USER'S GUIDE

FireRight Sr

Temperature/Rate Control Systems

Fifth Edition
April 1, 1997

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CAUTIONS - WARNINGS

1. NEVER LEAVE YOUR KILN UNATTENDED BEYOND THE SCHEDULED FIRING TIME.

2. Never place the controller on top of your kiln.

3 . NEVER CONNECT THE TEMPERATURE SENSOR TO THE CONTROLLER WITHOUT ASSURING THAT THE THERMOCOUPLE ELEMENT HAS BEEN PROPERLY INSTALLED AND SECURELY FASTENED TO YOUR KILN.

4. No man-made product can be made fully fail-safe. 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.

5. THE SAFETY OF YOUR KILN IS YOUR RESPONSIBILITY.

COMMUNICATIONS EQUIPMENT (RFI)

Portable communications equipment, especially devices with high-powered transmitters such as citizens' band receiver-transmitters and cellular telephones, will interfere with your control system if operated within 50-feet of the controller or sensor cable. Radio frequency interference (RFI) will typically cause spurious and erratic temperature indications, and may cause controllers operating in the shut-off mode to stop the firing prematurely. (Low power portable telephones do not ordinarily produce RFI problems.) ***Security guards should be cautioned about using portable communications devices near this equipment.***

FEATURES INVOLVING SAFETY

1. In the event of a sensor failure (eventual burn-out, open sensor circuit or connections reversed), the controller will automatically disable the heating circuit. It will also provide a flashing "00" temperature indication accompanied by a flashing "SENSOR" warning. You will not be able to operate the kiln until the sensor problem has been corrected.

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

3. 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.

GENERAL DESCRIPTION

The *FireRight Sr* Temperature/Rate Controller is designed specifically for firing ceramics and annealing glass. Users typically include hobbyists, professional/commercial artists, educational institutions, industrial research labs and light industrial production facilities.

Like conventional temperature controllers, the *FireRight Sr* is capable of holding the temperature at a preset level. It is also capable of serving as a shut-off ... a device which simply turns the kiln off when a preset temperature is reached. Unlike conventional controllers, the *FireRight Sr* is able to control the rate of change from one temperature to another, up or down.

The *FireRight Sr* uses a type K (nickel-chromium vs. nickel-aluminum) thermocouple as its temperature sensor, and has an operating range of 0/2500°F (-17/1371°C). The temperature set points are infinitely adjustable over this range. The rate of temperature change is also infinitely adjustable, with a range of 0-540°F/Hr (0-300°C/Hr); for annealing operations, an internal jumper permits the user to reduce this range by a factor of ten (0-54°F/Hr, 0-30°C/Hr).

The measured temperature is continuously displayed on a large digital indicator. This same indicator is used to display and adjust the RATE, LIMIT and RAMP settings. The indicator can convert °F to °C, and visa versa, at the push of a button. Twenty-one other indicators continuously display the status of all of the controllers other functions.

There are two standard *FireRight Sr* Temperature/Rate Control Systems, rated at 48-amps and 75-amps, respectively. These packages include the controller, an electrical power controller, the sensor and the necessary interconnecting cables. The electrical power and kiln cables must be direct-wired to the terminals inside the power controller by an electrician, but everything else simply plugs in. Both units handle 208/240vac power. The 75-amp system may be used with either single phase or 3-phase power.

A special system is provided for installation by kiln and annealer manufacturers. This system makes use of the kiln's standard control circuit, and is quickly and easily installed by the manufacturer, using the modular plug-in cables.

A great deal of care has been taken "uncomplicate" the *FireRight Sr*, making it easy for "real people" to understand and use. The connectors are keyed and clearly labeled, making it almost impossible to hook the cables up incorrectly. The controls and indicators are logically arranged, and are labeled in plain English, to make their functions readily apparent.

A quick reading of this booklet will familiarize you with its contents, and the not-so-apparent features of the equipment.

INSTALLATION & HOOK-UP

Installation instructions are provided only for *FireRight* 48-Amp and 75-Amp Temperature/Rate Control Systems. Refer to the kiln manufacturer's handbook for information regarding factory-installed controllers and control systems.

FireRight control systems are easy to install. Everything is fully assembled and ready to use. The main power cable and the kiln's power cable must be hard-wired to the power contactor inside of the new power controller. Otherwise, everything just plugs-in, and the connectors are keyed to fit only their proper receptacles.

MOUNTING THE POWER CONTROLLER

1. The power controller is the heavy steel box containing the main heating relay (also called the "power contactor".

2. Choose a location on the wall near the kiln's electrical service.

3. If mounting 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.

4. 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.

5. Tape the paper template to the wall or plywood mounting panel, and drive the four #8 x 3/4" sheet metal screws (provided) through it. Drive these screws straight, and almost fully into the wall or panel, leaving only about 1/16" clearance, then tear the template away and discard it.

6. Push the power controller onto these four screws, then down, to lock it in place.

MOUNTING THE TEMPERATURE SENSOR

1. Most commercial kilns have a sensor port opposite their "peepholes". If one of the peep-holes must be used, users are cautioned about using the other peepholes for venting purposes, since the resulting drafts inside the kiln may affect the temperature measurement.

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

3. Drill a 7/64" hole through the jacket of the kiln at these locations.

4. Push the sensor back into the hole and fasten it in place using the two #8 x 3/4" sheet metal screws (provided).

CHOOSING A LOCATION FOR THE TEMPERATURE/RATE CONTROLLER

1. The controller will be damaged if left on top of the kiln during the firing. It is suggested that cables lengths be restricted to make such accidents impossible.

2. The standard control cable and thermocouple extension cable are seven feet long. Longer extension cables may be used to locate the controller remote from the kiln or lehr.

ELECTRICAL HOOK-UP

1. Connect the 2-wire SENSOR cable to the mating receptacle on the *FireRight Sr* controller.

2. Connect one end of the 3-wire control cable to the POWER receptacle on the *FireRight Sr* controller. Connect the other end to the modular receptacle on the power controller.

3. Refer to the wiring diagram in the Appendix, and proceed as follows:

WARNING

PROCEED NO FURTHER UNTIL YOU HAVE ASSURED YOURSELF THAT ALL POWER HAS BEEN REMOVED FROM THE SERVICE CABLE THAT WILL DELIVER POWER TO THE POWER CONTROLLER BOX.

a. The Power Controller requires a source of 208/240vac power. Long runs of undersized wire constitute a fire and safety hazard, and may also result in a voltage drop which will limit the kiln's heating capacity, and may cause fuses to blow in the power controller. Refer to the kiln's instruction book for the manufacturer's wiring recommendations.

b. System power connections have already been made at the auxiliary "quick connect" terminals on one side of the contactor inside of the power controller. Bring the service cable into the power controller, and connect it to the screw terminals on this side the contactor. ***PLEASE DO NOT USE THE QUICK-DISCONNECT TERMINALS FOR THIS CONNECTION.***

Single Phase Power: Use the left and right contactor terminals, making no connection to the center terminal on 75-amp contactors. Connect the ground wire from the service cable to the power controller's chassis using an appropriate lug at the hole provided.

Three Phase Power: (75-amp units only) Use all three contactor terminals, and connect the ground wire from service cable to the power controller's chassis.

c. In the same manner, connect the kiln's cable to the screw terminals on the opposite side of the contactor. ***PLEASE DO NOT USE THE QUICK-DISCONNECT TERMINALS FOR THIS CONNECTION***. The ground wire from the kiln (usually GREEN) must be connected to the power controller's chassis.

IMPORTANT NOTE

To avoid unreliable operation due to electrical feedback, keep the sensor and control cables well away from these current-carrying cables.

CONTROLS, CONNECTORS AND INDICATORS

The various connectors, operating controls and indicators are described in the following familiarization procedure. Become familiar with each item prior to operating the controller for the first time.

1. Two cables are connected to the back of the controller. The 2-wire cable goes to the temperature sensor on the kiln. The 6-wire cable brings in low level ac power from the power controller and returns a dc control signal that regulates the heating circuit.

   The highest potential on either of these cables does not normally exceed 24-volts, so there is normally no electrical shock hazard associated with the temperature/rate controller itself. The two modular (telephone type) connectors are keyed by size, and will only fit the correct socket.

   Simply unplug these two connectors to remove the controller for service or storage.

2. Push the "ON" button to start the controller.

   An internal initializing system makes sure that everything starts up in the right operating mode ... i.e., the controller always starts up in the "SHUT OFF" mode, with the "LATCH" tripped ... etc.

3. Push the LIMIT button and, using a small pocket screwdriver, set the desired limit temperature ... for example, 2000°F ... by turning the LIMIT set point adjustment.

   Wait a few seconds and you'll see the display automatically switch back to the temperature function. You need not worry about leaving the display on the wrong function, since it always goes back to the kiln temperature within 30-seconds.

4. In a similar manner, push the RATE button and set the desired rate of temperature change ...typically 270°F/Hr.

Note the SCALE indication changes from °F to °F/Hr when the RATE setting is being displayed. With 270°F/Hr set, push the "C" scale button and note the display automatically converts the reading to 150°C/Hr. °F/°C conversion is available for all four display parameters simply by pressing the "F" and "C" SCALE buttons.

5. With the limit set at 2000°F, and the measured temperature at some lesser value (typically at room temperature), press the "LATCH" button to reset the controller.

Note that the green "Tripped" light goes off, and the red "UP" light begins to flash on and off. This means that the actual temperature set point ... the RAMP ... is now being increased from zero to the 2000°F limit setting, at the rate you've set ... 270°F/Hr.

6. To speed things up, press the "RAMP" button ... then press the "UP" (up arrow) button.

The "RAMP" reading will now rapidly move to any value you select using the up and down (arrow) buttons. Notice that the up and down buttons are only active as long as the RAMP button is active. When the display is switched to some other function, the up and down buttons are disabled, to prevent accidental set point changes.

... in this manner, set the RAMP at about 1000°F.

7. The HEAT light will now be on, since the temperature is less than the set point (ramp setting). Push the RAMP button, then hold the DOWN (arrow) button to adjust the set point to 100°F. When the measured temperature reaches this level, the controller will turn the HEAT off. Then press the RAMP and UP (arrow) buttons to adjust the set point to a slightly higher temperature (e.g.; 120°F), observing that the HEAT is turned on again.

In actual operation, this will occur over and over again, as the RAMP automatically increases at the set rate, and the kiln's heaters are operated as required to keep its temperature equal to the ramp value.

8. Turn the LIMIT setting all of the way down (fully counterclockwise). The green "LATCH" tripped light will now come on since the measured temperature is now higher than the limit setting. Press the RAMP button, and you'll see that this value has now been reset to zero. This is what typically occurs at the end of a firing to shut the kiln off and keep it off.

When the controller is operated in the SOAK mode, it will hold the kiln at the limit setting indefinitely ... just like any conventional temperature controller.

9. Momentarily disconnect the sensor cable from the back of the controller. This will produce a flashing "00" indication, accompanied by a flashing "SENSOR" warning.

This controller has a unique bi-directional sensor fault detection circuit. Thermocouple sensors eventually burn out ... and when this happens the controller tells you. Unlike conventional controllers, it also tells you when the sensor connections have been reversed. In both cases, the controller will not permit the kiln to operate until the sensor problem has been corrected.

10. Press the PROG (program) button. Then observe the LIMIT and RATE settings. As you'll see, pressing the PROG button provides a limit setting of about 55°F and a rate setting of about 270°F/Hr. Used in conjunction with the SOAK function, this provides an easy way to do a controlled cool-down.

11. Press the OFF button to turn off the control system ... and the kiln or lehr.

When the equipment is not going to be used for several days, disconnect it from the power line by unplugging the main power cord or switching off its circuit breakers. This safety measure will also protect your control system from power line surges, disturbances resulting from electrical storms, etc.

PREFIRING CHECK-OUT PROCEDURE

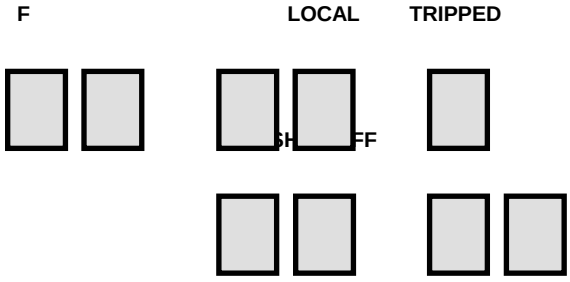
A brief inspection and test of the control system prior to each firing can prevent interruptions during the firing that may spoil the batch. The following procedure is simple enough to soon be committed to memory and performed thereafter as a matter of habit.

1. Inspect the temperature sensor for loose connections and excessive corrosion.

   Corrosion of the thermocouple sensor is directly related to temperature and firing time. Soaking at high temperature (above 1800°F (1000°C) rapidly degrades the element. The corrosion process attacks the wire from its outside surface, inward. To check the thermocouple element, scrape away the scale on the surface of the wire until good shiny material is exposed. The element should be replaced when the remaining good material has been reduced to about one-third of its original diameter.

2. With power applied to the control system, only the green OFF light should be on.

3. Push the ON button. The temperature display should be reasonably close to the expected value (typically room temperature), and only the following lights should be on:



4. Press the RATE button and adjust the rate to 270°F/Hr.

5. Press the LIMIT button and adjust the limit to 2500°F (1371°C).

6. Press the RAMP button and observe that the ramp is at 0°F (-17°C).

7. Press the LATCH button. The green TRIPPED light will go out, and the red UP (arrow) indicator will begin to operate.

8. Press the RAMP button. Then push the UP (arrow) button to adjust the RAMP setting to any level higher than the measured temperature. When the RAMP setting passes the actual temperature, the red HEAT light will come on, and the contactor in the power controller (or on the kiln) will click on.

9. Momentarily disconnect the sensor cable from the back of the controller. A flashing "00" indication, accompanied by a SENSOR warning signal will result. The green TRIPPED light will also be actuated, and the RAMP setting will be reduced to zero.

OPERATION

The following representative firing instructions will serve as a guide to the proper use of the controller. They are not presented as proper firing technique. Determine how each load should be processed, then refer to these instructions as a guide to setting up the firing.

BASIC (BISCUIT) FIRINGS

1. Push the ON button to turn the control system on.

2. Push the RATE button and adjust the RATE set point to 270°F/Hr (150°C/Hr), or to whatever rate you consider appropriate for the early firing stages.

3. Push the LIMIT button and adjust the LIMIT set point to the desired shut-off temperature.

> Conversion charts are provided in the Appendix, which relate cone numbers to temperature settings, depending on the set rate of temperature change. Faster rates require higher limit settings to achieve the same results, and visa versa.
>
> Exact limit settings are possible to achieve, but the setability of the limit adjustment has practical limitations. To set the limit temperature exactly, you must set the parameter within ½°F, or within 200 parts per million, of an arbitrarily selected number. This is difficult to do, is usually not essential to good results, and therefore isn't usually the effort. Do try to set the limit to within 10°F (5°C) of the tabulated temperature.

4. If the kiln has switches, set them all at "High" (or full on).

5. Press the TRIPPED button to begin the firing.

> The firing will begin from 0°F (-17°C). You may expedite the start-up, if desired, by pressing the RAMP button, then pressing the UP (arrow) button to manually drive the ramp setting higher than the measured temperature ... at which point the kiln will be turned on.

6. The firing will then proceed to the limit setting. The system will then be turned off, allowing the kiln to cool at its own rate.

7. If controlled cooling is desired, press the SOAK button any time prior to the end of the firing. When the set limit temperature is reached, the controller will hold the kiln at that level indefinitely. When ready to cool, turn the LIMIT adjustment all the way down, and adjust the rate setting to the desired cooling rate.

GLAZE FIRINGS

The above procedure is also applicable to glaze firings, except that it is often permissible to fire glaze more rapidly, slowing down near the end of the firing, or soaking briefly at the limit, to permit the glaze to settle out. To slow down, simply reduce the RATE setting prior to reaching the limit setting. To soak at the limit, press the SOAK button before the limit temperature is reached, let the kiln soak at that temperature for as long as desired, then press the SHUT-OFF button.

CRYSTALLINE GLAZE

1. Press the ON button.

2. Set the RATE at 270°F/Hr (150°C/Hr), or as desired.

3. Set the LIMIT at 2400°F (1315°C), or as desired.

4. Press the SOAK button.

5. Press the TRIPPED button to begin the firing.

6. Watch the temperature closely as it approaches the limit. Let the kiln soak at that setting for about 20-minutes (or as desired), then reduce the LIMIT setting to 2100°F (1150°C), or the desired soak level.

> The RAMP will automatically drop to this new level, at the 270°F/hr (150°C/Hr) rate. To expedite this, press the RAMP button, then the DOWN (arrow) button to manually drive the ramp set point to the new limit setting.

7. Crystal development is a function of soak time at this set point. Soak time at this temperature is typically six to twelve hours, depending upon the results desired.

8. When done, press the SHUT-OFF button to stop the firing, or set up for controlled cooling if desired, by turning the LIMIT adjustment all the way down, and setting an appropriate cooling rate.

ANNEALING GLASS

1. Press the ON button to turn the control system on.

2. Adjust the LIMIT setting to 1000°F (540°C), or the desired melt temperature.

3. Press the SOAK button.

4. Press the TRIPPED button to reset the control system.

5. Adjust the RATE to the desired heat-up rate. If desired, drive the RAMP to the limit setting manually by pressing the RAMP and UP (arrow) buttons.

6. When the load has stabilized at the melt temperature, reduce the RATE setting to 50°F/Hr 28°C/Hr), or the desired cooling rate, then turn the LIMIT adjustment all the way down.

The controller will now reduce the temperature of the lehr to room temperature at the slow cooling rate. If desired, the cooling rate may be altered within the annealing cycle.

IMPORTANT NOTE

An internal jumper reduces the RATE scale by a factor of ten to permit the setting of very slow rates. Remove the cover from the controller, find this jumper at the rear, right-hand corner of the top circuit board, and switch it from the "**Norm**" position to the "**÷10**" position. Then, to set a cooling rate of 5°F/Hr, adjust the reading to "50" and interpret it as 5.0°F/Hr.

7. To stop the annealer prior to its having cooled to room temperature, press the SHUT-OFF button, or simply turn the controller OFF.

LIMITED WARRANTY

FireRight Controls warrants *FireRight Sr* control systems for one-year from the date of purchase. Units that develop defects attributable to material or workmanship will be repaired or replaced without charge.

SERVICE ASSISTANCE - FACTORY SERVICE

When control system problems arise, technical assistance is available directly from the factory at ...

Warner Instruments
1320 Fulton Street Box 604
Grand Haven, Michigan 49417-0604 USA
Phone: (616) 842-7658
FAX: (616) 842-1471
e-mail: *support@fireright.com*
Internet: *http://www.fireright.com*

Control system problems can often be diagnosed over the phone. If a phone is near enough to the control system to permit you to discuss the problem and work on the system according to our instructions during your call, we will probably be able to diagnose the problem. Otherwise, "telephone trouble-shooting" is effective only about 50% of the time.

If you have already determined that a particular component of your control system is defective, 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. All service is performed by factory production personnel, and usually takes less than one week.

Warranty work is handled at no cost to the user, except possibly for shipping and insurance. Non-warranty service is billed at standard flat rates, which can be quoted in advance. All shipping and insurance costs will be prepaid and added to the billing.

Your dealer may be able to handle your service transaction for you. If not, pack your controller carefully and ship it to us via UPS, if possible. The shipment should be insured for its replacement cost. 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.

TEMPERATURE EQUIVALENTS FOR ORTON™ STANDARD PYROMETRIC CONES

(As Determined at the National Bureau of Standards)

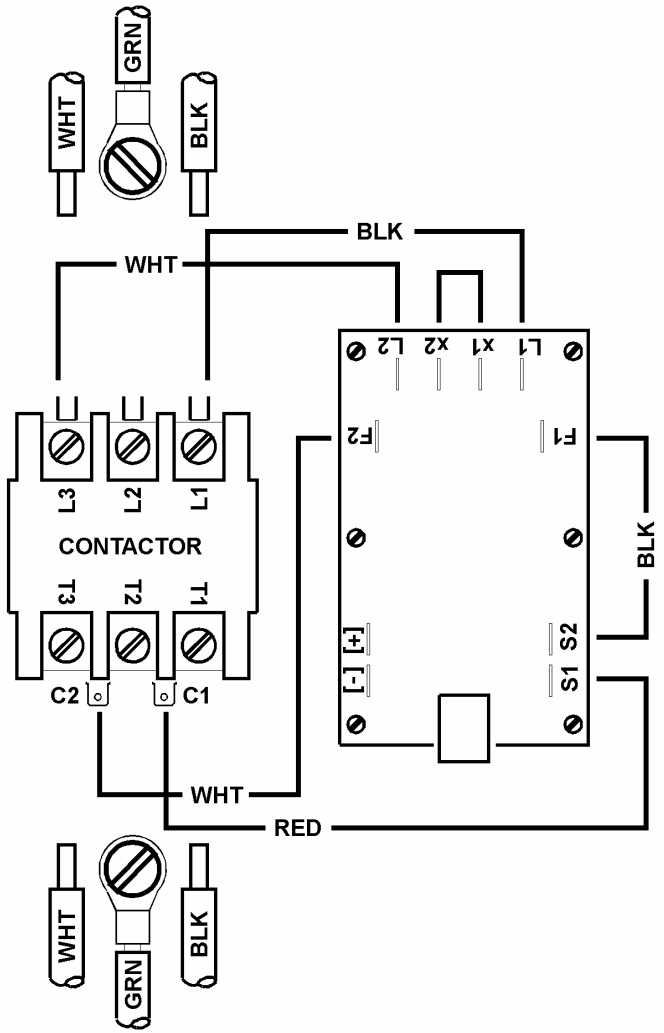
CONE	LARGE CONES Heating Rate in °F/Hr		small	Color	Firing Stage	Customary Firing
	108°F/Hr	270°F/Hr	540°F/Hr			
		302		"black	free water "boils" out	
		437		heat"	alpha to beta cristobalite inversion	
		1022			alpha to beta quartz inversion	
		1067				
022	1085	1112	1165		dehydration	
021	1116	1137	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 glost
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 ORTON™ STANDARD PYROMETRIC CONES

(As Determined at the National Bureau of Standards)

CONE	LARGE CONES		small	Color	Firing Stage	Customary Firing
	Heating Rate in °C/Hr					
	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	teracottas	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	teracottas	
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				

INPUT POWER CABLE
208 - 240 vac 50/60 Hz



OUTPUT CABLE
TO KILN OR LEHR

PORTABLE CORDAGE RECOMMENDATIONS					
Single Phase			Three Phase		
CABLE	Maximum Amps	Maximum Feet	CABLE	Maximum Amps	Maximum Feet
14/3	18	95	14/4	15	131
12/3	25	109	12/4	20	157
10/3	30	144	10/4	25	200
8/3	40	171	8/4	35	226
6/3	55	195	6/4	45	275
4/3	70	242	4/4	60	326
2/3	95	287	2/4	80	393

Type SO portable cordage 60°C 600V, with green conductor used for grounding only.
Length specified for 5% maximum volt loss from minimum 208v line.

NOTES:

1. **To prevent interference due to electrical feedback, keep the sensor and control cables well away from the power cables.**
2. **The quick connect terminals on the contactor must be used for auxiliary power connections only. Use the screw terminals for line and load connections.**
3. **Solid state relays and power controllers can be driven from the [+] and [-] terminals. When these terminals are used, open the link on the printed circuit board that connects these two terminals.**

TITLE: **WIRING DIAGRAM** *FireRight* Power Controllers		
SCALE		DRAWN BY GLW
DATE 25APL92		REV 20MAR96
USED ON 011017, etc		DRAWING NO. 470747

***FireRight* Controls**/Warner Instruments
1320 Fulton Street Box 604
Grand Haven, Michigan 49417-0604 USA
Phone: (616) 843-5342
e-mail: *info1@fireright.com*
Internet: *http://www.fireright.com*