CANNON INSTRUMENT COMPANY®

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Certificate of Calibration

CANNON-FENSKE ROUTINE VISCOMETER

Size 350 **Serial Number 512N**

Temperature °C	Constant mm^2/s^2, (cSt/s)	Expanded Uncertainty* (k=2) %	Kinematic Viscosity Range mm^2/s, (cSt)
40	0.5011	0.294	100 - 500
100	0.4986		

* In alignment with the Calibration and Measurement Capabilities of National Metrology Institutes, the expressed uncertainty is relative to the viscosity of water, and therefore the uncertainty of the viscosity of water (ISO/TR 3666 (1998), 0.17%) is not taken into account.

CALIBRATION DATA AT 40°C

Viscosity Standard	Kinematic Viscosity mm^2/s, (cSt)	Efflux Time Seconds	Constant mm^2/s^2, (cSt/s)
I100	125.6	250.82	0.5008
I200	234.7	468.01	0.5014

Average = 0.5011

ADDITIONAL INFORMATION

Ambient Temperature (approximate) 22 °C C_o = 0.5019 B = 82 x 10^{-6}/°C

Charge (approximate) 6.8 ml Driving fluid head (approximate) 8.7 cm Working diameter of lower reservoir 3.0 cm

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 D 2162, and the Journal of Research of the National Bureau of Standards, Vol. 52, No. 3, March 1954, Research Paper 2479.

Kinematic viscosities are traceable to the viscosity of water, ISO 3666, at 20°C (ITS-90). Temperature measurements are traceable to NIST fixed-point calibration of SPRTs.

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].

Calibrated by TJI on 10/20/2011

under supervision of _____

D. T. Trowbridge Ph.D Laboratory Technical Director
J. T. Mastropierro Deputy Laboratory Technical Director
M. T. Zubler Director of Quality Assurance

ilac-MRA ACCREDITED
A2LA Cal Lab Cert #1262.01
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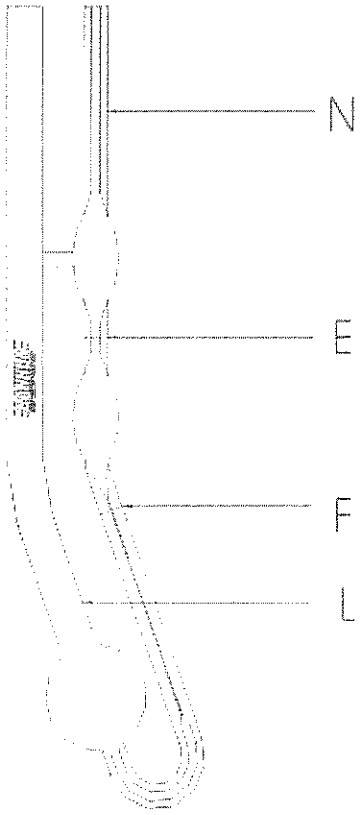
INTENDED USAGE

Kinematic Viscosity Measurment per Standard Test ASTM D 445, IP 71 and ISO 3104.

INSTRUCTIONS FOR USE

See also ASTM D445, D446 and ISO 3104, 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 sintered glass filter or fine mesh screen.
3. To charge the sample into the viscometer, invert the instrument and apply suction to tube L, immersing tube N in the liquid sample, and draw liquid to mark F. Wipe clean arm N, and turn the instrument to its normal vertical position.
4. Place the viscometer into the holder, and insert it into the constant temperature bath. A viscometer holder which fits the Cannon-Fenske Opaque viscometer and the Cannon-Manning Semi-Micro viscometer will also fit the Cannon-Fenske Routine viscometer. Align the viscometer vertically in the bath by means of a small plumb bob in tube L, if a self-aligning holder is not used.
5. Allow approximately 10 minutes for the sample to come to the bath temperature at 40°C and 15 minutes at 100°C.
6. Apply suction to tube N (or pressure to tube L) and draw the liquid slightly above mark E.
7. To measure the efflux time, allow the liquid sample to flow freely down past mark F, measuring the time for the meniscus to pass from mark E to mark F.
8. A check run may be made by repeating steps 6 and 7.
9. Calculate the kinematic viscosity in mm^2/s(cSt) of the sample by multiplying the efflux time in seconds by the viscometer constant

The viscometer constant at other temperatures can be obtained by interpolation or extrapolation. 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 (cP), multiply the kinematic viscosity in mm^2/s (cSt) by the density in grams per milliliter.

The constants assume a value for the coefficient of thermal expansion typical to that for mineral oil, and that the viscometer was filled with test sample at room temperature. If the filling temperature T_F is substantially different than room temperature, the viscometer constant at test temperature T_T is $C_v (1 - B [T_T - T_F])$. The values of C_v and B shown are based on a coefficient of thermal expansion typical to that for a mineral oil.

*WARNING: The use of dichromate acid cleaning solution or non-chromium containing strongly oxidizing acid cleaning solution is recommended to clean deposits from glass-capillary kinematic viscometers (see ASTM D445, Para. 12 Cleaning of Viscometer).

The use of alkaline liquid detergents or cleaning solutions whose pH is above 8.0 may result in the enlargement of the working capillary of the viscometer and a significant change in the calibration constant of the viscometer. Changes in calibration constants in excess of 20% have been reported with repeated use of such alkaline cleaning solutions. THE USE OF THESE CLEANING SOLUTIONS IS NOT RECOMMENDED.

MEASUREMENT UNCERTANITY

The expanded uncertainty is provided at the 95% confidence interval. An expanded uncertainty U is determined by multiplying the combined standard uncertainty u_c by a coverage factor k: $U = k * u_c$ where k=2. See NIST Technical Note 1297, 1994 edition, Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results.

EXPIRATION OF CERTIFICATION

Historically Cannon Instrument Company has found that glass capillary viscometer calibrations remain 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.

Contact Cannon Instrument Company for additional information regarding this certificate.