CERTIFICATE OF CALIBRATION

ISSUED BY PARAGON SCIENTIFIC LIMITED

Date of Issue: **30-May-19** Certificate No. **U2487**

0649 4589

Paragon Scientific Ltd

UKAS accredited calibration laboratory No. 0649 accredited to ISO/IEC 17025
UKAS accredited reference material producer No. 4589 accredited to ISO 17034
6 Prenton Way, North Cheshire Trading Estate, Prenton, Wirral, UK. CH43 3DU.
Telephone: +44 (0) 151 649 9955 Fax: +44 (0) 151 649 9977
e-mail: sales@paragon-sci.com Web Site: www.paragon-sci.com

Approved Signatory

Name Mr. P. Whitehurst.

Signature

ISO 17025 / ISO 17034 VISCOSITY AND DENSITY REFERENCE STANDARD

Standard type: **N18000** Lot No: **3161403** Expiry Date: **29-May-21**

Temperature		Viscosity				Density
(°C)	(°F)	mm^2/s (cSt) Kinematic	mPa·s (cP) Dynamic	SUS	SFS	(g/mL)
20.00	68.00	106285	95061			0.8944
25.00	77.00	65942	58800			0.8917
37.78	100.00	21653	19156			0.8847
40.00	104.00	18077	15971			0.8835
50.00	122.00	8447	7417			0.8781
60.00	140.00	4235	3696			0.8727
80.00	176.00	1280	1103			0.8620
98.89	210.00	501.8	427.5			0.8519
100.00	212.00	477.3	406.4			0.8514

Paragon Scientific Ltd. certifies that the kinematic viscosity measurements have been made in accordance with ASTM D2162 using long capillary Master Viscometers at all temperatures. See also ASTM D445, D446, D2171, ISO 3104, ISO 3105, IP 71 Sections 1 and 2 and IP 222. The viscosity data reported is based on the primary standard of pure water at 20 °C (ITS-90) having a value of 1.0034 mm^2/s (cSt) ± 0.17%, as adopted by NIST, ASTM, IP and ISO (ISO 3666). Density measurements were made in accordance with ASTM D1480. Temperature measurements were made using thermometers specified in ASTM D2162 which have a current calibration traceable to the National Physical Laboratory (NPL), National Institute Standards and Technology (NIST) and other recognised national standards laboratories. SUS and SFS values have been calculated in accordance with ASTM D2161 where stated. The calibrations of this product are traceable to NIST.

Uncertainties:

	Expanded Uncertainty	
Viscosity Range	**Kinematic Viscosity mm^2/s (cSt)**	**Dynamic Viscosity mPa·s (cP)**
0.3 to 7.4	± 0.07 %	± 0.07 %
7.4 to 10	± 0.09 %	± 0.09 %
10 to 30	± 0.12 %	± 0.12 %
30 to 72	± 0.14 %	± 0.14 %
72 to 180	± 0.15 %	± 0.15 %
180 to 520	± 0.17 %	± 0.17 %
520 to 1000	± 0.19 %	± 0.19 %
1000 to 2700	± 0.20 %	± 0.20 %
2700 to 8000	± 0.22 %	± 0.22 %
8000 to 82 500	± 0.23 %	± 0.23 %

Uncertainties stated on this certificate do not include the uncertainty for the value of the viscosity of water at 20 °C (ITS-90) having a value of 1.0034 mm^2/s (cSt) ± 0.17%.

Density Uncertainties: Expanded Uncertainty ± 0.01 %

The reported expanded uncertainty is based on a combined standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95%.

The evaluation has been carried out in accordance with UKAS requirements.

Notes: The shelf life of this product is guaranteed until the expiry date, provided the bottle is unopened and stored at ambient temperature (15 to 30 °C). The guarantee is void if the bottle seal is broken. Filtration of product before use is not necessary. No minimum volume is required to guarantee homogeneity.

Units: Kinematic Viscosity: 1 cSt = 10^{-2} St = $10^{-6} m^2/s$ = 1 mm^2/s
Dynamic Viscosity: 1 mPa·s = 10^{-3} Pa·s = 1 cP = 10^{-2} P
Dynamic Viscosity = Kinematic Viscosity x Density (at the same temperature)