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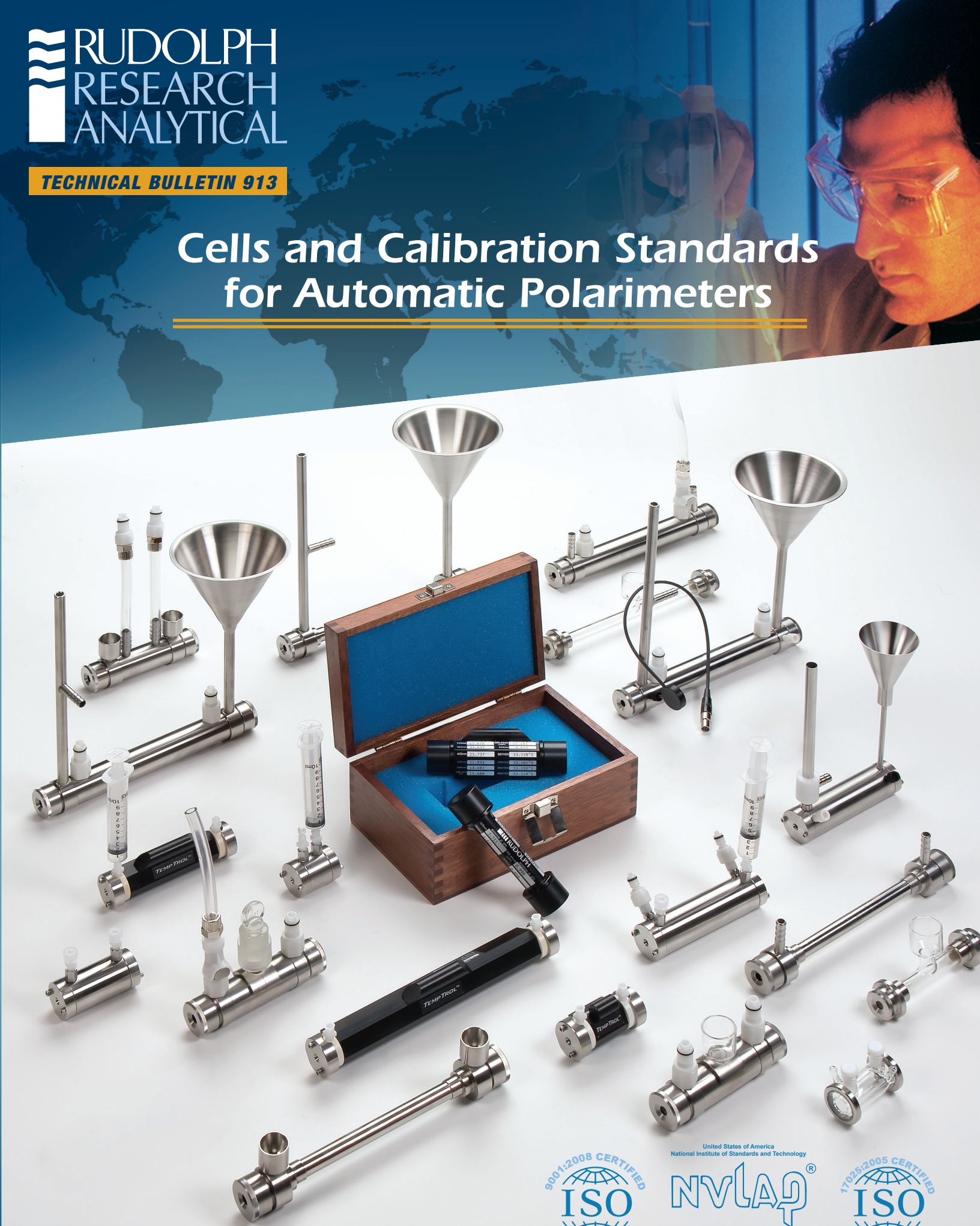
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RUDOLPH RESEARCH ANALYTICAL

TECHNICAL BULLETIN 913

Cells and Calibration Standards for Automatic Polarimeters



9001:2008 CERTIFIED ISO RUDOLPH RESEARCH
United States of America
National Institute of Standards and Technology
NVLAP®
NVLAP LAB CODE: 200898-0
Accreditation to ISO/IEC 17025:2005
17025:2005 CERTIFIED ISO RUDOLPH RESEARCH

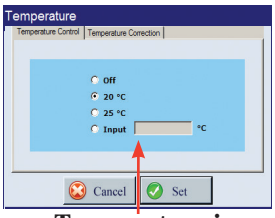
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Two Temperature Control Solutions

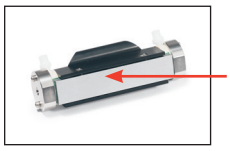
1. Patented TempTrol™ Technology Eliminates the Need for a Water Bath



TempTrol™ heating and cooling transfer surface



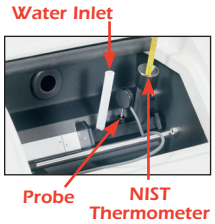
Temperature is selected via touch screen.



TempTrol™ cell with mating heating and cooling absorbtion surface



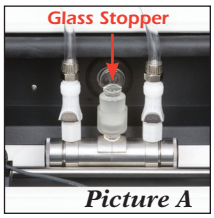
Place the TempTrol™ cell in your TempTrol equipped Autopol® sample chamber to measure to within ±0.2°C of the USP, EP, JP or BP specified temperature (normally 20°C or 25°C ±0.5°C)



Rudolph provides a temperature validation cell with every TempTrol™ system. The temperature validation cell along with an optional NIST traceable thermometer is designed to validate the temperature control performance of the polarimeter and cell to ±0.2°C.

2. Temperature Control With Water Bath





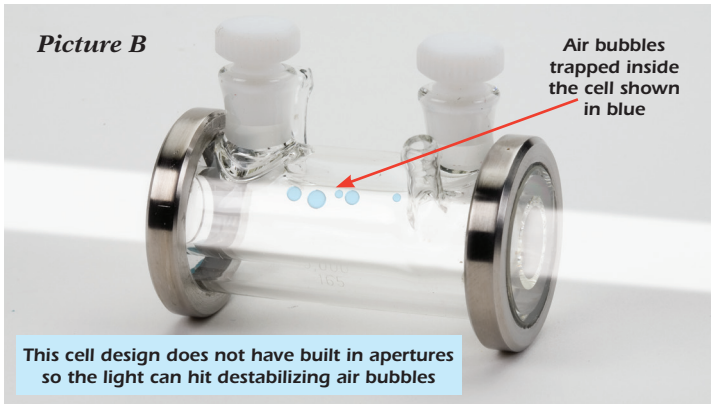
As seen above, almost all Rudolph Research Analytical jacketed cells come standard with quick release fittings which allow cells to be easily removed from the sample chamber. Tubing is held in place by rubber gasketing on top of the trough and the door. Optional stopper (choose "S" after the cell part no.) for evaporative samples (Picture A).

Temperature control is obtained through the use of an external water bath and a jacketed cell (Figure 1).



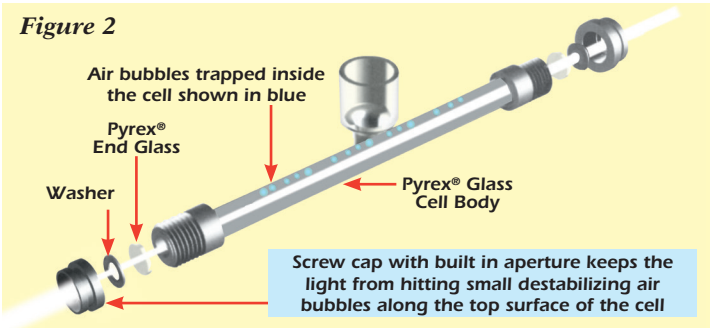
Better By Design

Many Rudolph Polarimeter Cell designs offer significant advantages over traditional fused end glass cell designs as shown in Picture B. All glass cells are easily broken and often build up optically active residue on the inside of the glass ends. Also these cells do not have built in apertures so the light passing through the sample is easily affected by small air bubbles caught inside the cell as shown in Picture B. Rudolph does offer this style cell for those customers who prefer a fused glass end but doesn't recommend them.



Rudolph Polarimeter Cells with built in apertures eliminate these problems because the stainless steel screw ends have apertures that are smaller than the internal diameter of the cell body to avoid the problem of the light being disturbed by small air bubbles along the surface of the cell. This design results in better measurement stability (Figure 2).

As shown below, the screw caps have precision apertures which reduce the beam diameter to less than the internal diameter of the cell so that, when the cells are aligned with the beam, internal sidewall reflections and consequent depolarizing effects are minimized.



Easy Cleaning

Another advantage over fused end cells is that screw caps, washers, and end plates are easily removed for cleaning the glass ends, sample cell interiors, or for replacement of the washers and end glass. To reassemble the cell requires following the configuration of Figure 2 and then applying finger tight pressure to the screw caps. As the screw caps are turned, the washers are compressed against the end glass creating a leak proof seal with the precision ground cell ends. Minimal screw cap pressure and the compressibility of the washer ensures a tight seal without causing stress induced birefringence in the glass end plates.

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Cells That Meet The Most Demanding Applications

Selection

With over 50 cells to choose from, Rudolph Research Analytical has a cell to meet every application.



AUTOPOL® Accepts Sample Cells from 10mm to 200mm Long

Some polarimeters accept only special sample cells, with maximum lengths of 100mm. The Autopol® accepts cells up to 200mm long. A 200mm sample cell offers twice the sensitivity when measuring the same solution in a 100mm cell. This additional optical path length is especially useful for solutions having small rotations. For precious samples and essential oils with large optical rotations, cells with only 0.05ml volumes and 10mm optical path lengths are available.



Autopol® 880 Dual Wavelength Saccharimeter



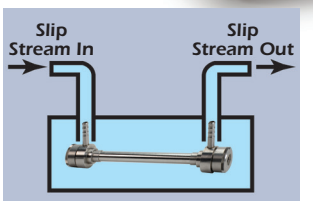
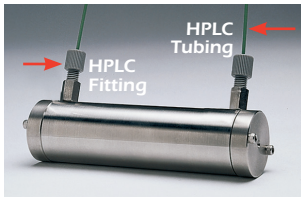


Figure 3: Continuous Sampling



Picture C: Pour In Sampling With Temperature Correction



Picture D: Micro Volumes for HPLC

Easy Filling

Sample solutions are either poured, injected with a syringe into an inlet port or pipetted into the center well. Air bubbles are released by tilting cells side to side or to one side while filling. Flexible tipped pipettes capable of reaching from the center well to either end of the sample can be helpful in filling narrow bore center fill cells.

Pour In Sampling Capability

Rapid operation is achieved by using a Type 31 or 33 Flow Through Polarimeter Sample Cell as seen in Picture C. Once the sample cell is filled, each successive sample poured into the funnel will displace the previous sample through the drain tube. This method eliminates opening and closing the sample chamber door and interchanging sample cells. Measurements can be made about as rapidly as successive samples can be poured.

Micro Volumes For Chiral Detection After HPLC

If your application demands 1ml or less, Type 32 Cells offer less than 0.5ml volumes. These cells come standard with HPLC fittings which transform your polarimeter into a chiral detector when connected to a chiral column after HPLC (Picture D).

Temperature Correction

For sucrose or other high volume applications where the temperature coefficient is known, a 33 Cell can be used as in Picture C. This cell has a built-in temperature port which, when the temperature probe is inserted, automatically measures the sample temperature inside the cell and sends the temperature to the Autopol® IV or Autopol® 880 for correction to 20ºC, 25ºC or any customer specified temperature.

Select the H-SI option when measuring Acids and Riboflavin.

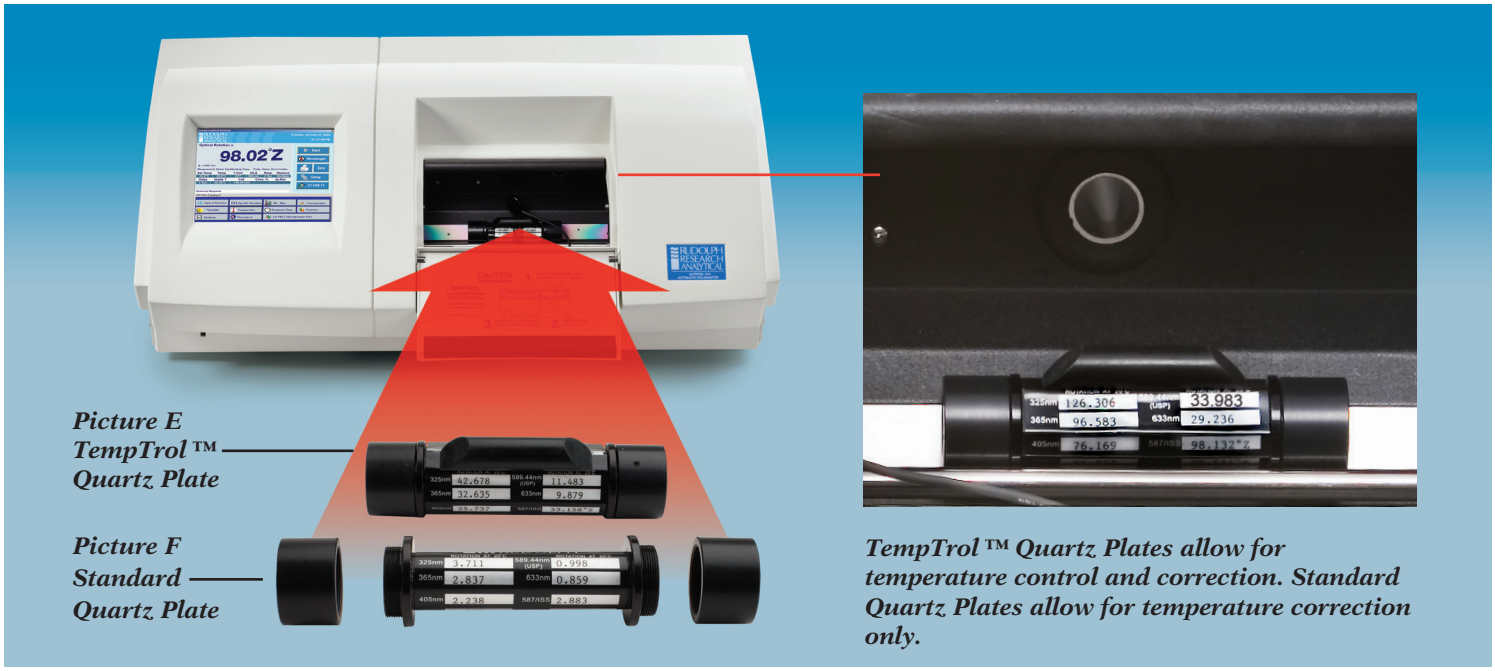
H option indicates Hastelloy® which is acid resistant. SI indicates Silco Steel which is also resistant to acids and will not change the color of samples that contain Riboflavin. Silco Steel is utilized to cover portions of the cell that come in contact with the sample.

A Rudolph Research Analytical Customer Service Representative or Technical Sales person would be happy to help you select the perfect cell for your specific application.

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NIST Traceable Calibration Standards



TempTrol ™ Quartz Plates allow for temperature control and correction. Standard Quartz Plates allow for temperature correction only.

Manufactured to NIST and ICUMSA Standards

Rudolph Research Analytical Quartz Control Plates provide a permanent calibration standard for polarimeters and saccharimeters. Every Rudolph calibration standard is manufactured using extremely stable crystalline quartz which is manufactured and polished to specific planeness, parallelism, purity and axis standards. These standards meet or exceed the specifications outlined on Page 61 of the National Institute for Standards and Technology (NIST) Circular C440 or as laid down by the International Commission for Uniform Methods of Sugar Analysis (ICUMSA). Each Quartz Plate comes complete with a label showing calibration at 11 different wavelengths (Picture G), a protective box and a NIST Traceable Certificate.



Selecting a Quartz Calibration Standard

Any rotation is available but generally available stock rotations are listed on back page. Quartz Plates come in single and 3 Rotation Quartz Plates. Single Quartz Plates (Picture E) have a single rotation value at each wavelength and are calibrated in ˚Arc (Optical Rotation) and ˚ISS/˚Z (Sugar Degrees). 3 Rotation Quartz Plates are also calibrated in ˚Arc and ˚ISS/˚Z, but have three rotation values at each wavelength (Picture F). This is possible because each plate is made up of one left or levo turning Quartz Plate (i.e. –28˚ Arc) and one right or dextro turning plate (i.e. +30˚ Arc) which may be used separately or together for a combined rotation of 2˚Arc (30˚–28˚). Every Rudolph Research Analytical Quartz Plate is manufactured to a reported uncertainty of ±0.002° Arc at 589. Please contact the factory for the Quartz Plate that is best suited for your needs.

Picture G: Quartz Plate Label:
Showing calibration values at 11 different wavelengths

Quartz Control Plate Calibration Standard
www.rudolphresearch.com

Serial No.	13699	Cal. Date	17-Jun-14

RUDOLPH

	ROTATION AT 20° C		ROTATION AT 20° C
325nm	42.449	589.44nm (USP)	11.421
365nm	32.460	633nm	9.826
405nm	25.599	587 / ISS	32.980
405nm	21.836	589 / ISS	32.983
546nm	13.424	880 / ISS	33.042
589.3nm (EP)	11.427	882 / ISS	33.041

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Call us to select a cell that meets your unique application

TYPE	DESCRIPTION	CELL PART NUMBER	ID (mm)	SAMPLE LENGTH (±0.02mm)	SAMPLE VOLUME (ml)
	**Type 40T** TempTrol™ Polarimeter Sample Cells: These cells are constructed of stainless steel and Delrin® and come with Luer® fittings at either end of the cell for easy filling with a plastic syringe or pipette. The cells have removable metal collars that allow for easy cleaning and glass cell end replacement. All cells come with Luer® lock and plug stoppers. Select Hastelloy® "**H**" when working with strong acids or bases. *Select HP for Automation or High Pressure Applications. Select H-SI Hastelloy® and Silco Steel® when working with strong acids and Riboflavin	40T-2.5-10-0.1 H/SI	2.5	10	0.1
		40T-2.5-50-0.35	2.5	50	0.35
		40T-2.5-100-0.7-H/SI	2.5	100	0.7
		40T-5.0-10-0.2	5.0	10	0.2
		40T-5-25-0.5	5.0	25	0.5
		*40T-5.0-50-1-H/HP/SI	5.0	50	1
		*40T-5.0-100-2-H/HP/SI	5.0	100	2
		40T-5.0-200-4-H/SI	5.0	200	4
	**Type 14** Polarimeter Sample Cells: Pyrex glass with center well for easy filling via pour-in method or with a flexible tipped pipette. Glass or Delrin stoppers are available as an option. Select "S" if you want a glass stopper. Select "DT" if you want a Delrin stopper with hole for Thermo Probe.	14-4.0-100-1.5-S/DT	4.0	100	1.5
		14-8.5-100-6.0-S/DT	8.5	100	6.0
		14-4.0-200-2.8-S/DT	4.0	200	2.8
		14-8.5-200-12-S/DT	8.5	200	12
	**Type 14J** Jacketed Polarimeter Sample Cells: Pyrex glass with center well. The main body of the cell is completely surrounded by a stainless steel jacket with quick release fittings at each end for circulation of temperature control fluids. Select "S" if you want a glass stopper. Select "DT" if you want a Delrin stopper with hole for Thermo Probe. **Select HT for temperatures above 160ºC.**	14J-4.0-100-1.5-S/DT	4.0	100	1.5
		14J-8.5-100-6.0-S/DT	8.5	100	6.0
		14J-4.0-200-2.8-S/DT	4.0	200	2.8
		14J-8.5-200-12-S/DT	8.5	200	12
	**Type 29** Flow-Through Sample Cells: Stainless steel with tubulations at each end for circulation of sample liquids. Designed so that sample flow washes interior windows eliminating dead volume in the optical path.	29-8.5-50-5	5.0	50	5.0
		29-8.5-100-10	8.5	100	10
		29-8.5-200-15	8.5	200	15
	**Type 29J** Flow-Through Jacketed Sample Cells: Type 29 but with a stainless steel jacket surrounding the main body of the cell for circulation of temperature control fluids.	29J-8.5-100-10	8.5	100	10
		29J-8.5-200-15	8.5	200	15
	**Type 30** Sample Cells: Stainless steel with a well at either end for easy filling.	30-4.0-100-3.7	4.0	100	3.7
		30-8.5-100-10	8.5	100	10
		30-4.0-200-5.0	4.0	200	5.0
		30-8.5-200-15	8.5	200	15
	**Type 30J** Stainless Steel Jacketed Sample Cells: Type 30 with stainless steel jacket surrounding the main body of the cell for circulation of temperature control fluids.	30J-4.0-100-3.7	4.0	100	3.7
		30J-8.5-100-10	8.5	100	10
		30J-4.0-200-5.0	4.0	200	5.0
		30J-8.5-200-15	8.5	200	15
	**Type 41T** TempTrol™ Flow-Through Sample Cells: Stainless steel funnel and exit tubing. The cell has a built-in temperature port which allows the temperature sensor and temperature control system to automatically measure and control the temperature inside the cell to 20°C, 25°C or any input temperature within the range of the TempTrol™ temperature control system.	41T-8.5-100-10	8.5	100	10
		41T-8.5-200-15	8.5	200	15
	**Type 33 or 33J** Flow-Through Sample Cells: Stainless steel funnel and exit tubing. This cell has a built-in temperature port which allows the temperature sensor to automatically measure the sample temperature inside the cell and send the temperature to the Autopol® IV or Autopol® 880 for correction to 20°C or 25°C. It comes in jacketed and unjacketed versions – select "J" for jacketing.	33-5-50-1.0	5.0	50	1.0
		33-5-100-2.0	5.0	100	2.0
		33-5-200-4.0	5.0	200	4.0
		33-8.5-100-10	8.5	100	10
		33-8.5-200-15	8.5	200	15
		33J-8.5-100-10	8.5	100	10
		33J-8.5-200-15	8.5	200	15
	**Type 32** Small Volume Sample Cells: Stainless steel with small inlet and outlet ports on both ends of the cell for filling with a pipette with HPLC fittings. *Select HP for Automation or High Pressure Applications.	32-2.5-10-0.05	2.5	10	0.05
		32-2.5-50-0.25	2.5	50	0.25
		32-2.5-100-0.5	2.5	100	0.5
		*32-5-25-0.5/HP	5.0	25	0.5
		*32-5-50-1.0/HP	5.0	50	1.0
		*32-5-100-2.0/HP	5.0	100	2
		32-5-200-4.0	5.0	200	4
	**Type 32J** Small Volume Jacketed Sample Cells: Type 32 with stainless steel jacket surrounding the main body of the cell for circulation of temperature control fluids. Also available with HPLC fittings.	32J-5-50-1.0	5.0	50	1.0
		32J-2.5-100-0.5	2.5	100	0.5
		32J-5-100-2.0	5.0	100	2.0
	**Type 50FJ** Fixed end glass cells with glass water jacket and small glass tubulations for connection to a waterbath. Comes with plastic stoppers.	50FJ-8.0-50-4	8.0	50	4.0
		50FJ-8.0-100-8	8.0	100	8.0

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Call Us To Select A Calibration Standard That Meets Your Application

Rudolph Research Analytical is the only Quartz Plate manufacturer in the world accredited by and traceable to NIST with accuracy of ±0.002 degrees optical rotation at 589nm.



United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200898-0

Rudolph Research Analytical Corporation
Hackettstown, NJ

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

CALIBRATION LABORATORIES

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2014-04-01 through 2015-03-31
Effective dates

For the National Institute of Standards and Technology

NVLAP-01C (REV. 2009-01-28)

TempTrol™ Quartz Plates indicated by the letter "T" have the facility for automatic temperature control when purchased with a TempTrol™ equipped polorimeter.

Every Quartz Control Plate is calibrated by Rudolph Research Analytical and is traceable to the National Institute of Standards and Technology.

Recalibration of Quartz Control Plates

Neither NIST nor ICUMSA provide guidelines for the frequency of Quartz Control Plate Recalibration. Since quartz is optically stable over time, changes in its optical rotation are the result of optical stress or surface scratches caused by physical handling. Therefore, it is the opinion of Rudolph Research Analytical that recalibration of a Quartz Calibration Standard every two to three years is satisfactory.

Single Rotation TempTrol™ Plate

TempTrol Quartz Control Plate Version A700T-1 with single rotation 11.483° Arc



TempTrol™ Quartz Control Plate A700T-1
Standard Quartz Control Plate A700-1

Standard Rotations at 589 nm in °Arc : 10.5°, 11°, 11.5°, 12°, 12.5°, 13°, 15°, 16°, 20°, 21.5°, 23°, 34°, 34.5°
Accuracy at 589 nm: ±0.002° Arc (ISS)

Standard Rotations at 589 nm in °Z(ISS): 30.32°, 31.77°, 33.21°, 34.66°, 36.10°, 37.54°, 43.32°, 46.21°, 57.76°, 62.09°, 66.42°, 98.19°, 99.64°
Accuracy at 589 nm: ±0.01°Z (ISS)

TempTrol™ Quartz Control Plate 302T
Standard Quartz Control Plate 302

Standard Rotations at 589 nm nm in °Arc: -10°, -10.5°, -10.75°, -11°, -12°, -15°, -16°, -22°
Accuracy at 589 nm: ±0.002° Arc

Standard Rotations at 589 nm in °Z(ISS): 30.32°, 31.77°, 33.21°, 34.66°, 36.10°, 37.54°, 43.32°, 46.21°, 57.76°, 62.09°, 66.42°, 98.19°, 99.64°
Accuracy at 589 nm: ±0.01°Z (ISS)

TempTrol™ Quartz Control Plate 300T-S
Standard Quartz Control Plate 300-S

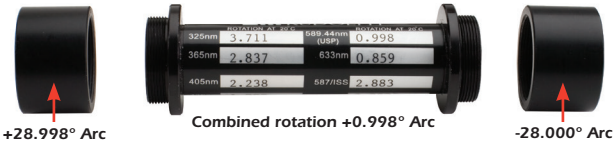
Standard Rotations at 589 nm nm in °Arc:
Customer Selected between +10° to +35° Arc
Accuracy at 589 nm: ±0.002° Arc

Standard Rotations at 589 nm in °Z(ISS): +28.88°Z to 101.08°
Accuracy at 589 nm: ±0.01°Z (ISS)

Quartz Control Plates are to be within ±0.5 degrees Arc or ±1.5 degrees ISS of the customer's specified rotation.

3 Rotation Standard Quartz Plate

Standard Quartz Control Plate Version A700-2 with 3 rotations



TempTrol™ Quartz Control Plate A700T-2
Standard Quartz Control Plate A700-2

Standard Rotations at 589 nm in °Arc: Approximately: 1°, 2°, 6°
Accuracy at 589 nm: ±0.002° Arc

Standard Rotations at 589 nm in °Z(ISS): 2.89°, 5.78°,17.33°
Accuracy at 589 nm: ±0.01°Z (ISS)

TempTrol™ Quartz Control Plate 301T-S
Standard Quartz Control Plate 301-S

Has a combined rotation between +1 to +10 angular degrees (°Arc) or +2 to +30 International Sugar Scale degrees (°ISS)/(°Z). The Quartz Control Plate consists of one left and one right turning quartz plate in separate cells, each of which can be removed from the cell holder for using either plate separately or together for a combined rotation. Quartz Control Plates are to be within ±0.5 degrees Arc or ±1.5 degrees ISS of the customer's specified rotation.

Standard Rotations at 589 nm in °Arc: Customer Selected between +1° to +10° Arc
Accuracy at 589 nm: ±0.002° Arc

Standard Rotations at 589 nm in °Z(ISS): Customer Selected between 2.89-28.98
Accuracy at 589 nm: ±0.01°Z (ISS)

TempTrol™ Quartz Control Plate 302T-S
Standard Quartz Control Plate 302-S

Standard Rotations at 589 nm in °Arc: Customer Selected -1° to -10° Arc
Accuracy at 589 nm: ±0.002° Arc

Standard Rotations at 589 nm in °Z(ISS): -2.89 to -28.89
Accuracy at 589 nm: ±0.01°Z (ISS)

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