USER'S GUIDE

KilnTronics "09/2"

Temperature/Rate Control Systems

Third Edition
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PERSONAL NOTE FROM THE WRITERS

The KilnTronics Model 09/2 was produced during late 1970's and early 1980's. The controller was very well received, since it was the first practical kiln temperature controller to offer automatic regulation of the heat-up rate. Many, if not most, of these units are probably still in use today.

The Model 09/2 controller was eventually replaced by the Model 09VR, which offered advanced features suggested by 09/2 users. Nevertheless, in its day, the Model 09/2 was the most popular electronic kiln temperature controller on the market, and it remains a very useful tool for those who still own one.

"WHO NEEDS A LEARNER'S MANUAL FOR KILN CONTROLS?"

The answer ... almost everyone except an electronic process control specialist. Today's controls are very sophisticated compared to those of just a few years ago. Some of the controller's functions and features are not obvious, and a little reading will guarantee that you get the most out of your kiln and its control system.

We encourage you to learn ALL about your remarkable 09/2 control system.

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INTRODUCTION

But do I REALLY have to take a course on 'How to Operate an Electronic Kiln Control System' to use this one?" No - not if you (1) like to experiment, (2) have a lot of time, and (3) really enjoy surprises.

If you want to learn to use all the functions and features which this control systems offers, approach it the same way you would any new toy ... with a healthy curiosity and an open mind. It probably far exceeds what you've become used to over the years. And it's probably a lot more advanced you'd expect from a control system inexpensive enough to call your own.

The 09/2 control system, will work with virtually any kiln. It's popularity is almost universal. Hobbyists enjoy being relieved from many of the doubts and uncertainties often connected with firing kilns. Schools, ceramic shops and teaching studios like the load-to-load repeatability that results from firing according to a closely controlled schedule, time after time. Professional artists and production potters go for the expanded firing capabilities possible with this advanced control system. Industrial users like the comparative simplicity and low pricing of the system.

And everybody likes the CONVENIENCE of not having to baby-sit the kiln for hours on end!

If you're on the industrial end of the user spectrum, you're certainly not going to be intimidated by this little "toy", since you probably seen systems much more complex and expensive. You, and the other more impatient readers, might as well head for the INSTALLATION section and have at it. The rest of us will take the time to learn to use it right - the first time.

And before we start - an important note ...

The firing instructions given in this booklet are representative only. Their purpose is to illustrate what the control system can do, and how you make it do what you want the kiln to do. If you usually do your firing differently ... great! Learn how to make the control system fire your kiln your way.

For those who feel their firing knowledge and skill is a bit rusty, there are several excellent books available. If you have a modem-equipped computer, log on to the "Book Stacks Unlimited BBS" at (216) 694-5732 and do a search on the key-words "ceramics" and "kilns". Otherwise, your local bookstore will be happy to search its data base of books in print for relevant titles.

LIMITED WARRANTY

Our products are guaranteed to be free of defects in materials and workmanship for a period of one (1) year from the date of purchase.

Please return your WARRANTY REGISTRATION CARD immediately upon receiving your control system. We must otherwise use our factory shipping date as the effective date of purchase, unless you are able to provide some other proof of purchase upon application for warranty service.

Your rights under this warranty consist solely of requiring us to repair or, in our sole discretion, to replace, free of charge, F.O.B. our factory, any defective product received in good condition at the factory within one (1) year from the date of purchase, and determined by us to be defective as claimed. Any defect appearing more than one (1) year from the date of purchase will be deemed to be due to ordinary wear and tear. Our products are identified by serial numbers, and cannot qualify for warranty service if their serial number has been altered or obliterated, or is missing entirely.

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CAUTIONS - WARNINGS

NEVER LEAVE YOUR KILN UNATTENDED BEYOND THE SCHEDULED FIRING TIME. Never place the controller on top of your kiln. NEVER CONNECT THE TEMPERATURE SENSOR TO THE CONTROLLER WITHOUT ASSURING THAT THE THERMOCOUPLE ELEMENT HAS BEEN PROPERLY INSTALLED AND SECURELY FASTENED TO YOUR KILN. No man-made product can be made fully failsafe. Automatic controls should be monitored or equipped with back-up safety devices to an extent which the user deems appropriate after carefully considering the possibility of failure, and the probable consequences thereof. The safety of your kiln is YOUR RESPONSIBILITY

FEATURES INVOLVING SAFETY

In the event of a sensor failure (eventual burn-out, or open sensor circuit), the controller will automatically provide a temperature indication exceeding 2500°F, which will cause the kiln to remain OFF.

Momentary power failures (due to lightening strikes, etc ...) will cause the controller to latch OFF, so as to prevent random start-ups, or re-firing previously shut-off loads, when the power is restored.

The control system is OFF only when manually turned off. Turn the controller off when not actually in use. To assure safety, turn the controller off when loading or unloading your kiln.

INSTALLATION & HOOK-UP

Installation is easy. In most cases, everything is fully assembled and ready to use. The power line cable and kiln's power cable will have to be hard-wired to the power contactor inside of your new power controller. Otherwise, everything is pre-wired, so you can't go wrong.

In the beginning, 09 control systems were shipped either with a "field kit" box mounted on the side of the kiln, which contained a power contactor and fuse ... or with the contactor built right in as an integral part of the kiln's switch box.

Due to the limited space inside the switch box on most kilns, and the possibility of rather high ambient temperatures, the "integral" set up is no longer recommended. Field kit boxes (called "power controllers" herein) may still be mounted on the outside jacket of the kiln, near its bottom, if desired ... but a better way is now recommended. We're now suggesting the power controller be mounted on the wall, just above the 50-amp electrical receptacle which you've provided for the kiln (or just below its breaker box, if your kiln draws more than 50-amps or must otherwise be direct-wired).

This set up assures that the components of the control system will not be subjected to temperatures higher than room temperature, and also permits you to use the control system with any standard kiln (no modification or alteration of the kiln is required).

The following instructions apply to these "factory pre-wired" systems. If you have purchased a controller only and intend to connect it to your own power controls, refer to the wiring diagrams in the appendix for further hook-up details.

MOUNTING THE POWER CONTROLLER

The power controller is the heavy black box.

> NOTE - For 50-amp systems, the power connector on your kiln's cord and your wall receptacle must match. Standard replacement cords and wall receptacles are normally available from your local kiln dealer, if required.

Choose a location on the wall for your 50-amp, 250-volt grounding-type service receptacle (typically NEMA Type 6-50R) ... or near your kiln's electrical service if mounting a 63-amp (or larger) power controller. Make sure that the kiln's power cord will be able to reach the power controller's receptacle.

If you have to mount the power controller on a concrete or cement block wall, fasten a piece of 3/4" plywood, about 8"x 12" to the wall using masonry nails or sheet metal screws with plastic anchors, to provide a mounting surface for the unit.

To accurately locate the pilot holes for the power controller, make a rubbing of the back of the unit using a piece of paper and a crayon, transferring the exact hole locations onto the paper.

Tape the paper template to the wall or plywood mounting panel, at the chosen mounting location. Then start the four #8 x 3/4" pan head sheet metal screws (provided). Drive these screws straight, and almost fully into the wall or panel, then remove them and discard the template.

Remove the cover from the power controller and mount it at this location.

MOUNTING THE TEMPERATURE SENSOR

Most kilns have a sensor port opposite their peepholes. Use it, if you can. If you must use one of the peepholes, you will have to be

careful about using the other peepholes for venting purposes, since the resulting drafts inside the kiln may affect the temperature measurement.

Push the thermocouple element all the way through the mounting hole. Its tip should protrude at least 2" into the firing chamber. Mark the locations of its two screw slots on the jacket of your kiln.

Carefully drill a 7/64" hole through the jacket of your kiln at these locations.

Push the sensor back into the hole and fasten it in place using the two #6 x 3/8" slotted hex head sheet metal screws (provided).

CHOOSING A LOCATION FOR THE TEMPERATURE/RATE CONTROLLER

Most systems are provided with a "free-standing" type Temperature/Rate Controller ... meaning that you can place it at any convenient location; on a nearby shelf, table or workbench BUT NOT ON TOP OF THE KILN!

The control cable and thermocouple extension wires are only seven feet long, so don't plan on having the controller in the kitchen if your kiln's in the garage.

It's always a good idea to protect electronic things from extremes of temperature, since expansion and contraction can lead to early failures. And, needless to say, you'll want to make sure that the controller isn't going to wind up in a "busy" location where it'll accidentally be pushed off the back of a crowded workbench.

HOOKING THINGS UP

Call up your electrician and have him connect the power line and kiln cables to the contactor terminals inside of the power controller, and to your 50-amp receptacle (if used). If you choose to make

these connections yourself, PROCEED NO FURTHER UNTIL YOU HAVE ASSURED YOURSELF THAT ALL POWER HAS BEEN REMOVED FROM THE SERVICE CABLE WHICH WILL DELIVER POWER TO THE POWER CONTROLLER.

The power controller requires a source of 208/240vac power. Long runs of undersized wire will not only present a FIRE AND SAFETY HAZARD, but will also result in a voltage drop which will limit the kiln's heating capacity, and may cause the fuses in the power controller to blow every now and then for no apparent reason (a real nuisance!). Refer to your kiln's instruction book or the table provided in the Appendix of this manual and use the wire size recommended for your kiln, based on its current requirements and distance from the electrical service.

Observe that one side of the contactor inside the power controller is equipped with male type "quick connect" terminals, and that we have already made some connections at these terminals. Bring the service cable into the power controller, and connect it to this side of the contactor.

Single Phase Power:

> Use the left and right contactor terminals, making no connection to its center terminal. Connect the ground wire from the cable to the power controller's chassis.

Three Phase Power:

> Use all three contactor terminals, and connect the ground wire from service cable to the power controller's chassis.

In making these connections, be very careful about your workmanship. Strip the insulation from the wires very carefully to avoid cut or broken strands of wire, and make sure that every strand of each wire is properly inserted and secured inside of the compression terminals on the contactor. Loose strands of wire, or

loose connections, can cause "hot spots" during operation of the system. Expansion and contraction then loosens the connection still more, and it gets still hotter ... and this process eventually burns up the contactor.

Connect the cable from the 50-amp receptacle (or from the kiln) to the opposite side of the contactor, in the same manner, so that when the contactor operates, it will connect the service cable to the kiln's cable, to provide heater current for the kiln. The ground wire from the kiln (usually GREEN) must be connected to the power controller's chassis.

WARNING

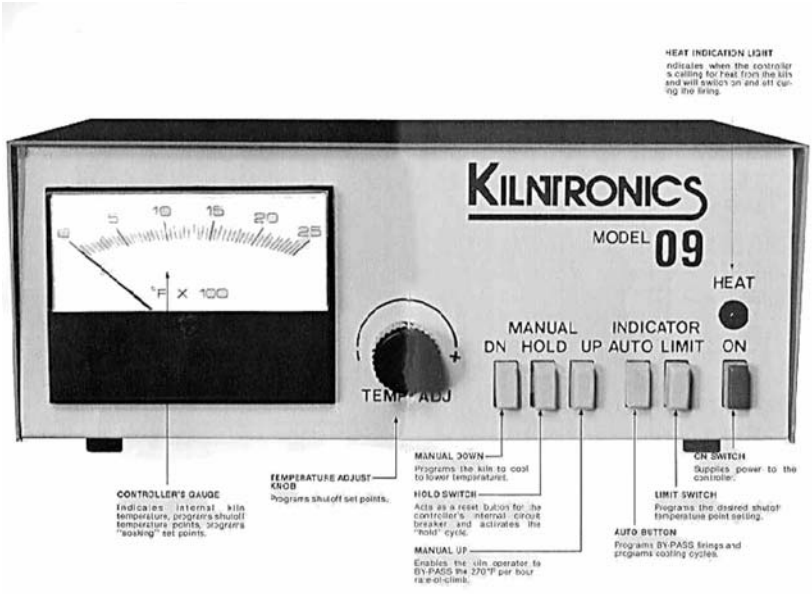
Never connect the sensor cable to the controller if the thermocouple element is not securely fastened to the kiln. If the sensor should happen to fall out of the kiln, an over-firing could easily result!

DANGER - HIGH VOLTAGE

POWER CONTROLLERS AND KILN SWITCH BOXES CONTAIN VOLTAGES WHICH ARE HIGH ENOUGH TO PRODUCE LETHAL ELECTRICAL SHOCKS.

NEVER OPERATE THIS EQUIPMENT WITH THE COVERS REMOVED. REFER SERVICING TO QUALIFIED PERSONNEL.

EXPLANATION OF THE CONTROLS



Refer to the front panel of your Temperature/Rate Controller as you read through the following explanation of what each front panel feature is and does. Don't be afraid to push the buttons and turn the knob. You won't break anything.

ON/OFF SWITCH

This switch turns the controller on and off, and thereby serves as an on/off switch for the kiln. Push this switch in to turn the control system on; push it again to release it, turning the system off.

Important Point No 1:

> It's important for you to know that the controller has a built-in safety feature which assures that it will always start up in the "latched off" condition. This feature is activated whenever power is first applied to the controller ... which may be when you turn it on, or when power is restored following momentary power failures (caused by lightening strikes, or backing into the

power pole at the end of the driveway). It assures an orderly, operator-directed start-up. It also assures that the equipment will not automatically restart itself, re-firing a previously completed, or partially fired, load.

Push the POWER ON switch in now. Note that the temperature indicator rises from 0°F to about 75°F, or whatever the actual kiln temperature is at the moment. Now push this button a second time ... it returns to its 'out' position, and the temperature indication now falls to zero.

Important Point No 2:

It's also important for you to know that the controller never shuts itself off; it latches its output off, but otherwise remains fully operational. There will be more on this below, but for now just remember that the control system is really turned off only when you physically turn it off with this switch.

THE TEMPERATURE INDICATOR AND IT'S TWO CONTROL SWITCHES

Now please turn the controller on again, then put your hands in your pockets. The temperature indicating meter is now displaying the actual temperature in the kiln.

Have you noticed that, unlike your simple little pyrometer, this meter works only when you turn the power on?

If you had, good for you! If you hadn't noticed, notice it now. This isn't just a glorified pyrometer ... nothing of the kind. Your new controller provides you with a precision, fully compensated electronic potentiometric temperature measuring system ... (wow!). Thermocouple type temperature sensors produce a very small voltage which is roughly proportional to temperature. Your little pyrometer uses this weak "temperature signal" as its source of

power. This is a neat trick, but unless carefully handled the so-called "limits of uncertainty" become rather broad. If you paid less than $100 for your pyrometer, its real uncertainties are about "11.1% of Span", so at cone 10, which should be 2381°F, it may read anything from 2117°F to 2643°F! Not too good, huh? Your new controller, on the other hand, is guaranteed to be within 1%, and is typically calibrated to within 1/4% of Span ... plus or minus only 6.25°F at cone 10 ... about the width of its pointer.

Important Point No 3:

> Don't check the controller for accuracy by comparisons with inexpensive pyrometers. They're in a class by themselves, and its not fair to them.

Important Point No 4:

> With the power turned off, the indicator's pointer should always rest exactly at the 0°F end-scale mark on the meter. Although age and vibration may cause this adjustment to shift, you can always restore it using a small screwdriver at the "mechanical zero adjustment" on the face of the meter. Never set it for room temperature, as you would your pyrometer, and never use it to compensate for suspected calibration errors.

The temperature indicator is also used to display two other values: the LIMIT temperature setting and the Set Point, or AUTO temperature setting. But we've learned enough under this heading, so for now let's just find these switches, and we'll learn more about them below.

First, push the LIMIT button. The indicator pointer will swing to some new value between 0°F and 2550°F. (O.K. ... if you just CAN'T wait, go ahead and turn the LIMIT ADJUST knob and watch the pointer swing back and forth!)

Next, push the AUTO button. The pointer falls to 0°F, right? (No ... don't touch it!)

THE LIMIT CONTROLS

In a normal ho-hum type firing, you might increase the kiln's temperature to some maximum value, then the kiln is shut off and allowed to cool at its own rate. The "maximum value" shall hereinafter be referred to as the LIMIT when using this controller.

To set the limit temperature, push the LIMIT button and turn the LIMIT ADJUST knob until the temperature indicator's pointer rests exactly at the desired temperature setting. That wasn't difficult, was it? That's all there is to that. Whenever you want to check the limit setting, push the LIMIT button. You may do this even when the kiln is firing: its only effect is to switch the indicator to the limit signal, so you can do this without upsetting the firing.

Important Point No 5:

> The LIMIT ADJUST knob is always enabled, so once you set it, be careful not to accidentally bump it, thereby inadvertently changing its setting. Make it a practice to verify the limit setting as a last step, whenever you do anything else at the control panel.

So now, what happens at the limit setting?

When you fire your kiln, the controller will automatically regulate the rate of temperature increase, so that it heats up at a rate of 270°F/Hour (150°C/Hour). When the kiln temperature finally reaches the LIMIT setting, the controller will shut it off, and latch it off ... permitting it to cool back down to room temperature at its own rate.

THE SET POINT RAMP GENERATOR AND IT'S CONTROLS

The best is yet to come ... and this is it. Here's what sets your control system apart from any other temperature controller or shut-off. Here's how it'll pay for itself over and over in the years to come. Your new controller can control the temperature rate-of-change between the starting point and the limit setting. This means convenience! Turn all your kiln's switches on 'High' and let the controller handle the firing. No need to remember to come back, time after time, to turn up the switches. Crystalline glaze? ... the controller's not fully automatic, so you'll need to intervene now and then, but its a lot more accurate and easier to work with.

You're probably wondering how the controller does it. Briefly, it uses the power line frequency of 60 cycles per second (50 cycles, in Europe and certain other locations) as its timing reference. This 'frequency' is divided several times by a 12-stage binary counter, to provide an accurate, very low frequency time base. This much slower series of pulses is then counted (accumulated) by an 8-stage binary up/down counter, and this count is then converted to the analog voltage which you measure when you push the AUTO button. ("analog" ... what does that mean ... ? Inside the controller, all temperature values are represented by voltage levels - i.e., voltage levels are analogous to temperature levels ... so they're called analog voltages.) The whole thing works just as if you were standing there for hours gradually increasing the temperature setting (called the "Set Point" in polite society).

The power line frequency in most locations is very closely regulated because of power grid requirements which the power utilities are forced to comply with. The accuracy of the controller's "ramp generator" is therefore equal to that of the line frequency ... which is usually exceptional!

By careful design and calibration, the ramp generator provides a controlled rate of temperature increase of 270°F per hour (150°C/Hr). This fixed rate complies with the conventions long established for pyrometric cones ... and common practice. This is approximately the rate which you'd achieved if you were to fire your kiln manually, following its manufacturer's instructions to the letter.

Important Point No 6:

> The 'Set Point' value will always be ramped towards the LIMIT setting, up or down, as required. When it arrives at the limit value, it will hold at that level, until the kiln temperature reaches that same value. Then, if the controller is operating in the shut off mode, the count will be zeroed and latched at zero. In the HOLD mode, the counters simply remain at a preset value ...

Say! ... what's these three little buttons next to the LIMIT knob?

The MANUAL - DOWN/HOLD/UP switches allow you to manually drive the accumulating counters up or down, or to force them to hold at any desired level. Naturally, you always have to push the AUTO button in to see what you're doing when you want to drive the Set Point up or down.

Turn the LIMIT knob all the way up, and reset the controller using the HOLD button ...

... Huh? "Reset"? ... using the HOLD button?????

Remember we mentioned, above, "Important Point No. 1" ... that the controller always starts up in its latched-off mode ...? (Tsk, tsk, tsk!) Press the AUTO button in ... what do you get on the meter? Right, 0°F! And that's all you'll ever get when the controller is latched off. To prove it, try holding the AUTO button in while pressing either the UP or DOWN buttons. Nothing! This zero set

point keeps the kiln off (assuming that the temperature in your part of the world never drops below 0°F).

To "reset" the latch circuit, press the HOLD button in, then press it again to release it (Press/Press). Do it now, and see what happens ... wasn't that exciting? "Click/Click." Now push the AUTO button again. The meter reads 0°F.

What if you wanted to start firing now? Since the rate is fixed at 270°F/Hour, it would take the set point signal 17-minutes just to get up to room temperature and turn the kiln on! What a waste of time ... but, not to worry! Simply press the AUTO button in, then the UP button - is the pointer now moving up-scale? Ahhhh ... that reset deal really works! ...

What's all this clicking noise? ...

Whenever you drive the Set Point higher than the kiln's actual temperature, the controller turns the heaters on, and visa versa. Alternately push the UP and DOWN buttons and watch the red HEAT ON indicator light.

Oh-oh ... this thing has flipped! We pushed the DOWN button and the set point flew up to 2500°F, right? Push the UP button in and hold it in; the needle goes up to 2500°F, then drops back to zero and starts over. Humm ... let's push the down button and hold it for a while. Yep; same thing ... in reverse! For the record, this is called "counter roll-over". In other words, the accumulating counters have a limited range (2620°F maximum, 0°F minimum). If, when counting up, they reach their limit, they just stupidly start over from zero ... but this makes for a nice built in safety feature ... knowing that they don't have the capability of counting up for ever and ever in the event that something goes wrong. The "zero roll-over" trick also provides a handy way to get to a high Set Point value in a hurry (good to remember).

Now let's push the HOLD button in and see what that does. Try to drive the Set Point manually, like we just did above. It's dead, right? Release the HOLD button, and drive the Set Point to 1500°F. Now push the HOLD button in again. Did it still disable the ramp generator? You bet! The HOLD button kills the reference frequency going to the accumulating counters, so whenever you push it in, the counters simply stop where they're at and wait. You can use this button any time you'd like to momentarily stop the progress of a firing.

For example, you might want to do a little "dry out" at the beginning of a firing, so you'd set up the whole firing schedule, then drive the set point up to about 300°F and push the HOLD button in. After the "smoke out", you'd close the kilns cover and peep holes, and release the HOLD button - and the firing would then resume (Boy ... these people think of everything!).

That about does it for the front panel of the controller. As a parting shot, here's something you must always remember:

WARNING

> If, for whatever reason, your kiln is unable to attain temperatures as high as your limit setting (e.g., low-fire kiln, low voltage at a the kiln, defective heaters or switches, etc.) the controller will not be able to shut it off at the limit, and an over-firing may result.
>
> You should not leave your kiln unattended beyond the planned firing time. If you plan to do so, you should equip your control system with either an optional shut-off timer, or a program time clock, to provide a back-up safety device which will assure that the kiln is shut off within a

reasonable period of time in the event that something goes wrong.

PREFIRING CHECK-OUT PROCEDURE

Now let's check out the whole control system, to see if this thing's really going to work. Incidentally, you'd better get to know this procedure by heart, since you'll be using it a lot. You'll want to go through this little routine before every firing, to make sure that everything is still working right ... and any other time you might suspect trouble. A 'troubleshooting' section follows. If anything goes wrong as you go through this simple little check-out ... try it again. If it's still wrong, check the same item number in the trouble-shooting section for some hints as to what might cause problems at the step where you got hung up.

1. With the controller turned OFF, let's check the mechanical zero adjustment of the temperature indicator. Line your eyeball up so that the width of the meter's knife-edge pointer is a small as you can make it. It should split the 0°F mark on the left end of the scale. If it's off a little bit, take out your pocket screwdriver and turn the adjustment of the front of the meter to make it read right.

2. Now let's hit the POWER ON button to fire this thing up. (Its the red one.) Checking the meter, it now reads a pleasant 75°F (... or whatever the kiln temperature actually is). All perfectly correct!

3. Hold the Phone! ... Did we put the sensor in the kiln, or not? Check it out, will you please. It must be (1) properly secured to the kiln, with it's tip protruding at least 2" into the firing chamber, (2) free of any obstructions - nothing shall touch it ... and (3) there must not be any perceptible movement of the indicator's pointer when you hold the thermocouple cable firmly near the sensor and near the controller, and wiggle the cable. Check the tip for "green rot" too. Eventually it'll eat right through it and then you can kiss it good-by and toss it into the trash. If it looks like it's

remaining useful life is about and hour and a half, you'd better plug in a new element before we go any further.

4. Would you now please hold your finger on the LIMIT button, and we'll check the meter for snags and the LIMIT ADJUST for ... well, just slowly turn the LIMIT ADJUST knob slowly up and down and keep your eye on the meter. The pointer should swing smoothly between about 0°F to just over 2500°F. You're looking for any sign of "sticktion" or discontinuity (whatever that means ?).

   Replacement thermocouple elements are normally available for immediate shipment - call us at (616) 842-7658.

   ... if you're done watching the pointer go up/and down, you can leave it at 500F (but don't let me hurry you. I know it's a lot of fun.)

5. Now this next item calls for some tricky finger-work on your part. If you're an accomplished pianist, this will be a breeze ... take you favorite two fingers (No, no, no ... on the same hand please!). Place one on the AUTO button and one on the UP button ... very good. Now, push. Bravo! Bravo! Ooops ... the applause meter reads zero. Well, you can't please everyone, right? (If the meter doesn't read zero, you've got a problem - troubleshoot it.)

   Push the HOLD button, and push the HOLD button. (That's right; two times ... Push/Push).

   Let's give the applause meter another try. Jab those two fingers into the AUTO and UP buttons again, but this time do it with style and finesse. Ayah ... look at that meter climb! Its going to go right off the end of the scale! (The meter must climb now, and as it passes the actual temperature in the kiln, the red HEAT ON light will turn on, and the contactor in the power controller will

also click on). (By the way ... remember what "roll-over" means?) (See Pg 13)

6. And finally, the finale. While holding the AUTO button in, turn the LIMIT ADJUST all the way that way (fully counter-clockwise). This MUST cause the set point indication to fall to zero, with the red HEAT ON light and kiln switched off!

That's it ... fun's over!

TROUBLESHOOTING

As mentioned in the previous section, the following items are numbered to correspond with the steps which make up the prefiring check-out procedure. Failure of the control system to perform exactly as that procedure prescribes may indicate a malfunction. In that case, refer to the trouble-shooting suggestions which appear in this section, under the same item number.

If a problem does exist, the prefiring check-out procedure will usually detect it, and the trouble-shooting section will usually enable you to determine which component of your control system is at fault. After having established that, refer to the service information section to find out how to get it fixed.

CAUTION

> The power service, the control system's power controller, and the kiln's switch box all contain electrical potentials that can readily cause serious injury ... or death. If you are skilled in electrical work, please work safely.
>
> If you have no electrical skills, please refer service problems to skilled service personnel.

Meter Problems:

Pointer stuck down-scale: tap the meter front sharply to free the pointer.

Pointer free, but does not respond to mechanical zero adjustment: zero adjustment mechanism defective - replace meter front

Pointer free, but will not zero ... rocking controller from side to side causes rest position of pointer to change from one

value to another: meter defective - broken taut band - replace meter.

Pointer appears to stick or hang-up at one point on the scale: possible contaminant between meter coil and magnet, inside meter - hold controller face-up and twist rapidly back and forth rapidly several times, causing the pointer to swing wildly back and forth between the limits of the scale to shake out foreign particles. Pointer may also be fouling on loose scale plate - remove meter front and readjust scale plate.

Problems at Turn-On:

HEAT ON light comes on momentarily, but then goes out: release the HOLD button and try again (this is not necessarily an abnormal indication)

HEAT ON light comes on as soon as controller is turned on: thermocouple connections reversed somewhere, else defective controller - recheck meter reading and if correct, replace controller. If incorrect, check for reversed sensor connections. If wired correctly, replace controller.

Controller does not appear to come on at all: recheck power cord and cable connections.

REMOVE POWER FROM THE SYSTEM, and check the fuses inside of the power controller. If blown, check for low power at the power contactor terminals with the kiln full on (contactor closed manually ... 208vac min - 240vac max).

Inspect the contactor to assure that pole pieces mate properly when solenoid is energized - clean or replace solenoid coil, if necessary.

Check the power transformer in controller for overheating or a "burned" odor - replace if necessary.

Temperature indicator pointer swings immediately up to right end of scale beyond 2500°F: sensor cable broken or not properly connected to controller, else sensor burned out, or controller defective - repair or replace sensor or sensor cable, if necessary.

If the controller is suspect; disconnect the sensor and short across the controller's sensor terminals 1 and 2 with a screwdriver blade - if the indication drops recheck the sensor circuit - if not, replace the controller.

Temperature indication does not appear to be accurate: inspect the sensor cable for signs of mechanical damage - replace if required. Possible indicator problem - tap to assure that pointer is not sticking, and recheck zero adjustment. Otherwise controller is defective - replace.

Power control contactor clicks on when controller is turned on, although HEAT ON light stays off: defective temperature controller - replace. (Note: the HEAT ON light and the power contactor may occasionally cycle on and off when the control system is turned on or off ... this is normal and inconsequential.)

Sensor Problems:

Indicator pointer jumps when thermocouple cable is wiggled near controller or sensor: loose connection - check connections at the sensor, at (or inside of) the temperature controller.

Sensor not tightly secured to kiln, or does not protrude well into the firing chamber: THE SENSOR MUST BE

SECURED TO THE KILN - turn the system off, and secure the sensor now. If the sensor does not protrude at least 2" into the firing chamber, measuring errors may result.

If the situation seems marginal, pack the sensor port with ceramic fiber insulation to stop any heat leaks around the sensor, and proceed.

If accuracy problems arise, or if the sensor is obviously too short, replace it with a longer type.

LIMIT Problems:

LIMIT reading swings fully up-scale or down-scale, will not respond to LIMIT ADJUST knob: defective controller - replace.

LIMIT reading will not reach 2500°F: possible sticking meter - tap face to free pointer. Controller slightly out of adjustment (useable so long as the desired limit temperature can be set, but watch limit setting for drift, and return for service as soon as possible).

LIMIT reading varies erratically as LIMIT ADJUST knob is moved: loose wiring inside controller or defective potentiometer - replace controller.

Ramp Problems:

AUTO reading swings fully up-scale, or down-scale to a value much less than 0°F, while supposedly latched at zero: controller defective - replace.

AUTO reading higher than 0°F and climbing when AUTO and UP buttons are pressed: The HOLD button might have been inadvertently pushed, resetting the shut-off latch prior

to this step - try again the controller is defective and should be replaced.

Reset Problems:

That's right ... push it two times (Push/Push), leaving it in the "out" position. If initially left in the "in" position, the HOLD function will disable the ramp generator with the set point at 0&176;F, and it will appear that the RESET did not take.

More Ramp Problems:

Set point reading will not move off zero when AUTO and UP buttons are pressed after resetting the shut-off latch: HOLD button left pushed in, otherwise latch circuit defective - replace controller.

AUTO reading moves up, but skips over large segments of the scale ... or moves up to a point, then falls back and repeats its travel over the same segment of the scale, never being able to reach the top: possible indicator sticking (see item 2), else ... counter defect - replace controller.

AUTO reading appears to move up-scale properly, but HEAT ON light does not come on and the power controller's contactor does not close as reading passes actual kiln temperature: recheck indicated kiln temperature; if correct, output circuit is faulty - repair or replace controller.

AUTO reading appears to move up-scale properly and HEAT ON light comes on as reading passes actual kiln temperature, but contactor in power controller does not close: check control cable for mechanical damage or loose connection; otherwise ... possible solid state relay failure - repair or replace power controller.

... and more Ramp problems ...:

AUTO reading does not fall to zero: shut off latch circuit faulty
- replace controller.

TECHNICAL ASSISTANCE - FACTORY SERVICE

If you think you've got a problem with your control system, refer to the "Pre-firing Check-Out" section. Then, if necessary, go to the "Troubleshooting" section of this booklet and attempt a diagnosis.

After you've tried that, if you feel that you need more help, help is available at ...

FireRight/Warner Instruments
1320 Fulton Street Box 604
Grand Haven, Michigan 49417-0604 usa
Phone: (616) 842-7658
FAX/Data: (616) 842-7658
e-mail: info@fireright.com

... and we'd welcome an opportunity to help you out!

Control system problems can often be diagnosed over the phone. If your phone is near enough to your control system to permit you to discuss the problem and work on the system according to our instructions during your call, we'll surely find the problem. Otherwise, "telephone troubleshooting" is effective only about 50% of the time.

If you have already determined that a particular component of your control system is defective, phone your dealer, or phone us at the above number, to determine the warranty status of your unit, current service rates, and the correct shipping address. Our factory repair service is highly efficient and very reasonable ... not what you're used to at all! Generally, anything you return will be "rebuilt" by our production people, regardless of the reason returned. We then inspect it, test it, re-calibrate it and get it on it's way back to you ... usually within one or two working days.

If it's a warranty situation, all this happens with no charge to you, except possibly for shipping and insurance. If you're paying, you'll be billed whatever the standard rate is for each item you've sent to us for service ... and these rates are fixed "flat rates". We can tell you in advance exactly what the charges will be, and they'll remain the same regardless of how much time and material we have to put into your equipment to make it "like new" again!

There's only one hitch ... "false pulls" (items found to be serviceable - no defect) don't qualify for warranty service, and therefore automatically accrue the service charge (because everything we receive must be re-shipped in good condition, and must therefore be reconditioned, defective or not ... and because "false pulls" actually take more time and effort to "prove a negative" than units with catastrophic failures). So please don't get mad and simply dump everything in a box and send it back to us ... try to decide what component of your system is bad, then send only that item. If you're not able to do that, give us a call, and we'll work something out.

Your dealer may be able to handle your service transaction for you. If not, pack your component up carefully and ship it to us via UPS, if possible. We can have UPS call for the package if UPS counter service is not conveniently available to you. All shipping costs are billed when we reship your unit to you. A concise service report is also provided.

SPECIAL NOTE FOR CANADIAN CUSTOMERS

Canadian customers are cautioned to execute the necessary Canadian customs forms prior to shipping controls for service. You should complete forms B13 and E15, which identify the equipment as your property and certify that the required service is not available in Canada. Our return shipment to you will otherwise be delayed in Canadian customs, and you might be reassessed duty on the value of equipment in question.

FIRING INSTRUCTIONS

GENERAL INFORMATION

Firing practices and techniques vary widely. There are probably as many different opinions as there are books on this subject ... and as you read more and more, you will find that conflicting information is commonplace. But there's a message in that, right? ... firing might not be so complex or critical as many writers and teachers suggest, and the limits of error are probably fairly wide. So rejoice; you can probably master it!

But while we're rejoicing ... let us not loose sight of the fact that firing is also "an art", and as your experience and skill increase, and as you attempt to create particular effects or duplicate previous results, you will become increasingly more concerned with its subtleties. Eventually, you'll forget about the basics and details, and set up each firing with no more forethought or difficulty than normally applied to the humming of a favorite tune. Then, when it comes to firing, you'll also insist on "the Gospel According to You" ... and why not? ... it works for you!

If you're already an expert, you might read the following just for entertainment ... to see what we say wrong (and to read some things that you forgot about a long time ago). If you're not an expert, welcome to our non-exclusive club. Let's get to it!

The stages in a bisque (or "biscuit") firing are generally summarized as follows:

Water Smoking

> ... occurring as the kiln temperature increases from room temperature to about 300°F (150°C). During this time, any free moisture in the clay boils away.

Dehydration

> ... removes most of the chemically bonded moisture (as opposed to "free moisture") as the temperature climbs through the 300 - 1100°F (150 - 600°C) range. A large volume of superheated (invisible) steam is generated during this period, and the vapor pressure in the kiln should be kept reasonably low by simple venting measures.

Oxidation

> ... occurs over the 750 - 1650°F (400 - 900°C) range, burning off most of the carbonaceous content of the clay. If the carbon is not completely oxidized, "black core" may form inside the body, or black spots may appear on its surface. At 1470°F (800°C) most of the moisture and carbon is gone, leaving the other constituents intact as a somewhat lighter and very porous piece. With experience, you may learn how to judge the firing result with the tip of your tongue ... since the suction of the dry biscuit will draw your moist tongue to it. If too porous, it has not been fired hard enough ... if too vitreous, it's been over-fired.

Vitrification

> ... occurs when the fluxes present in the body soften and react with the clays, gradually changing it to a glass-like substance by fusion. If taken well beyond the proper firing temperature, the fluxes begin to boil, causing blistering and bloating. Vitrification occurs from about 1650°F (900°C) up to the firing temperature of the clay.

Points of special interest in the firing process focus around moisture removal and the processes known as "silica inversions". The rate of temperature increase through the 0 - 300°F (0 - 150°C) range must be slow enough to permit steam to escape through the clay without building up bubbles which will eventually burst and

ruin the piece. At about 440°F (225°C), and through the range 1020 - 1070°F (550 - 575°C), the silica inversions cause a sudden expansion (if heating) or contraction(if cooling) of the body. If heated or cooled too rapidly through these inversions, the piece might be damaged or deformed by stresses which develop if its temperature is not perfectly uniform throughout its mass ... causing some areas to suddenly expand or contract before others.

Commercial green-ware and other typically thin pieces will usually tolerate firing rates up to 270°F (150°C) per hour. Thicker pieces will obviously require slower firing, as will pieces with thick sections, such as pots with heavy bases ... perhaps as slow as 100°F (55°C) per hour.

PYROMETRIC CONES

Firing instructions provided with materials, or in texts and magazine articles, frequently refer to cone numbers rather than temperatures, because the heat treating process involves both time and temperature. Pyrometric cones are special formulations which are designed to mature at different extremes of applied heat, are therefore useful in gauging the progress of a firing. The 'time vs temperature' relationship is reflected in the tables furnished in standard cone charts.

As you can see, a "cone 6" firing can result from a variety of schedules ...

to 2194°F (1201°C) in 20.5 hours,
to 2232°F (1222°C) in 8.27 hours,
to 2291°F (1255°C) in 4.24 hours,
... etc.

When firing with the controller, you must establish the LIMIT setting on the basis of the terminal firing rate (i.e., the rate of

temperature change at the end of the firing), using the data presented in this table as a guide.

Example:

> Firing to cone 6, you intend to approach the limit temperature at a rate of 270°F (150°C) per hour. So you turn to the tables, find "Cone Number" 6 in the first column, then move your finger across the page to the "270°F/HR" (or "150°C/HR") column, to find the suggested LIMIT setting ... which is 2232°F (or 1222°C).

This matter of rate vs limit setting naturally applies to the final few hundred degrees of the firing, and you must also consider the nature of the load ... is the rate slow enough to assure a reasonable degree of temperature uniformity throughout just prior to shut-off? On the other hand, if you're firing to a high temperature ... say, over 2100°F ... you might well expect that your kiln will not have enough heating capacity to keep up with the controller's 270°F/Hr ramp, so the "final approach" will occur at some slower, kiln dependent, rate. Experience will help you decide how much to "fudge" on the limit setting to compensate for this "kiln lag".

OVERTIME OR OVER-TEMPERATURE - OVER-FIRED WARE!

This is a simple, but often overlooked point ... its important that you remember it. You can see from the Cone Charts that firing is a matter of (1) temperature and (2) time. Too much, or not enough, of either ... and the results will be poor; perhaps a complete loss. Keep this in the back of your mind: if you come up with an over-fired load, it can just as well be the result of too much time, as too much temperature.

Suppose that you're firing to a fairly high temperature ... near the limit of your kiln's capability. Its getting late, and everything's gone fine up to this point, so you trustingly go to bed thinking that the kiln will shut off in an hour or so anyway. But then the boys down at the power plant shut down "Old No 2" for a quick oil change during the 'off peak' hours (... oops! Your line voltage just dropped 5% ... and so did your kiln's heating capacity).

Finally, the sun comes up, and "Old No 2" and you both come back on line. After breakfast you go down to unload the kiln ... ouch! Its still a bit too warm. That's odd, looks like it switched off ok. Humm ... Oh well, let's open it up anyway ...

YECHT! (and a few special cuss words) ... over-fired!

You'll probably never find out why this happened ... and for a long time your confidence in the control system will be shaken. It happened, of course, because the volt-loss during the night was just enough to make your kiln "stall out" just below the LIMIT setting. So it just sat there and cooked all night long, until the power come back up; then it finally shut off. Even though the temperature never got higher than the LIMIT setting, the ware was fired far too long at that high temperature, and melted down.

There are other ways that this can happen and, as you've probably guessed, it does happen. This is one of the hazards of modern living! The main point is this: IF YOU CAN'T BE ON HAND TO ASSURE THAT THE KILN SHUTS-OFF ON SCHEDULE, ADD A SHUT-OFF TIMER OR PROGRAM TIME CLOCK TO YOUR CONTROL SYSTEM AS A BACK-UP DEVICE

That's the main point. But remember also that if a load has fired properly according to your schedule, but appears to be a little overfired, shorten the firing schedule next time. This can be accomplished simply by reducing the LIMIT setting somewhat. The

reverse would apply to an underfiring, of course, maybe you rushed it too much.

BASIC (BISCUIT) FIRINGS - Step by Step

1. Perform the prefiring check-out procedure.
2. Push the POWER ON button in.
3. Hold the LIMIT button in, and adjust the LIMIT ADJUST knob to move the indicator pointer to the desired shut-off temperature, as determined above (see "Pyrometric Cones)".
4. Set all of your kiln's switches, if used, at "High" (or full-on). Prop the lid open using an inch-thick piece of firebrick, and pull the peep hole plugs.
5. Depress and release (push - push) the HOLD button to reset the shut-off latch. The HOLD button must now be "out".

   The firing has now begun ... but from 0°F! In about 17-minutes (75°F divided by 270°F/Hour rate) the ramped set point will reach the kiln's temperature (room-temperature, at this point). The HEAT ON light will then come on, any you will hear the contactor in the Power Controller click on. To eliminate this "dead time", push the AUTO and UP buttons momentarily to drive the set point rapidly up to the kiln's temperature.

   Allow the controller to "ramp" your kiln up to the shut-off point at the 270°F/Hr rate. The controller will then latch the kiln off. Close the cover at about 300°F (150°C) and begin installing the peep hole plugs.

   At 1100°F (600°C) the kiln should be fully closed up.

During the Firing ..

Pushing the LIMIT button during the firing will not upset the process, and the shut-off setting may be rechecked at will ...

do it; its a good habit to get into. The limit setting may also be changed during the firing, except that when changed to a value lower than the kiln's temperature, the shut-off function will be tripped. To clear that condition, simply set the limit higher than the kiln's temperature, then press and release (push - push) the HOLD button. Then, to avoid any loss of heat, press the AUTO and UP buttons momentarily to drive the set point back up to the kiln's present temperature, and pick up the firing where previously disturbed.

The AUTO button may also be used at any time to monitor the progress of the set point, without disturbing the firing process.

If you wish to expedite the firing through any zone, you can manually drive the set point to a somewhat higher lever ... this forces the kiln to operate at full capacity to catch up, then it will resume the previously set rate. To do this, push the AUTO button to display the set point, then push the UP button to drive the set point to a higher value.

The kiln can be held at any temperature during the firing for "soak" purposes, simply by pushing the HOLD button in when the kiln reaches the desired soak temperature. This stops the automatic ramping of the set point, holding the kiln at that level until the HOLD button is released. To move rapidly to any soak temperature, push the AUTO and UP or DOWN buttons, as required, to drive the set point to the desired temperature, then press the HOLD button in and leave it in.

Remember that the limit setting must always be set somewhat higher than your preset soak temperature, since the controller will shut down the kiln whenever the temperature indication goes higher than the limit setting.

To retard the firing process through any zone, use the opposite procedure to that given in Step 9; push the AUTO and DOWN buttons to reduce the set point value, forcing the kiln to turn off and wait for the set point to ramp back up to its temperature level.

GLAZE FIRINGS

NOTE - Glaze firings may be done using the same methods as suggested for bisque firings, with the following exceptions ...

Proceed slowly for the first hour or two, to drive away any surplus moisture retained in the ware as a result of the glaze application. The operation can then often be expedited, if desired, up to the firing temperature of the glaze.

If the kiln has fired faster than 270°F (150°C) per hour, it would probably be a good idea to slow down over the last hundred degrees to permit time for the glaze to heal over any craters which might have been formed by escaping gas ... else soak the kiln at the firing temperature for thirty minutes prior to shut-off. To use this latter method, you'll have to be on hand as the kiln approaches the shut-off point. Just prior to shut-off, push the HOLDbutton in and turn the LIMIT adjust knob all the way up (clockwise), but remember ... YOU will have to shut the kiln off after the soak period, since the controller's shut off function is now disabled!

For good glossy glaze, let the kiln drop slowly for the first 200°F (100°C) after it shuts off. Then speed up the cooling rate down to 1375°F (750°C) by partially pulling the top peep hole plugs. At this point, close the kiln up again and permit it to cool at its own rate down to 300°F (150°C), where you may slowly begin to open it up to expedite the final cooling process.

CRYSTALLINE GLAZE

1. As always, start with a prefiring check-out.
2. Push the POWER ON button in.
3. Set the LIMIT ADJUST control all the way up (fully clockwise).
4. Depress and release (push - push) the HOLD button to reset the shut-off latch, then press the AUTO and UP buttons in, and hold them in until the HEAT ON light comes on.
5. Watch the temperature closely as it approaches 2400°F. At that point, press the HOLD button in and let the kiln soak at 2400°F (1315°C) for about 20-minutes. Then push the HOLD button again to release it, and using the AUTO and DOWN buttons, reduce the set point to 2100°F (1150°C).

   Crystal growth is a function of soak time at this set point (2100°F/1150°C). For small crystals soak here for four to five hours. For larger crystals, soak at this temperature for 8 to 10 hours.

   Push the HOLD button to release it, then turn the LIMIT control all the way down (counter-clockwise). This will trip the shut-off latch, turning the kiln off.

   Allow the kiln to cool according to your customary practice.

Appendix

CONE CHARTS

WIRING DIAGRAMS

DN470327: for 110-120vac Systems, original relay output configuration (28Kb)

DN470328: for 208-240vac Systems, original relay output configuration (29Kb)

DN470326: for 110-120vac Systems, dc pulse output (modified controls) (30Kb)

DN470325: for 208-240vac Systems, dc pulse output (modified controls) (31Kb)

TEMPERATURE EQUIVALENTS FOR STANDARD PYROMETRIC CONES (°F)

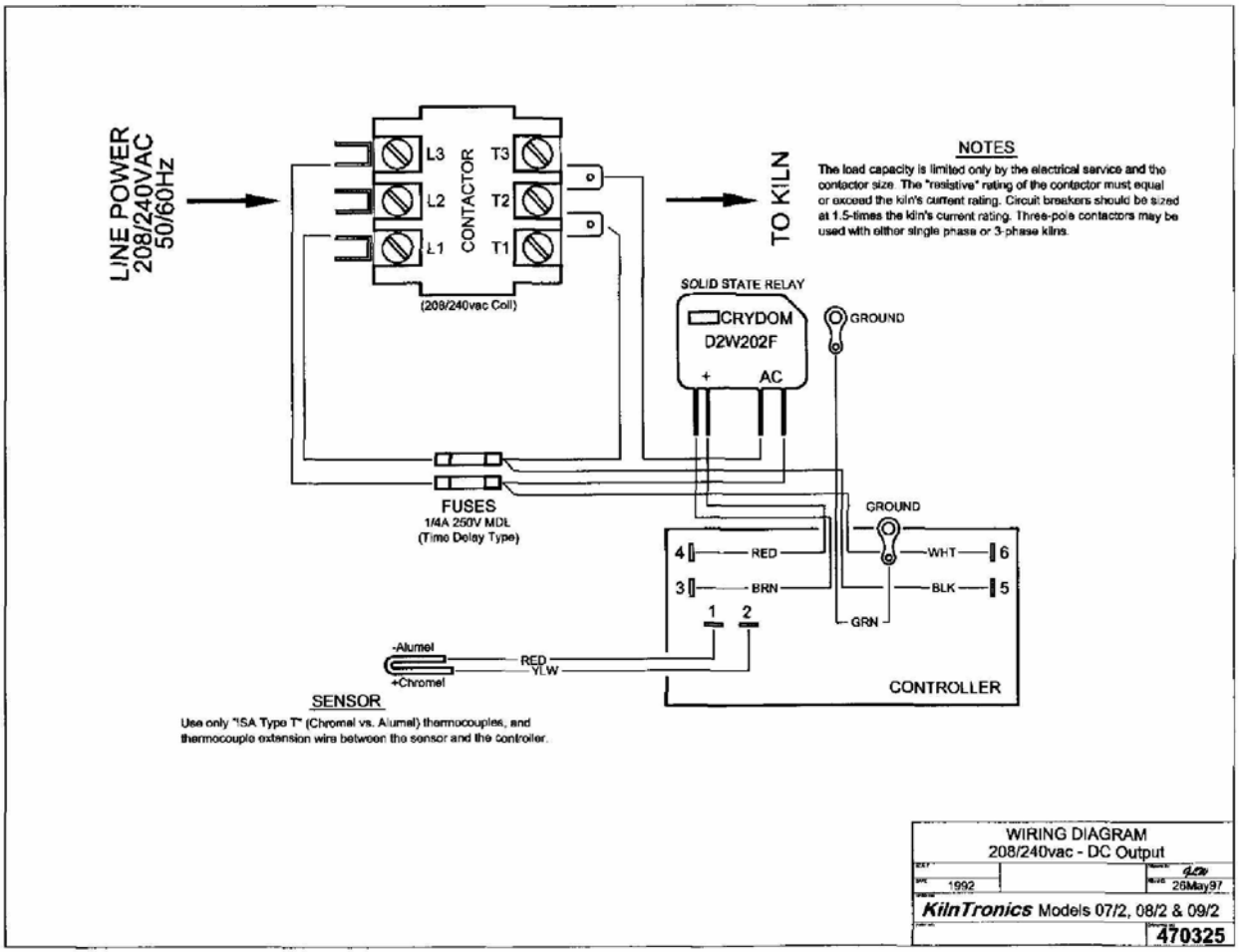
(As Determined at the National Bureau of Standards)

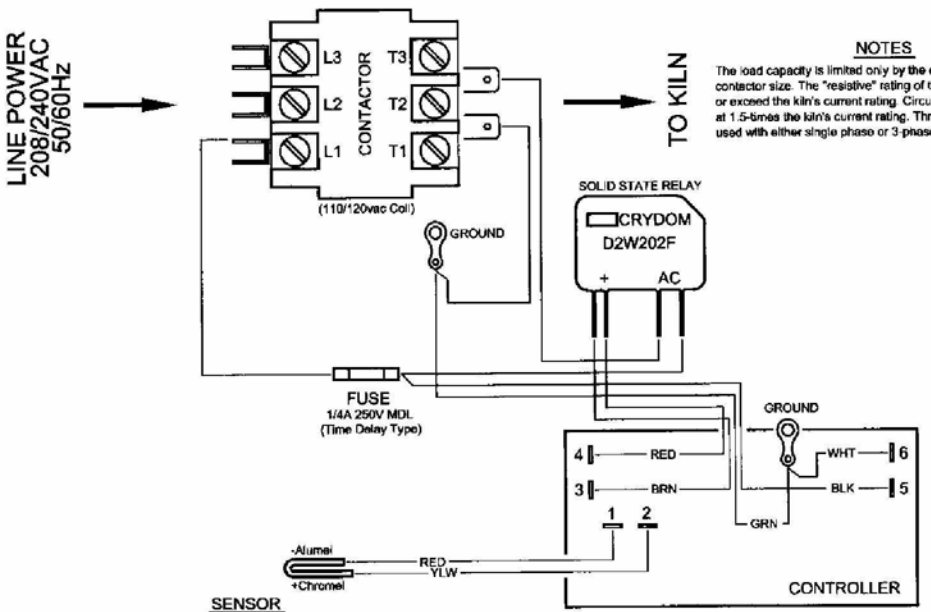
CONE NUMBER	LARGE CONES Heating Rate in °F/Hr		small	Color	Firing Stage	Customary Firing Application
	108°F/Hr	270°F/Hr	540°F/Hr			
		302		"black	free water "boils" out	
		437		heat"	alpha to beta cristobalite inversion	
		1022			alpha to beta quartz inversion	
		1067				
022	1085	1112	1165		dehydration	
021	1116	1137	1189		90% complete	
020	1157	1175	1231			
019	1234	1261	1333	dull		overglaze colors
018	1285	1323	1386	red		enamels and gold
017	1341	1377	1443			ceramic decals
016	1407	1458	1517			
015	1454	1479	1549			glass sagging
014	1533	1540	1596			chrome & red glaze
013	1596	1566	1615			
012	1591	1623	1650	cherry		
011	1627	1641	1680	red	most of	lustre glaze
010	1629	1641	1686		organic matter	
09	1679	1693	1751		now burnt	
08	1733	1751	1801	cherry	away	low firing lead &
07	1783	1803	1846	red to		fritted glazes
06	1816	1830	1873	orange	teracottas	porous biscuit-low
05	1888	1915	1944		mature	fire earthenware
04	1922	1940	2008	orange		
03	1987	2014	2068	changing		
02	2014	2048	2098	to		
01	2043	2079	2152	yellow/	earthenware	industrial earthen
1	2077	2109	2154	orange	matures	ware, bisque and
2	2088	2124	2154			bone china gloat
3	2106	2134	2185	yellow/		
4	2134	2167	2208	orange	teracottas	
5	2151	2185	2230	yellow to	melt, increasing	
6	2194	2232	2291	lt. yellow	formation	semi-porcelain
7	2219	2264	2307		of beta type	salt glaze
8	2257	2305	2372	yellow	cristobalite	stoneware
9	2300	2336	2403	with white		bone china bisque
10	2345	2381	2426	tinge		& some porcelain
11	2361	2399	2437	intense		porcelain
12	2383	2419	2471	yellow-		
13		2455		white		
14		2491				
15		2608				

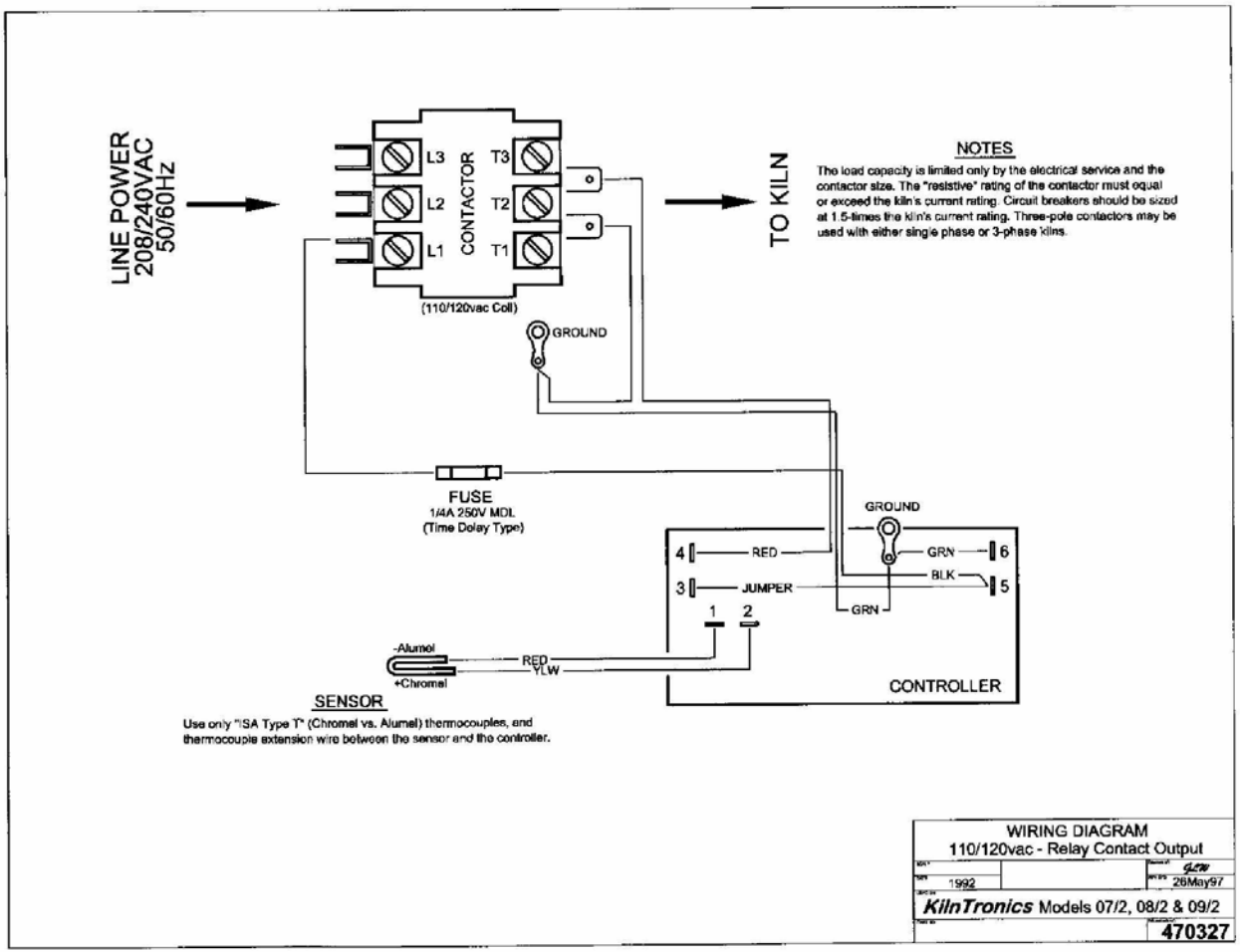
TEMPERATURE EQUIVALENTS FOR STANDARD PYROMETRIC CONES (°:C)

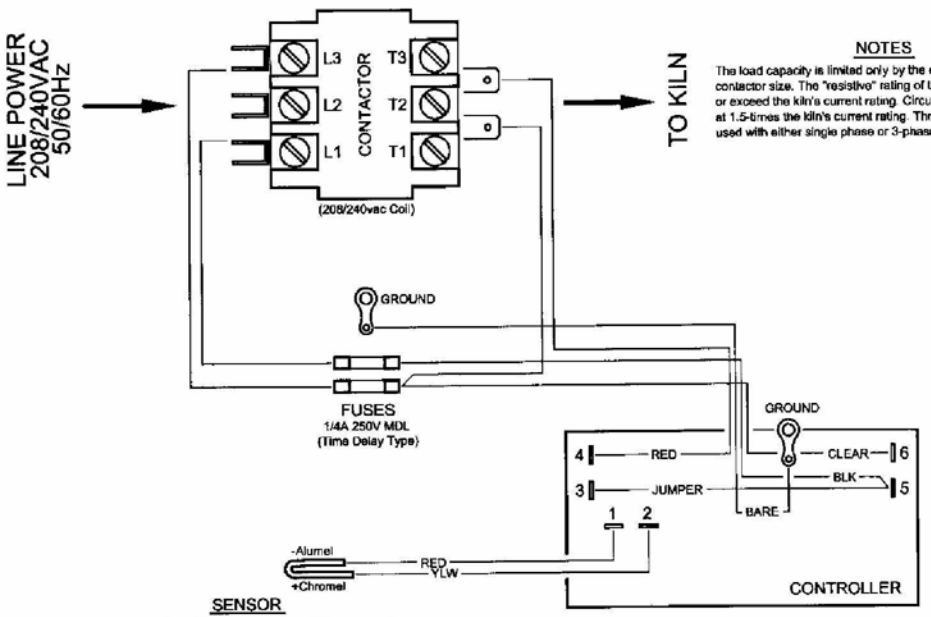
(As Determined at the National Bureau of Standards)

	LARGE CONES		small			
CONE NUMBER	Heating Rate in °C/Hr			Color	Firing Stage	Customary Firing Application
	60°C/Hr	150°C/Hr	300°C/Hr			
		150		"black	free water "boils" out	
		225		heat"	alpha to beta cristobalite inversion	
		550			alpha to beta quartz inversion	
		575				
022	585	600	630		dehydration	
021	602	614	643		90% complete	
020	625	635	666			
019	668	683	723	dull		overglaze colors
018	696	717	752	red		enamels and gold
017	727	747	784			ceramic decals
016	764	792	825			
015	790	804	843			glass sagging
014	834	838	870			chrome & red glaze
013	869	852	880			
012	866	884	900	cherry		
011	886	894	915	red	most of	lustre glaze
010	887	894	919		organic matter	
09	915	923	955		now burnt	
08	945	955	983	cherry	away	low firing lead &
07	973	984	1008	red to		fritted glazes
06	991	999	1023	orange	terracottas	porous biscuit-low
05	1031	1046	1062		mature	fire earthenware
04	1050	1060	1098	orange		
03	1086	1101	1131	changing		
02	1101	1120	1148	to		
01	1117	1137	1178	yellow/	earthenware	industrial earthen
1	1136	1154	1179	orange	matures	ware, bisque and
2	1142	1162	1179			bone china glost
3	1152	1168	1196	yellow/		
4	1168	1186	1209	orange	terracottas	
5	1177	1196	1221	yellow to	melt, increasing	
6	1201	1222	1255	lt yellow	formation	semi-porcelain
7	1215	1240	1264		of beta type	salt glaze
8	1236	1263	1300	yellow	cristobalite	stoneware
9	1260	1280	1317	with white		bone china bisque
10	1285	1305	1330	tinge		& some porcelain
11	1294	1315	1336	intense		porcelain
12	1306	1326	1355	yellow-		
13		1346		white		
14		1366				
15		1431				


LINE POWER
208/240VAC
50/60Hz
L3
L2
L1
CONTACTOR
T3
T2
T1
(208/240vac Coil)
TO KILN
NOTES
The load capacity is limited only by the electrical service and the contactor size. The "resistive" rating of the contactor must equal or exceed the kiln's current rating. Circuit breakers should be sized at 1.5-times the kiln's current rating. Three-pole contactors may be used with either single phase or 3-phase kilns.
SOLID STATE RELAY
CRYDOM
D2W202F
+
AC
GROUND
FUSES
1/4A 250V MDL
(Time Delay Type)
GROUND
4
RED
WHT
6
3
BRN
BLK
5
1
2
GRN
-Alumel
+Chromel
RED
YLW
CONTROLLER
SENSOR
Use only "ISA Type T" (Chromel vs. Alumel) thermocouples, and thermocouple extension wire between the sensor and the controller.
WIRING DIAGRAM
208/240vac - DC Output
1992
26May97
KilnTronics Models 07/2, 08/2 & 09/2
470325


LINE POWER
208/240VAC
50/60Hz
L3
L2
L1
CONTACTOR
T3
T2
T1
TO KILN
(110/120vac Coil)
GROUND
SOLID STATE RELAY
CRYDOM
D2W202F
+
AC
FUSE
1/4A 250V MDL
(Time Delay Type)
GROUND
4
RED
3
BRN
WHT
6
BLK
5
GRN
1
2
-Alumel
+Chromel
RED
YLW
CONTROLLER
SENSOR
Use only "ISA Type T" (Chromel vs. Alumel) thermocouples, and thermocouple extension wire between the sensor and the controller.
NOTES
The load capacity is limited only by the electrical service and the contactor size. The "resistive" rating of the contactor must equal or exceed the kiln's current rating. Circuit breakers should be sized at 1.5-times the kiln's current rating. Three-pole contactors may be used with either single phase or 3-phase kilns.
WIRING DIAGRAM
110/120vac - DC Output
1902
26May97
KilnTronics Models 07/2, 08/2 & 09/2
470326


LINE POWER
208/240VAC
50/60Hz
L3
L2
L1
CONTACTOR
T3
T2
T1
(110/120vac Coil)
TO KILN
GROUND
FUSE
1/4A 250V MDL
(Time Delay Type)
GROUND
4
RED
3
JUMPER
1
2
GRN
6
BLK
5
GRN
-Alumel
+Chromel
RED
YLW
CONTROLLER
SENSOR
Use only "ISA Type T" (Chromel vs. Alumel) thermocouples, and thermocouple extension wire between the sensor and the controller.
NOTES
The load capacity is limited only by the electrical service and the contactor size. The "resistive" rating of the contactor must equal or exceed the kiln's current rating. Circuit breakers should be sized at 1.5-times the kiln's current rating. Three-pole contactors may be used with either single phase or 3-phase kilns.
WIRING DIAGRAM
110/120vac - Relay Contact Output
1992
26May97
KilnTronics Models 07/2, 08/2 & 09/2
470327



NOTES

The load capacity is limited only by the electrical service and the contactor size. The "resistive" rating of the contactor must equal or exceed the kiln's current rating. Circuit breakers should be sized at 1.5-times the kiln's current rating. Three-pole contactors may be used with either single phase or 3-phase kilns.

SENSOR

Use only "ISA Type T" (Chromel vs. Alumel) thermocouples, and thermocouple extension wire between the sensor and the controller.

WIRING DIAGRAM
208/240vac - Relay Contact Output

1992

26May97

KilnTronics Models 07/2, 08/2 & 09/2

470328

Notes:

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