AUTOPOL CALIBRATION CERTIFICATE

Date of Calibration: 03/09/11 Instrument Serial No.: 80311 Instrument Type: APV

CALIBRATION TEST 1

NIST Traceable Quartz Control Plate Calibration Standard Serial No.: 8832

* Certified Rotation at 633 nm and 20° C: 9.883
* Certified Rotation at 589 nm and 20° C: 11.488
* Certified Rotation at 546 nm and 20° C: 13.503
* Certified Rotation at 436 nm and 20° C: 21.965
* Certified Rotation at 405 nm and 20° C: 25.750
* Certified Rotation at 365 nm and 20° C: 32.651
* Certified Rotation at 325 nm and 20° C: N/A 03/09/11
* ISS Certified Rotation at 589 nm and 20° C:
* ISS Certified Rotation at 880 nm and 20° C:

* A copy of the NIST traceable calibration certificate is available for purchase

---

Instrument Readings at 633nm after calibration
1) 9.884 °Arc
2) 9.884 °Arc
3) 9.884 °Arc
☐Uncorrected ☒Corrected to 20°

Instrument Readings at 589nm after calibration
1) 11.487 °Arc
2) 11.488 °Arc
3) 11.488 °Arc
☐Uncorrected ☒Corrected to 20°

Instrument Readings at 546nm after calibration
1) 13.504 °Arc
2) 13.504 °Arc
3) 13.504 °Arc
☐Uncorrected ☒Corrected to 20°

Instrument Readings at 436nm after calibration
1) 21.967 °Arc
2) 21.967 °Arc
3) 21.967 °Arc
☐Uncorrected ☒Corrected to 20°

Instrument Readings at 405nm after calibration
1) 25.750 °Arc
2) 25.750 °Arc
3) 25.750 °Arc
☐Uncorrected ☒Corrected to 20°

Instrument Readings at 365nm after calibration
1) 32.649 °Arc
2) 32.649 °Arc
3) 32.649 °Arc
☐Uncorrected ☒Corrected to 20°

Instrument Readings at 325nm after calibration
1) N/A 03/09/11 °Arc
2) °Arc
3) °Arc
☐Uncorrected ☐Corrected to 20°

Instrument Readings at 589nm after calibration
1) °Z
2) N/A 03/09/11 °Z
3) °Z
☐Uncorrected ☐Corrected to 20°

Instrument Readings at 880nm after calibration
1) °Z
2) N/A 03/09/11 °Z
3) °Z
☐Uncorrected ☐Corrected to 20°

The following formula is used to calculate temperature correction for quartz control plates when measured on a Rudolph Research Analytical Autopol. Temperature correction calculation is done automatically on newer models.

$$\alpha^{T}_{QCP} = \alpha^{20}_{QCP} / [1-0.000043(T-20)],$$

$$= \alpha^{20}_{QCP} / \delta$$

Based on the readings above, Instrument Type: APV Serial No. 80311 Belonging to: GlaxoSmithKline Meets Rudolph Research Analytical reproducibility and accuracy specifications as found in Rudolph Research Analytical Technical Bulletin 928.

Date 03/09/11 Rudolph Research Analytical Service Engineer Raul Rivera Jr.

RUDOLPH RESEARCH ANALYTICAL • 55 Newburgh Rd., Hackettstown, New Jersey 07840 U.S.A. • 973-584-1558 • Fax 973-584-5440

CALIBRATION TEST 2

NIST Traceable Quartz Control Plate Calibration Standard Serial No.: 8524-8248

* Certified Rotation at 633 nm and 20° C: 0.858
* Certified Rotation at 589 nm and 20° C: 0.997
* Certified Rotation at 546 nm and 20° C: 1.172
* Certified Rotation at 436 nm and 20° C: 1.906
* Certified Rotation at 405 nm and 20° C: 2.234
* Certified Rotation at 365 nm and 20° C: 2.833
* Certified Rotation at 325 nm and 20° C: N/A 03/09/11
* ISS Certified Rotation at 589 nm and 20° C:
* ISS Certified Rotation at 880 nm and 20° C:

* A copy of the NIST traceable calibration certificate is available for purchase

---

Instrument Readings at 633nm after calibration
1) 0.859 °Arc
2) 0.859 °Arc
3) 0.859 °Arc
☐Uncorrected ☒Corrected to 20°

Instrument Readings at 589nm after calibration
1) 0.997 °Arc
2) 0.997 °Arc
3) 0.997 °Arc
☐Uncorrected ☒Corrected to 20°

Instrument Readings at 546nm after calibration
1) 1.174 °Arc
2) 1.174 °Arc
3) 1.174 °Arc
☐Uncorrected ☒Corrected to 20°

Instrument Readings at 436nm after calibration
1) 1.907 °Arc
2) 1.907 °Arc
3) 1.907 °Arc
☐Uncorrected ☒Corrected to 20°

Instrument Readings at 405nm after calibration
1) 2.236 °Arc
2) 2.236 °Arc
3) 2.236 °Arc
☐Uncorrected ☒Corrected to 20°

Instrument Readings at 365nm after calibration
1) 2.833 °Arc
2) 2.833 °Arc
3) 2.833 °Arc
☐Uncorrected ☒Corrected to 20°

Instrument Readings at 325nm after calibration
1) N/A 03/09/11 °Arc
2) °Arc
3) °Arc
☐Uncorrected ☐Corrected to 20°

Instrument Readings at 589nm after calibration
1) N/A 03/09/11 °Z
2) °Z
3) °Z
☐Uncorrected ☐Corrected to 20°

Instrument Readings at 880nm after calibration
1) N/A 03/09/11 °Z
2) °Z
3) °Z
☐Uncorrected ☐Corrected to 20°

The following formula is used to calculate temperature correction for quartz control plates when measured on a Rudolph Research Analytical Autopol. Temperature correction calculation is done automatically on newer models.

$$\alpha^{T}_{QCP} = \alpha^{20}_{QCP} / [1-0.000043(T-20)],$$

$$= \alpha^{20}_{QCP} / \delta$$

Based on the readings above, Instrument Type: APV Serial No. 80311 Belonging to: GLAXOSMITHKLINE Meets Rudolph Research Analytical reproducibility and accuracy specifications as found in Rudolph Research Analytical Technical Bulletin 928.

Date 03/09/11 Rudolph Research Analytical Service Engineer Raul Rivera Jr.

RUDOLPH RESEARCH ANALYTICAL • 55 NEWBURGH RD., HACKETTSTOWN, NEW JERSEY 07840 U.S.A. • 973-584-1558 • FAX 973-584-5440

AUTOPOL TEMPERATURE VALIDATION CERTIFICATE

☐ **This page is not applicable – No Temperature Display**

Date of Validation: 03/09/11 Instrument Serial No: 80311

NIST-Traceable Thermometer Serial No(s): Left 1107 Right or Single 1053

Autopol Polarimeters with Temperature Display

Column	A		B		C		D	E	
Temperature Control Setting on Autopol (if applicable)	NIST Thermometer Reading						Autopol Temperature Reading	Difference Between Column C and D	
	Measured Temperature Reading		Correction to Thermometer Reading as Shown on NIST Certificate		Actual Thermometer Reading After Correction				
	Left	R or Single	Left	R or Single	Left	R or Single		Left	R or Single
20° C	20.0°C	19.9°C	0.0°C	+0.1°C	20.0°C	20.0°C	20°C	0.0°C	0.0°C
25° C	25.1°C	25.0°C	0.0°C	0.0°C	25.1°C	25.0°C	25°C	0.1°C	0.0°C
30° C	30.1°C	30.0°C	-0.1°C	0.0°C	30.0°C	30.0°C	30°C	0.0°C	0.0°C
OTHER			(RD)		N/A	03/09/11			

The results shown under the heading "Autopol Temperature Reading" in column D should be within 0.2 ° C of the results shown under the heading "Actual Thermometer Reading after Correction" in column C. Stated further, all results in column E should be equal to or less than 0.2 °C.

Verified by: Raul Rivera Jr. (Print Name) Raul Rivera Jr. (Signature) 03/09/11 (Date)

RUDOLPH RESEARCH ANALYTICAL • 55 NEWBURGH RD., HACKETTSTOWN, NEW JERSEY 07840 U.S.A. • 973-584-1558 • FAX 973-584-5440