# CANNON INSTRUMENT COMPANY Certificate of Calibration

## Viscometer No. 0B L161

**UBBELOHDE TYPE**

(Standard Test ASTM D 445 and ISO 3104)

ACCREDITED

1262.01

*The inclusion of the A2LA logo does not imply certification/approval of the products calibrated or tested.*

Viscometer Constant **0.005071** $mm^2/s^2$, (cSt/s)

The viscometer constant is the same at all temperatures.

To obtain kinematic viscosity in $mm^2/s$ (cSt) multiply the efflux time in seconds by the viscometer constant. To obtain viscosity in mPa·s, multiply the kinematic viscosity by the density in g/ml.

Kinematic viscosities of the standards used in calibrating were established in Master Viscometers as described in Ind. Eng. Chem. Anal. Ed. 16, 708(1944), ASTM D2162, and the Journal of Research of the National Bureau of Standards, Vol. 52, No. 3, March 1954, Research Paper 2479.

Kinematic viscosities are based on the primary viscosity standard, water, at 20°C (ITS-90). The internationally accepted value for the viscosity of water at 20°C (ITS-90) is 1.0016 mPa·s or kinematic viscosity is 1.0034 $mm^2/s$ as listed in ISO 3666. The gravitational constant, g, is 980.1 $cm/sec^2$ at the Cannon Instrument Company. The gravitational constant varies up to 0.1% in the United States. To make this small correction in the viscometer constant, multiply the above viscometer constant by the factor [g (at your laboratory) / 980.1]. The calibration data below are traceable to the National Institute for Standards and Technology. Temperature measurement is traceable to NIST (Test No. 260470).

### CALIBRATION DATA AT 40°C

| Viscosity Standard | Kinematic Viscosity $mm^2/s$, (cSt) | Efflux Time Seconds | Constant $mm^2/s^2$, (cSt/s) |
|---|---|---|---|
| **I1** | **1.368** | **269.98** | **0.005066** |
| **I2** | **2.417** | **476.26** | **0.005076** |

Average =**0.005071**

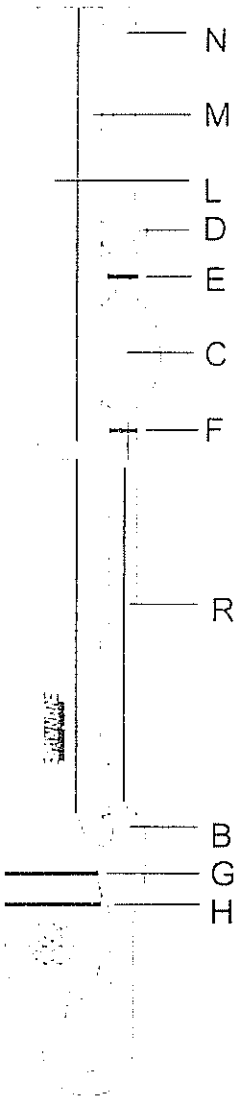
Calibrated by **RMB on 11/9/2009** under supervision of

K.O. Henderson M.T. Zubler
Cannon Instrument Co.
State College, PA 16803, USA
www.cannoninstrument.com

Please note: This calibration remains valid for 10 years unless (1) the viscometer has been damaged or (2) materials which chemically attack borosilicate glass (e.g., hydrofluoric acid or highly alkaline solutions) have been used. Nonetheless, it is recommended that the calibration be verified with kinematic viscosity standards periodically; if a change in calibration is indicated, carefully examine all sources of error, including especially temperature measurement since most apparent changes in calibration of the viscometer are due to errors in temperature measurement.



The S.I. unit of kinematic viscosity is 1 meter squared per second, and is equal to $10^4$ stokes. The S.I. unit of viscosity is 1 pascal second, and is equal to 10 poises. One centistokes is equal to one millimeter squared per second.




# Instructions for the use of The Ubbelohde Viscometer

See also ASTM D 445, D 446 and ISO 3105

1. Clean the viscometer using suitable solvents, and by passing clean, dry, filtered air through the instrument to remove the final traces of solvents. Periodically, traces of organic deposits should be removed with chromic acid or non-chromium cleaning solution.
2. If there is a possibility of lint, dust, or other solid material in the liquid sample, filter the sample through a fritted glass filter or fine mesh screen.
3. Charge the viscometer by introducing sample through tube L into the lower reservoir; introduce enough sample to bring the level between lines G and H.
4. Place the viscometer into the holder, and insert it into the constant temperature bath. Vertically align the viscometer in the bath if a self-aligning holder has not been used.
5. Allow approximately 20 minutes for the sample to come to the bath temperature.
6. Place a finger over tube M and apply suction to tube N until the liquid reaches the center of bulb D. Remove suction from tube N. Remove finger from tube M, and immediately place it over tube N until the excess sample drops away from the lower end of the capillary into bulb B. Then remove finger and measure the efflux time.
7. To measure the efflux time, allow the liquid sample to flow freely down past mark E, measuring the time for the meniscus to pass from mark E to mark F.
8. Calculate the kinematic viscosity of the sample by multiplying the efflux time by the viscometer constant.
9. Without recharging the viscometer, make check determinations by repeating steps 6 to 8.

## Ubbelohde Type For Transparent Liquids

RECOMMENDED VISCOSITY RANGES FOR THE UBBELOHDE VISCOMETER

| Size | Kinematic Viscosity Range $mm^2/s^2$, (cSt/s) | $mm^2/s$, (cSt) | | |
|---|---|---|---|---|
| 0 | 0.001 | 0.3 | to | 1 |
| 0C | 0.003 | 0.6 | to | 3 |
| 0B | 0.005 | 1 | to | 5 |
| 1 | 0.01 | 2 | to | 10 |
| 1C | 0.03 | 6 | to | 30 |
| 1B | 0.05 | 10 | to | 50 |
| 2 | 0.1 | 20 | to | 100 |
| 2C | 0.3 | 60 | to | 300 |
| 2B | 0.5 | 100 | to | 500 |
| 3 | 1.0 | 200 | to | 1000 |
| 3C | 3.0 | 600 | to | 3000 |
| 3B | 5.0 | 1000 | to | 5000 |
| 4 | 10 | 2000 | to | 10000 |
| 4C | 30 | 6000 | to | 30000 |
| 4B | 50 | 10000 | to | 50000 |
| 5 | 100 | 20000 | to | 100000 |

The expanded uncertainty[1] with 95% confidence of the calibration measurements relative to the primary standard is as follows:

| Range of Viscosity $mm^2/s$ | Combined Expanded Uncertainty |
|---|---|
| < 10 | 0.16% |
| 10 – 100 | 0.22% |
| 100 – 1000 | 0.29% |
| 1000 – 10000 | 0.38% |
| 10000 - 100000 | 0.44% |

The assigned uncertainty of the primary viscosity standard at 20°C is ± 0.17%. See ISO 3666.

[1] An expanded uncertainty U is determined by multiplying the combined standard uncertainty $u_c$ by a coverage factor k: $U = ku_c$, where k = 2. See NIST Technical Note 1297, 1994 edition, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results.*

THIS PRODUCT WAS CALIBRATED WITHIN A QUALITY SYSTEM WHICH IS REGISTERED TO ISO 9001:2000.