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 MSDS section if you have any questions about materials used in the kiln.

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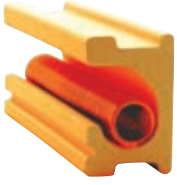

L&L Kiln's patented hard ceramic element holders protect your kiln.

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CAUTION INSTRUCTIONS

KILNS THESE CAUTIONS APPLIES TO

CURRENT PRODUCTION KILNS

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

OBSOLETE MODELS

- 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 THESE 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.

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CAUTION INSTRUCTIONS FOR L&L KILNS

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.

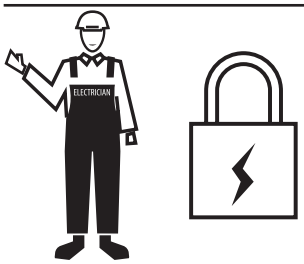
3. Kilns operate at high temperatures and make use of high voltages/amperages and if improperly installed, maintained, or used, can cause serious personal or property damages.

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.

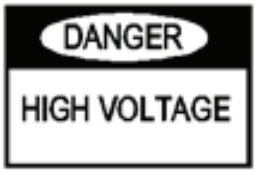
ELECTRICAL SAFETY



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

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CAUTION INSTRUCTIONS FOR L&L KILNS

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.

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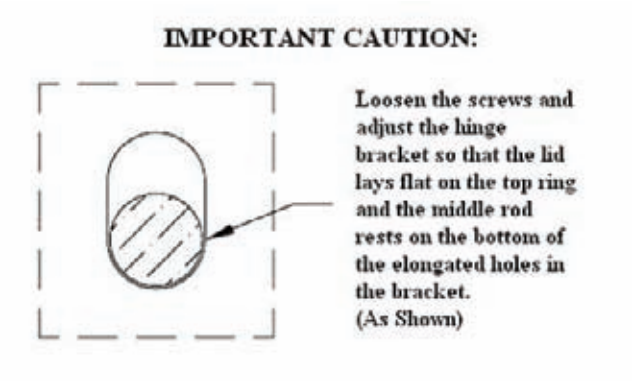
CAUTION INSTRUCTIONS FOR L&L KILNS

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.

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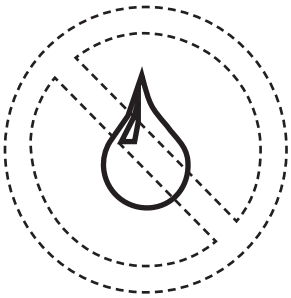
3. If the cord touches the hot case it could melt and cause a short circuit and/or fire.

KEEP KILN DRY & IN PROTECTED SPACE



1. The kiln must be kept dry.

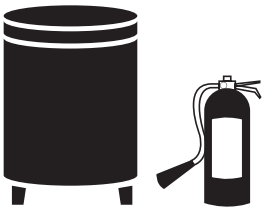
2. It is best to keep it in an enclosed room away from inclement weather. See specific details in the INSTALLATION INSTRUCTION section of your instruction manual or on-line at: ***hotkilns.com/easy-school-install*** or: ***hotkilns.com/general-installation-instructions.***

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

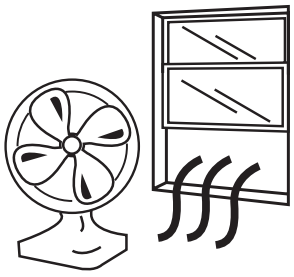
1. If you have a sprinkler system be careful to check the temperature rating and location of the heads so that you do not inadvertently cause them to actuate under normal firing conditions.

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

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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.

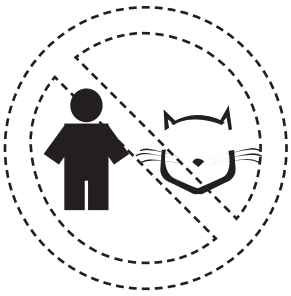
SURFACE IS HOT AND CAN CAUSE BURNS

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

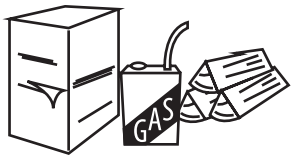


1. Protect any children, animals, and unqualified adults (anyone who is not able to understand these cautions) that may be near the kiln.

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.

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CAUTION INSTRUCTIONS FOR L&L KILNS

TRIPPING HAZARDS

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

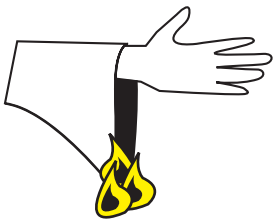
2. In particular be sure to keep the kiln cord out of traffic areas.

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. See the MSDS sheets in your instruction manual or here: ***hotkilns.com/msds***.

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).

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

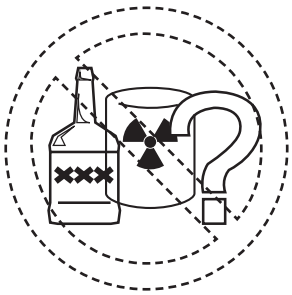
1. Shelves can absorb moisture.

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



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CAUTION INSTRUCTIONS FOR L&L KILNS

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.

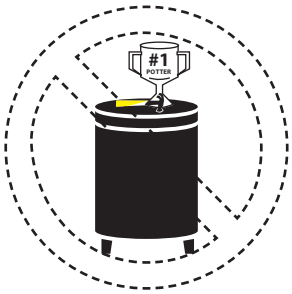
2. Otherwise the weight of the lid over time may force the hinge and stainless wrap to move down.

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.

DO NOT STORE ANYTHING ON LID

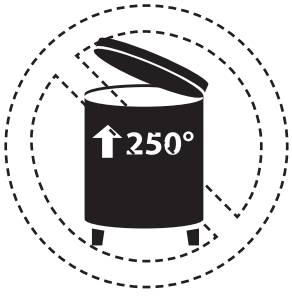


1. Do not use the lid as a storage shelf.

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



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CAUTION INSTRUCTIONS FOR L&L KILNS

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

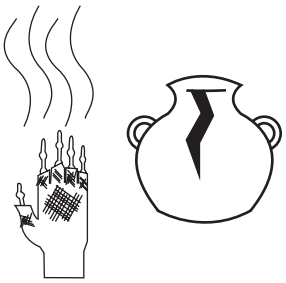
2. You could burn your hand on the handle and/or the radiant heat from the kiln.

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.

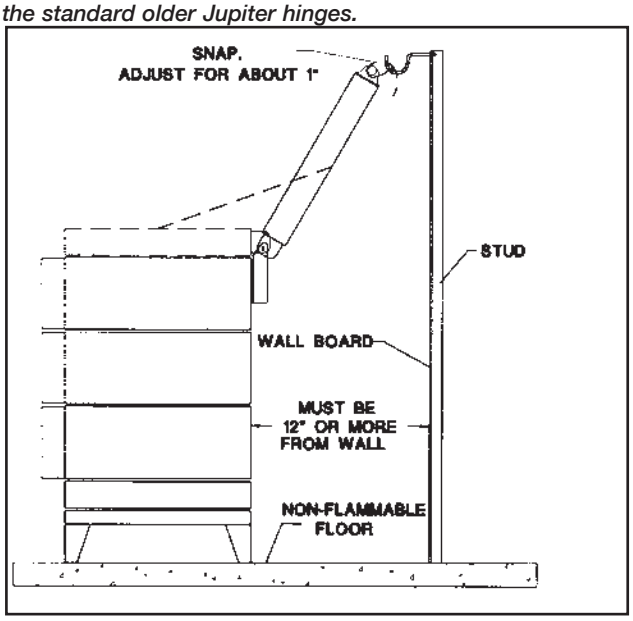
2. There is one on each side of a DaVinci kiln. Use both chains.

IF YOU HAVE A BASIC HINGE WITH CHAIN SUPPORTS

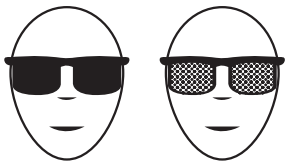
1. A special safety system is supplied with your Fuego, Liberty-Belle, e18S, e18T, J18, or J18X kiln (and some other older models). This is a door safety chain.

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

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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. ***ALMOST ALL OVERFIRED KILNS WE SEE ARE FROM A MALFUNCTION OF A KILN SITTER. 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.

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).

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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.

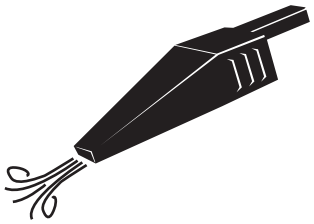
POST FIRING CAUTIONS

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.

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CAUTION INSTRUCTIONS FOR L&L KILNS

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***

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CAUTION INSTRUCTIONS FOR L&L KILNS

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.

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HERCULES & EASY-LOAD INSTRUCTION MANUAL

L&L Kilns
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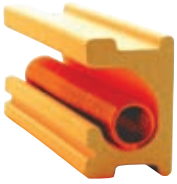

L&L Kiln's patented hard ceramic element holders protect your kiln.

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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**.

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BASIC OPERATION OF L&L KILNS WITH A DYNATROL 700

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.

NOTE ABOUT WHAT YOU SEE: Most DynaTrol's will read 200°F during a **PREHEAT** phase even though actual temperature in the kiln is about 180°F. This is because the thermocouple offset used to compensate for the thickness of the thermocouple protection tubes acts. When it is climbing the temperature displayed is the real temperature inside the kiln.

6) 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.

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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 200°F is reached; the 200°F temperature is then held for the programmed amount of time.

NOTE: Remember when the kiln holds for a while at 200°F it is it is slowly cooling to 182°F inside the kiln because of the way that the 18°F preprogrammed thermocouple offset acts during a hold 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**

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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-instruct-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-instruct-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-instruct-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-instruct-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

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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.

ADJUSTING THERMOCOUPLE OFFSET

NOTE: Offsets come already programmed into the control.

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 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.

Note: At room temperature (no heat in the kiln) the control will display a high temperature (it adds the thermocouple offset to the actual room temperature). (Typically it will show from 80°F to 100°F). You can always change thermocouple and cone offsets. The RESET option in OTHER will NOT reset these settings.

1) The industrial thermocouple protection tubes that are used in your Easy-Fire kiln have many advantages such as long thermocouple life, clean operation (no metallic spalling) and inexpensive replacement cost. However, they do introduce a known error into the system. The thickness of the ceramic tube creates an offset in measured temperature vs the actual kiln temperature. The composition of the tube makes a difference in the necessary offsets. This has changed as we have improved the tube and the offsets preprogrammed into the control reflect the testing that we do in the factory.

2) If you are going to be using the VARY-FIRE programs then Cone Offset won't do anything.

3) See section 4.3.3.5 in the dynatrol-instruct-700.pdf for information on how to change Cone Offsets and section 4.3.3.8 to change Thermocouple Offsets (that is also described just ahead). The **RESET** option in **OTHER** will NOT reset these settings.

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

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glaze firings which are more critical and then using cone offsets to adjust bisque temperatures (if you need to).

STEP BY STEP

1) Turn kiln on with toggle switch. Wait 5 seconds.

2) Press **1**, wait 5 seconds. The kiln display will say **STOP** and then go into **IdLE** mode.

3) Press **OTHER** about eight times until you see **TCOS**

4) Press **ENTER**. See **TC 1**

5) Press **ENTER** again

6) It will flash between **°FOS** (which stands for Deg F Offset) and **0018** (The **0018** stands for a thermocouple offset of 18°F - which comes preprogrammed into the control to compensate for the ceramic protection tubes. By changing the offset to **0010** we are REDUCING the offset by 8°F- making it fire 8 deg hotter). (**NOTE**: On older kilns with a slightly different composition thermocouple protection tube the preprogrammed value is **0050**).

7) Press **0008** to reduce thermocouple offset by 10°F.

8) Press **0013** to reduce thermocouple offset by 5°F.

9) Press **ENTER** to accept your input.

10) Do the same for all your thermocouples. The prompts will scroll past in the order of **TC1**, **TC2** and **TC3**.

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. See section 4.3.3.5 in the dynatrol-instruct-700.pdf for instructions.

FOR MORE INFORMATION

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

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

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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 G in the dynatrol-instruct-700.pdf for a list of error codes and their meanings.

See Section 4.4 in the dynatrol-instruct-700.pdf for extensive information on how to troubleshoot a firing.

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-instruct-700.pdf for a list of all the displays and their meanings.

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FIRST FIRING INSTRUCTIONS FOR L&L KILNS WITH A DYNATROL

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.

> **NOTE**: This version is for kilns with the DynaTrol 700 control board (Blue Board).

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 brick helps to reflect the heat radiated from the elements, strengthen the surface of the firebrick, and help 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 an error code on 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, thermocouples, and kiln-sitter tube, 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 tradeoff). 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.

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FIRST FIRING INSTRUCTIONS FOR L&L KILNS WITH A DYNATROL

NOISES IN AN AUTOMATIC KILN

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

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 VERY 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**).

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FIRST FIRING INSTRUCTIONS FOR L&L KILNS WITH A DYNATROL

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 an AutoCone 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 **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.

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FIRST FIRING INSTRUCTIONS FOR L&L KILNS WITH A DYNATROL

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.

> **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***

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 brick (which is one reason L&L kilns stay so durable over time) and 2) seat the elements in the holders and 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.

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KILNS BUILT TO LAST
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NOTICE

The backup insulation of this kiln needs to go through a curing cycle where the organic binders burn out. This will happen mostly during the first test firing of the kiln.

The burn out of these organic binders causes a non-toxic but acrid odor.

You will start to notice it once the kiln reaches about about 1300°F (700°C).

Be sure to do this first firing will plenty of ventilation. It is also best to do this when students or other personell are not present.

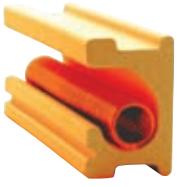
This is an organic binder made from starch (e.g., starch) and is used to bind the inorganic fibers together until the material is fired to a high temperature to form a bond. During the initial firing to at least 800 Deg C, the binders are 'burned out' of the insulation, and subsequent firings are odorless unless there are byproducts from the load itself.

Oxides of carbon and trace of ammonia may be released from starch during initial heating of this product. This is similar in kind to the nuisance odor from ceramic fireplace logs, which are made from the same material for both vented and unvented gas fireplaces.

HERCULES & EASY-LOAD INSTRUCTION MANUAL

LOG, CONES,TIPS,
CERAMIC PROCESS

L&L Kilns
hotkilns.com



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

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FIRING LOG FOR L&L KILNS

DATE	PROGRAM	CONE	TIME	FINAL TEMP	LOAD WEIGHT	CLAY BODY	GLAZE

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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

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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.

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	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

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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

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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***.

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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.

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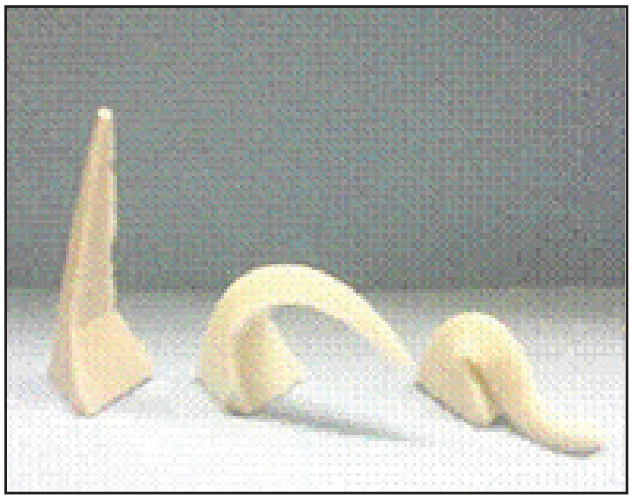
WHAT CONE NUMBERS MEAN: WHY YOU SHOULD CARE

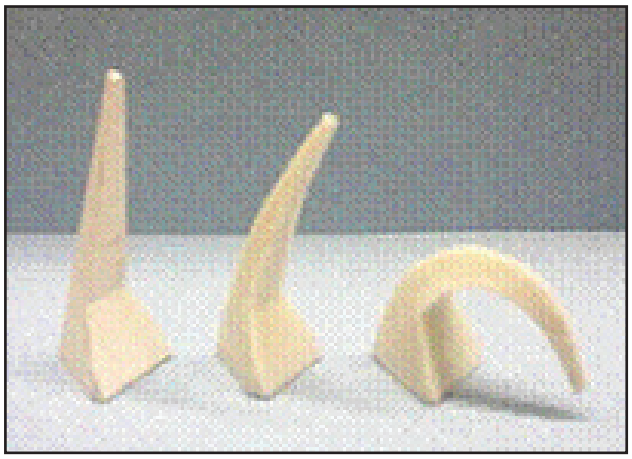
Figure 1: Cone 07 is over-fired and cone 06 indicates a successful cone 06 firing.



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

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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,

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

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.

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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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?

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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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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?

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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

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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.

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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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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?

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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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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.

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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.

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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.

For information on Orton products, see your Orton dealer or distributor. For information on the Firing Institute or publications, contact

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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.

For information on Orton products, see your Orton dealer or distributor.

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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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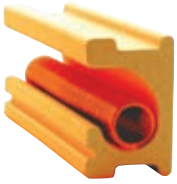

L&L Kiln's patented hard ceramic element holders protect your kiln.

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REGULAR MAINTENANCE OF YOUR L&L KILN

WATCH THIS VIDEO

This video shows you the basics of how to do routine maintainence on your L&L kiln:
hotkilns.com/maintaining-kiln

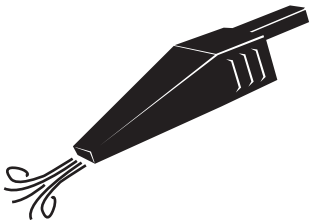
REGULAR KILN MAINTENANCE

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 detractants, 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.

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

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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 t***roubleshoot-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 thermcouples when you change elements.)

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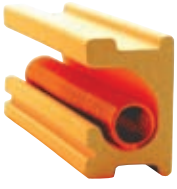

L&L Kiln's patented hard ceramic element holders protect your kiln.

CONTROL

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Zone Control Advanced Uniformity

Modern Automatic Zone Control Technology Allows Dynamic Adjustment of Electric Kilns to Ensure Uniform Firings.

Zone control in ceramic electric kilns has been around for quite a few years. However, only since zone control became automated within the past few years has it become more popular.

The typical ceramic top-loading electric kiln, based on designs that are now almost a half-century old, has always had a problem with temperature uniformity, especially from top to bottom. Typically the center or the top of the kiln fires the hottest, while the bottom fires colder. This differential can be up to a whole cone or more.

There are a number of techniques that are used to counteract this effect. One of the oldest, used in batch kilns from time immemorial, is to learn the firing characteristics of a kiln and load the kiln accordingly. You can load certain pieces in the cold spots that won't be as affected by the temperature differences or perhaps load heavier pieces in the center that would absorb more heat. This has the obvious disadvantage of constraining the artist or productive output of the kiln. For instance, it would be difficult to uniformly fire 100 coffee mugs with the same glaze in a conventional polygonal electric kiln.

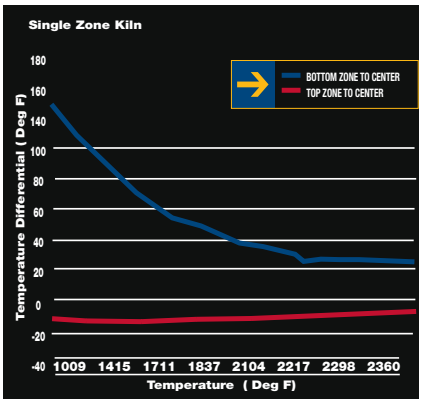
Another technique used in many electric kilns today is to grade the power output of the elements so more power goes towards the top and the bottom of the kiln. This can produce a very even kiln if done right. The problem with this method, however, is that the power output of the elements changes with age and so the heating characteristics of the kiln may become less uniform. It can become a big problem if one element gets ruined by glaze, for instance, and has to be changed. You may have to change all the elements in the kiln. Also this method may not accommodate changes in the loading patterns. (Interestingly when we designed the School-Master kilns, which have graded elements for uniformity, we only had to vary the ohms slightly and then only on the top to achieve perfect results - which indicates that the basic kiln design is extremely uniform.)

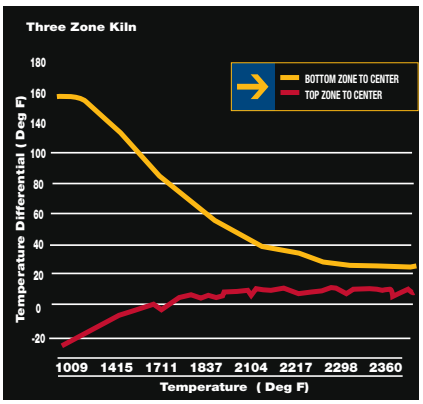
Another method of evening out temperatures in an electric top-loading kiln is to use a downdraft vent. This system pulls a small amount of air down from the top of the kiln and out the bottom. It counteracts the natural tendency of the heat to rise. Our tests have shown about a ½ cone uniformity improvement using this technology.

The other method of dealing with uniformity issues is by using zone control. This is a technology that L&L has used in its industrial division at great expense to achieve critical results for important processes like firing million-dollar loads of ceramic-based superconducting wire (We have built special kilns with up to 24 separate heating zones). In addition, L&L has had a long history of utilizing manual zone control on its top-loading electric pottery kilns. The use of manually controlled infinitely adjustable switches allows control of manual kilns zone by zone. This system, especially when used in conjunction with a multi-thermocouple pyro-meter system, allows potters to see which zone is getting hotter and make adjustments while firing. This, however, can be a tedious process.

In the past few years newer electronic controls designed just for electric kilns have begun to incorporate true automatic multi-zone operation. These controls typically use three separate thermocouple inputs and three relay outputs for the power control. Each zone of the kiln is independently controlled on a separate control loop – sophistication typically only available in controllers costing much more money.

The great advantage of automatic zone control technology is that it allows dynamic adjustment of the kiln to accommodate changing elements and different loads. Typical uniformity is within ½ a cone or better. Another nice feature of zone control is that you can bias zones. For instance, if the top of the kiln fires cooler, you can subtract a few degrees from the top zone thermocouple reading to make that zone fire to a higher temperature.





The downside of zone control is that it can slow down the kiln by turning off power to hotter zones. However, this technology has matured over the past few years. The new controls include the ability to turn zone control off during all but the last segment of the program to speed up firing. The key to good functioning now is to ensure that there is enough power in the kiln to compensate for the effects of the zone control.

Zone control is an excellent technical answer to the age-old difficulty of batch kiln uniformity problems.

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KILNS BUILT TO LAST

Bulletin No: ZC-3-15

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 Appendex K at the end of the manual.

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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 labled #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.

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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.

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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.

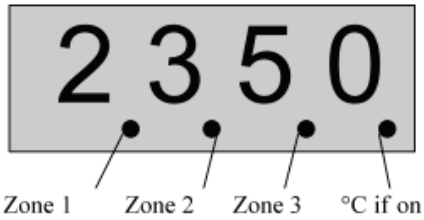
2.2 VARY-FIRE PROGRAMMING SECTION

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.

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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°

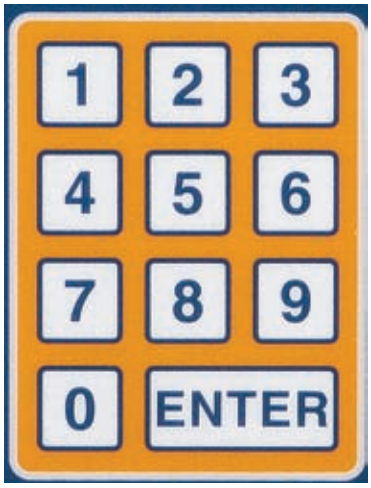
Error codes ON or OFF ERCd

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

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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.

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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.

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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.

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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.

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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 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 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.

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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(#)

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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

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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, H1d8)
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.

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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.

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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 ▪

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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.

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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

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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.

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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., rAt) 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.

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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
CONE	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
CNOS	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
HOLd	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 ON or OFF
ON	Error codes are ON
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.

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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 Travelling 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)

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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 CHGº
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.

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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.

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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. This is part of the compensation necessary for the mullite thermocouple protection tubes.

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.

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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 18	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. Note that the control comes with 18 degrees already preprogrammed in as a thermocouple offset to help compensate for the ceramic protection tube. Press **ENTER** if you wish to keep this offset, OR press **0000** and then press **ENTER** to have no offset on that thermocouple OR in this example we would press **33**
33	33	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.

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ENTER	°FOS 0050	Keep at 0018. If this number reads something other than 0018, 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 0050	Keep at 0018. If this number reads something other than 0018, 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.

NOTE: The Thermocouple Offset comes already programmed into the control at 0018 (+ 18 Deg F) when it leaves the factory. Note the room temperature will show 18 Deg F higher than it actually is. The RESET option in Other will NOT reset these settings. IF YOU DO NOT USE THE THERMOCOUPLE PROTECTION TUBES THEN YOU NEED TO CHANGE THERMOCOUPLE OFFSET TO 0000. (Note that on DynaTrols sent out before Oct 1, 2004 the thermocouple offset was set for 0050)

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

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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

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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 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

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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 REST 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

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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.

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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-**

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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 OFF when they should be On 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.

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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

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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

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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

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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.

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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.

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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

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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.

SHTO. 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.

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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		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		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.

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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		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		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		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		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.

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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		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		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		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		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.

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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		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		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		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		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.

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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		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		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.

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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).	

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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

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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

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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

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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

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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***)

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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 you expected it to) 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”

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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

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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

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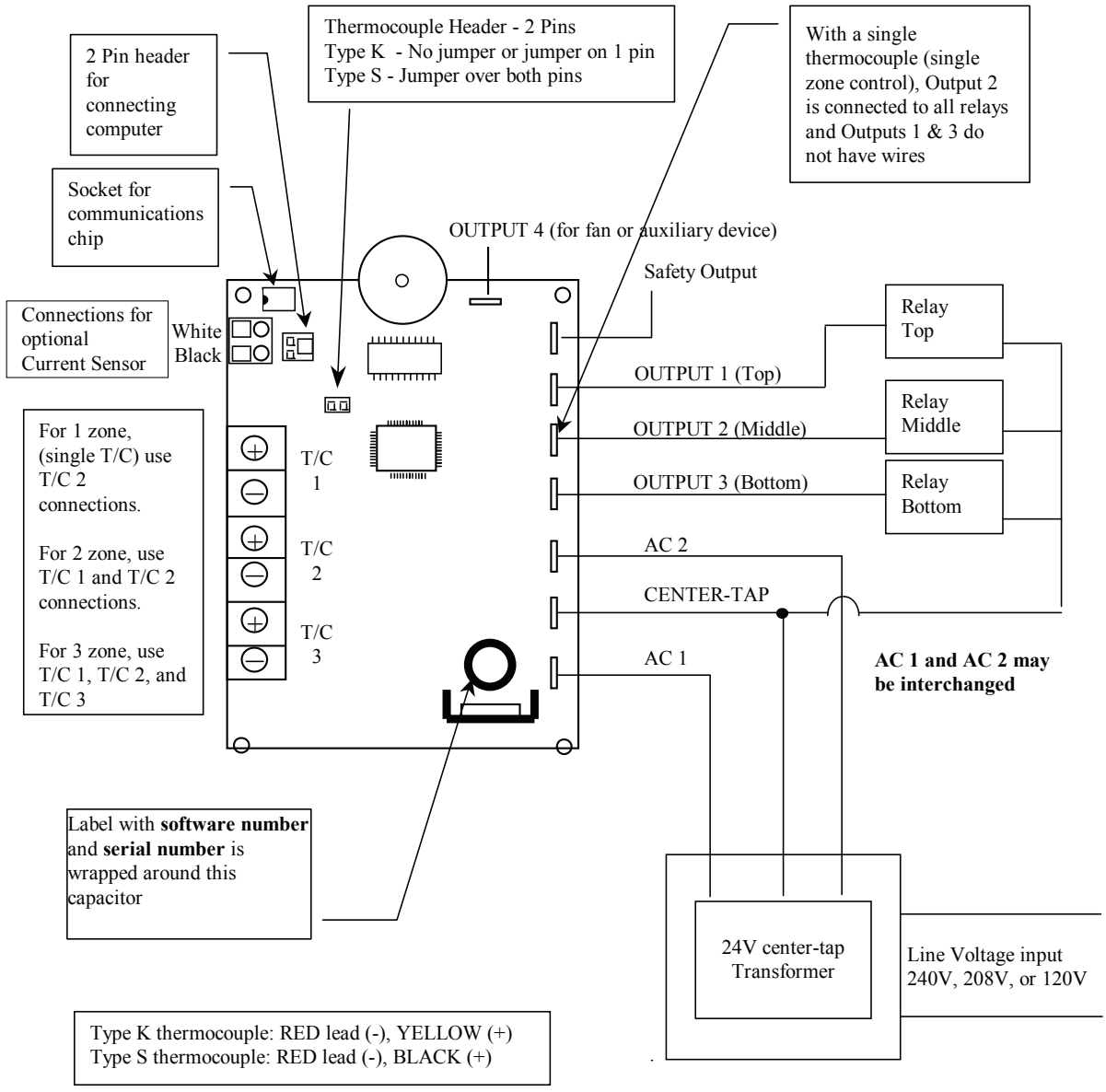
15. APPENDIX I: HOOKUP DIAGRAM

Connection Diagram - Series 700



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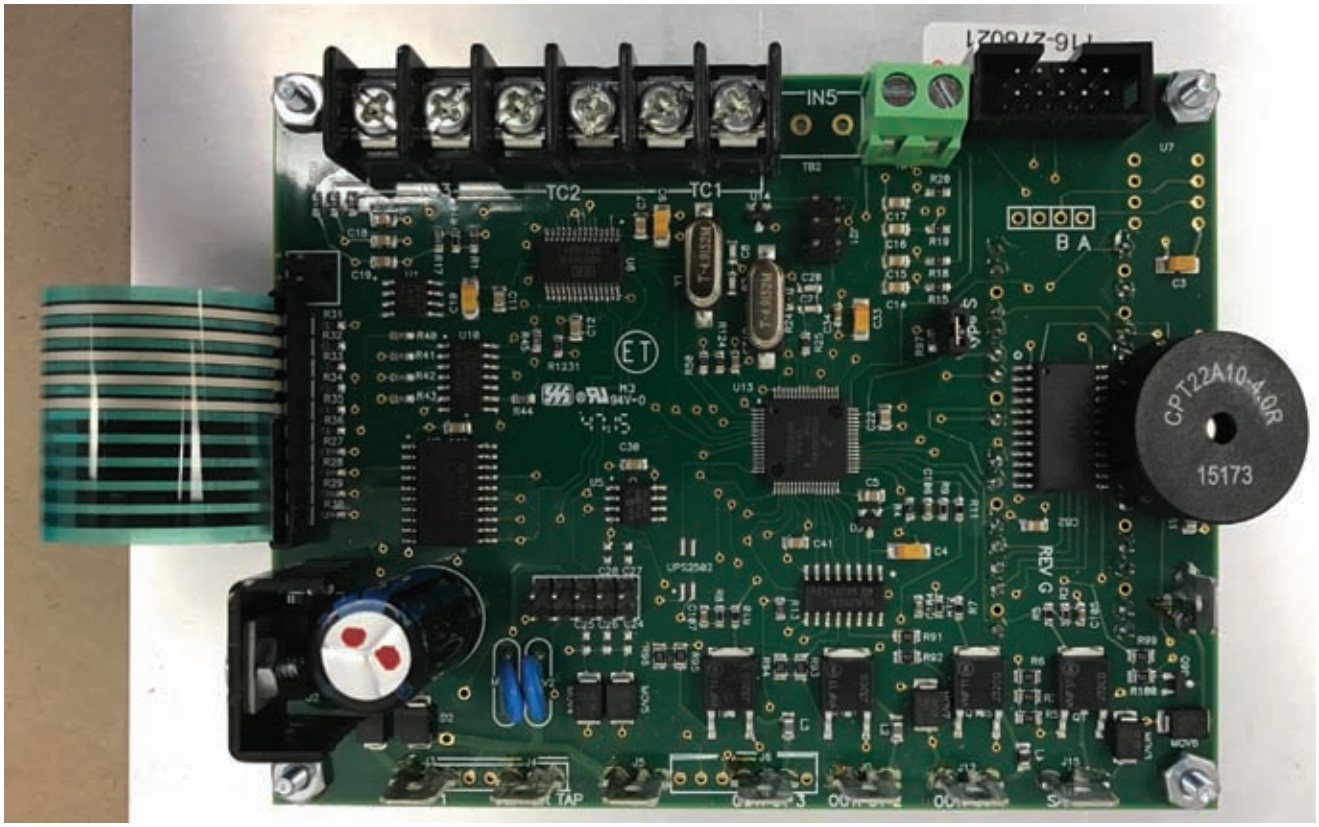
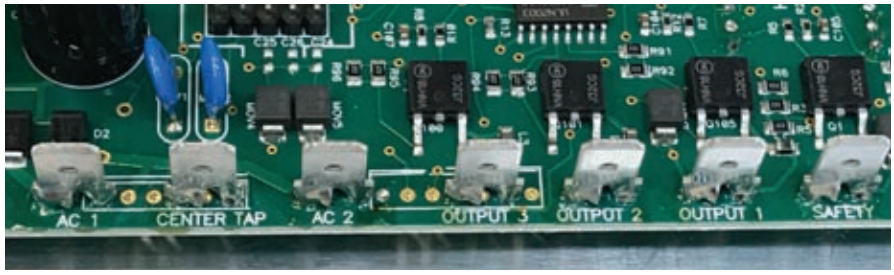
16. APPENDIX J: PHOTOGRAPHS

Back of the DynaTrol:



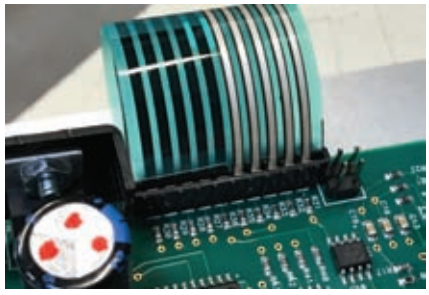
Inputs:



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):

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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***)

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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***)

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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***)

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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***)

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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***)

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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***)

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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***)

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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***)

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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			

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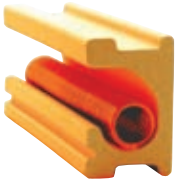
HERCULES & EASY-LOAD INSTRUCTION MANUAL

L&L Kilns
hotkilns.com



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

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Vent-Sure Downdraft Vent

Downdraft Vent for L&L Kilns

Features & Benefits

Type of Vent: Downdraft - pulls air from the bottom of a kiln to ventilate fumes from the kiln under vacuum. Vents kiln fumes to the outside. Produces better firing by promoting higher temperature uniformity in the kiln - up to a 1/2 cone improvement. Improves element and overall kiln life (sometimes dramatically).

Voltage and Amperage: 120 Volts at 1.37 Amps.

On/Off Switch and Cord: Switch on six foot cord (120 volt models only).

Blower Mounting: Blower is normally mounted on the wall with discharge through a 4" round opening. (See Options below for optional Multi-mount bracket). This keeps the heat of the kiln away from the motor (for long motor life) and keeps the motor vibration away from the kiln (which can cause ware to move, damage to the kiln, and misfiring of cones on a kiln sitter). Although the vent motor normally discharges right through the wall it is mounted on, use of 4" duct can extend this distance 60 feet (horizontally or vertically) with up to four 90 degree bends.

Duct Work: 15 Feet of 3" flexible and expandable duct is included along with necessary hose clamps. Longer lengths or lengths of 3" stove pipe can be used as well.

Capacity: The blower vents up to 130 cfm (cubic feet per minute). This will handle up to a 20 cubic foot kiln (and usually larger) or even two separate kilns. More than one vent can be attached to larger kilns.

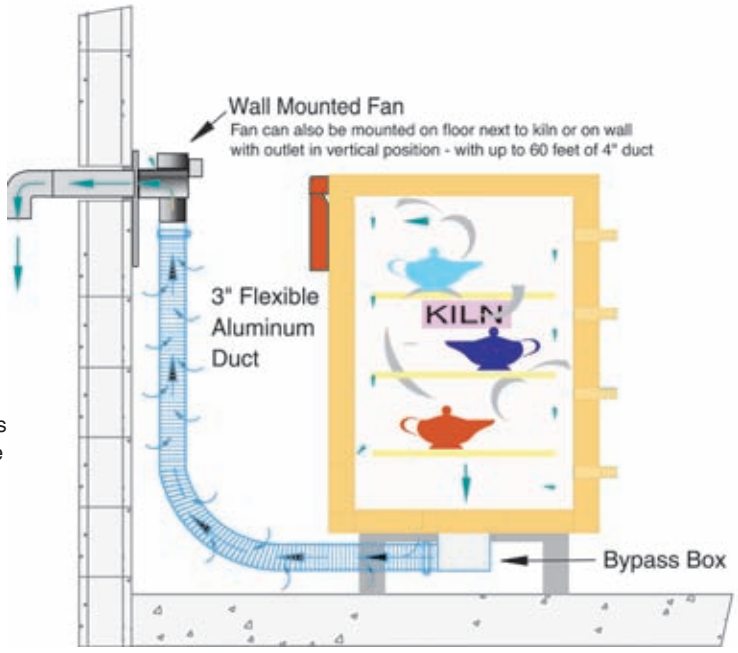
Vent Control: A vacuum bypass on the kiln bypass/collection box adjusts the amount of venting from the system.

Application: Designed to be used on most L&L kilns.

Warranty: Limited 3 year warranty. **(hotkilns.com/warranty)**.

UL Listing: The Vent-Sure is c-MET-us listed to UL499 standards for use with Easy-Fire, Jupiter, Liberty-Belle, and DaVinci kilns. It is MET-us listed to UL499 standards for use with Hercules and Easy-Load kilns.

Part Number for 120 Volt Model: M-V-VENT/00



The Vent-Sure pulls air out of the kiln and the room keeping fumes in the duct under vacuum so any leaks get pulled out instead of pushed into your room. The Vent-Sure is the worry-free, super-safe vent!

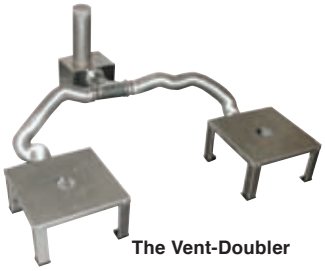
Options

Multi-Mounting Bracket: An adapter to mount our motor on the floor is available for people who don't want to mount the motor on the wall. There is a 4" duct outlet that you can hook up to an existing wall opening. This can be used to mount motor on wall as well with output going into an existing ventilation system. **M-V-BRKT/00**

The Multi-Mounting Bracket

220-240 Volt Option: Motor is 220-240 volt. Plug to be specified. **M-V-VENT/EU**

Vent Doubler: The Vent-Doubler allows you to connect two kilns to a Vent-Sure vent system. This can be added to an existing vent system or ordered with a new vent. In some cases you may be able to fire two kilns at once. The Vent-Sure has enough force to vent at least 20 cubic feet of kiln. The "T" duct fitting attaches to the inlet of the fan motor. There are two dampers on it to allow you to both control the flow and to shut off one or the other kiln. Flexible aluminum duct connects this "T" duct and the two fittings that attach to the kiln stands.**M-V-VENT/DB**



The Vent-Doubler

Auto Vent Control: The Auto 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). The Vent Control consists of a relay that is controlled from output #4 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. **M-V-CNTL/00**

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KILNS BUILT TO LAST

Bulletin No: VS-11-16

Vent-Sure Downdraft Vent

Useful Web Links

See this video on how to install a vent:
hotkilns.com/install-vent-sure

See this video on how to drill holes for a vent:
hotkilns.com/drilling-holes-vent-sure-vent-system

Frequently Asked Questions

How do I know if the system is working?

The easiest way to test the operation of the vent system is to turn the unit on and to place a lit match directly over and level with one of the holes in the bottom of the kiln. The flame from the match should be gently pulled into the kiln as a result of the draft.

How hot does the duct get during the firing?

Due to the introduction of fresh air through the plenum of the vent system mixing with the hot gases being drawn from the kiln, the temperature of the duct is below 150°F. This will prevent burns from occurring in the event of the duct being touched.

How long can the duct be and with many bends?

Up to 60 feet of ducting containing four 90 degree bends may be safely used with no drop in static air flow at the duct exhaust point or a reduction in draw at the kiln. The ducting can be run either horizontally or vertically.

Do I need double wall duct when going through the roof?

You do not normally need double wall ducting when going through the roof since the pipe or duct does not reach high temperature. It is always advisable to check your local building codes for their requirements.

What type of duct do I use if I need more than 15 feet?

You can use more of the flexible aluminum dryer ducting or you can use galvanized furnace ducting. We recommend using 4" diameter galvanized duct.

Will the fumes coming through the vent damage my plants, the neighborhood pets or disturb the local environment?

No. The fumes and the gases coming from the kiln have been diluted with enough fresh air to make them safe for the environment. Do not, however, place the outlet of the vent below an open window.

Will using the vent cause my firing to take longer?

The vent system pulls only a very small amount of air out of the kiln, so very little heat is removed and firing times will change very little. For some kilns, a high firing may take a little longer. The insulation value and the number of air leaks in the kiln also determine the length of the firing. We have seen vents overpower smaller kilns - so it is important to adjust the amount of venting in some cases. On the other hand an example of an e23T seven cubic foot kiln firing an 85 pound load on Fast Glaze program to cone 8 took 7 hours and 4 minutes with a vent on and 6 hours and 24 minutes without a vent. The vent was on the whole time.

What does it cost to operate the vent system?

The vent system typically costs less than 1 cent/hour to operate (electricity costs). Vent systems save on heating and cooling costs when compared to hoods. Hoods remove massive amounts of air from the kiln room - air that may have been heated or cooled, depending on the time of year. Downdraft type vents remove 80% less air in the kiln room than a hood. (It does cost more to run the vent because it does take heat out of the kiln. For instance an e23T in the example above took 70 KW hours with a vent on and 62 KW hours without a vent. At 8 cents per KW hour that would be a cost of $0.64. The vent was on the whole time).

Will the cold air entering the kiln damage the product?

The amount of air that is entering the kiln is so small that it does not cause problems with the ware. The top holes are placed toward the outside of the chamber area so that no air comes down directly onto ware that is placed near the top of the kiln. (L&L NOTE: This is fine but we do not normally recommend holes in the lid - a kiln is porous enough).

Will faster cooling crack the ware if I leave the vent on during the cooling Cycle?

No. Some kilns can cool an average of 4-1/2 hours faster with the use of the vent system. The cooling is faster but it is taking place at an even rate throughout the kiln avoiding uneven stresses being placed on the ware. Most ceramic ware can be cooled more quickly if the cooling takes place at an even rate. The rate of cooling increase will depend on the kiln size and the density of the load. The vent will remove more molecules of air and hence heat as the kiln cools. This is because the density of the air increases the lower in temperature you go. This is one reason why kiln vents are so efficient - they don't remove too much heat when you don't want them too at the higher temperatures).

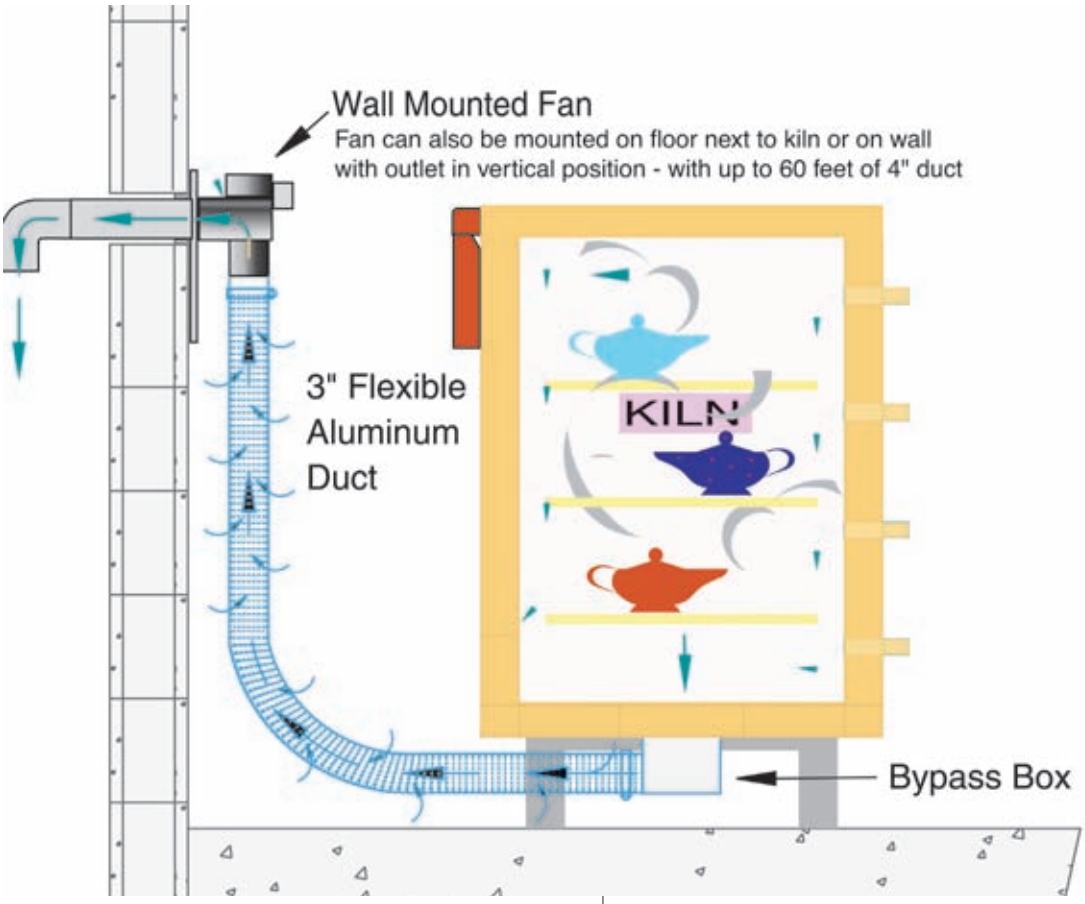
What should I do if I still smell fumes?

You should check your duct work to make sure it is properly connected and that the joints are sealed. You can also check for extra air leaks around your kiln and repair these if necessary.

Note: These Frequently Asked Questions are provided courtesy of The Edward Orton Jr. Ceramic Foundation with some modification based on our Vent-Sure vent system and experience.

This shows several small kilns hooked up with one Vent-Sure using two Vent-Doublers. (Up to 20 cubic feet can be ventilated with one vent).

L&L VENT-SURE DOWNDRAFT KILN VENT INSTRUCTIONS



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READ THE INSTRUCTIONS

You are now the proud owner of an L&L “VENT-SURE” kiln ventilation system, engineered to give you the utmost in performance and results. This is an expensive and potentially hazardous appliance (if not used with proper caution). PLEASE TAKE THE TIME TO READ THESE INSTRUCTIONS. There is important information that you need to understand in order to operate your L&L kiln ventilation system safely and effectively.

USEFUL WEB LINKS

See this video on how to install a vent:
hotkilns.com/install-vent-sure

See this video on how to drill holes for a vent:
hotkilns.com/drilling-holes-vent-sure-vent-system

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L&L VENT-SURE DOWNDRAFT KILN VENT INSTRUCTIONS

CHECKING SHIPMENT

Your ventilation system was carefully packed and inspected prior to shipment to make sure that all parts were in perfect condition.

When carrier makes delivery, you should immediately unpack your ventilation system and accessories to determine whether or not any damage has occurred in transit.

If damage has occurred, retain all of the packaging material and notify L&L at once. Retain all papers to ensure that a proper claim can be filed.

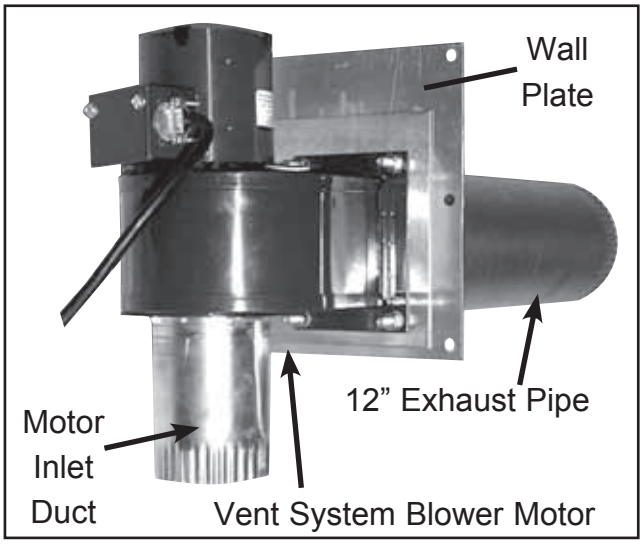
WHAT IS INCLUDED WITH VENT

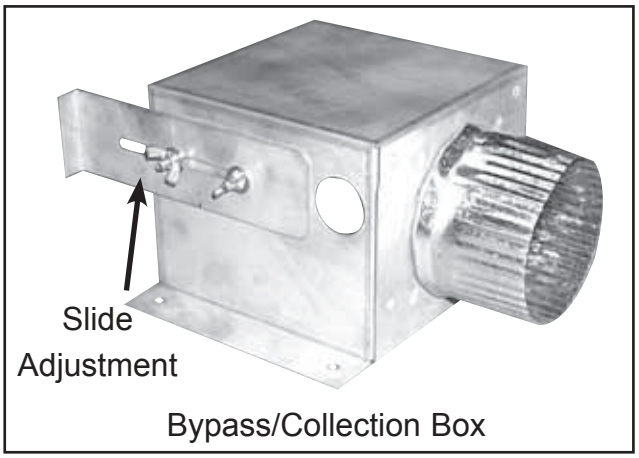
One (1) wall-mounted blower mounted on a bracket with vent pipe to go through outside wall and a Motor Inlet Duct. An 8 foot power cord with an attached On/Off switch plugs into a 120 volt standard receptacle. (Note: 220-240 volt models will have a different cord).

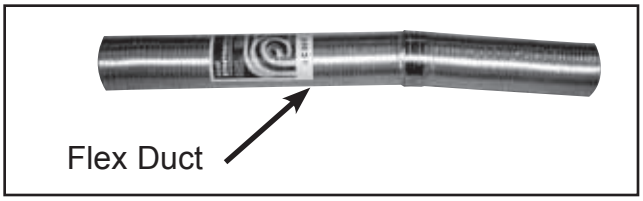
One (1) Bypass Collection Box to be mounted to the kiln stand, with mounting hardware.

One (1) length of flexible aluminum ducting (expands to 15 feet) with two (2) hose clamps.

One (1) 4" diameter 90 degree elbow (for outside the building).







IMPORTANT CAUTIONS

Check duct occasionally to see if there is wax or other residual build up. Wax could condense in the duct, which is a potential fire hazard. This is especially important if you are using a wax resist.

Be sure that the exhaust of the vent is not being brought back into your building. Keep exit of vent at least four feet away from any open windows or doors.

We recommend the use of a carbon monoxide monitor in your kiln room. These are available from good hardware stores for about $50 (This is another good way to be sure you are getting proper venting).

Disconnect power cord from power source when doing any maintenance on the fan motor. Do not put your fingers inside the blower without disconnecting power. Blower may start unexpectedly because of automatic thermal shut off switch built into the motor.

DO NOT place anything in the blower/motor while powered. Serious injury and/or damage to the motor could result.

INSTALLATION TIP BEFORE STARTING

NOTE: Attach the Bypass Box to the stand and the aluminum duct to the Bypass Box before installing the kiln on the stand because it can be hard to do this when the kiln is on top of the stand.

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L&L VENT-SURE DOWNDRAFT KILN VENT INSTRUCTIONS

INTRODUCTION

WHAT DOES THE VENT DO?

The Vent-Sure Kiln Ventilation System is designed to pull air contaminated with carbon monoxide and other fumes including those of volatile metals, decals, sulfur oxide, and others in a down draft fashion out of the kiln and then vent it outside or to a central vent system.

KILN VENTILATION CAUTIONS

VENTILATION IS ESSENTIAL

1. Kilns generate harmful fumes when firing ceramics including: carbon monoxide, sulfur oxides, hydrogen fluoride and metal vapors (all of which can be toxic).
2. Install kiln in a well-ventilated area and never operate in an enclosed space unless you have good airflow.
3. Severe corrosion can be caused by kiln fumes, salt air ,or other environmental conditions.

AMBIENT HEAT AND VENTILATION

1. The kiln should operate in an environment that is between -18°C (0°F) and 38°C (100°F).
2. Kiln vents do not take care of ambient ventilation of the kiln room to remove the heat of the kiln.
3. See the following web page for guidance on how to calculate ventilation requirements for a kiln room: **hotkilns.com/calculate-kiln-room-ventilation**

INSTALLATION

IMPORTANT CAUTION

MAKE CERTAIN KILN POWER IS OFF BEFORE PROCEEDING WITH INSTALLATION.

Step 1. Turn Off Kiln Power

This is critical for safety reasons.

Step 2. Drill Holes (if needed)

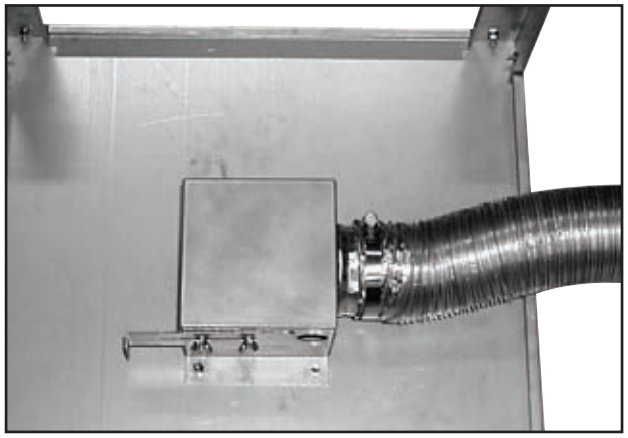
Before mounting the Bypass Box, you should drill the vent holes. (Note: if you bought the vent system with a new kiln, it should be pre-drilled) The easiest way to drill the vent holes is to place the stand upside-down on the kiln bottom, center it, and then drill your holes within the large aperture. Otherwise you can measure out the center of your kiln slab and draw a circle in the middle with a radius of 1.5" Then drill your vent holes within that circle.

Step 3. Install Bypass Collection Box

With the vent holes taken care of, you can install the Bypass Collection Box. Just simply use the studs on the bottom of the stand and secure with the provided hardware.

IMPORTANT: Remember to have the outlet pointed towards your fume exhaust location.

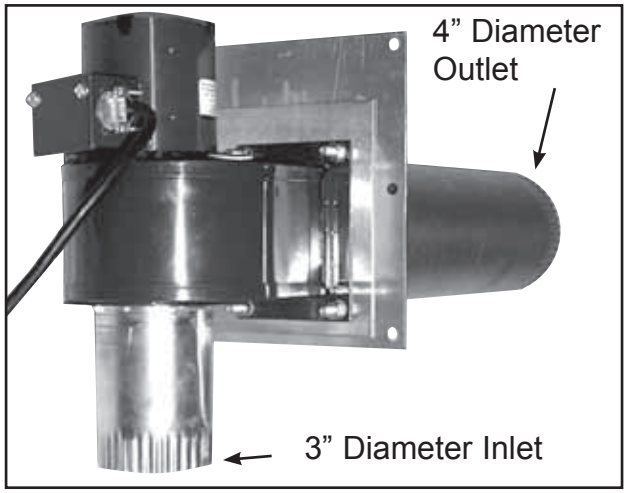
The Bypass Collection Box is mounted to the bottom of the stand with provided hardware.



Step 4. Install Blower System

Install blower system by penetrating outside wall or setting into a window with appropriate support. Attach the provided 90 degree elbow to point down on the outside of the building (this is to prevent rain water from getting into the duct). (Note: this procedure will change if you use the Multi-Mount bracket). Mount securely because motor may vibrate over time especially if it builds up any dust in the blower.

The motor assembly comes pre-mounted onto the Wall mount bracket:



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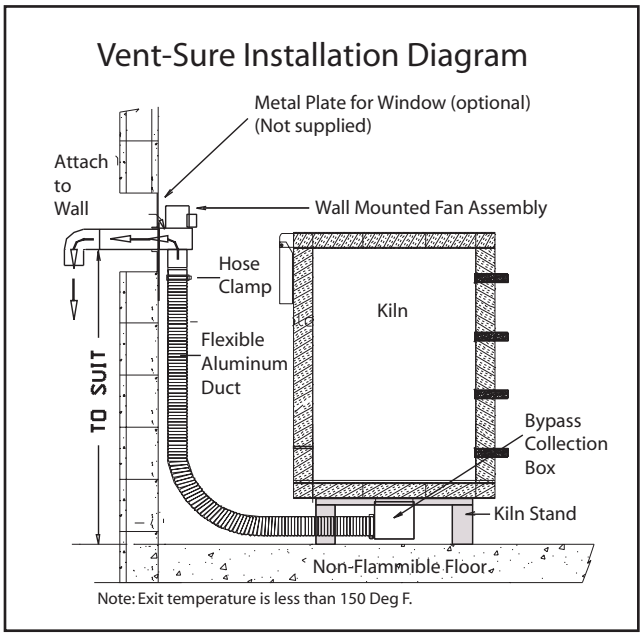
L&L VENT-SURE DOWNDRAFT KILN VENT INSTRUCTIONS

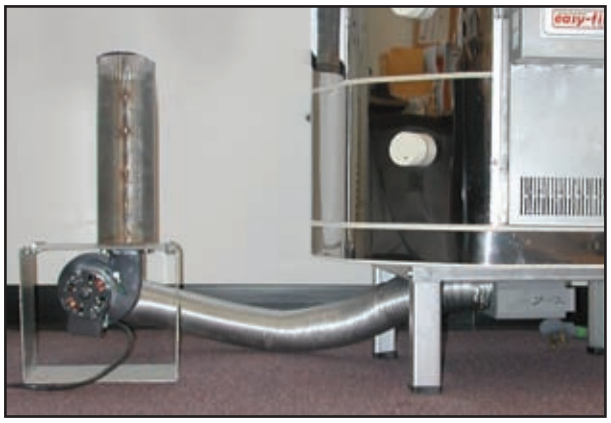
CAUTION: Make sure that the vent outlet is at least four feet from any open windows or doors. This is to make sure fumes do not get back into your building. Also the fumes can be hazardous to plants within a few feet.



A CAUTION ABOUT MOUNTING VERTICALLY

If the discharge duct of the vent is mounted pointing up (as shown on the photograph to the left), water that condenses in the duct may drop down and rust the motor. We recommend having a water trap in the bottom of a vertical duct run to drain off the water before it runs into the motor. This is not a problem when the vent has been mounted horizontally. The Multi-Mount bracket will allow you to mount the motor horizontally as well. You can then use 90 degree bends or flexible duct to go vertically. Just remember that there is water in the exhaust that will condense somewhere as it cools after it discharges from the vent motor.

A special Multi-Mount bracket is available from L&L which will allow you to mount the vent on the floor or wall with the outlet of the vent pointing up. This is useful when you want to use an existing penetration in a wall that won't support the vent (like a window) or when you want to have the vent go out of a roof or into a central vent system.



Step 6. Connect Flexible Duct

Attach blower system to bypass/collection box by stretching the flexible aluminum duct carefully (it can extend up to 15 feet) and securing to both the blower housing and the bypass/collection box with the provided hose clamps. **NOTE: You may want to firmly attach this to the Bypass Collection Box before installing the kiln on the stand because it can be hard to maneuver under the kiln.**

Step 7. Plug In Vent

Plug in the switched cord to a standard 120 volt receptacle. **If need be you can safely use a grounded extension cord because of the small amperage required.** Be sure to secure cord away from heat of kiln. Note: On 220-240 volt models this may vary.

ROOM AIR REPLACEMENT

ROOM AIR REPLACEMENT:

The Vent-Sure system moves up to 146 cubic feet of air per minute. We suggest opening a window slightly, or bringing another fresh air source into the room, to replace this room air.

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L&L VENT-SURE DOWNDRAFT KILN VENT INSTRUCTIONS

DRILL CHART

MODEL	CUBIC FT	NO OF HOLES	DIA HOLE
FUEGO	1.5	1	1/4”
e23S	4.7	2	1/4”
e23T, SM23T, EQ23T	7.0	2	1/4”
e28S	6.9	2	1/4”
e28T, SM28T, EQ2827	10.3	3	1/4”
JD18, E18S, LB18	2.6	1	1/4”
JD18X, E18T	3.9	1	1/4”
JF23	4.7	2	1/4”
J230	7.0	2	1/4”
J236, EQ2836	9.4	3	1/4”
J245	11.75	3	1/4”
J2918	6.9	2	1/4”
J2927	10.3	3	1/4”
J2936	13.8	4	1/4”
J2945	17.2	5	1/4”
X1818	3.4	1	1/4”
X1827	5.1	2	1/4”
XB2318	5.0	2	1/4”
X2327	8.1	2	1/4”
X2336	10.8	3	1/4”
X2345	13.5	4	1/4”
XB2818	7.8	2	1/4”
X2827	11.7	3	1/4”
X2836	15.6	4	1/4”
X2845	19.5	3	5/16”
XB3218	10.0	3	1/4”
X3227	15.0	4	1/4”
X3236	20.0	3	5/16”
X3245	25.0	4	5/16”
TB2318	9.7	3	1/4”
T2327	14.6	4	1/4”
T2336	19.4	3	5/16”
T2345	24.3	4	5/16”
TB3418	13.8	4	1/4”
T3427	20.7	3	5/16”
T3436	27.6	5	5/16”
T3445	34.5	6	5/16”
EL2424	8.0	2	1/4”
EL2427	9.0	3	1/4”
EL2436	12.0	3	1/4”
EL2448	16.0	4	1/4”
EL2848	20.0	4	5/16”
EL3048	25.0	5	5/16”

OPERATION

1. Plug blower cord into 120 Volt receptacle. (Note: 220-240 volt models may be different).
2. Close all kiln apertures such as peepholes unless you very specifically want more air vented.
3. Turn on Vent with the in-line switch on the power cord.
4. Close the lid and fire. For heavy loads with lots of fumes you may want to avoid firing faster than 150°F per hour to prevent the generation of more fumes than the system can eliminate.
5. Use the flow control on the Bypass Box to modify the flow of exhaust - a larger flow control opening reduces the flow of exhaust fumes from the kiln, and a smaller flow control opening increases the exhaust.

ADJUSTING THE BYPASS SYSTEM

The sliding adjuster allows you to fine adjust the amount of venting that is done to your kiln. It is easy to adjust but hard to know just how to adjust it. The problem is that there are many factors that contribute to the amount of “pull” required. For instance, the amount of fumes that are being given off by your specific work is one factor. Some clays have a lot of carbon in them; others do not. Depending on the size of the load, and the ingredients in the clay/glaze, there will be more or less fumes generated. Another factor is the “static pressure” in your vent ducts. If you have a lot of curves, 90 degree bends, or long runs of duct this will increase the static pressure (back pressure) and hence increase the need for more venting force. One suggestion is to start with the valve in the half open position and see what happens.

The Smoke Method:

1) With power disconnected from the kiln and with the kiln empty, turn the vent on.

2) Start with the bypass valve in the fully closed position. This will give it the maximum suction in the kiln.

3) Light a piece of paper on fire or something that will create smoke. Blow it out, and hold it near the cracks around the closed lid.

4) If the smoke is being pulled into the kiln around these door cracks, open the Bypass (decreasing flow from the kiln) until the smoke stops being pulled in, then back up the valve slightly, so the draw increases just slightly again. Try this when kiln is at about 100°F.

5) You can do the same test directly at the bottom hole with the kiln open also to test the differential between the pull

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at the actual suction hole from the kiln and the pull around the lid.

For Gross Adjustment:

Remember that the sliding adjuster is for fine adjustment. Drilling or plugging the holes in the floor (and possibly adding or plugging holes in the top) is how you would dramatically change the amount of air vented.

VENTING CODES

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 listed to UL499 standards by MET for L&L Kilns and is appropriate to meet this ventilation requirement. 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.

REGULAR MAINTENANCE

Occasionally check for leaks in the aluminum duct. Replace if necessary. Check for corrosion especially if you are using clay with a high content of sulfur, phosphorus or fluorine. Check for wax or carbon build up if you are using a wax resist process or a high carbon content clay.

We recommend unmounting the fan and blowing out the squirrel cage with compressed air every two years or so especially if you are in a very dusty or if you have it mounted on the floor where it is more likely to pick up dust.

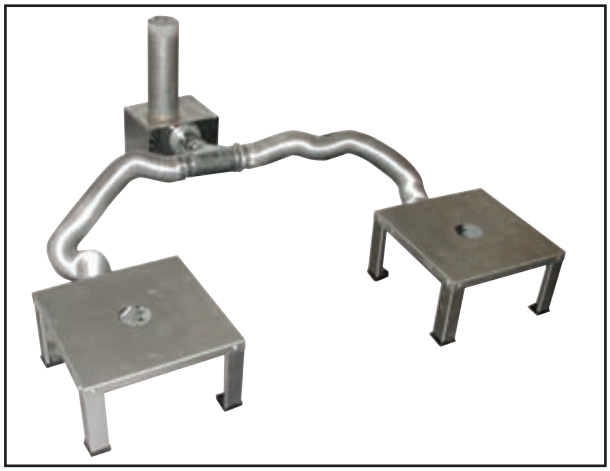
If the discharge duct of the vent is mounted pointing up you may get water that condenses in the duct drop down and rust out the motor. Taking it apart and spraying with WD-40 can restore the motor in some cases. We recommend having a water trap in the bottom of a long vertical duct run to drain off the water before it runs into the motor. This is not a problem when the vent has been mounted horizontally.

INSTALLATION OF MULTIPLE VENTS

For more information see:
hotkilns.com/vent-doubler-system

VENT DOUBLER SYSTEM

This shows a photograph of the Vent Doubler System:



The Vent Doubler system includes a bracket for mounting the vent motor on the floor or wall (as shown), an extra Bypass Collection Box, an extra Flexible Aluminum Duct and a “T” Connector with dampers. You can vent two 10 cubic kilns with one Vent-Sure plus this Vent Doubler System.

CENTRAL VENT SYSTEMS

Multiple Vent-Sure systems may be installed individually, or each system may be connected to a central duct. The following information is provided to help the installer make decisions concerning the size and length of the central duct.

CENTRAL DUCT SIZING

QTY OF SYSTEMS	SIZE OF CENTRAL DUCT
1	4”
2	6”
3	8”
4	8”
5	10”
6	10”

EXTENDING DUCT LENGTH

The duct may be 60 feet in length, and include up to four 90° bends, without a significant drop in static air flow or a reduction in kiln air pull. You may use any galvanized, stainless or aluminum duct. The outlet duct size (after the motor) is 4” diameter. The inlet duct (before the motor) is 3” diameter.

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OPTIONAL VENT CONTROL

For more information see:
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).

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 DynaTrols and Genesis controls.

It may not be used with kilns with powered bottoms (because the same output on the control is used)

Operation

NOTE: These options are set in the “Hidden Menu” of the DynaTrol.

OPTION A (OP A)

Used to control a vent. 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 150F.

OPTION B (OP B)

Used to control a vent. 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.

OPTION C (OP 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 Vary-Fire program. Output 4 is off during Easy-Fire programs.

FREQUENTLY ASKED QUESTIONS

How do I know if the system is working?

See our comments under “Adjusting the Bypass Valve”

How hot does the duct get during the firing?

Not very, for two reasons. One is that the Vent-Sure does not draw out much heat from the kiln. The hotter the kiln gets, the less hot air that is extracted by the vent motor. The other is that the bypass box combines fresh cool air with the hot air from the kiln before passing through the ductwork.

How long can the duct be and how many bends can it have?

Up to 60 feet of ducting containing four 90 degree bends may be safely used with no drop in static air flow at the duct exhaust point or a reduction in draw at the kiln. The ducting can be run either horizontally or vertically. (The Vent-Sure should handle more static pressure than the Orton vent because of the stronger motor. This translates into longer lengths of pipe and more 90 degree bends. If you have a choice run two 45 deg bends rather than one 90 degree bend or use flexible duct which has a gentler bend).

Can I vent through a ceiling and/or roof?

Yes. You will need the multi-mounting bracket (M-V-MULT/00), so that you can position the motor output vertically. Additionally, you need to make sure that you install a water trap. At the bottom of the longest vertical run, install a u-shaped bend to catch any condensation that forms before it enters the motor. Of course if you are going through a roof, you will also need a rain cap and screen.

You do not normally need double wall ducting when going through the roof since the pipe or duct does not reach high temperature. It is always advisable to check your local building codes for their requirements.

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How do I determine the size, number, and location of holes in the top and bottom of the kiln?

As a general rule, you should have one 1/4 inch hole for every 4 cubic feet of kiln volume. The holes are normally placed within a 4 inch circle in the center of the kiln floor. Please see our hole chart on page 7. L&L does not normally recommend drilling holes in the top except for certain instances where airflow needs to be increased such as for glazes which need an oxygen rich environment.

Will the fumes coming through the vent damage my plants, the neighborhood pets or disturb the local environment?

For the most part, the fumes have been diluted enough already when they are exhausted, however that depends on how you have your bypass box setup. We do not recommend placing the outlet of the vent below an open window and we have heard of plants near the vent outlet being affected by the vent fumes so keep this in mind when locating vent outlet. Once the fumes are exhausted, they will quickly be diluted by the outside air, so it is only the immediate area around the vent that you need be concerned about.

Will using the vent cause my firing to take longer?

Generally only a little bit longer. The vent system removes only a small amount of heat from the kiln due to the physics of how thin air gets at very high temperatures. (L&L NOTE: We have seen vents overpower smaller kilns - so it is important to adjust the amount of venting in some cases. On the other hand an example of an e23T 7 cubic foot kiln firing an 85 pound load on Fast Glaze program to cone 8 took 7 hours and 4 minutes with a vent on and 6 hours and 24 minutes without a vent. The vent was on the whole time).

What does it cost to operate the vent system?

The vent system should likely cost less than 1 cent/hour to operate (electricity costs). Downdraft vents are still vastly more efficient than hoods which remove tons of air from the kiln room while the Vent-Sure only removes a small amount of air from the kiln. (It does cost more to run the vent because it does take heat out of the kiln. For example an e23T 7 cubic foot kiln firing an 85 pound load on Fast Glaze program to cone 8 took 70 KW hours with a vent on and 62 KW hours without a vent. At 8 cents per KW hour that would be a cost of $0.64 more for the firing. The vent was on the whole time).

Will the cold air entering the kiln damage the product?

No. The amount of air coming in is too small unless you drill holes in the lid, which is not normally recommended. The air coming in is also distributed throughout the kiln evenly.

Will faster cooling crack the ware if I leave the vent on during the cooling Cycle?

No. Most kilns will cool faster with the vent system, but it is achieved at such an even rate and distribution that there would not be any damage to ware. (L&L NOTE: The vent will remove more molecules of air and hence heat as the kiln cools. This is because the density of the air increases the lower in temperature you go. This is one reason why kiln vents are so efficient - they don't remove too much heat when you don't want them too at the higher temperatures).

What should I do if I still smell fumes?

Check all ductwork for leaks and see our comments on "Adjusting the Bypass System".

If using a hood type vent (like the Vent-a-Kiln) do you need a kiln vent (like the Vent-Sure) also?

You need to vent fumes from the kiln and the room and heat from the room. You must have ambient ventilation in a small room for heat and to remove fumes that may not be fully removed by the kiln vent. If you have a very large room that can dissipate heat and trace fumes than you may not need ambient ventilation.

The Vent-Sure is designed to remove fumes that are generated in the kiln from the kiln and therefore from the room. The Vent-Sure downdraft kiln vent does not remove enough heat from a small room to be used for ambient ventilation.

If you have a good overhead vent hood you may discharge the output of the Vent-Sure into that hood.

At what temperature should you turn off the Vent-Sure kiln vent?

A customer writes: When firing glazes what is a good temp to turn off the vent so kiln can hit target temp in my case 2190 Deg F. Do glazes off-gas after say 2000 degrees? Is there a general temperature to turn off vent?

Answer: Generally speaking it is best for your kiln to leave the Vent-Sure on for the entire time the kiln is heating up. Mostly this is to get all of the corrosive fumes before they get to your elements, wiring, and other metal parts of the kiln.

You can leave it on for the cooling as well if you need it to cool off more quickly.

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Usually a slower cool-down is preferred though, so often the fan is turned off for the cool-down.

High-fire clays and glazes out-gas until the kiln begins to cool. Once the glaze has set, and the clay has vitrified no more gasses escape.

The heat in a red-hot kiln is almost all radiant heat. The hotter the kiln gets, the fewer and fewer air molecules are even present inside. Because of this- it is only helping the heating rate a tiny little bit to turn off the vent before the end of the firing.

How long does a Vent-Sure downdraft vent last?

The Vent-Sure downdraft kiln vent is pulling not only air but moisture and the products of hot moisture and the chemicals that are present in the clay. Some of these products are highly acidic (like sulfuric acid, hydrofluoric acid and others). The exact amount and composition of the effluents of your kiln, and hence in the vent, will vary with how dry your work is and what is in the clay to begin with. The Vent life seems to be totally dependent on these conditions. The more moisture and acids created by the materials in the clay and water then the shorter the vent life. If you have good conditions the vent can last for many years - if not - then you will be replacing various parts over the years.

That said - L&L's experience has been very positive. We have sold thousands of Vent-Sures for over 15 years. We sell very few replacement motors and other parts. The most vulnerable part seems to be the thin aluminum flexible duct that goes from the kiln to the vent motor. This is cheap and you can find replacements locally.

The motors hold up very well in terms of lubrication and vibration. The Vent-Sure is warranted for three years.

FEATURES AND SPECIFICATIONS

ADJUSTABLE AMOUNT OF VENTING

A sliding adjuster on the vent Bypass Collection Box adjusts the amount of venting from the system (see photo on page 3). Vent only what you need to vent - don't waste heat and energy by venting more than you need.

EXTERNAL VENTING

External venting is safer and surer than venting to the inside of your kiln room with a filter.

REMOTE MOUNTING OF MOTOR

The vent blower motor is mounted to a wall plate with a 12" length of exhaust pipe that mounts on the wall (see photo). This keeps the heat of the kiln away from the motor (for longer motor life) and keeps the motor vibration away from the kiln. (With the special "Multi-Mounting Bracket" the vent motor may be mounted on the floor or a wall with the outlet pointing up and then connected to an existing vent system or 4" wall outlet. If you decide to mount it this way see the caution on page 5).

MOUNTS ON ANY L&L KILN

The Vent-Sure vent system can be installed on almost any kiln. It requires only that you drill several small vent holes through the kiln floor (note that if mounting the bypass/ collection box to the stand, that four studs are factory installed on the bottom of the stand). Mounting hardware is included.

Note: L&L Vent-Sure vent are not c-MET-us listed for use on any kiln except those made by L&L Kiln Mfg., Inc.

POWERFUL VENT MOTOR

The blower vents up to 146 CFM (cubic feet per minute at 0 static pressure and 110 CFM at 0.500-In. static Pressure). Remember - not all of this air comes from the kiln - some comes from the Bypass Collection Box.

OUTLET TEMPERATURE UNDER 150°F

The outlet temperature of the air is less than 150°F as long as you do not exceed the recommended holes in the kiln.

FLEXIBLE DUCT INCLUDED

15 feet of flexible expandable aluminum 3" diameter duct is included along with necessary hose clamps. Longer lengths or lengths of 3" stove pipe can be used as well.

LOW ELECTRICITY USAGE

The Vent-Sure vent System uses only 0.75 amps at 120 volts.

VENTS UP TO 20 CUBIC FEET OR MORE

The Vent-Sure vent System was designed to be used with all L&L model kilns. We recommend one vent system for kilns up to approximately 20 cubic feet. On larger kilns, depending on how much venting you need, you may need more than one vent system. (This really depends on how much venting you need for your situation). Even our largest 35 cubic feet DaVincis have usually been adequately vented with one Vent-Sure. Note that you can always add another vent if you find you need more venting.

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MOTOR SPECIFICATIONS

120 VOLT MOTOR

PSC Blower, Type:Forward Curve, Direct Drive

Wheel Dia. (In.):3-15/16,Wheel Width (In.):2-1/2

CFM @ 0.000-In. SP:146, CFM @ 0.100-In. SP:140, CFM @ 0.200-In. SP:126, CFM @ 0.300-In. SP:124. CFM @ 0.400-In. SP:120, CFM @ 0.500-In. SP:110,

Voltage:115, Hz:50/60, Phase:1, Full Load Amps:0.75, RPM:3100

Bearing Type:Ball, Motor Type:Permanent Split Capacitor, Motor Enclosure:Open, Motor Insulation:Class B, Thermal Protection:Auto

Lead Length (In.):13, Conduit Box:Yes,

Ambient Temp. (Deg. F):104, Max. Inlet Temp. (Deg. F):104

Inlet Dia. (In.):3-1/8, Outlet Height (In.):2-3/16, Outlet Width (In.):3-1/4, Overall Height (In.):5-3/4, Overall Width (In.):6-5/16, Overall Depth (In.):5-3/8, Mounting:All Position, Housing Finish:Gray Enamel, Housing Material:Rolled Steel

Agency Compliance:UL Recognized US and Canada (E47479)

220-240 VOLT MOTOR

Item-PSC Blower,Type-Forward Curve, Direct Drive

Wheel Dia. (In.):3-3/4, Wheel Width (In.):1-7/8

CFM @ 0.000-In. SP:133,CFM @ 0.100-In. SP:128, CFM @ 0.200-In. SP:126, CFM @ 0.300-In. SP:119, CFM @ 0.400-In. SP:112, CFM @ 0.500-In. SP:105,

Voltage:230, Hz:50/60, Phase:1

Full Load Amps:0.33, RPM:2880

Bearing Type:Ball, Motor Type:Permanent Split Capacitor, Motor Enclosure:Open, Motor Insulation:Class B, Thermal Protection:Auto, Lead Length (In.):13, Conduit Box:Yes, Ambient Temp. (Deg. F):104, Max. Inlet Temp. (Deg. F):104

Inlet Dia. (In.):3-1/4, Outlet Height (In.):2-1/2, Outlet Width (In.)2-9/16, Overall Height (In.)6-9/16, Overall Width (In.):5-5/8, Overall Depth (In.):6-9/16

Mounting:All Position, Housing Finish:Gray Enamel, Housing Material:Rolled Steel

The Vent-Sure vent is c-MET-us 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.

PARTS

Prices of all parts are listed at:
hotkilns.com/parts

Complete Vent-Sure Kiln Vent System

M-V-VENT/00 ..... (see web)

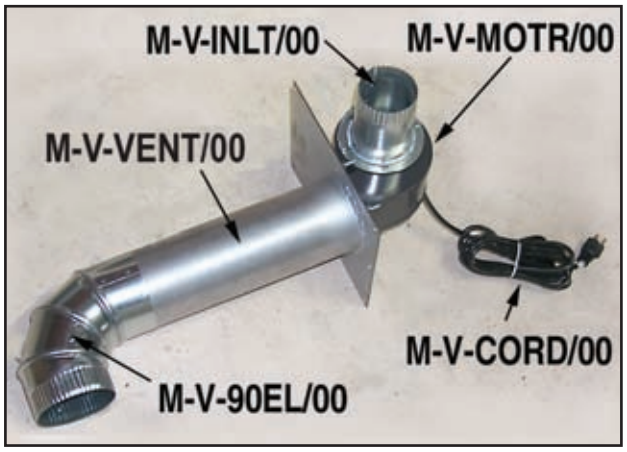
VENT-SURE Vent. 120 Volt. Complete System as described above and on our separate Vent-Sure brochure. This includes the motor, an 8 foot cord with a rocker type On/Off switch mounted in line in the cord, the inlet duct attached to the motor, the wall mounting bracket, a 90 deg elbow for mounting on the end of the outlet pipe (to keep rain water out), the Bypass Collection Box for attaching to the kiln stand or kiln side along with mounting hardware for mounting to an L&L kiln stand and one section of 15 foot flexible aluminum duct with hose clamps.

M-V-VENT/41 ..... (see web)

VENT-SURE Vent. 220-240 Volt. Typically used in non-US installations.

You can also purchase individual parts to suit your own configuration or as replacements:

Below shows the vent system blower assembly with the motor, cord and switch set, 3" inlet duct to hold the flexible duct, 12" duct to go through a wall and 90 Degree elbow.



M-V-FANK/00.....(see web)

Complete blower assembly. Pictured above ^

M-V-FAN0/00 ..... (see web)
Fan/Blower Motor for Vent-Sure. 120 Volts. This is just the motor with no attached brackets or inlets. Cord is not included.

M-V-FAN0/41 ..... (see web)
Fan/Blower Motor for Vent-Sure. 220-240 Volts. This is just the motor with no attached brackets or inlets. Cord is not included.

M-V-BRKT/00..... (see web)
Steel plate onto which the motor mounts. Includes 4" x 12" outlet pipe and output mounting plate.

M-V-INLT/00.....(see web)
Motor Inlet Duct. This is the piece of duct that attaches to the inlet of the motor. The expandable aluminum duct fits onto this.

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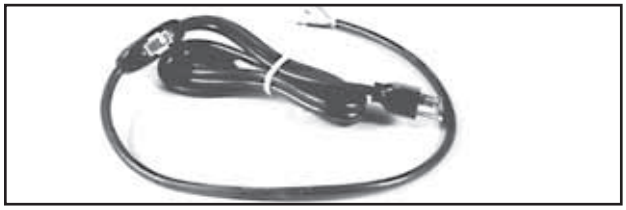
L&L VENT-SURE DOWNDRAFT KILN VENT INSTRUCTIONS

M-V-OUTT/00.....(see web)
Motor Outlet Duct. This is the piece of duct that attaches to the outlet of the motor.

M-V-90EL/00.....(see web)
90 Deg 4" elbow. Used for attaching to motor mount duct to the outside to prevent water from getting into duct.

M-V-CORD/00 ..... (see web)
Power Cord for Vent-Sure. Includes a cord mounted on/off switch. (Call factory for non-USA cords)

Power Cord with On/Off switch:

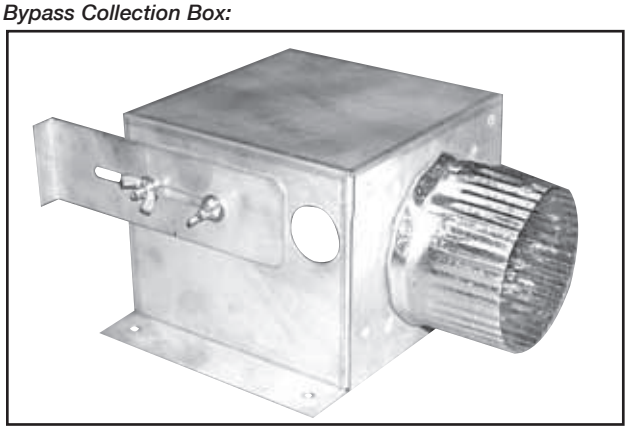


M-V-DUCT/00..... (see web)
Flexible Vent Duct 2-1/2 to 15 Feet Expandable, Flexible Aluminum 3" duct with two hose clamps.

Flexible Aluminum Duct shown with hose clamps:

M-V-BBOX/00 ..... (see web)
Bypass Collection Box. Includes hardware for mounting and slide control. Note: This has the proper mounting hole configuration to be mounted to any L&L kiln stand. It can also be mounted to the side of other kilns (typically on the bottom section).

Bypass Collection Box:

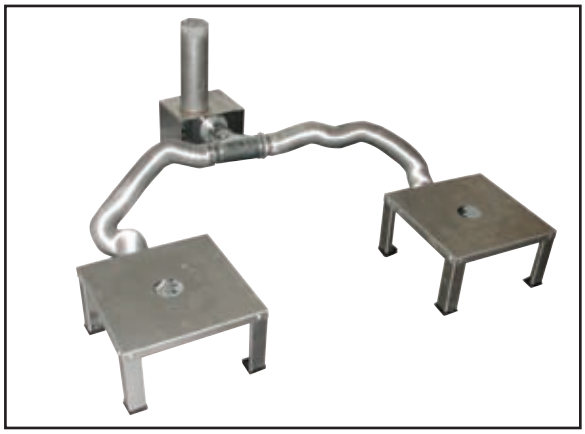


M-V-MULT/00..... (see web)
Mult-Mounting Bracket. Comes with six (6) sets of 1/4-20 bolts, nuts and lock washers for mounting this to the "Wall mount bracket" (M-V-VENT/BK).

This special "Multi-Mounting Bracket" will allow you to mount the vent on the floor or wall with the outlet of the vent pointing up. There are mounting holes on the bottom (for floor mounting) and on the side as well (for wall mounting):

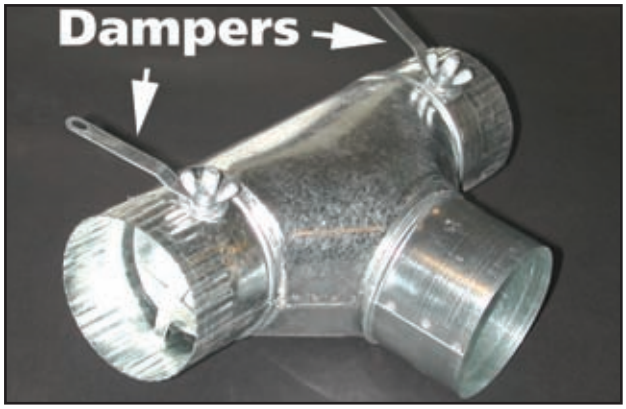
M-V-VENT/DB..... (see web)
Vent Doubler System for Vent-Sure. Includes a "T" duct with dampers, an extra Bypass Collection Box, Extra Flexible Duct. (Consider buying the Multi-Mounting Bracket which is not included but sometimes useful for this installation as shown in the photo-graph).

Vent Doubler System:



M-V-TDUC/00..... (see web)
"T" DUCT to attach two aluminum flexible ducts to. Includes dampers on the two inlets. The outlet fits onto the Motor Inlet Duct of the Vent-Sure and the Flexible Vent Duct(s) fit onto the inlets of this "T" Duct.

Special "T" duct for doubler system:



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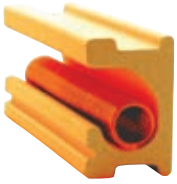

L&L Kiln's patented hard ceramic element holders protect your kiln.

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HERCULES & EASY-LOAD INSTRUCTION MANUAL

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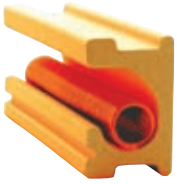

L&L Kiln's patented hard ceramic element holders protect your kiln.

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INSTALLING YOUR L&L KILN

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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/easy-fire-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***.

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CLEARANCES & SURFACES

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."

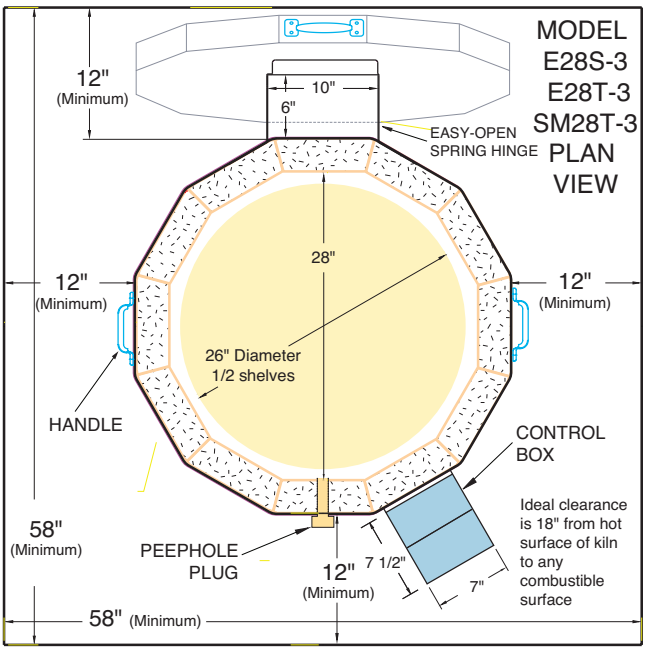
The National Fire Protection Agency states that temperatures at combustible ceilings and floors be kept below 160 Deg F (71 Deg C) near industrial furnaces (which are like kilns).

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.

A Typical Kiln Installation



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 autoignition temperature. (The autoignition 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

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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 has 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.

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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

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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.

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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.

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sales@hotkilns.com • hotkilns.com

INSTALLATION CHECKLIST AND ACCEPTANCE FORM FOR HERCULES & EASY-LOAD FRONT-LOADING KILNS

Thank you for ordering an L&L Front-Loading kiln! In order to complete the process it will be necessary to complete the attached questionnaire. This form needs to be filled out by people with the most knowledge and responsibility. L&L must have this filled out form **BEFORE** the kiln is scheduled for production. You should keep a copy for your records and have it on hand when the kiln is received.

GENERAL

MODEL NUMBER: _____

Voltage:_____ Phase:_____ Fuse or Circuit Breaker Size:_____amps

CUSTOMER/COMPANY/INSTITUTION: _____

Person filling out this form: _____

Phone: _____ Email: _____

CONTACTS

Fill out as much of this as makes sense for your organization. Just make sure we have everyone's contact information that is involved with the kiln and may need to be contacted.

Main Contact (if different than above): _____

Phone: _____ Email: _____

Facilities (institutions and industry only): _____

Phone: _____ Email: _____

Contractor/Architect (only if involved in specifying): _____

Phone: _____ Email: _____

Other (describe _____): _____

Phone: _____ Email: _____

FRONT-LOADER DELIVERY AND INSTALLATION CHECKLIST

For HERCULES & EASY-LOAD

MOVING ON SITE

Moving and setting the kilns in place

All L&L front-loading kilns come on boards with shock absorbing donuts designed so you can move it from either the front or back with a pallet jack or forklift. If you use a forklift go slow and do not tilt the kiln too much.

1. Remove all the wood crating except the donut running boards. After the kiln is in position in the kiln room, raise the kiln off of the floor with a pallet jack and remove the lag screws that hold the donut running boards to the kiln base and lower the kiln to the floor.
2. Remove the steel door supports that keep the door bolted to the kiln body during shipment. There will be one or two depending on the model and are clearly marked with a red tag stating their purpose. Replace the bolts in the holes after removing the supports.
3. Open the door and carefully remove the wood and foam structure that is in place to support the arch and interior of the kiln during shipment.
4. Remove the ceramic pieces that are in the element holders to keep the elements in the holders during shipment.
5. Before the first firing make sure that the elements are seated properly in the element holders. Once the kiln is heated the elements will settle further into the element holders.

INSPECTION

Shipping inspection

The sooner any damage is found the easier it is to resolve any problems.

1. Understand the importance of inspecting the kiln for damage as soon as it is delivered.
2. Inspect the external crate for any obvious damage like broken wood.
3. Check the plastic air donuts that the skid is attached to. If the kiln has been dropped hard these will show damage and evidence of crushing.
4. Inspect the door seal. If the kiln has damage it is likely to show up in broken brick around the door.
5. If it is at all possible open the crate and open the door and look in the kiln. If you can't do this before the driver leaves at least make this your first priority.
6. If there is damage contact us immediately. Call L&L at 856-294-0077. We will contact the local agent of the transportation company immediately and an inspection will be arranged.
7. THIS IS CRITICAL. DO NOT DISCARD ANY PACKAGING MATERIAL UNTIL YOU HAVE CAREFULLY CHECKED THE KILN FOR DAMAGE. After that, if there is damage, you will be responsible. Once you sign for the kiln it is yours. Make your notations as specific as possible to protect yourself in the event that concealed damage is subsequently discovered.
8. Inspect kiln as soon as possible AND DEFINITELY **WITHIN 2 to 3 DAYS** –EVEN IF YOU ARE GOING TO STORE THE KILN. Claims must be filed within 2 to 3 days of receipt of goods.
9. **We suggest taking digital pictures as soon as you receive the kiln. This protects you.**
10. Hold damaged goods with any packing material undisturbed for an inspection by the carrier's agent. DO NOT RETURN ANY DAMAGED GOODS TO L&L WITHOUT PRIOR AUTHORIZATION OF L&L AND THE CARRIER.

Safety Inspection

(For institutions and industry) Do you need a third-party safety or code inspection? ☐ - Yes ☐ - No

Explain:

_____

FRONT-LOADER DELIVERY AND INSTALLATION CHECKLIST

For HERCULES & EASY-LOAD

ELECTRICAL

See our electrical specifications to make sure your fuse and amperage available are sufficient. Also – we HIGHLY recommend actually putting a meter to your power unless you are absolutely certain of what you have. Many mistakes have been made by looking at some appliance nearby and assuming that the rating on that is what you have.

Distance to Disconnect Box:____ Feet (This should be under 15 feet according to the National Electrical Code)

Distance to Circuit Breaker Box:____ Feet (may affect the size of the wires you need to run)

VENT SYSTEM

All kilns should be vented. Some people have or intend to have a hood over the kiln. It is possible to have both a hood and the Vent-Sure. There are several advantages of having a Vent-Sure. You get the corrosive fumes out of the kiln using negative pressure. This means that the kiln will last longer. Uniformity is also improved. If you have both it is also possible to vent the output of the Vent-Sure into the Vent hood.

Are you getting a Vent-Sure installed on the kiln? ☐ - Yes ☐ - No

Is there a 120-volt standard wall outlet near the kiln? ☐ - Yes ☐ - No

(The Vent-Sure has a 6-foot cord but this can be hard wired or used with an extension cord if necessary)

Do you have a vent hood over the kiln area? ☐ - Yes ☐ - No

If so what is the height from the floor to the bottom of the hood? _____ inches

Is the kiln near an outside wall? ☐ - Yes ☐ - No

Is there any problem for you to make a 4" diam penetration in the wall for the vent outlet? ☐ - Yes ☐ - No

Is there good ambient ventilation to remove heat so the kiln room does not get too hot? ☐ - Yes ☐ - No

OTHER

If you have sprinklers near the kiln have you checked their rating? ☐ - Yes ☐ - No

Too low a rating can cause a major and expensive problem by setting off the sprinklers. Generally speaking these are only found in institutions and industry.

Is the floor rated for the weight of the kiln? ☐ - Yes ☐ - No

(Probably only a potential issue with the Easy-Load kilns)

Are you going to have a fire extinguisher (rated ABC)? ☐ - Yes ☐ - No

This is a good idea no matter where you put the kiln.

You should familiarize yourself with L&L's complete INSTALLATION & PREORDER INFORMATION FOR L&L KILNS (www.hotkilns.install.pdf) for more information and guidance.

ACCEPTANCE AND INSPECTION

L&L Kiln Mfg Inc. makes great effort to ensure that our Easy-Load and Hercules line of front-loading kilns are manufactured to the highest standards of design, materials and workmanship. Due to the fact that these are so different than the more commonly used top loading kilns we have found it necessary to explain our how we ship these kilns, what to expect when you get the kiln, and what the customer's responsibilities are when the kiln is received.

FRONT-LOADER DELIVERY AND INSTALLATION CHECKLIST

For HERCULES & EASY-LOAD

Packaging

L&L goes to considerable effort to pack these front-loading kilns to prevent shipping damage. This includes the following special items:

1. We build a support cage inside the kiln interior to prevent kiln bricks from shifting and cracking – although, no matter what, some minor cracking of the firebrick is always going to be present.
2. We attach air cushions on the packing skids. (Those are the orange "donuts" you will see on the skids). These help protect the kiln from vibration during shipping.
3. We attach steel braces between the door and the case that keep the door slightly ajar from the front of the kiln so that the door does not rub against the front of the kiln. (These need to be removed to inspect and use the kiln).

   We protect the outside of the kiln with wood and foam-in-place crating material to protect the outside surface and control panel.

   We make sure that the kiln can be picked up and moved form either direction.
4. We make the skid larger than the outside dimension of the kiln.
5. We attach "Shockwatch" and "Tiltwatch" labels to the packaging. These can indicate whether the kiln has been subjected to rough handling during shipping.

When you take possession of the kiln

1. Examine the "Shockwatch" and "Tiltwatch" labels. If they indicate a problem note it on the Bill of Lading.
2. Remove the steel braces from the door and front of the kiln and open the door.
3. Remove the inside cage and inspect the firebrick carefully for signs of any cracking or damage. Note that there is almost always some minor patching that is done in the factory because of the nature of firebrick. This is normal. Compare with the photos in case you are uncertain. Do your best to do this when the kiln is delivered and before the driver leaves. If this is not possible do it immediately afterward even if you do not intend to move or use the kiln for a while.
4. **DAMAGES MUST BE REPORTED IMMEDIATELY**. IF THERE IS ANY PROBLEM AT ALL YOU MUST **CALL L&L (856-294-0077)** (preferably before the driver leaves and note any visible damage on the receiving documents). If you don't there is no recourse against the carrier who is responsible of the condition of the kiln when it is delivered. **TAKE PICTURES!! AND NOTE ON THE BILL OF LADING ANY DAMAGE**.
5. Once you accept the kiln it is not returnable.

Firebrick and Cracking

The basic material used in kilns of this nature is an insulating firebrick that can, under normal circumstances, crack and spall once it is fired. The design of the kiln is such that this will not affect the proper functioning of the kiln. Cracking is not a warranty issue, which is clearly stated in the Standard L&L Limited Warranty (see www.hotkilns.com/warranty for the full text of our limited warranty). In addition, although the utmost care is used in cementing the firebricks together, it is entirely possible that cracks may appear over time or immediately between cemented firebricks. Again the design of the kiln, in particular the arched top and backup insulation, prevents such cracking from becoming a performance issue when using the kiln.

The person signing this represents that they have the authority to make decisions with regard to accepting the kiln being purchased. And that they understand the conditions under which the kiln is being delivered.

Signed: _____ Date: _____

Printed:_____ Title or Position:_____

BTU ANALYSIS FOR L&L HERCULES EASY-LOAD FRONT-LOADING KILNS FOR HVAC CALCULATIONS

These tables can be used to calculate maximum BTU output into a room when firing a kiln at various temperatures.
It is meant for HVAC calculations.

MODEL NUMBER	INTERIOR DIMENSIONS			Cubic Feet	K.W.	Square Inches of surface area			Total BTU loss/Hr at 1800 Deg F				Total BTU loss/Hr at 2000 Deg F				Total BTU loss/Hr at 23500 Deg F			
	Width	Depth	Height to Bottom of Arch			Floor	Side, Back, Door	Roof	Floor	Side, Back, Door	Roof	TOTAL	Floor	Side, Back, Door	Roof	TOTAL	Floor	Side, Back, Door	Roof	TOTAL
EL2424H	25	25	22	8.0	15.0	625	2200	688	1293	4400	229	5923	1549	5286	1055	7891	2088	6997	1423	10508
EL2427H	25	25	27	9.8	16.5	625	2700	688	1293	5400	229	6923	1549	6488	1055	9092	2088	8588	1423	12098
EL2436	25	25	34	12.3	19.0	625	3400	688	1293	6800	229	8323	1549	8169	1055	10774	2088	10814	1423	14324
EL2448	25	25	46	16.6	24.2	625	4600	688	1293	9200	229	10723	1549	11053	1055	13657	2088	14631	1423	18141
EL2848	31	25	46	20.6	27.0	775	5152	853	1604	10304	284	12192	1921	12379	1308	15609	2589	16386	1764	20739
EL3048	31	31	46	25.6	31.5	961	5704	1057	1989	11408	352	13749	2382	13705	1622	17710	3210	18142	2188	23540

WALLS

BTU'S HEAT LOSS PER SQ FT PER HOUR AT 1800 DEGF:	288	BTU's per Square Foot per hour
BTU'S HEAT LOSS PER SQ FT PER HOUR AT 2000 DEGF:	346	BTU's per Square Foot per hour
BTU'S HEAT LOSS PER SQ FT PER HOUR AT 22350 DEGF:	458	BTU's per Square Foot per hour

FLOOR

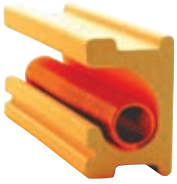
BTU'S HEAT LOSS PER SQ FT PER HOUR AT 1800 DEGF:	298	BTU's per Square Foot per hour
BTU'S HEAT LOSS PER SQ FT PER HOUR AT 2000 DEGF:	357	BTU's per Square Foot per hour
BTU'S HEAT LOSS PER SQ FT PER HOUR AT 22350 DEGF:	481	BTU's per Square Foot per hour

ARCHED ROOF

BTU'S HEAT LOSS PER SQ FT PER HOUR AT 1800 DEGF:	48	BTU's per Square Foot per hour
BTU'S HEAT LOSS PER SQ FT PER HOUR AT 2000 DEGF:	221	BTU's per Square Foot per hour
BTU'S HEAT LOSS PER SQ FT PER HOUR AT 22350 DEGF:	298	BTU's per Square Foot per hour

HERCULES & EASY-LOAD INSTRUCTION MANUAL

L&L Kilns
hotkilns.com



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

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HERCULES & EASY-LOAD INSTRUCTION MANUAL

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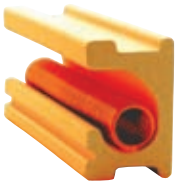

L&L Kiln's patented hard ceramic element holders protect your kiln.

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HIGH TEMPERATURE (CONE 10) KILN WASH

TECHNICAL DESCRIPTION

L&L High temperature (cone 10) kiln wash is available in one pound and five pound boxes. It is made from a mixture of Silica, kaolin, and Alumina Hydrate.

DIRECTIONS FOR USE

Kiln wash is applied to kiln shelves to protect them from glaze drips. On a washed shelf, drips can be easily removed without gouging or marring the kiln shelf.

Some people also apply the kiln wash to the kiln bottom. Because this has both its benefits and detractants, we recommend that it only be done based on the kiln user's individual preferences.

Mix the kiln wash with water to a thin cream consistency. Apply only one coat at a time. Use a wide paintbrush or utility brush (a 2" - 3" wide, soft bristle brush generally works best). Three individually fired-on coats of kiln wash are preferable.

APPLYING KILN WASH

1) Make sure the tops of the shelves are coated with kiln wash. This will protect these surfaces from melting glaze and ceramics. If desired, also apply to the kiln bottom.

2) Do not coat the bottom or sides of the shelves.

3) Do not apply kiln wash to the brick sides or element holders.

4) Apply the kiln wash to the thickness of a post card.

5) The only purpose of kiln wash is to prevent any glaze that drips from a piece from sticking to the floor or shelves. This saves both the piece and the floor or shelves. If dripping should occur, simply remove dripping and cover the spot with new kiln wash.

6) When you are applying kiln wash to your shelves for the first time, it helps to dampen the top of your shelves with a wet sponge or a water-filled spray bottle first. This makes the kiln wash go on easier and more evenly.

7) For the kiln wash to really protect the kiln shelves it is best to apply three separate coats. In addition it is best to fire each coating separately. (If you brush one coat on, let it dry and then brush on another, you could actually be brushing off the first in the process, so ideally each coat should be fired on). The shelf can be used while firing the kiln wash on, 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 get away fine without three firings of the kiln wash. However, we include this recommendation as a "best practice".

8) If you notice that your kiln wash is flaking off, use a paint scraper (or something similar) to remove any loose bits, then reapply kiln wash. If glaze drips onto your shelf, use the paint scraper to pop the glaze drip off and clean up any loose areas around the area, then dab some more kiln wash in the bare area.

PROGRAM TO QUICKLY DRY KILN WASH

Here is a program that will dry the kiln wash in a hurry:

In the Vary-Fire section:

Press **Enter Prog**, Press '**1**'

Press **ENTER**, Press '**1**'

Press **ENTER**, Press '**60**'

Press **ENTER**, Press '**200**'

Press **ENTER**, Press '**600**' (for 6 hours, 400 for 4 hours, 800 for 8 hours etc of hold time at 200 degrees)

Press **ENTER**, Press **9999**

Press **ENTER**, Press **START**

APPLYING KILN WASH TO A KILN SITTER

If you have a kiln sitter/timer, put kiln wash on the cone supports (not sensing rod) for accurate cone action. Clean off the old wash and reapply new wash each time you fire or when it begins to chip away.

IMPORTANT CAUTIONS

1) Kiln wash contains silica. Long term exposure to silica dust could cause lung damage.

2) Reference ***hotkilns.com/msds-kiln-wash*** for the material safety data sheet for kiln wash.

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).

5) Store kiln shelves in a dry location. Shelves can absorb moisture and this can cause them to explode when they are fired.

6) Do not fire cracked shelves. They can fail in the middle of a firing causing the whole load in your kiln to collapse.

7) We recommend attending the kiln during all firings, as no automatic safety device is foolproof.

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INDUSTRIAL GRADE CERAMIC THERMOCOUPLE PROTECTION TUBES

A standard 8 gauge Type K Thermocouple:

The ceramic mullite protection tube it goes in:

ADVANTAGES

1. Longer life than the metallic sheathed thermocouples or exposed thermocouples.
2. No metal spalling in the kiln.
3. Protection from contamination found in clay such as sulfur.
4. Cheaper replacement cost for thermocouples.

SAVE MONEY ON TC REPLACEMENTS

One major advantage of these protection tubes is that you can replace your old thermocouples with the cheaper standard 8 gauge thermocouples without changing the protection tube. A replacement 8 gauge thermocouple is less expensive than the metal-sheathed thermocouples. Over time the protection tubes may have to be replaced if they get contaminated from materials in the kiln; however, it should take a long time for contaminants to leach through the relatively impervious 1/8" thick mullite tube. The tube can be easily replaced independently from the thermocouples - they are not sealed or cemented together.

SIZE AND DESCRIPTION

The protection tubes are ¾" in outside diameter with a ½" inside diameter (which accommodates the standard 8 gauge Type K thermocouple). There is a flange on the back end of the thermocouple to prevent it from going into the kiln. If you are retrofitting an older kiln you will have to drill out the brick to ¾". This is no problem. In fact the stainless steel where the thermocouples go through is, in most cases, punched at 1" diameter.

L&L TEST PROGRAM

The industrial 2300mi thermocouples that had been used for several years are no longer available because Hoskins, who made the material, is no longer in business. This is L&L's careful response to this issue.

Mullite ceramic protection tubes over 8 gauge type k thermocouples offer superior life than 2300mi thermocouples.

L&L tested 23 different thermocouples in a kiln by firing them to Cone 10 (2350°F) and soaking the kiln for one hour repeatedly and then measuring the thermocouples with a sophisticated datalogger. The main thermocouple to control the kiln was a platinum Type S. The various test thermocouples were our standard 8 gauge thermocouple with a butt-welded end, one with a twisted end, both in a heavy mullite protection tube and exposed to air, 14 gauge Type K exposed thermocouples, Type N thermocouples of various types, a Hoskins 2300mi, several metallic sheathed thermocouples with Inconel and various grades of Pyrocil (the replacement for the 2300mi), etc.

One of our standard Type K 8 gauge thermocouples in the industrial protection tube achieved 139 firings. The standard 8 gauge thermocouple without a protection tube made it to 100 firings. The metal-sheathed Pyrocil was good but not as good as the 8 gauge with the protection tube (it worked for 130 firings). An 8 gauge Type N did slightly better (143 firings) but the potential confusion of using this outweighed the simplicity and backward compatibility of the Type K.

The conclusion from the test is that a standard 8 gauge thermocouple with an industrial mullite ceramic protection tube offered the best combination for cost of replacement, cleanliness (there is no contamination of the kiln with metal spalling), resistance to contaminants in the kiln like sulfur, backward compatibility, and long life.

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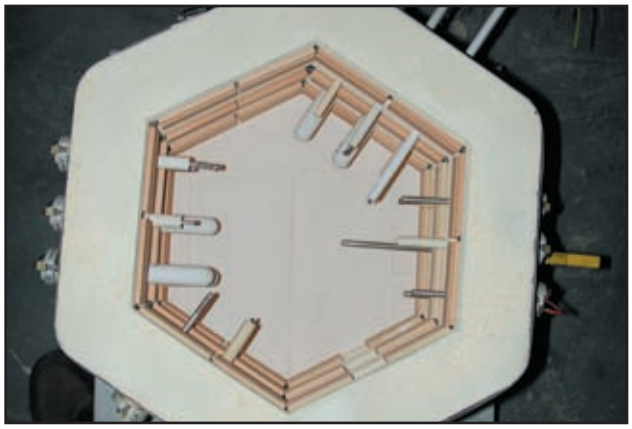
The kiln the thermocouples were tested in, before and after the test:



THERMOCOUPLE & CONE OFFSETS

A thermocouple in a protection tube has a slightly delayed response and hence an offset from a more sensitive thermocouple like the metallic sheathed thermocouple. However, our test indicated that every thermocouple measured slightly different temperatures anyway. A detailed analysis of responses after about 130 firings showed the 8-gauge Type K thermocouple in the protection tube to be between the control Type S platinum thermocouple and the metallic sheathed Pyrocil Type K. In any case the DynaTrol control has thermocouple offsets and cone offsets to allow you to compensate for any such effects. For ceramic work we recommend calibrating the kiln performance with cones and adjusting the control to match the performance of the firing cones. The most important thing is to get a consistent reading from the thermocouples. In a separate series of tests in our Easy-Fire kilns we came up with the exact offsets that seemed to work time and again. We ran various Easy-Fire cone programs on the DynaTrol with various offsets programmed into the control and measured accuracy of results with Large Self-Supporting Cones. The "Blue" DynaTrol (in use since April 2003) comes with these Thermocouple Offsets and Cone Offsets preprogrammed. From cone 022 to cone 017 the cone offsets are set at 9020. All other cones are preset at 0000. The Thermocouple Offset comes programmed into the control at 0018 (+18°F) when it leaves the factory. Note the room temperature will show around 90°F to 100°F. You can easily program these settings into the older "Green" DynaTrol. If you do not use the thermocouple protection tubes then you need to change thermocouple and cone offsets to 0000. See ***dynatrol-basic-operation.pdf*** in the OPERATION section for more information on calibration. (Note that we used a greater offset from April 2003 to Oct 2004 because the protection tubes were not as sensitive as the ones we currently use.)

METALLIC PYROCIL TC OPTION

For those who prefer the metal-sheathed thermocouples for greater sensitivity they are available by special order.

See the separate PDF file on this:
hotkilns.com/metallic-tc

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TYPE S PLATINUM THERMOCOUPLES FOR L&L KILNS

THE BEST THERMOCOUPLE

The standard thermocouple used on the DynaTrol is Type K. The most common thermocouple configuration that we use is an 8 gauge exposed Type K thermocouple protected with a mullite ceramic protection tube (standard on Easy-fire, Easy-Fire XT, School-Master, Jupiter, eQuad-Pro, Hercules, Easy-Load, DaVinci, Liberty-Belle 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). You can special order a DynaTrol with Type S thermocouples. The control is 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 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 three lengths. The short one used in the Easy-fire, Easy-Fire XT, Jupiter, eQuad-Pro, JH Series, DaVinci, and Doll kilns is 120 mm (4.75") long. The medium one used in the Hercules and Easy-Load front-loading kilns is 160 mm long (6.3"). There is a special order extra long one used in the discontinued Renaissance front-loading kilns which is 220 mm long (8.66"). Termination is in the ceramic terminal block.

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. Nor for use with any kilns not using a DynaTrol or Genesis control board.
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 Hercules and 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.

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INDUSTRIAL METAL SHEATHED THERMOCOUPLES FOR L&L KILNS

METAL SHEATHED THERMOCOUPLES ON L&L KILNS

The standard thermocouple used on the DynaTrol is Type K. The most common thermocouple configuration that we use is an 8 gauge exposed Type K thermocouple protected with a mullite ceramic protection tube (standard on Easy-fire, Easy-Fire XT, School-Master, Jupiter, eQuad-Pro, Hercules, Easy-Load, DaVinci, Liberty-Belle and Doll kilns).

An alternative to the standard 8 gauge thermocouple is the Type K industrial Pyrocil metal-sheathed thermocouples. You can special order an Easy-fire, Easy-Fire XT, Jupiter, eQuad-Pro, Hercules, Easy-Load, DaVinci, or Doll kiln with Type K pyrocil thermocouples in place of the 8 gauge Type K thermocouple.

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).

Based on our life testing the pyrocil sheathed thermocouples got about 130 cone 10 firings vs. the 139 cone 10 firings of the 8 gauge thermocouple with the industrial mullite protection tube (a 100 firings for an exposed 8 gauge thermocouple).

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.

THERMOCOUPLE OFFSET

The typical thermocouple offset of +18 Deg F is NOT used with these Pyrocil thermocouples. The thermocouple offset is initially set for 0 Deg.

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

NOTE: Pyrocil thermocouples can be ordered with a kiln as part of the original equipment.

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KILN INTERFACE & DATALOGGER SOFTWARE SYSTEM (K.I.S.S.)

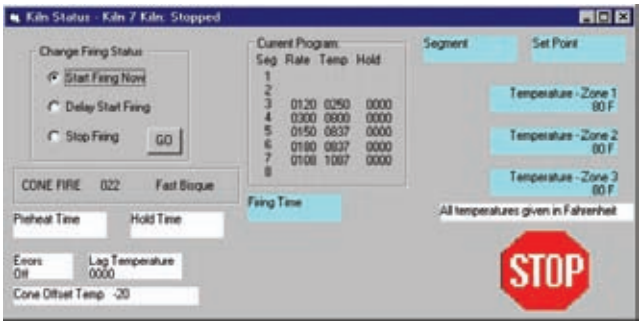
FEATURES

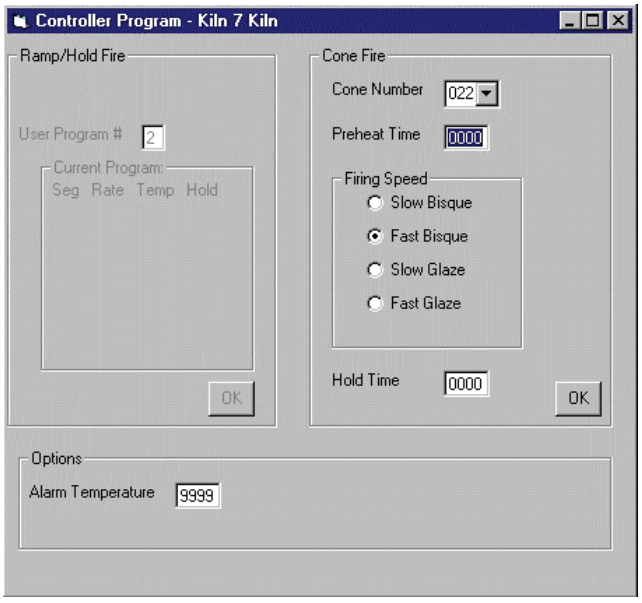
KISS (kiln interface software system) connects up to 50 DynaTrol controllers to a personal computer running Windows 95, Windows 98, Windows 2000, Windows XP, Vista, Windows 7, and Windows 10 (just not Windows NT).

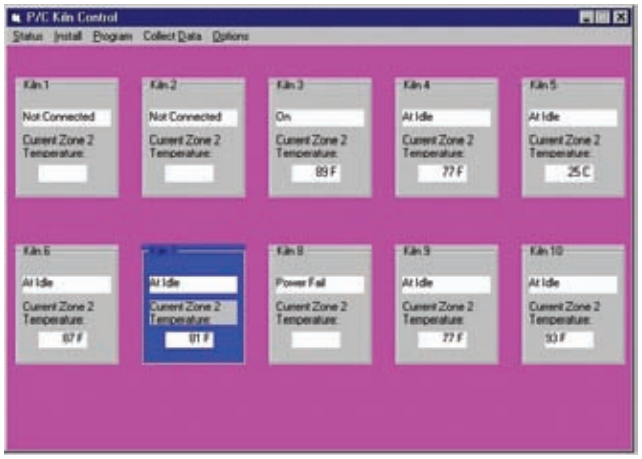
KISS is an easy-to-use interface for programming and monitoring of the controller from a computer up to 4000 feet away. You can see the state of all 50 kilns at a glance or view the in depth status of any individual kiln.

The "collect data option" turns your computer into data acquisition system to store the set-points and the kiln temperatures in a file for graphing. It puts the data into a spreadsheet form.

The summary report will keep a history file of the date, program fired, firing time and final temperature for each firing of each kiln to help with maintenance records.







THE STARTER KIT

The starter kit includes KISS Windows-based software on CD, a 25 foot modular cable (to connect from the computer to the kiln), a modular connector to install on the kiln, an RS485 chip to install in the controller and either an opto-isolated RS232 to RS485 converter or a USB to RS485 converter.

KISS KILN KIT

The KISS Kiln Kit (for adding on additional kilns) includes a modular "T" adapter, 25 feet modular cable, surface mount modular jack with kiln connection wires, RS485

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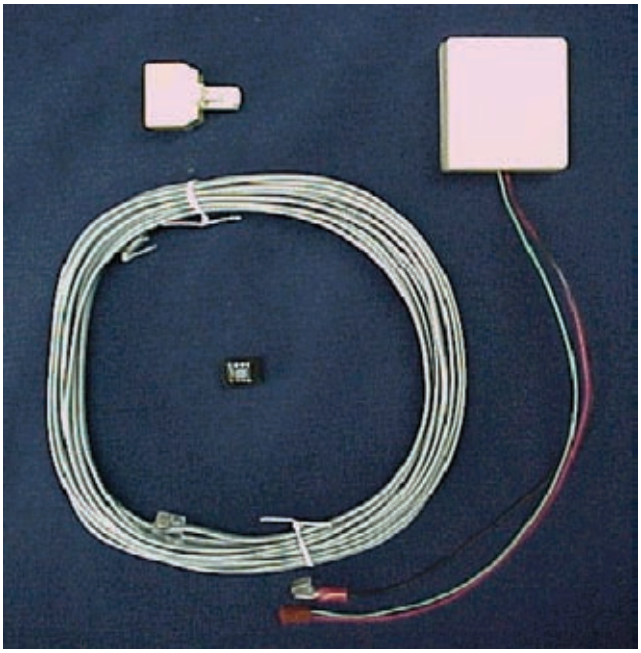
communications chip (MAX487 integrated circuit) to put onto the DynaTrol controller.



REMOTE CONTROL

Connect To Your Kiln Remotely From Another Location Via Internet

Using a program such as PCAnywhere, GoToMyPC, or LogMeIn you can control and monitor the control computer remotely.

Some of these programs are totally free or very inexpensive.

You can control your computer remotely as well as see what it is doing.

If you can remotely control your computer that is connected to the kiln network, then you will be able to access all the functions available from the software. That includes the capability to start the kilns, stop them, change the programs, collect data, etc.

It is extremely important if you access those functions remotely, especially such as starting the kiln, that the user is fully confident that the kiln is securely closed and there are no objects near it that could be harmed by the extreme heat.

One-Time Cost With No Subscription Fees

There is a one-time cost (shown below) for the first kiln and then a small charge for each additional kiln that you connect. This is for all the hardware and software necessary to do the job.

Questions And Answers

Can We Download The Program Before We Get The Hardware?

Sorry, but there is not currently have a way to download the program. The good news is that the software part of the system is usually the easy part to get up and running. The hardware connections seem to generate more customer service calls to Bartlett than the software part.

Is There A Maximum Length The Kiln Can Be From The PC?

The first kiln in the chain of kilns can be up to 1000 feet from the computer.

How Can I Determine Which Of The Kilns We Have Can Be Hooked Up The KISS System.

The controller has to be a “Series 600” or “Series 700” Bartlett (DynaTrol) controller. Here’s a link to a page on the Bartlett web site that shows the difference in displays between a 600 board and the, more current, 700 board. There are serial numbers on the circuit board inside the controller itself and those would also tell whether the controller can communicate with the KISS system. The 600 series requires a KISS 2 extension kit, but, with 700 series controllers, there are some different hardware configurations that determine a bit of difference in which extension kit is required.

What kind of wire can I use?

Use the cable supplied with the KISS system. Using the wrong wire is a common cause of problems. The ESSENTIAL part is that the cable must be straight-thru wire and most cable on the market is twisted-pair wire. The cable looks like an ordinary phone cable, but phone cable is generally twisted-pair. If you choose to do otherwise, the specifications for the cable supplied is that it is a 25’ modular cord, 6-position, 4 contacts, straight-thru wiring, RJ11-6P4C.

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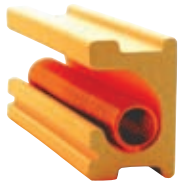

L&L Kiln's patented hard ceramic element holders protect your kiln.

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TROUBLESHOOTING AND REPAIR INSTRUCTIONS FOR L&L KILNS

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TROUBLESHOOTING AND REPAIR INSTRUCTIONS FOR L&L KILNS

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/video***).

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.pdf*** 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.

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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.

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***

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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.

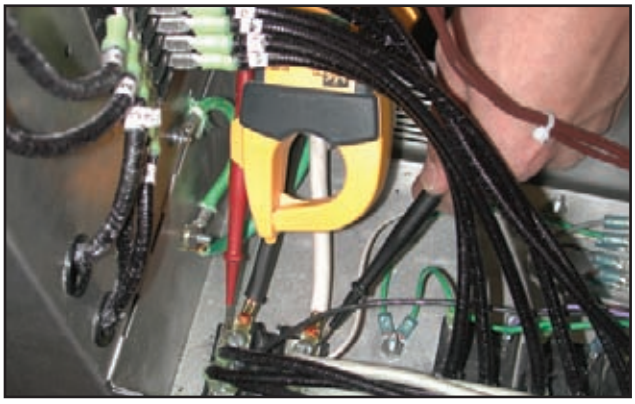
2) With power off examine the electrical cord. Look for burned or melted areas and breaks or pinched sections. Look closely at the head of the plug. If there is an internal problem with the wires and the plug parts you won't be able to see it but you may detect a softening or melting of the plastic at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

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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.

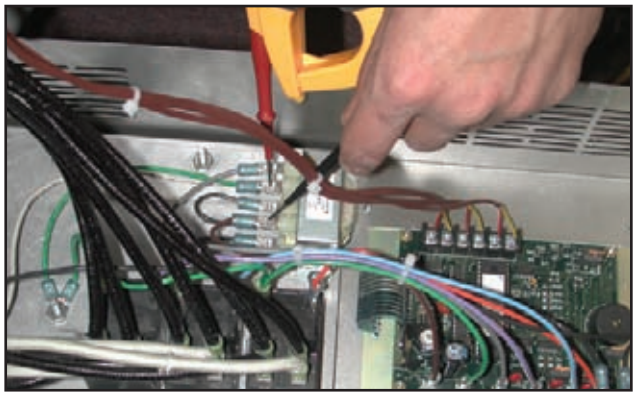
2) Check for worn wires that may have shorted against the case. Examine wire insulation. If the wire insulation has become frayed the wires could short to the metal casing which is electrically grounded.

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***

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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.

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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 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.

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

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

Loading

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.***

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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

1) The ceramic thermocouple protection tubes introduce a known error into the system. This is covered in the Operational Instructions but bears repeating here. The temperature that is measured by the tip of the thermocouple is approximately 18 Deg F cooler than the actual kiln temperature. We have found through extensive testing that the best way to compensate for this is to put in a Thermocouple Offset of + 18 Deg on each thermocouple. The specific setting is 0018 on Easy-Fire kilns, along with a Cone Offset of -20 (setting is 9020) for EACH cone that you fire to on the Easy-Fire Programs (or 9030 on cones 022 to 017).

2) We have already programmed the control with this information so that you don't have to do it. However, we also provide step-by-step instructions on how to do it in BASIC OPERATION OF L&L KILNS WITH A DYNATROL 700 in the OPERATION tab of your manual (or ***hotkilns.com/basic-operation-dynatrol***) and the OPERATION OF L&L KILNS WITH A ONE-TOUCH™ (Deg F) in the OPERATION tab of the School-Master instruction manual (or ***hotkilns.com/basic-one-touch-f***) If you are using the VARY-FIRE programming on an Easy-Fire kiln then use a Thermocouple Offset of plus 70 (setting is 0070).

Thermocouple Drift

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

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KILN FIRES SLOWLY - BOTH SERIES

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.

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).

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

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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.

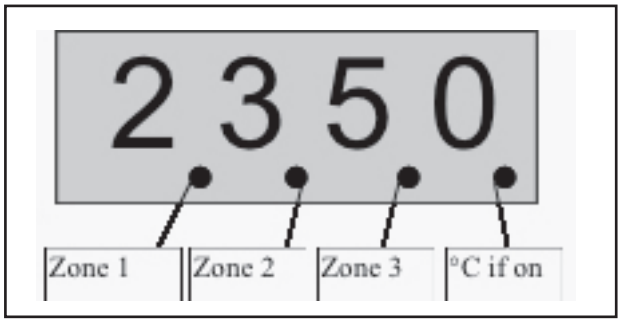
2) Check your circuit breaker for proper operation. These sometimes go bad over time.

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.

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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.

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ShtO (SHUT-OFF) SETTING

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

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

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

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

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

6) OFF means that the DynaTrol will not let the hottest zone's temperature rise until the average temperature of the three zones reaches that segment's set point. Then the kiln can begin the "hold time" or the next segment. This will result in more even firing.

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

PId SETTING

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

2) This setting comes pre-programmed at the factory for 65%. Basically this setting determines how much help the middle zone of the kiln gives the bottom zone of the kiln when the bottom zone is lagging behind during heating. This comes into play when the bottom zone is on 100% of the time. With this feature, the middle zone of the kiln will come on the programmed percent (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).

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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.

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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

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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

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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

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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. If this is suspected, the control panel should be returned to L&L for testing and possible modification. Also 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

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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.

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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.

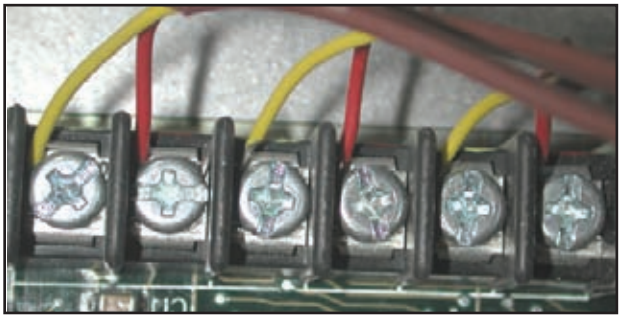
3) Open up the control box and hinge down for access (as shown on page 2)

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.

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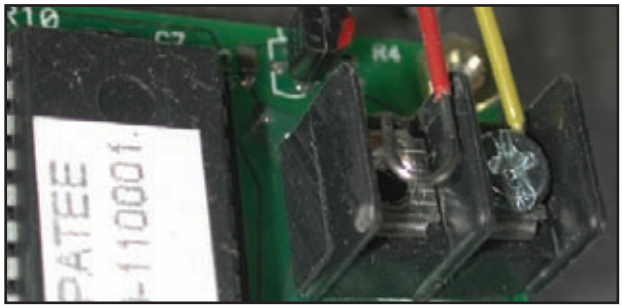
Picture showing thermocouple wires installed on Control. One screw is removed to show how the TC wire should be prepared with a "U" shape.



7) Double check that the proper color coded wire goes to the proper terminal.

Orange = OUT

Gray = AC1

Green = CT

Brown = AC2

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 loose. If there are any doubts about the integretity of the wire or the connector replace the whole wire or harness.

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

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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)

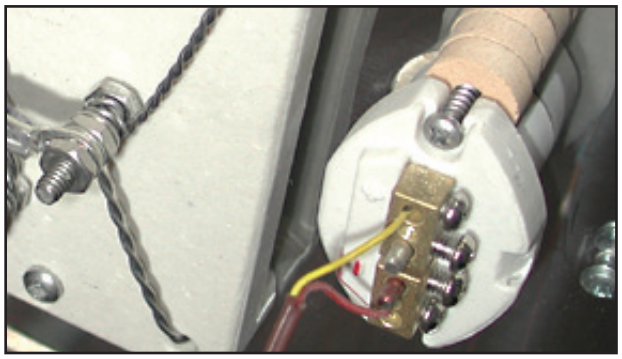
5) Remove Thermocouple.

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

Note - only some popular models are listed here. Check your wiring diagram for resistence values for your kiln.

Easy-Fire Element Ohm Chart

MODEL	VOLTS/ PHASE	ELEMENT OHMS	CIRCUIT OHMS
e18S-240	240/1	9.6	4.8
e18S-208	208/1	8.3	4.2
e18S-220	220/1 (non-US)	8.8	4.4
e18T-240	240/1	9.9	5.0
e18T-208	208/1	7.4	3.7
e18T-220	220/1 (non-US)	8.3	4.2
e18T-240-3P	240/3	9.9	5.0
e18T-208-3P	208/3	7.4	3.7
e18T-380-3P	380/3 (non-US)	8.3	4.2
e23S-240	240/1	23.5	11.8
e23S-208	208/1	20.0	10.0
e23S-220	220/1 (non-US)	21.5	10.8
e23T-240	240/1	28.9	14.5
e23T-208	208/1	25.0	12.5
e23T-220	220/1 (non-US)	26.5	13.3
e23T-240-3P	240/3	28.9	14.5
e23T-208-3P	208/3	22.7	11.4
e23T-380-3P	380/3 (non-US)	24.5	12.3
e28S-240	240/1	19.3	9.7
e28S-208	208/1	16.7	8.4
e28S-220	220/1 (non-US)	17.2	8.6
e28T-240	240/1	28.9	14.5
e28T-208	208/1	25.0	12.5
e28T-220	220/1 (non-US)	26.5	13.3
e28T-240-3P	240/3	20.0	10.0
e28T-208-3P	208/3	17.4	8.7
e28T-380-3P	380/3 (non-US)	15.1	7.6

School-Master Top Element Ohm Chart

MODEL	VOLTS/ PHASE	ELEMENT OHMS	CIRCUIT OHMS
SM23T-240	240/1	29.3	14.7

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SM23T-208	208/1	25.3	12.7
SM23T-220	220/1 (non-US)	26.8	13.4
SM23T-240-3P	240/1		
SM23T-208-3P	208/1	23.0	11.5
SM23T-380-3P	220/1 (non-US)	24.8	12.4
SM28T-240	240/1	29.3	14.7
SM28T-208	208/1	25.3	12.7
SM28T-220	220/1 (non-US)	26.8	13.4
SM28T-240-3P	240/3	20.2	10.1
SM28T-208-3P	208/3	17.6	8.8
SM28T-380-3P	380/3 (non-US)	18.8	9.4

School-Master Bottom Element Ohm Chart

MODEL	VOLTS/ PHASE	ELEMENT OHMS	CIRCUIT OHMS
SM23T-240	240/1	28.3	14.2
SM23T-208	208/1	24.5	12.3
SM23T-220	220/1 (non-US)	25.9	13.0
SM23T-240-3P	240/1		
SM23T-208-3P	208/1	22.2	11.1
SM23T-380-3P	220/1 (non-US)	24.0	12.0
SM28T-240	240/1	28.3	14.2
SM28T-208	208/1	24.5	12.3
SM28T-220	220/1 (non-US)	25.9	13.0
SM28T-240-3P	240/3	19.6	9.8
SM28T-208-3P	208/3	17.0	8.5
SM28T-380-3P	380/3 (non-US)	18.2	9.1

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***

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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

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Photo of a 1-phase control panel for a three section Easy-Fire kiln

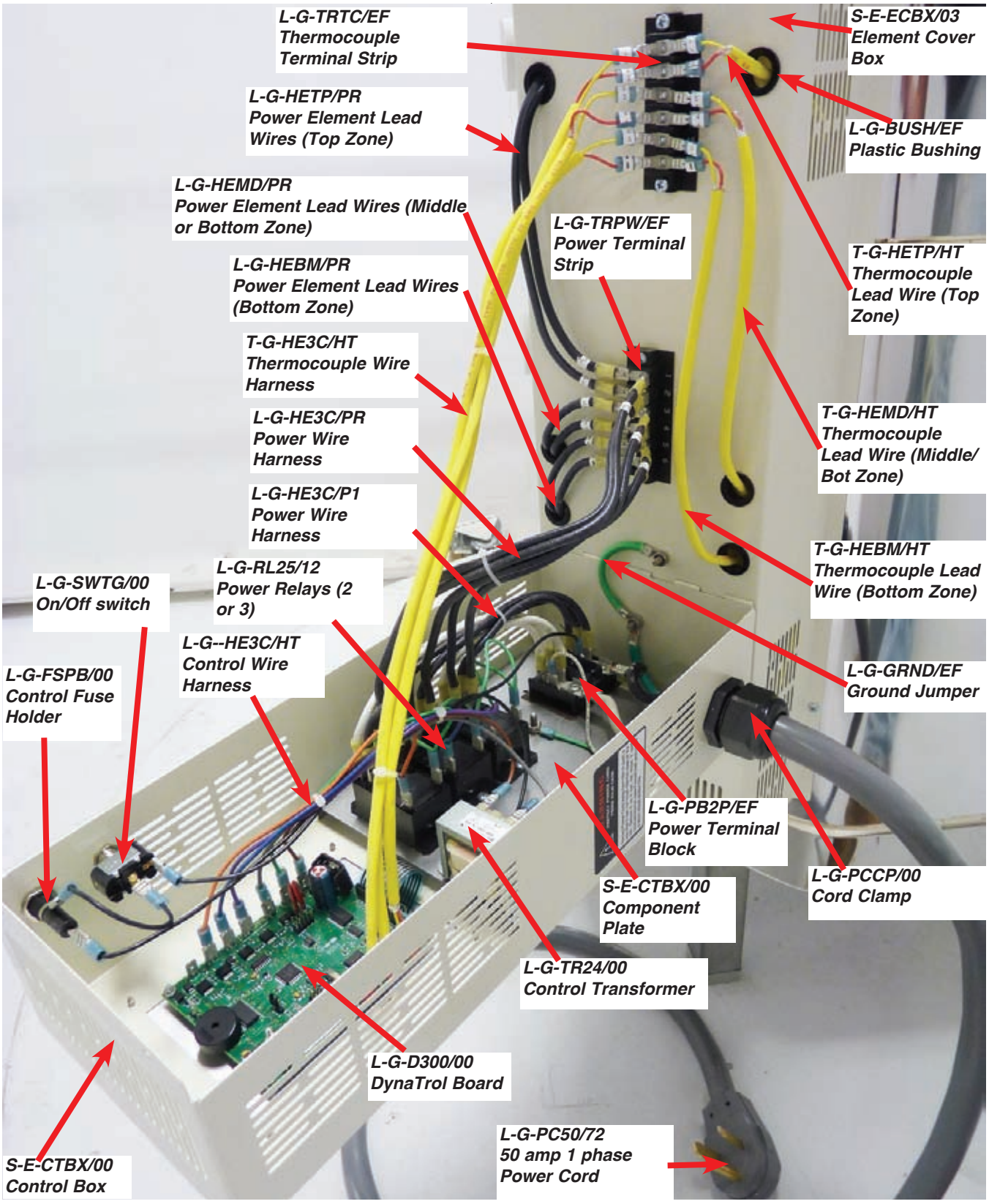

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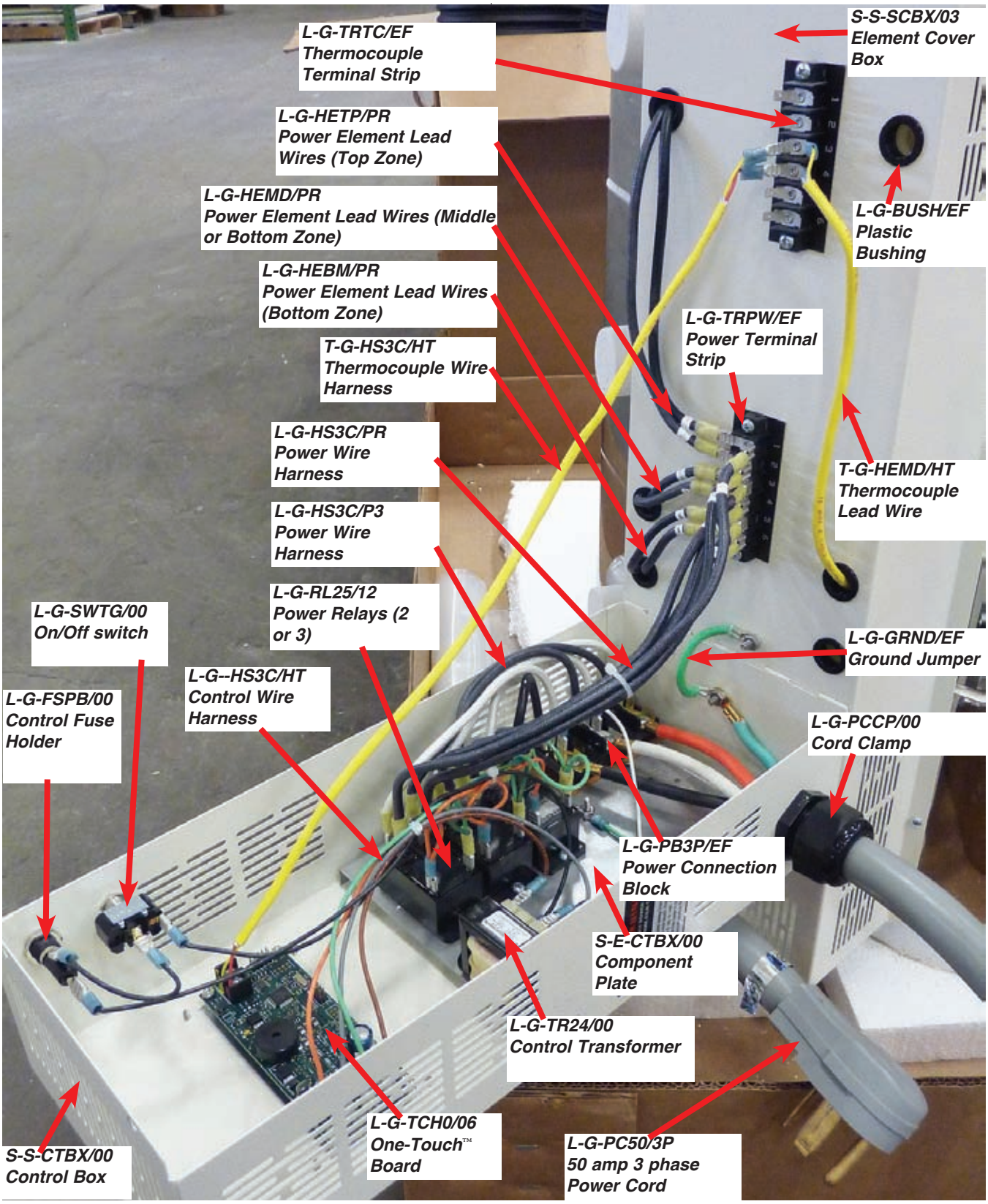
Photo of a 3-phase control panel for a three section School-Master kiln



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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.

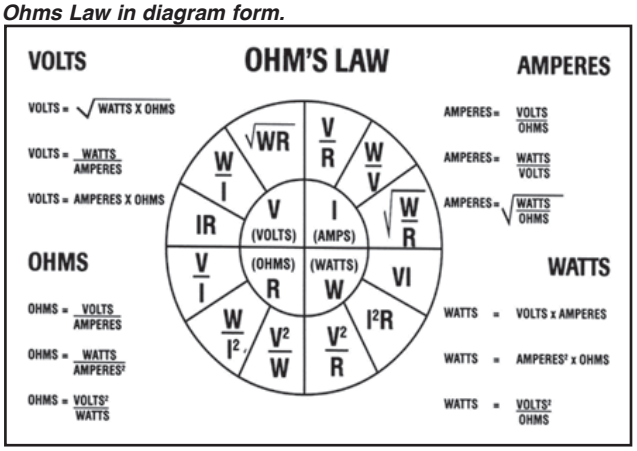
Amps = "I" (think "intensity of amperage")

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.



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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

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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:

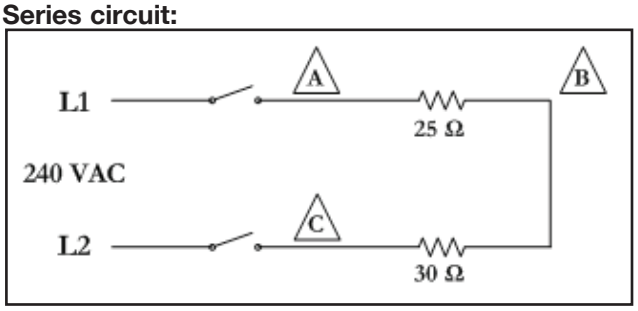
240 x (25Ω/55Ω) = 109 Volts.

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.

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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.

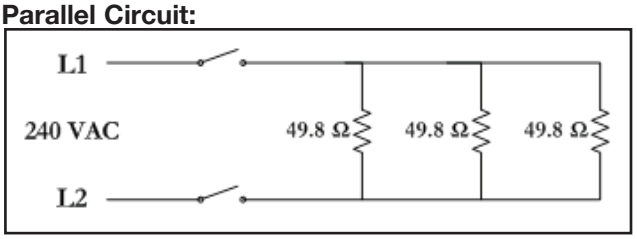
In this example, each element has a resistance of 49.8Ω. At 240 VAC, each element develops

(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 resistence on each element.

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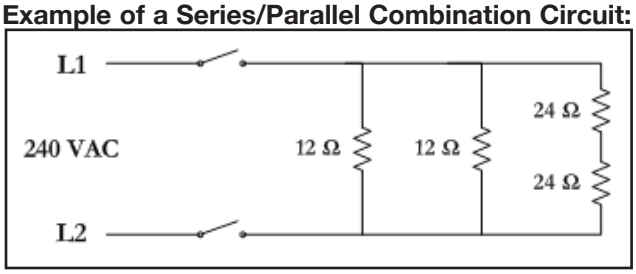
SERIES/PARALLEL or COMBINATION CIRCUITS

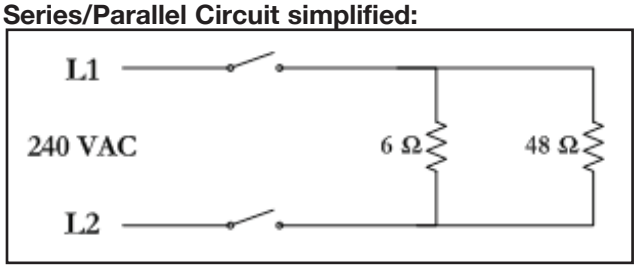
Certain circumstances require the use of Series/Parallel, or Combination circuits (in which series and parallel circuits are combined). In some front-loading kilns these circuits are used to combine, for instance, sidewall heating elements and backwall heating elements (often shorter than sidewall) in 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 Resistence = 1 / ((1 / R1) + (1 / R2) + (1 / R3))

Total Resistence = 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

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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.

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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:

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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

See this video: ***hotkilns.com/test-resistance-ez***

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

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 with #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

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per SECTION. See above for more info on understanding the readings.

Jupiter, Davinci

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.

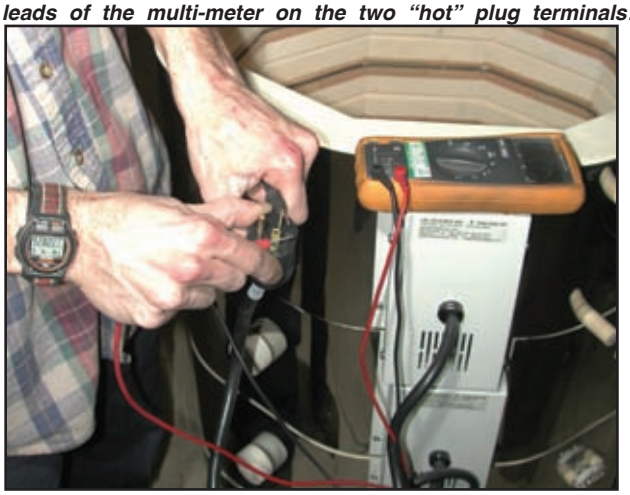
2. Unplug the first jumper cord from the control panel.

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, A J18 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. The picture illustrates this by having power come in via the top left terminal bolt, go through the top element to the right hand terminal bolt, through the bottom element and then back to the power source from the bottom left terminal bolt. This is the most typical series setup.

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. L&L's model J14 is a good example of this. It has two series circuits, wired in parallel. The model J230 is wired the same way, but its two series circuits are not as easy to recognize because each series circuit has only one element in it.

The J14, however, has series circuits with two elements in each one. Power still comes through the two wires inside the jumper cord, and goes to both ends of each circuit. At one of these ends, another wire, a 'jumper', conducts the electricity to the end of the other series circuit, which begins at the end of the first circuit so they can share one power wire. Thus, both series circuits get power at the same time, making them series-parallel circuits. What this does to the total resistance of the J14's element circuit is intriguing. If each element has 10 ohms, each series circuit has 20 ohms (2 elements multiplied by 10 ohms each). Two 20-ohm circuits wired in parallel equals 10 ohms total resistance, just like with one element, except now there are four.

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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.

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ELEMENT TROUBLESHOOTING & INSTALLATION INSTRUCTIONS

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:

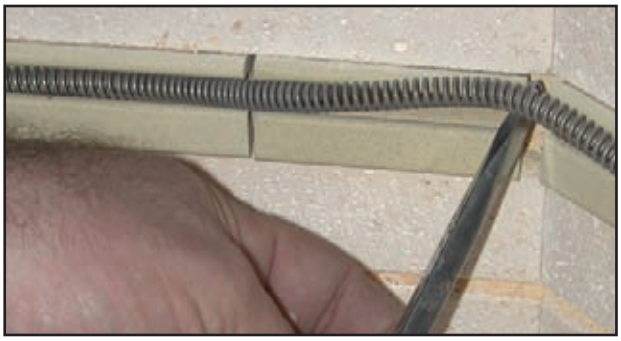
5) Cut the old elements off as close to the "through hole" on the outside of the kiln as possible. You want a straight element tail to pull through the through hole, not a crooked one.

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

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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 mulitmeter 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.

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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 needlenose 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.

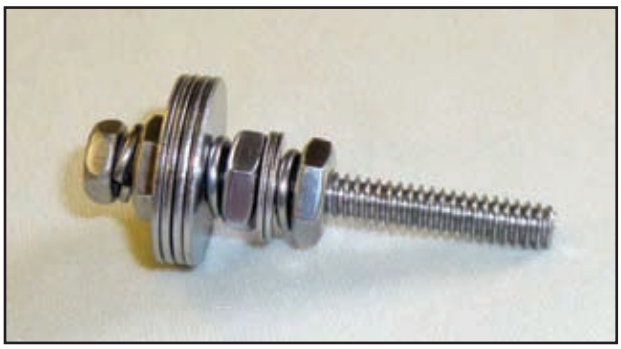
3) Pull them up tight up to the wall of the kiln by pulling from outside the kiln.

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

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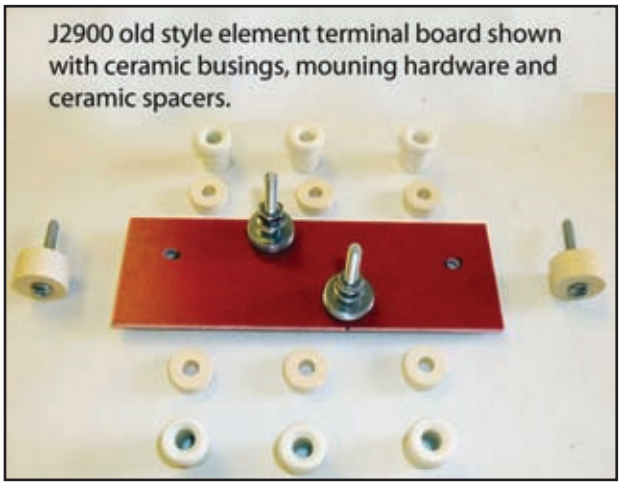
element connection bolt onto the element connection board. A tight connection is very important, but if you tighten too much and twist the element on the bolt too far you could break the element, the bolt, or the insulator.

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:

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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) Firebrick piece

(1) 1/8 pint of Phosphate Cement (in a ½ pint container)

(1) Quart container of Brick Dust

(1) ½ print Brick Facing

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 Phosphate 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.

CAUTION: PHOSPHATE CEMENT

The special cement that is used by itself and with the grout is a phosphorous based cement. It has unusually strong adhesive properties which makes it ideal for repair work. It is different from the cement we normally use for cementing our firebrick.

The phosphorus makes phosphoric acid. It is best to use rubber gloves. Be sure to wash your hands with soap and water immediately following your use. Phosphoric acid is very hazardous to your eyes. Protect your eyes with glasses.

BRICK REPAIRS

APPLICATION OF BRICK FACING/HARDENER

1) First brush and vacuum the surface of the brick clean to remove any loose material or crumbling firebrick.

2) Next wet the brick surface lightly. Use a paint brush or spray bottle (make sure there is no soap residue in the bottle).

3) Then apply a thin coat of the brick hardener with a soft 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 or sprayings on wet brick is enough.

4) Let the hardener dry for 24 hours.

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TROUBLESHOOTING AND FIXING BRICK PROBLEMS

5) Run the First Firing Cycle (See the OPERATION Section in your manual).

REPAIRING SMALL HOLES & CHIPS IN BRICK

1) Brush and vacuum the surface of the brick clean to remove any loose material or crumbling firebrick.

2) Next wet the brick surface lightly. Use a paint brush or spray bottle (make sure there is no soap residue in the bottle).

3) Apply a very thin coat of brick cement (no more than 1/3" to 1/6") all over the hole. Do this with your finger or a small brush.

4) 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 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.

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TROUBLESHOOTING AND FIXING BRICK PROBLEMS

This crack is OK:

TIGHTENING STAINLESS BANDS

See these videos:

hotkilns.com/replace-side-brick-kiln

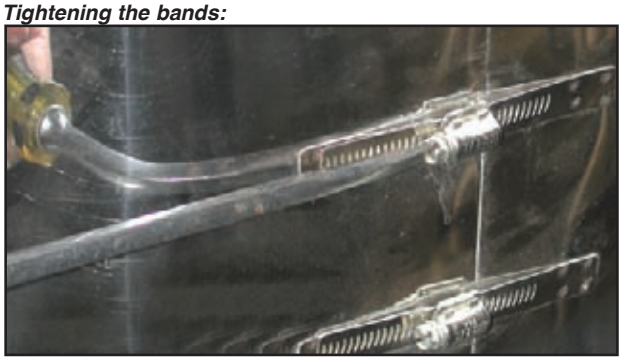
hotkilns.com/replace-side-brick-davinci

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

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TROUBLESHOOTING AND FIXING BRICK PROBLEMS

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.

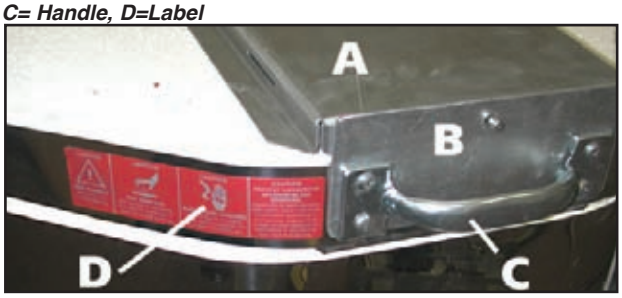
NOTE: You may want to experiment with using the old bottom as a secondary back up bottom if it is not too badly damaged. Just make sure it is totally flat so that it doesn't crack the new bottom. Some people find that having this extra insulation thickness helps firing times and bottom uniformity.

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.

A= Top Hinge Part, B= Front Hinge Part
C= Handle, D=Label



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.

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REPLACING SMALL NON-SPRING HINGE LIDS

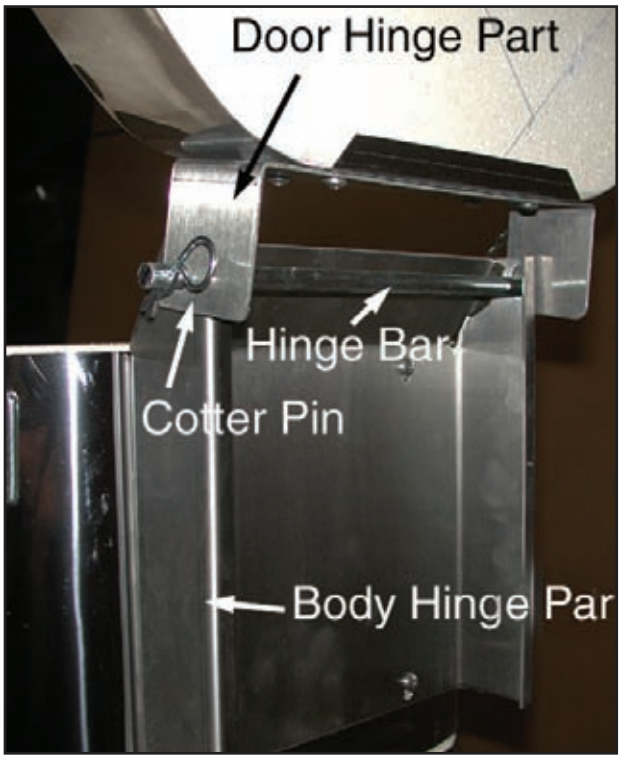
1) Remove one of the Cotter pins from the Hinge Bar.

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***

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HERCULES & EASY-LOAD INSTRUCTION MANUAL

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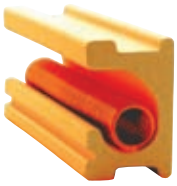

L&L Kiln's patented hard ceramic element holders protect your kiln.

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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 DISTRIBUTOR

Call your local distributor, 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 and exhibiting its problem when they test it. Sometimes it

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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

Distributors 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 distributor 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 distributor or dealer, subject to the following terms and conditions, including but not limited to, the exclusions and limitations set forth herein.

1) A sales receipt is 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. FAILURE 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.

4) On-site labor is not part of this warranty and is not covered by L&L. Any warranty labor provided by Dealers and Distributors is provided at their own discretion and expense.

APPLICATION

Applies to Easy-Fire, Easy-Fire XT, Jupiter, DaVinci, Easy-Load, Doll/Test, JH Series, Quad-Pro kilns, Fuego and Liberty-Belle kilns when used for non-industrial 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 Kiln Sitter, The Orton Sitter, the DynaTrol, One-Touch control, the Bartlett 3-Button 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.**

The Kiln Sitter, in particular, 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.

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.

4) 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.

5) Controls made by Orton (including the Orton Kiln Sitter), 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.

6) 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 environmental and

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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.

7) Damage due to neglect, inadequate room or kiln ventilation, mechanical abuse, improper storage, inadequate maintenance, improper use or freight damage.

8) 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.

9) 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 is rated for use up to 125°F (52°C). That means that the room that you fire in should be less than 110°F (43°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.

10) Failure to report defect within fifteen (15) days after it becomes manifest or known.

11) Any alteration of parts or design that vary from factory designs.

12) Thermocouple Protection Tubes are not warranted against breakage.

13) L&L's warranty is strictly limited to repair or replacement of defective items. Kilns may not be returned.

14) Distributors and Dealers 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.

15) 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.

16) 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 Purchase within one (1) year after delivery of the equipment to Purchaser.

17) 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 distributor's warehouse the date would be based on when it was shipped and/or sold from the distributor. The warranty is not extended for any period of where operation of the kiln is delayed for shipping, warehousing, or other reasons.

5) This replacement schedule is limited to new kilns. 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).

6) Labor to replace elements is not covered.

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STANDARD LIMITED THREE YEAR WARRANTY FOR L&L KILNS

7) 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.

PRO-RATED SCHEDULE FOR MOST 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 JH SERIES KILNS AND FOR ALL KILNS THAT DO NOT HAVE A VENT-SURE INSTALLED

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.

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 distributor or dealer. 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 distributors 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.

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HERCULES & EASY-LOAD INSTRUCTION MANUAL

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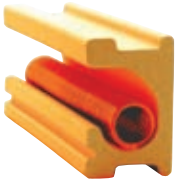

L&L Kiln's patented hard ceramic element holders protect your kiln.

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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 now be found on our website at,

hotkilns.com/parts

HOW TO SEARCH FOR PARTS

Use the "Kiln Series" Parts Filter to narrow down the list of available parts to those that pertain to your specific kiln.

Choose by Model Series (or Old Model Series): If you are unsure about what your kiln series is look at the serial number data nameplate on your kilns.

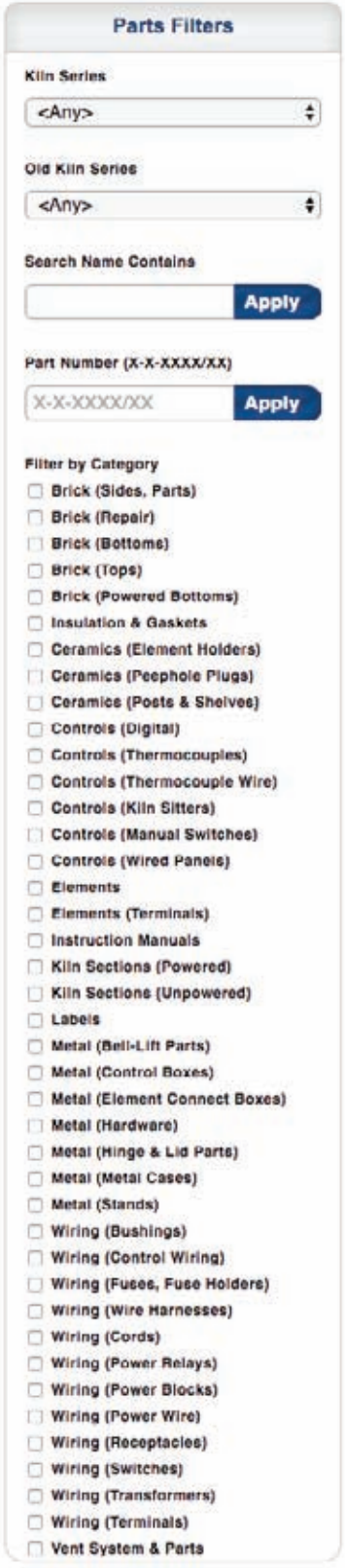
Choose by Search Name Contains: Note that the less text you use will yield more results.

Choose by Part Number (X-X-XXXX/XX): Fewer characters = more results. For instance put in M-A-____/__ and get every part number that starts with those letters.

Choose by Category: Pick the categories from the list as shown to the right.

DATA NAMEPLATE

This is a Data Nameplate that you will find on your kiln. Obtain the Serial Number, Model Number, Voltage, Phase, Amps and Watts and email to ***service@hotkilns.com*** for quicker better service.



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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: ☐ COD ☐ Purchase Order:_____
Purchase Orders must have preapproved credit with

CHARGE TO: ☐ Visa ☐ Mastercard

Card Account Number _____

Name on Card _____

Issuing Bank _____

Expiration Date _____

CSV (3 digit V-code on Card)_____

Customer Signature _____

To be filled out by L&L

Merchandise Total:		
6% sales tax for shipments to Pennsylvania: (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		

STANDARD DELIVERY & HANDLING CHARGES

Kiln Shelf kits, lids, and bottoms have a $38.00 packing charge plus common carrier shipping charges. Typical packing charge for small parts ranges from $3.00 to $25.00 depending on the physical size of the parts order. UPS or FedEx shipping charges are billed at cost. L&L will add the proper amount onto this order. See *hotkilns.com/ship.pdf* for more information on shipping.

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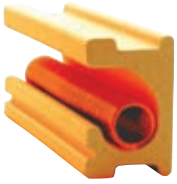
HERCULES & EASY-LOAD INSTRUCTION MANUAL

MSDS SHEETS



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

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L&L KILN COMPONENTS MATERIAL SAFETY DATA SHEETS

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PQ Corporation

MSDS

MATERIAL SAFETY DATA SHEET

Trade Name: **KASIL® 6 Potassium Silicate Solution**
Date Prepared: **07/26/06**

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product name:	**KASIL® 6 Potassium silicate solution**
Product description:	**A 2.10 weight ratio potassium silicate, 39.2% solution in water**
Manufacturer:	**PQ Corporation** **P. O. Box 840** **Valley Forge, PA 19482 USA**
Telephone:	**610-651-4200**
In case of emergency call:	**610-651-4200**
For transportation emergency Call CHEMTREC:	**800-424-9300**

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical and Common Name	*CAS Registry Number*	*Wt. %*	*OSHA PEL*	*ACGIH TLV*
Water	**7732-18-5**	**60.8%**	**Not Established**	**Not Established**
Silicic acid, potassium salt; Potassium silicate	**1312-76-1**	**39.2%**	**Not Established**	**Not Established**

3. HAZARDS IDENTIFICATION

Emergency Overview:	**Clear to hazy, colorless, odorless, thick liquid. Causes moderate eye irritation, slight skin irritation and digestive tract irritation. Spray mist causes irritation to respiratory tract. High pH of product is harmful to aquatic life. Noncombustible. Spills are slippery. Reacts with acids, ammonium salts, reactive metals and some organics.**
Eye contact:	**Causes moderate irritation to the eyes.**
Skin contact:	**Causes slight irritation to the skin.**
Inhalation:	**Spray mist irritating to respiratory tract.**
Ingestion:	**May cause irritation to mouth, esophagus, and stomach.**
Chronic hazards:	**No known chronic hazards. Not listed by NTP, IARC or OSHA as a carcinogen.**
Physical hazards:	**Dries to form glass film which can easily cut skin. Spilled material is very slippery. Can etch glass if not promptly removed.**

4. FIRST AID MEASURES

Eye:	**In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.**
Skin:	**In case of contact, immediately flush skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention.**
Inhalation:	**Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.**

Ingestion:	**If swallowed, DO NOT induce vomiting. Get medical attention immediately. If victim is fully conscious, give a cupful of water. Never give anything by mouth to an unconscious person.**

5. FIRE FIGHTING MEASURES

Flammable limits:	**This material is noncombustible.**
Extinguishing Media:	**This material is compatible with all extinguishing media.**
Hazards to fire-fighters:	**See Section 3 for information on hazards when this material is present in the area of a fire.**
Fire-fighting equipment:	**The following protective equipment for fire fighters is recommended when this material is present in the area of a fire: chemical goggles, body-covering protective clothing, chemical resistant gloves, and rubber boots.**

6. ACCIDENTAL RELEASE MEASURES

Personal protection:	**Wear chemical goggles, body-covering protective clothing, chemical resistant gloves, and rubber boots. See section 8.**
Environmental Hazards:	**Sinks and mixes with water. High pH of this material is harmful to aquatic life, see Section 12. Only water will evaporate from a spill of this material.**
Small spill cleanup:	**Mop up and neutralize liquid, then discharge to sewer in accordance with federal, state and local regulations or permits.**
Large spill cleanup:	**Keep unnecessary people away; isolate hazard area and deny entry. Do not touch or walk through spilled material. Stop leak if you can do so without risk. Prevent runoff from entering into storm sewers and ditches which lead to natural waterways. Isolate, dike and store discharged material, if possible. Use sand or earth to contain spilled material. If containment is impossible, neutralize contaminated area and flush with large quantities of water.**
CERCLA RQ:	**There is no CERCLA Reportable Quantity for this material. If a spill goes off site, notification of state and local authorities is recommended.**

7. HANDLING AND STORAGE

Handling:	**Avoid contact with eyes, skin and clothing. Avoid breathing spray mist. Keep container closed. Promptly clean residue from closures with cloth dampened with water. Promptly clean up spills.**
Storage:	**Keep containers closed. Store in clean steel or plastic containers. Separate from acids, reactive metals, and ammonium salts. Storage temperature 0-95º C. Loading temperature 45-95 º C. Do not store in aluminum, fiberglass, copper, brass, zinc or galvanized containers.**

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering controls:	**Use with adequate ventilation. Keep containers closed. Safety shower and eyewash fountain should be within direct access.**
Respiratory protection:	**Use a NIOSH-approved dust and mist respirator where spray mist occurs. Observe OSHA regulations for respirator use (29 C.F.R. §1910.134)**
Skin protection:	**Wear body-covering protective clothing and gloves.**
Eye protection:	**Wear chemical goggles.**

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	**Thick liquid.**
Color:	**Clear to hazy white.**
Odor:	**Odorless or musty odor.**
pH:	**Approximately 11.7**
Specific gravity:	**1.39 g/cm$_3$ (20ºC), 40.4º Bé, 11.56 lbs/gal**
Solubility in water:	**Miscible.**

10. STABILITY AND REACTIVITY

Stability:	**This material is stable under all conditions of use and storage.**
Conditions to avoid:	**None.**
Materials to avoid:	**Gels and generates heat when mixed with acid. May react with ammonium salts resulting in evolution of ammonia gas. Flammable hydrogen gas may be produced on contact with aluminum, tin, lead, and zinc.**
Hazardous decomposition products:	**Hydrogen.**

11. TOXICOLOGICAL INFORMATION

Acute Data:	**When tested for primary irritation potential, this material caused moderate irritation to the eyes and slight irritation to the skin. Human experience indicates that irritation occurs when potassium silicates get on clothes at the collar, cuffs or other areas where abrasion may occur. The acute oral toxicity of this product has not been tested. When chemically similar sodium silicates were tested on a 100% solids basis, their single dose acute oral LD_{50} in rats ranged from 1500 mg/kg to 3200 mg/kg. The acute oral lethality resulted from nonspecific causes. This product contains approximately 39.2% potassium silicate.**
Subchronic Data:	**The subchronic toxicity of this material has not been tested. In a study of rats fed chemically similar sodium silicate in drinking water for three months, at 200, 600 and 1800 ppm, changes were reported in the blood chemistry of some animals, but no specific changes to the organs of the animals due to potassium silicate administration were observed in any of the dosage groups. Another study reported adverse effects to the kidneys of dogs fed potassium silicate in their diet at 2.4g/kg/day for 4 weeks,**

whereas rats fed the same dosage did not develop any treatment-related effects. Decreased numbers of births and survival to weaning was reported for rats fed sodium silicate in their drinking water at 600 and 1200 ppm.

Special Studies: **The mutagenic potential of this material has not been tested. Chemically similar sodium silicate was not mutagenic to the bacterium E. Coli when tested in a mutagenicity bioassay. There are no known reports of carcinogenicity of potassium silicates. Frequent ingestion over extended periods of time of gram quantities of silicates is associated with the formation kidney stones and other siliceous urinary calculi in humans. Potassium silicate is not listed by IARC, NTP or OSHA as a carcinogen.**

12. ECOLOGICAL INFORMATION

Ecotoxicity: **The ecotoxicity of potassium silicate has not been tested. The following data is reported for chemically similar sodium silicates on a 100% solids basis: A 96 hour median tolerance for fish (Gambusia affnis) of 2320 ppm; a 96 hour median tolerance for water fleas (Daphnia magna) of 247 ppm; a 96 hour median tolerance for snail eggs (Lymnea) of 632 ppm; and a 96 hour median tolerance for Amphipoda of 160 ppm. This product contains approximately 39.2% potassium silicate.**

Environmental Fate: **This material is not persistent in aquatic systems, but its high pH when undiluted or unneutralized is acutely harmful to aquatic life. Diluted material rapidly depolymerizes to yield dissolved silica in a form that is indistinguishable from natural dissolved silica. It does not contribute to BOD. This material does not bioaccumulate except in species that use silica as a structural material such as diatoms and siliceous sponges. Where abnormally low natural silica concentrations exist (less than 0.1 ppm), dissolved silica may be a limiting nutrient for diatoms and a few other aquatic algal species. However, the addition of excess dissolved silica over the limiting concentration will not stimulate the growth of diatom populations; their growth rate is independent of silica concentration once the limiting concentration is exceeded. Neither silica nor potassium will appreciably bioconcentrate up the food chain.**

Physical/Chemical: **Sinks and mixes with water. Only water will evaporate from this material.**

13. DISPOSAL CONSIDERATIONS

Classification: **Disposed material is not a RCRA Hazardous waste.**

Disposal Method: **Dispose in accordance with federal, state and local regulations and permits.**

14. TRANSPORT INFORMATION

DOT UN Status: **This material is not regulated hazardous material for transportation.**

15. REGULATORY INFORMATION

CERCLA:	**No CERCLA Reportable Quantity has been established for this material.**
SARA TITLE III:	**Not an Extremely Hazardous Substance under §302. Not a Toxic Chemical under §313. Hazard Categories under §§311/312: Acute**
TSCA:	**All ingredients of this material are listed on the TSCA inventory.**
FDA:	**Potassium silicate is regarded as GRAS (Generally Recognized As Safe) as a corrosion preventative in potable water.**

16. OTHER INFORMATION

Prepared by:	**John G. Blumberg**
Supersedes revision of:	**03/24/06**

THE INFORMATION ON THIS SAFETY DATA SHEET IS BELIEVED TO BE ACCURATE AND IT IS THE BEST INFORMATION AVAILABLE TO PQ CORPORATION THIS DOCUMENT IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONS FOR HANDLING A CHEMICAL BY A PERSON TRAINED IN CHEMICAL HANDLING. PQ CORPORATION MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED WITH RESPECT TO SUCH INFORMATION OR THE PRODUCT TO WHICH IT RELATES, AND WE ASSUME NO LIABILITY RESULTING FROM THE USE OR HANDLING OF THE PRODUCT TO WHICH THIS SAFETY DATA SHEET RELATES. USERS AND HANDLERS OF THIS PRODUCT SHOULD MAKE THEIR OWN INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE INFORMATION PROVIDED HEREIN FOR THEIR OWN PURPOSES.

Thermal Ceramics

MATERIAL SAFETY DATA SHEET

MSDS No: 151-1	Date Prepared: 03/28/1995	Current Date: 9/14/2007 Last Revised: (09/14/2007)

1. PRODUCT AND COMPANY IDENTIFICATION

Product Group: **INSULATING REFRACTORY BRICK**
Chemical Name: Aluminosilicate Product
Intended Use: High Temperature Thermal Insulation
Trade Names: K-20, K-22 HS, K-23, JM-20, JM-23, K-24 HS, K-25, K-26, IFB Dust (Low Temp), TC-23, TC-23 HS

Manufacturer/Supplier:

Thermal Ceramics Inc.
P. O. Box 923; Dept. 300
Augusta, GA 30903-0923

For Product Stewardship and Emergency Information -
Hotline: 1-800-722-5681
Fax: 706-560-4054

For additional MSDSs and to confirm this is the most current MSDS for the product, visit our web page [*www.thermalceramics.com*]

2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT & CAS NUMBER	% BY WEIGHT	OSHA PEL	ACGIH TLV
Anorthite NONE	Up to 70	15 mg/m^3 (total dust) 5 mg/m^3 (respirable dust)	10 mg/m^3 (inhalable dust) 3 mg/m^3 (respirable dust)
Glass 65997-17-3	Up to 30	15 mg/m^3 (total dust) 5 mg/m^3 (respirable dust)	10 mg/m^3 (inhalable dust) 3 mg/m^3 (respirable dust)
Mullite 1344-28-1	Up to 20	15 mg/m^3 (total dust) 5 mg/m^3 (respirable dust)	10 mg/m^3 (inhalable dust) 3 mg/m^3 (respirable dust)
Crystalline silica 14808-60-7 or 14464-46-1	Up to 5	See notes[(1)]	0.05 mg/m^3 (respirable dust)

NOTES:

(1) Depending on the percentage and type(s) of silica in the mineral, the OSHA Permissible Exposure Limit (PEL) for respirable dust containing crystalline silica (8 HR TWA) is based on the formula listed in 29 CFR 1910.1000, "Air Contaminants" under Table Z-3, "Mineral Dust". For quartz containing mineral dust, the PEL = 10 mg/m³ / (% of silica + 2); for cristobalite or tridymite, the PEL = 5 mg/m³/ (% of silica + 2); for mixtures, the PEL = 10 mg/m³ / (% of quartz + 2 (% of cristobalite) + 2 (% of tridymite) + 2).

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines.)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

WARNING!
Respirable dust from these products may contain crystalline silica, which is known to cause respiratory disease.
(See Section 11 for more information)

POSSIBLE HEALTH EFFECTS

Target Organs:	Eyes, skin, nose and/or throat
Primary Entry Route:	Inhalation
Acute effects:	May cause temporary, mild mechanical irritation to the eyes, skin, nose and/or throat. Pre-existing skin and respiratory conditions may be aggravated by exposure.
Chronic effects:	Prolonged/repeated inhalation of respirable crystalline silica may cause delayed lung injury (e.g.: silicosis, lung cancer).

HAZARD CLASSIFICATION

Dust samples from these products have not been tested for their specific toxicity, but may contain more than 0.1% crystalline silica, for which the following apply:

The **International Agency for Research on Cancer (IARC)** has classified crystalline silica inhaled in the form of quartz or cristobalite from occupational sources as carcinogenic to humans (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.

The **American Conference of Governmental Industrial Hygienists (ACGIH)** has classified crystalline silica (quartz) as “A2-Suspected Human Carcinogen.”

The **State of California,** pursuant to Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986, has listed "silica, crystalline (airborne particles of respirable size)" as a chemical known to the State of California to cause cancer.

The **Canadian Workplace Hazardous Materials Information System (WHMIS) –** Crystalline silica [quartz and cristobalite] is classified as Class D2A - Materials Causing Other Toxic Effects.

The **Hazardous Materials Identification System (HMIS) –**
Health: 0* Flammability: 0 Reactivity: 0 Personal Protection Index: X (Employer determined)
(* denotes potential for chronic effects)

4. FIRST AID MEASURES

EYE IRRITATION:
Flush with large amounts of water for at least 15 minutes. Do not rub eyes.

SKIN IRRITATION:
Wash affected area gently with soap and water. Skin cream or lotion after washing may be helpful.

INGESTION:
Unlikely route of exposure.

INHALATION:
Remove affected person to dust free location. See Section 8 for additional measures to reduce or eliminate exposure.

- If symptoms persist, seek medical attention. -

5. FIRE FIGHTING MEASURES

NFPA CODES: **Flammability:** 0 , **Health:** 1 , **Reactivity:** 0 , **Special:** 0

NFPA Unusual Hazards: None
Flash Point: None
Extinguishing Media: Use extinguishing media suitable for type of surrounding fire.
Explosion Hazards: None
Hazardous Decomposition Products: None

6. ACCIDENTAL RELEASE MEASURES

SPILL/LEAK 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.

7. HANDLING AND STORAGE

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.

STORAGE

Store in original factory container in a dry area. Keep container closed when not in use.

EMPTY CONTAINERS

Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS

Use engineering controls, such as ventilation and dust collection devices, to reduce airborne particulate concentrations to the lowest attainable level.

RESPIRATORY PROTECTION

When it is not possible or feasible to reduce airborne crystalline silica or particulate levels below the PEL 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.

PROTECTIVE CLOTHING

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.).

EYE PROTECTION

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	Solid brick or block
CHEMICAL FAMILY:	Insulating refractory brick
BOILING POINT:	Not applicable
WATER SOLUBILITY (%):	Not soluble in water
MELTING POINT:	2750℉ to 2800℉
SPECIFIC GRAVITY:	Not applicable
VAPOR PRESSURE:	Not applicable
pH:	Not applicable
VAPOR DENSITY:	Not applicable
VOLATILE BY VOLUME (%):	Not applicable
MOLECULAR FORMULA:	Not Applicable

10. STABILITY AND REACTIVITY

HAZARDOUS POLYMERIZATION:	Will not occur
CHEMICAL INCOMPATIBILITIES:	Powerful oxidizers; fluorine, manganese trioxide, oxygen disulfide
HAZARDOUS DECOMPOSITION PRODUCTS:	None

11. TOXICOLOGICAL INFORMATION

TOXICOLOGY

Dust samples from these products have not been tested. They may contain respirable crystalline silica.

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.

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”.

12. ECOLOGICAL INFORMATION

Adverse effects of this material on the environment are not anticipated.

13. DISPOSAL INFORMATION

WASTE MANAGEMENT

To prevent waste materials becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended. Comply with federal, state and local regulations.

DISPOSAL

If discarded in its purchased form, this product would not be a hazardous waste under Federal regulations (40 CFR 261) Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under 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

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

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

INTERNATIONAL

Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train) or IMDG (ship).

15. REGULATORY INFORMATION

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.

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

SARA TITLE III HAZARD CATEGORIES

Acute Health:	No	**Pressure Hazard:**	No
Chronic Health:	Yes	**Reactivity Hazard:**	No
Fire Hazard:	No		

MSDS No: 151-1	Date Prepared: 03/28/1995	Current Date: 9/14/2007 Last Revised: (09/14/2007)

DEFINITIONS:

ACGIH:	American Conference of Governmental Industrial Hygienists
ADR:	Carriage of Dangerous Goods by Road (International Regulation)
CAA:	Clean Air Act
CAS:	Chemical Abstracts Service Registry Number
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act
EPA:	Environmental Protection Agency
EU:	European Union
f/cc:	Fibers per cubic centimeter
HEPA:	High Efficiency Particulate Air
HMIS:	Hazardous Materials Identification System
IARC:	International Agency for Research on Cancer
IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m^3 :	Milligrams per cubic meter of air
mppcf:	Million particles per cubic meter
MSHA:	Mine Safety and Health Administration
NFPA:	National Fire Protection Association
NIOSH:	National Institute for Occupational Safety and Health
OSHA:	Occupational Safety and Health Administration
PEL:	Permissible Exposure Limit
PNOC:	Particulates Not Otherwise Classified
PNOR:	Particulates Not Otherwise Regulated
RCRA:	Resource Conservation and Recovery Act
RID:	Carriage of Dangerous Goods by Rail (International Regulation)
SARA:	Superfund Amendments and Reauthorization Act
Title III:	Emergency Planning and Community Right to Know Act
…Section 302:	Extremely Hazardous Substances
…Section 304:	Emergency Release
…Section 311:	MSDS/List of Chemicals
…Section 312:	Emergency and Hazardous Inventory
…Section 313:	Toxic Chemicals Release Reporting
STEL:	Short-Term Exposure Limit
TCLP:	Toxicity Characteristics Leaching Procedures (EPA)
TLV:	Threshold Limit Values (ACGIH)
TSCA:	Toxic Substance Control Act
WHMIS:	Workplace Hazardous Materials Information System (Canada)
29 CFR 1910.134 & 1926.103:	OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59:	OSHA Hazard Communication Standards

Revision Summary: MSDS revision date updated.

MSDS Prepared By: 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 Material Safety Data Sheet. Employers may use this MSDS 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 MSDS. Therefore, given the summary nature of this document, 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.

Thermal Ceramics

MATERIAL SAFETY DATA SHEET

MSDS No: 141	Date Prepared: 05/01/1987	Current Date: 4/12/2006 Last Revised: (04/10/2006)

1. PRODUCT AND COMPANY IDENTIFICATION

Product Group: **REFRACTORY MORTAR**
Chemical Name: Aluminosilicate Product
Intended Use: High Temperature Thermal Insulation
Trade Names: Air-Set™ (Dry, Wet); Smooth-Set (Dry, Wet); High Temp: IFB (Dry, Wet); SR®-90 Dry; Mul-Set™ F (Dry, Wet); Unistik® A; K®-Bond (Dry, Wet); Cements; Cer-Flex® Mortars

Manufacturer/Supplier:

Thermal Ceramics Inc.
P. O. Box 923; Dept. 300
Augusta, GA 30903-0923

For Product Stewardship and Emergency Information -
Hotline: 1-800-722-5681
Fax: 706-560-4054

For additional MSDSs and to confirm this is the most current MSDS for the product, visit our web page [*www.thermalceramics.com*].

2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT & CAS NUMBER	% BY WEIGHT	OSHA PEL	ACGIH TLV
Aluminum silicate 1302-76-7	Up to 52	15 mg/m^3 (total dust); 5 mg/m^3 (respirable dust)	10 mg/m^3 (inhalable dust) 3 mg/m^3 (respirable dust)
Aluminum oxide 1344-28-1	Up to 50	15 mg/m^3 (total dust); 5 mg/m^3 (respirable dust)	10 mg/m^3
Silica, amorphous 7631-86-9	Up to 40	(80 mg/m^3 ÷ % SiO_2) or 20 mppcf	10 mg/m^3
Kaolin 1332-58-7	Up to 27	15 mg/m^3	2 mg/m^3 (respirable dust)
Crystalline silica 14808-60-7 or 14464-46-1	Up to 20	See notes[(1)]	0.05 mg/m^3 (respirable dust)
Water 7732-18-5	0 to 11	Not established	Not established
Borate, tetra, sodium salt, decahydrate 1303-96-4	0 to 2	15 mg/m^3 (total dust); 5 mg/m^3 (respirable dust)	5 mg/m^3

NOTES:

(1) Depending on the percentage and type(s) of silica in the mineral, the OSHA Permissible Exposure Limit (PEL) for respirable dust containing crystalline silica (8 HR TWA) is based on the formula listed in 29 CFR 1910.1000, "Air Contaminants" under Table Z-3, "Mineral Dust". For quartz containing mineral dust, the PEL = 10 mg/m³ / (% of silica + 2); for cristobalite or tridymite, the PEL = 5 mg/m³/ (% of silica + 2); for mixtures, the PEL = 10 mg/m³ / (% of quartz + 2 (% of cristobalite) + 2 (% of tridymite) + 2).

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines.)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

WARNING!

Respirable dust from these products may contain crystalline silica, which is known to cause respiratory disease. (See Section 11 for more information)

POSSIBLE HEALTH EFFECTS

Target Organs:	Eyes, skin, nose and/or throat
Primary Entry Route:	Inhalation
Acute effects:	May cause temporary, mild mechanical irritation to the eyes, skin, nose and/or throat. Pre-existing skin and respiratory conditions may be aggravated by exposure.
Chronic effects:	Prolonged/repeated inhalation of respirable crystalline silica may cause delayed lung injury (e.g.: silicosis, lung cancer).

HAZARD CLASSIFICATION

Dust samples from these products have not been tested for their specific toxicity, but may contain more than 0.1% crystalline silica, for which the following apply:

The **International Agency for Research on Cancer (IARC)** has classified crystalline silica inhaled in the form of quartz or cristobalite from occupational sources as carcinogenic to humans (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.

The **American Conference of Governmental Industrial Hygienists (ACGIH)** has classified crystalline silica (quartz) as "A2-Suspected Human Carcinogen."

The **State of California,** pursuant to Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986, has listed "silica, crystalline (airborne particles of respirable size)" as a chemical known to the State of California to cause cancer.

The **Canadian Workplace Hazardous Materials Information System (WHMIS) –** Crystalline silica [quartz and cristobalite] is classified as Class D2A - Materials Causing Other Toxic Effects.

The **Hazardous Materials Identification System (HMIS) –**
Health: 1* Flammability: 0 Reactivity: 0 Personal Protection Index: X (Employer determined)
(* denotes potential for chronic effects)

4. FIRST AID MEASURES

EYE IRRITATION:
Flush with large amounts of water for at least 15 minutes. Do not rub eyes.

SKIN IRRITATION:
Wash affected area gently with soap and water. Skin cream or lotion after washing may be helpful.

INGESTION:
Unlikely route of exposure.

INHALATION:
Remove affected person to dust free location. See Section 8 for additional measures to reduce or eliminate exposure.

- If symptoms persist, seek medical attention. -

5. FIRE FIGHTING MEASURES

NFPA CODES: **Flammability: 0 , Health: 1 , Reactivity: 0 , Special: 0**

NFPA Unusual Hazards:	None
Flash Point:	None
Extinguishing Media:	Use extinguishing media suitable for type of surrounding fire.
Explosion Hazards:	None
Hazardous Decomposition Products:	None

6. ACCIDENTAL RELEASE MEASURES

SPILL/LEAK 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.

7. HANDLING AND STORAGE

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.

STORAGE
Store in original factory container in a dry area. Keep container closed when not in use.

EMPTY CONTAINERS
Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS
Use engineering controls, such as ventilation and dust collection devices, to reduce airborne particulate concentrations to the lowest attainable level.

RESPIRATORY PROTECTION
When it is not possible or feasible to reduce airborne crystalline silica or particulate levels below the PEL 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.

PROTECTIVE CLOTHING

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.).

EYE PROTECTION

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	Concrete like material
CHEMICAL FAMILY:	Refractory mortar
BOILING POINT:	Not applicable
WATER SOLUBILITY (%):	Not soluble in water
MELTING POINT:	Up to 3200°F (depending on the product)
SPECIFIC GRAVITY:	Not applicable
VAPOR PRESSURE:	Not applicable
pH:	Not applicable
VAPOR DENSITY:	Not applicable
VOLATILE BY VOLUME (%):	Not applicable
MOLECULAR FORMULA:	Not Applicable

10. STABILITY AND REACTIVITY

HAZARDOUS POLYMERIZATION:	Will not occur
CHEMICAL INCOMPATIBILITIES:	Powerful oxidizers; fluorine, manganese trioxide, oxygen disulfide
HAZARDOUS DECOMPOSITION PRODUCTS:	None

11. TOXICOLOGICAL INFORMATION

TOXICOLOGY

Dust samples from these products have not been tested. They may contain respirable crystalline silica.

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.

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”.

12. ECOLOGICAL INFORMATION

Adverse effects of this material on the environment are not anticipated.

13. DISPOSAL INFORMATION

WASTE MANAGEMENT

To prevent waste materials becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended. Comply with federal, state and local regulations.

DISPOSAL

If discarded in its purchased form, this product would not be a hazardous waste under Federal regulations (40 CFR 261) Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under 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

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

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

INTERNATIONAL

Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train) or IMDG (ship).

15. REGULATORY INFORMATION

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.

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

SARA TITLE III HAZARD CATEGORIES

Acute Health:	No	**Pressure Hazard:**	No
Chronic Health:	Yes	**Reactivity Hazard:**	No
Fire Hazard:	No		

MSDS No: 141	Date Prepared: 05/01/1987	Current Date: 4/12/2006 Last Revised: (04/10/2006)

DEFINITIONS:

ACGIH:	American Conference of Governmental Industrial Hygienists
ADR:	Carriage of Dangerous Goods by Road (International Regulation)
CAA:	Clean Air Act
CAS:	Chemical Abstracts Service Registry Number
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act
EPA:	Environmental Protection Agency
EU:	European Union
f/cc:	Fibers per cubic centimeter
HEPA:	High Efficiency Particulate Air
HMIS:	Hazardous Materials Identification System
IARC:	International Agency for Research on Cancer
IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m^3 :	Milligrams per cubic meter of air
mppcf:	Million particles per cubic meter
MSHA:	Mine Safety and Health Administration
NFPA:	National Fire Protection Association
NIOSH:	National Institute for Occupational Safety and Health
OSHA:	Occupational Safety and Health Administration
PEL:	Permissible Exposure Limit
PNOC:	Particulates Not Otherwise Classified
PNOR:	Particulates Not Otherwise Regulated
RCRA:	Resource Conservation and Recovery Act
RID:	Carriage of Dangerous Goods by Rail (International Regulation)
SARA:	Superfund Amendments and Reauthorization Act
Title III:	Emergency Planning and Community Right to Know Act
…Section 302:	Extremely Hazardous Substances
…Section 304:	Emergency Release
…Section 311:	MSDS/List of Chemicals
…Section 312:	Emergency and Hazardous Inventory
…Section 313:	Toxic Chemicals Release Reporting
STEL:	Short-Term Exposure Limit
TCLP:	Toxicity Characteristics Leaching Procedures (EPA)
TLV:	Threshold Limit Values (ACGIH)
TSCA:	Toxic Substance Control Act
WHMIS:	Workplace Hazardous Materials Information System (Canada)
29 CFR 1910.134 & 1926.103:	OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59:	OSHA Hazard Communication Standards

Revision Summary: **Section 1:** Product Cer-Flex® added.

MSDS Prepared By: 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 Material Safety Data Sheet. Employers may use this MSDS 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 MSDS. Therefore, given the summary nature of this document, 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.

Printing date 05/12/2004 Reviewed on 06/12/2007

1 Identification of substance

· **Product details**

· **Trade name: GREENSET-94-P**

· **Manufacturer/Supplier:**
ANH Refractories Company
400 Fairway Drive
Moon Township, PA 15108

General Phone: (412)375-6600

· **Information department:** MSDS Technical Information: (412)375-6837
· **Emergency information:** CHEMTREC 24 HOUR EMERGENCY PHONE NUMBER: 1-800-424-9300.

2 Composition/Data on components

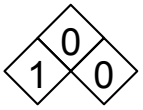
· **Chemical characterization**
· **Description:** Mixture of the substances listed below with nonhazardous additions.

· **Components:**		
1344-28-1	non-fibrous alumina	60-100%
7664-38-2	phosphoric acid	5-10%
13530-50-2	aluminum phosphate binder (as P2O5)	1-2.5%
1302-78-9	bentonite	1-2.5%
14808-60-7	crystalline silica (quartz)	0.1-0.5%

· **Additional information:** For the wording of the listed risk phrases refer to section 16.

3 Hazards identification

· **Hazard description:**
Toxic
· **Medical conditions aggravated by exposure to the product:** Asthma, chronic lung disease, and skin irritation.
· **Carcinogenicity Information:**
Crystalline silica is listed by IARC as a Group 1 Carcinogen "sufficient evidence of carcinogenicity in humans", and is listed by NTP as K, "Known To Be A Human Carcinogen".
· **Information pertaining to particular dangers for man and environment:**
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.
May cause cancer by inhalation.
Irritating to eyes, respiratory system and skin.
· **NFPA ratings (scale 0-4)**



Health = 1
Fire = 0
Reactivity = 0

(Contd. on page 2)

Trade name: GREENSET-94-P

(Contd. from page 1)

· **HMIS Classification**

HEALTH	1
FIRE	0
REACTIVITY	0

Health: 1
Flammability: 0
Reactivity: 0

4 First aid measures

· **After inhalation:** Move to fresh air; consult doctor if needed.
· **After skin contact:** Immediately wash with water and soap and rinse thoroughly.
· **After eye contact:** Flush eyes with water for 15 minutes. If irritation persists, consult a doctor.
· **After swallowing:**
This product is intended for industrial applications; in the unlikely event that this product is swallowed, consult a physician if any adverse medical conditions occur.

5 Fire fighting measures

· **Suitable extinguishing agents:** Use fire fighting measures that suit the environment.
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Person-related safety precautions:** Not required.
· **Measures for environmental protection:** No special measures required.
· **Measures for cleaning/collecting:**
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.

7 Handling and storage

· **Handling:**
· **Information for safe handling:**
Ensure good ventilation/exhaust at the workplace.
Prevent formation of dust.
· **Information about protection against explosions and fires:** No special measures required.

· **Storage:**
· **Requirements to be met by storerooms and containers:** No special requirements.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:** Store product inside, out of extreme weather conditions.

(Contd. on page 3)

(Contd. from page 2)

8 Exposure controls and personal protection

· **Components with limit values that require monitoring at the workplace:**

1344-28-1 non-fibrous alumina	
PEL	15*;5** mg/m³ *Total dust **Respirable fraction
TLV	10 mg/m³ (e)
7664-38-2 phosphoric acid	
PEL	1 mg/m³
REL	Short-term value: 3 mg/m³ Long-term value: 1 mg/m³
TLV	Short-term value: 3 mg/m³ Long-term value: 1 mg/m³
14808-60-7 crystalline silica (quartz)	
REL	0.05* mg/m³ *Respirable dust
TLV	0.05 R mg/m³

· **Personal protective equipment:**
· **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Wash hands before breaks and at the end of work.
Store protective clothing separately.
Avoid contact with the eyes and skin.
· **Breathing equipment:**

NIOSH approved respirators should be used if dust is present. A respiratory protection program should be implemented if exposures exceed OSHA PELs.

· **Protection of hands:**

Protective gloves recommended

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation
· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.
· **Penetration time of glove material**
The exact break trough time has to be found out by the manufacturer of the protective gloves and has to be observed.

(Contd. on page 4)

(Contd. from page 3)

· **Eye protection:** Safety glasses with side shields recommended

9 Physical and chemical properties

· **General Information**	
Form:	Solid
Color:	According to product specification
Odor:	No specific odor.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Auto igniting:**	Product is not selfigniting.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Density:**	Not determined.
· **Solubility in / Miscibility with**	
Water:	Insoluble.

10 Stability and reactivity

· **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
· **Dangerous reactions** No dangerous reactions known.
· **Dangerous products of decomposition:**
Refractories containing crystalline silica may, after service,contain more or less crystalline silica. Care must be taken to avoid and/or control dust from demolition. If in doubt of the proper protection, seek advice from a safety professional.

11 Toxicological information

· **Acute toxicity:**
· **Primary acute effects:**
· **Skin contact:** Irritant to skin and mucous membranes.
· **Eye contact:** Irritating effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
The product shows the following dangers according to internally approved calculation methods for preparations:
Irritant
Carcinogenic if inhaled.

(Contd. on page 5)

(Contd. from page 4)

12 Ecological information

· **General notes:** At present there are no ecotoxicological assessments.

13 Disposal considerations

· **Recommendation for Disposal of Product:**
As sold, this product is not RCRA hazardous. Final used condition must be evaluated prior to disposal. Dispose of waste product in accordance with Federal, State and Local regulations.
Dust created during demolition of used product may contain crystalline silica.

· **Recommendation for Disposal of Uncleaned Packaging:** Reuse, recycle or treat as industrial waste.

14 Transport information

· **Transport/Additional information:** Not dangerous according to available information.

15 Regulations

· **SARA 313 TOXIC CHEMICALS**

No material listed in the components in Section 2 of this MSDS is on the SARA 313 list.

· **SARA 302 EXTREMELY HAZARDOUS SUBSTANCES**

No material listed in the components in Section 2 of this MSDS is on the SARA 302 list.

· **TSCA (Toxic Substances Control Act)**
This substance or all the ingredients of this product are on the Chemical Substances Inventory of the Toxic Substances Control Act (TSCA Inventory). The presence on this list does not require any legal reporting.

· **WHMIS Classification**
Class D - Division 2 - Sub Division A
Untested mixture containing a very toxic material
Class D - Division 2 - Sub Division B
Untested mixture containing a toxic material
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

· **Cancerogenity categories**

· **EPA (Environmental Protection Agency)**

None of the ingredients is listed.

· **IARC (International Agency for Research on Cancer)**

14808-60-7	crystalline silica (quartz)	1

· **NTP (National Toxicology Program)**

14808-60-7	crystalline silica (quartz)	R

· **TLV (Threshold Limit Value established by ACGIH)**

1344-28-1	non-fibrous alumina	A4
14808-60-7	crystalline silica (quartz)	A2

(Contd. on page 6)

(Contd. from page 5)

· **MAK (German Maximum Workplace Concentration)**		
1344-28-1	non-fibrous alumina	2
14808-60-7	crystalline silica (quartz)	1

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**	
14808-60-7	crystalline silica (quartz)

· **OSHA-Ca (Occupational Safety & Health Administration)**
None of the ingredients is listed.

· **Classification according to EU-guidelines**

· **Hazard symbols:**
Toxic

· **Hazard-determining components of labeling:**
crystalline silica (quartz)

· **Risk phrases:**
May cause cancer by inhalation.
Irritating to eyes, respiratory system and skin.

· **Safety phrases:**
When using do not eat or drink.
Do not breathe dust.
Avoid contact with eyes.
In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
After contact with skin, wash immediately with plenty of soap and water
Wear suitable protective clothing and gloves.
In case of accident or if you feel unwell, seek medical advice immediately.

· **National regulations:**

· **The following ingredients are known in the state of California to be a cancer risk (Proposition 65):**	
14808-60-7	crystalline silica (quartz)

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Contact:** Patricia A. Kott 412-375-6712
· **Creation date:** 08/14/2000

IMERYS

100 Mansell Court East, Suite 300; Roswell, GA 30076
Telephone (770) 594-0660 Fax: (770) 645-3384
Customer Service: (800) 251-6327

MATERIAL SAFETY DATA SHEET

Section 1 - Material Identity

Product Trade Name(s): 6-Tile
Common Names(s): Kaolin Clay, China Clay
Chemical Name: Kaolin
CAS Number: 1332-58-7 (In TSCA Inventory)
Physical Form: White Powder

HMIS Ratings	
Health Hazard	1
Flammability Hazard	0
Reactivity Hazard	0
Max. Personal Protection	E

Manufacturer's Name & Address: IMERYS Pigments & Additives Group, 100 Mansell Court East, Suite 300; Roswell, GA 30076
Emergency Telephone: (800) 424-9300 CHEMTREC

Section 2 - Ingredients and Hazards

Ingredient	Wt. % (Approx.)	CAS No.	OSHA PEL*	ACGIH TLV*
Kaolin - $Al_2Si_2O_5(OH)_4$	> 98%	1332-58-7	5 mg/m^3 Resp. 15 mg/m^3 Total	2 mg/m^3 Resp. --
Crystalline Silica, Quartz	> 0.1% - ~1%	14808-60-7	0.1 mg/m^3 Resp.	0.05 mg/m^3 Resp.
Water	< 2%			

* Unless otherwise noted, all PEL and TLV values are reported as 8 hour time weighted averages (TWA).

Section 3 - Hazards Identification and Cautions

Appearance: White Powder
Primary Routes of Entry: Skin contact, skin absorption, eye contact, ingestion: Hazard Classification - None. (Historical basis for classification.)
Target Organs: Eye, skin and lungs
Medical Conditions Aggravated by Exposure: Skin contact may aggravate existing dermatitis. Breathing excessive quantities of kaolin dust may aggravate pre-existing respiratory conditions.

Potential Health Effects:

Eye Contact: This product may produce irritation upon contact with the eye. See also Section 4 below.
Skin Contact: Prolonged or repeated exposure may cause skin irritation. Kaolin is not expected to be absorbed through the skin in harmful amounts or to produce an allergic skin reaction. See also Section 4 below.
Ingestion: No adverse effect is expected. If ingested, seek medical advice. See also Section 4 below.
Inhalation: Inhalation of excessive quantities of kaolin dust may irritate the respiratory tract. Prolonged exposure to respirable kaolin dust without use of appropriate respiratory equipment could adversely affect respiratory function including fibrogenic response. See Am. Rev. Respir. Dis. 1983; 127:215-220; 231-253; 141-142; Doc. Thres. Limit Values and Bio. Exp. Ind., Sixth Edition, 1991: OSHA PEL-29 C.F.R. 1910.1000.
Subchronic, Chronic: None expected. No applicable information was found concerning any potential health effects resulting from subchronic or chronic exposure to kaolin.

This product typically contains crystalline silica (quartz sand) above 0.1% as a naturally occurring impurity. The International Agency for Research on Cancer has concluded that "crystalline silica inhaled in the form of quartz or

cristobalite from occupational sources is carcinogenic to humans (Group 1)." It also noted that carcinogenicity was not detected in all industrial circumstance studies, and may be dependent on external factors affecting its biological activity or distribution of its polymorphs. (See IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 68 (1997).) Exposure to respirable silica has also been associated with silicosis, scleroderma, and nephrotoxicity. (See Occupational Lung Disorders, Third Edition, Chapter 12 (1994) and American Journal of Respiratory and Critical Care Medicine, Volume 155, pp 761-765 (1997).)

Section 4 - First Aid Measures

Eye Contact: Follow good industrial hygiene practices. In case of contact, immediately flush eyes with plenty of water. Seek medical aid if necessary.

Skin Contact: Follow good industrial hygiene practices. Wash affected skin areas thoroughly with soap and water. Seek medical aid if necessary.

Inhalation: Follow good industrial hygiene practices. If excessive exposure by inhalation is suspected, remove to fresh air. If necessary, a MSHA/NIOSH or OSHA/NIOSH approved respirator is recommended. Seek medical aid if necessary.

Ingestion: Follow good industrial hygiene practices. If ingested, do not induce vomiting. If conscious, drink two glasses of water. Seek medical aid if necessary.

Section 5 - Fire Fighting Measures

Explosion Data: Not Explosive
LEL: Not Applicable
UEL: Not Applicable
Extinguishing Media: Product will not burn.
NFPA 704M Hazard Classification: Health: 1 Flammable: 0 Reactivity: 0

Flammability: Not Flammable or Combustible
Flash Point: Not Applicable
Auto-Ignition: Not Applicable

Use appropriate extinguishing media for packaging material if applicable.

Section 6 - Accidental Release Measures

Vacuum, pump or scoop spilled material into containers for reclaiming or disposal. Use proper respiratory and personal protective equipment. MSHA/NIOSH or OSHA/NIOSH approved respirator recommended. Spilled materials may cause slippery conditions when wet. Care should be exercised when walking on spills on floors or concrete pads. No neutralizing chemicals required. Material is inert and nonreactive. Kaolin is not a CERCLA listed hazardous substance.

Section 7 - Handling and Storage

Storage in a cool, dry location is recommended.
Spilled materials may cause slippery conditions when wet. Care should be exercised when walking on spills on floors or concrete pads.
Minimize dust generation & accumulation.
If excessive dust is generated, provide adequate ventilation and use proper respiratory and personal protective equipment.
MSHA/NIOSH or OSHA/NIOSH approved respirator recommended

Section 8 - Exposure Control/Personal Protection

Hazardous Ingredient	Weight %(Approx.)	CAS No.	MSHA PEL	OSHA PEL	ACGIH TLV
		1332-58-7	10mg/cu.m. Total	15mg/cu.m. Total 5 mg/cu.m. Resp.	2 mg/cu.m. Respirable
Crystalline Silica, Quartz	> 0.1% - ~1%	14808-60-7	0.1 mg/m3 Resp	0.1 mg/m^3 Resp.	0.05 mg/m^3 Resp.

Unless otherwise noted, all PEL and TLV values are reported as 8 hour time weighted averages (TWA).

Respiratory Protection: If respirator is required, use of a MSHA/NIOSH or OSHA/NIOSH approved respirator is recommended.
Ventilation: Use exhaust ventilation, if required, to maintain dust concentration below recommended exposure limits.
Protective Equipment: Wear side shield safety glasses. Rubber gloves are recommended for prolonged exposure.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance & Odor: Odorless, white powder
pH (Aqueous Suspension): 4.0 - 6.0
Specific Gravity: ~2.6
% Solubility in Water: Insoluble

Boiling Point: Not Applicable
Freezing Point: Not Applicable
Vapor Pressure: Not Applicable
Vapor Density: Not Applicable
VOC: None

Melting Point: Not Determined, > 1500°C **Evaporation Rate:** Not Applicable

Section 10 - Stability and Reactivity

Chemically Stable? Yes _X_ No___ Inert and nonreactive.
Compatible with Other Substances? Yes _X_ No ___ Inert and nonreactive.
Hazardous Decomposition/By-Products: No hazardous decomposition or by-products expected. Inert and nonreactive.
Conditions Contributing to Hazardous Polymerization: None, inert and nonreactive.

Section 11 - Disposal Considerations

EPA Waste Number: Under RCRA (40 CFR 261) kaolin is a non-hazardous waste. Dispose of waste material in accordance with all local, state and federal requirements.

Section 12 - Toxicological Information

kaolin - CAS No. 1332-58-7
Primary Route of Exposure: _X_ Skin; _X_ Eye Contact; _X_ Inhalation; ___ Ingestion

Acute Health Hazards:
Eye contact may cause mechanical irritation if exposed to excessive amounts of kaolin.
Skin contact may aggravate existing dermatitis.
Inhalation from prolonged and continuous exposure to excessive quantities of dust may aggravate existing asthmatic or respiratory conditions.
No adverse effect expected when ingested.

Chronic Health Hazards:
Prolonged inhalation of excessive levels of kaolin dust may cause a simple pneumoconiotic condition, not normally associated with a decrement in lung function. In cases of long term exposure to extremely high levels of dust, complicated pneumoconiosis with lung function impairment may occur.

Carcinogenicity*: NTP? No IARC? No OSHA? No

Mutagenicity: None known **Teratogenicity:** None known **Reproductive Effects:** None known

* See Section 3 for discussion of crystalline silica.

Section 13 - Transport Information

EPA Waste Number: Not Regulated
DOT Classification: Not Regulated **DOT/IMO Classification:** Not Regulated
Internal UN: Not Regulated

Section 14 - Regulatory Information

FDA: Kaolin is as generally recognized as safe (GRAS) under the FDA in accordance with 21 CFR 186.1256. Additionally, kaolin is established as a component of the uncoated or coated food-contact surface of paper and paperboard in accordance with 21 CFR 176.170 (aqueous and fatty foods) and 21 CFR 176.180 (dry foods).

SARA Title III Section 302 Extremely Hazardous Substances: This product does not contain extremely hazardous substances subject to the reporting requirements of Section 302 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 355.
SARA Title III Section 311 and 312 Health and Physical Hazard Categories per 40 CFR 370.2:

Immediate	Delayed	Fire	Pressure	Reactivity
Yes	Yes	No	No	No

SARA Section 313 Notification: This product does not contain toxic chemicals subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

TSCA: Product is listed in Initial Inventory, Vol. 1, Appendix A, CAS No. 1332-58-7.

The International Agency for Research on Cancer has concluded that "crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group I)." It also noted that carcinogenicity was not detected in all industrial circumstance studies, and may be dependent on external factors affecting its biological activity or distribution of its polymorphs. (See IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 68 (1997).) Exposure to respirable silica has also been associated with silicosis, scleroderma, and nephrotoxicity. (See Occupational Lung Disorders, Third Edition, Chapter 12 (1994) and American Journal of Respiratory and Critical Care Medicine, Volume 155, pp 761-765 (1997).)

WARNING: This product may also contain extremely small amounts of one or more naturally-occurring materials known to the State of California to cause cancer, birth defects, or other reproductive harm.

While this information and recommendations set forth herein are believed to be accurate as of the date hereof, IMERYS PIGMENTS & ADDITIVES GROUP MAKES NO WARRANTY, EXPRESS OR IMPLIED, WITH RESPECT HERETO

AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.

IMERYS is a business name of IMERYS Pigments, Inc., IMERYS Kaolin, Inc. and IMERYS Marble, Inc. Registered in the USA. Registered Office: 100 Mansell Court East, Suite 300, Roswell, GA 30076.

Date Prepared: 07/27/82
Revised: 06/2000

MSDS Number: **A2796** * * * * * *Effective Date:* ***11/09/06*** * * * * * *Supercedes:* ***02/12/04***

This material is used in the Cone 10 Kiln Wash

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300
National Response in Canada
CANUTEC: 613-996-6666
Outside U.S. And Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

Aluminum Hydroxide

1. Product Identification

Synonyms: Aluminum hydrate; Aluminum trihydrate; Hydrated alumina
CAS No.: 21645-51-2
Molecular Weight: 78.00
Chemical Formula: Al(OH)3
Product Codes: 0518

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Aluminum Hydroxide	21645-51-2	98 - 100%	Yes

3. Hazards Identification

Emergency Overview

WARNING! CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; PROPER GLOVES
Storage Color Code: Green (General Storage)

Potential Health Effects

Inhalation:
Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath.
Ingestion:
Not expected to be a health hazard via ingestion.
Skin Contact:
Not expected to be a health hazard from skin exposure.
Eye Contact:
Causes irritation, redness, and pain.
Chronic Exposure:
Repeated exposure may cause symptoms similar to those listed for acute effects. Prolonged contact with skin may result in minor mechanical irritation.
Aggravation of Pre-existing Conditions:
No information found.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Not expected to require first aid measures. If large amounts were swallowed, give water to drink and get medical advice.
Skin Contact:
Wash exposed area with soap and water. Get medical advice if irritation develops.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
None established.
Ventilation System:
In general, dilution ventilation is a satisfactory health hazard control for this substance. However, if conditions of use create discomfort to the worker, a local exhaust system should be considered.
Personal Respirators (NIOSH Approved):
For conditions of use where exposure to dust or mist is apparent and engineering controls are not feasible, a particulate respirator (NIOSH type N95 or better filters) may be worn. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
White Powder.
Odor:
Odorless.
Solubility:
Practically insoluble in water.
Specific Gravity:
2.42
pH:
> 7 (Basic).
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
No information found.

Melting Point:
300C (572F)
Vapor Density (Air=1):
Not applicable.
Vapor Pressure (mm Hg):
Not applicable.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Aluminum hydroxide forms a gel on prolonged contact with water; absorbs acids and carbon dioxide.
Hazardous Decomposition Products:
May produce oxides of aluminum.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong acids, strong oxidizers. Aluminum hydroxide can react dangerously with bismuth.
Conditions to Avoid:
Moisture and incompatibles.

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Aluminum Hydroxide (21645-51-2)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Aluminum Hydroxide (21645-51-2)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Aluminum Hydroxide (21645-51-2)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Aluminum Hydroxide (21645-51-2)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Aluminum Hydroxide (21645-51-2)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **1** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
WARNING! CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT.
Label Precautions:
Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.
Avoid breathing dust.
Keep container closed.
Use only with adequate ventilation.
Label First Aid:
In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes. Remove material from skin and clothing. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 3.
Disclaimer:
****
Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
****
Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

HMIS RATING
HEALTH - - - - - - - - - - - - - 1
FLAMMABILITY - - - - - - - - - 0
REACTIVITY - - - - - - - - - - 0
PERSONAL PROTECTION - E

Material Safety Data Sheet

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY *(As Used on Label and List)*
HALTEX® Alumina Trihydrate (all grades)

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

Section I

Manufacturer's Name **TOR Minerals International**	Emergency Telephone Number **361/883-5591**
Address *(Number, Street, City, State, and ZIP Code)* **722 Burleson Street (Plant)**	Telephone Number for Information **361/883-5591**
Corpus Christi, TX 78402	Date Prepared **January 2006**
	Signature of Preparer *(optional)*

Section II - Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% *(optional)*
Aluminium Trihydrate ($Al(OH)_3$)	**10 mg/m³ (dust)**	**10 mg/m³ (dust)**		**100.0%**
(CAS No. 21645-51-2)				

(These are typical quantities and may change slightly with different lots.)

Section III - Physical/Chemical Characteristics

Boiling Point	**2980 ± 60**	Specific Gravity (H_2O = 1)	**2.38 - 2.42**
Vapor Pressure (mm Hg.)	**N/A**	Melting Point	**2015 ± 15**
Vapor Density (AIR = 1)	**N/A**	Evaporation Rate (Butyl Acetate = 1)	**N/A**
Solubility in Water	**Insoluble**		
Appearance and Odor	**Fine white powder with no odor.**		

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used)	**Non-flammable**	Flammable Limits	**N/A**	LEL **N/A**	UEL **N/A**
Extinguishing Media	**As appropriate for surrounding combustibles. Does not burn or support combustion.**				
Special Fire Fighting Procedures	**Fire fighters should wear self-contained breathing apparatus.**				
Unusual Fire and Explosion Hazards	**No fire or explosion hazard.**				

Section V - Reactivity Data

Stability	Unstable		Conditions to Avoid: None in normal or expected use
	Stable	X	
Incompatibility *(Material to Avoid)*	None Known		
Hazardous Decomposition or Byproducts	None in normal or expected use		
Hazardous Polymerization	May Occur		Conditions to Avoid: None in normal or expected use
	Will Not Occur	X	

Section VI - Health Hazard Data

Route(s) of Entry: Primary — Inhalation? Yes — Skin? No — Eye ? Yes — Ingestion? Yes

Health Hazards *(Acute and Chronic)*
Hydrated Alumina is environmentally safe and is not regulated under RCRA. None of the components are on the EPA list of Extremely Hazardous Substances. However, high exposure to Alumina dust may produce irritation to the eyes and respiratory system.

Carcinogenicity: None known. — NTP? N/A — IARC Monographs? N/A — OSHA Regulated? N/A

Signs and Symptoms of Exposure
Inhalation of dust may cause mechanical irritation of the respiritory tract. Skin and eye contact may cause mechanical abrasion - irritation.

Medical Conditions Generally Aggravated by Exposure
Pre-existing upper respiritory and lung diseases such as, but not limited to , brochitis, emphysema, and asthma.

Emergency and First Aid Procedures
Eye contact: Flush eye with generous amounts of water for 15 min., consult a physician.
Inhalation: Remove to fresh air. **Skin contact**: Wash from skin with soap and water. **Ingestion**: Consult a physician.

Section VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled
Prevent spread of material and keep dust level down. Scoop up material or use vacuum technique and place in closed container.

Waste Disposal Method
Disposal must be made in accordance with Federal, State, and Local regulations, and pursuant to 40 CFR p. 261 of RCRA regulations currently in effect. Discarded hydrated alumina would not be classified as hazardous waste.

Precautions to Be Taken in Handling and Storing
Handle and keep in dry building area. Avoid handling methods which cause dusting. Avoid breathing dust. Use ventilation that will maintain exposure below recommended TLV. Wear goggles and use NIOSH/MSHA approved respirator. Wash thoroughly after handling.

Other Precautions: No special requirements. Use good, acceptable industrial hygene practices.

Section VIII - Control Measures

Respiratory Protection *(Specify Type)*: **Use NIOSH approved respirator in accordance with air contaminant standard.**

Ventilation	Local Exaust: Provide local system.		Special
	Mechanical *(General)*: Is recommemded for potentially dusty conditions.		Other

Protective Gloves: No special requirement, ordinary work type.
Eye Protection: Safety glasses or vented goggles.

Other Protective Clothing or Equipment: No special requirement, ordinary work clothes.

Work/Hygienic Practices
Good industrial hygiene practices. Wash thoroughly with soap and water before eating, drinking, or using tobacco products.

The information herein is believed to be correct and reliable. However no warranty is expressed or implied regarding the accuracy of these data, and none is made as to the marketability of the material or its fitness for any purpose. The consumer accepts the responsibility of and the conditions for liability of use of the products.

MATERIAL SAFETY DATA SHEET **MSDS No: 093**

UNIMIN CORPORATION
258 Elm Street
New Canaan, CT 06840

Emergency Telephone Number
(203) 966-8880

Telephone Number for Information
(203) 966-8880

Date Prepared: July 2000

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SECTION 1: IDENTIFICATION

PRODUCT NAME: Kaolin Slurry

SYNONYMS: Kaolin, China Clay, Hydrated Aluminum Silicate

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SECTION 2: COMPONENTS

CAS#	Component	Percentage	Exposure Limits
1332-58-7	Kaolin	>65%	PEL – 5 mg/m^3 TWA (respirable fraction) TLV- 2 mg/m^3 TWA (respirable fraction) MSHA - 5 mg/m^3 TWA (respirable fraction)
14808-60-7	Crystalline Silica in the form of Quartz	<1%	PEL - See Below TLV- 0.05 mg/m^3 TWA (respirable fraction) MSHA - See Below
13463-67-7	Titanium Dioxide	<2%	PEL – 15 mg/m^3 TWA (total dust) TLV- 10 mg/m^3 TWA MSHA - 15 mg/m^3 TWA (total dust)
7332-18-5	Water	<34%	None Established

OSHA PEL and MSHA Exposure Limit for Crystalline Silica, Quartz: (Respirable) 10 mg/m^3 / % Silica + 2

National Institute for Occupational Safety and Health (NIOSH) has recommended that the permissible exposure limit be changed to 50 micrograms respirable free silica percubic meter of air (0.05 mg/m^3) as determined by a full shift sample up to 10 hour working day, 40 hours per week. The 1974 NIOSH Criteria for a recommended Standard for Occupational Exposure to Crystalline Silica should be consulted for more detailed information.

PEL means OSHA Permissible Exposure Limit.
TLV means American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value.
MSHA means Mine Safety and Health Administration Exposure Limit.
TWA means 8 hour time weighted average.

Note: The Permissible Exposure Limits (PEL) reported above are the pre-1989 limits that were reinstated by OSHA June 30, 1993 following a decision by the 11th Circuit Court of Appeals. These PELs are now being enforced by Federal OSHA. Be aware that more restrictive exposure limits may be enforced by some states, agencies or other authorities.

SECTION 3: HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

This product is an aqueous slurry of a chemically inert, non-combustible mineral. A single exposure will not result in serious adverse effects. When this product is in a dryer form, prolonged and excessive inhalation of dust may cause lung disease, pneumoconiosis, with symptoms of shortness of breath and reduced pulmonary function. See "Cancer Status" in this Section
==========

HEALTH HAZARDS:

Inhalation: Breathing prolonged and excessive amounts of kaolin dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may have the following serious chronic health effects:

Pneumoconiosis: Excessive inhalation of respirable dust may cause pneumoconiosis, a respiratory disease, which can result in delayed, progressive, disabling and sometimes fatal lung injury. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with pneumoconiosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1 - carcinogenic to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (published in June 1997) in conjunction with the use of these materials. The National Toxicology Program classifies respirable crystalline silica as "known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

Other Data with Possible Relevance to Human Health:

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by fibrosis of the lungs, skin and other internal organs) and kidney disease.

For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768, 1997.

Inhalation of dust may cause irritation of the nose, throat and respiratory passages.

Skin Contact: No adverse effects expected.

Eye Contact: Contact may cause mechanical irritation and possible injury.

Ingestion: No adverse effects expected for normal, incidental ingestion.

Chronic Health Effects: See "Inhalation" subsection above with respect to silicosis, cancer status and other data with possible relevance to human health.

Medical Conditions Aggravated by Exposure: Individuals with respiratory disease, including but not limited to, asthma and bronchitis, or subject to eye irritation should not be exposed to respirable quartz dust.

Signs and Symptoms of Exposure: There are generally no signs or symptoms of exposure to crystalline silica (quartz). See "Inhalation" subsection above for symptoms of silicosis.

==========

SECTION 4: FIRST AID

Gross Inhalation: Remove victim to fresh air. If breathing has stopped, perform artificial respiration. If breathing is difficult have qualified personnel administer oxygen. Get prompt medical attention.

Skin Contact: No first aid should be needed since this product does not affect the skin. Wash exposed skin with soap and water before breaks and at the end of the shift.

Eye Contact: Flush the eyes immediately with large amounts of running water, lifting the upper and lower lids occasionally. If irritation persists or for imbedded foreign body, get immediate medical attention.

Ingestion: If large amounts are swallowed, get immediate medical attention.
==========

SECTION 5: FIRE AND EXPLOSION DATA

Flash Point (Method Used): Fully oxidized, will not burn.

Autoignition Temp: Will not burn.

Flammable Limits: LEL: Not applicable UEL: Not applicable

Extinguishing Media: This product will not burn but is compatible with all extinguishing media. Use any media that is appropriate for the surrounding fire.

Special Fire Fighting Procedures: None required with respect to this product. Firefighters should always wear self-contained breathing apparatus for fires indoors or in confined areas.

Unusual Fire and Explosion Hazards: None.

Hazardous Combustion Products: None.
==========

SECTION 6: ACCIDENTAL RELEASE MEASURES

Wear appropriate protective equipment. If uncontaminated, collect using dustless method (HEPA vacuum or wet method) and place in appropriate container for use. If contaminated: a) use appropriate method for the nature of contamination, b) consider possible toxic or fire hazards associated with the contaminating substances. Collect for disposal.
==========

SECTION 7: HANDLING AND STORAGE

Do not breathe dust. Do not rely on your sight to determine if dust is in the air. Silica may be in the air without a visible dust cloud. Use normal precautions against bag breakage or spills of bulk material. Avoid creation of respirable dust. Use good housekeeping in storage and use areas to prevent accumulation of dust in work area.

Use adequate ventilation and dust collection. Maintain and use proper, clean respiratory equipment (See Section 8). Launder clothing that has become dusty. Empty containers (bags, bulk containers, storage tanks, etc.) retain silica residue and must be handled in accordance with the provisions of this Material Safety Data Sheet. WARN and TRAIN employees in accordance with state and federal regulations.

WARN YOUR EMPLOYEES (AND YOUR CUSTOMERS - USERS IN CASE OF RESALE) BY POSTING AND OTHER MEANS OF THE HAZARDS AND OSHA PRECAUTIONS TO BE USED. PROVIDE TRAINING FOR YOUR EMPLOYEES ABOUT OSHA PRECAUTIONS.

Additional information on silica hazards and precautionary measures can be found at the following websites:

NIOSH Joint Campaign on Silicosis Prevention http://www.cdc.gov/niosh/sicampn.html
OSHA Crystalline Silica Website http://www.osha-slc.gov/SLTC/silicacrystalline/index.html
MSHA Silicosis Prevention Website http://www.msha.gov/S&HINFO/SILICO/SILICO.HTM

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SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Ventilation: Use local exhaust as required to maintain exposures below applicable occupational exposure limits (See Section 2). See also ACGIH "Industrial Ventilation - A Manual for Recommended Practice", (current edition).

Respiratory Protection: Use appropriate respiratory protection for respirable particulates based on consideration of airborne workplace concentrations and duration of exposure arising from intended end use. Refer to the most recent standards of ANSI (Z88.2), OSHA (29 CFR 1910.134), MSHA (30 CFR Parts 56 and 57) and NIOSH Respirator Decision Logic.

Gloves: Protective gloves recommended.

Eye Protection: Safety glasses or goggles recommended.

Other Protective Equipment/Clothing: As appropriate for the work environment. Dusty clothing should be laundered before reuse.

==========

9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance and Odor: White to cream colored slurry with a slight earthy odor.

pH: Not determined
Boiling Point: Not applicable
Melting Point: Not applicable
Solubility in Water: Negligible
Percent Volatile: Not determined
Specific Gravity (water=1): 1.78-2.58
Vapor Pressure: Not applicable
Vapor Density: Not applicable
Evaporation Rate: Not applicable
Fusion Range: 1569-1785°C

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SECTION 10: STABILITY AND REACTIVITY

Stability: Stable

Conditions to Avoid: When exposed to high temperatures, free quartz can change crystal structures to form tridymite (above 870°C) or cristobalite (above 1470°C) which have greater health hazards than quartz.

Incompatibility: Powerful oxidizing agents such as fluorine, chlorine trifluoride, manganese trioxide, etc.
Hazardous Decomposition Products: Silica will dissolve in hydrofluoric acid producing a corrosive gas, silicon tetrafluoride.
Hazardous Polymerization: Will not occur.

Conditions to Avoid: None

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SECTION 11: TOXICOLOGICAL INFORMATION

No acute toxicity data is available for product or components. Refer to Section 3 for health hazard information.

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SECTION 12: ECOLOGICAL INFORMATION

No ecotoxicity data is available. This product is not expected to present an environmental hazard.

==========

SECTION 13: DISPOSAL

Waste Disposal Method: If uncontaminated, dispose as an inert, non-metallic mineral. If contaminated, dispose in accordance with all applicable local, state/provincial and federal regulations.

==========

SECTION 14: TRANSPORTATION DATA

U.S. DOT HAZARD CLASSIFICATION

Proper Shipping Name: Not Regulated
Technical Name: N/A
UN Number: N/A
Hazard Class/Packing Group: N/A
Labels Required: None
DOT Packaging Requirements: N/A
Exceptions: N/A

==========

SECTION 15: OTHER REGULATORY INFORMATION

SARA 311/312: Hazard Categories for SARA Section 311/312 Reporting: Chronic Health

SARA 313 This Product Contains the Following Chemicals Subject to Annual Release Reporting Requirements Under the SARA Section 313 (40 CFR 372): None

CERCLA Section 103 Reportable Quantity: None

California Proposition 65: This product contains crystalline silica (respirable) which is known to the State of California to cause cancer.

Toxic Substances Control Act: All of the components of this product are listed on the EPA TSCA Inventory or exempt from notification requirements.

European Inventory of Commercial Chemical Substances: All of the components of this product are listed on the EINECS Inventory or exempt from notification requirements. (The EINECS number for Quartz: 231-545-4)

Canadian Environmental Protection Act: All the components of this product are listed on the Canadian Domestic Substances List or exempt from notification requirements.

Japan MITI: All of the components of this product are existing chemical substances as defined in the Chemical Substance Control Law.

Australian Inventory of Chemical Substances: All of the components of this product are listed on the AICS inventory or exempt from notification requirements.

Canadian WHMIS Classification: Class D, Division 2, Subdivision A (Very Toxic Material causing other Toxic Effects)

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16: OTHER INFORMATION

European Community Labeling Classification: Harmful (Xn)

European Community Risk and Safety Phrases: R40, R48, S22

NFPA Hazard Rating: Health: 1 Fire: 0 Reactivity: 0

HMIS Hazard Rating: Health: * Fire: 0 Reactivity: 0
* Warning - Chronic health effect possible - inhalation of silica dust may cause lung injury/disease (silicosis). Take appropriate measures to avoid breathing dust. See Section 3.

References:

Registry for Toxic Effects of Chemical Substances (RTECS), 1998
Patty's Industrial Hygiene and Toxicology
NTP Ninth Report on Carcinogens, 2000
IARC Monograph Volume 68, Silica, Some Silicates and Organic Fibres, 1997

Revision Summary: New Product

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The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process. The information set forth herein is based on technical data the Unimin Corporation believes reliable. It is intended for use by persons having technical skill and at their own discretion and risk. Since conditions of use are outside the control of Unimin Corporation, no warranties, expressed or implied, are made and no liability is assumed in connection with any use of this information. Any use of these data and information must be determined by the user to be in accordance with federal, state and local laws and regulations.

U. S. SILICA COMPANY

MSDS - MATERIAL SAFETY DATA SHEET

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Names/Trade Names:

Silica Sand sold under various names: ASTM TESTING SANDS • GLASS SAND • FLINT SILICA • DM-SERIES • F-SERIES • FOUNDRY SANDS • FJ-SERIES • FP-SERIES • H-SERIES • L-SERIES • N-SERIES • NJ-SERIES • OK-SERIES • P-SERIES • T-SERIES • HYDRAULIC FRACING SANDS • MIN-U-SIL® Ground Silica• MYSTIC WHITE® • #1 DRY • #1 SPECIAL • PENN SAND® • Q-ROK® • SIL-CO-SIL® Ground Silica • SUPERSIL® • MASON SAND • GS-SERIES • PER-SPEC

Synonyms/Common Names: Sand, Silica Sand, Quartz, Crystalline Silica, Flint, Ground Silica.

Manufacturer's Name:
U. S. Silica Company
P. O. Box 187
Berkeley Springs, WV 25411

Emergency Telephone Number: 304-258-2500 (8:30 am to 5:00 pm eastern)
304-258-8295 (fax)

Date Prepared: June 30, 2006 (revising February 10, 2005)

SECTION 2 - HAZARD IDENTIFICATION

EMERGENCY OVERVIEW:

The U. S. Silica Company material is a white or tan sand, or ground sand. It is not flammable, combustible or explosive. It does not cause burns or severe skin or eye irritation. A single exposure will not result in serious adverse health effects. Crystalline silica (quartz) is not known to be an environmental hazard.

Crystalline silica (quartz) is incompatible with hydrofluoric acid, fluorine, chlorine trifluoride or oxygen difluoride.

OSHA REGULATORY STATUS

This material is considered hazardous under the OSHA Hazard Communications Standard (29 CFR 1910.1200).

POTENTIAL HEALTH EFFECTS:

Inhalation:

a. Silicosis — Respirable crystalline silica (quartz) can cause silicosis, a fibrosis (scarring) of the lungs. Silicosis may be progressive; it may lead to disability and death.

b. Lung Cancer — Crystalline silica (quartz) inhaled from occupational sources is classified as carcinogenic to humans.

c. Tuberculosis — Silicosis increases the risk of tuberculosis.

d. Autoimmune and Chronic Kidney Diseases — Some studies show excess numbers of cases of scleroderma, connective tissue disorders, lupus, rheumatoid arthritis, chronic kidney diseases and end-stage kidney disease in workers exposed to respirable crystalline silica.

e. Non-Malignant Respiratory Diseases (other than silicosis) — Some studies show an increased incidence in chronic bronchitis and emphysema in workers exposed to respirable crystalline silica.

Eye Contact: Crystalline silica (quartz) may cause abrasion of the cornea.

Skin Contact: Not applicable. **Ingestion:** Not applicable.

Chronic Effects: The adverse health effects -- silicosis, lung cancer, autoimmune and chronic kidney diseases, tuberculosis, and non-malignant respiratory diseases-- are chronic effects.

Signs and Symptoms of Exposure: Generally, there are no signs or symptoms of exposure to crystalline silica (quartz).

Medical Conditions Generally Aggravated by Exposure: The condition of individuals with lung disease (e.g., bronchitis, emphysema, chronic obstructive pulmonary disease) can be aggravated by exposure.

See Section 11, Toxicological Information, for additional detail on potential adverse health effects.

SECTION 3 - COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients:

	Chemical Formula	Typical %, By Weight	CAS #
Crystalline Silica (quartz)	SiO_2	99.0 - 99.9	14808-60-7
Aluminum Oxide	Al_2O_3	< .8	1344-28-1
Iron Oxide	Fe_2O_3	< .1	1309-37-1
Titanium Oxide	TiO_2	< .1	13463-67-7

SECTION 4 - FIRST AID MEASURES

Inhalation: No specific first-aid is necessary since the adverse health effects associated with exposure to crystalline silica (quartz) result from chronic exposures. If there is a gross inhalation of crystalline silica (quartz), remove the person immediately to fresh air, give artificial respiration as needed, seek medical attention as needed.

Eye Contact: Wash immediately with water. If irritation persists, seek medical attention.

Skin Contact: Not applicable.

Ingestion: Not applicable.

SECTION 5 - FIRE FIGHTING MEASURES

Crystalline silica (quartz) is not flammable, combustible or explosive.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

Spills: Use dustless methods (vacuum) and place into closable container for disposal, or flush with water. Do not dry sweep. Wear protective equipment specified below.

Waste Disposal Method: See Section 13.

SECTION 7 - HANDLING AND STORAGE

Precautions During Handling and Use: Do not breathe dust. Use adequate ventilation and dust collection. Keep airborne dust concentrations below permissible exposure limit ("PEL"). Do not rely on your sight to determine if dust is in the air. Respirable crystalline silica dust may be in the air without a visible dust cloud.

If crystalline silica dust cannot be kept below permissible limits, wear a respirator approved for silica dust when using, handling, storing or disposing of this product or bag. See Section 8 for further information on respirators. Practice good housekeeping. Do not permit dust to collect on walls, floors, sills, ledges, machinery, or equipment. Maintain, clean, and fit test respirators in accordance with OSHA regulations. Maintain and test ventilation and dust collection equipment. Wash or vacuum clothing that has become dusty.

The OSHA Hazard Communication Standard, 29 CFR Sections 1910.1200, 1915.1200, 1917.28, 1918.90, 1926.59 and 1928.21, and state and local worker or community "right-to-know" laws and regulations should be strictly followed.

Do not use U. S. Silica Company materials for sandblasting.

Precautions During Storage: Avoid breakage of bagged material or spills of bulk material. Use dustless methods (vacuum) and place into closable container for disposal, or flush with water. Do not dry sweep. See control measures in Section 8.

The OSHA Hazard Communication Standard, 29 CFR Sections 1910.1200, 1915.1200, 1917.28, 1918.90, 1926.59 and 1928.21, and state and local worker or community "right-to-know" laws and regulations should be strictly followed. WARN YOUR EMPLOYEES (AND YOUR CUSTOMERS IN CASE OF RESALE) BY POSTING AND OTHER MEANS OF THE HAZARDS AND THE REQUIRED OSHA PRECAUTIONS. PROVIDE TRAINING FOR YOUR EMPLOYEES ABOUT THE OSHA PRECAUTIONS.

For additional precautions, see American Society for Testing and Materials (ASTM) standard practice E 1132-99a, "Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica."

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

Local Exhaust Ventilation: Use sufficient local exhaust ventilation to reduce the level of respirable crystalline silica to below the OSHA PEL. See ACGIH "Industrial Ventilation, A Manual of Recommended Practice" (latest edition).

Respiratory Protection:

If it is not possible to reduce airborne exposure levels to below the OSHA PEL with ventilation, use the table below to assist you in selecting respirators that will reduce personal exposures to below the OSHA PEL. This table is part of the NIOSH Respirator Selection Logic, 2004, Chapter III, Table 1, "Particulate Respirators". The full document can be found at www.cdc.gov/niosh/npptl/topics/respirators; the user of this MSDS is directed to that site for information concerning respirator selection and use.

The assigned protection factor (APF) is the minimum anticipated level of protection provided by each type of respirator worn in accordance with an adequate respiratory protection program. For example, an APF of 10 means that the respirator should reduce the airborne concentration of a particulate by a factor of 10, so that if the workplace concentration of a particulate was 150 ug/m^3, then a respirator with an APF of 10 should reduce the concentration of particulate to 15 ug/m^3.

Assigned protection factor [1]	Type of Respirator (Use only NIOSH-certified respirators)
10	Any air-purifying elastomeric half-mask respirator equipped with appropriate type of particulate filter. [2] Appropriate filtering facepiece respirator. [2,3] Any air-purifying full facepiece respirator equipped with appropriate type of particulate filter. [2] Any negative pressure (demand) supplied-air respirator equipped with a half-mask.
25	Any powered air-purifying respirator equipped with a hood or helmet and a high efficiency (HEPA) filter. Any continuous flow supplied-air respirator equipped with a hood or helmet.
50	Any air-purifying full facepiece respirator equipped with N-100, R-100, or P-100 filter(s). Any powered air-purifying respirator equipped with a tight-fitting facepiece (half or full facepiece) and a high-efficiency filter. Any negative pressure (demand) supplied-air respirator equipped with a full facepiece. Any continuous flow supplied-air respirator equipped with a tight-fitting facepiece (half or full facepiece). Any negative pressure (demand) self-contained respirator equipped with a full facepiece.
1,000	Any pressure-demand supplied-air respirator equipped with a half-mask.

1. The protection offered by a given respirator is contingent upon (1) the respirator user adhering to complete program requirements (such as the ones required by OSHA in 29CFR1910.134), (2) the use of NIOSH-certified respirators in their approved configuration, and (3) individual fit testing to rule out those respirators that cannot achieve a good fit on individual workers.
2. Appropriate means that the filter medium will provide protection against the particulate in question.
3. An APF of 10 can only be achieved if the respirator is qualitatively or quantitatively fit tested on individual workers.

Exposure Guidelines:

Component	CAS No.	Percentage (by wt.)	OSHA PEL		ACGIH TLV		NIOSH REL		
			TWA	STEL	TWA	STEL	TWA	STEL	Unit
Crystalline Silica (quartz)	14808-60-7	99.0-99.9	$\frac{10}{\% SiO_2 + 2}$	None	.025	None	.05	None	mg/m^3

If crystalline silica (quartz) is heated to more than 870°C, it can change to a form of crystalline silica known as trydimite; if crystalline silica (quartz) is heated to more than 1470°C, it can change to a form of crystalline silica known as cristobalite. The OSHA PEL for crystalline silica as trydimite or cristobalite is one-half of the OSHA PEL for crystalline silica (quartz).

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance: White or tan sand; granular, crushed, or ground.

Boiling Point: 4046°F/2230°C **Odor:** None

Vapor Pressure (mm Hg.): None **Specific Gravity (Water = 1):** 2.65

Vapor Density (Air = 1): None **Melting Point:** 3110°F/1710°C

Solubility in Water: Insoluble in water **Evaporation Rate (Butyl Acetate = 1):** None

SECTION 10 - STABILITY AND REACTIVITY

Stability: Crystalline silica (quartz) is stable.

Incompatibility (Materials to Avoid): Contact with powerful oxidizing agents, such as fluorine, chlorine trifluoride and oxygen difluoride, may cause fires.

Hazardous Decomposition or Byproducts: Silica will dissolve in hydrofluoric acid and produce a corrosive gas - silicon tetrafluoride.

Hazardous Polymerization: Will not occur.

SECTION 11 - TOXICOLOGICAL INFORMATION

The method of exposure to crystalline silica that can lead to the adverse health effects described below is inhalation.

A. SILICOSIS

The major concern is silicosis, caused by the inhalation and retention of respirable crystalline silica dust. Silicosis can exist in several forms, chronic (or ordinary), accelerated, or acute.

Chronic or Ordinary Silicosis (often referred to as Simple Silicosis) is the most common form of silicosis, and can occur after many years of exposure to relatively low levels of airborne respirable crystalline silica dust. It is further defined as either simple or complicated silicosis.

Simple silicosis is characterized by lung lesions (shown as radiographic opacities) less than 1 centimeter in diameter, primarily in the upper lung zones. Often, simple silicosis is not associated with symptoms, detectable changes in lung function or disability.

Simple silicosis may be progressive and may develop into complicated silicosis or progressive massive fibrosis (PMF). Complicated silicosis or PMF is characterized by lung lesions (shown as radiographic opacities) greater than 1 centimeter in diameter. Although there may be no symptoms associated with complicated silicosis or PMF, the symptoms, if present, are shortness of breath, wheezing, cough and sputum production. Complicated silicosis or PMF may be associated with decreased lung function and may be disabling. Advanced complicated silicosis or PMF may lead to death. Advanced complicated silicosis or PMF can result in heart disease secondary to the lung disease (cor pumonale).

Accelerated Silicosis can occur with exposure to high concentrations of respirable crystalline silica over a relatively short period; the lung lesions can appear within five (5) years of initial exposure. Progression can be rapid. Accelerated silicosis is similar to chronic or ordinary silicosis, except that lung lesions appear earlier and progression is more rapid.

Acute Silicosis can occur with exposures to very high concentrations of respirable crystalline silica over a very short time period, sometimes as short as a few months. The symptoms of acute silicosis include progressive shortness of breath, fever, cough and weight loss. Acute silicosis is fatal.

B. CANCER

IARC - The International Agency for Research on Cancer ("IARC") concluded that there was "*sufficient evidence* in humans for the carcinogenicity of crystalline silica in the forms of quartz or cristobalite from occupational sources", and that there is "*sufficient evidence* in experimental animals for the carcinogenicity of quartz and cristobalite." The overall IARC evaluation was that "crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is *carcinogenic to humans* (*Group 1*)." The IARC evaluation noted that "carcinogenicity was not detected in all industrial circumstances studies. Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs." For further information on the IARC evaluation, see IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 68, "Silica, Some Silicates..." (1997).

NTP - The National Toxicology Program's Eleventh Annual Report on Carcinogens classifies "silica, crystalline (respirable size)" as a known human carcinogen.

OSHA - Crystalline silica (quartz) is not regulated by the U. S. Occupational Safety and Health Administration as a carcinogen.

C. AUTOIMMUNE DISEASES

Several studies have reported excess cases of several autoimmune disorders, -- scleroderma, systemic lupus erythematosus, rheumatoid arthritis -- among silica-exposed workers**.** For a review of the subject, the following may be consulted: "Occupational Exposure to Crystalline Silica and Autoimmune Disease", Environmental Health Perspectives, Volume 107, Supplement 5, pp. 793-802 (1999); "Occupational Scleroderma", Current Opinion in Rheumatology, Volume 11, pp. 490-494 (1999).

D. TUBERCULOSIS

Individuals with silicosis are at increased risk to develop pulmonary tuberculosis, if exposed to persons with tuberculosis. The following may be consulted for further information: Occupational Lung Disorders, Third Edition, Chapter 12, entitled "Silicosis and Related Diseases", Parkes, W. Raymond (1994); "Risk of pulmonary tuberculosis relative to silicosis and exposure to silica dust in South African gold miners," Occup Environ Med., Volume 55, pp.496-502 (1998).

E. KIDNEY DISEASE

Several studies have reported excess cases of kidney diseases, including end stage renal disease, among silica-exposed workers. For additional information on the subject, the following may be consulted: "Kidney Disease and Silicosis", Nephron, Volume 85, pp. 14-19 (2000).

F. **NON-MALIGNANT RESPIRATORY DISEASES**

The reader is referred to Section 3.5 of the NIOSH Special Hazard Review cited below, for information concerning the association between exposure to crystalline silica and chronic bronchitis, emphysema and small airways disease. There are studies that disclose an association between dusts found in various mining occupations and non-malignant respiratory diseases, particularly among smokers. It is unclear whether the observed associations exist only with underlying silicosis, only among smokers, or result from exposure to mineral dusts generally (independent of the presence or absence of crystalline silica, or the level of crystalline silica in the dust).

Sources of information:

The ***NIOSH Hazard Review - Occupational Effects of Occupational Exposure to Respirable Crystalline Silica*** published in April 2002 summarizes and discusses the medical and epidemiological literature on the health risks and diseases associated with occupation exposures to respirable crystalline silica. The *NIOSH Hazard Review* should be consulted for additional information, and citations to published studies on health risks and diseases associated with occupational exposure to respirable crystalline silica. The *NIOSH Hazard Review* is available from NIOSH - Publications Dissemination, 4676 Columbia Parkway, Cincinnati, OH 45226, or by calling 1-800-35-NIOSH (1-800-356-4676), or through the NIOSH web site, www.cdc.gov/niosh/topics/silica, then click on the link "NIOSH Hazard Review: Health Effects of Occupational Exposure to Respirable Crystalline Silica".

SECTION 12 - ECOLOGICAL INFORMATION

Crystalline silica (quartz) is not known to be ecotoxic; i.e., there are no data that suggests that crystalline silica (quartz) is toxic to birds, fish, invertebrates, microorganisms or plant

SECTION 13 - DISPOSAL CONSIDERATIONS

General: The packaging and material may be landfilled; however, material should be covered to minimize generation of airborne dust.

RCRA: Crystalline silica (quartz) is not classified as a hazardous waste under the Resource Conservation and Recovery Act, or its regulations, 40 CFR §261 et seq.

The above applies to materials as sold by U. S. Silica Company. The material may be contaminated during use, and it is the responsibility of the user to assess the appropriate disposal of the used material.

SECTION 14 - TRANSPORT INFORMATION

Crystalline silica (quartz) is not a hazardous material for purposes of transportation under the U. S. Department of Transportation Table of Hazardous Materials, 49 CFR §172.101.

SECTION 15 - REGULATORY INFORMATION

UNITED STATES (FEDERAL AND STATE)

TSCA No.: Crystalline silica (quartz) appears on the EPA TSCA inventory under the CAS No. 14808-60-7.

RCRA: Crystalline silica (quartz) is not classified as a hazardous waste under the Resource Conservation and Recovery Act, or its regulations, 40 CFR §261 et seq.

CERCLA: Crystalline silica (quartz) is not classified as a hazardous substance under regulations of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), 40 CFR §302.

Emergency Planning and Community Right to Know Act (SARA Title III): Crystalline silica (quartz) is not an extremely hazardous substance under Section 302 and is not a toxic chemical subject to the requirements of Section 313.

Clean Air Act: Crystalline silica (quartz) mined and processed by U.S. Silica Company is not processed with or does not contain any Class I or Class II ozone depleting substances.

FDA: Silica is included in the list of substances that may be included in coatings used in food contact surfaces, 21 CFR §175.300(b)(3)(xxvi).

NTP: Respirable crystalline silica, primarily quartz dusts occurring in industrial and occupational settings, is classified as Known to be a Human Carcinogen.

OSHA Carcinogen: Crystalline silica (quartz) is not listed.

California Proposition 65: Crystalline silica (airborne particles of respirable size) is classified as a substance known to the State of California to be a carcinogen.

California Inhalation Reference Exposure Level (REL): California established a chronic REL of 3 ug for silica (crystalline, respirable). A chronic REL is an airborne level of a substance at or below which no adverse health effects are anticipated in individuals indefinitely exposed to the substance at that level.

Massachusetts Toxic Use Reduction Act: Silica, crystalline (respirable size, <10 microns) is "toxic" for purposes of the Massachusetts Toxic Use Reduction Act.

Pennsylvania Worker and Community Right to Know Act: Quartz is a hazardous substance under the Act, but it is not a special hazardous substance or an environmental hazardous substance.

CANADA

Domestic Substances List: U. S. Silica Company products, as naturally occurring substances, are on the Canadian DSL.

WHMIS Classification: D2A

OTHER

EINECS No.: 238-878-4

EEC Label (Risk/Safety Phrases): R 48/20, R 40/20, S22, S38

IARC: Crystalline silica (quartz) is classified in IARC Group 1.

Japan MITI: All of the components of this product are existing chemical substances as defined in the Chemical Substance Control Law.

Australian Inventory of Chemical Substances: All of the components of this product are listed on the AICS inventory or exempt from notification requirements.

National, state, provincial or local emergency planning, community right-to-know or other laws, regulations or ordinances may be applicable--consult applicable national, state, provincial or local laws.

SECTION 16 - OTHER INFORMATION

Hazardous Material Information System (HMIS):

Health	*
Flammability	0
Reactivity	0
Protective Equipment	E

* For further information on health effects, see Sections 2 and 11 of this MSDS.

National Fire Protection Association (NFPA):

Health	0
Flammability	0
Reactivity	0

Web Sites with Information about Effects of Crystalline Silica Exposure:

The U. S. Silica web site will provide updated links to OSHA and NIOSH web sites addressing crystalline silica issues. www.u-s-silica.com, click in "Information", then click on "Health & Safety".

U. S. SILICA COMPANY DISCLAIMER

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, express or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects that may be caused by purchase, resale, use or exposure to our silica. Customers-users of silica must comply with all applicable health and safety laws, regulations, and orders, including the OSHA Hazard Communication Standard.

Printing date 11/29/2006 Reviewed on 11/29/2006

1 Identification of substance

· **Product details**

· **Trade name: INSBLOK-19**

· **Manufacturer/Supplier:**
ANH Refractories Company
400 Fairway Drive
Moon Township, PA 15108

General Phone: (412)375-6600
· **Emergency information:** CHEMTREC 24 HOUR EMERGENCY PHONE NUMBER: 1-800-424-9300.

2 Composition/Data on components

· **Chemical characterization**
· **Description:** Mixture of the substances listed below with nonhazardous additions.

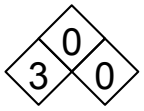
· **Components:**

	fiberglass (CAS# 65997-17-3, fibrous form)	30-60%
71888-52-3	hydrous alumina silicate	10-20%
93763-70-3	perlite volcanic glass	10-20%
9005-25-8	Starch	2.5-5%
14808-60-7	crystalline silica (quartz)	1-2.5%
8052-42-4	Asphalt	1-2.5%

· **Additional information:** For the wording of the listed risk phrases refer to section 16.

3 Hazards identification

· **Hazard description:**
Toxic
· **Medical conditions aggravated by exposure to the product:** Asthma, chronic lung disease, and skin irritation.
· **Carcinogenicity Information:**
Crystalline silica is listed by IARC as a Group 1 Carcinogen "sufficient evidence of carcinogenicity in humans", and is listed by NTP as K, "Known To Be A Human Carcinogen".
Fibrous glass has been classified by IARC as a category 2B substance, possibly carcinogenic to humans.
· **Information pertaining to particular dangers for man and environment:**
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.
May cause cancer by inhalation.
Irritating to eyes, respiratory system and skin.
Toxic: danger of serious damage to health by prolonged exposure through inhalation.
· **NFPA ratings (scale 0-4)**



Health = 3
Fire = 0
Reactivity = 0

(Contd. on page 2)

Trade name: INSBLOK-19

(Contd. from page 1)

· **HMIS Classification**

HEALTH	*3
FIRE	0
REACTIVITY	0

*Health: *3*
Flammability: 0
Reactivity: 0

4 First aid measures

· **After inhalation:** Move to fresh air; consult doctor if needed.
· **After skin contact:** Immediately wash with water and soap and rinse thoroughly.
· **After eye contact:** Flush eyes with water for 15 minutes. If irritation persists, consult a doctor.
· **After swallowing:**
This product is intended for industrial applications; in the unlikely event that this product is swallowed, consult a physician if any adverse medical conditions occur.

5 Fire fighting measures

· **Suitable extinguishing agents:** Use fire fighting measures that suit the environment.
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Person-related safety precautions:** Not required.
· **Measures for environmental protection:** No special measures required.
· **Measures for cleaning/collecting:**
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.

7 Handling and storage

· **Handling:**
· **Information for safe handling:**
Ensure good ventilation/exhaust at the workplace.
Prevent formation of dust.
· **Information about protection against explosions and fires:** No special measures required.

· **Storage:**
· **Requirements to be met by storerooms and containers:** No special requirements.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:** Store product inside, out of extreme weather conditions.

(Contd. on page 3)

(Contd. from page 2)

8 Exposure controls and personal protection

· **Components with limit values that require monitoring at the workplace:**

93763-70-3 perlite volcanic glass	
PEL	15* 5** mg/m³ *total dust **respirable fraction
REL	10* 5** mg/m³ *total dust **respirable fraction
TLV	TLV withdrawn
9005-25-8 Starch	
PEL	15* 5** mg/m³ *total dust **respirable fraction
REL	10* 5** mg/m³ *total dust **respirable fraction
TLV	10 mg/m³
9004-34-6 Cellulose	
PEL	15* 5** mg/m³ *total dust **respirable fraction
REL	10* 5** mg/m³ *total dust **respirable fraction
TLV	10 mg/m³
14808-60-7 crystalline silica (quartz)	
PEL	see Quartz listing
REL	0.05* mg/m³ *respirable dust
TLV	0.025 R mg/m³
8052-42-4 Asphalt	
REL	Short-term value: C 5* mg/m³ *15-min
TLV	0.5 I mg/m³ as benzene-soluble aerosol

· **Personal protective equipment:**
· **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Wash hands before breaks and at the end of work.
Store protective clothing separately.
Avoid contact with the eyes and skin.
· **Breathing equipment:**

NIOSH approved respirators should be used if dust is present. A respiratory protection program should be implemented if exposures exceed OSHA PELs.

(Contd. on page 4)

(Contd. from page 3)

If during use or handling of this product dust is generated, suitable respiratory protection shall be used. Specific to this product, a NIOSH approved particulate respirator with an N, R, or P filter (95, 99, 100) should be used where exposure levels are below ten times exposure guidelines. See NIOSH for further information on selecting an N, R, or P filter and assigned protection factors. For exposures greater than ten times the TWA, a supplied air respirator operated in a continuous flow mode shall be used.

· ***Protection of hands:***

Protective gloves recommended

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation
Chemical resistant gloves recommended.

· ***Material of gloves***
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.

· ***Penetration time of glove material***
The exact break trough time has to be found out by the manufacturer of the protective gloves and has to be observed.

· ***Eye protection:*** *Safety glasses with side shields recommended*

9 Physical and chemical properties

· ***General Information***	
Form:	*Solid*
Color:	*According to product specification*
Odor:	*No specific odor.*
· ***Change in condition***	
Melting point/Melting range:	*Undetermined.*
Boiling point/Boiling range:	*Undetermined.*
· ***Flash point:***	*Not applicable.*
· ***Auto igniting:***	*Product is not selfigniting.*
· ***Danger of explosion:***	*Product does not present an explosion hazard.*
· ***Density:***	*Not determined.*
· ***Solubility in / Miscibility with***	
Water:	*Insoluble.*

10 Stability and reactivity

· ***Thermal decomposition / conditions to be avoided:*** *No decomposition if used according to specifications.*
· ***Dangerous reactions*** *No dangerous reactions known.*

(Contd. on page 5)

(Contd. from page 4)

· ***Dangerous products of decomposition:***
Refractories containing crystalline silica may, after service,contain more or less crystalline silica. Care must be taken to avoid and/or control dust from demolition. If in doubt of the proper protection, seek advice from a safety professional.

11 Toxicological information

· ***Acute toxicity:***
· ***Primary acute effects:***
· ***Skin contact:*** *Irritant to skin and mucous membranes.*
· ***Eye contact:*** *Irritating effect.*
· ***Sensitization:*** *No sensitizing effects known.*
· ***Additional toxicological information:***
The product shows the following dangers according to internally approved calculation methods for preparations:
Irritant
Carcinogenic if inhaled.

12 Ecological information

· ***General notes:*** *At present there are no ecotoxicological assessments.*

13 Disposal considerations

· ***Recommendation for Disposal of Product:***
As sold, this product is not RCRA hazardous. Final used condition must be evaluated prior to disposal. Dispose of waste product in accordance with Federal, State and Local regulations.
Dust created during demolition of used product may contain crystalline silica.

· ***Recommendation for Disposal of Uncleaned Packaging:*** *Reuse, recycle or treat as industrial waste.*

14 Transport information

· ***Transport/Additional information:*** *Not dangerous according to available information.*

15 Regulations

· ***SARA 313 TOXIC CHEMICALS***
No material listed in the components in Section 2 of this MSDS is on the SARA 313 list.

· ***SARA 302 EXTREMELY HAZARDOUS SUBSTANCES***
No material listed in the components in Section 2 of this MSDS is on the SARA 302 list.

· ***TSCA (Toxic Substances Control Act)***
This substance or all the ingredients of this product are on the Chemical Substances Inventory of the Toxic Substances Control Act (TSCA Inventory). The presence on this list does not require any legal reporting.

(Contd. on page 6)

(Contd. from page 5)

· **WHMIS Classification**
Class D - Division 2 - Sub Division A
Untested mixture containing a very toxic material
Class D - Division 2 - Sub Division B
Untested mixture containing a toxic material
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

· **Cancerogenity categories**

· **EPA (Environmental Protection Agency)**		
None of the ingredients is listed.		

· **IARC (International Agency for Research on Cancer)**		
14808-60-7	crystalline silica (quartz)	1
8052-42-4	Asphalt	2B

· **NTP (National Toxicology Program)**		
14808-60-7	crystalline silica (quartz)	K

· **TLV (Threshold Limit Value established by ACGIH)**		
93763-70-3	perlite volcanic glass	A4
9005-25-8	Starch	A4
14808-60-7	crystalline silica (quartz)	A2
8052-42-4	Asphalt	A4

· **MAK (German Maximum Workplace Concentration)**		
14808-60-7	crystalline silica (quartz)	1
8052-42-4	Asphalt	3

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**	
14808-60-7	crystalline silica (quartz)
8052-42-4	Asphalt

· **OSHA-Ca (Occupational Safety & Health Administration)**
None of the ingredients is listed.

· **Classification according to EU-guidelines**

· **Hazard symbols:**
Toxic

· **Hazard-determining components of labeling:**
fiberglass (CAS# 65997-17-3, fibrous form)
crystalline silica (quartz)

· **Risk phrases:**
May cause cancer by inhalation.
Irritating to eyes, respiratory system and skin.
Toxic: danger of serious damage to health by prolonged exposure through inhalation.

· **Safety phrases:**
When using do not eat or drink.
In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

(Contd. on page 7)

(Contd. from page 6)

Wear suitable protective clothing and gloves.
In case of accident or if you feel unwell, seek medical advice immediately.

· ***National regulations:***

· ***The following ingredients are known in the state of California to be a cancer risk (Proposition 65):***	
	fiberglass (CAS# 65997-17-3, fibrous form)
14808-60-7	*crystalline silica (quartz)*

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· ***Contact:*** *Rhonda L. Vete 412-375-6848*
· ***Creation date:*** *10/10/2000*

MATERIAL SAFETY DATA SHEET

MSDS No. M4115	Effective Date: 09/11/2007

1. IDENTIFICATION OF THE PRODUCT AND OF THE COMPANY

Trade Names: **INSULFRAX® THERMAL INSULATION PRODUCTS**

FIBERS:
Insulfrax Fiber, Insulfrax RG fiber, Spun Bulk 3010, Spun Bulk 3011

Chemical Name: **ALKALINE EARTH SILICATE FIBER (AES)**

Synonym(s): Synthetic vitreous fiber (SVF), man-made vitreous fiber (MMVF), man-made mineral fiber (MMMF), alkaline-earth-silicate fiber, calcium magnesium silicate fiber

Manufacturer/Supplier: **Unifrax I LLC**
2351 Whirlpool St.
Niagara Falls, NY 14305-2413
Product Stewardship Information Hotline
1-800-322-2293 (Monday - Friday 8:00 a.m. - 4:30 p.m. EST)
For additional MSDSs, visit our web page, http: //www.unifrax.com, or call Unifrax Customer Service at (716) 278-3872

CHEMTREC Assist: CHEMTREC will provide assistance for chemical emergencies. Call **1-800-424-9300**

2. COMPOSITION / INFORMATION ON INGREDIENTS

DESCRIPTION

INSULFRAX® THERMAL INSULATION PRODUCTS are available as fibers, papers, blankets and modules.

COMPONENTS	CAS NUMBER	% BY WEIGHT
Amorphous alkaline-earth-silicate (calcium-magnesium-silicate) fiber (SiO_2 62-67 %, CaO 28-33 %, MgO 1-6 %, trace elements 0-1%)	436083-99-7	100

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines)

3. HAZARDS IDENTIFICATION

MAY IRRITATE EYES, SKIN and RESPIRATORY TRACT

May cause temporary mechanical irritation to eyes, skin, and respiratory tract (nose, throat & lungs).

Pre-existing medical conditions, including dermatitis, asthma or chronic lung disease may be aggravated by exposure; individuals who are atopic (with a history of allergies) may experience greater amounts of skin and respiratory irritation.

HAZARD CLASSIFICATION

The **Hazardous Materials Identification System (HMIS)** –

Health 1 Flammability 0 Reactivity 0 Personal Protection Index: X (Employer Determined)

4. FIRST AID MEASURES

FIRST AID PROCEDURES

RESPIRATORY TRACT (nose & throat) IRRITATION:
If respiratory tract irritation develops, move the person to a dust free location. Get medical attention if the irritation continues. See Section 8 for additional measures to reduce or eliminate exposure.

EYE IRRITATION:
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. Get medical attention if irritation persists.

SKIN IRRITATION:
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.

GASTROINTESTINAL IRRITATION:
If gastrointestinal tract irritation develops, move the person to a dust free environment.

NOTES TO PHYSICIANS:
Skin and respiratory effects are the result of temporary, mild mechanical irritation; fiber exposure does not result in allergic manifestations.

5. FIRE FIGHTING MEASURES

Non-combustible (does not burn) product.

Packaging and surrounding materials may be combustible.
Use extinguishing agent suitable for surrounding combustible materials.

6. ACCIDENTAL RELEASE MEASURES

SPILL PROCEDURES

Avoid creating airborne dust. Dust suppressing cleaning methods such as wet sweeping or vacuuming should be used to clean the work area. If vacuuming, the vacuum must be equipped with a HEPA filter. Compressed air or dry sweeping should not be used for cleaning.

7. HANDLING AND STORAGE

STORAGE

Store in original container in a dry area. Keep container closed when not in use.

HANDLING

Handle fiber carefully. Limit 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.

EMPTY CONTAINERS

Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROL / PERSONAL PROTECTION

INDUSTRIAL HYGIENE STANDARDS AND OCCUPATIONAL EXPOSURE LIMITS

Components	OSHA	MANUFACTURER
Amorphous alkaline-earth-silicate (calcium-magnesium-silicate) fiber	None established	See below**

There is no specific regulatory standard for INSULFRAX® in the U.S. OSHA's "Particulate Not Otherwise Regulated (PNOR)" standard [29 CFR 1910.1000, Subpart Z, Air Contaminants] applies generally; Total Dust 15 mg/m^3; Respirable Fraction 5 mg/m^3.

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)
ACGIH TLV's : Amorphous alkaline-earth-silicate (calcium-magnesium-silicate) -- Particulates Not Otherwise Classified (PNOC) : Inhalable particulate -- 10 mg/m³. Respirable particulate -- 3 mg/m³.

** As with most industrial materials, it is prudent to minimize unnecessary exposure to respirable dusts. Note that Industrial hygiene standards and occupational exposure limits differ between countries and local jurisdictions. Check with your employer to identify any "respirable dust", "total dust" or "fiber" exposure standards to follow in your area. If no regulatory dust or fiber control standard apply, a qualified industrial hygiene professional can assist with a specific evaluation of workplace conditions and the identification of appropriate respiratory protection practices. In the absence of other guidance, the supplier has found that it is generally feasible to control occupational fiber exposure to 1 f/cc or less.

ENGINEERING CONTROLS:

Dust suppressing control technologies such as local exhaust ventilation, point of generation dust collection, down draft work stations, emission controlling tool designs, and materials handling equipment are effective means of minimizing airborne fiber emissions. For additional information, contact the Unifrax I LLC Product Stewardship Information Line at 1-800-322-2293 (See Section 16).

PERSONAL PROTECTION EQUIPMENT

Skin Protection:

Wear gloves, head coverings and full body clothing 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, employers should ensure employees are thoroughly 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.).

Eye Protection:

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

Respiratory Protection:

When effective engineering and/or administrative controls are insufficient, the use of appropriate respiratory protection,

pursuant to the requirements of OSHA 1910.134, is recommended. For dust concentrations below the applicable exposure limit value, PPE is not required. 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.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	White, odorless, fibrous material
CHEMICAL FAMILY:	Calcium Magnesium Silicate Fibers
BOILING POINT:	Not Applicable
WATER SOLUBILITY (%):	Not Soluble in Water
MELTING POINT:	1260° C (2300° F)
SPECIFIC GRAVITY:	2.60
VAPOR PRESSURE:	Not Applicable
pH:	Not Applicable
VAPOR DENSITY (Air = 1):	Not Applicable
% VOLATILE:	Not Applicable
MOLECULAR FORMULA:	$SiO_2CaO.MgO.$

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY:	Stable under conditions of normal use.
INCOMPATIBILITY:	Avoid direct contact with strong acid environments.
CONDITIONS TO AVOID:	None.
HAZARDOUS DECOMPOSITION PRODUCTS:	None.
HAZARDOUS POLYMERIZATION:	Not Applicable.

11. TOXICOLOGICAL INFORMATION

EPIDEMIOLOGY

This product has not been the subject of epidemiological study. Epidemiological studies related to other fiber chemistries of similar solubility have not identified a statistically significant incidence of exposure-related respiratory disease.

TOXICOLOGY

This product has been the subject of limited testing.

A review of available scientific literature suggests an inverse relationship between dissolution rate and potential health effects; i.e. the higher the dissolution rate of a fiber the lower its potential to produce health effects. The dissolution rate of INSULFRAX® fiber has been determined through standardized *in vitro* testing. The dissolution rate of INSULFRAX® fibers is higher than that of other fiber types that have been tested in chronic animal studies and did not produce respiratory disease.

This product possesses a fiber chemistry within the regulatory (European Commission Directive 97/69/EC) definition as a "man-made vitreous (silicate) fiber with random orientation with alkaline oxide and alkaline earth oxide (Na2O + K2O + CaO + MgO + BaO) content greater than 18% by weight". INSULFRAX® fibers have been tested pursuant to EU protocol ECB/TM/26, rev. 7, Nota Q, Directive 97/69/EC. The results for the short term biopersistence test by inhalation (IH test) was 7 days; well below the regulatory threshold of 10 days cited in Directive 97/69/EC. Based on testing results, INSULFRAX® based products are not regarded as potential carcinogens and they ARE EXEMPT from European classification as such. By virtue of these test results, these products ARE EXEMPT from European regulatory guidelines that require hazard warning labels with specific risk phrases citing respiratory disease potential. In addition, INSULFRAX® fibers have been tested in an independent laboratory, by intratracheal (IT test) instillation, under a protocol that was consistent with the requirements of the German Hazardous Substances Ordinance (BGBI. I pp. 1782, 2049, Third Amendment, Appendix V, No. 7). The half-life clearance of INSULFRAX® fibers was 30 days; well below the applicable regulatory thresholds. Based on the IT test results, INSULFRAX® products ARE EXEMPT from the requirements of the German Ordinance.

The definition of "irritant" contained in the hazard communication standard, 29 CFR 1900.1200, Appendix A, is "...a reversible inflammatory effect on living tissue by chemical action...". INSULFRAX® fiber is an inert material which doesn't interact chemically with exposed skin. However, there is a possibility that exposure to this product may cause temporary mechanical irritation to the eyes, skin or respiratory tract (nose, throat, lungs). This temporary irritation can be mitigated with proper handling practices designed to limit exposure and the use of protective clothing (glasses, gloves, clothing).

This product has not been specifically evaluated by any regulatory authority or other classification entity, such as the International Agency for Research on Cancer (IARC) or the National Toxicology Program (NTP). Other types of man-made vitreous fibers (MMVF) have been evaluated and subsequently classified as potential carcinogens. Various classifications, such as "possible carcinogen", "probable carcinogen", and "reasonably anticipated to be a carcinogen" have been given to other MMVF's.

12. ECOLOGICAL INFORMATION

No ecological concerns have been identified.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT

To prevent waste materials from becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended.

DISPOSAL

INSULFRAX® fiber, as manufactured, is not classified as a hazardous waste according to Federal regulations (40 CFR 261). Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under 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.

EUROPEAN UNION

Waste from this product is not classified as “hazardous” or “special” under European Union regulations. Disposal is permitted at landfills licensed for industrial waste.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

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

INTERNATIONAL

Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train) or IMDG (ship).

15. REGULATORY INFORMATION

UNITED STATES REGULATIONS

EPA: **Superfund Amendments and Reauthorization Act (SARA)** Title III - This product does not contain any substances reportable under Sections 302, 304, 313, (40 CFR 372). Sections 311 and 312 (40 CFR 370) apply (delayed hazard).

Toxic Substances Control Act (TSCA) - All substances in this product are listed, as required, on the TSCA inventory.
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the **Clean Air Act (CAA)** - INSULFRAX® contains fibers with an average diameter greater than one micron and thus is not considered a hazardous air pollutant.

OSHA: Comply with **Hazard Communication Standards** 29 CFR 1910.1200 and 29 CFR 1926.59 and the **Respiratory Protection Standards** 29 CFR 1910.134 and 29 CFR 1926.103.

States: INSULFRAX® products are not known to be regulated. However, state and local OSHA and EPA regulations may apply to these products. If in doubt, contact your local regulatory agency.

INTERNATIONAL REGULATIONS

Canada: **Canadian Workplace Hazardous Materials Information System (WHMIS):** No Canadian Workplace Hazardous Materials Information System (WHMIS) categories apply to this product.
Canadian Environmental Protection Act (CEPA) - All substances in this product are listed, as required, on the Domestic Substance List (DSL)

European Union: **European Directive 97/69/EC** - By virtue of testing results, INSULFRAX® fiber has been exempted from classification and labeling as a potential carcinogen.

16. OTHER INFORMATION

After-Service Insulfrax® Thermal Insulation: Removal

As produced, Insulfrax® fibers are vitreous (glassy) materials, which do not contain crystalline silica. Continued exposure to elevated temperatures may cause these fibers to devitrify (become crystalline). The first crystalline formations to occur are diopside and wollastonite, which begin to form at about 900º C (1652º F). Under recommended usage, it is unlikely that Insulfrax fibers will be exposed to the temperatures and conditions required for the formation of crystalline phase silica. The occurrence and extent of crystalline phase silica formation is highly dependent on temperature, the duration of time that the fibers are exposed to high temperatures, fiber chemistry, and the presence of fluxing agents. The presence of crystalline phase silica can only be confirmed through laboratory analysis of the "hot face" fiber.

IARC's evaluation of crystalline silica states "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)" and additionally notes "carcinogenicity in humans was not detected in all industrial circumstances studied" (IARC Monograph Vol. 68, 1997). NTP lists all polymorphs of crystalline silica amongst substances which may "reasonably be anticipated to be carcinogens".

During removal operations, the use of a full face respirator is recommended to reduce inhalation exposure along with eye & respiratory tract irritation. A specific evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified industrial hygiene professional. For more detailed information regarding respirable crystalline silica, call the Product Stewardship Information Hotline (see below).

PRODUCT STEWARDSHIP PROGRAM

The Unifrax I LLC has established a program to provide customers with up-to-date information regarding the proper use and handling of fiber-based products. In addition, Unifrax I LLC has also established a program to monitor airborne fiber concentrations at customer facilities. If you would like more information about this program, please call the Unifrax I LLC Product Stewardship Information Line at 1-800-322-2293.

DEFINITIONS

ACGIH:	American Conference of Governmental Industrial Hygienists
ADR:	Carriage of Dangerous Goods by Road (International Regulation)
CAA:	Clean Air Act
CAS:	Chemical Abstracts Service
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act
DSL:	Domestic Substances List
EPA:	Environmental Protection Agency
EU:	European Union
f/cc:	Fibers per cubic centimeter
HEPA:	High Efficiency Particulate Air
HMIS:	Hazardous Materials Identification System
IARC:	International Agency for Research on Cancer
IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m³:	Milligrams per cubic meter of air
mmpcf:	Million particles per cubic meter
NFPA:	National Fire Protection Association
NIOSH:	National Institute for Occupational Safety and Health
OSHA:	Occupational Safety and Health Administration
29 CFR 1910.134 & 1926.103:	OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59:	OSHA Hazard Communication Standards
PEL:	Permissible Exposure Limit (OSHA)
PIN:	Product Identification Number
PNOC:	Particulates Not Otherwise Classified
PNOR:	Particulates Not Otherwise Regulated
PSP:	Product Stewardship Program
RCRA:	Resource Conservation and Recovery Act
REL:	Recommended Exposure Limit (NIOSH)
RID:	Carriage of Dangerous Goods by Rail (International Regulations)
SARA:	Superfund Amendments and Reauthorization Act
SARA Title III:	Emergency Planning and Community Right to Know Act
SARA Section 302:	Extremely Hazardous Substances
SARA Section 304:	Emergency Release
SARA Section 311:	MSDS/List of Chemicals and Hazardous Inventory
SARA Section 312:	Emergency and Hazardous Inventory
SARA Section 313:	Toxic Chemicals and Release Reporting
STEL:	Short Term Exposure Limit`
SVF:	Synthetic Vitreous Fiber
TDG:	Transportation of Dangerous Goods
TLV:	Threshold Limit Value (ACGIH)
TSCA:	Toxic Substances Control Act
TWA:	Time Weighted Average
WHMIS:	Workplace Hazardous Materials Information System (Canada)

Revision Summary: Key change: Change in Trade Names. Replaces 03/19/2007 MSDS.

MSDS Prepared By: UNIFRAX RISK MANAGEMENT DEPARTMENT

DISCLAIMER

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Material Safety Data Sheet. Employers may use this MSDS 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 MSDS. Therefore, given the summary nature of this document, Unifrax I LLC 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.

MATERIAL SAFETY DATA SHEET

MSDS No. M0372	Effective Date: 10/05/2007

1. IDENTIFICATION OF THE PRODUCT AND OF THE COMPANY

Trade Names: **ISOFRAX® 1260C PAPER**
Chemical Name: **ALKALINE EARTH SILICATE WOOL (AES)**
Synonym(s): Synthetic vitreous fiber (SVF), man-made vitreous fiber (MMVF), man-made mineral fiber (MMMF), alkaline-earth-silicate fiber, magnesium silicate fiber
Manufacturer/Supplier: **Unifrax I LLC**
2351 Whirlpool St.
Niagara Falls, NY 14305-2413
Product Stewardship Information Hotline
1-800-322-2293 (Monday - Friday 8:00 a.m. - 4:30 p.m. EST)
For additional MSDSs, visit our web page, http: //www.unifrax.com, or call Unifrax Customer Service at (716) 278-3872
CHEMTREC Assist: CHEMTREC will provide assistance for chemical emergencies. Call **1-800-424-9300**

2. COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENTS	CAS NUMBER	% BY WEIGHT
Amorphous alkaline-earth-silicate (magnesium-silicate) wool (SiO2 70-80 %, MgO 18-27 %, trace elements 0-4%)	436083-99-7	80-90
Acrylic latex	MIXTURE	5-10
Aluminum sulfate	10043-01-3	0-5

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines)

3. HAZARDS IDENTIFICATION

MAY IRRITATE EYES, SKIN and RESPIRATORY TRACT

May cause temporary mechanical irritation to eyes, skin, and respiratory tract (nose, throat & lungs).

Pre-existing medical conditions, including dermatitis, asthma or chronic lung disease may be aggravated by exposure; individuals who are atopic (with a history of allergies) may experience greater amounts of skin and respiratory irritation.

HAZARD CLASSIFICATION

The **Hazardous Materials Identification System (HMIS)** –

Health 1 Flammability 0 Reactivity 0 Personal Protection Index: X (Employer Determined)

4. FIRST AID MEASURES

FIRST AID PROCEDURES

RESPIRATORY TRACT (nose & throat) IRRITATION:
If respiratory tract irritation develops, move the person to a dust free location. Get medical attention if the irritation continues. See Section 8 for additional measures to reduce or eliminate exposure.

EYE IRRITATION:
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. Get medical attention if irritation persists.

SKIN IRRITATION:
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.

GASTROINTESTINAL IRRITATION:
If gastrointestinal tract irritation develops, move the person to a dust free environment.

NOTES TO PHYSICIANS:
Skin and respiratory effects are the result of temporary, mild mechanical irritation; fiber exposure does not result in allergic manifestations.

5. FIRE FIGHTING MEASURES

Non-combustible (does not burn) product.

Packaging and surrounding materials may be combustible.
Use extinguishing agent suitable for surrounding combustible materials.

6. ACCIDENTAL RELEASE MEASURES

SPILL PROCEDURES

Avoid creating airborne dust. Dust suppressing cleaning methods such as wet sweeping or vacuuming should be used to clean the work area. If vacuuming, the vacuum must be equipped with a HEPA filter. Compressed air or dry sweeping should not be used for cleaning.

7. HANDLING AND STORAGE

STORAGE

Store in original container in a dry area. Keep container closed when not in use.

HANDLING

Handle fiber carefully. Limit 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.

EMPTY CONTAINERS

Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROL / PERSONAL PROTECTION

INDUSTRIAL HYGIENE STANDARDS AND OCCUPATIONAL EXPOSURE LIMITS

COMPONENTS	OSHA PEL	MANUFACTURER REG
Amorphous alkaline-earth-silicate (magnesium-silicate) wool	None established	See below**
Acrylic latex	None established	None established
Aluminum sulfate	None established	None established

There is no specific regulatory standard for ISOFRAX® in the U.S. OSHA's "Particulate Not Otherwise Regulated (PNOR)" standard [29 CFR 1910.1000, Subpart Z, Air Contaminants] applies generally; Total Dust 15 mg/m^3; Respirable Fraction 5 mg/m^3.

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

ACGIH TLV's : Amorphous alkaline-earth-silicate (magnesium-silicate) wool -- Particulates Not Otherwise Classified (PNOC) : Inhalable particulate -- 10 mg/m³. Respirable particulate -- 3 mg/m³. Acrylic latex -- None established. Aluminum sulfate -- None established.

** As with most industrial materials, it is prudent to minimize unnecessary exposure to respirable dusts. Note that Industrial hygiene standards and occupational exposure limits differ between countries and local jurisdictions. Check with your employer to identify any "respirable dust", "total dust" or "fiber" exposure standards to follow in your area. If no regulatory dust or fiber control standard apply, a qualified industrial hygiene professional can assist with a specific evaluation of workplace conditions and the identification of appropriate respiratory protection practices. In the absence of other guidance, the supplier has found that it is generally feasible to control occupational fiber exposure to 1 f/cc or less.

ENGINEERING CONTROLS:

Dust suppressing control technologies such as local exhaust ventilation, point of generation dust collection, down draft work stations, emission controlling tool designs, and materials handling equipment are effective means of minimizing airborne fiber emissions. For additional information, contact the Unifrax Product Stewardship Information Line at 1-800-322-2293 (See Section 16).

PERSONAL PROTECTION EQUIPMENT

Skin Protection:

Wear gloves, head coverings and full body clothing 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, employers should ensure employees are thoroughly 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.).

Eye Protection:

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

Respiratory Protection:

When effective engineering and/or administrative controls are insufficient, the use of appropriate respiratory protection, pursuant to the requirements of OSHA 1910.134, is recommended. For dust concentrations below the applicable exposure limit value, PPE is not required. 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.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	White, odorless, fibrous material
CHEMICAL FAMILY:	Alkaline Earth Silicate Wool (AES) Magnesium Silicate
BOILING POINT:	Not Applicable
WATER SOLUBILITY (%):	Not Soluble in Water
MELTING POINT:	1500-1550°C (2730-2820°F)
SPECIFIC GRAVITY:	2.60
VAPOR PRESSURE:	Not Applicable
pH:	Not Applicable
VAPOR DENSITY (Air = 1):	Not Applicable
% VOLATILE:	Not Applicable
MOLECULAR FORMULA:	SiO_2MgO.

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY:	Stable under conditions of normal use.
INCOMPATIBILITY:	Avoid direct contact with strong acid environments.
CONDITIONS TO AVOID:	None.
HAZARDOUS DECOMPOSITION PRODUCTS:	
HAZARDOUS POLYMERIZATION:	Not Applicable.

11. TOXICOLOGICAL INFORMATION

EPIDEMIOLOGY

This product has not been the subject of epidemiological study. Epidemiological studies related to other fiber chemistries of similar solubility have not identified a statistically significant incidence of exposure-related respiratory disease.

TOXICOLOGY

This product has been the subject of limited testing.

A review of available scientific literature suggests an inverse relationship between dissolution rate and potential health effects; i.e. the higher the dissolution rate of a fiber the lower its potential to produce health effects. The dissolution rate of ISOFRAX® fiber has been determined through standardized *in vitro* testing. The dissolution rate of ISOFRAX® fibers is higher than that of other fiber types that have been tested in chronic animal studies and did not produce respiratory disease.

This product possesses a fiber chemistry within the regulatory (European Commission Directive 97/69/EC) definition as a "man-made vitreous (silicate) fiber with random orientation with alkaline oxide and alkaline earth oxide (Na2O + K2O + CaO + MgO + BaO) content greater than 18% by weight". ISOFRAX® fibers have been tested pursuant to EU protocol ECB/TM/26, rev. 7, Nota Q, Directive 97/69/EC. The results for the short term biopersistence test by inhalation (IH test) was 6 days; well below the regulatory threshold of 10 days cited in Directive 97/69/EC. Based on testing results, ISOFRAX® based products are not regarded as potential carcinogens and they ARE EXEMPT from European classification as such. By virtue of these test results, these products ARE EXEMPT from European regulatory guidelines that require hazard warning labels with specific risk phrases citing respiratory disease potential. In addition, ISOFRAX® fibers have been tested in an independent laboratory, by intratracheal (IT test) instillation, under a protocol that was consistent with the requirements of the German Hazardous Substances Ordinance (BGBI. I pp. 1782, 2049, Third Amendment, Appendix V, No. 7). The half-life clearance of Isofrax® fibers was 32.7 days; well below the applicable regulatory thresholds. Based on the IT test results, Isofrax products ARE EXEMPT from the requirements of the German Ordinance.

The definition of "irritant" contained in the hazard communication standard, 29 CFR 1900.1200, Appendix A, is "...a reversible inflammatory effect on living tissue by chemical action...". ISOFRAX® fiber is an inert material which doesn't interact chemically

with exposed skin. However, there is a possibility that exposure to this product may cause temporary mechanical irritation to the eyes, skin or respiratory tract (nose, throat, lungs). This temporary irritation can be mitigated with proper handling practices designed to limit exposure and the use of protective clothing (glasses, gloves, clothing).

This product has not been specifically evaluated by any regulatory authority or other classification entity, such as the International Agency for Research on Cancer (IARC) or the National Toxicology Program (NTP). Other types of man-made vitreous fibers (MMVF) have been evaluated and subsequently classified as potential carcinogens. Various classifications, such as "possible carcinogen", "probable carcinogen", and "reasonably anticipated to be a carcinogen" have been given to other MMVF's.

12. ECOLOGICAL INFORMATION

No ecological concerns have been identified.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT

To prevent waste materials from becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended.

DISPOSAL

ISOFRAX® fiber, as manufactured, is not classified as a hazardous waste according to Federal regulations (40 CFR 261). Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under 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.

EUROPEAN UNION

Waste from this product is not classified as “hazardous” or “special” under European Union regulations. Disposal is permitted at landfills licensed for industrial waste.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

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

INTERNATIONAL

Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train) or IMDG (ship).

15. REGULATORY INFORMATION

UNITED STATES REGULATIONS

EPA: **Superfund Amendments and Reauthorization Act (SARA)** Title III - This product does not contain any substances reportable under Sections 302, 304, 313, (40 CFR 372). Sections 311 and 312 (40 CFR 370) apply (delayed hazard).
Toxic Substances Control Act (TSCA) - All substances in this product are listed, as required, on the TSCA inventory.

Comprehensive Environmental Response, Compensation and Liability Act (**CERCLA)** and the **Clean Air Act (CAA)** - ISOFRAX® contains fibers with an average diameter greater than one micron and thus is not considered a hazardous air pollutant.

OSHA: Comply with **Hazard Communication Standards** 29 CFR 1910.1200 and 29 CFR 1926.59 and the **Respiratory Protection Standards** 29 CFR 1910.134 and 29 CFR 1926.103.

States: ISOFRAX® products are not known to be regulated. However, state and local OSHA and EPA regulations may apply to these products. If in doubt, contact your local regulatory agency.

INTERNATIONAL REGULATIONS

Canada: **Canadian Workplace Hazardous Materials Information System (WHMIS):** No Canadian Workplace Hazardous Materials Information System (WHMIS) categories apply to this product.
Canadian Environmental Protection Act (CEPA) - All substances in this product are listed, as required, on the Domestic Substance List (DSL)

European Union: **European Directive 97/69/EC** - By virtue of testing results, ISOFRAX® fiber has been exempted from classification and labeling as a potential carcinogen.

16. OTHER INFORMATION

After-Service ISOFRAX® Thermal Insulation: Removal

As produced, Isofrax fibers are vitreous (glassy) materials, which upon continued exposure to elevated temperatures (above about 800°C) might devitrify, intitially forming magnesia-bearing phases (enstatite). At higher temperatures, (above about 1000°C) crystalline phase silicas may occur. The occurrence and extent of crystalline phase formation is dependent on the duration and temperature of exposure, fiber chemistry and/or the presence of fluxing agents. The presence of crystalline phases can be confirmed only through laboratory analysis of the “hot-face” fiber.

IARC’s evaluation of crystalline silica states “Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)” and additionally notes “carcinogenicity in humans was not detected in all industrial circumstances studied” (IARC Monograph Vol. 68, 1997). NTP lists all polymorphs of crystalline silica amongst substances which may "reasonably be anticipated to be carcinogens".

During removal operations, the use of a full face respirator is recommended to reduce inhalation exposure along with eye & respiratory tract irritation. A specific evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified industrial hygiene professional. For more detailed information regarding respirable crystalline silica, call the Product Stewardship Information Hotline (see below).

PRODUCT STEWARDSHIP PROGRAM

Unifrax has established a program to provide customers with up-to-date information regarding the proper use and handling of fiber-based products, including ISOFRAX® THERMAL INSULATION. In addition, Unifrax has also established a program to monitor airborne fiber concentrations at customer facilities. If you would like more information about this program, please call the Unifrax Product Stewardship Information Line at 1-800-322-2293.

DEFINITIONS

ACGIH: American Conference of Governmental Industrial Hygienists

ADR:	Carriage of Dangerous Goods by Road (International Regulation)
CAA:	Clean Air Act
CAS:	Chemical Abstracts Service
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act
DSL:	Domestic Substances List
EPA:	Environmental Protection Agency
EU:	European Union
f/cc:	Fibers per cubic centimeter
HEPA:	High Efficiency Particulate Air
HMIS:	Hazardous Materials Identification System
IARC:	International Agency for Research on Cancer
IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m³:	Milligrams per cubic meter of air
mmpcf:	Million particles per cubic meter
NFPA:	National Fire Protection Association
NIOSH:	National Institute for Occupational Safety and Health
OSHA:	Occupational Safety and Health Administration
29 CFR 1910.134 & 1926.103:	OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59:	OSHA Hazard Communication Standards
PEL:	Permissible Exposure Limit (OSHA)
PIN:	Product Identification Number
PNOC:	Particulates Not Otherwise Classified
PNOR:	Particulates Not Otherwise Regulated
PSP:	Product Stewardship Program
RCRA:	Resource Conservation and Recovery Act
REL:	Recommended Exposure Limit (NIOSH)
RID:	Carriage of Dangerous Goods by Rail (International Regulations)
SARA:	Superfund Amendments and Reauthorization Act
SARA Title III:	Emergency Planning and Community Right to Know Act
SARA Section 302:	Extremely Hazardous Substances
SARA Section 304:	Emergency Release
SARA Section 311:	MSDS/List of Chemicals and Hazardous Inventory
SARA Section 312:	Emergency and Hazardous Inventory
SARA Section 313:	Toxic Chemicals and Release Reporting
STEL:	Short Term Exposure Limit`
SVF:	Synthetic Vitreous Fiber
TDG:	Transportation of Dangerous Goods
TLV:	Threshold Limit Value (ACGIH)
TSCA:	Toxic Substances Control Act
TWA:	Time Weighted Average
WHMIS:	Workplace Hazardous Materials Information System (Canada)

Revision Summary: Updated corporate name. Added "wool" to CAS nomenclature. Replaces 05/19/05 MSDS.

MSDS Prepared By: UNIFRAX RISK MANAGEMENT DEPARTMENT

DISCLAIMER

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Material Safety Data Sheet. Employers may use this MSDS 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 MSDS. Therefore, given the summary nature of this document, Unifrax I LLC 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.

Industrial Insulation Group
A Calsilite/Johns Manville Joint Venture

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Rev: 1.0.3
Replaces: 4/1/2003

Material Safety Data Sheet

Material Name: Fire Resistant Mineral Wool Insulation

Section 1— Chemical Product and Company Identification

Product Name(s): MinWool-1200™ Board, Flex, Blanket, Pipe, Sound Attenuation Fire Batts, Safing, Curtainwall, Pipe and Tank

Manufacturer Information
Industrial Insulation Group MinWool
908 John Bussey Drive
Phenix City, AL 36869
Web site: www.iig-llc.com

Trade Names: MinWool-1200
Phone number for Health and Safety Information: 970.858.6211 (M-F, 7am to 4 pm, Mountain Time)

Section 2 — Composition and Information on Ingredients

CAS #	Component	Percent	OSHA PEL	ACGIH TLV	NIOSH REL
65997-17-3	Synthetic Vitreous Fiber	95+	15(T) 5(R) mg/M^3	1f/cc	NE
25104-55-6	Cured Urea Formaldehyde/Phenol Binder	0-5	NE	NE	NE

ACGIH TLVs are 2003 values. OSHA PELs are those in effect on the date of preparation of this MSDS. The listed PELs, TVLs and RELs are time weighted average exposure limits.

Component Related Regulatory Information

This product may be regulated, have exposure limits or other information identified as the following:
Nuisance Particulates, Rock Wool Fibers

Section 3 — Hazards Identification

Emergency Overview:

Appearance and Odor: Commercial Board, Batt, and Pipe insulation is solid, green/yellow.

This product is an article and under normal conditions of use, this product is not expected to create any unusual emergency hazards. However, cutting, sawing, or abrading may increase the risk of personnel exposure.

Inhalation of excessive amounts of dust created when fabricating, cutting, or other mechanical alterations of the product may cause temporary upper respiratory irritation and/or congestion— remove affected individuals to fresh air.

Skin irritation may be treated by gently washing affected area with soap and warm water.

Eye irritation may be treated by flushing eyes with large amounts of water. If irritation persists, contact a physician.

Prolonged contact with dust from this product may cause Dermatitis.

Acrid smoke may be generated in a fire, use normal fire fighting procedures to prevent inhalation of smoke and gases.

HMIS Rating: Health: 0, Fire: 0, Reactivity 0, Other: 0
NFPA Rating: Health: 0, Flammability: 0, Reactivity: 0
WHMIS Class: IIG MinWool-1200 products are not controlled products

Potential Health Effects

Summary

Breathing dust from this product may cause a scratchy throat, congestion, and slight coughing.

Getting dust or fibers on the skin, or in the eyes may cause itching, rash, or redness.

Breathing large amounts of dust or fibers from this product may lead to chronic health effects as discussed in Section 11 of this material safety data sheet.

Inhalation:

If inhaled, remove the affected person to fresh air. If irritation persists, seek medical attention.

Skin Contact:

Dusts and fibers from this product may cause temporary mechanical irritation to the skin.

Eye Contact:

Dusts and fibers from this product may cause temporary mechanical irritation to the eyes.

Ingestion:

This product is not intended to be ingested or eaten under normal conditions of use. If ingested, it may cause temporary irritation to the gastrointestinal (GI) tract, especially the stomach.

Target Organs

Upper respiratory passages, skin, and eyes.

Primary Routes of Entry (Exposure)

Inhalation (breathing dust), skin, and eye contact.

Medical Conditions Aggravated by Exposure:

Chronic respiratory or skin conditions may temporarily worsen from exposure to this product.

Section 4 — First Aid Measure

First Aid: Inhalation

Remove to fresh air. Drink water to clear throat, and blow nose to remove dust. If irritation persists, get medical attention.

First Aid: Skin

Wash gently with soap and warm water to remove dust. Use a wash cloth to help remove fibers. To avoid further irritation, do not rub or scratch affected areas. Rubbing or scratching may force fibers into the skin. If irritation persists get medical attention. Never use compressed air to remove fibers from the skin. Wash hands before eating or using the restroom.

First Aid: Ingestion

Product is not intended to be ingested or eaten. If this product is ingested, irritation of the gastrointestinal (GI) tract may occur, and should be treated symptomatically. Watch the person for several days to make sure that partial or complete intestinal obstruction does not occur. Do not induce vomiting unless directed to do so by medical personnel. Rinse mouth with water to remove fibers, and drink plenty of water to help reduce the irritation. No chronic effects are expected following ingestion.

First Aid: Eyes

Do not rub or scratch your eyes. Fibers may cause the eye to be scratched. Flush eyes with large amounts of water for at least 15 minutes. If irritation persists, contact a medical professional.

First Aid: Notes to Physician

This product is a mechanical irritant, and is not expected to produce any chronic health effects from acute exposures. Treatment should be directed toward removing the source of irritation with symptomatic treatment as necessary.

Section 5 — Fire Fighting Measures

Flash Point:	Not applicable	**Method Used:**	Not applicable
Upper Flammable Limit (UFL):	Not applicable	**Lower Flammable Limit (LFL):**	Not applicable
Auto Ignition:	Not determined	**Flammability Classification:**	Non combustible
Rate of Burning:	Not applicable		

General Fire Hazard

There is no potential for fire or explosion.

Extinguishing Media

Use any extinguishing media appropriate for the surrounding fires

Fire Fighting Equipment/Instructions

No special procedures are expected to be necessary for this product. Normal fire fighting procedures should be followed to avoid inhalation of smoke and gases produced by other materials.

Hazardous Combustion Products:

Primary combustion products are carbon monoxide, carbon dioxide, ammonia, and water. Other undetermined compounds could be released in small quantities.

Section 6 — Accidental Release Measures

Containment Procedures

Pick up large pieces. Vacuum dusts. If sweeping is necessary, use a dust suppressant such as water. Do not dry sweep dust accumulation or use compressed air for clean-up. These procedures will help to minimize potential exposures. This material will sink and disperse along the bottom of waterways and ponds. It can not easily be removed after it is waterborne; however, the material is non-hazardous in water.

Clean-Up Procedures

Wastes are not hazardous as defined by the RCRA (40 CFR 261). Comply with state and local regulations for disposal of these products. If you are unsure of the regulations, contact your local Public Health Department, or the local office of the EPA.

Section 7 — Handling and Storage

Handling Procedures

Use protective equipment as described in Section 8 of this material safety data sheet when handling uncontained material. Keep product in its packaging, as long as practicable to minimize potential dust generation. Keep work areas clean. Avoid unnecessary handling of scrap materials by placing them in waste disposal containers and equipment, kept as to close working areas as possible, to prevent release of fibers and dust. Good housekeeping practices should be used to prevent generation and accumulation of dusts. After handling product, wash face and hands before eating, drinking, or smoking.

Storage Procedures

Warehouse storage should be in accordance with package directions, if any. Material should be kept dry, and protected from the elements.

Section 8 — Exposure Control and Personal Protection

General Product Information

Follow all applicable exposure limits and use OSHA-recommended equipment and work practices. A complete copy of these practices can be obtained from IIG MinWool LLC (see Section 1 of this Material Safety Data Sheet), and is also available on the OSHA website (http://www.osha.gov/SLTC/syntheticmineralfibers).

Personal Protective Equipment

Personal Protective Equipment: Eyes/Face

Safety glasses with side shields are recommended to keep dust out of the eyes.

Personal Protective Equipment: Skin

Leather or cotton gloves should be worn to prevent skin contact and irritation. Barrier creams may also be used to reduce skin contact and irritation caused by mineral wool fibers. Normal work clothing (long sleeved shirts and long pants) is recommended. Skin irritation is known to occur chiefly at the pressure points such as around the neck, wrists, waist and between the fingers.

Personal Protective Equipment: Respiratory

A respirator should be used if ventilation is unavailable, or is inadequate for keeping dust and fiber levels below the applicable exposure limits. In those cases, use a NIOSH-certified disposable or reusable particulate respirator with an efficiency rating of N95 or higher (under 42 CFR 84) when working with this product. For exposures up to five times the established exposure limits use a quarter-mask respirator, rated N95 or higher; and for exposures up to ten times the established exposure limits use a half-mask respirator (e.g., MSA's DM-11, Racal's Delta N95, 3M's 8210), rated N95 or higher.

Operations such as sawing, blowing, tear out, and spraying may generate airborne fiber concentrations requiring a higher level of respiratory protection. For exposures up to 50 times the established exposure limits use a full-face respirator, rated N99 or higher.

Ventilation

In fixed manufacturing settings, local exhaust ventilation should be provided at areas of cutting to remove

airborne dust and fibers. General dilution ventilation should be provided as necessary to keep airborne dust and fibers below the applicable exposure limits and guidelines. The need for ventilation systems should be evaluated by a professional industrial hygienist, while the design of specific ventilation systems should be conducted by a professional engineer.

Personal Protective Equipment: General

Loose-fitting, long-sleeved clothing should be worn to protect the skin from irritation. Exposed skin areas should be washed with soap and warm water after handling.

Section 9 — Physical & Chemical Properties

Appearance: Fibrous semi-circle, blanket, or board insulation.

Odor:	Organic	**pH:**	Not applicable
Physical State:	Solid	**Vapor Density:**	Not applicable
Vapor Pressure:	Not applicable	**Melting Point:**	Not determined
Boiling Point:	Not applicable	**Specific Gravity:**	Not determined
Solubility (H2O):	Nil	**Freezing Point:**	Not applicable
Viscosity:	Not applicable	**Evaporation Rate:**	Not applicable
VOC:	Not applicable	**Percent Volatile:**	0

Section 10 — Chemical Stability & Reactivity Information

Chemical Stability

This is a stable material. This product is not reactive.

Hazardous Decomposition

None.

Hazardous Polymerization

Will not occur.

Incompatible Materials:

This product reacts with hydrofluoric acid.

Hazardous Decomposition Products:

Primary combustion products are carbon monoxide, carbon dioxide, ammonia, and water. Other undetermined compounds could be released in small quantities.

Section 11 — Toxicological Information

Acute Toxicity

A: General Product Information

Dusts may cause mechanical irritation to eyes and skin. Ingestion may cause transient irritation of throat, stomach and gastrointestinal tract. Inhalation may cause coughing, nose and throat irritation, and sneezing. Higher exposures may cause difficulty breathing, congestion, and chest tightness.

B: Component Analysis - LD50/LC50

No LD50/LC50's are available for this product.

Carcinogenicity

A: General Product Information

OSHA, NTP, IARC, and ACGIH have not classified this product in its entirety as a carcinogen.

B: Component Analysis - LD50/LC50

Cured Urea/formaldehyde/phenol binder (25104-55-6)

Oral LD50 Rat : 7 gm/kg

Oral LD50 Mouse : 7 gm/kg

Carcinogenicity:

A: General Product Information

In October 2001 the IARC concluded its re-evaluation of the carcinogenic risk of mineral wool fibers. The result was a reclassification of the fibers from Group 2B (possibly carcinogenic to humans) to Group 3 (not classifiable as to the carcinogenicity to humans). Epidemiological studies published during the 15 years prior to the 2001 IARC review provide no evidence of increased risk of cancer from occupational exposure during manufacture or use of mineral wool fiber.

B: Component Carcinogenicity

ACGIH, IARC, OSHA, and NTP carcinogen lists have been checked for those components with CAS registry numbers.

Synthetic Vitreous Fiber (65997-17-3)

ACGIH: A3 - animal carcinogen (related to rock wool fibers) with unknown relevance to humans

IARC: Monograph 43, 1988 (related to Glass filaments) (Group 3 (not classifiable))

Section 12 — Ecological Information

Ecotoxicity

A: General Product Information

No data available for this product.

B: Component Analysis - Ecotoxicity - Aquatic Toxicity

No ecotoxicity data are available for this product's components.

Section 13 — Disposal Considerations

US EPA Waste Number & Descriptions

A: General Product Information

This product, as supplied, is not regulated as a hazardous waste by the U.S. EPA under RCRA regulations. Comply with state and local regulations for disposal. If you are unsure of the regulations, contact your local Public Health Department, or the local office of the EPA.

B: Component Waste Numbers

No EPA Waste Numbers are applicable for this product's components.

Disposal Instructions

Dispose of waste material according to Local, State, Federal, and Provincial Environmental Regulations.

Section 14 — Transport Information

US DOT Information

Shipping Name: This product is not classified a hazardous material for transport.

Section 15 — Regulatory Information

US Federal Regulations

A: General Product Information

No information on this product as a whole. Formaldehyde content is below the SARA 313 0.1% 'de minimis concentration.

B: Component Analysis

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Synthetic Vitreous Fiber(65997-17-3)

CERCLA: Includes mineral fiber emissions from facilities manufacturing or processing glass rock or slag fibers (or other mineral derived fibers) of average diameter 1 micrometer or less; Statutory RQ = 1 pound (.454 kg); no final RQ is being assigned to the generic or broad class (related to Fine mineral fibers)

State Regulations

A: General Product Information

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): WARNING! This product contains a chemical known to the state of California to cause cancer.

Other Regulatory Information

A: General Product Information

No information available for the product.

B: TSCA Status

All ingredients of this product are included in the US EPA Chemical Substance Inventory or are not required to be listed.

C: CERCLA

Includes mineral fiber emissions from facilities manufacturing or processing glass rock or slag fibers (or other mineral derived fibers) of average diameter 1 micrometer or less; Statutory RQ = 1 pound (.454 kg); no final RQ is being assigned to the generic or broad class (related to Fine mineral fibers).

D: Clean Air Act

Mineral wool fiber appears on the Clean Air Act-1990 Hazardous Air Pollutants List.

International Regulations
A: General Product Information
Canada Workplace Hazardous Materials Information System (WHMIS)

WHMIS Classification: D2B– Irritant

Product classified as a manufactured article as defined in Hazardous Product Act (HPA), Section 11(1). Section 12(I) exempts it from the WHMIS supplier label and MSDS requirements of the Act.

B: Component Analysis - WHMIS IDL

No components are listed in the WHMIS IDL.

Section 16 — Other Information

Information about "Health and Safety Research on Rock- and Slag-wool" can be obtained from the North American Insulation Manufacturers Association (NAIMA), 44 Canal Center Plaza, Suite 310, Alexandria, VA 22314, or on the web at http://www.naima.org

This product has been classified according to the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

Key/Legend:
EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act; ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; NFPA = National Fire Protection Association; HMIS = Hazardous Material Identification System; RCRA = Resource Conservation and Recovery Act; CERCLA = Comprehensive Environmental Response, Compensation and Liability Act; SARA = Superfund Amendments and Reauthorization Act; DSL = Canadian Domestic Substance List; EINECS = European Inventory of New and Existing Chemical Substances; WHMIS = Workplace Hazardous Materials Information System; CAA = Clean Air Act; CHPA=Canadian Hazardous Product Act; IDL=Canadian Hazardous Disclosure List

Revision Summary:
This is a revised MSDS which replaces Revision 1.0.2 with new formatting and updated exposure information. A new ID number was assigned to this document to be consistent with other IIG documents.

Get this and other MSDS forms electronically via Internet: http://www.iig-llc.com.

As of the date of preparation of this document, the foregoing information is believed to be accurate and is provided in good faith to comply with applicable federal and state law(s). However, no warranty or representation with respect to such information is intended or given.

IMPORTANT SAFETY NOTICE: The information in this MSDS relates only to the specific material described herein and does not relate to use in combination with any other material or substance or in any process. Because of the use of this information and the conditions of use of this product are not within the control of Industrial Insulation Group, it is the users obligation to determine the conditions of safe use of this product. Users of this product should study this MSDS and become aware of the product hazards and safety information before using this product. Users should also notify their employees, agents, and contractors regarding information contained in this MSDS and any product hazards and safety information in order to provide for safe use of this product.

Material Safety Data Sheet

SILICA, AS, CAS, AS/AR, CAS/AR, ASM and AST SERIES

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Trade Names/Synonyms	Amorphous silica in various forms - cloth, tapes, blankets, mat, tubing, etc.
Product Identification	AS, CAS, AS/AR, CAS/AR, ASM and AST series.
Chemical Name/Synonyms	Continuous filament silicon dioxide (SiO_2)/fibrous silica, amorphous silica chemical family.
Manufacturer's Name	DAR Industrial Products Inc 2 Union Hill Road Bldg # 1 West Conshohocken, Pa. 19428 (610) 825-4900
Date prepared	February 17, 1994
Revised	November 7, 1996 (second revision) November 4, 1997 (third revision: update Section 7, Handling based on IARC reclassification)
Reviewed for content & accuracy	April 16, 2007

2. COMPOSITION / INFORMATION ON INGREDIENTS

Hazardous Ingredients	Weight %	OSHA-PEL	ACGIH-TLV	OTHER
Silicone dioxide, continuous filament	≥ 90	a.	10 mg/ m^3. 8-hr TWA	none known
Nonhazardous Ingredients				
Sizing/bound water	≤ 10	----------none established----------		

a. OSHA has not established a specific PEL for fibrous silicone dioxide (amorphous silica). It is considered to be a "particulate not otherwise regulated" (PNOR) and is covered under the OSHA nuisance dust PEL's of 5 mg/m^3 for the respirable dust fraction and 15 mg/m^3 for the total dust fraction for an 8-hr TWA (Time Weighted Average). Chemically, AMI-SIL® is amorphous silica which has an OSHA limit of 20 mppcf or 80 mg/m^3.

3. HAZARDS IDENTIFICATION

PRIMARY ROUTES OF EXPOSURE: Inhalation and skin contact.

HEALTH HAZARDS (Including acute and chronic effects and symptoms of overexposure):

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Material Safety Data Sheet

SILICA, AS, CAS, AS/AR, CAS/AR, ASM and AST SERIES

3. HAZARDS IDENTIFICATION (CONT)

ACUTE:

Inhalation: Inhalation of dusts and fibers may result in irritation of the upper respiratory tract (mouth, nose and throat).

Skin Contact: Skin contact with dusts and fibers may produce itching and temporary mechanical irritation.

Eye Contact: Eye contact with fibers and dusts may produce temporary mechanical irritation.

Ingestion: Temporary mechanical irritation of the digestive tract. Observe individual. If symptoms develop, consult a physician.

CHRONIC: See carcinogenicity section below. There are no known health effects associated with chronic exposure to this product.

CARCINOGENICITY:

Hazardous Ingredients:	Listed as carcinogen by:	ACGIH	IARC	NTP	OSHA
Silicone dioxide, continuous filament		NA	NA	NA	NA

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Persons with a history of chronic respiratory or skin conditions that are aggravated by mechanical irritants may be at increased risk for worsening their condition from exposure during use of the product.

4. FIRST AID MEASURES

Inhalation: Move individual to fresh air. Seek medical attention if irritation persists.

Skin Contact: Wash with mild soap and running water. Use a washcloth to help remove fibers. To avoid further irritation do not rub or scratch irritated areas. Rubbing or scratching may force fibers into the skin. Seek medical attention if irritation persists.

Eye Contact: Flush eyes with flowing water for at least 15 minutes. Seek medical attention if irritation persists.

Ingestion: N. A. (Not Applicable)

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Material Safety Data Sheet

SILICA, AS, CAS, AS/AR, CAS/AR, ASM and AST SERIES

5. FIRE FIGHTING MEASURES

Flash Point (^{O}F): NA (Not Applicable)

Auto Ignition Temperature (^{O}F): NA

Flammability Limits (%): LEL: NA UEL: NA

Extinguishing Media: Water, foam, carbon dioxide, dry chemical

Special Fire-Fighting Instructions: In a sustained fire, self contained breathing apparatus should be worn.

Unusual Fire and Explosion Hazards: None known.

6. ACCIDENTAL RELEASE MEASURES

ACTION TO TAKE FOR SPILLS (Use Appropriate Safety Equipment): For solid product, not applicable. For dusts and fibers generated during fabrication vacuum up and containerize.

7. HANDLING, STORAGE AND DISPOSAL

HANDLING: See Section 8.

The toxicologic data indicate that these materials should be handled with caution. The handling practices described in Section 8 of this MSDS must be strictly followed.

Product which has been in service at elevated temperature (> 1800^{O} F) may undergo partial conversion to cristobalite, a form of crystalline silica. This reaction occurs at the lining hot face. As a consequence, this material becomes more friable (brittle); special caution must be taken to minimize generation of airborne dust. The amount of cristobalite present will depend on the temperature and length in service.

IARC has recently reviewed the animal, human and other relevant experimental data on silica in order to critically evaluate and classify the cancer causing potential. Based on its review, IARC has now classified crystalline silica/cristobalite as a Group 1 carcinogen. Crystalline silica inhaled in the form of quartz or cristobalite from industrial sources was classified as ***carcinogenic to humans*** on the basis of a relatively large number of epidemiological studies that together provided ***sufficient evidence*** in humans for the carcinogenicity of inhaled crystalline silica under the conditions specified. Crystalline silica is also listed by the NTP as a substance reasonably anticipated to be a carcinogen.

Material Safety Data Sheet

SILICA, AS, CAS, AS/AR, CAS/AR, ASM and AST SERIES

7. HANDLING, STORAGE AND DISPOSAL (CON'T)

HANDLING (CON'T): See Section 8.

Therefore, special care should be taken when working with "used" material to minimize the generation of dust. The OSHA permissible exposure limit (PEL) for cristobalite is 0.05 mg/m^3 (resp.). The ACGIH threshold limit value (TLV) for cristobalite is 0.05 mg/m^3 (resp.). (ACGIH 1989 - 90). If exposure limits are exceeded or if irritation is experienced, NIOSH approved respiratory protection should be worn. NIOSH approved respirator for particulates with a TLV of less than 0.05 mg/m3 is generally acceptable, except that supplied air respirators are required for high airborne dust concentrations.

STORAGE: Store in a clean, dry area. Keep containers closed.

DISPOSAL: Dispose in accordance with federal, state and local regulations as a solid nonhazardous waste.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

VENTILATION: General dilution ventilation and/or local exhaust ventilation should be provided, as necessary, to maintain exposures below PEL's or TLV's. **Adequate ventilation must be provided at elevated temperatures.** The base silica material is noncombustible; however, at temperatures above 250°F, the coating may generate some light steam and/or smoke for a brief period which may require local ventilation and/or exhaust.

RESPIRATORY PROTECTION: A properly fitted NIOSH/MHSA approved disposable dust respirator such as the 3M model 8710 or model 9900 (in high humidity environments) or equivalent should be used when: high dust levels are encountered; the level of fibers in the air exceeds the OSHA permissible exposure limits; or if irritation occurs. Use respiratory protection in accordance with your company's respiratory protection program and OSHA regulations under 29 CFR 1910.134.

EYE PROTECTION: Wear safety glasses or chemical goggles to prevent eye contact. Contact lenses should not be worn unless chemical goggles are also used and care is taken not to touch the eyes with contaminated body parts or materials. Have eye washing facilities readily available where eye contact can occur.

PROTECTIVE CLOTHING: Wear loose fitting, long sleeved shirt that covers to the base of the neck, and long pants. Skin irritation from exposure to silica fibers is known to occur chiefly at pressure points such as around the neck, wrist and waist. Wear gloves when handling product.

Material Safety Data Sheet

SILICA, AS, CAS, AS/AR, CAS/AR, ASM and AST SERIES

8. EXPOSURE CONTROLS / PERSONAL PROTECTION (CONT)

WORK/HYGIENIC PRACTICES: Handle in accordance with good industrial hygiene and safety practices:

- Avoid unnecessary exposure to dusts and fibers
- Remove fibers from skin after exposure
- Be careful not to rub or scratch irritated areas. Rubbing or scratching may force the fibers into the skin. The fibers should be washed off. Use of barrier creams can, in some instances, be helpful.
- Use vacuum equipment to remove fibers and dusts from clothing. **COMPRESSED AIR SHOULD NEVER BE USED.** Always wash work clothes separately and wipe out the washer/sink in order to prevent loose fibers from getting on other clothes.
- Keep the work area clean of any dusts and fibers generated during fabrication. Use vacuum equipment to clean up dusts and fibers. Avoid sweeping or using compressed air as these techniques resuspend dusts and fibers into the air.
- Have access to safety showers and eye wash fountains.
- For professional use only. **Keep out of children's reach.**

9. PHYSICAL AND CHEMICAL PROPERTIES

MELTING POINT (Softening): >3000°F

BOILING POINT (°C): NA (Not Applicable)

SPECIFIC GRAVITY : 2.2

PERCENT VOLATILE: NA

VAPOR PRESSURE (mm Hg): NA

VAPOR DENSITY (Air = 1): NA

EVAPORATIVE RATE (Ethyl Ether = 1): NA

SOLUBILITY IN WATER: Not soluble

APPEARANCE AND ODOR: White/off-white/tan colored solid with no odor; AR series has an orange color.

pH: NA

Material Safety Data Sheet

SILICA, AS, CAS, AS/AR, CAS/AR, ASM and AST SERIES

10. STABILITY AND REACTIVITY

STABILITY (Conditions to Avoid): Product is stable.

INCOMPATIBILITY (Materials to Avoid):	Basic phosphates, hydrofluoric acid, some oxides and hydroxides.
HAZARDOUS DECOMPOSITION PRODUCTS:	Sizings or binders may decompose in a fire. Primary decomposition products include carbon monoxide, carbon dioxide, other hydrocarbons and water.

HAZARDOUS POLYMERIZATION: Will not occur.

To the best of our knowledge, the information contained herein is accurate. The information provided is based upon data furnished by our suppliers. However, neither DAR Industrial Products Inc., nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. While believed to be reliable, the information or products are intended for use by skilled persons at their own risk. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards which exist.

Material Safety Data Sheet

WIRE MESH, IWM Series

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Trade Names/Synonyms	Inconel Mesh Cable
Product Identification	Inconel Mesh Cable
Chemical Name/Synonyms	Inconel alloy.
Manufacturer's Name	D.A.R. Industrial Products Inc. 2 Union Hill Road, Bldg # 1 West Conshohocken, Pa. 19428
Date prepared	October 19, 1998
Reviewed for accuracy & content	April 2, 2007

2. COMPOSITION / INFORMATION ON INGREDIENTS

Hazardous Ingredients	Weight %	OSHA-PEL	ACGIH-TLV	OTHER
Iron (Fe) (as oxide fume)	proprietary	10 mg/m^3	5 mg/m^3	----------
Chromium (Cr)	proprietary	1 mg/m^3	0.5 mg/m^3	----------
Nickel (Ni)	proprietary	1 mg/m^3	1 mg/m^3	----------
Cobalt (Co)	proprietary	0.1 mg/m^3	0.1 mg/m^3	----------
Aluminum (Al)	proprietary	none	10 mg/m^3	----------
Manganese (Mn)	proprietary			
Dust		5 mg/m^3 C*	5 mg/m^3 C*	----------
Fume		3 mg/m^3	----------	----------
Molybdenum (Mo)	proprietary	15 mg/m^3	10 mg/m^3	----------
Tantalum (Ta)	proprietary	5 mg/m^3	5 mg/m^3	----------
Tungsten (W)	proprietary	none	5 mg/m^3	----------
Yttrium (Y)	proprietary	1 mg/m^3	1 mg/m^3	----------
Nonhazardous Ingredients	**Weight %**	**OSHA-PEL**	**ACGIH-TLV**	**OTHER**
Niobium (Nb)	proprietary	----------none----------		
Iron (Fe) Dust	proprietary	----------none----------		

C* = Ceiling Limit

Material Safety Data Sheet

AMI-FAB® WIRE MESH, IWM Series

3. HAZARDS IDENTIFICATION

PRIMARY ROUTES OF EXPOSURE: Inhalation and skin contact of dusts and fumes.

HEALTH HAZARDS (Including acute and chronic effects and symptoms of overexposure):

ACUTE: NOTE: Inconel products in their usual physical state do not pose any health hazards. However, when subjected to welding, burning, grinding, cutting, abrasive blasting, heat treatment, pickling, or similar operations, potentially hazardous fumes or dusts may be emitted. Despite the fact that welding, burning, etc. of inconel products in this category may produce fumes containing manganese, chromium, nickel and copper, the air concentrations generated of these components are expected to be extremely low.

Iron (Fe): Subjecting iron and alloys containing iron to high temperatures (such as welding) will cause the formation of iron oxide. Long-term exposure to iron oxide fumes or dusts has been associated with a benign lung condition known as siderosis which is observable as an x-ray change. No physical impairment of lung function has been linked to siderosis.

Manganese (Mn): Mn intoxication is usually due to the oxide or salts of Mn; elemental Mn exhibits very low toxicity. The dusts and fumes can act as minor irritants to the eyes and respiratory tract. Both acute and chronic exposure may adversely affect the central nervous system (CNS), but symptoms are more likely to occur after at least one or two years of prolonged or repeated exposures. Early symptoms may include weakness in the lower extremities, sleepiness, salivation, nervousness and apathy. In more advanced stages, severe muscular incoordination, impaired speech, spastic walking, mask-like facial expressions and uncontrollable coughing may occur. Manganese fumes have also been reported to result in metal fume fever, a flu-like syndrome with symptoms such as dizziness, chills, fever, headache and nausea. An increased incidence of pneumonia, bronchitis and pneumonitis has been reported in some worker populations exposed to manganese. Animal studies indicate exposure may increase susceptibility to bacterial and viral infection.

Chromium (Cr): The toxicity and health hazards of chromium are heavily dependent on its oxidation state. The elemental (as in the metals), divalent and trivalent forms are of very low toxicity. The hexavalent form (such as occurs in chromates and chromic acids) is very toxic and can produce both acute and chronic effects. Adverse effects on the skin may include ulcerations, irritative dermatitis and allergic skin reactions. Adverse effects on the respiratory system may include bronchospasms, edema, hypersecretion, bronchitis, irritation, allergic asthmatic reactions, and, ulceration and perforation of the nasal septum. Respiratory symptoms may include coughing and wheezing, shortness of breath and nasal itch. Eye irritation or inflammation can also be produced. Exposure to some hexavalent chromium compounds have also been shown to be associated with an increased risk of lung cancer.

Nickel (Ni): Ni fumes and dust are respiratory irritants and may cause severe pneumonitis. Skin contact with nickel and its compounds may cause an allergic dermatitis. The resulting skin rash is often referred to as "nickel itch". Ni and its compounds may also produce eye irritation, particularly on the inner surfaces of the eyelids (i.e. the conjunctiva). Animal and/or epidemiology studies have linked nickel and certain nickel compounds to an increased incidence of cancer of the lungs and nasal passages.

Material Safety Data Sheet

AMI-FAB® WIRE MESH, IWM Series

3. HAZARDS IDENTIFICATION (CONT'D)

Copper (Cu): Inhalation of copper fume may cause irritation of the eyes and throat and a flu-like illness called metal fume fever. Signs and symptoms of metal fume fever include fever, muscle aches, nausea, chills, dry throat, cough and weakness. Cu fume may also produce a metallic or sweet taste. Repeated or prolonged exposure to Cu fume may cause discoloration of the skin or hair.

Aluminum (Al): There are no reported known health effects. Aluminum is generally considered to be in the nuisance dust category.

Silicon (Si): Silicon may produce x-ray changes in the lungs. There has been no known disability reported from the x-ray changes.

Tungsten (W): There has been some reported evidence of pulmonary involvement such as a cough.

Molybdenum (Mo): Molybdenum has caused, in animal studies, irritation of the nose and throat, weight loss and digestive disturbances. There have been no reports of industrial poisoning.

Cobalt (Co): Cobalt has been reported to cause asthma. It may also cause interstitial pneumonitis and sensitization of the respiratory system.

ACUTE: Inhalation: Inhalation of dusts and fibers may result in irritation of the upper respiratory tract (mouth, nose and throat).

Inconel - dust or fumes may give a metallic taste; headache; nausea; chills; fever; tightness of chest; irritation of the respiratory tract, eyes, nose; cough.

Loss of consciousness/death **due to welding gases** or lack of oxygen.

Skin Contact: Skin contact with dusts and fibers may produce itching and temporary mechanical irritation.

Eye Contact: Eye contact with fibers and dusts may produce temporary mechanical irritation.

Ingestion: Temporary mechanical irritation of the digestive tract. Observe individual. If symptoms develop, consult a physician.

CHRONIC: See carcinogenicity section below. Chronic exposure to Chromium (Cr)/Nickel (Ni)/Manganese (Mn) fumes or dust may cause skin sensitization, asthma, bronchitis, lung fibrosis or pneumoniosis. It may also cause damage to the kidneys and liver as well as the nervous system.

Material Safety Data Sheet

AMI-FAB® WIRE MESH, IWM Series

3. HAZARDS IDENTIFICATION (CONT'D)

CARCINOGENICITY:

Hazardous Ingredients:	Listed as carcinogen by: ACGIH IARC NTP OSHA
Chromium (Cr)/Nickel (Ni)**	----none known----

****Dusts and fumes containing Chromium (Cr) or Nickel (Ni) should be considered carcinogens.**

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Persons with a history of chronic respiratory or skin conditions that are aggravated by mechanical irritants may be at increased risk for worsening their condition from exposure during use of the product.

4. FIRST AID MEASURES

Inhalation: Move individual to fresh air. Seek medical attention if irritation persists. Administer artificial respiration, if breathing has stopped.

Skin Contact: Wash with mild soap and running water. To avoid further irritation do not rub or scratch irritated areas. Seek medical attention if irritation persists.

Eye Contact: Flush eyes with flowing water for at least 15 minutes. Seek medical attention if irritation persists.

Ingestion: N. A. (Not Applicable)

5. FIRE FIGHTING MEASURES

Flash Point (°F): NA (Not Applicable)

Auto Ignition Temperature (°F):NA

Flammability Limits (%): LEL: NA UEL: NA

Extinguishing Media: Water, foam, carbon dioxide, dry chemical

Special Fire-Fighting Instructions: In a sustained fire, self contained breathing apparatus should be worn.

Unusual Fire and Explosion Hazards: None known.

6. ACCIDENTAL RELEASE MEASURES

ACTION TO TAKE FOR SPILLS (Use Appropriate Safety Equipment): For solid product, not applicable. For dusts and fibers generated during fabrication vacuum up and containerize.

Material Safety Data Sheet

AMI-FAB® WIRE MESH, IWM Series

7. HANDLING, STORAGE AND DISPOSAL

HANDLING: See Section 8.

STORAGE: No special precautions necessary.

DISPOSAL: Dispose in accordance with federal, state and local regulations as a solid nonhazardous waste.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

VENTILATION: General dilution ventilation and/or local exhaust ventilation should be provided, as necessary, to maintain exposures below PEL's or TLV's. **Adequate ventilation must be provided at elevated temperatures. Adequate ventilation must also be provided when welding or grinding the inconel core.**

RESPIRATORY PROTECTION: A properly fitted NIOSH/MHSA approved disposable dust respirator should be used when: high dust levels are encountered; the level of Chromium/Nickel/Manganese/Cobalt/ Aluminum/Molybdenum/Tantalum/Tungsten/Yttrium dust in the air exceeds the OSHA permissible exposure limits; or if irritation occurs. Use an air supplied respirator in confined spaces. Use industrial hygiene air monitoring to insure that TLV or PEL values are not exceeded. Use respiratory protection in accordance with your company's respiratory protection program and OSHA regulations under 29 CFR 1910.134 .

EYE PROTECTION: Safety glasses, goggles or face shields should be worn.

PROTECTIVE CLOTHING: Wear loose fitting, long sleeved shirt that covers to the base of the neck, and long pants. Wear gloves when handling product.

WORK/HYGIENIC PRACTICES: Handle in accordance with good industrial hygiene and safety practices:

= Avoid unnecessary exposure to dusts.

= **Do not expose skin when cutting, grinding or welding the inconel mesh cable.**

= Be careful not to rub or scratch irritated areas. Use of barrier creams can, in some instances, be helpful.

= Use vacuum equipment to remove dusts from clothing. **COMPRESSED AIR SHOULD NEVER BE USED.** Always wash work clothes separately.

= Keep the work area clean of any dusts generated during fabrication. Use vacuum equipment to clean up dusts. Avoid sweeping or using compressed air as these techniques resuspend dusts into the air.

= Have access to safety showers and eye wash fountains.

= For professional use only. **Keep out of children's reach.**

Material Safety Data Sheet

AMI-FAB® WIRE MESH, IWM Series

9. PHYSICAL AND CHEMICAL PROPERTIES

MELTING POINT (Softening): NM (Not Measured)

BOILING POINT (°C): NA (Not Applicable)

SPECIFIC GRAVITY (Bare Glass): NM

PERCENT VOLATILE: NA

VAPOR PRESSURE (mm Hg): NA

VAPOR DENSITY (Air = 1): NA

EVAPORATIVE RATE (Ethyl Ether = 1): NA

SOLUBILITY IN WATER: Not soluble

APPEARANCE AND ODOR: Metallic appearing mesh with no odor.

pH: NA

10. STABILITY AND REACTIVITY

STABILITY (Conditions to Avoid): Product is stable.

INCOMPATIBILITY (Materials to Avoid): None known.

HAZARDOUS DECOMPOSITION PRODUCTS: SEE SECTION 3.

HAZARDOUS POLYMERIZATION: Will not occur.

To the best of our knowledge, the information contained herein is accurate. The information provided is based upon data furnished by our suppliers. However, neither [redacted], nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. While believed to be reliable, the information or products are intended for use by skilled persons at their own risk. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards which exist.

Industrial Insulation Group
A Calsilite/Johns Manville Joint Venture

Date: 8/31/2005
MSDS ID: 20501
Rev: 1.0.4
Replaces: 10/6/2003

Material Safety Data Sheet

Material Name: Calcium Silicate Insulation

Section 1— Chemical Product and Company Identification

Product Name: Thermo-12® Gold Calcium Silicate Insulation
CAS# Mixture/None Assigned
Generic Name: Insulation (Calcium Silicate)
Formula: Mixture
Chemical Name: Synthetic Calcium Silicate

Manufacturer Information
Industrial Insulation Group
2100 Line Street
Brunswick, GA. 31520

Phone number for Health and Safety Information: 970.858.6211 (M-F, 7:00a.m. to 4:00p.m., Mountain Time)

Trade Name: Thermo-12 Gold

Section 2 — Composition and Information on Ingredients

CAS #	Component	Percent	OSHA PEL	ACGIH TLV	NIOSH REL	UNITS
1344-95-2	Synthetic Calcium Silicate	> 93	15(T) 5(R)	10	10(T) 5(R)	mg/M^3
51274-00-1	Iron-based color	< 1	15(T) 5(R)	10	NE	mg/M^3
65997-17-3	Synthetic Vitreous Fiber	0 - 2	15(T) 5(R)	5	5	mg/M^3
9004-34-6	Cellulose Fiber	0 - 2	15(T) 5(R)	10	10(T) 5(R)	mg/M^3
1344-09-8	Sodium Silicate	0 - 6	15(T) 5(R)	10	NE	mg/M^3

NE = Not Established
ACGIH TLVs are 2003 values. OSHA PELs are those in effect on the date of preparation of this MSDS. The listed PELs, TVLs and RELs are time weighted average exposure limits.

Component Related Regulatory Information
This product may be regulated, have exposure limits or other information identified as the following:
Nuisance particulates.

Section 3 — Hazards Identification

Emergency Overview
APPEARANCE AND ODOR: Odorless, Yellow semi-circle or block insulation with coloring throughout as a visual marker to indicate this is an asbestos-free product.

This product is an article and under normal conditions of use, this product is not expected to create any unusual emergency hazards. However, cutting, sawing, or abrading may increase the risk of personnel exposure.

Inhalation of excessive amounts of dust created when fabricating, cutting, or other mechanical alterations of the product may cause temporary upper respiratory irritation and/or congestion— remove affected individuals to fresh air.

Skin irritation may be treated by gently washing affected area with soap and warm water.

Eye irritation may be treated by flushing eyes with large amounts of water. If irritation persists, contact a physician.

Prolonged contact with dust from this product may cause Dermatitis.
In the event of fire, use normal fire fighting procedures to prevent inhalation of smoke and gases.

HMIS Rating: Health: 1, Fire: 0, Reactivity 0, Other: 0
WHMIS Class: Thermo-12 Gold is not a WHMIS controlled product

Potential Health Effects

Summary

Breathing dust from this product may cause a scratchy throat, congestion, and slight coughing.

Getting dust or fibers on the skin, or in the eyes may cause itching, rash, or redness.

Breathing large amounts of dust or fibers from this product may lead to chronic health effects as discussed in Section 11 of this material safety data sheet.

Inhalation

Irritation of the upper respiratory tract (scratchy throat), coughing, and congestion may occur in extreme exposures.

Skin

Temporary irritation (itching) or redness may occur.

Absorption

Not applicable

Ingestion

This product is not intended to be ingested or eaten under normal conditions of use. If ingested, it may cause temporary irritation to the gastrointestinal (GI) tract, especially the stomach.

Eyes

Temporary irritation (itching) or redness may occur.

Target Organs

Upper respiratory passages, skin, and eyes.

Primary Routes of Entry (Exposure)

Inhalation (breathing dust), skin, and eye contact.

Medical Conditions Aggravated by Exposure

Pre-existing chronic respiratory, skin, or eye diseases or conditions may be aggravated by exposure to this product

Section 4 — First Aid Measures

First Aid: Inhalation

Remove to fresh air. Drink water to clear throat, and blow nose to remove dust.

First Aid: Skin

Wash gently with soap and warm water to remove dust. Wash hands before eating or using the restroom.

First Aid: Ingestion

Product is not intended to be ingested or eaten. If this product is ingested, irritation of the gastrointestinal (GI) tract may occur, and should be treated symptomatically. Rinse mouth with water to remove fibers, and drink plenty of water to help reduce the irritation. No chronic effects are expected following ingestion.

First Aid: Eyes

Do not rub or scratch your eyes. Dust particles may cause the eye to be scratched. Flush eyes with large amounts of water for 5-15 minutes. If irritation persists, contact a medical professional.

First Aid: Notes to Physician

This product is a mechanical irritant, and is not expected to produce any chronic health effects from acute exposures. Treatment should be directed toward removing the source of irritation with symptomatic treatment as necessary.

Section 5 — Fire Fighting Measures

Flash Point:	Not applicable	**Method Used:**	Not applicable
Upper Flammable Limit (UFL):	Not applicable	**Lower Flammable Limit (LFL):**	Not applicable
Auto Ignition:	Not determined	**Flammability Classification:**	Non combustible
Rate of Burning:	Not applicable		

General Fire Hazard

There is no potential for fire or explosion.

Extinguishing Media

Use any extinguishing media appropriate for the surrounding fires

Fire Fighting Equipment/Instructions

No special procedures are expected to be necessary for this product. Normal fire fighting procedures should be followed to avoid inhalation of smoke and gases produced by other materials.

Section 6 — Accidental Release Measures

Containment Procedures

Pick up large pieces. Vacuum dusts. If sweeping is necessary, use a dust suppressant such as water. Do not dry sweep dust accumulation or use compressed air for clean-up. These procedures will help to minimize potential exposures.

Clean-Up Procedures

Wastes are not hazardous as defined by the RCRA (40 CFR 261). Comply with state and local regulations for disposal of these products. If you are unsure of the regulations, contact your local Public Health Department, or the local office of the Environmental Protection Agency (EPA).

Section 7 — Handling and Storage

Handling Procedures

Use protective equipment as described in Section 8 of this material safety data sheet when handling uncontained material. Good housekeeping practices should be used to prevent generation and accumulation of dusts. After handling product, wash face and hands before eating, drinking, or smoking.

Storage Procedures

Warehouse storage should be in accordance with package directions, if any. Material should be kept dry, and protected from the elements.

Section 8 — Exposure Control and Personal Protection

General Product Information

This product may contain trace amounts of crystalline silica as a natural contaminant in the raw materials. However, standard industrial hygiene air monitoring surveys conducted under normal and test (worst-case) situations have not detected any airborne respirable crystalline silica in the occupational environment.

Personal Protective Equipment

Personal Protective Equipment: Eyes/Face

Safety glasses with side shields are recommended to keep product out of the eyes.

Personal Protective Equipment: Skin

Leather or cotton gloves should be worn to prevent skin contact and irritation. Barrier creams may also be used to reduce skin contact and irritation caused by fiber glass.

Personal Protective Equipment: Respiratory

A respirator should be used if ventilation is unavailable, or is inadequate for keeping dust and fiber levels below the applicable exposure limits. In those cases, use a NIOSH-certified disposable or reusable particulate respirator with an efficiency rating of N95 or higher (under 42 CFR 84) when working with this product. For exposures up to five times the established exposure limits use a quarter-mask respirator, rated N95 or higher; and for exposures up to ten times the established exposure limits use a half-mask respirator (e.g., MSA's DM-11, Racal's Delta N95, 3M's 8210), rated N95 or higher.

Operations such as sawing, blowing, tear out, and spraying may generate airborne fiber concentrations requiring a higher level of respiratory protection. For exposures up to 50 times the established exposure limits use a full-face respirator, rated N99 or higher.

Ventilation

In fixed manufacturing settings, local exhaust ventilation should be provided at areas of cutting to remove airborne dust and fibers. General dilution ventilation should be provided as necessary to keep airborne dust and fibers below the applicable exposure limits and guidelines. The need for ventilation systems should be evaluated by a professional industrial hygienist, while the design of specific ventilation systems should be conducted by a professional engineer.

Personal Protective Equipment: General

Loose-fitting, long-sleeved clothing should be worn to protect the skin from irritation. Exposed skin areas should be washed with soap and warm water after handling.

Section 9 — Physical & Chemical Properties

Appearance: Semi-circle or block insulation with yellow coloring throughout as a visual marker to indicate this is an asbestos free product.

Odor:	Odorless	**pH:**	Not applicable
Physical State:	Solid	**Vapor Density:**	Not applicable
Vapor Pressure:	Not applicable	**Melting Point:**	1200-1500°C
Boiling Point:	Not applicable	**Specific Gravity:**	0.24-0.27
Solubility (H2O):	Nil	**Freezing Point:**	Not applicable
Viscosity:	Not applicable	**Evaporation Rate:**	Not applicable
VOC:	Not applicable	**Percent Volatile:**	0

Section 10 — Chemical Stability & Reactivity Information

Chemical Stability

This is a stable material. This product is not reactive.

Hazardous Decomposition

None.

Hazardous Polymerization

Will not occur.

Section 11 — Toxicological Information

Acute Toxicity

A: General Product Information

The primary acute health effects of this product include mechanical irritation of the skin and eyes and skin dryness as a result of contact with dust, amorphous silica, and fibers.

B: Component Analysis - LD50/LC50

No LD50/LC50's are available for this product or its components.

Carcinogenicity

A: General Product Information

OSHA, NTP, IARC, and ACGIH have not classified this product in its entirety as a carcinogen.

B: Component Carcinogenicity

Calcium silicate (1344-95-2)

ACGIH: A4 - Not Classifiable as a Human Carcinogen

Synthetic Vitreous Fiber (65997-17-3)

ACGIH: A4 - Not Classifiable as a Human Carcinogen (related to rock wool fiber)
IARC: Monograph 43, 1988 (related to Glass filaments) (Group 3 (not classifiable))

Section 12 — Ecological Information

Ecotoxicity

A: General Product Information

No data available for this product.

B: Component Analysis - Ecotoxicity - Aquatic Toxicity

No ecotoxicity data are available for this product's components.

Section 13 — Disposal Considerations

US EPA Waste Number & Descriptions

A: General Product Information

This product, as supplied, is not regulated as a hazardous waste by the U.S. Environmental Protection Agency (EPA) under Resource Conservation and Recovery Act (RCRA) regulations. Comply with state and local regulations for disposal. If you are unsure of the regulations, contact your local Public Health Department, or the local office of the EPA.

B: Component Waste Numbers

No EPA Waste Numbers are applicable for this product's components.

Disposal Instructions

Dispose of waste material according to Local, State, Federal, and Provincial Environmental Regulations.

Section 14 — Transport Information

US DOT Information

Shipping Name: This product is not classified a hazardous material for transport.

Section 15 — Regulatory Information

US Federal Regulations

A: General Product Information

No information on this product as a whole.

B: Component Analysis

None of this product's components are listed under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), or CERCLA (40 CFR 302.4).

State Regulations

A: General Product Information

No information available for the product.

Other Regulatory Information

A: General Product Information

No information available for the product.

B: TSCA Status

No information available for the product.

International Regulations

Canada Workplace Hazardous Materials Information System (WHMIS)

WHMIS Classification: D2B– Irritant

Product classified as a manufactured article as defined in HPA, Section 11(1). Section 12(I) exempts it from the WHMIS supplier label and MSDS requirements of the Act.

Component Analysis - WHMIS IDL

The following components are identified under the CHPA IDL:

Sodium Silicate—CAS 1344-09-8

Section 16 — Other Information

This product has been classified according to the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

Key/Legend:

EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act; ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; NFPA = National Fire Protection Association; HMIS = Hazardous Material Identification System; CERCLA = Comprehensive Environmental Response, Compensation and Liability Act; SARA = Superfund Amendments and Reauthorization Act; DSL = Canadian Domestic Substance List; EINECS = European Inventory of New and Existing Chemical Substances; WHMIS = Workplace Hazardous Materials Information System; CAA = Clean Air Act; CHPA=Canadian Hazardous Product Act; IDL=Canadian Hazardous Disclosure List

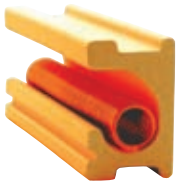
Revision Summary:

This is a revised MSDS which replaces Revision 1.0.3 with new formatting and clarified exposure limits. Get this and other MSDS forms electronically via Internet: http://www.iig-llc.com or by calling 1-970-858-6200.

As of the date of preparation of this document, the foregoing information is believed to be accurate and is provided in good faith to comply with applicable federal and state law(s). However, no warranty or representation with respect to such information is intended or given.

IMPORTANT SAFETY NOTICE: The information in this MSDS relates only to the specific material described herein and does not relate to use in combination with any other material or substance or in any process.
Because of the use of this information and the conditions of use of this product are not within the control of Industrial Insulation Group, it is the users obligation to determine the conditions of safe use of this product. Users of this product should study this MSDS and become aware of the product hazards and safety information before using this product. Users should also notify their employees, agents, and contractors regarding information contained in this MSDS and any product hazards and safety information in order to provide for safe use of this product.

HERCULES & EASY-LOAD INSTRUCTION MANUAL



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

LITERATURE

© 2016 L&L Kiln Mfg, Inc. 505 Sharptown Road, Swedesboro NJ 08085 P:856.294.0077 F:856.294.0070 service@hotkilns.com hotkilns.com

LLKilns
hotkilns.com

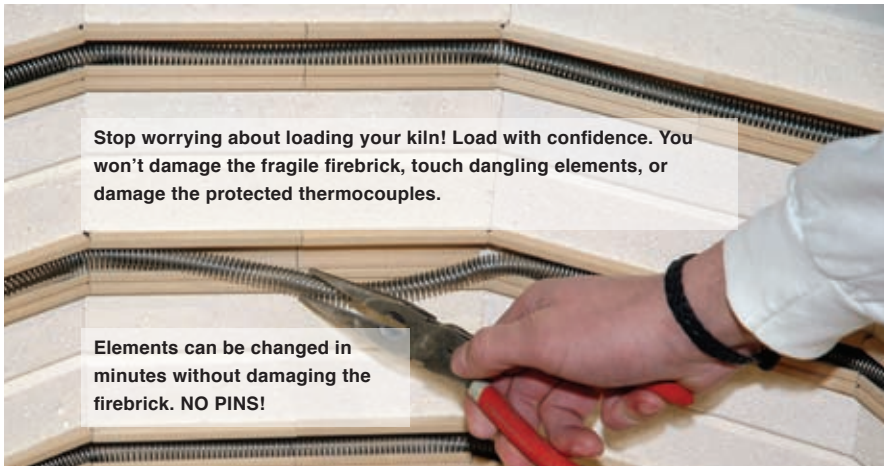
2016 KILN CATALOG

KILNS BUILT TO LAST

WHY BUY AN L&L?

HARD CERAMIC ELEMENT HOLDERS - KEY TO L&L'S DURABILITY

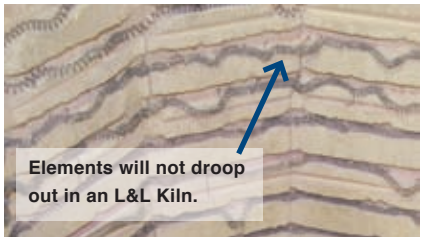
The smooth, hard surface of the inside ceramic channel allows the elements to expand and contract freely. No pins! This prevents catastrophic element failure. Elements do not droop out of broken firebrick channels. The dense ceramic DynaGlow holders extend element life because they do not insulate the hot elements from the kiln interior.



Stop worrying about loading your kiln! Load with confidence. You won't damage the fragile firebrick, touch dangling elements, or damage the protected thermocouples.

Elements can be changed in minutes without damaging the firebrick. NO PINS!

There are no pins like this in an L&L kiln.



Elements will not droop out in an L&L Kiln.

Moving elements will not break the firebrick on an L&L Kiln.

DURABILITY

PROTECTED THERMOCOUPLES

L&L thermocouples are shielded from corrosion by a ceramic protection tube. We use the finest "special limit" aerospace-grade heavy-gauge thermocouple wire. The protection tube prevents black dust from the thermocouple end from discolouring your work. **(hotkilns.com/tc-protection)**

CERAMIC ELEMENT TERMINALS

Ceramic element terminals make element changes easy. **(hotkilns.com/ceramic-terminal)**

SOLID PEEP PLUGS

Solid straight ceramic peephole plugs are strong and will not slip out like tapered, fragile, slip-cast plugs. **(hotkilns.com/peephole-plugs)**

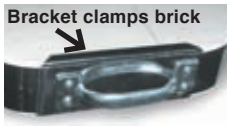
CORROSION RESISTANCE

Stainless steel, aluminized, and galvanealed steel are used where needed. **(hotkilns.com/corrosion-resistant)**

PROPRIETARY BRICK COATING

L&L's proprietary reflective brick coating protects the surface of the firebrick and keeps dusting down inside the kiln. **(hotkilns.com/reflective-coating)**

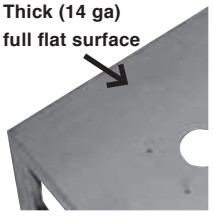
LID BRICK IS SECURED WITH CLIPS



Stainless "U" brackets secure lids - not friction. **(hotkilns.com/lid-clips)**

FULL-SUPPORT STANDS

Full-support 14 gauge aluminized steel stand is stronger than hollow frame stands and provides important support in the center of the bottom. **(hotkilns.com/full-stand)**



PERFORMANCE

DYNATROL IS EASY AND POWERFUL

DynaTrol with 4 Easy-Fire programs (Slow Bisque, Fast Bisque, Slow Glaze, Fast Glaze), 6 custom programs, PreHeat, Delay, Program, Segment Review, and Diagnostics. **(hotkilns.com/dynatrol)**

DYNAMIC ZONE CONTROL

The DynaTrol separately measures temperatures in the bottom, middle and top of the kiln and automatically adjusts the heat output of three zones during the entire firing. Kiln temperatures are automatically evened out to within 1/2 cone or better top to bottom. Zone control automatically compensates for many loading issues and element changes over time. Even on kilns where we use graded elements, L&L kilns are fundamentally uniform because the element holders radiate the heat more evenly. **(hotkilns.com/zone)**

"EASY-OPEN, EASY-LOAD" LID OPENS WIDE FOR LOADING

The whole kiln supports the lid (not just one section). Our positive safety pin secures the lid safely. No support bars (like other kilns) get in the way of loading when the lid is fully tilted back. **(hotkilns.com/spring-hinge)**

FROM AN UNSOLICITED EMAIL...

Dear L&L -

I just want to tell you guys that your web site rocks! It is well laid out and intuitive to use. It provides extra information that it thinks I might want, and it's usually right. The information is well written, in depth, and easy to understand. The videos don't even need voiceover because they are so easy to understand.

The element holder idea is brilliant, I realize, as I try to repair an old [competitor's] kiln.

I'll be buying one of your kilns later this year.

Thanks for doing it right.

SAFETY

UL499 LISTING

Most L&L kilns are c-MET-us listed to UL499 standards. See each kiln series for details. **(hotkilns.com/ul499)**

SAFE MATERIALS

No asbestos, mercury, lead, or other hazardous materials are used in L&L kilns.

SAFETY LATCHES ON LIDS

All lids and lifting devices include a safety latching system.

MAINTAINABILITY

L&L KILNS ARE EASY TO TROUBLESHOOT

Open up any L&L kiln control panel and see how easy it is to check amps, element resistance, and voltage. No other kiln can be serviced as quickly, easily, or inexpensively as an L&L kiln.

SECTIONAL CONSTRUCTION MAKES REPAIR WORK EASY

All top-loading L&L kilns are sectional. Even the large 35 cubic foot standard DaVinci kiln is easy to move, set up, and repair.

THREE-YEAR WARRANTY

See **hotkilns.com/warranty.** Free email, web and phone support forever.

IN-DEPTH SUPPORT

One customer said: "I am truly impressed with your website, it is more than informative and your products are well designed. The fact that all the information, including repair manuals, are listed, speaks well of your dedication to customer service." Our website has thousands of pages of technical help - all easily searchable - plus we provide expert free support with phone and email.

VISUAL INSTRUCTIONS

No one has a better or more complete instruction manual. Our visual instructions address the needs of the artist, the installer, and the repair person. You get a fully illustrated operation and service manual. Various instructional videos are available. **(hotkilns.com/videos)**

EASY-FIRE KILNS

L&L's Flagship Kilns

This is the classic L&L pottery kiln used by most of our customers. Now with a new angled control panel for easy viewing.

- DynaTrol Dynamic Three Zone Control
- 4 Easy-Fire plus 6 Custom Programs
- Hard Ceramic Element Holders
- Cone 10 • 2350°F • 1290°C (except for single phase e28T-3 models)
- Choice of 2-1/2" or 3" Brick
- Full-View Solid Peephole Plugs
- Stainless Spring Hinge - Wide Open for Easy Loading
- Full-Support Heavy-Duty 14 Gauge Aluminized Stand
- Fold Down Panel for Easy Maintenance
- c-MET-us listed to UL499 Standards

Features & Benefits

CONSTRUCTION

Sectional: Made of 9" high sections with a reversible bottom and a spring-hinged top. The case is stainless steel wrapped around 2-1/2" or 3" of K23 highly insulating firebrick with 3 adjusting screw clamps per section. Easy to move: **hotkilns.com/ assemble-easy-fire**

Brushed stainless steel spring hinge (on 23" & 28" diameter models) makes opening easy while still allowing lid to be supported and providing an unobstructed opening for easy loading. Safety pin prevents lid from closing while loading.

Firebrick is coated with a proprietary anti-dusting, hardening, and reflective coating.

Ceramic element terminals make element changes easy using a wrench.

A heavy 14 gauge full support solid stand with multiple bends for strength. Includes molded plastic feet protectors.

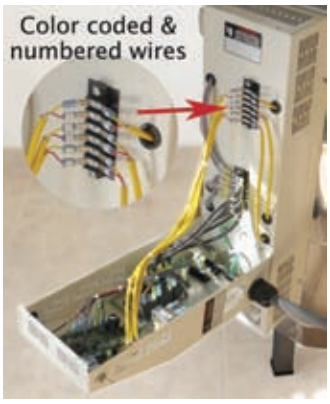
Full-view solid ceramic peephole plugs are 1" diameter non-tapered with heat-locked head. There is one for each section.

ELEMENT HOLDER SYSTEM

Patented hard ceramic element holders protect brick and elements from wear and loading damage. No pins! All-ceramic element connection block and hard holders makes changing elements easy.

DYNATROL ZONE CONTROL

DynaTrol with 4 Easy-Fire programs (Slow Bisque, Fast Bisque, Slow Glaze, Fast Glaze), 6 Vary-Fire custom programs, PreHeat, Delay, Program & Segment Review, and Diagnostics. Zone control with 2 or 3 zones with separate thermocouples. Type K 8 gauge thermocouple with ceramic protection tubes.



PIGGY-BACKED COOL-FIRE CONTROL PANEL

All controls and components are in a separate angled control panel that is piggy-backed on top of the element connection box. Both boxes are hinged and open and remove easily. A layer of insulation plus the separate control box keep the controls and relays cool. Power wires are oversized to run cool. On/off switch and control fuse included.

INSTRUCTIONS AND SUPPORT

Complete visual instructions with control reference, process information, assembly, troubleshooting, and parts list. Web videos show how to use the control. (**hotkilns.com/videos**)

Limited 3 year warranty. (**hotkilns.com/warranty**)

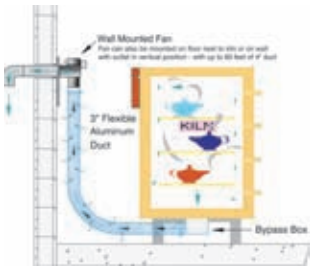
You can view all features of L&L Kilns at **hotkilns.com/features**

Options

FURNITURE KIT

Includes Cone 11 full shelves and half shelves as listed below plus a square post kit which includes six each 1/2", 1", 2", 4", 6" and 8" high 1-1/2" square cordierite posts plus heat-resistant gloves and 1 lb of cone 10 kiln wash. **[Prices below]**

POWERFUL VENT-SURE DOWNDRAFT KILN VENT



Vent-Sure 130 CFM downdraft vent pulls air down to bottom of kiln to improve temperature uniformity and vent corrosive fumes. Bypass collection box mounted on kiln allows adjustment of venting. Fan motor, mounted away from the kilns, stays cool and no vibration transmitted to the kiln. 120 volts. **[$480]**

CONTROL OPTIONS

Type S platinum thermocouples: [$230 each]
Pyrocil metallic sheathed thermocouples: [$40 each]
KISS Computer Software (hotkilns.com/kiss): [$650]
Door Interlock Switch (hotkilns.com/door-interlock): [$250]

ELEMENT OPTIONS

Quad Element Option: Four rows of elements for each 9" kiln section. Maximum element life for constant high-firing. **[Prices below]**

APM Elements. **[Custom pricing]**

VOLTAGE OPTIONS

Order 240 or 208 volts, single or three phase, or international voltages. KW, amperage, and fuse size for each voltage below. 480 volts is not available. **[No Charge for any voltage options]**

SINGLE-ZONE EASY-FIRE KILNS *WITH REDUCED PRICES*

PRICE COMPETITIVE WITH OTHER KILNS - BUT WITH FAR MORE VALUE-ADDED FEATURES

Get all of the features of Easy-Fire kilns but without zone-control. These models use graded elements to produce even firing. All other features, including the Dyna-Trol, hard element holders, protected thermocouple, solid stand, solid full-view peephole plugs, Easy-Lift, Easy-Load spring-loaded stainless steel hinge system, c-MET-us listing, three-year warranty, etc. are all the same as on the Easy-Fire kiln. **[Upgrade to a zone control system anytime with an installation kit for only $185 for three zone kilns (27" high) or $150 for two zone kilns (18" high).]**

Model No.	Kiln Price	Furn Kit	Brick Thick	Inside Diam	Inside Height	Cubic Feet
e18S-G	$1735	$310	2.5"	17.5"	18"	2.6
e18S-3-G	$1800	$310	3"	16.5"	18"	2.5
e18T-G	$2340	$350	2.5"	17.5"	27"	3.9
e18T-3-G	$2425	$350	3"	16.5"	27"	3.7
e23S-G	$2360	$350	2.5"	23.5"	18"	4.7
e23S-3-G	$2470	$350	3"	22.5"	18"	4.4
e23T-G*	$2970	$435	2.5"	23.5"	27"	7.0
e23T-3-G	$3050	$435	3"	22.5"	27"	6.7
e28S-3-G	$2925	$545	3"	28"	18"	6.8
e28T-3-G	$3500	$665	3"	28"	27"	10.2

Specifications: All electrical and cone ratings, dimensions, plug configurations, and UL and CE standards are the same as on standard Easy-Fire kilns.

Model No.	Kiln Price	Furn Kit	Quad Elem	No. Shelves F=full, H=half	Brick Thick	Inside Diam	Inside Height	Cubic Feet	Exterior Dimensions (in)	240/1 KW~Amp~Fuse	240/3 KW~Amp~Fuse	208/1 KW~Amp~Fuse	208/3 KW~Amp~Fuse	Lbs Kiln	Lbs w/Kit
e18S	$1885	$310	$180	15.5" (1F, 4H)	2.5"	17.5"	18"	2.6	29W x 31H x 30D	5.7~23.9~30	5.7~20.7~30	5.0~23.9~30	5.0~20.8~30	190	245
e18S-3	$1950	$310	$180	15" (1F, 4H)	3"	16.5"	18"	2.5	29W x 32H x 30D	5.7~23.9~30	5.7~20.7~30	5.0~23.9~30	5.0~20.8~30	220	255
e18T	$2490	$350	$260	15.5" (2F, 4H)	2.5"	17.5"	27"	3.9	29W x 40H x 30D	8.4~35.0~50	8.4~20.2~30	8.4~40.4~60	8.4~23.3~30	230	305
e18T-3	$2575	$350	$260	15" (2F, 4H)	3"	16.5"	27"	3.7	29W x 41H x 30D	8.4~35.0~50	8.4~20.2~30	8.4~40.4~60	8.4~23.3~30	255	325
e23S	$2510	$350	$210	21" (1F, 4H)	2.5"	23.5"	18"	4.7	31W x 32H x 42D	9.5~39.4~50	9.5~34.1~50	8.3~40.0~50	8.3~34.6~50	265	350
e23S-3	$2620	$350	$210	20" (1F, 4H)	3"	22.5"	18"	4.4	31W x 33H x 42D	9.5~39.4~50	9.5~34.1~50	8.3~40.0~50	8.3~34.6~50	305	375
e23T	$3120	$435	$310	21" (2F, 4H)	2.5"	23.5"	27"	7.0	31W x 41H x 42D	11.5~48.0~60	11.5~27.7~40	10.0~48.0~60	11.0~30.5~40	325	420
e23T-3	$3200	$435	$310	20" (2F, 4H)	3"	22.5"	27"	6.7	31W x 42H x 42D	11.5~48.0~60	11.5~27.7~40	10.0~48.0~60	11.0~30.5~40	360	455
e28S-3	$3075	$545	$285	25-1/2" (6H)	3"	28"	18"	6.8	37W x 33H x 48D	11.5~47.9~60	11.5~41.5~60	10.0~48.0~60	10.0~41.6~60	370	470
e28T-3	$3650	$665	$415	25-1/2" (8H)	3"	28"	27"	10.2	37W x 42H x 48D	11.5~48.0~60	16.6~40.0~50	10.0~48.0~60	14.3~39.8~50	460	565

Cone Rating: All models are rated to Cone 10 except the single phase e28T-3 which is rated to Cone 8 at 240V/1 Phase, Cone 5 at 208V/1 Phase, but Cone 10 for any 3 phase kiln. If planning continuous Cone 6 firings on a *10 cubic foot single phase* kiln we recommend the eQuad-Pro eQ2827-3 (page 7) or the Jupiter JD2927-3 (page 8) (both have more KW than the e28T-3 in their single phase versions).

Plugs on US Models only: 6-50 on single phase and 15-50 on three phase.

UL Listing: c-MET-us listed to UL499 standards. **CE Listing:** CE Listed models are available.

More: See Easy-Fire Specification Sheets at **hotkilns.com/spec-easy-fire** for shipping dimensions, electrical ratings, fuse and wire sizes.

SCHOOL-MASTER

Made For Schools

For busy school teachers who want a simple control.

Features & Benefits

- ***SPECIAL FIVE-YEAR LIMITED WARRANTY (hotkilns.com/five-year-warranty)***
- **One-Touch™ Intuitive Kiln Control**

The One-Touch™ Control is designed for busy school teachers - One touch and you are ready to fire the bisque and glaze programs typically used in schools. (It is also easy to adjust simple parameters like cone, delay, hold, heat-up and cool-down rates). You can even create four custom ramp/hold programs. **hotkilns.com/one-touch**

- **Cone 6 • 2230°F • 1220°C (except for 208 volt single phase SM28T-3 model)**
- **Single zone with graded elements**
- **Includes all other features of the Easy-Fire Kiln Series**

FURNITURE KIT

Includes Cone 11 full shelves and half shelves as listed below plus a square post kit which includes six each 1/2", 1", 2", 4", 6" and 8" high 1-1/2" square cordierite posts plus heat-resistant gloves and 1 lb of cone 10 kiln wash. **[Prices below]**

POWERFUL VENT-SURE DOWNDRAFT KILN VENT

Vent-Sure 130 CFM downdraft vent. 120 volts. See page 17. **[$480]**

VOLTAGE & CONTROL OPTIONS

Voltage: Order 240 or 208 volts, single or three phase, or international voltages. KW, amperage, and fuse size for each voltage below. 480 volts is not available. **[No Charge for any voltage options]**

Door Interlock Switch (hotkilns.com/door-interlock): [$250]

Model No.	Kiln Price	Furn Kit	No. of Shelves F=full, H=half	Brick Thick	Inside Diam	Inside Height	Cubic Feet	Exterior Dimensions	240/1 KW~Amp~Fuse	240/3 KW~Amp~Fuse	208/1 KW~Amp~Fuse	208/3 KW~Amp~Fuse	Lbs Kiln	Lbs w/Kit
SM23T	$3020	$435	21" (2F, 4H)	2.5"	23.5"	27"	7.0	31W x 41H x 42D	11.5~48.0~60	11.5~27.7~40	10.0~48.0~60	11.0~30.5~40	325	420
SM23T-3	$3100	$435	20" (2F, 4H)	3"	22.5"	27"	6.7	31W x 42H x 42D	11.5~48.0~60	11.5~27.7~40	10.0~48.0~60	11.0~30.5~40	360	455
SM28T-3	$3555	$665	25.5" (8H)	3"	28"	27"	10.2	37W x 42H x 48D	11.5~48.0~60	16.6~40.0~50	10.0~48.0~60	14.3~39.8~50	460	565

Cone Rating: All models rated for Cone 6 except for the single phase 208 volt SM28T-3, which is rated for Cone 5. If planning continuous Cone 6 firings on a *10 cubic foot single phase* kiln we recommend the eQuad-Pro eQ2827-3 (page 7) or the Jupiter JD2927-3 (page 8) because they have more power. **Plugs on US Models only:** 6-50 on single phase and 15-50 on three phase. **UL Listing:** c-MET-us listed to UL499 standards. **CE Listing:** CE Listed models are available. **More**: See **hotkilns.com/spec-school-master** for shipping dimensions, electrical ratings, fuse and wire sizes.

EASY-FIRE XT

Square Kilns with Easy-Fire Control Panel

- **Same basic control panel and other features as 3" Easy-Fire kilns**
- **Same square body shape used in our DaVinci Series with strong arched sides with extra space added to interior dimensions for good air circulation**
- **Stainless steel spring hinge used on the Easy-fire kilns**
- **6-50 or 15-50 plug on most models (some are direct wired - see specification sheet)**
- **Three-year Limited Warranty**

Not UL499 Listed

Model No.	Kiln Price	Furn Kit	Quad Elem	Shelves in Furn Kit	Inside W x D	Inside Height	Cubic Feet	External Dimensions	Stand KW	240/1 Amp~Fuse	240/3 Amp~Fuse	208/1 Amp~Fuse	208/3 Amp~Fuse	Lbs Kiln	Lbs w/Kit
E2318-XT	$3790	$375	$260	(4) 20" x 10"	22" Square	18"	5.0	40W x 32H x 42D	9.5	39.4~50	34.1~50	45.5~60	39.4~50	500	550
E2327-XT	$4280	$475	$360	(6) 20" x 10"	22" Square	27"	8.1	40W x 41H x 42D	11.5	48.8~60	27.1~40	48.0~60*	32.0~40	600	665
E2818-XT	$4625	$410	$285	(4) 23" x 11.5"	26.5" Square	18"	7.8	45W x 32H x 43D	11.5	48.0~60	41.6~60	48.0~60*	48.0~60	625	695
E2827-XT	$5675	$530	$415	(6) 23" x 11.5"	26.5" Square	27"	11.7	45W x 41H x 43D	14.9	48.0~60*	35.9~50	48.0~60*	41.4~60	735	835

Furniture Kit: Includes Cone 11 shelves listed above plus Large Square Post Kit, insulated gloves for unloading, and 1 lb of Cone 10 kiln wash.

Cone Rating and Special High Amperage Models: Cone 10 for all voltages except 208 volts, single phase (which is Cone 1), and 240 volts, single phase (which is Cone 5). Most models have cords but a few require a direct hookup. *These models are available in a higher amperage/KW direct-wire cone 10 version. See **hotkilns.com/spec-easy-fire-xt** for shipping dimensions, electrical ratings, fuse and wire sizes, cone rating, and special higher KW models.

eQUAD-PRO KILNS

Super-Duty High Production Kilns

The eQuad-Pro sets a new standard in production kilns.

Not UL499 listed

Features & Benefits

- **Cone 10 • 2350°F • 1290°C - with extra power with branch fusing for high production and dense loads**
- **Quad element system (fours rows of super heavy gauge elements per 9" high section)**
- **3" K23 brick**
- **DynaTrol with Dynamic Zone Control (3 Zones)**
- **Piggy-back cool-fire control panel like Easy-Fire**
- **Hard ceramic element holders**
- **Type K 8 GA thermocouples with ceramic protection tubes**
- **Full support 14 gauge aluminized steel stand**
- **Solid peephole plugs with full 1" view**
- **Proprietary reflective brick coating that protects brick and minimizes dusting**
- **"Easy-Lift, Easy-Load" stainless steel spring hinge system with full-support when door is up and tilted back (there are no support bars to get in the way of loading)**
- **Three-year Limited Warranty**

Options

FURNITURE KIT

Cone 11 full shelves and half shelves as listed below plus a square post kit, heat-resistant gloves and 1 lb of cone 10 kiln wash. **[Prices below]**

POWERFUL VENT-SURE DOWNDRAFT KILN VENT

Vent-Sure 130 CFM downdraft vent. 120 volts. See page 17. **[$480]**

CONTROL OPTIONS

Type S platinum thermocouples. [$230 each]

Pyrocil metallic sheathed thermocouples. [$40 each]

KISS Computer Software for monitoring and controlling the kiln remotely. **[$650]**

VOLTAGE OPTIONS

Order 240 or 208 volts, single or three phase, or international voltages. KW, amperage, and fuse size for each voltage below. 480 volts is not available. **[No Charge for any voltage options]**

QUAD ELEMENT SYSTEM INCLUDED

This photograph shows the inside of an eQuad-Pro while firing. Notice how the element holders glow and disperse the radiant heat. The large diameter elements (both of the wire gauge and outside diameter of the element coil), coupled with the unique glowing feature of the hard dense ceramic element holders make these elements last for a very long time. **(hotkilns.com/quad)** **Optional APM Elements** [Custom pricing]

Model No.	Kiln Price	Furn Kit	No. of Shelves F=full, H=half	Inside Diam	Inside Height	Cubic Feet	Exterior Dimensions	240/1 KW~Amp~Fuse	240/3 KW~Amp~Fuse	208/1 KW~Amp~Fuse	208/3 KW~Amp~Fuse	Lbs Kiln	Lbs w/Kit
eQ2327-3	$3950	$435	20" (2F, 4H)	22.5"	27"	6.7	31W x 42H x 42D	13.4~56.0~70	13.4~32.4~50	11.7~56.0~70	11.7~32.4~50	365	485
eQ2827-3	$4565	$665	25.5" (8H)	28"	27"	10.2	37W x 42H x 48D	15.0~62.3~80	15.0~36.0~50	15.0~71.9~90	15.0~41.5~60	480	585
eQ2836-3	$5350	$790	25.5" (10H)	28"	36"	13.6	37W x 51H x 48D	19.0~79.2~100	19.0~51.5~70	19.0~91.3~125*	19.0~60.4~80	595	725

***Note**: Special model eQ2836-X-208-1P is available with 16.6 KW, 208 Volt/1 Phase, 80 amps for a 100 amp fuse.

More: See **hotkilns.com/spec-equad-pro** for additional information like shipping dimensions, electrical ratings, fuse sizes and wire connection sizes. All models are direct wired with no cords. For controls see **hotkilns.com/dynatrol** and **hotkilns.com/zone.**

Listings: These kilns are not UL499 Listed

JUPITER KILNS

Easy To Take Apart & Highly Customizable

Jupiter kilns are easy-to stack and disassemble because of the plug-in sections.

- Sections can be added later or removed for smaller loads
- DynaTrol with Dynamic Zone Control (2 zones in 18" high models, 3 zone in all other models)
- Hard Ceramic Element Holders
- Most Models are Cone 10 • 2350°F • 1290°C (See grid)
- Choice of 2-1/2" or 3" Brick
- Full-View Solid Peephole Plugs
- Stainless "Easy-Lift, Easy-Load" Spring Hinge
- Wide Open Easy Loading
- Heavy-Duty 14 Gauge Aluminized Stand
- Removable Panel for Easy Maintenance
- c-MET-us listed to UL499 Standards

Features and Benefits

CONSTRUCTION

Sectional: Made of 9" high sections with a reversible bottom and a spring-hinged top (23" & 28" models). The case is stainless steel wrapped around 2-1/2" or 3" of K23 highly insulating firebrick with 3 adjusting screw clamps per section.

Brushed stainless steel spring hinge (on 23" & 28" diameter models) makes opening easy while still allowing lid to be supported while providing an unobstructed opening for easy loading. Safety pin prevents lid from closing while loading.

Firebrick is coated with a proprietary anti-dusting, hardening, and reflective coating.

Ceramic element terminals make element changes easy using a wrench.

A heavy 14 gauge full support solid stand with multiple bends for strength. Includes molded plastic feet protectors.

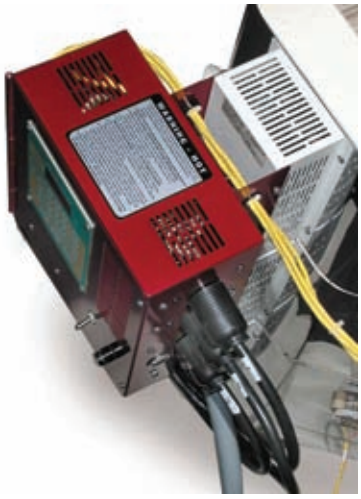
Full-view solid ceramic peephole plugs are 1" diameter non-tapered with heat-locked head. There is one for each section.

ELEMENT HOLDER SYSTEM

Patented hard ceramic element holders protect brick and elements from wear and loading damage. No pins! All-ceramic element connection block and hard holders makes changing elements easy.

DYNAMIC ZONE CONTROL

DynaTrol with 4 Easy-Fire programs (Slow Bisque, Fast Bisque, Slow Glaze, Fast Glaze), 6 Vary-Fire custom programs, PreHeat, Delay, Program & Segment Review, and Diagnostics. Zone control with 2 or 3 zones with separate thermocouples. Type K 8 gauge with ceramic protection tubes.



SEPARATE PLUG-IN CONTROL PANEL

The Jupiter control panel is separate from the kiln. Keeps controls and relays cool. All sections plug into it. Hinged and removable for easy maintenance. On/off switch and control fuse included.

INSTRUCTIONS AND SUPPORT

Complete visual instructions with control reference, process information, assembly, troubleshooting, and parts list. Web videos show how to use the control. **(hotkilns.com/videos)**

Limited 3 year warranty. **(hotkilns.com/warranty)**

You can view all features of L&L Kilns at **hotkilns.com/features**

Options

FURNITURE KIT

Includes Cone 11 full shelves and half shelves as listed below plus a post kit which includes six each 1/2", 1", 2", 4", 6" and 8" high 1-1/2" square cordierite posts plus heat-resistant gloves and 1 lb of cone 10 kiln wash. **[Prices below]**

POWERFUL VENT-SURE DOWNDRAFT KILN VENT

Vent-Sure 130 CFM downdraft vent. 120 volts. See page 17. **[$480]**

CONTROL OPTIONS

Type S platinum thermocouples [$230 each]

Pyrocil metallic sheathed thermocouples [$40 each]

KISS Computer Software for monitoring and controlling the kiln remotely. **[$650]**

High Limit Back Up Digital Control (latching relay back up control system). **[$590]**

Back Up Contactors (actuated by the High Limit Back Up Digital Control). **[2-Section: $155, 3-Section: $205, 4-Section: $260, 5-Section: $310]**

120 volt power supply with EMI electrical noise filter for the automatic control. **[$195]**

ELEMENT OPTIONS

Quad Element Option: Four rows of elements for each 9" kiln section. For maximum element life for constant high-firing. **[Prices below]**

APM Elements [Custom pricing]

VOLTAGE OPTIONS

240 or 208 volts, single or three phase, or international voltages. KW, amperage, and fuse size for each voltage below. 480 volts available on JD2900 Series. **[No Charge except for 480 volts]**

480 volts/3 phase. (needs NEMA1 panel for MET-us listing) (sections hard wired to power box). **[$690]**

NEMA 1 Control box for industrial use (MET-us listed with this extra option for 480 volts). **[$690]**

PULL-APART OPTION FOR SCULPTURE

"Pull-Apart" Option for sculpture. Includes floor mount stand for control panel, lift off lid with extra handles but no hinge. This option allows the entire kiln to be dismantled to make it easy to load large sculptural pieces. The kiln sections are unplugged and then taken off one at a time. **(hotkilns.com/pull-apart-kilns)**

[There is no charge for this option. However, If you want the "Easy-Lift, Easy-Load" spring hinge with it there is a $215 extra charge.]

Model No.	Kiln Price	Powered Bottom	Furn Kit	Quad Elem	No. of Shelves F=full, H=half	Inside Diam	Inside Height	Cubic Feet	Cone Rating	240/1 KW~Amp~Fuse	240/3 KW~Amp~Fuse	208/1 KW~Amp~Fuse	208/3 KW~Amp~Fuse	Lbs Kiln	L b s w/Kit
JD JUPITER KILNS WITH 2.5" BRICK															
JD18	$1905	n/a	$310	$180	15.5" (1F, 4H)	17.5"	18"	2.6	10	5.5~23.0~30	5.5~19.9~30	5.5~26.5~30	5.5~23.0~30	200	245
JD18X	$2645	n/a	$350	$260	15.5" (2F, 4H)	17.5"	27"	3.9	10	8.3~34.5~50	8.3~19.9~30	8.3~39.8~50	8.3~23.0~30	245	295
JD23V	$2510	$475	$350	$205	21" (1F, 4H)	23.5"	18"	4.7	5	7.0~29.3~40	7.0~25.4~40	6.1~29.3~40	6.1~25.4~40	275	350
JD230V	$3115	$475	$435	$310	21" (2F, 4H)	23.5"	27"	7.0	10	10.6~44.0~60	10.6~25.4~40	9.1~44.0~60	9.1~25.4~40	330	425
JD236V	$3750	$475	$505	$410	21" (3F, 4H)	23.5"	36"	9.4	10	14.1~58.6~80	14.1~38.1~50	12.2~58.6~80	12.2~38.1~50	360	455
JD245V	$4390	$475	$585	$515	21" (4F, 4H)	23.5"	45"	11.8	10	17.6~73.3~100	17.6~50.8~70	15.2~73.3~100	15.2~50.8~70	445	560
JD JUPITER KILNS WITH 3" BRICK															
JD18-3	$1955	n/a	$310	$180	15" (1F, 4H)	16.5"	18"	2.5	10	5.5~23.0~30	5.5~19.9~30	5.5~26.5~30	5.5~23.0~30	230	280
JD18X-3	$2760	n/a	$350	$260	15" (2F, 4H)	16.5"	27"	3.7	10	8.3~34.5~50	8.3~19.9~30	8.3~39.8~50	8,3~23.0~30	270	320
JD23V-3	$2645	$475	$350	$205	20" (1F, 4H)	22.5"	18"	4.5	5	7.0~29.3~40	7.0~25.4~40	6.1~29.3~40	6.1~25.4~40	315	340
JD230V-3	$3250	$475	$435	$310	20" (2F, 4H)	22.5"	27"	6.7	10	10.6~44.0~60	10.6~25.4~40	9.1~44.0~60	9.1~25.4~40	385	470
JD236V-3	$3920	$475	$505	$410	20" (3F, 4H)	22.5"	36"	8.9	10	14.1~58.6~80	14.1~38.1~50	12.2~58.6~80	12.2~38.1~50	460	545
JD245V-3	$4630	$475	$585	$515	20" (4F, 4H)	22.5"	45"	11.1	10	17.6~73.3~100	17.6~50.8~70	15.2~73.3~100	15.2~50.8~70	540	650
JD2918-3	$3645	$610	$545	$260	25.5" (6H)	28"	18"	6.8	5	9.1~38.0~50	9.1~32.9~50	8.3~40.0~50	8.3~34.6~50	380	480
JD2927-3	$4560	$610	$665	$360	25.5" (8H)	28"	27"	10.2	10	13.7~57.0~80	13.7~32.9~50	12.5~60.0~80	12.5~34.6~50	450	575
JD2936-3	$5795	$610	$790	$490	25.5" (10H)	28"	36"	13.6	10	18.2~76.0~100	18.2~49.3~70	16.6~80.0~100	16.6~52.0~70	565	715
JD2945-3	$6870	$610	$910	$590	25.5" (12H)	28"	45"	17.0	10	22.8~95.0~125	22.8~65.8~90	20.8~100.0~125	20.8~69.3~90	645	820

Note About EZ Models: All the J2300 series are available with higher watts "EZ" elements (the same elements used in the e23T kilns) at no extra charge. See web and specification sheet for details.

Cone Rating: See above chart. **More**: See various Jupiter Automatic specification sheets at **hotkilns.com/spec-jupiter-auto** for additional information like shipping dimensions, electrical ratings, fuse sizes and wire connection sizes. **Power Hookup:** Plugs on kilns that have less than 48 amps, otherwise direct wired. For controls see **hotkilns.com/dynatrol** and **hotkilns.com/zone.**

DAVINCI KILNS

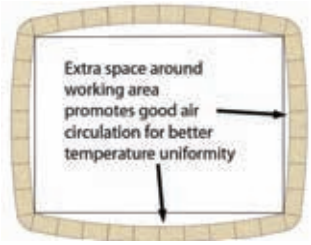
Square & Rectangular Top-Loading Kilns

This is L&L's classic production kiln. Also great for Universities and high volume High School programs.

- DynaTrol with Dynamic Zone Control (2 zones in 18" high models, 3 zone in all other models)
- Cone 10 • 2350°F • 1290°C (All models)
- Counterbalanced Lid with springs inside of tubes
- Safety Latches for Lid
- Welded angle-iron powder-coated stand and hinge
- 3" brick with all brick construction (including lid)
- Strong arched sides with extra space added to interior dimensions for good air circulation
- Three elements per 9" section
- Ceramic Element Terminals
- Hard ceramic element holders
- Plug in kiln sections
- Floor mounted control panel (except for X2300 series)
- c-MET-us listed to UL499 Standards

Features & Benefits

CONSTRUCTION



Sectional: Made of 9" high sections with a reversible bottom. The case is stainless steel wrapped around 3" of K23 highly insulating firebrick with 3 adjusting screw clamps per section.

Strong arched sides with extra space added to interior dimensions for good air circulation.

Spring-hinged counterbalanced top. Safety latch prevents lid from closing while loading. Design allows extra sections to be added and adjusted.

Firebrick is coated with a proprietary anti-dusting, hardening, & reflective coating.

Full-view solid ceramic peephole plugs are 1" diameter non-tapered with heat-locked head. There is one for each section.

ELEMENT HOLDER SYSTEM

Patented hard ceramic element holders protect brick and elements from wear and loading damage. No pins! All-ceramic element connection block and hard holders makes changing elements easy.

DYNAMIC ZONE CONTROL

DynaTrol with 4 Easy-Fire programs (Slow Bisque, Fast Bisque, Slow Glaze, Fast Glaze), 6 Vary-Fire custom programs, PreHeat, Delay, Program & Segment Review, and Diagnostics. Zone control with 2 or 3 zones with separate thermocouples. Type K 8 gauge with ceramic protection tubes.

FLOOR STANDING PANEL

All controls and components are mounted in a separate control box mounted on the floor away from the kiln. Branch fused and neatly laid out circuits. On/off switch and control fuse included.

INSTRUCTIONS AND SUPPORT

Complete visual instructions with control reference, process information, assembly, troubleshooting, and parts list. Web videos show how to use the control. **(hotkilns.com/videos)**

Limited 3 year warranty. **(hotkilns.com/warranty)**

You can view all features of L&L Kilns at **hotkilns.com/features**

Options

FURNITURE KIT

Includes Cone 11 shelves as listed below plus one to three post kits which includes six each 1/2", 1", 2", 4", 6" and 8" high 1-1/2" square cordierite posts plus heat-resistant gloves and 1 lb of cone 10 kiln wash. **[Prices below]**

POWERFUL VENT-SURE DOWNDRAFT KILN VENT

Vent-Sure 130 CFM downdraft vent. 120 volts. See page 17. [$480]

CONTROL OPTIONS

Type S platinum thermocouples [$230 each]

Pyrocil metallic sheathed thermocouples [$40 each]

KISS Computer Software. For monitoring and controlling the kiln remotely. **[$650]**

High Limit Back Up Digital Control (latching relay back up control system). **[$590]**

Back Up Contactors (actuated by the High Limit Back Up Digital Control). **[2-Section: $360, 3-Section: $440, 4-Section: $515, 5-Section: $590]**

120 volt power supply with EMI electrical noise filter for the automatic control. **[$195]**

ELEMENT OPTIONS

Quad Element Option: Four rows of elements for each 9" kiln section. For maximum element life for constant high-firing. **[Prices below]**

APM Elements [Custom pricing]

VOLTAGE & POWER OPTIONS

XB and TB elements, which have a higher KW rating, are available on the 27", 36" and 45" high DaVinci kilns. **[See High Power below]**

240 or 208 volts, single or three phase, or international voltages. KW, amperage, and fuse size for each voltage below. **[No Charge except for 480 volts]**

480 volts/3 phase: (needs NEMA1 panel for MET-us listing) (sections hard wired to power box). **[$690]**

NEMA 1 Control box: for industrial use (MET-us listed with this extra option for 480 volts). **[$690]**

BELL-LIFT OPTION FOR X3200 OR T3400

Available on any X3200 series or T3400 series.

Includes hand operated winch. Safety Latches are included. Specification sheet: **hotkilns.com/spec-bell-lift**

Bell-Lift Option [$4995]

Motorized Winch (instead of hand winch). **[$1235]**

Model No.	Kiln Price	Power Botm	High Power	Furn Kit	Quad Elem	Shelves in Furn Kit	Post Kits	Inside W x D	Inside Height	Cubic Feet	External Dimensions	Stand KW	High KW	240/1 Fuse	240/3 Fuse	208/1 Fuse	208/3 Fuse	Lbs Kiln	Lbs w/Kit
XB2318-D	$4805	n/a	n/a	$375	$260	(4) 20" x 10"	(1)	22" Square	18"	5.0	40W x 32H x 42D	8.9	n/a	50	40	60	50	600	650
X2327-D	$5300	n/a	$35	$475	$360	(6) 20" x 10"	(1)	22" Square	27"	8.1	40W x 41H x 42D	11.7	13.4	60	40	70	40	700	765
X2336-D	$6060	n/a	$75	$725	$480	(8) 20" x 10"	(2)	22" Square	36"	10.8	40W x 50H x 42D	15.6	17.9	80	60	90	60	775	870
X2345-D	$6665	n/a	$105	$820	$590	(10) 20" x 10"	(2)	22" Square	45"	13.5	40W x 59H x 42D	19.5	22.3	100	40	125	80	875	985
XB2818-D	$5670	$765	n/a	$410	$285	(4) 23" x 11.5"	(1)	26.5" Square	18"	7.8	45W x 32H x 43D	11.6	n/a	60	60	70	60	725	795
X2827-D	$6805	$765	$60	$530	$410	(6) 23" x 11.5"	(1)	26.5" Square	27"	11.7	45W x 41H x 43D	14.9	17.4	80	50	90	60	835	935
X2836-D	$7620	$765	$95	$820	$540	(8) 23" x 11.5"	(2)	26.5" Square	36"	15.6	45W x 50H x 43D	19.9	23.2	100	70	125	80	935	1075
X2845-D	$8405	$765	$125	$940	$695	(10) 23" x 11.5"	(2)	26.5" Square	45"	19.5	45W x 59H x 43D	24.9	29.0	125	90	150	100	1050	1220
XB3218-D	$6460	$915	n/a	$495	$335	(4) 28" x 14"	(1)	30.5" Square	18"	10.0	49W x 32H x 49D	14.2	n/a	80	70	90	80	880	985
X3227-D	$7590	$915	$120	$655	$515	(6) 28" x 14"	(1)	30.5" Square	27"	15.0	49W x 41H x 49D	18.0	21.3	100	60	125	70	1000	1150
X3236-D	$8610	$915	$140	$970	$695	(8) 28" x 14"	(2)	30.5" Square	36"	20.0	49W x 50H x 49D	24.4	28.4	125	80	150	100	1135	1340
X3245-D	$9565	$915	$185	$1135	$850	(10) 28" x 14"	(2)	30.5" Square	45"	25.0	49W x 59H x 49D	30.5	35.5	175	125	200	125	1275	1525
TB2318-D	$6395	$1050	n/a	$510	$335	(6) 22" x 11"	(1)	26.5" x 34.75"	18"	9.7	54W x 32H x 43D	15.3	n/a	80	70	100	80	900	995
T2327-D	$7485	$1050	$125	$685	$515	(9) 22" x 11"	(1)	26.5" x 34.75"	27"	14.6	54W x 41H x 43D	19.5	23.0	100	60	125	70	1035	1175
T2336-D	$8245	$1050	$145	$1025	$695	(12) 22" x 11"	(2)	26.5" x 34.75"	36"	19.4	54W x 50H x 43D	26.0	30.7	125	90	150	100	1165	1355
T2345-D	$9295	$1050	$190	$1190	$850	(15) 22" x 11"	(2)	26.5" x 34.75"	45"	24.3	54W x 59H x 43D	32.5	38.4	175	125	200	125	1300	1530
TB3418-D	$6905	$1240	n/a	$790	$410	(6) 28" x 14"	(2)	30.5" x 43.5"	18"	13.8	62W x 32H x 49D	19.9	n/a	100	90	125	100	1065	1225
T3427-D	$8085	$1240	$140	$1045	$620	(9) 28" x 14"	(2)	30.5" x 43.5"	27"	20.7	62W x 41H x 49D	24.9	36.5	125	80	150	90	1225	1455
T3436-D	$9365	$1240	$190	$1280	$825	(12) 28" x 14"	(2)	30.5" x 43.5"	36"	27.6	62W x 50H x 49D	33.3	39.9	175	125	200	125	1475	1775
T3445-D	$10,995	$1240	$215	$1745	$1030	(15) 28" x 14"	(3)	30.5" x 43.5"	45"	34.5	62W x 59H x 49D	41.6	49.8	200	150	225	175	1675	2050

More: See see various DaVinci specification sheets at **hotkilns.com/spec-davinci** for additional information like shipping dimensions, electrical ratings, fuse sizes and wire connection sizes. **Power Hookup:** Direct wired - no plugs. For controls see **hotkilns.com/dynatrol** and **hotkilns.com/zone.**

Crating: Protected with wood crate and foam-in-place packaging for shipment by Common Carrier. Depending on the model there are either two or three crates. Some smaller models can ship in skidded cartons.

HERCULES KILNS

Professional Medium Front-Loading Kilns

This medium-sized front-loading kiln has elements in the door, gasketed door with plug heat lock, 4-1/2" arched brick roof, door shut-off switch, removable stand, separated cool-firing control panel, powder-coated heavy fabricated case and more.

Woven tadpole fiberglass door gasket for superior door seal

4-1/2" thick K25 Full Arch for extra strength

Door Elements for Even Heating

Thick Powder-Coated Steel Case

Welded Stand (can be removed on Hercules kilns). Move by pallet jack from all four sides.

Safety Door Switch shuts off power when door is opened.

Features & Benefits for Hercules & Easy-Load

- Adjustable door with plug seal and fiberglass tadpole gasket for tight seal
- Heavy 12 and 10 gauge welded powder-coated case with stand and leveling pads
- Extra-tough High Temperature 2500°F 4-1/2" firebrick arch. Other insulation is 3" of K23 brick with 2" of mineral wool backup insulation
- Elements on door, sides and back for even firing
- Door power safety shut-off switch
- Hard ceramic element holders
- DynaTrol with Dynamic Zone Control (2 zones for EL2424-H, 3 zones for all others)
- Type K 8 gauge thermocouples with ceramic protection tubes
- Control panel mounted with air space between it and the case
- Branch fusing in control panel
- Solid peephole plugs with full 1" view in the door (2 for EL2424H, 3 for all others)
- Proprietary reflective brick coating that protects brick and minimizes dusting
- MET-us listed to UL499 standards

MANUAL VENTILATION AND COOLING SYSTEM

There is a 2-3/4" by 1-7/8" brick plug on the top of the kiln and a sliding damper on the bottom to allow you to introduce cool air into the kiln without opening the door. (Note: this is not meant to replace the recommended Vent-Sure downdraft vent system).

Model No.	Price	Furn Kit	Inside Dimensions	Cubic Feet	Hearth Size	Shelves in Furn Kit	Hearth Height	KW	240/1 Amp~Fuse	240/3 Amp~Fuse	208/1 Amp~Fuse	208/3 Amp~Fuse	480/3 Amp~Fuse	Lbs Kiln	Lbs w/Kit
EL2424H	$8680	$375	25W x 25D x 24H	8	22" x 22"	(4) 11" x 22"	30"	15.0	63.0~80	55.0~70	73.0~100	63.0~80	28.0~40	1075	1250
EL2427H	$9490	$485	25W x 25D x 27H	9	22" x 22"	(6) 11" x 22"	30"	15.0	68.8~90	39.6.0~50	79.3~100	45.7~60	19.8~25	1200	1450

Furniture Kit: Includes the Cone 11 shelves listed above plus the Large Square Post Kit, insulated gloves for unloading, and 1 lb of Cone 10 kiln wash. **More**: See **hotkilns.com/spec-hercules** for additional information like shipping dimensions, electrical ratings, fuse sizes and wire connection sizes. **Power Hookup:** Direct wired. For controls see **hotkilns.com/dynatrol** and **hotkilns.com/zone**.

EASY-LOAD KILNS

Professional Large Front-Loading Kilns

Big, strong, well-built - if you need a large front-loading kiln we have it. L&L has been building front-loading kilns for over 65 years. Includes the same features as the Hercules.

These are excellent kilns for large studios, universities, and advanced high schools as well as for industrial applications. This is a fully loaded EL2436.

Options for Hercules & Easy-Load

FURNITURE KIT

Includes Cone 11 full shelves and half shelves as listed below plus a post kit which includes six each 1/2", 1", 2" 4", 6" and 8" high 1-1/2" square cordierite posts plus heat-resistant gloves and 1 pound of cone 10 kiln wash. **[Prices below]**

POWERFUL VENT-SURE DOWNDRAFT KILN VENT

Vent-Sure 130 CFM downdraft vent. 120 volts. See page 17. [$480]

CONTROL OPTIONS

Type S platinum thermocouples [$230 each]

Pyrocil metallic sheathed thermocouples [$40 each]

KISS Computer Monitoring/Control. **[$650]**

High Limit Back Up Digital Control (latching relay back up control system). **[$590]**

Back Up Contactors (actuated by the High Limit Back Up Digital Control). **[EL2424H: $360, All other models: $440]**

120 volt power supply with EMI electrical noise filter for the automatic control. **[$195]**

VOLTAGE OPTIONS

240 or 208 volts, single or three phase, or international voltages. KW, amperage, and fuse size for each voltage below. **[No Charge except for 480 volts]**

480 volts/3 phase: (needs NEMA1 panel for MET-us listing) (sections hard wired to power box). **[$690]**

NEMA 1 Control box: for industrial use (MET-us listed with this extra option for 480 volts). **[$690]**

SPECIAL HINGE MOUNTING

Hinge mounted on right and panel mounted on left (Special order: allow extra production time). **[$980]**

Model No.	Price	Furn Kit	Inside Dimensions	Cubic Feet	Hearth Size	Shelves in Furn Kit	Hearth Height	KW	240/1 Amp~Fuse	240/3 Amp~Fuse	208/1 Amp~Fuse	208/3 Amp~Fuse	480/3 Amp~Fuse	Lbs Kiln	Lbs w/Kit
EL2436	**$13,955**	**$755**	25W x 25D x 36H	12	22" x 22"	(8) 11" x 22"	29"	19.0	80.0~100	46.0~60	92.0~125	53.0~70	24.0~30	1350	1500
EL2448	**$17,025**	**$865**	25W x 25D x 48H	16	22" x 22"	(10) 11" x 22"	18"	24.2	101.0~125	59.0~80	117.0~150	68.0~90	30.0~40	1500	1750
EL2848	**$18,295**	**$1155**	31W x 25D x 48H	20	28" x 24"	(12) 14" x 24"	18"	27.0	113.0~150	66.0~90	130.0~175	75.0~100	33.0~50	1750	2000
EL3048	**$21,165**	**$1210**	31W x 31D x 48H	25	28" x 28"	(12) 14" x 28"	18"	31.5	132.0~175	76.0~100	152.0~200	88.0~125	39.0~50	2000	2300

Furniture Kit: Includes Cone 11 shelves listed above plus 2 Large Square Post Kits, insulated gloves for unloading, and 1 lb of Cone 10 kiln wash.

More: See **hotkilns.com/spec-easy-load** for additional information like shipping dimensions, electrical ratings, fuse sizes and wire connection sizes. **Power Hookup:** Direct wired. For controls see **hotkilns.com/dynatrol** and **hotkilns.com/zone.**

Shipping & Moving: All the kilns except the EL3048 will go through a 34-1/2" wide by 75" high door. The EL3048 needs a minimum door size of 40-1/2" wide by 76" high. All Easy-Load and Hercules kilns can be moved with a pallet-jack from any side. Crated with interior support and air-cushion skids. Shipping by air-ride truck. Fill out installation checklist prior to order: **hotkilns.com/front-load-checklist**.

FUEGO

13.5”D x 18”H
20 Amp
Cone 10
Craft
Kilns

Not UL499 Listed

The Fuego Craft Kiln reaches Cone 10 with power to spare. This ideally sized home craft kiln uses a minimal 240 volt 20 amp circuit. Includes simple One-Touch™ program control. Great for apartments or houses with smaller power systems.

The FUEGO has the full range of premium L&L features such as hard ceramic element holders, Type K 8 gauge thermocouple with ceramic protection tube, full support 14 gauge aluminized steel stand, two solid peephole plugs with full 1” view, proprietary reflective brick coating that protects brick and minimizes dusting, and three-year limited warranty. Brick thickness is 3” and also includes a layer of non-RCF fiber between the stainless steel case and firebrick for extra insulation, a door shut-off switch for the elements, and an extra peephole plug in the top for venting.

The One-Touch™ Control is simple to use. Program custom programs.

The Fuego kiln has been used for years internationally and is now being introduced in the USA with even more power for faster heat up and longer element life.

Temperature: 2350ºF, Cone 10
Cubic Feet: 1.5
Inside Diam: 13.5” **Inside Height:** 18”
Outside Dimensions: 22” W x 27” D x 31” H

Model No.	Kiln Price	Furn Kit	Temperature Control	Watts	Amps	Volts	Fuse	Plug	Lbs Kiln	Lbs w/Kit
F1418-3	$1435	$140	One-Touch	3840	16	240	20	6-20	150	175

Furniture Kit: Includes three 12” diameter full shelves and four each of 1”, 2”, 4” and 6” triangular posts plus 1 lb of Cone 10 kiln wash.

More: See **hotkilns.com/spec-fuego-usa** for additional information like shipping dimensions, electrical ratings, fuse sizes and wire connection sizes.

LIBERTY-BELLE

16.5 or 17.5”D x 18”H
Plugs into Dryer Outlet

The perfect hobby kiln and great for people who need to stay portable. The 12 foot cord plugs into your 30 amp dryer outlet!

Features & Benefits

- **One-Touch™ Intuitive Kiln Control**
- **12 foot long cord with Nema 14-30 dryer type plug**
- **Cone 10 • 2350°F • 1290°C**
- **Hard ceramic element holders**
- **Full support 14 gauge aluminized steel stand**
- **Solid peephole plugs with full 1” view**
- **Proprietary reflective brick coating**
- **c-MET-us listed to UL499 standards**
- **Three-year Limited Warranty**

Options

240, 220 or 208 single phase are all standard options. 3 phase not available. **[No Charge for any voltage options]**

Quad Element System (watts & amps do not change - elements doubled & more massive with Quad system). **[Prices below]**

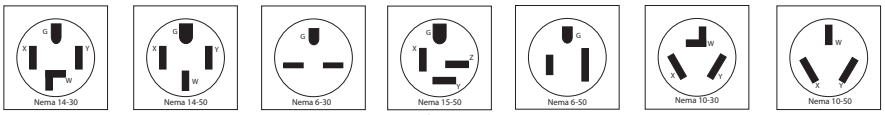
Vent-Sure Vent 120 Volt. **See page 17. [$480]**

PLUG & CORD OPTIONS

Standard Nema 12 foot long 14-30 plug can be changed by customer to NEMA 14-50 (hardware is included to do this).

A 12 foot NEMA 6-30 plug, NEMA 15-50 or 6-50, NEMA 10-30 or NEMA 10-50 plug is available for prices below. A 6 foot long 6-50 plug is available at No charge.

All plugs can be easily changed in the field.



[Standard] [Standard] [No charge] [$65] [$65] [$65] [$65]

Model No.	Kiln Price	Furn Kit	Quad Elem	No. of Shelves F=full, H=half	Brick Thick	Inside Diam	Inside Height	Cubic Feet	Exterior Dimensions	240V KW~Amp~Fuse	208V KW~Amp~Fuse	Ship Lbs	Lbs w/Kit
LB18	$1700	$225	$180	15.5” (1F, 4H)	2.5”	17.5”	18”	2.6	29W x 31H x 30D	5.7~23.9~30	5.0~23.9~30	200	240
LB18-3	$1750	$225	$180	15” (1F, 4H)	3”	16.5”	18”	2.5	29W x 32H x 30D	5.7~23.9~30	5.0~23.9~30	215	250

Furniture Kit: Includes Cone 11 shelves as listed above plus four each of 1”, 2”, 4” and 6” triangular posts plus one lb of Cone 10 kiln wash. You can substitute two half shelves for one full shelf at no charge. **More**: See **hotkilns.com/spec-liberty-belle** for additional information like shipping dimensions, electrical ratings, fuse sizes and wire connection sizes. Also see **hotkilns.com/Spec-One-Touch** for more information about the One-Touch™ control.

JH SERIES

Crystalline Glaze Kilns

This is the "Thoroughbred" of kilns. Designed specifically for Crystalline Glaze firing - fast, responsive and precise.

Not UL499 Listed

Features & Benefits

- **Designed specifically for firing crystalline glaze with fast heat up, fast cool down to freeze crystals and the ability to soak without prematurely aging elements**
- **Cone 12 • 2400°F • 1315°C**
- **Includes 2-1/2" of K25 2500°F firebrick on sides and bottom with a 3" thick top**
- **Approximately 25% more power than base models**
- **Quad element holder system with super heavy-duty elements**
- **Type S platinum thermocouples included as standard**
- **DynaTrol with Dynamic Zone Control**
- **Includes other features that are standard on the base models**
- **Three-year Limited Warranty**

Options

FURNITURE KIT

Includes Cone 11 full shelves and half shelves as listed below plus a post kit, heat-resistant gloves and 1 lb of cone 10 kiln wash.

VENT-SURE DOWNDRAFT VENT

Vent-Sure 130 CFM downdraft vent. 120 volts. See page 17. **[$480]**

CONTROL OPTION

KISS Computer Monitoring/Control. **[$650]**

ELEMENT OPTION

APM Elements [See below]

VOLTAGE OPTIONS

Order 240 or 208 volts, single or three phase, or international voltages. KW, amperage, and fuse size for each voltage below. 480 volts is not available.
[No Charge for any voltage options]

Model No.	Kiln Price	APM Elements	Furn Kit	No. of Shelves F=full, H=half	Inside Diam	Inside Height	Cubic Feet	240/1 KW~Amp~Fuse	240/3 KW~Amp~Fuse	208/1 KW~Amp~Fuse	208/3 KW~Amp~Fuse	Lbs Kiln	Lbs w/Kit
JD18-JH	$2810	$615	$310	15.5" (1F, 4H)	17.5"	18"	2.6	8.8~36.7~60	8.8~31.7~50	8.8~42.3~60	8.8~36.8~50	255	300
e23S-JH	$3285	$725	$350	21" full (1F, 4H)	23.5"	18"	4.7	10.5~47.9~60	10.5~41.5~50	10.0~48.0~60	10.0~41.6~50	280	365
JD230-JH	$5205	$1085	$435	21" full (2F, 4H)	23.5"	27"	7.0	13.7~57.0~80	13.7~32.9~50	12.5~60.0~80	12.5~34.7~50	400	505
JD2927-JH	$6625	$1125	$665	25.5" (8H)	29"	27"	10.3	18.0~75.2~100	18.0~43.5~60	18.0~86.7~125	18.0~50.1~70	580	710

More: See **hotkilns.com/spec-jh** for additional information like shipping dimensions, electrical ratings, fuse sizes and wire connection sizes. For controls see **hotkilns.com/dynatrol** and **hotkilns.com/zone**. Plugs vary with model, voltage and phase. See Specification sheet.

DL SERIES

11"D x 9"H Test Kilns

Not UL499 Listed

The DL Series is a small test kiln available in 120, 208 or 240 volts and with either a One-Touch or DynaTrol program control. It has the full range of premium L&L features such as hard ceramic element holders, Type K 8 gauge thermocouple with ceramic protection tube, full support 14 gauge aluminized steel stand, solid peephole plug with full 1" view, proprietary reflective brick coating that protects brick and minimizes dusting, and three-year limited warranty. Now features 3" Top & bottom.

Temperature: (See below)
Cubic Feet: 0.5
Inside Diameter: 11" **Inside Height:** 9"
Outside Dimensions: 19" W x 25" D x 22" H

Model No.	Kiln Price	Furn Kit	Temperature Control	Cone Rating	Watts	Amps	Volts	Fuse	Plug	Lbs Kiln	Lbs w/Kit
DL11-DB	$1160	$125	One-Touch	5	1800	15	120	20	5-15	110	130
DLH11-DB	$1160	$125	One-Touch	6	2160	18	120	25	5-20	110	130
DL11-D	$1300	$125	DynaTrol	5	1800	15	120	20	5-15	110	130
DLH11-D	$1300	$125	DynaTrol	6	2160	18	120	25	5-20	110	130
DLH11-DXB-240	$1160	$125	One-Touch	10	2800	11.7	240	15	14-30	110	130
DLH11-DXB-208	$1160	$125	One-Touch	10	2800	13.5	208	20	14-30	110	130
DLH11-DX-240	$1300	$125	DynaTrol	10	2800	11.7	240	15	14-30	110	130
DLH11-DX-208	$1300	$125	DynaTrol	10	2800	13.5	208	20	14-30	110	130

Furniture Kit: Includes two 9" diameter full shelves and four each of 1/2", 1", 1-1/2", 2", 2-1/2", 3" and 4" triangular posts plus 1 lb of Cone 10 kiln wash. **More**: See **hotkilns.com/spec-dlll** for additional information like shipping dimensions, electrical ratings, fuse sizes and wire connection sizes. **NOTE:** The 240 or 208 volt versions are highly recommended for high fire applications.

SUPERIOR KILN FURNITURE

PERFECT POSTS

L&L sells the highest grade ceramic extruded posts. They are very straight (even in lengths up to 12" long), precision cut for squareness (which makes shelves stable), and are strong without being excessively thick.

Posts & Post Kits

POST KITS

Large Square Post Kit
(Six each 1/2", 1", 2", 4", 6" & 8" square posts) (C-G-SPKT/LG) $160

Small Square Post Kit
(Four each 1/2", 1", 2", 4", 6" & 8" square posts) (C-G-SPKT/SM)..... $105

DL Series Post Kit
(Four each of 1/2", 1", 1-1/2", 2", 2-1/2", 3" and 4" triangular posts)
(C-G-TPKT/DB)..... $66

Liberty-Belle Post Kit
(Four each 1", 2", 4" & 6" triangular posts)
(C-G-TPKT/LB) $44

Large Triangular Post Kit
(Six each 1/2", 1", 1-1/2", 2", 2-1/2", 3", 4", 5" & 6" triangular posts)
(C-G-TPKT/01)..... $130

Small Triangular Post Kit
(Four each 1", 2", 3", 4", 5" & 6" triangular posts) (C-G-TPKT/00) $70

SQUARE POSTS (1-1/2" SQUARE)

1/2" Square Post (C-G-S005/00) $2.60
1" Square Post (C-G-S010/00) $3.50
2" Square Post (C-G-S020/00) $4.10
4" Square Post (C-G-S040/00) $4.50
6" Square Post (C-G-S060/00) $5.50
8" Square Post (C-G-S080/00) $6.50
10" Square Post (C-G-S100/00) $8.25
12" Square Post (C-G-S120/00) $10.25

TRIANGULAR POSTS

NOTE: Single triangular posts are available on the web.

FREIGHT FOR SHELVES AND FURNITURE KITS

Depending on the quantity and size of shelves, posts and furniture kit(s) ordered, the order may have to ship by common carrier freight. **[Skid/carton charge: $40]**

Round & Polygonal Shelves

11" DIAMETER KILNS

For Doll/Test Kilns

Full Round 9" diameter shelf (3/8" thick)
(H-D-9000/00) $28

14" DIAMETER KILNS

For Fuego Kilns (with 3" brick)

Full Round 12" diameter (1/2" thick)
(H-J-1200/00)..... $32

For J14 Kilns (with 2-1/2" brick)

Full Round 13" diameter (1/2" thick)
(H-J-1300/00)..... $32

Half Round 13" diameter (1/2" thick)
(H-J-1350/00)..... $19

16-1/2" DIAMETER KILNS

For LB18-3, e18S-3 & e18T-3, and J18-3 kilns with 3" brick

Full Round 15" diameter (5/8" thick)
(H-J-150A/00) $40

Half Round 15" diameter (5/8" thick)
(H-J-155A/00) $24

17-1/2" DIAMETER KILNS

For LB18, e18S & T, and J18 kilns with 2-1/2" brick

Full Octagonal 15-1/2" diameter (5/8" thick) (H-J-1500/00) $40

Half Octagonal 15-1/2" diameter (5/8" thick)(H-J-1550/00) $24

22" DIAMETER KILNS

For e23S-3, e23T-3, SM23T-3, & J2300-3 kilns with 3" brick

Full Round 20" diameter (3/4" thick)
(H-J-2000/00)..... $78

Half Round 20" diameter (3/4" thick)
(H-J-2050/00)..... $39

23" DIAMETER KILNS

For e23S, e23T, SM23T & J2300 kilns with 2-1/2" brick

Full Round 21" diameter (3/4" thick)
(H-J-2100/00)..... $79

Half Round 21" diameter (3/4" thick)
(H-J-2150/00)..... $40

28" & 29" DIAMETER KILNS

For e28S, e28T, SM28T, J2900 Series with 2-1/2" or 3" brick

Half Round 25-1/2" diameter (3/4" thick)
(H-J-2650/00)..... $67

HIGH ALUMINA SHELF MATERIAL CONE 11 RATING

All shelves are made of a press-molded (not cast) high alumina cordierite body that holds up to Cone 11 firing with little warping.

Square & Rectangular Shelves

17" SQUARE KILNS

For SQ1818, SQ1827, X1800 Series, EL1824, EL3648

8" x 16" rectangular (5/8" thick)
(H-S-1608/00) $35

16" x 16" square (3/4" thick)
(H-S-1616/00) $67

22" SQUARE KILNS

For X2300 Series

20" x 10" rectangular (5/8" thick)
(H-X-2010/00) $47

26" SQUARE KILNS

For X2800 Series and X2800-XT Series

23" x 11-1/2" rectangular (3/4" thick)
(H-X-2311/00) $60

26" X 35" RECTANGULAR KILNS AND 24" SQUARE FRONT-LOADERS

For T2300 Series, T2300-XT Series, EL2424-H, EL2427-H, EL2436 & EL2448

22" x 11" rectangular (3/4" thick)
(H-X-2211/00) $56

30" X 28" FRONT LOADER KILNS

For EL2848

24" x 14" rectangular (3/4" thick)
(H-J-2414/00)..... $70

30" SQUARE, & 30" X 43" RECTANGULAR KILNS

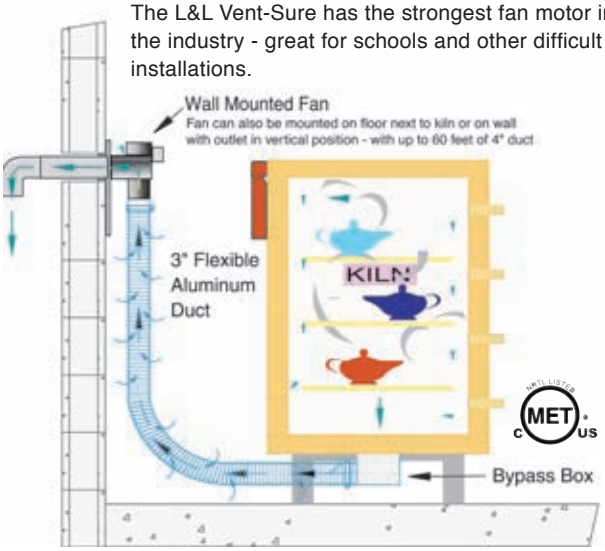
For X3200 Series, T3400 Series & EL3048

28" x 14" rectangular (3/4" thick)
(H-J-2814/00)..... $76

OPTIONS AND ACCESSORIES

VENT-SURE DOWNDRAFT KILN VENT SYSTEM

The L&L Vent-Sure has the strongest fan motor in the industry - great for schools and other difficult installations.



MORE INFORMATION: **hotkilns.com/vent-sure**

PRICES

120 VOLT VENT-SURE KILN VENT: [$480]

220-240 VOLT VENT-SURE: [$530]

MULTI-POSITION MOUNTING BRACKET for mounting motor on floor or in vertical position on wall. **(hotkilns.com/multi)**: [$26]

Features

- **Downdraft venting pulls air down to bottom of kiln**
- **Improves temperature uniformity inside the kiln**
- **Powerful 130 CFM fan motor, typically mounted on wall, allows fumes to be under vacuum in your studio**
- **The strong fan motor helps overcome static pressure in long exhaust lines. The duct may be up to 60 feet in length, and include up to four 90° bends**
- **120 volts with on/off switch on cord (240 volts available)**
- **15 foot long flexible aluminum duct**
- **Bypass collection box mounted on kiln allows adjustment of venting.**
- **Fan motor, mounted away from the kilns, stays cool and no vibration transmitted to the kiln**
- **Three-year Limited Warranty**
- **c-MET-us Listed to UL499 standards for use on c-MET-us L&L Kilns (Easy-fire, School-Master, Jupiter, Davinci, Ergo-Lift). MET-us Listed to UL499 standards on Hercules, and Easy-Load kilns).**

VENT DOUBLER (includes all parts necessary to vent two kilns - up to 10 cubic feet each) with one vent **(hotkilns.com/doubler)**: [$145]

VENT CONTROL allows DynaTrol to control vent **(hotkilns.com/vent-control)**: [$150]

CONTROL & POWER OPTIONS

INDUSTRIAL CONTROLS: Three zone Eurotherm control plus others. **(hotkilns.com/ eurotherm3).** [Custom pricing]

480 VOLTS/3 PHASE: (sections hard wired to power box) **(hotkilns.com/480).** [$690]

NEMA 1 CONTROL BOX: (480 volts becomes MET-us listed with this extra option). Also used in industrial applications. [$690]

KISS SOFTWARE: Monitor and control kiln remotely. For the DynaTrol only. **(hotkilns.com/kiss).** [$650]

HIGH LIMIT BACK UP CONTROL (latching relay back up control system) **(hotkilns.com/high-limit)**. [$590]

BACK UP CONTACTORS (actuated by the High Limit Back Up Digital Control, needs a large box) **(hotkilns.com/high-limit)** [Price Varies with model]

120 VOLT POWER SUPPLY: with EMI electrical noise filter **(hotkilns.com/noise).** [$195]

INDUSTRIAL CONTROLS

Eurotherm and other controls are available. **(hotkilns.com/eurotherm3)**

THERMOCOUPLE OPTIONS

TYPE S THERMOCOUPLES: The best thermocouple for constant high fire applications. No thermocouple drift. **(hotkilns.com/type-s)**. [$230 each]

PYROCIL SHEATHED THERMOCOUPLES: For greater sensitivity to temperature change. Use below 2200°F for sensitivity (glass is a good example) **(hotkilns.com/pyrocil-tc)**. [$40 each]

ELEMENT OPTIONS

QUAD ELEMENT OPTION: Four rows of elements for each 9" kiln section. For maximum high-fire element life. (The combination of larger coil diameter of L&L elements, ceramic holders, and the Quad option is the best in the industry. **(hotkilns.com/quad)** [See price grids]

APM SINTERED ELEMENTS: Available as a special option. Increases element life in certain situations. **(hotkilns.com/apm).** [Custom pricing]

POWERED BOTTOMS

Available on some Jupiter and DaVinci kilns. [See price grids]

CUSTOM OPTIONS

Discuss your custom needs with us. We customize our kilns for industrial applications and special ceramic needs. We can make very tall kilns, very large diameter kilns, add special holes, make ceramic fiber tops, use mercury relays and SSRs, add insulation. We have many years of industrial and special design experience.

CUSTOM, INDUSTRIAL & COMMERCIAL KILNS

Years of Custom Design Experience

L&L kilns are used in many industries including advanced industrial ceramics, abrasives, aerospace, piezo ceramics, optical glass, heating processes, melting, preheating for welding, annealing, stress-relieving, solution hardening, calcining, and steel heat treating.

The wide range of standard designs and built-in heavy-duty durability features allow L&L to quickly and economically configure many designs for rigorous production use.

Special industrial controls are available from Eurotherm, Honeywell, Watlow and others.

Our sister company, L&L Special Furnace Co., Inc., makes aerospace grade heat treating furnaces.

Call L&L to discuss your needs. We have years of experience to share.

(hotkilns.com/industry)

LARGE SQUARE & RECTANGULAR KILNS

hotkilns.com/custom-davinci-kilns

L&L designs and builds custom square and rectangular DaVinci kilns. Sizes are very flexible. The top is typically made of 4” thick ceramic fiber modules.

CAR BOTTOM KILNS

hotkilns.com/car-bottom-kilns

The ELC3648 Car Kiln works with a standard pallet jack for easy moving of the car and great sealing.

L&L also makes large traditional car bottom and shuttle kilns.

JUMBO 100 CU FT BELL-LIFT KILN

hotkilns.com/jumbo-bell-lift-kilns

MODEL TB644754

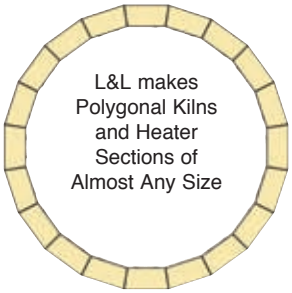
100 cubic feet:
(66" Wide x 47" Deep x 54" High)

Motorized winch is included. Safety Latches are included. Available with wheeled cars. Available in other sizes.

CUSTOM LARGE POLYGONAL KILNS

hotkilns.com/large-polygonal-kilns

Custom polygonal kilns with 4-1/2" of firebrick are available by special quote. L&L can make almost any diameter and any height in multiples of 9" high sections. There are three elements per 9" high section. The base is made of welded angle-iron with leveling bolts. The bottom is typically 4-1/2" of K23 brick. These are typically cemented in sections and then held together with a stainless steel band. The top is typically made of 4" thick folded and formed ceramic fiber modules. Temperatures are limited to 2350°F (1285°C).



LARGE FRONT-LOAD KILNS

hotkilns.com/large-custom-front-loading-kilns

We design and build special larger front-loading kilns beyond the standard EL sizes.

WHAT L&L CUSTOMERS SAY

BILL CAMPBELL

"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 10. They take a real beating and keep on going."

DIANE EMERSON

"I switched to L&L because of the deterioration of the element channels in my last kiln. I load larger tiles and I need the extra durability on the face of the firebrick."

FRANK GIORGINI

"My original L&L (J2927) has provided outstanding service and reliability through the firing of countless pots, tiles, udu drums, sculptures and two New York City MTA Subway projects. It's still in service right next to my DaVinci kiln."

More Information & Support at hotkilns.com

Prices in this catalog are subject to change without notice. Prices are always current on our web site. Find complete specifications, support videos, photos, parts, PDF Library, and thousands of pages of knowledgebase information easily, using our sophisticated search engine.

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KILNS BUILT TO LAST

Prices Effective April 1, 2016 **Bulletin No: CAT-4-16**