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**CERTIFICATE OF CALIBRATION**

ISSUED BY THE PSL CALIBRATION LABORATORY



0247

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**Approved Signatory:**

Steven Sims - Quality Manager

**Type:** ZEITFUCHS CROSS-ARM**Marked:** PSL 7**Viscometer No:** 94121

This viscometer has been calibrated against reference viscometers calibrated by the method of ASTM D2162-21 held at the Laboratory and the constant C was found to be:

$$C = 3.008 \text{ (mm}^2\text{/s)/s}$$

Results only relate to the item calibrated.

The calibration was carried out at a temperature of 40°C with the upper portion of the air tube set vertical in accordance with the general procedure given in ISO 3105:1994, BS 188:1977, IP 71 Section 2/97 and ASTM D446-12(2017).

The kinematic viscosity  $\nu$  (mm<sup>2</sup>/s) of a liquid may be calculated from a mean measured flow time  $t$  (seconds) using the formula:

$$\nu = C.t$$

if the viscometer is used in accordance with ISO3104, IP71 Section 1, ASTM D445, then the above formula applies when the flow time in this viscometer is not less than 200 seconds. If used in accordance with other test methods, refer to the appropriate formula.

UNITS: the SI unit of viscosity is the meter squared per second (m<sup>2</sup>/s). The recommended sub multiple is the mm<sup>2</sup>/s, where 1 mm<sup>2</sup>/s = 1 cSt (centistokes) = 10<sup>-6</sup>m<sup>2</sup>/s.

**Batch No:**30733

This viscometer was calibrated on the 08 June 2023 and has been supplied unused. The expiry date should be determined by the user according to the date of first use (see Note 6 on page 2).

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.

**CERTIFICATE OF CALIBRATION**

UKAS ACCREDITED LABORATORY NUMBER 0247

**NOTES****1. Basis**

The value of **C** given overleaf is based upon a value for the kinematic viscosity of distilled water at 20.00°C of 1.0034mm<sup>2</sup>/s.

**2. Gravity Correction**

If the viscometer is used where the gravity differs significantly from the PSL value of 9.812 m/s<sup>2</sup>, a correction should be applied to the reported value of **C** thus

$$C_x = (g_x / 9.812) \times C$$

Where  $g_x$  is the local acceleration to gravity expressed in m/s<sup>2</sup>.

**3. Measurement of Kinematic Viscosity**

Description of the use of the viscometers is to be found in the standard methods of test set out on page one of this certificate.

**4. Measurement Uncertainty**

| Order of C<br>(mm <sup>2</sup> /s) | Direct Flow–<br>Ubbelohde<br>Suspended Level<br>uncertainty<br>± (%) | Reverse Flow<br>uncertainty<br>± (%) |
|------------------------------------|--|--------------------------------------|
| 0.001                              | 0.27   | 0.31                                 |
| 0.003                              | 0.27   | 0.31                                 |
| 0.01                               | 0.27   | 0.31                                 |
| 0.03                               | 0.28   | 0.34                                 |
| 0.1                                | 0.30   | 0.35                                 |
| 0.3                                | 0.31   | 0.37                                 |
| 1.0                                | 0.32   | 0.40                                 |
| 3.0                                | 0.36   | 0.43                                 |
| 10.0                               | 0.36   | 0.43                                 |
| 30.0                               | 0.50   | 0.55                                 |
| 100.00                             | 0.50   | 0.55                                 |

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 mm<sup>2</sup>/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. Effect of Temperature**

For all those viscometers which have the volume of sample adjusted at bath temperature, (and in the case of all suspended level viscometers), the constant **C** is independent of temperature, within the limits of uncertainty given in note 4. These include the following types of viscometers:

**U-Tube Viscometers** – types BS/U, BS/U/M, BS/IP/RF;

**Suspended Level Viscometers** – types BS/IP/SL, BS/IP/SL(S), BS/IP/MSL;

**ASTM Ubbelohde, Cannon-Ubbelohde, Cannon-Ubbelohde (Dilution), Cannon-Ubbelohde Semi-Micro, DIN Ubbelohde and Zeitfuchs Cross-Arm Viscometers.**

**6. Expiration of Certificate of Calibration**

The calibration of a glass capillary viscometer will not change until the instrument is used. Therefore, the calibration data on this certificate is valid from the date of first use of the viscometer. In accordance with standard methods of test ASTM D445-IP71, ISO 3014, the calibration of the viscometer should then be verified on a regular basis. Any sources of error should be investigated.

Depending upon use, PSL has generally found that the calibration of glass capillary viscometers will remain valid for a period up to 10 years.

However, any physical damage to the viscometer (external or internal), residual film left on the inside of the capillary or chemicals that attack the borosilicate glass will cause a change in the calibration constant stated on this certificate.