CANNON INSTRUMENT COMPANY®
2139 High Tech Road
State College, PA 16803
814-353-8000 • 800-676-6232 • Fax 814-353-8007
sales@cannoninstrument.com
www.cannoninstrument.com

Item 1640

CERTIFICATE OF ANALYSIS

CANNON® CERTIFIED VISCOSITY REFERENCE STANDARD

Viscosity Standard: **C350** *Lot Number:* **16301**

Certification/Issue Date: **09/28/2016** *Expiry Date:* **09/30/2018**

Kinematic Viscosity @ 20 °C	Kinematic Viscosity @ 23 °C	Kinematic Viscosity @ 25 °C
mm2/s (cSt)	mm2/s (cSt)	mm2/s (cSt)
1,011	834.9	737.7

Flow Cup Designation	Flow Cup Size	Flow Time @ 20 °C seconds	Flow Time @ 23 °C seconds	Flow Time @ 25 °C seconds
Zahn	4	------	61.41	54.85
Zahn	5	43.96	36.30	32.08
Ford	5	------	71.00	62.97
Shell	6	62.91	52.04	46.04

Tested and certified in the U.S.A.

USAGE INFORMATION[1]

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 flow cup viscometers. 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 temperatures 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: ***Poly-Alpha-Olefin (100%)*** **[CAS#(s)** ***68037-01-4*****]**. Consult MSDS 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.

Certification Under Supervision of:
D.B. Trowbridge, Ph.D.
J.T. Mastropierro
M.T. Zubler

ISO/IEC 17025
ilac-MRA A2LA ACCREDITED Calibration Laboratory CERT#1262.01

The inclusion of the A2LA and ILAC MRA logos does not imply certification/approval of the products calibrated or tested.

ISO 9001
Registered by UL-DQS #10002540 QM

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DISCUSSION OF DATA[1]

Derivation of Certified Values: CANNON Instrument Company certifies that the kinematic viscosities were determined by the Master Viscometer technique reported in the Journal of Research of the National Bureau of Standards, (Vol. 52, No. 3, March 1954, Research Paper 2479) 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.

The kinematic viscosity at temperatures between 20 and 25 °C 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.

Viscosity cup flow times were calculated using the equations referenced in Table 1.

TABLE 1

Cup No.	Equation	Flow Time Limitation (s)		Cup No.	Equation	Flow Time Limitation (s)	
		Min.	Max			Min.	Max.
	Source: ISO 2431				**Source: DIN 53211**		
ISO 3 mm	mm^2/s (cSt) = 0.443 t - 200/ t	30	100	DIN 4	mm^2/s (cSt) = 4.57 t - 452/ t	30	110
ISO 4 mm	mm^2/s (cSt) = 1.37 t - 200/ t	30	100				
ISO 6 mm	mm^2/s (cSt) = 6.90 t - 570/ t	30	100				
	Source: ASTM D1200#				**Source: ASTM D4212#**		
Ford No. 1	mm^2/s (cSt) = 0.49 (t - 35.0)	55	100	Zahn No. 1	mm^2/s (cSt) = 1.1 (t - 29)	35	80
Ford No. 2	mm^2/s (cSt) = 1.44 (t - 18.0)	20	100	Zahn No. 2	mm^2/s (cSt) = 3.5 (t - 14)	20	80
Ford No. 3	mm^2/s (cSt) = 2.31 (t - 6.58)	20	100	Zahn No. 3	mm^2/s (cSt) = 11.7 (t - 7.5)	20	80
Ford No. 4	mm^2/s (cSt) = 3.85 (t - 4.49)	20	100	Zahn No. 4	mm^2/s (cSt) = 14.8 (t - 5)	20	80
Ford No. 5	mm^2/s (cSt) = 12.1 (t - 2.00)	20	100	Zahn No. 5	mm^2/s (cSt) = 23 t	20	80
	Source: ASTM D4212#				**Source ASTM D4212#**		
Shell No. 1	mm^2/s (cSt) = 0.226 (t - 13)	20	80	Shell No. 3 ½	mm^2/s (cSt) = 2.17 (t - 1.5)	20	80
Shell No. 2	mm^2/s (cSt) = 0.576 (t - 5)	20	80	Shell No. 4	mm^2/s (cSt) = 3.45 (t - 1)	20	80
Shell No. 2 ½	mm^2/s (cSt) = 0.925 (t - 3)	20	80	Shell No. 5	mm^2/s (cSt) = 6.5 (t - 1)	20	80
Shell No. 3	mm^2/s (cSt) = 1.51 (t - 2)	20	80	Shell No. 6	mm^2/s (cSt) = 16.2 (t - 0.5)	20	80

#The form of the equations used in ASTM D1200 and ASTM D4212 is not of the preferred form (kin vis = Ct - B/t), and may lead to significant errors especially at the minimum flow times.

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 of the laboratory measurements summarized at the 95% confidence interval are as follows:

Kinematic Viscosity (15 °C to 45 °C)

Range of Kinematic Viscosity (mm^2/s)	Expanded Uncertainty* (%)
<10	0.16
10-100	0.22
100-1000	0.29
1000-10,000	0.38

** 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.*

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

[1]*Consult www.cannoninstrument.com for additional information.*