze on thicker ware or for bisque firing very thin ware. Typical firing time is 6-8 hours depending on the cone number.
		Or MedSlo	MedSlo is used to bisque medium pieces or thinner ware that requires less time for water smoking and carbon burn-out. Typical firing time is 9-11 hours, depending on cone number.
		Or Slow	Slow is used to bisc thicker, hand thrown ware. The slow speed gives extra time for release of water and carbon burn-out. Typical firing times range from 13-17 hours depending on the cone number. Hand built pieces may need a preheat stage.
5	Preheat Time?		Choose the preheat time, either None, 4 Hr, 8 Hr, or 12 Hr.
		None	No preheat time is needed when the pieces are a thin, bone dry bisc or glaze.
		Or 4 Hr	Use a 4 hour preheat time for thicker, slightly wet pieces.

		Or 8 Hr	Use an 8 hour preheat time for thick, wet pieces.
		Or 12 Hr	Use a 12 hour preheat time for hand built, kids pieces.
6	Program Loaded:	OK	Return to Home Screen at IDLE.

Ceramics Programming - Novice Mode Off:

Step	Display Shows	Key Press	What This Selection Means
1	Home Screen	Load	You're ready to load a different program into the controller memory.
2	Load Program		Choose between 1-Bisc, 2-Glaze, 3-Glass, or 4-Custom
		1-Bisc	The default bisc program will be loaded to the controller. Any saved changes made to the bisc program will overwrite the default program.
		Or 2-Glaze	The default glaze program will be loaded to the controller. Any saved changes made to the glaze program will overwrite the default program.
3	Program Loaded:	OK	Returns to Home Screen. To make changes to the loaded program, go into the edit menu.
4	Home Screen	Edit	Displays the current settings for the firing. To change the settings, press the setting to be changed and select the new

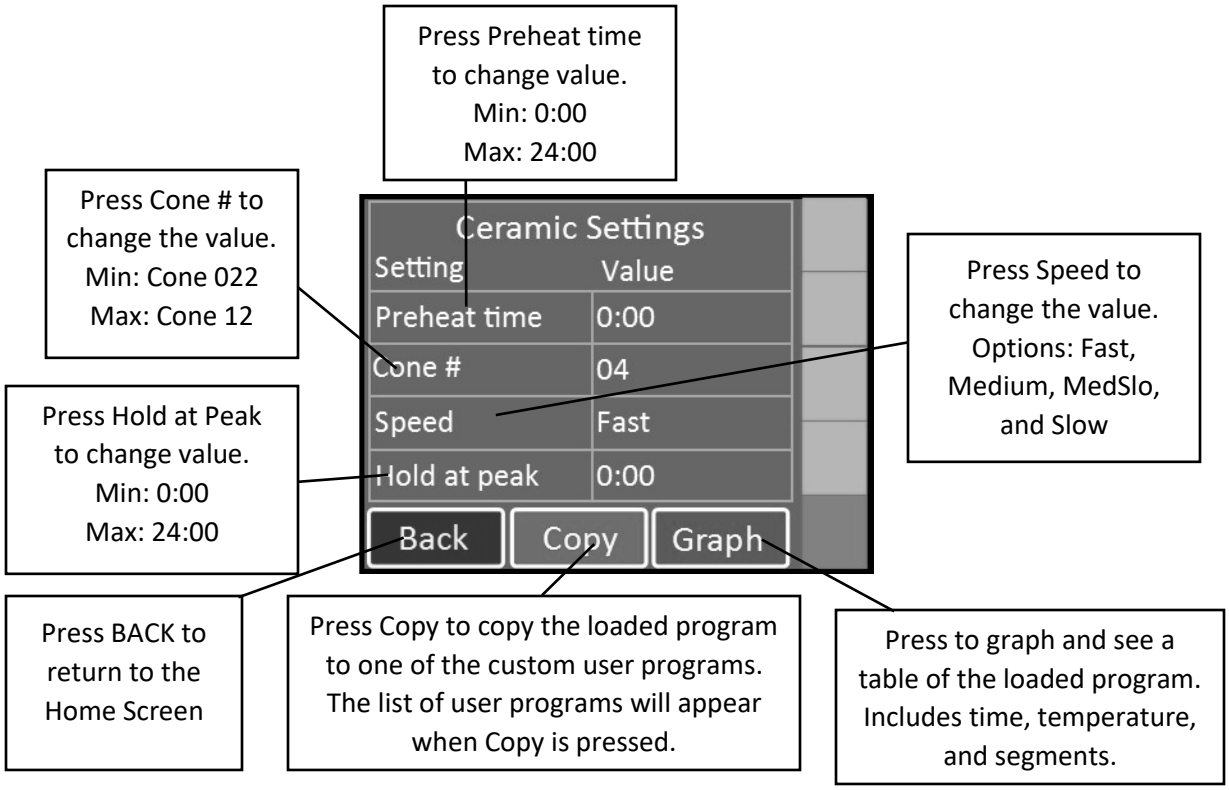


Figure 2: *Ceramics programming sample.*

			setting. For example: To change the preheat time, press Preheat Time, type in the new preheat time, and press str.
5	Ceramics Settings Preheat Time Cone # Speed Hold at Peak Cooling	Back	Returns to Home Screen at IDLE.

Note: When a preheat is selected, the temperature ramps up at 60°F/hour (33°C/hr) to 200°F (93°C) for the amount of time programmed.

When the copy function is used and Copy is selected, the controller will return to the IDLE screen. The loaded program will become the copied program in its new user location.

Notes for Cooling (Not Pictured): Scroll down to select Cooling. Cooling is set to Off unless changed by the user. With cooling turned on, it adds 2 segments on to the end of the firing. The first segment cools the kiln from the top temperature down to 1900°F at a rate of 9999 (As fast as possible). The 2nd and final segment cools the kiln from 1900°F down to 1500°F at a rate of 150°F per hour.

Glass Programming

Programming in Novice mode is the easiest method to program the controller for glass firings. Programming consists of choosing the type of firing, firing speed, and COE (Coefficient of Expansion). The firing speed is chosen by the size of the glass being fired.

Glass Programming – Novice Mode ON:

Step	Display Shows	Key Press	What This Selection Means
1	Home Screen	Load	You're ready to load a different program into the controller memory.
2	What are you firing?	Glass	Choose from Ceramics, Glass, and Other. Choose Glass for slumping, fusing, or casting glass.
3	What type of firing?		Choose the type of firing, either Slump, Tac Fuse, Full Fuse, or Cast.
		Slump	Slump is used for firing glass pieces that you want to conform to a mold.
		Tac Fuse	Tac Fuse is used for fusing glass that result in softened edges
		Full Fuse	Full Fuse is used for fusing glass that result in soft, round edges
		Cast	Cast is used for melting glass pieces together.
4	What speed?		Choose the firing speed, either Fast, Medium, MedSlo, or Slow.
		Fast	Fast is the fastest firing speed and is used for glass pieces that are either under 2in. x 2in. or very thin
		Medium	Medium is used for glass pieces that are under 4in. x 4in. or very thick.
		MedSlo	MedSlo is used for glass pieces that are under 8in. x 8 in. or 2 to 3 layers thick.

		Slow	Slow is the slowest firing speed and is used for glass pieces that are over 8in. x 8in. or multiple sheets thick.
5	Program Loaded:	OK	Return to Home Screen at IDLE.

Glass Programming – Novice Mode OFF:

Step	Display Shows	Key Press	What This Selection Means
1	Home Screen	Load	You're ready to load a different program into the controller memory.
2	Load Program	3-Glass	Choose between 1-Bisc, 2-Glaze, 3-Glass, or 4-Custom
3	Glass		Choose the type of glass firing, either Slump, Tac Fuse, Full Fuse, or Cast.
		Slump	Slump is used for firing glass pieces that you want to conform to a mold.
		Tac Fuse	Tac Fuse is used for fusing glass that result in softened edges
		Full Fuse	Full Fuse is used for fusing glass that result in soft, round edges
		Cast	Cast is used for melting glass pieces together.
4	Program Loaded:	OK	Returns to Home Screen. To make changes to the loaded program, go into the edit menu.
5	Home Screen	Edit	Displays the current settings for the firing. To change the settings, press the setting to be changed and select the new setting. For example: To change the speed, press Speed, select the desired speed, and press Save.
6	Glass Settings Temperature Hold Time Speed Glass COE	Graph	Press to graph the currently loaded program.
7	Graph	Table	Press TABLE to view and edit each individual segment of the firing. Use the scroll bar at the right side of the screen to view each segment in the loaded program. Displays the current settings for each segment of the firing (rate, temperature, and hold time for each segment). To change the settings, press the setting to be changed and select the new setting. For example: To change the rate for Segment 1, press the temperature listed under Segment 1's rate, type in the new temperature, and press Save. Any saved changes made to the Custom user program will overwrite the default program.
8		Back	Returns to Home Screen at IDLE.

Custom Programming

The default custom programs are listed in Appendix C: Custom Firing Default Programs. The Genesis has 30 Custom user programs to store and reuse. User programs 1-12 have 32 segments each, while 13-30 have 8 segments each. Each segment has a firing rate, a soak temperature and a hold time. Custom programs can only be edited with Novice Mode set to OFF. See page 19 for more information.

Custom Programming – Novice Mode ON:

Step	Display Shows	Key Press	What This Selection Means
1	Home Screen	Load	You're ready to load a different program into the controller memory.
2	What are you Firing?	3 - Other	Choose from Ceramics, Glass, and Other. Choose Other for custom firings
3	Other User1- User2- User3-	UserX -	Using the scroll bar on the right side of the screen, scroll until the desired program is displayed. For a complete list of the default programs, see Appendix C: Custom Firing Default Programs.
4	Program Loaded: CUSTOM UserX	OK	The selected custom program has been loaded.
5	Home Screen	View	Use the scroll bar at the right side of the screen to view each segment in the loaded program. There is specific rate, temperature, and hold time for each segment. You cannot add, delete, or change segments when Novice Mode is activated.
6	UserX – #, Rate, Temp, Hold, F	Back	Returns to Home Screen at IDLE.

Custom Programming – Novice Mode OFF:

Step	Display Shows	Key Press	What This Selection Means
1	Home Screen	Load	You're ready to load a different program into the controller memory.
2	Load Program	4-Custom	Choose between 1-Bisc, 2-Glaze, 3-Glass, or 4-Custom
3	Custom	UserX -	Using the scroll bar on the right side of the screen, scroll until the desired program is displayed. For a complete list of the default programs, see Appendix C: Custom Firing Default Programs.
4	Program Loaded: CUSTOM UserX	OK	The selected custom program has been loaded.

5	Home Screen	Edit	To make changes to the loaded program, go into the edit menu. Use the scroll bar at the right side of the screen to view each segment in the loaded program. Displays the current settings for each segment of the firing (rate, temperature, and hold time for each segment). To change the settings, press the setting to be changed and select the new setting. For example: To change the rate for Segment 1, press the temperature listed under Segment 1's rate, type in the new temperature, and press Save. Any saved changes made to the Custom user program will overwrite the default program.
6	UserX- #, Rate, Temp, Hold, F	Back	Returns to Home Screen at IDLE.

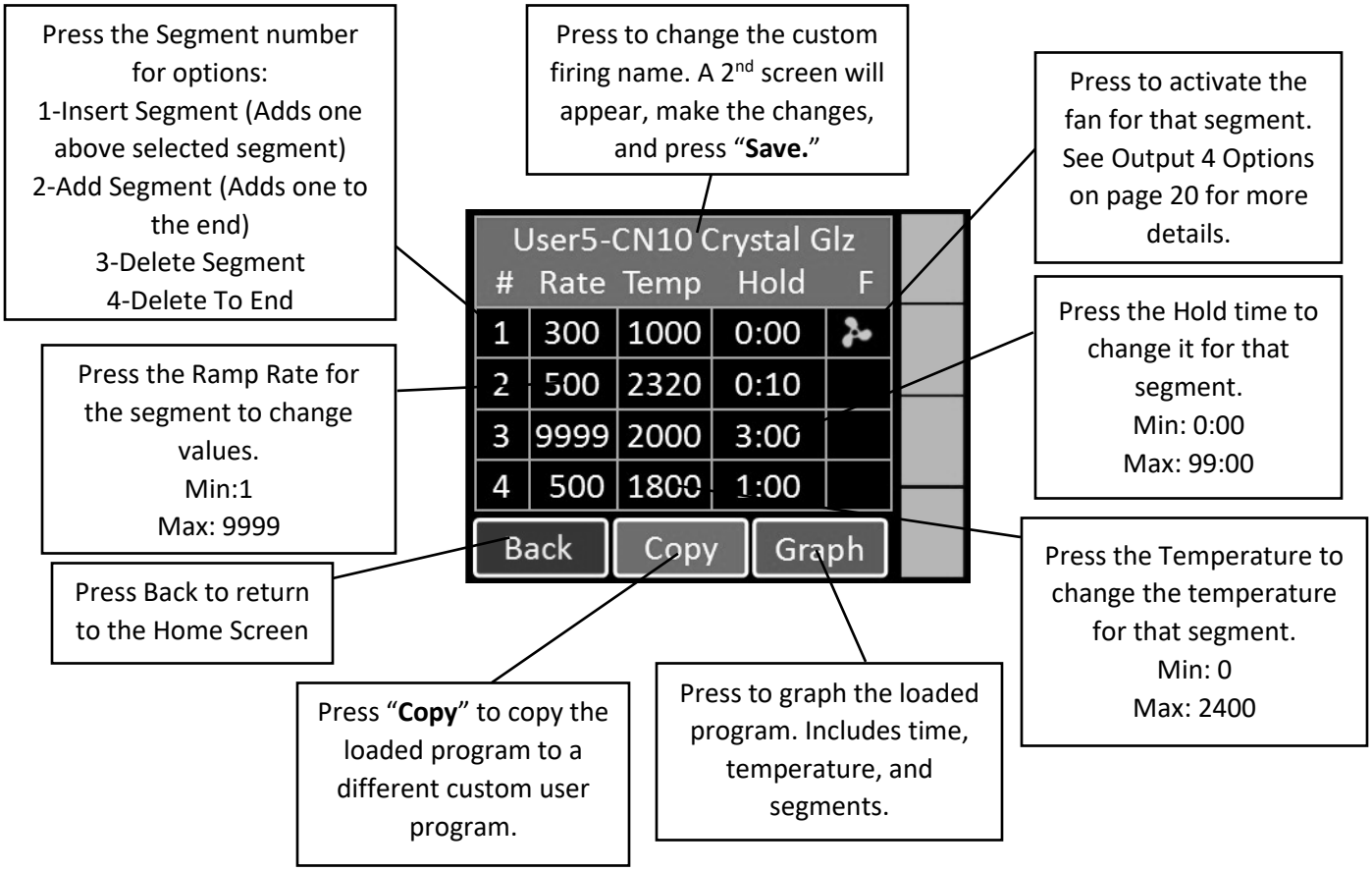


Figure 3: *Sample of a Custom Program.*

Notes For Custom Programming:

1. A firing will start in the earliest segment that has a soak temperature greater than the current kiln temperature. If the current kiln temperature is above all soak temperatures, the controller will go directly to complete.

2. To ramp up or down at the maximum rate, enter a rate of 9999.
3. To program a down ramp, enter the rate/hour then a temperature below the previous segment's temperature.
4. It is best to write out the firing profile that you plan to program before you begin programming. A blank form for writing your firing programs can be found in **Appendix D: Blank Firing Program**. Photo-copy as needed.

Calculating Ramp Rates for Custom Firing

If you want to go from room temperature to 750°F in 3 hours, use this method to calculate the ramp rate. Take the temperature that you want to go to (750°F) minus the starting temperature (70°F – approximate room temperature) to get the number of degrees you want to increase in 3 hours (750 – 70 = 680). Divide this number by the time you want to get to 750 to give you the ramp rate (680°F ÷ 3 hrs = 227°F/hr). If you want to add another segment to go from 750°F to 1000°F in 4 hours, the same procedure is used. Take the end temperature minus the starting temperature (1000 – 750 = 250) and divide this number by the number of hours to reach 1000°F (250°F ÷ 4 hrs = 63°F/hr).

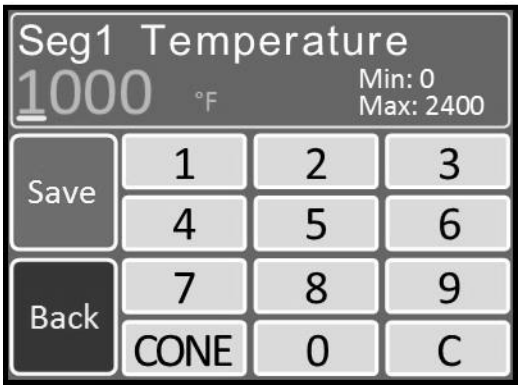


Figure 4: *During a Custom Firing, you can enter the desired temperature or press CONE. Choose the desired Cone Number and the controller will enter the corresponding temperature.*

Custom Ceramics Program

Writing your own ceramics program combines the versatility of the Custom program and the heat-work calculation of a ceramics firing. It is a great way to get custom heating and cooling rates and still have the controller do the heat-work calculation to get the correct cone bend regardless of firing rate. The steps to write your own cone fire are the same as entering a Custom program except when programming the top temperatures, press the "**CONE**" button, scroll until the desired cone number is displayed, and press "**SAVE**". The selected cone's top temperature will be displayed under Temp for that segment. The cone temperature can be entered into any segment so you can also have cool down segments in the program.

Start A Firing

Press "**Start**" to open the Start Firing Screen. There are 3 options as to how you'd like to begin the firing. To start the kiln immediately, press "**1-Start Now**", enter the start code (Default = 1), and press "**Start**". To program the kiln to start in a set amount of time press "**2-Start Later**", enter the start code, press "**Start**", enter a delay start time of up to 4 hours, and press "**SAVE**". **CAUTION: Make sure the kiln area will stay clear and safe throughout the delay time and firing time.** To arm the controller

for a remote start via the KISS program, press "**3-Remote Start**", enter the start code, and press "**Start**". The controller will now read "**REMOTE**" at the top. This means the area around the kiln is clear, it's loaded, and it can be fired at any time from the KISS program.

Operation of the Controller During A Firing

The Genesis controller eliminates much of the "babysitting" that is required with a manual kiln. To ensure the most consistent results from one firing to the next, you should understand how the controller operates and monitor the firing to ensure proper operation. The following diagram and flow chart show the basic components of a kiln's control system.

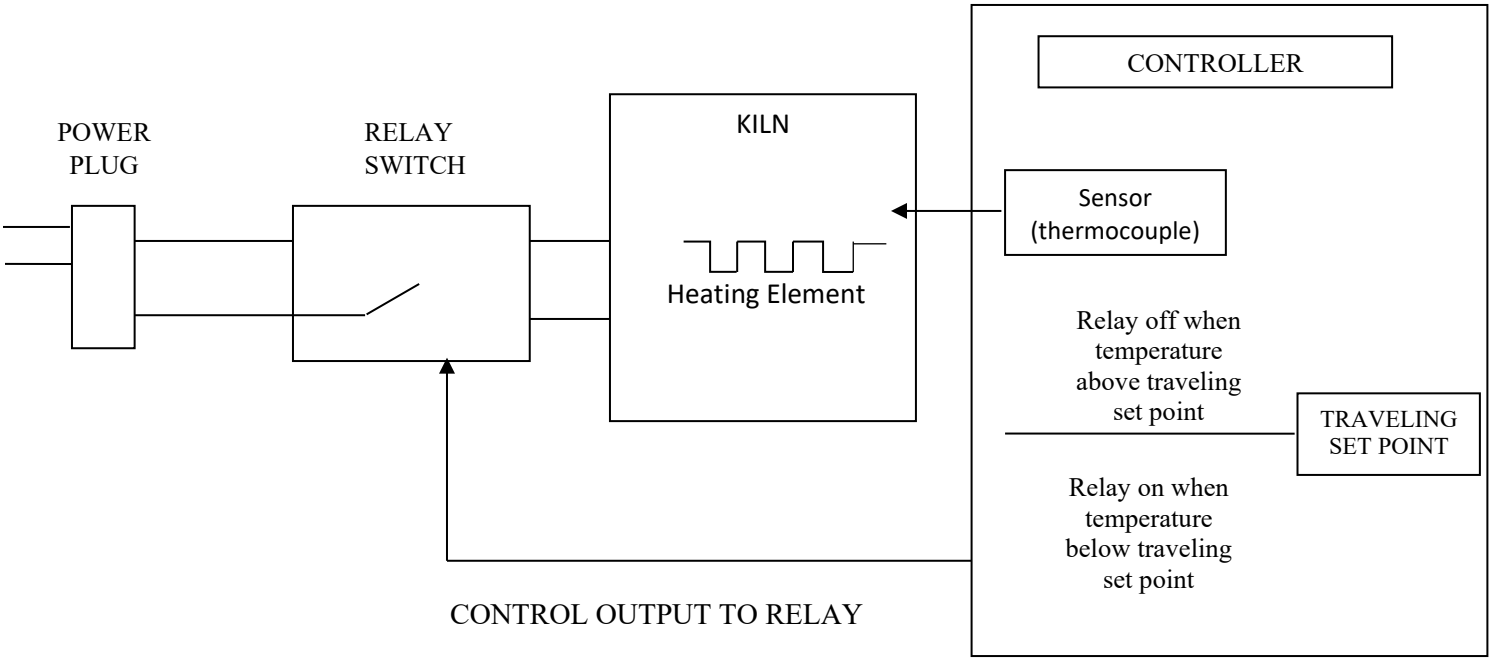


Figure 5: Kiln Operation

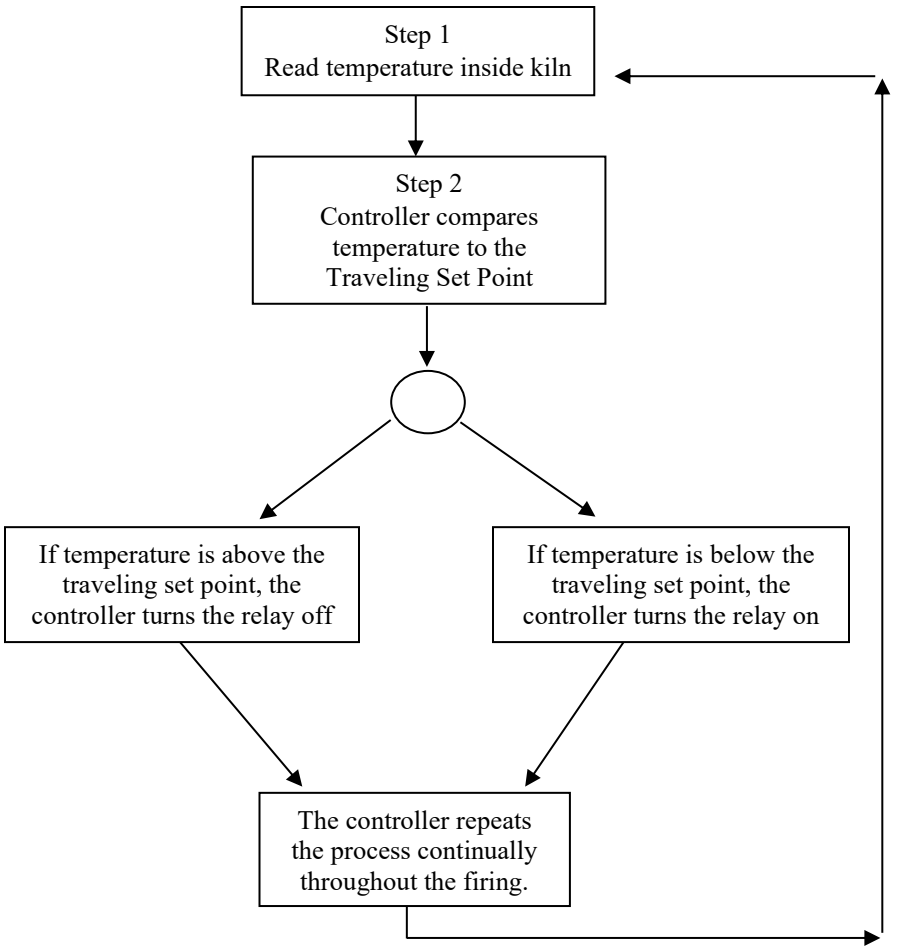


Figure 6: *Shows a flow chart of the control algorithm in its simplest form. Like your home thermostat.*

The diagram and flow chart show that the kiln control system, in its simplest form, works like your thermostat at home – when the temperature is too cool the heater comes on; when the temperature is too hot the heater turns off. The major components of the control system are the Genesis controller, thermocouple temperature sensor, relay switch, power source, and heating elements. The controller is the brain of the operation; the controller adjusts the traveling set point according to your program, reads the temperature in the kiln, cycles the relay on or off and determines when to end the program.

The thermocouple (T/C) sensor is the first part to inspect when loading the kiln. The tip of the T/C should protrude approximately 1- 1/2" into the firing chamber. Next, "START" is pressed, the controller reads the kiln temperature and uses that temperature as a starting point for a traveling set-point (also called the local set point). The displayed temperature is the temperature inside the kiln. You should then hear the relay(s) start cycling on and off to keep the temperature near the traveling set point. As the firing progresses the controller moves the traveling set-point according to the programmed firing rate. The displayed temperature should increase with the traveling set-point and the relay will be "on" longer. This sequence continues until the final temperature is reached and the controller turns off the kiln. The display reads "COMPLETE".

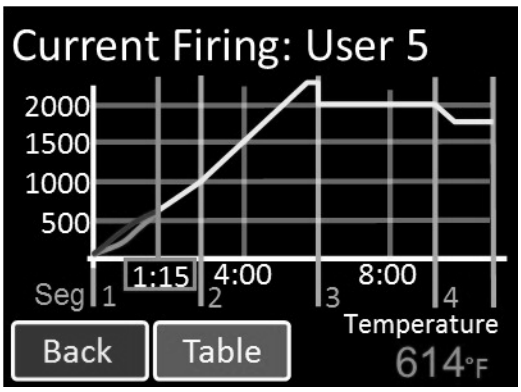


Figure 7: Sample graph of program during a firing.

Adjustments During a Firing

Once a firing has been started, the screen will change to the Firing Screen, as seen on page 6. You can still view the program and make adjustments to the firing.

Stop

Press STOP at any point in the firing to immediately stop the firing. The controller will return to the Home Screen. To start the program again, simply restart the kiln. The controller will start in the segment with an up-ramp equal to the kilns current temperature. If the kiln does not restart in the segment it was stopped in, press the Adjust button and skip to the desired segment.

View (Applies to Novice Mode)

View the setting for the firing. For a ceramic firing, the preheat time, cone #, speed, and hold time will be displayed. Press the "**Graph**" button to view the firing as a graph. This includes time, temperature, and segments. To see each individual segment, press the "**TABLE**" button. Changes or adjustments to the firing can't be made here once the firing has started. To make adjustments, press the Adjust button.

Graphing Key:

Item On Graph	**Meaning**
Orange Vertical Line W/ Number	Segment of the firing
Green Vertical Line W/ Time	Current firing time. Represents where the firing is currently, compared to the graph
Gray Vertical Line W/ Time Below	Time at various points throughout the firing
Yellow Graphing Line	Projected path of the firing
Green Graphing Line	Firing's actual path
Red Graphing Line	Firing's supposed path (Shown only when actual path and supposed path are not the same)
Horizontal Gray Line W/ Temperature	Kiln Temperature

Edit (Applies to when Novice Mode is Off)

"Edit-on-the-fly". Pressing the Edit key while firing a custom program will present the table view. Gray segments have already been fired and cannot be changed. All edit features listed on page 12 are available to segments that have not been completed.

Adjust

Press Adjust to make adjustments to the firing while a firing is in progress. Pressing "**Add Time**" during a hold segment of the firing will add 5 minutes to the hold. It has no effect if the firing is not in a hold when pressed. Pressing "**Add Temperature**" during a hold segment will increase the hold temperature by 5°F. It has no effect if the firing is not in a hold when pressed. Pressing "**Skip Step**" will skip the current segment and move to the next in the firing. This feature is used when enough heat work has been done at the current segment and you want to immediately go to the next ramp rate. Pressing "**Alarm Temp.**" allows you to adjust the alarm temperature for the firing. A temperature of 9999 shuts the alarm off.

Menu

The firing menu allows for viewing of statistics and mid-firing diagnostics. By pressing "**Diagnostics**", the controller runs a manual diagnostics test during the firing. Pressing "**TC Offsets**" allows the user to change the temperature offsets for each thermocouple. Minimum: -99°F Maximum: 99°F. For more information see **TC Offsets** under the **Adjustment Menu** on page 19.

End of Firing – COMPLETE

When the firing is complete, an alarm will sound and the controller will display COMPLETE with the current temperature and firing time. To return to IDLE, press "**Clear**". You may open the kiln when the temperature has cooled to 150°F.

Care of Thermocouple

The small metal rod protruding into the firing chamber is the temperature sensor, or thermocouple. Do not let shelves, posts, or ware touch the thermocouple; this could affect the temperature reading.

Bumping the thermocouple during loading can damage it or push it out of the firing chamber. It should protrude into the firing chamber about 1 -1/2". Check the kiln manufacturer's placement instructions. Also, avoid firing clay with high sulfur content. The sulfur erodes the thermocouple making it brittle and easy to break.

Menu Screen

By pressing the Menu button on the Home Screen, you'll be taken to the Menu Screen. The Menu Screen is a list of various options from checking your last firing status, diagnostics, offsets, and controller configuration among other things. To navigate through the Menu options, press and hold the green slider on the right side of the screen and slide up or down for more options. For more information on each component of the Menu, see the descriptions below:

Data Menu

The Data Menu holds 3 types of lists of information: diagnostic information, status information, and kiln information.

Last Firing Status

Contains diagnostics information specific to the last firing of the kiln.

Last Error Status

Contains diagnostic information specific to the last error that was encountered by the controller when firing.

Factory Diagnostics

Contains diagnostic information from factory. This includes amperage readings for each section, line voltage readings, and board output. This information can be used for comparison when a manual diagnostic test is run.

Last Element Change

Contains diagnostic information from the last new elements diagnostics. This includes amperage readings for each section, line voltage readings, and board output.

Last Manual Diagnostics

Contains diagnostic information from the last manual diagnostics test. This includes amperage readings for each section, line voltage readings, and board output.

Graph Past Firing

Contains the graphs from the last 10 firings. Use the scroll bar to find the desired firing to graph and select it. If WiFi is connected during the firing, the month and day will be displayed next to the firing. If WiFi is not connected, it will read 0/0 after the name of the firing.

Kiln Info

Contains the firmware version plus the serial number and mac address for registering and viewing your kiln at www.bartinst.com. Updating firmware will **NOT** affect the firing programs.

Diagnostics

Board Temperature

Displays the current board temperature. Displaying the board temperature is a diagnostics function to check the operation of the board. The safe range for board temperature is between 0°F - 160°F. Any temperatures below or above that range may cause damage to the controller.

Run Manual Diagnostics

This is used to manually begin a diagnostics test. It turns on each section of elements to read amperages and voltage. The results are stored under Data Menu – Last Manual Diagnostics.

New Element Diagnostics

Run New Element Diagnostics when the elements have been changed to record amperages and voltages for the new element. The results are stored under Data Menu – Last Element Change.

Relay Health

Keep track of the number of on/off cycles of the relays on your kiln. An on/off cycle will be counted as one. When a relay is replaced, press the corresponding zone and press the RESET button to set the number of cycles back to 0.

Adjustments

Adjustments allows you to change the Cone and Thermocouple offsets as well as the Alarm temperature and Output 4 Percentage On for the controller.

Cone Offset

Cone offset is used to raise or lower the final cone temperature. The final cone temperature can be raised or lowered a maximum of 99°F (37°C). To correct an under-firing set a positive cone offset. To correct an over-firing, set a negative (-) cone offset. To change the Cone Offset, press "**Cone Offset",** and use the scroll bar to select the cone offset. When the correct cone is displayed, press **"Edit"**, enter the desired offset and press "**Save**".

Cone Offset Example		
Degrees	**Meaning**	**Effect**
20°	Raise the final cone temperature by 20°F	Increases heat work
45°	Raise the final cone temperature by 45°F	Increases heat work
-15°	Lower the final cone temperature by -15°F	Decreases heat work
-35°	Lower the final cone temperature by -35°F	Decreases heat work

Thermocouple Offset

Thermocouple offset is used to raise or lower the temperature indicated by the thermocouples. This is generally used to balance the heat-work in a zone controller kiln. The maximum TC Offset is 99°F (37°C). To correct an under-firing set a negative TC Offset. To correct an over-firing, set a positive TC Offset. To change the TC Offset for thermocouple 1, press "**TC Offsets"**, press "**TC1 Offset**", enter the desired number and press "**Save**". Repeat for TC2 Offset and TC3 Offset if needed.

Alarm Temperature

Set the alarm temperature for the kiln. To set the alarm before the firing, press "**Set Alarm**", type the desired alarm temperature, and press "**SAVE**". The default alarm temperature is 9999°F (Off). The alarm setting will change as you change the loaded program. For example, the USER1 program is loaded and the user sets the alarm to 2400°F. The user then loads the USER2 program and sets the alarm to 1700°F. If the user loads USER1 again, the alarm temperature will change back to 2400°F automatically.

Out 4 Percent On

Sets the "on time" Output 4 as a percent of output three's "on time". Only used when enabled by the kiln manufacturer.

End of Hold Alarm

When enabled, the alarm will sound when a hold has come to an end. To stop the alarm, simply tap anywhere on the screen. To enable the End of Hold Alarm, press "**Enable**" and press "**SAVE**".

Start of Hold Alarm

When enabled, the alarm will sound when a hold has started. To stop the alarm, simply tap anywhere on the screen. To enable the End of Hold Alarm, press "**Enable**" and press "**SAVE**".

PID Gain

Check with your kiln manufacturer before making changes to this setting.

Configuration

Novice Mode

The Genesis may come set in Novice Mode depending on the kiln manufacturer's preference. Novice Mode is meant for beginner users to make programming easier. For more advanced programming, Novice Mode can be turned off. To turn Novice Mode off, select "**Off**" and press "**Save**".

Communications

Set up Wi-Fi for Firmware download and KISS ID for monitoring firings from your PC. (Additional computer software required for PC monitoring)

Kiss ID – Each controller to be monitored must have a unique KISS ID number ranging from 1 to 50. See KISS manual for details.

Enable Wi-Fi – Enable or disable the Wi-Fi feature. **Off** turns Wi-Fi capabilities off at all times. **On When Firing** enables Wi-Fi only when a firing is in progress. **Always On** turns the Wi-Fi on anytime it is within range of a setup Wi-Fi connection.

Wi-Fi Setup – To set up Wi-Fi for the Genesis, press "**Wi-Fi Setup**" and the controller will scan for nearby networks. Select your desired network and enter the password (if required) and press "**Save**".

*****For security reasons, we highly recommend that the user place all controllers into a separate logical network or VLAN, separate from other networks, routers, and hardware.**

Download Firmware – If your controller is connected to the internet through the WiFi module, by pressing Download Firmware, you will connect to www.bartinst.com to see if any updates are available. Once it has found the firmware, you have the option to update your controller. Updating firmware will **NOT** affect the firing programs.

Reset WiFi – Press Reset WiFi when having trouble with the WiFi connection. The controller will reset the WiFi connection and attempt to reconnect to your currently saved connection.

Export Log File – Used to activate Server Mode. This allows the controller to "serve" a file to a computer/phone that is on the same access point as the controller. When **"Export Log File"** is pressed, the controller will list an IP address and a code. Type the address listed on the controller into your internet browser and then enter the code when prompted.

The last 10 firings will be listed and each firing has 2 files – the temperature data and the event file. The temperature file collects data every 30 seconds. The event file collects data any time an "event" occurs such as a hold or an error occurs. Click on the file to be observed to download it.

Manual WiFi Setup – Used to manually set up a WiFi network that is hidden or otherwise not found when running WiFi Setup. Enter the network name under SSID and press "**Save**". Under password, enter the network password at press "**Save**".

Temperature F/C

Choose which temperature scale to use with your kiln, Fahrenheit or Celsius. To change the temperature scale, press "**Temperature F/C**", press the desired temperature scale, either "**Fahrenheit**" or "**Celsius**", and press "**Save**".

Error Codes

Turn the error codes on or off for the kiln. The default setting for the controller is On. We recommend you keep the error codes on to protect your firings. They can be turned Off, in special cases, such as jewelry or glass firings where the kiln is left open. They may also be turned off when troubleshooting kiln problems.

Number of Zones

Change the number of zones (Thermocouples) the Genesis will control. For 3140 model choose: 1, 2, or 3. The Model 1120 can only be set for 1 zone.

Output 4 Options – (Usually set as a factory option)

Output 4 has 3 modes for running vent fans (Options A, B, & C), one mode that uses Output 4 to indicate the alarm has triggered (Alarm), and one mode for running elements in the lid or floor of the kiln (Percent).

Option A – Used to control a vent. Output 4 can be programmed to be on or off during each segment of a Custom program. During a Ceramic or Glass program, output 4 come on at the beginning of the firing and turns off after the kiln has cooled to 150°F.

Option B – Used to control a vent. Output 4 can be programmed to be on or off during each segment of a Custom program. Output 4 comes on at the beginning of a Ceramic or Glass program, off at 1450°F, back on after the firing is complete and the kiln has cooled to 1000°F and finally off again when the temperature is below 150°F.

Option C – Used to control a vent, an alarm, or other atmospheric control. Output 4 can be programmed to be on or off during each segment of a Custom program. Output 4 is off during Ceramic and Glass programs.

Alarm – When this option is selected, Output 4 comes on when the alarm is triggered or an error code is encountered.

Percent – Output 4 can be programmed to be on for a percent of the time Output 3 is on. This option is used when Output 4 controls floor or lid elements. To ensure Output 4 stays off at all times, use this option and set the percentage to zero.

Start Code

The Start Code is entered to start a firing. Enter any 4 number combination and press "**Save**". Default = 1. This will be entered anytime the kiln is fired.

Calibrate Touch

Used to re-calibrate the touch screen if buttons aren't working properly. Press the "**Calibrate Touch**" button and follow the onscreen instruction to re-calibrate.

Cost Setup

Enter the cost per kilowatt hour and the wattage for each zone in the kiln. The cost per kilowatt hour has a minimum of \$0.001 (1/10th of a penny) and a maximum of \$9.999. This information can be acquired from your electric company. The zone wattage has a minimum of 0 and a maximum of 50,000 Watts. This information can be acquired from the kiln manufacturer or consult your kiln's manual. If it a multi-zone kiln, you can enter the kiln's wattage in Zone 2, or divide the kiln's wattage and split evenly between the 3 zones.

Example: The cost per kilowatt hour is 16 cents and the kiln is a single zone with a wattage of 16,000. Press **Cost/KWH**, type in 0.16 and press **SAVE**. Press **Zone1 Watts**, type in 0, and press **SAVE**. Press **Zone2 Watts**, type in 16,000, and press **SAVE**. Press **Zone 3 Watts**, type in 0, and press **SAVE**.

Indefinite Hold

Turn to ON to activate the Indefinite Hold feature. Once turned on, a user can program an indefinite hold by entering 9999 into a hold time of a segment of a user program. Once set, the controller will hold at that temperature indefinitely until the user stops the program.

Restore Presets

Restore all preset programs and offsets to factory settings.

Restore User Programs

Restore individual User Programs 1-12 back to factory setting. Select the User Program to be restored and press "**RESTORE**". This will clear any changes made to that user program from factory settings. Once you press "**RESTORE**" this cannot be undone. The restored default program will be loaded into the controller upon pressing "**RESTORE**".

Reset TC Offsets

Reset thermocouple offsets to factory settings. Default TC Offset = 0 for all thermocouples. To reset: Press "**2-Reset TC Offsets**" and press "**RESTORE**".

Restore Cone Offsets

Reset cone offsets to factory settings. Default Cone Offset = 0 for all cones. To reset: Press "**3-Reset Cone Offs**" and press "**RESTORE**".

Restore Glass

Restore the Glass firing setting back to factory. Once "**RESTORE**" is pressed, any changes made to the Glass profiles will be restored back to factory and cannot be undone.

Customization

Customization allows you to change what program menus are available and which set of custom User profiles to be loaded into the controller either a Mix, Heat Treat, or PMC.

Ceramic Menus

Allows the user to enable or disable the ceramic programming menus. When disabled, the Bisc and Glaze programs will be removed under "**Load Program**".

Glass Menus

Allows the user to enable or disable the glass programming menus. When disabled, the glass programs will be removed under "**Load Program**".

User Library

Allows the user to change which customizable user programs are to be loaded into the controller. Options for programs include "**Mix**", "**Heat Treat**", and "**PMC**". For a list of the User Libraries, see **Appendix C**.

Factory Configuration

Factory configuration is used by the kiln manufacturer to set kiln specific parameters for the controller such as thermocouple type, top temperature, and board temperature. For more information, see the technical manual online. Contact the kiln manufacturer before making any changes that might damage the kiln.

Appendix A: Error Codes

If you get an error code, it is important to note the error letter or number. It will help you in diagnosing any problem with the kiln. When an error code is displayed, it will give a short description of the error. Press "**Clear**" to clear an error code.

The list of error codes follows:

NOTE: THESE ERRORS WILL ONLY BE DETECTED IF THE ERROR CODES ARE TURNED ON:

Error Code	Description	Possible Causes
ERROR 1	Kiln temperature increasing slower than 12°F per hour when ramping up	This is a kiln heating problem, not a controller problem. Do the Full Power Test to check elements and relays. Low or dropping voltage to the kiln could also be the cause. A thermocouple reading incorrectly or improperly placed may also be the cause.
ERROR 2	Kiln temperature 50°F above hold temperature	A relay latched in the "on" position may cause this error. Another possible cause is if the kiln lid is opened for rapid cooling, then closed, such as for glass firings.
ERROR 3	Kiln temperature 50°F below hold temperature	Relay failure.
ERROR 4	Kiln temperature 50°F above previous hold when ramping down	Same causes as for **E-2**.
ERROR 5	Kiln temperature 50°F below traveling set point when ramping down.	Relay failure.
ERROR D	Kiln temperature 50°F above traveling set point	Stuck relay or stuck output. If using zone control, then the outputs or t/c's may be in the wrong zones.

NOTE: THE ERROR CODE SETTING DOES NOT AFFECT THESE ERRORS:

Error Code	Description	Possible Causes and/or Corrections
ERROR 0	Software error	Check the selected program and reprogram, if necessary. If error persists or program does not hold in memory, controller may need to be returned to factory for service.
ERROR 6	Problem with thermocouple leads	This generally indicates the thermocouple is connected incorrectly, possibly reversed. Ensure the thermocouple extension wires are connected correctly to the controller and at all connection blocks back to the thermocouple.
ERROR 8	In cone fire mode, temperature decreasing in last segment	If the kiln has a kiln-sitter, it may have turned the kiln off before the controller did. Other possible causes are broken element or relay failure.
ERROR 9	Software thermocouple selection does not match the hardware thermocouple jumper selection	The jumper on the circuit board and the setting for thermocouple TYPE in the software do not match.
E--	Power loss during EEprom write	Turn the controller off and back on. Recheck the selected program and reprogram, if necessary.

ERROR A	Invalid program variable	Reprogram all segments of the program being fired. If error persists, controller may need to be returned to factory for service.
ERROR bd	Board temperature too high	The control box temperature may be too hot or the limit temperature may need to be reset. If the room temperature is very hot, aiming a fan at the control box may decrease the temperature.
ERROR E	Hardware error	Controller will need to be returned to the factory for service.
ERROR R	Microprocessor memory does not match program storage memory (EEprom)	Reprogram and try to fire again. If error persists, controller may need to be returned to factory for service.
ERRP	ERRP will display. To clear the display, press "Clear". The firing in progress will continue.	Power outage; kiln is still firing.
Thermocouple FAIL	**Thermocouple FAIL** indicates one or more t/c's have failed. If more than one thermocouple is connected, the controller will indicate which thermocouple has failed.	Check the board temperature under Diagnostics under Menu. If the board temperature is approximately room temperature, then the t/c is defective. If the board temperature shows a high temperature the circuit board is defective.
PF	Power failure. Firing has stopped.	Power was lost during a firing and the kiln temperature was below 140°F or the kiln temperature dropped more than 250 degrees during the power outage.

Full Power Test

The full power test is used to check the relays and elements of the kiln. To set the controller for a full power test, simply load the User12 program and turn the alarm to 9999. With the kiln empty and the lid open, start the firing. Visually inspect the elements after the kiln has fired for 20 – 25 minutes. Observe each element from where it comes into the kiln all the way around to see that it is equally bright throughout. The following observations are possible:

One section of the kiln is dark and not coming on. – This could indicates a defective relay since there is usually one relay per section.
One element is not glowing at all. – This indicates a broken or bad element.
There are darker (Cool) spots along the elements. – This indicates worn elements.
The top and bottom elements appear brighter. – This is normal for many kilns that have hotter elements in the top and bottom.

After you've made your observations, turn off the kiln. Contact your kiln manufacturer for kiln replacement parts (relays and elements). If there is an issue with your controller, please contact us.

Appendix B: Cone Fire Temperature Profiles

Firing Profiles for Cone 04, Temperature 1945°F (1063°C)

Ceramics – Slow (Bisc Hand Thrown)			
Segment	Rate/hr	Temperature	Stage Time
1	80	250	2.25
2	200	1000	3.75
3	100	1100	1.00
4	180	1695	3.31
5	80	1945	3.13
Total Firing Time:			**13 hrs. 26 min.**

Ceramics – Medium (Glaze Larger Pieces or Bisc Thin)			
Segment	Rate/hr	Temperature	Stage Time
1	150	250	1.20
2	400	1695	3.61
3	120	1945	2.08
Total Firing Time:			**6 hrs. 54 min.**

Ceramics – MedSlo (Bisc Medium Pieces)			
Segment	Rate/hr	Temperature	Stage Time
1	120	250	1.50
2	300	1000	2.50
3	150	1100	0.67
4	180	1695	2.64
5	108	1945	2.31
Total Firing Time:			**9 hrs. 38 min.**

Ceramics – Fast (Glaze Thin Pieces)			
Segment	Rate/hr	Temperature	Stage Time
1	570	1695	2.85
2	200	1945	1.25
Total Firing Time:			**4 hrs. 6 min.**

Firing Profiles for Cone 6, Temperature 2232°F (1222°C)

Ceramics – Slow (Bisc Hand Thrown)			
Segment	Rate/hr	Temperature	Stage Time
1	80	250	2.25
2	200	1000	3.75
3	100	1100	1.00
4	180	1982	4.90
5	80	2232	3.13
Total Firing Time:			**15 hrs. 2 min.**

Ceramics – Medium (Glaze Larger Pieces or Bisc Thin)			
Segment	Rate/hr	Temperature	Stage Time
1	150	250	1.20
2	400	1982	4.33
3	120	2232	2.08
Total Firing Time:			**7 hrs. 37 min.**

Ceramics – MedSlo (Bisc Medium Pieces)			
Segment	Rate/hr	Temperature	Stage Time
1	120	250	1.50
2	300	1000	2.50
3	150	1100	0.67
4	180	1982	3.92
5	108	2232	2.31
Total Firing Time:			**10 hrs. 54 min.**

Ceramics – Fast (Glaze Thin Pieces)			
Segment	Rate/hr	Temperature	Stage Time
1	570	1982	3.35
2	200	2232	1.25
Total Firing Time:			**4 hrs. 36 min.**

Appendix C: Custom Firing Default Programs

The custom firing programs will change based off the users customization settings. If Novice mode is off, you can write over them to create your own programs. See Programming for Custom Firings to make changes to a preloaded program. For all programs, the alarm is set to off (9999). When the alarm temperature is changed, it only changes for the loaded program, not all programs.

Custom Programs: Mix

User 1 – Blank 1			
Seg	**Rate**	**Temperature**	**Hold**
1	100	100	0:01

User 2 – Blank 2			
Seg	**Rate**	**Temperature**	**Hold**
1	200	200	0:02

User 3 – Blank 3			
Seg	**Rate**	**Temperature**	**Hold**
1	300	103	0:00

User 4 – CN6 Crystal Glz			
Seg	**Rate**	**Temperature**	**Hold**
1	300	1000	0:00
2	500	2230	0:15
3	9999	2000	0:00
4	500	1800	4:00

User 5 – CN10 Crystal GLz			
Seg	Rate	Temperature	Hold
1	300	1000	0:00
2	500	2320	0:10
3	9999	2000	3:00
4	500	1800	1:00

User 6 – Bead Annealing			
Seg	Rate	Temperature	Hold
1	9999	960	8:00
2	9999	960	0:45

User 7 – Wine Bottle			
Seg	**Rate**	**Temperature**	**Hold**
1	500	500	0:15
2	500	1000	0:15
3	600	1250	0:20
4	500	1475	0:15
5	9999	1100	0:30
6	200	970	0:30
7	120	750	0:10

User 8 – PMC FAST			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1650	0:10

User 9 – PMC3 FAST			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1290	0:10

User 10 – Lost Wax Silver			
Seg	**Rate**	**Temperature**	**Hold**
1	500	300	2:00
2	500	700	1:00
3	500	1350	4:00
4	9999	900	8:00

User 11 – Lost Wax Gold			
Seg	**Rate**	**Temperature**	**Hold**
1	500	300	2:00
2	500	700	1:00
3	500	1350	4:00
4	9999	800	8:00

User 12 – Full Power Test			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1000	0:40

Custom Programs: Heat Treat

User 1 –154CM ATS34			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1900	0:30

User 2 – AISI 0-1			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1450	0:20

User 3 – 440C S.S			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1850	0:25

User 4 – AISI D-2			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1850	0:20

User 5 – AISI A-2			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1750	0:20

User 6 – Draw 900 X2			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	900	2:00
2	9999	125	0:00
3	9999	900	2:00

User 7 – Draw 500			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	500	2:00

User 8 – Draw 400			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	400	2:00

User 9 – Draw 375			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	375	2:00

User 10 – Draw 300			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	300	2:00

User 11 – Draw 275 X2			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	275	2:00
2	9999	120	0:00
3	9999	275	2:00

User 12 – Draw 220/200			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	220	2:00
2	9999	120	0:00
3	9999	200	2:00

Custom Programs: PMC

User 1 –PMC Stand			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1650	2:00

User 2 – PMC +			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1650	0:10

User 3 – PMC 3			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1290	0:10

User 4 – PMC Gold			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1650	0:10

User 5 – ArtClay Silver			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1436	0:05

User 6 – ArtClay Gold			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1814	1:00

User 7 – Bronze Clay			
Seg	**Rate**	**Temperature**	**Hold**
1	350	1550	2:30

User 8 – Bronze Fast Fire			
Seg	**Rate**	**Temperature**	**Hold**
1	1525	1525	1:00

User 9 – Copper Clay			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1750	3:00

User 10 – White Copper			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	1850	2:00

User 11 – Burnout Stage			
Seg	**Rate**	**Temperature**	**Hold**
1	600	650	0:30

User 12 – Dry			
Seg	**Rate**	**Temperature**	**Hold**
1	9999	120	1:00

Appendix D: Blank Firing Program

Keep this page as a Master and photocopy as needed.

Firing Program Number: _____

Segment	Rate Per Hour	Temperature	Hold
1			
2			
3			
4			
5			
6			
7			
8			

Firing Program Number: _____

Segment	Rate Per Hour	Temperature	Hold
1			
2			
3			
4			
5			
6			
7			
8			

Appendix E: Common Questions and Situations

Q. How do I clear an error message?

A. To stop the sounding alarm, press anywhere on the screen. Then to clear the message, press "**Clear**" and the controller will return to the IDLE screen.

Q. What is a segment?

A. A segment is the basic building block of a program. Each segment consists of a ramp rate in degrees per hour, a temperature you want to achieve, and whether you want to hold there or not. For example, a program for drying ware going at 60°F/hour to 200°F and holding for 2 hours would be a one segment firing, the ramp is 60, the temperature is 200, and the hold is 2.00.

Q. Do I need to use witness cones for each firing?

A. After checking your kiln with witness cones for the first few firings, if you are satisfied with the results you are getting and how even the kiln is from top to bottom, then you do not need to use cones in each firing. It is a good practice to periodically place witness cones in the kiln to check for proper firing. If you suspect a problem or your results have changed, then it is a good idea to check the operation of the kiln with witness cones.

Q. Who do I contact for parts for my kiln?

A. For replacement parts for your kiln (relays, elements, etc.), contact the kiln manufacturer. For any issues with your controller contact us at Bartlett Instrument Co. for a solution.

Appendix F: Zone Control

Your kiln must have multiple thermocouples and be wired for multiple zones to take advantage of these features.

1. Features and Enhancements

- 3 separately controlled zones (3 T/C inputs, 3 outputs)
- Adjustable offsets for each thermocouple (T/C)
- Continues to fire with 1 or 2 failed thermocouples (T/C's)
- Slows ramping when any zone lags the set-point
- Reset function which zeros the TC offsets and turns the errors on

2. General Description

The Genesis advanced 3-zone control system is programmed the same as the single zone control but it ensures an even firing from the top to the bottom of the kiln. A 3-zone control has 3 temperature sensor inputs (thermocouples) and 3 independent outputs so the kiln can have 3 separately controlled sections (zones). The controller senses the temperature in each section of the kiln, compares the temperature to the desired temperature (traveling set-point) and adjusts the power going to each section separately giving each just the right amount of power to keep the temperature at the correct setting. The single zone controller only measures the temperature at the center of the kiln and gives all sections the same amount of power.

3. Automatic Lag Function

Lag refers to when the temperature of a kiln's section "lags" behind the traveling set point because the programmed ramp rate is faster than the kiln's temperature can rise. The Genesis will slow the ramp rate when a section of the kiln lags. The ramp rate determines the amount of "lagging" that is allowed before the firing rate is slowed. Fast ramp rates (>500 °F/hr) will allow the greatest temperature difference between sections. Slow ramp rates (<70 °F/hr) will have the smallest temperature differences between sections. Therefore, when the controller is programmed to go fast it will sacrifice evenness to obtain speed. Likewise, when the controller is programmed to go slow, the controller will maintain tighter control. The controller will try to balance speed and tight control when a medium speed is programmed.

4. Thermocouple Offsets

(See T/C offsets and Cone offsets on page 18 for more information)

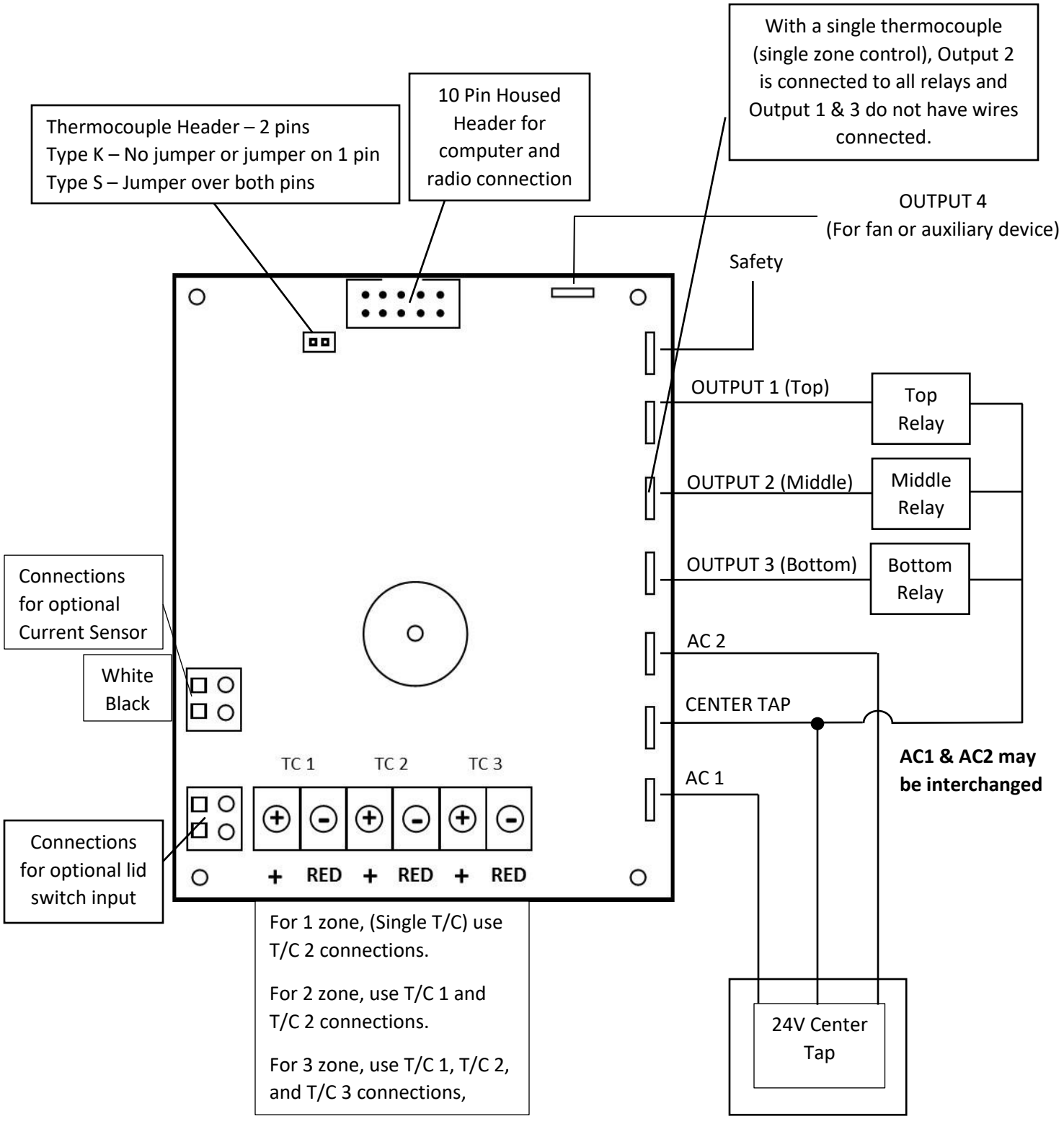
Normal variation in thermocouples can cause a section to fire too hot or too cold. The zone control has an offset feature to adjust the reading of each thermocouple to compensate for any error. For example, if shelf cones indicate that the bottom section is under firing, it means that the controller thinks the bottom section actually reached the ending temperature when it really was below the ending temperature. To correct this problem, a negative thermocouple offset is required. This offset will be subtracted from the actual reading and will lower the temperature reading in that section. A negative offset will cause a section to fire to a higher temperature increasing the heat-work for that section. A positive offset will cause a section to fire to a lower temperature decreasing the heat-work for that section. To return all TC offsets to zero, press "**Menu**", scroll down and press "**5-Restore Presets**", press "**2-Reset TC Offsets**", and press "**RESTORE**".

5. Three Thermocouples

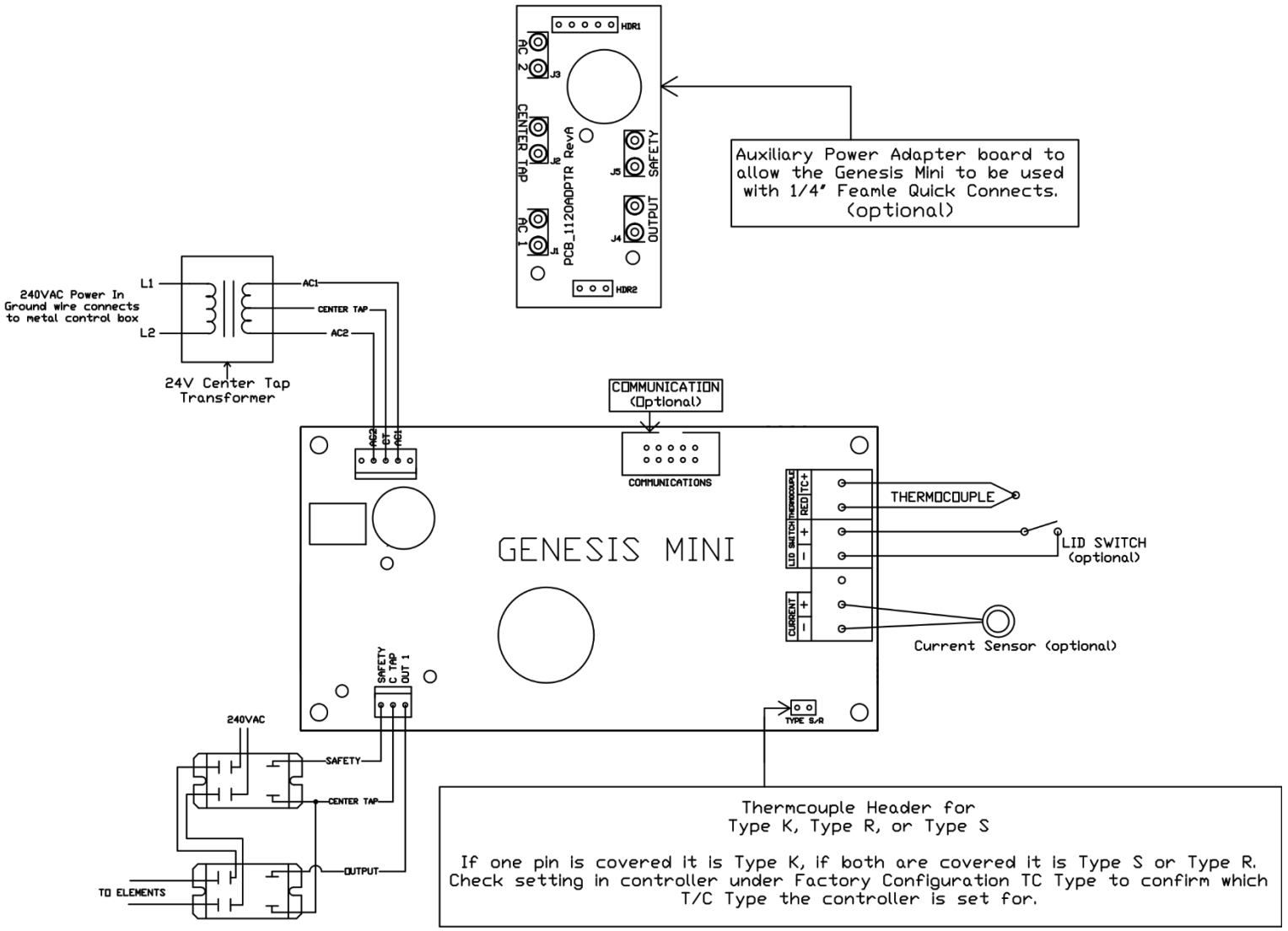
Besides better measuring of the temperature, the zone control also offers security through its three thermocouples. With a single zone controller, a firing will be stopped if the thermocouple fails. The zone control with 3 T/C's will continue to fire if one or two of its thermocouples fail during a firing. If the top or bottom thermocouple fails, that section will be controlled by the top T/C. If the controller is at IDLE and a T/C fails, "Error Thermocouple Failed" will appear on the screen.

When using three thermocouples, thermocouple 2's temperature is displayed under current temperature. The temperature of each zone can be viewed during the firing. To view the other thermocouple temperatures, press the screen where the current temperature is displayed. The temperatures for all three T/Cs, percentage of power to the elements, and the current Set Point will appear.

Appendix G: Genesis Connection Diagram



Appendix H: Genesis Mini Connection Diagram



GENESIS (Model LT3140) & Genesis Mini (Model LT1120) Technical Manual

GENERAL DESCRIPTION

The Genesis & Genesis Mini controllers are Bartlett Instrument's 8th generation kiln controller. We've enhanced all the great features from older models and added many new ones. The Genesis & Genesis Mini kiln controllers regulates the temperatures in a kiln according to the program set by the artist. It has two different programming modes, Novice Mode and Advanced Programming. It can control a single zone or multi-zone kiln (Genesis Model LT3140 Only).

POWER SUPPLY

The Genesis LT3140 board requires a 24V center-tap transformer. It connects to the board's bottom three quick connects, labeled AC1, CENTER TAP, and AC2. The VA rating of the transformer is dependent on the electrical load of the board and relays. The board requires approximately 80mA at 12V DC and a relay typically requires approximately 140mA at 12V DC. Therefore, a three-relay system will require a transformer with a minimum rating of 6VA (500mA X 12V DC = 6 VA).

The Genesis Mini LT1120 board requires a 24V center-tap transformer. It connects to the board's 5 pin friction lock connector or to the left three quick connects, labeled AC1, CENTER TAP, and AC2 if the adapter board is installed. The VA rating of the transformer is dependent on the electrical load of the board and relays. The board requires approximately 80mA at 12V DC and a relay typically requires approximately 140mA at 12V DC.

OUTPUTS

The Genesis Model LT3140 board has five 12V DC outputs. Four outputs are given power by a safety transistor, outputs 1, 2, 3, and safety. The safety transistor is capacitor coupled to the microprocessor so it only powers the output transistors when the microprocessor is operating correctly. Outputs 1, 2, and 3 respond to their respective thermocouple inputs. All outputs are capable of driving a 500mA 12 V DC load. Output 4 is an extra output that can be programmed to run a fan, alarm, or extra kiln section. The maximum combined output of all outputs is 1 Amp. The safety output powers on at the beginning of a firing and off at the end of the firing. It is used to drive a safety relay that sends line power to the switching relays on outputs 1, 2, and 3. When using the optional current sensor, wiring one section to each output will give an Amp reading per section for better diagnostics. See Configuration in the controllers Menu for details on the output 4 options.

The Genesis Model LT1120 board has three 12V DC outputs. Two outputs are given power by a safety transistor, outputs 1 and safety. The safety transistor is capacitor coupled to the microprocessor so it only powers the output transistors when the microprocessor is operating correctly. All outputs are capable of driving a 500mA 12 V DC load. The maximum combined output of all outputs is 1 Amp. The safety output powers on at the beginning of a firing and off at the end of the firing. It is used to drive a safety relay that sends line power to the switching relays on output 1. When using the optional current sensor, wiring one section to each output will give an Amp reading per section for better diagnostics. See Configuration in the controllers Menu for details on the output 4 options.

FACTORY CONFIGURATION - "HIDDEN MENU"

The "hidden" menu allows programming of options that are normally set at the factory. The options are listed in the order they appear in the menu with a description. The "hidden" menu can be entered by pressing "MENU", scroll down to "Factory Configuration", and selecting "Factory Configuration. Then, type in the sequence 4, 4, 3, and the Factory Configuration options will be displayed. Use the scroll bar on the right to scroll through the options found below: **TC Type, Max Program Temperature, Max Board Temperature, SSR Mode, Cycle Time, Current Sensor Rating, Run Factory Diag., Rotate Display, Output Config., Mini Version, Lid Switch, and Output 3 Alarm.**

TC Type

Change the thermocouple type used with the controller from Type K, Type S, or Type R. To change thermocouple type in Factory Configuration, select the thermocouple type being used with the controller and press "**Save**". When changing from a Type K to a Type S or Type R, you must change the software setting as well as placing a jumper on the circuit board. To change from a Type S or Type R to a Type K requires changing the software setting and removing a jumper from the circuit board.

WARNING: Using a Type S thermocouple and a controller set for Type K will cause serious over-fire. Using a Type K thermocouple and a controller set for Type S will cause an under-fire. Type S thermocouples must use Type S extension wire. Type K thermocouples must use Type K extension wire. If changing thermocouple type be sure to change the extension wire. Make sure the software and jumper settings match the type of thermocouple and extension wire you are using.

Max Program Temperature

Enter the top temperature the kiln is rated for. Set the Max Program Temperature to the maximum temperature rating for the kiln. Check the side of the kiln or the kiln's manual for its temperature rating. The max setting is 2400°F (1316°C).

Max Board Temperature

Set the maximum temperature the circuit board can reach. Valid temperature are 0 - 250°F. If the board reached a temperature higher than 250°F, it can cause serious damage to the circuit board.

SSR Mode

SSR Mode can be turned on when solid state relays are being used on the kiln. When SSR mode is turned on, it cycles the relays at 500 millisecond intervals. This works the same with either 60hz or 50hz systems.

Cycle Time

Sets the output cycle time. The cycle time is the length of time between an output coming on two consecutive times. If the cycle time is set for 14 seconds the output will come on every 14 seconds as needed. Cycle time can be set from 10 seconds to 60 seconds. To change the cycle time in the Factory Configuration Menu, press "5-Cycle Time", type in the new time, and press "SAVE".

Current Sensor Rating

The Current Sensor Rating is used to set the number of Amps that will generate a 5V output from a current sensor. Factory default is 50 Amps.

Run Factory Diag.

This is used by the kiln manufacturer. The factory diagnostics can be used for comparison when future diagnostics tests are ran. To view the amperages and voltages from the Factory Diagnostics test, press the "MENU" button, "1-Data Menu", then "3-Factory Diagnostic" to view the results.

Rotate Display

When set to on, the display will rotate 180 degrees. To rotate the screen, press "On" and then press "Save".

Output Config.

This setting should always be set on Standard, unless prior approval from your kiln manufacturer.

Mini Version

Use to switch screen formatting from larger Genesis screen to the smaller Genesis Mini screen. This setting should remain set to off for the LT3140 version.

Lid Switch

The Genesis LT3140 has connections for a lid switch. When a lid is connected and the lid switch setting is set to on, the controller shut power off to the elements, sound an alarm, and give a LID OPEN message when the lid is opened during a firing. When a lid is connected and this is set to off, the controller will continue to fire as scheduled, even when the lid is opened.

Output 3 Alarm

The Genesis Model LT3140, when in single zone mode and Output 3 Alarm is enabled, output 3 will turn on and off with the alarm. It is used by some to run a louder alarm.

PROGRAMMING NUMBER OF THERMOCOUPLES

Selecting the number of thermocouples is set up in the regular Menu. This allows one controller board to be used for single or multi-zone kilns (Genesis Model LT3140 Only). To program the number of thermocouples, press **"MENU"**, scroll down to **"4-Configuration"**, and select it. Scroll down to **"5-Number of Zones"** and select it. The Genesis Mini only has the option to be set to 1 zone. When using the Genesis, type in the desired number of zones (1, 2, or 3) and press **"SAVE"**. When programmed as a single zone board, TC1, TC2, and TC3 will all read the same temperature on the Home Screen. When in multi-zone mode, they will read the temperature for the corresponding thermocouple.

SINGLE ZONE (NUMBER OF THERMOCOUPLES IS ONE)

On the Genesis LT3140, the input T/C 2 is used when it is programmed for single zone control. All three outputs work in unison so there are two alternatives for connecting the output. All relays can be connected to output 2 or one relay could be connected to each output. The first method allows direct replacement of the current single zone controller without changing wiring. The second method would allow an easy upgrade to a multi-zone kiln in the future by just adding thermocouples and reprogramming the number of T/C's. The second method also allows for better use of the diagnostic routines.

On the Genesis Mini LT1120, there is only one thermocouple input on the controller.

3-ZONE (NUMBER OF THERMOCOUPLES IS THREE) – Genesis LT3140 Only**

T/C 1 is the top thermocouple, T/C 2 is the middle, and T/C3 is the bottom. Likewise, output 1 drives the top relay, output 2 the middle, and output 3 the bottom. For taller kilns, output 2 can control several middle sections.

2-ZONE (NUMBER OF THERMOCOUPLES IS TWO) - Genesis LT3140 Only**

When two thermocouples are selected, use inputs T/C1 and T/C2 and outputs 1 and 2.

FULL DIAGNOSTIC ROUTINE

The full diagnostic routine checks all the output voltages, the amperage or current draw of each section of the kiln, as well as the no load and full load kiln voltages. The amperage or current draw is used to measure the current draw of each section of the kiln. The diagnostic routines can only control each section separately if the outputs are wired for zone control. When checking the output voltages, the controller will turn on each section, starting with the top, for a few seconds. This allows checking to see if all elements are heating. The kiln voltages during load and without load are also measured. This helps to diagnose firing problems when the kiln is not able to reach a programmed temperature. First, it will read the voltages with the elements off, then the elements will come on momentarily and read the voltages again. To run a full diagnostics routine follow these steps:

1. Press the “MENU” button.
2. Press the “2-Diagnostics” button.
3. Press the “2-Run Manual Diag.” button and the controller will begin the diagnostics routine.
4. The controller will flash to the home screen and “CHK ALL” will be displayed across the firing banner. When the test is complete, it will return to IDLE.
5. To view the results, press the “MENU” button.
6. Press the “1-Data Menu” button.
7. Scroll down to “5-Last Manual Diag.” and select it.
8. Use the scroll bar to observe the results. You can use the Factory Diagnostics for comparison with your results. When you are finished press the “BACK” button.
9. To return to the Home Screen, press “HOME”.

VOLTAGE CALIBRATION

To display voltage using the Genesis controller, a calibration must be done. Before calibration, make sure the relays and elements are connected. To run the voltage calibration follow these steps:

1. Press the “MENU” button
2. Scroll down to the “6-Factory Config” button and select it.
3. Type in the sequence “4”, “4”, “0”, and press the “SAVE” button.
4. The screen will read, “Are you sure you want to calibrate the voltages?” If you are ready, press the “START” button to begin or “CANCEL” to return to the menu.
5. After the “START” button has been pushed you’ll be asked to enter the no load voltage. The No Load voltage will need to be measured and entered into the controller. Min: 0 Max: 999.
6. Once you’ve typed in the No Load voltage, press the “SAVE” button and the screen will change to the Full Load voltage screen, and the power to the elements will be turned on.
7. Measure the Full Load voltage and enter the value into the controller and press the “SAVE” button.
8. The screen will read Voltage calibration is complete. Press the “HOME” button to return to the home screen.

TECHNICAL SPECIFICATIONS

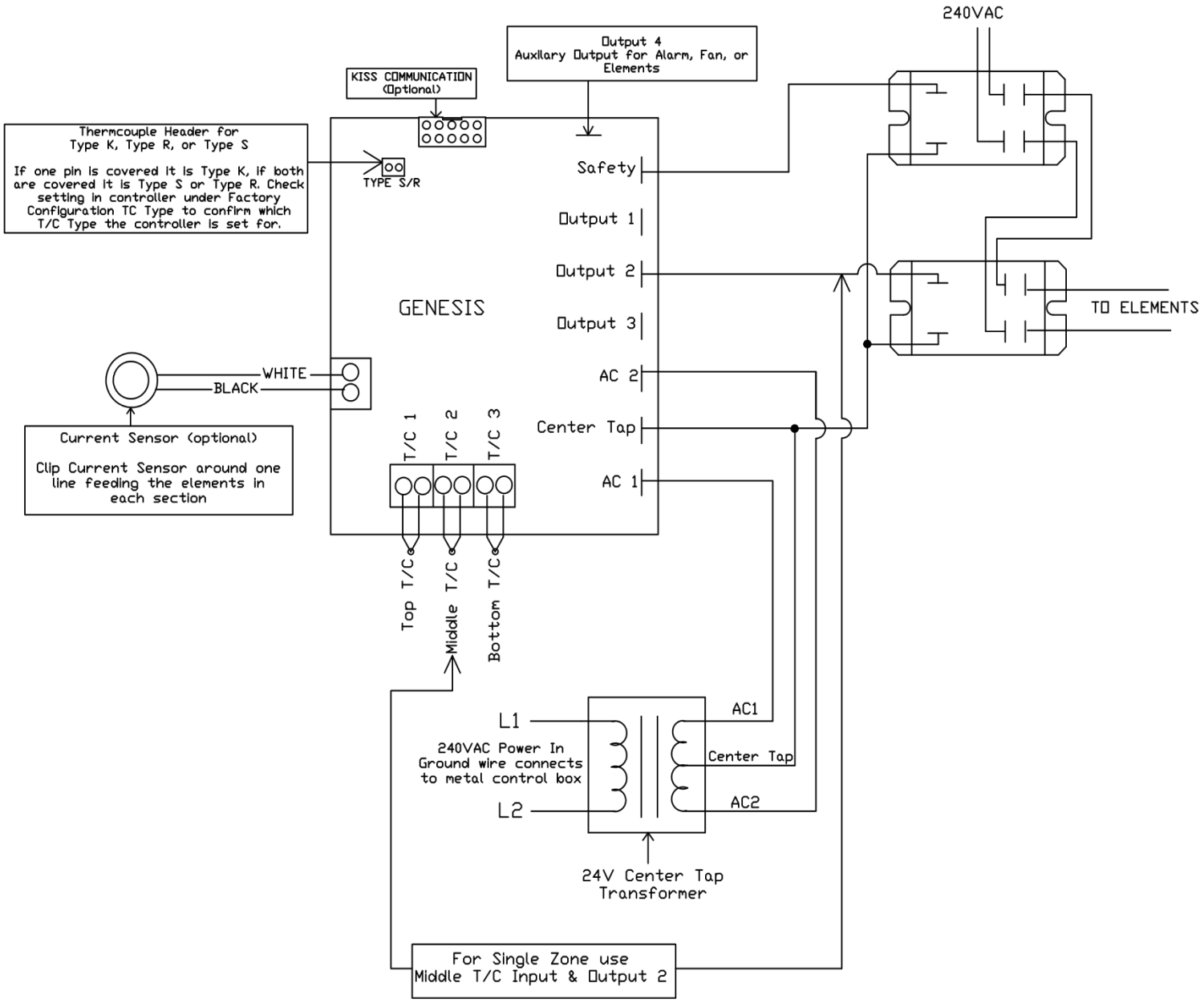
THERMOCOUPLE	TYPE K, S, and R (MAXIMUM RESISTANCE 100 OHMS)
ACCURACY	+/- 10˚F
COLD JUNCTIONCOMPENSATION	ELECTRONIC
POWER INPUT	24V CENTER-TAP TRANSFORMER
OUTPUTS 1, 2, 3, 4, AND SAFETY	500 mA AT 12V; FIVE 12V RELAYS WITH 80 OHM COIL
OPERATING TEMPERATURE RANGE	0°F TO 125°F OR 0°C TO 52°C

PRECAUTIONS

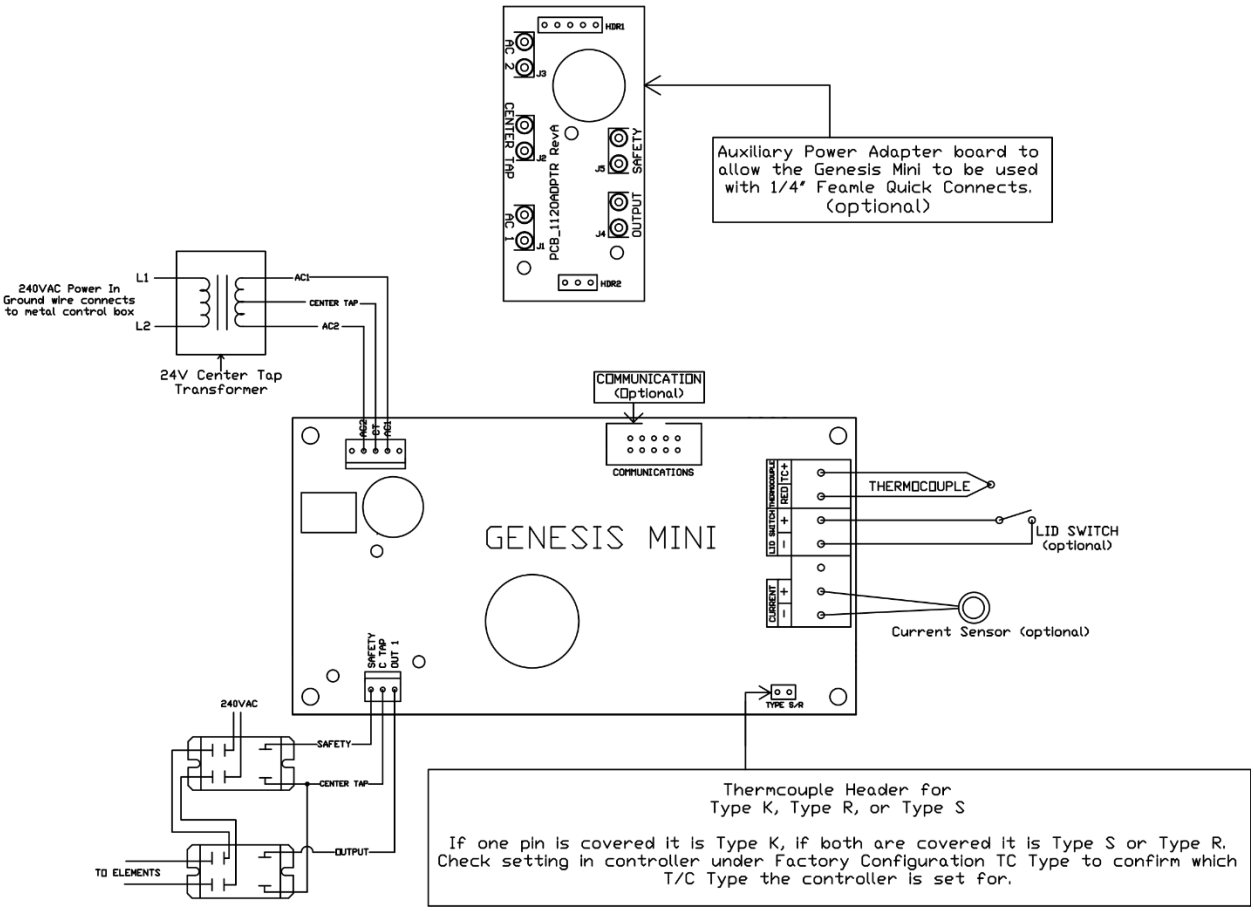
This controller contains static sensitive parts, which can be damaged by static electricity. Use ground strap or touch a grounded object when handling this controller. Pack in anti-static treated material or paper. Do not pack in plastic bags or untreated packing.

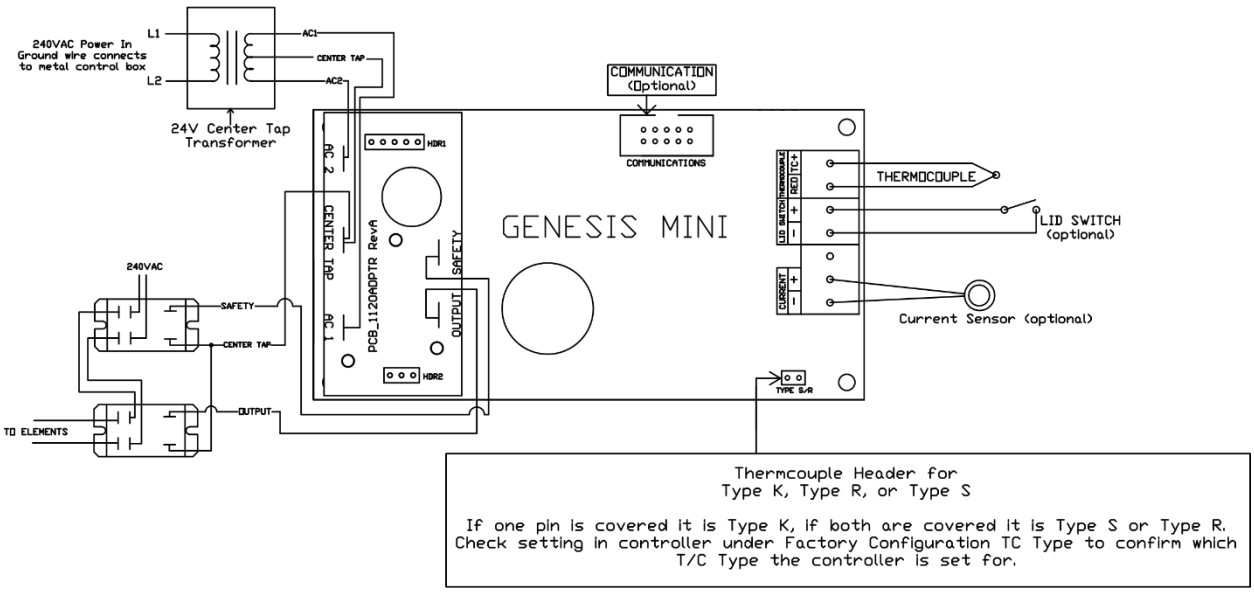
This controller is a temperature-regulating device not a safety device. You should attend your kiln during firings.

GENESIS (Model LT3140) & Genesis Mini (Model LT1120)
Technical Manual



GENESIS (Model LT3140) & Genesis Mini (Model LT1120)
Technical Manual





DOLL INSTRUCTION MANUAL

L&L Kiln's patented hard ceramic element holders protect your kiln.

REGULAR MAINTENANCE OF YOUR L&L KILN

WATCH THIS VIDEO

This video shows you the basics of how to do routine maintenance on your L&L kiln:
hotkilns.com/maintaining-kiln

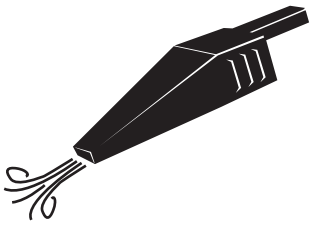
REGULAR KILN MAINTENANCE

To keep your kiln in top operating condition, we recommend the following minimum housekeeping:

AFTER EACH FIRING

1) Turn off the kiln at the circuit breaker or fused disconnect switch.

2) Check element holders and walls for glaze, clay chips or anything that could melt at a high temperature. If melted clay or glaze comes in contact with an element, a rapid failure could result. The molten material traps the heat radiating from the element and subsequently raises the surface temperature of the wire. The temperature will quickly pass the maximum recommended for the wire and burn it up. To clean holders, a good shop vacuum with a HEPA filter will handle dust and loose crumbs. A very gentle chisel or grinder may help with glaze contamination on element holders, but remember that the elements themselves are quite brittle when they are cool. Replace the contaminated holder if you can not clean it. Remove any glaze that has splattered on the firebrick or shelves. **(CAUTION: USE SAFETY GLASSES WHEN DOING THIS BECAUSE GLAZE CAN BE LIKE BROKEN GLASS)**. Vacuum afterward.



VACUUMING NOTE: It is possible to build up a strong static electricity charge when you are vacuuming. If this somehow manages to discharge into the control it can ruin the electronic circuit. Make sure the vacuum is grounded and periodically touch some grounded metal surface away from the kiln to discharge the energy.

3) Make sure the tops of the shelves are coated with kiln wash as it will keep running glaze from ruining the shelf. Some people also apply the kiln wash to the kiln bottom. Because this has both its benefits and drawbacks, we recommend that it only be done based on the kiln user's individual preferences. (Do not coat the undersides or the sides of the shelves because you do not want the kiln wash to fall off into the kiln).

4) Keep a kiln log of firings. Tracking the performance of your kiln over time may turn out to be an extremely valuable tool if you ever need to diagnose future problems. Remember that you can easily get the firing time and final temperature at the end of the firing by hitting the Prog Review button if you have a DynaTrol. On the Genesis control you will see COMPLETE with the current temperature and firing time.

CAUTION: KILN WASH AND CLAY CONTAIN SILICA

1. Long term exposure to silica dust could cause lung damage.

2. See the MSDS sheets.

3. Exercise proper caution when mixing the dry powder and when removing it from your shelves.

4. Use a NIOSH approved particulate respirator for dust and use proper ventilation. You can buy these from safety supply houses. (NIOSH_approval #TC-21C-132 is an example).

AFTER 10 FIRINGS

1) Check temperatures of the main power cord at the main receptacle and the main kiln breaker while the kiln is at its hottest. If these are hotter than normal, it could be a sign of a loose or corroded connection, or possibly the wire gauge used in the power hook-up is the wrong size for the amount of current being drawn by the kiln. Immediately diagnose and fix this because it could cause a fire.

2) If you have a plug on your kiln, unplug it from the receptacle and check for oxidation, any burn marks, discoloration, or melted spots on the plug. If you see this replace the plug (and the receptacle) before using the kiln again. Make sure the receptacle feels tight when you press the plug into the outlet. A loose receptacle indicates worn springs, which will lead to overheating.

NOTE: An oxidation inhibitor can be used on the plug's prongs.

3) Check element resistance. You will need a digital multimeter (see the Troubleshooting Guide). Keep track of this information.

4) Check tightness of case and retighten if necessary. (the case will expand and contract during each firing and may eventually become loose. Brick also shrinks slightly with

use - especially if used at the higher temperatures like cone 10).

5) Repair any firebrick problems.

6) If you have a manual kiln (or the Orton AutoCone backup on an automatic kiln) be sure it is properly adjusted. See the AutoCone instructions. Overfiring could result. The tube assembly should be replaced if it gets overly corroded or contaminated with condensed glaze or other materials. Orton recommends checking the pivot point for corrosion and sluggishness every 6 to 12 months.

AFTER 30 FIRINGS OR ANNUALLY

1) Check wires for deterioration or oxidation. Replace any that seem brittle or where the wire insulation has deteriorated or fallen off.

2) Check terminals for oxidation (discoloration). If you are near salt air or if you notice corrosion on the stainless exterior of the kiln for whatever reason then do this far more frequently.

3) Check power connection terminals in the kiln and control box for tightness. Be sure to do this with the power disconnected (unplugged) for the kiln. If these terminal connections get loose, heat can be generated (because the electrical resistance gets greater) and this can cause a fire.

CHECK THERMOCOUPLE CALIBRATION

Thermocouples will drift in reading over time. This could potentially lead to an overfiring before the thermocouple actually fails. Although you can not easily check thermocouple calibration, the general accuracy of the entire kiln system can be checked by firing with witness cones. See *troubleshoot-cones.pdf.*

Replace thermocouples once they are no longer reasonably accurate. (Note: Type K thermocouples last about the same as kiln elements so it is recommended to change thermocouples when you change elements.)

See ***hotkilns.com/calibration*** for more complete step-by-step instructions on how to calibrate your kiln.

DOLL INSTRUCTION MANUAL

L&L Kiln's patented hard ceramic element holders protect your kiln.

INSTALLATION
WIRING

GENERAL DIMENSION DRAWING

BEFORE YOU START ASSEMBLY

An up-to-date General Dimension Drawing for your specific model can be normally be found on our website. These drawings provide important information on ventilation and installation requirements and will also help you visualize how to assembly your new kiln.

Special Models

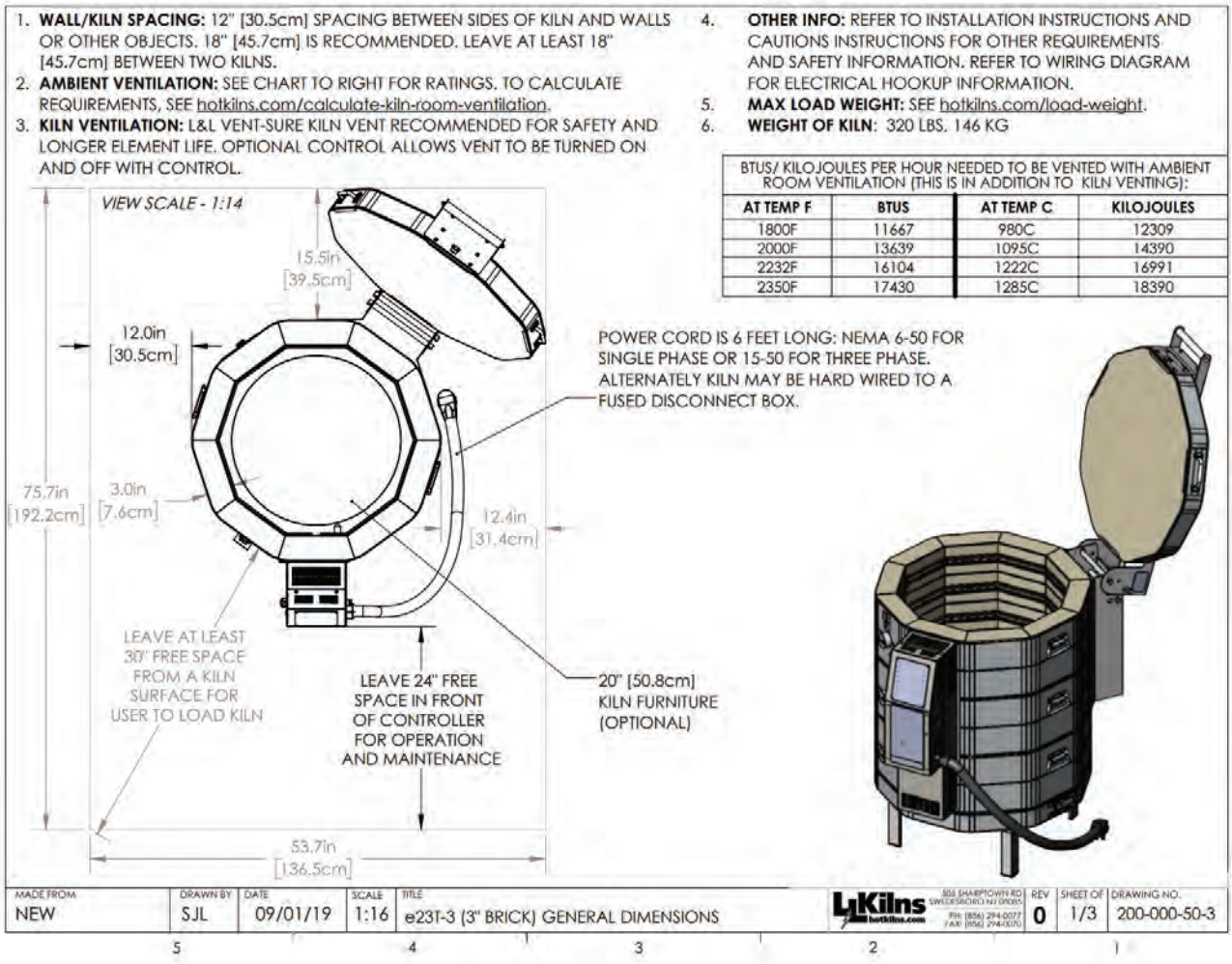
Some special or custom models may not have a general dimension drawing but this is rare.

TO FIND YOUR DRAWINGS

1. **Find your kiln model on our website (hotkilns.com)**
2. **Click on the General Dimension Diagram button.**

AN EXAMPLE (of a typical e23T-3 kiln)

Each model has its own General Dimension Drawing so yours will look different. The format is generally the same as shown below.



INSTALLING YOUR L&L KILN

TABLE OF CONTENTS

CAUTIONS

See the CAUTIONS section of the Instruction Manual. (or ***hotkilns.com/cautions***)

DATED INFORMATION

The information in these installation instructions is believed to be correct to the best of our knowledge at the time of publication (see the date at the bottom). You can download the most recent update from our web site at ***hotkilns.com/install.pdf*** at any time.

SAFETY APPROVALS & LISTINGS

LOCAL CODES

Local fire and safety codes supersede information that is provided in these installation instructions or in our caution instructions.

MET LISTING TO UL STANDARDS

Many but not all kilns are listed to UL 499 Standards for both the US and Canada by MET (An NRTL - Nationally Recognized Testing Laboratory). The Vent-Sure vent is listed in both the US and Canada for use with L&L listed kilns. UL 499, CSA C22.2, No. 122, CSA C22. Listing No E112742. If your kiln is listed it will have a listing mark on the data nameplate and on the wiring diagram. You can also check ***hotkilns.com/met***.

NATIONAL ELECTRICAL CODE

Be sure your electrician follows the National Electric Code and any other local requirements when hooking up the kiln. **One of the requirements of this code that bears particular mentioning is the fact that you must fuse your kiln appliance for 125% of its rated maximum amperage draw.** This explains why you see fusing requirements in our electrical specifications that is in excess of the amperage draw of the kiln. The fuse for the kiln is either a circuit breaker or a fused disconnect switch.

NATIONAL FIRE PROTECTION ASSOCIATION

To the best of our knowledge, the NFPA has nothing specific about the installation of kilns. The NFPA 86 goes into considerable detail about industrial furnaces and ovens but generally with respect to internal processes and gas-fired equipment. There is one section in the NFPA 86 (Section 2-1.5 concerning Floors and Clearances) that might be construed as applicable to kilns. It requires that temperatures at combustible ceilings and floors be kept below 160°F (71°C). In general the NFPA recommends installing furnaces on noncombustible surfaces and has specific requirements if this is not possible. You can order a copy of this by going to their web site at ***www.nfpa.org*** or by calling 617-984-7249.

UNIFORM MECHANICAL CODE

Section 920.0 specifically discusses Small Ceramic Kilns and their installation. Some of the clearance information from this is given further on. However, it is best to refer to this book for complete details. This is published by the International Association of Plumbing and Mechanical Officials and can be purchased online at ***iapmomembership.org***.

CLEARANCES & SURFACES

GENERAL DIMENSION DRAWINGS

You should download the General Dimension Drawing for your particular kiln model from our website. There is a button on each kiln model page. This will give you all of the dimensions and clearance information you need as well at BTU ratings for HVAC design.

CLEARANCES IN KILN ROOM

L&L strongly recommends an 18" clearance to all walls.

Make certain floor is not flammable.

The Uniform Mechanical Code 2000 Edition states that "the sides and tops of kilns shall be located a minimum of eighteen (18) inches (457 mm) from any noncombustible wall surface and three (3) feet (914 mm) from any combustible wall surface."

The National Fire Protection Agency states that temperatures at combustible ceilings and floors be kept below 160 Deg F (71 Deg C) near industrial furnaces (which are like kilns).

Note that, when L&L tested kilns for UL, temperatures where measured 12" from the walls of the kiln and found to be safe from a flammability standpoint. However, locating a kiln just 12" from a wall may violate the Uniform Mechanical Code and possibly local fire codes so do this at your own risk.

WALL MATERIALS

Check with local building codes for recommended non-combustible wall materials for walls that are adjacent to the kiln. Cement board, cinder blocks, and masonry tile are possible choices.

FLOORS

The Uniform Mechanical Code 2000 Edition states that "kilns shall be installed on noncombustible flooring consisting of at least two (2) inches (51 mm) of solid masonry or concrete extending at least twelve (12) inches (305 mm) beyond the base or supporting members of the kiln."

Recommended floor surfaces are cement, ceramic tile, stone, slate, cinder blocks or brick. Do not install on a wood floor or on carpet. Vinyl flooring may be combustible. Protect linoleum flooring from discoloration with a noncombustible covering.

BE VERY CAREFUL ABOUT IMPLEMENTING THESE SUGGESTIONS. Remember that the kiln is putting out heat over a long period of time and that this could very well start a fire under certain conditions. Also, if an overfiring occurs, materials like glass and glazes can be super-heated and electrically conductive, and they can melt right through the kiln floor. If there is a combustible floor, this could cause a fire. Also keep in mind the continued heat of the kiln can dry out combustible surfaces over time and reduce their flash point.

The NFPA 86 (Section 2-1.5 concerning Floors and Clearances) that might be construed as applicable to kilns requires that temperatures at combustible ceilings and floors be kept below 160°F (71°C). In general the NFPA recommends installing furnaces on noncombustible surfaces and has specific requirements if this is not possible.

USE THE SUPPLIED KILN STAND

Do not use kiln without the factory supplied stand.

L&L stands typically raise the floor of the kiln by 8” (20 cm).

It is CRITICAL to have air circulation under the kiln. This prevents heat from being directly conducted to the floor surface. If the floor (or subfloor) is combustible a fire could result. Even if the floor is non-combustible (like solid cement) you would create a very inefficient system by placing the kiln directly on the floor.

Using a proper stand is critical because, without a kiln stand that moves the radiant heat of the kiln away from the floor, some flooring could catch on fire. For instance, over time the radiant heat from the kiln can cause wood to lose its moisture and lower the auto ignition temperature. (The auto ignition temperature is the specific temperature at which a substance ignites and causes a fire.)

OTHER CLEARANCES

Make sure there is adequate clearance in the room for opening the kiln lid, and for periodic maintenance such as opening the element connection boxes, opening the control panel, thermocouple replacement, etc. 18" to 24" clearance around the outside wall of the kiln is usually sufficient.

Combustible surfaces that stay below 71°C (160°F) are generally considered safe from the point of view of starting a fire. However, this is a maximum and we recommend keeping surface temperatures near the kiln under 52°C (125°F).

KILN ROOM ENVIRONMENT

KEEP KILN DRY & IN PROTECTED SPACE

The kiln must be kept dry so it must be kept in an enclosed room away from inclement weather. The electrical circuits must not get wet. If for some reason they do get wet they must be thoroughly dried before operating the kiln. Kilns can corrode fairly rapidly if kept in rooms that have no

climate control. The constant heating and cooling in an unheated shed, for instance, can cause dew to form on the cold metal and this can cause corrosion. Also exposure to salt air will accelerate corrosion dramatically. Also failure to adequate vent the kiln will allow the corrosive fumes that are generated in the firing process to corrode the metal, the wiring and even the firebrick. This sort of damage is specifically excluded from warranty coverage.

AMBIENT TEMPERATURE

The kiln should operate in an environment that is between 0°F and 100°F. Some people keep their kilns in unheated garages or sheds. This is OK as long as the room is dry. The DynaTrol and Genesis have a specification that says it can work from 32°F to 125°F. These limits can be exceeded on the low end. (The control won't deal with negative numbers so if you go below 32°F you must have the control set up for Deg F - not Deg C) On the low end it has more to do with the accuracy of the control. As the kiln reaches the point where accuracy is an issue then the control will most likely be warmed sufficiently by the kiln to insure that it is operating within specification. However, on the high end, the electronics could degrade if operated for long periods above 125°F.

SURFACE IS HOT AND CAN CAUSE BURNS

Kiln surface can be extremely hot: up to 260°C (500°F). Display a sign near the kiln that warns everyone of how hot the kiln is.

FIRE EXTINGUISHER

We recommend that an adequate fire extinguisher be kept near the kiln and checked on a regular basis. You may want to check with your local fire authorities to see if there are any specific requirements they have such as sprinkler systems, automatic foam extinguishers, etc. **Use a fire extinguisher that is rated for electrical fires. We recommend an ABC fire extinguisher.**

FIRE SPRINKLERS

If you have a sprinkler system be careful to check the temperature rating and location of the heads so that you do not inadvertently cause them to actuate under normal firing conditions.

Position the sprinkler heads in the ceiling away from the kiln(s). The rising heat from the kiln, under normal operating conditions, could set off the sprinklers which will cause water damage. Use the highest temperature rating on your sprinkler heads that is allowed by code. Or consider using a higher one that is set off by smoke.

Be sure to monitor temperature while the kiln is at its highest firing temperature and conditions are at their worse (for instance when the door to the kiln room is closed or the ventilation fan is turned off).

Serious damage to the kiln and your premises can take place if the sprinkler system goes off when the kiln is at high temperature - especially if no one is in the building when it happens.

KILN ADJUSTMENTS

LEVELING THE KILN

Level the kiln while you are installing it. Use thin metal shims under the legs to accomplish the leveling (never wood or other combustible materials). Some kilns have leveling bolts or pads. Make sure that the base will not wobble.

ADJUST THE HINGE PROPERLY

See the assembly instructions for your specific kiln. (Assembly instructions are available at ***hotkilns.com/assembly-instructions***) The hinge of any kiln must be adjusted so that expansion caused by the heating process has room to expand up and down. (L&L includes expansion slots in the hinges.) (This only applied to top loading kilns.)

THERMOCOUPLES

Thermocouples must be inserted into the kiln at least 1" (2.5 cm) in from the inside surface of the kiln. They must protrude into the kiln itself because, if the measuring tip of the thermocouple is buried inside the insulation, the thermocouple will measure a lower temperature than the actual temperature in the kiln. This could cause an overfire of the kiln.

NOTE: Replace thermocouples once they are no longer reasonably accurate. (Note: Type K thermocouples last about the same as kiln elements so it is recommended to change thermocouples when you change elements.)

If you have taken the kiln apart carefully observe the thermocouple polarity and zone placement. See the DynaTrol instructions in your manual or ***hotkilns.com/tc-polarity.***

VENTILATION REQUIREMENTS

VENTILATION IS ESSENTIAL

Kilns generate harmful fumes when firing ceramics. Fumes can include carbon monoxide, formaldehyde, sulfur dioxide,

heavy metal vapors, and fluorides (all of which can be very toxic). Install kiln in well-ventilated area.

Never operate in an enclosed space such as a closet 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.

Severe corrosion can be caused by kiln fumes, salt air or other environmental conditions. Good venting can minimize these problems.

Ventilation must be to the outside. We recommend room ventilation of at least 25-50 times the cubic feet of the kiln per minute. For example, if a kiln has 10 cubic feet then 250 to 500 CFM should be adequate. See ***hotkilns.com/calculate-kiln-room-ventilation*** for a more precise method of calculating heat removal requirements. 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.

VENTILATION FOR THE KILN

In addition, we recommend our VENT-SURE downdraft kiln vent system. This will take care of most of the venting of the fumes of 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 as well as good element life). See the separate instructions in this book for the VENT-SURE vent system. Although you can use other kiln venting systems please note that the VENT-SURE is c-UL-us listed for use with L&L listed kilns. If UL listing is an issue then you may want to ensure that another brand of vent will be acceptable to your local authorities. Also if you use another brand of vent be sure to check with the vent manufacturer for specific installation requirements with our specific kiln model. See ***hotkilns.com/vent-sure*** for more information

CARBON MONOXIDE MONITORING

We recommend the use of a carbon monoxide monitor in your kiln room.

VENTING CODES

The following information is provided courtesy of The Edward Orton Jr. Ceramic Foundation.

OSHA has set standards for carbon monoxide exposure of 35 ppm (parts per million) for long-term exposure and 200 PPM for short-term exposure. Independent testing has shown that fumes near the kiln can exceed 200 PPM near the kiln during the firing of greenware. This can cause headaches, fatigue, sore throats and nausea. When properly installed and operated, a downdraft vent removes all harmful fumes and provides a safer working environment.

Most states and localities have set venting requirements for firing kilns in public places. Your local and state health board should have this information. The Uniform Mechanical Code says that you must vent ceramic kilns. It says that you can use a canopy-type hood (and gives specific requirements for such use) or that "listed exhaust blowers may be used when marked as being suitable for the kiln and installed in accordance with manufacturer's instructions." Our Vent-Sure vent is UL listed and is appropriate to meet this ventilation requirement. If you decide to use a vent other than the UL listed Vent-Sure vent make sure you check with the manufacturer of the vent to be certain that it is an approved application. L&L takes no responsibility for improperly installed vents or kilns nor do we take responsibility for the use of other vents with our kilns. The manufacturer of the vent must specifically approve it for use with our kiln.

Note about canopy type vent hoods: While canopy type vent hoods can be suitable for venting a kiln from a safety point of view, they will not give you the superior advantages of a downdraft type vent like our Vent-Sure. A downdraft type vent pulls the rising hot air down to the bottom of the kiln which helps even out the firing. In addition it provides uniform distribution of oxygen in the kiln.

HVAC AND AIR CONDITIONING ISSUES

Kilns put out a lot of ambient heat. If you need to size HVAC units to handle this see the chart below. This shows the BTU output if the kiln was held at these temperatures under steady-state conditions (which is rarely the case for a ceramic kiln). Typically it would never be worse than what is shown in the this chart which makes this a safe figure to use for sizing HVAC systems.

You can download charts of BTU outputs for most L&L kilns at ***hotkilns.com/btu.***

Voltage is not an issue with regards to BTU output.

ELECTRICAL INSTALLATION

VOLTAGE

L&L makes different configurations for 208 volts, 220 volts, 240 volts, 380 volts and 480 volts.

It is important that the kiln be hooked up to the proper voltage. 208 volt kilns hooked up to 240 volt power supplies will generate too many amps. 240 volt kilns hooked up to a

208 volt power supply will heat up about 25% slower than they should and may not reach the higher temperatures. Although it is possible to hook a single phase kiln to two legs of a three phase supply it will cause an unbalanced load on your electrical supply. CHECK WITH A QUALIFIED ELECTRICIAN. It is best to get a three phase kiln for a three phase power supply.

In addition to the power wires there is, on all L&L kilns, a ground wire. The ground wire is not used as a neutral (i.e. no electricity normally flows through the ground). **BE SURE TO GROUND THE KILN PROPERLY USING THE GROUND WIRE. AN UNGROUNDED KILN IS A DANGEROUS KILN.** Also it is important for the control operation to have a good earth ground as well (to get rid of electrical noise).

HOOKING UP TO POWER

Most L&L kilns under 48 amps include either a 6-50P plug (for single phase kilns) or a 15-50P plug (for three phase kilns). See the specification sheet or wiring diagram to be sure.

Have your electrician install the proper receptacle (if you are using a plug) and safety switch at your kiln location. Be sure that your fuse ampere capacity is enough to carry the electrical load required. Also, ensure that your power lines are heavy enough to carry the required electrical load. If this is being used in an industrial or institutional setting be sure to follow lock out/tag out requirements and procedures.

DIRECT HOOK UP KILNS

All kilns over 48 amps are direct hook-up. This means an electrician needs to install a conduit (rigid or flexible) from the fused disconnect or circuit breaker panel to the kiln. Some kilns under 48 amps are also direct hook up.

CHANGING TO DIRECT HOOK-UP

All L&L power cords are rated for 105°C. Anything less than this can cause a malfunction and possible fire where the power leads connect to the control box.

It is OK, and will not void the warranty, to remove the plug that comes with the kiln and direct wire the kiln. However, the connection wires must be rated for a minimum of 105°C.

INSTALLING A PLUG RECEPTACLE

If your kilns comes with a plug, install the receptacle in such a way that the cord hangs down (not up). Do not place the outlet so close to floor that the kiln cord bends up at a sharp angle. The principle to pay attention to is make sure the plug seats securely in the receptacle. Otherwise it could overheat and corrode which could cause an electrical fire.

PROTECT POWER CORD FROM KILN CASE

If you have a flexible cord, rout cord away from kiln in such a way that it can not touch the hot case of the kiln. Secure it so it can not move. If cord touches the hot case it could melt and cause a short circuit and/or fire.

USE A FUSED DISCONNECT

We recommend having a separate fused disconnect box with a lockout provision mounted near the kiln, even if you also have a separate circuit breaker for your kiln. This way you can easily turn off power to the kiln and prevent unauthorized people from turning it on. We recommend this even for kilns with plugs because it makes it so much easier to disconnect all power to the kiln when not using it. Note that if you unplug a kiln frequently the spring tension in the outlet can weaken over time. A Fused Disconnect switch allows you to positively turn off power to the kiln without unplugging it.

LOCATE KILN WITHIN 50 FEET OF BREAKER

Try to locate the kiln within 50 feet of your breaker box. For longer runs you will probably have to increase the size of the hook up wire that we recommend in our literature. In any case, be sure to have a licensed electrician who knows the National Electrical Code hook up the kiln and size the hook up wire.

FUSING YOUR CIRCUIT

Be sure your electrician follows the National Electric Code and any other local requirements when hooking up the kiln. The full load amps is listed on the data nameplate of the kiln. CHECK WITH A QUALIFIED ELECTRICIAN.

USE PROPER GROUNDING

Make sure your electrician properly grounds the kiln and then tests for proper grounding after the installation. All electrical appliances should be properly grounded. This can be to either a cold water pipe or proper system ground in your building. If there is ever a short circuit (where the electricity flows through to the case or control panel and where you might touch it) you could be electrocuted if the kiln is not grounded. This is especially important with the high voltage used on kilns. The higher the voltage the more easily it could flow through your body. In addition, because of the heat generated in a kiln, wires are subject to potential deterioration over time and expansion and contraction can move insulators and cause short circuits. BE SURE TO REPLACE ANY DETERIORATED WIRES!

USE THE PROPER WIRE GAUGE

Hook-up wire sizes are provided for many of our kilns in the electrical specifications. However, this can vary depending on ambient temperature conditions and length of wire run.

Running power for your kiln over a long distance will result in a drop in voltage. This chart gives some approximate idea of this:

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.

USE COPPER WIRE FOR HOOK UP

Don't use aluminum wire. It is cheaper to use aluminum wire and you may be tempted to do so. Many electricians will tell you that, with the new types of connectors, it is OK. However, it is of particular importance with kilns not to use aluminum wire for the hook ups. The specific reason particular to kilns is that the wire tends to get hotter near the kiln than it might going into some other types of appliance. Also, being a resistive load, there is constant heat being generated by the conductors. When aluminum wire gets hot it accelerates oxidation. Aluminum oxide is a resistor; copper oxide is not as much. If the connection at the terminal board gets oxidized it will really heat up - to the point where it could cause a fire. Braided copper wire is preferred.

DO NOT USE EXTENSION CORDS

Extension cords are only OK to use for the 120 volt vent system. Do NOT use an high power extension cord for the kiln.

OFF-PEAK ELECTRICAL USAGE

Some utilities offer special rates for running energy intensive appliances (like kilns) during off-peak hours. Check with local utility. This would require a special time-of-use electrical meter.

WHERE TO GET MORE INFORMATION

See ***hotkilns.com/volts*** for a complete description of electrical theory, fusing, hook-up wire sizes, etc. as they apply to kilns or, for a more basic description, at ***hotkilns.com/basic-electric-kilns.***

ELECTRICAL SPECIFICATIONS

See your wiring diagram and data nameplate for voltage and amperage requirements.

DOLL INSTRUCTION MANUAL

L&L Kiln's patented hard ceramic element holders protect your kiln.

ACCESSORIES THAT CAN BE ADDED FOR L&L KILNS

GENESIS CONTROL

If you have a DynaTrol you can upgrade to a Genesis Touch Screen Control.

Highlights of the Genesis

1. Touch-screen technology for the user interface
2. Easy-to-follow screen descriptions
3. Different user-interface levels, which can be set to match the user's firing knowledge
4. Graphical display of the firing process right at the controller. This means you can graph the firing in real time and compare the program with actual results.
5. Glass programs included.
6. Store up to 12 custom user programs
7. Up to 32 segments per program
8. Ability to make adjustment during a firing such as add segments, add temperature, and skip segments

WiFi enabled for easy software updating. (Note KISS software is not needed for this to work). This works by connecting through a local WiFi connection to the Bartlett servers and downloading the latest software. It is very easy to do and requires no more than setting up your WiFi connection and pressing a few buttons.

For more information

See ***hotkilns.com/genesis***

For pricing

See ***hotkilns.com/retrofit-genesis***

ROLLING STANDS

You can add this to most polygonal kilns that is 27" or less in height.

L&L's rolling kiln stand features heavy gauge (14 ga) galvannealed steel construction with multiple bends for extra strength, steel swivel locking casters with polypropylene wheels, integrated vent collection box support, and guide rails for the kiln. Each size is fitted to the kiln.

There are three sizes:

Small for an 8 sided kiln like an e18S (22.5" by 22.8")

Medium for a 10 sided kiln like an e23T (28.8" by 30")

Large for a 12 sided kiln like an e28T (34.3" by 34")

NOTE: There are the same height from the floor to the top of the stand as our normal stands.

The vent collection box is not included but, when you order a Vent-Sure vent system the longer duct is included with the system. The Rolling Stand for a 12 Sided kiln uses an 18' long duct and the Rolling Stand for the 8 Sided and 10 Sided kilns use a 12" long duct.

These ship by UPS.

For more information

See ***hotkilns.com/rolling-stands***

Pricing for retrofit stands

hotkilns.com/kiln-parts/rolling-stand-8-sided-kiln

hotkilns.com/kiln-parts/rolling-stand-10-sided-kiln

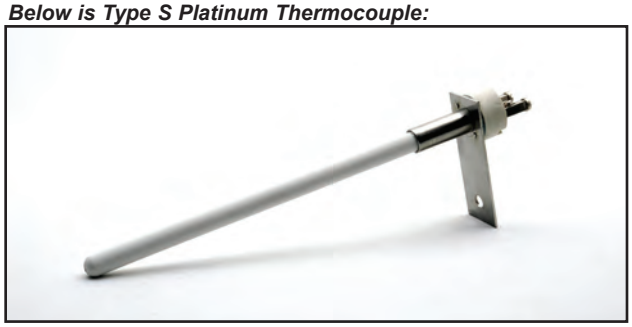
hotkilns.com/kiln-parts/rolling-stand-12-sided-kiln

PLATINUM TYPE S THERMOCOUPLES

The standard thermocouple used on the DynaTrol or Genesis control is Type K. The most common thermocouple configuration that we use is an 8 gauge exposed Type K thermocouple. This is standard on Easy-Fire, School-Master, Jupiter, eQuad-Pro, Hercules, Easy-Load, DaVinci, Fuego and Doll kilns.

The very best thermocouple for constant high fire applications is a Type S platinum thermocouple with an alumina sheath. This is standard on the JH Series kilns and is recommended for the most extreme conditions (like firing crystalline glazes). If you have a DynaTrol or Genesis control on your kiln, you can order Type S thermocouples. The control is soft and hard programmed for this (to avoid potential misfiring) and special calibrated wire connects the platinum thermocouples with the control.

Below is Type S Platinum Thermocouple:



TECHNICAL INFORMATION

Type S thermocouples are composed of a positive leg which is 90% platinum and 10% Rhodium, and a negative leg which is 100% platinum. It is usable from 32°F to 2700°F. (0°C to 1480°C). It has a different EMF output than Type K thermocouples (meaning the same temperature will produce different voltages to the control which must then be interpreted differently).

At temperatures used in pottery kilns (even the highest 2400°F) these thermocouples can last for a very long time (as long as they are not mechanically broken).

The lead wires that go from the Type S thermocouple to the control are a special grade that is not interchangeable with Type K lead wire.

On DynaTrols used before Jan 1, 2006, or on One-Touch controls, this is not a retrofittable option.

On DynaTrol 700 controls (used after Jan 1, 2006) the control can be easily converted from Type K to Type S in the field. You will still need to change the lead wire. Contact L&L for more information.

DESCRIPTION

The Type S thermocouples that we provide have a 5/16” OD alumina sheath. They are ungrounded. There are two lengths. The short one used in the Easy-fire, Jupiter, eQuad-Pro, JH Series, DaVinci, and Doll kilns is 120 mm (4.75”) long. The medium one used in the Easy-Load front-loading kilns is 160 mm long (6.3”).

Polarity

Black Wire = PLUS (+)

Red Wire = MINUS (-)

RETROFITTING CAUTIONS

CHECK THE CONFIGURATION OF ANY REPLACEMENT CONTROL TO MAKE SURE YOU DON’T MELT YOUR KILN! See your control instructions for how to do this.

A replacement control, if ever needed, will typically have our standard configuration for Type K thermocouples with 3 zone control. THIS WILL NOT MATCH YOUR KILN IF YOU HAVE TYPE S THERMOCOUPLES!

This is the MOST IMPORTANT thing to do. If your kiln has Type S thermocouples and the control is set up for type K thermocouples you could overfire the kiln to the point of a complete melt-down.

Type K thermocouple extension wire (the wire that goes from the thermocouple to the control) is either yellow or brown. Type S extension wire is green (in the USA). See this for more information on thermocouple wires and hookup: hotkilns.com/tc-polarity

ORDERING

PART NUMBER: T-G-SXXX/00

Type-S Thermocouple - 120 mm (Standard Length). Type S Platinum Thermocouple with Alumina Protection Tube and Terminal Block - Unit is 120 mm (4-3/4”) Long x 1/4” Diameter. Can be used on any polygonal, square, or rectangular kilns with standard 2-1/2” or 3” brick insulation using a DynaTrol control board. Not for use on any Front-Loading kilns, or custom kilns with more than 3” of insulation.
hotkilns.com/type-s-thermocouple-standard

PART NUMBER: T-G-SXXX/06

Type-S Thermocouple - 160 mm (Medium length). Type S Platinum Thermocouple with Alumina Protection Tube

and Terminal Block - Unit is 160 mm (6-5/16”) Long x 1/4” Diameter. Used on Easy-Load kilns where wall thickness is 5”.

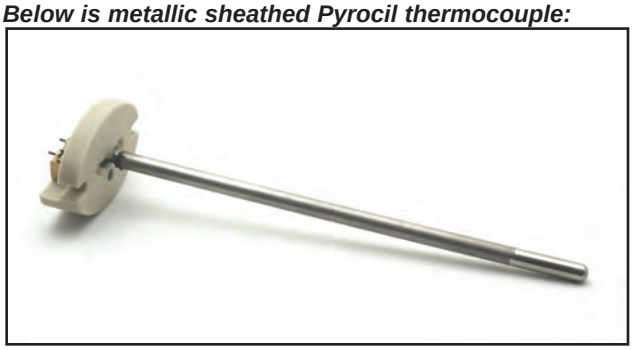
hotkilns.com/type-s-thermocouple-long

NOTE: Type S thermocouples can be ordered with a kiln as part of the original equipment on all kilns that have a DynaTrol or Genesis Control.

METAL SHEATHED THERMOCOUPLES

An alternative to the standard 8 gauge thermocouple is the Type K industrial Pyrocil metal-sheathed thermocouples.

Below is metallic sheathed Pyrocil thermocouple:



APPLICATION

These thermocouples are useful where greater responsiveness is required than you will get with the 8 gauge inside of a 1/8” wall thickness ceramic protection tube. This is typically for industrial applications. Most ceramic firing does not need quick response.

We do not recommend using these above cone 6 temperatures (2232°F, 1222°C).

DESCRIPTION

Industrial Grade Pyrocil Metal Sheathed Thermocouples are made with a high temperature alloy called Pyrocil.

L&L provides these special thermocouples with a 1/4” diameter sheath. These will last longer than the smaller 1/8” diameter thermocouples that some manufactures use. We use a high quality ceramic terminal block on the end.

The standard Pyrocil thermocouple is 6-1/2” long.

Because the Pyrocil thermocouples are still Type K, no changes need to be made with the control board to use them.

You will need a special ceramic bushing to fill up the hole left fy the standard Type K thermocouple.

ORDERING

PART NUMBER: T-G-E23M/05

Type-K Industrial Grade Pyrocil Sheathed Thermocouples with Ceramic Terminal Block - Unit is 5” Long x 1/4” Diameter. Used on DaVinci, Jupiter, Easy-Fire and other kilns with 2-1/2” or 3” brick walls.

hotkilns.com/type-k-pyrocil-sheathed-thermocouple-5-long

PART NUMBER: T-G-E23M/06

Type-K Industrial Grade Pyrocil Sheathed Thermocouples with Ceramic Terminal Block - Unit is 6-1/2” Long x 1/4” Diameter. Used on Hercules and Easy-Load kilns where the wall has a thickness is 5” of insulation.

hotkilns.com/type-k-pyrocil-sheathed-thermocouple

ELECTRICAL NOISE FILTER AND 120V CONTROL POWER SUPPLY

Electrical Noise Problems

L&L kilns that use the DynaTrol or One-Touch™ electronic control normally get their control voltage transformed from the incoming line voltage that the kiln operates on. This is standard and proper industrial practice. However, in some cases this is not desirable.

If you have problems with short power outages, voltage spikes, voltage drops, or excessive environmental line noise (such as is caused by large 3-phase motors or phase angle fired SCRs), this can cause unpredictable behavior in the electronic control. These are conditions found on overburdened power grids, in some factories, and sometimes in rural areas. It is hard to detect without very specialized equipment (most electricians would not be able to “see” these problems).

How To Solve The Problem

When you have the above conditions we recommend having the control feed by a separate 120 volt line (with a standard 6 foot long cord) and having that voltage filtered though an EMI (Electrical Magnetic Interference) noise filter.

We then recommend plugging the 120 volt cord into a good computer surge protector or better yet a UPS (Uninterruptable Power Supply) power supply with isolation transformer. You can buy a good UPS for at a computer store for less than $100.

For information and pricing

See ***hotkilns.com/noise-filter***

APM ELEMENTS

Technical Description

APM element wire is a very special sintered alloy that Kanthal makes. It resists grain growth at high temperatures and has a very high hot strength (which keeps the coils from flattening as easily as with Kanthal A1 or equivalent wire). You can get more technical information from the Kanthal web site at ***kanthal.com.***

This is from Kanthal's web site:

Kanthal APM is an advanced powder metallurgical, dispersion strengthened, ferritic iron-chromium-aluminum alloy (FeCrAl alloy) which is used at wire temperatures up to 1425°C (2595°F). Kanthal APM has good hot strength, giving good form stability of the heating elements with less need for element support. It has low tendency to ageing, low resistance change and long element life. Kanthal APM has an excellent surface oxide, which gives good protection in corrosive atmospheres as well as in atmospheres with high carbon potential, and no scaling. The combination of excellent oxidation properties and form stability makes the alloy unique. Typical applications for Kanthal APM are in furnaces for firing of high temperature ceramics, in high temperature heat treatment furnaces, in high temperature laboratory furnaces, in high temperature furnaces in the electronic industries, and in diffusion furnaces.

These elements are recommended for crystalline glaze applications because the same process that causes crystal growth in glazes also causes grain growth in the standard Kanthal A-1 alloy used in electric ceramic pottery kilns.

Pricing of retrofit elements

These typically cost about three times what you would pay for regular replacement elements. For pricing of retrofit elements email ***service@hotkilns.com***

VENT CONTROL

The Vent Control allows you to automatically control the operation of the Vent-Sure kiln vent with one of the outputs from the DynaTrol (or Genesis). If you have a vent this can be easily retrofitted with a little wiring into your control panel.

Construction

The Vent Control consists of a relay that is controlled from output #4 on the DynaTrol (or Genesis).

There is a female 120 volt receptacle to plug the vent into and a cord to plug into a 120 volt wall outlet.

There is a 6 foot wire that connects the control box to the kiln control panel. A grommet is included for non-factory installation.

Where It Can Be Used

It is only available for kilns with a DynaTrol or Genesis. (Not available on the One-Touch).

It may not be used with kilns with powered bottoms (because the same output on the control is used)

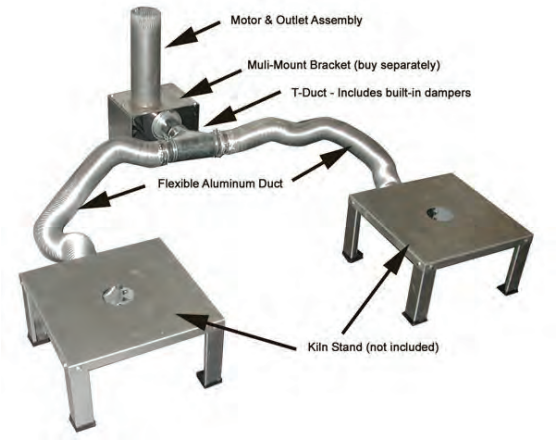
For more information and pricing

See ***hotkilns.com/vent-control***

VENT DOUBLER

Vent Doubler Allows The Use Of One Vent With Two Kilns

You can get a vent doubler options which allow you to vent two kilns that are each up to 10 cubic feet. This can be added to most kilns if you are adding another kiln and want to save money on the extra vent.



For more information and pricing
See ***hotkilns.com/vent-doubler***

DOLL INSTRUCTION MANUAL

LOG, CONES,TIPS,
CERAMIC PROCESS

L&L Kiln's patented hard ceramic element holders protect your kiln.

FIRING LOG FOR L&L KILNS

DATE	PROGRAM	CONE	TIME	FINAL TEMP	LOAD WEIGHT	CLAY BODY	GLAZE

Temperature Equivalent Chart for Orton Pyrometric Cones (° F) Cone Numbers 022-14

	Self Supporting Cones						Large Cones				Small
	Regular			Iron Free			Regular		Iron Free		Regular
	Heating Rate ° F/hour (last 180° F of firing)										
Cone	**27**	**108**	**270**	**27**	**108**	**270**	**108**	**270**	**108**	**270**	**540**
022		1087	1094				N/A	N/A			1166
021		1112	1143				N/A	N/A			1189
020		1159	1180				N/A	N/A			1231
019	1213	1252	1283				1249	1279			1333
018	1267	1319	1353				1314	1350			1386
017	1301	1360	1405				1357	1402			1443
016	1368	1422	1465				1416	1461			1517
015	1382	1456	1504				1450	1501			1549
014	1395	1485	1540				1485	1537			1598
013	1485	1539	1582				1539	1578			1616
012	1549	1582	1620				1576	1616			1652
011	1575	1607	1641				1603	1638			1679
010	1636	1657	1679	1600	1627	1639	1648	1675	1623	1636	1686
09	1665	1688	1706	1650	1686	1702	1683	1702	1683	1699	1751
08	1692	1728	1753	1695	1735	1755	1728	1749	1733	1751	1801
07	1764	1789	1809	1747	1780	1800	1783	1805	1778	1796	1846
06	1798	1828	1855	1776	1816	1828	1823	1852	1816	1825	1873
05½	1839	1859	1877	1814	1854	1870	1854	1873	1852	1868	1909
05	1870	1888	1911	1855	1899	1915	1886	1915	1890	1911	1944
04	1915	1945	1971	1909	1942	1956	1940	1958	1940	1953	2008
03	1960	1987	2019	1951	1990	1999	1987	2014	1989	1996	2068
02	1972	2016	2052	1983	2021	2039	2014	2048	2016	2035	2098
01	1999	2046	2080	2014	2053	2073	2043	2079	2052	2070	2152
1	2028	2079	2109	2046	2082	2098	2077	2109	2079	2095	2163
2	2034	2088	2127				2088	2124			2174
3	2039	2106	2138	2066	2109	2124	2106	2134	2104	2120	2185
4	2086	2124	2161				2120	2158			2208
5	2118	2167	2205				2163	2201			2230
5½	2133	2197	2237				2194	2233			N/A
6	2165	2232	2269				2228	2266			2291
7	2194	2262	2295				2259	2291			2307
8	2212	2280	2320				2277	2316			2372
9	2235	2300	2336				2295	2332			2403
10	2284	2345	2381				2340	2377			2426
11	2322	2361	2399				2359	2394			2437
12	2345	2383	2419				2379	2415			2471
13	2389	2428	2458				2410*	2455*			N/A
14	2464	2489	2523				2491*	2530*			N/A

Pyrometric cones have been used to monitor ceramic firings for more than 100 years. They are useful in determining when a firing is complete, if the kiln provided enough heat, if there was a temperature difference in the kiln or if a problem occurred during the firing.

Cones are made from carefully controlled compositions. They bend in a repeatable manner (over a relatively small temperature range - usually less than 40° F). The final bending position is an indication of how much heat was absorbed.

Behavior of Pyrometric Cones

Typically, it takes 15 to 25 minutes for a cone to bend once it starts. This depends on the cone number. The cone bends slowly at first but once it reaches the half way point (3 o'clock), it bends quickly. When the cone tip reaches a point level with the base, it is considered properly fired. This is the point for which temperature equivalents are determined. Differences between a cone touching the shelf and a cone at the 4 o'clock position are small, usually 1 or 2 degrees.

Temperatures shown on the charts were determined under controlled firing conditions in electric kilns and an air atmosphere. Temperatures are shown for specific heating rates. These heating rates are for the last 100° C or 180° F of the firing. Different heating rates will change the equivalent temperature. The temperature will be higher for faster heating rates and lower for slower heating rates.

Cone bending may also be affected by reducing atmospheres or those containing sulfur oxides. Orton recommends the use of Iron-Free cones for all reduction firings (cones 010-3). If a cone is heated too fast, the cone surface fuses and binders used to make cones form gases that bloat the cone. If cones are to be fired rapidly, they should be calcined (pre-fired) before use. Cones should be calcined to about 850° F (455° C) in an air atmosphere.

If a cone is soaked at a temperature near its equivalent temperature, it will continue to mature, form glass and bend. The time for the cone to bend depends on several factors and as a general rule, a 1 to 2 hour soak is sufficient to deform the next higher cone number. A soak of 4 to 6 hours will be required to deform two higher (hotter) cones.

for more information on pyrometric cones, contact Orton or visit us at www.ortonceramic.com

Orton®
The Edward Orton Jr. Ceramic Foundation
P.O. Box 2760 • Westerville, OH 43086-2760
(614) 895-2663 • (614) 895-5610 fax
info@ortonceramic.com
www.ortonceramic.com

These tables provide a guide for the selection of cones. The actual bending temperature depends on firing conditions. Once the appropriate cones are selected, excellent, reproducible results can be expected. Temperatures shown are for specific mounted height above base. For Self Supporting - 1¾"; for Large - 2"; for Small - 15/16". For Large Cones mounted at 1¾" height, use Self Supporting temperatures. * These Large Cones have different compositions and different temperature equivalents.

Temperature Equivalent Chart for Orton Pyrometric Cones (° C) Cone Numbers 022-14

	Self Supporting Cones						Large Cones				Small
	Regular			Iron Free			Regular		Iron Free		Regular
	Heating Rate ° C/hour (last 100° C of firing)										
Cone	**15**	**60**	**150**	**15**	**60**	**150**	**60**	**150**	**60**	**150**	**300**
022		586	590				N/A	N/A			630
021		600	617				N/A	N/A			643
020		626	638				N/A	N/A			666
019	656	678	695				676	693			723
018	686	715	734				712	732			752
017	705	738	763				736	761			784
016	742	772	796				769	794			825
015	750	791	818				788	816			843
014	757	807	838				807	836			870
013	807	837	861				837	859			880
012	843	861	882				858	880			900
011	857	875	894				873	892			915
010	891	903	915	871	886	893	898	913	884	891	919
09	907	920	930	899	919	928	917	928	917	926	955
08	922	942	956	924	946	957	942	954	945	955	983
07	962	976	987	953	971	982	973	985	970	980	1008
06	981	998	1013	969	991	998	995	1011	991	996	1023
05½	1004	1015	1025	990	1012	1021	1012	1023	1011	1020	1043
05	1021	1031	1044	1013	1037	1046	1030	1046	1032	1044	1062
04	1046	1063	1077	1043	1061	1069	1060	1070	1060	1067	1098
03	1071	1086	1104	1066	1088	1093	1086	1101	1087	1091	1131
02	1078	1102	1122	1084	1105	1115	1101	1120	1102	1113	1148
01	1093	1119	1138	1101	1123	1134	1117	1137	1122	1132	1178
1	1109	1137	1154	1119	1139	1148	1136	1154	1137	1146	1184
2	1112	1142	1164				1142	1162			1190
3	1115	1152	1170	1130	1154	1162	1152	1168	1151	1160	1196
4	1141	1162	1183				1160	1181			1209
5	1159	1186	1207				1184	1205			1221
5½	1167	1203	1225				1201	1223			N/A
6	1185	1222	1243				1220	1241			1255
7	1201	1239	1257				1237	1255			1264
8	1211	1249	1271				1247	1269			1300
9	1224	1260	1280				1257	1278			1317
10	1251	1285	1305				1282	1303			1330
11	1272	1294	1315				1293	1312			1336
12	1285	1306	1326				1304	1324			1355
13	1310	1331	1348				1321*	1346*			N/A
14	1351	1365	1384				1366*	1388*			N/A

Pyrometric cones have been used to monitor ceramic firings for more than 100 years. They are useful in determining when a firing is complete, if the kiln provided enough heat, if there was a temperature difference in the kiln or if a problem occurred during the firing.

Cones are made from carefully controlled compositions. They bend in a repeatable manner (over a relatively small temperature range - usually less than 40° F). The final bending position is an indication of how much heat was absorbed.

Behavior of Pyrometric Cones

Typically, it takes 15 to 25 minutes for a cone to bend once it starts. This depends on the cone number. The cone bends slowly at first but once it reaches the half way point (3 o'clock), it bends quickly. When the cone tip reaches a point level with the base, it is considered properly fired. This is the point for which temperature equivalents are determined. Differences between a cone touching the shelf and a cone at the 4 o'clock position are small, usually 1 or 2 degrees.

Temperatures shown on the charts were determined under controlled firing conditions in electric kilns and an air atmosphere. Temperatures are shown for specific heating rates. These heating rates are for the last 100° C or 180° F of the firing. Different heating rates will change the equivalent temperature. The temperature will be higher for faster heating rates and lower for slower heating rates.

Cone bending may also be affected by reducing atmospheres or those containing sulfur oxides. Orton recommends the use of Iron-Free cones for all reduction firings (cones 010-3). If a cone is heated too fast, the cone surface fuses and binders used to make cones form gases that bloat the cone. If cones are to be fired rapidly, they should be calcined (pre-fired) before use. Cones should be calcined to about 850° F (455° C) in an air atmosphere.

If a cone is soaked at a temperature near its equivalent temperature, it will continue to mature, form glass and bend. The time for the cone to bend depends on several factors and as a general rule, a 1 to 2 hour soak is sufficient to deform the next higher cone number. A soak of 4 to 6 hours will be required to deform two higher (hotter) cones.

for more information on pyrometric cones, contact Orton or visit us at www.ortonceramic.com

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These tables provide a guide for the selection of cones. The actual bending temperature depends on firing conditions. Once the appropriate cones are selected, excellent, reproducible results can be expected. Temperatures shown are for specific mounted height above base. For Self Supporting - 1¾"; for Large - 2"; for Small - 15/16". For Large Cones mounted at 1¾" height, use Self Supporting temperatures. * These Large Cones have different compositions and different temperature equivalents.

TROUBLESHOOTING KILN FIRING WITH CONE PACKS

BASIC CONE INFORMATION

PYROMETRIC CONES

Pyrometric cones are made of clay and other minerals and are precisely formulated to soften when fired in a kiln. They will bend over when they have absorbed a certain amount of heat. The amount of heat is related to both time and temperature. They mirror fairly accurately what goes on in a ceramic body and can be a more reliable guide to firing than a thermocouple instrument.

Differing materials in the cones result in different firing temperatures. The cones you are likely to use in an L&L kiln are numbered from Cone 022 to Cone 10 (coldest to hottest). The number is imprinted on the cone. Usually clay and glaze comes with a recommended cone to fire to. A cone is a tall (about 2-½") pyramid made from specific damp-pressed ceramic materials. Each cone has a slight lean to it when placed on a flat surface. Be careful not to drop cones or expose cones to moisture.

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.

LARGE SELF SUPPORTING CONES

Although there are various types of cones available we recommend using the "self-supporting large cones". They have a built-in base that allows the cone to sit flat while always placing the pyramid part of it at the proper angle. The angle is there to ensure that the cone bends in the direction you want it to, and doesn't just slump and puddle.

CONE PACKS

The best way to use the cones, especially if they are all you have to tell how hot your kiln is getting, is to use 'cone packs', or the three cone system. The three cones are placed in a line, aimed so that when they fall, they will fall in a line. The first cone to fall should be in the front of the three cone line. This cone should be one cone number lower than the one you wish to fire to. The target cone (the cone you wish to fire to) should be the next one to fall and should be in the middle. The last cone should be one cone number higher than the target cone. The first cone is to warn you that the firing is almost done. The target cone tells you when to turn off the kiln, and the last cone tells you if the kiln got hotter than you thought it did.

Picture of a "cone pack" (Courtesy of Orton). The ones in the back are before the firing and the ones in the front are after a perfect firing/ These are Self-Supporting Large Cones.

USE CONES TO CONTROL ACCURACY IN AN AUTOMATIC KILN

We recommend checking the accuracy of your control and thermocouples every so often by placing at least one large cone (the target cone or cone number you are firing to) in the top, middle and bottom. Thermocouples will drift in their accuracy, but you can adjust the cone offset or thermocouple offset (or both) to compensate for this. You know how many degrees off the thermocouple reads at the end of the firing. Using a cone near the thermocouple and a "cone to temperature chart" will help to calibrate a thermocouple accurately. Remember though, cone temperatures are affected by their location in the kiln, the angle at which they are held, and the rate at which they are heated. Slight variations throughout the kiln should be expected. You can see a "cone to temperature" chart in the LOG, CONES, TIPS, CERAMIC PROCESS section of your manual or at ***hotkilns.com/orton-cone-chart***.

TROUBLESHOOTING FIRING PROBLEMS

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

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 cone the firing should go to is called the target cone, 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. Pay attention to how you position the cones as they are designed to only fall in one particular direction if placed on a level surface. You do not want a lower-numbered cone stuck in the cone pack behind a higher-numbered cone because the lower-numbered one will fall first and might lean against or knock over the higher-numbered cone, which will compromise the accuracy of both cones.

2) Once the cone packs are positioned on shelves (or on a post lying on its side) and are visible through the peepholes, fire the kiln to the middle cone's number.

3) Near the end of the firing start watching the cone packs. Look for the first cone to fall over in each pack, not necessarily at the same time, but pretty close, probably in the middle zone first.

4) Now watch for the middle cone in each pack. Keep checking the DynaTrol display to be sure it does not say **CPLt**. The middle cone in each pack should start to fall at pretty much the same time in the top, middle and bottom of the kiln. When the tip of the cone touches the melted cone in front of it note the temperature readout on the display for that zone's thermocouple.

a) If the middle cones did not go down together then immediately note the differences in each thermocouple reading from the one thermocouple in the same zone as the first cone that went down. Later on, use the "thermocouple offset" feature to add or subtract degrees from each thermocouple accordingly. Use the differences between the thermocouple readings as a guide to know how much to offset each thermocouple.

b) If the three thermocouple temperatures are close enough to be reading the same thing (the middle cones did all go over at the same time), then the kiln should say **CPLt** right when the cone tips bend over and touch or just before it. If the kiln is still firing after this point, note how many degrees higher it goes before shutting itself off. Then use the "cone offset" feature to change the temperature equivalent of that cone. Subtract the same amount of degrees from the temperature equivalent that the kiln over-fired the cone by.

c) If the kiln shut itself off before bending the cones properly, you want to reprogram it and then re-start it as quickly as possible. Note the temperature at which the kiln shut down. Get from **CPLt** to **IdLE**, **tC2**, current temperature by pressing either **START/STOP** or **ENTER**. Re-program the same program to one cone number higher, then re-start the firing. Do these steps quickly. Now watch the middle cones again and note at what temperature the cones properly bend. If they bent while you were programming then just offset the temperature by 5 or 6 degrees. Shut the kiln off once you note that temperature. Using the "cone offset" feature, add the difference of the two readings to that cone's temperature equivalent.

Note: From the factory, the settings that interpret temperature signals in the DynaTrol are hard-programmed; they will not change unless part of the microprocessor has been affected. There is a range of acceptability for the accuracy however and the cone offset feature exists to allow you to fine tune the kiln to particular sized loads. It is best to use all new thermocouples to properly tune the cone offset before individual thermocouples begin to drift. Even keeping one new thermocouple solely for calibrating the individual thermocouples will help to keep the kiln accurate.

CALIBRATING YOUR DYNATROL

This is also covered in the instruction sheet called **dynatrol-basic-operation.pdf** in the OPERATION section of your manual or at ***hotkilns.com/calibrating-kiln.***

HELPFUL VIDEOS & LINKS

Calibration

More information on calibrating your kiln:
hotkilns.com/calibrating-kiln

Cone Offset

How to change cone offset in a DynaTrol:
hotkilns.com/change-cone-offset

How to change the thermocouple offset on a DynaTrol. This helps you calibrate the control to match your kiln:
hotkilns.com/change-thermocouple-offset

Firing with Witness Cones

This video shows you how to use witness cones to check the accuracy of the control and your kiln in an L&L Easy-Fire kiln. This video applies to any kiln:
hotkilns.com/firing-kiln-witness-cones

Orton Ceramic Institute

See ***ortonceramics.com*** for lots of very helpful information on how to use cones and for many firing tips and great information on firing kilns.

Cone Chart

You can see a "cone to temperature" chart in the LOG, CONES, TIPS, CERAMIC PROCESS section of your manual or at ***hotkilns.com/orton-cone-chart***.

WHAT CONE NUMBERS MEAN: WHY YOU SHOULD CARE

The pyrometric cones used today by ceramic artists and industrial manufacturers were developed in the late 1800's by Edward Orton Jr. Dr. Orton recognized that ceramists needed a way to determine when their ware was fired correctly to develop the properties they required in their finished products. Thus all ceramic products were assigned a cone number to which they were to be fired to assure maturity of the ware during the firing process such as Cone 06 glazes, Cone 04 bodies, etc. Later, the development of electronic temperature controllers simplified the control of the firing process, but they could not replace the cones as a measure of the accumulative effect of time and temperature on the ceramic ware.

An interesting parallel to this principle would be the cooking of a turkey in your electric oven. You can set the oven temperature to 350 degrees Fahrenheit and place the turkey in the oven and estimate how long to cook it to attain an internal temperature of 180 degrees Fahrenheit. However if you want to be assured the turkey reaches the desired internal temperature you can place a meat thermometer into the turkey and it will tell when you have reached the desired internal temperature. Changing the oven temperature will surly effect the time required to reach the desired internal temperature. Cones serve a similar purpose in the firing of ceramics.

Both the Orton and the Bartlett electronic temperature controllers' cone-fire programs were developed based on the actual firing behavior of Orton cones and would not work without the information on cone behavior provided by the Orton Ceramic Foundation. These controllers automatically adjust the final firing temperature based on the actual heating rate of the kiln so that the kiln delivers the correct amount of heat work specified by the cone number program selected. Therefore the most efficient and reliable way to fire your kiln is to utilize the cone-fire programs built into your controller.

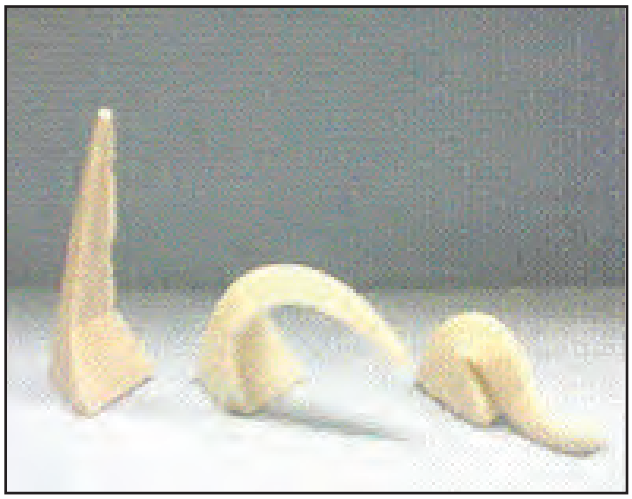
However, the electronic controller is not the ultimate answer for assurance that your ware has been fired correctly. The electronic controller measures the temperature inside the kiln via the thermocouple that is usually mounted in the side wall of the kiln and extending into the kiln 1to 1½ inches. The thermocouple is great for measurement of temperature at a point in space and a point in time and provides the controller feedback needed to control the firing cycle. But heat work is a function of both temperature and time as measured by the bending of pyrometric cones.

Why is it so important to know if you have attained the correct cone firing? Look at the label on your glaze jar. The odds are that the glaze is specified as a "Cone X" glaze. The unstated instruction for firing such a glaze is to "apply heat work equal to the cone number specified and the glaze will be properly matured". The glaze manufacturer has developed the glaze formula to mature at a certain cone number. The glaze manufacturer has conducted sufficient testing to know the fired characteristics of the mature glaze as related to glaze fit to the body, color development, the chemical resistance of the glaze surface, food-safe, etc. Under-firing or over-firing can prevent the glaze from attaining the appearance and properties you expect.

Since the thermocouple and the controller do not measure heat work how do you know if you actually matured the glaze in every firing? The thermocouple measures the temperature near the wall of the kiln where the heating elements are located and unfortunately has no means of measuring the temperature within the setting of the ware in the kiln and therefore cannot confirm if the distribution of heat work was uniform throughout the kiln. Remember the turkey story? One could fire the kiln with such a long firing cycle that all areas within the kiln received the desired amount of heat work, but this practice could require additional kilns to meet firing needs and the energy consumption would be wasteful. A definite overkill approach without merit. The programmable controller, coupled with the use of pyrometric cones, allows for the development of firing profiles to meet all your firing conditions. Since most shop operators want to have their kiln fully utilized during each firing, we will consider a fully loaded kiln of glazed ware to be fired to cone 06. The load placed in the kiln has a direct bearing on the firing profile required to successfully fire your ware. Select the cone-fire program consistent with the recommendation of the glaze manufacturer, in this case cone 06. Remember that selecting a cone-fire program alone does not insure that you will obtain uniform heat distribution throughout your ware. The controller is designed to compensate if the kiln is heating slower than the expected rate, but only at the tip of the thermocouple, it has no information about what is occurring in the interior of the ware setting. Place a series of three cones, 07, 06, 05 (self-supporting cones are the most convenient to use) one series located on the outside perimeter of the ware setting, and the second series located in the center of the ware setting on each shelf in the kiln (commonly referred to as "witness cones"). Fire the kiln. Once cool, remove the cones marking their location in the kiln. If the cone 06 is bent so that the tip is at the same level as the top of the foot of the cone in all locations, congratulations, you have just achieved a successful firing to cone 06. See Figure 1.

WHAT CONE NUMBERS MEAN: WHY YOU SHOULD CARE

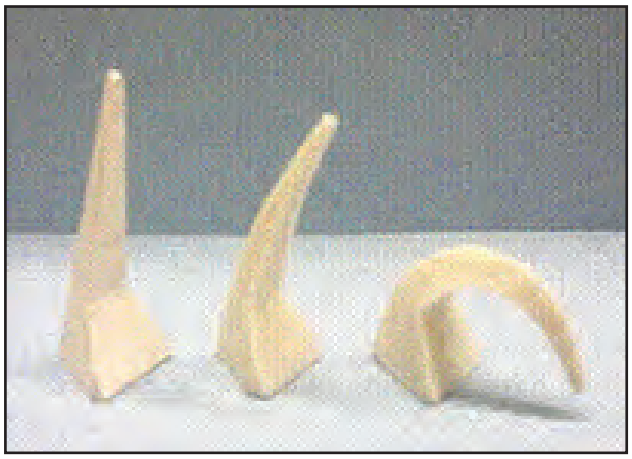
Figure 1: Cone 07 is over-fired and cone 06 indicates a successful cone 06 firing.



Cone 05 Cone 06 Cone 07

If some of the locations indicate that you did not reach cone 06, the tip of cone 06 is not bent enough, you will need to modify your firing cycle on your controller. By having cone 07 along side cone 06 you can determine by how much you failed to reach a cone 06 firing. Cone 07 measures a lesser amount of heat work than cone 06, therefore if cone 07 is bent so that the tip is at the same level as the top of the foot of the cone you are only one cone away from the desired heat work. See Figure 2. There are two simple ways to correct poor heat distribution within your kiln. First, for your cone-fire program if you selected either fast(#1) or standard(#2) heating speeds try slow(#3), which will allow more time during the firing cycle for the heat to equalize in the ware setting, or you can add additional hold time (soak) at the final cone temperature. A combination of both may be necessary depending on how heavily the kiln is loaded. Your kiln manufacturer or your controller manufacturer can be a good resource for suggestions to improve your firing program. The first question you will likely be asked is "what do your witness cones show". Repeat the procedure above once the change(s) to the firing cycle have been made.

Figure 2: Cone 06 has not reached the proper bending angle, indicating an under-fired condition.



Cone 05 Cone 06 Cone 07

Since minor under-firing may not be obvious to the eye, the use of cones in every firing will alert you if there is a potential problem with the correct amount of heat work being delivered uniformly to your ware. And, when the cones confirm a successful firing, you can sleep a little better knowing you have taken a proactive, safe approach to providing your customers a high quality firing process. Retaining the cones constitutes physical proof that the ware was fired according to the glaze manufacturer's specification.

For more information on the use of pyrometric cones and the firing of ceramics please visit the Edward Orton Jr. Ceramic Foundation on the internet at ***www.Ortonceramic.com.***

(Text written by the Edward Orton Jr. Ceramic Foundation, reformated by L&L Kiln Mfg. Inc.)

VIDEO AVAILABLE

This video shows you how to use witness cones to check the accuracy of the control and your kiln in an L&L Easy-Fire kiln. This video applies to any kiln.

hotkilns.com/firing-kiln-witness-cones

The Ceramic Process Firing Tips

What happens when you fire clay

LOADING KILN WITH GREENWARE

When placing greenware in a kiln, all pieces may touch each other. To prevent possible distortion, place lids on the pieces they go with when firing to bisque. It is important to place the tallest pieces on the center of the shelf and work outward to the shortest pieces. This will give you the best heat circulation. Be sure the ware is totally dry before firing (unless you use a very long drying cycle). Moisture in the work can cause cracking or even an explosion. We suggest using either the SLOW BISQUE program for heavy loads with a Preheat time of between two to three hours or the FAST BISQUE program for lighter loads (again with a Preheat time of two to three hours). If you want to make up your own program, use the preset program as a guide (see Appendix F in the DynaTrol instructions, **hotkilns.com/dynatrol-700**, for a description of the segments in the preset programs). It is not a bad idea to Preheat the kiln overnight, as its only purpose is to thoroughly dry and start the expansion of the ware, so that the higher heat will not negatively affect it.

VENTING

If you are using the Vent-Sure automatic vent system, you can turn it on and leave it on during the entire firing. If you use an automatic vent, you do not normally need to prop the lid open or remove peephole plugs. If manually venting (without a powered vent), fire in the beginning with all the peepholes out. Then put bottom peephole plugs into peepholes after the low firing is over (you will know it is over when you start to see red heat through the peepholes). You typically want to leave the top peephole out during the entire firing if you do not have an automatic downdraft vent. NOTE: HEAVY GREENWARE MAY TAKE LONGER TO DRY. Be sure to use the Preheat feature in the DynaTrol for ensuring dry work. NOTE: If you have a lot of moisture in your work you may want to prop open the lid for the first hour of preheat even if you have an automatic vent system. (CAUTION: Propping open a lid in this way can cause the lid to crack if you are not careful).

LOADING KILN WITH GLAZE WARE

Robert Shenfeld's studio in Syracuse NY where he produces production quantities of hand-crafted tiles.

When placing ware into the kiln to be glaze-fired, we suggest placing the pieces ½" apart so that when they expand there is no danger of them touching each other. If pieces are placed too close together, they may touch and stick to each other, thereby ruining both pieces of ware.

Except for placing ware the proper distance from each other for good heat circulation, follow the instructions for the firing of greenware. Be certain that no piece while expanding can touch the thermocouples. Use either the FAST GLAZE or SLOW GLAZE program depending on your glaze needs (experiment if you are not sure), or make up your own program. Ask the supplier of your glaze if you use a commercial glaze. There are some good firing recipes in various glaze books such as **Mastering Cone 6 Glazes**. Your clay and glaze supplier will know the cone number to which you should fire your work.

OVERGLAZE FIRING

When firing overglazes such as Gold, Palladium, Mother of Pearl, China Paints, etc., the kiln must be vented during the firing up to 1,100°F. If you are manually venting, leave the peepholes open. (NOTE: This is if you are not using a vent system such as an L&L Vent-Sure which automates the venting process). Check with your clay and glaze supplier for recommended cycles.

SPEED OF FIRING

Although the kiln may be capable of firing relatively fast, this does not mean you should fire it as fast as it is capable of firing. The speed of firing will depend on what you are trying to accomplish. Check with the glaze or clay manufacturer or supplier for a recommended firing cycle.

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KILNS BUILT TO LAST

Bulletin No: CP-3-15

The Ceramic Process Firing Tips

SOAKING

Soaking is holding the kiln at any given temperature for a set amount of time. One purpose is to achieve uniform temperatures on the inside and outside of your pieces. Other benefits include the smoothing out of glazed surfaces to get rid of pin holes or craters in the glazed surface. During the bisque firing, people often hold at different temperatures to allow the clay body to out-gas more of its organic material. Holding is also useful at a low temperature like 150°F to 180°F to dry out pottery or kiln wash on shelves.

The downside to holding only happens at high temperatures. There is almost no downside to holding at low temperatures except increased firing time and slight element and thermocouple degradation from the extra firing time. At high temperatures the amount of degradation to the elements and thermocouples is exponentially greater. As a result, holding the kiln at a high temperature will affect the element and thermocouple life.

Try soak times in the range of 5 or 10 minutes at the most. If longer, exercise care as the kiln may over-fire your work. Compensate by reducing the cone's temperature in the cone offset setting, or raise the thermocouple offset. Use witness cones that you can see through your peephole (and be sure to use dark safety glasses when doing so). If you see the cones bending (which would indicate proper heat-work achieved), then you can always turn off the control at that point manually. The Orton website has a great program available for free which helps you calculate how different temperature ramps and hold times will affect the "heat-work" and cone bending in a kiln.

FIRING LOG

Keep a firing log. Keep track of firing times, approximate load weight, firing temperatures and notes on results of the firing. There is a sample log in our instruction manuals (**hotkilns.com/ firing-log**).

APPLYING KILN WASH

Kiln wash the floor of the kiln and the upper sides of the shelves only. Apply the kiln wash to the thickness of a postcard. The purpose of kiln wash is to prevent any glaze that drips from ware from sticking to the floor or shelves. If dripping should occur, remove dripping and cover the spot with new kiln wash. Kiln wash is a powder mixed with water to a light creamy consistency.

For best results, apply three separate coats. If you brush one coat on, let it dry and then brush on another; you can brush off the first in the process, so ideally each coat should be fired on. The shelf can be used while firing the kiln wash, so theoretically you would put one coat on, load the shelves and do your test-firing of the kiln. The second coat would be fired on in the first bisque and the third coat in the second bisque or first glaze (whichever comes next). Fire at least to cone 018—hot enough to give the kiln wash enough adherence to the shelf to prevent it from coming off in the second coating. Note that some people make do without three firings of the kiln wash. However, we include this recommendation as a "best practice".

WHAT HAPPENS WHEN YOU BISQUE AND GLAZE IN YOUR KILN

When you fire a kiln, you chemically and physically alter clay and glaze compounds in a way that, to some degree, can be anticipated and accounted for. There is quite a bit more going on during firing than meets the eye. It is useful to divide the processing cycle into separate distinct stages or segments. The stages that clay and glaze go through in a typical firing can be divided as follows:

COMPLETE DRYING

Even after you room-dry your work there will be some moisture left in the seemingly dry ware. Your ware will pick up moisture from the air, even if it is left for weeks on a warm, dry shelf. Bisque ware can also absorb moisture during glazing, and the newly applied glaze is really a very fine-grained clay coating at this point; it will retain the water it was mixed with and the water in the air until it is completely dry.

When you put this piece in the kiln it will first go through a complete drying stage. This is where any water that was in your ware evaporates and expands to 1,170 times its original volume. This moisture must escape from your ware before the kiln temperature gets to 212°F. It is important that the kiln temperature climb very slowly at first, and that the lid be propped 1" with several soft pieces of firebrick or ceramic posts and the peepholes opened if there is no forced venting system. (CAUTION: Keep in mind that propping open a lid in this way can cause the lid to crack if you are not careful). If you have a lot of moisture in your work you may want to prop open the lid for the first hour of preheat even if you have an automatic vent system. The amount of drying needed depends on factors such as how much mass is in the kiln and how wet the ware is. Factors that lead to a longer drying time include fine-grained clay and thick-walled ware. Be sure to use the Preheat feature in the DynaTrol which automatically sets the kiln temperature at the right drying temperature. Preheating overnight is recommended. It is best to be conservative to prevent the ware from exploding in the kiln. After a while you will get a feel for how long is necessary. Remember to carefully vacuum out your kiln if a piece that is not fully dried explodes.

THE "CERAMIC CHANGE"

This happens to each crystal and mineral particle in the clay body. Even though water between the crystals and minerals has already evaporated (hopefully during the slow preheat time), there is still water in these crystals and minerals that is venting off. This can occur all the way until the kiln reaches red heat. Slow firing is not as critical as there are pathways for the steam to travel through where the water molecules between the particles used to be. Venting, however, is critical to remove the water vapor.

The Ceramic Process Firing Tips

QUARTZ INVERSION

This is a generic name for the 20 or so changes quartz goes through as the temperature increases and the molecules/particles/atoms become increasingly mobile. Most phases that a particle of quartz goes through as the kiln is heating will reverse during cooling. One of the largest and quickest changes the quartz goes through is roughly at 1,060°F with about a 2% increase in the size of the particles during heating. The process is reversed during cooling. Also, during cooling another 2% contraction takes place at about 439°F. This is caused by the formation of "crystobalite" in some clay bodies. There is a lot of other material in your clay besides quartz, so it is not always that important to account for the quartz while the kiln is heating up. The structure of unfired clay is full of pores and non-glass bound particles, so it can withstand the expansion of a few of its quartz particles. Once the clay is fired, though, the particles become part of a solid mass of glass. This mass is extremely intolerant of the expanding quartz particles. This is especially true in the glaze firing (even more so if the bisque was even slightly under-fired). In under-fired ware the quartz never has a chance to react with the fluxes and remains intact during a second firing, ready to expand and contract as your kiln heats and cools. This is one cause of dunting (fine cooling cracks). The glass mass simply has no room for the expanding quartz crystals.

BURNOUT

This is the burning off of any trapped organic matter in the clay. Burnout generally takes place at and above red heat. Sufficient airflow and time are necessary to burn off all the organic matter. If a bisque piece is under-fired, or fired too quickly, any unburned organic matter will bubble up through the glaze during the second firing. Even if the bisque is properly fired, there will still be some organic matter in the clay that will burn out once you pass the bisque's firing temperature. A glaze that fluxes too early will block off the exits for the gasses in the clay body and cause bloating or pitting.

SINTERING

This is the point at which powdered clay particles will begin to form chemical bonds with each other. Although the clay is not melting yet, it is forming a lump from the powdered clay. The point at which this begins to happen is called the 'sintering point'. This, like burnout, happens right around red heat.

DECOMPOSITION

This is where fluxes really start to react and clay and glaze ingredients are deconstructed into their basic building blocks. This process can emit gasses such as sulfur and carbon dioxide which must travel out of the clay body. Once the firing is finished and the kiln cools, reconstruction takes place and the glaze and clay body recompose into a glass.

VITRIFICATION

This is a process that develops in the clay body during firing. At one point a piece of clay might be under-fired and at a higher point it may have good strength, but not good color; at another point it may be perfect and at another, even hotter point, the piece may warp, or melt. What is important to understand is that as the firing progresses, more and more activity is taking place on a molecular level. This is good only to a certain point, after which you are left with a warped blob, or puddle. You want to achieve the "glassification" of the clay. This occurs right before the clay body begins to slump. At this point the molecular bond between fluxes, quartz, silica and other materials makes the "glass". However, it is the formation of the long mullite crystals (which only occurs above 2,000°F) from the decomposing clay crystals that gives the ware its strength.

GLAZE SET, COOL & FREEZE

Unlike the clay body, the glaze melts completely, and the bond between it and the clay becomes more complete as the temperature rises; eventually, the glaze starts to run. Things like fluidity and surface tension are determined first by the chemistry of the glaze, then by the layer formed by the heightened interaction between the glaze and clay molecules. When the ingredients of the clay and glaze have been properly matched, the nature of the molten layer between the two is such that when the kiln is at maximum temperature during firing, things like pinholes and bubbles can rise through this layer and reach the surface from the clay body within, and not remain trapped in the surface when the glaze sets and begins to cool. Once maximum temperature is reached and the kiln begins to cool, the glaze and clay body will follow. The glaze will not solidify until some time after the kiln begins to cool. When this happens depends on the rate of cooling and the chemistry of the glaze. Right before the glaze solidifies, however, crystals can form. Depending on its chemistry, the glaze can solidify quickly and form crystals. Or, with some glazes, crystal formation can take place throughout the initial cooling until the glaze finally solidifies several hundred degrees lower than the highest temperature. By adjusting the glaze recipe slightly, one can maximize or minimize the forming of crystals in the glaze during cooling. Once the glaze solidifies it is still important for the kiln to cool slowly. Crazing (fine cracking) can occur if cooling is too rapid. Heat shock, which is usually catastrophic, is something that can happen in the kiln or may occur gradually over time.

In truth, simply test-firing the kiln and the ware to be fired is usually enough to deal with the complexity of the process. Every kiln and kiln-load fires differently, and a new kiln is no exception. The use of a vent system is recommended simply because it will exhaust any detrimental particles and fumes from the kiln, circulate air in the kiln and provide an oxygen-rich atmosphere. See ortonceramics.com for helpful information on how to use cones, firing tips and great information on firing kilns. They have an excellent program available for free which helps you calculate how different temperature ramps and hold times will affect the "heat-work" and cone bending in a kiln.

Bill Campbell at work.

"I make a living out of my five L&L kilns. I really beat them up firing them at least three times a week to Cone ten. They take a real beating and keep on going" -Bill Campbell

Firing Glass in a Ceramic Kiln

How to use an L&L Ceramic Kiln with a DynaTrol to Fire Glass

BASIC IDEAS

Glass is not as forgiving as clay when fired in a kiln. Temperatures and firing times must be more precise; as such firing glass requires special considerations when fusing and slumping in a pottery kiln.

Using a kiln sitter with cones is a difficult process when fusing and slumping glass and will not be discussed here. The following instructions address how to use a DynaTrol digital controlled pottery kiln when fusing and slumping glass. Glass casting is a special process and is not covered by the following information.

Pottery kilns heat from the side elements where as glass kilns heat from the lid element and side element. In most glass kilns the lid element provides 70% of the heat and the side elements provide 30% of the heat. The lid element throws heat down in a uniform manner across the kiln shelf. The side element is only there to adjust for the height of the kiln.

A pottery kiln heats from the sides toward the center. Using a standard glass firing sequence in a pottery kiln will cause the glass pieces on the outer edges of the kiln shelf to fuse long before the glass pieces in the center of the kiln shelf. If firing a large piece of glass the outer edges will fuse quickly and trap air bubbles in the glass and by the time the center of the piece reaches fusing temperature the outer edges will be over fired and may become distorted and thin.

The number of stacked shelves (amount of furniture) will impact the firing of the kiln. Kiln furniture absorbs heat before the glass absorbs heat causing what is referred to a heat steal. Also impacting glass firing in a pottery kiln is the size of the kiln plus if the kiln is made of 3 inch brick will also affect the firing. Glass kilns tend to be shorter in height than potter kilns and are usually made of 2 ½ inch brick or refractory fiber board or blanket.

With side elements, kiln furniture, size of the kiln and brick thickness you must fire slow in a pottery kiln when firing glass. If you fire too fast you will have an over fire plus you may also thermoshock the glass causing it to break. If you cool too fast you will thermoshock the glass causing it to break.

The following fusing sequences are to be used as a starting point from which you will develop your own firing sequence for successful firing of your projects. The sized of your kiln and how you load the furniture may require refining the sequence below.

You would use the same firing sequence for small jewelry pieces as well as large platters and bowls.

On the left of the DynaTrol digital controller is a yellow section labeled “VARY-FIRE”. This feature has 6 user programs each user program has 8 segments. A segment permits the artist to input firing sequences with a specified ramp rate in degrees per hour, a soak temperature, and a soak time. These three items comprise a segment. You select the number of segments needed for your firing sequence.

Simple firings like jewelry and small plates and bowls you should be able to obtain good results with the use of 2 segments.

If you are loading the kiln with multiple shelf levels or a single shelf you would use the 3 zone feature of your kiln to obtain uniform heating.

The assumption is made that you already know how to safely and correctly operate your DynaTrol digital controlled kiln. The following information is provides a guide line for adjusting your firing from pottery to glass.

The following information is not to replace the instructions provided in your kiln owner’s manual. Refer to the owner’s manual for complete information on the operation and features of the DynaTrol digital controller.

After loading your kiln you would set the DynaTrol digital controller in the following manner.

NOTE: All degrees listed below are degrees F. If you want to use degrees C you will need to set the controller for degrees C and convert the degrees F below to degrees C for you firing.

The firing schedule below is for use with Bullseye, Uroboros, or Spectrum Glass. It is not for use with float or borosilicate glass.

FUSING GLASS

1. If the kiln has an off/on switch, turn the kiln on.

2. The kiln should indicate it is in the idle mode by flashing “IdLE”, the number of zones and the temperature inside the kiln.

3. Press the “Enter Prog” key in the VARY-FIRE section. You will see the display flashing between “USER” and a number between 1 and 6. At this point you want to choose which USER program you want to use. You can set USER 1 for a fusing project and you can set USER 2 for a slumping project, as an example.

4. Press the number 1 on the key pad, then press the ENTER button in the number key pad area. You have chosen to use “USER 1”

5. The display will now flash SEGS and a number. It is asking how many segments you want to use for your firing.

6. Press the number 2 on the key pad, then press the ENTER button in the number key pad area. You have chosen to use 2 segments for your firing.

7. The display will now flash RA 1 and a number. It is asking for the ramp rate in degrees per hour for the first segment.

8. Pressing the number keys enter 150, then press the ENTER button in the number key pad area. You have instructed the controller to heat at 150 degrees per hour. This means that after 1 hour the kiln will be at room temperature plus 150

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Firing Glass in a Ceramic Kiln

degrees, after 2 hours it will be at room temperature plus 300 degrees, and so forth.

9. The display will now flash °F 1 and a number. It is asking for the soak temperature for the first segment.

10. Pressing the number keys enter 1450, then press the ENTER button in the number key pad area. You have instructed the controller to heat to 1450 °F. This means that the kiln will heat at a rate of 150 degrees per hour and go to 1450 degrees, taking roughly 9.66 hours to do so.

11. The display will now flash HLd 1 and a number with a decimal point 2 digits to the left, You may have a number which looks like 12.30 or 1.20 or 0.20. The decimal point separates minutes from hours. Hours to the left of the decimal point and minutes to the right of the decimal point. It is asking for the soak time period for the first segment.

12 - Pressing the number keys enter 15, then press the ENTER button in the number key pad area. You have instructed the controller to soak for 15 minutes. On review of the program you would see: 0.15. You have entered the first segment.

13. The display will now flash RA 2 and a number. It is asking for the ramp rate in degrees per hour for the second segment.

14. Pressing the number keys enter 150, then press the ENTER button in the number key pad area. You have instructed the controller to cool at 150 degrees per hour.

15. The display will now flash °F 2 and a number. It is asking for the soak temperature for the second segment.

16. Pressing the number keys enter 100, then press the ENTER button in the number key pad area. You have instructed the controller to cool to 100 °F. This means that the kiln will cool at a rate no faster than 150 degrees per hour and go to 100 degrees, taking roughly 14.5 hours to do so.

17. The display will now flash HLd 2 and a number with a decimal point 2 digits to the left, You may have a number which looks like 12.30 or 1.20 or 0.20. The decimal point separates minutes from hours. Hours to the left of the decimal point and minutes to the right of the decimal point. It is asking for the soak time period for the second segment.

18. Pressing the number keys enter 30, then press the ENTER button in the number key pad area. You have instructed the controller to soak for 30 minutes. On review of the program you would see: 0.30

19. The display will now flash ALRM and 9999. It is asking if you want to have an alarm sound when the kiln reaches a particular temperature. The number 9999 instructs the controller NOT to sound any alarm.

20. Press the ENTER button in the number key pad area, with the 9999 number in the display, if you do NOT want an alarm. If you want the controller to sound an alarm notifying you that it has reached a particular temperature enter that temperature number on the key pad and then press the ENTER button in the number key pad area.

21. The display will now display CPL for a few seconds then switch to the IdLE mode. You have entered the second and final segment. The digital controller has the above firing sequence in its memory as USER 1. It will remember this firing sequence even after the kiln is turned off. You can edit and change the firing sequence any time.

22. When the display is in the IdLE mode press the “Recall Prog” button in the VARY FIRE section of the key pad. The display will flash USER and a number. Press the number 1 and then press the “START /STOP” button. The display will briefly show STOP then switch to the IdLE mode. Press the START/STOP button again. The display will show -- ON -- and the controller will start the firing the USER 1 program.

Note: The digital controller does not understand heating or cooling. It only understands what temperature it is at and what temperature it is to go to. Thus it will adjust the firing to go to the destination temperature.

The above glass firing sequence has instructed the kiln to do the following.

Heat at 150 degrees per hour, go to 1450 degrees, stay at that temperature for 15 minutes then cool at 150 degrees per hour, go to 100 degrees and stay at that temperature for 30 minutes then stop firing.

SLUMPING GLASS

To slump glass you will use the same sequence however you must change the soak temperature from 1450 degrees to 1250 degrees, all other values remain the same.

HOW TO CORRECT FOR OVER OR UNDER FIRING WITH THE ABOVE FIRING SEQUENCE

Only change one variable at a time.

1. I suggest that you adjust the soak time not the temperature.

2. If the glass is over fired reduce the soak time by 5 minutes.

3. If the glass is under fired add 5 minutes to the soak time

ANNEALING GLASS

The above firing sequence passes through the annealing temperature so slowly that the glass is annealed. If you want to use a formal annealing cycle you would use 3 segments with the second segment having the annealing soak temperature and soak time in it. The heating and cooling rate would remain the same.

Marty Dailey - Sept 2006

Firing Tips

LOADING A KILN FOR BEST RESULTS

Loading a kiln for firing is not a simple matter of placing shelves and stacking ware. The more thought and planning that is put into loading, the better the results. Ware and shelf placement, the size of the load, the firing characteristics of the kiln and the type of ware being firing are all important factors.

First the Furniture

Kiln shelves come in all shapes and sizes. For economy of space, it is best to choose shelves similar in shape and size to your kiln chamber. For instance, use a round or multi-sided shelf in a round or multi-sided kiln. Keep the size small enough so there is at least 1" of space between the shelf edge and the side of the kiln or the Kiln-Sitter®. Also allow some room between the top of your ware and the lid of the kiln and leave space for witness cones amongst your ware.

Select posts in heights to accommodate the ware you are firing. Leave some room between the kiln shelves for air to flow, for heat transfer and for removal of fumes.

Half shelves are very useful to improve air movement in the kiln. Use two side by side with a 1/2" space between them and you don't lose much stacking space.

Some kiln manufacturers recommend placing shelves directly on the floor of the kiln. Most suggest using 1" posts to put the bottom up from the cooler floor. This creates an insulating layer much like a storm door.

Setters and Stilts

Air movement in the kiln is clearly a big consideration - one of the most important when loading a kiln. Ceramics need to heat uniformly to prevent warping and stresses in the ware. Air needs to move around shelves and around individual pieces.

Plates and tiles benefit from the use of tile and plate setters or stackers. Shelf-style setters allow air to move under the large flat objects so they heat more evenly. Avoid heating large flat objects directly on the cooler shelf. If you are firing decorated tiles or plates, vertical setters economize on space, and sets can be stacked to fit even more.

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Glazed ware needs to be stilted or dry footed or the melting glaze will stick the ware to the kiln shelf, ruining both. Stilts also provide space for air to move around all sides of the ware. Porcelain and stoneware can not be stilted. The stilts embed into the ware during firing. Instead, use high fire kiln wash or silica sand on the shelf. Use prop to prevent sagging of porcelain.

Consider Heat Distribution

It is important to evaluate heat flow in your kiln and to make this a consideration in loading. Use pyrometric cones to determine the heating characteristics of your kiln so you know where the hot and cooler places are. Arrange your ware with different sized pieces on the same shelf to allow better heat flow.

Don't Overfill

Perhaps one of the most important factors in good fired results is enough air to mature the ware - to burn out organics in bisque and develop best colors in glazes. Shelf and ware placement and the use of setters and stilts can all help this, but here are a couple more tips:

1. When stacking bisque, invert bowls and mugs opening to opening instead of nesting - this helps air move around all sides of a piece and prevents black rings and spots in the bottom of ware.

2. Fire bisque lids and bottoms together. To get the best fit for lids, fire them on the piece they match. This will let the two pieces shrink together so you get a good tight fit. Fire all glaze pieces separately.

3. Leave space between ware - don't overfill. There is a temptation to cram as much as possible into the kiln to economize on firing costs. Ware fired too closely together creates firing problems. If you must overfill, fire very slowly and vent adequately.

4. Mix thin and thick-walled pieces together throughout the load - don't concentrate them in one area where they are competing for air and heat.

5. Use downdraft venting to move air through the kiln and to remove fumes created during firing.

Want to learn more?

Read more about Loading A Kiln in the Orton Firing Line and Technical Tips publications. Each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate. Orton's 80 minute video, *Key Principles of Successful Firing*, is also an excellent resource on firing.

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Firing Tips

UNDERSTANDING HEAT TRANSFER

How Heat is Transferred

Heat moves through the kiln from hotter to cooler zones by:

1. convection
2. conduction
3. radiation

Convection

Convection is the first step in the heating process in the kiln. Air is heated as it passes across the warming kiln elements. As the hot air rises and cool air falls, air currents are created which circulate hot air to cooler places in kiln. This heat is transferred to the ware, shelves, etc.

The kiln will not be uniform in temperature at this early stage of firing unless the hot air is pushed through the kiln by mechanical means. Low cone firings such as 022 and 021 depend more heavily on convection for heat transfer.

The most common type of convection we are familiar with is wind chill. The cool air passes across the face and pulls heat from our warmer body, which lowers our skin temperature.

Conduction

When heat moves through a solid, it is conducted. An example would be heat moving through the handle of a saucepan. This is a slow way to heat, but the handle will eventually get hot.

In a kiln, conduction moves heat from the inside to the outside of the kiln and from the outside to the inside of the ware. Conduction is the main way we get uniform heating in the kiln. This is a slow process and if we fire too fast, the inside of our ware will receive too little heat and not fire properly.

Radiation

At the beginning of the firing, the elements are the hottest part of the kiln. The heat from the elements radiates out - like the sun warming us on a cool day. Eventually the firebrick and the ware will also get hot and will radiate heat as well.

As the temperature increases, more and more of the heat is transferred by radiation from the heating elements. For uniform heating, is important that all surfaces of the ware be exposed to heating elements, even partially.

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4. Time and temperature profile during the burn out period

Both time and temperature are important for proper burn out of the carbon. Some carbons require much higher temperatures than others. Oxidation should be completed below red heat (1400°F).

Carbon burns out from the surface first. As more oxygen penetrates the body, then more carbon is reacted to form the CO or CO_2 gas and the burn out process continues. If there is sufficient time, temperature and oxygen, then complete burn out occurs. If these conditions do not exist, the resulting incomplete burn out is referred to as black coring (where the center of the piece has a black or gray cast).

Incomplete Burn Out

Incomplete burn out can result in several firing problems including:

1. Bloating of the ware
If the temperature is hot enough, the outside of the piece will seal up before all the gases can escape. As the body becomes plastic due to glass forming, gases trapped inside the body expand with heat and cause bloating and sometimes cracking of the ware.

2. Glaze defects, such as pinholes
The escaping gases will push through the glaze surface and cause bubbles which pop. If these do not heal, then pinholes will result.

3. Appearance of fired bisque
Where carbon burn out is incomplete, the piece will have a grayish cast (white bodies) or may have a greenish cast (red bodies). The body will also be more porous and weak.

Preventing Incomplete Burnout

1. Slow down the firing.
2. Be sure the kiln is vented adequately so there is sufficient oxygen.
3. Load the kiln with burn out requirements in mind.

Leave plenty of space between ware and shelves. Do not stack ware. Use tile and plate stackers and invert pieces on top of one another to help conserve space and insure proper burnout.

Want to learn more?

Read more about carbon related glaze and body defects in the Orton Firing Line and Technical Tips publications. Each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate. Orton's 80 minute video, *Key Principles of Successful Firing*, is also an excellent resource on firing.

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Firing Tips

CRACKING AND THERMAL SHOCK

Cracks that appear in fired ware which were not caused by casting or drying problems may be the result of thermal shock.

Thermal shock occurs when too much stress is created in a piece of ware during the heating and cooling process. It comes from temperature differences in the ware and can cause small to large cracks in the piece, or the piece may actually break.

Why Does Cracking Occur?

The tendency of a piece of be susceptible to thermal shock is related to:

- the strength of the piece
- the thermal expansion of the material

Thermal shock can result when changes in temperature occur in the kiln during heating and cooling. As temperature changes rapidly, the outside of the ware and kiln furniture becomes much hotter or cooler than the inside. This causes stresses which may result in cracking or breaking.

The following can effect thermal shock

- a fast heating rate or rapid cooling
- a sudden influx of cool air such as opening the kiln lid when the kiln has not finished cooling
- in a gas kiln - turning off the gas and allowing cool air from the burners to enter the kiln

Thermal shock can also occur when ware is stressed in use such as a casserole or dish that is taken from the freezer or refrigerator and put into a hot oven.

The stronger ware is, the better able it is to resist cracks due to thermal shocking. Weak ware will be more likely to break when stressed.

A piece that is porous will also be weaker, making it easier to crack. Water or condensation that enters pores in the ware can turn into steam and expand and this can cause cracking when heated. The harder (hotter) ware is fired, the less porous it will be.

Ware that expands and shrinks a great deal during heating and cooling is also more likely to be affected by thermal shock. Most kiln shelves contain

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cordierite because this material has a lower expansion than most of our ware and so less affected by thermal shock.

What Happens to Ware During Firing?

During heating and cooling, the body and glaze undergo many physical and chemical changes. Some of these include:

- moisture is driven out of the ware - if this occurs too rapidly, cracking can occur
- organic material is oxidized and released from the material
- the glaze softens, melts and flows during heating and may trap gas
- the body expands as it is heated and contracts during cooling
- the glaze solidifies and contracts during cooling

If the body or glaze contains silica, it will expand rapidly at 1063°F on heating and contract during cooling. If the heating or cooling is rapid near this temperature, this change can lead to cracking of the piece.

Control of heating and cooling is especially critical when firing thick-walled pieces or pieces with an irregular wall thickness.

Reducing Thermal Shock

There are several easy ways to minimize the potential for thermal shock:

- use a smooth, moderate heating rate
- let the kiln cool naturally with the lid closed
- use a controller to slow down the cooling time
- avoid sudden temperature changes

A programmable controller such as the Orton AutoFire™ is the best solution to control the heating and cooling rates and to get a smooth temperature rise.

If instrumentation is not available, heat loss during cooling can be controlled to some extent by keeping the kiln closed until well below red heat (900°F).

To be sure that ware is properly matured, be sure to use witness cones. Underfired bisque will continue to shrink during the glaze firing and this can result in a poor glaze fit.

Want to learn more?

Read more about cracking and thermal shock in the Orton Firing Line and Technical Tips publications. Each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate. Orton's 80 minute video, *Key Principles of Successful Firing*, is also an excellent resource on firing.

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Firing Tips

CRACKING AND WARPING CAUSED BY DRYING AND CASTING

In some instances cracking and warping problems share a common source: the casting and drying of the piece. In other cases, cracking may be related to how the piece is fired. This Tip looks at problems related to casting and drying

DRYING CERAMICS

Ceramics contain clay which can absorb and hold water. Before firing, it is important to remove all of the physical water so that the piece will not crack or explode when heated. This is often accomplished in steps with firing being the final stage. During firing, the chemical water is removed from the piece and it gains strength while developing physical surface characteristics.

UNDERSTANDING DRYING

Simplified, drying is the removal of water from body by evaporation. As the ware is dried, the film of water separating the clay particles gets thinner and thinner, the solid particles get closer together and the piece shrinks. Shrinkage stops when the particles finally contact each other.

DRYING FAULTS

Cracking, distorting and warping are problems that may not become evident until after firing. They are usually caused by drying too fast or unevenly.

If ware is heated too fast, the pressure from water vapor inside the piece can cause cracking. Ware dried only on one side, can shrink more on that side causing warping or bending of the somewhat plastic (flexible) piece. When one surface finishes drying, the piece is now too stiff to recover and the warping becomes permanent. This can lead to cracking.

Bodies made of very plastic clays or compositions having a high clay content require attention to uniform, slow drying.

Thicker walled pieces will often have a greater tendency to warp or distort.

Care needs to be taken to allow for uniform air movement around all sides of a piece to avoid drying problems. Sometimes drying must be slowed down to avoid cracking.

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Handles on cups can have a tendency to pull away from the mug. Doll heads and chest cavities may deform inward.

REDUCING WARPING AND CRACKING

To reduce warping and cracking, take steps to dry more slowly and more evenly from all sides.

Don't dry a flat object on a wet or cool surface like a formica or plastic table top or damp newspaper. The piece can only dry on one side. Instead, dry objects on something porous like wood or plaster or set them so air can circulate around them. If necessary, turn pieces over during drying for more even result.

Slow the drying of thick walled pieces and hand built ware.

Support areas during drying that might cause stresses to build up.

DRYING TECHNIQUES

slip cast ware - may warp or crack if stressed (deformed) when removed from the mold. Even if the ware is gently returned to the original shape, the created stress will ultimately cause the piece to warp or crack.

wheel thrown ware -should not distort during drying unless subjected to further mechanical forces - let the ware dry naturally on a bat or shelf and it should be fine.

thick handbuilt ware - needs to be dried for a very long time before it can fired or it may explode during firing. Several days may be required or a low heat drying in an oven may be necessary to remove all the water.

plates - even drying is particularly important with plates. Warping can cause the center of plate to fall or arch up. Rims and centers must dry evenly to prevent warps, humps and cracks.

drying tiles - drying tiles can present a particular challenge because it can be difficult for the piece to dry evenly. Usually air is passed over the top of the tile. This results in warping because the bottom of the tile remains wet. Drying tiles in tile racks can help air movement for more even drying.

Want to learn more?

Read more about Solving Cracking and Warping Problems in the Orton Firing Line and Technical Tips publications. Each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate. Orton's 80 minute video, *Key Principles of Successful Firing*, is also an excellent resource on firing.

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Firing Tips

USING THE THREE CONE SYSTEM

All ceramic products fire within a range to develop best fired properties. Some products such as stoneware have a wide firing range. Other products such as porcelain slip and leadless glazes have a narrow firing range (less than 2 cone numbers).

To be sure ware is properly fired, it is important to understand how your kiln is firing. The Three Cone System is an excellent way to do this.

What is the Three Cone System

The Three Cone System consists of three consecutively numbered cones:

Firing Cone - cone number recommended by manufacturer
Guide Cone - one cone number cooler
Guard Cone - one cone number hotter

For example: Cones 017 (guide cone), 018 (firing cone), 016 (guard cone)

Uses for the Three Cone System

- determine temperature uniformity in the kiln
- check the performance of the Kiln-Sitter® or electronic controller
- manually shut off the kiln by direct observation of the cones bending
- evaluate heatwork that ware receives during firing

How Witness Cones Work

Pyrometric cones indicate how much heat has been absorbed. Witness cones set on the shelf near the ware are true indicators of whether the ware received the proper amount of heat. Products are expected to be fired to a cone number or within a range of numbers. For some products, good results can be obtained at a cone lower or higher. Other products have to be fired very precisely.

Using the Three Cone System for Manual Shut-off

By observing the witness cones during firing, the end of the firing can be determined for manual kiln shut off.

To use the Three Cone System for manual shut-off, place cones on a kiln shelf near the center of the load ,but out of a draft and where they can be observed through the peephole

When the kiln is near its firing point, the Guide cone will begin to bend. The ware is approaching maturity and soon the kiln can be shut off.

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It takes about 15 to 20 minutes for the Firing Cone to reach it's end point. The cone bends slowly at first, and more quickly after the half way point. When the cone tip is even with the top of the cone base, it is time to shut off the kiln. If the Guard Cone bends, the desired heatwork has been exceeded.

Using the Three Cone system to Evaluating Kiln Performance

Most kilns have temperature differences from top to bottom. The amount of difference depends on

- design of the kiln
- age of the heating elements
- load distribution in the kiln
- cone number being used

Usually, there will be a greater temperature difference at lower cone numbers than at higher ones. Placing a set of cones on each shelf during various firings allows you to determine the heating uniformity of your kiln for the materials you fire.

After firing, observe the cones and evaluate the heat distribution in the kiln. If only the guide cone is bent, there is less heat on that shelf. If the guard cone is bent, there is more heat on that shelf.

If you do find a difference, the heating uniformity can be improved by changing the kiln loading, adjusting switching or adding a downdraft vent system.

Checking Kiln-Sitter® Performance

The Kiln-Sitter® is designed to shut off the kiln as a Small Cone or Bar deforms. Here's how it works:

- Small Cone/Bar is placed under sensing rod
- firing begins, cone/bar receives heat, begins to soften
- sensing rod presses down, cone bends with weight
- movement of rod activates shut -off

Because the cone or bar in the Kiln-Sitter® is near the kiln wall (closer to the heating elements), it may receive more heat than witness cones on the shelf. If the kiln shuts off before the witness cones have properly deformed, you may need to use the next hotter cone number in the Sitter®.

Witness Cones Are Like Insurance

Cones are considered an inexpensive way to monitor your kiln and detect problems before a crisis occurs. Use Self-Supporting Cones for the Three Cone System because they are the easiest to use and most consistent cones available.

Want to learn more?

Read more about The Three Cone System in the Orton Firing Line and Technical Tips publications. Published 8 times a year, each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate.

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Firing Tips

CONES AND CONTROLLERS

Automatic controllers and shut-off devices are a convenient way to heat and turn off a kiln. But for consistent results it is still is important to know how much heat the ware received. Only cones provide this information.

Witness cones set near the ware tell if the firing reached the cone value necessary to properly mature the ware. Cones also help in diagnosing firing problems.

Advantages of Controllers

Electronic controllers have many advantages. They:

- allow heating rate control - heat up/cool down of the kiln
- permit slow down of the firing below red heat to burn out carbon and organic materials
- permit elimination of a kiln shut-off device, although some use this as a safety backup
- allow soaking of kiln at the firing temperature to get more uniformity of fired pieces or for special results
- provide more consistency from firing to firing

So with all of these advantages, why are cones still needed?

Firing Ceramics

Firing ceramics is much like baking food, except ceramics go to higher temperatures. When we bake, we leave food in the oven at a temperature for a certain time. A thermometer may help measure the temperature of our food or we may stick a fork in to test whether it seems right.

It is the same with firing - a combination of temperature and time "cooks" the ware. However, unlike baking we can't put our ware into a preheated kiln and poke a fork in our pot to test doneness. The next best thing is to place Pyrometric Cones near the ware to measure whether it has received enough heat.

Firing With Cones

The bodies, glazes and decoration products we use are all formulated to be correctly fired when they have received enough heat to properly bend a cone. The companies and individuals who make and test these supplies use Orton Cones. Cones deform when they have received the

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right amount of heat, not just when the kiln reaches a certain temperature. In other words, cones behave just like your ware. This is why they are such good indicators of whether the ware was properly fired.

How Controllers Work

Electronic controllers regulate power to the heating elements. They do this by comparing the temperature measured by a thermocouple with the expected temperature programmed into the controller. If the temperature is low, heat is added.

Controllers fire a kiln to a temperature. If this temperature is not measured accurately, the controller will fire the kiln improperly. Most controllers use a Type K thermocouple, which is less expensive, or a platinum thermocouple (Type S), which costs more but is more accurate and has a longer life.

Measuring Temperature

Even brand new, a Type K thermocouple can vary from a true reading, as shown below. On the other hand, a Self-Supporting witness Cone will vary no more than 4°F.

Variation in New Thermocouples			Max. Cone Variation
Cone	Type K	Type S	Cones
020	8.5°F	2.9°F	4°F
06	13.5°F	4.5°F	4°F
6	16.6°F	5.6°F	4°F

This variation in the temperature measured by a thermocouple becomes even larger after the thermocouple has been used for awhile. It is not unusual for a Type K thermocouple to have an error of more than 25°F when fired to Cone 6 repeatedly. This means that more than a full cone error can be introduced.

Using Controllers and Cones

Controllers do a good job at what they do - controlling the heating and cooling rate and providing consistency from firing to firing. However, if witness cones are not used with the controller, there is no way of determining what the actual firing conditions were, except by how the ware looks. By then, it may be too late.

Want to learn more?

Read more about using cones and controlling a kiln in the Orton Firing Line and Technical Tips publications. Each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate. Orton's 80 minute video, *Key Principles of Successful Firing*, is also an excellent resource on firing.

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Firing Tips

AVOIDING CARBON BURNOUT PROBLEMS

Materials used in ceramics contain naturally occurring impurities that can affect the color, appearance and maturing temperature of the product.

Carbon, found in most clays, is normally considered one of these impurities. Carbon can also be present in the additives and binders which make up clay bodies, slips, decals and lusters.

How Carbon Burns Out

During heating (firing) the carbon reacts with oxygen to form carbon dioxide and carbon monoxide gases. The carbon leaves the body as a gas.

Binders are burned off at a relative low temperature: 300°F to 500°F.

Naturally occurring carbon in clay burns off (become gases) at higher temperatures: up to 1200°F-1400°F.

The rate at which this carbon burns out is related to:

1. The amount of carbon present (that is, the amount of natural contaminants in the body)

Some bodies have more contaminants than others, such as red clays. This needs to be considered when planning the firing.

2. Amount of air available (air provides oxygen for burnout)
Air needs to get to the carbon inside the body.

This is impacted by several factors. A load that is fired very quickly will not allow enough time for the oxygen to react with the carbon, form gases and leave the ware.

If ware is stacked during bisque firing, oxygen may not be able to penetrate all surfaces of or inside all the pieces.

Also, if gases are not removed from the kiln and replaced with fresh air, then there may not be sufficient oxygen to burn out the carbon.

3. Thickness of the piece

Air has to penetrate through the entire thickness of the piece and the gases have to escape the same way. It takes longer for carbon to burn out of a thicker piece of ware.

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4. Time and temperature profile during the burn out period

Both time and temperature are important for proper burn out of the carbon. Some carbons require much higher temperatures than others. Oxidation should be completed below red heat (1400° F).

Carbon burns out from the surface first. As more oxygen penetrates the body, then more carbon is reacted to form the CO or CO_2 gas and the burn out process continues. If there is sufficient time, temperature and oxygen, then complete burn out occurs. If these conditions do not exist, the resulting incomplete burn out is referred to as black coring (where the center of the piece has a black or gray cast).

Incomplete Burn Out

Incomplete burn out can result in several firing problems including:

1. Bloating of the ware
If the temperature is hot enough, the outside of the piece will seal up before all the gases can escape. As the body becomes plastic due to glass forming, gases trapped inside the body expand with heat and cause bloating and sometimes cracking of the ware.

2. Glaze defects, such as pinholes
The escaping gases will push through the glaze surface and cause bubbles which pop. If these do not heal, then pinholes will result.

3. Appearance of fired bisque
Where carbon burn out is incomplete, the piece will have a grayish cast (white bodies) or may have a greenish cast (red bodies). The body will also be more porous and weak.

Preventing Incomplete Burnout

1. Slow down the firing.
2. Be sure the kiln is vented adequately so there is sufficient oxygen.
3. Load the kiln with burn out requirements in mind.

Leave plenty of space between ware and shelves. Do not stack ware. Use tile and plate stackers and invert pieces on top of one another to help conserve space and insure proper burnout.

Want to learn more?

Read more about carbon related glaze and body defects in the Orton Firing Line and Technical Tips publications. Each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate. Orton's 80 minute video, *Key Principles of Successful Firing*, is also an excellent resource on firing.

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Firing Tips

FIRING HANDBUILT OR THICK CAST WARE

Most pinch pots, coiled or slab built ware generally have thicker walls than their slip cast cousins, although molded pieces may be cast heavily as well. With these types of pieces, the thicker walls create some unique challenges for firing.

Basic problems that can occur when firing handbuilt or thick cast ware include cracking (or exploding) and carbon burnout. Because of the thicker walls it is important to fire slower and control heating and cooling during firing. Preparation of the piece is important as well.

During forming, stresses within the piece may result in hairline cracks that appear during firing. It takes longer to fully dry a thick piece. Uneven drying can result in warping or cracking.

For pieces properly prepared, handled and dried, the next critical step is firing.

Firing issues

- Is the ware fully dry?

  Ware that is not adequately dried will crack or explode during the early stages of firing. Water inside the pores of the ware turns to steam, exerting pressure inside the ware. To fully dry a thick walled piece, the ware needs to be warm for more than 12 hours.

- Am I firing too fast?

  All bodies expand when heated and shrink when cooled. If the outside wall expands more than the inner wall, stresses occur. If these stresses are large enough, they pull the body apart and cause cracking. A 1" thick wall can have more than a 10°F difference in temperature between the hotter and cooler surfaces. Firings need to be slowed down for thicker wall pieces. Likewise, it is important not to cool too fast.

- Have I allowed enough time for carbon burnout?

  It is important to burn out all carbon from the ware before higher temperatures are reached (1200°F or 650°C). It takes time for oxygen to move into the porous body, react with the carbon and then leave. If carbon remains, many problems can occur. These include problems with color, glaze fit, strength, blistering and discoloration. Use of a downdraft vent system, combined with slower heating, virtually eliminates carbon-related problems.

Heating & cooling control

The best way to control cracking problems during firing is by controlling the rate of heating and cooling for the kiln.

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During firing, materials that make up the body undergo many changes. Special care must be taken at temperatures below 1500°F (815°C) to heat the body uniformly.

Remember, the thicker the wall, the slower the heating should be done. Above 1500°F, temperatures can be increased more rapidly because the changes are less likely to causes stress cracks within the ware.

- What kind of changes occur?

  All clays and many minerals contain water which does not leave the body until above 700°F. Organic (carbon) materials need to be oxidized (burned out). Other minerals, such as calcite, break down and give off a carbon dioxide gas. Minerals such as flint (silica) undergo a sudden expansion on heating to 1060°F and contraction during cooling.

- How can I control my heating?

  This depends on the controls for the kiln. With switches, leave them on medium settings longer. It should take more than 3 hours to reach red heat and even longer for thick pieces or a heavily loaded kiln.

  Make sure the kiln is well vented below red heat and closed up completely above red heat. Keep the kiln closed during cooling for 8 hours or until well below red heat.

- When did cracking occur?

  Often the crack itself can be examined to determine when it occurred. If the edges are sharp, then it probably occurred during cooling. If the edges are rounded or if glaze has flowed into the crack, then it occurred during heating.

- What else can cause cracking?

1. Uneven heating is a primary culprit that causes cracking during firing.

   Hot and cold spots in the kiln can cause uneven heating of pieces.

   Use witness cones to diagnose hot and cold spots and then adjust the switching or use a downdraft vent to help even out the heating.

   Careful loading of the ware in setters and on stilts can also help heat circulate around the piece.

2. Underfired bisque is not as strong and may crack more easily during the glaze firing.

   Use witness cone to assure a proper firing and prevent underfired bisque.

3. Gas expanding in air pockets which developed in the ware during forming can cause large cracks during firing.

Want to learn more?

Read more about firing handbuilt and thickcast ware in the Orton Firing Line and Technical Tips publications. Published 8 times a year, each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate.

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Firing Tips

FIRING CERAMIC BODIES

Most bodies and glazes contain clay. These fine clay particles give the body and glaze many desired properties and bonds other materials together.

When the body is fired:

- clay and other minerals in the body start to change
- clay/minerals break down and react with other materials to produce gases
- at 900 F (red heat), tightly held water molecules begin to break free and leave
- gases such as sulfur oxides and some fluorine may be released
- as the temperature increases, clay and other minerals continue to change and react with each other to form new compounds that will be part of the final product
- some products form glass which will bond everything together

Gases

The gases which form need to be removed from the body. For example, carbon is in the clay and organics are added to the body, glaze or decoration to improve strength during handling or application. These must be removed during firing to avoid defects.

Firing Conditions

Firing conditions can also determine many properties of the fired product. Firing too fast at lower temperatures may not allow sufficient time for materials to react and gases to leave the body or glaze.

Firing too fast can result in

- weaker bodies
- pinholing
- bubbling of the glaze
- color changes in the body
- color changes in the decoration
- mildewing of porcelain
- crazing or peeling of glazes if body is not properly mature

TYPES OF BODIES

Earthenware

- typically fired from Cone 07 - 03
- made with talc, less expensive clays
- clays contain many impurities, need fired longer at lower temperatures
- low shrinkage
- porous after firing
- usually tan or red in color
- frequently glazed or stained
- sometimes used as-fired.

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Often, problems arise because bodies are underfired. The piece may look okay, but is porous and weak. Also, underfired bodies may not match the expansion of the glaze used in a later firing. This can result in glaze fit problems or cracking of the body in use.

The high iron and carbon content of these clays requires plenty of air during firing to maintain good color and to burn out all of the carbon. If this is not done, many problems can occur when the product is glazed and refired.

Stoneware

- typically fired between Cone 6 -10
- large number of compositions
- contain clays and other minerals with many impurities, including sand, feldspar and grog
- additives are used to provide plasticity, workability, strength, color and to reduce shrinkage
- colors depend on raw materials

Because of the additives and impurities, care needs to be given to how stoneware is fired and to proper ventilation of the kiln early in the firing to burn out organics.

Stoneware is vitreous and contains a high percentage of glass in the fired product. For color variations, mature the ware under reducing conditions.

Porcelain

- typically fired from Cone 3 - 10
- compositions vary, but contain high quality materials
- colorants may be added.
- bodies are hard, white, translucent
- very high glass content
- narrow firing range - need to be fired close to slump or sag point for best fired properties.

Because color is very important, these bodies need to be fired with plenty of air below red heat to be sure all the carbon is removed. Shrinkage is high and special care must be given to supporting porcelain during firing or it will warp and distort.

CRITICAL FIRING PERIODS

For all clay containing bodies and for most glazes and decorations:

- be sure ware is dry before firing
- fire slowly below red heat (1100 F) where many changes occur in the clay and other materials
- provide plenty of air below red heat for oxidation and to burn out organics and carbon
- do not to force cool the kiln while it shows red heat.

Want to learn more?

Read more about successfully firing ceramic bodies in the Orton Firing Line and Technical Tips publications. Published 8 times a year, each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate.

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Firing Tips

FIRING LEAD FREE GLAZES

Changes in glazes

Lead free glazes are becoming the standard for commercial use. This is due to government regulation and health concerns by the manufacturers.

As the name implies, lead free glazes are made from compositions or materials where lead has not been added.

To eliminate lead, glazes are reformulated. This can change some of their properties. Some of the differences you may notice include:

- does not flow or run as much in firing as lead containing glazes
- brush marks may show after firing
- not as wide a firing range
- may not be compatible with as many bodies (improper fit). This leads to shivering or crazing of the glaze.
- color does not match lead glazes
- more surface defects

For problem-free results with lead free glazes, firings must be more closely controlled and kilns well vented. Bodies may have to be bisqued to a higher or lower cone number to solve a problem.

Why do problems occur?

Lead softens a glaze and allows it to be fired over several cone numbers. Glazes made without lead have a narrower firing range. Typically, lead glazes are able to be fired over a four cone number range (example 08 to 05).

Lead free glazes typically need to be fired within two cone numbers (example 06-05) - less than half of that for lead glazes.

Glaze and body fit

Since the glaze and the body on which it is fired (bisque) are made from different materials, it is important that they expand and shrink a like amount when heated and cooled. If they don't, then the fired glaze can be stretched to the point where it can crack (crazing), or it can be pushed together on to itself to a point where shivering or crawling occurs.

When using lead free glazes:

1. Make test firings of the body and glaze to their recommended cone number, first the unglazed body and then the glazed bisque.

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2. Use witness cones placed near the ware to be sure the proper cone number was reached. Differences may exist between the Kiln-Sitter® and a witness cone or from the top to the bottom of the kiln. Firing with a controller to a cone number or a temperature may not be adequate.

3. If crazing occurs and the witness cone indicates the glaze and bisque firings are properly fired, make some tests by firing the bisque progressively hotter (e.g. if you fire bisque to 05, test to 04, then 03).

   When you fire hotter, the expansion of the bisque is changed and glaze on the bisque may fit better.

4. If shivering occurs, fire one cone cooler. You may need to select another body for your bisque. Firing too cool is not a good idea since the strength is reduced and porosity increased, both of which may cause problems during use of the final piece.

Is Your Kiln Uniform in Temperature?

If temperature in your kiln varies by more than 1 to 2 cones, then glazed ware in one part of your kiln may fire okay, while ware fired in another part of your kiln will have a problem.

Most kilns vary in temperature from top to bottom. To determine how much your kiln varies, place witness cones on each shelf when making firings. Usually, there is less difference top to bottom for hotter firings.

Each kiln has its own personality and the solution for improving temperature uniformity may vary.

If you have glaze firing problems because of too much variation, then we recommend the following:

1. Make sure cracks and holes are repaired to keep heat in your kiln.

2. Fire slower during the early part of your firing, before red heat (below 1200°F). This allows heat to soak into the refractory and even out temperatures in the kiln.

3. Consider changing the switching pattern to even out top and bottom temperatures. Switch the bottom to a higher setting before the top or vice versa. Higher settings add more heat.

4. Consider adding an Orton KilnVent. These pull hot gases from the top to the bottom of the kiln and cut temperature variations in half. Hoods above the kiln will not help temperature uniformity problems.

Want to learn more?

Read more about glaze and body fit, heat distribution and measuring heatwork in the Orton Firing Line and Technical Tips publications. Published 8 times a year, each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate.

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Firing Tips

FIRING RED GLAZES

Red glazes are among the liveliest, brightest colors we can use, but unfortunately, red glaze problems are legendary. Many of us simply give up using reds or accept whatever results we can get, including the problems.

Common Red Glaze Problems

improper color development - dark bluish or purple cast to the glaze
color loss - glaze looks gray, white
poor surface texture - a rough matte finish and/or visible surface defects
"The Strawberry Effect" - tiny black dots or spots in the fired glaze
crazing - a crackled or cracked appearance in the fired glaze

Some of these problems relate to the preparation of the piece and application of glaze, but many defects are the result of improper firing practices.

Preparation and Application

1. ware must be clean and free of dust
2. do not apply red glaze to greenware
3. apply only to properly fired bisque (use witness cones to verify firing) -
4. work area and tools should be kept clean and free of contaminants
5. no eating/smoking in glazing area
6. glaze away from cleaning areas
7. apply adequate coats of glaze - four coats is often recommended
8. allow each coat to dry

How Colors Develop

Many ceramic glazes need to be fired in an oxidizing (air) atmosphere for best results. Red, orange and yellow glazes in particular are very oxygen sensitive. This means they require sufficient air during the firing to bring out the colors to their fullest and to prevent surface/finish defects.

Firing reds requires us to control the firing rate and properly vent the kiln.

Controlling the Firing Rate

Nearly all ceramics fire better when fired slowly below red heat. Slow firings have the advantage of allowing the necessary physical and chemical changes to occur in the ware. Slower firings also permit time for sufficient air to enter the kiln and displace the carbon monoxide. This is true for both bisque and glaze firings.

Firing rate can be controlled using the settings on an automatic kiln, programming an electronic controller or by adjusting the switching. Control or slowing of the firing rate is most important in the early stages of the firing when most of the reactions are occurring and when air is needed to

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burn out the organics in ceramic materials. Near vitrification (the end of the firing) a faster rate is desirable and can usually be applied.

Venting for Proper Air

It is most important that enough air gets into the kiln in the early stages of firing. This is when the organic materials are burning out of the ware and air reacts with carbon to form carbon monoxide. Kilns can be vented manually or with an automatic venting system.

Manual Venting

Manual venting lets the fumes out of the kiln, but is only somewhat successful at letting air into the kiln. For manual venting, the top lid should be propped and the peephole plugs out for at least the first hour and a half. Slower firings require additional time. When the kiln reaches red heat, the lid can be closed and peephole plugs replaced. Leaving the peephole plugs out for the whole firing is not recommended since it can cause cold spots in the kiln.

Manual venting works better with a smaller load. Also, using split shelves allows air circulation and helps ventilation.

Manual venting is recommended whenever a downdraft vent is not available. When venting manually, it may be desirable to locate red glazes on the top shelf to assure sufficient air.

Automatic Downdraft Venting

A downdraft automatic venting system like the Orton KilnVent efficiently brings the proper amount of air into the kiln and removes the fumes for exhausting. The kiln lid and peepholes remain closed the entire firing. Using the Orton Vent, tests have shown reds can even be fired with other colors with good results.

Firing to Proper Cone Number

Using witness cones on the kiln shelf to verify results is important to good results. Many problems occur when red glazes are not fired to the proper cone number. Blistering can occur if underfired and loss of color if overfired. Glaze on underfired bisque may craze. Firing lead free glazes to the proper cone number is especially important.

Firing reds can be a challenge, but by following good preparation, application, firing and venting practices, and by firing to the proper cone number, most problems can be eliminated.

Want to learn more?

Read more about Firing Reds in the Orton Firing Line and Technical Tips publications. Each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate. Orton's 80 minute video, *Key Principles of Successful Firing*, is also an excellent resource on firing.

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Firing Tips

UNDERSTANDING CRAZING

What is Crazing

Crazing is one of the most common problems related to glaze defects. It appears in the glazed surface of fired ware as a network of fine hairline cracks. The initial cracks are thicker and spiral upward. These are filled in horizontally with finer cracks.

Crazing is caused by the glaze being under too much tension. This tension occur when the glaze contracts more than the body during cooling. Because glazes are a very thin coating, most will pull apart or craze under very little tension.

Crazing can make foodsafe glazes unsafe and ruin the look of a piece.

There are two types of crazing, each with a different cause:

immediate crazing
- appears when piece removed from kiln or shortly thereafter
- caused by glaze body fit (glaze fits too tightly to body)

delayed crazing
- shows up weeks/months later
- caused by moisture getting into ware

Immediate Crazing

Size Changes During Firing

All ceramic bodies change in size during heating (firing) and cooling. What is desired is for the glaze to shrink a little more than the body during cooling. If it doesn't then glaze problems may occur.

It is important for ware and glaze expansion and shrinkage to match or crazing can occur.

Glazes During Firing

1. during firing, glaze undergoes physical and chemical changes
2. as heating progresses, glaze melts
3. with further heating more liquid forms until viscous or thick fluid
4. more heating, more fluid glaze
5. at this point, vicous (thick flowing) glaze still conforms to size of the bisque.
6. any gas evolving from body will form blisters which can heal if glaze is still fluid
7. when kiln shuts off, glaze and body cool together
8. during cooling, both the body and glaze shrink
9. eventually glaze becomes a hard glass that will no longer flow

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Thermal expansion/shrinkage properties of both the body and the glaze determine if the glaze crazes.

Glazes are designed to shrink less than the body which puts them in compression, makes them stronger, and makes them less susceptible to crazing.

Solution to Glaze and Body Fit

1. test samples for a good fit
2. bisque to 1-2 cone numbers hotter than glaze to insure body is mature
3. use Self-Supporting Witness Cones to verfiy heatwork
4. recognize that bodies and glazes will have different fits for different heatwork. A glaze might fit bisque fired to 03, but craze on 07 bisque

DELAYED CRAZING

This type of crazing shows up weeks or months later and is practically always caused by underfiring.

If ware is underfired (does not reach maturity), it can, in time, expand when moisture fills the pores causing the bodyu to expand. Sudden changes in temperature can cause crazing if the body and glaze do not expand or contract uniformly.

Either the body expanding or the glaze shrinking can cause fine hairline cracking (crazing) to occur. Refiring to the proper cone will sometimes solve the problem.

Proper Firing

Firing to the proper cone number is critical to help eliminate crazing problems. Witness cones must be used to verify the heatwork the ware receives.

If the Kiln-Sitter® turns the kiln off and a witness cone is not properly deformed, then the ware is not fired to maturity.

Underfiring can occur because of:
- variations in kiln heating uniformity
- Kiln-Sitter® out of adjustment and shutting kiln off early
- controller thermocouple inaccurate
- differences in heatwork between kiln shelf and Kiln-Sitter® location

Crazing can also be reduced by slower cooling and slower firing.

LEAD FREE GLAZES

Lead-free glaze formulations today have less of firing range. They develop their fired properties more quickly and this makes proper firing more critical.

Want to learn more?

Read more about crazing in the Orton Firing Line and Technical Tips publications. Published 8 times a year, each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate.

For information on Orton products, see your Orton dealer or distributor.

For information on the Firing Institute or publications, contact

Orton Firing Institute, PO Box 460, Westerville OH 43081, 614-895-2663

Firing Tips

SOLVING GLAZE DEFECTS BLISTERS, CRATERS and PINHOLES

Blisters, craters and pinholes are related glaze surface defects. They show up as a rough, grainy or bubbled surface on the ware and appear after the glaze firing or decorating firing.

What Causes These Defects?

This family of problems can be caused by many different factors including:

- dust and contamination in the glaze
- air bubbles in the glaze
- air trapped in the slip
- improperly mixed slip
- a dirty kiln

Most commonly, however, the problems are related to gases coming from the body, glaze or kiln atmosphere.

What Happens During Firing?

Clays and glazes contain organic materials. When heated, these burn out of the body, forming gases such as carbon, sulfur and water.

If the carbon in materials is not fully removed from the body, then gas will form during the glaze or decorating firing, forming bubbles or blisters. These may pop to become craters or pinholes.

These defects can occur because:

1. There was not enough air in the kiln during firing for the carbon to properly burn out.

   Any combustion process requires air. Without air, oxidation cannot occur.

2. Carbon monoxide formed by oxidation of carbon has not been adequately reomved from kiln.

   If the gases produced during firing are not removed from the kiln, they may deposit onto the glaze surface or affect the glaze color.

3. The kiln was heated so quickly that there was not enough time for the carbon to burn out.

   Carbon which is only partially burned will continue to oxidize during the glaze or decorating firing causing defects.

4. The ware was underfired. That is, there was not enough heatwork.

   When the body is underfired, it is weaker and its expansion may no longer fit the glaze.

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FIRING TIPS is a series of firing problem solvers. New TIPS are available every month. Contact your Orton supplier for your copy.

How Do I Solve Glaze Defects?

To make sure that glaze defects do not occur, it is important to properly mix glazes and slips and to use good pouring (slip) and application (glaze) techniques. Proper housekeeping for the kiln and workplace should be observed. Straining glaze through nylon often helps remove any lumps.

Most critical for good results are proper firing practices. We recommend the following:

1. Bring air into the kiln and make sure it circulates around the ware especially during bisque firings:

   - use setters and stilts to improve air flow around the ware
   - use half shelves to improve air flow through the kiln
   - adequately vent the kiln
   - position ware to take best advantage of air flow in the kiln

   Use a downdraft vent like the Orton KilnVent to bring a controlled amount of air into the kiln and circulate it throughout the kiln. This helps remove fumes and even out the temperatures in the kiln.

2. Control the firing.

   Fire slower, especially below 1200°F (650°C). Slow down the firing by adjusting switches to lower settings or soak/hold at a temperature to allow carbon to burn out.

   Use an automatic controller to set heating rates and hold times.

3. Use witness cones to verify heatwork.

   Underfiring can occur due to burned out heating elements, an improperly adjusted Kiln-Sitter®, a controller thermocouple which has changed or differences in heating within the kiln. Witness cones give a true reading of the heatwork the ware received.

   Witness cones placed throughout the kiln show differences in heat distribution.

4. Vent the kiln to remove gases and prevent them from redepositing on ware. Only downdraft venting removes the gases from the kiln.

If good firing and venting practices are observed during firing, problems with glaze surface defects can be controlled.

Want to learn more?

Read more about glaze surface defects in the Orton Firing Line and Technical Tips publications. Published 8 times a year, each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate.

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Firing Tips

SUCCESSFUL GLASS FUSING

Probably the most common problem encountered when fusing glass is that it breaks during firing. There are several causes, including:

1. glass incompatibility
2. glass sticking to shelves
3. glass heated too rapidly
4. glass annealed too quickly

Glass Compatibility

To be compatible, glasses must expand and contract at the same rate when heated and cooled. When this does not occur, they are considered incompatible.

If incompatible glass is fused together and then cooled, stresses will occur in the piece. If the stress is excessive, the fused glass will break either immediately upon cooling or months or even years later.

Glasses are rated using a coefficient of thermal expansion scale. This is based on the linear size change or expansion during heating.

What this means is that the amount the glass expands during heating is measured and compared to a scale. The larger the number, the greater the expansion. Glass with low expansions will have greater resistance to thermal shock and breaking or cracking.

When you purchase glass, be sure all of the materials you are planning to use in a piece have similar expansion (coefficient) numbers.

Glass Sticking

If kiln wash (shelf primer) is applied unevenly or bare patches are left, the glass may stick as it moves (expands) during the firing process. When this happens, the glass can pull itself apart and break.

Kiln wash should be cleaned off and reapplied in a thin even coating to prevent sticking problems. Take care not to use too much shelf primer as it may require sandblasting to remove it from the bottom of the fired piece.

Glass Heating Too Rapidly

Thermal shocking of glass during

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heat up can lead to uneven heating and cracking of the piece. Thermal shocking means that the surface of the glass changes temperature rapidly.

When fusing glass, it is important to control the heating rate between about 150°F and 500°F. For larger or thicker pieces more time is needed. Glass fired in a mold is more susceptible to uneven heating since contacts with the cooler refractory (mold) can lead to uneven heating.

Direct radiant heat from heating elements needs to fall uniformly on the class or it can cause uneven heating. Most glass firing is done in electric kilns, often with elements above the glass.

Glass Annealed Too Quickly

Annealing is done to reduce stresses in the glass that can result in cracks or breaks. Typically annealing is accomplished by soaking during the cooling cycle (at about 900°F) and then slow cooling between 900°F and 500°F. The amount of time the glass is annealed depends on its thickness. Annealing permits all the glass to equalize in temperature.

When glass is annealed too quickly, stresses can remain that can cause cracking.

When thick sheets or pieces of glass are being annealed, a process called firing down may be necessary. Firing down is done during the slow cooling phase of annealing. Firing down is used if the kiln is unable to maintain the slow cooling rate required for the piece. The process of firing down involves adding a small amount of heat to the kiln as it cools.

The best way to control cooling during annealing is to use an automatic controller. The desired anneal temperature, soak time and cooling rate are set and the kiln operates automatically. Temperature is displayed. However, even with a controller, the coooling rate set by the operator may be too fast for the kiln to achieve. It is necessary to monitor the temperature change to insure the proper annealing and cooling down occurs.

The thickness of the glass being fired

Want to learn more?

Read more about annealing and firing glass in the Orton Firing Line and Technical Tips publications. Each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate. Orton's 80 minute video, *Key Principles of Successful Firing*, is also an excellent resource on firing.

For information on Orton products, see your Orton dealer or distributor. For information on the Firing Institute, video or publications, contact

Orton Firing Institute, PO Box 2760, Westerville OH 43086, 614-895-2663

Firing Tips

SUCCESS WITH GOLDS

Gold overglazes are known as liquid precious metals. They are expensive and because of this they are traditionally used only for decoration.

Golds are typically used to add detail or distinction to plates, cups and china blanks.

There are several types of gold available in different forms, including bright golds and burnished golds.

Bright Golds

These are gold overglazes. They are not solid gold; instead they contain some percentage of gold, usually about 5 to 15%.

They come as a liquid solution and are usually applied with a brush to reduce waste. A thin coat is preferred to prevent the decoration from running, or failing to adhere.

If the liquid gold becomes too thick, it can be thinned with gold essence. Both of these products are very expensive and come in small vials or bottles.

Burnished Gold

Burnished golds are also gold overglazes. They differ from bright golds in that they require finishing (burnishing) to develop a lustrous finish and bright sheen.

Burnished golds are more durable and have a higher resistance to scratching than other golds. Their appearance is very rich and dense and slightly more matte. The brightness or matte quality can be controlled by application. A thinner application makes for a brighter gold.

Burnished golds contain 16-32% gold, including gold powder. Burnished golds are available in several forms: liquid, paste, dry powder or concentrated pats. The dry powder is extremely expensive.

There are some burnished golds that do not require polishing. These contain between 12 and 20% gold.

Firing Golds

Golds generally fire in the 022 to 018

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cone range. This can vary greatly depending on the gold itself and the ware it is being used on. For typical glassware, an 022-021 firing is the most common. For china blanks, the gold can fire as high as 011. Follow the instructions of the manufacturer when firing golds.

Gold will adhere best with a slow firing and a soak. This helps them to develop the proper color and finish. A faster firing increases the risk of surface defects which can be magnified through washing or use.

Golds contain heavy solvents which make kiln ventilation a must for both health and safety reasons and to bring air into the kiln. Usually gold is fired alone to reduce contamination problems.

Typical Gold Faults

Most gold faults are surface defects. These include:

cloudy appearance
caused by inadequate ventilation or too heavy application,
firing too fast or overfiring

gold not adhering
caused by underfiring
or too heavy application

gold is running
caused if application is too heavy

burnished gold is dull
caused by insufficient burnishing or possible underfiring

dull or scummy appearance
caused by inadequate ventilation or possible overfiring

cracking in finish
caused by firing too fast

pinholes and blemishes
caused by poor quality of gold or contamination of gold

blisters
caused by heavy application

Application and proper firing are the key to great gold results. Gold should be applied in moderation using a very light coating. Be sure to vent the kiln until it glows red hot. Use witness cones to verify the proper heatwork was achieved.

Want to learn more?

Read more about using golds in the Orton Firing Line and Technical Tips publications. Each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate. Orton's 80 minute video, *Key Principles of Successful Firing*, is also an excellent resource on firing.

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Firing Tips

SUCCESS WITH DECALS

Decals offer an opportunity to add decoration to ceramic and glass ware without the time and skill required for hand painting. When properly applied and fired, decals can add color, texture, design and personalization to a piece.

To achieve professional results with decals, it's important to understand how to select, apply and fire the decals.

- type of decals
  - different decals are made for glass and ceramics
  - ceramic decals often fire hotter than those for glass
- application
  - decals must have good contact with the surface of the ware
  - all wrinkles and bubbles need to be smoothed away
  - avoid tearing the decal
- firing
  - decals are generally low firing - from cone 022 to 016
  - check the package for the proper firing range
- venting
  - decals contain lots of organics which need to burned off
  - often smelly fumes result during decal firings

Firing Decals

A decal isn't fired that much differently than any other piece of ware, although there are some special considerations.

1. Venting is very important to good results with decals - especially to get true colors.

   Problems related to venting include:

   - poor color development
   - a cloudy or hazy appearance

2. Proper heatwork is also an important factor. Decals that are under or overfired may exhibit the following:

   - faded colors (overfired)
   - color shift (underfired)
   - decals rub off (underfired)
   - dull appearing metallics (underfired)

Determining Firing Range

Because the colors on decals can so easily be affected by the amount of heatwork they receive, we recommend test firings to determine the best firing range.

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Use a series of witness cones to fire samples of the decals on tiles or blanks. Make several firings and then select the fired appearance which looks the best.

Color development

Cloudy looking decals or decals where the color is not bright need to have additional air to develop properly. Organics need to be burned out and carbon monoxide fumes have to be removed from the kiln.

Manual venting by propping the lid and removal of peephole plugs will improve the firing, but may not help bring enough air to the bottom of the kiln or to distribute it evenly throughout the load.

A downdraft vent system will ensure sufficient air is brought into the kiln and circulated throughout.

Measuring heatwork

Heatwork is another critical factor in the color development of decals.

Fading, shifting and dullness are signs of too much or too little heatwork. This is also true when decals rub off after firing. (White or blank spots or burned off areas are generally related to application, not firing.)

Use witness cones to measure heatwork and to check the heat distribution in the kiln. Firing to a temperature or firing to a Kiln-Sitter® cone may not give the same results as found with a witness cone next to the ware.

Measuring heat distribution

Differences in heat distribution from top to bottom in the kiln are usually far more noticeable for cooler firings like decals. A 2 or 3 cone difference at 022 may only be a 1 cone difference at cone 6. This is because at higher temperatures radiation heats the kiln more effectively.

Slowing the first half of the firing can help heat distribution problems. This also helps by allowing more time for air to enter the kiln and burn out organics and for carbon monoxide to leave the kiln.

Use a controller to set heating rates and soaks for more precise firings.

Want to learn more?

Read more about successfully firing decals in the Orton Firing Line and Technical Tips publications. Published 8 times a year, each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate.

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Firing Tips

MAKING FOODSAFE WARE

When making ware to contain food and beverages, it is very important to be sure it is foodsafe. Some of important considerations for mugs, serving pieces and dinnerware include:

- body composition
- design of the ware
- glaze selection
- decoration
- firing to maturity
- testing for lead safety
- government regulations

What Type of Ware?

The design of some pieces of ware have inherent problems which make them unsuitable to contain food and beverages.

Design-related cracks, rough areas, crevices and nooks and crannies are difficult to clean and might trap bacteria. They can also be difficult to thoroughly glaze. Pitchers with hollow handles can have the same problems.

Ware also needs to be serviceable - that is, it should be strong so it won't fail or break during service.

Making Smart Glaze Choices

While glazes are extremely durable, most are not completely insoluable. If attacked by acids in foods such as orange juice, vinegar and tomatoes, small amounts of the glaze may dissolve and pose a health hazard.

Acid resistant glazes have passed rigorous tests and are labeled as foodsafe. These should be selected for glazing food ware. Lead-free glazes may not be acid-resistant and should not be used unless labeled as foodsafe.

Homemade, altered, crackle, matte or specialty glazes also should be avoided for surfaces of containers that will contact food and beverages.

How to Decorate

When glazing, be sure to completely glaze the ware to ensure the entire body is sealed. Properly bisqued porcelain may be dry footed, but only if the porcelain has been fired to vitrification. Label the ware as foodsafe for future users.

China paints, decals and rim designs

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are a popular way to decorate plates and mugs, but may not be safe for food surfaces. Specific regulations exist for the location of rim decorations which must be followed.

Decals should be used on the outside of a piece where they will not be in contact with food or beverages. Use china paints on decorative items only.

Safe Firing

Proper glaze firing and the bisque firing are very important to insure ware is foodsafe. If the bisque is underfired, it may create problems with glaze and body fit that result in crazing of the glaze, or glaze surface defects such as pinholes. These would not be acceptable for ware used to contain food and beverages.

If the glaze is not properly matured, it will not meet the foodsafe standards under which it was tested and may craze while in service.

Using pyrometric witness cones on the kiln shelf is the only way to insure that a proper firing has occurred. For foodsafe ware, many prefer to fire their bisque to an 03 witness cone just to be sure it is fully mature. Read and follow the manufacturer's instructions for glazes for the best and safest results.

Regulations

There are several very specific regulations for ware which will contain or contact food and beverages. California has the most stringent rules for dinnerware and new standards have been set by the FDA for rim decorations. These rules are available from state and federal agencies. If you are selling your dinnerware you may be subject to additional regulation.

How to Test for Lead Release

Several easy to use products are available on the market to test for lead release. These are primarily quantitative tests - that is, they tell you yes or no if the surface has lead above a certain level. The most commonly used kit is a thick cotton swab which turns pink if lead levels are exceeded. This test does not harm ware so if it tests too high in lead, the piece can still be used as decoration. These tests are a simple, economical way to feel confident that your ware is safe.

Want to learn more?

Read more about Making Foodsafe Ware in the Orton Firing Line and Technical Tips publications. Each issue is packed full of articles to help you learn more about firing. Members of the Orton Firing Institute receive these publications at no charge. Single copies are available to non-members at a per issue rate. Orton's 80 minute video, *Key Principles of Successful Firing*, is also an excellent resource on firing.

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DOLL INSTRUCTION MANUAL

L&L Kiln's patented hard ceramic element holders protect your kiln.

TABLE OF CONTENTS

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.**

You can buy an inexpensive digital multimeters for around $40-$50. 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.**

TROUBLESHOOTING GUIDE

This manual is meant to assist and educate kiln owners and service technicians. 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.

VIDEOS

ALSO WE ENCOURAGE YOU TO USE THE VIDEOS ON OUR WEB SITE (***hotkilns.com/videos***).

TROUBLESHOOTING WEB TOOLS

The latest troubleshooting information is on the web. This is constantly updated. See ***hotkilns.com/knowledgebase***

RELATED L&L GUIDES

CAUTION INSTRUCTIONS

See CAUTION INSTRUCTIONS FOR L&L KILNS in the CAUTIONS section of your Instruction Manual. THIS IS SOMETHING YOU MUST READ. (Also ***hotkilns.com/cautions***)

REGULAR KILN MAINTENANCE

See REGULAR MAINTENANCE OF YOUR L&L KILN in the MAINTENANCE section of your Instruction Manual. THIS IS SOMETHING YOU MUST READ.

BASIC ELECTRICITY FOR TROUBLESHOOTING

See BASIC ELECTRICITY FOR TROUBLESHOOTING KILNS in the TROUBLESHOOTING section. Also see ***hotkilns.com/volts*** for more in-depth information about electricity for kilns.

TROUBLESHOOTING BRICK PROBLEMS

See TROUBLESHOOTING AND FIXING BRICK PROBLEMS in the TROUBLESHOOTING section for information on firebrick problems and instructions on how to repair firebrick problems.

TROUBLESHOOTING ELEMENT PROBLEMS

See ELEMENT TROUBLESHOOTING & INSTALLATION INSTRUCTIONS in the TROUBLESHOOTING section for information on elements problems and instructions on how to install elements and element holders.

TROUBLESHOOTING FIRING PROBLEMS WITH CONE PACKS

See TROUBLESHOOTING KILN FIRING WITH CONE PACKS in the LOG, CONES, TIPS section.

THE CERAMIC PROCESS

See THE CERAMIC PROCESS in the LOG, CONES, TIPS section.

REPLACEMENT PARTS

See the PARTS section.

SERVICE

See 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.

Err1 (ERROR 1) - THE MOST COMMON ERROR

This is the most common troubleshooting problem we see. It generally means one of two things. 1) The elements have aged with increased resistance and therefor lower power. 2) A relay is not working. See The section in these instructions on Error Codes, CHECKING ELEMENT OHMS, and various paragraph on checking the relays. There are several good videos (***hotkilns.com/videos***) about how to check relays and ohms.

CONTROL DISPLAY DOESN'T SHOW ANYTHING

On/Off Switch

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

Fuse

1) Check control fuse in side of control box. Twist open the fuse holder and physically check the fuse. If the metal element inside is melted if it is blown. You can also use your digital multi-meter to check continuity across the fuse. Replace if faulty: ***hotkilns.com/control-panel-fuse***

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

Fuse Holder

If you notice that the fuse holder itself is damaged replace it. See: ***hotkilns.com/change-fuse-holder***

On/Off Switch

The on/off switch rarely needs replacing but if you have to replace that see this video: ***hotkilns.com/ replace-on-off-switch***

Plug & Cord (if you have one)

1) Make sure the power cord is plugged into the receptacle. Reseat plug. Make sure it is held firmly and that the springs inside the receptacle seem to be working.

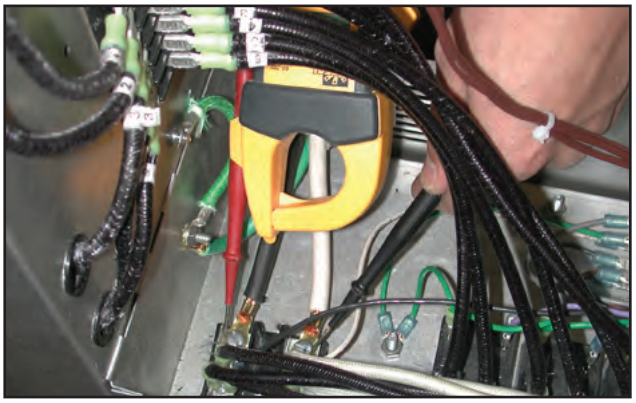
2) With power off examine the electrical cord. Look for burned or melted areas and breaks or pinched sections. Look closely at the head of the plug. If there is an internal problem with the wires and the plug parts you won't be able to see it but you may detect a softening or melting of the plastic at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

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.

If you have to replace the power cord see this video. It includes video of changing a power cord. ***hotkilns.com/ change-phase-easy-fire***

Checking voltage at the power terminal block.



Circuit Breaker / Power Source

1) Check voltage at the receptacle. **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 are 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.**

Control Transformer

See this video: ***hotkilns.com/check-control-transformer*** and ***hotkilns.com/change-transformer.***

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 (or 208) volts across terminals 1 & 4 (black and white wires) and 24 volts across terminals 5 & 8 (where the gray and brown wires come out). 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. See photo below. If you are receiving 240/208 Volts in, but not getting the proper approximate 24 Volts out, then you need to replace the control transformer. See: ***hotkilns.com/control-transformer-12-va***

2) If there is no voltage coming into terminals 1 & 4, white & black, 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.

DynaTrol: ***hotkilns.com/dynatrol-control-board***

Genesis: ***hotkilns.com/genesis-control-board***

One-Touch for School-Master kilns: ***hotkilns.com/one-touch-control-board-cone-6***

One-Touch for Doll, Liberty-Belle and Fuego kilns: ***hotkilns.com/one-touch-control-board-cone-10***

See this for how to replace: ***hotkilns.com/replace-dynatrol***

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 or page 3 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.

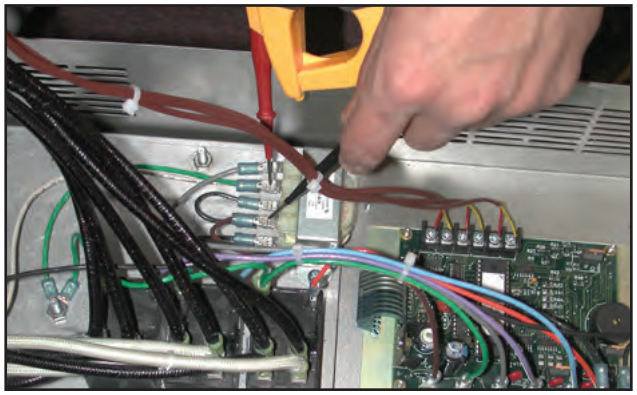
2) Check for worn wires that may have shorted against the case. Examine wire insulation. If the wire insulation has become frayed the wires could short to the metal casing which is electrically grounded.

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 either 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.

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

Checking output of the Control Transformer (DANGER-live test).



EASY-FIRE DISPLAY READS FAIL

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

Typically this will just mean that your thermocouple(s) need replacing. Overtime the thermocouple tip will corrode and cause a circuit to `FAIL`. We recommend replacing all thermocouples simultaneously rather than as they fail.

See this to replace thermocouple: ***hotkilns.com/change-thermocouple***

1) Unplug the kiln. Open the Control Panel. Remove

the offending thermocouples connection wires from the Thermocouple Terminal Strip and bind the red and yellow wires together with electrical tape. Close up the panel and plug in the kiln. The control should read room temperature for that thermocouple (approximately 90 Deg F because of the thermocouple offsets).

2) 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 wire in the Control Thermocouple Harness or the control is bad.

3) 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. See this: ***hotkilns.com/replace-dynatrol***

EASY-FIRE DISPLAY READS 2400 or CPLt WHEN IT STARTS UP

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 milivoltage (an open circuit) it interprets 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. NOTE: You have to open up the Element Cover Box and remove the thermocouples to check the ends.

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 to the Thermocouple Terminal Strip. 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 inside the Element Cover Box.

3) A very easy check is to check resistance (ohms) right on the Thermocouple Terminal Strip. Unplug kiln or disconnect from live power by turning off circuit breaker or fused disconnect switch. Open panel. You don't even have to remove the thermocouple wires. Just touch the terminal strip itself with your probes (terminals #1 & #2 for TC1, terminals #3 & #4 for TC2 and terminals #5 & #6 for TC3). 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.

4) If you have a bad thermocouple replace it with a new one. Although you may be able to "make it work" by twisting the ends of the wire together this could easily fail during an important load and could also be extremely inaccurate.

ONE-TOUCH CONTROL DISPLAY READS FAIL

Usually `FAIL` will be seen flashing along with a `tC` indicating the thermocouple has failed.

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. NOTE: You have to open up the Element Cover Box and remove the thermocouple to check the end.

See this to replace thermocouple: ***hotkilns.com/change-thermocouple***

2) Check thermocouple circuit. For instance check to make sure that all the thermocouple lead wires are firmly connected to the Thermocouple Terminal Strip. 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 inside the Element Cover Box.

3) A very easy check is to check resistance (ohms) right on the Thermocouple Terminal Strip. Unplug kiln or disconnect from live power by turning off circuit breaker or fused disconnect switch. Open panel. You don't even have to remove the thermocouple wires. Just touch the terminal strip itself with your probes (terminals #1 & #2 for TC1, terminals #3 & #4 for TC2 and terminals #5 & #6 for TC3). 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.

4) If you have a bad thermocouple replace it with a new one. Although you may be able to "make it work" by twisting the ends of the wire together this could easily fail during an important load and could also be extremely inaccurate.

DISPLAY IS NORMAL BUT KILN WON'T HEAT UP

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 the **Review Prog** button on the Easy-Fire or hold down the **Custom/Review** button on the School-Master 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. Using your multimeter set on resistance you can check continuity of each element circuit by pacing the probes on each set of outputs on each Power Relay or right at the Power Terminal Strip (as shown below).

Picture showing a Multimeter testing for continuity in an element circuit.

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.

EASY-FIRE Control Board Outputs

1) It is possible that the internal switches on the DynaTrol or Genesis 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 (where the orange, blue and purple wires come out) to ground (any green wire). CAUTION: This test should only be done by an experienced person familiar with electricity and its dangers. See this video: ***hotkilns.com/ check-switches-dynatrol***

ONE-TOUCH Control Board Outputs

1) It is possible that the internal switches on the One-Touch™ control board could be bad. You can test that by checking to see if you find voltage (12 volts DC) between the output contacts (AC1 & AC2 marked 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

See this video: ***hotkilns.com/checking-relay*** and ***hotkilns.com/change-relay***

1) You should be able to hear contactors going on and off with a soft 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 next section.

Run a Simple Paper Test

This will tell you if all kiln sections are firing. If they are not it could be a bad relay or maybe a bad internal switch on the control. See this: ***hotkilns.com/paper-test***

1. Place a little piece of paper in each element.

2. Then run a Fast Glaze (or turn the manual switches to Hi on a manual kiln) while you watch the papers.
3. They begin to smolder in about 2 minutes. After 3 or 4 minutes shut the kiln off.
4. This shows you if the elements are operating (or which ones are and which ones are not).

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 lid.

See the TROUBLESHOOTING AND FIXING BRICK PROBLEMS section in the TROUBLESHOOTING tab of your instruction manual or ***hotkilns.com/brick-troubleshooting***

Elements

1) Elements may have differentially changed in resistance which will also have an effect on uniformity. The three zone control mostly compensates for this but there are limits. Check element resistance (see section at end of this Troubleshooting Guide called “CHECKING ELEMENT OHMS”).

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.

RUN AN EASY-FIRE DIAGNOSTIC

There is a useful diagnostic program within the DynaTrol on Easy-Fire Kilns. 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.

1) Press **OTHER, 4, 4, 3.**

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

3) 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 `0Ut1`, then `0Ut2`, 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

The Dynamic Zone Control of the EASY-FIRE kilns can compensate for many uneven loading situations. The SCHOOL-MASTER kilns, however, do not employ Zone Control so pay particularly close attention to the following steps.

1) 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. You can discern how your kiln fires in each section by using cones.

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) Run an empty kiln with three cone packs top- middle - bottom. This will tell you if the load contributes to the problem.

2) Try using cone packs in all sections (top, center, bottom) of the kiln during loaded firings and keep records of what happens. See the TROUBLESHOOTING KILN FIRING WITH CONE PACKS in the LOG, CONES,TIPS, CERAMIC PROCESS tab or ***hotkilns.com/troubleshooting-cones.***

EASY-FIRE Thermocouple Offsets

Thermocouples can drift 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. You may need to adjust the offsets to trick the kiln into firing hotter or cooler in certain zones. Read about Thermocouple Offset in section 9.9 of the DYNATROL 700 INSTRUCTIONS FOR L&L KILNS in the CONTROL section of the Instruction Manual and the and the CALIBRATING THE CONTROL section in the BASIC OPERATION OF L&L KILNS WITH A DYNATROL 700 in the OPERATION section of the manual. Also see this: ***hotkilns.com/calibrating-kiln.***

ONE-TOUCH Thermocouple Offsets

Thermocouples can drift in their accuracy over time and this can cause inaccurate firings in the kiln. You may need to adjust the offset to trick the kiln into firing hotter or cooler. Read about THERMOCOUPLE OFFSET in the OPTIONS Section of the OPERATION OF L&L KILNS WITH A ONE-TOUCH™ (Deg F) in the OPERATION tab in your instruction manual. Also see this: ***hotkilns.com/calibrating-kiln.***

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°F to 140°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.

2) If you want to increase draw first close the Bypass valve on the Bypass Collection Box under the kiln. 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 the L&L VENT-SURE DOWNDRAFT KILN VENT INSTRUCTIONS in the VENT section of your instruction manual or ***hotkilns.com/vent-sure-instructions***.

KILN FIRES TOO HOT OR COLD

Firing with Cones

Try using cone packs in all sections (top, center, bottom) of the kiln and keep records of what happens. See the TROUBLESHOOTING KILN FIRING WITH CONE PACKS in the LOG, CONES,TIPS, CERAMIC PROCESS tab or ***hotkilns.com/troubleshooting-cones.***

Easy-Fire vs Vary-Fire (on DynaTrol)

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 applies to Easy-Fire and cone-fire Vary-Fire programs.

Be Careful with 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 underfired work. Just test this in small increments.

Control Settings and Calibration

You may need to calibrate your kiln with thermocouple offsets. See ***hotkilns.com/calibrate*** for the most up-to-date information on this process.

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. **You should change all thermocouples when you change elements because they age at approximately the same rate.**

KILN STALLS

1) The kiln 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. The most likely cause is old or failing elements or relays. An issue in one circuit/section/zone can cause the whole kiln to stall as it waits for the problem section to “catch up”. Check the temperatures in all zones to see if one zone is lagging behind and test elements and relays.

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.

5) Generally you will see the error message Err1 when this happens.

KILN FIRES SLOWLY - BOTH SERIES

Run a Simple Paper Test

See page 7.

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.

4) Check to see what the wire size of your circuit is. If it is very long (more than 50 feet) from your main circuit box then the wire size might need to be higher (e.g. #8 instead of #10 wire).

Element Aging

1) Elements both age and increase in resistance when fired. When they increase in resistance the amount of power they develop decreases. See the section on “CHECKING ELEMENT RESISTANCE” at the end of this guide.

2) Replacing only one element per section or zone may cause an unbalance in firing. In Easy-Fire kilns the multi-zone control will compensate for much of this imbalance automatically, however, this will not be the case in School-Master kilns.

3) Use original L&L parts for satisfactory maintenance. (Elements, in particular, provided by other vendors may not work well in your L&L kiln. Some of our customers have found this out the hard way and thought it was an L&L problem. Only L&L has the design information to make our elements properly).

4) Empty the kiln. Then turn kiln on 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. See the diagnostic program described in the earlier section called KILN FIRES UNEVENLY.

5) Elements expand and grow with age. If you fire low-fire clay and glazes and never get above cone 05 or so, your elements will last a long time, especially if you are only bisque firing. This is good, to a point. If you only low-fire, the problem you are most likely to encounter over many years is that the elements will expand as they age. The length and the coil diameter increase. Meanwhile the atmosphere in the kiln slowly eats away at the metal of the element. Although the total resistance usually increases as the elements age, sometimes it decreases, or reverses itself. This usually only happens when the elements are very old but have not yet failed completely. As the element expands, it binds up in the corners. This can make the individual coils push together and touch each other in the corners, making a short cut for the electricity, reducing the amount of element material the electricity must pass through, and therefore reducing the resistance in the whole element. This may make it hotter in the kiln, but if there is a lot of element material jammed in the corners there will not be enough material left in the coiled form to radiate the heat generated by the increased amperage and decreased resistance. Only the parts of the wire not touching the coils on either side of them will emit heat. More amperage through the electrical components in the control could cause damage if the situation continues or the resistance drops far enough. In addition, the expanding diameter of an element can make it difficult to get it out of the holder. Usually this will not happen to those firing to higher temperatures because the maximum temperature of the kiln is quickly compromised by increases in the resistance,

requiring the elements to be changed long before they can jam up in the corners. Also, high temperatures and glaze firings are more prone to eating through the element, causing it to fail, before the element can expand enough to cause the problems mentioned above. Visually inspect your elements for the above conditions and do a resistance check. If you see this it may be time to change elements.

Power Relays

As mechanical switches, power relays will fail over time. In particular, the coil which actuates the switch closure increases in resistance to the point where it no longer has the power to close, especially as it gets hot. This means that a relay can work at low temps but fail at elevated ones, making it more difficult to diagnose.

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.

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.

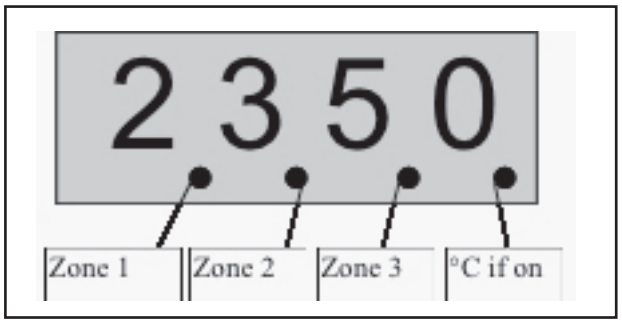
2) Check your circuit breaker for proper operation. These sometimes go bad over time.

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.

Check amperage under load with an amp-probe.

3) To check to see if all zones are firing on an Easy-Fire kiln, press 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 e18S, e23S, or e28S then you are firing at full load. If you see three dots on an e18T, 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.

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 ***hotkilns.com/non-rcf-fiber-blanket*** 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.

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 terminal hardware. See ***hotkilns.com/parts*** and filter for **Model Series** and **Elements (Terminals)**

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).

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.

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 FIRES SLOWLY - EASY-FIRE

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 models e23S and e28S are programmed to have two zones and models e23T and e28T are programmed to have three zone control. 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.

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.

Pld 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 (Pld) 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.

Change elements to graded elements.

This is an extreme solution for Easy-fire kilns but can be effective. Contact factory.

KILN HEATS TOO FAST

Relays

1) A stuck relay, meaning that the power relay is stuck closed, delivering constant power to the elements, can cause the kiln to heat uncontrolled. If the kiln is still heating even when no program is firing or even the toggle switch is off, then you have a stuck relay. Whichever section is still heating, that is the relay that needs replacing.

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 later in this section).

2.) Make sure the elements are wired properly. Check the wiring diagram.

EASY-FIRE ERROR MESSAGES

See this for a complete description on the web: ***hotkilns.com/error-codes.*** You can also see more information in

the instruction manual in the CONTROL section: Appendix E in DYNATROL 700 INSTRUCTIONS FOR L&L KILNS.

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 make the most frequent appearances. Errd means there is a temperature difference of more than 50 degrees between the zones. **Err1** indicates that the kiln is climbing too slowly in an Easy-Fire program. 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 (PF 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.

Errd

1) If the kiln was just re-assembled and Errd is the error code, then double-check that the element connection wires go to their proper power relays and that the thermocouple wires are connected to the proper zones.

2) 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:

3) 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).

4) 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.

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

6) A thermocouple wire has melted against the kiln case. The wire must be replaced.

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

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

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

10) 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, and discoloration.

Err1

1) 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.

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

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

4) The elements are the wrong resistance. Check new elements with your multimeter just to be safe. Mistakes can happen.

5) 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°C for the power wiring 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 (see the Parts List).

Err2
During a hold segment the temperature rises to greater than 50 degrees above the hold temperature which was set. The temperature must stay 50 degrees above this set temperature for 18 seconds before the error is displayed.

Err3
During a hold segment the temperature is more than 50 degrees below the hold temperature which was set. The temperature must stay 50 degrees below this set temperature for 18 seconds before the error is displayed.

Err4
The temperature is more than 50 degrees above the previous hold temperature during a ramp segment where the temperature is programmed to decrease. The temperature must stay 50 degrees above this set temperature for 18 seconds before the error is displayed.

Err5
The temperature is more than 50 degrees below the local setpoint temperature during a ramp segment where the temperature is programmed to decrease. The temperature must stay 50 degrees below this set temperature for 18 seconds before the error is displayed.

Err6
A Negative temperature is displayed. This generally indicates the thermocouple is connected incorrectly. To correct this situation, ensure the red and yellow wires are connected correctly to the controller and at all junctions. You can identify the red lead on an unmarked thermocouple with a magnet because a magnet will be attracted to the red lead.

Err7
The temperature is more than 50 degrees above the local setpoint temperature during a ramp segment where the temperature is programmed to increase. The temperature must stay 50 degrees above this set temperature for 18 seconds before the error is displayed.

Err8
When using the Easy Fire Mode, the temperature is decreasing during the last ramp segment. This could indicate that the lid was up or the peepholes open or some other physical thing is causing the kiln to decrease in temperature.

ErrP + PF
Continuous `PF` in display. Indicates a long term power outage. The kiln has been shut down. Press **1** to clear the display.

`ErrP` and the current temperature are alternately flashing. To clear the display, press the **1** key. If a firing was in progress, the kiln will continue to fire even though this message is flashing. This error can also happen as a result of RF (radio frequency) noise that resets the microprocessor. If this is suspected, the control panel should be returned to L&L for testing and possible modification. Also see ***hotkilns.com/noise***

Err-
The `Err` with a dash indicates there was a power loss to the controller while writing a program to the non-volatile memory chip. Recheck the selected program, and reprogram if necessary.

FAIL
1) If, upon inspection, the error code `FAIL` turns out to be a burned out thermocouple then replace it. You typically will not need to replace the mullite protection tube - just the internal thermocouple “element” (see ***hotkilns.com thermocouple-k-standard***). 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.

2) 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.

A) Turn OFF the power at the Disconnect Switch or Circuit Breaker and/or unplug the kiln.

B) Open the cover of the control.

C) Remove the Thermocouple wires from the DynaTrol and the Thermocouple Terminal Strip. Take out of the Control Box and set aside.

D) Make tiny “U” shaped jumper wires from paperclips and jumper between each of the + and - connections on the DynaTrol board.

E) 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.

F) Close up the Control Box and 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).

Turning Error Codes On or Off

1) When you receive your DynaTrol the error codes are turned on. In most cases, you will want the error codes on. They can be turned off if you are doing special firings, such as jewelry or glass firing where the kiln is opened while hot. Turning the error codes off turns off the dynamic zone control feature that keeps the temperature in the kiln even top to bottom. It eliminates nuisance shut downs but side steps built in fail-safe measures.

2) The only Error codes that this can not turn off are Err6, FAIL, and ErrP in both the "Easy Fire" and "Vary Fire" modes. In addition Err1 and Err8 are not turned off in the last segment of an "Easy Fire" program. This is because the built in calculations would make no sense if the kiln were firing too slowly.

3) To turn Error Codes off do the following:

4) Press the **OTHER** button several times until you see ErCd.

5) Press **ENTER**

6) Display will say On (which indicates that the error codes are turned on) or OFF (which indicates that the Error Codes are Off). You can toggle back and forth between on and off by pressing the **1** key.

7) Hit **ENTER** when you see On or OFF and you want to keep that setting

8) CPL will display for a few seconds. IdLE, tC2, and the current temperature then cycle in the display.

Can you restart the kiln after it stops because of Error Codes?

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 tC2, 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 tC2'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, tC2, 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.

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, a relay, or a thermocouple burn out.

ONE-TOUCH 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 make the most frequent appearances.

Errd

Error d indicates that the kiln temperature is 100°F above the traveling set-point, which is the current desired temperature in the kiln. The traveling set-point will increase or decrease according to the programmed rate.

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

2) The Thermocouple Lead Wire has melted against the kiln case. The wire must be replaced.

3) The thermocouple is about to fail. Perform a physical inspection, or just re-start the kiln and monitor it carefully.

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

5) The relay has just failed.

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, and/or discoloration.

Err1

Error 1 indicates the temperature in the kiln is rising during an up ramp slower than 15°F/hr. If this rate continues for 8 minutes the firing will be stopped. Err1 may be an indication that the elements are worn or that a relay has stopped working.

1) 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. Err1 can mean either you need new elements or a new relay. 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.

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

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

4) The elements are the wrong resistance. Check new elements with your multimeter just to be safe. Mistakes can happen.

5) 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°C for the power wiring 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 (see the Parts List).

ErrP

ErrP is displayed whenever there is a power interruption that is long enough to stop the firing. If the power interruption is brief the kiln will continue to fire when power is restored; in this case there will no indication of a power failure. To clear the error, press any key.

This error can also happen as a result of RF (radio frequency) noise that resets the microprocessor. See ***hotkilns.com/noise***

ErrF

ErrF indicates the temperature in the kiln is decreasing during a down ramp less than 15°F/hr. If this rate continues for 8 minutes the firing will be stopped. ErrF may be an indication that a relay has stuck in the on position.

tC-

tC- indicates that the red and yellow thermocouple wires are reversed. Make sure they are right all the way through the circuit.

FAIL

See the section in these Troubleshooting Instructions called DISPLAY READS FAIL and tC.

Can you restart the kiln after it stops because of Error Codes?

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 Err1 at the end of the firing will re-start but will probably re-occur in about 22 minutes.

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.

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 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 the 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, 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.

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.

SERVICE FOR YOUR KILN

WHERE TO GET SERVICE

See the SERVICE Section of your Instruction manual or see ***hotkilns.com/technical-support***

WHERE TO BUY PARTS

You can order parts for your L&L Kiln through L&L or your local distributor. See the Parts List that pertains to your particular kiln model. Our on-line parts list is easy to navigate. See ***hotkilns.com/parts***. Standard Parts are typically shipped the day after an order is placed. Rush service is available.

REPLACEMENT ELEMENTS

Replacement Elements made by L&L Kiln Mfg., Inc. are designed for each individual model for long life and superior performance. Good element design is a complex balance of watt density, design voltage, stretch ratio, wire gauge, element length and material. It takes many hours and years of experience to design a good element for each model. Do not expect an outside supplier with no interest in your kiln performance or long experience with L&L kilns to spend the necessary time to do this right. In the end you will not save

NOTE: Many of these procedures have accompanying instructional videos. Look out for the video links in each section or go to hotkilns.com/videos for more.

REMOVING PANEL FOR SERVICE

1) It is easy to access the inside of the control panel for troubleshooting. In addition it is easy to remove this panel and send it back to the factory for inspection and/or repair.

2) Disconnect power and unplug the kiln.

3) Follow the instructions in ASSEMBLY INSTRUCTIONS FOR in the ASSEMBLY tab of your instruction manual or see ***hotkilns.com/assemble-easy-school*** in order to remove the Control Box for Easy-Fire and School-Master kilns.

4) Pack the control panel with cushioning material such as bubble wrap, balled-up newspaper or foam in a cardboard box and follow instructions from the factory or your local distributor about where to send it. DO NOT SEND A CONTROL PANEL WITHOUT CALLING FIRST.

CAUTION: The controller contains electronic components which are sensitive to static electricity. Before handling the controller dissipate any static charge you may have by touching metal or a screw on the controller panel, the electrical box, the kiln lid, or some other grounded object.

REPLACING DYNATROL

See this video: ***hotkilns.com/replace-dynatrol***

1) Unplug kiln or turn off the kiln at the fused disconnect switch.

2) Remove the four #6 screws that hold the DynaTrol in place from the front face of the control panel.

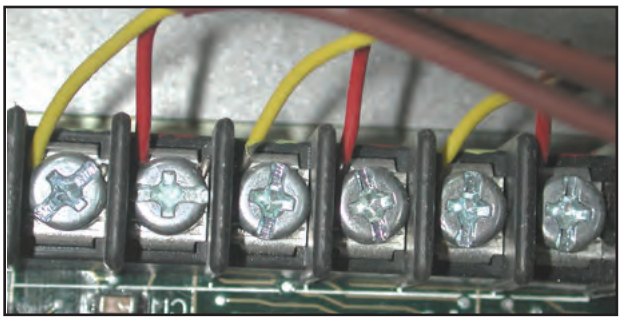
3) Open up the control box and hinge down for access (as shown on page 2)

4) Pull off the spade connectors from all the connection points on the back of the control. Loosen the screws that hold down the thermocouple wires and pull out the wires from under the screw heads. It is OK to remove the screws if this is easier for you. First note where all the wires go. These are all clearly marked with color coding on the Wiring Diagram.

5) Pull old control out. Put new control in and screw in place with the #6 mounting screws. Replace wires on proper connectors.

6) Be careful to get the Red or Yellow of the thermocouple wires to match the colors painted on the DynaTrol board.

Picture showing thermocouple wires installed on DynaTrol. There is no need to wrap the thermocouple wire around the screw head- although it is OK to do so. However, do make sure the wire is tight and secure UNDER the screw head.



7) Double check that the proper color coded wire goes to the proper terminal.

Orange = OUT 1

Blue = OUT 2

Purple = OUT 3 (not on e18S, e23S, and e28S)

Gray = AC1

Green = CT

Brown = AC2

TC1 = TC1

TC2 = TC2

TC3 = TC3 (not on e18S, e23S, and e28S)

REPLACING ONE-TOUCH™

See this video: ***hotkilns.com/replace-dynatrol*** (Note the process of changing a DynaTrol is very similar)

1) Unplug kiln or turn off the kiln at the fused disconnect switch.

2) Remove the four #6 screws that hold the One-Touch™ in place from the front face of the control panel.

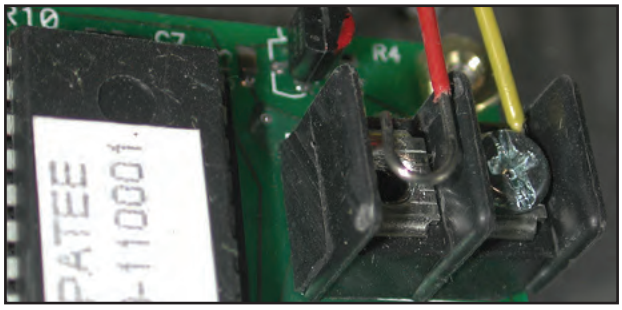
3) Open up the control box and hinge down for access (as shown on page 3)

4) Pull off the spade connectors from all the connection points on the back of the control. Loosen the screws that hold down the thermocouple wires and pull out the wires from under the screw heads. It is OK to remove the screws if this is easier for you. First note where all the wires go. These are all clearly marked with color coding on the Wiring Diagram.

5) Pull old control out. Put new control in and screw in place with the #6 mounting screws. Replace wires on proper connectors.

6) Be careful to get the Red or Yellow of the thermocouple wires to match the colors painted on the control board.

Picture showing thermocouple wires installed on Control. One screw is removed to show how the TC wire should be prepared with a "U" shape.



7) Double check that the proper color coded wire goes to the proper terminal.

Orange = J5

Gray = J2

Green/Yellow= J4

Brown = J3

REPLACING TRANSFORMER

See this video: ***hotkilns.com/change-transformer***

1) Unplug kiln or turn off the kiln at the fused disconnect switch.

2) Open up the control box and hinge down for access (as shown on page 2).

3) Using needle nose pliers pull off the wires from the transformer. THIS CAN BE TRICKY. It can take a good bit of force sometimes to remove these little spade connectors. You will probably not be able to do it with just your hands.

Also the spade connectors on the transformer are not very strong. Take your time. Of course, if you are replacing a bad transformer it doesn't matter if you damage it.

Showswires being pulled off the control transformer.

4) Unscrew the two #8 screws that hold the control transformer onto the Contactor Panel and remove the transformer.

5) Before installing the new transformer put the small jumper wire onto terminals #2 and #3 on the bottom row of terminals. Note the little numbers by the contacts.

REPLACING POWER RELAYS

See this video: ***hotkilns.com/change-relay***

1) Unplug kiln or turn off the kiln at the fused disconnect switch.

2) Open up the control box and hinge down for access (as shown on page 2).

3) Pull off the wires to the relay(s) that you are replacing. Everything is color coded and marked so you can refer to the wiring diagram when replacing if you forget where the wires go. The wire lengths also don't give you much choice and will help keep you from making a mistake.

4) Unscrew the #8 screws that hold the relays in place. Remove old relay and replace with new one.

5) Visually inspect the wire connectors. Do they look corroded or "cooked"? Are the wires frayed? Any corrosion on the wire itself? If any of this is questionable you may need to replace the appropriate wire harness.

6) Reconnect all wires. Visually inspect to make sure the spade connectors are down as far as they can go and feel to see that they are tight (a gentle tug should not remove one). If they are loose for some reason remove the wire and slightly squeeze the spade connector with pliers to tighten it.

IMPORTANT: The slip on wire connectors can not be loose or corroded. If there is a bad connection then heat will be generated and the component that they slip onto (relay, terminal strip, etc) may overheat and fail. If you squeeze the slip on terminal to make it tighter - be sure to squeeze it evenly so that one side is not tight and the other

REPLACING FUSE HOLDER

See this video: ***hotkilns.com/change-fuse-holder***

1) Unplug kiln or turn off the kiln at the fused disconnect switch.

2) Open up the control box and hinge down for access (as shown on page 2).

3) Remove the wire connectors from the end of the fuse holder on the inside of the panel.

4) Unscrew the nut that holds the fuse holder in place.

5) Remove and replace with a new fuse holder. Reconnect wires.

REPLACING THERMOCOUPLES

See this video: ***hotkilns.com/change-thermocouple***

1) Unplug kiln or turn off the kiln at the fused disconnect switch.

2) Remove the Control Box and Element Terminal Box as shown in the Assembly Instructions.

3) Remove the Thermocouple Lead Wires.

4) Unscrew the Thermocouple from the kiln (these are #6 x 1-1/2" screws)

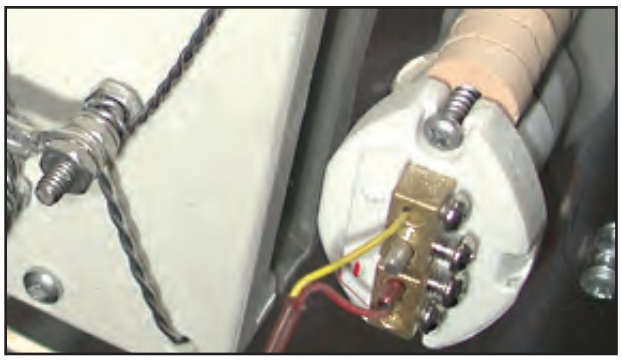
5) Remove Thermocouple.

6) Remove Thermocouple Protection Tube. Shake it and dump out the oxide powder that has accumulated inside the tube. Then reinsert the tube into the hole in the kiln.

7) Install a new Thermocouple and screw in place.

8) Replace Thermocouple Lead Wires and tighten. Be sure to get Red matched to the Minus (-) sign and the Yellow matched to the Plus (+) sign.

Picture showing end of thermocouple.



CHECKING ELEMENT OHMS

See this video: ***hotkilns.com/test-resistance-ez***

See the instructions in the TROUBLESHOOTING Section of your instruction Manual (ELEMENT TROUBLESHOOTING & INSTALLATION INSTRUCTIONS)or here: ***hotkilns.com/element-troubleshooting***

Element Ohm Charts

Check your wiring diagram for resistence values for your kiln.

CHANGING ELEMENTS

SEE THESE VIDEOS FIRST

For most top loading kilns:
hotkilns.com/change-elements-ez

For kilns with Quad elements:
hotkilns.com/change-element-quad

See the instructions in the TROUBLESHOOTING Section of your instruction Manual (ELEMENT TROUBLESHOOTING & INSTALLATION INSTRUCTIONS) or here: ***hotkilns.com/element-troubleshooting***

REPLACING ELEMENT HOLDERS

See this video: ***hotkilns.com/change-element-holder***

1) When ordering a new holder provide model number of kiln and length of the element holder. See the Parts List for this information.

2) 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.

See the extensive instructions in the TROUBLESHOOTING Section of your instruction Manual or here: ***hotkilns.com/element-troubleshooting***

CRACKS IN THE LID & BOTTOM

See these videos for bad cracks:
hotkilns.com/fix-cracks-front-load
and ***hotkilns.com/repair-cracked-top***

See this video for hairline cracks:
hotkilns.com/repair-hairline-cracks

See the instructions in the TROUBLESHOOTING Section of your instruction Manual (TROUBLESHOOTING & FIXING BRICK PROBLEMS)or here: ***hotkilns.com/brick-troubleshooting***

TIGHTENING STAINLESS BANDS

See these videos:
hotkilns.com/replace-side-brick-kiln
h***otkilns.com/replace-side-brick-davinci***

See the instructions in the TROUBLESHOOTING Section of your instruction Manual (TROUBLESHOOTING & FIXING BRICK PROBLEMS)or here: ***hotkilns.com/brick-troubleshooting***

REPLACING FIREBRICK IN SIDES

See these videos:
hotkilns.com/replace-side-brick-kiln
h***otkilns.com/replace-side-brick-davinci***

See the instructions in the TROUBLESHOOTING Section of your instruction Manual (TROUBLESHOOTING & FIXING BRICK PROBLEMS) or here: ***hotkilns.com/brick-troubleshooting***

DRILLING OUT HOLES FOR PEEPHOLES

See the instructions in the TROUBLESHOOTING Section of your instruction Manual (TROUBLESHOOTING & FIXING BRICK PROBLEMS) or here: ***hotkilns.com/brick-troubleshooting***

DRILLING OUT FOR ELEMENT CONNECTIONS

See the instructions in the TROUBLESHOOTING Section

of your instruction Manual (TROUBLESHOOTING & FIXING BRICK PROBLEMS) or here: ***hotkilns.com/brick-troubleshooting***

REPLACING BOTTOMS

See the instructions in the TROUBLESHOOTING Section of your instruction Manual (TROUBLESHOOTING & FIXING BRICK PROBLEMS) or here: ***hotkilns.com/brick-troubleshooting***

REPLACING LIDS

See the instructions in the TROUBLESHOOTING Section of your instruction Manual (TROUBLESHOOTING & FIXING BRICK PROBLEMS) or here: ***hotkilns.com/brick-troubleshooting***

MORE ABOUT TROUBLESHOOTING CERAMIC PROBLEMS

1) We provide many firing tip brochures from Orton in the pdf library on our website. For a more in depth explanation Orton has a great booklet called Successful Firing Practices. They also have a number of other booklets available such as Cones and Firing (20 pages), Using Orton Cones/Temperature Charts, Kiln Safety Booklet, Kiln-Sitter Maintenance & Repair and Porcelain Firing Guide. Contact Orton at 614-895-2663 for more information. See ortonceramic.com for lots of very helpful information on how to use cones and for many firing tips and great information on firing kilns.

2) Check out a book called Electric Kiln Ceramics written by Richard Zakin, a book called What Every Potter Should Know by Jeff Zamek and Mastering Cone 6 Glazes by Ron Roy and John Hesselberth. Check out a book called “Ceramic Faults and their remedies” by Harry Fraser, A&C Black, London.

4) The magazines Ceramics Monthly (***ceramicsmonthly.org***) and Clay Times (claytimes.com) have many good articals and resources.

5) Also check out the great web resource, the Clayart discussion group at ***potters.org***.

6) Check the links page on our web site.

7) Your ceramic supplier is a good source of knowledge and will have a wide variety of helpful books and videos as well

Photo of a 1-phase control panel for a three section Easy-Fire kiln

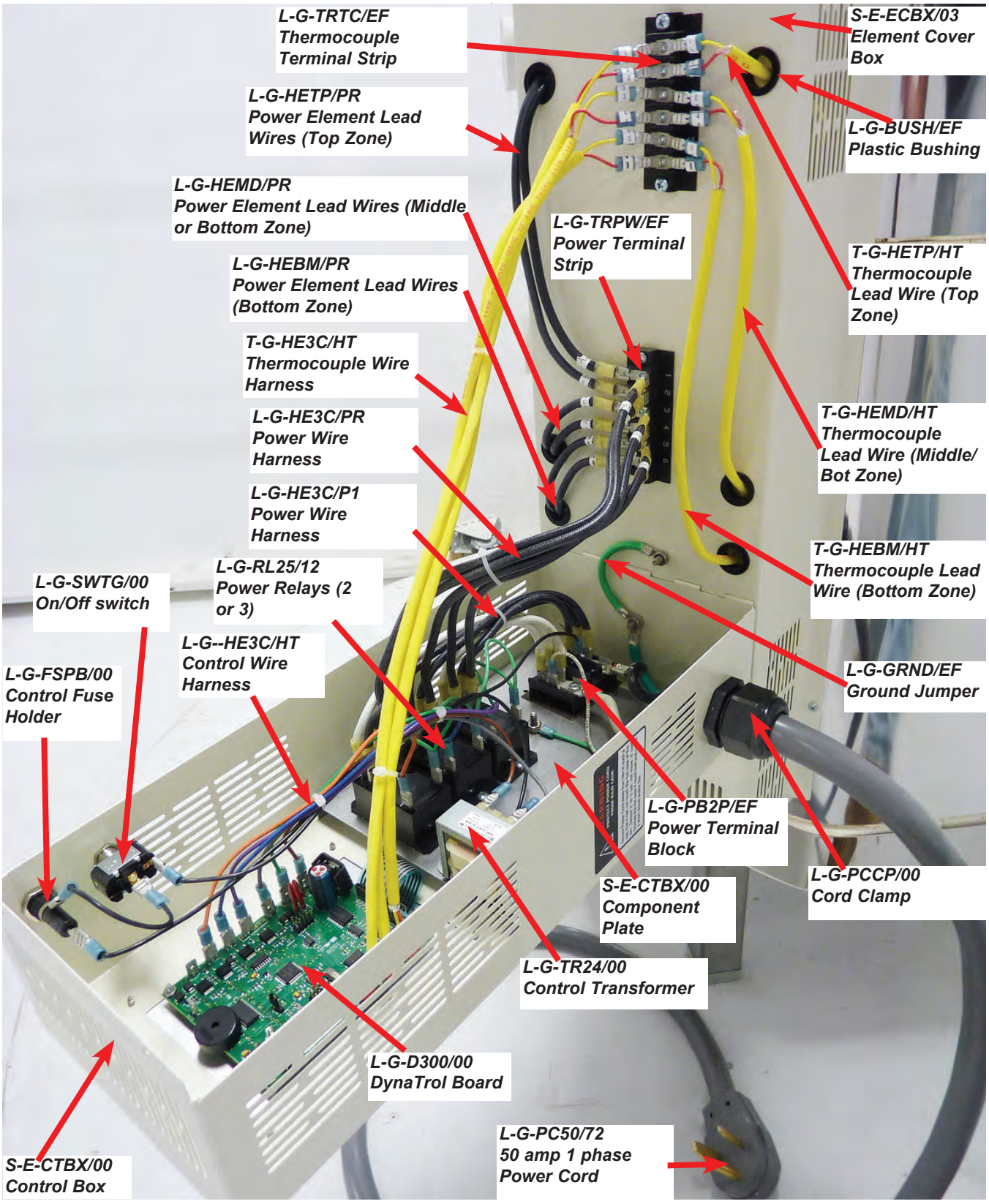
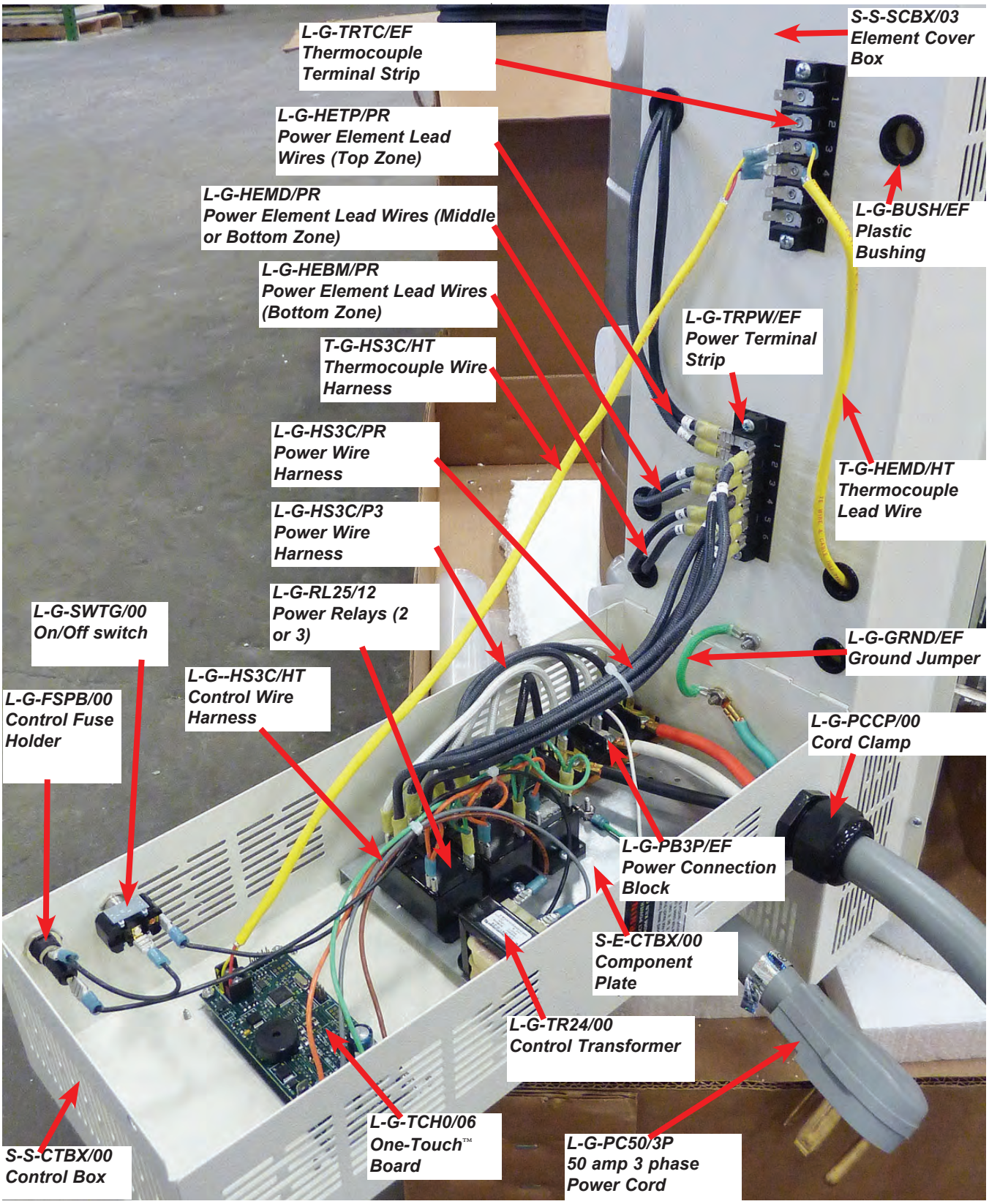


Photo of a 3-phase control panel for a three section School-Master kiln



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TROUBLESHOOTING KILN FIRING WITH CONE PACKS

BASIC CONE INFORMATION

PYROMETRIC CONES

Pyrometric cones are made of clay and other minerals and are precisely formulated to soften when fired in a kiln. They will bend over when they have absorbed a certain amount of heat. The amount of heat is related to both time and temperature. They mirror fairly accurately what goes on in a ceramic body and can be a more reliable guide to firing than a thermocouple instrument.

Differing materials in the cones result in different firing temperatures. The cones you are likely to use in an L&L kiln are numbered from Cone 022 to Cone 10 (coldest to hottest). The number is imprinted on the cone. Usually clay and glaze comes with a recommended cone to fire to. A cone is a tall (about 2-½") pyramid made from specific damp-pressed ceramic materials. Each cone has a slight lean to it when placed on a flat surface. Be careful not to drop cones or expose cones to moisture.

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.

LARGE SELF SUPPORTING CONES

Although there are various types of cones available we recommend using the "self-supporting large cones". They have a built-in base that allows the cone to sit flat while always placing the pyramid part of it at the proper angle. The angle is there to ensure that the cone bends in the direction you want it to, and doesn't just slump and puddle.

CONE PACKS

The best way to use the cones, especially if they are all you have to tell how hot your kiln is getting, is to use 'cone packs', or the three cone system. The three cones are placed in a line, aimed so that when they fall, they will fall in a line. The first cone to fall should be in the front of the three cone line. This cone should be one cone number lower than the one you wish to fire to. The target cone (the cone you wish to fire to) should be the next one to fall and should be in the middle. The last cone should be one cone number higher than the target cone. The first cone is to warn you that the firing is almost done. The target cone tells you when to turn off the kiln, and the last cone tells you if the kiln got hotter than you thought it did.

Picture of a "cone pack" (Courtesy of Orton). The ones in the back are before the firing and the ones in the front are after a perfect firing/ These are Self-Supporting Large Cones.

USE CONES TO CONTROL ACCURACY IN AN AUTOMATIC KILN

We recommend checking the accuracy of your control and thermocouples every so often by placing at least one large cone (the target cone or cone number you are firing to) in the top, middle and bottom. Thermocouples will drift in their accuracy, but you can adjust the cone offset or thermocouple offset (or both) to compensate for this. You know how many degrees off the thermocouple reads at the end of the firing. Using a cone near the thermocouple and a "cone to temperature chart" will help to calibrate a thermocouple accurately. Remember though, cone temperatures are affected by their location in the kiln, the angle at which they are held, and the rate at which they are heated. Slight variations throughout the kiln should be expected. You can see a "cone to temperature" chart in the LOG, CONES, TIPS, CERAMIC PROCESS section of your manual or at ***hotkilns.com/orton-cone-chart***.

TROUBLESHOOTING FIRING PROBLEMS

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

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 cone the firing should go to is called the target cone, 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. Pay attention to how you position the cones as they are designed to only fall in one particular direction if placed on a level surface. You do not want a lower-numbered cone stuck in the cone pack behind a higher-numbered cone because the lower-numbered one will fall first and might lean against or knock over the higher-numbered cone, which will compromise the accuracy of both cones.

2) Once the cone packs are positioned on shelves (or on a post lying on its side) and are visible through the peepholes, fire the kiln to the middle cone's number.

3) Near the end of the firing start watching the cone packs. Look for the first cone to fall over in each pack, not necessarily at the same time, but pretty close, probably in the middle zone first.

4) Now watch for the middle cone in each pack. Keep checking the DynaTrol display to be sure it does not say `CPLt`. The middle cone in each pack should start to fall at pretty much the same time in the top, middle and bottom of the kiln. When the tip of the cone touches the melted cone in front of it note the temperature readout on the display for that zone's thermocouple.

a) If the middle cones did not go down together then immediately note the differences in each thermocouple reading from the one thermocouple in the same zone as the first cone that went down. Later on, use the "thermocouple offset" feature to add or subtract degrees from each thermocouple accordingly. Use the differences between the thermocouple readings as a guide to know how much to offset each thermocouple.

b) If the three thermocouple temperatures are close enough to be reading the same thing (the middle cones did all go over at the same time), then the kiln should say `CPLt` right when the cone tips bend over and touch or just before it. If the kiln is still firing after this point, note how many degrees higher it goes before shutting itself off. Then use the "cone offset" feature to change the temperature equivalent of that cone. Subtract the same amount of degrees from the temperature equivalent that the kiln over-fired the cone by.

c) If the kiln shut itself off before bending the cones properly, you want to reprogram it and then re-start it as quickly as possible. Note the temperature at which the kiln shut down. Get from `CPLt` to `IdLE`, `tC2`, current temperature by pressing either **START/STOP** or **ENTER**. Re-program the same program to one cone number higher, then re-start the firing. Do these steps quickly. Now watch the middle cones again and note at what temperature the cones properly bend. If they bent while you were programming then just offset the temperature by 5 or 6 degrees. Shut the kiln off once you note that temperature. Using the "cone offset" feature, add the difference of the two readings to that cone's temperature equivalent.

Note: From the factory, the settings that interpret temperature signals in the DynaTrol are hard-programmed; they will not change unless part of the microprocessor has been affected. There is a range of acceptability for the accuracy however and the cone offset feature exists to allow you to fine tune the kiln to particular sized loads. It is best to use all new thermocouples to properly tune the cone offset before individual thermocouples begin to drift. Even keeping one new thermocouple solely for calibrating the individual thermocouples will help to keep the kiln accurate.

CALIBRATING YOUR DYNATROL

This is also covered in the instruction sheet called BASIC OPERATION OF L&L KILNS WITH A DYNATROL 700 in the OPERATION section of your manual or at ***hotkilns.com/calibrating-kiln***.

HELPFUL VIDEOS & LINKS

Calibration

More information on calibrating your kiln:
hotkilns.com/calibrating-kiln

Cone Offset

How to change cone offset in a DynaTrol:
hotkilns.com/change-cone-offset

How to change the thermocouple offset on a DynaTrol. This helps you calibrate the control to match your kiln:
hotkilns.com/change-thermocouple-offset

Firing with Witness Cones

This video shows you how to use witness cones to check the accuracy of the control and your kiln in an L&L Easy-Fire kiln. This video applies to any kiln:
hotkilns.com/firing-kiln-witness-cones

Orton Ceramic Institute

See ***ortonceramics.com*** for lots of very helpful information on how to use cones and for many firing tips and great information on firing kilns. See this: ***ortonceramic.com/Resources/Pyrometric_Cones***

Cone Chart

You can see a "cone to temperature" chart in the LOG, CONES, TIPS, CERAMIC PROCESS section of your manual or at ***hotkilns.com/orton-cone-chart.***

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BASIC ELECTRICITY TROUBLESHOOTING FOR L&L KILNS

SAFETY CHECKLIST

When repairing a kiln or working around any electrical equipment, always remember...

1. Wear appropriate PPE (personal protective equipment): rubber-soled/closed-toed shoes, safety goggles, or face shield if possible, work gloves, long pants and short sleeves, and remove all jewelry.

2. Do not work on live equipment unless absolutely necessary: unplug power cable and lock out electrical power.

3. If working with live equipment: use only one hand near the equipment; when touching the leads of a multimeter to your circuit, clamp one of them in place and operate the other lead with one hand, keeping your free hand away from the equipment.

4. Clean the area around the kiln and make sure it's free of water.

5. Use the proper tools and don't improvise: for example, use a fuse puller to remove blown fuses; don't use a screwdriver for this.

BASIC ELECTRICITY FOR KILNS

Electricity can be measured in four different ways: amps (current), volts (energy or potential energy), ohms (resistance), and watts (power). You will likely recognize a few of these as in your 15 amp, 120 volt outlet or your 60 watt light bulb. Let's go into a little more detail on each component of electricity.

Volts:

Volts can be thought of as the force or pressure pushing the electricity through the circuit. The higher the voltage the higher the force. (This is why high voltage can be dangerous). Voltage will likely be predetermined in your location, but it varies from place to place. In the United States, we typically have 240V available in most homes with 208V or 480V available in industrial or commercial settings and many schools. Some of your major household appliances (like ovens and house-sized air conditioners)will use 240V while your typical household outlets will use 120V for your small electronics.

Amps:

Amp(ere) is the unit of measurement for electrical current or flow. The higher the amperage the greater the total volume of electricity. Current is important because it represents the strain that will be placed on your electrical system. Your house for example will only have a set amount of amps (very typically 200 amps) that it can handle and every wire and component must be sized to handle the appropriate amps.

Ohms:

Ohms are the measure of resistance to flow in an electrical circuit. Certain materials are more conductive than others (think copper vs. rubber). Copper has a very low resistance, which allows electricity to freely flow. Our elements are made of a metal alloy that is somewhat resistive, which is good because where there is resistance, heat builds up. Otherwise the kiln would never get hot!

Watts:

Finally, watts are the measure of power. This is important because the more power you have, the faster your kiln will heat up and the higher temperature it can get to. Larger kilns will need more watts than smaller ones, as they need more power to heat up the space in them.

Ohm's Law:

All four of these measurements are related to each other in what is called Ohm's Law. Using this, we can use two measurements to find a third. For example, we can find a kiln circuits amperage by dividing volts by ohms.

Mathematical Relationships (formulas)

For use with single phase only: The electrical industry has designated letters to stand for amps, volts, ohms, and watts.

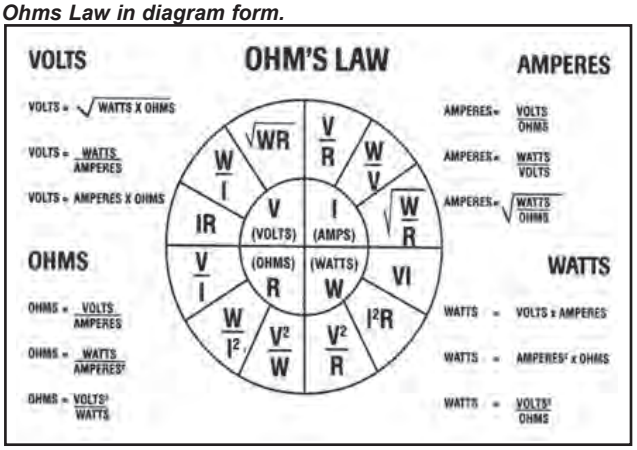
Amps = "I" (think "intensity of amperage")

Volts = "E" (think "energy")

Ohms = "R" (think "resistance") (Ω is the symbol used to indicate ohms)

Watts = "P" (think "power")

Ohms Law in diagram form.



Single vs. Three Phase:

Electricity can also be delivered in two ways: single or three phase. Single phase means that electricity is moved along two “hot” wires. Think of it as flowing in one wire and out the other. Three phase meanwhile utilizes three “hot” wires to distribute electricity. The advantage here is that current is more spread out meaning that your kiln will draw fewer amps. Fewer amps means smaller wire and circuit breaker are needed.

THE WATER ANALOGY FOR UNDERSTANDING ELECTRICITY IN KILNS

Electricity is analogous to water

Electricity is easiest to understand when compared to water flow and pressure. As far as your kiln is concerned, its supply of electricity is like a huge reservoir of water. Imagine that a kiln is like a bucket with small holes for the water to leak out of (which would represent the heat loss of the kiln). Imagine that the water flowing into the bucket is like electricity. To fill two different sized buckets with the same porosity (i.e. same number of small holes per square inch which would be like the standard heat loss in firebrick) you will need different flow rates of water. If you turn on the small 2.6 cubic foot model e18S, electricity will flow into the kiln at one particular rate, measurable in “watts” per hour (actually Kilowatts per hour, or kWh, 1000 watts = 1 kWh). If you turn on a T3445 which has 34.5 cubic feet, electricity will flow into it at a much greater rate, still measurable in watts per hour. Likewise the larger bucket needs more gallons per hour than the smaller bucket not only to get filled at the same speed but to get filled up at all (because of the porosity). This analogy can help you to understand why it takes longer or might even be impossible for some kilns to heat up to very high temperatures. Note that the heat loss gets greater as the kiln gets hotter so it takes more and more electricity to heat a kiln the hotter it gets. It is like the porosity increasing over time as you fill up the bucket in the above analogy.

Amps (amperes) = flow

If the volume of water can be measured in gallons per second, then the volume of electricity flowing is measured in “amps”, a particular amount of electrons flowing through a wire in one second.

Volts (voltage) = pressure

Water is forced through the pipes by water pressure. A water tank at the top of a hill will provide you with more water pressure than a water tank only half-way up the hill. Electricity is forced through the wires by electrical pressure, called volts. A 12 volt battery is like the lower water tank: there is not much voltage to push the electrons along the wire. A 120 volt house power source is like the higher water tank, pushing a much greater volume of electricity (many more amps) down the same diameter wire than the 12 volt source.

Ohms (resistance) = resistance to flow

Say your house in the valley is somehow fed by both of these two water tanks. Sink number one has water from the top-of-the-hill water tank flowing to it. Sink number two, which is right next to sink number one, has water from the half-way-up-the-hill water tank flowing to it. Sink number one will have much greater water pressure and much more water coming from it than sink number two (assuming the same size orifice in the faucet). To get them to flow at the same rate, you must use a smaller diameter pipe to connect the water to sink number one than the pipe connecting the water to sink number two. By restricting the heavier flow of water with a smaller pipe, you can make the same amount of water come out of each sink. Electricity can be restricted (or “resisted”) as well. A small diameter wire can resist electricity like the smaller pipe resisted the water. In the same way that a large pipe will let more water through than a small pipe, a thick wire will have less resistance and will allow more electricity through than a thin wire. A short wire will have less resistance and let more electricity through than a long wire. This amount of electrical resistance can be measured in terms of “ohms”. The higher the number of ohms, the higher the resistance of the circuit.

Watts (power) = work

In the same way that the combination of water pressure and the actual water itself (measured in gallons per second) comes together to perform “work”, the combination of voltage (pressure) and amps (volume) comes together to perform “work” as well. This electrical work is measured by multiplying the values of the volts and the amps together. The result is called “watts”. Watts are a measurement of the work done by electricity.

Single Phase Power

Like voltage, the phase is specific to each location. The huge electrical lines you see across the country use three “hot” lines, what is termed “three phase”, with 1000’s of volts

running through them. From these three “hot” lines any two can be tapped (eventually, after stepping down the voltage through transformers) to provide power for any single phase circuit. To use a small electrical appliance as an example, if you trace the two wires that make up the cord for the appliance back through the lines you will eventually end up at two of the three wires from some main power line, and from there back to the generating plant. Often the power for a residential area is all single phase, from a junction station to a single house in the neighborhood. There may be no way for three phase power to be obtained without the equipment (mainly the extra line) in place. Industrial areas, large facilities, and schools usually have access to three phase power. Even then, sometimes the three phase ends at the main junction box in the building and the single phase power supplies branch out from there.

Three Phase Power

Three phase power uses three “hot” wires to supply electricity to the circuit. From the main power supply, the three lines remain three lines all the way through to the circuit. The same amount of electricity is simply split over three wires instead of two. The benefit of three phase is not a lower electric bill, since the kilowatts used are still the same. The benefit is in the cost of setting up the supply line itself. For example, a model T3427 208 volt in single phase draws 119.88 amps. It will need two “2/0” awg wires to supply it with power. The circuit breaker would need to be a two pole, 150 amp breaker, and any safety switches would need to be rated for at least 150 amps, if not more. That same kiln in three phase will draw 69.21 amps. It would only need three 2 awg wires to supply it with power. The circuit breaker would only need to be a three pole, 90 amp breaker, and any safety switches would only need a 90 or more amp rating. The cost of material and components for creating electrical lines are expensive. This cost increases exponentially with the size of the service. A 2/0 awg wire costs considerably more per foot than a 2 awg wire. The size of the conduit that houses the wires costs more as the diameter increases. A 150 amp circuit breaker is large and has a heavy protective housing. It has mechanical arms to provide leverage and physically move the electrical contacts together or apart. A 90 amp breaker is more familiar looking, with its plastic switching arm and the way it sits side-by-side with the other breakers in the box. The total cost (especially if power needs to be run for some distance) is much less for three phase than for single phase. The cost for another wire in the three phase is almost always offset by the potentially vast difference in total cost between installing single and three phase.

SERIES CIRCUITS

A circuit that only has one path over which current can flow is a series circuit.

A break in any part of a series circuit stops current flow.

All components in a series circuit see the same amount of current; therefore, each component must be capable of carrying that number of amperes.

RULES FOR SERIES CIRCUITS

1) The value of a current (amperage) flowing in a series circuit is the same through all parts of the circuit.

2) The total voltage of a series circuit is equal to the sum of the voltages across each part of the circuit.

3) The total resistance (ohms) of a series circuit is equal to the sum of the resistances across each part of the circuit.

4) Line voltage is divided across each component in a series circuit in proportion to the component resistance values. Referring to the schematic below, the total resistance is (25Ω + 30Ω = 55Ω). Voltage measured between points A and B is:

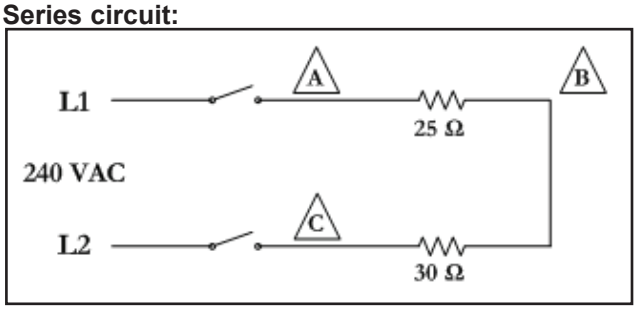
240 x (25Ω/55Ω) = 109 Volts.

Voltage measured between points B and C is:

240 x (30Ω/55Ω) = 131 Volts.

Note that 109 + 131 = 240 volts

Series circuit:



If there were (2) resistances whose values were equal, the voltage would be divided equally in half, and would measure 120 Volts.

Measuring Resistance in Series Circuits

The total resistance of a series circuit is the sum of all the individual resistances.

PARALLEL CIRCUITS

A circuit that has two or more current paths is a parallel circuit.

Each component is connected to line voltage, and current still flows through part of the circuit if one component fails.

Each component must be capable of withstanding the full line voltage.

The amount of current (amperes) varies according to the resistance of each separate part of the circuit.

The more circuit paths, the less opposition to the flow of electrons. Total circuit resistance decreases when more paths are added.

RULES FOR PARALLEL CIRCUITS

1) The total current (amperage) supplied to a parallel circuit is equal to the sum of the currents through the branches.

2) The voltage across any branch of a parallel circuit is equal to the supply voltage.

3) The total resistance of a parallel circuit is always less than the resistance of any of the branches.

Example of a Parallel Circuit in an L&L kiln

The following parallel circuit is typical of the DaVinci, Doll and J2900 kiln rings; there are (3) elements per ring, connected in parallel.

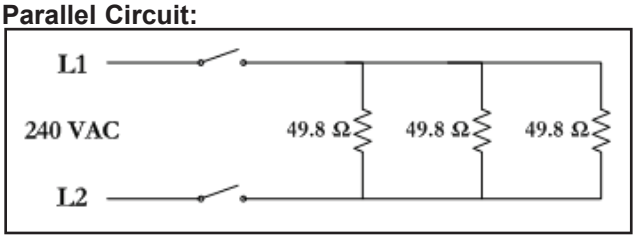
In this example, each element has a resistance of 49.8Ω. At 240 VAC, each element develops

(240 VAC/49.8Ω) = 4.82 Amperes

The total circuit amperes, then, is

4.82 + 4.82 + 4.82 = 14.46 Amperes.

Parallel Circuit:



Measuring Resistance in Parallel Circuits

The total resistance is always less than the lowest reading of a single element. Often this is difficult to measure if all the elements in the circuit are connected to two points with no way to isolate them.

If all elements are known to all have the same resistance then you can multiply the number of elements by the resistance value of the entire circuit to get one element's approximate resistance. In the above example The resistence of the entire circuit is 49.8Ω / 3 = 16.6Ω.

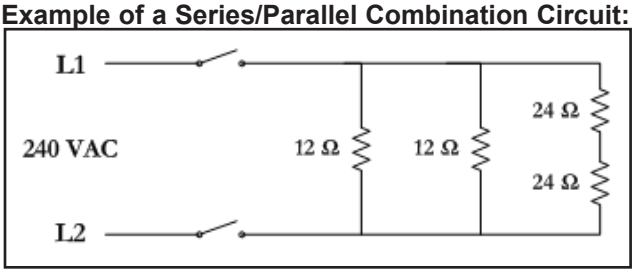
Total Resistence = 1 / ((1 / R1) + (1 / R2) + (1 / R3))

If the elements in the circuit have different resistances, like in School-Master kilns, there is no easy way to determine the individual resistances of the elements. The best way to solve an element problem with these kilns is to replace all the elements in the troublesome circuit. You can also measure the resistance on each element.

SERIES/PARALLEL or COMBINATION CIRCUITS

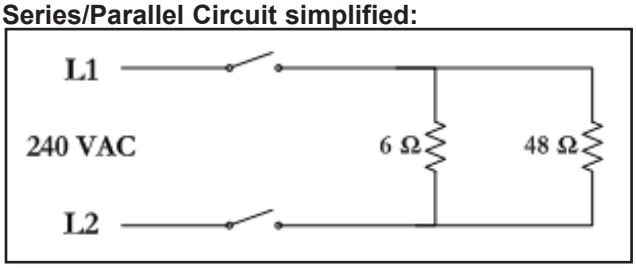
Certain circumstances require the use of Series/Parallel, or Combination circuits (in which series and parallel circuits are combined). In some front-loading kilns these circuits are used to combine, for instance, sidewall heating elements and backwall heating elements (often shorter than sidewall) in a combination circuit that is controlled by one power relay.

Example of a Series/Parallel Combination Circuit:



In the above example, the total resistance can be found by first dealing with each branch circuit individually. Starting from the right, this circuit is a series circuit; add the (24Ω + 24Ω = 48Ω). The other two circuits are parallel and are equal in value (12ΩW each); therefore, the resistance value of these two circuits is equal to (12Ω/2 = 6Ω). Drawing an equivalent circuit with (2) parallel circuits, one of 6Ω and one of 48Ω, looks like the following:

Series/Parallel Circuit simplified:



Solving for this circuit:

Total Resistance = 1 / ((1 / R1) + (1 / R2) + (1 / R3))

Total Resistance = 1 / ((1 / 6Ω) + (1 / 48Ω)) =

1 / (.1666 + .02083) = 5.33Ω

WHERE TO GET MORE INFORMATION ABOUT ELECTRICITY

hotkilns.com/volts.pdf
www.elec-toolbox.com

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ELEMENT TROUBLESHOOTING & INSTALLATION INSTRUCTIONS

TABLE OF CONTENTS

ELEMENT TROUBLESHOOTING

Getting E-1 Error

If you get an E1 or E-1 or Err1 error code on your DynaTrol or On-Touch control it means that your kiln no longer can get to temperature. It is slowing down. There are three main 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 contactors 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?

Old elements generally increase in their resistance. Mathematically this increase in resistance will decrease the amount of amperage and, ultimately, the amount of heat given off by the elements. This is why older kilns sometimes go so 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 fire low-fire clay and glazes and never get above cone 4 or so, your elements will last a long time, especially if you are only bisque firing. This is good, to a point. If you only low-fire, the problem you are most likely to encounter over time is that the elements expand as they age. The length and the coil diameter increase. Meanwhile the atmosphere in the kiln slowly eats away at the metal of the element. Although the total resistance usually increases as the elements age, sometimes it decreases, or reverses itself. This usually only happens when the elements are very old but have not yet failed completely. As the element expands, it binds up in the corners. This can make the individual coils push together and touch each other in the corners, making a short cut for the electricity, reducing the amount of element material the electricity must pass through, and therefore reducing the resistance in the whole element. This may make it hotter in the kiln, but if there is a lot of element material jammed in the corners there will not be enough material left in the coiled form to radiate the heat generated by the increased amperage and decreased resistance. Only the parts of the wire not touching the coils on either side of them will emit heat. More amperage through the electrical components in the control could cause damage if the situation continues or the resistance drops far enough.

In addition, the expanding diameter of an element can make it difficult to get it out of the holder. Usually this will not happen to those firing to higher temperatures because the maximum temperature of the kiln is quickly compromised by increases in the resistance, requiring the elements to be changed long before they can jam up in the corners. Also, high temperatures and glaze firings are more prone to eating through the element, causing it to fail, before the element can expand enough to cause the problems mentioned above. Use the multi-meter. Visually inspect your elements.

What if I see charred and blackened corners?

The coils that sometimes get squashed together in the corners do not always touch each other, but they may be close enough to allow the electricity to 'arc' across the gap. An electrical arc can generate extreme temperatures for the millisecond it arcs. Charred and blackened corners of the kiln are warning signs for this problem.

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

Factors shortening element life

1) Contamination (such as glaze or kiln wash). Silica, a main ingredient of both of these, attacks the element wire.

2) Tightly wound areas on element coils resulting from improper stretch. Have the elements been stretched evenly? This is important. If the element coils are bunched up along the length of the element the element will overheat where the coils are too close. Some replacement elements are shipped unstretched. Even prestretched elements may need some stretching. See section below on stretching elements.

3) Glaze accidentally rubbing off into holder and on element in loading kiln. If this occurs immediately vacuum the kiln and element holders thoroughly. Glaze will cause very rapid element failure.

4) Blow ups or explosion of bisque ware cause small pieces of clay to be blown into holder and element. If not immediately removed clay may melt, contaminating the element and element holder. Keep in mind that temperatures are considerably higher right next to the element so that you may very well exceed the clay melting temperature next to the element even if the kiln temperature is correct for the clay body.

To avoid explosions make certain clay is very dry before firing and, in the case of heavy handmade pieces, fire on low for a long period until you are sure ware is dried out thoroughly. If you hear a "pop" when firing such pieces, stop firing, cool the kiln. If blow-up has occurred, vacuum all element grooves very thoroughly. If you have the DynaTrol use the PreHeat feature for this final forced drying.

5) Firing pieces too close to elements. We recommend at least 1-1/2" from piece to element. Further if large flat surfaces are parallel to kiln wall.

6) Reducing atmospheres will destroy elements. Do not use wood chips, oils and other materials to generate a reducing atmosphere. A very rapid element failure may result. NOTE: Reducing atmospheres are the opposite of oxidizing atmospheres (plain air is an oxidizing atmosphere). The word reducing comes from the ability of a reducing atmosphere to "reduce" oxides.

7) Are any waxes, oils, carbon, fluorine, fumes present? Are you using any lead glazes? Iron-Chrome-Aluminum elements require an oxidizing atmosphere to give dependable service. The aluminum in the element forms a protective aluminum oxide. Oil from tools or carbon from wax burnout will attack the element coating. Halogens such as chlorine or fluorine will attack the elements. Molten metals, for instance, zinc, aluminum and copper, react with iron- chrome-aluminum elements. Moreover, these metals oxidize easily and their oxides have an unfavorable effect on iron-chrome-aluminum. The salts of the alkali metals, halogen salts, nitrates, silicates, and compounds of borax, disturb the formation of oxide and are, therefore, harmful to these elements. This is also true of the oxides of such metals as copper, lead and iron. Do not use with free carbon. Lead oxide attacks the protective alumina oxide coating on the element. If you are using lead glaze (or are creating any of these other problems) be sure to use a kiln vent. Also try firing every other load or as often as you can with a non corrosive load (such as a bisque firing). This will help the element restore its protective alumina oxide coating. Note that clay almost always has organics (which will create a slightly reducing atmosphere, sulfur (which will also attack elements) and fluorine which is also corrosive. This is one reason why proper venting is critical for long trouble-free operation of your kiln.

8) Excessive soaking time will accelerate increase in element resistance. The higher the temperature, the longer the soak, the sooner the element will decrease in life. Usually short soaks work fine.

9) Are they genuine L&L elements? There are a number of people selling "replacement elements" for kilns. These people do not have access to the proper design information for L&L elements. Designing an element is a complicated process which balances such things as voltage, wire diameter, watt density, stretch ratio, etc. It is very easy to make an element that has the same watts as an L&L element and have nowhere near the other design qualities that result in long element life.

10) If the failure is taking place at the element end it may be twisted too tightly, causing stress at terminal through holes. This causes local overheating at the "through hole", and element failure. (Contact factory).

11) 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.

Element Terminal Burn-out

Sometimes the ends of the elements can burn out at the element terminals (connections). This can be due to any or all of the following causes:

1) The element ends are not twisted properly. If the twist is too loose this could generate extra heat at the element ends.

2) 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 ceramic fiber (we have non-RCF ceramic fiber available in our parts list) in the element holes.

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.

4) The hardware should be stainless steel or at least nickel plated. Check to see if the hardware is in good shape. If not replace at least the hardware with stainless steel hardware or better yet replace the whole terminal board assembly with one of our new ones.

CHECKING ELEMENT OHMS

The most common cause of kiln slowdown, E-1 messages, and failure to reach temperature is element wear. As your elements age they generally increase in electrical resistance. According to Ohm's Law, when resistance, measured in Ohms, increases, both Watts and Amperes will decrease, assuming Voltage remains constant. Since Amps and Watts are the measures of current and power respectively, they can be thought of as the amount of juice that your kiln has to generate heat. Obviously if you don't have enough power, your kiln will fire slowly and might not even reach the desired temperature.

Using resistance, we can tell exactly how much power your kiln has lost over the course of your element's life. For example on an e23T that uses 240V, a brand new kiln section would read about 14.5 ohms. If you measured this same kiln section after several months of cone 6 firings let's say and the reading was 16.5 Ohms, you would know that this section of elements has lost approximately 14% of it's power (16.5/14.5=1.138, or close to a 14% increase). Again, an increase in resistance means decrease in power. A very general rule of thumb is that most people will typically begin to notice some slowdown once you've lost more than 10% of your power. It will certainly vary based on the kiln you have, your voltage, as the types of firing you do. People only doing low fire work will continue to get by on lower power than those needing to go to higher temperatures (cone 6+). As you can see, measuring your element Ohms is the best way to identify when elements need replacing.

Keep in mind that the ohms on the wiring diagram are per ELEMENT while your reading will be per SECTION. How you figure out the section ohms 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 you take the per element ohms listed and divide by the number of elements per section. Ex. e23T 240V 1 Phase is 28.9 Ω per element with two elements per ring = 14.5 Ω per section. Ex. 2. JD2927 240V is 36.5 Ω per element with three elements per ring = 12.2 Ω per section. See this link for more info on Series vs. Parallel

Here we will show how to best measure your element resistance for two groups of L&L Kilns, into which most models fall.

Easy-Fire, eQuad-Pro, Liberty Belle, Doll, School Master, e23S-JH

See this video: ***hotkilns.com/test-resistance-ez***

In these series' of kilns a piggy-backed control panel covers up the element terminals.

1. Turn the power to the kiln completely OFF and unplug it if possible. If it is direct wired, then you should at least turn off all power at the disconnect switch or circuit breaker.

2. Open the outermost control panel by unscrewing it either 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 Doll kilns.

3. Once you open up that control panel you will see the element power wire terminal strip. See the picture. It will have numbered wires coming from the element terminal blocks and wires connecting to the power relays. There are two wires per kiln section/ring, so numbers 1 & 2 are for the top section, 3 & 4 for the middle, and 5 & 6 for the bottom section on a three ring kiln.

4. Set your multimeter to Ohms (Omega symbol Ω) and using your testing leads, place one in between the two tabs/ terminals w/ #1 wires connected. There is a small circular

divot that the lead fits into (see picture). Put the other lead on terminal #2 and make note of the reading. Repeat the process for 3 & 4 and then for 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. Keep in mind 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.

Jupiter, Davinci

See this video: ***hotkilns.com/test-resistance-jupiter***

In these series' of kilns, the control panel is separated from the kiln body and the element terminals are connected to the controls via external jumper cords or plugs.

1. Turn the power to the kiln completely OFF and unplug it if possible. If it is direct wired, then you should at least turn off all power at the disconnect switch or circuit breaker.

2. Unplug the first jumper cord from the control panel.

3. Set your multimeter to Ohms (Omega symbol 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. Keep in mind 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 to check ohms of an entire L&L kiln section. Put the test leads of the multi-meter on the two "hot" plug terminals:

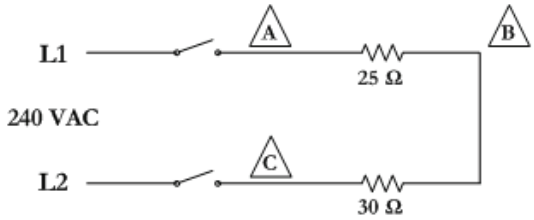
HOW ELEMENTS ARE WIRED

Why is this important?

The way the elements in a particular kiln are wired is important. Different wiring schemes with the same resistance elements 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 look at the elements because even one element out in a series circuit can make all the elements in that circuit appear to be burned out. If this same kiln had parallel circuits you would first look at 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 properly, in series, draws 23 amps at 240 volts. Wired in parallel it would draw around 90 amps at 240 volts, which would be disastrous.

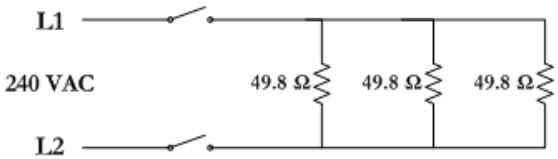
Series Circuits

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.



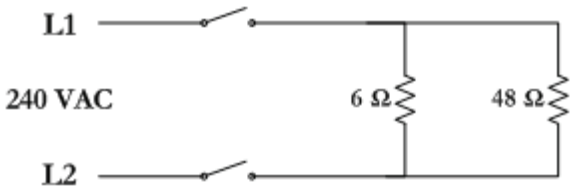
Parallel Circuits

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 even 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 power 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 (the year and month are coded into the serial number) it has larger cross-section element holders. These new holders are capable of holding a larger diameter, heavy gauge element. These high grade heavy duty elements feature lower watt density than the standard elements and that, coupled with the heavier gauge wire, results in longer element life. If you are experiencing short element life because of your duty cycle (frequent firing, high temperature firing, long soak times) you should try these heavy duty elements. They have the same ohm rating (resistance) as the standard elements. This means that the power rating of the kiln does not change. It also means that you can use them with the standard elements. One consideration with mixing the standard and heavy duty elements is that the heavy duty elements will age more slowly than the standard elements and may have an effect on uniformity in the kiln. This is really no different than what you would experience when you change just one element and so have a new element (unaged) with older elements. Dynamic Zone Control will automatically balance your system and compensate for this problem. We do suggest, however, that you put any newer elements in the bottom ring where temperatures tend to be cooler and hence need as much power as they can get. Keep in mind that L&L can not 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 on kilns. It is sintered and resists the crystallization that normal Kanthal type alloy experiences. 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 a subject to the same problems like glaze contamination that any elements 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 retorfitted into older kilns.

CHANGING ELEMENTS

SEE THESE VIDEOS FIRST

For most top loading kilns:

hotkilns.com/change-elements-ez

For kilns with Quad elements:

hotkilns.com/change-element-quad

REMOVING OLD ELEMENTS

1) Unplug kiln or turn off the kiln at the fused disconnect switch.

2. First remove the control box or element boxes and their wire connections from the kiln. Before undoing any wires, however, label how the wires and the elements are configured inside the element boxes (take pictures if needed). After you are certain you have documented the wiring then you can carefully remove the wires.

3) Using a 3/8” nut driver remove the nuts that hold the element end onto the Element Terminal Bolt. If you don’t have this tool you can use an adjustable wrench - it will just take longer.

A 3/8” nut driver:

4) Untwist the element end from around the Element Terminal Bolt. Straighten it out as much as possible.

Untightening the element terminal:

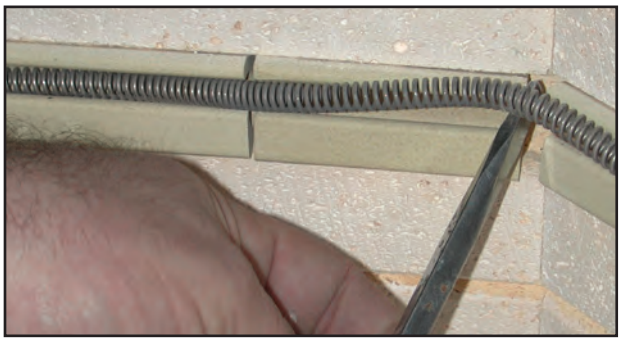
5) Cut the old elements off as close to the “through hole” on the outside of the kiln as possible. You want a straight element tail to pull through the through hole, not a crooked one.

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 with new stainless steel terminal bolts, nuts, and washers. If the terminal board itself is burnt or broken replace that as a complete unit with new hardware.

6) In most cases you can just lift the element out of the holder at this point. Sometimes, if the element has really disintegrated, you need to remove it in pieces with needle nose pliers.

Using a sharp tool like a screw driver 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:

Lift Elements out of the groove of the ceramic holders:



Sometimes very old elements can become wedged in the element holders, making it necessary to carefully pry/twist/break them out. A propane torch or just turning the kiln on for a few minutes (if it will come on) will soften the wire of the elements and make them easier to get out. Use heat protecting gloves such as welding gloves or heat treating gloves (you can buy these from L&L) and a pair of needle nose pliers to pull out the softened element. DANGER: You could burn or electrocute yourself if you get the elements too hot or forget to unplug the kiln after warming them up. IF YOU DECIDE TO USE THIS METHOD BE VERY CAREFUL OF THE POTENTIAL FOR BURNING YOURSELF.

7) Be sure to check for failure points for evidence of contamination on the element and the element holder. If the element holder is contaminated it will cause rapid failure of the new element. Replace contaminated holders with new ones (See later in this sheet how to do this).

8) From the inside of the kiln, using needle nose pliers, grab the element as close to where it goes through the brick wall to the Terminal Block. Pull the element end through the hole. Be careful not to enlarge the hole in the firebrick. The brick is quite soft and will not take much abrasion.

Removing element from inside the kiln:

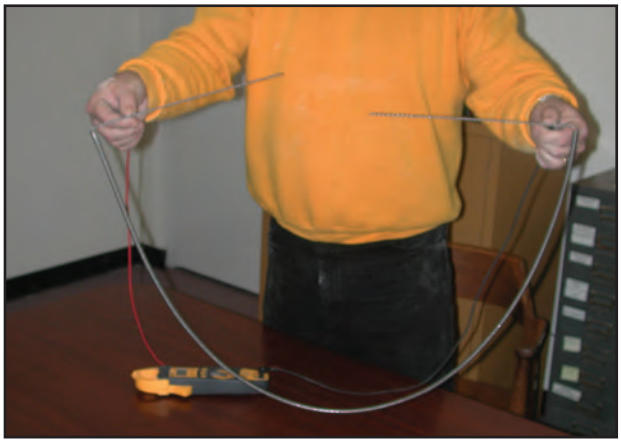
9) FOR OLDER MODELS WITHOUT CERAMIC TERMINAL BOARDS: There are normally ceramic insulator bushings on the outsides of the through holes that the elements pass through. On some models (particularly older J2900 kilns and DaVinci kilns) there are spacers to keep these insulators in place. These may fall out (and chip or break) if you are not careful. Be sure not to lose these spacers when replacing elements. Note carefully how they are positioned so you can replace in the same way. Note that on the new all ceramic terminal boards used on the J2900 and DaVinci kilns there are no bushings or spacers - it is all one integrated piece.

10) Once the old elements are out, carefully vacuum all the element holders. Watch for any glaze or material contamination. Anything that will melt (i.e. glaze, slip, porcelain, etc).will cause rapid failure of the new element. Chip or scrape carefully to remove the contaminant, or replace the affected element holders. DO NOT replace the element if there is foreign material stuck in the element holders. You must fix that problem first by either cleaning or replacing the contaminated element holder.

CHECKING ELEMENTS

Examine your new elements. Look to see the wire thickness is similar to that of the old ones. Look to see that the coils per inch and the diameter of the coils are also similar. Using your multimeter check the resistance of your new element. Compare to the factory resistance value(s) for your kiln's elements. 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 call the factory to get it exchanged. This is the time to deal with the problem. DO NOT WAIT UNTIL YOU HAVE STARTED THE JOB, STRETCHED THE ELEMENT OR EVEN INSTALLED IT BECAUSE AT THAT POINT YOU WOULD NOT BE ABLE TO RETURN IT.

Checking resistance of the elements before you put them in. This is a good double-check and can save you a lot of trouble if there is a mistake. Put the probes on the twisted element ends about 3" from the beginning of the coil:



STRETCHING ELEMENTS

NOTE: Most replacement elements come prestretched. All elements are slightly understretched and will have to be adjusted for final fit. The following are instructions for how to stretch unstretched elements:

To determine total length to stretch an element measure total length of element grooves.

IF ELEMENTS NEED TO BE STRETCHED

1) Mark floor with two marks for 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.

2) Examine for evenness of stretch. Selectively stretch close wound sections to provide uniformity of stretch.

3) Repeat this procedure several times.

4) You will have to pull element beyond last mark in order to obtain full stretch.

5) If overstretch occurs insert a metal rod or small diameter dowel into the element coil and compress with needle nose pliers.

6) Stretch uniformity is necessary for satisfactory element life.

INSTALLING NEW ELEMENTS

NOTE: We highly recommend you get all new element terminal hardware when you replace your elements. In fact we offer a 50% discount on element terminal hardware when buying elements.

1) Replace one element at a time so that you do not make a mistake with the wiring.

2) Insert the tails through the through holes from the inside out. Element ends should be straight at this point.

3) Pull them up tight up to the wall of the kiln by pulling from outside the kiln.

4) Lay the element into the groove. Note that the unfired element is going to have some springiness to it before it is fired for the first time. You may need to use a screw drive to press the element into the holder. YOU DO NOT NEED PINS.

5) FOR KILNS WITH NON-CERAMIC TERMINAL BLOCK OR ON RETROFITTED KILNS WHERE YOU HAVE ADDED A CERAMIC TERMINAL BLOCK BUT STILL NEED BUSHINGS: Be sure to replace the insulators and spacers over the element tails.

6) Consulting your picture or labeling, wrap the appropriate element tails around the appropriate element connection bolt, clockwise, once around, and cut off the excess tail. If you have the newer large washer system you just need to make a "U" around the bolt and let the large washer do the clamping.

Detail showing the terminal set:

Detail showing all the parts:

Detail showing how all the hardware gets assembled on the Terminal Bolt:

7) Install the elements and hardware:

a) A washer goes under the first element

b) Twist the first element end CLOCKWISE around the Terminal Bolt.

c) The next element gets twisted around the Terminal Bolt on top of the first element.

d) Then another washer goes over the Terminal Bolt.

e) Then the nut goes over it and get tightened.

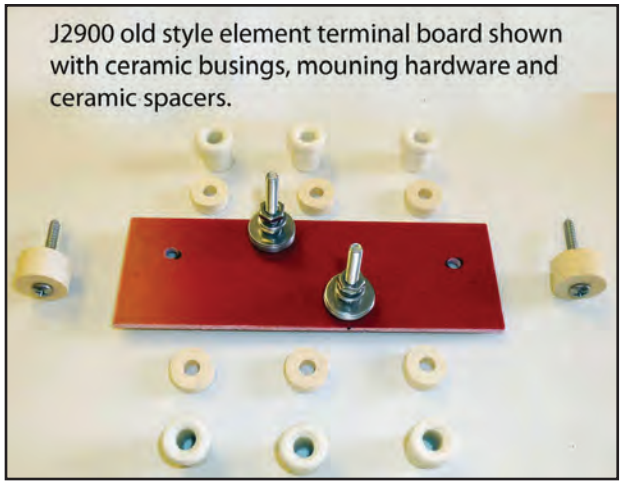
f) Then a washer goes on.

g) Then the Ring Terminal of the Power Lead Wire goes on.

h) Then a washer goes on.

i) Then another nut goes on and gets tightened. How tight you can make this is dependent on how tight you got the element connection bolt onto the element connection board. A tight connection is very important, but if you tighten too much and twist the element on the bolt too far you could break the element, the bolt, or the insulator.

Detail showing how all the parts for an older style "red board" terminal system for a J2900 kiln:



8) Place the wires from the jumper cord or connecting wires onto the appropriate bolts and tighten with stainless steel nuts.

9). Reattach the ground wires and the element box if the kiln has them. DO NOT FORGET TO ATTACH GROUND WIRES. IF EACH KILN SECTION IS NOT GROUNDED THIS CAN BE VERY DANGEROUS.

10) Test the ohms at the jumper cord's plug head or at the other end of the connecting wires.

11) Reattach the control box, turn the kiln on and make sure all the elements come on.

FIRST FIRING WITH NEW ELEMENTS

NOTE: You may experience some smoking from the kiln on its first firing with new elements. This, if it occurs, is due to residual oil left on the element wire when the wire was made. We recommend firing the kiln empty to cone 5 once to oxidize the new elements (no particular speed is necessary) and to seat the new elements in the holders.

REPLACING ELEMENT HOLDERS

See this video: ***hotkilns.com/change-element-holder***

1) When ordering a new holder provide model number of kiln and length of the element holder. See the Parts List for this information.

2) 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

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

2) Using a chisel or large screw driver and a hammer carefully crack the holder that needs to be removed.

Just take your time with this. You can break the holder into little pieces so that it comes out:

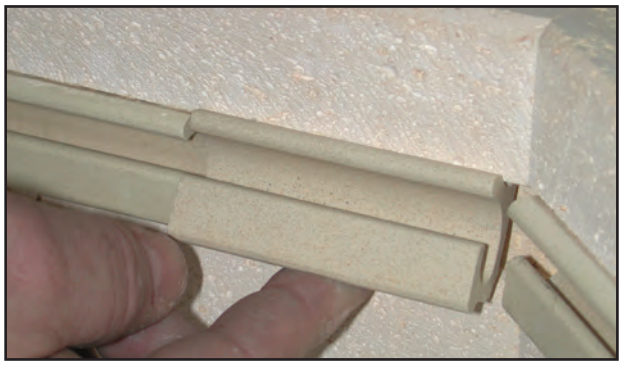
The holder shown with about half the job done:

The groove is shown with the holder removed:

Using Linemen's Pliers snap off the BOTTOM edge of the holder

A normal holder compared to one with edge removed:

You can now just snap the new holder into the slot in the firebrick. It will hold in place with no cement:



Method #2

This method requires you to take the kiln sections apart.

1) Take the section with the bad holder off the kiln and put it on a flat surface like a flat floor or table.

2) Carefully pull the elements out of the element holders of the brick section involved and allow them to hang loose. Take great care not to “break” the element as they are very brittle after firing.

4) Loosen up the adjustable clamps that hold the stainless steel wrapping. Loosen them just enough to allow the brick to slide out with slight hand pressure (so that the other bricks stay in place). NOTE: If you don’t have the section on a flat surface then the bricks will all come out of proper alignment at this point.

5) Pull up the brick with the bad element holder just enough to allow removal of the defective element holder and replace with new one. Slide the bad brick(s) out and put in new brick(s). Be sure the element holders line up with the other holders on either side. Note there is a top and a bottom in the element holder so be sure to get the orientation correct.

6) Retighten the clamps on the wrap. Alternately tighten the bottom and top clamp so that you don’t cock the stainless casing.

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TROUBLESHOOTING AND FIXING BRICK PROBLEMS

BRICK PROBLEMS

EXCESSIVE BRICK WEAR

1) Excessive brick wear can be the result of various conditions. Most common is improper curing of the brick when first fired. **FOLLOW THE INSTRUCTIONS FOR THE FIRST FIRING AND CURING CYCLE in the OPERATION Section of the instruction manual).**

2) All insulating firebrick expands and contracts when heated and cooled. Over time this will lead to cracking and spalling. Spalling is the continued cracking of the brick which eventually results in large pieces of the brick falling out from the brick section. This is a normal condition as long as the emphasis is on eventually. Factors such as how close the kiln is operated at or near maximum temperature, how often and how fast the kiln is cycled up to heat and then cooled, how heavy the loads are, all figure into the brick wear equation. There is no set rule as to how long a brick lining will last. There are some L&L kilns which are 25 to 40 years old with the original lining still in usable shape.

3) Frequent door openings when the kiln is at high temperatures can cause thermal shock, leading to excessive cracking and spalling.

INSTRUCTIONS FOR USING BRICK REPAIR KIT

To order see: ***hotkilns.com/brick-repair-kit***

GENERAL NOTE: Firebrick is a very fragile material and subject to breakage, spalling and heat shock. The good news is that it is very easy to repair and maintain with the proper materials and techniques. Our Brick Repair Kit has all the materials you will need to do a first class job.

LIST OF BRICK REPAIR KIT MATERIALS

(1) 3” X 4.5” x 9” K23 Firebrick piece

(1) 1/2 pint of Brick Cement (in a ½ pint container)

(1) One Quart container of Brick Dust

MIXING A BATCH OF GROUT

The grout should be mixed up JUST prior to use. (Otherwise it will dry out). Mix the ingredients with a small spatula in a container (like a glass jar or plastic cup). Mix in the following:

½ cup firebrick dust

¼ cup water

1 tablespoon Brick Cement

NOTE ABOUT GROUT

The special grout material is firebrick dust mixed with water and a small amount of cement. The cement makes a matrix of the firebrick dust. This compound dries into a material almost exactly like the original firebrick with the same color, consistency, texture and insulating properties.

BRICK REPAIRS

APPLICATION OF BRICK FACING/HARDENER

1) Mix water and high temperature cement in a 50/50 mix.

2) First brush and vacuum the surface of the brick clean to remove any loose material or crumbling firebrick.

3) Next wet the brick surface lightly. Use a paint brush or spray bottle (make sure there is no soap residue in the bottle).

4) Then apply a thin coat of this mixture with a soft clean sponge or brush over the surface of the firebrick. Do not make too thick a coat of the hardener or it will spall off. One or two light brushings on wet brick is enough.

4) Let the coating dry for 24 hours.

5) Run the First Firing Cycle (See the OPERATION Section in your manual).

REPAIRING SMALL HOLES & CHIPS IN BRICK

1) Mix water and high temperature cement in a 50/50 mix.

2) Brush and vacuum the surface of the brick clean to remove any loose material or crumbling firebrick.

3) Next wet the brick surface lightly. Use a paint brush or spray bottle (make sure there is no soap residue in the bottle).

4) Apply a very thin coat of brick cement mix (no more than 1/3” to 1/6”) all over the hole. Do this with your finger or a small brush.

5) Fill hole with the special grout material. Apply grout with a spatula (like plaster.) You can also use your finger. Push it into the hole. It is OK to let it be a rough surface or slightly larger than the hole it is filling.

5) Let dry for 24 hours.

6) Take some rough sandpaper and sand surface to even it out with the rest of the firebrick.

7) Run the First Firing Cycle (See the OPERATION Section in your manual).

8) You can brush on hardener or facing afterward if you desire.

REPAIRING VERY LARGE HOLES IN BRICK

See this video: ***hotkilns.com/repair-brick-front-load***

1) Cut out an area around the brick chip with a small knife, saw or router. The hole that you make should have 90° angles so that a square or rectangular block will fit in the hole.

2) Cut a piece of firebrick to fit into this cut out hole. The piece should be slightly smaller than the hole (by about 1/16" to 1/8").

3) Both the hole and the brick piece should be brushed and vacuumed clean.

4) Wet the brick surface lightly. (Both the hole and the surface of the block that you are going to insert in the hole). Use a paint brush or spray bottle (make sure there is no soap residue in the bottle).

5) Apply the High Temp Kiln Cement to the surface of the piece that you are going to put in the hole as well as the hole itself. Use only about 1/32" to 1/16" of an inch of cement. Push the brick plug in hard and move slightly for a second or two to make sure the cement adheres to all surfaces.

6) Let dry for 24 hours.

7) Sand off excess brick and cement.

8) Cover with Brick Facing and allow to dry for another 24 hours.

9) Run the First Firing Cycle (See the OPERATION Section in your manual).

FIRST FIRING AFTER REPAIR

(See FIRST FIRING INSTRUCTIONS in the Operation Section). The only difference is that you can fire to a lower temperature because you do not need to reseat the elements. Firing to cone 05 instead of 5 is OK.

The kiln needn't be empty either.

If you have the DYNA-TROL program control fire the following program: Using the "Easy-Fire" mode fire on Slow Bisque to Cone 05 with a PreHeat setting of 3 hours and a hold of 1 hour.

For kilns with the manual control fire the kiln on low (setting #2) for two hours to bake out any moisture. Then set to medium (setting #5) for two hours and then increase enough to reach final temperature. Fire it to cone 05 (1888°F).

CRACKS IN THE LID & BOTTOM

See these videos for bad cracks:
hotkilns.com/fix-cracks-front-load
and ***hotkilns.com/repair-cracked-top***

See this video for hairline cracks:
hotkilns.com/repair-hairline-cracks

1) It is quite normal to get hairline cracks in both the lid and the bottom firebricks.

2) They are caused by the expansion and contraction of the firebrick as it heats and cools.

3) As long as the bottom is fully supported by the stand the cracks in the bottom will not adversely affect the operation of the kiln.

4) The stainless steel clips we use in our lids also help keep these natural cracks from normally becoming a problem in the lids.

5) Note that it is possible to put another bottom under the original bottom as a second layer (this can also improve performance and heat up rate of the kiln).

8) You can tighten the stainless steel band.

This crack is OK:

TIGHTENING STAINLESS BANDS

See these videos:

hotkilns.com/replace-side-brick-kiln

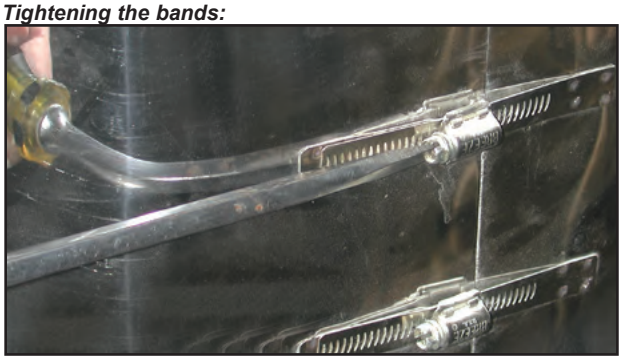
hotkilns.com/replace-side-brick-davinci

1) The brick will shrink slightly over time. This is more pronounced when using the kiln at higher temperatures like cone 10. If you only use the kiln for low fire bisque you may never notice this condition.

2) If the bricks shrink too much they will become loose.

3) Tighten the case by turning the screws of the case clamps. Do this 1/4 of a turn at a time on each of the clamps. Keep a balanced tightening (i.e don't tighten one clamp too much at one time). Slow is good.

Tightening the bands:



4) You can do this on the bands around the top and bottom also. This will help maintain the integrity of those slabs even if there is a crack.

REPLACING FIREBRICK IN SIDES

See these videos:

hotkilns.com/replace-side-brick-kiln

hotkilns.com/replace-side-brick-davinci

1) If you need to replace a firebrick piece in one of the sections do the following. While it does not require a great deal of experience to accomplish it does take time and patience.

2) Order the firebrick precut and prerouted from L&L Kiln. You can order this with the proper element holders already in place or you can reuse the holders from your old brick. Be sure to order it for your specific model kiln. Also, be sure to say whether it is a brick where the element connections come through (because this has different element holders).

3) There are no holes drilled in the brick for either peepholes or element connections. This has to be done in the field.

4) Take the section off the kiln and put it on a flat surface like a flat floor or table. Elements will have to be removed and probably replaced. If the elements are old they will be brittle. They may break so be prepared to get new elements.

5) Loosen up the adjustable clamps that hold the stainless steel wrapping. Loosen them just enough to allow the brick to slide out with slight hand pressure (so that the other bricks stay in place). NOTE: If you don't have the section on a flat surface then the bricks will all come out of proper alignment at this point.

6) Slide the bad brick(s) up and out and put in new brick(s). Be sure the element holders line up with the other holders on either side. Note there is a top and a bottom in the element holder so be sure to get the orientation correct.

7) Retighten the clamps on the wrap. Alternately tighten the two or three clamps (about a 1/4 or 1/2 turn at a time) so that you don't cock the stainless casing.

8) Sand off the top surface of the firebrick to match the surface of the other firebricks. Sandpaper will work fine. Reface with Brick Facing.

9) You can see this action in this video:
hotkilns.com/replace-side-brick-kiln

DRILLING HOLES FOR PEEPHOLES

1) Some of the bricks that you may need to replace will need to have holes drilled in them in the field. These holes can not be drilled in the factory because the alignment would not be perfect.

2) To drill out for peepholes use a 1" diameter drill bit or hole saw. You can also drill with a smaller drill and then file out with a round hasp type file. Drill slowly through the firebrick using the prepunched hole in the stainless steel. You may have to remove the bit several times and clean it out as you drill deeper. **It is a good idea to have someone help you by watching from the side to make sure you are drilling straight. It is hard to see this when you are doing the drilling.**

3) For sections that have two element rows: the hole is drilled perpendicular to the stainless case.

4) For sections that have three element rows: the hole is not drilled at a perfect 90° perpendicular angle to the kiln case. It will be drilled at a slightly down angle (about 5° to 7°). This is to miss the element holders.

5) Before drilling, as a precaution, you can measure down from the top of the brick to the top of the existing hole in the stainless steel case. This measurement on the inside will show you where the top of the drill bit will protrude. Adjust your angle of drilling accordingly.

Drilling the peephole:

DRILLING ELEMENT CONNECTIONS

1) Use a 1/8” to 3/16” diameter drill bit and drill out from the center of the hole in the stainless steel case. Do this slowly with a speed control.

2) Do this perpendicular to the case.

REPLACING BOTTOMS

1) Remove the kiln sections.

2) Take the old bottom off the stand.

3) Put the new bottom on the stand.

4) Relevel the kiln. (This is important).

5) Replace the kiln sections.

NOTE: You may want to experiment with using the old bottom as a secondary back up bottom if it is not too badly damaged. Just make sure it is totally flat so that it doesn’t crack the new bottom. Some people find that having this extra insulation thickness helps firing times and bottom uniformity.

REPLACING EASY-LIFT LIDS

1) Remove the Hinge Pin and take the old top off the kiln. See the Assembly Instructions for guidance if you have questions about how to do this. Use the Hinge Tool to take the tension off the spring. BE SURE TO USE SAFETY GLASSES - THERE IS A LOT OF TENSION ON THE SPRING AND INJURY COULD RESULT.

2) Remove the Top Hinge Part from the old lid. Note that there are three parts to this. There is the main Top Hinge Part. Then there is the Front Hinge Part (the little 3” x 4” aluminized steel plate with a small hole that gets attached to the front of the top with the screws for the Handle). Then there is the Handle. Note that the hole in the Front Hinge Part should be centered around the little stud that protrudes from the Top Hinge Part.

3) Using the old top as a guide, install the Top Hinge Part onto the new lid.

4) Reinstall the top and reset the spring. See the Assembly Instructions if you have questions about how to do this.

5) See this video: ***hotkilns.com/replace-easy-fire-lid***

REPLACING SMALL NON-SPRING HINGE LIDS

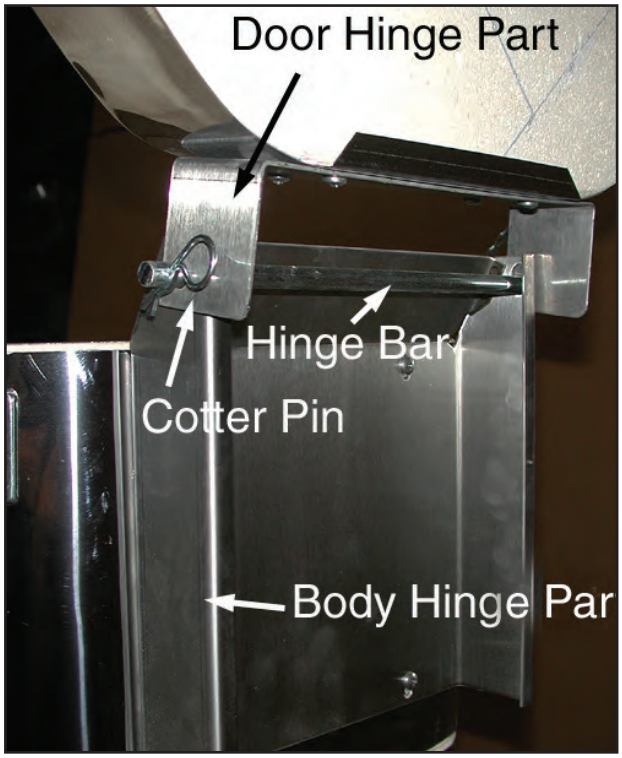
1) Remove one of the Cotter pins from the Hinge Bar.

2) Pull out the Hinge Bar.

3) Unscrew the chains from the stainless steel case of the lid.

4) Remove the Top Hinge Part from the old lid.

A simple hinge with parts marked



5) Using the old top as a guide, install the Top Hinge Part onto the new lid.

4) Reinstall the top.

REPLACING DAVINCI LIDS

See this video: ***hotkilns.com/replace-davinci-lid***

DOLL INSTRUCTION MANUAL

PARTS, SERVICE & WARRANTY

L&L Kiln's patented hard ceramic element holders protect your kiln.

PARTS FOR ALL KILNS (ONLINE DATABASE)

PARTS LIST

A comprehensive and up-to-date listing of parts that pertain to all Kiln Series' built by L&L Kiln Mfg., Inc. can be found on our website at: ***hotkilns.com/parts***

DATA NAMEPLATE

Have the Nameplate Information

You can get Model Number, Serial Number and voltage information about your kiln from the Data Nameplate affixed to your kiln. You will typically find this on the control panel. Please have this available when ordering parts. It helps us make sure you are getting the proper parts!

This is a Data Nameplate that you will find on your kiln. Obtain the Serial Number, Model Number, Voltage, Phase, Amps and Watts from this nameplate.

If you cannot find the data nameplate

If the nameplate has come off your kiln we can help you determine the model number by the number of ring sections and the diameter of the rings. You will need to know your voltage by checking your line voltage with a voltmeter. Most household voltage in the United States is 240 volts single phase. Industrial, commercial and institutional locations often have 208 volts and may be either three phase or single phase. THIS NEEDS TO BE KNOWN! Check with an electrician if you aren't sure.

HOW TO ORDER PARTS

Delivery Times for Parts

We ship most parts such as elements, kiln shelves and posts, switches and other electrical items, and ceramic parts usually very quick. See each part number on the website for specific lead times.

How to Place an Order

You can place an order by phone or by using the handy order form in the back of this parts list. This order form can be faxed to 856.294.0070. Be sure to include your Visa or Mastercard number and expiration date, three digit verification code, your name, phone number and correct shipping address. For more information see: ***hotkilns.com/ordering-parts***

Payment

Most customers pay by Visa, Mastercard or American Express. For more information see: ***hotkilns.com/payment***

Shipment

Most parts ship by UPS. Unless you specify we choose the carrier based on the cheapest price. You can specify overnight or second day shipment or Saturday delivery. Kiln sections and tops and bottoms must ship by motor freight. for more information see: ***hotkilns.com/shipping-policy***

Packing Charges

For packing and crating charges see: ***hotkilns.com/shipping-policy***. UPS, USPS or FedEx shipping charges are billed at cost.

Returning Parts

Some parts are returnable; some are custom and cannot be returned. The policy for each part is listed on the page for that part. For the general policy see: ***hotkilns.com/return-parts***

Sales Tax

For where we collect sales tax and for sales tax exemption policies see: ***hotkilns.com/sales-tax***

FAX ORDER FORM FOR L&L KILNS AND PARTS
Fax to 856.294.0070

ORDERED BY:

Date:_____

Company_____

Name_____

Street Address_____

_____

City _____

State _____ Zip/Postal Code _____

Day Phone _____

Fax:_____

Email:_____

SHIP TO: (if different from "ORDERED BY")

Company_____

Name_____

Street Address_____

_____

City _____

State _____ Zip/Postal Code _____

Day Phone _____

Fax:_____

Email:_____

QTY	ITEM NO.	VOLTS	DESCRIPTION	AMOUNT	TOTAL

PAYMENT METHOD:

☐ Purchase Order:_____

Purchase Orders must have preapproved credit with L&L.

☐ Visa ☐ Mastercard ☐ AmerExp ☐ Discovery

CHARGE TO:

Card Account Number _____

Name on Card _____

Issuing Bank _____

CSV (3 Digit V-Code on back of Card)_____

Expiration Date _____

Customer Signature _____

Merchandise Total:		
6% sales tax for shipments to PA or NJ: (unless accompanied by a sales tax exempt form):		
Standard Packing & Handling Charge (See below. To be filled in by L&L)		
UPS, Fed X or Common Carrier Charges. (To be filled in at time of shipment. Based on Actual Cost.)		
TOTAL:		

To be filled out by L&L

PLEASE PROVIDE THIS TECHNICAL INFORMATION

MODEL#_____

SERIAL#_____

VOLTS:_____ PHASE:_____

SERVICE FOR L&L KILNS

IN GENERAL

SERVICE FOR YOUR KILN

L&L kilns are designed to be as easy to work on and fix as possible. This is one of the great advantages of L&L kilns.

TROUBLESHOOTING GUIDE

Check out the “Support” section of our web site, ***hotkilns.com*** for all of our troubleshooting references. We are constantly adding to our troubleshooting guides and the web site has the most up-to-date information on it. Also try the search engine on our website with your question.

THE MOST COMMON ERROR MESSAGES AND WHAT TO DO ABOUT THEM

Error 1, Err1: ***hotkilns.com/e1***

Error D, ErrD: ***hotkilns.com/e-d***

All Error messages on the DynaTrol:
hotkilns.com/error-codes

Adjusting and Calibrating the DynaTrol for More Accurate Firing: ***hotkilns.com/calibrating-kiln***

What to do if the kiln fires slowly?: ***hotkilns.com/slow-kiln***

YOUR LOCAL RESELLER

Call your local reseller, most of whom service the kilns they sell. If they don’t they may be able to direct you to a local kiln service person.

OTHER KILN REPAIR PEOPLE

Search for a local kiln service person online or try your local yellow pages. L&L may also be able to recommend a local service person. We maintain a listing of kiln service people around the country. If you can’t find a person experienced specifically in kiln repair, then a good electrician is often more than adequate to repair most problems that commonly occur.

REMOVABLE CONTROL PANELS

Some of the more difficult problems occur within the control panel. One of the unique features of most L&L kilns is the easy ability to remove this panel and send it back to the factory for inspection and/or repair. Call the factory for details on your kiln.

CUSTOMIZED TECHNICAL SUPPORT

To get technical support from L&L Kilns please send an email to service@hotkilns.com

Include in your email the following important information:

1. Your name.
2. Your organization name.
3. The Serial Number, Model Number and Voltage information from your Data Nameplate.
4. Your phone number and possible times to reach you during business hours.
5. A description of the problem you are having and anything you have done so far to troubleshoot it.
6. **Send Photos!**

You will get prompt, effective, and detailed expert answers. We are committed to answering service emails within one business day but normally they are answered far more quickly. If you need a phone call we can help you better if we have this information before we call.

Note about element resistance values: You can find the proper ohms for your elements on the wiring diagram which comes with your instruction manual.

PREPARING FOR A TECHNICAL SUPPORT PHONE CALL

Get Your Wiring Diagram

Be sure to get your wiring diagram if you don’t have it. You can get this emailed free from our office if you know your model number, serial number and voltage. This is the key to understanding what is happening electrically and it makes a great visual reference to share with the tech support department over the phone.

Get A Multimeter

Get a “Digital Multimeter”. Digital Multi-meters are inexpensive. For around $50 or less you can get one at a place like Amazon or Home Depot. Get one that can test at least 250 volts AC and 28 volts DC, also ohms from 0 to 200, and is able to show at least the tenths decimal place for accuracy.

If You Need An Electrician

Sometimes you may need get an electrician or experienced person, to test live electricity if you cannot. If you get someone to provide on-site service, the kiln must be hot

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and exhibiting its problem when they test it. Sometimes it is difficult to coordinate the electrician, a hot kiln, and our technical support on the phone all at the same time, but it can be necessary to make the most of the electrician's time, and to fix the kiln in a timely fashion. It is usually best also to discuss with our technical support department the date and approximate time an electrician is expected to arrive.

Be Aware Of Limitations

As a practical matter the technical support staff is limited by the fact that we are at a distance from your kiln, communicating by email or telephone and are often working with you through multiple sessions to fix your kiln's problem. We rely heavily on your accurate and complete description of the problem, and your responses to our questions. We rely on you to remember where we are in the process of fixing your kiln each time we talk. (Email is easier because there is a recorded thread of communication).

Application Support

Resellers often offer a degree of application support. For instance if you are having problems with firing your work the first place to go for answers is the people who supply your clay and glazes. We offer some application support on this web site but it is minimal. Generally, this is outside the scope of our service. Look at the External Links for many great sites that can help you.

Be Comprehensive And Proactive

We have found through long experience that is best when trouble starts to replace all of a certain part. If your elements are old and one burns out – change the whole set of elements. The same is true for thermocouples, thermocouple wires, element terminal screws, power cords, and contactors. Do not expect control panel components to reliably perform after 15 or 20 years. The heat of kilns causes unavoidable oxidation of electrical components - some that you can't see. Kilns need to be rebuilt occasionally. Changing JUST the part that is causing the immediate problem is just asking for more trouble in short order.

WHERE TO BUY PARTS

You can order parts through your local reseller or directly from the factory. L&L stocks almost all parts we sell including elements. We normally ship within one to three days although some parts do take longer. Most parts are listed at ***hotkilns.com/parts***.

FREE LIFETIME SUPPORT IS CONTINGENT ON THE USE OF L&L FACTORY PARTS. USE OF NON-L&L PARTS WILL VOID THE WARRANTY.

WHAT WE CAN'T DO

We can not give you advice over the phone on hooking up your kiln to your electrical system. You must have a qualified electrician who can physically see what your specific electrical situation is and who understands any local codes.

SELECTING AN ELECTRICAL CONTRACTOR

A quality electrical contractor:

1. Complies with state and local codes and regulations.
2. Carries the proper business and workers compensation insurance.
3. Is knowledgeable on a wide range of new equipment, technology and design procedures.
4. Has a local facility, and is willing to have you visit.
5. Is prompt and courteous and provides fast, reliable service -- attempting to perform service at your convenience.
6. Is neat and well groomed. This neatness should be reflected in their vehicles and offices as well as their personal appearance.
7. Provides a detailed written proposal, clearly outlining the work to be done and the agreed upon cost, including labor and materials. Make sure you understand every word of any contract before you sign it.
8. Asks in detail about any problems and offers understandable solutions.

CONSIDER THE FOLLOWING

1. Ask for references. Find out if other customers were satisfied. Check with the local Better Business Bureau regarding any filed complaints.
2. Compare price. Get bids from a few contractors. Make sure you give each contractor the same specifications and materials needed for the job.
3. Remember! How a company treats you now reflects how they will treat you if there's a problem. A quality electrical contractor listens to your problems, understands what you want accomplished and is willing to follow up after the work is completed.

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STANDARD LIMITED THREE YEAR WARRANTY FOR L&L KILNS

THREE YEAR LIMITED KILN WARRANTY

L&L Kilns are warranted to be free of defects in workmanship for a period of three (3) years, starting on the date of original purchase from L&L Kiln Mfg., Inc. (L&L) or from an authorized L&L reseller, subject to the following terms and conditions, including but not limited to, the exclusions and limitations set forth herein.

1. A sales receipt may be required for proof of purchase.
2. In addition, L&L may require you to deliver defective parts to L&L for examination to determine the applicability of these warranty provisions. *Do not discard parts before contacting l&l for instructions. ailure to adhere to l&l's instructions, including those contained in the instruction manual and as stated herein, will void this warranty.*
3. L&L will replace or repair any defective part that is covered by this warranty and sent freight-prepaid to L&L. L&L will prepay return shipping cost without charge in the Continental United States. Shipping outside the Continental United States is at cost.
4. On-site labor is not part of this warranty and is not covered by L&L. Any warranty labor provided by resellers is provided at their own discretion and expense.
5. Warranty is not valid for second-hand or damaged kilns that are sold by unauthorized sellers.
6. Any modifications to the original kiln by anyone other than the factory or someone specifically authorized in writing by the factory will void the warranty. Any modification is made solely at the risk of the customer. L&L takes no responsibility for hazardous conditions created by unauthorized modifications.

APPLICATION

Applies to Easy-Fire, Jupiter, Davinci, Doll/Test, JH Series, Quad-Pro kilns, eFL Series and Fuego kilns when used for ceramics and glass.

EXCLUSIONS AND LIMITATIONS

The following are examples of items that are not covered by and/or circumstances that will void L&L's warranties:

1. **Use of elements and/or other parts other than genuine L&L Kiln parts.**
2. Kiln warranty may be voided by firing materials that introduce harmful atmospheres into the kiln. Atmospheres containing carbon, reducing atmospheres (caused, for example, by introducing carbonaceous gasses or solids like graphite or paper into the kiln), binders from lusters and decals, wax burn out effluents, florines, halogens, acids, metal oxides, and salts are some of the corrosive and harmful atmospheres that will damage a kiln. Most ceramic processes will release some of these harmful constituents into the kiln and venting will prevent most of the problems that those processes would cause. Also, depending on the concentration of the harmful gasses, kiln source ventilation (such as our Vent-Sure) may limit the damage to the kiln. It is the customer's sole responsibility to ensure that the materials and the processes used are not harmful. This is of particular importance for industrial uses where processes may be unusual.
3. Over-firing damage for any reason and regardless of cause. I**MPORTANT: We specifically warn you not to fire the kiln unattended. Neither the DynaTrol, Genesis, One-Touch control, nor any other electronic control used by L&L is designed to be a failproof shut off device. L&L is not responsible for damage caused by failure of any of these controls.**
4. Controls made by Orton, Future Controls, Eurotherm, Honeywell or other manufactures are warranted by their manufacturers. L&L is not responsible for damage caused by failure of one of these controls.
5. Also note that it is easy to melt clay if you inadvertently fire it hotter than its rating. It is possible in some controls to limit the upper firing limit of the kiln to avoid accidental overfirings of this type. Contact factory or read your control instruction manual if you would like further information on this.
6. Firebrick by its nature is fragile and will chip, crack, and create dust. L&L designs its kilns to minimize the effects of this but can not warrant against cracking, breakage, spalling or dusting. There is specifically no warranty for cracked arches, tops, lids or bottoms.
7. Corrosion of the case is specifically not warranted. Corrosion is typically due to use of a kiln in an unheated outside shed (where morning dew condenses on the kiln and humidity attacks the kiln) or from an unvented kiln (where the water vapor and fumes generated by firing ceramic materials attack the kiln case). However, even a vented kiln can corrode due to all the

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environmental and process conditions that a kiln can be exposed to. Exposure to other ambient conditions, including but not limited to humidity, rain, snow, dust, and salt air will also cause corrosion.

8. Damage due to neglect, inadequate room or kiln ventilation, mechanical abuse, improper storage, inadequate maintenance, improper use or freight damage.
9. Damage to the elements or element holders due to failure to properly keep the kiln clean (i.e. allowing glaze or ceramic chards from exploding pots) to make contact with the element holders.
10. Damage to the kiln caused for firing in ambient conditions that are too hot for the control or other components in the kiln. The DynaTrol or Genesis is rated for use up to 125°F (52°C). That means that the room that you fire in should be less than 100°F (38°C) (because the control will be slightly hotter than room air dues to transferred heat from the kiln). Note that direct sunlight on the control face may raise the temperature of the board beyond what you would expect from the ambient temperature or the kiln heat. Also note that the DynaTrol specifically allows the operator to check the control board temperature.
11. Failure to report defect within fifteen (15) days after it becomes manifest or known.
12. Any alteration of parts or design that vary from factory designs.
13. Thermocouple Protection Tubes are not warranted against breakage.
14. L&L's warranty is strictly limited to repair or replacement of defective items. Kilns may not be returned.
15. Resellers are not authorized by L&L to modify and/or assume any other obligations or liabilities other than those expressed in this limited warranty and any such additional obligations are null and void.
16. EXCEPT AS SPECIFICALLY WARRANTED HEREIN, KILNS ARE SOLD AS IS. L&L MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, COVERING THE GOODS AND SPECIFICALLY DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Purchaser acknowledges that certain conditions or circumstances may be created or incurred by Purchaser or user or over which L&L has no control, including, but not limited to, climactic conditions, improper use, inadequate maintenance, and Purchaser, as a condition of purchase or use, assumes responsibility for and releases L&L from liability arising out of the use of the kilns attributable to such causes.
17. L&L SHALL NOT BE LIABLE FOR ANY INCIDENTAL, SECONDARY, OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO BODILY INJURY OR DEATH, LOST PROFITS, LOSS OF USE, OR OTHER ECONOMIC LOSSES. Purchaser agrees that L&L's total liability for any damages or remedies arising hereunder shall be limited to direct damages, in an amount not exceeding the purchase price actually paid. Replacement or repair or refund, at L&L's sole discretion, of the purchase price of the equipment purchased shall constitute the exclusive and sole remedy available to Purchaser. Any action for breach of contract or negligence must be commenced by Purchaser within 6 months after delivery of the equipment to Purchaser.
18. L&L's full Terms and Conditions of Sale are available at ***hotkilns.com/terms.***

3 YEAR PRO-RATED ELEMENT & THERMOCOUPLE LIMITED WARRANTY

Elements and thermocouples are warranted for three (3) years on a pro-rated basis with the following exceptions:

1. Glaze damage to the elements caused by accidentally scraping edges of unfired glazed ware against element groove. WARNING: causing unfired glaze to contaminate element will damage elements and can lead to element failure, and creates a fire hazard.
2. Firing of kiln to a temperature that exceeds the lower of either the maximum rating of kiln or 2350°F (1290°C).
3. Damage to elements caused by explosion of ceramic object. WARNING: this may cause damage to the elements and can lead to element failure, and creates a fire hazard.
4. **Elements are warranted on a prorated schedule based on the ship date of the kiln.** All dates are based on ship date from factory if sold direct or drop shipped to customer. If sold from a reseller's warehouse the date would be based on when it was shipped and/or sold from the reseller. The warranty is not extended for any period of where operation of the kiln is delayed for shipping, warehousing, or other reasons.

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STANDARD LIMITED THREE YEAR WARRANTY FOR L&L KILNS

5. Labor to replace elements is not covered.
6. **The pro-rated discount schedule only is valid for elements that you are actually replacing.** In other words you can't buy a whole set of elements at these prices for anticipated future replacement. We reserve the right to ask for replaced elements in return.
7. This replacement schedule is limited to new kilns.

PRO-RATED SCHEDULE FOR KILNS THAT DO HAVE A VENT-SURE INSTALLED

Date from time of shipment from factory	Price of thermocouples and elements
0-12 Months	No Charge
12-24 Months	25% of full list price
24-36 Months	50% of full list price

PRO-RATED SCHEDULE FOR ALL KILNS THAT DO NOT HAVE A VENT-SURE INSTALLED AND ALL JH SERIES KILNS

JH KILNS

The pro-rated schedule for elements for the JH series kilns varies because of the hard use these kilns get during the crystalline glaze firing process.

KILNS WITHOUT VENTS

In kilns used without an automatic Vent-Sure, the elements will corrode a lot quicker than normally and fail more quickly and this pro-rated schedule takes this into account. NOTE: The vent on the kiln must be an L&L Vent-Sure downdraft vent or this exclusion will apply even with a vent made by other companies.

Date from time of shipment from factory	Price of thermocouples and elements
0-6 Months	No Charge
6-12 Months	25% of full list price
12-24 Months	50% of full list price

3 YEAR LIMITED VENT WARRANTY

L&L VS-1 Vent-Sure is warranted to be free of defects in workmanship for a period of (3) years, starting from date of original purchase from L&L Kiln Mfg., Inc. or from an authorized L&L reseller. A sales receipt is required for proof of purchase. In addition, L&L may require you to send in defective parts for examination to determine the applicability of these warranty provisions. DO NOT DISCARD PARTS BEFORE CONTACTING L&L. L&L Kiln Mfg., Inc. will replace or repair any defective part sent freight-prepaid to L&L Kiln Mfg., Inc. following L&L's written acknowledgement and authorization regarding the specific issue. L&L Kiln Mfg., Inc. will prepay return shipping cost without charge in the Continental United States. On site labor is not covered by the factory; however, local resellers or dealers may offer this service.

EXCLUSIONS & LIMITATIONS

1. The Vent-Sure must be used as instructed in our vent instructions.
2. The use of any wax process that might cause condensation of wax or other similar substance in the vent system will void the warranty.
3. The Vent-Sure is not warranted to vent highly corrosive fumes, and any such use will void any warranties otherwise provided.

PARTS WARRANTY

1. L&L does not warrant replacement elements and thermocouples except for catastrophic failure (for instance, a situation where the element end broke off without fault of the operator).
2. Parts (aside from elements and thermocouples) are warranted for ninety (90) days from time of shipment. Complete control panels are warranted for one (1) year from time of shipment. Warranty is for replacement or repair only and does not include labor.

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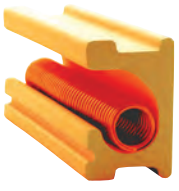
DOLL INSTRUCTION MANUAL



L&L Kiln's patented hard ceramic element holders protect your kiln.

SAFETY DATA & LITERATURE

SAFETY DATA SHEET

Following Regulation 1910.1200

SDS Number: 151-1 Date of first issue: 28 March 1995 Date of last revision: 08 June 2021

1 - Identification of product

a - Product identifier used on the label

Tradenames: IFB 23 Tile, Insalcor, Isolmos 450, Isolmos 550, JM-20, JM-23, JM-23US, JM-26, JM-28, JM-30, JM-32, K-20, K-23, K-24, K-25, K-26 , K-28, K-30, SR-90, TC-23, TC-26, TJM-26, TJM-28,

b - Other means of identification

INSULATING REFRACTORY BRICK

c - Recommended use of the chemical and restrictions on use

High Temperature Thermal Insulation

d - Name, address, and telephone number

Morgan Advanced Materials
P. O. Box 923; Dept. 300
Augusta, GA 30903-0923
Telephone: 706-796-4200

e - Emergency Phone Number

For Product Stewardship and Emergency Information:
Hotline - 1-800-722-5681
Fax - 706-560-4054

For additional SDSs and to confirm this is the most current SDS for the product, visit our web page www.morganthermalceramics.com or send a request to MT.NorthAmerica@morganplc.com

2 - Hazard Identification

a - Classification of the chemical in accordance with paragraph (d) of §1910.1200

The U.S. Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (HCS) 2012 indicates that IARC Group 1 corresponds to OSHA HCS 2012 Category 1A carcinogen classification (see, e.g., §1910.1200, Appendix F, Part D).

b - Signal word, hazard statement(s), symbol(s) and precautionary statement(s) in accordance with paragraph (f) of §1910.1200

Under OSHA HCS 2012, crystalline silica (inhaled in the form of quartz or cristobalite from occupational sources) is classified as a GHS category 1A - Known human carcinogen.

Hazard Pictograms

Signal Words
Danger

Hazard Statements
May cause cancer by inhalation.

Precautionary Statements
Do not handle until all safety instructions have been read and understood.
Use respiratory protection as required; see section 8 of the Safety Data Sheet.
If concerned about exposure, get medical advice.
Store in a manner to minimize airborne dust.
Dispose of waste in accordance with local, state and federal regulations.

Emergency Overview

Respirable dust from these products may contain crystalline silica, which is known to cause respiratory disease.
(See Section 11 for more information)

c - Describe any hazards not otherwise classified that have been identified during the classification process

d - Mixture Rule

Not applicable.

3 - Composition / Information On Ingredients

a - Composition table

COMPONENTS	CAS NUMBER	% BY WEIGHT
Ceramic Matrics (consist of glass, mullite and anorthite)	NONE	95 - 99
Crystalline Silica	14808-60-7 or 14464-46-1	Up to 5

b - Common Name

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines)

d - Impurities and Stabilizing Additives

Not applicable.

4 - First-Aid measures

a - Description of necessary measures, subdivided according to the different routes of exposure, i.e., inhalation, skin and eye contact, and ingestion

Eyes

Flush with large amounts of water for at least 15 minutes. Do not rub eyes.

Skin

Wash affected area gently with soap and water. Skin cream or lotion after washing may be helpful.

Respiratory Tract

Remove affected person to dust free location. See Section 8 for additional measures to reduce or eliminate exposure.

Gastrointestinal

Unlikely route of exposure.

c - Indication of immediate medical attention and special treatment needed, if necessary

5 - Fire-fighting measures

a - Suitable (and unsuitable) extinguishing media and

Use extinguishing media suitable for type of surrounding fire

c - Special Protective Equipment and Precautions for Firefighters

NFPA Codes: Flammability: 0 Health: 1 Reactivity: 0 Special: 0

b - Specific hazards arising from the chemical (e.g., nature of any hazardous combustion products):

None

6 - Accidental Release Measures

a - Personal precautions, protective equipment, and emergency procedures

Avoid creating airborne dust. Follow routine housekeeping procedures. Vacuum only with HEPA filtered equipment. If sweeping is necessary, use a dust suppressant and place material in closed containers. Do not use compressed air for clean-up. Personnel should wear gloves, goggles and approved respirator.

b - Methods and materials for containment and cleaning up

Pick up large pieces and dispose in a closed container. Follow precaution stated in above section for clean up.

7 - Handling and storage

a - Precautions for safe handling

Limit the use of power tools unless in conjunction with local exhaust. Use hand tools whenever possible. Frequently clean the work area with HEPA filtered vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

b - Conditions for safe storage, including any incompatibilities

Store in a manner to minimize airborne dust.

c - empty containers

Product packaging may contain residue. Do not reuse.

8 - Risk Management Measures / Exposures Controls / Personal Protection

a - OSHA permissible exposure limit (PEL), American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV), and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the safety data sheet, where available

EXPOSURE GUIDELINES			
MAJOR COMPONENT	***OSHA PEL***	***ACGIH TLV***	***MANUFACTURER'S REG***
Crystalline Silica	0.05 mg/m^3 **(1)**	0.025 mg/m^3 (respirable dust)	NONE
(1) OSHA new Permissible Exposure Limit (PEL) for respirable crystalline silica is 0.05 mg/m^3 (8-hr TWA), an Action Level (AL) of 0.025 mg/m^3 (8-hr TWA), together with associated ancillary requirements listed under General Industry and Maritime Standard (29 CFR 1910.1053) and Construction Standards (29 CFR 1910.1153).			
OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)			
Ontario Canda OEL - Silica,Crystalline: Quartz/Tripoli = 0.1 mg/m^3 (R); Cristobalite = 0.05 mg/m^3 (R). Industrial hygiene standards and occupational exposure limits vary between countries and local jurisdictions. Check which exposure levels apply to your facility and comply with local regulations. If no regulatory dust or other standards apply, a qualified industrial hygienist can assist with a specific workplace evaluation including recommendations for respiratory protection.			

b - Appropriate Engineering Controls

Use engineering controls, such as ventilation and dust collection devices, to reduce airborne particulate concentrations to the lowest attainable level.

c - Individual protection measures, such as personal protective equipment

PPE - Skin

Wear full body clothing, gloves, hat, and eye protection as necessary to prevent skin irritation. Washable or disposable clothing may be used. If possible, do not take unwashed work clothing home. If soiled work clothing must be taken home, employers should ensure employees are trained on the best practices to minimize or avoid non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, rinse washer before washing other household clothes, etc.).

PPE - Eye

As necessary, wear goggles or safety glasses with side shields.

PPE – Respiratory

When it is not possible or feasible to reduce airborne crystalline silica or particulate levels below the appropriate PEL/OEL through engineering controls, or until they are installed, employees are encouraged to use good work practices together with respiratory protection. Before providing respirators to employees (especially negative pressure type), employers should 1) monitor for airborne crystalline silica and/or dust concentrations using appropriate NIOSH analytical methods and select respiratory protection based upon the results of that monitoring , 2) have the workers evaluated by a physician to determine the workers' ability to wear respirators, and 3) implement respiratory protection training programs. Use NIOSH-certified particulate respirators (42 CFR 84), in compliance with OSHA Respiratory Protection Standard 29 CFR 1910.134 and 29 CFR 1926.103, for the particular hazard or airborne concentrations to be encountered in the work environment. For the most current information on respirator selection, contact your supplier.

9 - Physical and chemical properties

a - Appearance	Solid Brick or Block
b -Odor	Not applicable
c - Odor Threshold	Not applicable
e- pH	Not applicable
d - Melting Point	2750°F to 3660°F (refer to specific product data sheets)
f- Initial Boiling Point/Range	Not applicable
g- Flashpoint	Not applicable
h - Evaporation Rate	Not applicable
i - Flammability	Not applicable
j - Upper/Lower Flammability or Explosive Limits	Not applicable
k - VAPOR PRESSURE	Not applicable
l - VAPOR DENSITY	Not applicable
m - Solubility	Not soluble in water
n - Relative Density	Not applicable
o - Partition Coefficient: n-Octanol/water	Not applicable
p - Auto-ignition temperature	Not applicable
q - Decomposition Temperature	Not applicable
r - Viscosity	Not applicable

10 - Stability and Reactivity

a - Reactivity

None.

b - Chemical Stability

This is a stable material.

c - Possibility of Hazardous Reaction

Will not occur.

d - Conditions to Avoid

None

e - Incompatible Materials

Powerful oxidizers; fluorine, manganese trioxide, oxygen disulfide

f - Hazardous decomposition products

None

11 - Toxicological information

a - TOXICOKINETICS, METABOLISM AND DISTRIBUTION

Dust samples from these products have not been tested. They may contain respirable crystalline silica.

b - Acute Toxicity

c - Epidemiology

No studies have been undertaken on humans exposed to these products in occupational environments.

Crystalline silica
Exposure to crystalline silica can cause silicosis, and exacerbate pulmonary tuberculosis and bronchitis. IARC (Monograph vol. 68, 1997) concluded that "crystalline silica from occupational sources inhaled in the form of quartz or cristobalite is carcinogenic to humans (Group 1)", and noted that "carcinogenicity in humans was not detected in all industrial circumstances studied" and "may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity".

d - Toxicology

Crystalline silica
Some samples of crystalline silica administered to rats by inhalation and intratracheal instillation have caused fibrosis and lung cancer. Mice and hamsters, similarly exposed, develop inflammatory disease including fibrosis but no lung cancer.

International Agency for Research on Cancer and National Toxicology Program

IARC, in 1997, Monograph v.68, classified crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to human (group 1).

The Ninth Annual Report on Carcinogens (2000), prepared by the National Toxicology Program (NTP), classified silica, crystalline (respirable size), as a substance known to be a human carcinogen.

12 - Ecological information

a - Ecotoxicity (aquatic and terrestrial, where available)

These products are not reported to have any ecotoxicity effects.

c - Bioaccumulative potential

No information for the product.

d - Mobility in soil

No information for the product.

e - Other adverse effects (such as hazardous to the ozone layer

No information available for the product.

13 - Disposal Considerations

Waste Management and Disposal

To prevent waste materials from becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended.

Additional information

This product, as manufactured, is not classified as a listed or characteristic hazardous waste according to U. S. Federal regulations (40 CFR 261). Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under U. S. Federal regulations, it is the waste generator's responsibility to properly characterize a waste material, to determine if it is a "hazardous" waste. Check local, regional, state or provincial regulations to identify all applicable disposal requirements.

14 - Transport information

a - UN number.

Hazard Class: Not Regulated United Nations (UN) Number: Not Applicable
Labels: Not Applicable North America (NA) Number: Not Applicable
Placards: Not Applicable Bill of Lading: Product Name

b - UN proper shipping name

Not applicable.

c - Transport hazard class(es)

Not applicable.

d - Packing group, if applicable

Not applicable.

e - Environmental hazards (e.g., Marine pollutant (Yes/No))

No.

f - Transport in bulk (according to Annex II of MARPOL 73/78 and the IBC Code)

Not regulated.

g - Special precautions which a user needs to be aware of, or needs to comply with, in connection with transport or conveyance either within or outside their premises

Not applicable.

International

INTERNATIONAL
Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train), IATA (air) or IMDG (ship).

15 - Regulatory information

15.1 - United States Regulations

UNITED STATES REGULATIONS
SARA Title III: This product does not contain any substances reportable under Sections 302, 304, 313 (40 CFR 372). Sections 311 and 312 apply.
OSHA: Comply with Hazard Communication Standards 29 CFR 1910.1200 and 29 CFR 1926.59 and Respiratory Protection Standards 29 CFR 1910.134 and 29 CFR 1926.103.
TSCA: All substances contained in this product are listed in the TSCA Chemical Inventory
California: "Silica, crystalline (airborne particles of respirable size)" is listed in Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986 as a chemical known to the State of California to cause cancer.
Other States: Crystalline silica products are not known to be regulated by states other than California; however, state and local OSHA and EPA regulations may apply to these products. Contact your local agency if in doubt.

15.2 - International Regulations

INTERNATIONAL REGULATIONS
Canadian WHMIS: Class D-2A Materials Causing Other Toxic Effects
Canadian EPA: All substances in this product are listed, as required, on the Domestic Substance List (DSL).

16 - Other Information

initial statement

Devitrification

Product Stewardship Program

HMIS HAZARD RATING

HMIS Health	1* (* denotes potential for chronic effects)
HMIS Flammable	0
HMIS Reactivity	0
HMIS Personal Protective Equipment	X (To be determined by user)

TECHNICAL DATA SHEETS

114-3, 114-2

Revision Summary

Revision date updated.

MSDS prepared by

SDS Prepared By: MORGAN THERMAL CERAMICS ENVIRONMENTAL, HEALTH & SAFETY DEPARTMENT

Disclaimer

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Safety Data Sheet. Employers may use this SDS to supplement other information gathered by them in their efforts to assure the health and safety of their employees and the proper use of the product. This summary of the relevant data reflects professional judgment; employers should note that information perceived to be less relevant has not been included in this SDS. Therefore, given the summary nature of this document, Morgan Thermal Ceramics does not extend any warranty (expressed or implied), assume any responsibility, or make any representation regarding the completeness of this information or its suitability for the purposes envisioned by the user.

SAFETY DATA SHEET

1. Identification

Product identifier **TAYCOR 320-TR MORTAR; TAYCOR 320-DC MORTAR**

Other means of identification

Brand Code 8802, 929B

Recommended use For Industrial Use Only

Recommended restrictions Users should be informed of the potential presence of respirable dust and respirable crystalline silica as well as their potential hazards. Appropriate training in the proper use and handling of this material should be provided as required under applicable regulations.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer

Company name HarbisonWalker International

Address 1305 Cherrington Parkway, Suite 100
Moon Township, Pennsylvania 15108 US

Telephone General Phone: 412-375-6600

Website www.thinkHWI.com

Emergency phone number CHEMTREC 24 HOUR EMERGENCY # 1-800-424-9300

2. Hazard(s) identification

Physical hazards Not classified.

Health hazards

Carcinogenicity	Category 1A
Specific target organ toxicity, repeated exposure	Category 1

Environmental hazards Not classified.

OSHA defined hazards Not classified.

Label elements

Signal word Danger

Hazard statement May cause cancer. Causes damage to organs through prolonged or repeated exposure.

Precautionary statement

Prevention Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not breathe dust. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Wear protective gloves/protective clothing/eye protection/face protection.

Response If exposed or concerned: Get medical advice/attention.

Storage Store locked up.

Disposal Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC) None known.

Supplemental information Users should be informed of the potential presence of respirable dust and respirable crystalline silica as well as their potential hazards. Overexposure to the respirable dust of crystalline silica (quartz or cristobalite, less than or equal to 5 microns in size) may lead to silicosis in humans, which is a progressive and irreversible lung disease. Appropriate training in the proper use and handling of this material should be provided as required under applicable regulations.

3. Composition/information on ingredients

Mixtures

Chemical name	Common name and synonyms	CAS number	%
Aluminium Oxide (Non-Fibrous)		1344-28-1	60 - 80
Kaolin		1332-58-7	2.5 - 10
Quartz (SiO2)		14808-60-7	2.5 - 10
Silicic Acid, Sodium Salt		1344-09-8	2.5 - 10
Mullite		1302-93-8	0.1 - 1
Titanium Dioxide		13463-67-7	0.1 - 1
Other components below reportable levels			10 - 20

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

4. First-aid measures

Inhalation Move to fresh air. Call a physician if symptoms develop or persist.

Skin contact Wash off with soap and water. Get medical attention if irritation develops and persists.

Eye contact Do not rub eyes. Rinse with water. Get medical attention if irritation develops and persists.

Ingestion Rinse mouth. Get medical attention if symptoms occur.

Most important symptoms/effects, acute and delayed Dusts may irritate the respiratory tract, skin and eyes. Prolonged exposure may cause chronic effects.

Indication of immediate medical attention and special treatment needed Provide general supportive measures and treat symptomatically. Keep victim under observation. Symptoms may be delayed.

General information IF exposed or concerned: Get medical advice/attention. If you feel unwell, seek medical advice (show the label where possible). Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media Use fire-extinguishing media appropriate for surrounding materials.

Unsuitable extinguishing media Not available.

Specific hazards arising from the chemical Not applicable.

Special protective equipment and precautions for firefighters Not available.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Wear appropriate protective equipment and clothing during clean-up. Do not breathe dust. Use a NIOSH/MSHA approved respirator if there is a risk of exposure to dust/fume at levels exceeding the exposure limits. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.

Methods and materials for containment and cleaning up Avoid dispersal of dust in the air (i.e., clearing dust surfaces with compressed air). Collect dust using a vacuum cleaner equipped with HEPA filter. Stop the flow of material, if this is without risk.

Large Spills: Wet down with water and dike for later disposal. Shovel the material into waste container. Following product recovery, flush area with water.

Small Spills: Sweep up or vacuum up spillage and collect in suitable container for disposal.

Never return spills to original containers for re-use. Put material in suitable, covered, labeled containers. For waste disposal, see section 13 of the SDS.

Environmental precautions Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Minimize dust generation and accumulation. Provide appropriate exhaust ventilation at places where dust is formed. Do not breathe dust. Do not breathe dust. Avoid prolonged exposure. When using, do not eat, drink or smoke. Should be handled in closed systems, if possible. Wear appropriate personal protective equipment. Wash hands thoroughly after handling. Observe good industrial hygiene practices.

Conditions for safe storage, including any incompatibilities Store locked up. Store in original tightly closed container. Store in a well-ventilated place. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure controls/personal protection

Occupational exposure limits

The following constituents are the only constituents of the product which have a PEL, TLV or other recommended exposure limit. At this time, the other constituents have no known exposure limits.

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
Aluminium Oxide (Non-Fibrous) (CAS 1344-28-1)	PEL	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.
Kaolin (CAS 1332-58-7)	PEL	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.
Quartz (SiO2) (CAS 14808-60-7)	PEL	0.05 mg/m3	
Titanium Dioxide (CAS 13463-67-7)	PEL	15 mg/m3	Total dust.

US. OSHA Table Z-3 (29 CFR 1910.1000)

Components	Type	Value	Form
Aluminium Oxide (Non-Fibrous) (CAS 1344-28-1)	TWA	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.
		50 mppcf	Total dust.
		15 mppcf	Respirable fraction.
Kaolin (CAS 1332-58-7)	TWA	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.
		50 mppcf	Total dust.
		15 mppcf	Respirable fraction.
Quartz (SiO2) (CAS 14808-60-7)	TWA	0.1 mg/m3	Respirable.
		2.4 mppcf	Respirable.
Titanium Dioxide (CAS 13463-67-7)	TWA	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.
		50 mppcf	Total dust.
		15 mppcf	Respirable fraction.

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Aluminium Oxide (Non-Fibrous) (CAS 1344-28-1)	TWA	1 mg/m3	Respirable fraction.
Kaolin (CAS 1332-58-7)	TWA	2 mg/m3	Respirable fraction.
Quartz (SiO2) (CAS 14808-60-7)	TWA	0.025 mg/m3	Respirable fraction.
Titanium Dioxide (CAS 13463-67-7)	TWA	10 mg/m3	

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value	Form
Kaolin (CAS 1332-58-7)	TWA	5 mg/m3	Respirable.
		10 mg/m3	Total
Quartz (SiO2) (CAS 14808-60-7)	TWA	0.05 mg/m3	Respirable dust.

Biological limit values No biological exposure limits noted for the ingredient(s).

Exposure guidelines Occupational exposure to nuisance dust (total and respirable) and respirable crystalline silica should be monitored and controlled. Occupational exposure to nuisance dust (total and respirable) and respirable crystalline silica should be monitored and controlled.

Appropriate engineering controls	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. If engineering measures are not sufficient to maintain concentrations of dust particulates below the Occupational Exposure Limit (OEL), suitable respiratory protection must be worn. If material is ground, cut, or used in any operation which may generate dusts, use appropriate local exhaust ventilation to keep exposures below the recommended exposure limits.

Individual protection measures, such as personal protective equipment

Eye/face protection	Chemical respirator with organic vapor cartridge, full facepiece, dust and mist filter.
Skin protection	
Hand protection	Wear appropriate chemical resistant gloves.
Other	Use of an impervious apron is recommended.
Respiratory protection	Use a NIOSH/MSHA approved respirator if there is a risk of exposure to dust/fume at levels exceeding the exposure limits.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations	Observe any medical surveillance requirements. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Solid.
Form	Powder.
Color	Not available.
Odor	Not available.
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	Not available.
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	Not available.
Solubility(ies)	
Solubility (water)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.

Viscosity	Not available.

Other information

Explosive properties	Not explosive.
Oxidizing properties	Not oxidizing.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Contact with incompatible materials.
Incompatible materials	Acids. Chlorine. Incompatibility is based strictly upon potential theoretical reactions between chemicals and may not be specific to industrial application exposure.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May cause damage to organs through prolonged or repeated exposure by inhalation. Dust may irritate respiratory system.
Skin contact	Dust or powder may irritate the skin.
Eye contact	Dust may irritate the eyes.
Ingestion	Expected to be a low ingestion hazard.
Symptoms related to the physical, chemical and toxicological characteristics	Dusts may irritate the respiratory tract, skin and eyes.

Information on toxicological effects

Acute toxicity	Not known.
Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.
Serious eye damage/eye irritation	Direct contact with eyes may cause temporary irritation.

Respiratory or skin sensitization

Respiratory sensitization	Not a respiratory sensitizer.
Skin sensitization	This product is not expected to cause skin sensitization.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	In 1997, IARC (the International Agency for Research on Cancer) concluded that crystalline silica inhaled from occupational sources can cause lung cancer in humans. However in making the overall evaluation, IARC noted that "carcinogenicity was not detected in all industrial circumstances studied. Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs." (IARC Monographs on the evaluation of the carcinogenic risks of chemicals to humans, Silica, silicates dust and organic fibres, 1997, Vol. 68, IARC, Lyon, France.) In June 2003, SCOEL (the EU Scientific Committee on Occupational Exposure Limits) concluded that the main effect in humans of the inhalation of respirable crystalline silica dust is silicosis. "There is sufficient information to conclude that the relative risk of lung cancer is increased in persons with silicosis (and, apparently, not in employees without silicosis exposed to silica dust in quarries and in the ceramic industry). Therefore, preventing the onset of silicosis will also reduce the cancer risk..." (SCOEL SUM Doc 94-final, June 2003) According to the current state of the art, worker protection against silicosis can be consistently assured by respecting the existing regulatory occupational exposure limits. May cause cancer. Occupational exposure to respirable dust and respirable crystalline silica should be monitored and controlled.

IARC Monographs. Overall Evaluation of Carcinogenicity

Quartz (SiO2) (CAS 14808-60-7)	1 Carcinogenic to humans.
Titanium Dioxide (CAS 13463-67-7)	2B Possibly carcinogenic to humans.

US. National Toxicology Program (NTP) Report on Carcinogens

Quartz (SiO2) (CAS 14808-60-7)	Known To Be Human Carcinogen.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

Reproductive toxicity This product is not expected to cause reproductive or developmental effects.

Developmental effects

Quartz (SiO2)	0

Developmental effects - EU category

Quartz (SiO2)	0

Embryotoxicity

Quartz (SiO2)	0

Reproductivity

Quartz (SiO2)	0

Specific target organ toxicity - single exposure Not classified.

Specific target organ toxicity - repeated exposure Causes damage to organs through prolonged or repeated exposure.

Aspiration hazard Not an aspiration hazard.

Chronic effects Causes damage to organs through prolonged or repeated exposure. Prolonged inhalation may be harmful. Prolonged exposure may cause chronic effects.

12. Ecological information

Ecotoxicity The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Persistence and degradability No data is available on the degradability of this product.

Bioaccumulative potential No data available.

Mobility in soil No data available.

Other adverse effects No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal considerations

Disposal instructions This product, in its present state, when discarded or disposed of, is not a hazardous waste according to Federal regulations (40 CFR 261.4 (b)(4)). Under RCRA, it is the responsibility of the user of the product to determine, at the time of disposal, whether the product meets RCRA criteria for hazardous waste.

Hazardous waste code Since this product is used in several industries, no Waste Code can be provided by the supplier. The Waste Code should be determined in arrangement with your waste disposal partner or the responsible authority.

Waste from residues / unused products Not available.

Contaminated packaging Not available.

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200. All chemical substances in this product are listed on the TSCA chemical substance inventory where required.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

SARA 304 Emergency release notification

Not regulated.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - No
Delayed Hazard - Yes
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical No

SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
Aluminium Oxide (Non-Fibrous)	1344-28-1	60 - 80

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations WARNING: This product contains a chemical known to the State of California to cause cancer.

US - California Proposition 65 - CRT: Listed date/Carcinogenic substance

Quartz (SiO2) (CAS 14808-60-7) Listed: October 1, 1988
Titanium Dioxide (CAS 13463-67-7) Listed: September 2, 2011

US. California. Candidate Chemicals List. Safer Consumer Products Regulations (Cal. Code Regs, tit. 22, 69502.3, subd. (a))

Quartz (SiO2) (CAS 14808-60-7)
Titanium Dioxide (CAS 13463-67-7)

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	No
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 03-23-2017

Version # 01

Disclaimer	This information is based on our present knowledge on creation date. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.
Revision information	This document has undergone significant changes and should be reviewed in its entirety.

SAFETY DATA SHEET

Following Regulation 1910.1200

SDS Number: 358 Date of first issue: 20 January 2001 Date of last revision: 23 December 2020

1 - Identification of product

a - Product identifier used on the label

Tradenames: FireMaster Door Seal +, FireMaster TCHTF, Mix 411-E Expandable Felt, Superwool 607 351-E Paper,

b - Other means of identification

ALKALINE EARTH SILICATE (AES) WOOL PRODUCT

c - Recommended use of the chemical and restrictions on use

Application as thermal insulation, heat shields, heat containment, gaskets and expansion joints in industrial furnaces, ovens, kilns, boilers and other process equipment and in the aerospace, automotive and appliance industries, and as passive fire protection systems and firestops. (Please refer to specific technical data sheets for more information)

d - Name, address, and telephone number

Morgan Advanced Materials
P. O. Box 923; Dept. 300
Augusta, GA 30903-0923
Telephone: 706-796-4200

e - Emergency Phone Number

For Product Stewardship and Emergency Information:
Hotline - 1-800-722-5681
Fax - 706-560-4054

For additional SDSs and to confirm this is the most current SDS for the product, visit our web page www.morganthermalceramics.com or send a request to MT.NorthAmerica@morganplc.com

2 - Hazard Identification

a - Classification of the chemical in accordance with paragraph (d) of §1910.1200

Not classified. Read the entire safety data sheet.

b - Signal word, hazard statement(s), symbol(s) and precautionary statement(s) in accordance with paragraph (f) of §1910.1200

None.

Emergency Overview

CLASSIFICATION OF THE SUBSTANCE/MIXTURE
The Twelfth Annual Report on Carcinogens (2011), prepared by the National Toxicology Program (NTP), classified "Certain Glasswool Fibers (inhalable)" as a substance reasonably anticipated to be a carcinogen.

The State of California, pursuant to Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986, has listed "glasswool fibers (airborne particles of respirable size)" as a material known to the State of California to cause cancer.

In Europe, Superwool products were developed after the IARC classification was made (1987). They are exonerated from any carcinogenic classification under Directive 97/69/EC in the European Union.

LABELING ELEMENTS
GHS labeling pending

OTHER HAZARDS WHICH DO NOT RESULT IN CLASSIFICATION
Mild mechanical irritation to skin, eyes and upper respiratory system may result from exposure.
These affects are usually temporary.

c - Describe any hazards not otherwise classified that have been identified during the classification process

Mild mechanical irritation to skin, eyes and upper respiratory system may result from exposure.
These effects are usually temporary.

d - Mixture Rule

3 - Composition / Information On Ingredients

a - Composition table

COMPONENTS	CAS NUMBER	% BY WEIGHT
Alkaline-Earth Silicate Wool[(1)]	436083-99-7	Up to 90
Graphite	7782-42-5	Up to 40
Latex	NONE	2 - 10
Fibrous Glass	65997-17-3	1 - 5

(1) **CAS definition:** Alkaline Earth Silicate (AES) consisting of silica (50-82 wt %), calcia and magnesia (18-43 wt %), alumina, titania and zirconia (less than 6 wt %), and trace oxides. This CAS composition also covers Morgan Thermal Ceramics products Calcium-Magnesium-Silicate Wool (CAS no. 329211-92-9) and Calcium-Magnesium-Zirconium-Silicate Wool (CAS no. 308084-09-5).

b - Common Name

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines)

d - Impurities and Stabilizing Additives

Not applicable.

4 - First-Aid measures

a - Description of necessary measures, subdivided according to the different routes of exposure, i.e., inhalation, skin and eye contact, and ingestion

Eyes

If eyes become irritated, flush immediately with large amounts of lukewarm water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Do not rub eyes.

Skin

If skin becomes irritated, remove soiled clothing. Do not rub or scratch exposed skin. Wash area of contact thoroughly with soap and water. Using a skin cream or lotion after washing may be helpful.

Respiratory Tract

If respiratory tract irritation develops, move the person to a dust free location. See Section 8 for additional measures to reduce or eliminate exposure.

Gastrointestinal

If gastrointestinal tract irritation develops, move the person to a dust free environment.

c - Indication of immediate medical attention and special treatment needed, if necessary

5 - Fire-fighting measures

a - Suitable (and unsuitable) extinguishing media and

Use extinguishing media suitable for type of surrounding fire

c - Special Protective Equipment and Precautions for Firefighters

NFPA Codes: Flammability: 0 Health: 1 Reactivity: 0 Special: 0

b - Specific hazards arising from the chemical (e.g., nature of any hazardous combustion products):

None

6 - Accidental Release Measures

a - Personal precautions, protective equipment, and emergency procedures

Minimize airborne dust. Compressed air or dry sweeping should not be used for cleaning. See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines.

b - Methods and materials for containment and cleaning up

Pick up large pieces and dispose in a closed container. Follow precaution stated in above section for clean up.

7 - Handling and storage

a - Precautions for safe handling

Limit the use of power tools unless in conjunction with local exhaust. Use hand tools whenever possible. Frequently clean the work area with HEPA filtered vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

b - Conditions for safe storage, including any incompatibilities

Store in a manner to minimize airborne dust.

c - empty containers

Product packaging may contain residue. Do not reuse.

8 - Risk Management Measures / Exposures Controls / Personal Protection

a - OSHA permissible exposure limit (PEL), American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV), and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the safety data sheet, where available

EXPOSURE GUIDELINES				
MAJOR COMPONENT	***OSHA PEL***	***ACGIH TLV***	***MANUFACTURER'S REG***	
Alkaline-Earth Silicate Wool	None Established	None Established	1 f/cc, 8-hr TWA	
Graphite(1)	15 mg/m^3 (total dust) 5 mg/m^3 (respirable dust)	2 mg/m^3	NONE	
Fibrous Glass	None Established	1 f/cc	1 f/cc	
Latex(2)	None Established	None Established	NONE	

(1) Trace amount of sulfuric acid and nitric acid fumes may release from acid treated graphite during heating of this product. The current OSHA PELs for these acids are: 1 mg/m^3 (8 hr.TWA); for sulfuric acid 2 ppm and 4 ppm (STEL) for nitric acid.

(2) Trace amount of formaldehyde may release from latex during initial heating of this product. The current OSHA PELs for formaldehyde are: 0.75 ppm (8 hr. TWA) and 2 ppm (STEL).

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)
Industrial hygiene standards and occupational exposure limits vary between countries and local jurisdictions. Check which exposure levels apply to your facility and comply with local regulations. If no regulatory dust or other standards apply, a qualified industrial hygienist can assist with a specific workplace evaluation including recommendations for respiratory protection.

b - Appropriate Engineering Controls

Use engineering controls such as local exhaust ventilation, point of generation dust collection, down draft work stations, emission controlling tool designs and materials handling equipment designed to minimize airborne fiber emissions.

c - Individual protection measures, such as personal protective equipment

PPE - Skin

Wear personal protective equipment (e.g gloves), as necessary to prevent skin irritation. Washable or disposable clothing may be used. If possible, do not take unwashed clothing home. If soiled work clothing must be taken home, employees should be informed on best practices to minimize non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, and rinse washer before washing other household clothes.

PPE - Eye

As necessary, wear goggles or safety glasses with side shields.

PPE – Respiratory

When engineering and/or administrative controls are insufficient to maintain workplace concentrations below the appropriate REG/PEL/REL, the use of appropriate respiratory protection, pursuant to the requirements of OSHA Standards 29 CFR 1910.134 and 29 CFR 1926.103, is recommended. A NIOSH certified respirator with a filter efficiency of at least 95% should be used. The 95% filter efficiency recommendation is based on NIOSH respirator selection logic sequence for exposure to particulates. Selection of filter efficiency (i.e. 95%, 99% or 99.97%) depends on how much filter leakage can be accepted and the concentration of airborne contaminants. Other factors to consider are the NIOSH filter series N, R or P. (N) **N**ot resistant to oil, (R) **R**esistant to oil and (P) oil **P**roof. These recommendations are not designed to limit informed choices, provided that respiratory protection decisions comply with 29 CFR 1910.134. The evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed , on a case by case basis, by a qualified industrial hygienist.

You may also refer to health and safety information on the HTIW Coalition website www.HTIWCoalition.org

9 - Physical and chemical properties

a - Appearance	Flexible paper or mat like material
b -Odor	Not applicable
c - Odor Threshold	Not applicable
e- pH	Not applicable
d - Melting Point	1093°C (2000°F) to 1275°C (2327°F)
f- Initial Boiling Point/Range	Not applicable
g- Flashpoint	Not applicable
h - Evaporation Rate	Not applicable
i - Flammability	Not applicable
j - Upper/Lower Flammability or Explosive Limits	Not applicable
k - VAPOR PRESSURE	Not applicable
l - VAPOR DENSITY	Not applicable
m - Solubility	Less than 1 mg/litre
n - Relative Density	2.5 - 3.0
o - Partition Coefficient: n-Octanol/water	Not applicable
p - Auto-ignition temperature	Not applicable
q - Decomposition Temperature	Not applicable
r - Viscosity	Not applicable

10 - Stability and Reactivity

a - Reactivity

None.

b - Chemical Stability

Stable under conditions of normal use.

c - Possibility of Hazardous Reaction

None

d - Conditions to Avoid

None

e - Incompatible Materials

Avoid contact with strong acids

f - Hazardous decomposition products

Decomposition of the latex binder will occur at temperatures above 200°C releasing smoke, water, carbon monoxide, carbon dioxid and hydrocarbons. The duration and the amount of release will depend upon the applied temperature, the thickness and area of the material and binder content. During the first heating cycles increased ventilation or the use of suitable respirator protection may be required.

11 - Toxicological information

a - TOXICOKINETICS, METABOLISM AND DISTRIBUTION

b - Acute Toxicity

IRRITANT PROPERTIES
Superwool fibers are negative when tested using approved methods (Directive 67/548/EEC, Annex 5, Method B4). Like all man-made mineral fibers and some natural fibers, fibers contained in this product can produce a mild mechanical irritation resulting in temporary itching or rarely, in some sensitive individuals, in a slight temporary reddening. Unlike other irritant reactions, this is not the result of allergy or chemical skin damage but is caused by mechanical effects.

c - Epidemiology

Silicon carbide
Bruusgaard (1949) found that X-rays of 10 out of 32 workers exposed to average levels of 34 mppcf of silicon carbide for 15 years or more, demonstrated pulmonary changes; these 10 workers were also tuberculin-positive. Miller, Davis, Goldman, and Wyatts (1953) described three cases of pulmonary reactions and hyperglobinemia in tungsten carbide industry workers; these authors concluded that exposure to silicon carbide was not a hazard unless the exposed workers already had pulmonary tuberculosis.

Crystalline silica
Exposure to crystalline silica can cause silicosis, and exacerbate pulmonary tuberculosis and bronchitis. IARC (Monograph vol. 68, 1997) concluded that "crystalline silica from occupational sources inhaled in the form of quartz or cristobalite is carcinogenic to humans (Group 1)", and noted that "carcinogenicity in humans was not detected in all industrial circumstances studied" and "may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity".

d - Toxicology

Fibers contained in the products listed in the title have been designed to be rapidly cleared from lung tissue. This low biopersistence has been confirmed in many studies on AES using EU protocol ECB/TM/27(rev 7). When inhaled, even at very high doses, they do not accumulate to any level capable of producing a serious adverse biological effect. In lifetime chronic studies there was no exposure-related effect more than would be seen with any "inert" dust. Subchronic studies at the highest doses achievable produced at worst a transient mild inflammatory response. Fibers with the same ability to persist in tissue do not produce tumors when injected into the peritoneal cavity of rats.

International Agency for Research on Cancer and National Toxicology Program

12 - Ecological information

a - Ecotoxicity (aquatic and terrestrial, where available)

These products are not reported to have any ecotoxicity effects.

c - Bioaccumulative potential

No bioaccumulative potential.

d - Mobility in soil

No mobility in soil.

e - Other adverse effects (such as hazardous to the ozone layer

No adverse effects of this material on the environment are anticipated.

13 - Disposal Considerations

Waste Management and Disposal

Unless wetted, such a waste is normally dusty and should therefore be properly sealed in containers for disposal. At some authorized disposal sites dusty waste may be treated differently, in order to ensure that they are dealt with promptly and to avoid them being windblown. Check for any national and/or regional regulations which may apply.

Additional information

This product, as manufactured, is not classified as a listed or characteristic hazardous waste according to U. S. Federal regulations (40 CFR 261). Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under U. S. Federal regulations, it is the waste generator's responsibility to properly characterize a waste material, to determine if it is a "hazardous" waste. Check local, regional, state or provincial regulations to identify all applicable disposal requirements.

14 - Transport information

a - UN number.

Hazard Class: Not Regulated United Nations (UN) Number: Not Applicable
Labels: Not Applicable North America (NA) Number: Not Applicable
Placards: Not Applicable Bill of Lading: Product Name

b - UN proper shipping name

Not applicable.

c - Transport hazard class(es)

Not applicable.

d - Packing group, if applicable

Not applicable.

e - Environmental hazards (e.g., Marine pollutant (Yes/No))

No.

f - Transport in bulk (according to Annex II of MARPOL 73/78 and the IBC Code)

Not regulated.

g - Special precautions which a user needs to be aware of, or needs to comply with, in connection with transport or conveyance either within or outside their premises

Not applicable.

International

INTERNATIONAL
Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train), IATA (air) or IMDG (ship).

15 - Regulatory information

15.1 - United States Regulations

UNITED STATES REGULATIONS
SARA Title III: This product does not contain any substances reportable under Sections 302, 304, 313 (40 CFR 372). Sections 311 and 312 apply.
OSHA: Comply with Hazard Communication Standards 29 CFR 1910.1200 and 29 CFR 1926.59 and Respiratory Protection Standards 29 CFR 1910.134 and 29 CFR 1926.103.
TSCA:AES wools have been assigned several CAS numbers; however, as "article", they are not required to be listed on the TSCA inventory.
CERCLA:AES wool contains fibers with an average diameter greater than one micron and thus is not considered a CERCLA hazardous substance.
CAA: AES wool contains fibers with an average diameter greater than one micron and thus is not considered a hazardous air pollutant.
States: AES wools are not known to be regulated by any State. If in doubt, contact your local regulatory agency.

15.2 - International Regulations

Canada WHMIS: No Canadian Workplace Hazardous Materials Information System categories apply to this product.
Canadian EPA: All substances in this product are listed, as required, on the Domestic Substance List (DSL).
European Union: These products are exonerated from any carcinogenic classification in the countries of the European Union under the provisions of Nota Q of the European Commission Directive 97/69/EC.

16 - Other Information

initial statement

Devitrification

PRECAUTIONARY MEASURES TO BE TAKEN AFTER SERVICE UPON REMOVAL
High temperature insulating wool (HTIW) is typically used in insulation applications to keep temperature exposure at 900°C or above in a closed space. The exposure temperature maximum occurs at the hot face surface of the insulation. The heat exposure on the insulation decreases from the hot face to the cold face as the insulation "insulates itself". As a result, only thin layers of the hot face surface of the insulation become devitrified and respirable dust generated during removal operations typically do not contain detectable levels of crystalline silica (CS).

Toxicological evaluation of the effect of the presence of CS in artificially heated HTIW material has not shown any increased toxicity in vitro and in vivo. The results from different factor combinations such as increased brittleness of fibers or micro crystals embedded in the glass structure of the fiber and therefore not biologically available, may explain the lack of toxicological effects. IARC evaluation as provided in Monograph 68 is not relevant since CS is not biologically available in after-service HTIW.

Product Stewardship Program

High concentrations of fibers and other dusts may be generated when after-service products are mechanically disturbed during removal. Therefore, ECFIA and HTIW Coalition recommend:
a) Controlled measures are taken to reduce dust emissions and
b) All personnel directly involved wear an appropriate respirator to minimize and comply with local regulatory limits.

For more information, call the Morgan Thermal Ceramics Product Stewardship Hotline (800-722-5681).

HMIS HAZARD RATING

HMIS Health: 1
HMIS Flammable: 0
HMIS Reactivity: 0
HMIS Personal Protective: To be determined by user

TECHNICAL DATA SHEETS

Left Blank Intentionally (pending datasheet number)

Revision Summary

Revision date updated.

MSDS prepared by

SDS Prepared By: MORGAN THERMAL CERAMICS ENVIRONMENTAL, HEALTH & SAFETY DEPARTMENT

Disclaimer

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Safety Data Sheet. Employers may use this SDS to supplement other information gathered by them in their efforts to assure the health and safety of their employees and the proper use of the product. This summary of the relevant data reflects professional judgment; employers should note that information perceived to be less relevant has not been included in this SDS. Therefore, given the summary nature of this document, Morgan Thermal Ceramics does not extend any warranty (expressed or implied), assume any responsibility, or make any representation regarding the completeness of this information or its suitability for the purposes envisioned by the user.