



SV3000 SAYBOLT VISCOMETER BATH

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

Petroleum Testing & Analysis Instrumentation • Custom Design & Manufacturing

CERTIFICATE OF CONFORMANCE


Constant Temperature Saybolt Viscosity Bath, SV3000 K214X0

This certificate verifies that part number K214X0, Constant Temperature Saybolt Viscosity Bath, was manufactured in conformance with the applicable standards set forth in this certification.

Specifications:

- ASTM D88
- ASTM D244
- ASTM E102
- AASHTO T72
- FTM 791-304

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

Table of Contents

1	Introduction	2
1.1	<i>Koehler's Commitment to Our Customers</i>	2
1.2	<i>Recommended Resources and Publications</i>	2
1.3	<i>Instrument Specifications</i>	2
1.4	<i>Software Specifications</i>	3
2	Safety Information and Warnings	3
3	Getting Started	3
3.1	<i>Packing List</i>	3
3.2	<i>Unpacking</i>	4
3.3	<i>Setup</i>	4
4	Descriptions	5
4.1	<i>Instrument Controls</i>	5
4.2	<i>Digital Temperature Control</i>	6
4.3	<i>Preparation of Apparatus</i>	7
5	Operation	8
6	Maintenance	8
6.1	<i>Routine Maintenance</i>	8
6.2	<i>Bath Maintenance</i>	9
6.3	<i>Replacement Parts</i>	9
7	Wiring Diagrams	14
7.1	<i>K21410 (115V) Model</i>	14
7.2	<i>K21420 (230V) Model</i>	15
8	Assembly Diagram	16
9	Troubleshooting	17
10	Service	17
11	Storage	17
12	Warranty	17
13	Returned Goods Policy	17
Notes	18
Notes	19
Notes	20

1 Introduction

The Koehler SV3000 Saybolt Viscometer Bath is the latest design for determining viscosity using Saybolt viscometer tubes and orifices. The bath operates at temperatures from ambient to 240°C (464°F). The instrument determines the time required for 60mL of sample to flow through a calibrated orifice under precisely controlled conditions. Saybolt Universal Seconds (SUS) is the standard measurement for lubricants, insulating oils, and lighter fuel grades, and Saybolt Furol Seconds (SFS) is used for heavier oils and bitumens. The instrument conforms to the ASTM D88 test method and related test specifications.

This manual provides important information regarding safety, technical reference, installation requirements, operating condition specifications, user facility resource requirements, and operating instructions for the Saybolt Viscometer Bath. 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 to provide 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
<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>
E-mail: service@astm.org

ASTM Publication:

- ASTM D88: Standard Test Method for Saybolt Viscosity
- ASTM D244: Standard Test Method for Emulsified Asphalts
- ASTM E102: Standard Test Method for Saybolt Furol Viscosity of Bituminous Materials at High Temperatures

- 2 American Association of State Highway and Transportation Officials (AASHTO)
444 North Capitol Street N.W., Suite 249
Washington, DC 20001
Phone: +1 202 624-5800
Fax: +1 202 624-5806
E-mail: info@aaashto.org

AASHTO Publication:

- AASHTO T72: Standard Method of Test for Saybolt Viscosity

- 3 Federal Test Method (FTM)

FTM Publication:

- FTM 791-304

1.3 Instrument Specifications

Models:	K21410 K21420
Electrical Requirements:	115V 50/60Hz 12.3A 220-240 V 50/60Hz 6.4A
Temperature Range:	ambient to 240°C (464°F)
Temperature Accuracy:	± 0.03°C (0.05°F)
Capacity:	Four viscometer tubes
Bath Capacity:	5 gal (19L)

Dimensions: 29x25x33, in.
(74x64x84cm)

Net Weight: 65 lbs (30kg)

Gross Weight: 82 lbs (39kg)

1.4 Software Specifications

PC System Requirements: Intel® Pentium II Processor or similar (minimum)

Operating System: Windows® 98 SE, 2000, NT, XP

Memory Requirements: 64Mb RAM (128Mb RAM recommended)

Disk Space: 30Mb free space (minimum)

Communication Ports: One RS 232 port for temperature controller

Other Software: Microsoft® Excel (97 or above)

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.

Equipment Modifications and Replacement Parts. Any modification or alteration of this equipment from that of factory specifications is not recommended because it 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. Repairs should only be carried out by authorized personnel.

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>. Dispose of all chemicals according to local and national regulations.

3 Getting Started

The instructions for preparing the equipment assume that the user is aware of the contents of this document, which lists the warranty conditions and important precautions.

3.1 Packing List

- SV3000 Saybolt Viscosity Bath (K21410 / K21420)
- K22011 Thermometer Support (4)
- K22060 Saybolt Oil Strainer
- K22050 Socket Wrench
- K214-7 Port Closure Plug (2)
- K22070 Cleaning Plunger
- K214-0-29 Chained Cork (4)
- K22090 Withdrawal Tube
- K22030 Orifice Wrench
- K214-0-27 Port Cover (4)

Accessories (purchased separately, see Section 4.2 for more information on test apparatus configurations):

Viscometer Tubes

Part Number	Description
K22009	Saybolt Viscometer Tube, Brass
K22309	Saybolt Viscometer Tube, Stainless Steel

Orifices

Part Number	Description
K22010	Saybolt Universal Orifice
K22010-C/F	Saybolt Universal Orifice with Calibration Certificate
K22020	Saybolt Furol Orifice
K22020-C/F	Saybolt Furol Orifice with Calibration Certificate
K22029	Kansas Road Oil Orifice

Additional Accessories

Part Number	Description
K21410-SFW	Saybolt Viscosity Software Package
355-001-002	Silicone heat transfer fluid. 1 gallon container. Order quantity 5 per bath
355-001-004	Silicone heat transfer fluid. 5 gallon container. Order quantity 1 per bath
332-003-003	Pyrex™ receiving flask
K22030	Orifice Wrench for Universal and Furol Orifices
K22039	Orifice Wrench for Kansas Road Oil Orifices
K22050	Socket Wrench
K22060	Oil Strainer
K22070	Cleaning Plunger
K22080	Displacement Ring Insert in viscometer tube gallery for bituminous materials testing. Meets ASTM E102 specs.
K22090	Withdrawal Tube
K22011	Thermometer Support

3.2 Unpacking

Carefully unpack and place the instrument and accessories in a secure location. Ensure that all parts listed on the packing list are present. Inspect the unit and all accessories 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 Setup

Equipment Placement. Place the instrument on a firm, level table in an area with adequate ventilation or in a hood. The unit may be leveled by making minor turning adjustments to the feet located at the base of the unit. Please note that Koehler does not supply a level with this equipment.

Ventilation. A fume hood or exhaust system is required when operating the unit. Flammable vapors and/or steam are generated during operation and must not be permitted to accumulate. A canopy-style hood may be used if the height from the top of the unit to the canopy is 5 feet or less. The exhaust blower should have a rating of 1000 C.F.M. or greater. The unit location should also be prevented from drafts.

Power. Connect the line cords to properly fused and grounded receptacles 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. Do **NOT** turn the power on unless the bath is filled with the proper medium; otherwise damage may occur to the unit and the warranty will be void.

4 Descriptions

4.1 Instrument Controls

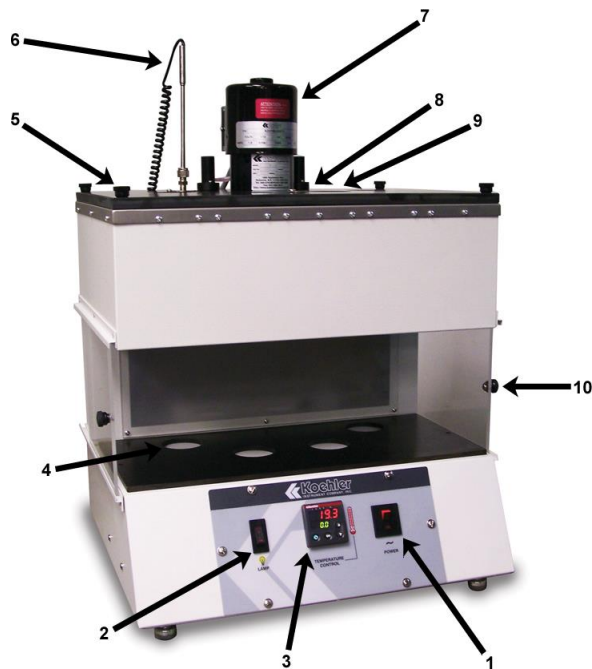


Figure 13: Instrument Descriptions (front)

1. **Power Switch.** This switch controls the power to the entire unit. When the power switch is in the **ON** position, power is supplied to the unit, turning on the digital temperature controller and stirrer motor.
2. **Lamp Switch.** This switch controls turning **ON/OFF** the lamp for illuminating the test samples.
3. **Temperature Controller.** The temperature controller regulates the bath temperature for the test procedure. Refer to Section 4.3 for full operational details.
4. **Receiving Flask Holder.** Properly positions the receiver flask under the bath reservoir in order to receive sample from the viscometer tube and orifice.
5. **Binding Post Knob.** There are four knobs located on the top plate of the viscometer bath. These Knobs must be unscrewed to remove the cover.

6. **Temperature Probe.** Senses bath temperature within the unit and relays the information to the temperature controller.
7. **Stirring Motor.** Constantly circulates bath medium to prevent temperature gradients and ensures temperature stability. When cleaning and/or servicing, please be sure to disconnect unit power to avoid possible injury.
8. **Thermometer/Thermocouple Port.** This port allows for independent temperature measurement of the bath temperature with a thermometer or a Pt-100 RTD probe for precise temperature measurements and digital temperature controller calibration. If the controller needs to be calibrated, then please contact the Koehler technical service department.
9. **Viscometer Tube Port.** Viscometer Tubes mount vertically through these ports into the Saybolt Viscosity bath.
10. **Sliding Draft Shield.** To prevent drafts from disrupting transfer of sample from the viscometer tube and orifice to the receiving flask.

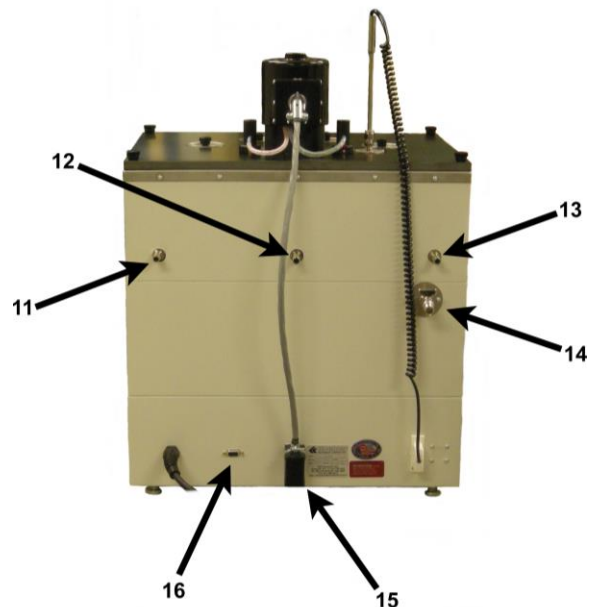


Figure 13: Instrument Descriptions (back)

11. **Cooling Coil Inlet Valve.** Connect suitable cold water or refrigerated coolant for operation at near-ambient temperatures.
12. **Overflow Outlet.** Connect tubing from overflow outlet to a waste receptacle in case of oil expansion.
13. **Cooling Coil Outlet Valve.** Exit valve for coolant.
14. **Bath Oil Draining Valve.** To drain the oil from the unit place waste receptacle under the drain valve. In the open position, the draincock will be parallel to the valve. When the bath is finished draining, close the draincock. In the closed position, the draincock will be perpendicular to the valve.
15. **Accessory Plug.** Powers Stirrer Motor and Heating Coils. Must be disconnected when removing top plate to fill bath.
16. **RS232 Port.** For communication with an external PC. Using the Communication Port Cable supplied for the Saybolt Viscosity Unit, connect the RS-232 port to a communication port on the PC.

4.2 Digital Temperature Control

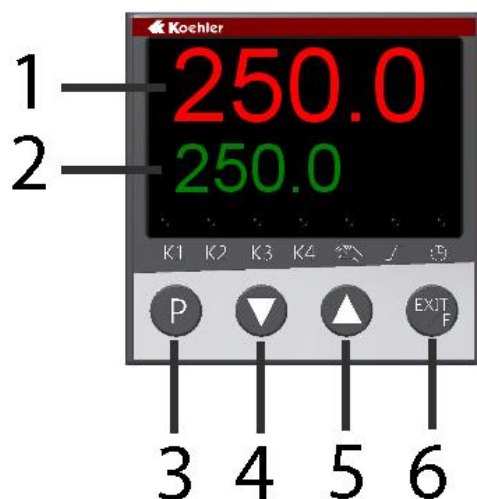


Figure 4. Temperature Controller

1. **Process Temperature Display.** The upper red LED display shows the

process temperature as read from the RTD probe.

2. **Set Point Temperature Display.** The lower green LED display shows the set point temperature of the controller.
3. **Programming Key.** Permits scrolling through controller menu parameters. One Level Forward
4. **Down Key.** Used to decrease the set point temperature and to decrease or change parameter values when programming the temperature controller.
5. **Up Key.** Used to increase the set point temperature and to increase or change parameter values when programming the temperature controller.
6. **Exit / Function Key.** This key is used to exit or leave a level. One level backward

IMPORTANT NOTE: 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.

Setting the Temperature. Set the desired operating temperature by adjusting the set point with the up and down keys. The set point will be displayed in the lower green Set Point LED display and the actual temperature will be displayed in the upper red Process LED display. Please allow the instrument to fully equilibrate before proceeding with any testing.

Temperature Calibration. This routine allows the digital temperature controller to be calibrated to a certified thermometer.

- a. Use a certified calibrated measuring device to acquire the temperature. Calculate the difference between the measuring device and the Process value displayed on the controller.
- b. Press the program key two times until **Pct** is displayed in the lower green LED

display. Press the DOWN key. CAL will display on the lower green display. If there is a value observed in the upper red LED display, add it to the calculated difference obtained in the previous step. This is the offset value.

- c. Press the Program Key. The lower green display will flash. Use the up or down keys to adjust to the new calibration offset value on the upper red display calculated in the previous step. When the value has been entered, the controller will automatically store the value. The lower green display will stop flashing. If further adjustments are necessary, press the Program Key again. Resume regular operations by pressing the Exit / Function key two times. Verify if the new calibration is correct by observing the upper red display and comparing the value with the calibrated reference device.

Auto Tune. This routine allows the digital temperature control to learn the heating parameters needed for any particular set point temperature. This operation should be done when installing a new unit, after replacing or changing the bath medium type, or utilizing a different temperature set point 20% different from the previously used set point temperature.

- a. Set the operating temperature to the desired setting.
- b. Press the up and down arrow buttons simultaneously for about 5 seconds. When Auto Tune is active, the lower green LED display will blink **TUNE**. Auto Tune will automatically toggle off when the set point temperature is reached. Auto tune can be terminated by pressing the up & down buttons simultaneously again.

4.3 Preparation of Apparatus

(According to ASTM D88):

1. Use a Universal orifice or tip for lubricants and distillates with efflux times greater than 32 seconds to give the desired accuracy. Liquids with efflux times greater than 1000 seconds are not conveniently tested with this orifice.
2. Use a Furol orifice or tip for residual materials with efflux times greater than 25 seconds to give the desired accuracy. The Saybolt Furol viscosity is approximately one tenth the Saybolt Universal viscosity and is recommended for characterization of petroleum products such as fuel oils and residual materials having Saybolt Universal viscosities greater than 1000 seconds.
3. Clean the viscometer thoroughly with an appropriate solvent of low toxicity; then remove all solvent from the viscometer and its gallery. Clean the receiving flask in the same manner.

NOTE: The plunger commonly supplied with the viscometer should never be used for cleaning; its use might damage the overflow rim and walls of the viscometer.

4. Set up the viscometer and bath in an area where they will not be exposed to drafts or rapid changes in air temperature, and dust or vapors that might contaminate a sample.
5. Place the receiving flask beneath the viscometer so that the graduation mark on the flask is from 100-130 mm (4 to 5 inches) below the bottom of the viscometer tube and so that the stream of oil will just strike the neck of the flask.
6. Fill the bath to at least 6 mm (1/4 inch) above the overflow rim of the viscometer with an appropriate bath medium.
7. Provide adequate stirring and thermal control for the bath so that the temperature of a test sample in the viscometer will not vary more than $\pm 0.03^{\circ}\text{C}$ ($\pm 0.05^{\circ}\text{F}$) after reaching the selected test temperature.

8. Do not make viscosity measurements at temperatures below the dew point of the room's atmosphere.
9. For calibration and referee tests, keep the room temperature between 20 and 30°C (68 and 86°F) and record the actual temperature. However room temperatures up to 38°C (100°F) will not introduce errors in excess of 1%.

5 Operation

1. Remove the four binding post knobs on top of the bath. Remove the plug from behind the bath which is connected to the terminal box. Gently remove the cover, making sure not to damage the heaters or stirrer shaft and place it in a safe location.
2. Choose an appropriate viscometer tube. Remove the nut provided from the viscometer tube to be used. Install an orifice into the bottom of the viscometer tube and tighten with the provided orifice wrench.
3. Insert a viscometer tube into one of the holes inside the bath. Be sure to place the lead gaskets between the top and bottom surfaces of the tank. Screw on the nut from underneath the tank and tighten with the provided socket wrench. Up to four viscometer tubes may be used.
NOTE: If only two viscometer tubes are to be used, close off the two remaining holes with the two provided port closures and tighten with the socket wrench. Be sure to place the Teflon gaskets between the top and the bottom surfaces of the tank.
4. Fill the bath with oil (recommended by the test method) 1.5" from the top of the bath. Never turn the power ON unless there is bath medium present otherwise the heaters will burn out which will automatically void the warranty. Do not let any "bath" oil fall into the viscometer tubes.
5. Reinstall the cover on top of the bath into the screws and replace the two binding posts.
6. Place the port covers over the port holes.

7. Connect the plug from the terminal box into the back of the unit.
8. Install the RTD probe into the holder located on the right side on top of the bath.
9. Install a calibrated thermometer into the holder (cork) located in the center at the top of the bath.
10. Connect tubing from the overflow outlet (middle valve) located in the rear of the unit to a waste receptacle in case of oil expansion.
11. Connect tubing to the cooling coil valves, located in the back of the instrument, to a suitable cold water supply (only if needed).
12. Turn the Line and Light switches to ON.
13. To set to the desired temperature, use the UP/DOWN keys to set the temperature. After a few seconds, the microprocessor will start the heater.
14. Place the chained corks into the bottom of the viscometer tubes.
15. Place the 60mL Pyrex™ receiving flask underneath the bath in the spaces provided, making sure the graduation marks on the flasks are visible.
16. When the test temperature is stabilized, proceed to test in accordance with any of the test methods specified in Section 1.2.

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, please do not hesitate to contact the Koehler technical service department.

6.1 Routine Maintenance

The SV3000 Saybolt Viscometer Bath requires little routine maintenance to provide many years of continuous service. However, over the course of time, 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).

6.2 Bath Maintenance

Replace the oil in the bath when the color turns light to medium brown to avoid unwanted oil expansion. To drain the oil from the unit, place a sufficient waste receptacle under the drain located in the back of the unit. In the open position, the draincock will be parallel to the valve. When the bath is finished draining, close the draincock. In the closed position, the draincock will be perpendicular to the valve.

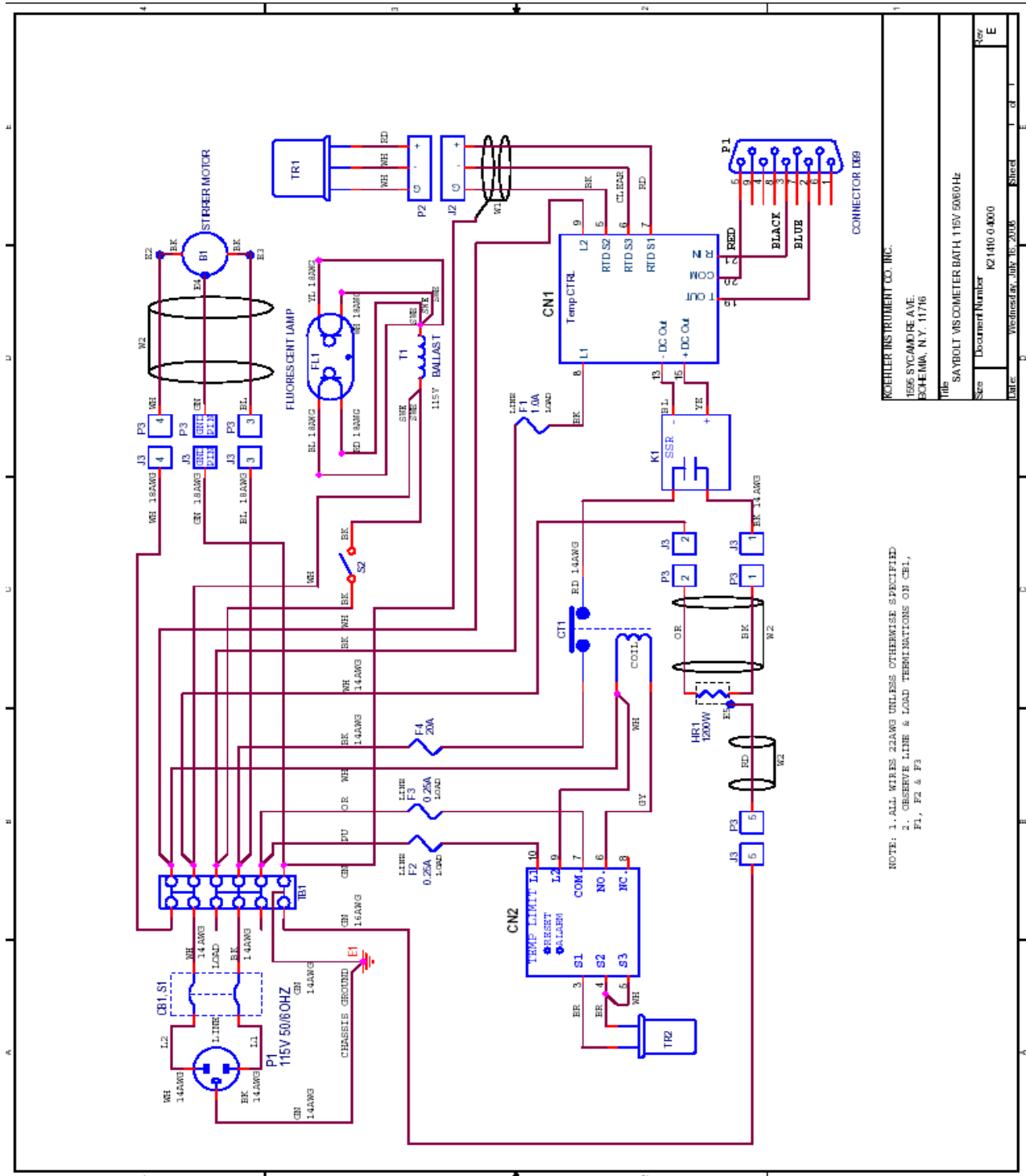
6.3 Replacement Parts

Part Number	Description
K22060	Oil Strainer
K214-0-29	Chained Corks
K214-0-31	Port Closure
K22050	Socket Wrench
K22090	Withdrawing Tube with Rubber Bulb
K22011	Thermometer Holder
K215-3	Teflon Gasket
K215-6	#5 Thermometer/Probe Holder (cork)
K23700-03013A	Stirrer Motor, 115V†
K21410-0-15	1200W Heater, 115V†
275-103-044	Temperature Controller
K23700-03014	Stirrer Motor, 230V‡
279-115-002	Fluorescent Lamp
265-600-001	RTD Probe, 0.25" x 4", 600F, Over Temperature
K70519	RTD Probe Assembly, Bath Temperature
240-115-008	Ballast, 120V, 60Hz †
240-230-014	Ballast, 230V, 50/60Hz ‡

Note: † For 115V only
‡ For 220-240V only

7 Wiring Diagrams

7.1 K21410 (115V) Model



NOTE: 1. ALL WIRES 22AWG UNLESS OTHERWISE SPECIFIED
2. OBSERVE LINE & LOAD TERMINATIONS ON CBI,
P1, P2 & P3
3. SWE INDICATES WIRES SUPPLIED WITH
EQUIPMENT

KOEHLER INSTRUMENTS CO., INC.

1595 SYCAMORE AVE.
ROCHESTER, N.Y. 11716

SCHEMATIC, SAYBOLT VISCOMETER BATH, 220-240V 50/60 Hz

Size	Document Number
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Date: Wednesday, July 16, 2008

9 Troubleshooting

WARNING: Troubleshooting procedures involve working with high voltages and/or temperatures which may result in personal injury or death, and should only be performed by trained personnel. Please do not hesitate to contact Koehler for assistance.

10 Service

Under normal operating conditions and with routine maintenance, the SV3000 Saybolt Viscometer Bath does 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: _____

11 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.

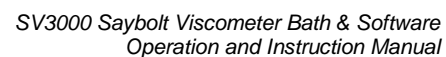
12 Warranty

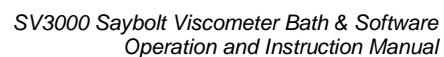
We, at Koehler, would like to thank you for your equipment purchase, which is protected by the following warranty. If within one (1) year from the date of receipt, but no longer than fifteen (15) months from the date of shipment, Koehler equipment fails to perform properly because of defects in materials 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.

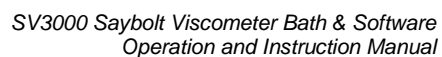
13 Returned Goods Policy

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 will 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.

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