



L-K INDUSTRIES

Demand a higher standard.

BENCHMARK C MANUAL

Heated Laboratory Centrifuge



To set the standard for
MANUFACTURING QUALITY and customer
service in the **PETROLEUM TESTING** industry.

Petroleum Testing Equipment Suppliers Worldwide **Since 1930**



Since 1930 we have taken great pride in building high quality products and providing excellent customer service. Our original "Melton" centrifuge set the standard in 1957 and continues to inspire our product development today.

We look forward to continuing the rich traditions that have made us successful and to manufacturing the next generation of oilfield testing supplies.

Thank you for your business.

Sincerely,

Eric R. Calderon
President and CEO
L-K Industries



Certifications

This apparatus is certified for use in Class I, Division 2 Groups B, C, D, T3A or unclassified locations. It conforms and/or is certified to the requirements of CSA and ETL, as specified by OSHA, CCOHS and Standards Council of Canada. It also conforms to global safety requirements defined by UL.

The ETL Mark on the nameplate is a recognized demonstration of product compliance in the United States and Canada and is proof of verification by a NRTL testing organization. Please see the Specification section for applicable standards.

Limited Product Warranty

L-K Industries warrants its manufactured products against defects in materials and workmanship for a period limited to one year from the date of shipment. If purchased from a Distribution Partner, the warranty lasts one year from the in-service date. During the one-year warranty period, L-K Industries shall repair or replace defective equipment free of charge. L-K Industries shall only be liable for repairs or replacements if L-K is contacted immediately following discovery of defect(s).

Defective products (under warranty) shall only be returned after contacting and receiving permission from L-K Industries. The warranty does not extend to L-K Industries products that have been misused, neglected, independently modified (without L-K Industries' approval), improperly installed or accidentally damaged. L-K Industries shall not be liable for damage or loss resulting from use of L-K Industries products—separately or in combination with other equipment.

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Getting Started

Introduction and Safety Precautions

The Benchmark C Heated Laboratory Centrifuge is intended for use in Class I, Division 2 testing laboratories and refineries. It operates on 120/240VAC and comes completely assembled and ready for installation. Also included are a set of tubes, cushions, shields and collars (four each). Unpacking and lifting the centrifuge should always be done by at least two people. Retain the custom packaging materials for future shipping or storage.

The unit is equipped with a programmable digital temperature controller with an LCD display. The RTD meter, or temperature controller, is preset at 140°F (60°C). There is an encoder driven tachometer with an LCD display of the actual motor speed. Variable speed motor control is included with a preprogrammed acceleration/deceleration ramp to ensure smooth operation.

The programmable countdown timer is integrated with the motor controller – the countdown begins only upon reaching the designated speed for the test. Both the timer and the temperature controller settings are adjustable.

This centrifuge is designed to optimize operator safety and includes an automatic-locking door. Carefully following safety guidelines (i.e. OSHA) and knowing the limits of this unit will help prevent accidents.

The following guidelines can help prevent user error/injury and improve operation:

- ⚠ **REMOVE** all foreign objects from the centrifuge bowl.
- ⚠ Keep the sliding door **CLOSED**, especially while samples are spinning.
- ⚠ **NEVER** try to slow the trunnion arm down manually. Allow the trunnion arm to come to a complete stop before removing samples.
- ⚠ Turn all switches **OFF** when not in use.
- ⚠ **NEVER** leave the centrifuge unattended while it is turned on or operating.
- ⚠ **DISCONNECT** the power supply before removing or replacing electrical or mechanical parts.
- ⚠ **DO NOT** leave oily or solvent saturated rags in or around the unit.
- ⚠ **DO NOT** allow unauthorized persons to operate the centrifuge.
- ⚠ **BE AWARE** of surroundings. **DO NOT** operate the unit when fatigued or under the influence of medication, alcohol or illegal substances.
- ⚠ If a tube has broken inside of a shield, the cushion **MUST** be replaced.
- ⚠ Use **CAUTION** during heated operation, as the top of the unit is hot to the touch.



Getting Started

Specifications

Equipment Ratings

- Line input: 120/240 VAC, 700W, 50/60 Hz, 1Ø
- Maximum Temperature: Maximum of 212°F (100°C)
- Current Protection: 20-AMP fuse/circuit breaker

NOTE: See the Operation section to learn more about high temperature protection.

Environmental Ratings

- Indoor use only
- Altitude: 0-2000 meters
- Humidity Range: 80% RH max.
- Pollution Degree 2

Applicable Testing Standards

- ASTM D4007 (API MPMS Ch. 10.3): Standard Test Method for Water and Sediment in Crude Oil by the Centrifuge Method (Laboratory Procedure)
- ASTM D91: Standard Test Method for Precipitation Number of Lubricating Oils
- API MPMS Ch. 10.4 (withdrawn ASTM D96): Determination of Sediment and Water in Crude Oil by the Centrifuge Method (Field Procedure)
- ASTM D1796: Standard Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory Procedure)
- ASTM D2273: Standard Test Method for Trace Sediment in Lubricating Oils
- ASTM D2709: Standard Test Method for Water and Sediment in Middle Distillate Fuels by Centrifuge
- ASTM D893: Standard Test Method for Insolubles in Used Lubricating Oils

Applicable Safety Standards

- UL 61010-1 Issued: 2012/05/11 Ed: 3 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements
- CAN/CSA-C22.2 No. 61010-1 Issued: 2012/05/11 Ed: 3 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use Part 1: General Requirements
- ISA 12.12.01 Issued: 2015/08/21 Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations
- CSA C22.2#213 Issued: 2015/08/21 Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations
- UL 823 Issue: 2006/10/20 Ed: 9 Rev: 2012/01/31 Electric Heaters for Use in Hazardous (Classified) Locations



Getting Started

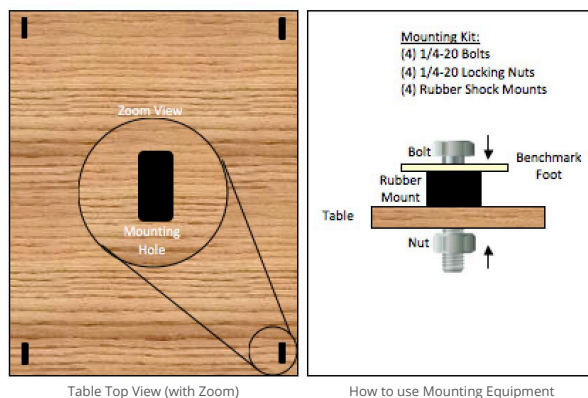
Warnings

- ⚠ Exposure to solvents (i.e. toluene) may degrade the sealing properties of materials used in the front panel switches.
- ⚠ EXPLOSION HAZARD – Substitution of components may compromise ability to use the unit in Class I, Division 2 areas.
- ⚠ EXPLOSION HAZARD – DO NOT replace fuses unless the main power has been switched off.
- ⚠ EXPLOSION HAZARD – DO NOT disconnect or disassemble equipment unless the main power has been switched off or the area is known to be non-hazardous.
- ⚠ DO NOT operate this machine with unbalanced tubes and shields.

Installation

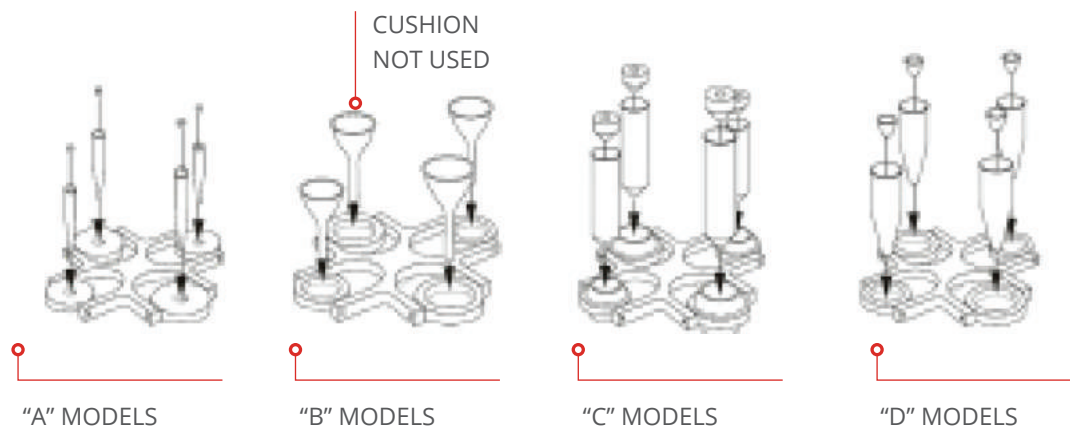
For best results, the centrifuge should be housed in a controlled environment. It is recommended that the centrifuge be secured to the benchtop, table, stand etc. using the hardware supplied. Allow for optimum working clearance around the unit. Mount centrifuge loosely with larger holes in the tabletop, to allow room for slight movement of centrifuge. Shown in Figures 1-3. Ensure the unit is level by adjusting the shock mounts.

Figure 1: Schematic of Mounting Bolts



Ensure that all collars, cushions and shields are installed properly and in the correct orientation, as shown in figure 2.

Figure 2: A/B/C/D Cushion Orientation



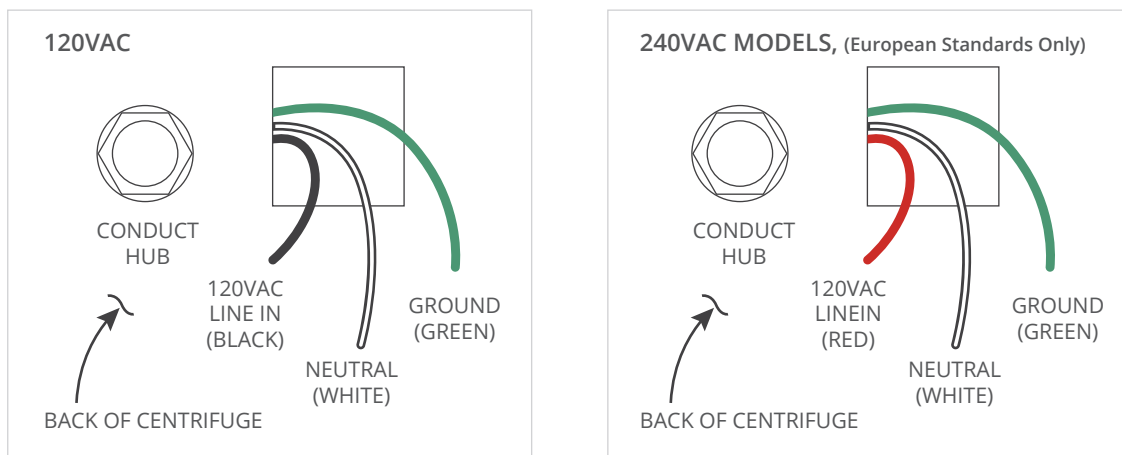


Getting Started

Electrical Connection

The unit should be installed in a fixed location and should be hard-wired using 12 AWG copper wire. The units should be connected using an external switch and a dedicated circuit breaker for disconnection and overcurrent protection of the equipment. The external switch should be near the unit as a safety precaution. All wiring should be completed by properly qualified electrical personnel, per local electric code and in conformance with the standards for Class I, Division 2 hazardous locations. Refer to the wiring detail below.

Figure 3: 120VAC/240VAC Model Wiring Diagrams



In geographical regions where power load is prone to fluctuation, power conditioning is Recommended to filter out reductions and spikes in power. Failure to do so may void the warranty on the unit. Contact L-K Industries for hard-wire power/line conditioner recommendations.

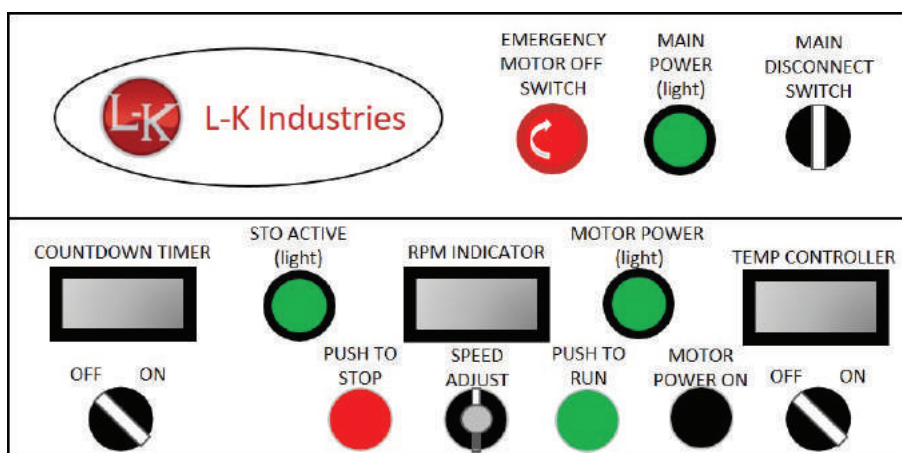


Operation

This unit and all L-K Industries sample tubes are designed and fabricated in compliance with API and ASTM standards. For optimal results, L-K Industries sample tubes (along with matching shields, cushions and collars) should be used. Verified and certified tubes are also available.

Before centrifugation, all tubes, collars, cushions and shields should be visually inspected for damage. Check for oil residue on cushions and ensure that the cushions rest flat inside the bottom of each shield. Damaged parts must not be centrifuged, as they may break and cause further damage to the centrifuge.

Figure 4: Front Panel Switches



Loading and Powering On

To supply power to the unit, turn the “MAIN DISCONNECT” switch to the right. The “MAIN POWER” green indicator light should signify that power is on. Verify that the red “EMERGENCY MOTOR OFF SWITCH” is not engaged.

Open the sliding door and place the filled sample tubes into the shields with collars resting at the top of the shields. Ensure that the tip of each tube rests firmly in the cushion. Before every test, inspect the inner bowl for foreign objects and close the door. The green “STO ACTIVE” indicator light turns on when the door is properly closed (Safe Torque Off/STO is a safety function that cuts off the supply voltage when the door is open). Press the black “MOTOR POWER ON” button to give voltage to the motor. The “MOTOR POWER” indicator should be lit.

Heated Operation

Preheat the unit by turning the “TEMPERATURE CONTROLLER” switch to the “ON” position. The unit is factory programmed to 140°F/60°C. In colder environmental conditions, it may be necessary to set the operating temperature approximately 15-20 degrees above the desired sample temperature (maximum recommended set point is 160°F/71°C). Keep the sliding door closed as often as possible to minimize heat loss. Once the temperature set point has been reached, the LCD display will switch from red to green. Dry block or water bath heaters may be purchased separately from L-K Industries to preheat samples.

The temperature probe is located underneath the lid, above the centrifuge bowl. The unit is equipped with dual high intensity heating elements. The temperature display indicates the temperature inside the bowl, NOT the samples. To determine sample temperature, a thermometer must be placed inside each sample tube once a test is complete. Thermometers may be purchased separately.



Operation

Changing Temperature Set Point

1. Press and hold "SEL" button, and then briefly press "SEL" again.
2. Press "RST" to enter security code (055).
3. Press and hold "SEL".
4. Press "RST" to until the 4-SPT input is reached.
5. The first input is SPSEL, press "RST" to change the input to SP-1.
6. Press "SEL" until the SPT-1 input is reached.
7. In the SPT-1 input, press "RST" (temperature set point will display with a flashing digit).
8. Continue to press "RST" until desired number is reached.
9. Press "SEL" to toggle between digits.
10. Press and hold "SEL" to set and press "SEL" until the end of the program is reached.

NOTE: The updated temperature controller settings will not be set until the "MAIN DISCONNECT" switch is cycled off and back on.

NOTE: While the temperature controller is being programmed, the dual heaters are not regulated. Temperature will begin to rise beyond the set point if left in "program mode" for significant periods. Be sure to exit all programming as soon as possible.

Call the L-K Industries Tech Helpline if any assistance is required.

High Temperature Protection

All centrifuge components and materials are chosen and designed to withstand temperatures up to 100°C (212°F). Although extremely rare, temperatures inside the centrifuge bowl may exceed the maximum rated temperature. All components are rated for Class I, Division 2 hazardous locations, but temperatures beyond 100°C may cause components to malfunction. In the case of runaway temperature, a manual reset mechanical thermal switch is installed in the lid above the bowl.

This normally-closed limit switch is set to open at 85°C (185°F). Once the switch opens, power to the dual bowl heaters is shut off. To reset the switch, turn off the "MAIN DISCONNECT" switch. Use a flathead screwdriver to remove the silver cap. Manually press the button until it clicks back into place. Turn the "MAIN DISCONNECT" switch on and begin operation as usual.

Timed Operation

The "COUNTDOWN TIMER" display indicates the amount of time remaining on a test. For timed operation, turn the timer switch to the "ON" position. The unit is preset to 10 minutes as specified by ASTM D 4007-08. If the countdown time must be changed, the controller must be reprogrammed (see below for instructions). When the motor reaches the speed set point (determined by the dial position of the potentiometer), the timer will begin to countdown.

Once the timer is complete, the motor will come to a controlled stop. When the timer switch is turned off, the motor will run until manually shut down ("PUSH TO STOP" button).



Operation

Changing Temperature Set Point

1. Press and hold "SEL" button, and then briefly press "SEL" again
2. Press "RST" to enter security code (055)
3. Press and hold "SEL"
4. Press "RST" to get to 1-INPut, and then press "SEL" until the t-Strt input is reached
5. In the t-Strt input, press "RST" (time set point will display with a flashing digit)
6. Continue to press "RST" until desired number is reached
7. Press "SEL" to toggle between digits
8. To continue changing each digit, press "RST"
9. Press and hold "SEL" to set and press "SEL" until the end of the program is reached

NOTE: *The updated timer settings will not be set until the "MAIN DISCONNECT" switch is cycled off and back on. Call the L-K Industries Tech Helpline if any assistance is required.*

Motor Operation

To start the motor, press the "PUSH TO RUN" button. Slowly tune the "SPEED ADJUST" knob until the desired test speed is displayed on the "RPM INDICATOR" (see Appendix A for various RCF values). The RPM INDICATOR, or rate meter, displays the actual speed (not theoretical). Physically mark that position for future reference. If multiple speeds are used, mark each potentiometer position. If the same speed is used repeatedly, the potentiometer knob may be left in that position while starting or stopping the motor and when the unit is turned off. The motor controller is preprogrammed to allow controlled acceleration and deceleration of the motor, regardless of speed set point.

NOTE: *To prolong centrifuge life, use the lowest feasible speed setting. The maximum allowable speed is 2300 rpm.*

DO NOT attempt to operate the unit with the sliding door open, as the motor will not run until the door is completely closed. The sliding door locking mechanism will remain engaged until the motion of the rotor has stopped.

To stop the motor during normal operation, press the "PUSH TO STOP" button. When the "RPM INDICATOR" reads "0", wait for the locking mechanism to disengage and then open the door. When the trunnion arm has come to a complete stop, remove samples and close the door.

In an emergency (i.e. tube breakage), press the "EMERGENCY MOTOR OFF SWITCH". Power to the motor will be shut off and the motor will free fall to a stop. Once troubleshooting is complete and it is safe to resume operation, twist and pull out the emergency switch. As an extra precaution, reset the unit by turning the "MAIN DISCONNECT" switch off and on. It will take approximately 1-2 minutes for the motor controller to boot up. If the "PUSH TO RUN" button is pressed during reboot, the motor will not run.

NOTE: *DO NOT open the sliding door immediately after the emergency switch has been engaged. The motor is still in free fall and any dislodged objects may be launched out of the centrifuge.*

NOTE: *It is recommended to take extra precaution while loading and unloading samples. Engage the "EMERGENCY MOTOR OFF SWITCH" while working inside the bowl.*

NOTE: *Contact the L-K Industries Tech Helpline for instructions for manually bypassing the locking mechanism. The manual bypass should ONLY be done to verify centrifuge speed.*



Maintenance

Replacement Parts & Repair Services

Replacement parts for all centrifuges can be purchased through the L-K Industries warehouse, on the L-K Industries website or from a Distribution Partner (see back cover). L-K Industries also repairs and rebuilds all centrifuge models in-house. For repairs, first obtain a RMA (Return Merchandise Authorization) number from L-K Industries. Then ship the unit to L-K Industries with a completed RMA form describing any problems.

Housekeeping

Clean the unit after each test. Oil residue can build up and cause difficulty operating the unit. Periodically check the sample tube cushions inside the trunnion shields for excess wear. Before each test, examine moving parts (electrical and mechanical) for wear and stress. Replace parts as necessary.

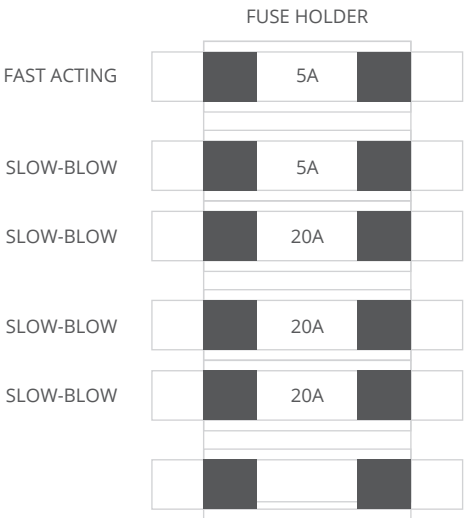
If a tube has broken inside a shield, the cushion MUST be replaced. Glass particles (not visible to the naked eye) can become embedded in the cushions and cause future breakage of tubes. Two extra cushions are provided.

NOTE: “B” style tubes DO NOT require cushions or collars.

Fuses

The fuses are used for over-current protection due to voltage spikes or other accidents. If replacement becomes necessary, turn off the “MAIN DISCONNECT” switch. Remove the fuses and replace with an appropriate L-K fuse that is CSA or UL certified. Contact L-K Industries Warehouse for the correct fuse part numbers.

Figure 3-1 Fuse Types





Troubleshooting

Common Issues

Issues that may occur during centrifuge operation include excessive vibration, broken tubes, broken or malfunctioning LCD screens, cushions stuck in shields, etc. For issues that cannot be identified and resolved by the user, more technical troubleshooting details can be found on the L-K Industries website. Alternatively, contact the L-K Industries Tech Helpline for assistance.

Motor

If the motor does not run when the “PUSH TO RUN” button is pushed, make sure there is power to the motor (green indicator light on). If the light is off, press the “MOTOR POWER ON” button. Ensure that the sliding door is completely closed. The door locking mechanism consists of a proximity switch that uses a sensor to determine whether the door is closed. When the door is closed, the switch closes a circuit feeding power to the motor. Also, check to make sure the “EMERGENCY MOTOR OFF SWITCH” is not pushed in.

If the motor stalls or does not come up to speed properly or the heaters do not turn on, check the fuses inside the front panel. Contact the L-K Industries Tech Helpline if assistance is needed in checking or changing fuses.

If using the Countdown Timer during operation, make sure there is time remaining. Once the timer runs out, the motor will automatically shut down. If the timer is not being used (i.e. for tests longer than the typical preset time), turn the timer to the “OFF” position.

When the motor controller is functioning properly, the green indicator light will be lit. If the green light does not turn on when the “MOTOR POWER ON” button is pressed, there are several possibilities for the error. Use a screwdriver to open the front panel of the unit and view fault codes on the LCD screen of the motor controller. Contact the L-K Industries Tech Helpline for help troubleshooting fault codes.

Heaters & Temperature Controller

If the temperature displayed on the temperature controller has dropped significantly, the temperature inside the bowl may have reached high enough temperature to open the manual reset mechanical thermal switch on top of the lid. This will disconnect power to the heaters. Check the switch on top of the lid to see if it has been tripped. Ensure that the button on the switch snaps back into place.

If the manual thermal switch has not been tripped, contact the L-K Industries Tech Helpline for assistance.

Lid and Door Assembly

The following are possible sources of failure of the lid and door locking mechanism:

- Sliding Door – Add grease for smoother opening and closing.
- Proximity Switch & Sensor – These work together to detect door position and allow power to the motor; failure of either prevents the motor from running.
- Magnet – This is mounted inside the sliding door and aligns with the sensor when the door is closed; can become detached.
- Solenoid & Locking Pin – These work together to lock the door during motor operation; locking pin may be misaligned with the door.

Contact the L-K Industries Tech Helpline to troubleshoot problems with the lid and door assembly.



Appendices

Appendix A: RCF/RPM Conversions**

MODEL	LB14-C120C	LB14-D120C
Tip-to-tip Diameter (")	20.38	19.72
RPM*	RCF	RCF
200	12	11
250	18	18
300	26	25
350	36	34
400	46	45
450	59	57
500	73	70
550	88	85
600	104	101
650	123	119
700	142	138
750	163	158
800	186	180
850	210	203
900	235	227
950	262	253
1000	290	281
1050	320	310
1100	351	340
1150	384	371
1200	418	404
1250	453	439
1300	490	475
1350	529	512



Appendices

Appendix A: RCF/RPM Conversions**

MODEL	LB14-C120C	LB14-D120C
Tip-to-tip Diameter (")	20.38	19.72
RPM*	RCF	RCF
1400	569	550
1450	610	590
1500	653	632
1550	697	675
1600	743	719
1650	790	765
1700	839	812
1750	889	860
1800	940	910
1850	993	961
1900	1048	1014
1950	1104	1068
2000	1161	1123
2050	1220	1180
2100	1280	1238
2150	1341	1298
2200	1405	1359
2250	1469	1422
2300	1535	1485
2350	1603	1551
2400	1672	1617
2450	1742	1686
2500	1814	1755

*RPM = $265 \times \sqrt{RCF/D}$, where D = tip-to-tip tube diameter in inches

**ASTM minimum recommended RCF: 600

Appendix B: Wiring & Assembly Diagrams

The following schematics may be found at: www.lk-ind.com/downloads

- 115VAC and 220VAC Wiring
- Outer Front Panel Schematic
- Inner Front Panel Schematic
- Motor Assembly
- Bowl Heater Assembly
- Bowl Assembly
- Door and Locking Mechanism Assembly
- Front Panel and Lid Assembly

Appendix C: Programming Overviews

The following programming diagrams may be found at: www.lk-ind.com/downloads

- Temperature Controller Quick Programming
- RPM Quick Programming
- Timer Quick Programming

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