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

Basic Kiln Repair Seminar - 
Kiln Components

Basic Kiln – Fusion 8

Heating Elements
Insulation
Digital Controller
Case / Chassis
Switch (on side)
Relays (inside Box)
Switchbox
Cord Set / Plug
Stand

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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

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.
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).

NEMA Chart

Toggle and Rocker Switch
- 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
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Switches

Three Way / Four Way

- Elements On or Off
- Require Neutral Line
  L1, L2, Neutral, Ground
- Interchangeability
- Various Failure Modes
  Burned Contacts
  Wired Wrong
  Shorted Terminals

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
Infinite Switch Circuit

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

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

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Controllers

Various Types

• Watlow Digital Controller
• Sentry 2.0 Controller
• Sentry Express Controller
A Thermocouple consists of two conductors of different metal alloys that produce an electrical voltage where the two conductors are in contact when heated.

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

**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

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

### 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

### 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

### 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
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Installation

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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

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Cones

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

Ideal Profile
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

GL22S Kiln

Firefly Kiln
Basic Kiln Repair Seminar - Wiring Diagrams

Dragon Kiln

Caldera XL Kiln

Basic Kiln Repair Seminar - Practical Troubleshooting

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?

Basic Kiln Repair Seminar - Practical Troubleshooting

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?