CANNON INSTRUMENT COMPANY Certificate of Calibration

Viscometer No. 300 H532

CANNON-FENSKE ROUTINE TYPE FOR TRANSPARENT LIQUIDS

(Standard Test ASTM D 445, IP 71 and ISO 3104)

1262.01

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

Constant at 40°C **0.2410** mm^2/s^2, (cSt/s)

Constant at 100°C **0.2398** mm^2/s^2, (cSt/s)

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 above 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 $C_o (1 - B [T_T - T_F])$. The values of C_o and B shown below are based on a coefficient of thermal expansion typical to that for a mineral oil.

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 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 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)
160	69.76	289.69	0.2408
1100	127.5	528.73	0.2412
			Average = 0.2410

Room Temp. (approx.) 22 °C.

Charge (approx.) 6.8 ml.

C_o = 0.2414

B = 83 x 10^{-6}/°C

Driving fluid head (approx.) 8.6 cm.

Working diameter of lower reservoir 3.0 cm.

Constant at 100° C. is 0.50 % lower than the constant at 40° C.

Calibrated by RMB on 4/22/2009 under supervision of Kenneth O. Henderson

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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.

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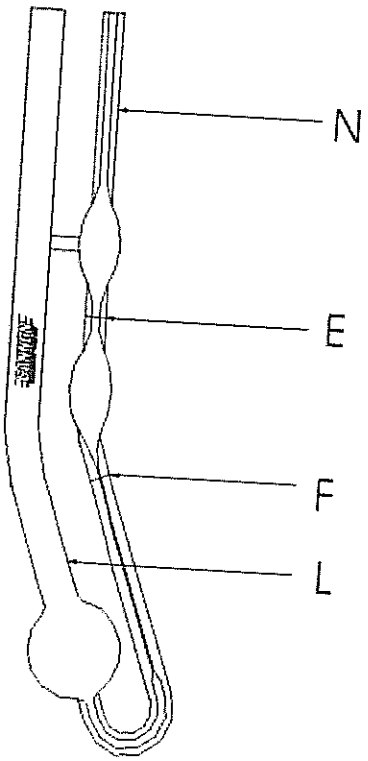
Instructions for the use of
The Cannon-Fenske Routine Viscometer

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 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.

Cannon-Fenske Routine Viscometer
For Transparent Liquids

RECOMMENDED VISCOSITY RANGES FOR THE CANNON-FENSKE ROUTINE VISCOMETERS

Size	Kinematic Viscosity Range mm^2/s^2, (cSt/s)	mm^2/s, (cSt)
25	0.002	0.5 to 2
50	0.004	0.8 to 4
75	0.008	1.6 to 8
100	0.015	3 to 15
150	0.035	7 to 35
200	0.1	20 to 100
300	0.25	50 to 250
350	0.5	100 to 500
400	1.2	240 to 1200
450	2.5	500 to 2500
500	8	1600 to 8000
600	20	4000 to 20000
650	45	9000 to 45000
700	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.

CANNON INSTRUMENT COMPANY

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