

For research, analysis and control

The Autopol[®] Series of Automatic Polarimeters

Exclusive Windows Embedded operating system providing unmatched flexibility



The brand of polarimeter used in more labs than any other.*



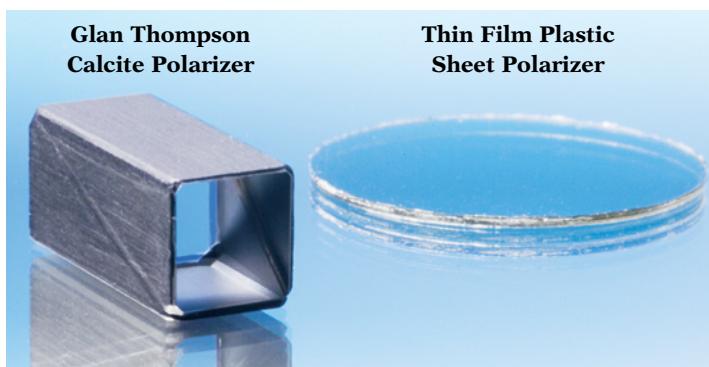
Full cGMP/GLP Compliance

Quality

No matter which model Autopol you choose, Rudolph uses the same high quality optics. While other manufacturers use Polaroid Plastic Dichroic Sheet Polarizers, Rudolph does not. Instead, Rudolph uses the same high quality Glan Thompson Calcite Polarizers in all its models.

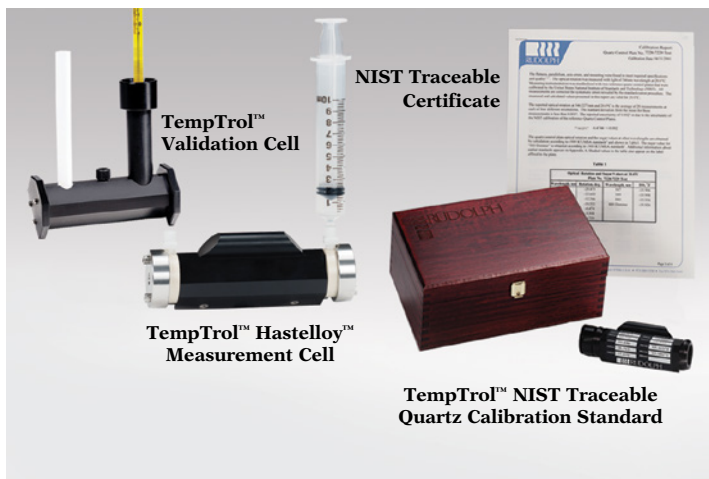
Why are high quality polarizing prisms important? Because prisms are two of the most critical optical components in the polarimeter. Polaroid polarizers are made of a polymeric plastic where the molecules are stretched and oriented in a specific direction so as to linearly polarize light. These types of plastic sheet polarizers are very inexpensive (\$50.00 USD) and are vulnerable to heat, warp over time, deteriorate from moisture, and also have greater light absorption than Calcite Polarizers. In many cases, the plastic polarizers must be replaced in 3 – 5 years. Glan Thompson Calcite Polarizers are comprised of a carbon crystalline structure similar to diamond and have excellent light transmission characteristics. The quality of these prisms is so good, Rudolph guarantees its prisms over the life of the polarimeter (See Photo 5)

Photo 5



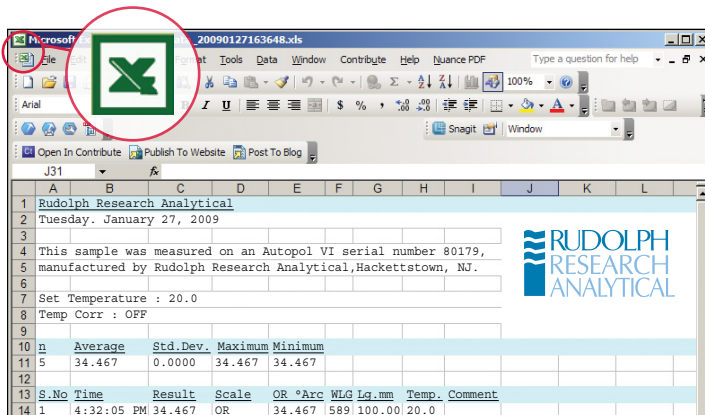
Validation and Calibration

Rudolph Research Analytical knows that you must be able to validate your instrument's operating performance regularly. Therefore, the Autopol® V, V Plus and VI come standard with the accessories, validation tools and automatic calibration functions necessary to ensure that the temperature control, temperature measurement and optical measurement processes are working accurately and reproducibly. All functions are accessed simply and conveniently through the Autopol® liquid sealed touchscreen.

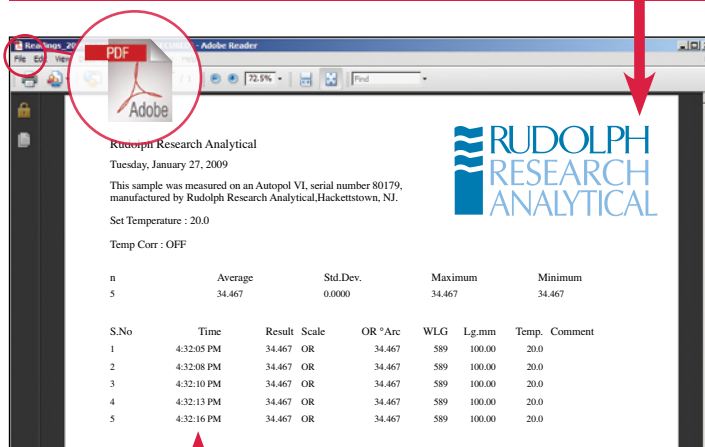


cGMP/GLP Printing

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 VI® touch screen



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

Just listen to our customers

"We have the AUTOPOL V from Rudolph Research Analytical (RRA)... I have used numerous polarimeters and this is by far the best. We have had it for 1-1/2 years and have had zero problems, the original lamp is still in the instrument. I recommend it over other instruments. RRA installed, trained and performed the IQOQ... It is one piece of equipment that you never worry about."

Alan Davis – Rockwell Medical Technologies

Polarimetry

Polarimetry

A sensitive nondestructive technique for measuring the optical activity exhibited by inorganic and organic compounds. A compound is considered to be optically active if linearly polarized light is rotated when passing through it. The amount of optical rotation is determined by the molecular structure and concentration of chiral molecules in the substance. Each optically active substance has its own specific rotation as defined in Biot's law:

$$[\alpha]_{\lambda}^T = \frac{\alpha_{\lambda}^T}{c \cdot l}$$

$[\alpha]$ = specific rotation

l = optical pathlength in dm

λ = wavelength

T = temperature

α = optical rotation

c = concentration in g/100ml

The polarimetric method is a simple and accurate means for determination and investigation of structure in macro, semi-micro and micro analysis of expensive and non-duplicable samples. Polarimetry is employed in quality control, process control and research in the pharmaceutical, chemical, essential oil, flavor and food industries. It is so well established that the United States Pharmacopoeia and the Food & Drug Administration include polarimetric specifications for numerous substances.

Research Applications

Research applications for polarimetry are found in industry, research institutes and universities as a means of:

- Isolating and identifying unknowns crystallized from various solvents, or separated by high performance liquid chromatography.
- Evaluating and characterizing optically active compounds by measuring their specific rotation and comparing this value with the theoretical values found in literature.
- Investigating kinetic reactions by measuring optical rotation as a function of time.
- Monitoring changes in concentration of an optically active component in a reaction mixture, as in enzymatic cleavage.



PHARMACEUTICALS



ESSENTIAL OILS



SUGAR & CONFECTIONERY PRODUCTS



ORGANIC CHEMISTRY

In each of these applications, the AUTOPOL offers up to six discrete wavelength selections to observe the effect of wavelength upon an optically active substance.

Quality and Process Control Applications,

both in the laboratory or on-line in the factory, are found throughout the pharmaceutical, essential oil, flavor, food and chemical industries. A few examples are listed below.

Pharmaceutical Industry

Determines product purity by measuring specific rotation and optical rotation of:

- Amino acids
- Amino sugars
- Analgesics
- Antibiotics
- Cocaine
- Codeine
- Dextrose
- Diuretics
- Serums
- Steroids
- Tranquilizers
- Vitamins

Flavor, Fragrance and Essential Oil Industry

Utilizes polarimetry for incoming raw materials inspection of:

- Camphors
- Citric acid
- Glyceric acid
- Gums
- Lavender oil
- Lemon oil
- Orange oil
- Spearmint oil

Food Industry

Ensures product quality by measuring the concentration and purity of the following compounds in sugar based foods, cereals and syrups:

- Carbohydrates
- Fructose
- Glucose
- Lactose
- Levulose
- Maltose
- Raffinose
- Sucrose
- Various starches
- Xylose
- Natural monosaccharides

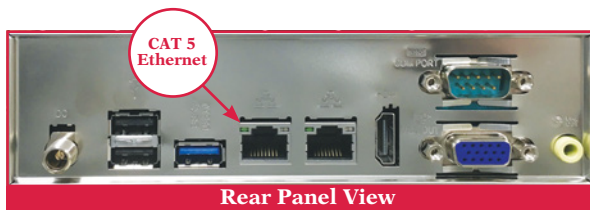
Chemical Industry

Analyzes optical rotation as a means of identifying and characterizing:

- Biopolymers
- Natural polymers
- Synthetic polymers

AUTOPOL® Series

Unmatched features and flexibility utilizing Windows Embedded



Windows Embedded Operating System

No virus, no malware and direct Ethernet connection to LIMS or Server without a PC.

Connect to almost any USB printer



Measurement Modes

The Autopol can read directly in one of four measurement modes: Optical Rotation, Specific Rotation, Concentration or Specific Rotation Plus. Specific Rotation Plus allows a correction to be applied to a result for loss on drying. Each measurement mode can be activated via touchscreen selection. Sample cells can be specified at any length (e.g., 50mm, 100mm, 200mm), or entered as a precise dimension (e.g., 199.98mm). Concentration is entered as a percentage. (See Photo 1)

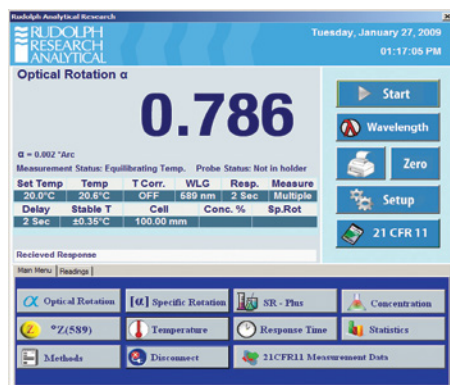


Photo 1

Cells 10mm to 200mm Long

Instruments of some manufacturers accept only special sample cells, with maximum lengths of 100mm. Autopols accept standard sample cells up to 200mm long. A 200mm sample cell offers twice the sensitivity as the same solution in a 100mm cell. This is especially useful for solutions having small rotations. Also some pharmacopeia monographs require a 200mm (2dm) cell like the USP monograph for Methotrexate. Rudolph Research sample cells are made to NIST standards; and the complete range of sizes and types are listed in Technical Bulletin 913. NIST certificates are available for cell length validation.



White-light Source Permits Spectral Versatility

The Tungsten-Halogen lamp employed in the Autopol is a compact, reliable, low-cost, high-intensity light source that allows any desired wavelength in the visible spectrum to be selected by means of a narrow band multilayer interference filter. (See Photo 3) The Autopol standard 10nm bandwidth is specified to permit high energy throughput and sensitivity for sample transmittances of only 0.01% (O.D. = 4), while minimizing the effects of sample ORD and color.

This lamp is keyed for easy alignment



Estimated Life = 2,000 hours
Estimated Cost = \$100 USD each

Photo 3

Temperature Control of Samples

is allowed through rubber gasketing in the Autopol door which permits tubing to be connected from an external temperature controlled Water Bath to the jacket of a jacketed polarimeter sample tube. (See Figure 2)

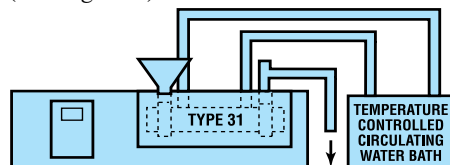


Figure 2

Multiple Wavelengths

The Autopol comes in single, dual and six wavelength models. Wavelength selection is completely automatic and is accomplished via menu selection. There are no lamps or filters to manually remove or insert. The following wavelengths are available: 365nm, 405nm, 436nm, 546nm, 589nm, and 633nm. Optional wavelengths are available; contact the factory for more information.

Temperature Display

The Autopol comes standard with a temperature probe which can be inserted into the Polarimeter cell as shown below or into the cell probe port. (See Photo 4)



Photo 4

Choosing a Polarimeter

That's right for your application and budget

Autopol® I



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 7 for direct connection to the network server and flexible USB printing.

Optional Features:

- 100mm or 200mm TempTrol™ heating and cooling: 15°C – 40°C ±.2°C
- AP Accuracy Option: 0.004° Arc Optical Rotation is wavelength specific. For USP Pharmaceutical, Rudolph recommends 0.002 accuracy for measurements ±1.000 degrees
- USR Resolution Option: 0.01, 0.001°Arc Selectable

Autopol® II



The Autopol II offers the same standard and optional features as the Autopol I, but allows greater wavelength flexibility.

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:

- 100mm or 200mm TempTrol™ heating and cooling: 15°C – 40°C ±.2°C
- AP Accuracy Option: 0.004° Arc Optical Rotation is wavelength specific
- USR Resolution Option: 0.01, 0.001°Arc Selectable

Autopol® III



The Autopol III is Rudolph's entry level USP pharmaceutical solution: Accuracy: 0.002°C, 0.2% above 1° Standard Wavelengths: 589nm and 546nm

Complete Accessory Package with IQOQPQ documentation, 2 user selectable cells and 1 NIST traceable calibration standard with NIST Certificate

Optional Features:

- 100mm or 200mm TempTrol™ heating and cooling: 15°C – 40°C ±.2°C
- Optional Wavelengths: 405nm, 436nm, 578nm, 633nm, (up to 4 wavelengths may be selected or added later.
- AP Accuracy Option: ±0.002° up to 10° Arc, ±0.004° 10° - 89°Arc
- USR Resolution Option: 0.01, 0.001, 0.0001°, Arc Selectable

Below is an example of why Polarimeters with accuracy of ±0.01 are not suitable for pharmaceutical applications. Please review the USP monograph for the material Ofloxacin. Ofloxacin must have a specific rotation between +1° and -1° at a concentration of 10mg per ml.

Biots Law:

$$[\alpha]_{\lambda}^T = \frac{\alpha_{\lambda}}{c \cdot l}$$

[α] = specific rotation, l = optical pathlength in dm; λ = wavelength, T = temperature, α = optical rotation, c = concentration in g/100ml

The Autopol I has an accuracy of ±0.02° optical rotation. Below is how its relative accuracy affects a hypothetical Ofloxacin sample:

$$[\alpha]_{\lambda}^T (\text{Specific Rotation}) = \frac{\pm 0.01}{(1)(0.01)} \leftarrow 10\text{mg/ml}$$

(Optical pathlength in dm) ↑ .01g/ml
1g/100ml = 1% = 0.01

Specific Rotation error = ±1.0

You cannot successfully inspect a pharmaceutical (such as Ofloxacin) having a Specific Rotation between +1 and -1 and a 1% concentration, which is quite common for most pharmaceuticals, with an instrument that has an accuracy of ±1.0 in Specific Rotation.

The Autopol IV has an accuracy of 0.002 for Optical Rotations of 1°Arc for a total unknown of +/-0.002 under the same conditions:

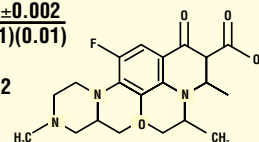
$$\text{Specific Rotation error} = \frac{\pm 0.002}{(1)(0.01)}$$

Autopol IV SR error = ±0.2

USP Ofloxacin

Specific rotation <781S>: between +1° and -1°

Test solution: 10mg per mL, in chloroform



Autopol® IV



This model is available in one, two and six wavelength versions and has a more expensive optical system than the Autopol III. It is the system of choice for research universities, pharmaceutical and fine chemical research departments. This instrument is also excellent for studying racemics and kinetics. Temperature control may be accomplished through a circulating Water Bath or with **Rudolph's optional Patented TempTrol™ System, which electronically heats and cools the sample to a specified temperature without the use of water circulation.**

IQOQPQ documentation is included with the instrument.

Autopol® V PLUS



The APV PLUS has all the features of the APV and adds resistance to acid erosion with its Silco Steel trough and Hastelloy cell. Furthermore this instrument comes standard with a 3 rotation quartz standard, Windows 7 operating system with Windows based navigation, 3 USB ports to allow quick & easy connection to a mouse, keyboard, printer, bar code scanner or memory stick, ethernet port for network cable connection. **The Autopol V Plus comes standard with Rudolph's Patented TempTrol™ System, which electronically heats and cools the sample to a specified temperature without the use of water circulation.**

The AutoPol V Plus and VI are available with 325nm to measure USP Dextromethorphan Hydrobromide.

IQOQPQ documentation is included with the instrument.

Autopol® V



This is a top of the line six wavelength polarimeter specifically designed with the input of the world's largest pharmaceutical companies. This unit comes standard with 21CFR11 software and **Rudolph's Patented TempTrol™ System, which electronically heats and cools the sample to a specified temperature without the use of water circulation.** IQOQ documentation is included with the instrument. This unit includes all wavelengths necessary to measure 99% of all monographs found in the USP, EP, JP and BP. Please see Technical Bulletin 928 for more details on the Autopol V.

IQOQPQ documentation is included with the instrument.

Autopol® VI



The APVI was developed for the most demanding advanced research laboratories and features 0.0003 accuracy for low rotation samples of +/- 1° Arc in addition to all of the features of the APV PLUS including **Rudolph's Patented TempTrol™ System, which electronically heats and cools the sample to a specified temperature without the use of water circulation.**

The AutoPol VI is available with 325nm to measure USP Dextromethorphan Hydrobromide.

IQOQPQ documentation is included with the instrument.

Specifications

Models	Autopol I	Autopol II	Autopol III
Measuring Mode	Optical Rotation, Specific Rotation, Specific Rotation Plus Concentration, User Defined Scale, Sugar Degrees, °Z (ISS)	Optical Rotation, Specific Rotation, Specific Rotation Plus Concentration, User Defined Scale, Sugar Degrees, °Z (ISS)	Optical Rotation, Specific Rotation, Specific Rotation Plus Concentration, User Defined Scale, Sugar Degrees, °Z (ISS)
Measuring Scale	Degrees Arc Optical Rotation	Degrees Arc Optical Rotation	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
Accuracy	0.01° Arc Optical Rotation, 0.03°Z (ISS) Sugar Degrees	0.01° Arc Optical Rotation, 0.03°Z (ISS) Sugar Degrees	0.002° Arc up to 1°, 0.2% above 1°, 0.01° Z (ISS)
AP Accuracy Option	Resolution: 0.001° Arc Optical Rotation Reproducibility: 0.002° Arc Optical Rotation, Accuracy: ±0.004° Arc Optical Rotation is wavelength specific	Resolution: 0.001° Arc Optical Rotation Reproducibility: 0.002° Arc Optical Rotation, Accuracy: ±0.004° Arc Optical Rotation is wavelength specific	Accuracy: ±0.002° up to 10°, ±0.004° 10° - 89° Arc Optical Rotation
USR Resolution Option	USR Selectable Resolution: 0.01, 0.001° Arc	AP Selectable Resolution: 0.01, 0.001° Arc	AP Selectable Resolution: 0.01, 0.001, 0.0001° Arc
Reproducibility	0.01° Arc Optical Rotation	0.01° Arc Optical Rotation	0.002° Arc Optical Rotation
Measuring Range	± 89.9° Arc Optical Rotation, ± 999.99° Arc Specific Rotation, 0-99.9% Concentration	± 89.9° Arc Optical Rotation, ± 999.99° Arc Specific Rotation, 0-99.9% Concentration	± 89.9° Arc Optical Rotation, ± 999.99° Arc Specific Rotation, 0-99.9% Concentration
Prism	Glan Thompson Calcite	Glan Thompson Calcite	Glan Thompson Calcite
Optical Wavelengths	589nm	589nm, 546nm standard Optional wavelengths: 365nm, 405nm, 436nm, 578nm	589nm, 546nm standard Optional wavelengths: 405nm, 436nm, 578nm
Wavelength Selection	Fixed	Touchscreen Selectable: 2 standard, 4 optional	Touchscreen Selectable: 2 standard, 4 optional
21 CFR Part 11 Compliant Software	Optional: External PC software or Internal Embedded solution with on/off option	Optional: External PC software or Internal Embedded solution with on/off option	Optional: External PC software or Internal Embedded solution with on/off option
Temperature Control	By external water bath (standard) TempTrol™ Automatic Electric Heating and Cooling 15°- 40°C ±0.2°C (optional)	By external water bath (standard) TempTrol™ Automatic Electric Heating and Cooling 15°- 40°C ±0.2°C (optional)	By external water bath (standard) TempTrol™ Automatic Electric Heating and Cooling 15°- 40°C ±0.2°C (optional)
Temp. Probe Range	10°C - 100°C	10°C - 100°C	10°C - 100°C
Temp. Probe Accuracy	±0.1°C	±0.1°C	±0.1°C
Measurement Time	5 measurements in less than 25 seconds (avg.)	5 measurements in less than 25 seconds (avg.)	5 measurements in less than 25 seconds (avg.)
Light Source Standard	Tungsten-Halogen 6V, 20W, avg. 2,000 hour life	Tungsten-Halogen 6V, 20W, avg. 2,000 hour life	Tungsten-Halogen 6V, 20W, avg. 2,000 hour life
Light Source Optional	LED 20-30 mA 100,00 hr. avg. life	N/A	N/A
Sample Chamber	Accepts sample tubes up to 200 mm	Accepts sample tubes up to 200 mm	Accepts sample tubes up to 200 mm
Data Storage	32 GB Non-removable Compact Flash	32 GB Non-removable Compact Flash	32 GB Non-removable Compact Flash
Communication Interface	3 – USB Ports, 1-USB 3.0, 2 – RS232 Ports, Ethernet Port for Network Connection	3 – USB Ports, 1-USB 3.0, 2 – RS232 Ports, Ethernet Port for Network Connection	3 – USB Ports, 1-USB 3.0, 2 – RS232 Ports, Ethernet Port for Network Connection
Calibration	Automatic calibration via touchscreen	Automatic calibration via touchscreen	Automatic calibration via touchscreen
Operating System	Windows	Windows	Windows
Display	8" color, 800 x 600 pixel resolution with 400 nits of brightness	8" color, 800 x 600 pixel resolution with 400 nits of brightness	8" color, 800 x 600 pixel resolution with 400 nits of brightness
User Interface	Touchscreen	Touchscreen	Touchscreen
Automatic Sensitivity Control	Measures samples with transmittance as low as 0.01% (up to O.D. 4.0)	Measures samples with transmittance as low as 0.01% (up to O.D. 4.0)	Measures samples with transmittance as low as 0.01% (up to O.D. 4.0)
Input Power	100 - 240V, 50/60 Hz	100 - 240V, 50/60 Hz	100 - 240 V, 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	24.3" W x 12.7" H x 17.5" D 617 mm W x 323 mm H x 445 mm D	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)	42 lbs. (19.05 kg)	42 lbs. (19.05 kg)

Specifications

Autopol IV	Autopol V	Autopol V Plus	Autopol VI
Optical Rotation, Specific Rotation, Specific Rotation Plus Concentration, User Defined Scale, Sugar Degrees, °Z (ISS)	Optical Rotation, Specific Rotation, Specific Rotation Plus Concentration, User Defined Scale, Sugar Degrees, °Z (ISS)	Optical Rotation, Specific Rotation, Specific Rotation Plus Concentration, User Defined Scale, Sugar Degrees, °Z (ISS)	Optical Rotation, Specific Rotation, Specific Rotation Plus Concentration, User Defined Scale, Sugar Degrees, °Z (ISS)
Degrees Arc Optical Rotation	Degrees Arc Optical Rotation	Degrees Arc, % Concentration	Degrees Arc, % Concentration
0.001° Arc Optical Rotation, 0.001% Concentration, 0.001 Specific Rotation	0.001° Arc Optical Rotation, 0.001% Concentration, 0.001 Specific Rotation	0.001° Arc Optical Rotation, 0.001% Concentration, 0.001° Specific Rotation	0.0001° Arc Optical Rotation, 0.0001% Concentration, 0.0001° Specific Rotation
0.002° up to 1°, 0.2% up to 5°, 0.01° above 5°	0.002° up to 1°, 0.2% up to 5°, 0.01° above 5°	0.002° up to 1°, 0.2% up to 5°, 0.01° above 5°	0.0003° Arc Optical Rotation See TB 926
Autopol IV Single Accuracy: ±0.002° Arc Optical Rotation Autopol IV Dual Accuracy: ±0.002° Arc Optical Rotation Autopol IV Six Wavelength Accuracy (546nm and 589nm): ±0.002° Arc Optical Rotation	Accuracy (546nm and 589nm): ±0.002° Arc Optical Rotation Accuracy for other wavelengths is the same as the standard model	Autopol V Plus Single Accuracy: ±0.002° Arc Autopol V Plus Six Wavelength Accuracy (546nm and 589nm): ±0.002° Arc Accuracy for other wavelengths is the same as the standard model	Not applicable
AP Selectable Resolution: 0.01, 0.001, 0.0001° Arc	AP Selectable Resolution: 0.01, 0.001, 0.0001° Arc	AP Selectable Resolution: 0.01, 0.001, 0.0001° Arc	Not applicable
0.002° Arc Optical Rotation	0.002° Arc Optical Rotation	0.002° Arc	0.0002° Arc Optical Rotation
±89.9° Arc Optical Rotation, ±999.99° Arc Specific Rotation, 0-99.9% Concentration	±89.9° Arc Optical Rotation, ±999.99° Arc Specific Rotation, 0-99.9% Concentration	±89.9° Arc Optical Rotation, ±999.99° Arc Specific Rotation, 0-99.9% Concentration	±89.9° Arc Optical Rotation, ±999.99° Arc Specific Rotation, 0-99.9% Concentration
Glan Thompson Calcite	Glan Thompson Calcite	Glan Thompson calcite quartz	Glan Thompson calcite quartz
365nm, 405nm, 436nm, 546nm, 589nm, 633nm (other wavelengths available: 578nm)	365nm, 405nm, 436nm, 546nm, 589nm, 633nm (other wavelengths available: 578 nm)	365nm, 405nm, 436nm, 546nm, 589nm, 633nm (other wavelengths available: 325 nm)	365nm, 405nm, 436nm, 546nm, 589nm, 633nm (other wavelengths available: 325 nm)
Touchscreen Selectable: 1, 2 and 6	Touchscreen Selectable: 6 standard	Touchscreen Selectable: 6 standard	Touchscreen Selectable: 6 standard
Optional: External PC software only	Optional: External PC software or Internal Embedded solution with on/off option	Optional: External PC software or Internal Embedded solution with on/off option	Standard: Embedded solution with on/off option
By external water bath (standard) TempTrol™ Automatic Electric Heating and Cooling 15°- 40°C ±0.2°C (optional)	TempTrol™ Automatic Electronic Heating & Cooling 15°-40°C (standard) ±0.2°C (standard)	TempTrol™ Automatic Electronic Heating & Cooling 15°-40°C (standard) ±0.2°C (standard)	TempTrol™ Automatic Electronic Heating & Cooling 15°- 40°C (standard) ±0.2°C (standard)
10°C - 100°C	10°C - 100°C	10°C - 100°C	10°C - 100°C
±0.1°C	±0.1°C	±0.1°C	±0.1°C
4°/sec. slewing rate & 5 sec. nominal settling time	4°/sec. slewing rate & 5 sec. nominal settling time	4°/sec. slew rate and 5 sec. nominal settling time	4°/sec. slew rate and 5 sec. nominal settling time
Tungsten-Halogen 6V, 20W, avg. 2,000 hour life	Tungsten-Halogen 6V, 20W, avg. 2,000 hour life	Tungsten-halogen 6V, 20W, avg. 2,000 hour life	Tungsten-halogen 6V, 20W, avg. 2,000 hour life
N/A	N/A	N/A	N/A
Accepts sample tubes up to 200 mm	Accepts sample tubes up to 200 mm	Accepts sample tubes up to 200mm	Accepts sample tubes up to 200mm
32 GB Non-removable Compact Flash	32 GB Non-removable Compact Flash	32 GB Non-removable Compact Flash	32 GB Non-removable Compact Flash
3 – USB Ports, 1-USB 3.0, 2 – RS232 Ports, Ethernet Port for Network Connection	3 – USB Ports, 1-USB 3.0, 2 – RS232 Ports, Ethernet Port for Network Connection	3 – USB Ports, 1-USB 3.0, 2 – RS232 Ports, Ethernet Port for Network Connection	3 – USB Ports, 1-USB 3.0, 2 – RS232 Ports, Ethernet Port for Network Connection
Automatic calibration via touchscreen	Automatic calibration via touchscreen	Automatic calibration by push-button	Automatic calibration via touch screen
Windows	Windows	Windows	Windows
8" color, 800 x 600 pixel resolution with 400 nits of brightness	8" color, 800 x 600 pixel resolution with 400 nits of brightness	Adjustable 10.4 inch diagonal, 800-600 pixels, color, Flat Panel Monitor with Resistant Touch Screen Interface, 200 nits brightness	Adjustable 10.4 inch diagonal, 800-600 pixels, color, Flat Panel Monitor with Resistant Touch Screen Interface, 200 nits brightness
Touchscreen	Touchscreen	Touchscreen	Touchscreen
Measures samples with transmittance as low as 0.01% (up to O.D. 4.0)	Measures samples with transmittance as low as 0.01% (up to O.D. 4.0)	Measures samples with transmittance as low as 0.01% (up to O.D. 4.0)	Measures samples with transmittance as low as 0.01% (up to O.D. 4.0)
100 - 240 V, 50/60 Hz	100 - 240 V, 50/60 Hz	100 - 240V, 50/60 Hz	100 - 240V, 50/60 Hz
30" W x 11.5" H x 17" D 762 mm W x 431.8 mm H x 279.4 mm D	30" W x 11.5" H x 17" D 762 mm W x 431.8 mm H x 279.4 mm D	32" W x 11.5" H x 19.75" D 813 mm W x 292 mm H x 457 mm D	32" W x 11.5" H x 19.75" D 890 mm W x 267 mm H x 432 mm D
85 lbs. (39 kg)	85 lbs. (39 kg)	90 lbs. (41 kg)	90 lbs. (41 kg)