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

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

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.
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).

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

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
Basic Kiln Repair Seminar -
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

Basic Kiln Repair Seminar -
Switches

Three Way / Four Way -
One Element Wiring

Infinite Switch

- Allows variable power output rather than being limited to a few switched levels
- 120 - 240 Volt, 15 Amp
- Palladium Contacts – 20 VA
- 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.
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

Basic Kiln Repair Seminar - Controllers

Various Types

• Watlow Digital Controller
• Sentry 2.0 Controller
• Sentry Express Controller
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.

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
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.

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
Basic Kiln Repair Seminar - Heating Elements

Installation

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

Basic Kiln Repair Seminar - Temperature Profiles

Cones

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

Ideal Profile

<table>
<thead>
<tr>
<th>Cone 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>200</td>
</tr>
<tr>
<td>300</td>
</tr>
<tr>
<td>400</td>
</tr>
<tr>
<td>500</td>
</tr>
<tr>
<td>600</td>
</tr>
<tr>
<td>700</td>
</tr>
<tr>
<td>800</td>
</tr>
<tr>
<td>900</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>1100</td>
</tr>
<tr>
<td>1200</td>
</tr>
<tr>
<td>1300</td>
</tr>
<tr>
<td>1400</td>
</tr>
<tr>
<td>1500</td>
</tr>
<tr>
<td>1600</td>
</tr>
<tr>
<td>1700</td>
</tr>
<tr>
<td>1800</td>
</tr>
<tr>
<td>1900</td>
</tr>
<tr>
<td>2000</td>
</tr>
<tr>
<td>2100</td>
</tr>
<tr>
<td>2200</td>
</tr>
</tbody>
</table>

HOURS
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

Basic Kiln Repair Seminar -
Wiring Diagrams

GL22S Kiln

Basic Kiln Repair Seminar -
Wiring Diagrams

Firefly Kiln
### 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?