CANNON INSTRUMENT COMPANY

CERTIFICATE OF ANALYSIS

CANNON® CERTIFIED VISCOSITY/DENSITY TESTING SERVICE					
Sample ID: PMX200-500cSt		Lot Number: H054N11013			
Certification/Issue Date: 06/29/2023					
Temperature		Kinematic Viscosity	Dynamic Viscosity	Density	
°C	°F	mm^2/s (cSt)	mPa•s (cP)	g/cm^3 (g/mL)	
20.00	68.00	543.5	528.8	0.9730	
25.00	77.00	491.0	475.5	0.9685	
30.00	86.00	445.5	429.5	0.9640	
35.00	95.00	406.6	390.1	0.9596	
40.00	104.00	371.6	354.9	0.9552	

GENERAL INFORMATION

Sample Condition

The sample was received at Cannon Instrument Company in good condition, unless otherwise noted or communicated to the customer.

Specific Testing Conducted

The received sample was tested as specified in the customer agreement with Cannon Instrument Company.

Sampling Plan and Procedures

Aliquots for testing were taken from the received sample in accordance with the test procedures. The requested test procedures were followed with no additions, exclusions, or deviations.

Validity of Test Results

The sample was tested as received and the results were valid at the time of testing. Cannon Instrument Company makes no guarantee as to the period of validity of the data for the tested sample, since the material's stability and shelf life is unknown. The test results relate only to the provided sample and there is no representation that it applies to similar materials or the remainder of the batch from which it was taken.

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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 (v) measurements in mm^2/s at the requested test temperatures were generally made using Cannon-Ubbelohde laboratory standard viscometers, as described in ASTM methods D445 and D446.

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 [$\eta = v \bullet \rho$]. 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 as appropriate 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.

Measurement Uncertainty

Cannon Instrument Company has determined and reported the measurement uncertainty of its laboratory capabilities. 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.

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
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.

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