

Date of Issue: 02 May 2024 Certificate Number: 41800

REFERENCE MATERIAL CERTIFICATE

ISSUED BY THE PSL CALIBRATION LABORATORY



5076

ACCREDITED TO ISO17034:2016

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Client:

Poulten Selfe and Lee Ltd.
Russell House
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Essex CM0 8TE

ASTM reference: S2000
Product Code: 2700-V15
Batch Number: 30988
Date of Calibration: 29 February 2024
Date of Expiry: 30 April 2026
Bottle Number: 101221

Approved Signatory:

Anna Milc - Quality Assistant

X

Samples representative of the whole batch of bottles were taken from this reference material and were measured using reference viscometers calibrated by the method of ASTM D2162-21, and pycnometers according to IP 189/190-2005 to generate the following certified values.

CERTIFIED VALUES

| Temperature (°C) | Kinematic Viscosity (mm ² /s) | Dynamic Viscosity (mPa.s) | Density (g/cm ³) |
|---------------------|---|------------------------------|---------------------------------|
| 20.00 | 9412 | 8231 | 0.8745 |
| 25.00 | 5980 | 5207 | 0.8708 |
| 40.00 | 1792 | 1547 | 0.8631 |
| 50.00 | 897.4 | 769.0 | 0.8569 |
| 80.00 | 174.1 | 146.3 | 0.8404 |
| 100.00 | 77.34 | 64.09 | 0.8287 |

Certified values determined by the PSL Calibration Laboratory which is accredited to ISO17025:2017 by UKAS.

UNITS: the SI unit of viscosity is the meter squared per second (m²/s). The recommended sub multiple is the mm²/s, where 1 mm²/s = 1 cSt (centistokes) = 10⁻⁶m²/s.

The SI unit of dynamic viscosity is the pascal second (Pa.s). The recommended sub multiple is the mPa.s, where 1 mPa.s = 1 cP (centipoise) = 10⁻³Pa.s.

The SI unit of density is the kilogram per cubic meter (kg/m³). The recommended sub multiple is the g/cm³, where 1 g/cm³ = 1000 kg/m³.

This certificate is issued in accordance with the Laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

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UKAS ACCREDITED LABORATORY NUMBER 5076

NOTES**1. Basis**

The values of viscosity given overleaf are based upon a value for the kinematic viscosity of distilled water at 20.00°C of 1.0034 mm²/s. (Reference ISO3666 1998).

2. Measurement of Kinematic Viscosity

The kinematic viscosity of the PSL calibrated reference oils is determined using calibrated glass capillary viscometers. Temperatures are determined with calibrated reference thermometers. Descriptions of the use of viscometers and reference oils are to be found in the standard methods of test ISO 3104, ISO 3015, BS188, IP Method 71 and ASTM Method D445.

3. Dynamic Viscosity

The dynamic viscosity values given in this certificate have been calculated from the measured values of kinematic viscosity and density at the same temperature. Density measurements are made following the procedures outlined in IP189/190. Each density measurement recorded is the mean of the values obtained in two pycnometers.

The following relationship is used: **Dynamic Viscosity = Kinematic Viscosity multiplied by density**

4. Measurement UncertaintyTemperature range 20°C to 150°C

| Kinematic Viscosity (mm ² /s) | Uncertainty (%) |
|--|-----------------|
| 0.4 to 8.8 | 0.44 |
| 8.9 to 21 | 0.45 |
| 22 to 46 | 0.46 |
| 47 to 127 | 0.48 |
| 128 to 260 | 0.75 |
| 261 to 620 | 0.76 |
| 621 to 1130 | 0.77 |
| 1131 to 2560 | 0.79 |
| 2561 to 6850 | 0.86 |
| 6851 to 20450 | 0.86 |
| 20451 to 43450 | 0.86 |
| 43451 to 150000 | 0.95 |

| Density (g/cm ³) | Uncertainty (%) |
|------------------------------|-----------------|
| 0.65 to 0.93 | 0.070 |

Temperature range -40°C to 0°C

| Kinematic Viscosity (mm ² /s) | Uncertainty (%) |
|--|-----------------|
| 0.4 to 21 | 0.46 |
| 22 to 260 | 0.48 |
| 261 to 1130 | 0.76 |
| 1131 to 150000 | 0.95 |

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements. These values do not take into account any uncertainty in the widely adopted value of 1.0034 mm²/s for the kinematic viscosity of freshly distilled water at 20.00°C, although this is unlikely to exceed ±0.17% [ISO TR3666-1998].

5. Storage Information

Provided that the container is kept closed, in the dark until the day of use and not subjected to temperatures greater than 50°C or less than 5°C the stated viscosity values are expected to remain within the uncertainty bands until the expiry date shown on this certificate. The sample should not be filtered before use, nor should it be re-used.

6. Usage and Handling Instructions

The certified reference material will typically be used for the verification of the calibration of glass capillary viscometers (manual and automated) according to ISO3104, IP71 Section 1 and ASTM D445. They may also be used to provide kinematic viscosity values for flow cups and dynamic viscosity values for rotational viscometers, cone and plate or other viscometer types determining dynamic viscosity.

Once the container has been opened, the stated viscosity values are expected to remain within the uncertainty bands for up to three months, provided the material is not contaminated and that the three-month period does not extend beyond the expiry date stated on the certificate. The container must continue to be stored according to the previous storage information. Under no circumstances should decanted sample be poured back into the container – the stated viscosity values will no longer apply in this event.

7. Temperature

As the viscosity of a liquid is always strongly dependent upon temperature, very precise measurement and control of temperature is required to make full use of this calibrated reference oil.