



HKV4000 HIGH TEMPERATURE KINEMATIC VISCOSITY BATH

OPERATION AND INSTRUCTION MANUAL

REV C

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

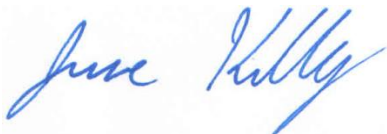
High Temperature Kinematic Viscosity Bath, HKV4000 K238X2

This certificate verifies that part number K238X2, High Temperature Kinematic Viscosity Bath, was manufactured in conformance with the applicable standards set forth in this certification.

Specifications:

ASTM D445
ASTM D2532
ASTM D6074
ASTM D6158
IP 71
ISO 3104
DIN 51550
FTM 791-305
NF T 60-100

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



EC Declaration of conformity

Koehler Instrument Company, Inc.
of 1595 Sycamore Av., Bohemia, New York USA

We declare that the product listed below meets all basic requirements in accordance with the following Directive(s) by design, type, and version placed upon the market by us.

2004/108/EC The Electromagnetic Compatibility Directive
2006/42/EC The Machinery Directive by way of the Low-Voltage directive 2006/95/EC

And hereby declare that:

Equipment: **HKV3000 and HKV4000 High Temperature Kinematic Viscosity Baths**
Model Number(s): **K23890 and K23892**

Qualifications:

This product may only be used in a professional laboratory setting by authorized personnel following the instruction handbook.

and

This product declaration is valid for unmodified equipment when installed and operated by authorized personnel following the instruction handbook.

Conforms to the following standards (as applicable):

Safety	Low-Voltage directive 2006/95/EC
EN 61010-1:2010	Safety Requirements for electrical equipment for measurement, control and laboratory use; by engineering design and risk review and by meeting the requirements of Hi-Pot Test (1500 VAC, 60 sec. per table 5) as detailed in the product's technical documentation.
EMC	Meets the essential requirements of EMC Directive 2004/108/EC by engineering design review and by meeting the requirements of Conducted Emissions Test for Group 1 Class A as detailed in the product's technical documentation.
EN 55011:2007	



James R. Ball
Dir. Research & Development

1595 Sycamore Av.
Bohemia, NY 11716
United States of America
March 20, 2014

www.koehlerinstrument.com

631-589-3800

WEEE Directive Compliance Statement

Background

The goal of the WEEE Directive is to encourage design of environment-friendly products that increase reuse, recycling and other forms of recovery to reduce waste streams and applies to listed Electronic and Electrical Equipment (EEE) and Koehler's equipment falls broadly into Appendix 1A; Section 9 Monitoring and Control Equipment: Measuring, weighing or adjusting appliances for household or as laboratory equipment.

Any associated non-embedded equipment such as Lighting (Saybolt Color) and PCs/Printers also fall under WEEE. If provided with an order these ancillary items must be WEEE compliant. For these and other reasons (printer cartridges are regionalized) the equipment must be supplied through a third party supplier in Europe.

The WEEE Directive applies to electrical and electronic equipment falling under the categories set out in Annex IA provided that the equipment concerned is not part of another type of equipment that does not fall within the scope of this Directive. Annex IB contains a list of products which fall under the categories set out in Annex IA.

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:037:0024:0038:en:PDF>

We do not qualify for any of the 10 exemption categories.

<http://www.dpa-system.dk/en/WEEE/Products/Exemptions>

Professional use

For equipment defined for 'professional use' local authorities have no role to play. Producers and importers are basically responsible for collection of WEEE recyclables from the professional user and for subsequent management. A separate statement is given cataloging the items that require separation from the equipment along with basic information on subsequent processing or recycling prior to disposal of the equipment.

<http://www.dpa-system.dk/en/WEEE/Products/Private-or-professional-use>

Responsibility for Registration and Annual Reporting:

Koehler will not sell directly to end users in the EU and so has no responsibility to register within each EU state and to make annual reports. Koehler declares that this responsibility is born by the importer who is the first level of the distribution chain and is subject to producer responsibility. We will communicate this in writing to our distributor/importers in the EU stating they are responsible to satisfy WEEE registration and reporting requirements in the EU states where they conduct sales activities.

It is illegal to market electrical and electronic equipment covered by producer responsibility without being registered.

<http://www.dpa-system.dk/en/WEEE/Producers/Whoissubjecttoproducerresponsibility>

Product Design

Koehler's designs allow for complete disassembly to a modular level which usually allows for standard recycling. A qualified refrigeration system technician must be consulted when disassembling and de-commissioning any equipment with refrigeration systems.

Koehler's scientific testing equipment is robustly designed to function over a long service life and are typically repaired many times over the course of years rather than being replaced. We believe that re-use and refurbishment is the very best form of re-cycling.

All batteries must be readily removable not soldered in place.

Recycling instructions

In the event that replacement becomes necessary, we will include instructions, particularized to each instrument that informs the customer of their recycling responsibilities and giving them

guidance in doing this. All Koehler equipment has been placed on the market since 13th August 2005 and so Koehler is defined as a "new WEEE producer". As such we must provide information on refurbishment, treatment, and re-use.

Our instrument manual will include this compliance statement and indicate that any collection of materials will be handled by their authorized distributor. In the event that the distributor is unreachable or is no longer a distributor for Koehler Instrument, Co., other arrangements may be made including accepting the materials directly.

Recycling is free of charge. Shipping is the responsibility of the end users. Whether shipping to a distributor or to Koehler directly, safe, properly declared, and labeled packaging and shipping expenses are the sole responsibility of the end user.

WEEE Marking



Since Koehler products are subject to the WEEE Directive we must display the WEEE symbol shown above in accordance with European Standard EN 50419 on the equipment. It must be indelible, at least 5mm in height, and clearly legible. If the equipment is too small the mark must be in the product literature, guarantee certificate, or on the packaging. Rules on marking are established in section 49 of the WEEE Order.

Koehler Instrument Company, Inc.
c/o RECYCLING
1595 Sycamore, Ave.
Bohemia, NY 11716

As a minimum the following substances, preparations and components have to be removed from any separately collected WEEE:

- Mercury containing components, such as switches or backlighting lamps (compact fluorescent lamps, CFL),
- Batteries
- Printed circuit boards if the surface of the printed circuit board is greater than 10 square centimeters (about 4 sq in.),
- Toner cartridges, liquid and pasty, as well as color toner,
- Chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC) or hydrofluorocarbons (HFC), hydrocarbons (HC)
- Liquid crystal displays (together with their casing where appropriate) of a surface greater than 100 square centimeters and all those back-lighted with gas discharge lamps,
- External electric cables
- Components containing refractory ceramic fibers as described in Commission Directive 97/69/EC of 5 December 1997 adapting to technical progress Council Directive 67/548/EEC relating to the classification, packaging and labeling of dangerous substances (2),
- Electrolyte capacitors containing substances of concern (height > 25 mm, diameter > 25 mm or proportionately similar volume)

2. The following components of WEEE that is separately collected have to be treated as indicated:

- Equipment containing gases that are ozone depleting or have a global warming potential (GWP) above 15, such as those contained in foams and refrigeration circuits: the gases must be properly extracted and properly treated. Ozone-depleting gases must be treated in accordance with Regulation (EC) No 2037/2000 of the European Parliament and of the Council of 29 June 2000 on substances that deplete the ozone layer (4).

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1 Introduction

The Koehler HKV4000 High Temperature Kinematic Viscosity Instrument is the latest design for performing kinematic viscosity tests with glass capillary viscometers according to the ASTM D445 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 Kinematic Viscosity Instrument and Data Acquisition Software. 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
<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

ASTM Publication:

- ASTM D445: Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
- ASTM D2170: Kinematic Viscosity of Asphalts (Bitumens)
- ASTM D6074: Standard Guide for Characterizing Hydrocarbon Lubricant Base Oils
- ASTM D6158: Standard Specification for Mineral Hydraulic Oils

2. International Organization for Standardization (ISO)
1, rue de Varembe
Case postale 56
CH-1211 Geneva 20, Switzerland
Tel: 41 22 749 01 11 • Fax: 41 22 733 34 30
<http://www.iso.org>

ISO Publication:

- ISO 3104: Petroleum products
Transparent and opaque liquids
Determination of Kinematic viscosity and calculation of dynamic viscosity

3. 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 71: Kinematic viscosity and calculation of dynamic viscosity
- IP 319: Kinematic viscosity of bitumens

4. Deutsche International Norm (DIN)
<http://www.din.de>

DIN Publication:

- DIN 51550: Determination of Kinematic Viscosity and Dynamic Viscosity

5. Federal Test Method (FTM)

FTM Publication:

- FTM 791-305: Kinematic Viscosity of Petroleum Products

6. Association Française de Normalisation (AFNOR)

<http://www.afnor.fr>

AFNOR Publication:

- NF T 60-100: Kinematic Viscosity of Petroleum Products

1.3 Instrument Specification

Models: K23802
K23892

Electrical Requirements: 115V 60Hz, single phase 12.7A
220-240V 50/60Hz, single phase 7.3A

Temperature Range: Ambient to 232°C (450°F)

Optional Temperature Range: 10° to 232°C (50° to 450°F)*

Temperature Control Stability: Exceeds ASTM requirements

Temperature Display: 0.1°C / 0.1°F resolution, calibrate to 0.01°C / 0.01°F

Viscometer Ports: Seven (7) round 2" (51mm) ports

Bath Medium: Water or suitable heat transfer fluid

Bath Medium Capacity: 22L (5.8 gal)

*Temperatures below ambient require an optional external chiller.

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 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.

Over Temperature Protection. This unit is equipped with Over Temperature Protection (OTP) circuitry to prevent overheating. The unit will automatically interrupt power whether equipment malfunction or operator error causes the temperature to exceed either 20 °C above the set point or the maximum recommended temperature range. The power can only then be restored by identifying and correcting the problem, allowing the unit to return to normal operating temperatures, and resetting the power to the unit.

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

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

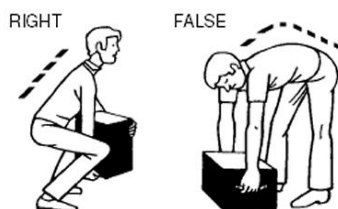
- HKV4000 Kinematic Viscosity Bath
- Seven (7) Viscometer Port Covers
- HKV4000-Manual HKV4000 Kinematic Viscosity Bath Operation and Instruction Manual

3.2 Unpacking

1. Check Shock Watch Label on Cardboard Box for indication of rough handling and possible damage.
2. Check labeling for correct orientation of instrument. (e.g. This Side Up)
3. Carefully open top of box with box cutter and remove packing foam.
4. Look inside bath from top of box, to verify that the Glass Bath Jar is in tact.
5. Make two additional vertical cuts, using box cutter, along length of two sides of the box and remove packing foam.
6. Extract instrument and place on suitable cart for transportation to work area / lab bench.



WARNING: Be sure two or more individuals are available for extracting and lifting instrument from box to cart and from cart to bench. Individuals must lift in accordance to proper technique. See Figure below.



7. Lift instrument from cart and place on bench.

8. Remove foam insert Borosilicate Glass Jar as per steps 9 thru 19.
9. Using a flat head screwdriver, remove the four (4) silver screws located at the four corners of the back panel.
10. Remove the back panel plate and set aside.
11. A collection of wires runs from the lower control panel up the left side, while looking at the back of the bath. Halfway up the wiring are three points where the wires can be disconnected. See Figure below:



12. There are a total of three joints to disconnect. First disconnect the single large cluster of wires by pressing in the sides of the lower plastic piece then pulling the top plastic piece.
13. Then disconnect the two smaller joints. Each side of the joint is labeled with an identical number one (1) or number two (2). This makes for easy connection when re-assembling the instrument.
14. Once the wiring is completely disassembled it is safe to remove the top assembly of the bath.
15. Remove the six (6) screws lining the two sides of the top assembly with a Philips head screw driver.
16. Make sure there is sufficient space with cleaning clothes to place the top assembly when lifted off the bath.
17. Lift the top assembly with one hand on the back side and one hand on the front side of the top assembly. Place top plate assembly on flat surface with the back side of the top plate assembly and the heating coils on the surface.

18. With the top plate assembly now removed from the main instrument it is now easy to access the bath jar to remove the protective foam insert.
19. Re-assemble the instrument
20. 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.



WARNING: Certain mechanical stresses applied to the tempered glass front panel and inner the inner borosilicate glass jar pose a hazard to personnel. Impacts to these during normal operation can shatter the glass components releasing the bath fluid posing thermal burn hazards and slipping hazards. For this reason the instrument must be operated by and accessible only to trained and authorized personnel and located in an area where this type of impact is likely to occur.

Environmental Conditions: The instrument environment must comply with the following conditions for proper setup:

- No / Low Dust
- No direct sunlight
- Not near heating or AC ventilation ducts
- No Vibrations
- Clearance from other instruments

- Temperature Range: 5 to 40°C
- Elevation to 2000 meters
- Relative Humidity: < 80%

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.

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

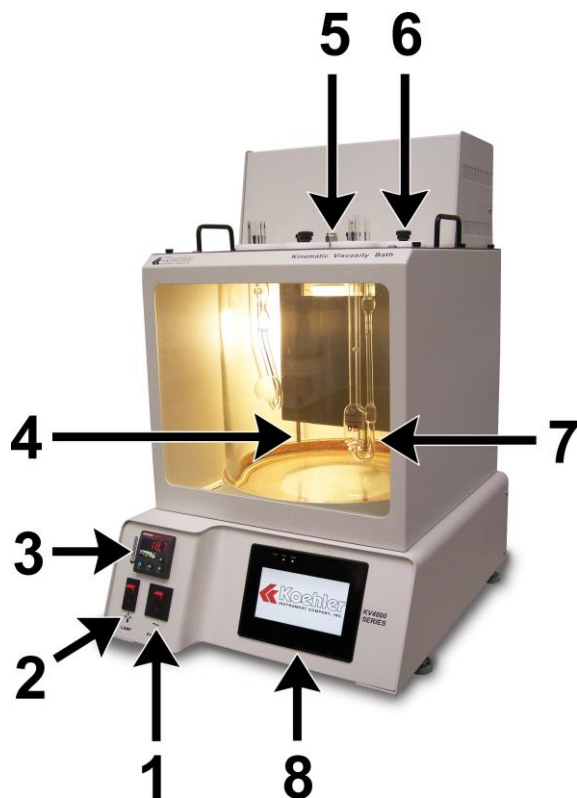


Figure 1. Instrument Descriptions

1. **Power Switch.** This switch controls the power to the entire unit. When the power switch is in the **ON** position, the digital temperature controller, and the stirrer are powered on.
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. **Temperature Regulation:** The heater coils stabilize the bath temperature to desired setting within $\pm 0.02^{\circ}\text{C}$. Running coolant through the cooling coils allows bath to maintain temperatures near or below ambient.

5. **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.
6. **Viscometer Ports:** The viscometer, once engaged into the assembly, is placed into the bath through the viscometer ports on top of the instrument.
7. **Bath / Bath Stirrer:** The stirrer 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. **Interface:** Here the user can set operation parameters and view results on the digital display.

4.2 Accessories for Running Tests

Glass Capillary Viscometer Tubes for HKV4000

Koehler offers a full selection of glass capillary kinematic viscometers, which are ordered separately from the HKV4000 instrument, for measuring kinematic viscosity of liquid products as per ASTM D445 and related standard test methods. All types of viscometers conform to ASTM D445 and related methods for glass capillary kinematic viscometers. The constant for each individual viscometer is written on the Certificate of Calibration, included in the packaging.

IMPORTANT: It is recommended when using a new viscometer for the first time to run a test with suitable standard. Different locations may result in a slightly different constant.

Cannon®-Fenske Routine Viscometers

The Cannon®-Fenske Routine viscometer is a rugged and inexpensive viscometer that works well if the sample is transparent or translucent.

- For kinematic viscosity of transparent liquids up to 20,000cSt.

- Requires a sample of approximately 7mL.

Catalog No.	Size	Approximate Constant, cSt/s	Kinematic Viscosity Range, cSt
378-025-C01	25	0.002	0.5 to 2
378-050-C01	50	0.004	0.8 to 4
378-075-C01	75	0.008	1.6 to 8
378-100-C01	100	0.015	3 to 15
378-150-C01	150	0.035	7 to 35
378-200-C01	200	0.1	20 to 100
378-300-C01	300	0.25	50 to 250
378-350-C01	350	0.5	100 to 500
378-400-C01	400	1.2	240 to 1,200
378-450-C01	450	2.5	500 to 2,500
378-500-C01	500	8	1,600 to 8,000
378-600-C01	600	20	4,000 to 20,000
378-650-C01	650	45	9,000 to 45,000
378-700-C01	700	100	20,000 to 100,000

Cannon®-Fenske Opaque Reverse Flow Viscometers

The reverse flow viscometers are designed for testing opaque liquids. These viscometers wet the timing section of the viscometer capillary only during the actual measurement and must be cleaned, dried and refilled before a repeat measurement can be made. By contrast, other viscometer types commonly used to measure transparent liquids allow the sample to be repeatedly drawn up into the capillary, permitting duplicate measurements.

- For measurement of transparent and dark liquids having kinematic viscosities of up to 20,000cSt
- Requires a sample of approx 12mL.
- Can be used for viscosities of asphalts by ASTM D2170 method.

Catalog No.	Size	Approximate Constant, cSt/s	Kinematic Viscosity Range, cSt
378-025-C02	25	0.002	0.4 to 2
378-050-C02	50	0.004	0.8 to 4
378-075-C02	75	0.008	1.6 to 8
378-100-C02	100	0.015	3 to 15
378-150-C02	150	0.035	7 to 35
378-200-C02	200	0.1	20 to 100
378-300-C02	300	0.25	50 to 250
378-350-C02	350	0.5	100 to 500

378-400-C02	400	1.2	240 to 1,200
378-450-C02	450	2.5	500 to 2,500
378-500-C02	500	8	1,600 to 8,000
378-600-C02	600	20	4,000 to 20,000
378-650-C02	650	45	9,000 to 45,000
378-700-C02	700	100	20,000 to 100,000

Ubbelohde

Ubbelohde viscometers measure transparent liquids, and unlike the Cannon®-Fenske Routine viscometers, they maintain the same viscometer constant at all temperatures. This is advantageous when samples are to be measured at different temperatures.

- Suspended-level type viscometers are for transparent liquids of up to 100,000cSt
- Requires a sample volume of approx 11mL.

Catalog No.	Size	Approximate Constant, cSt/s	Kinematic Viscosity Range, cSt
378-000-C03	0	0.001	0.3 to 1
378-00C-C03	0C	0.003	0.6 to 3
378-00B-C03	0B	0.005	1 to 5
378-001-C03	1	0.01	2 to 10
378-01C-C03	1C	0.03	6 to 30
378-01B-C03	1B	0.05	10 to 50
378-002-C03	2	0.1	20 to 100
378-02C-C03	2C	0.3	60 to 300
378-02B-C03	2B	0.5	100 to 500
378-003-C03	3	1	200 to 1,000
378-03C-C03	3C	3	600 to 3,000
378-03B-C03	3B	5	1,000 to 5,000
378-004-C03	4	10	2,000 to 10,000
378-04C-C03	4C	30	6,000 to 30,000
378-04B-C03	4B	50	10,000 to 50,000
378-005-C03	5	100	20,000 to 100,000

Viscometer Holders

To perform viscosity measurements, Koehler offers viscometer holders for use with the HKV4000. The correct holder must be used with the corresponding viscometer tube for proper operation:

Viscometer Tube Type	Corresponding Holder
Cannon®-Fenske Routine	K23381
Reverse Flow	K23383
Ubbelohde	K23382

4.3 Temperature Controller Operation

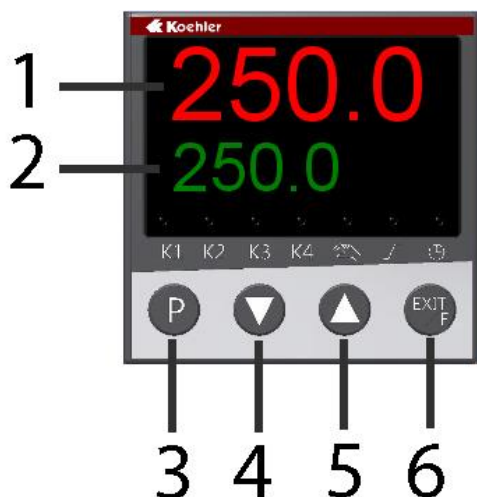


Figure 4. Temperature Controller

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. In the calibration mode, the display will always give 2 decimal places.

- 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.

4.4 Recommended Accessories

- **Withdrawal Bulb.** Use to pull sample into viscometer tube.
Catalog Number: K22090
- **Viscometer Tube Stopper.** Insert in the top opening of the viscometer tube to prevent sample from flowing due to gravity.
Catalog Number: K23311 for a pack of 12
- **Operation near or below ambient temperatures.** A water supply or external chiller may be used to maintain the temperature of the bath for cooler temperature. Hose-barb connections for water or refrigerated coolant are located at the back of the bath. There are two connections: inlet and outlet. The hose connections can be secured with copper wire or pull ties to prevent the tubing from disengaging from the connection.

5 Operation

This unit is designed for performing kinematic viscosity tests using glass capillary viscometers. Please be sure to read the safety and hazard warnings, the installation procedure, and any of the standard test methods before operating this instrument.

5.1 Bath



WARNING: 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 would be void.

Fill the bath with the appropriate heat transfer fluid based upon the testing temperature. Fill the bath with the medium from the top through one of the seven port openings using a wide neck funnel with a 500mL griffin beaker adding about ½ L at a time to 2" (5 cm) from the top of the bath to allow room for fluid expansion. This will provide the proper depth for immersing the viscometers and allow for thermal expansion.



NOTE: Do not attempt moving the bath when filled with fluid medium. Drain all fluid before moving or relocating the instrument. See section 7.2 of this document. Sudden starting and stopping could result in hot bath fluid being forcefully ejected from the bath. It could also result in overbalancing and tipping over the instrument.

NOTE: Do not drain the bath until the fluid is at ambient temperature.

Testing Temperature	Recommended Fluid
15 - 50°C*	Distilled water will be suitable.
50 - 95°C	Koehler supplies highly refined white technical oil (part # 355-001-001) that contains an oxidation inhibitor to limit clouding at higher temperatures. CAS# 8042-47-5 Minimum Flash Point: 120°C (248°F) Fire Point: 202°C (395°F)
95 - 150°C	Koehler supplies a clear silicone heat transfer fluid (part # 355-001-002) with high oxidation resistance and low volatility. CAS # 63148-62-9. Minimum Flash Point: 200°C (392°F).



NOTE: Do not use bath fluids that will decompose or volatilize producing flammable vapors below the maximum instrument operating temperature +25°C.



NOTE: Coloration of the Mineral or Silicon Bath Oil is an indication that the Medium must be changed. See Draining instructions in section 7.3 of this document. When a decision is made to discard this material, dispose of this material and its container to a hazardous or special waste collection point. Country, State, or local laws may impose additional regulatory requirements regarding disposal. Dispose in accordance to all applicable regulations.



WARNING: Bath oils contaminated with light ends can pose a flammability hazard.

5.2 Start Up

1. Turn on the main power switch to the unit.



WARNING: 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 would be void.

2. Install the appropriate ASTM thermometer in the top of the bath using the holder provided.
3. Set the desired bath test temperature with the digital temperature controller and allow for the bath medium to come to equilibrium. This process could take 1 to 2 hours due to the high accuracy requirement of standardized viscosity tests. Verify the temperature displayed by the temperature controller matches that of the ASTM Thermometer. Calibrate if necessary. (See Section 4.3 for full operational details of the temperature controller).

5.3 Control Panel Operation

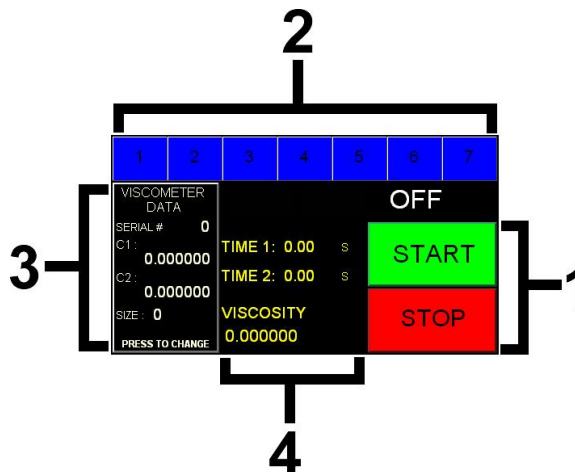







Figure 3. Control Panel_Main Screen

1. **Start / Stop.** Pressing the green start button  will start the time, beginning a test. A single press of the red stop button  will stop the time and a resulting viscosity value will automatically be calculated and displayed. Holding the red stop button  for 2 seconds or more will reset the time and viscosity data.
2. **Viscometer Ports.** A row of blue box buttons  line across the top of the control panel. These boxes are designated 1 thru 7 and represent the 7 viscometer ports available for use in the bath. Pressing the different blue box buttons  allow the user to virtually scroll through individual test ports for test monitoring, data entry, etc.
3. **Viscometer Data.** The Viscometer Data Box displays information regarding the viscometer to be used during a test. The information includes the viscometers serial number, constant 1, constant 2 (if applicable), and size. Pressing the Viscometer Data Box brings the user to the Viscometer Setup Screen (See Figure 4), where the user can input the viscometer parameters displayed.
4. **Test Data.** Displays the run time during a test in seconds. Time 1 indicates the

elapsed time for a standard test for a viscometer with a single constant. The Time 2 is only used when a viscometer has two constants (C1 & C2, e.g. Cannon-Fenske Opaque). The Test Data area also displays the Viscosity value automatically after a test is complete.

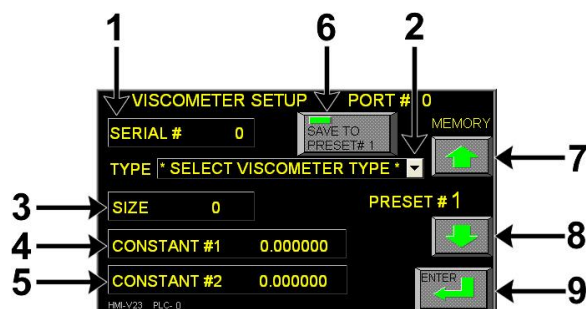





Figure 4. Control Panel_Viscometer Setup Screen

1. **Serial #.** Pressing the serial number button will bring up a numerical keypad where the user can input a serial number provided on the calibration certificate provided with the viscometer.
2. **Type.** Press the down arrow for a pull down menu of available viscometer tube types. Choose the desired type by pressing on the appropriate name. The name will then appear in the Type Window.
3. **Size.** Pressing the Size button allows the user to input the size of the viscometer tube using the pop up numerical keypad. The size of the viscometer can be found on the calibration certificate provided with the viscometer.
4. **Constant #1.** Press the Constant #1 button to input the viscometer tube constant value using the pop up numerical keypad. The constant value can be found on the calibration certificate provided with the viscometer.
5. **Constant #2.** Press the Constant #2 button to input a second viscometer tube constant value using the pop up numerical keypad. A second constant value can be found on the calibration certificate provided with viscometers that utilize two constants. E.g. Cannon-Fenske Opaque Type.


6. **Save to Preset.** After inputting the viscometer parameters: Serial #, Type, Size, Constant, pressing the Save to Preset

button  will save the input parameters to one of the 20 available memory programs. The user can then easily access the information of a specific viscometer by scrolling the memory presets using the up and down arrows.

7. **Up Arrow.** Press the up arrow  to scroll through the 20 available viscometer preset programs.

8. **Down Arrow.** Press the down arrow  to scroll through the 20 available viscometer preset programs.

9. **Enter.** Once you have input the viscometer parameters, saved to a selected preset and chosen that particular preset, press the

enter button  to export the viscometer parameter data to the main menu screen. The viscometer data entered / chosen will automatically be uploaded to the main menu and will be displayed in the Viscometer Data box.

5.4 Test Procedure

A quick guide for operating the HKV4000 High Temperature Kinematic viscosity bath is given below. Use this guide along with an applicable standardized test procedure listed in section 1.2 of this document when performing Kinematic viscosity testing.

After the main power switch to the instrument is turned on, the control panel will illuminate and display the Koehler Instrument Splash Screen. After a few seconds the main screen will display on the control panel. See Figure 3 in section 5.3 and Figure 5 below for an additional illustration.



Figure 5. Control Panel_Main Screen

NOTE: Detailed descriptions for the functionality of each button are described in section 5.3 of this document.

Verify that the bath medium had come to equilibrium at the required test temperature as per section 5.2 of this document.

Fill viscometer tube with test sample using a laboratory funnel or other filling device.



WARNING: Do not test or run materials that boil or exhibit high vapor pressure at the bath test temperature.

Pull the sample through the viscometer tube using a withdrawal bulb or vacuum system to the initial testing position above the first line. This is also called charging the viscometer.

Place stopper in the top of the viscometer tube and remove the withdrawal bulb.

NOTE: The procedure for charging a specific viscometer will vary depending on the viscometer used. Please refer to ASTM D446 or related international specification for a detailed charging procedure specific to the viscometer tube being used.

Engage the charged viscometer into an appropriate viscometer holder and place into one of the seven available ports through the top of the viscosity bath.

The sample temperature must come to equilibrium with the bath temperature prior to testing. Depending on the sample type, this process could take 30-45 minutes. Use this time to input the required viscometer data into the control panel.

Press the Viscometer Data Box (section 5.3, point 3) to access the Viscometer Setup Screen. See Figure 4 in section 5.3 and Figure 6 below for an additional illustration.




Figure 4. Control Panel_Viscometer Setup Screen


Refer to Section 5.3, points 5 thru 12 for instructions on how to input and load viscometer parameter data.

After all required parameters are entered and the sample temperature has reached the test temperature it is time to begin the test.


Remove the stopper. When the sample passes the first indication line of the viscometer tube, press the Start button **START** on the Control Panel. The viscometer status, which as a default displays **OFF**, will change to **RUN** and the integrated timer will begin.

When the sample passes the second indication line, press the Stop button **STOP**. The time will stop, the status will display **DONE**, and a viscosity value will automatically be displayed at the bottom of the Test Data area (Figure 3, point 4).

Pressing and holding the Stop button  for 2 seconds or more will reset the time and viscosity values and OFF will display as the status.

When using a viscometer with two (2) constants, two (2) time values are used to calculate viscosity. This means that when running a viscosity test using a two constant viscometer the Stop button  must be pressed twice.

When the sample passes the first indicator line the **Time 1** will stop and **Time 2** will begin. The status will change from **RUN** to **RUN 2**.

Once the sample passes the second indicator line on the viscometer tube, press the Stop button  a second time and the **TIME 2** will stop. The status will change from **RUN 2** to **DONE** and the viscosity value will automatically be calculated and displayed.

6 Safety Features

The Koehler HKV4000 High Temperature Kinematic Viscosity System is equipped with several safety and protection features, which are described in the following sections.



WARNING: The bath is **NOT** Explosion Proof.

6.1 Over-Temperature Protection

The Koehler HKV4000 High Temperature Kinematic Viscosity System is equipped with Over-temperature Protection (OTP) circuitry, which prevents the unit from exceeding unsafe operating temperatures. If the unit cannot maintain the set point temperature and begins to decline, the OTP circuitry may have been activated. Please follow these steps.

1. Turn off the unit power switch and disconnect the line cord.
2. Determine the source of the problem and correct the situation.
3. Restart the unit. Monitor the operations to ensure that the unit is operating properly. If you are still experiencing trouble, please

contact Koehler technical service for assistance.

6.2 Over-Power Protection

The Koehler HKV4000 High Temperature Kinematic Viscosity System is equipped with Over-power Protection circuitry, which prevents the unit from unsafe electrical conditions. If power to the unit is lost, then turn off the main power and turn it back on again. The main power switch also functions as a circuit breaker.

7 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.

7.1 Unit does not power-up

- Establish that the socket outlet is providing proper and adequate voltage.
- Check if Overpower Protection circuitry located directly behind the temperature controller inside the front tray has been activated.
- Check if line switch is in the **ON** position.
- If problem persists, please call the Koehler technical service department for assistance.

7.2 Unit is on and keeps resetting into start up routine

- For 220V units, make sure that the socket outlet is greater than 215V.
- Check if there is a steady and reliable power source.
- Make sure the connector plug on the rear panel is firmly plugged in.

7.3 Unit is on but bath does not heat up

- Make sure that the actual temperature reading is not higher than the set-point temperature.
- Determine if the temperature controller is properly calibrated by comparison to an ASTM standard thermometer.

- Determine if the Overtemperature Protection (OTP) circuitry has been activated.

7.4 Bath heats up but temperature does not stabilize

- Make sure there are no drafts from open doors, windows, or environmental control vents in the vicinity of the bath.
- If the set temperature is close to ambient, then you may need to circulate cold water through the coils in order to achieve proper temperature stability.

8 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.

8.1 Routine Maintenance

The HKV4000 High Temperature Kinematic Viscosity System 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).

8.2 Bath Cleaning

- To clean the instrument's exterior, which includes all painted surfaces and glass, either a solution of soap and water or laboratory grade detergent may be used.
- Apply cleaner to clean wipe or cloth, not to the instrument directly. Wipe surface clean.
- **Do Not** clean bath exterior with organic chemicals such as Acetone, Toluene, Hexane, etc.
- For more difficult cleaning of finished surfaces, a dilute solution or isopropanol in water may be used.

- It is not recommended that more aggressive solvents be used on painted surfaces since paint color will tarnish or be stripped from the instrument.
- Stainless Steel surfaces, such as on the top plate, may be cleaned using a more aggressive solvent such as a stainless steel cleaner.
- Glass surfaces may be cleaned using a more aggressive solvent such as acetone, if necessary.



SHOCK AND BURN HAZARD: Only clean inside the bath when equipment is de-energized and unplugged from the mains power supply. Allow adequate time for heating coils to completely cool before cleaning.

8.3 Draining / Changing Bath Medium



WARNING: Do not begin draining the bath medium until it has reached ambient temperature.

NOTE: When a decision is made to discard this material, dispose of this material and its container to a hazardous or special waste collection point. Country, State, or local laws may impose additional regulatory requirements regarding disposal. Dispose in accordance to all applicable regulations.

1. Remove one of the seven port covers from the top plate of the bath.
2. Insert a siphoning tube into the port opening and lower tube to bottom of glass bath jar.
3. Apply a reduced pressure to the opposite end of the tube with a pump or withdrawal bulb.

NOTE: Be sure the discharging end of the tube is below the surface of the bath reservoir.

4. Remove the withdrawal bulb or suction pump from the end of the tube and allow the bath medium to drain into a lower reservoir or receptacle.

5. Once the bath fluid is drained from the bath, it is time to remove the complete top assembly of the bath.
6. Using a flat head screwdriver, remove the four (4) silver screws located at the four corners of the back panel.
7. Remove the back panel plate and set aside.
8. A collection of wires runs from the lower control panel up the left side, while looking at the back of the bath. Halfway up the wiring are three points where the wires can be disconnected. See Figure 4 below:



Figure 4. Wiring Disconnection Point

9. There are a total of three joints to disconnect. First disconnect the single large cluster of wires by pressing in the sides of the lower plastic piece then pulling the top plastic piece.
10. Then disconnect the two smaller joints. Each side of the joint is labeled with an identical number one (1) or number two (2). This makes for easy connection when re-assembling the instrument.
11. Once the wiring is completely disassembled it is safe to remove the top assembly of the bath.
12. Remove the six screws lining the two sides of the top assembly with a Philips head screw driver.
13. Make sure there is sufficient space with cleaning clothes to place the top assembly when lifted off the bath.

14. Lift the top assembly with one hand on the back side and one hand on the front side of the top assembly. Place top plate assembly on flat surface with the back side of the top plate assembly and the heating coils on the surface.
15. With the top plate assembly now removed from the main instrument it is now easy to access the inside of the bath jar for further cleaning.
16. With the top assembly resting on its back, it is now possible to clean the heating coils, stirrer blade and rod and other components that have been in contact with the bath medium during operation.
17. Once the bath jar and top assembly are clean and dry, re-assemble the instrument and fill the bath with new medium as per section 5.1 of this document.

8.4 Changing Bath Lamp / Bulb

1. Using a flat head screwdriver, remove the four (4) silver screws located at the four corners of the back panel.
2. Remove the back panel plate and set aside.
3. The lamp / light bulb is located at the top right cover of the instrument. See Figure 5.



Figure 5. Lamp Location

4. Turning counterclockwise, remove the old light bulb.
5. Replace with new light bulb and re-assemble the back plate.

8.5 Replacement Parts

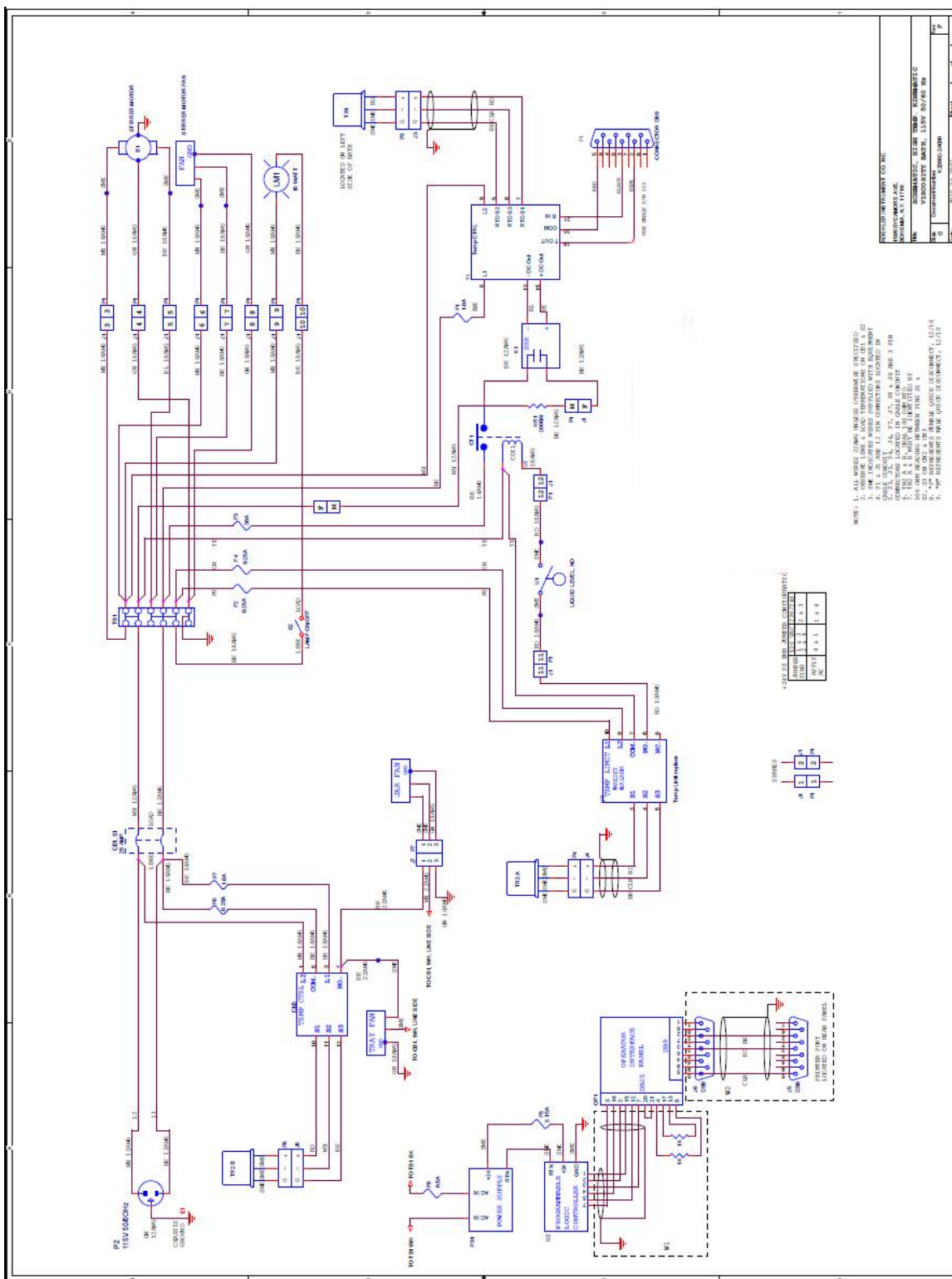
Part Number	Description
050-001-028	Single Pole Switch, 15A
091-032-001	Solid State Relay, 4-32 VDC, 20A
275-103-036	RTD Temperature Safety Limit, 120V [†]
275-103-037	RTD Temperature Safety Limit, 230V [‡]
278-001-002	Slow-Blow Fuse, 1A, 5x20 mm
278-104-002	Slow-Blow Fuse, 0.25A, 5x20 mm
278-003-001	Slow-Blow Fuse, 3.15A, 5x20mm
278-020-004	Time Delay Fuse, 20A, 600VAC
278-102-003	Fast-Acting Fuse, 0.5A, 2AG
278-002-002	Fuse, 2A,Slo-Blo,5x20mm
275-103-027	Temperature Controller 100-240V, with RS-232 Board
279-115-009	Fluorescent Compact, 120V, 15W
379-001-001	Liquid Level Switch
K23700-02003	RTD Assembly
K23700-03024	Moisture Barrier Gasket
K23800-03006	Heater, 115V, 1700W [†]
K23800-03015	Heater, 230V, 1700W [‡]
K23700-03013A	Stainless Steel Shaft Motor, 115V, 60Hz, 1/20HP [†]
K23700-03014A	Stainless Steel Shaft Motor, 230V, 50/60W, 1/15HP [‡]
090-240-021	DPST Contactor, 240V, 30A [‡]
240-230-004	Transformer [‡]

[†]For 115V model ONLY (K23802)

[‡]For 220V model ONLY (K23892)

9 Wiring Diagrams

9.1 K23802 Wiring (115V)



10 Service

Under normal operating conditions and with routine maintenance, the HKV4000 High Temperature Kinematic Viscosity System 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: _____

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,

HKV4000-Manual

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.



Notes

This image shows a full page of blank white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for writing or drawing. There are no margins, text, or other markings on the paper.



Notes

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