Guide to Operations

C-24 Classic Benchtop Incubator Shaker

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WARNING!

The C-24 Classic Benchtop Incubator Shaker *must* be operated as described in this manual. If guidelines are not followed, equipment damage can occur. Please read entire User's Guide before attempting to use the Shaker.

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New Brunswick Scientific Co., Inc. reserves the right to change information in this document without notice. Updates to information in this document reflect our commitment to continuing product development and improvement.

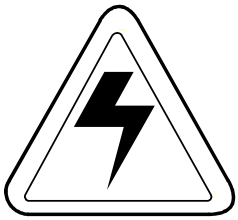
Manual Conventions

NOTE:

Notes contain essential information that deserves special attention.

CAUTION!

***Caution* messages appear before procedures which, if caution is not observed, could result in damage to the equipment.**



WARNING!

***Warning* messages alert you to specific procedures or practices which, if not followed correctly, could result in serious personal injury.**

Bold

Text in bold face type emphasizes key words or phrases.

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WARRANTY
Every Instrument manufactured by the New Brunswick Scientific Co., Inc. is warranted to be free from defects in material and workmanship. This apparatus, with the exception of glassware, lamps and electrodes (where supplied), is warranted against faulty components and assembly for 2 years in the United States & Canada and for 1 year elsewhere. Our obligation under this warranty is limited to repairing or replacing the instrument or part thereof, which shall, upon our examination, prove to be defective. The warranty period begins at the date of shipment. This warranty does not extend to any NBS products which have been subjected to misuse, neglect, accident or improper installation or application; nor shall it extend to products which have been repaired or altered outside the NBS factory without prior authorization from the New Brunswick Scientific Co., Inc.

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1 OVERVIEW

The C-24 Classic Benchtop Incubator Shaker is a portable shaker utilizing an eccentric counter balanced drive to provide horizontal plane rotary motion in a 3/4" (1.9 cm) circular orbit. A Proportional/Integral (PI) Microprocessor controller with instantaneous digital feedback controls the speed over a range of 50-400 rpm. It also provides temperature control over a range of 7°C above ambient to 60°C.

The shaker may be operated either continuously or in a timed mode via a programmable timer for shaking periods of 0.1 hr. to 99.9 hrs.

For safe operation, the C-24 is provided with a safety switch which automatically stops the shaker mechanism, when the lid is lifted. Additionally, the lid can be operated with one hand and latches when fully opened and an upward motion deactivates the latch for closing the lid.

In addition, the C-24 is equipped with visual alarms that alert the user to the following conditions:

- The end of a timed run
- Deviations of shaking speed
- Deviations of temperature setpoint
- Power failure
- Lid open

A wide variety of platforms can be used with the C-24. Dedicated platforms are available for a variety of flask sizes. Universal platforms, utility trays, utility carriers and test tube racks are also available.

1.1 Specifications

C-24 Classic Benchtop Incubator Shaker	
Speed **Control Accuracy** **Indication** **Stroke**	50-400 rpm +/- 2 rpm 3 Digit LED ¾ inch (1.9 cm)
Temperature **Control** **Indication** **Heaters**	7°C above ambient temperature to 60°C ± 0.25°C Digital LED display in 0.1°C increments Low-watt density resistance type
Ambient Operating Environment	5 - 40°C, 20 to 90% relative humidity, non-condensing
Alarms	Visible warning indication when speed deviates more than 5 rpm, and temperature more than 1°C from setpoints, and when timer has expired.
Timer	0.1 hr to 99.9 hours. Shuts off agitation at end of period. Can be deactivated for continuous operation.
Automatic Restart	Automatic restart after power is restored. Setpoints and operating status are retained in memory during power interruption.
Drive Interrupt	Automatic drive-interrupt when cover is opened.
Electrical Requirements	110/120V AC 50/60 Hz, 1320 VA 220/240V AC 50/60 Hz, 1320 VA
Platform	18 inches X 18 inches (46 X 46 cm), Stainless Steel
Overall Dimensions	21 inches W X 27 inches D X 20 inches H (53 cm W X 69 cm D X 51 cm H) Overall height with lid open: 40 inches (102 cm)
Chamber Dimensions	20.5 inches W X 22 inches D X 13 inches H (51 cm W X 56 cm D X 33 cm H)
Weight	115 lbs (52 kg) Net 145 lbs (66 kg) Gross

2 INSPECTION, VERIFICATION & UNPACKING OF EQUIPMENT

WARNING!
The unit is heavy. Do not attempt to lift or move it by yourself.

2.1 Inspection of Boxes

After you receive your order from New Brunswick Scientific, inspect the boxes carefully for any damage that may have occurred during shipping. Report any damage to the carrier and to your local NBS Sales Order Department.

2.2 Packing List Verification

Verify against your NBS packing list that you have received the correct materials.

2.3 Unpacking of Equipment

Save all packing materials and User's Guide. If any part of your order was damaged during shipping, missing pieces, or fails to operate properly, please fill out the *Customer Satisfaction Form 6300* and return by fax.

There are two small plastic straps holding the bearing housing in place during shipping. Remove the straps from the bearing housing once the unit is unpacked and inspected.

2.4 Inspection of equipment

Verify that you have received the following equipment :

- ☐ **C-24 CLASSIC BENCHTOP INCUBATOR SHAKER**
  100/120V 50/60 Hz (M1247-0004)
  220/240V 50/60 Hz (M1247-0005)

- ☐ **POWER KIT (POWER CORD, FUSE AND HEX KEY)**
  100/120V 50/60 Hz (M1247-0600)
  220/240V 50/60 Hz (M1247-0601)

3 PREPARING THE LOCATION

WARNING!
The unit is heavy. Do not attempt to lift or move it by yourself.

3.1 Physical Location

It is essential that the instrument be situated in a area where there is sufficient space for the shaker and platform to clear walls and obstructions during operation. The surface on which the unit is placed must be smooth, level, and able to support the shaker under full load operating conditions.

3.2 Environment

The shaker is designed to operate optimally in the following ambient conditions:

- 5 - 40°C
- 20 to 90% Relative Humidity non-condensing

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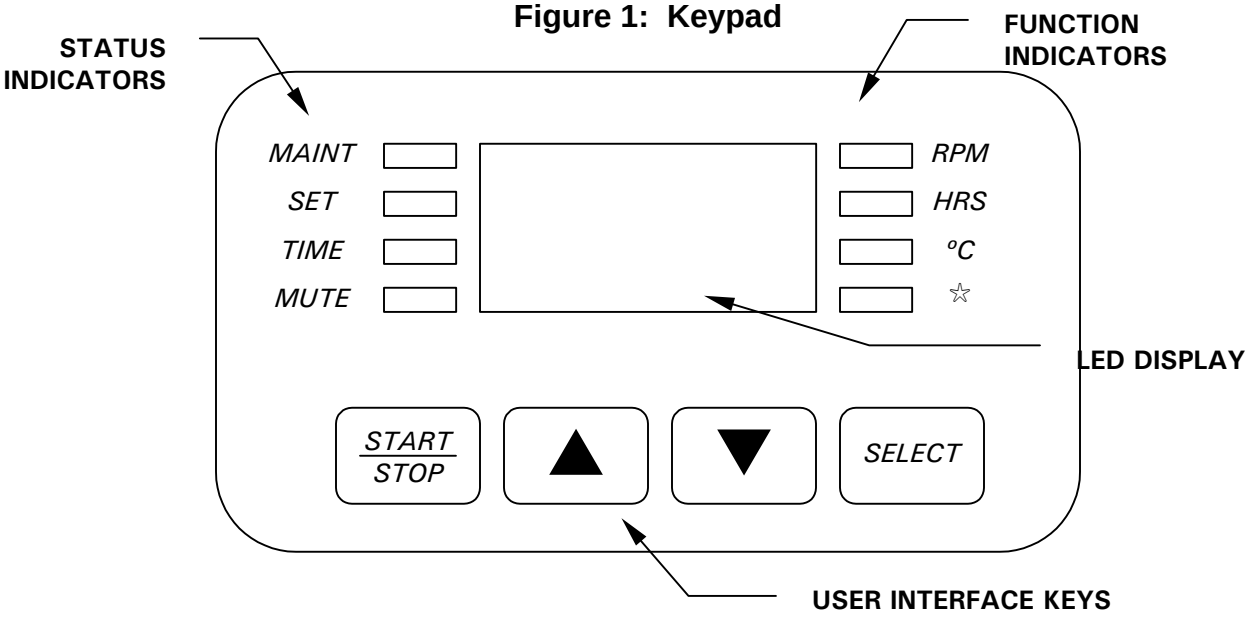
4 C-24 SHAKER FEATURES

4.1 Keypad

Figure 1: Keypad



LED DISPLAY:

The digital display on the control panel is a three-digit **LED DISPLAY**. During normal shaker operation the display will indicate:

- Shaker status (On/Off)
- Shaking speed
- Chamber temperature
- Setpoints
- Hours remaining (timed run)
- Lid open

USER INTERFACE KEYS:

- **START/STOP** This key is used to start or stop the shaker. It will also activate or stop the timer when a timed run is desired.

- **SELECT** This key is used to change the displayed parameter.

- **▲(UP), ▼(DOWN)** These keys are used to adjust the setpoint of a displayed parameter up or down. They also allow the user to enter the **SET MODE** for setpoint changes.

STATUS INDICATORS:

Four status indicator lights are located to the left of the **LED DISPLAY**. They are:

- **MAINT** Remains lit after 10,000 hours of use. Accumulated running time is internally monitored and may be displayed as a guideline.
- **SET** Indicates that the shaker is in the **SET MODE** and setpoints are being displayed and can be altered.
- **TIME** Indicates that the timer is in operation. The shaker can be programmed to run for a preset time from 0.1 hour to 99.9 hours. The timer can be disengaged without stopping an ongoing run.
- **MUTE** Not applicable

FUNCTION INDICATORS:

Four function indicator lights are located to the right of the **LED DISPLAY**. They indicate the current parameter being displayed.

- **RPM** revolutions per minute
- **HOURS** time remaining
- **°C** interior chamber temperature
- ***** not applicable

4.2 Platform Assemblies

The C-24 can be used with a wide variety of NBS 18-inch X 18-inch (46 X 46 cm) platforms, which will accept a variety of clamps for flasks test tubes, etc. **A platform is a separate item and is required for operation**. Refer to the Replacement Parts and Accessory Information section of this manual for details.

5 GETTING STARTED

5.1 Installation of Platform

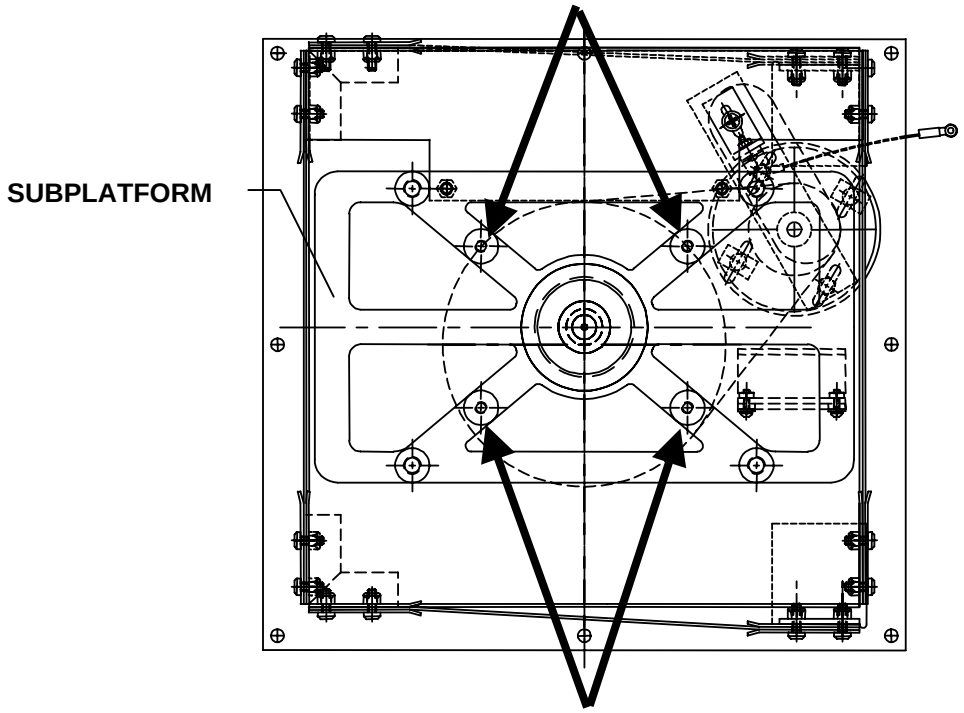
A platform is required for operation. To install a platform on the unit:

NOTE:

There are two small plastic straps holding the bearing housing in place during shipping. The straps must be removed from the unit.

1. Using the 5/32-inch hex wrench provided, remove the four Allen head platform screws from the **SUBPLATFORM**.
2. Place the platform on the **SUBPLATFORM**. Align the mounting holes of the platform with the platform screw locations in the **SUBPLATFORM**.
3. Insert the platform screws and tighten them down with the 5/32-inch hex wrench to secure platform.

Figure 2: Platform Screw Locations



5.2 Installing Flask Clamps

Flask clamps purchased for use with universal platforms (*see Section 9.2*) require installation. Clamps are installed by securing the base of the clamp to the platform with the correct type and number of screws. All clamps are shipped complete with hardware.

Clamps for 2-, 2.8- and 4-liter flasks are shipped with an additional girdle to keep the flasks in place. The girdle is an assembly of springs and sections of rubber tubing. One girdle is already in place on the clamp, the other is packed separately. To install these double girdle clamps:

1. Place the clamp on the platform, aligning its mounting holes with holes on the platform. Secure the clamp in place using the flat Phillips head screws provided (#S2116-3051, 10-24 x 5/16-inch). *Use Figure 3b to help you identify the proper screws, as three different types of screws are shipped with the clamps.*
2. With the first girdle in place, as delivered, on the upper part of the clamp body (*see Figure 3a*), insert an empty flask into the clamp.
3. After making sure the sections of tubing are located between the clamp legs, roll the first girdle down the legs of the clamp as far as it can go. The tubing sections will rest against the platform, and the springs will be under the clamp base.
4. Place the second girdle around the upper portion of clamp body (just as the first girdle was initially). Make sure that its spring sections rest against the clamp legs, while its rubber tubing sections sit against the flask, in between the clamp legs.

Figure 3a: Double Girdle Clamp Installation

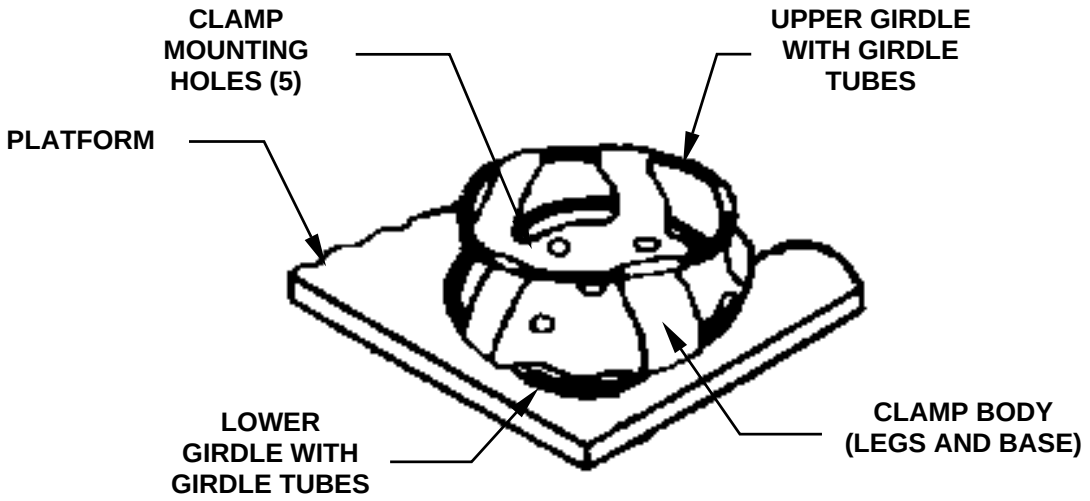


Figure 3b: Clamp Fastener

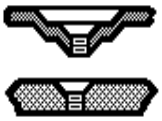
NOTE:

The upper girdle secures the flask within the clamp, and the bottom girdle keeps the flask from spinning.

NBS flask clamps are used on a variety of shaker platforms. Flat head screws of different lengths and thread pitch are used to secure the clamp. To identify the proper screw for your shaker application by reference to the head style, consult Table 1 below, find the proper screws and set the others aside:

Table 1: Clamp Hardware Application Chart

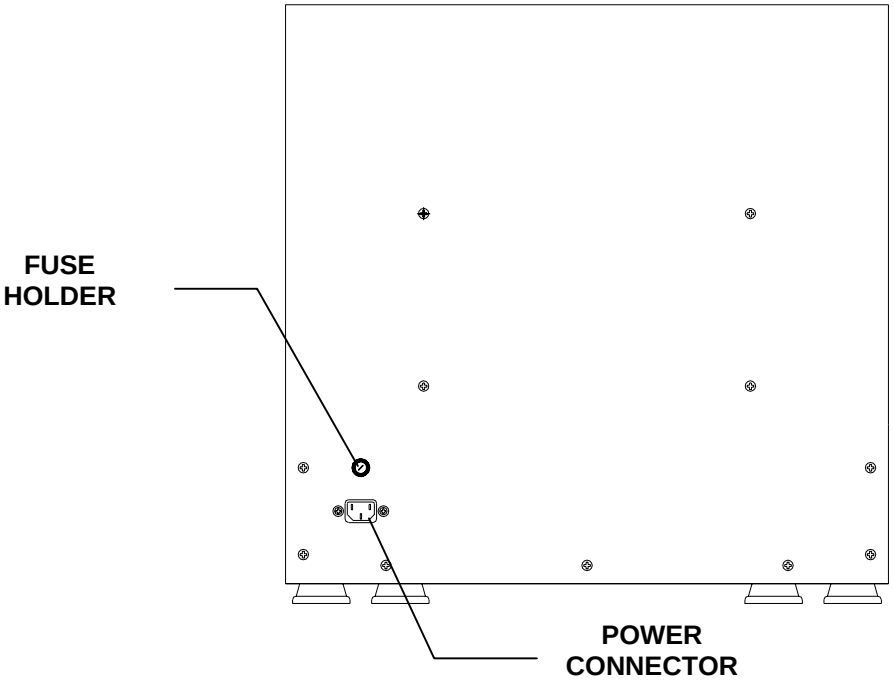
No matter what size the clamp, use these screws to fasten them to your platform:

Description	*Part Number*	*Qty.*	*Application*
 10-24 x 5/16 (7.9 mm) flat Phillips (+) head screw	S2116-3051	1	5/16" (7.9 mm) thick aluminum, phenolic and stainless steel platforms. 

5.3 Electrical Connections

Before making electrical connections, verify that the power source voltage matches the voltage on the **ELECTRICAL SPECIFICATION PLATE** and the **ON/OFF SWITCH** is on the **OFF** position. The **ELECTRICAL SPECIFICATION PLATE** is located on the side panel of the unit near the **ON/OFF SWITCH**. Connect the **POWER CORD** to the **POWER CONNECTOR** (see Figure 4 on the following page) and the other end to a suitable, grounded receptacle.

Figure 4: C-24 Rear Panel

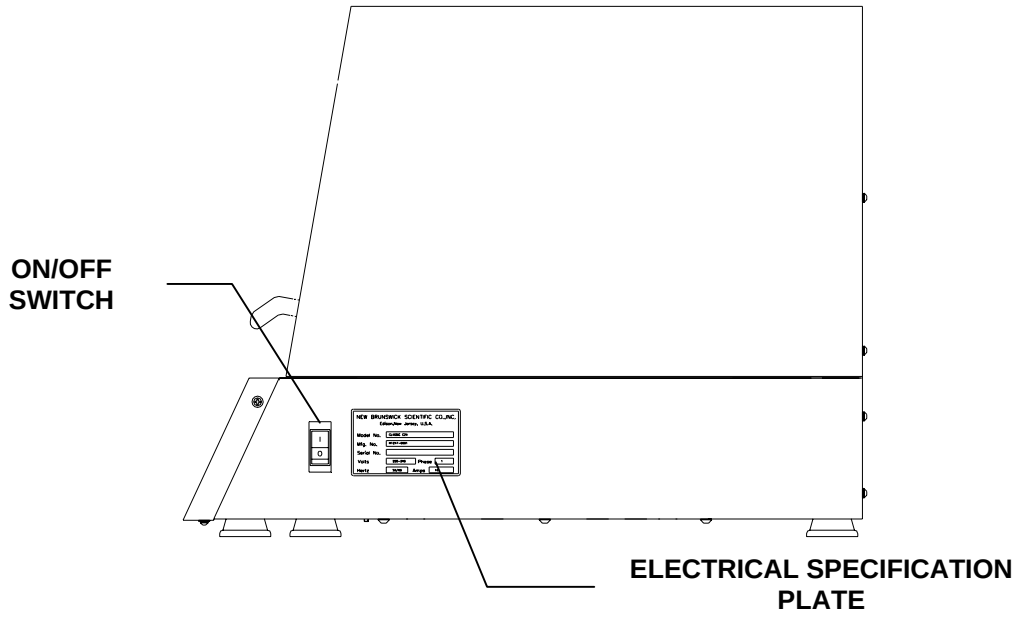


6 OPERATION

6.1 Starting the C-24

To initially start the shaker, close the lid and turn the **ON/OFF SWITCH** on the side of shaker to the **ON** position. If the Shaker begins to operate, the **LED DISPLAY** will track the speed as it accelerates to the last entered setpoint. The shaking action may be stopped or started by pressing the **START/STOP KEY**.

Figure 5: Side View



NOTE:

The Shaker will not operate if the lid is open. This is indicated by the word "lid" appearing in the LED DISPLAY.

6.2 Continuous (Unlimited) Run

1. Press **SELECT** until the **RPM INDICATOR** is illuminated.
2. If the display indicates that the shaker is **OFF**, press the **START/STOP KEY**.
3. Press either ▲ or ▼ **KEY** to enter **SET MODE** (the **SET INDICATOR** will illuminate).
4. Set the speed by using the ▲ or ▼ **KEY** until the desired setpoint is displayed. Holding the ▲ or ▼ **KEY** will cause the setting to change more rapidly.

NOTE:

The setpoint may be changed during a run without stopping the shaker by following steps 2-4. During speed changes, a visual alarm (flashing RPM INDICATOR) will flash until the speed returns to within 5 rpm of the setpoint.

6.3 Checking Any Setpoint

1. Press **SELECT** until the desired indicator is illuminated.
2. Press either ▲ or ▼ **KEY** to enter the **SET MODE** and display the current setpoint.

CAUTION!
Holding the ▲ or ▼ for more than 0.5 seconds causes the speed setpoint to change. Should this occur, resetting will be necessary.

6.4 Timed Functions

The shaker may be programmed to automatically stop after a preset time period of 0.1 hour - 99.9 hours. There must be power to the shaker in order to set the timer. However, a timed run can be initiated while the unit is either shaking or stopped.

To set the timer:

1. Press the **SELECT KEY** until the **HRS INDICATOR** is illuminated.
2. Press either ▲ or ▼ **KEY** to enter the **SET MODE** and set between 0.1 - 99.9 hours.
3. While the **SET INDICATOR** is illuminated, press the **START/STOP KEY** to program the time (and start the run). The **TIME INDICATOR** will light and remain on for the duration of the run. At the end of the timed run the display will read **OFF**, and the **TIME INDICATOR** will flash.

To disable the alarm (flashing **TIME INDICATOR**), press the **SELECT KEY** and change to any other function.

To cancel the timer without stopping the shaker:

Repeat steps 1 and 2. Then immediately press the **START/STOP KEY**. The **TIME INDICATOR** will cease to flash and the display will read **OFF**.

6.5 Alarm Functions

The shaker has a visible alarm (flashing **TIME INDICATOR**) that is activated (a) at the end of a timed run, or (b) if the temperature is 1ºC or more from the setpoint, or if the speed is 5 RPM or more from the setpoint.

6.6 Temperature Setpoint

Press the **SELECT KEY** until the function **°C INDICATOR** illuminates. The temperature can be set from 7°C above the current ambient temperature up to 60.0°C. Ambient temperature is defined as the temperature within one meter of the shaker. Increase or decrease the setpoint using the ▲ or ▼ **KEY**.

During operation, if the temperature of the chamber is more than 1.0°C higher or lower than the temperature setpoint, a visual alarm is triggered. This alarm consists of a flashing **°C INDICATOR**. The alarm will automatically deactivate as the unit achieves the set temperature.

6.7 Total Running Time

The control modules of the C-24 shaker totalize the time the shaker has been "**ON**" to track hours of usage. To display the accumulated running time:

1. Press **SELECT** until the **HRS INDICATOR** is illuminated.
2. **Simultaneously** press the ▲ and ▼ **KEYS**.

The **SET** and **MAINT INDICATORS** will flash and the accumulated running time will be displayed in hundreds of hours (i.e., "02" equals 200 hours; "102" equals 10,200 hours). This display will continue for 10 seconds and then default to the previous mode readout.

6.8 Maint Indicator

After 10,000 hours of operation, the **MAINT INDICATOR** will illuminate. Preventive maintenance is recommended at this point.

To deactivate the **MAINT INDICATOR**:

1. Press **SELECT** until the **HRS INDICATOR** is illuminated.
2. **Simultaneously** press the ▲ and ▼ **KEYS**.
3. Press the ▼ **KEY**.

6.9 Power Failure

In the event of a power failure, the C-24 Benchtop Incubator Shaker is equipped with an automatic restart function.

If the Shaker was in operation prior to the power interruption, the Shaker will begin to operate at its last entered setpoint. The **LED DISPLAY** will flash indicating that a power failure has occurred. Press any key to cease the flashing in the display.

7 PREVENTIVE MAINTENANCE

WARNING!
Always turn off the shaker and disconnect the power cord from the power supply before performing maintenance on the unit.

7.1 Cleaning External Surfaces

The unit may be cleaned using a damp cloth or any standard, household or laboratory cleaner to wipe down its outer surfaces. Do not use abrasive or corrosive compounds to clean this instrument, as they may damage the unit and void the warranty.

The exercise of reasonable care in cleaning the chamber lid will minimize scratching. Wash the plastic cover with a mild soap or detergent and lukewarm water solution. Rinse well. Dry by blotting with a damp cloth or chamois. Polish the cover with NBS door/lid polish and polishing cloths (P0860-0949).

Do NOT use: window cleaning fluids, scouring compounds, gritty cloths, leaded or ethylene gasolines or solvents such as alcohol, acetone, carbon tetrachloride, etc.

7.2 Fuse Replacement

The electrical fuse of the unit is housed in the fuse holder on the rear panel of the unit above the **POWER CORD CONNECTOR**.

To check or replace the fuse:

1. Set the **ON/OFF SWITCH** to **OFF** and disconnect the **POWER CORD** from the power source.

2. Insert a small flat-bladed screwdriver into the fuse holder groove (*see Figure 4, repeated for reference on the following page & Figure 6 below it*) and turn counter-clockwise until it disengages and the fuse holder springs free.

Figure 4: C-24 Rear Panel

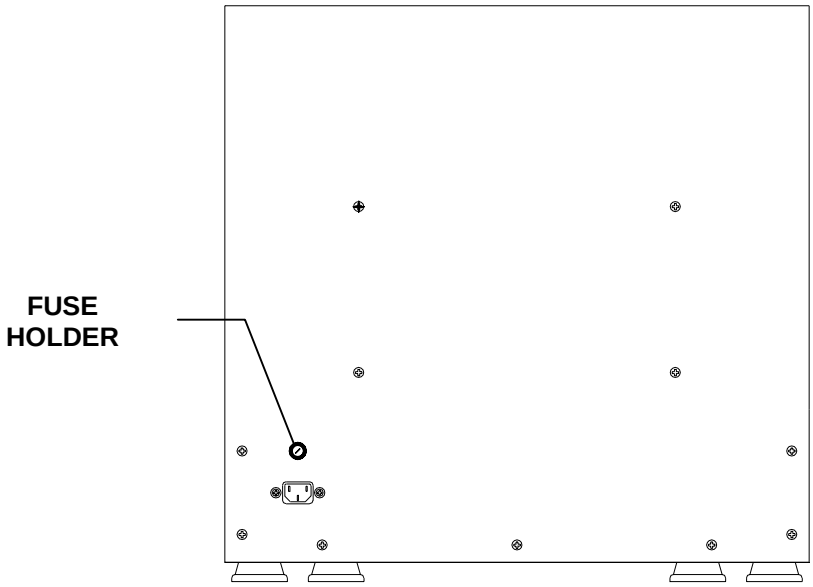
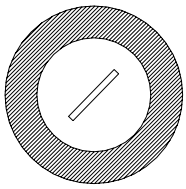


Figure 6: Fuse Holder Detail



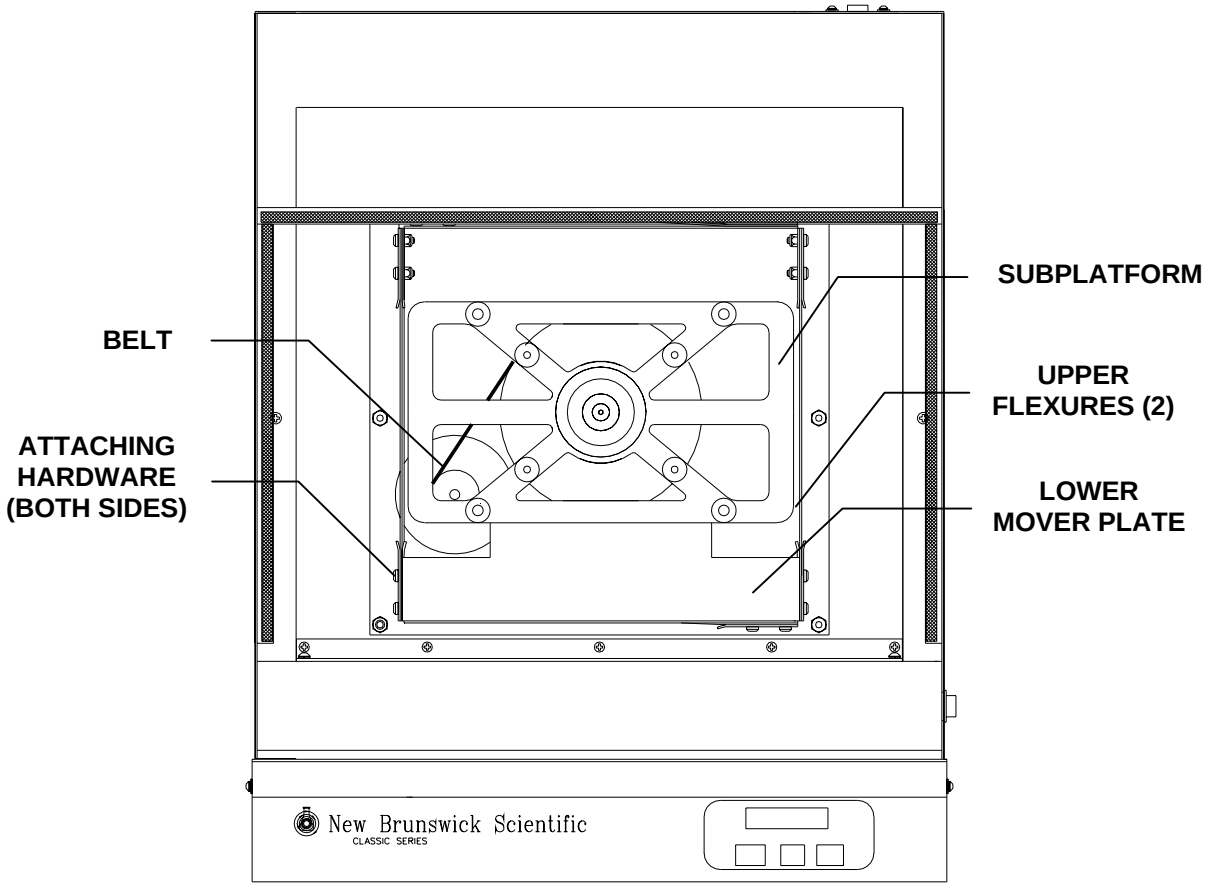
3. Check the fuse and if it has failed, replace the fuse.

7.3 Belt Replacement

To replace the drive belt of the shaker:

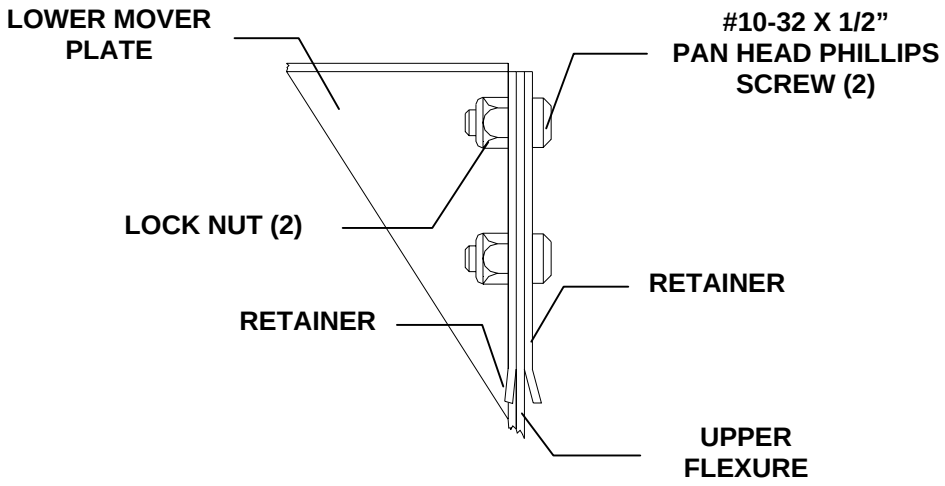
1. Turn off the unit, and disconnect the **POWER CORD** from the power source.
2. Open the lid.
3. Remove the platform, if one is present. Set the platform and platform screws aside.

Figure 7: Belt Removal



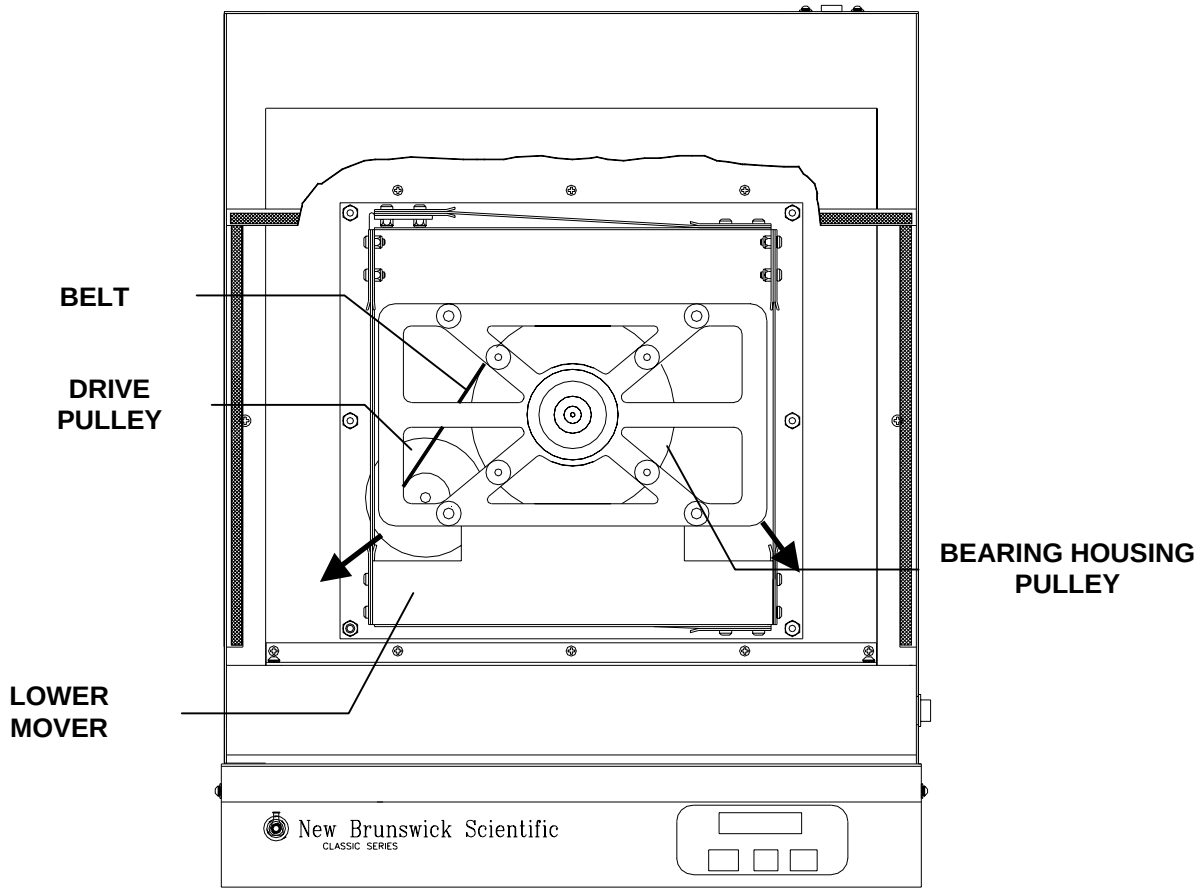
4. Loosen and remove the hardware that attaches the **UPPER FLEXURES** to **LOWER MOVER PLATE**.

Figure 8: Flexure-Attaching Hardware (Reverse View)



5. Using your fingers, reach under the **SUBPLATFORM** and move the belt so that it falls off the drive pulley. Remove the belt from the bearing housing pulley.

Figure 9: Belt Removal (cutaway)



6. Grab the belt from underneath the **SUBPLATFORM**, pull it forward and over one corner of the **SUBPLATFORM**. Repeat for the other corner until the belt clears the **SUBPLATFORM**, but is constrained by the **LOWER MOVER PLATE**.
7. Slide the belt to one of the unattached sides of the **LOWER MOVER PLATE** and pull it through the opening.
8. Slide the belt to the other side of the **LOWER MOVER PLATE**, pull it through the opening, and remove it from the unit.
9. Install the replacement belt in similar fashion.
10. Reattach the **UPPER FLEXURES** to the **LOWER MOVER PLATE**.
11. Reinstall the platform if desired, and close the lid.
12. Reconnect the **POWER CORD** to the unit.

8 TROUBLESHOOTING

If any problems occur with your shaker, do not attempt to perform any service on the unit other than specified in this manual. Unauthorized servicing may void the warranty. Please contact your local NBS Sales Order Department

In any correspondence with NBS, please refer to the Model Number and Serial Number of your unit. This information is on the **ELECTRICAL SPECIFICATION PLATE** which is located on the side panel of the unit near the **ON/OFF SWITCH**.

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9 REPLACEMENT PARTS AND ACCESSORY INFORMATION

When ordering replacement or accessory parts, or requesting service information, please provide the Model Number and Serial Number of your shaker. This information is on the **ELECTRICAL SPECIFICATION PLATE** which is located on the side panel of the unit.

9.1 Replacement Parts

Part Description	*NBS Part Number*
V-Belt	R-243
Fuse, Slo Blo .5 A, 250 V	P0380-3150

9.2 Accessories

9.2.1 Cleaning Supplies

Part Description	*NBS Part Number*
Door & Lid Polishing Kit	P0860-0949

9.2.2 Dedicated Platforms

Accessory Description	*Capacity*	*NBS Part Number*
50 ml Erlenmeyer Flasks	64	M1119-9903
125 ml Erlenmeyer Flasks	34	M1191-9904
250 ml Erlenmeyer Flasks	25	M1191-9905
500 ml Erlenmeyer Flasks	16	M1191-9906
1 L Erlenmeyer Flasks	9	M1191-9907
2 L Erlenmeyer Flasks	5	M1191-9908
2.8 L Fernbach Flasks	4	M1233-9932

9.2.3 Universal Platform

The following is a list of flask capacities for the Universal Platform, NBS part number M1250-9902. Flask clamps are ordered separately (*see Tables 1 & 2 for details*).

Flask Type	*Capacity*
10 ml Erlenmeyer Flasks	109 each
25 ml Erlenmeyer Flasks	64 each
50 ml Erlenmeyer Flasks	45 each
125 ml Erlenmeyer Flasks	21 each
250 L Erlenmeyer Flasks	18 each
500 L Erlenmeyer Flasks	14 each
1 L Erlenmeyer Flasks	8 each
2 L Erlenmeyer Flasks	4 each
2.8 L Fernbach Flasks	4 each

9.2.4 Accessory Flask Clamps

The following stainless steel accessory flask clamps are available:

Clamp Type	*NBS Part Number*
10 ml Erlenmeyer Clamp	ACE-10S
25 ml Erlenmeyer Clamp	M1190-9004
50 ml Erlenmeyer Clamp	M1190-9000
125 ml Erlenmeyer Clamp	M1190-9001
250 ml Erlenmeyer Clamp	M1190-9002
500 ml Erlenmeyer Clamp	M1190-9003
1 L Erlenmeyer Clamp	ACE-1000S
2 L Erlenmeyer Clamp	ACE-2000S
2.8 L Fernbach Flask Clamp	ACFE-2800S

9.2.5 Carriers & Test Tube Racks

Accessory Description	*NBS Part Number*
Utility Carrier with rubber mat and 2 cross bars for captivating glassware and other containers	M1194-9909
Utility Tray with rubber mat for shaking 96 well plates, petri dishes and other labware at low speeds.	M1194-9910
Angled Test Tube Rack Holder for user supplied test tube racks that are 4-5 in. (10-13 mm) wide and up to 15 inches (38 mm) long. Capacity: 2 racks/platform.	TTR-210*
Angled Test Tube Rack Spacer for use with TTR-210 to accommodate test tube racks that are less than 5 inches (13 mm) wide and up to 15 inches (38 mm) long.	TTR-215*
Microtiter Plate Carrier, capacity up to 5 microtiter plates	TTR-221*

*Universal Platform Required

...continued...

Accessory Description	*NBS Part Number*
80-tube (8-11mm ∅) Adjustable Angle Test Tube Rack	M1289-0100✧
60-tube (12-15mm ∅) Adjustable Angle Test Tube Rack	M1289-0200✧
42-tube (15-18mm ∅) Adjustable Angle Test Tube Rack	M1289-0300✧
30-tube (18-21mm ∅) Adjustable Angle Test Tube Rack	M1289-0400✧
22-tube (22-26mm ∅) Adjustable Angle Test Tube Rack	M1289-0500✧
20-tube (26-30mm ∅) Adjustable Angle Test Tube Rack	M1289-0600✧
Microplate Holder, stack 3 deep-well or 9 standard microplates	M1289-0700✧

✧ Platform capacity is 4 racks

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10 DRAWINGS

Figure 10: Control Schematic, 110-120 VAC 50/60 Hz

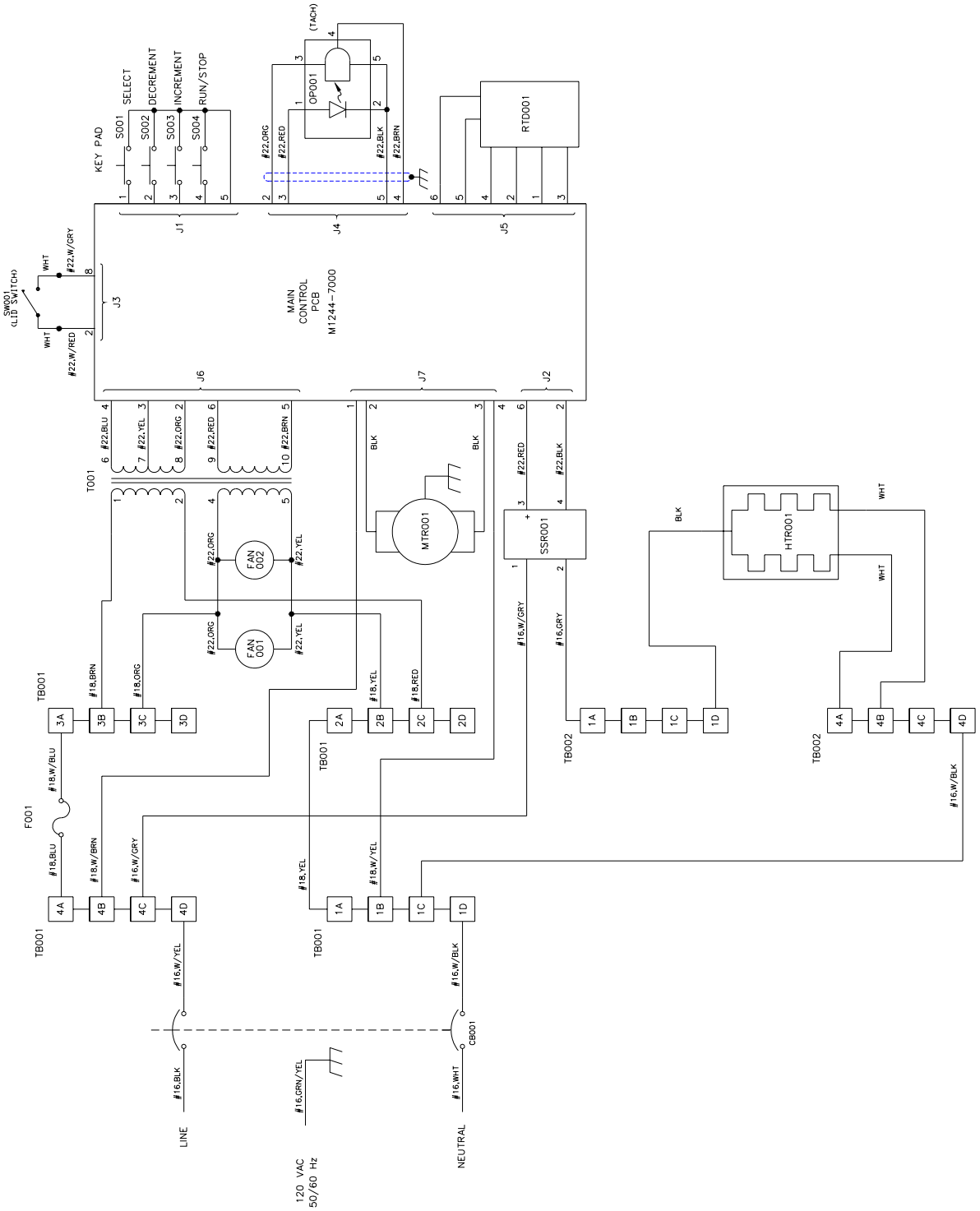
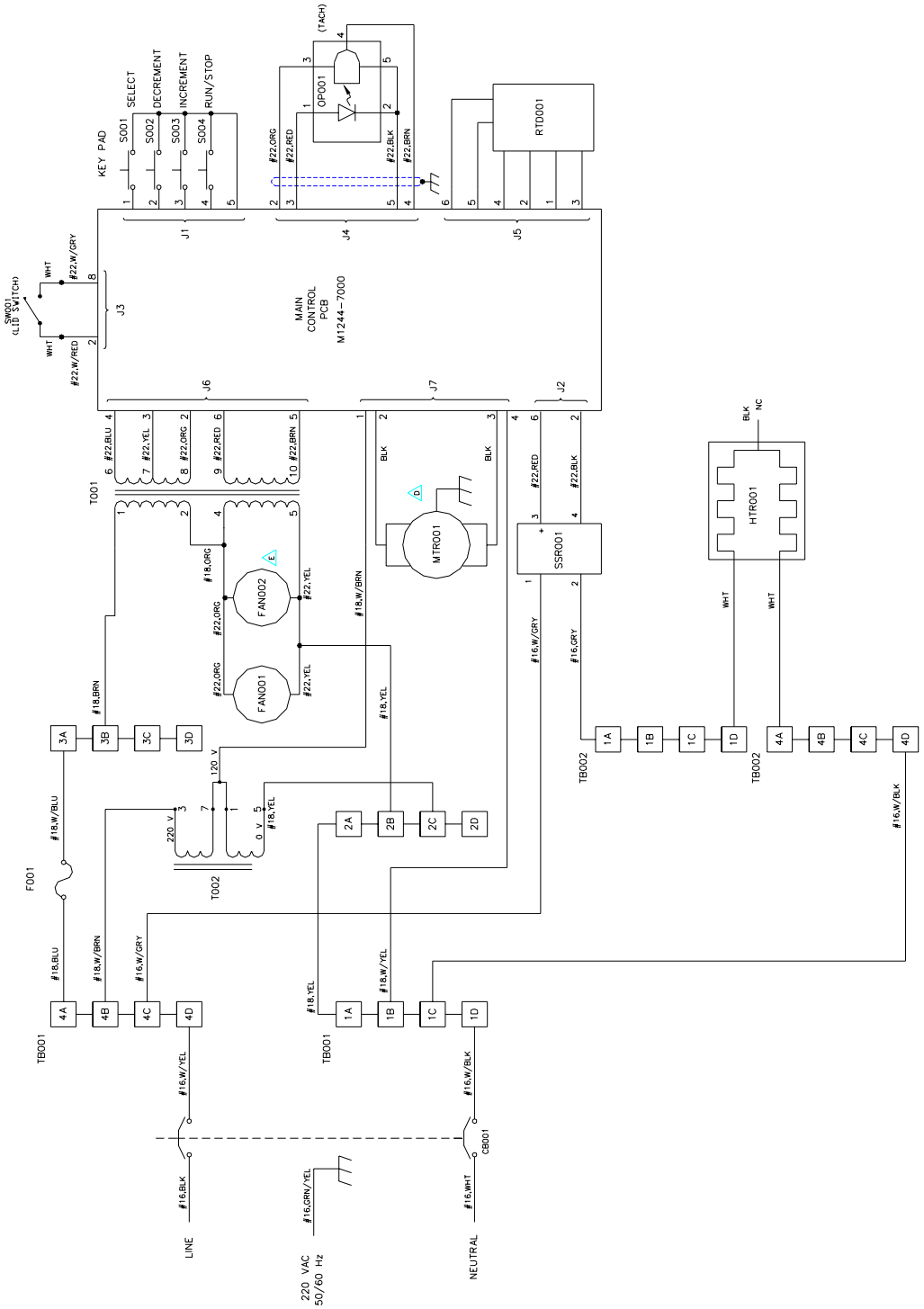


Figure 11: Control Schematic, 220-240 VAC 50/60 Hz



10.1 List of Drawings

10.2 List of Tables

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