RUDOLPH RESEARCH ANALYTICAL

TECHNICAL BULLETIN 932



The AUTOPOL® I, II, and III Series of Polarimeters

For Budget Focused, General Purpose and GLP/GMP Laboratories



Meeting the needs of your industry and application

- University Education and Research
- Flavor, Fragrance and Essential Oil
- Nutraceuticals
- Chemical
- Pharmaceutical

RUDOLPH LIFETIME CELL WARRANTY · 20 YEAR Service Guarantee · 8 YEAR Software Update Pledge · 3 YEAR WARRANTY · ISO 17034 · ISO 17025 · ISO 9001

Rudolph Research Analytical serving its customers with Integrity, Quality, and Innovation for over 50 years.

Rudolph subjects itself to a variety of industry accreditations and outside examination. Visit our website to learn how these apply to your purchase.

Select the Model and Features



Autopol I / Autopol I-T-AP-USR

- The Autopol I is our entry-level polarimeter model designed for:
- University Education
- Starch Analysis
- Lactose in Milk
- Flavors
- Chemicals
- Natural Product Research
- Invert Sugar
- Vitamins
- Fragrance
- Limited USP Monograph Compliance

Standard Features: ±0.01° Arc Accuracy, 589nm fixed wavelength, built in thermoprobe for temperature measurement, Windows Embedded for direct connection to the network server and flexible USB printing.

Optional Features:

- AutoFill™
- 100mm or 200mm TempTrol™ heating and cooling: 15°C – 40°C ±0.2°.
- AP Accuracy Option at 589 nm only : ±0.004° + 0-89.99° Arc Optical Rotation Range
- USR Resolution Option: 0.01, 0.001°Arc Selectable
- LED Light Source



Autopol II / Autopol II-T-AP-USR

Features: Standard accuracy of ±0.01° Arc Accuracy and 0.003° Arc with AP Accuracy Option. Standard Wavelengths: 589nm and 546nm wavelength, built in thermoprobe for temperature measurement, Windows Embedded for direct connection to the network server and flexible USB printing.

Standard Wavelengths: 589nm and 546nm
Optional Wavelengths: 365nm, 405nm, 436nm, 578nm, 633nm

A total of 2-4 extra wavelengths may be ordered at time of purchase or added later when needed.

Optional Features:

- AutoFill™
- 100mm or 200mm TempTrol™ heating and cooling: 15°C – 40°C ±0.2°C
- AP Accuracy Option at 589 nm only: ±0.003° + 0-89.99° Arc Optical Rotation Range
- USR Resolution Option: 0.01, 0.001°Arc Selectable
- LED Light Source



Autopol III / Autopol III-T-AP-USR

The Autopol III is Rudolph's budget focused pharmaceutical solution: Accuracy: ±0.002°C, 0.2% above 1°, 0.01° Arc above ±5° Arc.

Standard Wavelengths: 589nm and 546nm.
Windows Embedded Operating system for unmatched network flexibilty.

Complete Accessory Package with IQOQPQ documentation, 2 non-TempTrol® sample cells, selected by the user or for Autopol III-T, 1 TempTrol® 100 mm cell, and 1 NIST traceable calibration standard with a NIST certificate.

Optional Features:

- AutoFill™
- 100mm or 200mm TempTrol™ heating and cooling: 15°C – 40°C ±0.2°C
- Optional Wavelengths: 365nm, 405nm, 436nm, 578nm, 633nm, (up to 4 wavelengths may be selected or added later)
- AP Accuracy Option at 589 nm only: ±0.002° up to 10°, ±0.003° +10°- 89.99° Arc Optical Rotation Range
- USR Resolution Option: 0.01, 0.001, 0.0001°, Arc Selectable
- LED Light Source

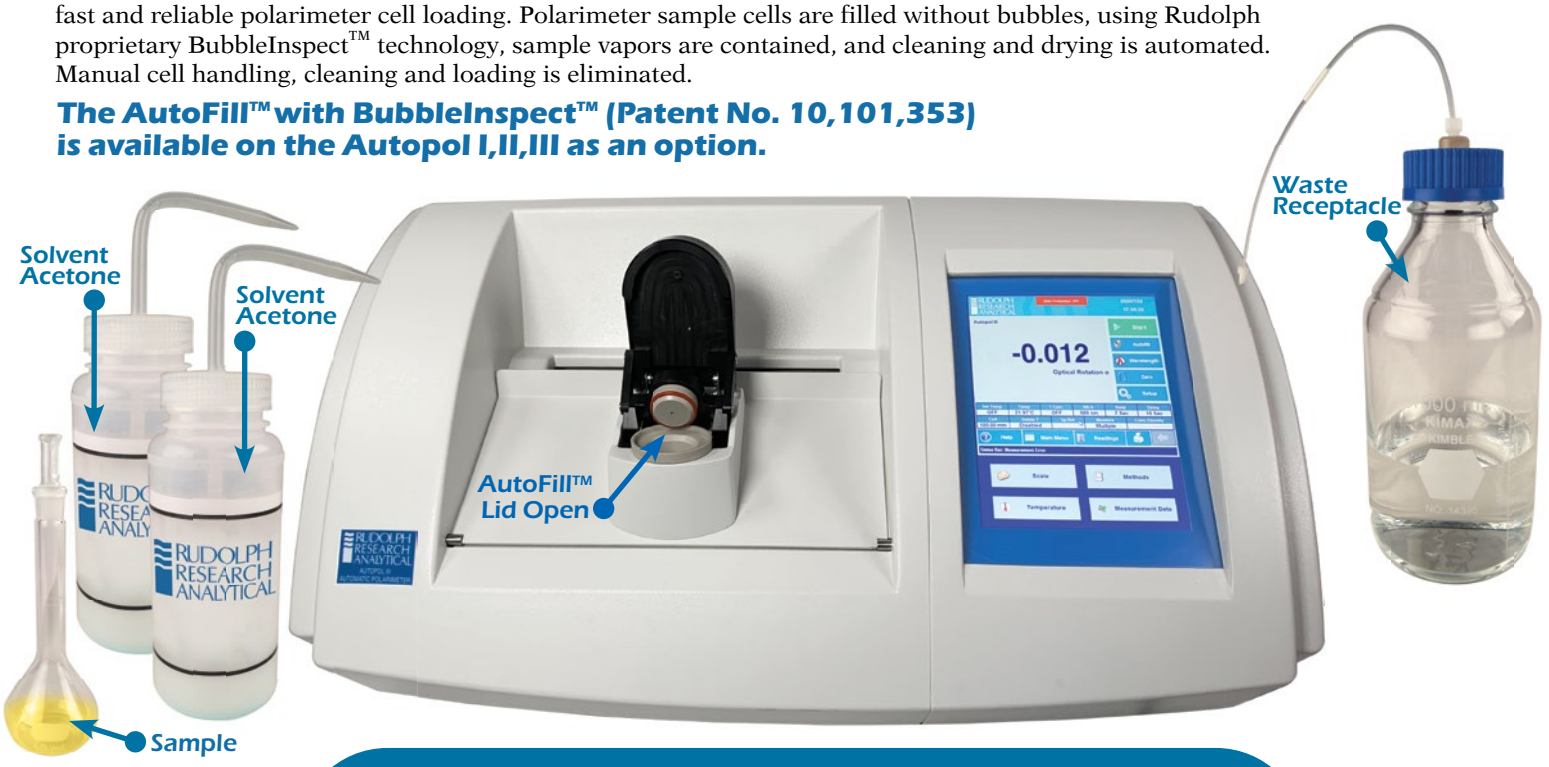
Rudolph Research Analytical 55 Newburgh Road, Hackettstown, NJ 07840 USA • Phone: 973-584-1558 • Fax: 973-584-5440 • E-mail: info@rudolphresearch.com • Internet: www.rudolphresearch.com

The Rudolph AutoFill™

Filling a Polarimeter Cell has never been easier.

Rudolph Research Analytical developed AutoFill™, Patent No. 10,101,353, a simple and easy way to allow fast and reliable polarimeter cell loading. Polarimeter sample cells are filled without bubbles, using Rudolph proprietary BubbleInspect™ technology, sample vapors are contained, and cleaning and drying is automated. Manual cell handling, cleaning and loading is eliminated.

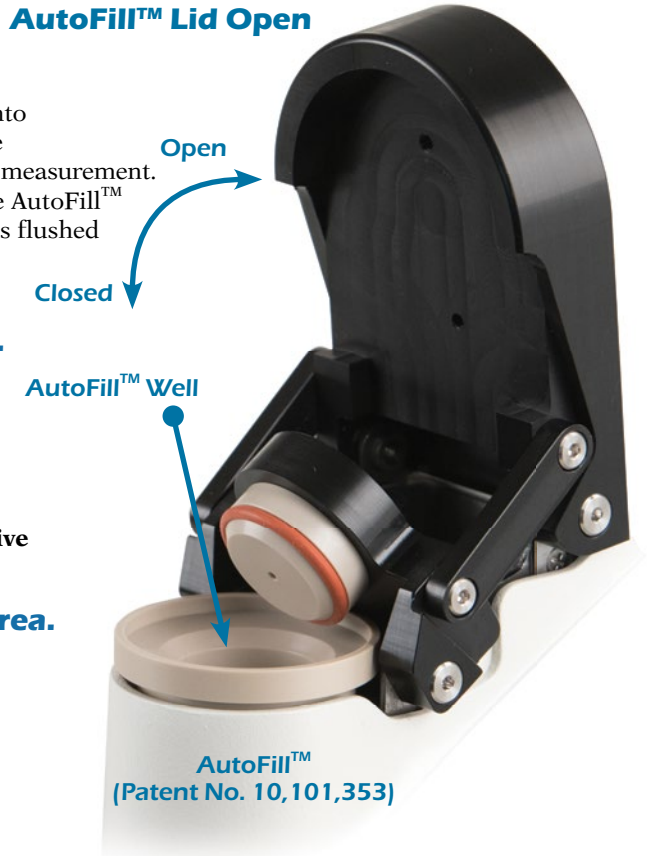
The AutoFill™ with BubbleInspect™ (Patent No. 10,101,353) is available on the Autopol I,II,III as an option.



AutoFill™ Option is now available on the Autopol I,II, and III. SampleInspect with sample integrity verification is included standard on the Autopol I,II,and III and BubbleInspect™ Technology is available on the Autopol V Plus and Autopol VI.

Engineered for perfect fills every time.

Operation is as simple as opening the AutoFill™ lid, pouring in your sample, closing the lid and pressing start. The sample will be advanced into the Polarimeter cell and stopped once full. The cell is now loaded and the measurement will automatically begin after BubbleInspect™ approves the measurement. When the measurement is complete the operator is prompted to open the AutoFill™ chamber and add a solvent. The AutoFill™ lid is closed and the solution is flushed through the cell to waste. Air drying will automatically begin and end. You are now ready for your next measurement.



AutoFill™ reduces sample loading and cleaning time.

- No need to inject samples with syringes. Samples are easily poured in the AutoFill™ sample well.
- Eliminate contact with acids and bases.
- Running air dry for the correct amount of time will fully dry the cell.
- Cleaning is made effortless.
- **A perfect cell load is guaranteed every time with Rudolph's exclusive Optical Rotation Homogeneity Inspection Solution.**

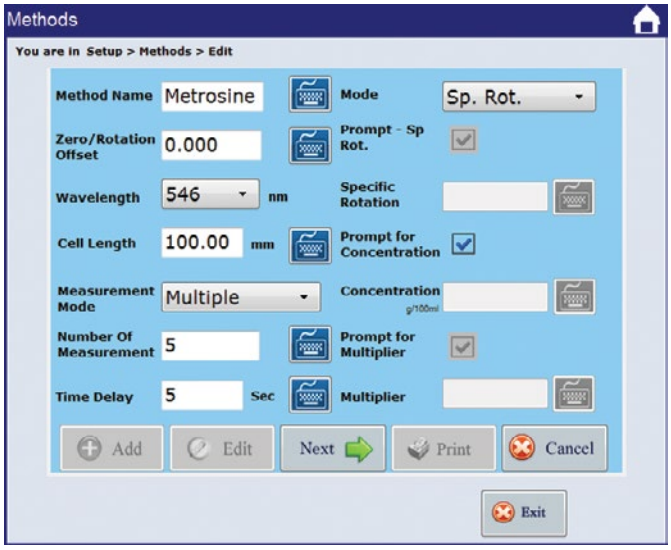
If Acids and Open Samples are Allowed in the Work Area.

- Sample is easily poured into the large AutoFill™ well.
- All wetted parts are made to stand up against the most aggressive samples including 6 Molar HCl.
- All Materials are Teflon, Peek, and Kalrez®.
- You may choose to clean with a single solvent or a combination of solvents.

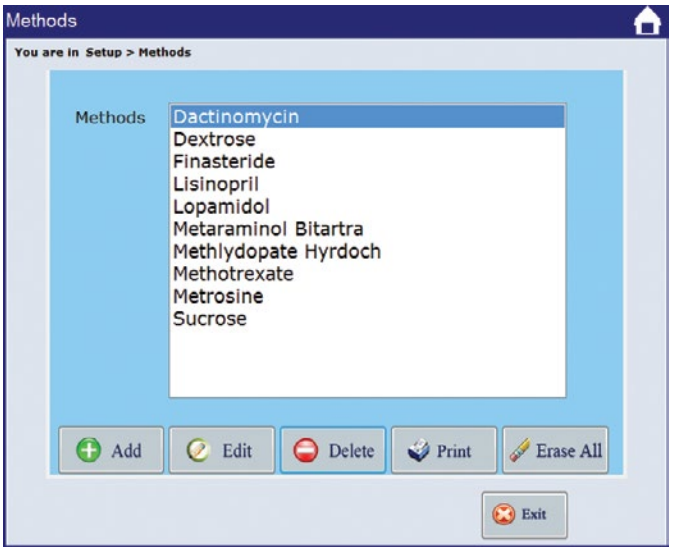
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Simple Solutions

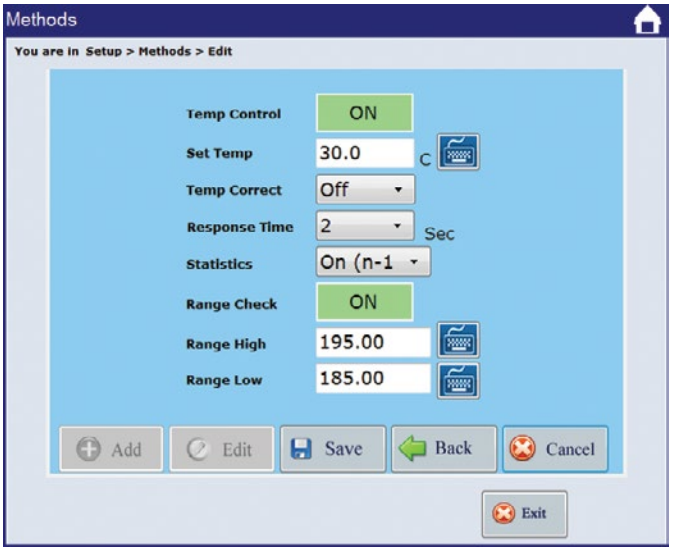
Set up a Method



Select a Method

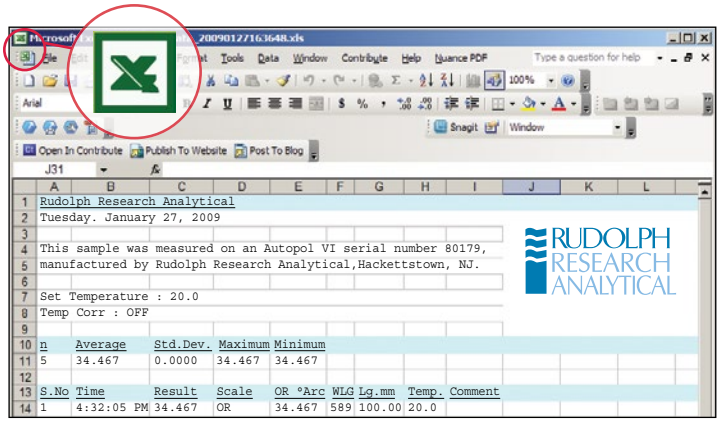


Select a Temperature

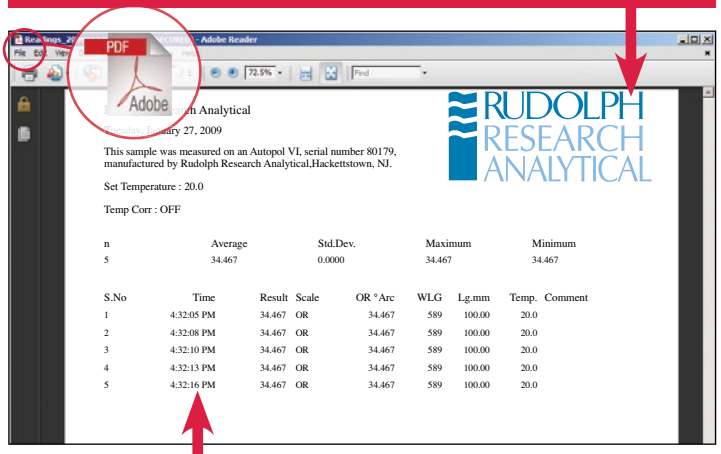


cGMP/GLP Printing

Measurement reports can be saved as an Excel or PDF file and edited quickly and easily. You can import logos and print your company's customized "C of A" directly.



Print your customized Certificate of Analysis including your company logo directly from the Autopol® touch screen



Capable of making multiple measurements on a single sample and reporting complete statistical data and all measurement results

Versatile Communication Capability

- Connect directly to Rudolph's service department for remote testing and diagnostics via Internet connection.
- Connect to any Windows® based printer via USB or direct to the server via Windows® Print Library.
- Save measurement data direct to your Network/Server.



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Select a Temperature Solution

1. Temperature Measurement Only

As shown in Figure A, the Autopol I, II, and III come with a Temperature Probe so that sample temperature can be measured, displayed, and printed.

However, if your product requires Temperature control, then we recommend a temperature control solution shown below.

For university education and research, starch analysis, invert sugar, flavors, and fragrances temperature control is not required and temperature measurement is normally sufficient for these applications.

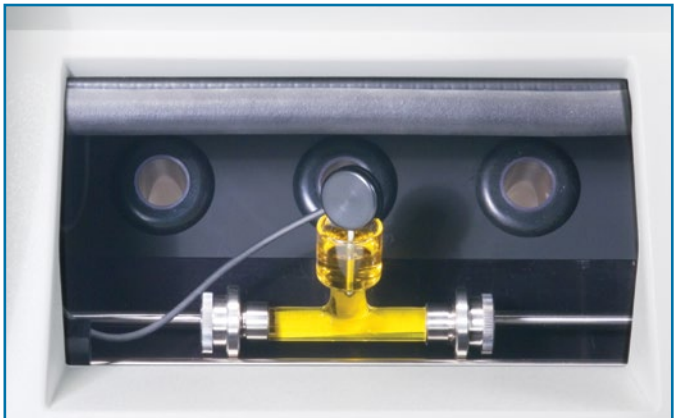


Figure A

2. Temperature Control With a Water Bath

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 (Figure B).

Temperature control is obtained through the use of an external water bath and a jacketed cell (Figure C). This temperature control solution is popular for very high temperature applications.



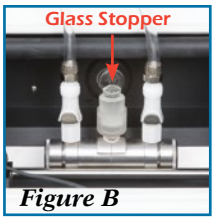


Figure B

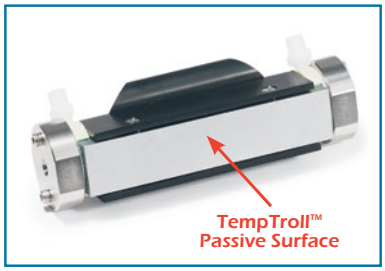


Figure C

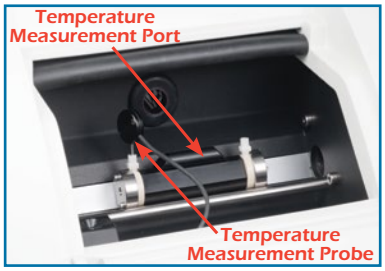
3. Patented TempTrol™ Technology Eliminates the Need for a Water Bath. Here's how the TempTrol™ System works:



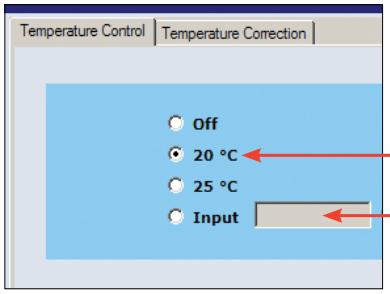
TempTrol™ heating and cooling Peltier transfer surface.



TempTrol™ cell with mating heating and cooling transfer surface.

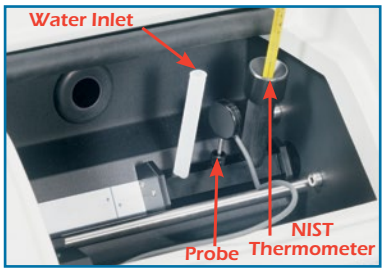


Place the TempTrol™ cell in your TempTrol™ equipped Autopol® sample chamber to measure to within ±0.2°C of the USP, EP, JP or BP specified temperature (normally 20°C or 25°C ±0.5°C).



Temperature is selected via touch screen. Temperature selection of 20°C shown at left.

Select temperature up to 40°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.

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Select the Accessories

Selection

With over 50 cells to choose from, Rudolph Research Analytical has a cell to meet every application.
Rudolph offers cells with volumes as small as 100 micro liters and cell lengths from 10 mm to 200 mm. Rudolph 40T and 316 stainless steel cells come with lifetime warranty against accidental breakage.

Autopol I and II

The Autopol I and II come standard with Package A, which includes:


Package A

2 lamps and a Type 14 center fill glass cell with a 100 mm length and a 6 ml volume.

For validation purposes Rudolph recommends a NIST Traceable Calibration Standard with NIST Certificate to ensure your polarimeter is operating according to specification. (Choose Package B)


Package B



TempTrol™ Ceramic Quartz
Lifetime Warranty on Ceramic Quartz and Stainless Steel style cells.

Autopol III

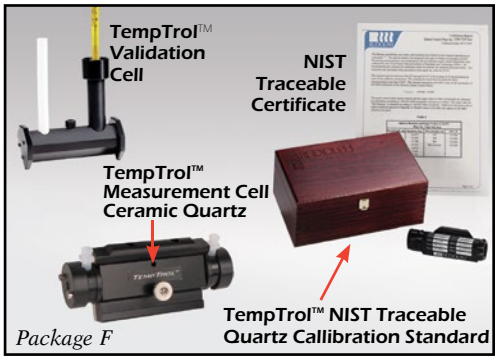
The Autopol III comes standard with 2 lamps, 2 user selectable cells and a calibration standard. Although the user may select from any of our 60 plus cells, popular packages (C, D, and E) are shown below. **If Temptrol™ is selected, Package F is supplied**.

TempTrol™ Ceramic Quartz Polarimeter Cells have a industry leading Lifetime Warranty for breakage and strong acids like HCl. No other manufacture matches Rudolph's Warranty. They are easy to fill, easy to handle, and are far better for temperature stabilization. Rudolph cells are the industry standard.


Package C


Package D


Package E



Package F

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Select the Cell

Type 60T is our best performing cell , now standard on all Autopol I-T, II-T, and III-T models

Type 60T
Ceramic TempTrol®



Type 60T TempTrol® Ceramic Polarimeter Sample Cells are constructed of Ceramic Quartz which is highly resistant to caustic samples such as 6 molar HCl. All cells come with Luer® lock fittings for easy filling with a plastic syringe or pipette. The cells have removable PTFE collars that allow for easy cleaning and glass cell end replacement. Rudolph's exclusive TempTrol® cells use an acid resistant NEDOX™ coated transfer surface to mate with the NEDOX™ coated TempTrol® active heating and cooling transfer surface.

Part #	ID (mm)	Cell Length (±0.02mm)	Sample Volume (ml)
60T-3.0-50-.6-C	3.0	50	.6
60T-5.0-50-1-C	5.0	50	1
60T-3.0-100-.9-C	3.0	100	0.9
60T-5.0-100-2-C	5.0	100	2
60TFT-3.0-50-.6-C	3.0	50	0.6
60TFT-5.0-50-1-C	5.0	50	1
60TFT-3.0-100-0.9-C	3.0	100	.9
60TFT-5.0-100-2-C	5.0	100	2

Type 40T
Ceramic TempTrol™ Cell



Type 40T TempTrol® Cells are for laboratories that work with strong acids and bases such as 6 Molar HCl; the Ceramic Quartz Polarimeter Sample Cell addresses the issues associated with corrosive samples. Rudolph's exclusive design also incorporates an improved sample flow through the cell to reduce cavitation and air bubbles. Available only from Rudolph, the Ceramic Quartz Cell is available on all models and comes standard on the Autopol® IV-T, Autopol® V, Autopol® V PLUS and Autopol® VI, a Rudolph exclusive offering.
*Select Type 40CFT for Automation and/or HP for High Pressure Applications.

Part Number	ID (mm)	Cell Length (±0.02mm)	Sample Volume (ml)
40T-3.0-100-.9-C *	3.0	100	0.9
40T-3.0-50-.6-C *	3.0	50	0.6
40T-5.0-100-2-C *	5.0	100	2
40T-5.0-200-4-C *	5.0	200	4
40T-5.0-50-1-C *	5.0	50	1
40T-5.0-25-0.5-C	5.0	25	0.5
40TFT-3.0-100-.9-C-HP*	3.0	100	0.9
40TFT-3.0-50-.6-C-HP *	3.0	50	0.6
40TFT-5.0-100-2-C-HP*	5.0	100	2
40TFT-5.0-200-4-C-HP*	5.0	200	4
40TFT-5.0-50-1-C-HP *	5.0	50	1

Type 32
Stainless Steel



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. The cell has a built-in temperature port which allows the temperature sensor system to automatically measure the temperature inside the cell. *Select HP for Automation or High Pressure Applications.

Part Number	ID (mm)	Cell Length (±0.02mm)	Sample Volume (ml)
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
Jacketed Stainless



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. The cell has a built-in temperature port which allows the temperature sensor system to automatically measure the temperature inside the cell.

Part Number	ID (mm)	Cell Length (±0.02mm)	Sample Volume (ml)
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

Cell Length Accuracy ±0.02 mm with optional NIST Certificate



- **Lifetime Warranty against breakage on Stainless Steel and Ceramic Quartz Cells.**
- **Acid Resistant Lifetime Warranty on Ceramic Cells.**
- **No Warranty on 14 and 14 J Glass Cells.**
- **All Cell Optical Path Lengths are Accurate to ±0.02 mm.**

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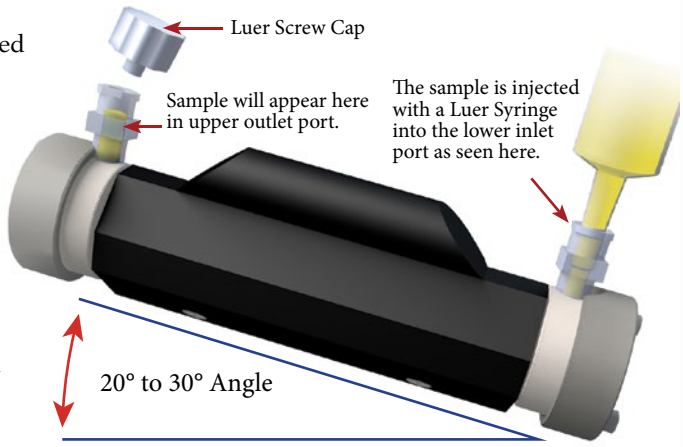
How to Fill Cells Manually

Rudolph Research Polarimeter Sample Cells

Rudolph Research Polarimeter Sample Cells are designed to be easily filled and cleaned with a Luer syringe.

When held at the correct angle and filled using the lower inlet port, the cell is filled with almost no possibility of leaving an air bubble in the cell. Filling from the lower inlet port forces any air bubbles up and out of the upper outlet port.

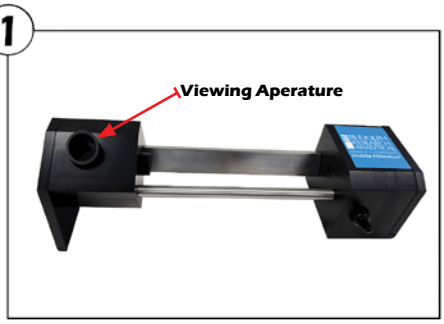
Rudolph cells are unlike other manufacturers' cells as they are uniquely designed to keep small air bubbles out of the light path. Filling the cell is as simple as holding the cell at a slight upward angle and filling from the bottom inlet using a Luer Syringe. When the sample appears near the top outlet port, simply place the Luer cap on the upper port and then lower port. Your cell is now filled, capped and air bubble free. Cells must be clean and dry to ensure proper filling with minimum sample.



How to use the Rudolph Research Polarimeter Cell FillStation®

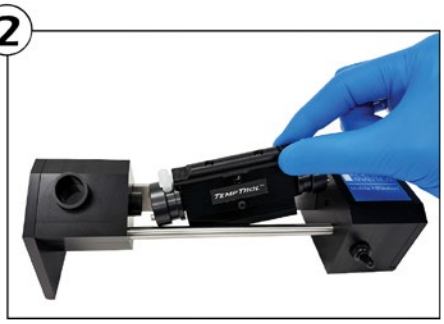
For users who prefer not to hold the cell while working with highly acidic or basic samples, the Rudolph Cell Fill Station™ should be used.

1



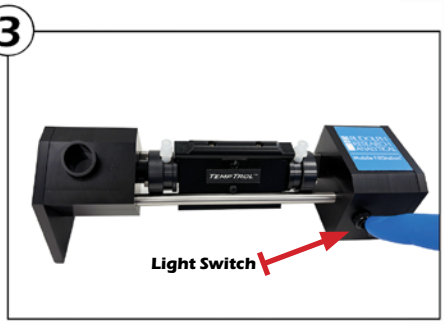
By design, the FillStation™ will hold the cell at a suitable angle.

2



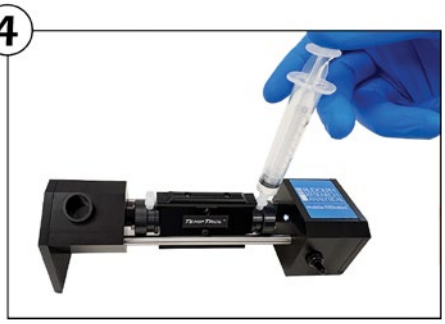
Place a 2.5mm or 5.0mm bore Polarimeter cell into the Rudolph FillStation™.

3



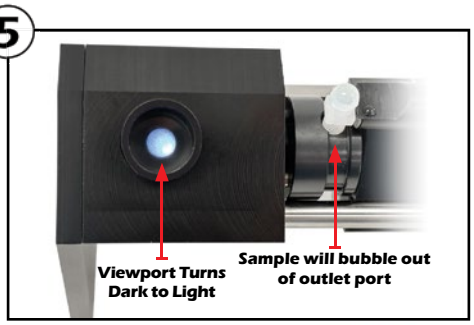
Turn the FillStation™ light on. The light will turn off automatically after a few minutes.

4



Make sure the cell is always clean and dry. Use compressed air and acetone for this process. Fill the cell from the lower inlet port with a Luer Syringe only.
As the cell becomes filled and sample begins to appear at the upper inlet, cap off the upper then lower inlet port. Your cell is now filled and air bubble free.

5



The FillStation™ creates a light image that will go from darker to bright white circle when the cell is filled and air-bubble free. A bubble free cell shows a illuminated white circle as shown on the right.



Please Note:
Filling a Rudolph Polarimeter cell is easy and you can be assured of an air bubble free sample cell. It is important to note that when using highly acidic or basic solutions samples the cell should not be filled in the Polarimeter, doing so may allow spillage into the instrument which over time may damage the instrument.

The Rudolph Polarimeter Cell FillStation™ accessory is available for all Rudolph Autopol Polarimeters and included free of charge with Autopol V, Autopol V PLUS, and Autopol VI Polarimeter Models.

Reading Your FillStation™



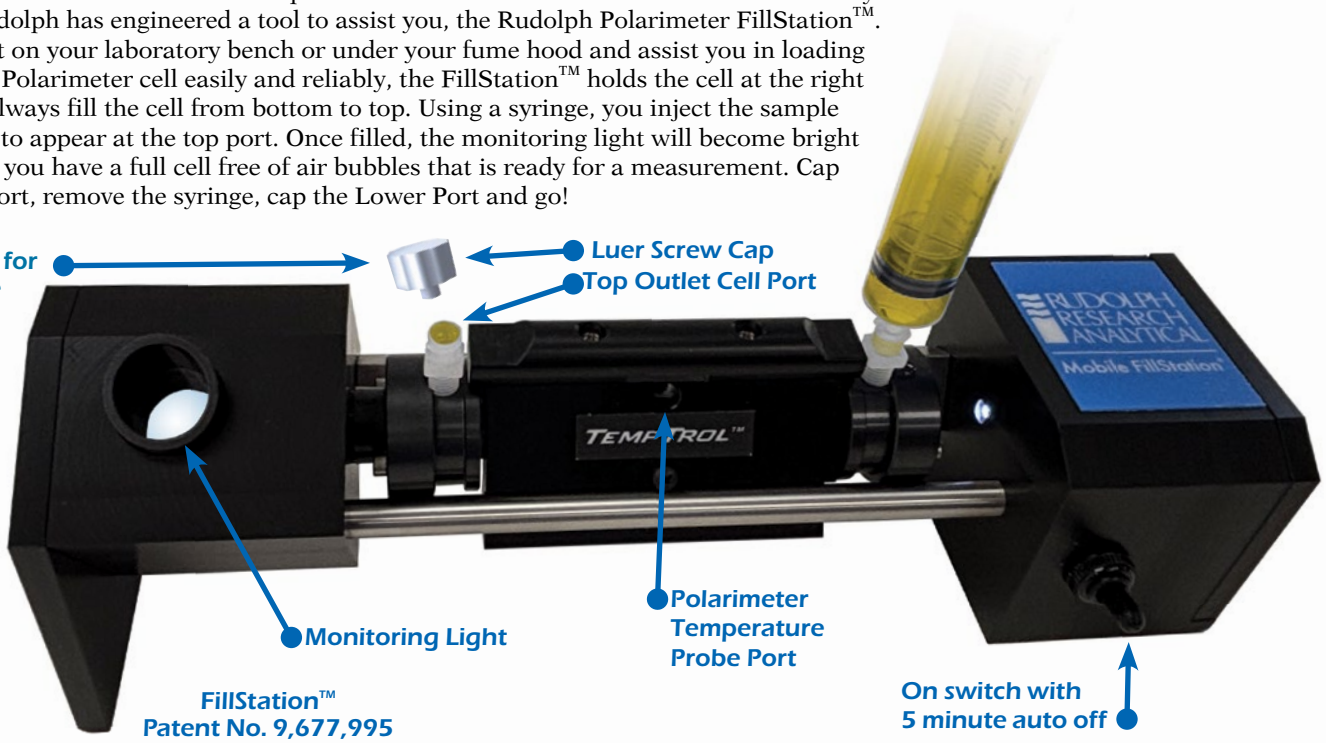
Empty Cell — Cell Being Filled — Air Bubbles detected during filling process — Cell filled and free of air bubbles

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The Rudolph FillStation™

Fill Rudolph Polarimeter Cells reliably outside of the instrument

Many users prefer to load cells with samples outside of the Polarimeter. When this fits with your work flow, Rudolph has engineered a tool to assist you, the Rudolph Polarimeter FillStation™. Designed to sit on your laboratory bench or under your fume hood and assist you in loading your Rudolph Polarimeter cell easily and reliably, the FillStation™ holds the cell at the right angle so you always fill the cell from bottom to top. Using a syringe, you inject the sample until it begins to appear at the top port. Once filled, the monitoring light will become bright and you know you have a full cell free of air bubbles that is ready for a measurement. Cap the Top Cell Port, remove the syringe, cap the Lower Port and go!



Advantages of using the Rudolph FillStation™

- The cell is held at the right angle and filled from the bottom just the way Rudolph cells were designed to be filled. Perfect every time.
- Filling from the bottom to top moves any air with the potential to cause a bubble up and out of the cell.
- Once you see the monitoring light go to bright there is no question that the cell is properly filled.
- Verification of air free sample loading for even inexperienced operators.
- Helps eliminate contact with acids, bases, or any sample the user does not want to come in contact with.
- Less experienced operators can learn to reliably fill cells with minimal training.

The FillStation™ (Patent No. 9,677,995) is included standard with all Rudolph Autopol V, Autopol V PLUS, and VI Polarimeters.



Today's laboratories and cGLP procedures demand that noxious fumes, strong acids and other caustic materials are filled in a designated safe area where a fume hood is used and there is minimal operator exposure. Instruments are now located in clean areas or a laboratory separate from the wet area. Rudolph addresses these concerns with its FillStation™ so that cells can be easily filled and capped inside the safe wet area.

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Supporting Over 8,000 Instruments In Over 80 Countries

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Suite C
Round Rock, Texas 78665
Phone: 866-917-2617

Dear Kathy,

I just wanted to tell everyone at Rudolph Research what a pleasure it has been working with each of you. From the customer service down to the documents provided with the instrument, everything has been top-notch. The experience Rudolph has dealing with the pharmaceutical field really shows through. Peter Marriot was here on Tuesday and did a great job getting the instrument up and running exactly the way we wanted and took the time to answer any questions I had. He also went through the qualification documents page by page and explained each test performed.

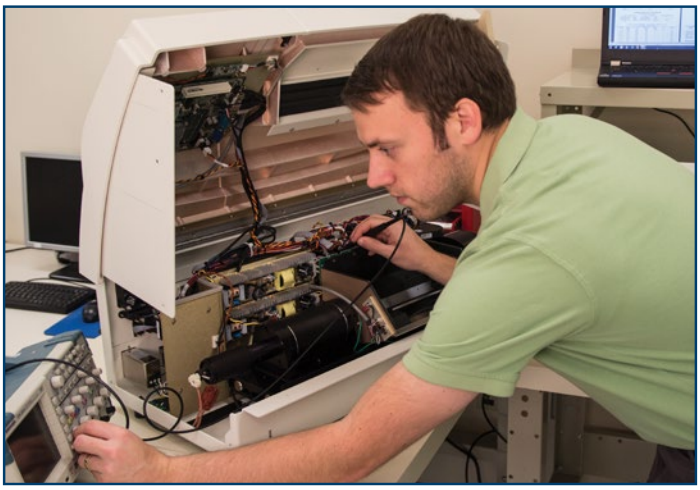
Over the past couple of years setting up a new lab I have had to deal with quite a few manufacturers and this has been one of the best experiences I've had in ordering an instrument from getting the quote to getting it qualified. To be quite honest, a lot of experiences I've had been somewhat excruciating but I won't name names. After Gary Mathurin was here about this time last year to give a demo, I was already pretty sure Rudolph was the company to go with but now I'm certain we made the right choice.

Thank you all!
Regards

Dale Smith
QA/QC Manager
Austin Pharma/Insys Therapeutics Inc.
811 Paloma Dr. Suite C
Round Rock, TX 78665

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Earning your loyalty everyday, through our commitment to exceptional service and attentive customer focus.

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Every new instrument purchase is backed by our commitment to a 20 year service support guaranteee and the knowledge that Rudolph is still repairing products built in the 1970's.

Specifications

Models	AUTOPOL I	AUTOPOL II	AUTOPOL III
Measuring Mode	Optical Rotation, Specific Rotation, Concentration, Sugar Degrees, °Z (ISS)		
Measuring Scale	Degrees Arc Optical Rotation		
Resolution	0.01° Arc Optical Rotation, 0.01% Concentration. 0.01 Specific Rotation	0.01° Arc Optical Rotation, 0.01% Concentration, 0.01 Specific Rotation	0.001° Arc Optical Rotation,0.001% Concentration, 0.001 Specific Rotation
Standard at 546nm & 589nm Accuracy	At 589nm 0.01° Arc Optical Rotation, 0.03°Z (ISS) Sugar Degrees, Range: ±0-89.99° Arc	At 589nm and 546nm 0.01° Arc Optical Rotation, 0.03°Z (ISS) Sugar Degrees, Range: ±0-89.99° Arc	At 589nm and 546nm 0.002° Arc up to ±1°Arc, 0.2% above ±1° Arc, 0.01° Z (ISS) 0.010° above ±5° Arc
(AP) Accuracy Option at 589nm only	Resolution: 0.001° Arc Optical Rotation Reproducibility: 0.002° Arc Optical Rotation, Accuracy: ±0.004° + 0-89.99° Arc Optical Rotation Range	Resolution: 0.001° Arc Optical Rotation Reproducibility: 0.002° Arc Optical Rotation, Accuracy: ±0.003° + 0-89.99° Arc Optical Rotation Range	Resolution: 0.001° Arc Optical Rotation Reproducibility: 0.002° Arc Optical Rotation, Accuracy: ±0.002° up to 10°, ±0.003° +10°-89.99° Arc Optical Rotation Range
(USR) User Selectable Resolution	(Optional) 0.01 and 0.001 ° Arc		(Optional) 0.01, 0.001 and 0.0001° Arc
AP Option Reproducibility / Repeatability 589nm, 546nm, 578nm	0.002° Arc Optical Rotation	0.002° Arc Optical Rotation	0.002° Arc Optical Rotation
Standard Reproducibility / Repeatability 365nm, 405nm, 436nm	±0.01° Arc Optical Rotation	±0.01° Arc Optical Rotation	±0.01° Arc Optical Rotation
Measuring Range	± 89.99° Arc Optical Rotation ± 999.99°Arc Specific Rotation 0-99.9% Concentration		
Prism	Glan Thompson Calcite		
Optical Wavelengths	589nm	589nm, 546nm standard Optional wavelengths: 365nm, 405nm, 436nm, 578nm (LED, 589nm only)	589nm, 546nm standard Optional wavelengths: 365nm, 405nm, 436nm, 578nm (LED, 589nm only)
Wavelength Selection	Fixed	Touchscreen Selectable: 2 standard, 4 optional	Touchscreen Selectable: 2 standard, 4 optional
21 CFR Part 11 Compliant Software	Yes, with optional Embedded or PC based software		
Operating System	Windows Embedded		
Temperature Control	By external water bath (standard) TempTrol™ Automatic Electric Heating and Cooling 15°- 40°C ±0.2°C (optional)		
Temp. Probe Range	10° - 100°C		
Temp. Probe Accuracy	±0.1°C		
Measurement Time	5 measurements in less than 25 seconds (avg.)		
Light Source Standard	Tungsten-Halogen 6V, 20W, avg. 2,000 hour life		
Light Source Optional	LED 20-30 mA 100,000 hr. avg. life		
Sample Chamber	Accepts sample tubes up to 200 mm		
Data Storage	32 GB Non-removable Compact Flash		
Communication Interface	4 – USB Ports, 2 – RS232 Ports, Ethernet CAT 16 Port for Network Connection		
Calibration	Automatic calibration via touchscreen		
Display	8" color, 800 x 600 pixel resolution with 400 nits of brightness		
User Interface	Touchscreen		
Automatic Sensitivity Control	Measures samples with transmittance as low as 0.01% (up to O.D. 4.0)		
Input Power	100 - 240V, 50/60 Hz		
Operating Dimensions	24.3" W x 12.7" H x 17.5" D 617 mm W x 323 mm H x 445 mm D		
Operating Weight	42 lbs. (19.05 kg)		

Rudolph Research Analytical 55 Newburgh Road, Hackettstown, NJ 07840 USA • Phone: 973-584-1558 • Fax: 973-584-5440 • E-mail: info@rudolphresearch.com • Internet: www.rudolphresearch.com