



K88500 AIR RELEASE VALUE INSTRUMENT

OPERATION AND INSTRUCTION MANUAL

REV C

Koehler Instrument Company, Inc.

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Petroleum Testing & Analysis Instrumentation • Custom Design & Manufacturing

CERTIFICATE OF CONFORMANCE

Air Release Apparatus K8850X

This certificate verifies that part number K8850X, Air Release Apparatus, was manufactured in conformance with the applicable standards set forth in this certification.

Specifications: **ASTM D3427**
 IP 313
 ISO 9120
 DIN 51381
 NF E 48-614

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

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 and are 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 K88500 Air Release Value Instrument and Data Acquisition Software is the latest design for performing the ASTM D3427 test method and related test specifications.

The air release value is the ability of a turbine, hydraulic, or lubricating oil to separate entrained air and is a key performance characteristic in applications where agitation causes a dispersion of air bubbles in the oil. To determine air release properties, the sample is heated to a specified test temperature and blown with compressed air. After the air flow is stopped, the time required for the air entrained in the oil to reduce in volume to 0.2% of original value is the air bubble separation time.

This manual provides important information regarding safety, technical reference, installation requirements, operating condition specifications, user facility resource requirements, and operating instructions for the Air Release Value 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.

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Tel: +1 631 589 3800
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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 D3427: Air Release Value of Petroleum Oils

2. International Organization for Standardization (ISO)
1, rue de Varembé
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 9120: Petroleum and related products – Determination of Air Release Properties of Steam Turbine and other Oils – Impinger Method

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 313: Air Release Properties of Petroleum Oils

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

DIN Publication:

- DIN 51381

5. Association Française de Normalisation (AFNOR)
<http://www.afnor.fr>

AFNOR Publication:

- NF E 48-614

1.3 Instrument Specifications

Model: K88500

Electrical Requirements: 115V 60Hz

Temperature Range: Ambient to 75°C (167°F)

**Dimensions
l_xw_xh, in.(cm):** 24x28x38¼ (61x71x97)
(Air Release Value Apparatus Only)

Net Weight: 225 lbs (103kg)
(Complete System)

Shipping Dimensions: 50.7 Cu.ft.

Shipping Weight: 300 lbs (136kg)
(Complete System)

1.4 Software Specifications

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

Operating System: Windows® 98 SE, 2000, NT, XP, Vista, 7 (32-Bit)

Memory Requirements: 32Mb RAM
(64Mb RAM recommended)
15 Mb Hard Disk Space
(minimum)

Other: One or Two RS-232 communication ports
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 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

- K88500 Air Release Value Instrument
- K88500-1 Jacketed Test Vessel
- 373-230-001 Density Balance
- K885-240-4 Drying Oven
- K885-240-3 Circulation Bath
- K88500-03016 Sinkers, 10mL
- K88500-03023 Sinkers, 5mL
- 250-000-12C ASTM 12C Thermometer
- 265-122-003 RTD Temperature Probe
- 311-100-005 Pressure Gauge, 0-1000 kpa
- K88500-Manual K88500 Air Release Value Instrument Operation and Instruction Manual

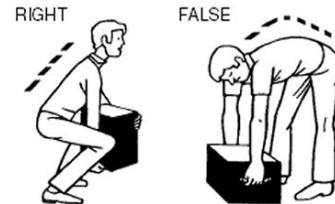
Accessories (purchased separately):

- K88520 Air Release Value Software Package
 - K88520-1 Temperature Male / Male null modem cable
 - 465-001-010 Balance Cable, Male / Female
 - 437-003-001 Converter, 2 port RS232 to USB
 - K88520-SW D3427 Air Release Software Disc

3.2 Unpacking

1. The K88500 Air Release Value instrument will ship and arrive in two large packages:
 - Wooden Crate
 - Cardboard Box
2. To open the Wooden Crate, a crowbar or prybar and a hammer will be required. Use the crowbar and hammer to first open the top of the crate.
3. Once the entire top piece is removed, observe inside the crate for the instruments orientation. Locate the front of the instrument and remove the corresponding front panel of the wooden crate.
4. Once the top and front panels of the crate have been removed it will be easy to remove the 2x4 supports.
5. Extract the instrument from the crate 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.



6. Lift instrument from cart and place on lab bench.
7. Before opening the Cardboard Box, check the Shock Watch Label on the Box for indication of rough handling and possible damage.
8. Check labeling for correct orientation of instrument. (e.g. This Side Up)
9. Carefully open top of box with box cutter and remove packing foam.
10. Make two additional vertical cuts, using box cutter, along length of two sides of the box and remove packing foam.
11. Extract the circulator bath, drying oven and density balance and place on suitable cart for transportation to work area / lab bench.
12. 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. Make sure the instrument is placed 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.

Place the water circulator to the right of the main unit, the analytical balance on the sliding tray located on the top of the main unit, and the oven in an appropriate and safe location.

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.

Air exits through a top opening of the jacketed test vessel and may expel traces of the sample test oil. It is recommended to connect ventilation tubing to this opening that leads to a waste container or receptacle.

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%

Thermometer. Place the thermometer into the thermometer holder located at the top of the main unit, inserting about 1cm above the -20 °C mark in order to avoid restricting the air path as well as causing breakage to the thermometer. Make sure to tighten the nut in order to secure the thermometer without breaking it, as this can be a source for air leaks while performing the test.

Glassware. Place the air inlet tube into the jacketed test vessel. Secure the assembly to the front of the main unit, where the rotating plate serves the resting base for the jacketed test vessel.

Analytical Balance. As mentioned above, the analytical balance should be placed on the top sliding tray and plugged into the main power supply. Slide out tray, and secure the bottom hook into the bottom of the balance. Level the unit and unlock clamping screw used for shipping. Locate the black knob on the front center of the balance and underneath the display area. Turn the knob counter clockwise until resistance is felt. Turn the unit power on and zero the balance reading. Refer to the separate user manual of the analytical balance for full operational details.

Water Circulator. The water circulator will be used to maintain the temperature of the test vessel. The hose-barb connections can be secured with copper wire or metal hose clamps to prevent the tubing from disengaging from the connection.

- a. Connect the water outlet from the circulator (the right rear hose-barb) to the water inlet on the main unit (bottom hose-barb located on the right side of the main unit).
- b. Connect the water outlet on the main unit (bottom hose-barb located at the front of the main unit) to the water inlet of the jacketed test vessel (located at the bottom of the test vessel).
- c. Connect the water outlet on the test vessel (upper glass hose-barb on the jacketed vessel) to the water inlet of the circulator (the left rear hose-barb).

Air Bath for Sinkers. Slide the O-ring onto the glass test tube, placing it 0.5 inches (1.25 cm) from the top of the tube. Place the tube in the top hole of the cover for the water circulator. The tube functions as the air bath for the sinkers during the test as prescribed by the standard test method.

Compressed Air Source. Connect a source of oil-free, filtered compressed air source to the main unit with a pressure of 15-20 kPa. The connection should be made to the middle hose-barb located on the right side of the main unit. Next, connect the upper hose-barb on the right side of the main unit to the air inlet tube of the test vessel assembly

(the long straight tube in the center of the glass assembly). The hose-barb connections can be secured with copper wire or metal hose clamps to prevent the tubing from disengaging from the connection.

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.

Communication Port Cables. Using the Communication Port Cable supplied with the Air Release Value Instrument Software, connect the RS-232 port located on the unit to a communication port on the PC.

Using the Communication Port Cable supplied for the analytical balance, connect the RS-232 port on the rear of the analytical balance to another communication port on the PC.



WARNING: Do NOT interchange these cables. Interchanging the cable will not damage any electronic components, but it will cause your computer to freeze.

3.4 Software Installation

1. Insert the Air Release Software CD-ROM into the CD tray of the PC. The CD should automatically display the setup screen. If this does not happen within 10 seconds, browse the files on the CD-ROM and double click on the setup file (setup.exe) to start the installation. Follow the instructions on the screen to setup the software. The software is ready to run once the installation has been completed.

NOTE: When first installed, the software is in demo mode, it must be registered in order for the software to work with the unit.

2. **Registration.** Start the program and then go to >> Help >> Register. A registration screen will appear with a registration number (Refer

to Figure 1, below). E-mail Koehler at software@koehlerinstrument.com or call with the registration number for the unlock code. Once the software has been registered, it must be restarted before tests are run.

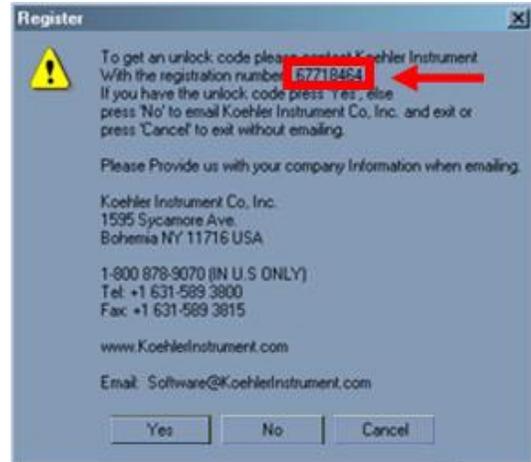


Figure 1. Registration Screen

4 Descriptions

4.1 Instrument Controls

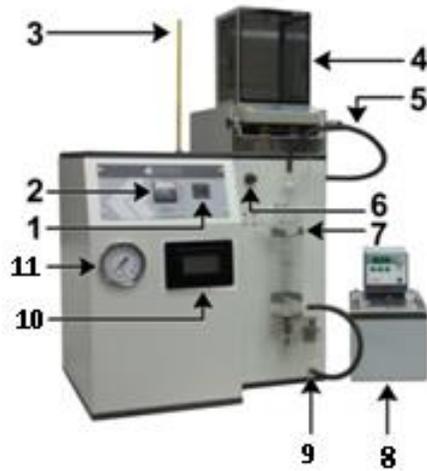


Figure 2. Instrument Controls

1. Power Switch
2. Temperature Controller
3. Thermometer
4. Density Balance
5. Air Inlet Tube
6. Air pressure adjustment knob
7. Jacketed Test Vessel
8. Circulation Water Bath
9. Water Inlet
10. Control Panel
11. Pressure Gauge

4.2 Temperature Controller Operation

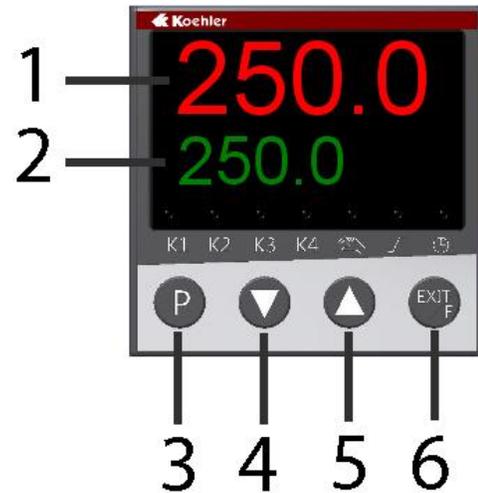


Figure 4. Temperature Controller

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.

- 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.

5 Operation

The Koehler Air Release Value Apparatus is designed for acquiring test data in accordance with the ASTM D3427 and related test procedures. Please be sure to read the safety and hazard warnings, the installation procedure, and the standard test method before operating this software and instrument.

5.1 General Operation

1. **Power.** Turn on main power switches to the Air Release Value Apparatus, water circulator, analytical balance, and laboratory oven. The Koehler Home screen will appear on the touch screen control panel. See Figure 5 below:



Figure 5. Home Screen

2. **Settings.** Set the digital temperature controller, water circulator, and oven to the desired test temperatures as prescribed by the test method. Fill water circulator with water, and place sinker in air bath test tube located in the circulator bath cover.

Adjusting Air Pressure. From the home screen, Press **NEXT** on the touch screen to display the main menu screen. See Figure 6. From the main menu screen touch the **SET AIR PRESS** box. This will display the Air adjustment screen (See Figure 7) and initiate the air flow through the system in order to set

the proper air pressure. Set the sample air pressure to 20 kPa using the adjustment knob located to the right of the power switch with the sample air tube connected to the glassware with the sample. The air pressure can be read from the pressure gauge located to the left of the control panel. Start and Stop the air flow by pressing the **AIR On/Off** box. When the pressure is properly adjusted, press **BACK** to return to the main screen. Disconnect the sample air tube from the glassware.



Figure 6. Main Menu Screen



Figure 7. Air Adjustment Screen

- Initial Density Measurement.** Pull out the sliding tray holding the analytical balance. Attach the sinker to one end of the platinum wire and the “S” hook to the other end. Then, hang the “S” hook from the bottom hook of the balance. The bottom of the sinker should be 10 ± 2 mm from the inside bottom of the test vessel. Allow sample to soak for the recommended period as per test specifications and observe the mass of the sample from the balance and calculate the density of the sample either by hand or using the Air Release Software Package.

⚠ WARNING: The sample air tube should remain disconnected from the glassware at this time.

- Density Entry.** Press **START TEST** on the main screen to go to the Enter Sample Density Screen (See Figure 8) and enter the calculated sample density. Press over the asterisk's to bring up the digital numerical keypad and (See Figure 9) and the Enter Sample Density. Press **NEXT** to go to the Start Test Screen.



Figure 8. Enter Sample Density Screen



Figure 9. Numerical Keypad Screen

- Starting the Test.** When you are in the Start Test screen (See Figure 10 below), again, be sure to have the air tube disconnected from the jacketed test vessel. Air will begin to flow through the air tube. The display will then indicate that the unit is preheating. Heated air discharged from the unit will preheat the air tube, providing a stable temperature air supply.



Figure 10. Start Test Screen

- After a five minute preheat period, an alarm will sound and the Connect Air Tube to Sample screen will display on the controller. See Figure 11. At this time, connect the air tube to the jacketed test vessel glassware, then readjust the sample air pressure to maintain the proper pressure level, if necessary.



Figure 11. Connect Air Tube Screen

- Measuring the Air Release Value.** After the air saturation period, the alarm will sound again, and the air supply will turn off. Press **NEXT** to silence the alarm and the Remove Air Tube Assembly screen will display. See Figure 12 below. Disconnect the air tube from the jacketed sample glassware, connect the sinker to the balance and submerge the sinker into the test sample, just as in step 3 of this section. Press **NEXT** to go to the Stop test screen.

⚠ WARNING: The air release value time period immediately begins once the air valve closes. Silencing the alarm does not interrupt or stop the time.



Figure 12. Remove Air Tube Assembly Screen

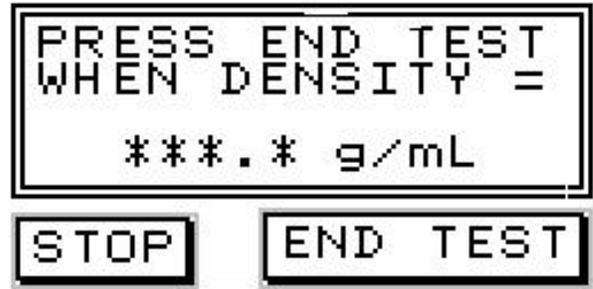


Figure 13. Stop Test Screen

- Stop Test Screen.** The Stop Test Screen (See Figure 13) will display 99.8% of the initial density value calculated before the test began. When the density value calculated from the balance or read from the software screen matches the value on the controller press the **STOP** button.
- Results Screen.** Pressing **END TEST** button to display the Results Screen (See Figure 14 below) indicating the length of time it took for the density of the sample to return to 99.8% of the initial density.



Figure 14. Results Screen

- Press the **START NEW TEST** button to return to the main screen to perform another test.

5.2 Circulator Operation



Figure 15. Constant Temperature Circulator

1. **Circulator Location.** Locate the Circulator on a level surface, free from drafts and out of direct sunlight. Do not place it where there are corrosive fumes, excessive moisture, high room temperatures, or excessive dust is present. Refrigerating/Heating Circulators must be a minimum of four inches (102mm) away from walls or vertical surfaces so air flow around the unit is not restricted. To help prevent voltage drops, position the Circulator as close as possible to the power distribution panel and a properly grounded outlet. The use of an extension cord is not recommended.
2. **Reservoir Liquid Level.** Fill the reservoir with the appropriate bath fluid. The liquid level should be sufficient to cover the heating coils, pump, over-temperature sensor, and at least one inch (25mm) of the temperature sensor.
3. **Power.** An IEC power cord is provided with the Circulator. This power cord should be plugged into the IEC receptacle on the rear of the Controller and then plugged into a properly grounded outlet. Make sure that the power outlet is the same voltage and frequency indicated on the identification label on the back of the Controller. The use of an extension cord is not recommended. However, if one is necessary, it must be properly grounded and capable of handling the total wattage of the unit. The extension cord must not cause more than a 10% drop in voltage to the Circulator. Once the unit has been connected to an appropriate electrical outlet, place the Circuit Breaker/Power Switch on the rear of the Controller in the ON position. Four decimal points (....) will appear on the digital

display. DO NOT place the Power Switch on the front of the Controller ON until the Safety Set has been adjusted to the desired temperature.

 **WARNING:** After filling the reservoir with fluid, you must set the Safety Set and Software High Limit as well as your desired control set point temperature.

4. **Setting the Safety Set Point.** The Safety Set feature automatically disconnects Controller power to the heater and pump in the event that the reservoir liquid level drops too low or the Controller fails. The Safety Set is user-adjustable between approximately 40° and 210°C. It should be set at least 5°C higher than the Software High Limit temperature. Use a flat blade screwdriver to rotate the Safety Set Indicator Knob to the desired temperature. Do not force the knob beyond the stops at either end of the temperature value range. Once the Safety Set temperature has been set, turn power to the Controller ON by pressing the Power Switch on the front of the Controller. The pump will begin operating, the display will flash the current temperature set point (tx.xx), the °C LED will light, and the current bath temperature will appear on this display. Pump speed selection is made using the Pump Speed Selection Switch on the rear of the Controller. If power is disrupted because the Safety Set temperature was exceeded, place the Circuit Breaker/Power Switch in the OFF position, press the Safety Set Reset Button, correct the problem (low liquid level, incorrect Safety Set temperature, etc.), and then restore power. Activation of the Safety Set during normal operation will display a fault (FLt 3) on the readout.
5. **Selecting Temperature Units.** The control set point and actual bath temperatures may be displayed in either °C or °F. The factory-default is °C. To change from °C to °F, place the Circuit Breaker/Power Switch on the rear of the Controller in the OFF position and then press and hold the P2 Button while turning the power back ON. To change from °F to °C, place the Circuit Breaker/Power Switch in the OFF position and then press and hold the P3 Button while turning the power back ON.

NOTE: When the temperature display units are changed, the Software High Limit value and all

temperature presets revert to the factory-default values. If a calibration value has been entered, the value will be retained.

6. **Setting the Software High Limit.** This feature provides additional safety and protection by allowing a selectable upper temperature limit set point. To avoid an unwanted shutdown during regular operation, the high limit value should be set at least 5°C higher than the selected control temperature to set the Software High Limit temperature set point, press the P2 and P3 keys simultaneously and repeat until (Hxxx) appears on the display. This is the current Software High Limit value. It is factory set at 152°C. To change the displayed value, press and turn the Select/Set Knob until the desired Software High Limit set point value is displayed. A clockwise rotation increases the value; a counterclockwise rotation decreases the value. Press the Select/Set Knob a second time to accept the new value and return to normal operation. If the Software High Limit value meets or exceeds the control temperature set point, (E-H1) will flash on the display. If this occurs, enter a higher value for the Software High Limit or reduce the control temperature set point. If the actual bath temperature reaches the Software High Limit setpoint, (FLt1) will flash on the display. Should this occur, the Controller will automatically remove power from the heater and, in Refrigerating/Heating units, the compressor as well. The pump will continue to operate. Once the problem is corrected (bath temperature reduced or Software High Limit value increased), press the Power button to clear the message.

7. **Setting the Set Point Temperature.** Press and release the Select/Set Knob. The decimal point flashes to indicate that the set point temperature can be changed. Turn the Select/Set Knob until the desired temperature set point is displayed. A clockwise rotation increases the setting; a counterclockwise rotation decreases the setting. Press the Select/Set Knob a second time to accept the displayed value. The decimal point stops flashing and the display will indicate the actual bath temperature. Allow sufficient time for the bath to stabilize at the desired temperature before making any adjustments to set point temperature. **NOTE:** The unit will automatically accept the displayed set point

after approximately 10 seconds of inactivity, even if the Select/Set Knob was not pressed. The set point temperature may be checked at any time by pressing the Select/Set Knob. If the set point temperature cannot be raised, it is possible that the Software High Limit value is set lower than the desired control temperature set point. Reset the Software High Limit value to 5°C or more above the desired set point temperature.

5.3 Drying Oven Operation



Figure 15. Drying Oven

The Koehler Laboratory Oven supplied with the Koehler Air Release Value Instrument is a standard laboratory oven. The On/Off power button turns on the power to the oven on and off, and the analog dial controlled the heating rate and maximum temperature.

Allow time for the oven to reach its maximum set temperature and to stabilize.

WARNING: Do not use in the presence of flammable or combustible materials or explosive gases. Do not use in the presence of pressurized or sealed containers – fire or explosion may result, causing death or severe injury.

WARNING: Do not heat any substance above a temperature that will cause it to emit toxic fumes; death or severe injury may result.

CAUTION: It is the user's responsibility to monitor oven action when setting and maintaining operating temperature; oven failure may occur

with possible property damage and/or injury to personnel.

 **WARNING:** To avoid electrical short or shock, do not allow any metal object to protrude into the space beneath the shelf/heater shield inside the oven. In addition, do not operate oven with the shield removed.

 **WARNING:** Hot Surface At the higher temperatures, the exterior of the oven and particularly the thermometer vent ring on the top become uncomfortably warm to the touch. To avoid burns, do not touch these surfaces.

6 Safety Features

The Koehler K88500 Air Release Value Instrument is equipped with several safety and protection features, which are described in the following sections.

 **WARNING:** The K88500 Air Release Value Instrument is **NOT** Explosion Proof.

6.1 Over-Temperature Protection

The Koehler K88500 Air Release Value Instrument 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 K88500 Air Release Value Instrument 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.

6.3 Over-Pressure Protection

The Koehler K88500 Air Release Value Instrument is equipped with Over-pressure Protection, which prevents the unit from operating under unsafe conditions. The top rear hose barb on the back of the instrument will release any excess air pressure over 70kPa in the system. The unit will also release all air pressure when not in operation. The lower rear hose barb on the back of the instrument will release any excess water of 10 psi. The hose barb should be attached to a drain hose that can be connected directly to the hose barb located on the top plate of the water circulator to recycle any excess water run-off.

7 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.

7.1 Routine Maintenance

The K88500 Air Release Value Instrument 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).

7.2 Instrument Cleaning

- To clean the instrument's exterior, which includes all painted surfaces, 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.

7.3 Replacement Parts

Part Number	Description
K885-115-200	Coil Heater, 115V, 200W
250-000-12C	ASTM 12C Thermometer
K23700-03012	Thermometer Holder
K88500-1	Jacketed Test Vessel
265-122-003	RTD Temperature Probe
275-103-044	Temperature Controller, 100-240V, 1 Out
278-003-001	Fuse, 3.15A, Slo-Blo
278-004-001	Fuse, 4A, Slo-Blow
278-102-002	Fuse, 0.5A, Slo-Blo
278-104-002	Fuse, 0.25A, Slo-Blo
275-020-002	Fuse, 20A, Slo-Blo Midget
278-001-002	Fuse, 1A, Slo-Blo, 5x20mm
278-020-004	Fuse, 20A, Time Delay, 600V
271-006-004	Circuit Breaker, 2 Pole, 6A
091-032-001	Solid State Relay, 4-32V, 20A
K885-H1	S-Hook
K88500-03016	Sinker, 10mL
K88500-03023	Sinker, 5mL
K88500-2	Hanging Device

8 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.

9.1 Unit does not power up

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

9.2 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.

9 Service

Under normal operating conditions and with routine maintenance, the K88500 Air Release Value Instrument 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 Disposal

11.1 General Recycling Information

- No refrigerants or pressurized materials.
- No charged capacitors or components that could electrically discharge.
- No components such as springs or spring powered gears that could store mechanical energy.
- No chemical hazards from any components.
- No radiation is emitted from any components.

11.2 Disposal Information

The K88500 Air Release Apparatus is Rohs compliant and is subject to the WEEE directive. Once the instrument has reached the end of its useful life, the instrument and or its components must be recycled or disposed of in accordance to Country, State, or local laws that may impose regulatory requirements regarding disposal. Dispose instrument and/or components in accordance to all applicable regulations.

The K88500 is composed of the following major components and materials:

Major Component	Material
Instrument Housing	Powder Coated, Cold-Rolled Carbon Steel 18
Supports and Racks	Stainless Steel, #316
Heater Coils	Copper

NOTE: There are No Refrigerants or Hazardous Materials contained in any component.

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.

