



## Basic Kiln Repair Seminar - Topics

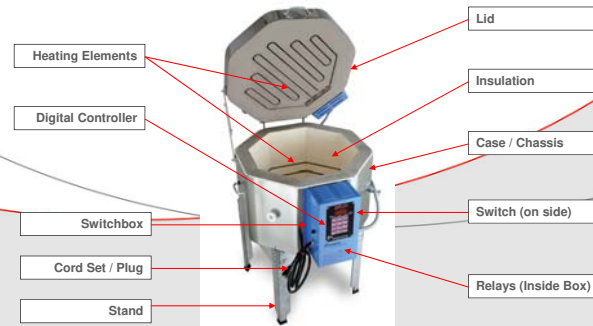
- Kiln Components
- Available Power
- Cord Sets, Plugs, Receptacles
- Electrical Switches
- Controllers
- Thermocouples
- Heating Elements
- Temperature Profiles
- Test Equipment
- Wiring Diagrams
- Practical Troubleshooting

Better Designed Kilns



## Basic Kiln Repair Seminar - Kiln Components

### Basic Kiln – Fusion 8



Better Designed Kilns



## Basic Kiln Repair Seminar - Available Power

### Typical Electrical Service

- 120 Volts, 15 Amps    1800 Watts  
Lights, Television, Microwave
- 240 Volts, 30 Amps    7200 Watts  
Electric Range, Clothes Dryer
- 240 Volts, 50 Amps    2000 Watts  
Air Conditioning Unit
- 208 - 240 Volts        3 Phase  
Commercial, Air Conditioning
- 480 Volts                3 Phase  
Industrial

Better Designed Kilns



## Basic Kiln Repair Seminar - Cord Sets, Plugs, Receptacles

### NEMA sets Standards

The National Electrical Manufacturers Association (NEMA) was founded in 1926 and maintains its headquarters near Washington, D.C.

The 450 member companies manufacture products used in the generation, transmission, distribution, control, and end use of electricity. These products are used in utility, industrial, commercial, institutional, and residential applications.

Better Designed Kilns



## Basic Kiln Repair Seminar - Cord Sets, Plugs, Receptacles

### NEMA Nomenclature

For straight-blade NEMA devices, designations are a numeral-numeral letter (example: 5-20P) format.

The numeral preceding the hyphen indicates the configuration - the number of poles, number of wires, voltage, and whether it is single- or three-phase.

The numeral following the hyphen is the rating of the device in amperes. The number is followed by the letter, R to indicate a receptacle (female connector) or the letter P to indicate a plug (male connector).

Better Designed Kilns



## Basic Kiln Repair Seminar - Cord Sets, Plugs, Receptacles

### NEMA Chart

VOLTAGE	Poles	15 AMPERE		20 AMPERE		30 AMPERE		50 AMPERE		60 AMPERE	
		Receptacle	Plug	Receptacle	Plug	Receptacle	Plug	Receptacle	Plug	Receptacle	Plug
125 V	1	1-15R	1-15P								
250V	2	2-15R	2-15P	2-20R	2-20P	2-30R	2-30P				
125V	5	5-15R	5-15P	5-20R	5-20P	5-30R	5-30P	5-50R	5-50P		
250V	6	6-15R	6-15P	6-20R	6-20P	6-30R	6-30P	6-50R	6-50P		
277V, A.C.	7	7-15R	7-15P	7-20R	7-20P	7-30R	7-30P	7-50R	7-50P		
125/250V	10			10-20R	10-20P	10-30R	10-30P	10-50R	10-50P		
3Ø 250V	11	11-15R	11-15P	11-20R	11-20P	11-30R	11-30P	11-50R	11-50P		
125/250V	14	14-15R	14-15P	14-20R	14-20P	14-30R	14-30P	14-50R	14-50P	14-60R	14-60P
3Ø 250V	15	15-15R	15-15P	15-20R	15-20P	15-30R	15-30P	15-50R	15-50P	15-60R	15-60P
3Ø Y 120/208V	18	18-15R	18-15P	18-20R	18-20P	18-30R	18-30P	18-50R	18-50P	18-60R	18-60P

Better Designed Kilns



## Basic Kiln Repair Seminar - Switches

### Various Types

- Toggle and Rocker Switch
- Three Way and Four Way Switch
- Infinite Switch
- SnF Timing Motor
- Kiln Sitter / Limit Timer
- Relay

Better Designed Kilns



## Basic Kiln Repair Seminar - Switches

### Toggle and Rocker

- Used as typically as a Power Switch
- Provides actuation of electrical contacts, or control current or main voltage
- Various Failure Modes



- Burned Contacts
- Wired Wrong
- Shorted Terminals



Better Designed Kilns



## Basic Kiln Repair Seminar - Switches

### Three Way / Four Way

- Elements On or Off
- Require Neutral Line
- Interchangeability
- Various Failure Modes

**Burned Contacts**

**Wired Wrong**

**Shorted Terminals**

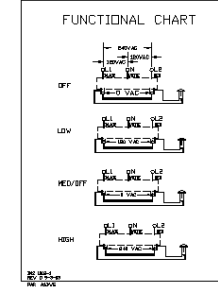
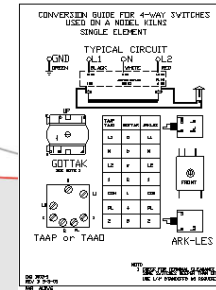


Better Designed Kilns



## Basic Kiln Repair Seminar - Switches

### Three Way / Four Way - One Element Wiring

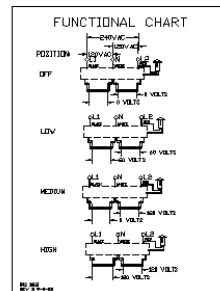
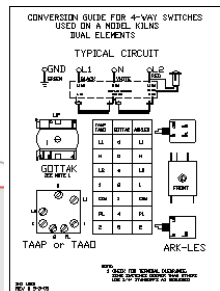


Better Designed Kilns



## Basic Kiln Repair Seminar - Switches

### Three Way / Four Way - Two Element Wiring



Better Designed Kilns



## Basic Kiln Repair Seminar - Switches

### Infinite Switch

- Allows variable power output rather than being limited to a few switched levels
- 120 - 240 Volt, 15 Amp
- Palladium Contacts - 20VA
- Duty-Cycle or Profile
- Failure Modes

**Oxidized Contacts**

**Burned Resistor**

**Burned Contacts**

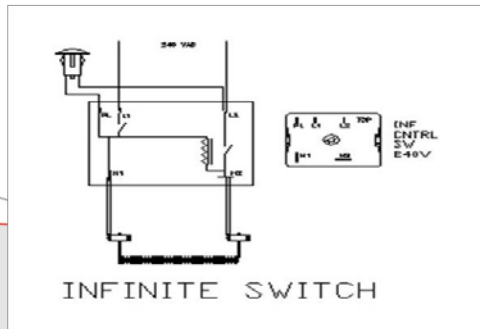


Better Designed Kilns



## Basic Kiln Repair Seminar - Switches

### Infinite Switch Circuit



Better Designed Kilns



## Basic Kiln Repair Seminar - Switches

### Kiln Sitter / Limit Timer

- Automatic Termination of Firing
- Timer to Limit Max Firing Time
- Various Failure Modes

Burned Contacts  
Bent/Stuck Sensing Rod  
Calibrated Wrong  
Wrong Cone

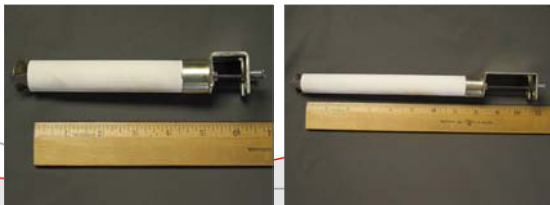


Better Designed Kilns



## Basic Kiln Repair Seminar - Switches

### Kiln Sitter / Limit Timer Tube Assemblies



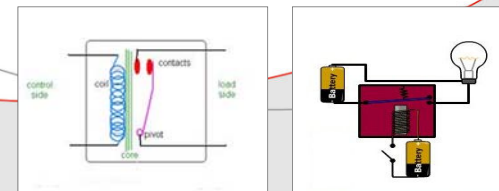
Better Designed Kilns



## Basic Kiln Repair Seminar - Switches

### Relay

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically.



Better Designed Kilns



## Basic Kiln Repair Seminar - Switches

### Relay

- Coil Voltage

Omron – 200 to 240 VAC

Potter Brumfield – 240 VAC or 12 VDC

MDR - 120 VAC or 200-240 VAC

- Contact Current

Omron – 25 Amps

Potter Brumfield – 30 Amps

MDR - 30 Amps, 60 Amps, or 100 Amps

- Contact Voltage

Omron – 277 Volts maximum

Potter Brumfield – 277 Volts maximum

MDR – 600 Volts maximum

*Better Designed Kilns*



## Basic Kiln Repair Seminar - Switches

### Relay - Examples



Standard Relay



Mechanical Relay



Solid State Relay



Magnetic Displacement  
Relay (MDR)

*Better Designed Kilns*



## Basic Kiln Repair Seminar - Switches

### Relay

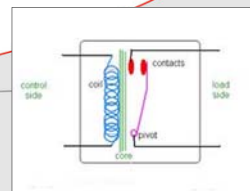
- Various Failure Modes

Pitted Contacts

Welded Contacts

Chatter

No Activation



*Better Designed Kilns*



## Basic Kiln Repair Seminar - Controllers

### Various Types

- Watlow Digital Controller

- Sentry 2.0 Controller

- Sentry Express Controller

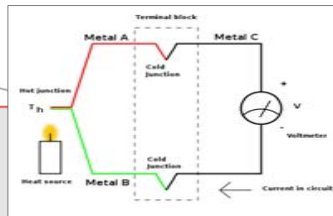
*Better Designed Kilns*



## Basic Kiln Repair Seminar - Thermocouples

### Thermocouple

A Thermocouple consists of two conductors of different metal alloys that produce an electrical voltage where the two conductors are in contact when heated.



Better Designed Kilns



## Basic Kiln Repair Seminar - Thermocouples

### Thermocouples

- Physical Considerations
  - Dissimilar Metals
  - Creates Voltage Proportional to Temperature
  - Curves are not Linear
  - Very Repeatable
- Reference Junction
  - Extension Wires
  - Red Lead Always Negative
  - Over Twelve Types of Thermocouples

Better Designed Kilns



## Basic Kiln Repair Seminar - Thermocouples

### Thermocouples – K Type

- Nickel / Chromium, Nickel / Aluminum (Magnetic)
- Red and Yellow Leads
- Negative (Red) Lead is Magnetic
- 2500° F Maximum Temperature
- 0 TO 0.055 VDC Output
- Open Weld or Sheathed



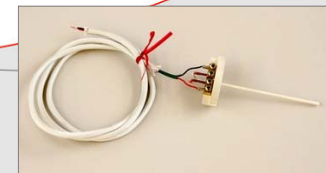
Better Designed Kilns



## Basic Kiln Repair Seminar - Thermocouples

### Thermocouples – S Type

- Platinum 100%, Rhodium 10% / Platinum 90%
- Red and Black Leads
- 3200° F Maximum Temperature
- 0 TO .019 VDC Output
- Expensive and Fragile
- Protection Tubes



Better Designed Kilns



## Basic Kiln Repair Seminar - Heating Elements

A Heating Element converts electricity into heat. As Electric current passes through the element, it encounters resistance, thereby producing heat



Better Designed Kilns



## Basic Kiln Repair Seminar - Heating Elements

### Design Parameters

- Watts per square inch- 10 to 20
- Wire Size- 12 AWG to 20 AWG
- Coil Size- 3/8" OD to 1/2" OD
- Stretch Length (Pitch)- 2 Wire Diameters

Better Designed Kilns



## Basic Kiln Repair Seminar - Heating Elements

### Materials

- Iron Chrome
  - Maximum Temperature – 2450° F
  - Grows Aluminum Oxide Coating
  - Brittle after firing
  - Must be supported
- Nickel Chrome
  - Maximum Temperature - 2000°F
  - Grows Chromium Oxide Coating
  - Does not sag
  - Used for roof elements

Better Designed Kilns



## Basic Kiln Repair Seminar - Heating Elements

### Installation

- Supported In Side Wall Insulation Grooves
- Stapled In Grooves Of Kiln Lid
- Suspended On Ceramic Rods
- Embedded In Insulation

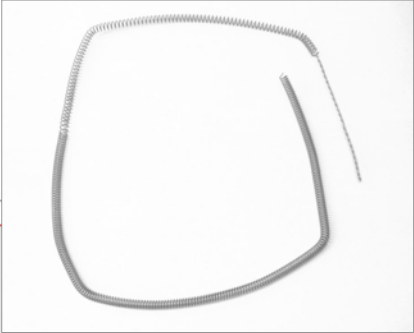
### Concerns

- Element terminations and pigtails
- Avoid crowding in corners
- Element staples
- Element creep
- Avoid contamination

Better Designed Kilns

**Paragon** Basic Kiln Repair Seminar - Heating Elements

**Installation**



Better Designed Kilns

**Paragon** Basic Kiln Repair Seminar - Temperature Profiles

**Typical Temperatures**


- Ramp / Hold
  - Glass Fusing  
1400° F to 1600° F
  - Glass Slumping  
1400° F to 1600° F
  - Heat Treating  
600° F to 2200° F
- Cone Fire
  - Ceramic Bisque  
Cone 019 (1240° F) to Cone 10 (2350° F)
  - Glazing
  - China Painting
  - Dolls

Better Designed Kilns

**Paragon** Basic Kiln Repair Seminar - Temperature Profiles

**Cones**

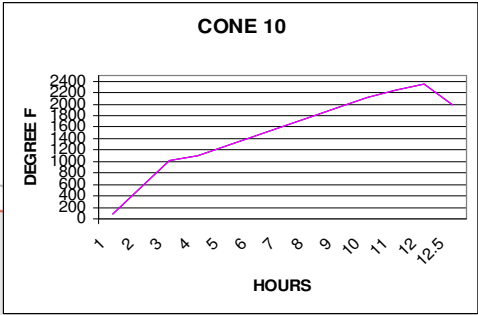
- The Edward Orton Jr. Ceramic Foundation
- Measures Heat Work
- Types
  - Self Supporting
  - Mini-Bars



Better Designed Kilns

**Paragon** Basic Kiln Repair Seminar - Temperature Profiles

**Ideal Profile**



Better Designed Kilns





## Basic Kiln Repair Seminar - Test Equipment

### Types Requires

- Voltmeter
  - Scale 0 to 600 Volts
  - Measure across the voltage source
- Ammeter
  - Clip-on Style
  - Clip over one wire at a time
- Ohmmeter
  - Always remove power from circuit under test
  - Scale 0 to 1000 or 1X
  - Zero meter first
  - Reading of 0 means short circuit
  - No movement or flashing display means open circuit

Better Designed Kilns



## Basic Kiln Repair Seminar - Test Equipment

### Multimeter

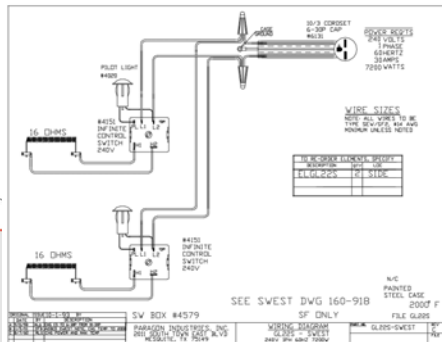


Better Designed Kilns



## Basic Kiln Repair Seminar - Wiring Diagrams

### GL22S Kiln

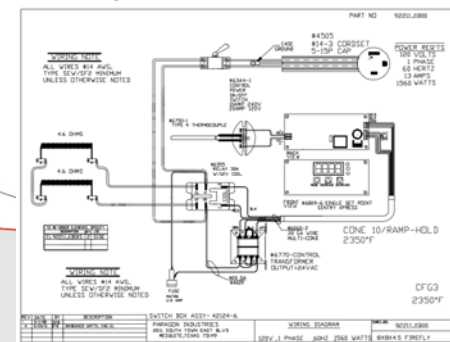


Better Designed Kilns



## Basic Kiln Repair Seminar - Wiring Diagrams

### Firefly Kiln

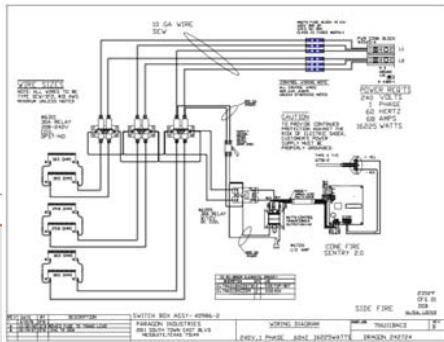


Better Designed Kilns



## Basic Kiln Repair Seminar - Wiring Diagrams

### Dragon Kiln

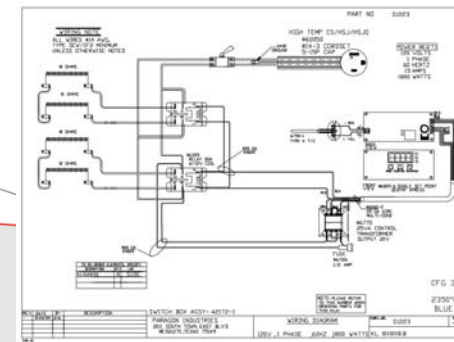


Better Designed Kilns



## Basic Kiln Repair Seminar - Wiring Diagrams

### Caldera XL Kiln



Better Designed Kilns



## Basic Kiln Repair Seminar - Practical Troubleshooting

### Basics

- Is there incoming power or is the Kiln Sitter on?
- Is Lid open with Lid Switch?
- Is there any warmth from the Elements?
- Are all Elements dark or just some?
- Paper on Element test
- Are Relays actuating and are the Switches firm?
- Does Digital Display work? Any Error Codes?

Better Designed Kilns



## Basic Kiln Repair Seminar - Practical Troubleshooting

### Basics

- Check Digital Controller Fuse
- Check for Warm Relays, Switches, Cord Sets
- Is there a burnt smell, or any blackened marks?
- Any loose, broken wires or Element Leads?
- Are any Elements touching each other, or the Case?

Better Designed Kilns