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Guide to Operations

innova™ 4400

Large Stackable Incubator Shakers

MANUAL NO: M1243-0050
Revision L
August 2, 2002

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CAUTION!

This equipment *must* be operated as described in this manual. If operational guidelines are not followed, equipment damage and personal injury *can* occur. Please read the entire User's Guide before attempting to use this unit.

Do not use this equipment in a hazardous atmosphere or with hazardous materials for which the equipment was not designed.

New Brunswick Scientific Co., Inc. (NBS) is not responsible for any damage to this equipment that may result from the use of an accessory not manufactured by NBS.

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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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TABLE OF CONTENTS

1 OVERVIEW 13

1.1 INNOVA 4400, FRONT VIEW 14
1.2 SPECIFICATIONS 15

2 INSPECTION, VERIFICATION & UNPACKING OF EQUIPMENT 17

2.1 INSPECTION OF BOXES 17
2.2 PACKING LIST VERIFICATION 17
2.3 UNPACKING OF EQUIPMENT 17

3 PREPARING THE LOCATION 19

3.1 PHYSICAL LOCATION 19
3.2 ENVIRONMENT 19
3.3 ELECTRICAL REQUIREMENTS 19
3.4 SPACE REQUIREMENTS 19

4 INSTALLING THE INNOVA 4400 21

4.1 TOOLS REQUIRED FOR INSTALLATION 21
4.2 LEVELING A SINGLE SHAKER 21
4.3 LEVELING THE OPTIONAL BASE 22
4.4 MOUNTING THE INNOVA 4400 ON THE OPTIONAL BASE 22
4.5 INSTALLING THE INNOVA 4400 STACKING KIT 24
4.6 STACKING THE INNOVA 4400 25
4.7 STACKING A THIRD INNOVA 4400 26

5 FEATURES 27

5.1 KEYPAD 27
5.2 LED DISPLAY 27
5.3 USER INTERFACE KEYS 28
5.4 STATUS INDICATORS 28
5.5 FUNCTION INDICATORS 29

6 GETTING STARTED 31

6.1 PLATFORM ASSEMBLIES 31
6.2 INSTALLATION OF PLATFORM 31
6.3 INSTALLATION OF CLAMPS 32
6.4 ELECTRICAL CONNECTIONS 33
6.5 OPTIONAL GASSING PORT KIT 35

7 OPERATION 37

7.1 STARTING THE SHAKER 37
7.2 CONTINUOUS (UNLIMITED) RUN 38
7.3 CHECKING ANY SETPOINT 38
7.4 TIMED FUNCTIONS 38
7.5 ALARM FUNCTIONS 39
7.6 TEMPERATURE SETPOINT 39
7.7 TEMPERATURE OFFSET CALIBRATION 40
7.8 TOTAL RUNNING TIME 41
7.9 MAINT [MAINTENANCE] INDICATOR 41
7.10 POWER FAILURE 41

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8 PREVENTIVE MAINTENANCE 43

8.1 CLEANING EXTERNAL SURFACES 43
8.2 FUSE REPLACEMENT 43
8.3 BELT REPLACEMENT 44

9 RECORDER ADAPTATION 47

10 SERVICE 49

10.1 TROUBLESHOOTING 49
10.2 REPLACEMENT PARTS 49
10.3 ACCESSORIES 50
10.3.1 Bolt-On Platforms 50
10.3.2 Lift-Out Platforms 51
10.3.3 Slide-Out Platform Accessory 52
10.3.4 Flask Clamps for Universal Platforms: 53
10.3.5 Replacement Clamp Hardware Kits 53
10.3.6 Carriers and Test Tubes 54
10.3.7 Optional Bases for Innova 4400 55
10.3.8 Stacking Kit for Innova 4400 55
10.3.9 Cleaning Supplies 55

11 DRAWINGS 57

11.1 CONTROL SCHEMATICS 57
11.2 100V POWER KIT SCHEMATIC 62
11.3 LIST OF DRAWINGS 63

12 INDEX 65

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1 OVERVIEW

The Innova 4400 Large Stackable Incubator Shakers are large capacity orbital shakers that utilize an eccentric counter-balanced drive mechanism. They provide horizontal plane rotary motion in either a 1-inch (2.54 cm) or a 2-inch (5 cm) diameter circular orbit, depending on the model. A Proportional / Integral (PI) microprocessor controller with instantaneous digital feedback controls the speed over a range of 25-400 rpm for the 1-inch (2.54 cm) orbit and 25-300 rpm for the 2-inch (5 cm) orbit.

The Innova 4400 provides temperature control from 5°C above ambient to 80°C. Refrigeration is available and can be added by a technician in the field to extend the temperature range down to 15°C below ambient, subject to a minimum setpoint of 4°C. The Shakers may be operated either continuously or in a timed mode via a programmable timer for shaking periods of 0.1 to 99.9 hours.

For safe operation, the Innova 4400s are designed with a safety switch that automatically stops the Shaker mechanism when the door is opened. Additionally, the door can easily be operated with one hand.

The Innova 4400 is equipped with visual and audible alarms that alert the user to the following conditions:

- The end of a timed run
- Deviations from speed setpoint
- Deviations from temperature setpoint
- Power failure
- Door open

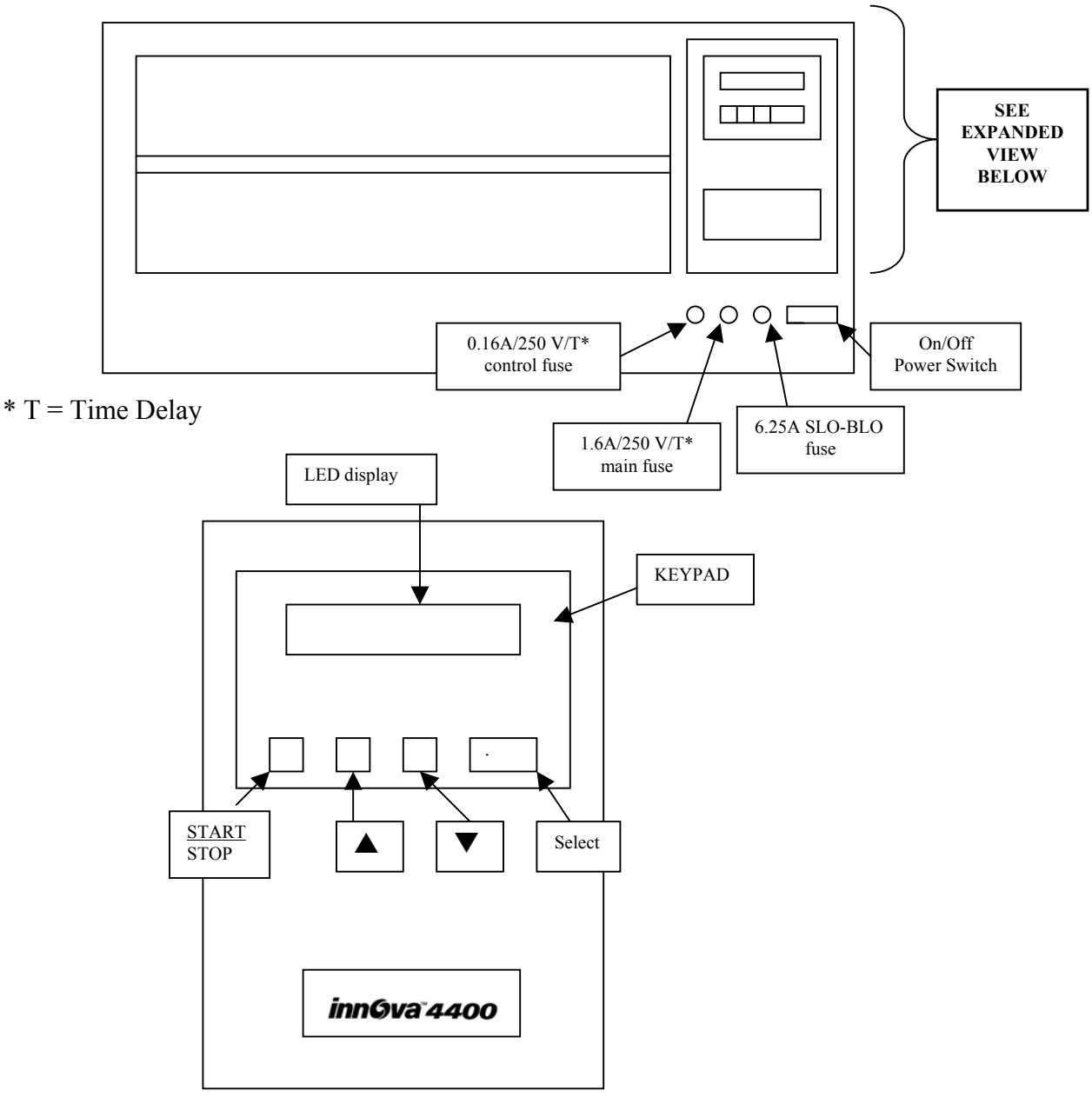
A wide variety of platforms can be used with the Innova 4400. There are two categories of platforms: *bolt-on* and *easy lift-out*. The *easy lift-out* platforms (which require Quick Release Platform Base P/N M1249-0200) allow complete removal without using tools. In each category, dedicated platforms and universal platforms are available for a variety of flask sizes. Test tube racks, microtiter plate holders, and test tube rack holders are also available (a universal platform is needed for all test tube racks and holders). For further information on these accessories, see Section 10.

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1.1 INNOVA 4400, Front View.

This drawing is for reference only. It is not to scale.

Figure 1: Front View



* T = Time Delay

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1.2 Specifications

These specifications assume a maximum load of 34 pounds (15.5 kg), including platforms, clamps, glassware and contents.

Innova 4400 Incubator Shaker			
SHAKING			
Speed	25-400 rpm with 1-inch (2.5 cm) stroke or 25-300 rpm with 2-inch (5.1 cm) stroke or 25-250 rpm with 2-inch (5.1 cm) stroke for 3 units stacked		
Control Accuracy	± 1 rpm		
Indication	3 Digit LED, in 1 rpm increments		
Stroke/Orbit	1-inch (2.5 cm) or 2-inch (5.1 cm)		
TEMPERATURE			
Range	5°C above ambient temperature to 80°C		
Control Accuracy	± 0.1°C from 30-40 °C, ± 0.5°C over the remaining range.		
Indication	3 Digit LED, in 0.1°C increments		
Heaters	Long-life, low-watt density resistance-type heaters with high temperature thermostats		
ALARMS	Visible and audible warning indication when speed deviates more than 5 rpm or temperature more than 1°C from setpoints, and when timer has expired. Audible alarm can be muted.		
LED DISPLAY	Indicates speed, temperature, running time alarm conditions, and displays readout of internal clock (actual accumulated operating time). Character height: 3/8 inches (9.5 mm)		
RECORDER OUTPUT	0-5 VDC output for tracking temperature (and speed) with an external recorder or computer.		
SETPOINT RETENTION	All setpoints and operating status are retained in non-volatile memory		
Automatic Restart	Automatic restart after power is restored, indicated by flashing display		
Stacking	Up to three units may be stacked; the second and third units require stacking kit(s).		
Drive	Triple-eccentric counterbalanced drive with nine permanently lubricated ball bearings		
Drive Motor	Solid-state brushless DC motor. Maximum torque 40 oz-in (2880 cm-g)		
Safety	Unique sensor automatically limits speed of Shaker when overloaded or unbalanced condition is detected. Drive Interrupt shuts off power to Shaker when door opens. Acceleration/deceleration circuit prevents sudden starts and stops, minimizing both splashing and mechanical damage.		
Electrical Requirements	100/120/230/240 VAC 50/60 Hz. 700 VA per Shaker.		
Overall Dimensions	Single Unit	Two Units	Three Units
Width	50" (127 cm)	50" (127 cm)	50" (127 cm)
Depth (Front to Back)	33" (84 cm)	33" (84 cm)	33" (84 cm)
Height	27" (69 cm)	52.25" (133 cm)	77.5" (197 cm)
Chamber Dimensions	34” (86.4 cm) W X 23” (58.4 cm) D X 15.5" (39.4 cm) H clearance above platform		
Chamber Door	32" X 14.5" (81.3 X 36.8 cm) see through door allows for viewing of cultures. Door swings out and up. Open door position adds 6" (15.2 cm) to depth (D) dimension and adds 18" to height (H) when open.		
Platform	Aluminum. Choice of 16.5" X 33.5" (42 X 85 cm) lift-out style, or 18" X 30" (46 X 76 cm) bolt-on style. Both platform styles are 5/16” (0.79 cm) thick.		
Weight	Net: 440 lbs (200 kg)		Gross: 540 lbs (245 kg)

NOTE: Add 18 in. (45.6 cm) to height and 6 in. (15.2 cm) to depth for door clearance.

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2 INSPECTION, VERIFICATION & UNPACKING OF EQUIPMENT

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



WARNING!
Do not attempt to lift the Innova 4400 by hand.
Always use a lifter or other suitable equipment when raising or handling the unit.

To unpack your Innova 4400, you will need the following:

- Hammer
- Forklift or other lifting equipment to lift more than 450 lbs (205 kg)
- Shears to cut ¾-inch (19 mm) wide steel strapping
- Tool to remove 3-inch (7.6 cm) metal staples

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

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3 PREPARING THE LOCATION

3.1 Physical Location

It is essential that the instrument be situated in an 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.



WARNING!
REMINDER: Do not attempt to lift the Innova 4400 by hand. Always use a lifter or other suitable equipment when raising or handling the unit.

3.2 Environment

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

- 5º to 35°C
- 20 to 90% Relative Humidity non-condensing

3.3 Electrical Requirements

100/120 or 230/240 V, 700 VA for each Innova 4400.

3.4 Space Requirements

Allow two inches (5 cm) around the Shaker for proper ventilation, and 14 inches (36 cm) on the right side for service access.

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4 INSTALLING THE INNOVA 4400



WARNING!
Reminder: Do not attempt to lift the Innova 4400 by hand. Always use a lifter or other suitable equipment when raising or handling the unit.

4.1 Tools Required for Installation

To install the Innova 4400 on an optional base and/or to stack Innova 4400 units, the following tools will be needed:

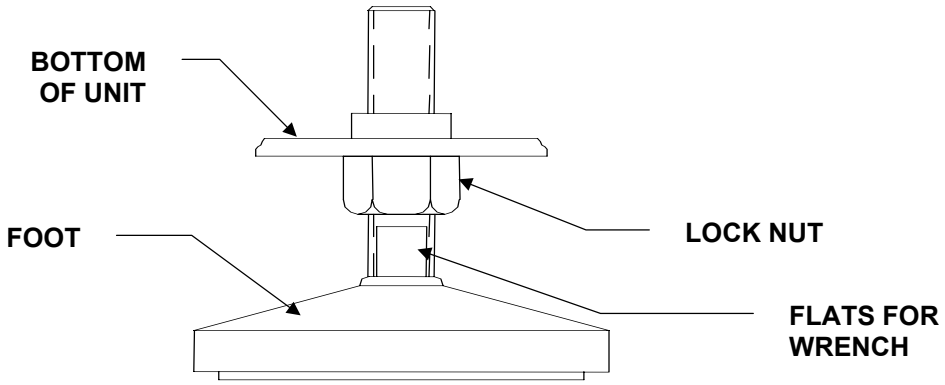
- Number 2 Phillips head screwdriver
- Level, ≥ 10-inch (25.4 cm)
- Two adjustable wrenches
- Forklift or other lifting equipment to lift more than 450 lbs (205 kg)
- Metal leveling shims

4.2 Leveling a Single Shaker

Make sure that the shaker is placed on a level surface and that all four feet are solidly on the surface. If the shaker is not level, adjust the feet as needed to achieve leveling:

1. Immobilize the top lock nut against the unit with one wrench **whenever you adjust the foot**, to keep the threaded stud from falling out.

Figure 2: Adjustable Foot



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2. With a second wrench against the flats of the threaded stud, just above the foot: rotate clockwise to lower the foot or counter-clockwise to raise the foot.
3. Place a level on the top of the unit.
4. If necessary, make further adjustments by repeating all steps until the unit is level.
5. Fully load the shaker and do a test run at normal speed. Make additional leveling adjustments if necessary.

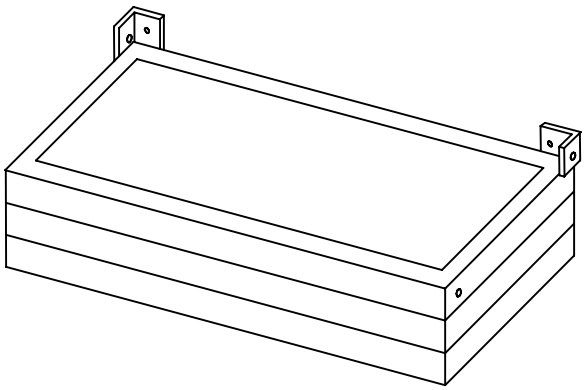
NOTE:

The maximum foot height adjustment is ~ ¼ inch (6.4 mm). If a higher adjustment is required, you will need to add metal shims.

4.3 Leveling the Optional Base

Place the base on a sturdy (capable of bearing the weight of the combined base shakers and shaker contents), level surface, making sure that all four corners are solidly on the surface. If the base is not level, place metal shims as needed under the base until it is level.

Figure 3: Optional Base

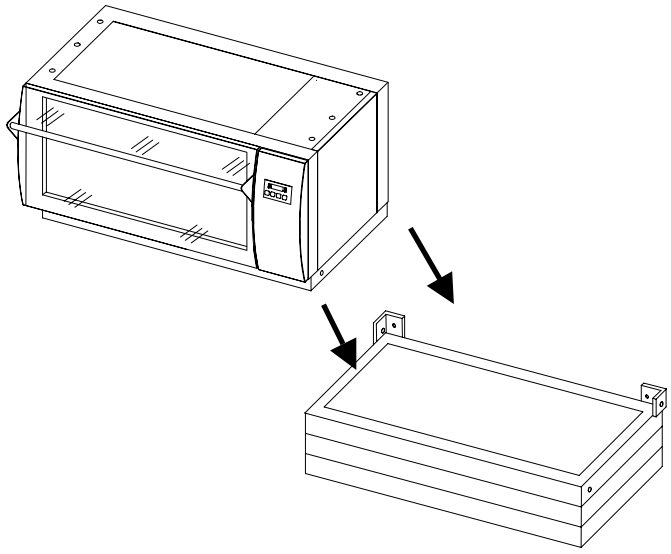


4.4 Mounting the Innova 4400 on the Optional Base

1. Using a forklift or lifter, raise the Innova 4400 so that its back end is tilted toward the rear of the base
2. Remove all four feet from the bottom of the Shaker. They will not be needed for stacking, but you may want to keep them for future use.
3. With two assistants, each holding the Shaker on one side, lower the unit onto the base, rear panel first. Slowly and gently remove the forklift or lifter and lower the front of the unit onto the base by hand.

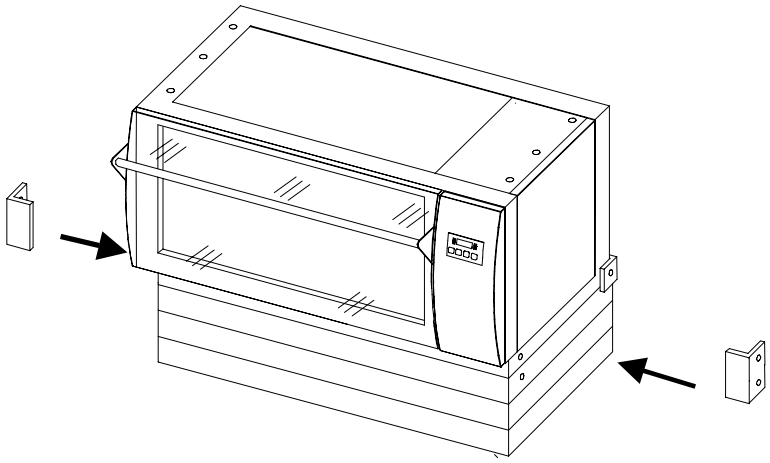
Figure 4: Mounting Shaker on Base

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4. Using the 10-24 x ½-inch screws, #10 lock washers and washers provided, secure the rear of the Innova 4400 to the corner braces in the base. With the remaining 10-24 x ½-inch screws, #10 lock washers and washers, attach the front corner braces to the unit.
5. Attach the front corner braces to the base using the two sets of 10-32 x ½-inch screws, lock washers and washers provided, and secure as shown below.

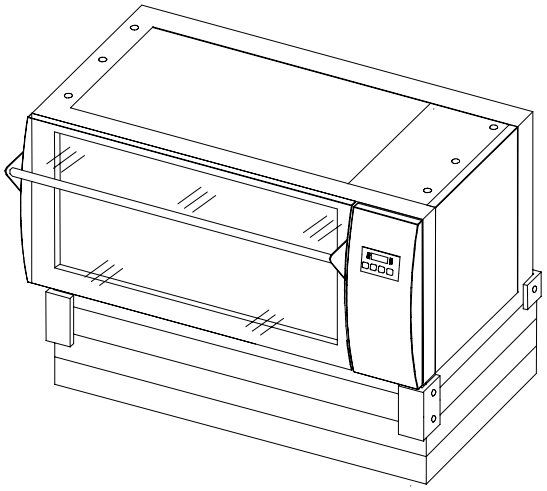
Figure 5: Mounting Corner Braces



With the corner braces securely in place, the Shaker mounted on its base will look like this:

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Figure 6: Shaker Installed on Base

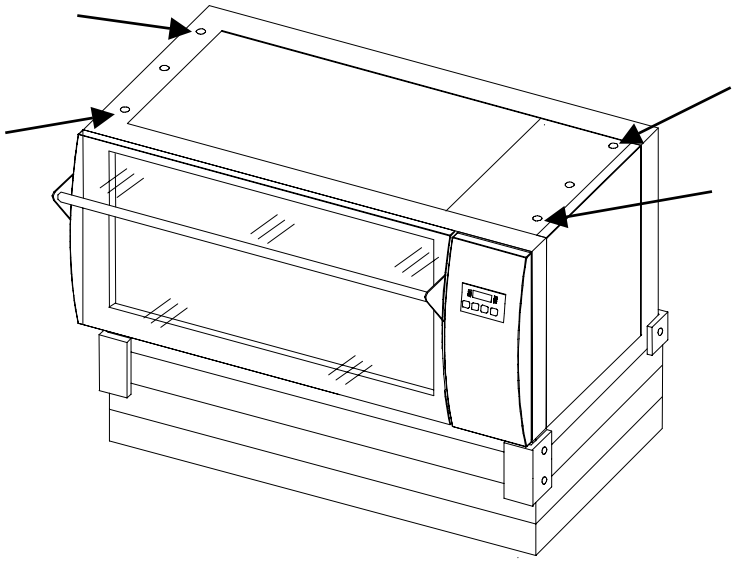


6. Make sure the Shaker is level; add metal shims under the base as needed to level the unit.
7. Fully load the shaker and do a test run at normal speed. Make additional leveling adjustments if necessary.

4.5 Installing the Innova 4400 Stacking Kit

1. Remove the four 10-32 pan head screws from the top of the shaker installed on the base.

Figure 7: Preparing to Stack Shakers

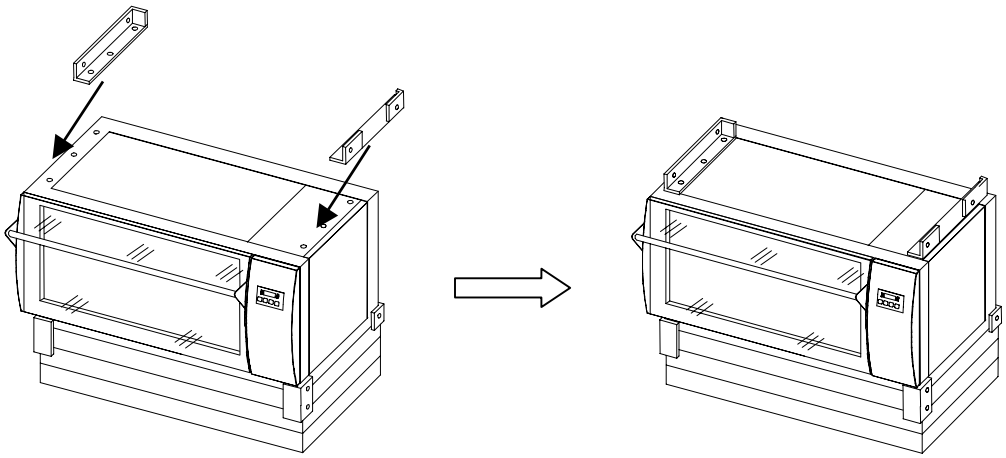


2. Using the four 10-32 flat head screws provided, attach the stacking kit mounting brackets to the top of the unit installed on the base. The mounting bracket with the

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cutout must be mounted on the right side of the unit (front view), nearest to the electrical connections. Secure the brackets in place as shown below.

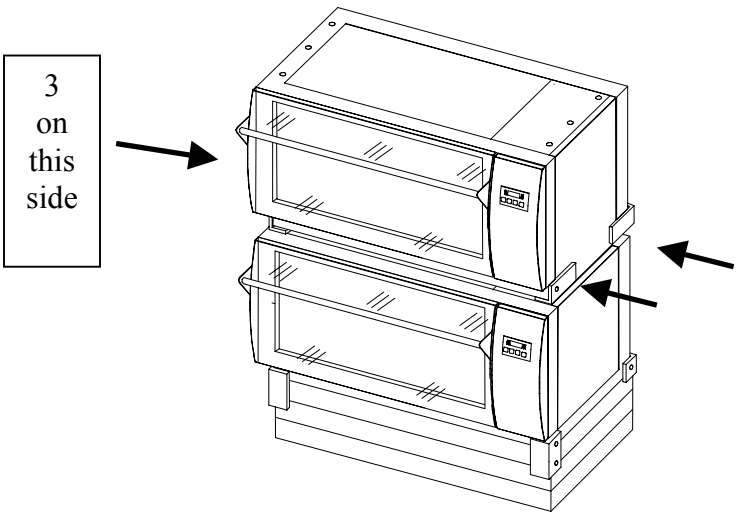
Figure 8: Installing Stacking Kit Brackets



4.6 Stacking the Innova 4400

1. Using a forklift or lifter, raise the Innova 4400 to be stacked so that its back end is tilted toward the rear of the mounting brackets.
2. Remove the feet from the unit. They will not be needed for stacking, but you may want to keep them for future use.
3. With two assistants, each holding the unit on one side, lower the Shaker onto the mounting brackets, rear panel first. Slowly and gently remove the forklift or lifter and lower the front of the unit onto the mounting brackets by hand.

Figure 9: Stacked Shakers



4. As indicated in the above drawing, secure the bottom of the upper Innova 4400 to the mounting brackets with the five sets of 10-24 x ½-inch screws, lock washers and washers provided.

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5. As before, make sure the Shakers are level; add metal shims under the base if needed.
6. Fully load the shaker and do a test run at normal speed. Make additional leveling adjustments if necessary.

4.7 Stacking a Third Innova 4400



CAUTION!
When stacking 3 shakers, it is imperative that all shaker loads be balanced. These shakers operate best at maximum speed with a load of 34 (±3) lbs/15.5 (± 1.4) kg, which includes all platforms, clamps, and filled glassware.



CAUTION!
For 3 stacked 2-inch stroke shakers, maximum operating speed must be limited to 250 rpm.

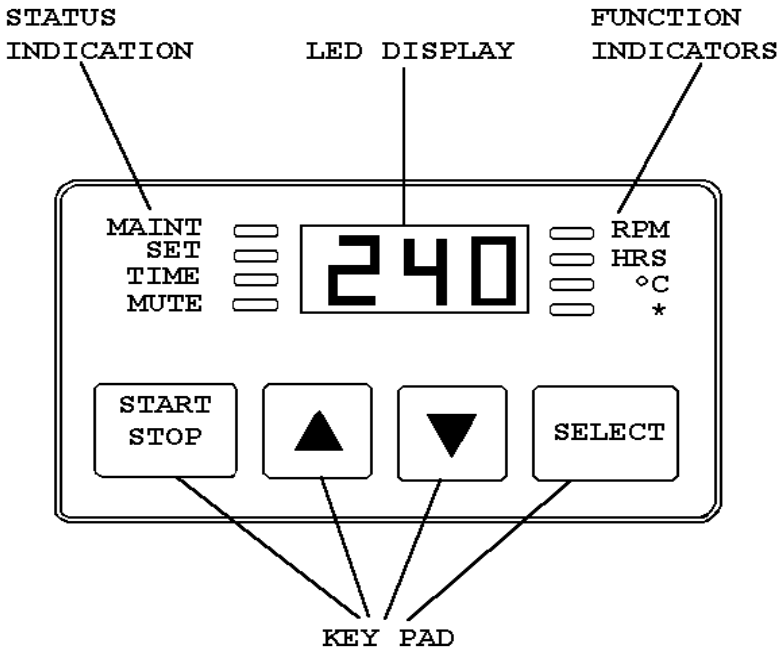
To stack a third Shaker, repeat the procedures in sections 4.5 and 4.6 above to install the stacking kit, stack the Shaker, and level the entire assembly.

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5 FEATURES

5.1 Keypad

Figure 10: Keypad



5.2 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 (in a timed run)
- Door ("**LID**") open

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5.3 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.

5.4 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**, when 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 from0.1 to 99.9 hours. The timer can be disengaged without stopping an ongoing run.
- **MUTE** — Indicates the status of the audible alarm. When illuminated, the audible alarm is disabled.

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5.5 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 (in a timed run)
- **°C** interior chamber temperature
- ★ not applicable on these models

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6 GETTING STARTED

6.1 Platform Assemblies

The Innova 4400 can be used with a wide variety of NBS 18-inch X 30-inch (46 X 76 cm) *bolt-on type* or 16.5-inch x 33-inch (42 x 85 cm) *easy lift-out type** platforms which will accept a variety of clamps for flasks, test tubes, etc. A platform is a separate item, not included with the Shaker assembly, which is required for operation. Refer to Section **Error! Reference source not found.** of this manual for details.

* Easy lift-out platforms require a Quick Release Platform Base (P/N M1249-0200)

An optional Slide-Out Accessory is available for use with a Quick Release platform base and a lift-out platform, to allow you to extend the platform in front of the shaker for easy access to all flasks. Refer to Section 10.3.3 of this manual for details.

6.2 Installation of Platform

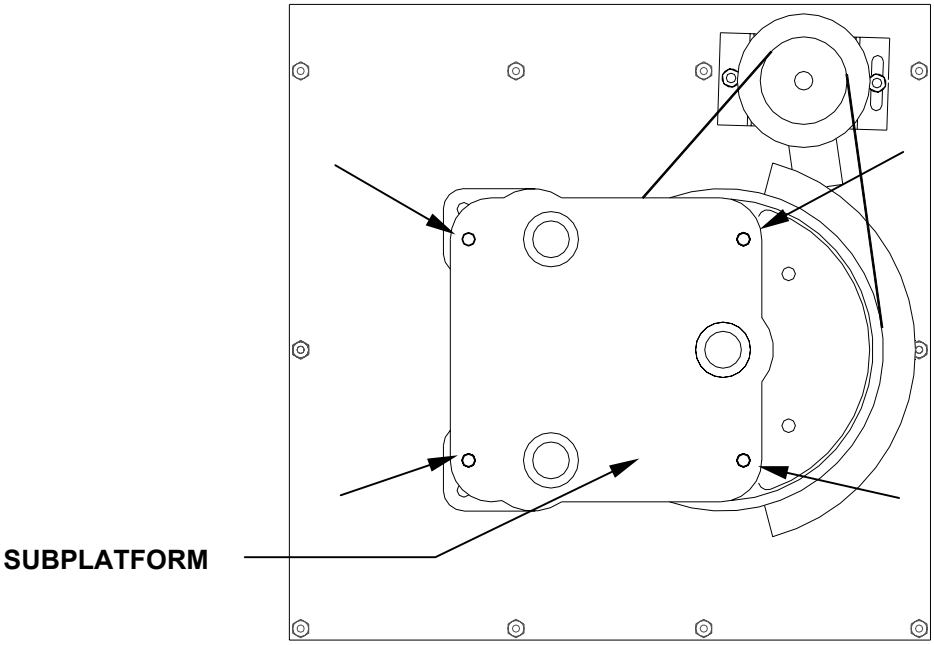
NOTE:

There are two small plastic straps that hold the bearing housing in place for shipping. The straps must be removed from the unit.

Prior to use, a platform must be installed on the unit. The unit is shipped with four Allen head PLATFORM SCREWS installed in the SUBPLATFORM of the BEARING HOUSING. These screws must be removed and set aside for use before a platform can be installed. (See diagram below.)

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Figure 11: Platform Screw Locations



1. Using the 7/32-inch hex wrench provided, remove the four Allen head platform screws from the subplatform. Set them aside.
2. Place the selected PLATFORM on the subplatform. Align the mounting holes of the platform with the platform screw locations in the subplatform.
3. Insert the four Allen head platform screws previously removed and set aside. Tighten them with the 7/32-inch hex wrench provided to secure the platform.

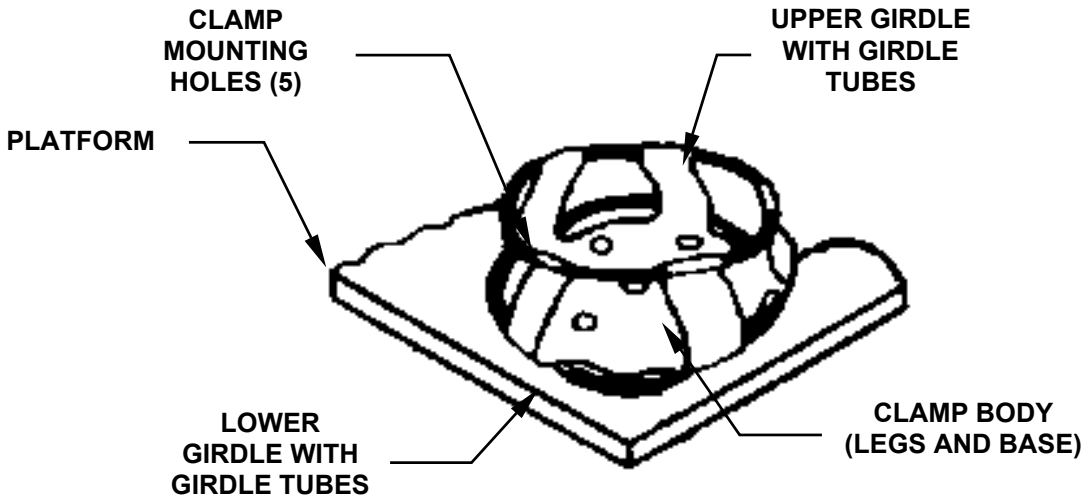
6.3 Installation of Clamps

Flask clamps purchased for use with universal platforms require installation. Clamps are installed by securing the base of the clamp to the platform with the correct type and number of screws (refer to Clamp Hardware Application Charts in Section 10 of this manual). All clamps are shipped complete with hardware. Clamps for 2- to 6-liter flasks are shipped with an additional girdle to keep the flasks in place. To install 2- to 6-liter clamps, perform the following steps:

1. Place clamp on platform, secure in place with correct type of screws (refer to Clamp Hardware Application Charts, Section 10).
2. Place the loose girdle around the upper portion of clamp body so that it is held in place by the legs of the clamp.
3. Insert the flask into the clamp.

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Figure 12: 2- to 6-Liter Clamp Installation



NOTE:

The above drawing is also applicable to 2800 ml Fernbach Flask Clamp.

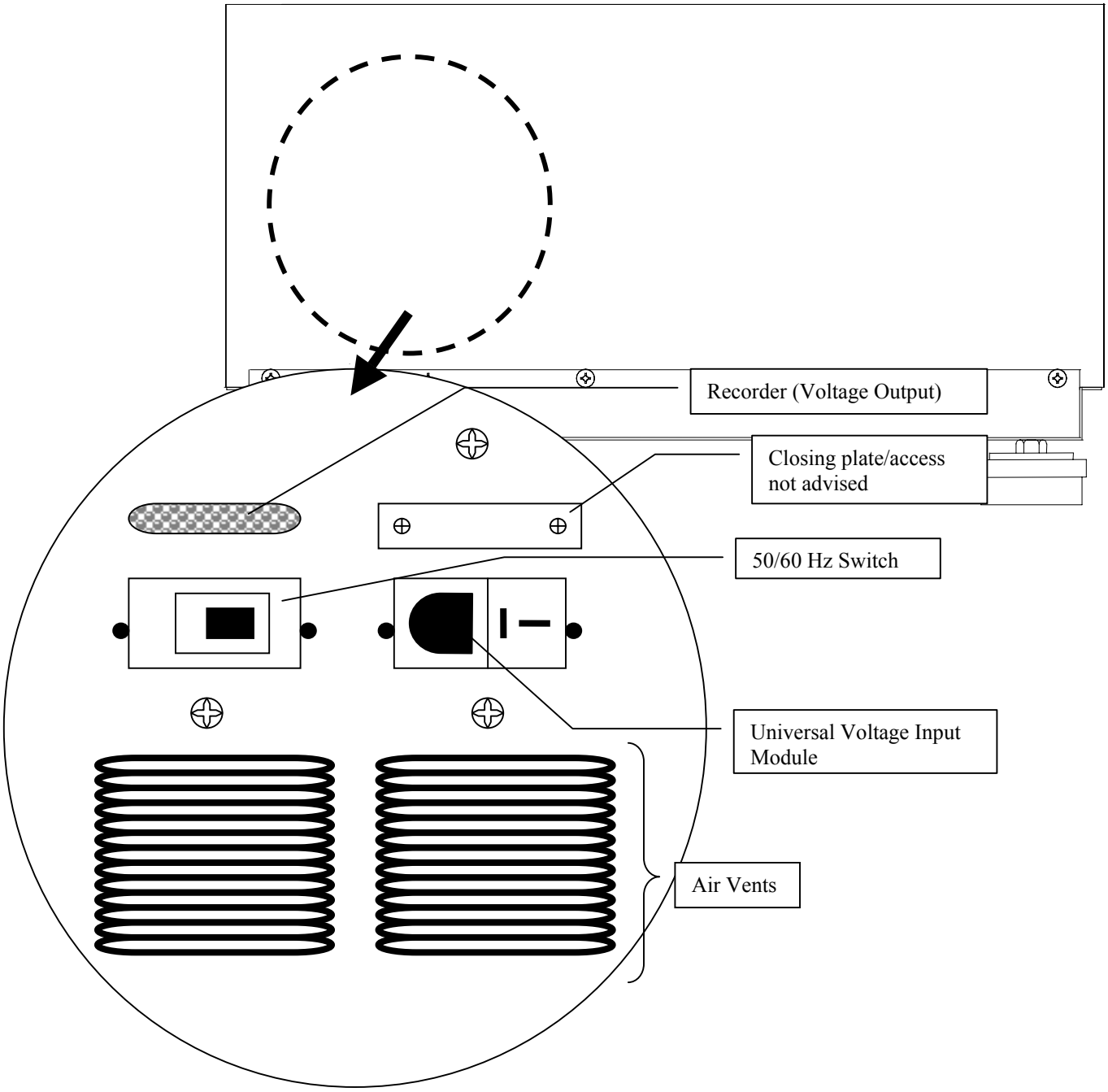
NBS flask clamps are used on a variety of Shaker platforms. Flat head screws of different lengths and thread pitch are used to secure the clamps. Should you require additional screws to attach the clamps, refer to the Clamp Hardware Application Charts in Section 10 to identify the proper screw for your Shaker by reference to the head style.

6.4 Electrical Connections

Before making electrical connections, verify that the power source voltage matches the voltage on the **ELECTRICAL SPECIFICATION PLATE** and that the **ON/OFF SWITCH** is on the **OFF** position. The **ELECTRICAL SPECIFICATION PLATE** is located on the rear panel of the unit near the **POWER CONNECTOR**. Connect the **POWER CORD** to the **POWER CONNECTOR** (Universal Voltage Input Module), then connect the other end to a suitable, grounded receptacle.

Figure 13: Rear Panel

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6.5 Optional Gassing Port Kit

On the rear panel of the Innova 4400, there is a plugged hole above the **POWER CONNECTOR**. This is an access port for the optional Gassing Port Kit, which is available from your NBS sales representative. The inlet port reserved for this use is located on the inside right wall of the chamber. This port is also plugged.

Installation and operation instructions are provided with the optional Gassing Port Kit.

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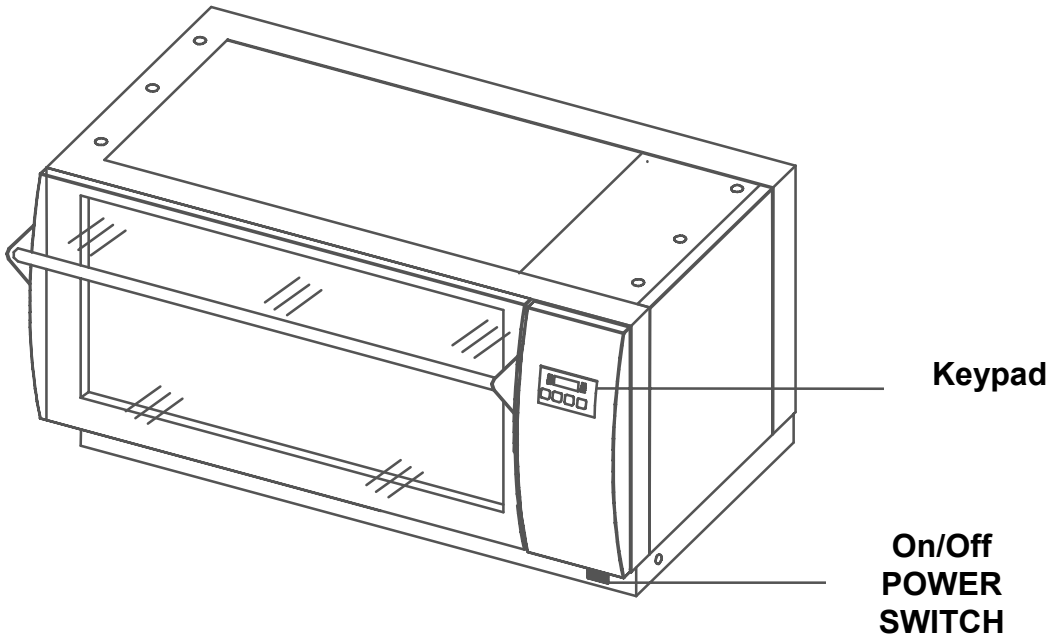
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7 OPERATION

7.1 Starting the Shaker

To initially start the Shaker, close the door and turn the **ON/OFF SWITCH** on the front panel of Shaker to the **ON** position. When 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 started or stopped by pressing the **START/STOP KEY** on the **KEY PAD**.

Figure 14: Front Panel



NOTE:

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

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7.2 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 ▲ (UP) or ▼ (DOWN) 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. Continued pressure on 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 above. During speed changes, a visual alarm (flashing RPM INDICATOR) will flash and an audible alarm will sound until the speed returns to within 5 rpm of the setpoint.

7.3 Checking Any Setpoint

1. Press SELECT until the desired indicator is illuminated.
2. Briefly press either the ▲ 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.

7.4 Timed Functions

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

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 the desired run time, between 0.1 and 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

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duration of the run. At the end of the timed run the display will read OFF, the TIME INDICATOR will flash and the audible alarm will beep.

To disable the visual 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 above, then immediately press the **START/STOP KEY**. The **TIME INDICATOR** will cease to flash and the display will read **OFF**.

7.5 Alarm Functions

The Innova 4400 Shakers have an audible alarm which is activated at predetermined times. It may be deactivated in the following way:

1. Press SELECT until the HRS INDICATOR is illuminated, **AND**
2. **Simultaneously** press the ▲ and ▼ KEYS. The SET and MAINT INDICATORS will flash.
3. While the SET and MAINT INDICATORS are flashing, press the START/STOP KEY. The MUTE INDICATOR will illuminate.

To reactivate the alarm, repeat steps 1-3.

7.6 Temperature Setpoint

Press the **SELECT KEY** until the function **°C INDICATOR** illuminates. The temperature can be set from 5°C above the current ambient temperature up to 80°C. Increasing or decreasing the setpoint is accomplished with the ▲ or ▼ **KEYS**.

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

If desired, the temperature control system may be shut off during set-up for special investigations. Perform the following steps:

1. To deactivate the temperature control system, press and hold the ▼ KEY until the setpoint is at 4.0°C.
2. Holding the ▼ KEY, press the START / STOP KEY.
3. The temperature setpoint display shows OFF and the heater will be deactivated.

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To reactivate the temperature controller, press the ▲ KEY until the desired temperature setpoint is displayed.

7.7 Temperature Offset Calibration

The temperature probe and the temperature controller are calibrated together at the factory. The temperature probe measures the temperature of the air at the probe's location, near the heat exchanger return vent. The controller uses the probe input to adjust air temperature, up or down, to match the temperature setpoint.

Depending on various conditions within the chamber, such as flask placement and size, the heat produced by growing organisms, heat losses due to liquid evaporation from flasks, etc., the display temperature may differ from temperatures within the flasks themselves.

If you wish to have the temperature display ("Indicated Temperature") match the temperature at a given point, or match the average of a series of points within the chamber ("Actual Temperature"), proceed as follows:

1. Let the unit equilibrate at or near the desired temperature. Record the Indicated Temperature.
2. Record the Actual Temperature.
3. Calculate the temperature correction value: Actual Temperature – Indicated Temperature = Temperature Correction Value.
4. Press the **SELECT KEY** until the function **°C INDICATOR** illuminates.
5. Simultaneously press the ▲ and ▼ KEYS. The **SET** and **MAINT INDICATORS** will light.
6. While the **SET** and **MAINT INDICATORS** are illuminated, use the ▲ or ▼ KEY to set the display to the calculated Temperature Correction Value.

NOTE:

The °C light will pulse rapidly for a short duration to indicate it is not operating in the factory default mode. It will pulse for a longer duration and less rapidly (with a frequency of approximately one second) to indicate temperature is more than one degree above or below setpoint.

To return to the factory calibration:

1. Press the **SELECT KEY** until the function **°C INDICATOR** illuminates.
2. Simultaneously press the ▲ and ▼ KEYS. The **SET** and **MAINT INDICATORS** will light.
3. While the **SET** and **MAINT INDICATORS** are illuminated, press the START / STOP KEY.

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7.8 Total Running Time

The control modules of the Innova 4400 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.

7.9 Maint [Maintenance] Indicator

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

To deactivate the **MAINT INDICATOR**, perform the following steps:

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

7.10 Power Failure

In the event of a power failure, the Innova 4400 Shakers are 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 stop the flashing of the **LED** display.

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8 PREVENTIVE MAINTENANCE



WARNING!
When performing maintenance on the unit, always turn off the shaker and disconnect the power cord from the power supply.

8.1 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. To avoid abrasion, we recommend the use of NBS door/lid polish (P0860-0949).

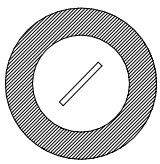
8.2 Fuse Replacement

The Innova 4400 requires three electrical fuses. They are housed in the three fuse holders located on front panel of the unit, in the lower right-hand corner, below the model nameplate (*see Figure 1*).

To check or replace the fuse, perform the following steps:

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 groove and turn counter-clockwise until it disengages and the fuse holder springs free.

Figure 15: Fuse Holder Detail



3. Check the fuse. If it has failed, replace the fuse.

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8.3 Belt Replacement

To replace the drive belt in the Innova 4400 Shaker, the following hardware is required:

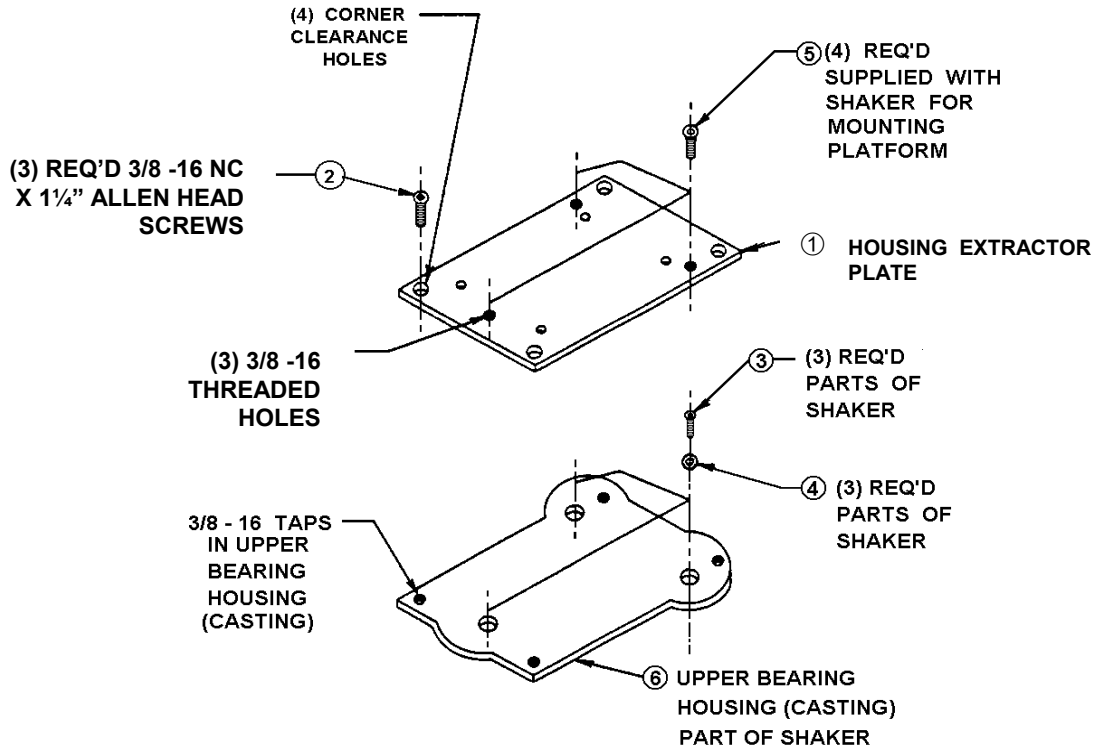
Part Description	Quantity	NBS Part Number
Housing Extractor Plate	1	M1191-9300
3/8-16 NC x 1 ¼" long flat head Allen screw	3	S1127-3206

Please contact your local NBS Sales Order Department to obtain these items.

To replace the drive belt, perform the following, according to the diagram below:

1. Thread the three 1 ¼-inch long Allen head screws ② into the three threaded holes in the housing extractor plate ① until they are flush to the back of the plate.
2. Remove the platform from the Shaker by unscrewing the four 3/8-inch flat head screws ⑤. Set the screws aside.

Figure 16: Extractor Plate & Bearing Housing, Exploded View



3. Using the small Allen key provided, remove the three ¼-inch- 20 x ½-inch long flat head Allen screws ③ that hold the bearings in place on the upper housing. Also remove the three countersunk washers ④.
4. Orient the extractor plate ① on the upper bearing housing ⑥ so that the three 3/8-inch screws ② are set in the center of the three bearings.

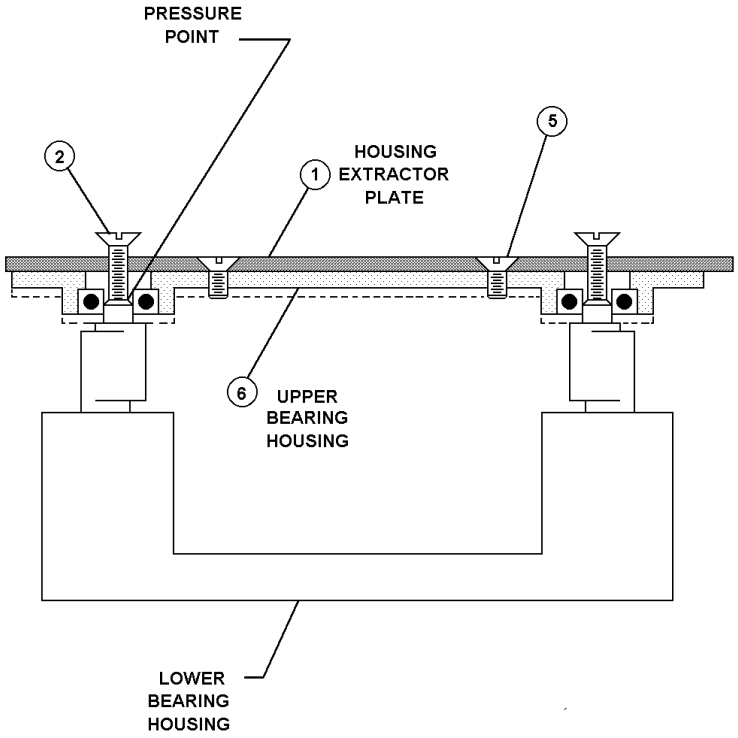
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5. Utilizing the four platform screws ⑤ (set aside in step 2), mount the extractor plate ① to the upper housing. Use the large Allen key provided to tighten the four screws securely.
6. Using the large Allen key on the three 3/8-inch screws ②, turn each screw one half turn in sequence until the upper bearing housing ⑥ is lifted free of the eccentric shafts. Remove the four platform screws ⑤, thus disconnecting the extractor plate ① from the upper bearing housing ⑥.
7. Remove the old belt by rotating the pulley slowly.
8. Install a new belt. Slip the new belt over the main eccentric shaft (the shaft with the counterweight—see diagram on page 50).
9. Position the three eccentric shafts so that they all face in the same direction.
10. Using a soft mallet or the back end of a wooden hammer handle, lightly tap the upper housing near the three bearings until there is even engagement of the bearings onto the shafts.



CAUTION!
Do not use metal to tap the casting.

Figure 17: Extractor Plate and Bearing Housing, Side View



11. Place the three washers ④, with countersink face up, onto each of the bearings.

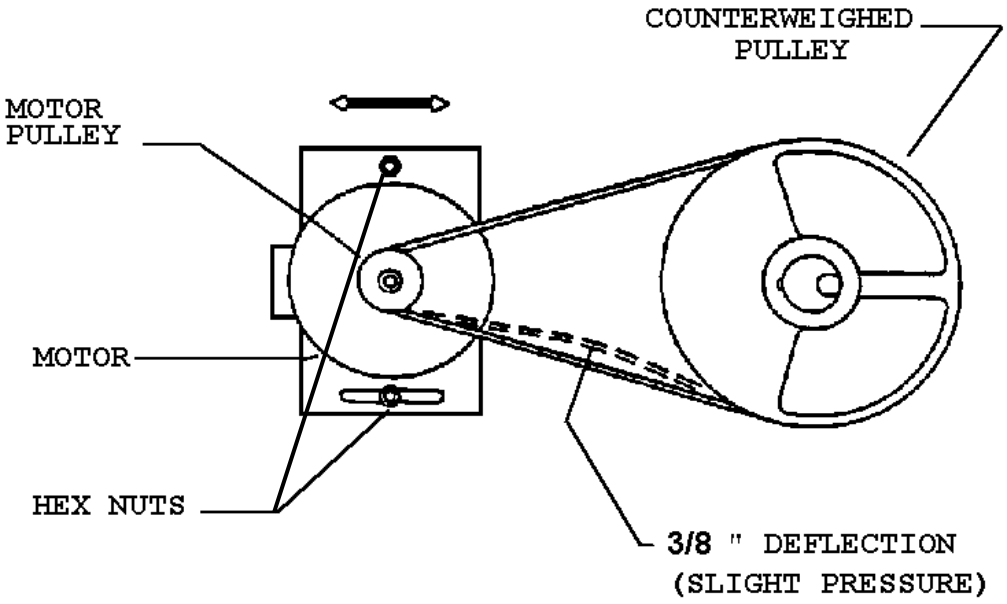
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12. Reposition the three ¼ - 20 x ½-inch long flat head Allen screws ③ through the washers and engage the eccentric shaft threads. Tighten evenly by half turns in sequence, making sure each bearing is fully seated on the shaft.
13. Guide the belt onto the two pulley grooves. Check the belt adjustment by applying finger pressure to the belt midway between the two pulleys. The belt should deflect approximately 3/8-inch (9.5 mm).

If an adjustment is required:

1. Loosen the two hex nuts on the motor assembly.
2. Move the motor assembly until the belt is tight.

Figure 18: Belt Replacement & Adjustment



3. Tighten the hex nuts and recheck the belt tension by exerting pressure on the belt. The belt should deflect approximately 3/8-inch (9.5 mm).
4. Reinstall the platform and secure it by performing the removal operation in reverse order (steps 6 through 1).

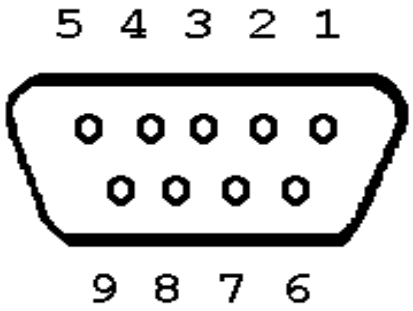
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9 RECORDER ADAPTATION

To record speed and temperature, a recorder (not supplied) can be used. The recorder must have the following capabilities:

- For speed and temperature, two channels are required. Each channel should have signal conditioning which accepts 0 to 5 volt input.
- The **pin out diagram** below and the **corresponding scale** identify the application:

Figure 19: Recorder Connector



Note: As seen from back of unit.

PIN #	SIGNAL NAME	SCALE
6 2	SPEED GROUND	1V = 100 RPM
7 3	TEMPERATURE GROUND	IV = 20° C

- A mating connector is required on the recorder cable (not supplied). This is a 9-pin male D subminiature connector: AMP Amplimite HDP-20 series or equivalent.

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10 SERVICE

10.1 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**, located on the rear panel of the unit, above the **POWER CONNECTOR**. The Serial Number is also labeled in the lower right corner of the front panel, below the chamber door seal.

10.2 Replacement Parts

When ordering replacement parts, or requesting service information, please provide the Model Number and Serial Number of your Shaker. This information is on the **ELECTRICAL SPECIFICATION PLATE**, located on the rear panel of the unit. The Serial Number is also labeled in the lower right corner of the front panel, below the chamber door seal.

Part Description	Qty. Req'd.	NBS Part Number
0.16A Fuse (Control Voltage)	1	P0380-3710
1.6A Fuse (Motor CKT)	1	P0380-3532
10 VA Transformer	1	P0420-1610
130 VA Transformer	1	M1191-5300
21000 μF Capacitor	1	P0320-0350
Diode Bridge	1	P0460-4091
130V Varistor	2	P0360-4040
Large Motor Assembly	1	M1191-4000
Main Control Board Kit	1	M1246-9940
Temperature Control Board	1	M1192-7000
Membrane Switch Panel	1	M1190-5000
15A Circuit Breaker	1	P0400-4305
10A Solid State Relay	1	P0400-3011
45A Relay	1	P0400-3151
450 Watt Heater	2	P0620-1381
RTD Assembly	1	M1195-8001
120V 15A Power Cord	1	P0720-2024
220V Power Cord	1	P0720-2021
Bearing, Upper Housing	3	B-162
Bearing, Shielded	6	P0180-0282
V-Belt	1	R-334

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Part Description	Qty. Req'd.	NBS Part Number
Bearing Housing Assembly	1	M1243-6330
Gasket, Door	1	M1243-9504
Switch, Proximity Reed	1	P0400-1532
Magnet Actuator	1	P0400-1537
6-inch Fan (Evaporator)	1	P0620-2561
Gas Springs	2	P0640-0383
6.25A Fuse	1	EF-118
Fuse Drawer	1	P0380-6640
1 kVA Transformer	1	P0420-1670
AC Connector, Power Entry	1	P0460-2205
Temperature Controller	1	P0460-7150
Temperature Sensor Probe	1	P0720-6290
50/60 Cycle Switch	1	P0400-1000

Belt Replacement Hardware:

Part Description	Qty. Req'd.	NBS Part Number
Housing Extractor Plate	1	M1191-9300
3/8-16 NC x 1 ¼-inch long flat head Allen screw	3	S1127-3206

10.3 Accessories

When ordering accessories, please provide the Model Number and Serial Number of your Shaker. This information is on the **ELECTRICAL SPECIFICATION PLATE**, located on the rear panel of the unit. The Serial Number is also labeled in the lower right corner of the front panel, below the chamber door seal.

10.3.1 Bolt-On Platforms

Dedicated Bolt-on Style Platforms, 18 inches x 30 inches (46 x 76 cm), according to flask size and capacity:

Application	Capacity	NBS Part Number
50 ml Erlenmeyer Flasks	108	M1191-9908
125 ml Erlenmeyer Flasks	60	M1191-9909
250 ml Erlenmeyer Flasks	40	M1191-9910
500 ml Erlenmeyer Flasks	24	M1191-9911
1 L Erlenmeyer Flasks	15	AG-1
2 L Erlenmeyer Flasks	12	AG-2
2.8 L Erlenmeyer Flasks	6	AG-28
4 L Erlenmeyer Flasks	6	AG-4

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For *Universal Bolt-On Style* Platform (P/N M1250-9900), 18 inches x 30 inches (46 x 76 cm), following is a list of Flask Capacities:

Flask Type	*Capacity**
50 ml Erlenmeyer Flasks	91 ea.
125 ml Erlenmeyer Flasks	39 ea.
250 ml Erlenmeyer Flasks	30 ea.
500 ml Erlenmeyer Flasks	18 ea.
1 L Erlenmeyer Flasks	12 ea.
2 L Erlenmeyer Flasks	8 ea.
2.8 L Erlenmeyer Flasks	6 ea.
4 L Erlenmeyer Flasks	6 ea.

*Clamps for Universal Platform are sold separately

10.3.2 Lift-Out Platforms

Dedicated Lift-Out Style Platforms, 16.5 inches x 33.5 (42 x 85 cm), according to flask size and capacity:

Accessory Description	*Capacity*	*NBS Part Number*
125 ml Erlenmeyer Flasks	72	M1249-0131
250 ml Erlenmeyer Flasks	48	M1249-0132
500 ml Erlenmeyer Flasks	31	M1249-0133
1 L Erlenmeyer Flasks	18	M1249-0134
2 L Erlenmeyer Flasks	11	M1249-0135
2.8 L Erlenmeyer Flasks	6	M1249-0136
4 L Erlenmeyer Flasks	6	M1249-0137

NOTE:

All Lift-Out Style Platforms require an optional Quick Release Base (P/N M1249-0200).

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For *Universal Lift-Out Style* Platform, 16.5 inches x 33.5 (42 x 85 cm), following is a list of Flask Capacities:

Accessory Description	*Capacity**
125 ml Erlenmeyer Flasks	45
250 ml Erlenmeyer Flasks	32
500 ml Erlenmeyer Flasks	21
1 L Erlenmeyer Flasks	14
2 L Erlenmeyer Flasks	8
2.8 L Erlenmeyer Flasks	5
4 L Erlenmeyer Flasks	5

*Clamps for Universal Platforms are sold separately

NOTE:

All Lift-Out Style Platforms require an optional Quick Release Base (P/N M1249-0200).

10.3.3 Slide-Out Platform Accessory

The Slide-Out Platform Accessory allows you to extend the platform in front of the shaker for easy access to all flasks. It requires a Quick-Release Base (P/N M1249-0200) and one Lift-Out Platform. The following table includes the 16½-inch x 33½-inch platforms that can be used with this accessory.

Description	*Part Number*
Slide-Out Accessory with Quick-Release Base	M1243-2520
Slide-Out Accessory alone (to retrofit an existing lift-out platform & quick-release base)	M1243-2510
Universal Platform (not for Sticky Matt)	M1249-0130
Universal Platform for Sticky Matt & clamps, 1-inch stroke	M1249-0139
Universal Platform for Sticky Matt & clamps, 2-inch stroke*	M1249-9441
125 mL Erlenmeyer flask Dedicated Platform	M1249-0131
250 mL Erlenmeyer flask Dedicated Platform	M1249-0132
500 mL Erlenmeyer flask Dedicated Platform	M1249-0133
1L Erlenmeyer flask Dedicated Platform	M1249-0134
2L Erlenmeyer flask Dedicated Platform	M1249-0135
2.8L Fernbach flask Dedicated Platform	M1249-0136
4L Erlenmeyer flask Dedicated Platform	M1249-0137

*2-inch orbit platform dimensions: 15¾ inches x 32 inches

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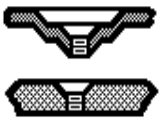
10.3.4 Flask Clamps for Universal Platforms:

Clamp Size	*Part Number*
10 ml Erlenmeyer Flask	ACE-10S
25 ml Erlenmeyer Flask	M1190-9004
50 ml Erlenmeyer Flask	M1190-9000
125 ml Erlenmeyer Flask	M1190-9001
250 ml Erlenmeyer Flask	M1190-9002
500 ml Erlenmeyer Flask	M1190-9003
1 L Erlenmeyer Flask	ACE-1000S
2 L Erlenmeyer Flask	ACE-2000S
2.8 L Fernbach Flask	ACSB-2800S
4 L Erlenmeyer Flask	ACE-4000S

10.3.5 Replacement Clamp Hardware Kits

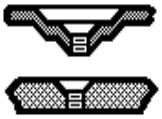
NBS Flask Clamps come complete with the proper hardware kits. However, from time to time you may want to obtain some additional Hardware Kits. The following tables below identify the proper screws for your Shaker application by reference to the head style.

(a) Hardware for 10 ml to 500 ml Clamps:

Description	*Part Number*	*Qty.*	*Application*
 **10-24 x 5/8 (15.87 mm) flat Phillips (+) head screw**	**S2116-3101**	**1**	**3/4" (19.05 mm) thick wood platform** 
 **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.** 
 **10-32 x 5/16 (7.9 mm) flat slotted (-) head screw**	**S2117-3050**	**1**	**all stainless steel platforms** 

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(b) Hardware for 1-Liter to 6-Liter Clamps:

Description	Part Number	Qty.	Application
10-24 x 5/8 (15.87 mm) flat Phillips (+) head screw	S2116-3101	5	3/4" (19.05 mm) thick wood platform 
10-24 x 5/16 (7.9 mm) flat Phillips (+) head screw	S2116-3051	5	5/16" (7.9 mm) thick aluminum, phenolic and stainless steel platforms. 
10-32 x 5/16 (7.9 mm) flat slotted (-) head screw	S2117-3050	5	all stainless steel platforms 

NOTE:

The above chart is also applicable to 2800 ml Fernbach Flask Clamps

10.3.6 Carriers and Test Tubes

Accessory Description	NBS Part Number
Utility Tray with rubber mat for shaking 96 well plates, petri dishes and other labware at low speeds.	AG-00
Angled Test Tube Rack Spacer Bar* for use with TTR-210 to accommodate test tubes racks that are less than 5 in. (13 mm) wide.	TTR-215
Angled Test Tube Rack Holder* for user-supplied test tube racks that are 4-5 in. (10-13 mm) wide and up to 15 in. (38 mm) long. Capacity: 4 racks per platform.	TTR-210
Adjustable Angled Test Tube Rack* for (15) 17-25 mm test tubes. Total Capacity: 4 racks per platform (16 test tubes per platform)	TTR-199
30 mm (50 ml) Centrifuge Tube Rack* Capacity: 15 tubes per rack, 7 racks per platform	TTR-208
13 mm or smaller Test Tube Rack* Capacity: 48 tubes per rack, 7 racks per platform	TTR-111
13 mm or smaller Test Tube Rack* Capacity: 33 tubes per rack, 7 racks per platform	TTR-121
13 mm or smaller Test Tube Rack* Capacity: 21 tubes per rack, 7 racks per platform	TTR-122

* Universal Platform Required

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10.3.7 Optional Bases for Innova 4400

Description	*NBS Part Number*
Short Base, raises bottom unit 4 inches (10 cm)	M1243-0600
Medium Base, raises bottom unit 12 inches (30.5 cm)	M1243-0800
Tall Base, raises bottom unit 18 inches (46 cm)	M1243-0700

10.3.8 Stacking Kit for Innova 4400

Description	*NBS Part Number*
Stacking hardware (to stack two units)	M1243-0500

10.3.9 Cleaning Supplies

Description	*NBS Part Number*
Door/Lid Polishing Kit (polish & cloths)	P0860-0949

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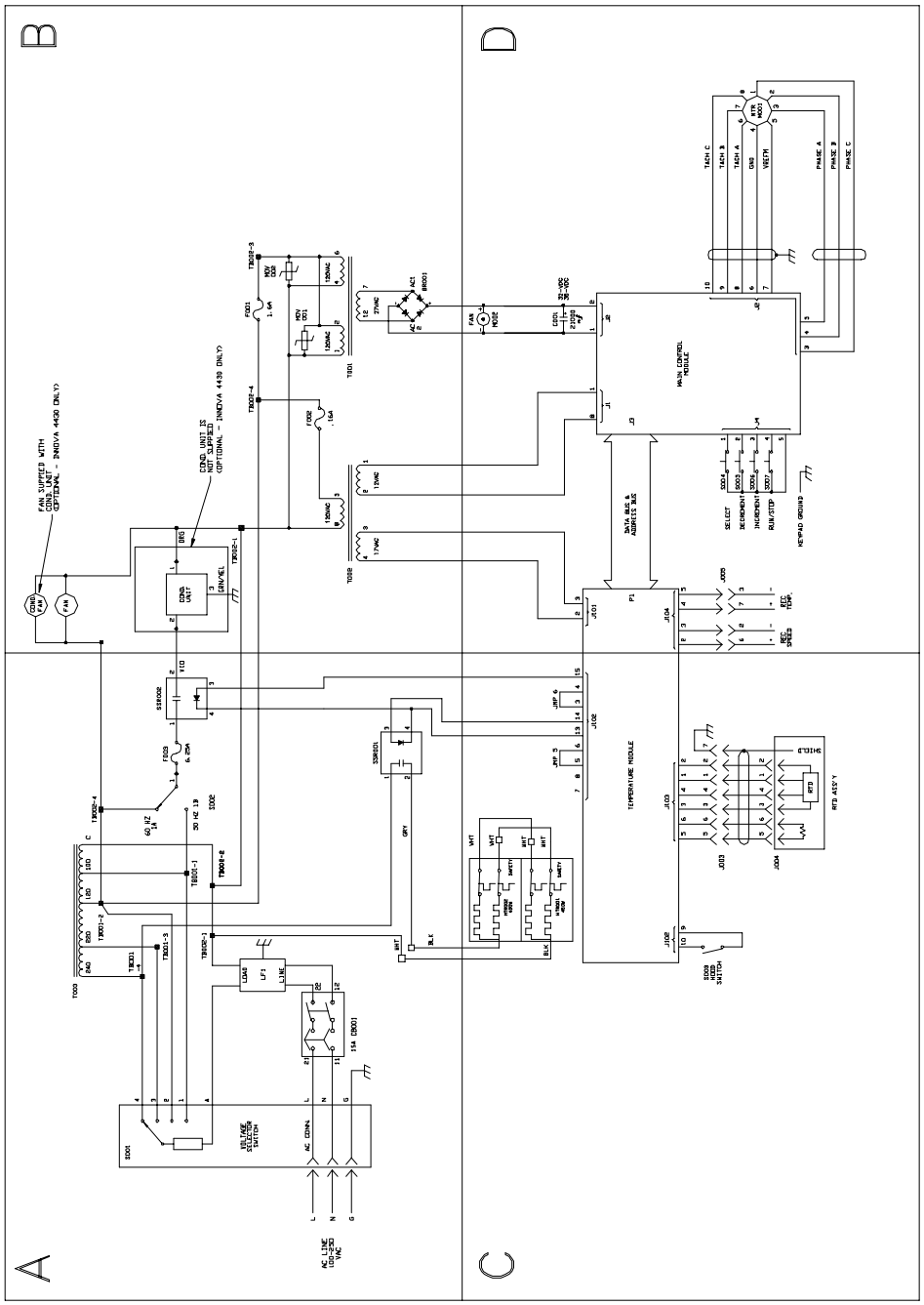
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11 DRAWINGS

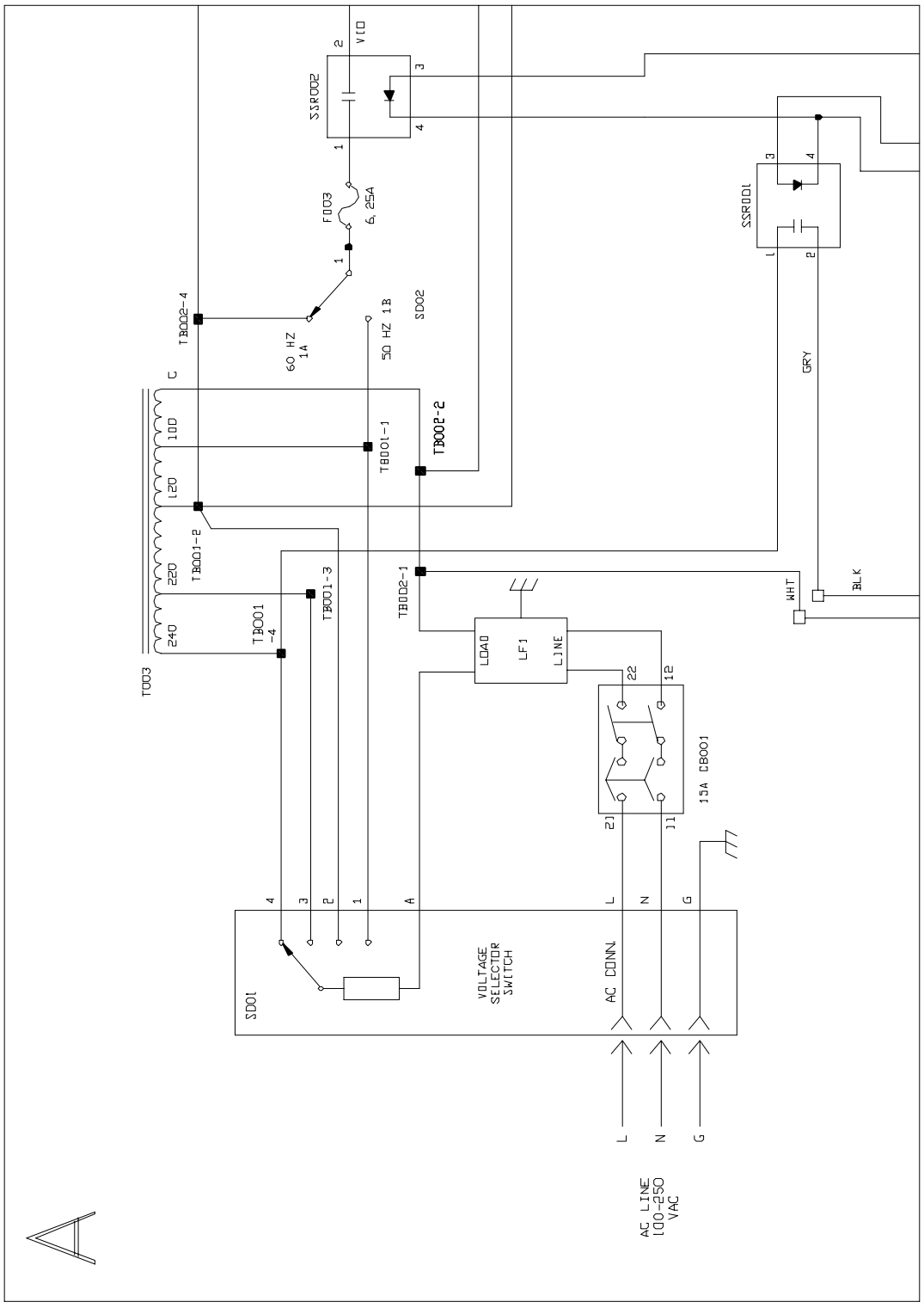
11.1 Control Schematics

Figure 20: Control Schematics, Overview



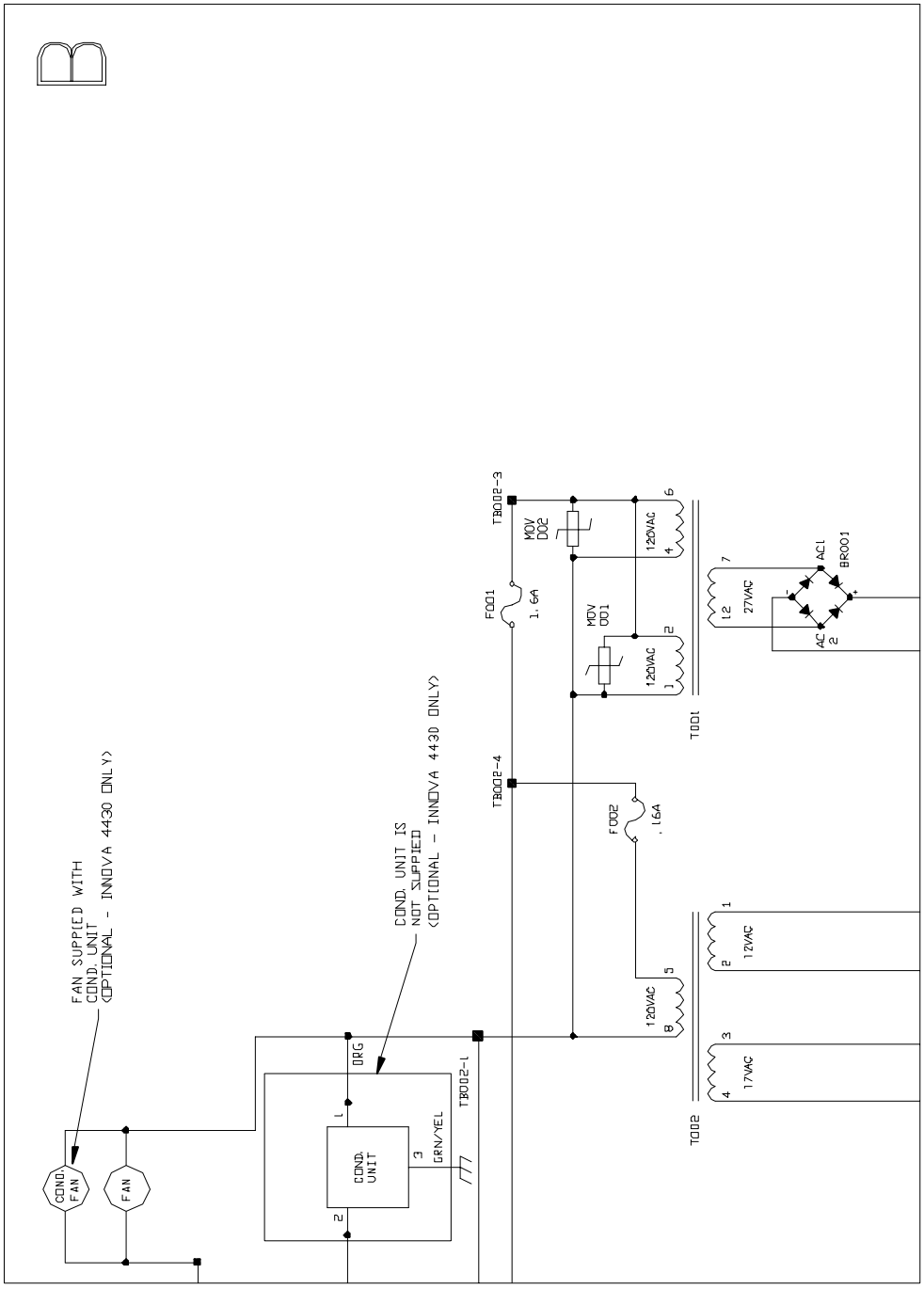
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Figure 21: Control Schematics, Quadrant A



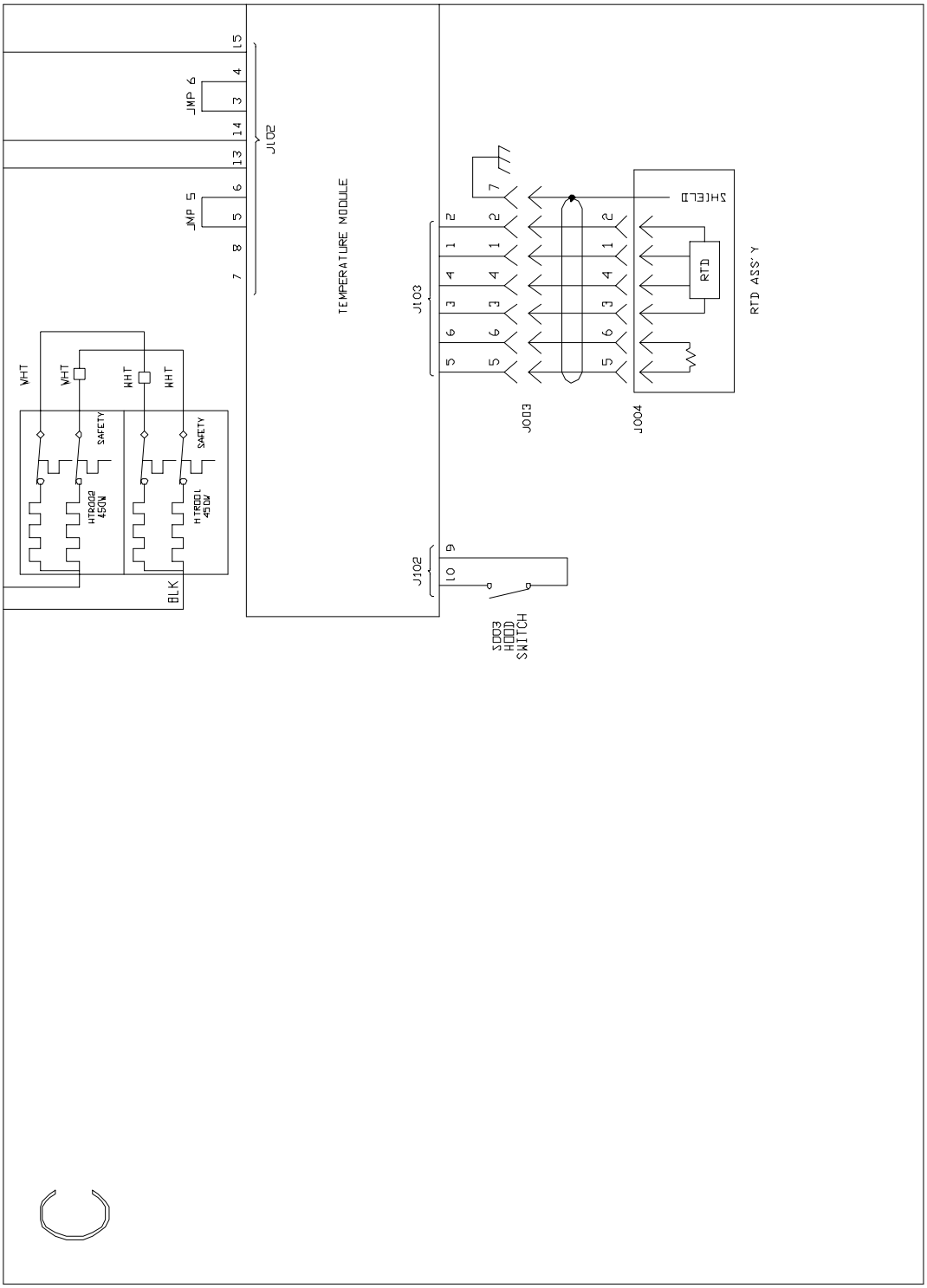
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Figure 22: Control Schematics, Quadrant B



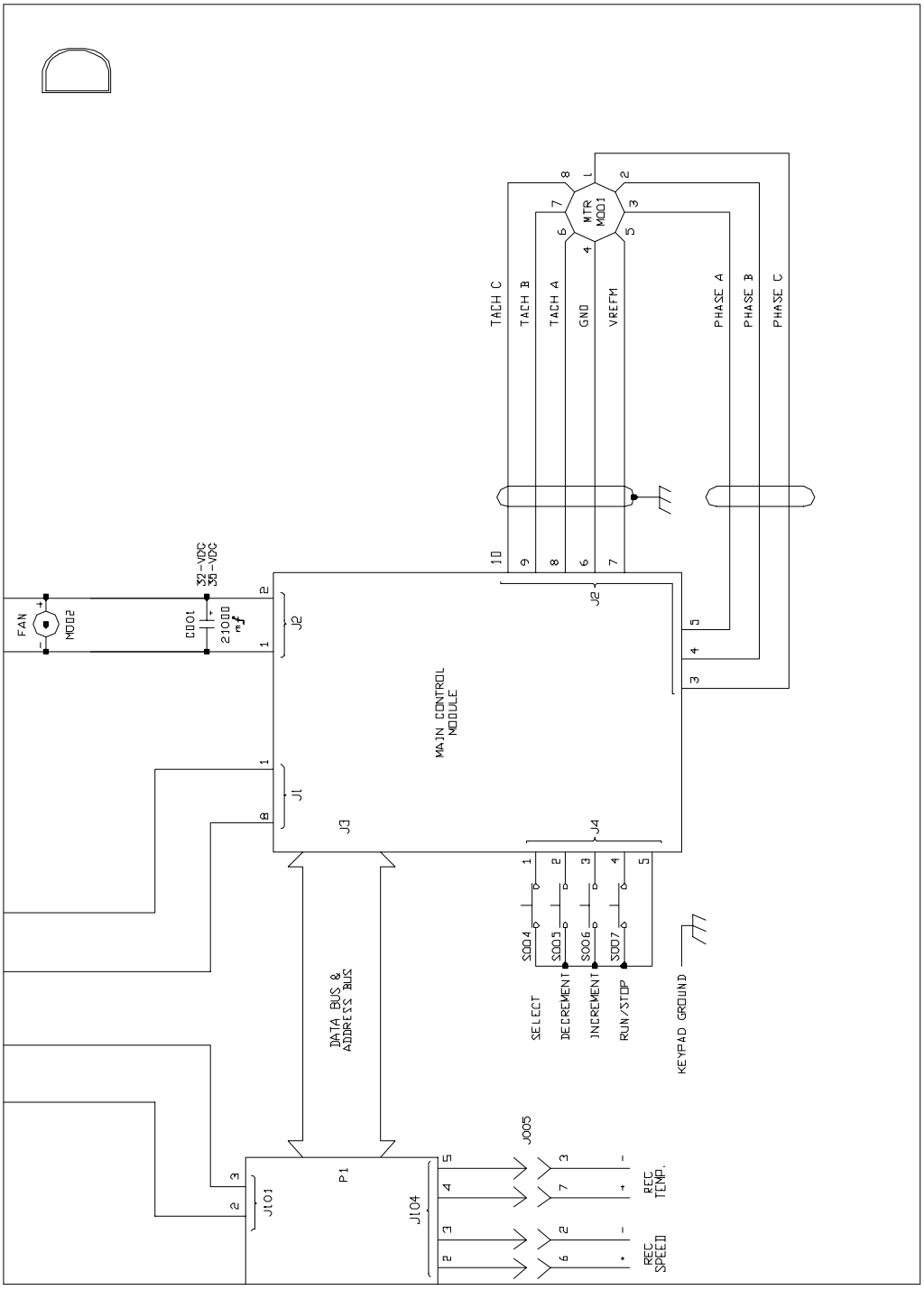
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Figure 23: Control Schematics, Quadrant C



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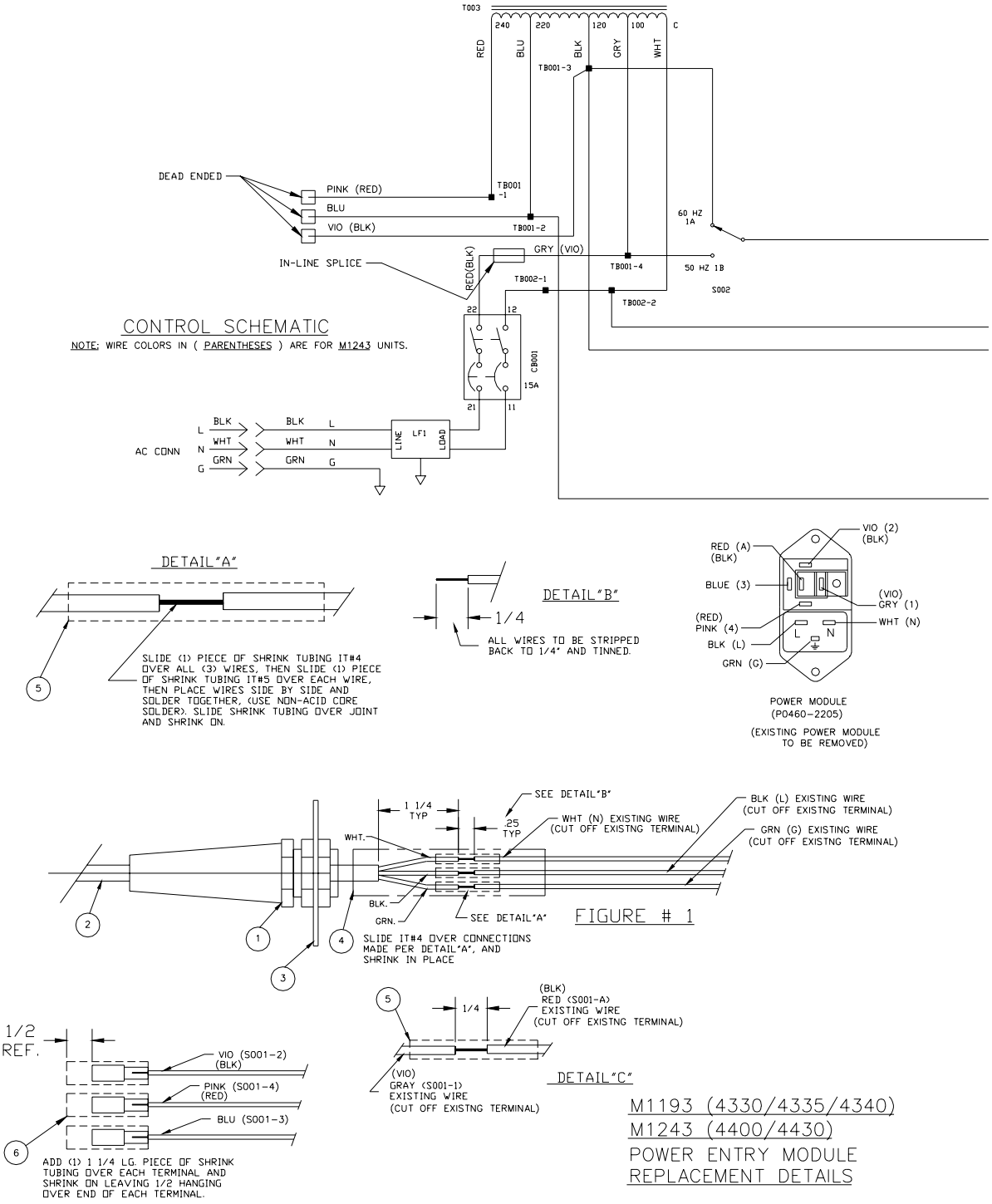
Figure 24: Control Schematics, Quadrant D



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11.2 100V Power Kit Schematic

Figure 25: 100V Power Kit Schematic



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11.3 List of Drawings

Figure	Description	Page
1	Front View	14
2	Adjustable Foot	21
3	Optional Base	22
4	Mounting Shaker on Base	23
5	Mounting Corner Braces	23
6	Shaker Installed on Base	24
7	Preparing to Stack Shakers	24
8	Installing Stacking Kit Brackets	25
9	Stacked Shakers	25
10	Keypad	27
11	Platform Screw Locations	32
12	2- to 6-Liter Clamp Installation	33
13	Rear Panel	34
14	Front Panel	37
15	Fuse Holder Detail	43
16	Extractor Plate & Bearing Housing, Exploded View	44
17	Extractor Plate & Bearing Housing, Side View	45
18	Belt Replacement & Adjustment	46
19	Recorder Connector	47
20	Control Schematics, Overview	57
21	Control Schematics, Quadrant A	58
22	Control Schematics, Quadrant B	59
23	Control Schematics, Quadrant C	60
24	Control Schematics, Quadrant D	61
25	100V Power Kit Schematic	62

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12 INDEX

1

100V Power Kit Schematic · 62

A

Accessories
  Descriptions and Part Numbers · 50, 51, 52, 54
Actual Temperature · 40
Alarm Functions · 39
Audible Alarm
  Disabling · 39

B

Belt Replacement · 44, 46

C

CAUTION
  Symbol for · vii
Checking Setpoints · 38
Clamps
  Installation · 33
Cleaning Supplies · 55
Continuous Run · 38
Control Schematics · 57, 58, 59, 61
Copyright Notice · vii

D

Disclaimer Notice · vii
Drawing Index · 63
Drawings
  List of · 63

E

Electrical Connections · 33
Environment · 19
Equipment
  Inspection Of · 17
  Unpacking Of · 17

F

Features
  Status Indicators · 28
Features
  Keypad · 27
Flask Capacities · 51
Flask Clamps · 53
Function Indicators · 29
Fuse
  Replacement · 43

I

Indicated Temperature · 40
Inspection
  Of Boxes · 17
Installation
  Platform Clamps · 33
  Platfrom · 31
International Offices
  List of · iii

K

Keypad
  Features · 27

L

LED Display · 27
Leveling
  Base (optional) · 22
  One shaker, no base · 21
  Shaker on base · 24
  Stacked shakers · 26
Lid Indication · 37

M

Maint Indicator
  Disabling · 41
Manual Conventions · vii

N

NOTE
  Symbol for · vii

O

Operation · 37
Overview · 13

P

Physical Location · 19

Artisan Scientific - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisan-scientific.com

Platform
Clamp Installation Chart · 33
Platform Assemblies · 31
Platfrom
Installation · 31
Power Failure · 41
Preventive Maintenance · 43

R

Replacement Parts
Belt Replacement Hardware · 50
Clamp Hardware Kits · 53, 54
Description & Part Numbers · 49
Descriptions & Part Numbers · 50

S

Slide-Out Platform Accessory · 31, 52
Stacking
Installing hardware kit · 24
Starting the Unit · 37
Status Indicators · 28

T

Temperature Comtrol
Disabling · 39
Temperature Correction Value · 40
Temperature Offset Calibration · 40
Temperature Setpoint · 39
Timed Functions · 38
Total Running Time · 41
Troubleshooting · 49

U

Unlimited Run · 38
User Interface Keys · 28

V

Visual Alarm
Disabling · 39

W

WARNING
Symbol for · vii
Warranty · ix

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