KOEHLER
INSTRUMENT COMPANY, INC.

K23050
SALT IN CRUDE ANALYZER

OPERATION AND INSTRUCTION MANUAL

REV A

Table of Contents

1   Introduction

The Koehler Salts-in-Crude Analyzer is a sophisticated instrument and designed for determining salt concentration in crude oils as per the ASTM D3230 test method. It is a multi-parameter analyzer that can display up to four parameters simultaneously.

This manual provides important information regarding safety, technical reference, installation requirements, operating condition specifications, user facility resource requirements, and operating instructions for the Salts-in-Crude Analyzer. 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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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 D3230: Salts in Crude Oil (Electrometric Method)

1.3   Instrument Specifications

Models:	K23050
Electrical Requirements:	115/230V 50/60Hz
Temperature Range:	-5 to +55°C
Resolution:	± 0.01°C
Accuracy:	± 0.02°C
Conductance Range:	0-2μS, 2-20μS, 20-200μS, 200-1500μS
Resolution:	0-2μS: ± 0.001μS 2-20μS: ± 0.001μS 20-200μS: ± 0.01μS 200-1500μS: ± 0.1μS
Accuracy:	±0.5% of range (±0.2% of high range)
pH Measurement Range:	0-14 pH
Resolution:	0.01 pH
Accuracy:	0.01 pH at point of calibration

1.4   Software Specifications

PC System Requirements:	Intel® Pentium II Processor or similar (minimum)
Operating System:	Windows® 98 SE, 2000, NT, XP, Vista
Memory Requirements:	256Mb RAM (512Mb RAM recommended) 15 Mb Hard Disk Space (minimum)
Other	One 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.

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

- Salt-in-Crude Analyzer
- Electrode Cap Assembly
- 100mL Pyrex Sample Beaker
- Power Adapter, Dual 115/230V
- RS232 Serial Cable Assembly

- Carrying Case
- NiCad Battery (4)
- Calibration Resistor
- Ground Electrode
- Temp. Probe and Conductance Assembly

3.2   Unpacking

Carefully unpack and place the instrument and accessories in a secure location. Ensure that all parts listed in previous section are present. Inspect the unit and all accessories for damage. If you find any damage, 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

Getting Started. Install batteries per the diagram in the battery compartment and charge them by plugging the AC adapter into the port labeled 'POWER' and the AC supply. To activate the unit press the **ON/RESET** key. The instrument will display those parameters that have been previously selected. To perform other tasks the operator presses the **SELECT** key. This brings up the main menu where other instrument functions may be selected, such as, calibration or selecting other parameters for display.

Calibration. In order to measure salt concentration the instrument must be calibrated for **temperature**, **conductance**, and **salt**. Temperature has been calibrated at the factory and under normal circumstances will not need to be recalibrated. It should be verified on a regular basis, however, to ensure that a failure has not occurred. Conductance has also been factory calibrated, but should be recalibrated on a daily basis. (Refer to the conductivity calibration procedure in the operating instructions.) The salt parameter has been calibrated at the factory using theoretical values for operational test purposes only. The instrument must be recalibrated using laboratory prepared standards in order to provide any meaningful salt determinations.

3.4   Software Installation

1. **Installation.** Insert the 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.
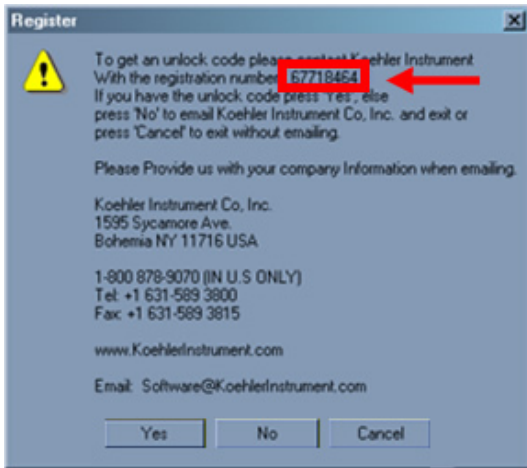
Figure 1. Registration Screen

3.5 Software Operation

1. To begin, click on >> the Windows Start Button >> Koehler Instrument >>Salts in Crude Test Software. The "Company Information" screen (Figure 2) will appear. Press any key or the mouse button to proceed.

Figure 2. Splash Screen

2. **Main Screen.** The Next Screen will be the Main Screen of the Salt-In-Crude Software. See Figure 3 below:

Figure 3. Main Screen (Comm. port tab open)

The Main Screen displays both "yellow" and "black" shaded fields. The "yellow" fields represent "User Defined Fields" where the user has the ability to input their own information. The "black" shaded fields automatically display data and parameters. The Standard Export Parameters displayed on the main screen include: Salt Concentration, Conductance @ 25°C, Temp C, and pH. Three tabs can be found at the top of the main screen. These tabs include a Comm. Port, Timer, and Stop Watch Tab. Three Data Retrieval buttons are located at the bottom of the main screen. These buttons include "Get Current Data", "Get Log Data" and "Get Calibration Table".

3. **Comm. Port Tab.** This tab allows for the user to choose a communication port numbered 1-4. After choosing a port number, clicking the "Initialize Port" button will open the desired port. The "Port Open" indicator light will turn red if the command is successful. The Comm. port tab is illustrated in Figure 3 above.

4. **Timer Tab.** This tab features a basic timing function. This screen allows the user to choose the duration of the timer in minutes, then by simply clicking on the "Start Timer" button the timer will begin and be displayed as Time Elapsed. The Timer Tab also features a text box

where the user can take additional notes. The Timer Tab is illustrated in Figure 4 below.

Figure 4. Timer Tab

5. **Stop Watch Tab.** Similar to the "Timer Tab" but lacking the ability to set a Duration Time. To Operate the Stop Watch Function simply click the "Start" button and the time elapsed will display at the right. This tab also has a text box for note taking. The Stop Watch tab is illustrated in Figure 5 below.

Figure 5. Stop Watch Tab

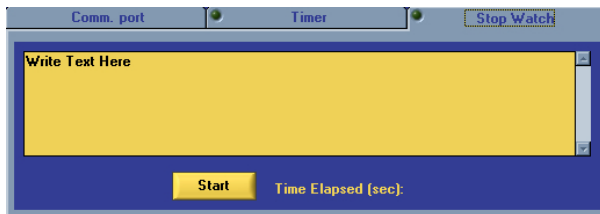6. **Get Current Data.** Clicking this button will cause the Data currently displayed on the Salt In Crude Apparatus to display in the "Text Received' box on the main screen. After 3 seconds this Data will appear in the parameters section (black) to the left.

7. **Get Log Data.** To use this function, the Salt in Crude Unit must be in "Upload" mode. The user must then click the "Get Log Data" button and the Data will be sent to the "Text Received" box. From here the user can copy and paste the Data into Microsoft Excel or other Text file.

8. **Get Calibration Table.** The procedure for this function is similar to that of the "Get Log Data" procedure. To use this function, the Salt in Crude Unit must also be in "Upload" mode. The user must then click the "Get Calibration Table" button and the Salt vs. Conductance Calibration Table will be sent to the "Text Received" box.

9. **Database.** This function can be used to store data. The Database screen is shown in Figure 6 below. To access this screen click on the "View" pull down tab. Then click "Database". Click on

the "Get Data" to display the Data from the "Main" screen to the "Database" screen. Once the desired Data is displayed here the user can use a variety of commands available in the "Database" screen.

Figure 6. Database Screen

10. **Database Commands.**

Add. Add the current entry as a new item to the database.

Save. Make changes and overwrite the current entry.

Delete. Deletes the current entry

Clear. Clears the fields.

Reload. Reloads the database.

Search. Search the database with any particular fields. The possible matches are displayed at the bottom of the screen.

Print. Prints the contents of the database that are currently being displayed.

Get Data. Fills the fields with information from a specified port.

Export To Excel. Exports the current test data to Excel. The user can choose to export temperature data when prompted.

Export To Notepad. Exports the current test data to Notepad (text file). The user can choose to export temperature data when prompted.

4 Instrument Description

4.1 General Description

Koehler's K23050 is a sophisticated, portable instrument for the measurement of conductance and temperature in crude oil samples, plus pH in

aqueous samples. In addition it can utilize the conductance and temperature data to calculate and display salt concentration per ASTM D3230.

The K23050 contains a high capacity, low-power CMOS memory that allows data to be logged either manually or automatically. Logged data can be retrieved and transferred to a PC for statistical analysis and archiving.

The device employs a four line, alphanumeric display that provides complete and descriptive data presentations plus the ability to easily setup operational modes and parameters. Calibration data and system variables are maintained in non-volatile, EEROM memory. These values will not be lost when power is turned off or internal batteries are removed.

The instrument is contained in a weatherproof housing with sealed keypad for maximum protection in a harsh field environment.

4.2   Microprocessor Control

The K23050 incorporates an internal microcontroller that oversees and directly activates all system functions. This allows the more complex portions of the control program to be written in a high level language and then compiled into the machine code required for instrument operation.

4.3   Display

The instrument display is a four line by 16 character alphanumeric module. The display presents four parameter readings simultaneously for operator review. The parameters are selected within a "display setup" menu and these selections remain until new parameters are selected. Available display parameters include: conductance (non-compensated), pH, millivolts (from pH channel), temperature (Celsius), temperature (Fahrenheit), conductance corrected to 25 C, salt concentration in pounds per thousand barrels (ptb), internal battery voltage, external battery voltage (if connected), date, time and a user input ID code used to identify station or sample information.

4.4   Keypad

A touch keypad is used for all user control inputs. A single key activates the instrument and resets the system processor. Other keys select operational menus and modes, adjust system variables and enter data.

4.5   Power Requirements

The K23050 has several power source options. The primary source for portable (short-term) field operation is the internal battery pack. It is comprised of four, AA, NiCad batteries. The instrument has a built in battery charger for the internal batteries. The internal batteries are charged by plugging the external AC adapter into the Power connector on the top of the unit.

For longer-term field applications an optional, external, sealed GEL cell battery pack is available. This power source fits into the system carrying case with its own charger. It is plugged into the Power connector on the top of the unit.

For continuous lab operation the instrument may be powered from an 115VAC source by plugging the external AC adapter into the Power connector.

The instrument maintains an auto-shutoff feature to prolong battery life when it is being used for intermittent measurements. This feature may be deselected in the setup menu. When the unit is operated from the internal batteries it has enough capacity for approximately eight hours of continuous operation and approximately 130 hours with the external battery.

4.6   pH Input

The pH channel of the instrument uses a low noise, ultra low input bias current instrumentation amplifier. It is configured as a differential input amplifier. The sensor to be used may be any combination pH electrode that will allow connection to the readout, BNC connector. The electrode should also have a temperature response that follows the "Nernst" equation, as this is the means used by the unit to temperature compensate the pH measurement.

The temperature value that is used during pH compensation is normally the measured temperature provided by the sensor in the conductance probe. During calibration the pH temperature may be input manually from the keypad or taken automatically from the conductance sensor.

5   Operation

The Koehler Salt-in-Crude Analyzer is a sophisticated instrument and designed for determining salt concentration in crude oils as per the ASTM D3230 test method. Please be sure to read the safety and hazard warnings, the installation procedure, and the standard test method before operating this instrument.

NOTE: **Operator must Calibrate Salt-in-Crude Analyzer prior to use (See section 6)**

5.1   Measurements

5.1.1   Conductance

The conductance measurement is performed by sensing the current produced in the cell while excited by a precision, bipolar signal. The circuitry eliminates dc-offset errors and minimizes troublesome polarization effects. The conductivity circuit automatically selects the most optimum range of operation out of the four available ranges.

The conductance cell is a precision machined Teflon and 316 stainless steel cell.

The system microcontroller periodically excites the electrode, performs the cell current measurement and applies offset and span correction to the resultant values. Thus, keeping a current conductivity value available for real-time display or logging. From the calibrated conductance value the system calculates conductance at 25 °C, and Salt Concentration.

5.1.2   Temperature

The Temperature sensor is a thermo linear thermistor composite with an effective range of -5 to 50 °C.

5.1.3   pH

The K23050 employs high impedance, differential preamplifier in the pH circuit. The system uses a BNC connector for connection of the sensor. This input channel can use any combination pH electrode or specific ion electrode compatible with these characteristics.

Note: The K23050 uses high impedance, differential amplifier in the pH/ion circuit. In order to keep the sensor's signal in the common mode range of the amplifier the solution must be kept at or near the potential of the instrument's circuit common. This is accomplished by placing the pH/ion ground electrode in the solution. The pH/ion electrode is connected to the unit via the ground port on the top of the unit.

The pH/ion ground electrode **must be** in the solution at all times when pH or ion readings are being made. This includes calibration as well as analytical measurements.

The pH channel is available for display in two modes. The first is the normal pH mode where the displayed data are temperature compensated pH units. This channel is calibrated using pH buffers. The other display mode for pH is millivolts. This is a separate analyzer channel and is in addition to the pH display channel. This input channel has a range of 0 to +/- 0.7500 volts DC. It is calibrated by applying a voltage standard to the pH input connector and selecting "pH mV" for calibration. This channel allows the user to track drift in a pH sensor because of aging or to record the output from a specific ion/orp sensor. The millivolt channel is not temperature compensated. During calibration it is recommended that the negative terminal of the voltage standard be connected to the pH/ion ground electrode, as well as the shield of the BNC connector.

5.2   Operation and Control

5.2.1   ON/RESET Key

The ON/RESET key is used to activate the instrument or to reset the device to its initial state. If the unit is off, press the ON/RESET key until the display activates. If the instrument is operating, pressing the key will restart the program resetting all system variables to their default state. This may be utilized to escape from a calibration menu entered in error.

5.2.2   SELECT Key

When the K23050 instrument is first activated it will begin monitoring the various system channels and displaying the selected parameters. Pressing the SELECT key brings up a Command list or menu. An "X" at the end of a line indicates which command is active. The selection "X" is moved from command to command by use of the arrow

keys. Pressing the 'down' arrow moves the selection cursor down. Pressing the 'up' arrow moves the "X" up a line. When the cursor moves to the bottom or top of the display the command list will scroll in the appropriate direction revealing the next command. When the last available command has been viewed the command list will roll around to the starting command.

When the desired command has been selected by placing the selection "X" on that line, press the ENTER key to perform the desired function.

The available commands are:

    a.   Main Screen
    b.   Calibration
    c.   Data Logging
    d.   Display Parameters
    e.   Logging Parameters
    f.   Set Date/Time
    g.   Auto shutoff
    h.   Power Off
    i.   Upload Data
    j.   Decimal Places
    k.   Access On/Off

5.2.3   Display Selected Parameters

The 'Display Selected Parameters' function directs the instrument to begin real time display of the selected parameters. Activate this function by placing the cursor on this line with the arrow keys and pressing the 'ENTER' key.

6   Calibration

The K23050, Salt in Crude Analyzer is equipped with a security feature designed to restrict access to the Calibration Menu. If the security check is turned on the user will be prompted to enter a code number before access is granted to the "Calibrate Menu". If the code number is improperly entered the message "Access Denied" will be shown and the instrument will revert to the "Main Menu". The code number to be entered is the device serial number. It is written inside the battery compartment on the bottom of the unit. The number is entered by pressing the "up" or "down" arrow keys until the proper number is displayed. The "ENTER" key is then pressed and the instrument will evaluate the entry.

This security feature may be selectively turned on or off through the "Access ON/OFF" menu. "Access ON/OFF" is listed in the main menu and

when selected the user will be prompted to enter the "access code number". This will always be the case in order to restrict unauthorized operators from controlling access to the "Calibration Menu". Once the proper code number is entered the user is presented with:

Security Check

Disabled_____

Enabled_____X

Use the arrow keys to position the "X" at the desired setting and then press the "ENTER" key; the security setting will be stored in non-volatile memory and the instrument will return to the main menu. The security feature will operate as selected from here on.

The 'Calibrate' function gives the user the ability to calibrate any of the measurement channels (conductance, temperature, pH, pH milliVolts, daily blank, salt curve, internal battery, and external battery). It is not recommended that the user calibrate the internal or external battery channels. If, this is done improperly it can cause improper operation of the power management module and subsequent battery failure.

When the 'Calibrate' function is selected from the command menu a 'Calibration' submenu is presented. Here a list of the available parameters is shown. The user moves the highlighting cursor (selection "X") to the desired parameter by means of the arrow keys, pressing the 'ENTER.' key to begin calibration of the designated parameter.

6.1   Calibrate Conductance

Conductance calibration involves establishing the zero and span points of the system. This is accomplished by using a dry sensor for "zero" and connecting a standard resistor for the conductance span value.

When conductance has been selected for calibration the K23050will display:

Conduct. Cal
Zero____X
Span____
Exit ____

Press the arrow keys to move the selection character ("X") from 'Zero' to 'Span' to 'Exit. When

the desired calibration function is designated press the 'ENTER' key to move to that operation.

6.1.1 Zero Conductance

When the conductance parameter is to be adjusted for zero offset connect the conductance/temperature sensor to the connector labeled C/T on the readout; make certain the electrodes have been cleaned (rinsed in alcohol) and dried; select "Zero" on the Conductivity Cal Menu and press ENTER. The display will show:

> Cal Conductance
> Adjust w/ Arrows
> Then Press Enter
> 0   μS

Make certain that 0 μS is set as the calibration value and press the 'ENTER' key to establish the zero offset point and store the new data in non-volatile memory. Once this has been done the K23050 will revert to the 'Conduct. Cal' menu. Here the 'Span' or 'Quit' function can be selected.

6.1.2 Span Conductance

When conductivity span or slope is to be adjusted clip the conductance calibration jacks between the two conductivity electrodes. Select "Span" on the unit and press "ENTER". The unit will retrieve the last conductivity span value that was used for calibration. This will be shown on the system display:

> Cal Conductance
> Adjust w/ Arrows
> Then Press Enter
> 1.0000   μS

Use the arrow keys to adjust the displayed conductivity value to the desired 1.0000μS. Once this is done press the 'ENTER' key. The unit will measure the conductance, establish the new slope and store the data in non-volatile memory. It will then revert to the 'Conduct. Cal' menu. If the calibration procedure has been completed, choose 'Exit' and press the 'ENTER' key. This will command the K23050 instrument back to the main function menu.

6.2 Calibrate Temperature

Under normal circumstances the temperature parameter is very stable and should not need to be recalibrated. If temperature calibration is lost or inadvertently changed then perform the following procedure. When Temperature has been selected for calibration the K23050 will display:

> Temperature Cal
>
> Zero_____X
> Span_____
> Exit_____

Press the arrow keys to move the selection character ("X") from 'Zero' to 'Span' to 'Exit'. When the desired calibration function is designated, press the 'ENTER' key to move to that operation.

Temperature must be calibrated at two points along its scale. One point will be a low value or 'Zero' point and the other an upscale value or 'Span' point. The 'Zero' point should be near 0.00 °C and the 'Span' value is pre-set at 50°C. When establishing the zero and span points the temperature sensor (the 1/4" stainless steel tube next to the conductivity electrodes) must be placed in a solution that is at the desired temperature. It should be noted that <u>only the lower end of the temperature tube below the tip jacks can be immersed in the liquid.</u>

6.2.1 Zero Temperature

When temperature is to be calibrated for zero offset the unit will retrieve the last temperature 'zero' value used and display:

> Temp 0.000 C   <-- Last cal. temp.
>
> Adjust w/ Arrows
> Then Press Enter

To establish the zero point prepare an ice/water slurry; place the sensor in the ice bath and allow the unit to equilibrate for several minutes, stirring or agitating the bath regularly. Use a laboratory thermometer to measure the temperature of the slurry; enter that temperature into the unit via the arrow keys; press the 'ENTER' key and the unit will measure the temperature, derive the offset and store the calibration data in non-volatile memory. When this is completed the unit will

revert to the 'Temperature Cal' menu where the user may continue calibration or return to monitoring.

6.2.2 Span Temperature

When this mode is selected the temperature sensor must be introduced to a stable, upscale temperature solution. An ambient temperature solution works well. If the sensor has just been in the ice slurry for zero calibration it will take some time for the sensor to reach equilibrium. Once the temperature of the sensor has stabilized in the span medium select "Span" in the temperature calibration menu; the display will show:

```
Temp 50.0 C    <-- Last cal. temp.
       Adjust w/ Arrows
       Then Press Enter
```

Use a laboratory thermometer to measure the temperature of the span solution. With the arrow keys, adjust the displayed temperature to the desired point of calibration. Press the 'ENTER' key and the unit will establish the slope of the temperature sensor, store the data in non-volatile memory and revert to the 'Temperature Cal' menu where the user may continue calibration or choose 'Exit' to return to the main menu.

6.3 Calibrate pH

When pH is selected for calibration the K23050 will display:

```
        pH Temperature

        Auto_____X
        Man._____
```

At this point the device is asking the user to indicate how it will determine the pH buffer solution temperature during calibration. This is an important factor as the pH sensor output varies with temperature. It therefore, must be compensated during calibration. This is accomplished in a transparent fashion to the user, but the system must know the solution temperature.

If 'Auto' is selected the unit will use the system temperature measurement for pH compensation during calibration. This assumes that the conductivity/temp probe is close in temperature to the buffer solution.

If 'Manual' is selected the unit will prompt the user to enter (via the arrow keys) the buffer solution temperature. Once this is done the unit will proceed to the 'Calibrate pH' menu.

After the pH Temperature selection has been performed the unit will display:

```
        pH Calibration

        Zero_____X
        Span_____
        Exit _____
```

Press the arrow keys to move the selection character ("X") to the desired function. When the appropriate command is designated press the 'ENTER' key and the instrument will proceed to that selection.

Note: The K23050 uses a high impedance, differential amplifier in the pH/ion circuit. In order to keep the sensor's signal in the common mode range of the amplifier the solution must be kept at or near the potential of the instrument's circuit common. This is accomplished by placing the pH/ion ground electrode in the solution. The pH/ion electrode is connected to the readout unit via the ground connector on the bottom of the module.

The pH/ion ground electrode must be in the solution at all times when pH or ion readings are being taken. This includes calibration as well as analytical measurements.

6.3.1 pH Zero

The pH sensor is placed in the appropriate buffer and allowed to equilibrate. The pH zero offset adjustment is intended to establish the isopotential point of the sensor. This is done by placing the sensor in a buffer 7.00 solution. pH buffers are readily available and are usually accompanied by a chart that gives the buffer value for various temperatures. Refer to this chart when entering the buffer value.

When 'pH Zero' is selected the display will show:

```
        pH   07.010

       Adjust w/ Arrrows
       Then press Enter
```

The unit recalls the last pH zero cal point from non-volatile memory and that is displayed.

The operator now uses the arrow keys to adjust the pH buffer 7 value to the appropriate setting for the temperature of the solution. When this is accomplished press the 'ENTER' key and the unit will derive the offset data, store the information in non-volatile memory and revert to the 'pH Calibration' menu.

6.3.2   pH Span

The pH electrode and ground electrode are placed in the appropriate buffer solution and allowed to equilibrate. The pH span point can be any buffer solution sufficiently far away from the zero point (7.00) to allow accurate slope derivation. This is typically a buffer 4.00 or 10.00.

The pH sensor should be thoroughly rinsed in distilled water and dried prior to insertion in the buffer solution. This will prevent contamination of the buffer solution. Allow several minutes for the sensor to equilibrate before proceeding. (Displaying pH or pH mV when the sensor is placed in the buffer will give an indication when the sensor has come to its final value.)

When pH Span is selected the display will show:

> pH   04.000
>
> Adjust w/ Arrows
> Then Press Enter

The unit recalls the last pH span value from non-volatile memory and presents it for display. The arrow keys are used to adjust the pH span value to the desired point. Once this is done the user presses the 'ENTER' key and the instrument will make the appropriate calculations and store the new cal data in non-volatile memory. The unit will then return to the 'pH Calibration' menu for further cal selections or exit to the main menu.

6.4   Calibrate pH Millivolts

The pH millivolt channel is a second display mode for the pH input channel. It utilizes separately stored calibration data and is intended for displaying the millivolt output from a sensor connected to the pH input, BNC connector. This

sensor may be a pH, specific ion, or ORP sensor. The displayed value is not temperature compensated.

To calibrate this channel a voltage standard must be connected to the pH input. A 'Zero' offset adjustment is performed with the voltage standard set near 0.0000 volts. The 'span' adjustment is then done with the standard set to a value between 0.5000 volt and 0.7500 volt. During calibration the pH/ion ground electrode must be connected to the negative terminal of the calibration voltage source.

When 'Calibrate pH Millivolts' is selected the instrument will display:

> pH Millivolt
>
> Zero_____X
> Span_____
> Exit_____

Use the 'ARROW' keys to choose the desired function, then press the 'ENTER' key to proceed to that task.

6.4.1   Zero pH Millivolt

When the pH millivolt channel is selected for zero offset calibration the pH input should be either shorted (connecting the center pin of the BNC connector to the outer shell) or have a voltage standard connected and set to near 0.0000 volts DC.

The unit will display:

> mV 0.0000 VDC
>
> ADJUST W/ARROWS
> THEN PRESS ENTER

Use the arrow keys to adjust the displayed voltage to the value set into the voltage standard or 0.0000 if the input is shorted. Press the 'ENTER' key when this has been done.

The unit will establish the zero offset value, store the calibration data and return to the pH Millivolt Cal menu.

6.4.2   Span pH Millivolt

Set the voltage standard connected to the pH input to a value between 0.5000 and 0.7500 volt. When 'Span pH Millivolt' is selected the instrument will display:

mV 0.5000 VDC

Adjust w/ Arrows
Then Press Enter

The voltage that is shown here is the value stored from the last millivolt span operation. Use the arrow keys to adjust the value to the current voltage setting. Press 'ENTER' when this has been done. The unit will establish the slope of the channel and store the calibration data in non-volatile memory. It will then return to the pH Millivolt Cal menu for further calibration or return to the main menu.

6.5   Calibrate Daily Blank

The Daily Blank feature offers a means of adjusting the salt calibration information for slight variations in system offset. This is accomplished by introducing the conductivity/temperature sensor to the Blank standard prepared per ASTM D3230. When the sensor has stabilized and the 'Enter' key pressed the instrument will determine the conductance of the solution; calculate the difference from the last Blank reading and adjust all of the Salt calibration data accordingly.

NOTE: In this step as with any of the salt calibration procedures the volume of standard solution used must be kept constant. Approximately 90 ml of solution is recommended (just enough to cover the electrodes in their sample beaker). This volume should be measured precisely as it effects the conductivity measurement.

6.6   Calibrate Salt

The Salt Calibration menu is the point where the instrument establishes its relationship between conductivity and salt concentration. Before entering this menu the instrument's temperature reading should have been verified and conductivity "zero" and "span" set. In addition the "salt" standards should have been prepared per ASTM D3230.

When this menu is selected the K23050 prompts the user with:

Salt Calibration
Erase Old Cals?

Yes____X
No_____

The operator uses the arrow keys to select whether the old calibration data will be erased from non-volatile memory or not. Once the desired selection is made the "ENTER" key is pressed to move to the Salt calibration menu. It should be noted that if a full calibration is to be performed Old Calibration data SHOULD be erased. This is the only way to ensure an appropriate curve for salt versus conductance. If, old calibrations are not erased, standards made with different blank solutions may be intermixed. This will provide erroneous salt measurements.

Once a Salt Calibration has been performed the operator may view the calibration data via the serial communication port. If it is determined that a calibration point was overlooked or improperly performed the user may chose to NOT erase old calibration data and re-enter the calibration point in question.

Once the "Salt Calibration Menu" is started a list of standard salt values is presented to the user. They are:
Blank, 1 ptb, 3 ptb, 5 ptb, 10 ptb, 15 ptb, 20 ptb, 25 ptb, 30 ptb, 40 ptb, 50 ptb, 65 ptb, 75 ptb, 85 ptb, 100 ptb, 150 ptb, and Exit

The calibration procedure is to be systematic:

1) Rinse the sensor electrodes in alcohol and dry.

2) Place the electrodes in a selected and precisely measured salt standard solution.

3) Select that standard from the list via the arrow keys and press "ENTER".

The instrument will display the conductance reading for operator view.

4) When the conductance reading has stabilized press the "ENTER" key.

The instrument will store the salt value and conductance reading in a table of calibration values.

The operator should now repeat salt calibration steps 1 through 4 for all salt standard values. Once the calibration is complete select "Exit" Press "ENTER". The unit will then revert to the main selection menu.

NOTE: Before monitoring data or reviewing the salt calibration table the operator should press the ON/RESET key to re-initialize the working salt memory table.

Several things should be noted about "Salt" calibration.

- The "Blank" standard must always be used.

- Not all of the remaining standard values are required to be entered. However, the instrument establishes a linear slope between each standard value used. Therefore, a much more accurate salt reading will be calculated if the maximum number of salt standards are entered.

- The instrument will not calculate a salt value if it encounters a conductivity measurement higher or lower than that obtained during salt calibration. In these instances it will display 999999 ptb as the measured salt value. For this reason it is advisable to utilize a salt standard well above those that will normally be measured, thus, avoiding ambiguous readings.

6.7   Calibrate Internal Battery

Note: This is typically a factory procedure.

The internal battery voltage is monitored by the CPU in order to alert the user of a pending low battery condition. When this mode is selected the unit will display:

> Internal. Batt. Cal
>
> Zero_____X
> Span_____
> Exit_____

Select the desired function with the 'SELECT' key then press the 'ENTER' key to execute the command.

6.7.1 Zero Internal Battery

To set the zero offset adjustment value for the internal battery the K23050 should be operating from the external DC power source (either the AC adapter or optional external battery). Remove one of the internal NICAD batteries from the battery compartment before proceeding.

The display will show:

> Int Bat   0.00 V
> Adjust w/ Arrows
> Then Press Enter

Press the 'ENTER' key and the unit will establish the zero point on the internal battery voltage channel, store the data in non-volatile memory and return to the 'Calibrate Internal Battery' menu.

6.7.2   Span Internal Battery

To set the span point of the internal battery channel the battery that was removed during the 'zero' process must be reinstalled. Activate the instrument and monitor the battery voltage with a digital volt meter.

> The display will show:
>
> Int Bat 5.50 V
>
> Adjust w/ Arrows
> Then Press Enter

Use the arrow keys to adjust the displayed battery reading to the appropriate value. Press the 'ENTER' key to establish the calibration of this channel. After this is accomplished the unit will revert to the 'Calibrate Internal Battery' menu.

6.8   Calibrate External Battery

Note: This is typically a factory procedure.

The external battery voltage is monitored by the CPU in order to alert the user of a pending low battery condition.

When this mode is selected the unit will display:

Ext. Bat. Cal

Zero____X
Span____
Exit ____

Select the desired function with the 'ARROW' keys then press the 'ENTER' key to execute the command.

6.8.1   Zero External Battery

To set the zero offset adjustment value for the external battery the unit should be operating from the internal battery. Disconnect the external battery from the readout. The display will show:

Ext Bat 0.00 V

Adjust w/ Arrows
Then Press Enter

Press the 'ENTER' key and the unit will establish the zero point on the external battery voltage channel, store the data in non-volatile memory and return to the 'Calibrate External Battery' menu.

6.8.2   Span External Battery

To set the span point of the external battery channel, activate the instrument and monitor the external battery voltage with a digital volt meter.

The display will show:

Ext Bat 6.45 V

Adjust w/ Arrows
Then Press Enter

Use the arrow keys to adjust the displayed battery reading to the appropriate value. Press the 'ENTER' key to establish the calibration of this channel. After this is accomplished the unit will revert to the 'Calibrate External Battery' menu.

7   Data Logging

The "Data Logging" menu offers the user control over the various logging parameters and functions. It allows the user to select which parameters will be stored when a data scan is logged; select either manual or automatic modes; set logging ID number and increment value; enable or disable the logging feature.

When the Data Logging function is selected the display will show:

Enable/Disable

Auto/Manual____X
ID Number_____
Exit_____

The user moves the selection character (X) to the desired function by pressing the "ARROW" keys. Once the desired function is marked press the "ENTER" key to perform that operation.

7.1   Enable/Disable Data Logging

The Enable/Disable menu shows the following display:

Logging

Disabled____X
Enabled____

This menu assumes that the set up procedures have been performed; the auto/manual entry has been made and any desired ID number and increment value entered.

Enabling logging, if in the manual mode, will periodically display 'Manual Logging Enabled' in the real time display mode. This tells the user that Logging is Enabled and pressing the 'ENTER' key will cause the selected parameters to be stored as a data scan. The parameters will be stored along with the date, time and logging ID number.

If automatic logging has been selected when logging is enabled the K23050 will prompt the user for the starting date, time, and interval between data scans. Also, the unit will periodically display 'Auto Logging Enabled while in the 'display parameters' mode.

7.2   Auto/Manual Data Logging

This entry informs the K23050 which type of logging function will be used. Manual logging may be used to store readings while sampling different sources or different sites. Each time the "ENTER"

key is pressed when the unit is displaying sensor information it will store the date, time, ID (if selected) and the selected sensor readings. These data will be available for recall (as long as power is not removed from the unit) and uploading to a remote computer.

If the ID parameter is selected and an increment value has been input the increment number will be added to the ID after each line of data are stored. In this fashion the ID number could represent different sample points or site locations.

The AUTO mode of logging is meant for unattended data gathering. In this mode a starting date and time will be entered along with an interval between data records. The instrument will remain in a standby condition until a logging time is reached. It will then scan the data channels and store the data in memory. After which it will return to standby until the next interval has elapsed. Pressing the "SELECT" key will terminate the AUTO logging mode and enter the main command menu.

The display will show:

Logging Mode

Manual___X
Auto_____

Press the "ARROW" keys to move the selection character to the desired mode then press the "ENTER" key to store the information and return to the Data Logging sub menu. If "Auto" is selected the K23050 will drop into a Set Up menu where the user enters the Starting Date as month and day; Starting Time as hour and minute; and logging interval as hour minute. Note the system date and time should have been set prior to entering the starting date and time.

7.3 ID Number

The logging ID number consists of up to a five digit integer that will be stored with the other logging information if it is selected. In this menu the display will show:

Initialize Log

ID_____X
Increment _____
Exit_____

Press the "ARROW" keys to move the selection character to the desired function then press "ENTER" key to perform that step.

7.4 ID

When ID is selected in the ID initialization menu the display will show:

Set Logging ID
Adjust w/ Arrows
Then Press Enter
1

Use the arrow keys to set the ID number to the desired value. Pressing an arrow key continuously will cause the rate of adjustment to increase. When approaching the end number let off the key and then press it again. This will slow the rate of adjustment and allow the desired number to be selected. Once the desired ID number is entered press "ENTER" and the unit will revert to the "Initialize Log" sub menu.

7.5 Increment

When Increment is selected in the ID initialization menu the user is going to enter a number that will be added to the ID number after a logging sequence. In this way different information may be identified in the report. (i.e. If different sample points were to be tested an increment number of 1 would cause the ID number to change by one with each logged record.)

Adjust the ID Increment value in the same manner as the ID number. Press 'ENTER' to terminate the ID Increment mode.

7.6 Data Logging Exit

Selecting "Exit" will put the system back to the main logging menu.

8 Select Display Parameters

The 'Select Display Parameters' function is used to select the four channels that may be displayed at one time. When the 'Sel Dsp Prmtrs' command is selected by positioning the Selection "X" on that line and pressing the 'ENTER' key the instrument will show a list of the available display parameters. Those that are selected have an asterisk on their line. Only four parameters may be selected for

viewing at one time. If the user wishes to select new parameters for display, simply place the cursor (an "UNDERLINE" character at the end of the line) on the line of the new parameter by means of the arrow keys then press the 'SELECT' key. This will place an asterisk at the end of this line indicating the parameter is selected for display.

When a new parameter is selected one of the old parameters must be deselected in order to keep the display list at four or less. Do this by placing the cursor on one of the selected parameter lines by means of the arrow keys and pressing the 'Select' key. This will remove the asterisk from that line and deselect the parameter from the display list.

The available display parameters are:

- Salt
- Conductance at 25 °C.
- Conductance
  (Non temperature compensated)
- pH
- pH (milli volt reading)
- Temperature °C.
- Temperature °F.
- Internal Battery voltage
- External Battery voltage
- Date
- Time
- ID
- ID Increment value

When the desired parameters have been selected the user presses the "ENTER" key to revert to the main command menu.

9   Select Log Parameters

The 'Select Log Parameters' function is used to select those items that will be stored in data RAM for later retrieval and transfer to a personal computer. When the 'Select Log Parameters' command is selected by placing the selection 'X' on the line that says 'Sel Log Prmtrs' and pressing the 'ENTER' key the instrument will show a list of the available logging parameters. Those that are selected have an asterisk on their line. As many parameters as you like may be selected. If the user wishes to select new parameters for logging, simply place the cursor (Underline Score at the end of the selected line) on the line of the new parameter by means of the arrow keys then press

the 'Select' key. This will place an asterisk at the end of this line.

If it is desired to remove a parameter from the selection list, place the cursor on the line containing the parameter to be removed using the arrow keys, then press the 'SELECT' key. This will remove the asterisk from that line and deselect the parameter from the logging list.

The available logging parameters are:

- Date
- Time
- Logging ID
- Salt
- Conductance at 25 °C.
- Conductance
  (Non temperature compensated)
- pH
- pH (milli volt reading)
- Temperature °C.
- Temperature °F.
- Internal Battery voltage
- External Battery voltage

When the desired parameters have been selected the user presses the "ENTER" key to revert to the main menu.

10 Set Date/Time

The microcontroller in the K23050 maintains the time and date in internal registers. This information is stored with each data record for later identification. The instrument does not contain a hardware clock chip. Therefore, time and date must be set each time the unit is activated, if, data logging is to be performed.

When this function is chosen the unit will show:

Set Date/Time

Date____X
Time____
Exit____

Use the "ARROW" keys to choose the desired function then press the "ENTER" key to proceed.

10.1 Set Date

The display will show:

Set Date

Month____X
Day_____
Year_____

Use the "SELECT" key to position the selection character (X) on the date item to be adjusted. Once this is done use the arrow keys to move the setting to the desired point. When full date is correct press "ENTER" key to return to "Set Date/Time menu.

10.2 Set Time

The display will show:

Set Time

Hour_____X
Minute____

Use the "SELECT" key to position the selection character (X) on the item to be adjusted. Once this is done use the arrow keys to move the setting to the desired point. When the correct time is shown press the "ENTER" key to return to the "Set Date/Time menu.

10.3 Exit Date / Time Set

Selecting Exit from the "Set Date/Time" menu will put the program back to the main function menu.

11 Auto Shutoff

The K23050 has the capability to turn itself off automatically in order to conserve battery power. This is done approximately two minutes after the last key is struck. If this is desired select Auto Shutoff__ON. If it is not desired select Auto Shutoff__OFF. This selection is stored in non-volatile memory and will remain in effect until changed. If auto shutoff is not selected, the instrument must be turned off via the "Power Off" function in the main command menu.

The display will show:

Auto Shutoff

On___X
Off____

Use the "SELECT" key to position the selection character (X) to the desired setting. Press "ENTER" to store the setting and return to the main command menu.

12 Power Off

Selecting "Power Off" from the main command menu is the way to secure power to the instrument. When this is selected and the "ENTER" key pressed the unit will display:

Power Will Be
Turned Off....

Yes_____X
No_____

Use the arrow keys to select Yes or No and press the "ENTER" key. If "Yes" is selected then instrument will power down. If, "No" is selected it will return to the main command menu.

13 Manual Upload

The 'Upload' command is selected when previously logged data are to be transferred to a PC or the user wishes to view the Salt Calibration table. Selecting this mode puts the instrument into a standby condition awaiting serial communication from the PC. The message "Wait" will be shown until the data transfer begins. This mode will terminate automatically when the logged data or Salt information has been transferred.

The user should connect the instrument to the PC via the K23050 COM connector and serial cable. Using Windows as outlined in section 3.4 of this manual run the K23050 software. With the K23050 in the "Upload" mode (displaying Wait) the user types a two character command followed by "ENTER". This will begin the desired data transfer. The serial commands are:

Command string	Result
"X" "L" "ENTER"	Sends comma delimited file of previously logged data.
"X" "C" "ENTER"	Sends the Salt versus Conductance calibration table.

The parameters will be in columnar format with a comma delimiter. The data columns are in the order that they appear in the "Sel Log Prmtrs"

menu of the K23050. If all parameters have been selected for logging the parameter columns will be listed in this order:

Date, Time, ID, Salt, Cond. @ 25, Cond., pH, pH millivolts, Temp C., Temp F., Internal Batt. V, External Batt. V.

If some parameters are not selected for logging they are simply removed from the list. The order of the remaining data columns will be the same.

If the user desires to terminate the upload process prior to completion, pressing the "SELECT" key will put the unit back to the main command menu.

14 Set Decimal Places

The 'Set Decimal Places' function allows the user to set the precision of each measured parameter. That is the number of displayed decimal places may be selected from one to four for each item that the instrument measures or calculates. When the 'SET DEC PLCS' command is selected by positioning the Selection "X" on that line and pressing 'Enter' the instrument will show a list of the measured or calculated parameters that may be displayed. The list contains these items:

a. Salt
b. Cond. at 25 °C.
c. Conductance
d. pH
e. pH millivolts
f. Temp Deg. C.
g. Temp Deg. F.
h. Int. Batt. Volts
i. Ext. Batt. Volts

To the right of each item is a number between 1 and 4 that designates how many decimal places will be displayed for that parameter. The number may be changed by selecting the desired parameter to edit using the arrow keys. An under bar below the decimal point number indicates which parameter is selected for editing. Pressing the 'SELECT' key will incrementally change the number of displayed decimal places for that parameter. Edit the list as desired and then press the 'ENTER' key. The decimal place selections will be stored in non-volatile memory and the unit will revert to the Main Menu.

15 Access On/Off

The K23050 has the capability to restrict access to the calibration menu. If people unfamiliar with calibration procedures have access to the instrument it is possible that inadvertent destruction of the instrument's calibration will occur. In order to limit this possibility a simple security feature is incorporated. The feature may be selected from the 'Access On/Off' menu.

When the Selection "X" is positioned on the line displaying "Access On/Off" and the 'Enter' key pressed the instrument will display:

Input Access #
Adj Code Number
Then Press Enter
1

Using the arrow keys the operator enters the instrument serial number in the display. The serial number is written inside the battery compartment of the readout. Once the correct serial number is displayed the user presses the 'ENTER' key. The K23050 will then display:

Security Check

Disabled _____X
Enabled_____

The operator may use the arrow keys to position the Selection "X" opposite the desired setting and then press the "ENTER" key. The selection will be stored in non-volatile memory and the unit will operate in that mode from then on. If the security feature is "Enabled" the operator will be prompted to enter the unit's serial number whenever the Calibrate function is selected from the main menu. If the serial number is incorrectly entered the unit will display "Access Denied" and then revert to the main menu. If, the serial number is entered appropriately, access to the calibration menu will be allowed as normal.

16 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. The Koehler Salt-in-Crude Analyzer requires very little maintenance for proper operation. If you have any questions about maintaining your equipment, then please do not

hesitate to contact the Koehler technical service department.

16.1 Battery Charging

The K23050 contains an internal battery pack comprised of four AA size, NICAD batteries. When fully charged these can provide approximately eight hours of continuous operation. The unit comes with an external AC adapter, which can be used to power the instrument directly or to charge the internal battery pack. To power the K23050 from the AC adapter plug the adapter connector into the jack labeled "Power". The instrument may be run continuously in this manner. If the instrument is primarily operated from AC power the user should periodically monitor the internal battery voltage and recharge when the battery falls below 4.9 volts. It is not intended for the unit to be secured by simply unplugging the AC power adapter. The instrument should be turned off by means of the "POWER OFF" procedure in the main menu.

To charge the internal batteries plug the adapter connector into the jack labeled "Power". The unit has a build in battery charging circuit that will recharge the internal batteries in 14 - 16 hours. This is assuming the unit is not activated. If it is operating a very limited amount of charging current will be available for the batteries.

The unit system offers an optional external, sealed Nickel Metal Hydride (NiMh) battery and external charger. This is a recommended option if the K23050 is going to be used on extensive field studies or when long time data logging is to be performed. Since data will be lost if the instrument is turned off or loses power while storing information, the larger capacity external battery is a good safeguard.

When fully charged the external battery can operate the K23050 for approximately 130 hours. To charge the external battery, simply plug the external battery charger, power adapter into a 115/230 volt wall outlet. The external battery will be fully charged in 18 to 20 hours.

The charge state of either battery can be checked by displaying the battery voltages on the unit system display. The internal battery back should measure 5.4 volts or higher when at full charge (without the charger on). The external battery will measure 6.8 volts at full charge without its charger plugged in).

16.2 Routine Maintenance

The K23050 Salt in Crude Analyzer 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).

16.3 Replacement Parts and Accessories

Part Number	Description
K23050-1	Electrode Cap Assembly
K23050-2	Serial Cable Assembly
K23050-3	Temperature Probe and Wire Assembly
K23050-4	Power Adapter, Dual Voltage 115/230V
K23050-5	Ground Electrode
K23050-6	Calibration Resistor
K23050-7	External Battery with Stand
K23050-8	Table Top Stand
K23000-CASE	Salt in Crude Case
K88615	Serial to USB Adapter
332-002-017	100 mL Beaker

17 Service

Under normal operating conditions and with routine maintenance, the K23050 Salt in Crude Analyzer 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: _____

18 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.

19 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.

20 Returned Goods Policy

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

Notes

Notes