



## **K60094**

### **PORTABLE HEATED OIL TEST CENTRIFUGE**

#### ***OPERATION AND INSTRUCTION MANUAL***

REV B

***Koehler Instrument Company, Inc.***

*1595 Sycamore Avenue • Bohemia, New York 11716-1796 • USA*

*Toll Free: 1-800-878-9070 (US only) • Tel: +1 631 589 3800 • Fax: +1 631 589 3815*

*<http://www.koehlerinstrument.com> • e-mail: [info@koehlerinstrument.com](mailto:info@koehlerinstrument.com)*

*Petroleum Testing & Analysis Instrumentation • Custom Design & Manufacturing*



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# CERTIFICATE OF CONFORMANCE

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## Heated Oil Test Centrifuge K60094

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This certificate verifies that part number K60094, Heated Oil Test Centrifuge, was manufactured in conformance with the applicable standards set forth in this certification.

Specifications:                      ASTM D96  
    API MPMS Chapter 10.4  
    API 2542

This unit is tested before it leaves the factory, to ensure total functionality and compliance to the above specifications and ASTM standards. Test and inspection records are on file for verification.



**Jesse Kelly**  
Application Engineer  
Koehler Instrument Company



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## 1 Introduction

The K60094 Oil Test Centrifuge is a portable model centrifuge designed expressly for the determination of water and sediment of crude oil during field custody transfers. This unit accommodates two centrifuge tubes of ASTM conical type 6". The molded PTFE supports provide for maximum protection and easy positioning of the tubes. Includes an integrated tube holder (2) and pre-heater (2) for ease of sample handling and pre-conditioning.

- Accommodates two 6" conical centrifuge short tubes
- Analog Speed Control
- Integrated Tube Holder (2) and Pre-heater (2)
- Independent Digital Temperature Displays for both the Bowl and Pre-heater temperature
- Switchable Temperature Display between °C / °F
- Substantial Insulation for Reduced Heat Loss
- 12V DC Power Requirement for field use
- Opening in Top Lid for Speed Calibration by Portable Laser Tachometer

This manual provides important information regarding safety, technical reference, installation requirements, operating condition specifications, user facility resource requirements, and operating instructions for the Portable Oil Test Centrifuge. This manual should also be used in conjunction with applicable published laboratory procedures. Information on these procedures is given in section 1.2.

### 1.1 Koehler's Commitment to Our Customers

Providing quality testing instrumentation and technical support services for research and testing laboratories has been our specialty for more than 50 years. At Koehler, the primary focus of our business is providing you with the full support of your laboratory testing needs. Our products are backed by our staff of technically knowledgeable, trained specialists who are experienced in both petroleum products testing and instrument service to better understand your requirements and provide you with the best solutions. You can depend on Koehler for a full range of accurate and reliable instrumentation as well as support for your laboratory testing programs. Please do not hesitate to contact us at any time with your inquiries about equipment, tests, or technical support.

**Toll Free: 1-800-878-9070 (US only)**  
**Tel: +1 631 589 3800 • Fax: +1 631 589 3815**  
**Email: [info@koehlerinstrument.com](mailto:info@koehlerinstrument.com)**  
**<http://www.koehlerinstrument.com>**

### 1.2 Recommended Resources and Publications

1. American Society for Testing and Materials (ASTM)  
100 Barr Harbor Drive  
West Conshohocken, Pennsylvania 19428-2959, USA  
Tel: +1 610 832 9500 • Fax: +1 610 832 9555  
<http://www.astm.org> • email: [service@astm.org](mailto:service@astm.org)

#### ASTM Publication:

- ASTM D96: Standard Test Method for Water and Sediment in Crude Oil by Centrifuge Method (Field Procedure)

2. Energy Institute (IP)  
61 New Cavendish Street  
London, WIM 8AR, United Kingdom  
Tel: 44 (0)20 7467 7100  
Fax: 44 (0)20 7255 1472  
<http://www.energyinstpubs.org.uk/>

#### IP Publication:

- IP: MPMS Chapter 10.4

### 1.3 Instrument Specifications

<b>Model:</b>	K60094
<b>Electrical Requirements:</b>	12V DC 40A
<b>Temperature Range:</b>	Ambient to 160°F (71.1°C)
<b>Temperature Readout:</b>	Two (2) independent digital displays for centrifuge bowl and pre-heater
<b>Rotor Swing Diameter:</b>	15.6" (396.24mm)
<b>Speed Range:</b>	300 - 1800 RPM
<b>RCF Range:</b>	20 - 700
<b>Capacity:</b>	Two (2) short cone 6" tubes
<b>Dimensions: (w x d x h, in.(cm))</b>	20.79 x 23.43 x 13.91 (with pre-heater lid open) (52.8 x 59.5 x 35.33)
<b>Net Weight:</b>	50 lbs (22.7 kg)

## 2 Safety Information and Warnings

**Safety Considerations.** The use of this equipment may involve *hazardous* materials and operations. This manual does not purport to address all of the safety problems associated with the use of this equipment. It is the responsibility of any user of this equipment to investigate, research, and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

### **WARNING: KEEP BOWL LID CLOSED WHILE SAMPLES ARE SPINNING!!!**



- **NEVER** try to slow the carousel arm down with your hands or place your hands or any object inside the bowl while the carousel arm is spinning. Allow the carousel arm to come to a complete stop before removing your sample.
- **NEVER** leave the centrifuge unattended while the samples are spinning.
- **NEVER** leave the centrifuge unattended while unit is on.
- **Ensure** lid switch is in locked position prior to spinning rotor.
- **Ensure** all switches are off when the unit is not in use.
- Be sure there are no foreign objects in the centrifuge bowl.
- Disconnect power supply before removing or replacing electrical or mechanical parts.
- **DO NOT** leave oily rags or any type of combustible material in or around your centrifuge.
- **DO NOT** allow unauthorized persons to access the centrifuge.

- **STAY ALERT!** Do not operate this unit while under the influence of medication, alcohol, or drugs.

**Equipment Modifications and Replacement Parts:** Any modification or alteration of this equipment from that of factory specifications is not recommended and voids the manufacturer warranty, product safety, performance specifications, and/or certifications whether specified or implied, and may result in personal injury and/or property loss. Replacement parts must be O.E.M. exact replacement equipment.

**Unit Design:** This equipment is specifically designed for use in accordance with the applicable standard test methods listed in section 1.2 of this manual. The use of this equipment in accordance with any other test procedures, or for any other purpose, is not recommended and may be extremely hazardous.

**Chemical Reagents Information:** Chemicals and reagents used in performing the test may exhibit potential hazards. Any user must be familiarized with the possible dangers before use. We also recommend consulting the Material Data and Safety Sheet (MSDS) on each chemical reagent for additional information. MSDS information can be easily located on the internet at <http://siri.uvm.edu> or <http://www.sigma-aldrich.com>.

## 3 Getting Started

### 3.1 Packing List

- K60094 Portable Heated Oil Test Centrifuge, 12VDC 40A
- Short Cone Centrifuge Tube Holder (2)
- Short Cone Centrifuge Tube Cushions (2)
- 12VDC Cable Cord, 6ft
- Support Bracket (2)
- K60094-Manual K60094 Portable Oil Test Centrifuge Operation and Instruction Manual

### 3.2 Unpacking

Carefully unpack and place the instrument and accessories in a secure location. Inspect the unit for damage. If any damage is found, keep all packing materials and immediately report the damage to the carrier. We will assist you with your claim, if requested. When submitting a claim for shipping damage, request that the carrier inspect the shipping container and equipment. Do not

return goods to Koehler without written authorization.

### 3.3 Installation

**Equipment Placement:** Place the instrument on a firm surface in a secure area.

The equipment comes with the z-brackets installed in the factory.

After the unit is mounted, plug the 12VDC cord to the back of the instrument. See Figure 3 below. Connect the opposite end of the cord to a power source. The power source can be either a 12VDC car/truck battery for field use or a 115/230VAC power supply adapter for Laboratory use.

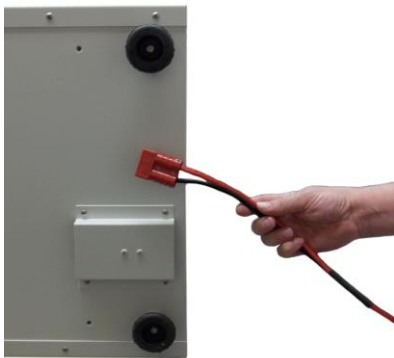


Figure 3. Power Connection

### 3.4 Accessories for Running Tests

6" long, 100mL sample capacity

<b>K61102</b>	Short Tube, marked in 200 parts every 4 parts above 20mL
<b>K61105</b>	Short Tube, marked in mL
<b>K61107</b>	Short Tube, marked in mL every 2mL above 10mL
<b>K61108</b>	Short Tube, 6", marked in 200 parts
<b>K60002-03058</b>	PTFE cushion for Short Tubes
<b>K61111</b>	Cork Stopper for Long, Short, and Pear Tube

## 4 Descriptions

### 4.1 Portable Oil Test Centrifuge



Figure 3. Portable Oil Test Centrifuge

- 1. Control Panel.** Provides for means to power on/off and adjustment of the speed and temperature of the centrifuge. Refer to Section 4.2 for detailed description of the control panel.
  - 2. Top Opening Lid.** Sliding Aluminum Lid provides access to centrifuge bowl and rotor assembly for loading samples and cleaning, if necessary.
- WARNING:** Never try to slow the carousel arm down with your hands or place your hands or any object inside the bowl while the carousel arm is spinning. Allow the carousel arm to come to a complete stop before removing your sample.
- 3. Tube Holder.** Provides for convenient means of holding two centrifuge tubes while preparing the sample prior to preheating and testing.
  - 4. Integrated Tube Pre-Heater.** For heating of two centrifuge tubes to test temperature prior to placing in rotor assembly of centrifuge for testing.



## 4.2 Control Panel

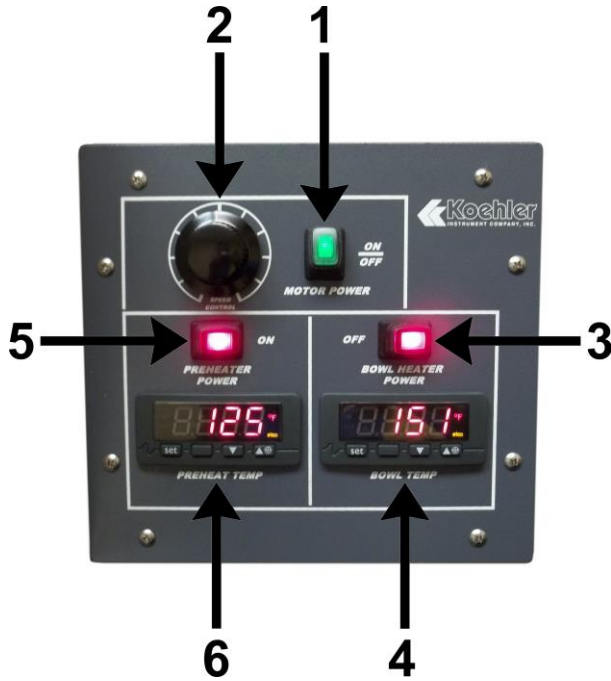


Figure 4. Control Panel

1. **Motor Power.** Controls power to the centrifuge motor. Press switch upward to power on. Press switch downward to power off.

**NOTE:** Motor is cooled by direct forced air for enhanced temperature maintenance during the test.

2. **Motor Speed Dial.** Motor dial should be set to the minimum value (turn counter-clockwise) while motor power switch is off. After motor switch is turned on, slowly turn the dial clockwise to desired speed setting.

**NOTE:** Indicator markings surrounding the dial are arbitrary and do not represent a specific set speed. Speed readings must be made and confirmed using a portable tachometer that can read the rotor speed through the small opening in the Centrifuge Lid.

3. **Bowl Heater Power.** Controls power to the main chamber or bowl of the centrifuge. Press switch to the right to power on. Press switch to the left to power off.
4. **Bowl Temperature Control.** For adjusting the set point temperature of the main chamber or bowl of the centrifuge. Refer to section 4.3 for detailed description of the Temperature Controller.

5. **Pre-heater Power.** Controls power to the two preheating chambers. These chambers are the two right most chambers of the integrated four place tube holder assembly. Press switch to the right to power on. Press switch to the left to power off.
6. **Pre-heater Temperature Control.** For adjusting the set point temperature of the two integrated centrifuge tube preheating chambers. Refer to section 4.3 for detailed description of the Temperature Controller.

## 4.3 Temperature Controller



Figure 5. Temperature Controller

1. **Temperature Display.** The red LED display shows the actual temperature as read from the K Type Thermocouple. Temperature set point ranges from ambient to 160°F (71.1°C).
2. **Display Message.** Shows condition of temperature controller. Refer to display messages below.

Output solidly lit	Heater is "ON"
Display flashing	Probe Error
°C	Temperature is measured in Celsius °C
°F	Temperature is measured in Fahrenheit °F

3. **Set Key.** Acts as a multi-functional action, advance or enter key. The Set Key is used in conjunction with the up and down arrow keys to adjust parameter values, programming, restoring factory default settings, etc.

4. **Down Arrow.** Used to decrease the set point temperature and to decrease or change parameters when programming temperature controller.
5. **Up Arrow.** Used to increase the set point temperature and to increase or change parameters when programming temperature controller.
6. **Output.** Indicates that the heater is "ON".

**WARNING:** The digital temperature controller for the unit comes pre-programmed from the Koehler factory. Please do NOT attempt to re-program the digital temperature controller as this will void the product warranty. If assistance is required, please do not hesitate to contact the Koehler technical service department.

**Adjusting the Set Point Temperature.** This routine allows the user to adjust the pre-programmed set point temperature of the digital temperature controller.

- a. Press **Set**
- b. Use **UP ARROW** or **DOWN ARROW** to adjust value of the temperature parameter to the required value
- c. Press **Set** again to store the value, this will be the new set point.

## 5 Operation

### 5.1 Power Connection

Plug the provided line cord into the power receptacle located at the back of the instrument then connect to properly fused and grounded receptacle with the correct voltage as indicated in section 1.3 or on the back of the unit.

**WARNING:** For safety, disconnect the power when performing any maintenance and/or cleaning.

### 5.2 Test Procedure

1. Switch both the Pre-heater and Bowl Heater Power Buttons to the ON position. The temperature displays will flash on and each unit will begin to heat to the set test temperature.
2. With the aid of the two left most non-heated centrifuge tube holders, fill each of two

centrifuge tubes to exactly the 50-mL (100-part) mark with the test sample.

3. Fill each tube with solvent to exactly the 100-mL (200-part) mark.

**NOTE:** Read the top of the meniscus at both the 50-mL and 100-mL (100-part and 200-part) marks

**NOTE:** If experience indicates that a demulsifier is required and one has not already been added to the solvent, add to each tube quantity of demulsifier solvent stock solution that has previously been determined to be satisfactory for the crude oil under test. Stopper each tube tightly and invert the tubes a minimum of 10 times to ensure that the oil and solvent are uniformly mixed.

**WARNING:** In general, the vapor pressures of hydrocarbons at 60°C (140°F) are approximately double those at 40°C (104°F). Consequently, tubes should always be inverted at a position below eye level.

**NOTE:** Where the crude oil is very viscous and mixing of the solvent with the oil is difficult, the solvent may be added to the centrifuge tube prior to the oil to facilitate mixing. In this case, extreme care must be taken to fill the centrifuge tube to exactly the 50-mL (100-part) mark with solvent and then to exactly the 100-mL (200-part) mark with the sample.

4. Place stoppers loosely on the centrifuge tubes to prevent pressure buildup during heating.
5. Place centrifuge tubes into the two right most preheated centrifuge tube holders and heat contents of the tubes to 60°C ± 3°C (140°F ± 5°F).
6. Once the sample temperature reaches and is stabilized at the desired test temperature, secure the stoppers and invert the tubes ten (10) times to ensure uniform mixing of the oil and solvent.
7. Open the lid and load filled tubes into both tube holders.

**WARNING:** Exercise caution when handling heated samples.

Make sure there are cushions at the bottom of the tube holders and there is no oil residue or build-up. Always check for and remove any foreign objects within the bowl.

**NOTE:** Always balance the rotor by assuring that two equal samples are used. Never load unequal samples.

8. Ensure all tubes are properly placed within their holders and close the lid.
9. Check that the Motor dial is set to the minimum value (turn counter-clockwise) before switching on the motor power.
10. Press the Motor Power switch upward to activate the centrifuge motor.
11. After motor switch is turned on, slowly turn the motor speed dial clockwise to a speed setting that produces a RCF of 500. Please refer to the equation below from ASTM D96 and the rotor diameter referenced in section 1.3 of this document to determine the appropriate RPM value.

$$\text{rpm} = 1335 \sqrt{\text{rcf}/d} \quad (1)$$

$$\text{rpm} = 265 \sqrt{\text{rcf}/d} \quad (2)$$

where:

- rpm = rotational speed, in revolutions per minute  
rcf = relative centrifugal force  
d = diameter of swing, in mm (eq 1) or in. (eq 2), measured between the tips of opposite tubes when the tubes are in their rotating position.

12. Spin the sample for at least 5 minutes.
13. After 5 minute test time is complete turn off motor power.
14. Immediately after the centrifuge comes to rest, verify the temperature. Do not disturb the oil-water interface with the thermometer. The test is invalid if the final temperature after centrifugation is below 52°C (125°F).

**NOTE:** If the final temperature is found to be below 52°C (125°F), adjust the centrifuge heater to increase the final test temperature and reinitiate the procedure, beginning with Step 4.

15. Read and record the combined volume of sediment and water at the bottom of each tube.

**WARNING:** Exercise caution when handling heated samples.

16. Reheat both tubes to 60°C ± 3°C (140°F ± 5°F), return the tubes without agitation to the centrifuge, and spin for another 5 minutes at the same speed rate. Repeat this operation until two consecutive consistent readings are obtained on each tube.
17. For the test to be considered valid, a clear interface must be observed between the oil layer and the separated water. No identifiable layering (that is, an emulsion) should be present immediately above the oil-water interface. In such cases, one or more of the following remedies may be effective:
  - i. Shake the mixture between whirlings in the centrifuge just enough to disperse the emulsion
  - ii. Use a different or an increased amount of demulsifier. (The demulsifier should not, however, contribute to the volume of sediment and water.)
  - iii. Use a different or an increased amount of solvent. After a satisfactory procedure for a particular type of oil has been worked out, it will ordinarily be suitable for all samples of the same crude oil.

## 6 Maintenance

**WARNING.** Disconnect power to the unit before servicing to avoid exposure to high voltages and/or temperatures which may result in personal injury or death. If you have any questions about maintaining your equipment, then please do not hesitate to contact the Koehler technical service department.

### 6.1 Routine Maintenance

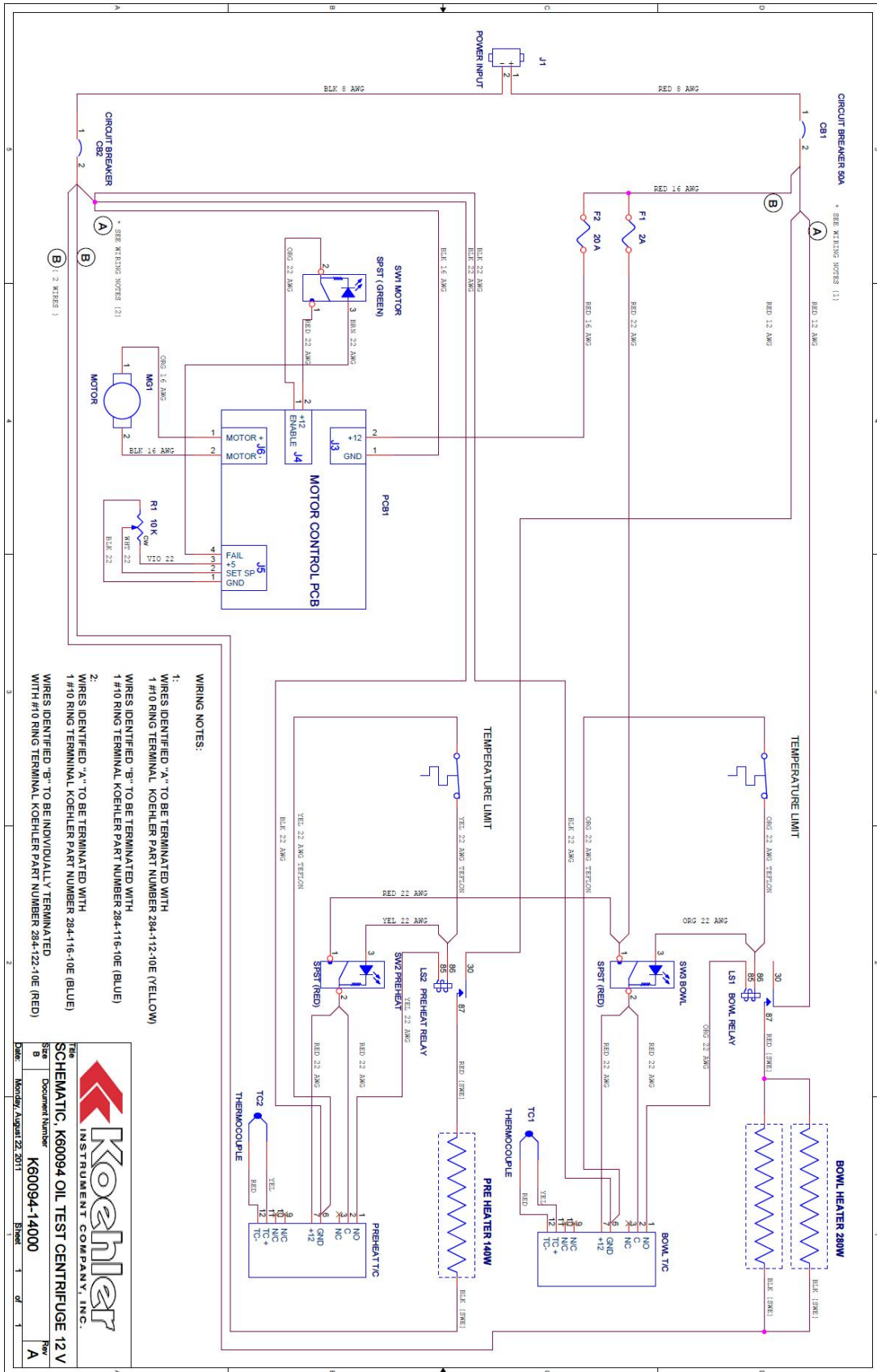
- Clean the unit after each test. Build-up of oil residues can cause problems with the operation and efficiency of the centrifuge.
- Periodically, check the sample tube cushion inside the carousel shields. Replace if worn excessively.
- **ALWAYS** check moving parts, both mechanical and electrical, for wear and stress. Replace if necessary.

### 6.2 Replacement Parts

Some instrument parts may need to be replaced. When ordering replacement part(s), please provide the model number, serial number, and product shipment date of your equipment so that we can ensure you will receive the proper replacement part(s).

Part Number	Description
K60094-23014	Rotor Assembly
K60002-03043	Short Tube Holder
K60002-03058	Short Tube PTFE Cushion
230-012-001	Band Heater, 140W, 12VDC
275-600-011	Digital Temperature Controller, 12-24V
265-000-007	Thermocouple, Type K
090-012-003	Relay, 40A, 12VDC SPST
278-002-001	Fuse, 2A
278-020-001	Fuse, 20A
288-012-003	Motor, 12VDC

## 7 Wiring Diagram



## 8 Troubleshooting

### 8.1 The test will not start

- Contact Koehler's Technical Service Department.

### 8.2 The motor stalls or will not come up to speed properly

- Check whether the motor power switch shown in section 4.2 is blinking. This indicates over current on the motor. Switch the power off to the instrument and check to see if there is something restricting the rotation of the carousel in the bowl.
- Check Fuses

### 8.3 The unit does not heat up

- Ensure the heater is powered on.
- Check fuses

## 9 Service

Under normal operating conditions and with routine maintenance, the K60094 Portable Heated Oil Test Centrifuge should not require service. Any service problem can be quickly resolved by contacting Koehler's technical service department either by letter, phone, fax, or email. In order to assure the fastest possible service, please provide us with the following information.

Model Number: \_\_\_\_\_

Serial Number: \_\_\_\_\_

Date of Shipment: \_\_\_\_\_

## 10 Storage

This laboratory test instrument is equipped with electrical components. Storage facilities should be consistent with an indoor laboratory environment. This testing equipment should not be subjected to extremes of temperature and/or moisture.

This equipment was shipped from the factory in a corrugated cardboard container. If long term storage is anticipated, re-packing the instrument in a water-resistant container is recommended to ensure equipment safety and longevity.

## 11 Warranty

We at Koehler would like to thank you for your equipment purchase, which is protected by the following warranty. If within one (1) year from the date of receipt, but no longer than fifteen (15) months from the date of shipment, Koehler equipment fails to perform properly because of defects in materials or workmanship, Koehler Instrument Company, Inc. will repair or, at its sole discretion, replace the equipment without charge F.O.B. its plant, provided the equipment has been properly installed, operated, and maintained. Koehler Instrument Company must be advised in writing of the malfunction and authorize the return of the product to the factory. The sole responsibility of Koehler Instrument Company and the purchaser's exclusive remedy for any claim arising out of the purchase of any product is the repair or replacement of the product. In no event shall the cost of the purchaser's remedy exceed the purchase price, nor shall Koehler Instrument Company be liable for any special, indirect, incidental, consequential, or exemplary damages. KOEHLER INSTRUMENT COMPANY, INC. DISCLAIMS ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE. Please save the shipping carton in the event the equipment needs to be returned to the factory for warranty repair. If the carton is discarded, it will be the purchaser's responsibility to provide an appropriate shipping carton.

## 12 Returned Goods Policy

To return products for credit or replacement, please contact Koehler Customer Service with your purchase order number, our packing list/invoice number, the item(s) to be returned and the reason for the return. You will be issued a Returned Authorization (RA) number, which must be prominently displayed on the shipping container when you return the material to our plant. Shipping containers without an RA number prominently displayed with be returned to the sender. Goods must be returned freight prepaid. Returns will be subject to a restocking charge, the application of which will depend upon the circumstances necessitating the return. Some returns cannot be authorized, including certain products purchased from outside vendors for the convenience of the customer, products manufactured on special order, products shipped from the factory past ninety (90) days, and products which have been used or modified in such a way that they cannot be returned to stock for future sale.





