2-90 / 2-160
Box Furnace

INSTALLATION,
OPERATION and
SERVICE MANUAL

NEY
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NEY 2-90 / 2-160

Thank you for purchasing a J. M. Ney Furnace. You will find it to be an excellent equipment investment. The NEY 2-90 / 2-160 furnace incorporates modern manufacturing methods to provide you with a furnace of the highest quality. Extended laboratory testing and actual use has shown it to produce consistent, quality results for a broad range of needs.

As a Ney furnace owner, we want you to be one of many satisfied customers, and we want to hear from you. Please feel free to write to us at any time with your comments and suggestions - and again thank you for buying one of our products.

THE J. M. NEY COMPANY
The J.M. Ney Company manufactures and sells products that use insulating refractories. These refractories contain Vitreous Aluminosilicate fibers. The ceramic fibers will form crystalline silica (Cristobalite) after operating at temperatures above 1600 degrees F. To comply with the OSHA regulations, Material Safety Data Sheets (MSDS) have been developed and are available to you upon request.

The information contained in the MSDS documents takes into account the "Intended Use" of the products. It may not necessarily address all processes or procedures in your particular application. We highly recommend that you determine the health hazard in every pertinent operation including, but not limited to, installation, maintenance, cutting, sawing, drilling or filing.

The MSDS documents and warning labels are for your training program to inform your employees of the hazards associated with the use of these products. Please read and thoroughly understand these warnings. This phase of the regulation took effect on May 27, 1986.

GENERAL

Unpacking

The shipping carton contains the following:

- One furnace
- One or two ceramic floor trays
- Two sample temperature pellets
- One Operator's Manual

Carefully remove the furnace from the shipping carton. Save the carton and packing materials. The carton serves as the best container for transporting the furnace.

Visible Loss or Damage

If there is any visible damage, do not attempt to operate the furnace. Note any external evidence of loss or damage on the freight way bill or express receipt, and have it signed by the carrier's agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier's refusal to honor your damage claim. The form required to file such a claim will be supplied by the carrier.

Concealed Loss or Damage

Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked and inspected. Should either occur, make a written request for inspection by the carrier's agent within 15 days of the delivery date. Then file a claim with the carrier since the damage is the carrier's responsibility.

J. M. Ney guarantees its full support of your claim to be compensated for loss from concealed damage if these instructions are followed.
**Figure 2:**

NEY 2-160:
Heating Rate Curves/Nominal AC Line Voltage Applied

**Electrical Requirements:**
- 17.0 amps @ 100V AC
- 14.2 amps @ 120V AC
- 7.7 amps @ 220V AC
- 7.1 amps @ 240V AC

**Delay Start Settable Range:**
0 to 99 hours in 1 hour increments

**Hold Time Settable Range:** 0 to 9.9 hours in 0.1 hours (6 minute) increments

**Wattage to Maintain 10000°C:**
- 2-90: 1450 watts
- 2-160: 1600 watts

**Chamber Dimensions:**
- 2-90: 5"W x 4.5"D x 4"H
- 2-160: 9"W x 4.5"D x 4"H

**Cabinet Dimensions:**
- 2-90: 12"W x 10.5"D x 17"H
  (30cm x 27cm x 43cm)
- 2-160: 16"W x 10.5"D x 17"H
  (41cm x 27cm x 43cm)

**Cabinet Construction:**
24 gauge stainless steel

**Muffle Material:** firebrick

**Unit Weight:**
- 2-90: 33lbs (15kg)
- 2-160: 48lbs (22kg)

**Shipping Weight:**
- 2-90: 42lbs (19kg)
- 2-160: 53lbs (24kg)

**INSTALLATION**

**SELECTING A LOCATION**

Remove all the packing and information materials from around the furnace and inside the furnace muffle.

Select a location near a wall outlet or receptacle. (The electrical cord is about five feet long.) The outlet should be protected with 15 or 20 amps of overcurrent protection in the form of a circuit breaker or fuse.

Locate the furnace on a level surface, six inches away from walls, other equipment, and heat sensitive materials. Do not mount under shelves or other structures that restrict the flow of air.

Firing trays are supplied in the accessory kit. Before using the furnace, place the firing trays inside the muffle. This prolongs the life of the muffle.

If the furnace is being used for combustion (ashing or burnout), locate it under a ventilation hood.
LOCATING THE CONTROL PANEL KEYS

Figure 4: CONTROL PANEL

1. ON/OFF
   Turns power to furnace on and off.

2. START/STOP
   Starts furnace operation if not currently running a cycle. Stops furnace operation if cycle is currently running.

3. TEMP/TIME
   Changes digital display from time remaining to chamber temperature during DELAY START, TIME 1 or TIME 2 operation cycle.

4. Digital Display
   Displays times, temperatures and error messages.

5. Numerical Keys
   1, 2, 3, 4, 5
   6, 7, 8, 9, 10
   Used to enter times, heat rates and temperatures.

6. °C/°F
   Changes temperature display from degrees Centigrade to degrees Fahrenheit when current temperature is being displayed.

7. ENTER
   Stores value entered by numerical keys into control memory. Memory is maintained only while power is on.
15. RATE 2 Controls the temperature increase rate of the second cycle. The control attempts to increase the muffle temperature at a linear rate equal to the programmed value in degrees per minute. If TEMP 2 is lower than TEMP 1, the chamber temperature drops at a natural rate, not the programmed RATE 2. The digital display shows the last RATE 2 value entered and allows the entering of a new value.

16. RATE 2 LED Flashes when the RATE 2 key is pressed. Current value of ramp/heat rate is displayed on the digital display. A new value can be entered when the LED is flashing. The LED is on during the entire RATE 2 cycle.

17. TEMP 2/TIME 2 Controls two functions:

1. Sets the temperature for the second cycle.

2. Sets HALF THE AMOUNT OF TIME the second cycle temperature will be held. After TIME 2 has expired, the control will continue to maintain TEMP 2 for a second TIME 2. Audio output beeps for one second every six minutes during the second TIME 2. END will be displayed at the end of the cycle.

TIME 2 is repeated to notify the operator that the regular programmed cycle is finished and to allow time to remove the furnace contents while they are still hot. To initiate furnace cool down before removal of contents, program TIME 2 for one-half of the desired hold period.

Digital display shows last TEMP 2 value entered when TEMP 2/TIME 2 is pressed once. Allows new value to be entered.

Digital display shows last TIME 2 value entered when TEMP 2/TIME 2 is pressed twice. Allows new value to be entered. Hold times are entered as hours and tenths of hours.

18. TEMP 2 LED Flashes when TEMP 2 key has been pressed. Current temperature value is displayed on the digital display. A new value can be entered when the LED is flashing. The LED is on during the entire TEMP 2 cycle.

19. TIME 2 LED Flashes when TIME 2 key has been pressed. Current hold time value is displayed on digital display. A new value can be entered when the LED is flashing. The LED is on during the entire TIME 2 cycle.
PROGRAMMING THE FURNACE

Temperature Display

The temperature can be displayed in either degrees Centigrade (C) or Fahrenheit (F).

At power up, the temperature is displayed in degrees Centigrade (C). To display the temperature in degrees Fahrenheit (F):

Wait until the actual muffle temperature is being displayed. Then press the °C/°F key.

Each time the °C/°F key is pressed, the digital display alternates between Centigrade and Fahrenheit.

Programmable Parameters

This furnace has seven programmable parameters:

- DELAY START function
- RATE 1 function
- RATE 2 function
- TEMP 1 function
- TEMP 2 function
- TIME 1 function
- TIME 2 function

To power up the system before programming:

Turn on the POWER switch labeled ON/OFF located on the right hand side of the furnace control panel.

The controls will go through a series of diagnostic tests, including a sequence of lighting each display bar or segment, all the LEDs and sounding the audio beeper.

At the end of this sequence, the muffle temperature will appear on the digital display. You can now enter the information for the cycle you require.

Programming the DELAY START Function

The DELAY START function is utilized to program a cycle to be started at a later time.

To program DELAY START:

1. Press DELAY START.

The DELAY START LED will flash and 00 H (zero hours) will appear on the digital display. (If the furnace has been on and used previously, the last delay time entered will be displayed.)

2. Press the 1 through 0 NUMERICAL KEYS to enter the DELAY START time (up to 99 hours).

If a wrong key is pressed, continue to enter the correct value until it appears on the digital display. (Note: If entering a single digit value such as 8, enter it as 08.)

3. Press ENTER to store your DELAY START time.

If ENTER is not pressed, the value entered is not stored or retained.

The new DELAY START value has now been programmed. It can be reviewed at any time by pressing DELAY START. If no changes are required, the digital display can be returned to the actual temperature display mode by pressing TEMP/TIME.

You are now ready to enter the sample DELAY START cycle that is part of example 2.
used previously, the last time setting entered will be displayed.)

2. Press the 1 through 0 NUMERICAL KEYS to enter the time setting (from 0.0 to 9.9 hours).

3. Press ENTER to store the time setting.

The TEMP 1/TIME 1 functions have now been programed.

The new TEMP 1 can be reviewed at any time by pressing TEMP 1/TIME 1 once.

The new TIME 1 can be reviewed at any time by pressing TEMP 1/TIME 1 twice.

If no changes are required, the digital display can be returned to the actual temperature display mode by pressing TEMP/TIME.

The TEMP 2 function controls the muffle's temperature setting for the second cycle. The TIME 2 function controls the length of time the cycle will run.

To program TEMP 2/TIME 2:

Follow programming instructions for TEMP 1/TIME 1, but press the TEMP 2/TIME 2 key.

The programming of TEMP 2 to a lower value than TEMP 1 causes the controller to allow the chamber temperature to cool naturally to TEMP 2 and then hold for the TIME 2 time. The controller does not control the decrease rate and ignores RATE 2.

When the TEMP 2/TIME 2 cycle has ended, a beeping cycle (one-second beeps every six minutes) will be heard, to indicate that the TEMP 2 temperature is being held, and that the TIME 2 cycle will be repeated.

To stop the cycle at this time press START/STOP. The muffle will be turned off and the cycle completed.

When the muffle door is opened and closed, the beeping will stop, and the current muffle temperature will be displayed on the digital display. The muffle will continue to heat, keeping the temperature at TEMP 2 for a second TIME 2. At the end of the second cycle, the muffle will turn off, all LEDs will be off and END will be displayed.

For example, if TEMP 2 is programed for 1000°F and TIME 2 set for 3 hours, the following will occur:

The muffle temperature will be held for three hours at 1000°F then start the beeping cycle. The digital display will show the temperature being maintained at 1000°F. The cycle will be repeated for an additional three hours; one beep will be heard every six minutes; then END will be displayed, and the muffle will turn off. (Total hold time having been 6 hours)

When parameters outside of the normal operating range (Figure 1) are entered, a one second beep alert will be heard, and a LO or HIGH will appear on the digital display.

When the door is opened, DOOR will appear on the digital display to tell you that the power has been disconnected. When the door is closed, a short beep will sound. The current muffle temperature will appear on the digital display, and the current cycle will resume.

The programmable parameters can be altered or reprogrammed while a cycle is in operation. New TEMP 1 and TEMP 2 settings can be entered. The temperature will adjust accordingly.
Example 2

Furnace to heat up to 803°C, at a rate of 2°C per minute. Hold at 803°C for two hours and 50 minutes. For the second cycle, temperature to rise to 1050°C, at a rate of 20°C per minute. Hold it at that temperature for nine hours. Program the furnace to cool down before the contents are removed. The entire program should start in two days.

Required key entries:

The following steps indicate the keys that must be pressed to program the furnace for example 2. We are assuming that:

- POWER is turned on
- The digital display is showing temperatures in degrees Centigrade
- The muffle is cool.

Also remember that the last hold time programmed (either TIME 1 or TIME 2) will be repeated unless START/STOP is pressed. During this repeated cycle, a beep sounds every six minutes to notify the operator that the regular programmed cycle is finished. The operator has time to remove the furnace contents while they are still hot. If you want the furnace to cool down before removal of the furnace contents, program the second hold time for one-half of your desired hold period.

**STEP NO. PRESS KEY:**

1. RATE 1
2. 2
3. ENTER
4. TEMP 1/TIME 1
5. 8
6. 0
7. 3
8. ENTER
9. TEMP 1/TIME 1
10. TEMP 1/TIME 1
11. 2
MAINTENANCE

Maintenance of the furnace involves cleaning and calibration.

Cleaning

Vacuum rather than air blow the inside of the muffle to minimize the air born dust.

Wipe the control panel clean with a soft, dry cloth. Do not use water, liquids, or spray cleaners. They can enter the control panel and cause damage.

Clean the outside of the cabinet with almost any household cleaner and a soft cloth.

Programming Calibration Cycle

With standard use, the advanced electronic design of the furnace does not require regular calibration. When severe thermocouple deterioration or failure of the thermocouple take place, calibration is necessary.

When calibration appears necessary, run a calibration test with the temperature tablets supplied in the accessory kit. Any independent temperature meter used should be of a high accuracy type. Write down the error determined by the test; it will be used to correct the calibration.

Program the calibration test so the temperature increase rate at the temperature of interest is very low. The following settings are recommended for the 705°C (1300°F) tablets:

- RATE 1: 30°C/min
- TEMP 1: 650°C
- TIME 1: 0.5 hr
- RATE 2: 2°C/min
- TEMP 2: 705°C
- TIME 2: 1.0 hr

When using the 815°C (1500°F) tablets:

Adjust TEMP 1 and TEMP 2. The new TEMP 1 value is 750°C; the new TEMP 2 value is 815°C.

Refer to "Calibration Adjustments" for details and instructions on how to compensate for temperature variations.

SERVICE

This section is provided as assistance to qualified service personnel. If you are qualified to service the furnace, please read the entire manual before you attempt any servicing. If you are not qualified to service the furnace, please read the paragraph below, and follow its instructions.

If the unit requires service, contact your dealer or The J.M. Ney Company, Yucaipa, CA. Describe the particular problem and give the serial number of the unit. A Return Material Authorization Number will be assigned to your unit as a control during the repair period. The Return material Authorization Number must accompany the unit. Ship the unit prepaid to:

The J.M. Ney Company
13553 Calimesa Boulevard
Yucaipa, CA 92399

(714) 795-2461
Telex: 676432
Figure 7: EXPLODED VIEW OF FURNACE
SERVICING AND TROUBLESHOOTING

After power up, all display segments, LED's, and audio output come on to indicate that they are operational.

The neon bulb on the power board is on when the power triac is off, and the muffle is functional. The power triac controls power to the muffle. The muffle heats when the bulb is off.

Problem or Symptom

1.00  No Heat and No Display

Check List and Conclusion

Check to see if the neon bulb on the power board is on?

If the neon bulb is not on:

- Make sure the wall outlet is powered or operational.
- Check the fuse continuity.
- Make sure the power switch is on.
- Check the line voltage at power board terminals (See Figure 8).

If the neon bulb is on:

- Disconnect and reconnect the ribbon cables between the power board and the control board and the display board.
- Check for output voltage from the power board.

2.00  Display on but No Heat

2.10  Displays door

Do the relays click when the door is closed?

If the relays do not click when the door is closed:

- Check the wiring to the door switch.
- Check the door switch continuity.
- Check the door actuator adjustment.
- Disconnect and reconnect the ribbon connectors.
5.00 Muffle Temperature Too High

Check power triac operation.

See Calibration in the Maintenance section.

6.00 Control Does Not Respond to Input Keys

Check the ribbon cable connections between the PC boards.

Check for keys which are stuck down - held down by front panel.

Note: The control does not respond during power up or with a error code/fault on the display.

Suspected Bad Component

Door Switch

Bad Component Symptoms

The digital display reads door.

No relay click when the door is closed.

There is no muffle heat.

The neon bulb is off.

Muffle

There is no heat in the muffle.

The neon bulb on the power board is off.

The digital display reads Err2 when the muffle is in cycle.

Thermocouple

The digital display reads Err1.

The temperature display is erratic.

Triac (shorted)

The furnace is over temperature, or there is no temperature control.

The furnace attempts to run away to high temperature.

The neon bulb on the power board is off.

Triac (open)

The muffle temperature is low.

The neon bulb is on.
8. Pull the control panel assembly out of the furnace. Feed the remainder of the line cord into the rear of the cabinet assembly while removing the control panel assembly.

To replace the control panel assembly, reverse the disassembly procedure.

**Thermocouple Replacement (Type K)**

To remove the thermocouple:

1. Turn off the power to the furnace. Allow the furnace to cool to room temperature.

2. Remove the line cord from the wall socket or receptacle.

3. Remove the two Phillips screws from the rear bottom edge of the furnace.

4. Pull the control panel assembly out from the front panel subassembly about six inches. Feed the line cord into the rear of the cabinet assembly while removing the control panel assembly.

5. Disconnect the thermocouple from the control board at terminals 1 and 2 JP3. Remove or loosen the strain relief at the control board.

6. Remove the eight screws from the back panel and the back panel from muffie enclosure.

7. Remove the angle bracket from rear of muffie enclosure.

8. Remove the thermocouple from rear of muffie.

To install the new thermocouple, reverse the disassembly procedure.

**Muffle Replacement**

Read the cautions on page 1 of the manual before continuing with the muffie replacement procedure.

To remove the muffie:

1. Completely remove the control panel assembly. Refer to the procedure in the previous section.

2. Remove the eight screws from the back panel, and bottom of the front panel subassembly. Note that lockwashers are located on the bottom screws.

3. Remove the back panel from the muffie enclosure.

4. Remove angle bracket from the rear of the muffie enclosure.

5. Remove the thermocouple from rear of muffie.

6. Remove the muffie lead wire from rear terminals.

7. Pull the muffie out back of enclosure.

To install the new muffie, reverse the disassembly procedure.

**Door Switch Replacement or Adjustment**

To disassemble the door switch for replacement or adjustment:

1. Turn off the power to the furnace. Allow the furnace to cool to room temperature.

2. Remove the line cord from the wall socket or receptacle.
### PARTS LIST

The furnace and its internal components and assemblies are delicate and need to be packed properly for return shipment. Pack all parts or assemblies in foam and seal them in suitable boxes. Use original packaging when it is available.

**REPLACEMENT PARTS:**

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<tr>
<th>Description</th>
<th>Part Number 2-90</th>
<th>Part Number 2-160</th>
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<tbody>
<tr>
<td>Muffle, 100 Volt</td>
<td>9490444</td>
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<td>Muffle, 120 Volt</td>
<td>9490310</td>
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<td>Muffle, 220 Volt</td>
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<td>9481937</td>
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<td>Muffle, 240 Volt</td>
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<td>9490445</td>
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<td>Thermocouple</td>
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<td>Trisc</td>
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<tr>
<td>Door Switch</td>
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<td>Display PC Board</td>
<td>9491938</td>
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<td>Power PC Board, 100 and 120 Volt</td>
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<td>Power PC Board, 220 and 240 Volt</td>
<td>9491733</td>
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<td>Control PC Board</td>
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<td>Power Switch</td>
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<td>Fuse, 1 Amp, 250 Volt, slo bio type MDA</td>
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**ACCESSORIES**

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<tr>
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<td>Temperature Pellets -- bottle of 25</td>
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<tr>
<td>705°C (1300°F) 9490911</td>
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<tr>
<td>815°C (1500°F) 9490912A</td>
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<tr>
<td>Tongs -- Stainless Steel</td>
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</tr>
<tr>
<td>10 inch</td>
<td>9390014</td>
</tr>
<tr>
<td>12 inch</td>
<td>9390015</td>
</tr>
<tr>
<td>Tongs -- Plated Steel (14 inch)</td>
<td>94910108</td>
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<tr>
<td>Tray -- Hard Ceramic (3.75&quot; x 4&quot;)</td>
<td>9390017</td>
</tr>
<tr>
<td>Shelf -- 2-160 only -- (1) 3/4&quot; height</td>
<td>9492211</td>
</tr>
</tbody>
</table>
LIMITED WARRANTY and LIMITATION OF LIABILITY

1. **WARRANTY:** Except with respect to those component parts and uses which are hereinafter described, NEYTECH warrants its products to be free from defects in material and workmanship for a period of one year from date of sale. NEYTECH warrants its muffler for a period of 6 months from date of sale. NEYTECH’s liability under this warranty is limited solely to repairing or, at NEYTECH’s option, replacing those products included within this warranty, which are returned to NEYTECH within the applicable warranty period (with shipping charges prepaid), and which are determined by NEYTECH to be defective. This warranty will not apply to any product which has been subjected to misuse, negligence, or accident; or misapplied; or modified or repaired by unauthorized persons; or improperly installed.

2. **WARRANTY EXCLUSIONS:** The warranty described in paragraph 1 does not include normal wear of NEYTECH’S products or its components.

3. **INSPECTION:** Buyer shall inspect the product promptly after receipt. The buyer shall notify NEYTECH, in writing, of any claims of defects in material and workmanship within thirty days after the buyer discovers or should have discovered the facts upon which the claim is based. Failure of the buyer to give written notice of such a claim within this time period shall be deemed to be waiver of such claim.

4. **DISCLAIMER:** The provisions of paragraph 1 are NEYTECH’S sole obligation and exclude all other remedies or warranties, express or implied, including warranties of MERCHANTABILITY and FITNESS FOR A PARTICULAR PURPOSE.

5. **LIMITATION OF LIABILITY:** Under no circumstances shall NEYTECH be liable to the buyer for any incidental, consequential or special damages, losses or expenses.

6. **LIMITATION OF ACTIONS:** Buyer must institute any action with respect to claims under the warranty described in paragraph 1 within one year after the cause of the action has accrued.
SAFETY PRECAUTIONS

This furnace is designed and manufactured to operate and last for years under normal conditions and with minimum care. The unit should be used for its intended application — alterations or modifications will void the warranty.

The furnace user should be aware of, and follow the guidance given by the cautions, warnings, and recommended operating conditions stated in this manual. These factors, along with proper maintenance, will allow safe and satisfactory operation of the furnace.

Please observe the following warnings and cautions.

CAUTION

1. Never use tongs or other objects to operate the control keys.

2. Do not use solvents to clean the control panel. A dry cloth is recommended.

3. Do not attempt to service the furnace until you have read and understood the service instructions included in this manual.

4. Always turn off the power and remove the line cord from the wall outlet before servicing.

5. Never operate the furnace with combustible materials on top of or in close proximity to the furnace.

WARNING

1. This furnace is not designed for use in Class I, II, or III locations as defined by the National Electric Code.

2. For personal safety, this furnace must be properly grounded.

The furnace power cord is equipped with a three prong (grounding) plug for use with wall receptacles to minimize the possibility of electric shock hazard from the furnace. The wall receptacle and circuit should be checked by a qualified electrician to make sure the receptacle is properly grounded.

Two prong wall receptacles must be replaced with three prong wall receptacles to ensure proper operation and safety. Two to three prong adapters are not considered reliable, safe methods of electrical connection.

3. This furnace must be connected to a properly sized power circuit with the correct overcurrent protection for safe and reliable operation.

4. As a routine laboratory precaution, always wear safety glasses and protective gloves when working with this product.


This regulation became effective on November 25, 1985, for manufacturers and distributors of products that OSHA has determined to be hazardous. Vitreous Aluminosilicate and Cristobalite mineral dusts are included in the OSHA tables as air contaminants.
Furnace Features

- Digital Proportional Temperature Control
- High Temperature Range to 2000°F (1100°C)
- Two Stages of Temperature Profile Control
- Seven Programmable Options (Features)
- Delay Start of Operation Timer
- Chamber Capacity
  2-90: 5"W x 4.5"D x 4"H
  2-160: 9"W x 4.5"D x 4"H
- Two Rear Exhaust Ports
- Open Door Indication and Muffle Power Interruption
- End of Cycle Visual Indicator
- High Performance Fast Heat Muffle with Fire Brick Lined and Mounted Elements
- Low and High Line Voltage Indicator

Programming Error Indication

Furnace Specifications

Temperature Control Settable Range:
32°C (90°F) to 1103°C (2017°F)

Temperature Control Accuracy:
±10°C (18°F)
In the range from: 400°C (752°F) to: 1103°C (2017°F)

Temperature Ramp/Heat Rate:
Linear Rate Settable from:
1°C (1°F) to: 40°C (72°F)

Actual performance may vary depending on the load size and the line voltage applied (See Figure 1 or Figure 2).

Wattage: 1700 watts at nominal voltage

Nominal Voltages of Available Models:
100V AC (90 to 110V AC)
120V AC (105 to 130V AC)
220V AC (205 to 230V AC)
240V AC (220 to 250V AC)
All 50/60 Hz

Figure 1: NEY 2-90: Heating Rate Curves/Nominal AC Line Voltage Applied
LOCATING THE FEATURES AND CONTROLS

Figure 3: FEATURES AND CONTROLS
8. DELAY START TIME
Causes the furnace to turn on at a later time and perform the preprogrammed cycle.

Causes the control to display the last DELAY START value entered. Allows the entering of a new DELAY START value. Used in conjunction with the START/STOP key to start a cycle with a DELAY START. The delay time is entered in hours.

9. DELAY START LED
Flashes when the DELAY START key is pressed. The current value of delay time is displayed on the digital display. A new value can be entered when the LED is flashing. The LED is on during the entire DELAY START cycle.

10. RATE 1
Controls the temperature ramp/heat rate of the first cycle. The control attempts to increase the muffle temperature at a linear rate equal to the programmed value in degrees per minute.

Causes the control to display the last RATE 1 value entered and allows the entering of a new value.

11. RATE 1 LED
Flashes when the RATE 1 key is pressed. The current value of the ramp/heat rate is displayed on the digital display. A new value can be entered when the LED is flashing. The LED is on during the entire RATE 1 cycle.

12. TEMP 1/TIME 1
Controls two functions:

1. Sets the temperature for the first cycle.

2. Sets the amount of time the first cycle temperature will be held.

Pressing the key once causes the control to display the last TEMP 1 value entered and allows the entering of a new value.

Pressing the key a second time causes the control to display the last TIME 1 value entered and allows the entering of a new value. The hold times are entered as hours and tenths of hours.

13. TEMP 1 LED
Flashes when TEMP 1/TIME 1 key is pressed for first time. The current temperature is displayed on the digital display. A new value can be entered when the LED is flashing. The LED is on during the entire TEMP 1 cycle.

14. TIME 1 LED
Flashes when the TEMP 1/TIME 1 key has been pressed twice. The current hold time is displayed on the digital display. A new value can be entered when the LED is flashing. The LED is on during the entire TIME 1 cycle.
Default Values

This furnace contains preprogrammed or default values which are loaded each time the unit is powered up.

The controller's memory is not permanent and the current cycle information is lost when the ON/OFF switch is set to OFF. The table (See Figure 5) shows the preset values for each of the parameters stored in the controller's memory, as well as maximum and minimum values that can be programmed.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Preset Value</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>DELAY START TIME: (Muffle off)</td>
<td>0 hours</td>
<td>0 hours</td>
<td>99 hours</td>
</tr>
<tr>
<td>RATE 1: Setting rate to zero cancels remaining part of the program.</td>
<td>10°C/min (18°F/min)</td>
<td>0°C/min (0°F/min)</td>
<td>40°C/min (72°F/min)</td>
</tr>
<tr>
<td>TEMP 1</td>
<td>160°C (320°F)</td>
<td>32°C (90°F)</td>
<td>1103°C (2017°F)</td>
</tr>
<tr>
<td>TIME 1</td>
<td>1.0 hour</td>
<td>0.0</td>
<td>9.9 hours*</td>
</tr>
<tr>
<td>RATE 2: Setting rate to zero cancels remaining part of the program.</td>
<td>10°C/min (18°F/min)</td>
<td>0°C/min (0°F/min)</td>
<td>40°C/min (72°F/min)</td>
</tr>
<tr>
<td>TEMP 2</td>
<td>512°C (954°F)</td>
<td>32°C (90°F)</td>
<td>1103°C (2017°F)</td>
</tr>
<tr>
<td>TIME 2</td>
<td>1.0 hour</td>
<td>0.0</td>
<td>9.9 hours*</td>
</tr>
</tbody>
</table>

Figure 4: PRESET VALUES STORED IN MEMORY

*Note: The last hold time, normally TIME 2, but TIME 1 if RATE 2 has been set to 0, is repeated a second time, maintaining the muffle temperature and beeping every six minutes. The beep notifies the operator that the regular programmed cycle is finished and allows the operator time to remove the furnace contents while they are still hot. If you want the furnace to cool down before removal of the contents, program the second hold time for one-half of the desired hold period.
Programming RATE 1 and RATE 2

The RATE 1 function controls the temperature increase rate of the first cycle. It increases the muffle temperature at a linear rate equal to the programmed value in degrees per minute.

To program RATE 1:

1. Press RATE 1.

The RATE 1 LED will flash and the preset value (10°C/18°F) will appear on the digital display. (If the furnace has been on and used previously, the last heat rate entered will be displayed.)

2. Press the 1 through 0 NUMERICAL KEYS to enter the heat rate (up to 40°C/72°F).

If a wrong key is pressed, continue to enter the correct value until it appears on the digital display.

3. Press ENTER to store your heat rate.

If ENTER is not pressed, the value entered is not stored or retained.

The new heat RATE 1 value has now been programmed. It can be reviewed at any time by pressing RATE 1. If no changes are required, the digital display can be returned to the actual temperature display mode by pressing TEMP/TIME.

Note: The programming of RATE 1 to zero (0) will end the cycle even before starting the first RATE. A single complete program would use only the RATE 1, TEMP 1, and TIME 1 cycles, with the optional addition of a DELAY START function.

The RATE 2 function controls the temperature increase of the second cycle. It increases the temperature of the second cycle at a linear rate equal to the programmed value in degrees per minute.

To program RATE 2:

Follow programming instructions for RATE 1, but substitute RATE 2 in step 1.

Note: The programming of RATE 2 to zero will cause the cycle to end after the first hold time.

Programming TEMP 1/TIME 1 and TEMP 2/TIME 2

The TEMP 1 function controls the muffle’s temperature setting for the first cycle. The TIME 1 function controls the length of time the cycle will run.

To program the TEMP 1 function:

1. Press TEMP 1/TIME 1 once.

The TEMP 1 LED will flash, and the preset value (160°C/320°F) will appear on the digital display. (If the furnace has been on and used previously, the last temperature setting entered will be displayed.)

2. Press the 1 through 0 NUMERICAL KEYS to enter the temperature setting (from 32°C/90°F to 1103°C/2017°F).

If a wrong key is pressed, continue to enter the correct value until it appears on the digital display.

3. Press ENTER to store the temperature setting.

To Program the TIME 1 function:

1. Press TEMP 1/TIME 1 twice.

The TIME 1 LED will flash and the preset value (1.0 hour) will appear on the digital display. If the furnace has been on and
START UP

When the furnace has been properly unpacked, installed, programmed, and broken in, it is ready for operation.

Operating Suggestions:

1. To start the furnace **without** using DELAY START, press the START/STOP button once.

   The RATE 1 LED will light.

2. To start the furnace using the DELAY START, press DELAY START once, then press START/STOP once.

   The DELAY START LED will light.

3. TIME 2, or TIME 1 if RATE 2 is programmed to zero (0), is repeated. The repeat time allows the operator to remove furnace contents while they are hot (before the furnace starts cooling down).

To cool down the furnace before removing the contents: Program TIME 2 (or TIME 1) for half the desired hold time.

4. To retain the program cycle that has just been completed - leave the unit ON. The digital display will reflect muffle temperature, but the unit will not heat up until START/STOP is activated.

The program cycle is NOT retained in memory if the unit is turned OFF.

OPERATION EXAMPLES

Now that you understand the basic functions of the keys on the furnace control panel, your next step will be to program the furnace for the three typical operations that follow.

**Example 1**

Furnace to heat up to 300°C at a rate of 5°C per minute. Hold at 300°C for one hour and 30 minutes. End the cycle, and hold at 300°C until the operator removes the contents.

**Required key entries:**

The following steps indicate the keys that must be pressed to program the furnace for example 1. We are assuming that:

- POWER is turned on
- The digital display is showing temperatures in degrees Centigrade
- The muffle is cool.

Also remember that the last hold time programmed (either TIME 1 or TIME 2) will be repeated unless START/STOP is pressed when the beeping cycle begins.

**STEP NO.** | **PRESS KEY:**
--- | ---
1 | RATE 1
2 | 5
3 | ENTER
4 | TEMP 1/TIME 1 (Press once for a temperature entry.)
5 | 3
6 | 0
7 | 0
8 | ENTER
9 | TEMP 1/TIME 1 (Press twice for a time entry.)
10 | TEMP 1/TIME 1
11 | 0
12 | 1 (This cycle will be repeated because it is the only hold time.)
8 (This stands for .8 hours which equals 48 minutes.)

ENTER
RATE 2
0
ENTER
TEMP 2/TIME 2
1
0
5
0
ENTER
TEMP 2/TIME 2
TEMP 2/TIME 2
4
5 (This stands for .5 hours which equals 30 minutes.)
ENTER
DELAY START
4
8
ENTER
DELAY START (This signals the furnace to activate the DELAY START feature)
START/STOP

The furnace will now start the cycle in two days. The display will show the current muffle temperature as the cycle progresses.

TIME 2 will be held for nine hours. During the last 4 1/2 hours, a one second beep will sound every six minutes to indicate the repeated TIME 2.
Error Codes

Figure 6 contains the error codes that can be displayed on the digital display.

<table>
<thead>
<tr>
<th>Display Code</th>
<th>Control Sound</th>
<th>Possible Causes</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>1 second beep</td>
<td>Parameter entered below specification</td>
<td>Reenter correct value See Figure 4.</td>
</tr>
<tr>
<td>HIGH</td>
<td>1 second beep</td>
<td>Parameter entered above specification</td>
<td>Reenter correct value See Figure 4.</td>
</tr>
<tr>
<td>AC L</td>
<td>None</td>
<td>Low line voltage (Line voltage below 85% of rated voltage)</td>
<td>Correct power supply voltage. See Specifications.</td>
</tr>
<tr>
<td>AC H</td>
<td>None</td>
<td>High line voltage (Line voltage above 115% of rated voltage)</td>
<td>Correct power supply voltage. See Specifications.</td>
</tr>
<tr>
<td>Err1</td>
<td>Beep twice each second</td>
<td>Open thermocouple, Over temperature</td>
<td>See Troubleshooting.</td>
</tr>
<tr>
<td>Err2</td>
<td>1 beep, 3 second pause, 1 beep, repeat...</td>
<td>Open muffle, Triac failure, Unit programmed for heat rate higher than physically possible</td>
<td>See Troubleshooting.</td>
</tr>
</tbody>
</table>

Figure 6: DIGITAL DISPLAY ERROR CODES
If the relays click when the door is closed:

- Disconnect and reconnect the ribbon connectors.

2.20 Displays Err1

Reset the control. Turn the power off and then on.

Check the thermocouple continuity.

Check the thermocouple position. Is it sticking into the muffle chamber more than 2"?

2.30 Displays Err2

Reset the control. Turn the power off and then on.

Disconnect and reconnect the ribbon connectors.

Check the muffle. If the neon bulb is on when the muffle is not in cycle, then the muffle is good.

Check the triac.

2.40 Displays Room Temperature Readings

Is the control in cycle? Is the LED on?

Is the control in the delay start cycle?

Check the muffle. If the neon bulb is on when the muffle is not in cycle, the muffle is good.

Check the triac.

3.00 Displays Erratic Temperature Readings

Disconnect and reconnect the ribbon connectors.

Reset the control. Turn the power off and then on.

Check the thermocouple continuity.

4.00 No Display But Muffle Heats or Neon Bulb on Power Board Cycles On and Off

Reset the control. Turn the power off and then on.

Check the ribbon cable connections between the PC boards.
Calibration Adjustments

To adjust furnace calibration:

1. Remove the line cord from the wall power outlet to disconnect power from the unit.

2. Remove the two Phillips screws from the bottom edge of the rear of the furnace (See Figure 7).

3. Carefully slide the panel and drawer out of the front of the furnace. Feed four-five inches of the power cord into the back during removal.

4. Turn the adjustment screw on potentiometer R5 to adjust furnace calibration. It is located near the center of the control PC board. The control PC board is the board located on the left-hand side, closest to the front of the control drawer (See Figure 8).

   - Turn calibration potentiometer R5 one turn clockwise for every 10° the muffle temperature needs to be raised.

   - Turn calibration potentiometer R5 one turn counterclockwise for every 10° the muffle temperature needs to be lowered.

5. Push the control drawer back into the cabinet. While returning the drawer to its position, pull the power cord out the back.

6. Replace the two Phillips screws on the rear of the furnace.

7. Put the line cord back into the wall socket. The furnace is now ready to operate.

Disassembly/Reassembly

Refer to Figure 7 during disassembly/reassembly.

The following tools are required for disassembly/reassembly of the furnace components:

- Medium Phillips screwdriver
- Small blade screwdriver
- Needle nose pliers

Control Panel Assembly

To remove the control panel assembly:

1. Turn off the power to the furnace. Allow the furnace to cool to room temperature.

2. Remove the line cord from the wall socket or receptacle.

3. Remove the two Phillips screws from the rear bottom edge of the furnace.

4. Pull the control panel assembly out from the front panel subassembly about six inches. Feed the line cord into the rear of the cabinet assembly while pulling the control panel assembly.

5. Disconnect the thermocouple from the control board at terminals 1 and 2 of JP3. Remove or loosen the strain relief at the control board.

6. Disconnect the two white door switch wires from the power board at the in-line connectors.

7. Disconnect the two blue muffle wires -- one from the triac MT2 terminal and the other from the power board terminal JP1.
3. Remove the muffle (see Muffle Replacement Section.)

4. Remove the actuator lever holding screw and lock nut.

5. Remove the two switch mounting screws.

To reassemble the control panel assembly, reverse the disassembly procedure.

**Fuse Replacement**

To replace the fuse:

1. Turn off the power to the furnace. Allow the furnace to cool to room temperature.

2. Remove the line cord from the wall socket or receptacle.

3. Push and turn the fuse holder cap at the rear of the furnace to remove it.

4. Remove the fuse from the holder, and replace it.

**ON/OFF Switch Replacement**

To replace the ON/OFF switch:

1. Remove the control panel assembly. (See Control Panel Assembly Section)

2. Compress the retaining legs of the ON/OFF switch with a screwdriver or needle nose pliers.

3. Disconnect the electrical connectors.

4. Remove the defective ON/OFF switch.

5. Push the new ON/OFF switch in from the front of the panel.