CANNON INSTRUMENT COMPANY

CERTIFICATE OF ANALYSIS

CANNON® CERTIFIED VISCOSITY REFERENCE STANDARD					
Viscosity Standard: N35		Lot Number: 23301			
Certification/Issue Date: 06/02/2023		Expiry Date: 06/30/2025			
Temperature		Kinematic Viscosity	Dynamic Viscosity	Density	Saybolt Viscosity
°C	°F	mm^2/s (cSt)	mPa•s (cP)	g/cm^3 (g/mL)	seconds
20.00	68.00	86.54	74.60	0.8619	
25.00	77.00	65.66	56.39	0.8588	
37.78	100.00	35.47	30.18	0.8507	166 SUS
40.00	104.00	32.19	27.34	0.8493	
50.00	122.00	21.64	18.25	0.8430	
80.00	176.00	8.619	7.104	0.8241	
98.89	210.00	5.603	4.551	0.8123	
100.00	212.00	5.477	4.445	0.8116	

USAGE INFORMATION

Intended Use and Instructions

This CANNON Certified Viscosity Reference Standard is intended for, but not restricted to, the calibration and performance verification of various types of viscometers or density measurement equipment. Consult user's manual and test methods specific to your equipment for operating instructions and procedures.

Storage and Handling

This CANNON Certified Viscosity Reference Standard should be stored in the original container with the lid tightly closed, away from direct light, and at ambient temperature and normal laboratory conditions. The standard was prepared in accordance with CANNON Standard Laboratory Operating Procedures to ensure homogeneity and therefore mixing is unnecessary before use and no minimum sample volume is required.

Composition and Product Safety

This CANNON Certified Viscosity Reference Standard is composed of Mineral Oil (100%) [CAS#(s) 64742-54-7]. Consult SDS for complete product safety information.

Expiration of Certification

The certification of this CANNON Certified Viscosity Reference Standard is valid, within the stated measurement uncertainty, until the expiry date that appears on this certificate, provided the material is stored and handled as stated. This certification is deemed null and void if the standard is modified or contaminated. The shelf life was determined empirically through a historical evaluation of material stability. If substantive technical changes occur to the product which affects the certification before the expiry date, Cannon Instrument Company will contact the purchaser.

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ACCREDITED ISO/IEC 17025 & ISO 17034 Cert #1262.01 & 1262.02

DISCUSSION OF DATA

Derivation of Certified Values

Cannon Instrument Company certifies that the kinematic viscosities were determined by the Master Viscometer Technique[1] using CANNON laboratory standard viscometers. All temperature measurements were conducted according to The International Temperature Scale of 1990 (ITS-90) using SPRTs with fixed point calibrations. The provided viscosity data are based upon the primary standard, water at 20 °C, with a kinematic viscosity of 1.0034 mm^2/s and an assigned accuracy of ±0.17% as per ISO 3666. See also ASTM methods D2162, D445, D446, D2161, and ISO methods 3104 and 3105.

Kinematic viscosity (ν) measurements in mm^2/s at temperatures of 20, 25, 37.78, and 40 °C were generally made using CANNON® and/or Cannon-Ubbelohde (long capillary) Master viscometers, as described in ASTM methods D2162, D445, and D446. Measurements at other temperatures have been made using Cannon-Ubbelohde laboratory standard viscometers. Density (ρ) in g/cm^3 (g/mL) was generally determined through measurement in an oscillating U-tube digital density meter or modified Bingham pycnometer. See ASTM methods D4052, D1480, and D1217.

Dynamic viscosity (η) in mPa•s was generally determined by measuring the kinematic viscosity and multiplying it by the density at the same temperature [$\eta = \nu \bullet \rho$]. In some cases, dynamic viscosity was measured directly using Cannon-Manning Vacuum laboratory standard viscometers. See ASTM method D2171.

Where appropriate, the kinematic viscosity, dynamic viscosity, or density at certain temperatures was determined through regression of all measured data using industry standard equations. These equations include the linear or quadratic viscosity/density-temperature equation derived from the ASTM viscosity–temperature charts for petroleum products as well as the NBS viscosity-temperature equation for petroleum products. See ASTM method D341 and NBS equation. Saybolt viscosity in Saybolt Universal Seconds (SUS) and in Saybolt Furol Seconds (SFS) was determined through mathematical conversion of measured kinematic viscosities in mm^2/s. See ASTM method D2161.

Traceability

All data are traceable to intrinsic standards and National Institute of Standards and Technology (NIST) calibration or calculated by ASTM or NIST methods. Kinematic viscosity values are traceable to the viscosity of water. Temperature measurements were conducted with SPRTs that have NIST traceable fixed-point calibrations. A complete traceability statement is available for purchase from Cannon Instrument Company.

Uncertainty

Cannon Instrument Company has determined and reported the uncertainty for the provided certification, which includes contributions for the measurement system, bottle-to-bottle variability due to standard homogeneity, and long-term standard stability throughout shelf life. The expanded uncertainties at the 95% confidence interval are as follows:

Kinematic Viscosity (-40 °C to 150 °C)

Range of Kinematic Viscosity (mm^2/s)	Expanded Uncertainty* (%) at Temperatures		
	<15 °C	15 to 45 °C	>45 °C
<10	0.21	0.16	0.21
10-100	0.26	0.22	0.26
100-1000	0.32	0.29	0.32
1000-10,000	0.47	0.38	0.38
10,000-150,000	0.53	0.44	0.48

Density (-56 °C to 150 °C)

Range of Density g/cm^3	Expanded Uncertainty* kg/m^3
0.7 – 1.2	0.05

**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[2].*

The expanded uncertainty for dynamic viscosity can be considered equivalent to the expanded uncertainty for kinematic viscosity since the uncertainty contribution of the density measurement is deemed negligible in the calculation of the total expanded uncertainty.

BOTTLED BY
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Tested and certified in the USA. Certification under supervision of:

Laboratory Technical Director: Joseph T. Mastropierro
Joseph T. Mastropierro

Vice President of QA and Technical Services:
M.T. Zubler

[1]Swindells, JF, RC Hardy, and RL Cottington. "Precise Measurements With Bingham Viscometers and Cannon Master Viscometers." *Journal of Research of the National Bureau of Standards* 52, no. 3 (March 1954): 105–20. https://doi.org/https://nvlpubs.nist.gov/nistpubs/jres/52/jresv52n3p105_A1b.pdf.
[2]Taylor, Barry N., and Chris E. Kuyatt. "NIST Technical Note 1297." NIST, November 25, 2019. https://www.nist.gov/pml/nist-technical-note-1297.

