



# *AR7 SERIES*

Automatic Refractometer

User's Guide



# Table of Contents

Preliminary Information	Table of Contents	3
	Warnings and Cautions	4
Introduction	Congratulations on your Purchase	5
	Environmental Conditions	6
	Electrical Ratings/Specifications	6
	Instrument Features	7
Instrument Initialization	Set Up	8
Operation	Set Point Calibration	9
	Multi Point Calibration	10
	Sample Reading	12
	Shadow line display	12
Operational Parameters / Features	Sample Temperature Effects on Readings	13
	Automatic Temperature Compensation	14
	Temperature coefficient and correction calculations	14
	Display Screen/Explanation of Functions	16
	Printer Output	18
	RS232 Serial Port	18
	Serial Control Codes	18
	Channel 1 – ICUMSA Brix	19
	Channels 2 – 15, User Programmable	19
	Key Pad Function, Lock/Unlock	19
	Error Messages	20
Maintenance / Specifications	Care and Cleaning	21
	Care of Prism Surface	21
	Preventative Maintenance	21
Accessories	Extended Precision Calibration Oils	22
	Flow Cell	22
	Funnel Cell	22
	Sample Press	22
Warranty	Warranty Terms	23

## Warnings and Cautions

**CAUTION:** IN ORDER TO INSURE THAT CORRECT OPERATION OF THE AR7 *SERIES* INSTRUMENT IS MAINTAINED, ANY REPAIR OR SERVICE MUST BE PERFORMED BY EXPERIENCED PERSONNEL THAT ARE TRAINED BY REICHERT INC.

**CAUTION ESDS:** THE INTERNAL CIRCUITRY OF THE AR7 *SERIES* CONTAINS ELECTROSTATIC DISCHARGE SENSITIVE DEVICES (ESDS). SUCH COMPONENTS MAY BE SENSITIVE TO HIGH VOLTAGES PRODUCED BY STATIC DISCHARGES.

**CAUTION:** DO NOT USE STRONG SOLVENTS OR STRONG CLEANING SOLUTIONS ON ANY PART OF THE AR7 *SERIES* OR DAMAGE TO THE UNIT MAY OCCUR.

**WARNING:** DO NOT REMOVE OR DEFEAT THE EARTH GROUND CONNECTION ON THE AR7 *SERIES* POWER INPUT CONNECTOR OR THE UNIT'S POWER CORD. DAMAGE TO THE AR7 *SERIES* INSTRUMENT AND/OR INJURY TO THE OPERATOR MAY OCCUR.

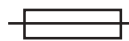
**WARNING:** THE AR7 *SERIES* SHOULD BE USED IN STRICT ACCORDANCE WITH THE INSTRUCTIONS OUTLINED IN THIS USER'S GUIDE. THE SAFETY OF THE OPERATOR AND THE PERFORMANCE OF THE INSTRUMENT CANNOT BE GUARANTEED IF USED IN A MANNER NOT SPECIFIED BY REICHERT INC.

## Symbol Information

The following symbols appear on the instrument:



CAUTION: Risk of electric shock



CAUTION: Replace with same type and rating fuse 5x20, 3.15A, 250V Quick Acting.



CAUTION: Indicates that important operating and maintenance are included in this User's Guide.

## INTRODUCTION

Congratulations on your purchase of your new Reichert AR7 *SERIES* Refractometer.

This manual describes the proper operation and care of this state of the art instrument. The AR7 *SERIES* is an automatic, bench top refractometer with digital read out and is capable of measuring % Solids (Brix), % Solids-TC (Brix-Temperature Compensated, Sucrose), Refractive Index and Refractive Index-TC. The Peltier controller eliminates the need for a water bath and has the greatest controllable temperature range set point available.

An AR7 *SERIES* has the capability to display data in four languages, English, Spanish, French and German and can measure refractive index of liquid solutions to a precision of 0.00005 or % solids (Brix) to 0.03. While the instrument has many capabilities it's functionality can be expanded considerably by a simple connection to a PC.

Please note that a Refractometer is a high precision optical instrument. It is absolutely necessary to properly maintain the instrument to obtain the best possible accuracy. This includes thoroughly cleaning the prism and well after each sample, routinely calibrating the instrument.



## ENVIRONMENTAL CONDITIONS

- Indoor Use only
- Temperature Range 10°C – 45°C
- Max. relative humidity – 80% for temperatures up to 31°C decreasing linearly to 50% (relative humidity at 40°C)
- Installation category II (over voltage category)
- Pollution degree 2
- Altitude up to 2,000 meters

## ELECTRICAL RATINGS/SPECIFICATIONS

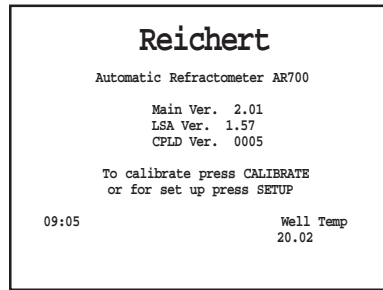
The Reichert AR7 *SERIES* incorporates an auto sensing, switching AC power supply. Never use an adapter, which will interrupt the protective grounding.



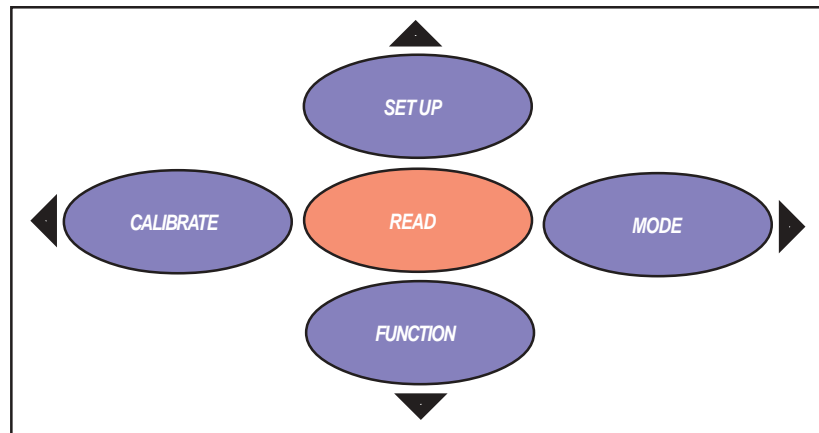
- Caution: Risk of electrical shock exists if the cover of the AR7 *SERIES* is removed. Hazardous voltages will be exposed, which can cause injury or death. Refer servicing to a qualified service technician.
- Supply Voltage: 90 to 264V AC, 47-63 HZ  
Input power – 220W P<sub>MAX</sub>
- Fuses: 3.15A/250VAC, Quick Acting
- Illumination: Long Life LED with 589nm bandpass filter.
- Range, Channel 1: 0 to 100% Dissolved Solids, Sucrose per ICUMSA.  
1.32000 to 1.60000 n<sub>D</sub> Refractive index (n<sub>D</sub> - Sodium D line refractive index).
- Readability: AR700: 0.01% Solids, 0.00001n<sub>D</sub>  
AR70: 0.1% Solids, 0.0001n<sub>D</sub>
- Precision: AR700: +/- 0.01% Solids, +/- 0.00001n<sub>D</sub>.  
AR70: +/- 0.1% Solids, +/- 0.0001n<sub>D</sub>.
- Accuracy: AR700: +/- 0.03% Solids, +/- 0.00005n<sub>D</sub>.  
AR70: +/- 0.1% Solids, +/- 0.0001n<sub>D</sub>.  
  
Typical clear samples, % Solids Temperature Compensated, as Sucrose.
- Temperature Compensation Range:  
Channel 1: 10 to 45° C per ICUMSA tables.  
Channels 2-15: user definable.
- Prism Assembly: Synthetic Sapphire mechanically sealed to Stainless Steel Well with Teflon Gasket.
- Dimensions: 13"W x 16"L x 4.5" H Weight: 17lbs  
(33cm x 40.6cm x 11.5cm) (7.7kg)

## INSTRUMENT FEATURES

1. **Instrument Display** – Digitally displays measurement values, operator instructions and error messages.



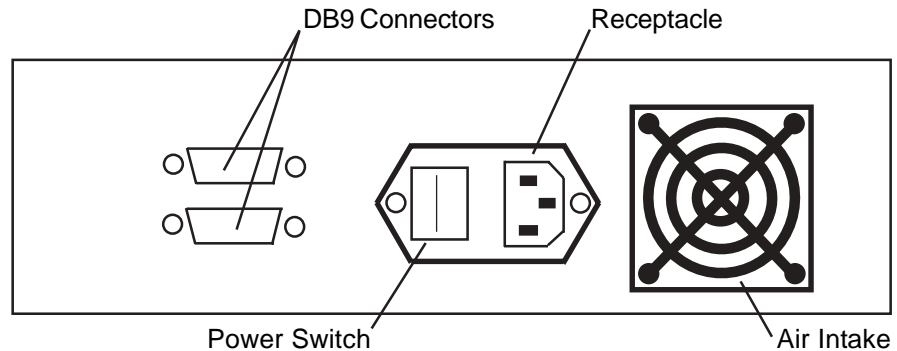
2. **Keypad Controls** – All five controls are soft touch membrane keys, FUNCTION/down, SET UP/up, CALIBRATE/left, MODE/right, and READ. These keys, other than the Read key, serve a dual purpose as function keys and also facilitate moving the displayed cursor/highlighter when selecting the many available options through the “SET UP” screen.



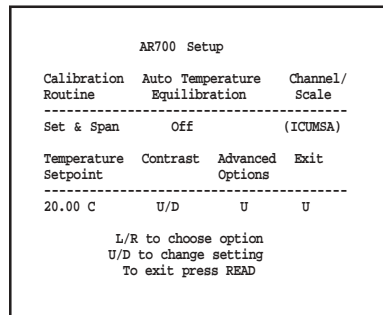
3. **Sample Well Cover** – The hinged, sample well cover is used to eliminate or minimize stray light when taking sample readings. It also reduces the effects of evaporation. Keeping the cover closed when the instrument is not in use will prevent possible damage and contamination to the sample well and prism surface. The sample well cover is made of Delrin.
4. **Sample Well** – The sample well is made of 416 grade Stainless Steel with a Sapphire Prism mounted to its center. When a sample is placed on the Sapphire Prism face, it is important that the sample cover the entire prism surface to attain an accurate reading. Avoid any air bubbles or particulate matter from settling on the prism to reduce reading variability.

## SET UP

- A. Unpack instrument from carton. Retain packing material for future storage/protection/shipping.
- B. Place the instrument indoors on a solid surface in an environment where the temperature is stable. Be sure to keep instrument away from air conditioning vents or water bath exhaust, drafts can affect the temperature stability.
- C. Plug the mating end of the Power Cord into the receptacle located on the back of the instrument. Plug the opposite end of the Power Cord into an appropriate receptacle to supply the instrument with power. Never use an adapter, which will interrupt the protective grounding. Supply Voltage: 90 to 264V AC, 47-63 HZ Input power – 220W PMAX



- D. Turn the instrument on by activating the power switch located on the rear panel.
- E. Set at the desired operating temperature in the set up screen by pressing **SET UP** and scrolling to Temperature Setpoint.



- F. Allow the instrument a warm up period of at least 30 minutes before calibration or sample reading.

## SET POINT CALIBRATION ( Calibration with distilled water only, also referred to single point calibration )

- A. Turn the instrument on by activating the power switch located on the rear panel.
- B. Set at the desired operating temperature in the set up screen by pressing **SET UP** and scrolling to Temperature Setpoint.
- C. Allow the instrument a warm up period of at least 30 minutes before calibration.
- D. Press **"CALIBRATE"**.



- E. Follow the displayed instructions to clean prism and press **"CALIBRATE"** again.

```

Clean prism and press
CALIBRATE again to reinitiate
or any other key to cancel

Well Temp
20.01 C

```

- F. Select reading mode by pressing **"MODE"**, Index-TC, Solids-TC.

```

Use MODE to select mode

Current mode
INDEX-TC

Add distilled water to sample well.
Allow to equilibrate then
press CALIBRATE.

Well temp.
20.01C

```

- G. Apply enough distilled water to cover the the prism surface, allow to temperature equilibrate and press **"CALIBRATE"**.

```

Reading and Calibrating
. . .

```

- H. Water calibration complete. Reported value should be 1.33299 +/- .00005.

```

Water calibration complete

1.33299 INDEX-TC

Reference Temperature 20 C

Press SETUP to continue

```

- I. Press **"SET UP"** to continue. You are now in the reading screen.

```

1.33299 INDEX-TC
20.00 C
3:28 PM

3:32 PM      Well Temp
Channel 1    Sucrose (ICUMSA) 24.99 C

```

- J. Note, it is recommended to clean the air intake on the back of the instrument and exhaust located on the bottom and perform the single point distilled water calibration daily, outlined above.



## SET & SPAN CALIBRATION ( Also known as Multi-point Calibration )

The AR7 *SERIES* can be calibrated with up to 5 points using 4 standards and distilled water. Performing a 2 point calibration will provide the required accuracy needed using distilled water and the supplied high refractive index certified standard. The reason for the 3, 4 and 5, point calibrations is to precisely calibrate the instrument to certified standards near the refractive index range where the measurements are being made. It is extremely important to note that when performing the multipoint calibration that the lowest valued standard be used first, proceeding upward to the highest valued standard, the standards should not be applied randomly. Please see the procedure below to perform the multipoint calibration.

- A. Raise the sample well cover and inspect the prism and well for cleanliness. Clean with soapy water, methanol or Isopropyl alcohol as required, followed by distilled water then dry the prism and well.
- B. Press the **"SET UP"** key on the touch panel, the *"Set Up"* screen will appear.

AR700 Setup			
Calibration Routine	Auto Temperature Equilibration	Channel/Scale	
Set & Span	Off	(ICUMSA)	
Temperature Setpoint	Contrast	Advanced Options	Exit
20.00 C	U/D	U	U

L/R to choose option  
U/D to change setting  
To exit press READ

- C. Highlight *"Calibration Routine"* using Left (calibrate), Right (mode), Up (read), Down (function) keys.
- D. Change the default setting to *"Set & Span"* using the Up/Down keys.
- E. Press the **"READ"** key to exit this screen.
- F. Press the **"CALIBRATE"** key to continue. Follow the displayed instructions to clean prism and press **"CALIBRATE"** again.

Clean prism and press  
CALIBRATE again to reinitiate  
or any other key to cancel

Well Temp  
20.01 C

Initiating - Please wait

- G. Follow the on screen instructions to add *Distilled Water*, allow to temperature equilibrate and press **"CALIBRATE"**. Water calibration complete 1.33299, press **"SET UP"** to continue.

Multipoint Calibration  
Use MODE to select mode

current mode  
Index-TC

Add distilled water to sample well.  
Allow to equilibrate then  
press CALIBRATE

Well temp.  
20.01C

Water calibration complete

1.33299 INDEX-TC

Reference Temperature 20 C

Press SETUP to continue

- H. Select the next point using the up/dwn keys to highlight the desired point, for example: 1.51416. Press **“READ”** to accept. Note that calibration must be in ascending order of refractive index value. If the calibration standard has a value other than listed, move the cursor to the value that is inbetween two values that bracket the standards value. For example, if the standard value is 1.52146, move cursor to 1.51416 since 1.52146 is higher than 1.45755 and lower than 1.57230. Proceed to step I.

SPAN CALIBRATION		
Highlight point, select with READ		
Repeat with additional points as needed		
When complete, select EXIT		
Refractive Index	Brix Equivalent	Last Calibrated
1.40229	41.24	-----
1.45755	67.72	-----
1.51416	88.73	-----
1.57230	N/H	-----
EXIT		
Use U/D to highlight, READ to select		

- I. Adjust the refractive index value which should now be displayed, to the value listed on the bottle of calibration fluid by pressing **“SET UP”**. Use the up/dwn/left/right keys to adjust value. When the value matches press **“READ”** to accept and continue. Adjust temperature coefficient value or press **“READ”** to continue. Change reference temperature or press **“READ”** to continue. If the displayed value matches the value as listed on the bottle of calibration oil, press **“CALIBRATE”** to continue.

Calibration Standard Index
1.51416
Press SETUP to edit
Press CALIBRATE to continue

- J. Add the stated Calibration Standard (ex: 1.51416) to cover prism, allow to temperature equilibrate and press **“CALIBRATE”** to continue.
- K. Calibration point complete, press **“SET UP”** to continue.

Calibration point complete
1.51416 INDEX
Reference Temperature 25 C
Press SETUP to continue

- L. Highlight another calibration point or EXIT and press **“READ”** to select.

SPAN CALIBRATION		
Highlight point, select with READ		
Repeat with additional points as needed		
When complete, select EXIT		
Refractive Index	Brix Equivalent	Last Calibrated
1.40229	41.24	-----
1.45755	67.72	-----
1.51416	88.73	-----
1.57230	N/H	-----
EXIT		
Use U/D to highlight, READ to select		

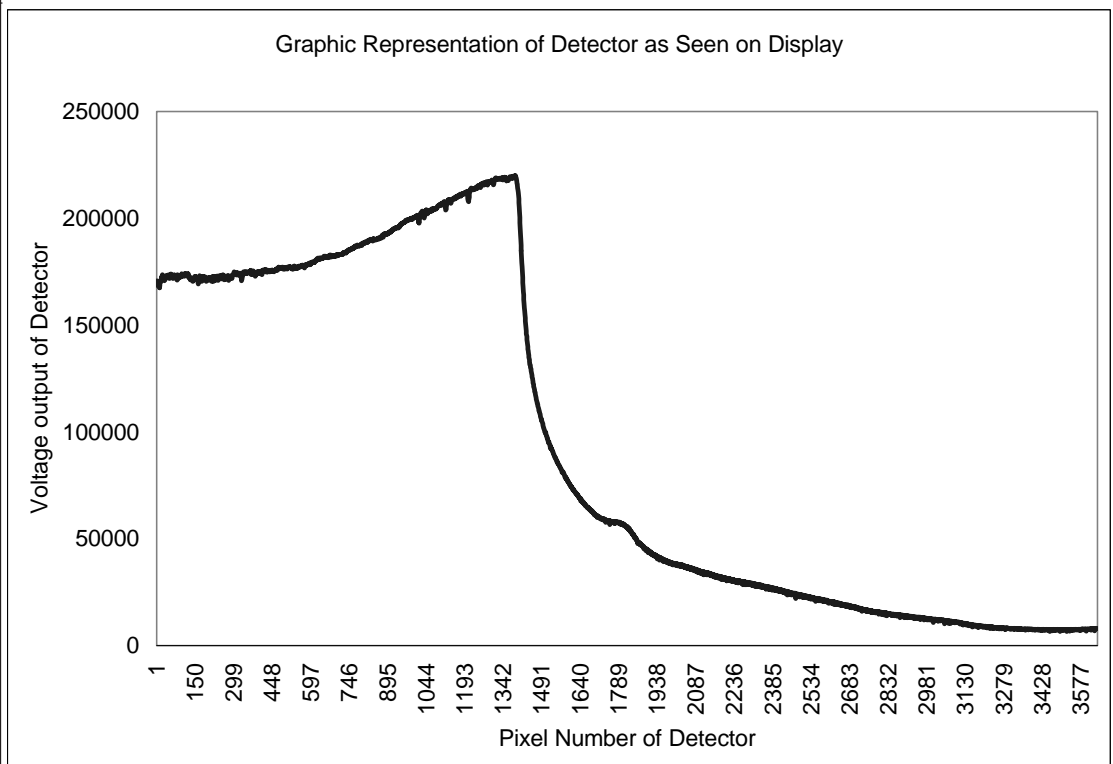
## SAMPLE READING

- A. Clean and dry the prism and well.
- B. Add sample and allow to temperature equilibrate.
- C. Press **"READ"**.
- D. Note value on display.
- E. Use **"MODE"** key to switch between the four modes of measurement:
  1. **INDEX** = Refractive index.
  2. **INDEX-TC** = Refractive Index, Temperature Compensated.
  3. **SOLIDS** = Percent Concentration.
  4. **SOLIDS-TC** = Percent Concentration, Temperature Compensated.

*The above modes in channel one are for measurement of Sucrose or "Brix" scale per the International Commission for Uniform Methods. All other channels are custom scales.*
- F. Compare reading to known value. Note any difference in well temperature from sample reference temperature and adjust refractive index reading mathematically from the **"INDEX"** displayed value.

## SHADOW LINE DISPLAY

The AR7 *SERIES* has the ability to graphically display the shadow line enabling the user to see what the instrument sees. To operate this feature after taking a reading press and hold the **"FUNCTION"** key for at least five seconds. When the key is then released the AR7 *SERIES* will generate and display a graph of the Linear Scanned Array output. To exit the shadow line display press **"READ"**.



## SAMPLE TEMPERATURE EFFECTS ON READINGS

Refractive Index is a physical property of a material. It changes with concentration and with temperature. As a result, samples need to be at a stable temperature when read and the reading will be different depending on the sample temperature. This phenomenon is true for Brix or any other unit of measure that a refractometer can be programmed to report in since these are calculated from refractive index.

The common methods of managing this are Automatic Temperature Compensation (ATC) and control of the sample/prism temperature.

### Automatic Temperature Compensation

Automatic Temperature Compensation (ATC). Since most uses of refractive index is in controlling concentration, it is useful to eliminate the temperature effects when looking at instrument readings. One standard method is to have programmed channels that calculate the correct reading at 20C for a sample that is being read at other temperatures. This allows comparing readings to formula or process specification using 20C values without doing complicated conversions. Note that custom channels to do temperature compensation are specific to the material developed for and most likely will provide poor readings if used for a different material.

The automatic temperature compensation modes built into...

## AUTOMATIC TEMPERATURE COMPENSATION

Automatic temperature compensation corrects readings over a range of temperatures. As an example: Samples taken at 10°C – 40°C are corrected to a reference temperature reading of 20°C. Temperature correction is necessary because refractive index varies inversely with temperature, as temperature of sample rises refractive index falls and as sample temperature drops refractive index will rise. The reason for this is that a sample whose temperature is changing will report changing refractive index measurements. To speed getting sample temperature to stabilize, the AR7 *SERIES* has an internal peltier which can be set to do this. It is necessary to allow the sample temperature to equilibrate so that the instrument can properly read the sample.

The automatic temperature compensation modes built into the AR7 *SERIES* are based on the temperature coefficients ( $n_D/^\circ\text{C}$ ) of sucrose, per the ICUMSA scales. When readings are taken in INDEX-TC (refractive index-temperature compensated) mode the coefficients are only valid for sucrose solutions. A typical temperature coefficient for an aqueous solution is  $-0.0002/^\circ\text{C}$  and for an organic solution it is typically  $-0.0004/^\circ\text{C}$ . You can calculate the correct temperature coefficient for a specific solution using the following routine.

### Temperature Coefficient Calculations (non-Sucrose samples)

To calculate the temperature coefficient of a sample, the sample must be read in the *Index Mode*. Take note of the reported value and the reading temperature. The sample must then be read at a second temperature. The following calculation may then be used.

$$\text{Temperature Coefficient} = (nD1 - nD2)/(T1 - T2)$$

where :

nD1 = Refractive Index of sample at temperature 1

nD2 = Refractive Index of sample at temperature 2

T1 = Temperature of Refractive Index reading 1

T2 = Temperature of Refractive Index reading 2

The temperature coefficient is almost always a negative number, in other words, refractive index increases as temperature decreases and therefore decreases as temperature rises. Typical temperature coefficients for fluids will be from  $-0.0001$  to  $-0.0004$ . Once a temperature coefficient is known, the temperature corrected refractive index can be calculated from an actual refractive index reading by the following formula:

$$RITC = ((RT-AT)*TC)+RI$$

Where:

RITC = Refractive Index Temperature Corrected

RT = Reference Temperature

AT = Actual Temperature as Read on Instrument

TC = Temperature Coefficient Of Sample

RI = Actual Refractive Index As Read On Refractometer

Example: Calibration Verification of an instrument using a known fluid

1. A certified calibration oil is read on an automatic refractometer as having a refractive index of 1.51519 at 22.48°C.
2. The actual value of the oil as certified by N.I.S.T. is R.I. = 1.51416, Reference Temperature = 25°C, Temperature Coefficient = -0.000412 dn/dt.
3. Temperature Differential = Reference Temp. - Actual Reading  
Temperature = 25.00 - 22.48 = 2.52
4. Temperature Compensation Factor = Temperature Differential times Temperature Coefficient = (2.52) x (-0.000412) = -0.00103824
5. -0.00103824 + 1.51519 = 1.51415176. This would be the temperature corrected refractive index at 25°C In this case, if the value obtained above differs from the known value of the calibration standard by more than the accuracy tolerance for the instrument, calibration of the instrument is necessary.

#### Sample/prism Temperature Control

Whether using ATC or not, if the temperature of the sample is changing while reading the reported value will be changing as well. This phenomenon was used in the previous section in a controlled way to calculate how the refractive index of a specific material changes with temperature. Another example is that calibration oils typically change about .0004 refractive index units/C (look on the label for the specific value). Controlling temperature during calibrations and when reading samples is important to accurate and reproducible readings.

To avoid the errors unstable sample temperature can cause, the AR700/AR70 has an internal peltier which can be set for any temperature from 10C below room temperature to as high as 100C. This is useful when working with samples that are not at room temperature as the instrument can be set to measure at the temperature the samples come into the lab at allowing for temperature equilibrium to be established quickly.

## DISPLAY SCREEN/EXPLANATION OF FUNCTIONS

Press the “**SET UP**” key to access the AR7 *SERIES* Setup screen. Use the “**RIGHT/LEFT**” keys to advance through the function choices. Use the “**UP/DOWN**” keys to change the default settings.

AR700 Setup			
Calibration Routine	Auto Temperature Equilibration	Channel/Scale	
Set Pt.	Off	(ICUMSA)	
Temperature Setpoint	Contrast	Advanced Options	Exit
20.00 C	U/D	U	U

L/R to choose option  
U/D to change setting  
To exit press READ

AR700 Setup			
Interval Timer	Delay Timer	Calibration History Display	
Off	Off	U	
Index Readability	Restore Defaults	More Options	Exit
0.00001	U	U	U

L/R to choose option  
U/D to change setting  
To exit press READ

AR700 Setup			
Baud Rate	Date	Time	
115200	Jan 6 2003	18:36	
Password	Language	Primary Options	Exit
OFF	English	U	U

L/R to choose option  
U/D to change setting  
To exit press READ

- A. CALIBRATION ROUTINE** – Default “Set Pt”, which is a calibration using distilled water only. “Set and Span” uses water and up to 4 user defined standards to more accurately target a refractive index range where most readings will be made.
- B. AUTO TEMPERATURE EQUILIBRATION** – Default “OFF”. Auto equilibration will automatically detect when the sample and prism have reached thermal equilibrium. When this feature is activated a sample is applied and “**READ**” has been pressed the instrument will monitor the temperature until it stabilizes. The instrument will then automatically take the reading. During the monitoring period a graph will be displayed of the dynamic well temperature vs. time.
- C. CHANNEL** – Default “ICUMSA”. Channel 1 is programmed for “BRIX” from the International Commission for Uniform Methods of Sugar Analysis sucrose (ICUMSA) scale, temperature compensated in TC mode to 20 °C. Channels 2 through 15 are user programmable channels. For directions and an explanation of the necessity of custom channels please request Technical Bulletin “Custom Channel Generation for Automatic Refractometer Line”. Notify your representative of the instruments software version, displayed when first turned on as Ver. XX.X.
- D. TEMPERATURE SETPOINT** – To control the sample/prism temperature, highlight this selection and use the UP/DWN keys to adjust.
- E. CONTRAST** - Once highlighted the display contrast can be adjusted by pressing and holding the up or down key until the desired contrast is attained.
- F. ADVANCED OPTIONS** – Selecting this option refreshes the display and offers another Setup screen with additional options.



- G. INTERVAL TIMER** – Default “OFF”. Set in HH:MM:SS format, this option allows the instrument to take readings at definable intervals. Once activated and defined the AR7 *SERIES* will continually take readings until a lock out error occurs such as a lack of sample, or the option is disabled. Interval Timer is set to “OFF” when the HH:MM:SS is set to 00:00:00 and it is deselected.
- H. DELAY TIMER** – Default “0 SECONDS”. Sets the time a sample is read once the “*READ*” or “*CALIBRATE*” keys are pressed. This parameter is set in 15 second intervals up to 4 minutes. A count down timer is displayed after pressing the “*READ*” or “*CALIBRATE*” keys when this option is used.
- I. CALIBRATION HISTORY** – Pressing the “*UP*” key will display the previous 512 calibration records. Some parameters extend beyond the limits of the display, to view these press the *Up/Dwn/Lft/Rt* keys until the desired parameter or record is visible.
- J. INDEX READABILITY** – Pressing the “*UP*” or “*DOWN*” key will change the index reported value from 0.00001 to 0.0001.
- K. RESTORE DEFAULTS** – Pressing the “*UP*” key will activate another screen with instructions to press “*FUNCTION*” to restore defaults or press “*SET UP*” to cancel. This allows the user to restore all factory defaults. It will not erase custom channels or calibration history.
- L. More Options**– Press the “*SET UP*” key to advance to further Set Up options.
- M. BAUD RATE** – Default “115200 bps”. Baud rate options for the RS232 serial ports are: 57600, 38400, 19200, 9600, 4800 and 2400bps.
- N. DATE** – Format is Month/Day/Year. Use the “*Up/Dwn/Lft/Rt*” keys to navigate and change the date.
- O. TIME** – Can be set to standard 12 hour am/pm or 24 hour military time. Use the “*Up/Dwn/Lft/Rt*” keys to navigate and change the time.
- P. PASSWORD** – Default “OFF”. Password protection can be used to secure options once they are set. Turning this option “ON” and pressing “*SET UP*” displays the “Enter Password” screen. Use the arrow keys to enter a 3 digit numerical password. Press “*SET UP*” to exit. A second screen confirming your password will appear. Press “*READ*” to accept the new password or “*SET UP*” to cancel. Once the password has been entered the AR7 *SERIES* will prompt the user for it each time the Set Up screen is accessed. Keeping a record of the password in a secure location is recommended.
- Q. LANGUAGE** – Default “ENGLISH”. Language can be changed to Spanish, French or German by pressing the “*UP*” or “*DOWN*” keys to advance through the choices. Note that the custom channel names and definitions will appear as entered in the custom channel program.
- R. PRIMARY OPTIONS** - Press the “*UP*” key to return to the initial AR7 *SERIES* Set Up screen.
- S. EXIT** - Pressing the “*UP*” key returns the AR7 *SERIES* to the normal display.

## PRINTER OUTPUT

The printer output is provided for connecting an external printer through either of two DB-9 female connectors located on the instrument's back panel. Communication is by a 7 bit, parallel bus interface with synchronous operation.

## RS232 SERIAL PORT

The AR7 *SERIES* includes two serial communications ports, DB-9 position female connectors, located on the instrument's back panel. Communications settings are: 8 Data Bits, No Parity, 1 Stop Bit. Flow Control Xon/Xoff, Baud Rate settings described in section 10.0 M, 19200 recommended. Connect to computer with a 9 pin serial cable, *DO NOT USE* a "Null Modem Cable" when making the connection.**IMPORTANT NOTE:** Connect any required accessories (printer, computer) to the appropriate COM port on the instrument utilizing the included null modem cables. Do not disconnect without turning off power to the instrument.

The AR7 *SERIES* is capable of being controlled from a computer through the Serial Port interface by using any standard communications program such as "Terminal" or "Hyperterminal". Reading output through the serial port may be formatted to retrieve virtually any data, in any order desired. To format the serial string output, type "help sf", brief instructions will appear. To set the serial format, type "sf" followed by the letters for the output options desired. The default setting is GFA.

## SERIAL CONTROL CODES

Many of the advanced functions can only be accessed and set through the serial port connection. For a complete list of those codes contact your technical customer service representative.

## CHANNEL 1 – ICUMSA BRIX

The AR7 *SERIES* is preprogrammed at the factory with channel 1 to read % Sucrose or “Brix” scale per the International Commission for Uniform Methods of Sugar Analysis (ICUMSA). Temperature Corrected (TC) readings in channel 1 are valid for Sucrose only!

## CHANNEL 2 – 15, USER PROGRAMMABLE

User programmable channels or custom channels may be programmed using your own Refractive index, Temperature, % Solids data. Access to the channels is from the Set Up screen. Custom channels can include definitions for units of measure such as specific gravity, % protein, g/ml, etc. The units of measure labels are completely definable and up to 20 characters can be used.

To learn more about Custom channel programming, request “Custom Channel Generation for Automatic Refractometer Line”. Be sure to inform the technical service representative of the software version in your instrument, which is displayed as Ver XX.X when the unit is first turned on.

## FUNCTION, LOCK/UNLOCK

During the opening screen when the instrument is first turned on, the keypad can be locked and unlocked by pressing the “*READ*”/“*CALIBRATE*” then “*READ*”/“*MODE*” keys in that order.

## ERROR MESSAGES

MESSAGE: **Refractive index of sample exceeds AR7 *SERIES* limits.**

CAUSE: Applied sample appears to have a refractive index greater than 1.60000

MESSAGE: **Refractive index of sample is below AR7 *SERIES* limits.**

CAUSE: Applied sample appears to have a refractive index lower than 1.32000

MESSAGE: **Refractive index of sample exceeds channel limits.**

CAUSE: Custom channel range does not include refractive index found.

MESSAGE: **The index of your sample was higher than expected.**

CAUSE: During calibration, the refractive index of an applied standard was found to be higher than either the default or user edited index by 0.005 index or more.

MESSAGE: **The index of your sample was lower than expected.**

CAUSE: During calibration, the refractive index of an applied standard was found to be lower than either the default or user edited index by 0.005 index or more.

MESSAGE: **The index of your sample was more variable than expected.**

CAUSE: During calibration, usually the result of the prism face not being sufficiently clean. Clean prism and repeat process.

MESSAGE: **The prism is not clean or the cover is open.**

CAUSE: During initialization, the sample well must be clean and dry. If not, this message is issued.

MESSAGE: **The temperature has changed since the last calibration.  
Perform a water calibration to maintain accuracy.**

CAUSE: Since the last calibration has been performed, the user has changed the well temperature either from the front panel setup menu or through the "TEMPERATURE" serial port command by an amount more than the current tolerance. The tolerance defaults to 3 degrees, but can be changed to 0 (in which case, the message is not displayed) or some other value using the serial command "TW".

## CARE AND CLEANING

The Reichert AR7 *SERIES* is a precision optical instrument. The prism surface and well should be cleaned immediately after use. The interior components are protected from dust, spills, and other damage. The stainless steel well and prism assembly is sealed with a Teflon gasket. All non-optical components can be cleaned with soap and water or methanol. Using strong solvents such as N, N-Dimethylformamide or N, N-Nimethylacetamide, cresols, phenols and other tar acids should be avoided, Tetrahydrofuran or some lacquer thinners and their components can also deteriorate the prism seal over time or when applied at elevated temperatures. Do not use acetone, acetone based products or other harsh solvents when cleaning the instrument's body or it's components.

## CARE OF PRISM SURFACE

The prism surface should be cleaned immediately after use. While the sapphire prism has excellent scratch and stain resistance, the use of strong acids or bases should not be measured with this instrument or used as a cleaning agents. Do not use any metal or sharp objects to clean or pry loose the prism seal or residue on the sample or well. The sample should be wiped off with a dry tissue, followed by a thorough cleaning. Warm water and soap is recommended for removing sugar residue and methanol for oil based samples followed by a distilled water rinse.

## PREVENTATIVE MAINTENANCE

Clean the dust filter located on the back of the instrument on the fan. To accomplish this carefully pry the inner filter retainer from the mount, there is no need to remove screws from the mount. Once removed lift the filter foam from where it is positioned and either blow it clean with light air pressure or wash and rinse it in water. If washed in water allow the filter to completely dry before reinstalling. Reverse procedure to install.

## ACCESSORIES

The *Extended Precision Calibration Oils* recommended are manufactured by Cargille Labs, Cedar Grove, NY 07009-1289 USA, Phone 201-239-6633. To our knowledge they are the only domestic USA source of extended precision standard calibration oils with *six significant figures in index*. The characteristics of these oils are:

- NIST traceable.
- Stated accuracy at  $\pm 0.00005 n_D$ .
- Temperature coefficients (TC) are guaranteed at their specified reference temperatures, usually 20 or 25°C.
- 5 year shelf life.

<b>Catalog No. 13K41330</b>	Calibration Oil, 1.51432
<b>Catalog No. 13K41340</b>	Calibration Oil, 1.40424
<b>Catalog No. 13K41350</b>	Calibration Oil, 1.45755
<b>Catalog No. 13K41360</b>	Calibration Oil, 1.48993
<b>Catalog No. 13K41370</b>	Calibration Oil, 1.57230

NOTE: The values for the above calibration oils are offered as a general range, and may change somewhat by the supplier of these oils due to their manufacturing process. A document package accompanies each bottle stating all of the appropriate values. When using any new oil for calibration those values should be confirmed.

### **Catalog No. 13107100 – Flow Cell with Temperature Control**

The flow cell allows samples to be pumped to the prism surface. Typically a peristaltic pump with a flow rate of approximately 10-15 ml./min is used. Use of the flow cell generally increases instrument precision and eliminates errors due to an unclean prism surface. Use of the flow cell also allows the user to pre-temperature equilibrate extremely hot or cold samples. Ports are provided for circulation of a controlled temperature fluid.

### **Catalog No. 13107200 – Funnel Flow Cell with Temperature Control**

This accessory offers the same benefits as the flow cell but eliminates the need for a pumping device. 13107200 includes the flow cell, funnel, funnel attachment and tubing.

### **Catalog No. 13107300 – Sample Press with Temperature Control**

The sample press creates an enclosed sample volume by contacting the top of sample and prism well. It is useful for decreasing equilibration times of very viscous, hot or cold samples. It is also useful for measuring volatile liquids such as alcohols. Ports are provided for circulation of a controlled temperature fluid.

## WARRANTY TERMS

Please refer to our web site [www.reichert.com](http://www.reichert.com), Analytical Products, and select *Terms and Conditions of Sale* for an explanation of the warranty covering this Instrument. The warranty period for this product is two years.



**Reichert Ophthalmic Instruments**

**Reichert, Inc.**

3362 Walden Ave  
Depew, NY 14043  
USA

Toll Free: 888-849-8955  
Phone: 716-686-4500  
email: [info@reichert.com](mailto:info@reichert.com)  
[www.reichert.com](http://www.reichert.com)

**Reichert GmbH**

Hubertusstrasse 4  
D-82229 Seefeld  
Germany  
Tel: +49-8152-993530

ISO-9001 Certified

