AMBER SCIENCE INC
277 BLAIR BLVD.
EUGENE, OREGON 97402-4147
(541) 345-6877
FAX (541) 345-6277

OPERATION MANUAL
ANALOG CONDUCTIVITY METER
MODEL 605, 605C & 605CR

Date:_____
Serial Number :_____
Dwg. Number:_____
Cell Part Number:_____
Calibrated By:_____

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Warranty

Amber Science, Inc. warrants this product to be free from defects in material and workmanship for a period of one year from date shipped. Warranty will be allowed whenever possible however, all warranty claims will be reviewed by Amber Science Inc.

Exclusions from Warranty

This warranty shall not apply to fuses, disposable batteries, (rechargeable type batteries, pH electrodes, temperature probes and conductivity cells are warranted for 90 days), or any product or part which have been subject to misuse, neglect, tampering, accident or abnormal conditions of operation.

Limited Liability

Amber Science, Inc. is pleased to offer suggestions on the use of this product; however, we have no control over its use or intended use. No representation or warranty, whether of merchantability, fitness for any particular purpose is made beyond the repair, replacement or refund of purchase price at the sole discretion of Amber Science, Inc. In no event shall Amber Science, Inc. be liable for special or consequential damages for injury to person or property, which may result from the use of this product. Users shall determine the suitability of this product for its intended applications before using and users shall assume all risk and liability whatsoever in connection therewith regardless of our suggestions as to applications or constructions.

Return of Items

Authorization must be obtained from our Customer Service department before returning any item for any reason. When applying for authorization, please include any data regarding the reason the item is being returned. All items must be carefully packed as to prevent shipping damage and insured against loss and shipping damage. Amber Science, Inc. will not be responsible for any shipping damage or loss. Items being returned without prior authorizations may not be accepted.

Note

Amber Science, Inc. reserves the right to make changes in specifications, designs, construction and appearance of our products without notice.

Upon receipt, the instrument should be carefully unpacked and inspected for shipping damage. All material in container should be checked against the enclosed packing list. If the instrument has been damaged in shipment, you must file a damage claim with the carrier.

SHIPPING CHECKLIST

Standard packing includes one each of the following:

Model 605 Analog Conductivity Meter (optional Models: 605C & 605CR)
One Pint bottle of 718 micro mho calibration solution (16 oz.)
Operation Manual

RELATED MODELS

605C	Analog conductivity meter with rechargeable (Ni-MH) battery and AC Adaptor
605CR	Analog conductivity meter with rechargeable (Ni-MH) battery, AC Adaptor and recorder output.

CELLS & ACCESSORIES

P/N 515	Conductivity Dip Cell (Au)
P/N 525	Conductivity Dip Cell (Pt)
P/N 535	Conductivity Multi-Purpose Cell (Au)
P/N 545	Conductivity Multi-Purpose Cell (Pt)
P/N 529	Conductivity Micro Flow Cell S/S (K=100 cm^{-1})
P/N 500-6	Cell connector (5 pin) with one meter Cable and 6K Thermistor (For user fabrication of custom conductivity cell).
P/N 6525	Lab Stand with Cell Holder (for bench top use).
P/N 8501	Platinizing Station (For Pt Cells P/N 525 & 545)

STANDARD CALIBRATION SOLUTION (pint, quart or gallon sizes available)

74.7 Micro mho calibration solution
718 Micro mho calibration solution
1409 Micro mho calibration solution
6660 Micro mho calibration solution
58700 Micro mho calibration solution

All solutions referenced at 25.0 degrees C.

INTRODUCTION TO CONDUCTIVITY

The basic unit of resistance is the ohm (Ω), conductance is the reciprocal of resistance, and its basic unit of measurement is the mho (É). The International System of Units for mho is Siemens (S).

The resistance of a conductor is inversely proportional to its cross sectional area and directly proportional to its length. In the measurements of aqueous solution, conductivity is based on the reciprocal of the resistance of a 1 -cm cube of material measured between opposite faces. This would be a constant of 1. Conductivity Cells usually consist of two metallic plates of a determined size mounted in a defined area. The cell constant K is the length L (or distance between the plates) of the conducting path in centimeters divided by the effective cross sectional area A of the conducting path in square centimeters (K=L/A).

The Model 605 series is designed to use a Cell with a constant between 9 and 11.

Conduction in aqueous solutions is by ionic movement and increases with temperature. This change is expressed in percent per degree Celsius, relative to 25EC and is called the Slope of the solution.

The Model 605 series has Automatic Temperature Compensation for slope correction.

The Total Dissolved Solids (TDS) in an aqueous solution that provides conduction is not temperature sensitive, as is the conductivity. By multiplying conductivity by an empirical factor, TDS may be displayed. This empirical factor is determined by the components and temperature of the solution. When the conductivity has been corrected to 25EC this factor is usually between 0.5 and 0.7. The Model 605 allows standardization with scale factors as low as 0.45 for direct display of TDS in parts per million (ppm).

CONDUCTIVITY STANDARDS

Approximate Molarity of Solution:	Weight of KCl Grams / 1000 grams	Conductivity in micro-mho @ 25EC
1.0	71.1352	111,342
.1	7.41913	12,856.0
.01	.745263	1,408.77

CELL CONSTANT DETERMINATION

Supplies needed:

Three (3) clean test tubes or beakers (example: 100 ml glass or plastic beakers)
Calibration solution of known value (example: pint of 718 shipped with instrument)
Beaker filled with tap or Deionized water (for soaking cell in prior to measurements)

1. Power On Battery check above 7.
2. Cell connected (Dry & Clean)
3. A.T.C. On
4. Range to 1 milli-mho

If possible, soak cell in Beaker filled with tap or Deionized water for 2 or 3 minutes prior to using the cell. This will help to wet plates of cell before taking actual measurements.

Prepare three samples of calibration solution (1 pint 718 shipped with instrument or standard of your choice) by pouring a small amount of standard solution into each of the (3) clean test tubes or beakers: (Example ounce in a 19 x 150 mm tube or 60 ml into a 100 ml beaker). Immediately replace cap on calibration solution to avoid contamination.

Hold calibration solution at or near 25EC if possible. Dip the cell into the first beaker or test tube of calibration solution and allow a few seconds for temperature to equilibrate. Withdraw cell and dispose of excess solution by carefully shaking off (do not touch or wipe off the cell). Repeat this process by dipping cell into next (second) beaker of calibration solution. Then place the cell in third (final) beaker of calibration solution, measurement should be made once the cell is in the third beaker. This reading will be most accurate if the measurement is made as soon as it is stable or about 10 seconds.
Readings may change in some cases due to gases or other impurities absorbed from the atmosphere. Using the standardize control, set the display to read 7.18. By changing the A.T.C. switch to the standardize position, the cell constant may be read directly from the display (example: 9.5, 10.0 10.5, etc.). The instrument is now ready to make precise conductivity measurements.

MAKING CONDUCTIVITY MEASUREMENTS

In making measurements of unknown solutions, first calibrate / standardize instrument with a known calibration solution close to the range you expect to be measuring. Then select 100 milli-mho on the Range switch, and A.T.C. On with the ATC switch. Using three samples (if available) of the unknown solution , rinse the cell in the first sample of solution. Select appropriate Range for the reading. Allow the cell to temperature equilibrate in the solution. Withdraw the cell and dispose of excess solution by carefully shaking off (do not touch or wipe off the cell). Repeat this process in the second sample of solution. Place the cell in the third sample for measurement. Measurement should be recorded once it becomes stable.

TOTAL DISSOLVED SOLIDS (TDS)

Select the scale factor for TDS of the solution to be measured.

Example: one gram per liter of K C l [1000 ppm] will yield a conductivity of 1793 micro-mhos (1000 / 1793 = .55772).
Next multiply the previously determined cell constant by this factor:
(Example: .55772 x 10.4 = 5.8)
With A.T.C. to standardize position, Range to 1 milli-mho, adjust front panel standardize so the display reads the product of TDS scale factor and cell constant (5.8).

Make TDS measurements in the appropriate range with A.T.C. On or the solution held at 25EC. The reading of the display, multiplied by the selected Range on the instrument will be parts per million (ppm) of TDS in the solution.

CONDUCTIVITY CELLS

There are several conductivity cells available. The (Au) cell is recommended for measurements of low conductivity or high purity solutions. The (Pt) cells are needed for measuring solutions with high conductivity readings such as sea water. It is important to remember that the conductivity cell is delicate and should be cared for properly.

The 525 Dip Cell and the 545 Multi-purpose Cell are coated with sponge black platinum. This coating gives the plates additional effective surface area required for good linearity. Should any part of this coating be removed in any way, the cell will be non linear and produce erroneous readings. Replatinizing the cell will be necessary. Replatinizing the conductivity cell can be accomplished two ways - the cell can be returned to the manufacturer for cleaning and replatinizing OR - the user can replatinize the Cell using the Model 8501 (or Model 7568) Platinizing Station and ASTM 1125 Platinizing Solution.

The 515 Dip Cell and 535 Multi-purpose Cell have gold plated plates and have much less tendencies to carry over solutions from one measurement to the next, as do the platinum cells. The linearity of the gold (Au) cells are not guaranteed above 2,000 micro-mhos.

Any foreign residue on the plates of a cell will decrease the effective surface area, in turn decreasing the cell s linearity range. NOTE: Cells must be kept clean and in good condition. Refer to the instruction sheet included with the Conductivity Cell for more information on care and cleaning of the conductivity cell.

When using the 529 Micro Flow Cell, which has a cell constant of 100, all displayed readings must be multiplied by 10. Refer to the instruction sheet included with the Micro Flow Cell for more information on care and cleaning of the micro flow cell.

INTRODUCTION

The Model 605 is an analog display conductivity instrument. It features three modes of operation, two for the measurement of solution conductivity from 0 to 110,000 micromhos in six ranges and one for standardize. The standardize function provides verification of proper operation and provides Scale Factor adjustments for Cell Constant and Total Dissolved Solids (TDS).

BRIEF CIRCUIT DESCRIPTION

A sine wave voltage is applied to the drive plate of the cell. The amplitude of this voltage is determined by the range selected and or A.T.C. On or Off . The range selected provides one of three different fixed voltages. One voltage for 100 & 10 milli-mho another for 1 milli-mho & 100 micro-mho and the third for the 10 & 1 micro-mho range when A.T.C. Off is selected. Selecting A.T.C. On provides a voltage varying inversely as to the temperature of the solution. This varying voltage compensates for the change in conductivity of the solution across a temperature range of 5EC to 45EC, (see Slope correction in this manual). The current through the solution to the sense plate of the cell is converted to a voltage by the input summing amplifier. This amplitude variable voltage is rectified by a phase sensitive synchronous rectifier and is then filtered and becomes the input to the analog meter.

SPECIFICATIONS

RANGES	CONDUCTIVITY (Linear)		RESISTIVITY (Non linear)	
	0 to 1.1	micromho	4 to .9	M ohms
	0 to 11	micromho	4 to 90	K ohms
	0 to 110	micromho	4 to 9	K ohms
	0 to 1.1	millimho	4 to 900	ohms
	0 to 11	millimho	4 to 90	ohms
	0 to 110	millimho	4 to 9	ohms

Cell constant adjustability — Nominal 10; Maximum 11; Minimum 4

Temperature Compensation 5EC to 45EC

Environmental Limits — Temperature: 5EC to 45EC (41 to 113EF); Humidity: 10% to 90% (relative, non condensing)

Display — Analog meter movement, rugged 3 " taut-band.

Linear conductance scale of 0 to 1.11 and non linear resistance scale of 4 to 0.9.

POWER REQUIREMENTS

One nine volt battery (NEDA 1604) is required. Battery life is approximately 200 hours. Battery voltage may be displayed on the analog meter by the power switch (Clockwise position). Battery life is independent of range selected and or solution being measured. If the instrument is not to be used for a period of several months, it is suggested that the battery be removed to prevent possible damage due to battery leakage.

AUTOMATIC TEMPERATURE COMPENSATION

The Slope correction for the Model 605 is set to an average of .1, .01 & .001 M of the following solutions: Potassium Chloride; Sodium Chloride; Ammonium Chloride; Lithium Chloride; Potassium Nitrate. The following is a representation of that average:

Temperature	Slope
5EC	1.88%
10EC	1.91%
15EC	1.94%
20EC	1.97%
25EC----------	----------2.00%
30EC	2.03%
35EC	2.06%
40EC	2.09%
45EC	2.12%

SIMULATING THE UNKNOWN

With A.T.C. Off a resistor connected between pin 1 and pin 3 of the cell connector socket will display a scale deflection of 10 with standardize control at the standardize pointer as charted below:

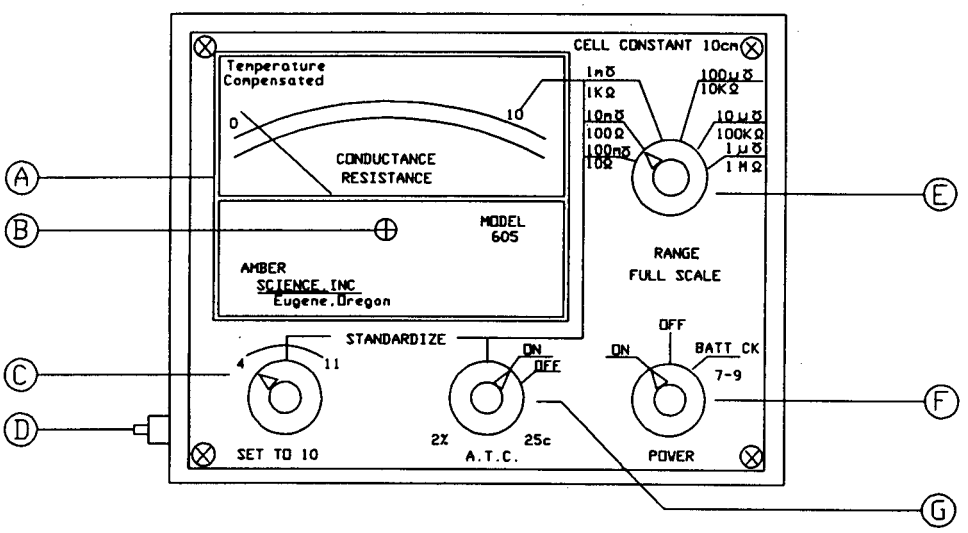
Resistor		Range			
100	ohm	100	millimho	/ 10	ohm
1K	ohm	10	millimho	/ 100	ohm
10K	ohm	1	millimho	/ 1K	ohm
100K	ohm	100	micromho	/ 10K	ohm
1M	ohm	10	micromho	/ 100K	ohm
10M	ohm	1	micromho	/ 1 M	ohm

With A.T.C. On a 6K ohm resistor must be connected between pin 3 and pin 5 of the cell connector socket to simulate the temperature sensing thermistor at 25EC.
Cell connector socket pins are numbered clockwise.

1, 4, 2, 5, 3

Pin 1 Sense plate
Pin 3 Drive plate
Pin 5 Thermistor feedback

FRONT PANEL DIAGRAM



Controls, Indicators and Connectors:

1. Analog display: From 0 to 1.1 Conductance and from 4 to .9 Resistance.
2. Mechanical Zero for Analog display.
3. Standardize Control - Master calibration control.
4. Cell Connector - 5 pin circular din connector.
5. Range Switch - allows operator to select one of six ranges.
6. Power Switch and battery check.
7. Function Switch - Selects A.T.C. On or Off and Standardize.

Note: Drawing is Model 605 and not to scale.

REPAIR & MAINTENANCE

The Model 605 requires no regular maintenance except for routine calibration by the end user using known value conductivity calibration standard solutions. Periodic replacement of 9 Volt battery will also be required. Occasional cleaning of the instrument should be done using a soft damp cloth with a mild soap solution. Do *not* allow fluids to run inside of instrument. Conductivity Cells should be inspected periodically and replaced when necessary.

Should the instrument become in need of repair or service, please contact:

Amber Science, Inc.
Customer Service Department
Telephone # (541) 345-6877 Fax # (541) 345-6277

E-mail - *info@amberscience.com*
URL - *www.amberscience.com*

Or by Mail: Amber Science, Inc.
277 Blair Blvd
Eugene, OR 97402-4147 USA

RECALIBRATION AFTER REPAIR

1. With power off, set mechanical zero on meter face to zero.
2. With power on, battery check above 7, select 1 millimho range, A.T.C. set to standardize , and Set to 10 set to the standardize position. Adjust R11 for a meter deflection of 10.
3. Select 100 millimho range, A.T.C. On , adjust R57 for zero display.
4. Select 1 micromho range, adjust R27 for zero display.
5. Repeat step 2.

USER INFORMATION

1. Immersion of Cell - the dip cell is to be immersed in solution a minimum of 1.5 inches for proper measurement. Solution must reach both plates inside the cell.
2. Minimum Sample required - minimum amount of solution required for proper measurement is 1 ml in a 10 mm (ID) test tube.
3. Equilibrating the Cell - Move the cell gently up and down in the solution to expediate temperature equilibration, this also assist in dislodging of air bubbles.
4. Avoid Solution carry over - Care must be taken to avoid solution carry over . Gently

shake off excess solution before next measurement. Do not touch cell.

5. Cells must be kept clean - refer to instruction sheet that was included with the conductivity cell for information on care and cleaning of the cell.

CONDUCTIVITY CALIBRATION DATA

Calibrating / Standardizing the instrument with a known conductivity calibration solution should be performed periodically. Calibration frequency (daily, weekly, or before each use) is a determination made by the user. Record data on a copy of this form or design a similar form.
Note: Turn ATC to ON position when calibrating instrument.

Date & Time:	Calibration Standard Solution:	Lot # and Expiration:	(Cell constant) Reference point:	Employee # And Name: