CANNON® Catalog
2007-2008

Innovations in Viscosity Measurement

CANNON INSTRUMENT COMPANY®

CANNON®

miniAV® Automatic Viscometer

Save Space—Save Time—Save Money!

It's finally here — true ASTM D 445 automation at a price guaranteed to make your lab manager smile. The new miniAV® from CANNON Instrument Company offers an exciting new tool for convenient and highly accurate kinematic viscosity (Kin Vis) measurement.

Occupying roughly the same footprint as a tabletop rotational viscometer, the benchtop miniAV automates the time-consuming sample measurement and viscometer tube wash/dry procedures associated with the ASTM D 445 method, freeing the laboratory technician for other duties. The miniAV provides a convenient first step toward full laboratory automation.

See page14 for more details about this exciting new addition to our automated viscometer line.

New Mini-Rotary Viscometer Design!

The new CANNON Mini-Rotary Viscometer model CMRV-5000 provides a high level of benchtop performance in a sleek, self-contained, thermoelectrically maintained system. No accessory refrigeration units or heat exchangers are required for this innovative redesign of the reliable CANNON Mini-Rotary Viscometer series. See page 56.

SAE J300 "Viscosity Check Oils" Now Available

CANNON Instrument Company has released a new line of viscosity check oils specifically designed for verification of SAE target viscosities per ASTM D 445, D 5293, and D 4684. These oils enable users to "check" the performance of their Cold-Cranking Simulator, Mini-Rotary Viscometer, and Kinematic Viscometers by measuring commercially-available formulated engine oils. See page 43.

Table of Contents

CANNON® Commitment to Quality & to You!

Since its founding in 1938 by scientist, inventor and educator Dr. Michael R. Cannon, CANNON Instrument Company has earned international acclaim for the quality of its viscosity-related products and services. The company's longstanding emphasis on production of premiere-quality test equipment has kept CANNON at the cutting edge of research and development for viscosity instrumentation serving a variety of industries.

Customer Satisfaction

Our staff maintains professional contact with industry experts in the fields of petroleum and petrochemicals, polymers, asphalt and paving, and many other areas. We also maintain a presence at national and international conferences and exhibitions serving our customers. Our quality processes and our company quality policy and mission statements emphasize our ongoing commitment to customer satisfaction.

CANNON Instrument Company is committed to quality excellence by:

- Working as a team, along with customers and suppliers
- We will ensure quality and pride in our products and services
- Through our positive attitude, commitment and experience.

It is CANNON Instrument Company's quality policy and mission to:

- Provide goods and services that consistently meet or exceed our customer expectations.
- Actively pursue constant improvement through programs that enable every employee to do his or her job right, the first time and every time.

Quality Assurance

CANNON-manufactured instruments are designed to meet and exceed specifications required by organizations including ASTM, the Society of Automotive Engineers (SAE), and the American Association of State Highway Transportation Officials (AASHTO). Our ongoing international development efforts have resulted in CE certification for a number of our products. Our internationally-recognized excellence in calibration has resulted in our unique standing as a NIST delegate for U.S. national standards for certified liquid viscosity reference materials.

ISO 9001:2000 Registration/Certification

CANNON's testing laboratory is ISO 9001:2000 certified through Underwriters Laboratories.

CANNON Instrument Company is ISO 9001:2000 registered with respect to the following products and services:

- SIC CODE 3823 (US): Industrial Instruments for Measurement, Display, and Control of Process Variables; and Related Products.
- The manufacture and certification of viscosity standards and the viscosity certification of customer-supplied materials.
- The provision of calibration services for viscometers and kinematic viscosity thermometers.

A2LA Accreditation

The American Association for Laboratory Accreditation, an original signatory of the ILAC Mutual Recognition Agreement, has accredited CANNON Instrument Company for technical competence in the field of calibration (certificate number 1262.01). The accreditation covers the calibration of glass capillary viscometers, the determination of kinematic and dynamic viscosity (including that of viscosity standards and the viscosity certification of customer samples), and the provision of calibration services for viscometers and kinematic viscosity thermometers in accordance with ISO/IEC 17025-1999.

CE Mark Certification

CANNON has been granted CE mark certification for several instruments. These instruments are indicated in this catalog with the "CE" designation. We are actively pursuing CE mark certification for additional products. Please contact CANNON Instrument Company if you have questions regarding the CE mark status of any CANNON product.

How To Contact Us

Our order entry personnel will be happy to assist you in placing your order. Please contact us during our regular business hours, 8:00 a.m. to 5:00 p.m., EST, Monday through Friday for phone orders. Orders for many products may also be placed at any time from the CANNON website.

Phone: 814-353-8000 or 800-676-6232
Fax: 814-353-8007
Email: cannon@cannoninstrument.com
Website: www.cannoninstrument.com
Mail: CANNON Instrument Company
2139 High Tech Road
State College, Pennsylvania 16803

Terms & Payments

Terms are net 30 days for qualified customers. As a service to our customers, CANNON accepts orders payable with American Express, MasterCard, Visa, and Discover credit cards. When placing your order, be prepared to provide the credit card type, number, expiration date, name to whom the credit card is assigned, and the three- or four-digit credit card security code.

Payments by check must be made to CANNON Instrument Company in U.S. dollars, and must be drawn on a U.S. Bank.

We also accept payments via electronic funds transfer. To initiate electronic payment, forward your corporate forms to the attention of our Controller.

A hazardous material charge of $25.00 per shipment will be added to normal shipping charges for applicable products including mercury thermometers, Nochromix®, viscosity standards/flash points reference materials with lower flash and certain other equipment items.

International Payments

Payment by customers outside the United States may also be made through either a U.S. dollar draft, wire transfer, or a confirmed irrevocable letter of credit on a U.S. bank, preferably Wachovia Bank N. A. Other terms may be arranged after credit responsibility has been established.

Prices are quoted in U.S. dollars and are subject to change without notice.

Shipping/Adjustments

If goods are broken or damaged in transit, we will adjust the claim, regardless of who is at fault.

For domestic shipment claims, if the damage is $100.00 or less, please report it directly to us and we will handle the adjustment. If the damage is valued at more than $100.00, you must retain the original shipping carton and notify the carrier within 15 days, then send us your claim along with a copy of the inspection report prepared by the carrier's agent.

We insure all export shipments (unless you specifically instruct us not to) against "all risks," including breakage. All wood packaging materials are ISPM 15 compliant. If goods insured through CANNON are damaged or lost during shipment, please notify us and we will make the adjustment directly. If insured by the customer, the adjustment may be made through the local agent of the customer's insurance company.

Use of Products

Warning: The products, reagents and chemicals listed in this catalog are for sale primarily to commercial, industrial, medical and educational institutions, for use by professionals or under the supervision of professionals. Where the manufacturer has provided instructions as to the use of a product, those instructions should be followed to ensure safe use. Certain items may be dangerous unless used by trained technical personnel or under their supervision.

The reagents and chemicals listed in this catalog are not intended for use as foods, drugs or cosmetics, or as components or ingredients in their preparation. Furthermore, these reagents and chemicals are not for sale to consumers for personal or household purposes.

Installation/Training

Installation and training by CANNON personnel are not required for any product listed in this catalog, with the exception of the CANNON Automatic Viscometer (CAV) and PolyVISC models. Pricing for these instruments is quoted upon request and includes installation and training as noted on the quotation.

Returned Goods

Before returning goods, please contact CANNON for a Receiving Authorization (RA) number. Received goods containing hazardous materials MUST be properly classified, packaged, marked and labelled in accordance with all applicable shipping regulations. Contact CANNON for assistance if needed. CANNON reserves the right to return to the sender, freight collect, any goods shipped to CANNON without authorization. If you intend to return goods, please contact us as soon as possible after you receive them. Goods which are not returnable include items not purchased from us and, generally, items which have been customized, modified, dated, or mutilated.

Returned goods may be subject to a restocking fee of 25%.

Returned goods should be addressed to:

CANNON Instrument Company
2139 High Tech Road
State College, PA 16803 USA

Please include the Receiving Authorization number on the shipping label.

Manufacturers' Limited Warranties

Products Limited Warranty

CANNON Instrument Company ("the Company") carries products from a variety of distinguished manufacturers. The manufacturers of products cataloged by us have been chosen on the basis of the Company's belief that their products meet the Company's rigorous specifications and standards. Statements made in this catalog regarding these products' specifications, standards and suitability for a particular use are made to the best of the Company's knowledge.

Most products are warranted by their manufacturers, and the terms of such warranties will be supplied with the products.

In addition to manufacturers' warrantees, CANNON Instrument Company ("the Company") warrants all products (other than reagents and chemicals) delivered to and retained by their original purchasers to be free from defect in materials and workmanship for one year from the date of the Company's invoice to the purchaser. For a period of one year from the date of such invoice, the Company will correct, either by repair or replacement at the Company's sole election, any defect in material or workmanship (not including defects due to misuse, abuse, abnormal conditions or operation, accidents or acts of God, or to service or modification of the product without prior authorization of the Company) without charge for labor, parts or shipment of the product to and from the service facility designated by the Company. The determination of whether any product has been subject to misuse or abuse will be made solely by the Company.

Reagent and Chemical Warranty

CANNON Instrument Company ("the Company") warrants all reagents and chemicals sold by the Company and delivered to and retained by their original purchasers to conform to the weight, specifications and standards stated on the package. The Company will, at its sole option, either replace or refund the price (net of freight, handling charges and taxes), of any reagent or chemical sold by the Company which does not conform to such weight, specifications and standards upon the prompt return of the unused portion. Except for replacement or refund of the net price, the Company shall not be liable for any damages occurring as a consequence of the failure of any reagent or chemical sold by the Company to conform to the weight, specifications and standards stated on the package.

Statements made in this catalog regarding the suitability of a reagent or chemical for a particular use are made to the best of the Company's knowledge. However, with the exception of the Company's viscosity standards, the Company has not independently tested these products or verified their suitability for a particular use. No representations or warranties are made concerning the suitability of any reagent or chemical for a particular use, and the Company shall not be liable for any damages occurring as a consequence of the failure of a reagent or chemical to be suitable for a particular use.

Limited Liability Notice

CANNON Instrument Company agrees to repair or replace our products for a period of one year. In exchange, we will not be responsible for any consequential damages.

The foregoing warranties are in lieu of all other warranties, guarantees, or representations, whether oral, written, or implied, including any warranty of merchantability or fitness for use of purpose.

Representations and warranties made by any person, including dealers and representatives of the Company, which are inconsistent, in conflict with or in excess of the terms of the foregoing warranties shall not be binding upon the Company unless placed in writing and approved by an authorized officer of the Company.

The Company shall not be liable for any special, incidental, or consequential damages, or any damage to plant, personnel, equipment or products, directly or indirectly resulting from the use or misuse of any product, reagent or chemical sold by the Company except as set forth in and limited by the foregoing warranties.

The Company's liability under the foregoing warranties (including liability for negligence or otherwise in tort) is limited exclusively to the remedies provided herein and no other right or remedy shall be available to any person.

The Company shall not be liable for any delay in performance under the foregoing warranties caused by any contingency beyond the Company's control, including war, government restrictions, strikes, acts of God or reduced supply of materials.

The foregoing warranties and all claims hereunder shall be governed by the laws of the Commonwealth of Pennsylvania, United States of America.

Introduction to Viscosity Measurement

Kinematic viscosity is easily determined in glass capillary viscometers which measure the time required for a fixed volume of liquid to flow through a capillary under gravity.

When the kinematic viscosity and density of a fluid are known at a given temperature, the viscosity of the fluid at that temperature can be calculated using the following simple equation:

viscosity = kinematic viscosity x density

The unit of viscosity is the poise or centipoise (cP) in the cgs system of units, and the pascal-second (Pa•s) or mPa•s in SI units.

The unit of kinematic viscosity is the stokes (St) or centistokes (cSt) in the traditional cgs system of units, and meters squared per second (m^2/s) or mm^2/s in SI metric units.

Although SI units are preferred, no confusion is caused by the use of either system because centipoise and mPa•s are numerically equal, and centistokes and mm^2/s are also equal.

Viscosity Conversion Table

Viscosity		Kinematic Viscosity	
Traditional cgs Unit :	poise (P) 1 centipoise (cP) = 0.01 poise	Traditional cgs Unit:	stokes (St) 1 centistokes (cSt) = 0.01 stokes
SI Metric Unit:	pascal second (Pa·s)	Metric Unit:	square metres per second (m^2/s)
Conversion Factors:	1 P = 0.1 Pa·s 1 Pa·s = 10 P 1 cP = 0.001 Pa·s = 1 mPa·s 1 Pa·s = 1000 cP	Conversion Factors:	1 St = 1 x 10^{-4} m^2/s 1 m^2/s = 10 000 St 1 cSt = 1 x 10^{-6} m^2/s = 1 mm^2/s 1 m^2/s = 1 000 000 cSt

Viscosity in centipoise = kinematic viscosity in centistokes x density of fluid being measured, all measured at the same temperature.

ASTM Test Method Quick Reference Chart

Specification	Test Instrument(s)	Pages	Test Description
ASTM D 36	Tanaka ASP-5	63	Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
ASTM D 56	Tanaka ATG-7	63	Test Method for Flash Point by Tag Closed Tester
ASTM D 86	Tanaka AD-6	64	Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure
ASTM D 93/IP34/ ISO 2719	Tanaka APM-7	64	Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
ASTM D 97	Tanaka MPC-102/MPC-302/MPC-602 Tanaka MPC-102A/L	64 64	Test Method for Pour Point of Petroleum Products
ASTM D 156	Tanaka ACL-2	63	Standard Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method)
ASTM D 189	Tanaka ACR-6	65	Standard Test Method for Conradson Carbon Residue of Petroleum Products
ASTM D 244	Digital Paddle Viscometer	50	Standard Test Methods and Practices for Emulsified Asphalts
ASTM D 323	Tanaka AVP-30D	66	Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method)
ASTM D 445* and ISO 3104	Glass Capillary Viscometers Automatic Viscometer (CAV 2000 Series) PolyVISC Viscosity Standards	24-37 6-7, 14 12 42-49	Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the calculation of Dynamic Viscosity)
ASTM D 446 and ISO 3105	Glass Capillary Viscometers Automatic Viscometers (incl. CAV 2000 Series) PolyVISC	24-37 6-7, 14 8-9	Standard Specifications and Operating Instructions for Glass Capillary Kinematic Viscometers
ASTM D 611 and ISO 2977	Tanaka AAP-5	64	Standard Test Methods for Aniline Point of Petroleum Products and Hydrocarbon Solvents
ASTM D 850	Tanaka AD-6	64	Standard Test Method for Distillation of Industrial Aromatic Hydrocarbons and Related Materials
ASTM D 1078	Tanaka AD-6	64	Standard Test Method for Distillation Range of Volatile Organic Liquids

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ASTM Test Method Quick Reference Chart (continued)

Specification	Test Instrument(s)	Pages	Test Description
ASTM D 1200	Ford Cup	69	Standard Test Method for Viscosity by Ford Viscosity Cup
ASTM D 1209	Tanaka ASP-5	63	Standard Test Method for Color of Clear Liquids (Platinum-Cobalt Scale)
ASTM D 1500	Tanaka ACL-2	63	Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)
ASTM D 1544	Tanaka ACL-2	63	Standard Test Method for Color of Transparent Liquids (Gardner Color Scale)
ASTM D 2500	Tanaka MPC-102A/L	64	Standard Test Method for Cloud Point of Petroleum Products
ASTM D 2622 and ISO 20884	WDXRF Sulfur Analyzer FX-700	66	Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry
ASTM D 2170	Glass Capillary Viscometers for Asphalt applications	26, 32, 35	Standard Test Method for Kinematic Viscosity of Asphalts
ASTM D 2171	Glass Capillary Viscometers for Asphalt applications	36-37	Standard Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer
ASTM D 2857	PolyVISC	12	Standard Practice for Dilute Solution Viscosity of Polymers
ASTM D 2892	Pro-Pak® Distillation Packing	61	Standard Test Method for Distillation of Crude Petroleum (15-Theoretical Plate Column)
ASTM D 3829*	CANNON Mini-Rotary Viscometer	56-57	Standard Test Method for Predicting the Borderline Pumping Temperature of Engine Oil
ASTM D 4212	Zahn Cup	69	Standard Test Method for Viscosity by Dip-Type Viscosity Cups
ASTM D 4294	Tanaka RX-360SH Sulfur Meter	65	Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectrometry
ATSM D 4741	Ravenfield "Tapered Plug" HTHS	53	Standard Test Method for Measuring Viscosity at High Temperature and High Shear Rate by Tapered-Plug Viscometer
ASTM D 4684*	CANNON Mini-Rotary Viscometer	56-57	Standard Test Method for Determination of Yield Stress and Aparent Viscosity of Engine Oils at Low Temperature
ASTM D 5125 and ISO 2431	ISO Cup	69	Standard Test Method for Viscosity of Paints and Related Materials by ISO Flow Cups
ASTM D 5293*	Cold-Cranking Simulator CCS-2100/2050	54-55	Standard Test Method for Apparent Viscosity of Engine Oils Between –5 and –35°C Using the Cold-Cranking Simulator
ASTM D 5481*	High Temperature High Shear Viscometer (HTHS)	53	Standard Test Method for Measuring Apparent Viscosity at High Temperature and High-Shear Rate by Multicell Capillary Viscometer
ASTM D 6045	Tanaka ACL-2	64	Standard Test Method for Color of Petroleum Products by the Automatic Tristimulus Method
ASTM D 6371 and IP 309	AFP-102/AFP-202	65	Standard Test Method for Cold Filter Plugging Point of Diesel and Heating Fuels
ASTM D 6648-01	Thermoelectric Bending-Beam Rheometer (TE-BBR)	58	Test Method for Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending-Beam Rheometer
ASTM D 6749	Tanaka MPC-102A/L	64	Standard Test Method for Pour Point of Petroleum Products (Automatic Air Pressure Method)
ASTM D 6821	Cannon CMRV-5000 and CMRV-4500 Mini-Rotary Viscometers	56-57	Standard Test Method for Low Temperature Viscosity of Drive Line Lubricants in a Constant Shear Stress Viscometer
ASTM D 6896	Cannon CMRV-5000 and CMRV-4500 Mini-Rotary Viscometers	56-57	Standard Test Method for Determination of Yield Stress and Apparent Viscosity of Used Engine Oils at Low Temperature
ASTM D 7060	Zematra ASA Automated Stability Analyzer	68	Standard Test Method for Determination of the Maximum Flocculation Ratio and Peptizing Power in Residual and Heavy Fuel Oils (Optical Detection Method)
ASTM D 7226	Digital Paddle Viscometer	50	Standard Test Method for Determining the Viscosity of Emulsified Asphalts Using a Rotational Paddle Viscometer
ASTM E 77	Thermometers	40-41	Standard Test Method for Inspection and Verification of Thermometers

* Referenced in SAE J300 Rev. DEC99

CANNON® CAV 2000 Series Automatic Viscometers

ASTM D 445, ISO 3104, IP 71, ASTM D 446, ISO 3105

- Modular Benchtop Unit (Small Footprint)
- Variable Temperature Selection from 20°C to 100°C (150°C with High-Temperature Option)
- Viscosity Range of 0.5 to 5000 cSt*
- ASTM D 445 Precision
- Powerful VISCPRO® for Windows® 98, 2000, NT, and XP® Software
- CE Marked for Safe, Reliable Performance

*Special viscometers with ranges up to 10,000 cSt are available upon request

The CANNON 2000 Series automatic viscometers are benchtop versions of the original CANNON Automatic Viscometer (CAV), the world's leading automatic viscometer for nearly 30 years, used by most major companies in the petroleum industry. 2000 Series instruments are now available in two models. The CAV-2100® features a single-bath modular construction with two viscometers per bath. The CAV-2200® features a dual-bath modular construction with a single viscometer in each bath. Most other specifications are identical for both models.

Capability

Designed for unattended operation, each CAV 2000 Series viscometer provides fully automatic kinematic viscosity testing within parameters specified by ASTM D 445. The CAV 2000 Series instruments measure flow rates within ±0.001 second by electronically timing the liquid meniscus as it moves between thermistor sensors. Bath temperature is controlled to an accuracy better than ±0.01°C at any selected temperature between 20°C and 100°C, and an accuracy better than ±0.03°C between 100°C and 150°C (high-temperature option required above 100°C), exceeding the precision requirements of ASTM D 445. Dark or opaque liquids may be measured with the same precision as transparent liquids.

Modularity

An outstanding feature of the CAV 2000 Series viscometers is modularity. A CAV 2000 Series instrument consists of: 1) one to four single- or dual-Bath Units, 2) a Service Unit (regulates vacuum/pressure and solvent flow), and 3) a Solvent Dispensing Unit for use with the customer's pressureless solvent vessel. As many as four single- or dual-Bath Units may be connected to a single Service Unit and Solvent Dispensing Unit, and IBM®-compatible computer. A laboratory may begin operating with a single Bath Unit containing two viscometers, then add additional Bath Units as the work load increases. The Multi-Unit Interface Kit included with the CAV 2000 Series allows two, three, or four bath units to be connected to a single PC computer.

Viscometer Tubes

All standard CAV 2000 Series viscometer tubes accurately measure kinematic viscosity over a 100-fold kinematic viscosity range (e.g., 1 to 100 cSt, 6 to 600 cSt, etc.). A kinematic viscosity range of 0.5 to 5000 cSt can be obtained within a single Bath Unit by selecting two viscometers with complementary viscosity ranges. (see table on page 8 for available tube sizes). Fast-run tubes (10-fold range) are also available for time-critical and/or high-throughput applications.

Sample-Handling

CANNON Instrument Company was the first to provide fully-automatic sample-handling for multiple-sample kinematic viscosity testing. Our pneumatic system is proven and safe (no complicated gears or electric motors), and so robust that original CAV instruments over 20 years old are still in use today. The CANNON quest for more efficient automatic sample-handling capability has generated a host of high performance options including 10-, 13-, 20- and 50-position sample trays, a Solo® Cup test option, plastic and glass sample vials, small-volume (4-5 mL) sample vials and adapters, heated sample trays, and other enhancements (see CAV Accessories & Options, pages 8-10). The standard unheated 13-position sample trays allow the operator to load up to 13 samples per viscometer tube for unattended operation. A sample quantity of approximately 12 mL is required for single or double determinations using standard-size sample vials. Throughput for each bath is up to 8 samples per hour for each standard viscometer tube, and up to 12-15 samples per hour per tube for optional Fast-Run viscometer tubes, depending on sample viscosity and user-configurable test and wash settings. A single instrument can now test up to 100 samples without operator input!

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CANNON® CAV 2000 Series Automatic Viscometers

ASTM D 445, ISO 3104, IP 71, ASTM D 446, ISO 3105

VISCPRO® Software

VISCPRO software for Windows® 98, 2000, NT, and XP® automates multiple sample testing for the CAV. With VISCPRO you can save and restore multiple instrument configurations and/or sample ID information with a few mouse clicks. Three security levels help to protect against inadvertent changes in instrument configuration or sample testing procedures. The VISCPRO software also includes configurable security features unavailable in previous DOS and Windows® versions. As VISCPRO controls the CAV, test data is written to a Microsoft® Access® database file. The software provides user-configurable reports which can be used to retrieve selected information from the database. Analyses can be displayed on the computer screen, printed, saved to an ASCII file or transmitted to the user's Laboratory Information Management System (LIMS) via a serial connection. VISCPRO is shipped with a companion program, the Database Manager, which provides convenient and powerful functions for managing and archiving database data. User-friendly Help files simplify the operation of VISCPRO.

Safety

The CAV 2000 Series incorporates many new safety features, including dual over-temperature fault circuits for each bath. A fluid level float built into the bath prevents the heating elements from operating when they are uncovered. All of the bath fluid expansion from cold-fill to 150°C is contained within the bath (CAV-2200) or an internal expansion vessel (CAV-2100). An electrical/pneumatic interlock on the solvent waste receiver prevents solvent dispensing with the drain disengaged. The confined sample area and integral vent manifold allows for efficient solvent vapor/fumes extraction. A dual-pane exterior window insulates the warm bath and isolates it from the user. Heated drain lines are now standard on all CAV 2000 Series automatic viscometers.

Required Equipment and Utilities (not provided by CANNON)

- Computer (contact CANNON for current specifications)
- 115V AC, 20 amp circuit or 230V AC, 10 amp circuit (depending on model number)
- External exhaust fan for solvent vapors (4-inch diameter hose connection on instrument)
- External compressed air supply (60 psi, 414 kPa) (low flow)
- Pressureless solvent vessel for use with the Solvent Dispensing Unit
- Nitrogen source for tube drying (if desired)

External cooling water chiller with built-in circulating pump (not required for CAV operation at temperatures higher than 10°C above ambient.)

CAV-2200's Twin Bath with Optional Heated Sample Trays

CAV 2000 Series Specifications

Bath Unit Dimensions:	305 mm wide x 1016 mm deep x 1245 mm high (12x40x49")
Service Unit Dimensions:	178 mm wide x 508 mm deep x 356 mm high (7x20x14")
Solvent Dispensing Unit Dimensions:	178 mm wide x 508 mm deep x 356 mm high (7x20x14")
Viscosity Range:	0.5 to 5000 cSt depending on viscometer tubes
Bath Temperature:	Variable from 20°C to 100°C with an accuracy better than ± 0.01°C. High temperature bath option (up to 150°C, ± 0.03°C) available by request.
Drop Time Resolution:	0.01 seconds (timing accuracy to ±0.001 second)
Operating Conditions:	10%-90% RH non-condensing. Installation category II; Pollution degree 2
Compliance:	CE Mark: EMC directive (89/336/EEC); Low voltage directive (73/23/EEC); HI-POT (1900 VDC, 60 sec.)
Preferred Bench Height:	28 to 30 inches
Computer:	Contact CANNON Instrument Company for current specifications and an installation guide detailing space, equipment and utility requirements.

CAV 2000 Series Order Information

Catalog #	*Item Description*
9725-A05	CAV-2100, 115 volts AC, 50/60 Hz, 1650W
9725-A07	CAV-2200, 115 volts AC, 50/60 Hz, 1650W
9725-A10	CAV-2100F, 230 volts AC, 50/60 Hz, 1750W
9725-A12	CAV-2200F, 230 volts AC, 50/60 Hz, 1750W
9725-A15	CAV-2100, 100 volts AC, 50/60 Hz, 1750W
9725-A17	CAV-2200, 100 volts AC, 50/60 Hz, 1750W

* Please specify exact voltage and frequency when ordering

CANNON® CAV 2000 Series Automatic Viscometers

ASTM D 445, ISO 3104, IP 71, ASTM D 446, ISO 3105

Functionality

The CAV 2000 Series has two modes of operation: 1) normal (remote) mode, providing fully-automatic computer-controlled operation using VISCPRO® software forWindows® 98, 2000, NT, and XP®; and 2) local mode, using instrument panel keypad commands for single drop flow time and kinematic viscosity determinations. Local mode does not require the use of a computer and is particularly useful in diagnostic work.

The temperature of the CAV 2000 Series bath is monitored by a thin-film RTD sensor and displayed on the front panel. The CAV-2100 includes a "quiet" stirred bath design while the CAV-2200 provides pump circulation of bath fluid; both systems permit rapid temperature recovery during tube washing and when changing from one test temperature to another. A self-training tube sensor level detection circuit eliminates the need for manual adjustments.

Calibration of the CAV 2000 Series viscometer tubes is simple – tubes can be calibrated from stored test data without interrupting regular testing. VISCPRO automatically incorporates calibration results into its calculations. Serviceability of the CAV 2000 Series viscometers is unparalleled in the industry.

Typical CANNON Automatic Viscometer Applications

- Used oil analysis
- Base stock analysis
- Additive analysis
- Fully-formulated oil analysis
- Marine fuel testing
- Crude oil testing
- Hydraulic oil testing
- Light and heavy fuel testing

Industries Served

- Refinery quality control laboratories
- Refinery satellite laboratories
- Research & development laboratories
- Lube oil blending and packaging facilities
- Oil analysis laboratories
- Engine manufacturers
- Transmission manufacturers
- Railroads
- Marine shipping lines
- Power companies
- Chemical companies
- Distribution terminals
- Grease manufacturers
- Manufacturing companies utilizing hydraulic robotics

Available CAV 2000 Series Tube Sizes

Standard Tubes	*Fast-Run Tubes*
Kinematic Viscosity Range*	
.5-50	–
1-100	1-10
2-200	2-20
3-300	3-30
4-400	4-40
5-500	5-50
6-600	6-60
7-700	7-70
8-800	8-80
10-1000	10-100
15-1500	15-150
20-2000	20-200
30-3000	30-300
40-4000	50-500

Other tube sizes available by special order.
*mm^2/s (centistokes)

CAV 2000 Series Accessories

High Capacity Sample Track

High Capacity Sample Track

The High Capacity Sample Track provides for throughput of up to 50 samples per viscometer tube for a total of 100 samples per CAV bath. This "caterpillar track" design is recommended for high-throughput facilities where it is desirable to test more than 13 samples per viscometer tube. With fast-run tubes, the CAV can test 100 samples in under seven hours with a single loading and fully automatic, unattended operation. With regular viscometer tubes, a complete test sequence takes less than a day. Sample Tracks replace the two 13 cup Standard Sample Trays in the basic CAV package.

Pedestal Base

Pedestal Base

The Pedestal Base permits floor-standing installation of the benchtop CAV at an ideal height for operation. The pedestal will support either one or two CAV bath units along with one service unit. The lightweight aluminum frame is of all-welded construction and is coated with a solvent-resistant epoxy powder-coat finish. The Pedestal Base is supplied with four adjustable leveling feet and all necessary mounting hardware for two bath units. Also included are four 3" (76-mm) diameter locking swivel-type casters that can be installed in place of the standard leveling feet. These casters allow easier movement of the CAV for service and maintenance in tight or otherwise difficult installations.

CANNON INSTRUMENT COMPANY • 2139 HIGH TECH ROAD • STATE COLLEGE • PENNSYLVANIA • 16803 • USA
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CANNON® CAV-2000 Series Accessories & Options

ASTM D 445, ISO 3104, IP 71, ASTM D 446, ISO 3105

CAV 2000 Series Enhanced Vapor Reduction System (EVRS)

- Factory-installed EVRS
- Upgrade EVRS

Available as a new purchase option or retrofit, the Enhanced Vapor Reduction System (EVRS) is designed to improve the CAV 2000 Series work environment, particularly for used oil applications. The EVRS is recommended for use with toluene solvent at all test temperatures; or with volatile solvents at test temperatures over 80°C. The EVRS is strongly recommended for all applications at test temperatures above 100°C. Both EVRS designs include a transparent hinged cover that mounts to the CAV-2000 frame over the sample trays. The retrofit version, designed for user installation with the bath in place, includes a three-piece clamp-ring to trap vapors below the bath. The new purchase EVRS option includes a vapor reduction plate that is factory-installed under the bath during production.

Multi-Unit Interface Kit

The kit consists of an RS-232 to 485 converter and associated RJ-45 cables. This kit is required for connecting 2, 3, or 4 CAV bath units to a single PC computer. A single CAV bath unit does not require this kit because a single bath unit can be connected to a PC computer via the supplied RS-232 cable. In all cases, however, the PC computer requires at least one available RS-232 serial port to interface to the CAV.

Table-Top Bath-Support Kit

This kit consists of two (2) support bars and mounting hardware for attachment to the Pedestal Base of a single CAV bath unit. These bars add additional support for single bath bench-top installations. The overall footprint width of the bath unit increases from 12" (305 mm) to 18" (457 mm).

Low-Volume Tube Option

(incl. Tube/Vials Adapter Sleeves)

The CANNON Low-Volume Tube option permits viscosity testing with as little as 4 mL of sample. Low-volume tubes are most appropriate for applications where sample is expensive or in short supply. Low-volume tubes have a specially designed tip that rests against the bottom of the vial during testing. Rugged aluminum vial adapter sleeves have a spring-loaded base, ensuring correct positioning of the low-volume sample vials. Low-volume tubes have a limited (10-fold) viscosity range and perform with the same accuracy as the standard 100-fold range tubes. The Low-Volume Tube Option includes one low-volume tube, 13 sample adapter sleeves, and a supply of disposable low-volume vials. See page 70 for order information.

Fast-Run Tube(s)

The CANNON Fast-Run Tubes permit more rapid testing of customer materials over a more limited (10-fold) viscosity range. They are most appropriate for high-throughput applications with sample materials that tend to vary slightly in viscosity. Fast-run tubes perform with the same accuracy as the standard 100-fold range tubes, and may be ordered in place of the standard tubes at no additional cost.

Cannon Bath Cooler

The Cannon Bath Cooler (CBC-2K) uses advanced technology to provide thermoelectric cooling power. It is recommended for baths operating below 40°.

Mounted atop the CAV temperature bath, the unit allows bath temperature stability within 10°C of ambient, and enables testing at 20°C in most labs.

Cannon Bath Cooler

Dual Solvent Option

The Dual Solvent Option permits the use of two different solvents for cleaning the viscometer tubes. It is recommended for testing hard-to-clean samples. The user can select either one or two solvents for each sample that is run. Includes the necessary hardware and software and permits the use of customer's, non-pressurized solvent container.

CAV 2000 Series Accessories Order Information

Catalog #	*Item Description*
P61.3558	High Capacity Sample Track
P61.3422	Pedestal Base
P61.3640	CAV-2000 Enhanced Vapor Reduction System (EVRS) Factory-installed EVRS
P61.3645	CAV-2000 Enhanced Vapor Reduction System Upgrade EVRS
P61.3527	Multi-Unit Interface Kit (115V)
P61.3674	CAV Low-Volume Tube Option
P61.3421	Table-Top Bath-Support Kit
P61.3600	Cannon Bath Cooler (Hazardous), 115V, 60 Hz
P61.3601	Cannon Bath Cooler (Hazardous), 230V, 60 Hz

CANNON® CAV 2000 Series Accessories & Options

ASTM D 445, ISO 3104, IP 71, ASTM D 446, ISO 3105

High-Temperature Bath Option

The High-Temp Bath Option increases the upper operational temperature range of the CAV-2100® bath unit from 100°C to 150°C. It is recommended for all applications requiring sample testing above the 100°C limit of the standard CAV bath. Includes heat shield, all necessary hardware and 2-½ gallons of 20 cSt silicone bath oil. The Enhanced Vapor Reduction System (EVRS) is recommended for high-temperature operation with this option. Depending on tube range, the Dual Solvent Option may be required.

Consult a Cannon Representative before ordering. Ensure temperature compatibility of all solvents in use with the CAV.

Heated Sample Tray Option

The standard CAV bath unit is supplied with two (2) non-heated 13-position sample trays. This option replaces one (1) of the sample trays with one (1) heated sample tray. The temperature of the heated sample tray is variable from ambient to 90°C and is adjusted by controls on the front panel of the CAV. Each heated sample tray has a built-in over-temperature safety limit of approximately 95°C. If both sample trays must be heated, two should be ordered. (Customer to indicate right or left when ordering)

Digital Thermometer (115V)

The Ertco-Hart RTD is a high precision digital thermometer with an accuracy of ± 0.05°C over a range of -183 to +850°C. See page 41 for order information.

Platinum Resistance Probes

Six-inch and twelve-inch probe from Ertco-Hart. Probe includes 6' lead and probe calibration certificate. See page 41 for order information.

Probe Accuracy (includes calibration uncertainty and short-term stability):

–196°C ± 0.030°C; 0°C ± 0.030°C; 200°C ± 0.031°C; 420°C ± 0.035°C

Initial added temperature calibration/configuration

Factory-calibration of the CAV-2000 at the customer-requested temperature. This option is helpful for customers who plan to operate the CAV instrument at two or more pre-set temperatures. Also includes calibration oils and an ASTM thermometer for the calibration temperature.

Heat Exchanger Tube (CAV-2200 only)

All CAV-2200 instruments are shipped with a Heat Exchanger Tube built into the left-hand bath. The Heat Exchanger Tube option provides the same cooling option for the RIGHT-HAND bath for circulation of cooling liquid from the user's refrigerated chiller. It is recommended when both baths may be operating below 40°C. The Heat Exchanger Tube facilitates bath temperature stability near ambient temperature and may make testing possible at slightly sub-ambient temperatures. The Heat Exchanger Tube must be used with a chiller.

Thermometer for Heated Trays

Analog lab-grade thermometer. For use in heated or high-heat sample trays. Probe protector has convenient pocket clip.

Thermometers for Heated Trays

Digital lab-grade thermometer. For use in heated or high-heat sample trays. Probe protector has convenient pocket clip.

Non-Heated 20-vial Sample Holder

20 cup Sample Holder replaces one 13-cup Standard Sample Tray. The 20-vial holder increases the number of samples that can be tested in the CAV without operator intervention. A total of 40 samples can be loaded for each bath unit. Requires Exhaust Collector Box [P61.3575] for use.

Exhaust Collector Box

One per bath unit, the Exhaust Collector Box is required when ordering the Non-Heated 20-cup Sample Holder.

10-Cup Sample Holder Option

Sample Holder for use with plastic Solo® cups. This option includes the 10-position sample tray and holder inserts. VISCPRO software configuration can easily be changed to accommodate the new tray.

For additional vial options for the CAV, see page 70.

Spare Parts Option

(Indicate tube range and temp when ordering)

Two Years Recommended Spare Parts, including pneumatic and electrical components, seals, tubing, ballast, gaskets, o-rings, screws, and more. Customer must specify Tube range.

CAV 2000® Series Accessories Order Information

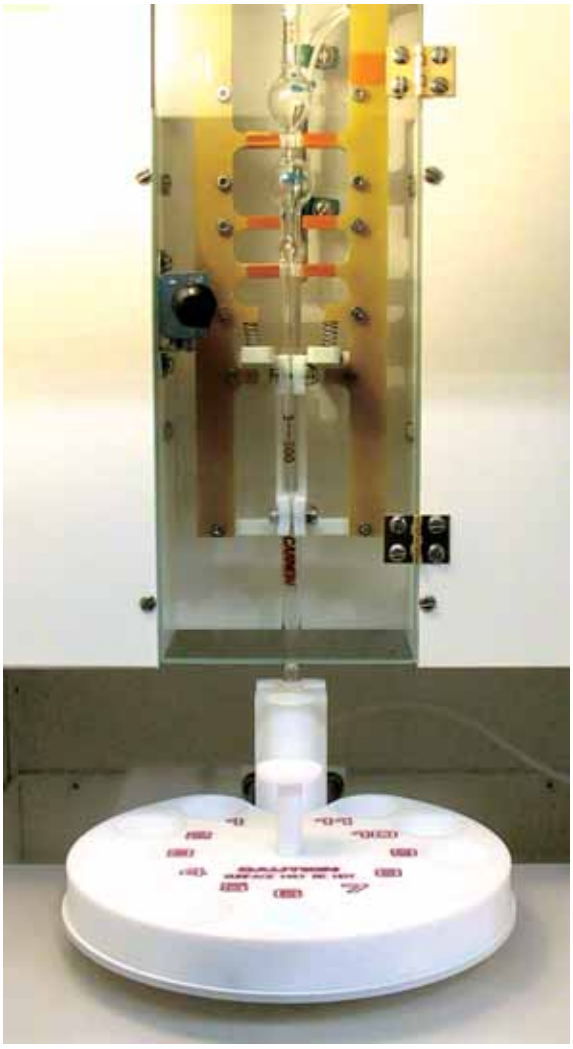
Catalog #	*Item Description*
P61.3427	High-Temperature Bath Option
P61.3425	Heated Sample Tray Option (Left Tray)
P61.3489	Heated Sample Tray Option (Right Tray)
9728-X50	Digital Thermometer (115V)
9728-X51	Platinum Resistance Probe, 6-inch (for miniAV)
9728-X52	Platinum Resistance Probe, 12-inch (for CAV instruments-see page 6)
P61.3626	Initial added temperature calibration/configuration
P61.3643	Heat Exchanger Tube (CAV-2200 only)
P61.3415	Analog Thermometer for Heated Trays
P61.3416	Digital Thermometers for Heated Trays
P61.3573	Non-Heated 20-vial Sample Holder
P61.3575	Exhaust Collector Box
P61.3671	10-Cup Sample Holder Option
P61.3620	Spare Parts Option (State Tube Range and Temp when Ordering)

* *Please specify exact voltage and frequency when ordering*

CANNON® PolyVISC® Accessories & Options

ASTM D 2857

The CANNON® PolyVISC® Automatic Glass Capillary Viscometer (see next page) combines automatic sampling, viscosity measurement, viscometer washing, and polymer solvent compatibility to provide a convenient benchtop unit ideal for dilute solution polymer viscosity analysis. Both transparent and opaque samples can be measured with the accuracy required by ASTM D 2857.



PolyVISC interior with Kynar®/Teflon® upgrade

Kynar®/Teflon® component upgrades

A Kynar® coating upgrade is available for the PolyVISC instrument. The AIRBATH interior is coated with this durable polyvinylidene fluoride (PVDF) compound. The upgrade permits testing with highly aggressive solvents, including concentrated sulfuric acid. The Kynar coating upgrade also includes a Kynar® wash platform and solid Teflon sample carrier and wash station.

PolyVISC Low Volume Testing Option

Offers low-volume testing with only 5 mL of sample.The PolyVISC Low Volume Testing Option consists of a specially-designed spring-loaded glass vial adapter insert with a 5 mL capacity—approximately ¼ the volume of the standard 20 mL sample vial. Ideal for use with a limited volume of sample, the adapters and springs come in packs of 12 each. The option also includes a modified capillary viscometer tube. Replacement vials (P65.0035) and springs (P65.0029) can also be ordered separately.

PolyVISC Volatile Sample Testing Option

Provides protection from solvent evaporation. The topless plastic screw cap for standard PolyVISC sample vials can be modified by the addition of a scored Mylar® film and rubber seat.

In conjuction with an aluminum foil seal, the Mylar® and rubber inserts enhance test precision for highly volatile samples by preventing evaporation that can affect the concentration of the polymer solution. The design also helps to reduce toxic and/or corrosive vapors in the AIRBATH® by resealing the cap aperture following the test, and the Mylar® and rubber inserts wipe the exterior of the viscometer tube as it is withdrawn from the vial, further reducing the risk of cross-contamination when performing multiple sample tests.

The solvent-resistant Mylar®/rubber inserts are sold in packages of one dozen each, and can be re-used multiple times with appropriate cleaning and drying procedures.

PolyVISC viscometer tubes

Two tube types are available for the PolyVISC instrument. The modified Atlantic compound viscometer tube is suitable for most samples. The modified Ubbelohde tube is particularly suited for more volatile samples, and may significantly enhance determinability and repeatability. Contact CANNON Technical Services for order information.

PolyVISC® Accessories Order Information

Catalog #	*Item Description*
P65.7500	Kynar®/Teflon® component upgrades
P65.3284	PolyVISC Low Volume Testing Option
P65.3283	PolyVISC Volatile Sample Testing Option
	PolyVISC viscometer tubes

CANNON® PolyVISC® Automatic Viscometer

ASTM D 2857/D 1628/D 4603 (PET), ASTM D 789, ISO 307 (Nylon), ASTM D 1243/D 3591, D 4603 (PVC), ASTM D 871/D 1795 (Cellulose), ASTM D 1601 (Ethylene Polymers)

- Automatic Polymer Viscosity Analysis from 0.3 to 20,000 cSt*
- Compatible with most Solvents Used for Polymer Work
- Unique AIRBATH® Technology – Ultrastable Thermostatic Air Chamber
- Temperatures from 20 to 100°C (100 to 135°C with High Temperature Option)
- VISCPRO® Windows® Software Calculates Relative Viscosity, Inherent Viscosity, Reduced Viscosity,and Intrinsic Viscosity

* Special viscosity ranges available upon request

PolyVISC® Automatic Viscometer

Features

The CANNON® PolyVISC® Automatic Glass Capillary Viscometer combines automatic sampling, viscosity measurement, viscometer washing, and polymer solvent compatibility to provide a convenient benchtop unit ideal for dilute solution polymer viscosity analysis. Both transparent and opaque samples can be measured with the accuracy required by ASTM D 2857 and many other application-specific methods. Infrared optical sensors are used for all transparent samples and some opaque samples. Thermal sensors are available upon request for heavily opaque samples.

The PolyVISC utilizes a unique "air bath" technology to maintain excellent temperature control. Analyses are made in an ultra-stable thermostatic air chamber (the AIRBATH®). The AIRBATH consists of an outer insulated chamber enclosing a second, inner chamber, where the viscometer and sample are continuously bathed in a thermally stabilized stream of air. Temperature is controlled within 0.01°C with advanced measuring electronics, thermoelectric cooling, and controlling software. Because both the sample carousel and the viscometer are completely contained in the AIRBATH, only the first sample requires a delay for thermal equilibrium. The AIRBATH also allows rapid temperature and viscometer changes. Built-in thermoelectric cooling enables testing below 40°C without the need for an external chiller.

Overview of Automatic Sample Loading and Analysis

Samples are placed in disposable vials which are then loaded into a carousel and inserted into the AIRBATH for analysis. The carousel accepts eleven vials, each containing 10 to 15 mL of sample. The extended-range viscometer used in the PolyVISC is similar to that in the CANNON Automatic Viscometer (CAV). The viscometer contains a lower and an upper timing bulb. First the sample is pulled into the lower chamber of the viscometer. The time required to fill the lower bulb is measured. If the time is short, the sample is pulled into the upper bulb. If the time is long, the lower bulb is used. Each PolyVISC viscometer covers a 100-fold viscosity range. This means that a single size 1-100 PolyVISC viscometer can analyze a range of samples that would require five manual viscometers. Viscometers can be easily changed in less than 60 seconds without the inconvenience of messy bath liquids.

After each analysis is completed, the sample flows back into the sample vial. Residual sample is cleaned from the inside, outside, and tip of the viscometer by automatic rinsing with a wash solvent, followed by a drying solvent. The viscometer is then dried. A typical wash requires only 10 to 20 mL of washing solvent and 10 mL of drying solvent. Wash parameters are adjustable by the user.

See PolyVISC® Accessories & Options on page 11.

PolyVISC® Specifications

Dimensions:	515 mm wide x 756 mm high x 520 mm deep (20.3 x 29.8 x 20.5")
Viscosity Range:	0.3 to 20,000 cSt (special ranges available on request)
Solvent Volume:	10 mL for each wash and rinse (application dependent)
Temperature Range:	20 to 100°C (135°C High-Temperature Option available)
Temperature Stability:	±0.01°C at calibrated temperature
Drop Time Resolution:	±0.01 second
Electrical:	115/230V, 50/60 Hz, 1750/1850 watts (please specify voltage when ordering)
Compliance:	CE Mark; EMC directive (89/336/EEC); Low voltage directive (73/2/EEC); HI-POT (1900 VDC, 60 sec.)

Computer Requirements

Please contact CANNON for Computer Specifications

Order Information

Catalog #	*Item Description*
9724-Z18	PolyVISC Automatic Viscosity Measuring System 115V, 50/60 Hz, 1750 watts
9724-Z20	PolyVISC Automatic Viscosity Measuring System 230V, 50/60 Hz, 1850 watts

CANNON® PolyVISC® SPS Solution Preparation System

PolyVISC® SPS Solution Preparation System

- Prepares Dilute Polymer Solutions for Relative Viscosity Measurements Using Weight-to-Weight Methodology
- Eliminates Errors Due to Variations in Solvent Density and Cumbersome Manual Weight and Volume Measurements
- Provides Concentration Accuracy Often Better than ±0.02%

The PolyVISC® SPS Solution Preparation System from CANNON Instrument Company is a semi-automated solution preparation system that uses gravimetric rather than volumetric methodology. The SPS can be used with the CANNON PolyVISC® Automatic Viscometer to provide a complete polymer analysis system.

Why Gravimetric Measurement?

When manual volumetric methods of preparing solutions are employed, variations of solvent density with temperature can lead to errors larger than the error inherent in the subsequent analytical procedure. In the PolyVISC SPS Solution Preparation System, the solvent is weighed rather than measured volumetrically, eliminating errors due to variations in solvent density. For samples over 100 mL, concentration accuracy is often better than ± 0.02 percent.

When solutions are prepared using the gravimetric method, the solution concentration can be expressed in units of volume when the density of the solvent is known. Thus, it is possible for the PolyVISC SPS Solution Preparation System to prepare solutions for procedures written for the volumetric method.

PolyVISC® SPS components

A computer-controlled burette pump and proprietary PolyVISC SPS software are at the heart of the Solvent Preparation System. The software permits convenient user configuration of multiple sample/solvent recipes.

Other required system components (ordered separately) include a Windows-compatible computer and an electronic balance. A number of digital electronic balances having an RS-232 (COM) output are compatible with the SPS software package.

Solution Preparation

SPS software for Windows® makes solution preparation rapid and simple. No volumetric glassware is used*. After the sample ID information is entered, and the user-configured recipe is selected, the operator places an empty container on the balance pan. The container is weighed and the operator adds the amount of solute specified by the computer to the sample container. The precise solute weight is obtained; then the computer calculates the appropriate amount of solvent and adds the solvent to the sample container on the balance. Solution concentration is calculated by the software, and all sample information is stored on the computer hard disk drive. A sample label can be printed.

*** Variomag stirring block, see page 69**

Specifications for the PolyVISC® SPS Solution Preparation System

Pump Module

Number of Pumps:	One
Type of Pumps:	Syringe
Flow Rate:	0 to 400 mL/min
Solution Types:	Weight-to-Weight, Weight-to-Volume, Dilution-to-Volume
Solution Preparation Accuracy:	± 0.02% or better for samples over 100 mL
Solution Preparation Time:	2 minutes (50 mL of solvent)
Compatible Balances:	Contact CANNON for updated list
Computer Operating System:	Windows® XP

Order Information

Catalog #	*Item Description*
9724-Z61	PolyVISC® SPS Solution Preparation System, 115V, 50/60HZ
9724-Z62	PolyVISC® SPS Solution Preparation System, 230V, 50/60HZ

CANNON® miniAV® Automatic Viscometer

ASTM D 445, ISO 3104, IP 71, ASTM D 446, ISO 3105

- Meets all ASTM D 445 Precision Specifications
- Convenient and Affordable Automated Testing
- 100-Fold Range Tubes for Kinematic Viscosities Between 0.3 and 5,000* mm^2/s
- Selectable Temperature Range Between 20° and 100°C
- Attractive and Compact Tabletop Unit—Save Space, Save Time, Save Money!

Additional application-specific extended range tube designs available.

MiniAV® Automatic Viscometer

Affordable D 445 Automation

The miniAV™ from CANNON Instrument Company offers every laboratory an exciting new tool for convenient and highly accurate kinematic viscosity (Kin Vis) measurement. Occupying roughly the same footprint as a tabletop rotational viscometer, the miniAV automates the time-consuming sample measurement and viscometer tube wash/dry procedures associated with the ASTM D 445 method, freeing the laboratory technician for other duties. The miniAV has been designed as an affordable alternative to traditional labor-intensive manual Kin Vis measurement methods, and provides a first step toward full laboratory automation.

The miniAV performs in tandem with the proven VISCPRO® II software for Windows® XP, providing convenient sample ID data entry, database maintenance, and powerful reporting and LIMS connectivity capabilities. Two miniAV™ instruments can be connected to a single PC to easily determine Viscosity Index for a sample.

Operation

Operation of the miniAV is simple. The user fills the sample vial, places it in the vial holder beneath the viscometer, and raises it into position. Sample ID information is entered via the computer. The user initiates the test with a single mouse click. Without further operator intervention, the sample is drawn up into the viscometer tube, held for temperature equilibration, and then measured. Data is automatically transferred to the computer database via the RS-232 serial connection. The sample is then ejected as waste, and the sample vial becomes a wash station as solvent is automatically metered into the viscometer tube and then evacuated to complete the cleaning cycle. Following tube drying, the vial holder is lowered to its original position, ready to receive the next sample. Total cycle time for a test is 3 to 5 minutes depending on the viscosity.

Accuracy

The miniAV provides automatic Kin Vis testing within parameters specified by ASTM D 445/446 and ISO 3104/3105. The miniAV measures flow rates within ±0.001 second by electronically timing the liquid meniscus as it moves between thermistor timing sensors. Bath temperature is controlled with accuracy better than ±0.02°C between 20° and 100°, as required by ASTM D 445/446. Dark or opaque liquids may be measured with the same precision as transparent fluids – without the need to change tubes.

Unlike non-traditional bench-top instruments which claim D 445 correlation, the miniAV is truly a KinVis instrument. Using a capillary viscometer defined in D 446, the miniAV performs equally well on Newtonian materials and fully formulated end products.

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CANNON® miniAV® Automatic Viscometer

ASTM D 445, ISO 3104, IP 71, ASTM D 446, ISO 3105

Features

The miniAV bath unit housing is only 10 inches wide, and the unit is less than 21 inches in height. Modular side panels swivel out for convenient maintenance/service. The modified Ubbelohde compound viscometer tube offers a 100-fold viscosity range (easily covering the range of 5 separate manual glass viscometers), and requires only 5 mL of sample (3 mL with Fast-Run tubes). The tube rests in a 1-liter temperature bath that also contains temperature and fluid level sensors, optional TE cooling device (required for testing below 40°C), heating element, and impellers that circulate bath fluid to ensure high temperature uniformity.

Like its fully-automatic cousins in the CAV 2000 Series, the miniAV offers selectable temperatures between 20° and 100°C. Data is transmitted to and from the controlling computer via an RS-232 or RS-485 serial interface.

The instrument is shipped with the VISCPRO II controlling software, external power supply, and waste receiver assembly. Convenient chromatography-type container lids may be used for connecting cap thread #38 reagent bottles to the miniAV.

miniAV® Operational Range Chart

Temperature		20°C	25°C	40°C	50°C	100°C
Minimum KV (cSt)		0.5	0.5	0.5	0.5	1
Maximum KV (cSt)		6000	6000	6000	3000	200
Standard Range Ubbelohde Style Tubes (100x range)						
Tube Range (mm^2/s)	Fast-Run Ubbelohde Style Tubes (10x range)					
0.3 - 30	Not available	≥ 0.5	≥ 0.5	≥ 0.5	≥ 0.5	≥ 1.0
0.6 - 60	Not available	✓	✓	✓	✓	✓
1 - 100	1 - 10	✓	✓	✓	✓	✓
2 - 200	2 - 20	✓	✓	✓	✓	✓
3 - 300	3 - 30	✓	✓	✓	✓	≤ 200
4 - 400	4 - 40	✓	✓	✓	✓	≤ 200
5 - 500	5 - 50	✓	✓	✓	✓	≤ 200
6 - 600	6 - 60	✓	✓	✓	✓	≤ 200
8 - 800	8 - 80	✓	✓	✓	✓	≤ 200
10 - 1000	10 - 100	✓	✓	✓	✓	≤ 200
15 - 1500	15 - 150	✓	✓	✓	✓	≤ 200
20 - 2000	20 - 200	✓	✓	✓	✓	≤ 200
30 - 3000	30 - 300	✓	✓	✓	✓	≤ 200
40 - 4000	Not available	✓	✓	✓	≤ 3000	≤ 200
50 - 5000	50 - 500	✓	✓	✓	≤ 3000	≤ 200
60 - 6000	Not available	≤ 6000	≤ 6000	≤ 6000	≤ 3000	≤ 200
100 - 10000	Not available	≤ 6000	≤ 6000	≤ 6000	≤ 3000	≤ 200

✓	=	Normal operating range
≤ 3000	=	Temperature-based maximum range limitation
≥ 0.5	=	Standard tube ranges
≥ 0.5	=	Fast-run tube ranges
≥ 0.5	=	Minimum range limitation

Required Accessories

The miniAV requires a computer with the Windows® 98/NT®/XP® operating system. The user must provide a suitable non-pressurized solvent container for each solvent. For test temperatures below 40°C or for operation in high-ambient environments, a thermoelectric cooler (available from CANNON) is required.

miniAV® Thermometers

Liquid-In-Glass thermometers and digital thermometers are available for the miniAV instrument. A special thermometer holder assembly is permanently attached to each of these thermometers to fit the miniAV. See below for thermometer assembly catalog numbers. For additional information and specifications for thermometers, see pages 40-41.

miniAV® Automatic Viscometer Specifications

miniAV Dimensions:	254 mm wide x 264 mm deep x 518 mm high (10 x 10.5 x 20.5")
Power Supply Dimensions:	330 mm wide x 356 mm deep x 159 mm high (13 x 14 x 6.25")
Weight:	12.5 kg (27.5 lbs) without bath fluid, Power Supply and Waste Receiver
Shipping Weight:	51 kg (113 lbs) with all units/accessories
Operating Conditions:	15°-30°C, 10%-90% RH non-condensing, Installation Category II, Pollution degree 2
Fuse Rating:	115V & 100V Units: M 250V 8A, 1.25 x 0.25"; 230V Unit: M 250V 4A, 1.25 x 0.25"
Compliance:	CE Mark pending: EMC directive (89/336/EEC); Low voltage directive (73/23/EEC); HI-POT (1900 VDC, 60 sec.)
Computer Requirements	Computer not included. Please contact CANNON for specifications.

miniAV® Order Information

Catalog #	*Item Description*
9725-A80	miniAV 115v 50/60 hz
9725-A81	miniAV 230v 50/60 hz
9725-A82	miniAV 100v 50/60 hz
P81.1085	44C thermometer (20° C)
P81.1086	120C thermometer (40° C)
P81.1087	121C thermometer (100° C)
P81.1088	46C thermometer (50° C)
P81.2450	DigiSense Thermometer, Digital Kit 115V
P81.2451	DigiSense Thermometer, Digital Kit 230V

CANNON® Constant Temperature Baths

ASTM D 445/ISO 3104

CANNON Instrument Company produces a full line of constant temperature baths featuring stand-alone thermoelectrically cooled low-temperature models and thermostated, reliable and safe high-temperature units. All CANNON baths satisfy the requirements of ASTM D 445.

Use the chart on page 17 to determine the desired bath for your needs. Then turn to the referenced catalog page for your model to view additional specifications and information.

CT-500/518

CT-2000

CT-1000

CT-500/518 – page 18

Specifically designed for precise viscosity determination with glass capillary viscometers, the CT-500 and CT-518 baths offer superior temperature control to 100°C. The CT-500 offers a 30.5 cm (12") bath jar that can accommodate most viscometers. The CT-518 bath provides a depth of 45.7 cm (18").

CT-1000 – page 19

This durable and accurate insulated bath offers quick-set temperature control options and ASTM D 445 reliability to 150°C. Up to seven viscometer tubes/holders can be placed in the bath. The unit is equipped with several safety features, including a bath level float and over-temperature themistor.

CT-1000HT – page 19

Our highest-temperature bath, the CT-1000HT provides exceptional temperature control at temperatures to 200°C. Twin heating units rapidly heat the bath medium to any temperature within the bath range.The unit is equipped with several safety features, including a bath level float and over-temperature thermistor. All wetted bath parts are made of stainless steel, glass, or Teflon®.

CT-2000 – page 20

Convenient keypad operation and ASTM reliability at temperatures to 150°C make the CT-2000 the bath of choice for many users. Microprocessor-controlled temperature regulation, on-screen temperature monitoring, and serial networking options make this digital bath an attractive and fully functional addition to the modern laboratory.

CT-600 – page 21

The CT-600 is similar to the CT-500 but includes built-in thermoelectric cooling modules, making it ideal for controlled temperature applications between 10°C and 30°C.

The CT-600 provide accurate temperature control per ASTM D 445 specifications between 10°C and 100°C.

CANNON® Commitment to Quality & to You!

ASTM D 445/ISO 3104

TE-1500

TE-3000

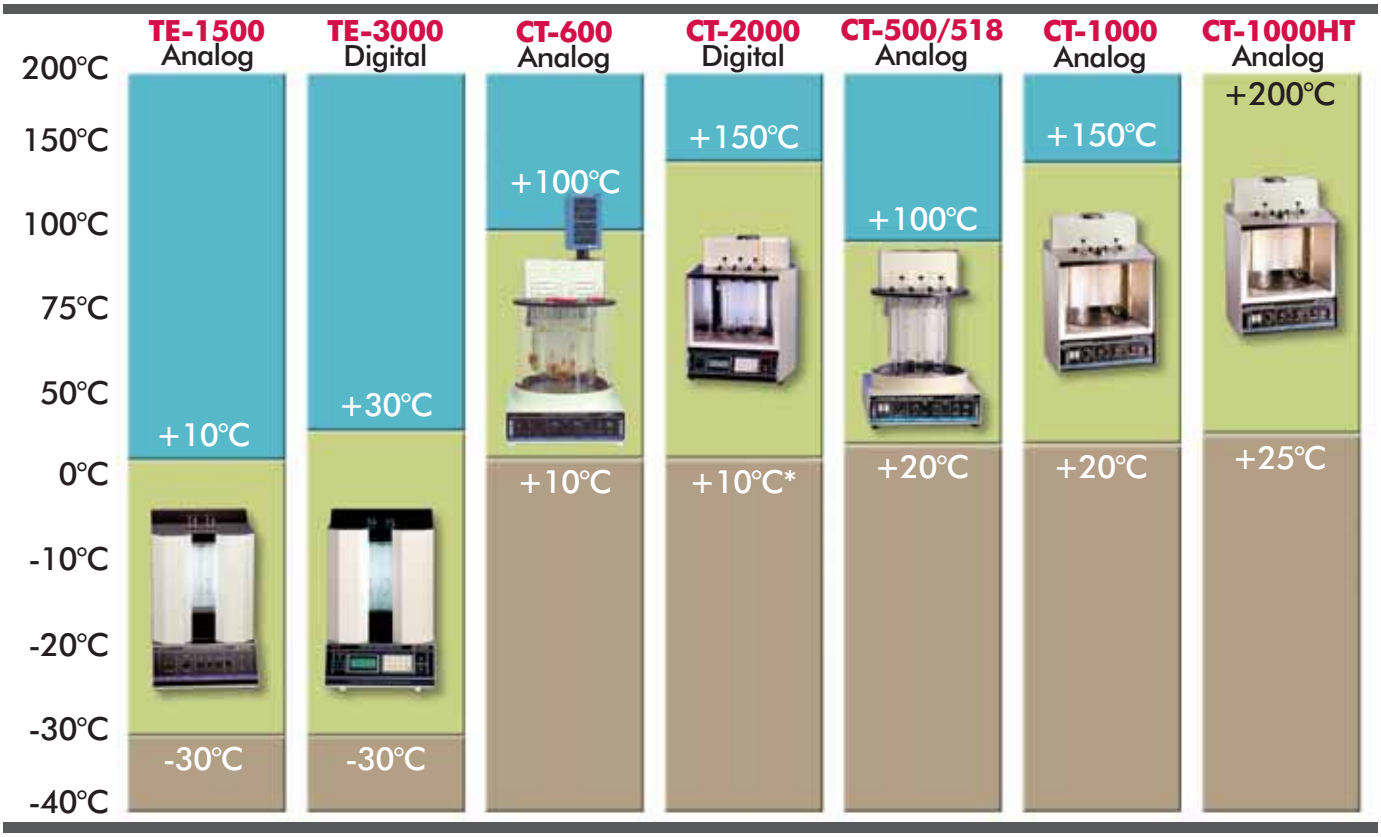
TE-1500 – page 22

The thermoelectrically-cooled TE-1500 provides rock-steady cooling to –30°C using Peltier cell technology. Cooling fans and front panel controls are the only moving parts in this advanced design. A four-pane frost-free viewing window and twin fluorescent lamps provide excellent visibility and illumination within the bath.

TE-3000 – page 23

Our premiere digital bath model for low-temperature applications, the TE-3000 combines reliable thermoelectric cooling with convenient keypad operation. Temperature settings remain stored in memory even if bath power is cut off. The liquid-crystal display indicates temperature in Celsius or Fahrenheit. A self-diagnostic routine and upgradable firmware are just two of many improvements in our internationally-respected bath technology.

*Need a CT bath manifold? See page 70.



* Requires optional chiller/cooler and/or use of built-in cooling coil for operation near and below ambient.

CANNON® CT-500 Constant Temperature Bath

ASTM D 445/ISO 3104

- Accurate Temperature Control from 20°C to 100°C
- Safe/Reliable Operation

The CANNON CT-500/518 baths maintain accurate temperature control of ± 0.01°C within the range of 20°C to 100°C, providing the temperature sensitivity required by ASTM D 445 for kinematic viscosity measurements with glass capillary viscometers. Two electric heating elements inside the bath rapidly heat the medium to any desired temperature within the range. A cooling coil, when connected to tap water or a cooling system, permits operation below or slightly above ambient temperature.

Temperature Selection

A special selector switch on the front panel facilitates rapid setting of ten popular temperatures for kinematic viscosity determinations.

Temperatures which may be selected with this switch are 20, 25, 30, 40, 50, 60, 70, 80, 90, and 100°C. After the switch has been set, the bath will equilibrate to within a fraction of one degree of the desired temperature. A fine tuning control then allows temperature adjustment to within ± 0.01°C of the target temperature. By switching to the "variable" setting on the front panel, any temperature within the operating range can be obtained.

CANNON CT-500 Constant Temperature Bath

Description of Bath

A solid-state control circuit provides proportional control of temperature. The sensing element for the control circuit is a stainless steel-encased thermistor.

A motor-driven stirrer ensures a uniform temperature throughout the bath. The entire electrical control system is located in a convenient drawer, mounted on glides for easy access if adjustment or repair is necessary.

The CT-500 bath chamber is a cylindrical clear glass vessel 305 mm (12 inches) in diameter and 305 mm (12 inches) high. The CT-518 bath chamber is a full 457 mm (18 inches) high. A Teflon®-coated stainless steel baffle located in the center of the bath provides a plain reflective background to aid in viewing instruments. The top cover contains seven round holes 51 mm (2 inches) in diameter for insertion of viscometer holders, allowing up to seven viscosity measurements to be made simultaneously. Covers are supplied for capping unused holes. Two additional holes 10 mm (⅜-inch) in diameter, are provided for thermometers. Other hole configurations are available on special order. All wetted parts of the CT-500/518 Constant Temperature Baths are made of stainless steel, glass, or Teflon. The frame is fabricated from heavy aluminum and coated with a corrosion-resistant epoxy finish. Viscometers, holders, bath oil, and thermometers must be purchased separately.

Safety Features

A thermistor in the bath senses any over-temperature fault condition. If such a condition occurs, all power is removed from the bath until an operator resets the over-temperature limit circuit. A second safety feature cuts power to the bath heaters if the control thermistor is disconnected. Finally, operation of the bath is not possible unless it is filled with liquid to a safe operating level. A liquid-level sensor prevents the control circuit from heating the bath until a safe operating level is attained. The bath heaters are automatically turned off when the bath liquid drops below minimum safe level.

CT-500 Constant Temperature Bath Specifications

Size (CT-500):	407 mm wide x 362 mm deep x 610 mm high (16 x 14.25 x 24 inches)
Capacity CT-500:	17 L (4.5 gal)
Capacity CT-518:	23.8 L (6.3 gal)
Weight (CT-500):	22 kg (48 lbs)
Shipping Weight (CT-500):	34 kg (75 lbs)

Order Information

Catalog #	*Item Description*
9726-A10	Model CT-500, 120 volts AC, 50/60 Hz, 1000 watts
9726-A15	Model CT-500F, 240 volts AC, 50/60 Hz, 1000 watts
9726-A17	Model CT-518, 120 volts AC, 50/60 Hz, 1300 watts
9726-A19	Model CT-518F, 240 volts AC, 50/60 Hz, 1300 watts

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CANNON® CT-1000/1000HT Constant Temperature Baths

ASTM D 445/ISO 3104

- Select Temperature from 20 to 150°C; 200°C for HT Model
- Multiple Safety Features

The CANNON CT-1000 Constant Temperature Bath maintains the accurate control required by ASTM D 445 for kinematic viscosity measurements with glass capillary viscometers. Within the range of 20 to 100°C temperature is controlled to 0.01°C; above 100°C temperature is controlled to 0.03°C.

Setting Temperature

Ten of the most popular temperatures for kinematic viscosity measurement can be quickly set by rotating a special switch on the bath's front panel. This switch allows 20, 25, 30, 40, 50, 60, 80, 100, 135, and 150°C to be selected. After selection of the temperature, the bath will equilibrate within a fraction of one degree of the desired temperature. A fine tuning control then allows temperature adjustment to within 0.01°C of the target temperature. By switching to the "variable" setting on the front panel, any temperature within the operating range can be obtained.

CANNON CT-1000 Constant Temperature Bath

Bath Features

The bath chamber is a cylindrical clear Pyrex® vessel 300 mm (12 inches) in diameter x 300 mm (12 inches) high. A stainless steel baffle coated with white Teflon is located in the center of the bath to provide a good background for viewing viscometers. Two fluorescent lamps illuminate the interior of the bath brightly and uniformly, without glare.

Two heating elements inside the bath rapidly heat the bath medium to any temperature within the bath range. A stainless steel cooling coil is also incorporated. When connected to tap water or a recirculating water chiller, the cooling coil allows operation at temperatures slightly above or below ambient.

The top cover contains seven round holes 51 mm (2 inches) in diameter. Up to seven glass capillary viscometers (in holders) can be placed in the bath. Other hole configurations can be supplied on special order.

A solid-state control circuit equipped with a stainless steel-encased thermistor provides proportional control of temperature. A motor-driven stirrer ensures a uniform temperature throughout the bath.

All wetted parts of the bath are made of stainless steel, glass, or Teflon®. The bath housing is fabricated from heavy aluminum and coated with a corrosion-resistant epoxy finish. Viscometers, holders, bath oil, and thermometers must be purchased separately.

Safety Features

There are multiple safety features. A thermistor in the bath senses any over-temperature fault condition. If such a condition occurs, all power is removed from the bath until an operator resets the over-temperature limit control circuit. A second safety feature cuts power to the heaters if the control thermistor is disconnected. A liquid-level sensor prevents the control circuit from heating the bath until a safe operating level is attained.

CT-1000HT Constant Temperature Bath

- Precision temperature control to 200°C

The CT-1000HT Constant Temperature Bath is identical to the CT-1000, except that the CT-1000HT can achieve a temperature range from 25°C to 200°C. The temperature selection dial includes quick-set options for 25, 40, 60, 80, 100, 135, 150, 165, 185, and 200°C Temperatures from 150 to 200°C can be controlled to 0.03°C (more precise than required by ASTM D 445 for high temperature viscometry).

CT-1000 Constant Temperature Bath Specifications

Dimensions:	438 mm wide x 464 mm deep x 584 mm high (17.25 x 18.25 x 23 inches)
Capacity:	17 L (4.5 gal)
Weight:	43 kg (95 lb)
Shipping Weight:	55.8 kg (123 lb)

Order Information

Catalog #	*Item Description*
9726-A20	CT-1000, 120 volts AC, 50/60 Hz, 1400 watts
9726-A25	CT-1000F, 240 volts AC, 50/60 Hz, 1400 watts
9726-A27	CT-1000HT, 120 volts AC, 50/60 Hz, 1400 watts
9726-A29	CT-1000HTF, 240 volts AC, 50/60 Hz, 1400 watts

CANNON® CT-2000 Constant Temperature Bath

ASTM D 445/ISO 3104

- Microprocessor-Controlled Temperature Regulation to 150°C
- Built-in Platinum Resistance Thermometer
- On-Screen Temperature Monitoring

The CANNON CT-2000 Constant Temperature Bath maintains the accurate control required by ASTM D 445 for kinematic viscosity measurements. Within the range of 20 to 100°C temperature is controlled to 0.01°C; above 100°C temperature is controlled to 0.03°C.

CANNON CT-2000 Constant Temperature Bath

Setting Temperature

A keypad permits microprocessor-controlled temperature selection to three decimal places at any setting within the operational range of the instrument. Twin electric heating elements inside the bath rapidly heat the medium to any desired temperature within the range. A cooling coil, when connected to tap water or a cooling system, permits operation below or slightly above ambient temperature. The built-in platinum resistance thermometer continuously monitors bath temperature and displays it digitally on a four line by twenty character back-lit liquid-crystal screen. Either Celsius or Fahrenheit display of temperature may be selected. On power-up the CT-2000 performs an automatic self-test of its circuits.

The CT-2000 also features RS-232 and RS-485 communication ports which permit data acquisition and networking via an external computer. Several baths may be networked to a single computer.

Bath Features

The bath chamber is a cylindrical clear Pyrex® vessel 300 mm (12 inches) in diameter x 300 mm (12 inches) high. A stainless steel baffle coated with white Teflon is located in the center of the bath to provide a good background for viewing viscometers. Two fluorescent lamps illuminate the interior of the bath brightly and uniformly, without glare.

The top cover contains seven round holes 51 mm (2 inches) in diameter. Up to seven glass capillary viscometers (in holders) can be placed in the bath. Two additional holes 10 mm (⅜-inch) in diameter are provided for thermometers.

A solid-state control circuit equipped with a stainless steel-encased thermistor provides proportional control of temperature. A motor driven stirrer ensures a uniform temperature throughout the bath. The entire electrical control system is located in a convenient drawer for easy access if adjustment or repair is necessary.

All wetted parts of the bath are made of stainless steel, glass, or Teflon®. The bath housing is fabricated from heavy aluminum and coated with a corrosion-resistant epoxy finish. The top cover consists of three parts: a stainless steel top surface, an insulating layer, and a bottom stainless steel heat reflector. The bath is designed to use water or oil (not supplied). Viscometers, holders, bath oil and thermometers must be purchased separately.

Safety Features

There are multiple safety features. A thermistor in the bath senses any over-temperature fault condition. If such a condition occurs, all power is removed from the bath until an operator resets the over-temperature limit control circuit. A second safety feature cuts power to the heaters if the control thermistor is disconnected. A liquid-level sensor prevents the control circuit from heating the bath until the safe operating level is attained. The bath heaters are automatically turned off when the bath liquid drops below the minimum safe level.

CT-2000 Constant Temperature Bath Specifications

Size:	438 mm wide x 464 mm deep x 584 mm high (17.3 x 18.3 x 23 inches)
Bath Volume:	17 liters (4.5 gallons)
Weight:	51.4 kg (113 lbs) without bath fluid
Shipping Weight:	60 kg (131 lbs) (total/two boxes)
Electrical:	Specify exact line voltage when ordering
Display Resolution:	3 decimal places

Order Information

Catalog #	*Item Description*
9726-A30	CT-2000, 100-130 VAC, 50/60 Hz, 1400 watts
9726-A35	CT-2000F, 200-250 VAC, 50/60 Hz, 1400 watts

CANNON® CT-600 & Bath Accessories

ASTM D 445/ISO 3104

CT-600 Constant Temperature Bath

- Ideal for kinematic viscosity determinations between 10 and 30°C
- Built-in thermoelectric cooling provides "rock-solid" temperature control at ambient and below
- Meets ASTM D 445 precision specifications from 10° to 100°C

The new Cannon CT-600 has many of the engineering and control features of the CT-500 bath (see page 18), but the CT-600 also includes a built-in thermoelectric cooling unit. The CT-600 controls temperature per ASTM D 445 precision specifications between 10°C and 100°C, and is ideal for controlled temperature applications between 10°C and 30°C. When tests at low temperatures are to be made, the cooling unit is engaged via a switch on the front panel. When working at higher temperatures (30°C and above), the switch is turned off. Nothing could be simpler.

A special selector switch on the front panel facilitates rapid setting of ten popular temperatures for kinematic viscosity determinations: 10, 15, 20, 25, 30, 40, 50, 60, 80, and 100°C. After the switch has been set the bath will equilibrate to within a fraction of a degree of the desired temperature. A fine-tuning control then allows temperature adjustment to within ± 0.01°C of the target temperature as measured by the user's reference thermometer. By switching to the "variable" setting on the front panel, any temperature within the operating range can be obtained.

For a description of bath safety features, see the CT-500 entry on page 18.

CBC-100 Bath Cooler

- Thermoelectrically Cools Baths as much as 15°C Below Ambient
- Compact – 1/10th the Size of Standard Refrigeration Units
- Improves Temperature Stability at Ambient and Below

The CANNON Bath Cooler (CBC-100) is a powerful addition to the quality line of CANNON thermoelectric products.

About one-tenth the size of many conventional chillers, the environmentally-friendly CBC-100 is an efficient and reliable laboratory workhorse. Solid-state electronics and proven thermoelectric technologies provide enough cooling power to control accurately at 15°C below ambient, even in open shallow baths.

CBC-100 Bath Cooler

Power Supply (same for both versions)

Size:	121 mm wide x 241 mm deep x 102 mm high (4.75 x 9.5 x 4 inches)

Cooling Column (excluding immersion probe)

Size:	108 mm wide x 190 mm deep x 222 mm high (4.25 x 7.5 x 8.75 inches)
CBC-100R:	Total height including immersion probe is 572 mm (22.5-inches)

*Need a CT bath manifold? See page 70.

Power Supply and Cooling Column for both versions

Weight:	5.7 kg (12.5 lbs)
Power Requirements:	100 to 240 volts, 50/60 Hz, 250 watts
Maximum Bath Temperature	The Cannon Bath Cooler should not be exposed to temperatures above 80°C.

Order Information

Catalog #	*Item Description*
9726-A36	CT-600 Constant Temperature Bath, 115V, 50/60 Hz
9726-A37	CT-600F Constant Temperature Bath, 230V, 50/60 Hz
9726-D05	CBC-100R (regular version with US plug)
9726-D10	CBC-100R-F (regular version with special plug)

CT Series Storage Unit

CT Series Storage Unit

- Convenient Viscometer Storage can be used as Bath Support

This sturdy two-drawer unit fits beneath all CANNON constant temperature baths. It provides elevated viewing of the bath, and ample room for storage of viscometers and other accessories.

CT Series Storage Unit Specifications

Size:	457 mm wide x 457 mm deep x 165 mm high (18 x 18 x 6.5 inches)
Weight:	10.9 kg (24 lbs)
Shipping Weight:	13.6 kg (30 lbs)

Order Information

Catalog #	*Item Description*
9726-A50	CT Series Storage Unit

CANNON® TE-1500 Constant Temperature Bath

ASTM D 445/ISO 3104

- Temperature Range from +10°C to –30°C
- Precision and Stability Satisfying ASTM D 445 Specifications
- Environmentally-Friendly Thermoelectric Cooling System
- Compact Footprint; No Accessory Heating/Cooling Units Required

The CANNON TE-1500 Thermoelectric Low Temperature Bath incorporates many new advances in science and technology, including custom-developed Peltier Cells and fan-cooled high-density heat sinks. The TE-1500 provides the precision required by ASTM D 445 for measurement of kinematic viscosity at low temperatures.

Compact Features

The TE-1500 is a compact, tabletop instrument which uses an air-cooled thermoelectric cooling system requiring no accessory heating or cooling units.

A selector switch on the front panel allows direct setting of eight temperatures commonly used for low-temperature measurement: 10, 0, –5, –10, –15, –20, –25, and –30°C. After this switch has been set, the bath will equilibrate to within a fraction of a degree of the desired temperature. A fine-tuning control then allows exact temperature adjustment. By switching to the "variable" setting on the front panel, any temperature within the operating range can be obtained.

CANNON TE-1500
Thermoelectric Low Temperature Bath

Safety/Reliability

Bath safety and reliability are ensured by a number of built-in features including an internal thermostat which senses any over-temperature fault condition. If such a condition occurs, all power is removed from the bath until the internal temperature decreases sufficiently to reset the thermostat. If the control thermistor is disconnected, all power is removed from the bath until the thermistor connection is restored.

Description of Bath

The bath holds 2.5 liters of bath medium (not supplied). The bath housing is fabricated from heavy aluminum coated with a corrosion-resistant epoxy finish. The top cover of the bath contains two round holes 51 mm (2 inches) in diameter for insertion of glass capillary viscometers or other instruments.

An additional hole is provided for a reference thermometer or probe. The aluminum bath vessel measures 305 mm high x 121 mm wide x 83 mm (12" x 4.75" x 3.25") deep. A baffle within the bath vessel facilitates circulation of liquid and provides a background for easy viewing of instruments. A four-pane "frost-free" viewing window and internal illumination by twin fluorescent lamps provide excellent visibility within the bath. Viscometers, holders, appropriate bath medium, and thermometers must be purchased separately.

TE-1500 Specifications

Bath Size:	375 mm wide x 420 mm deep x 620 mm high (14.8 x 16.5 x 24.4 inches)
Bath Capacity:	2.5 liters (0.66 gal)
Bath Dimensions (Internal):	121 mm wide x 83 mm deep x 305 mm high (4.75 x 3.25 x 12 inches)
Viewing Area:	265 mm high x 95 mm wide (10.45 x 3.75 inches)
Bath Weight:	43.1 kg (95 lbs)
Bath Shipping Weight:	59 kg (130 lbs)
Electrical:	Available in 120V, 220V, and 240V models. All models 50/60 Hz Please specify exact line voltage when ordering.

Order Information

Catalog #	*Item Description*
9726-A62	TE-1500, 120 volts, 50/60 Hz, 1000 watts
9726-A66	TE-1500F, 230 volts, 50/60 Hz, 1000 watts
9726-A68	TE-1500, 100 volts, 50/60 Hz, 1000 watts

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CANNON® TE-3000 Constant Temperature Bath

ASTM D 445/ISO 3104

- Temperature Range from –30°C to +30°C
- Self-Contained Thermoelectric Cooling — No Accessory Units Required
- Convenient Keypad Data Entry
- Selectable Temperature Scale (Celsius or Fahrenheit)
- Meets ASTM D 445 Requirements for Temperature Stability

CANNON TE-3000 Thermoelectric Constant Temperature Bath

The CANNON TE-3000 Thermoelectric Constant Temperature Bath provides accurate temperature control between –30°C and +30°C, meeting the requirements of ASTM D 445 for measurement of kinematic viscosity at low temperatures.

The low temperatures are obtained by built-in air-cooled Peltier cells which provide thermoelectric cooling. No external refrigeration unit or air/water heat exchanger is used.

Keypad Operation

The desired bath temperature and calibration temperatures are entered digitally by means of a keypad located on the front panel. Temperatures remain in memory even if power to the bath is accidentally cut off. Both the target temperature and the actual temperature of the bath are displayed continuously on a liquid crystal display. An on-screen menu permits selection of Celsius or Fahrenheit operation, along with several diagnostic features.

Durable Construction

The top cover of the bath contains two round holes 51 mm (2 inches) in diameter for insertion of glass capillary viscometers or other instruments. An additional hole is provided for a reference thermometer or probe. A four-pane "frost-free" viewing window and internal illumination by fluorescent lamps provide excellent visibility within the bath.

The bath holds 2.5 liters (0.66 gal) of bath medium (not supplied). The bath housing is fabricated from heavy aluminum coated with a corrosion-resistant epoxy finish. Contained in the housing is an aluminum bath vessel that measures 305 mm high x 121 mm wide x 83 mm deep. A baffle within the bath vessel facilitates circulation of the liquid and provides a smooth background for viewing instruments.

Viscometers, holders, appropriate bath medium, and thermometers must be purchased separately.

TE-3000 Specifications

Bath Size:	375 mm wide x 420 mm deep x 620 mm deep (14.8 x 16.5 x 24.4 inches)
Bath Capacity:	2.5 liters (0.66 gal)
Bath Dimensions (Internal):	121 mm wide x 83 mm deep x 305 mm high (4.75 x 3.25 x 12 inches)
Viewing Area:	265 mm high x 95 mm wide (10.45 x 3.75 inches)
Bath Weight:	43.1 kg (95 lbs)
Bath Shipping Weight:	59 kg (130 lbs)
Electrical:	Available in 120V, 220V, and 240V models. All models 50/60 Hz Please specify exact line voltage when ordering.

Order Information

Catalog #	*Item Description*
9726-A70	TE-3000, 120 volts, 50/60 Hz, 1000 watts
9726-A75	TE-3000F, 240 volts, 50/60 Hz, 1000 watts
9726-A77	TE-3000, 100 volts, 50/60 Hz, 1000 watts

CANNON® Glass Capillary Viscometers
Size, Range, & Expanded Uncertainty

ASTM D 446, ASTM D 2171, ISO 3104, ISO 3105

CANNON Glass Capillary Viscometers

Glass Capillary Viscometers

The tables on this page provide size and range information for viscometers on pages 26-30. Additional sizing information is available on the individual product pages for other viscometer types.

Why does CANNON offer so many different types of glass capillary viscometers? Primarily because no single capillary viscometer is ideally suited for all kinematic viscosity determinations. Individual analysts also have their own preferences. The brief descriptions on the following page may assist you in determining which viscometer is most appropriate for your particular application. Feel free to contact CANNON with your questions. Our experienced staff will be happy to assist you.

Expanded Uncertainty

CANNON Instrument Company provides expanded uncertainty data with all of our calibrated viscometers. This is the universally accepted statistic when dealing with calibration data. In order to maintain A2LA accreditation, we are required to determine and specify the expanded uncertainty for all our calibration data.

ISO publications define expanded uncertainty as "quantity defining the interval about the result of a measurement within which the values that could reasonably be attributed to the measurement may be expected to lie with a high level of confidence."

Expanded uncertainty is a more comprehensive and meaningful term than "precision" because it incorporates all variables in the measurement process. When comparing the accuracy of viscometers it is essential that the expanded uncertainty be specified. Detailed information regarding CANNON measurements and expanded uncertainty is available for download from the CANNON website, www.cannoninstrument.com.

CANNON Instrument Company also provides uncertainty data with every bottle of our certified viscosity standards (see pages 42-49).

Specifications for CANNON® Viscometers

Table 1
Cannon-Fenske, Cannon-Ubbelohde, and Cannon-Ubbelohde Dilution Viscometers

Size	Approx. constant, cSt/s	Range centistokes*
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 20 000
650	45	9000 to 45 000
700	100	20 000 to 100 000

* Ranges in centistokes represent flow times of 250 to 1000 seconds for Size 25, and 200 to 1000 for all other sizes.

Table 2
Ubbelohde Viscometers

Size	Approx. constant, cSt/s	Range centistokes*
0	0.001	0.3 to 1
0C	0.003	0.6 to 3
0B	0.005	1 to 5
1	0.01	2 to 10
1C	0.03	6 to 30
1B	0.05	10 to 50
2	0.1	20 to 100
2C	0.3	60 to 300
2B	0.5	100 to 500
3	1.0	200 to 1000
3C	3.0	600 to 3000
3B	5.0	1000 to 5000
4	10	2000 to 10 000
4C	30	6000 to 30 000
4B	50	10 000 to 50 000
5	100	20 000 to 100 000

* Ranges in centistokes represent flow times of 300 to 1000 seconds for Size 0, and 200 to 1000 seconds for all other sizes.

CANNON® Glass Capillary Viscometers Types & Applications

ASTM D 446, ASTM D 2171, ISO 3105

CANNON offers many types of glass capillary viscometers that are not listed in our catalog. Examples include Atlantic, Cannon Master and Ubbelohde Master, Cannon-Ubbelohde Filter-Stick Dilution, Fitzsimons, Lantz-Zeitfuchs, Methylcellulose, SIL, and other viscometers. We can also manufacture glass capillary viscometers with customer-specified constants. Please contact CANNON for order information.

Cannon-Fenske Routine

The Cannon-Fenske Routine viscometer (page 26) is a rugged and inexpensive viscometer that works well if the liquid to be measured is transparent or translucent. In general, if the meniscus (the curvature at the top of the liquid column) can be readily observed through a column of liquid 3-mm in diameter, the Cannon-Fenske Routine viscometer and other transparent-type viscometers (such as the Zeitfuchs Transparent {page 31} and BS/U-Tube {page 33} viscometers) can be used.

Ubbelohde

The Ubbelohde viscometer (page 27) and other suspended level viscometers are also used to measure transparent liquids. Unlike the Cannon-Fenske Routine viscometer, suspended level viscometers possess the same viscometer constant at all temperatures. This property is advantageous when measurements are to be made at a number of different temperatures. CANNON has improved the design of the Ubbelohde viscometer to make a more rugged instrument called the Cannon-Ubbelohde viscometer (pages 27-28). Other suspended level viscometers in this catalog include the BS/IP/SL, BS/IP/SL(S), and BS/IP/MSL viscometers (pages 34-35).

Reverse Flow Viscometers

Special reverse flow viscometers have been designed for testing opaque liquids. Reverse flow viscometers wet the timing section of the viscometer capillary only during the actual measurement. The Cannon-Fenske Opaque (page 26), Zeitfuchs Cross-Arm (page 32), and BS/IP/RF U-Tube viscometers (page 35) are all reverse flow types. Reverse flow viscometers must be cleaned, dried, and refilled before a repeat measurement can be made. In contrast, other viscometer types commonly used to measure transparent liquids allow the same sample to be repeatedly drawn up into the capillary, permitting multiple measurements for verification.

Small Volume Viscometers

In some situations, such as in a clinical laboratory, the amount of liquid available for measurement is quite small. Several viscometers have been designed which require one milliliter or less of liquid. These are referred to as semi-micro or micro viscometers. The Cannon-Manning Semi-Micro (page 30) is a U-tube viscometer that has been modified to measure the kinematic viscosity of samples as small as 1.0 mL. The Cannon-Ubbelohde Semi-Micro viscometer (page 28) is a modification of the standard size Cannon-Ubbelohde viscometer requiring a sample volume of only one milliliter. The Cannon-Manning Semi-Micro Extra Low Change viscometer (page 30) will permit kinematic viscosity determination with as little as 0.5 milliliters of sample.

Dilution Viscometers

Estimates of the molecular size and shape of large polymer molecules can be obtained from kinematic viscosity measurements of dilute solutions of the polymers. The Cannon-Ubbelohde Dilution viscometer (page 30) has an extra-large reservoir which allows polymer solutions to be diluted several times. Dilute polymer solutions frequently appear to exhibit changes in kinematic viscosity when the shear rate is changed. By using the Cannon-Ubbelohde Four-Bulb Shear Dilution viscometer (page 29), measurements can be made at four different shear rates.

Vacuum Viscometers

In most glass capillary viscometers, the samples flow under gravity. When liquids are too viscous to flow readily under gravity, vacuum viscometers may be used to measure viscosity (in mPa•s or cP). In these instruments a vacuum is applied to one end of the viscometer to pull the liquid through the capillary into the timing bulb(s). CANNON offers several types of vacuum viscometers, including the Cannon-Manning Vacuum (page 36), the Asphalt Institute Vacuum (page 36), and the Modified Koppers Vacuum (page 37). Like the Cannon-Fenske Opaque viscometer, these are all "reverse flow" viscometers. Vacuum viscometers require a vacuum that is very accurately controlled. The CANNON DVR-1000 or DVR-1500 Digital Vacuum Regulator (see page 60) is an ideal instrument for maintaining constant vacuum.

Companion Product!
Digital Vacuum Regulator for vacuum viscosity - see page 60.

CE

Routine & Opaque Cannon-Fenske Viscometers

ASTM D 445, ASTN D 446, ISO 3104, ISO 3105

9721-A50 Series
9721-B50 Series

Cannon-Fenske Routine Viscometers

Calibrated CFRC Series

For measuring kinematic viscosity of transparent Newtonian liquids, particularly petroleum products or lubricants, according to ASTM D 445 and ISO 3104. Specifications conform to ASTM D 446 and ISO 3105.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Minimum sample volume 7 mL. Require liquid bath depth of 203 mm (8 inches).
- Constants and ranges are as specified in Table 1 on page 24.
- Holder is not supplied. For holders, see 9726-M50 and -M53 on page 37.
- Viscometers with special constants are available by special order at additional cost.

Size	Uncalibrated CFRU Series	Calibrated CFRC Series
25	9721-A50	9721-B50
50	9721-A53	9721-B53
75	9721-A56	9721-B56
100	9721-A59	9721-B59
150	9721-A62	9721-B62
200	9721-A65	9721-B65
300	9721-A68	9721-B68
350	9721-A71	9721-B71
400	9721-A74	9721-B74
450	9721-A77	9721-B77
500	9721-A80	9721-B80
600	9721-A83	9721-B83
650	9721-A86	9721-B86
700	9721-A89	9721-B89

Uncalibrated CFRU Series

Similar to 9721-B50 series, but uncalibrated.

- Holder is not supplied. For holders, see 9726-M50, -M53, and -M79 on page 37.

9721-E50 Series
9721-F50 Series

Cannon-Fenske Opaque Viscometers

Reverse-flow type for dark liquids

Calibrated CFOC Series

Reverse-flow type, for measurement of kinematic viscosity of dark Newtonian liquids according to ASTM D 445 and ISO 3104. Permit measurements of liquids whose meniscus cannot be seen at the timing marks when using Cannon-Fenske Routine-type viscometer. Used to measure kinematic viscosity of liquid (cutback) asphalts and road oils at 60°C (140°F) in range of 30 to 6000 centistokes according to ASTM D 2170. Also used to study lubricating oils at low temperatures when investigating the effect of various additives on lubricating and hydraulic oils. External pressure can be applied to vary shear stress and shear rate. Specifications conform to ASTM D 446 and ISO 3105 for single determinations of viscosity for opaque liquids. Upper bulb may be used for determining the degree of non-Newtonian behavior of the sample.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Minimum sample volume 12 mL. Require liquid bath depth of 229 mm (9 inches).
- Size 25 has approximate constant 0.002 cSt/s and range of 0.4 to 2 cSt. Constants and ranges for other sizes are as given in Table 1 on page 24.
- Holder is not supplied. For holders, see 9726-M50 and -M53 on page 37.
- For replacement micro stoppers, see 9726-N98 on page 37.
- Viscometers with special constants are available by special order at additional cost.

Size	Uncalibrated CFOU Series	Calibrated CFOC Series
25	9721-E50	9721-F50
50	9721-E53	9721-F53
75	9721-E56	9721-F56
100	9721-E59	9721-F59
150	9721-E62	9721-F62
200	9721-E65	9721-F65
300	9721-E68	9721-F68
350	9721-E71	9721-F71
400	9721-E74	9721-F74
450	9721-E77	9721-F77
500	9721-E80	9721-F80
600	9721-E83	9721-F83
650	9721-E86	9721-F86
700	9721-E89	9721-F89

Uncalibrated CFOU Series

Similar to 9721-F50 series, but uncalibrated.

- Holder is not supplied. For holders, see 9726-M50, -M53, and -M79 on page 37.

Suspended Level Ubbelohde Viscometers

ASTM D 445, ASTM D 446, ISO 3104, ISO 3105

9721-N50 Series
9721-R50 Series
9721-U50 Series

Ubbelohde Viscometers

Calibrated UBC Series

For measurement of kinematic viscosity of transparent Newtonian liquids by suspended level principle as described in ASTM D 445 and D 446, and ISO 3104 and 3105. Similar to Cannon-Ubbelohde but less rugged in design.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Minimum sample volume 11 mL. Require liquid bath depth of 241 mm (9.5 inches).
- Constants and ranges are as specified in Table 2 on page 24.
- Holder is not supplied. For holder, see 9726-M82 on page 37.

Size	*Uncalibrated UBU Series*	*Calibrated UBC Series*	*Calibrated UBXC Series*
0	9721-N50	9721-R50	9721-U50
0C	9721-N53	9721-R53	9721-U53
0B	9721-N56	9721-R56	9721-U56
1	9721-N59	9721-R59	9721-U59
1C	9721-N62	9721-R62	9721-U62
1B	9721-N65	9721-R65	9721-U65
2	9721-N68	9721-R68	9721-U68
2C	9721-N71	9721-R71	9721-U71
2B	9721-N74	9721-R74	9721-U74
3	9721-N77	9721-R77	9721-U77
3C	9721-N80	9721-R80	9721-U80
3B	9721-N83	9721-R83	9721-U83
4	9721-N86	9721-R86	9721-U86
4C	9721-N89	9721-R89	9721-U89
4B	9721-N92	9721-R92	9721-U92
5	9721-N95	9721-R95	9721-U95

Uncalibrated UBU Series

Similar to 9721-R50 series, but uncalibrated.

- Holder is not supplied. For holder, see 9726-M82 on page 37.

Ubbelohde Unity Factor Calibrated UBXC Series

Similar to 9721-R50 series, but with constant within ± 0.2% of values listed in Table 2 on page 24. Provided with certificate of calibration and instruction sheet.

- Holder is not supplied. For holder, see 9726-M82 on page 37.

9721-J50 Series
9721-K50 Series

Cannon-Ubbelohde Viscometers

Calibrated CUC Series

Suspended level viscometer for measurement of kinematic viscosity of transparent Newtonian liquids according to ASTM D 445 and ISO 3104. Also used for evaluating jet and hydraulic lubricants. Especially suited for use at temperatures above 93°C (200°F) or below –18°C (0°F). Require no kinetic energy corrections over 0.5 to 100 000 centistokes range. Viscometer constant is same at all temperatures. Specifications conform to ASTM D 446 and ISO 3105.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Minimum sample volume 11 mL. Require liquid bath depth of 254 mm (10-inches); must be submerged to approximately 220 mm (8.5-inches).
- Constants and ranges are as specified in Table 1 on page 24.
- Holder is not supplied. For holders, see 9726-M70, -M73, and -M76 on page 37.

Size	*Uncalibrated CUU Series*	*Calibrated CUC Series*
25	9721-J50	9721-K50
50	9721-J53	9721-K53
75	9721-J56	9721-K56
100	9721-J59	9721-K59
150	9721-J62	9721-K62
200	9721-J65	9721-K65
300	9721-J68	9721-K68
350	9721-J71	9721-K71
400	9721-J74	9721-K74
450	9721-J77	9721-K77
500	9721-J80	9721-K80
600	9721-J83	9721-K83
650	9721-J86	9721-K86
700	9721-J89	9721-K89

Uncalibrated CUU Series

Similar to 9721-K50 series, but uncalibrated.

Holder is not supplied. For holders, see 9726-M70, -M73, and -M76 on page 37.

Semi-Micro & Dilution Cannon-Ubbelohde Viscometers

ASTM D 445, ASTM D 446, ISO 3104, ISO 3105

9722-G50 Series
9722-H50 Series

Cannon-Ubbelohde Semi-Micro Viscometers

Semi-Micro Calibrated CUSMC Series

For measuring kinematic viscosity of small samples of transparent Newtonian liquids according to ASTM D 445 and ISO 3104. Specifications conform to ASTM D 446 and ISO 3105. Viscometer constant is same at all temperatures.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Minimum sample volume approximately 1.0 mL. Sizes 400 through 600 may require larger sample volume. Initial sample can be diluted to as much as 20 mL for intrinsic viscosity determinations. Require liquid bath depth of 240 mm (9.5 inches).
- Size 25 has approximate constant 0.002 cSt/s and a range of 0.4 to 2 cSt. Constants and ranges for all other sizes are as given in Table 1 on page 37.
- Holder is not supplied. For holders, see 9726-M70, -M73, and -M76 on page 37.

Size	*Uncalibrated CUSMU Series*	*Calibrated CUSMC Series*
25	9722-G50	9722-H50
50	9722-G53	9722-H53
75	9722-G56	9722-H56
100	9722-G59	9722-H59
150	9722-G62	9722-H62
200	9722-G65	9722-H65
300	9722-G68	9722-H68
350	9722-G71	9722-H71
400	9722-G74	9722-H74
450	9722-G77	9722-H77
500	9722-G80	9722-H80
600	9722-G83	9722-H83

Semi-Micro Uncalibrated CUSMU Series

Similar to 9722-H50 series, but uncalibrated.

- Holder is not supplied. For holders, see 9726-M70, -M73, and -M76 on page 37.

9722-L50 Series
9722-M50 Series

Cannon-Ubbelohde Dilution Viscometers

Dilution Type Calibrated CUDC Series

For measurement of intrinsic viscosity of transparent Newtonian liquids according to ASTM D 445 and ISO 3104. Specifications conform to ASTM D 446 and ISO 3105. Viscometer constant is same at all temperatures.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Minimum sample volume of 8 mL can be diluted to 40 mL. Require liquid bath depth of 305 mm (12 inches). The CANNON CT-518 bath is recommended.
- Constants and ranges are as specified in Table 1 on page 24.
- Holder is not supplied. For holders, see 9726-M70, -M73, and -M76 on page 37.

Size	*Uncalibrated CUDU Series*	*Calibrated CUDC Series*
25	9722-L50	9722-M50
50	9722-L53	9722-M53
75	9722-L56	9722-M56
100	9722-L59	9722-M59
150	9722-L62	9722-M62
200	9722-L65	9722-M65
300	9722-L68	9722-M68
350	9722-L71	9722-M71
400	9722-L74	9722-M74
450	9722-L77	9722-M77
500	9722-L80	9722-M80
600	9722-L83	9722-M83

Dilution Type Uncalibrated CUDU Series

Similar to 9722-M50 series, but uncalibrated.

- Holder is not supplied. For holders, see 9726-M70, -M73, and -M76 on page 37.

Cannon-Ubbelohde Four-Bulb Shear Dilution Viscometers

ASTM D 445, ASTM D 446, ISO 3104, ISO 3105

9723-L50 Series
9723-M50 Series
9723-N50 Series
9723-R50 Series

Cannon-Ubbelohde Four-Bulb Shear Dilution Viscometers

Five-fold dilution type

Calibrated CUSDC-11 Series

For measurement of intrinsic viscosities extrapolated to zero shear rate. Provide five-fold range of shear rates. Design gives extra mechanical strength. Negligible kinetic energy correction.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Minimum sample volume 20 mL. Require liquid bath depth of 280 mm (11 inches).
- Holder is not supplied. For holders, see 9726-M70, -M73, and -M76 on page 37.

Uncalibrated CUSDU-11 Series

Similar to 9723-M50 series, but uncalibrated.

- Holder is not supplied. For holders, see 9726-M70, -M73, and -M76 on page 37.

Ten-fold dilution type

Calibrated CUSDC-17 Series

Similar to 9723-M50 series, but provide ten-fold range of shear rates.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Minimum sample volume 20 mL. Require liquid bath depth of 430 mm (17 inches). The CT-518 bath is recommended.
- Holder is not supplied. For holders, see 9726-M70, -M73, and -M76 on page 37.

Uncalibrated CUSDU-17 Series

Similar to 9723-R50 series, but uncalibrated.

- Holder is not supplied. For holders, see 9726-M70, -M73, and -M76 on page 37.

Specifications for Ten-fold Dilution Type

Size†	Approx. constant, cSt/s	*Range cSt	Shear rate at wall, reciprocal seconds
25	0.002	0.4 to 2	82 to 3300
50	0.004	0.8 to 4	45 to 1800
75	0.008	1.6 to 8	24 to 960
100	0.015	3 to 15	15 to 600
150	0.035	7 to 35	8 to 320

* Ranges in centistokes represent flow times of 200 to 1000 seconds.

Size†	Uncalibrated CUSDU-11 Series	Calibrated CUSDC-11 Series
25	9723-L50	9723-M50
50	9723-L53	9723-M53
75	9723-L56	9723-M56
100	9723-L59	9723-M59
150	9723-L62	9723-M62

Specifications for Five-fold Dilution Type

Size†	Approx. Constant, cSt/s	*Range cSt	Shear rate at wall, reciprocal seconds
25	0.002	0.4 to 2	82 to 1650
50	0.004	0.8 to 4	45 to 900
75	0.008	1.6 to 8	24 to 480
100	0.015	3 to 15	15 to 300
150	0.035	7 to 35	8 to 160

* Ranges in centistokes represent flow times of 200 to 1000 seconds.

Size†	Uncalibrated CUSDU-17 Series	Calibrated CUSDC-17 Series
25	9723-N50	9723-R50
50	9723-N53	9723-R53
75	9723-N56	9723-R56
100	9723-N59	9723-R59
150	9723-N62	9723-R62

†Additional tube sizes with larger constants available by request.

Cannon-Manning Semi-Micro Low Charge Viscometers

ASTM D 445, ASTM D 446, ISO 3104, ISO 3105

9721-X50 Series
9721-Y50 Series

Cannon-Manning Semi-Micro Viscometers

Calibrated CMSMC Series

For measurement of kinematic viscosity of small samples of transparent Newtonian liquids, including petroleum products or lubricants, according to ASTM D 445 and ISO 3104. Specifications conform to ASTM D 446 and ISO 3105.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Sample volume approximately 1.0 mL. Sizes 400 through 600 may require more sample. Require liquid bath depth of 200 mm (8 inches).
- Size 25 has approximate constant 0.002 cSt/s and a range of 0.4 to 2 cSt. Constants and ranges for all other sizes are as given in Table 1 on page 24.
- Holder is not supplied. For holders, see 9726-M50 and -M53 on page 37.

Size	*Uncalibrated CMSMU Series*	*Calibrated CMSMC Series*
25	9721-X50	9721-Y50
50	9721-X53	9721-Y53
75	9721-X56	9721-Y56
100	9721-X59	9721-Y59
150	9721-X62	9721-Y62
200	9721-X65	9721-Y65
300	9721-X68	9721-Y68
350	9721-X71	9721-Y71
400	9721-X74	9721-Y74
450	9721-X77	9721-Y77
500	9721-X80	9721-Y80
600	9721-X83	9721-Y83

Uncalibrated CMSMU Series

Similar to 9721-Y50 series, but uncalibrated.

- Holder is not supplied. For holders, see 9726-M50 and -M53 on page 37.

9722-C50 Series
9722-D50 Series

Cannon-Manning Semi-Micro Extra Low Charge Viscometers

Extra Low Charge Calibrated CMSMEC Series

Similar to 9721-Y50 series, but require smaller sample volume of approximately 0.5 mL. Sizes 200 through 600 may require larger volume of sample.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Without holder.

Size	*Uncalibrated CMSMEU Series*	*Calibrated CMSMEC Series*
25	9722-C50	9722-D50
50	9722-C53	9722-D53
75	9722-C56	9722-D56
100	9722-C59	9722-D59
150	9722-C62	9722-D62
200	9722-C65	9722-D65
300	9722-C68	9722-D68
350	9722-C71	9722-D71
400	9722-C74	9722-D74
450	9722-C77	9722-D77
500	9722-C80	9722-D80
600	9722-C83	9722-D83

Extra Low Charge Uncalibrated CMSMEU Series

Similar to 9722-D50 series, but uncalibrated.

- Without holder.

Companion Product!

Constant Temperature Baths (ASTM D 445 compliant) - see pages 16-23.

CANNON® Zeitfuchs Transparent Viscometers

ASTM D 445, ASTM D 446, ISO 3104, ISO 3105

9723-A50 Series
9723-B50 Series

Zeitfuchs® Transparent Viscometers With permanently attached round metal holder

Calibrated ZTC-RO Series

For measurement of kinematic viscosity of transparent Newtonian liquids according to ASTM D 445 and ISO 3104. Specifications conform to ASTM D 446 and ISO 3105. Filling, measurement, and cleaning can be done without removal from constant temperature bath.

Certificate of calibration and instruction sheet provided. See page 24 for significance of expanded uncertainty.

- Minimum sample volume 15 mL. Require liquid bath depth of 292 mm (11.5 inches).
- For constants and ranges, see table at right.
- Manufactured with permanently attached round metal holder, for hole 51 mm (2 inches) in diameter.

Uncalibrated ZTU-RO Series

Similar to 9723-B50 series, but uncalibrated.

Specifications for Zeitfuchs® Transparent* & Zeitfuchs® Cross-Arm Viscometers

Size	*Approximate constant, cSt/s*	*Viscosity, cSt†*
1	0.003	0.6 to 3
2	0.01	2 to 10
3	0.03	6 to 30
4	0.1	20 to 100
5	0.3	60 to 300
6	1.0	200 to 1000
7	3.0	600 to 3000
8	10	2000 to 10 000
9	30	6000 to 30 000
10	100	20 000 to 100 000

* Zeitfuchs Transparent viscometers are available only in sizes 1 through 7.

† Ranges in centistokes represent flow times of 200 to 1000 seconds.

Size	*Uncalibrated ZTU-RO Series*	*Calibrated ZTC-RO Series*
1	9723-A50	9723-B50
2	9723-A55	9723-B55
3	9723-A60	9723-B60
4	9723-A65	9723-B65
5	9723-A70	9723-B70
6	9723-A75	9723-B75
7	9723-A80	9723-B80

9723-C50 Series
9723-D50 Series

With permanently attached rectangular metal holder

Calibrated ZTC-RE Series

For measurement of kinematic viscosity of transparent Newtonian liquids according to ASTM D 445 and ISO 3104. Specifications conform to ASTM D 446 and ISO 3105. Filling, measurement, and cleaning can be done without removal from constant temperature bath.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Minimum sample volume 15 mL. Require liquid bath depth of 292 mm (11.5 inches).
- For constants and ranges, see table (above right).
- Manufactured with permanently attached rectangular metal holder which requires a bath opening of 25 x 48 mm (1 x 1.9 inches).

Calibrated ZTU-RE Series

Similar to 9723-D50 series, but uncalibrated.

Size	*Uncalibrated ZTU-RE Series*	*Calibrated ZTC-RE Series*
1	9723-C50	9723-D50
2	9723-C55	9723-D55
3	9723-C60	9723-D60
4	9723-C65	9723-D65
5	9723-C70	9723-D70
6	9723-C75	9723-D75
7	9723-C80	9723-D80

CANNON® Zeitfuchs Cross-Arm Viscometers

ASTM D 445, ASTM D 446, ASTM D 2170, ISO 3104, ISO 3105

9723-S50 Series
9723-U50 Series

Calibrated Zeitfuchs® Cross-Arm Viscometers

For measurement of kinematic viscosity of transparent and opaque Newtonian liquids according to ASTM D 445 and ISO 3104. Specifications conform to ASTM D 446 and ISO 3105. Also used to measure kinematic viscosity of liquid (cutback) asphalts and road oils at 60°C (140°F) and asphalt cements at 135°C (275°F) in the range of 30 to 6000 centistokes according to ASTM D 2170. Can be filled and cleaned while in constant temperature bath.

- Minimum sample volume 1 to 3 mL. Require liquid bath depth of 230 mm (9 inches).
- Constants and ranges are as described in table on page 33.
- All instruments calibrated. Certificate of calibration and instruction sheet provided. See page 24 for expanded uncertainty. Offered with and without holder as described below.

ZCAC Series

As described above. Without holder.

- For holder, see 9726-M95 and -M98 on page 37.

Unity Factor ZCAXC Series

Similar to 9723-S50 series, but have constant within ± 0.2% of values listed in table on page33.

- For holder, see 9726-M95 and -M98 on page 37.

Size	ZCAC Series	ZCAXC Series Unity Factor
1	9723-S50	9723-U50
2	9723-S53	9723-U53
3	9723-S56	9723-U56
4	9723-S59	9723-U59
5	9723-S62	9723-U62
6	9723-S65	9723-U65
7	9723-S68	9723-U68
8	9723-S71	9723-U71
9	9723-S74	9723-U74
10	9723-S77	9723-U77

9723-W50 Series
9723-Y50 Series
9724-B50 Series
9724-D50 Series

With permanently attached round metal holder

ZCAC-RO Series

As described above. Supplied with permanently attached round metal holder, for hole 51 mm (2 inches) in diameter.

Unity Factor ZCAXC-RO Series

Similar to 9723-W50 series, but have constant which is within ± 0.2% of values listed in table on page 33.

Size	ZCAC-RO Series	Unity Factor ZCAXC-RO Series
1	9723-W50	9723-Y50
2	9723-W53	9723-Y53
3	9723-W56	9723-Y56
4	9723-W59	9723-Y59
5	9723-W62	9723-Y62
6	9723-W65	9723-Y65
7	9723-W68	9723-Y68
8	9723-W71	9723-Y71
9	9723-W74	9723-Y74
10	9723-W77	9723-Y77

With permanently attached rectangular metal holder

ZCAC-RE Series

As described above. Supplied with permanently attached rectangular metal holder which requires bath opening 25 x 48 mm (1 x 1.9 inches).

Unity Factor ZCAXC-RE Series

Similar to 9724-B50 series, but have constant within ± 0.2% of value listed in table on page 33.

Size	ZCAC-RE Series	Unity Factor ZCAXC-RE Series
1	9724-B50	9724-D50
2	9724-B53	9724-D53
3	9724-B56	9724-D56
4	9724-B59	9724-D59
5	9724-B62	9724-D62
6	9724-B65	9724-D65
7	9724-B68	9724-D68
8	9724-B71	9724-D71
9	9724-B74	9724-D74
10	9724-B77	9724-D77

CANNON® BS/U-Tube Viscometers

ASTM D 445, ASTM D 446, ISO 3104, ISO 3105

9724-E50 Series

BS/U-Tube Viscometers For Transparent Liquids

For measurement of kinematic viscosity of transparent Newtonian liquids according to ASTM D 445 and ISO 3104. Specifications conform to ASTM D 446 and ISO 3105.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Minimum sample volume 7 mL in sizes A to C, 12 mL in sizes D to F, and 23 mL in sizes G and H. Require liquid bath depth of 280 mm (11 inches).
- Without holder.

Specifications for BS/U-Tube Viscometers

Size	Approx. Constant, mm^2/s^2 (cSt/s)	Viscosity Range mm^2/ sec (cSt)*
A	0.003	0.9 to 3
B	0.01	2.0 to 10
C	0.03	6 to 30
D	0.1	20 to 100
E	0.3	60 to 300
F	1.0	200 to 1000
G	3.0	600 to 3000
H	10.0	2000 to 10 000

* Ranges in centistokes represent flow times of 300 to 1000 seconds for Size A and 200 to 1000 seconds for all other sizes.

Size	Calibrated BS/U-Tube Series
A	9724-E50
B	9724-E53
C	9724-E56
D	9724-E59
E	9724-E62
F	9724-E65
G	9724-E68
H	9724-E71

9724-E80 Series

BS/U/M Miniature U-Tube Viscometers

For measurement of kinematic viscosity of transparent Newtonian liquids according to ASTM D 445 and ISO 3104. Specifications conform to ASTM D 446 and ISO 3105.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Minimum sample volume 2 mL. Require liquid bath depth of 230 mm (9 inches).
- Without holder.

Specifications for BS/U/M Miniature U-Tube Viscometers

Size	Approx. Constant, mm^2/s^2 (cSt/s)	Viscosity Range, mm^2/ sec (cSt)*
M1	0.001	0.2 to 1
M2	0.005	1 to 5
M3	0.015	3 to 15
M4	0.04	8 to 40
M5	0.1	20 to 100

* Ranges in centistokes represent flow times of 200 to 1000 seconds.

Size	Calibrated BS/U/M Series
M1	9724-E80
M2	9724-E83
M3	9724-E86
M4	9724-E89
M5	9724-E92

CANNON® Suspended Level Viscometers

ASTM D 445, ASTM D 446, ISO 3104, ISO 3105

9724-F10 Series

BS/IP/SL Suspended Level Viscometers

For measurement of kinematic viscosity of transparent Newtonian liquids according to ASTM D 445 and ISO 3104. Specifications conform to ASTM D 446 and ISO 3105.

Provided with certificate of calibration and instruction sheet.
See page 24 for significance of expanded uncertainty.

- Minimum sample volume 11 mL. Require liquid bath depth of 250 mm (10 inches).
- Holder is not supplied. For holder, see 9726-M99 on page 37.

Specifications for BS/IP/SL Suspended Level Viscometers

Size	*Approx. Constant mm^2/s^2 (cSt/s)*	*Viscosity Range, mm^2/sec (cSt)**	*Calibrated BS/IP/SL Series*
1	0.01	3.5 to 10	9724-F10
1A	0.03	6 to 30	9724-F13
2	0.1	20 to 100	9724-F16
2A	0.3	60 to 300	9724-F19
3	1.0	200 to 1000	9724-F22
3A	3.0	600 to 3000	9724-F25
4	10	2000 to 10 000	9724-F28
4A	30	6000 to 30 000	9724-F31
5	100	20 000 to 100 000	9724-F34

* Ranges in centistokes represent flow times of 350 to 1000 seconds for Size 1 and 200 to 1000 seconds for all other sizes.

9724-F50 Series

BS/IP/SL(S) Viscometers

For measurement of kinematic viscosity of transparent Newtonian liquids according to ASTM D 445 and ISO 3104. Specifications conform to ASTM D 446 and ISO 3105.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Minimum sample volume 10 mL. Require liquid bath depth of 230 mm (9 inches).
- Holder is not supplied. For holder, see 9726-M99 on page 37.

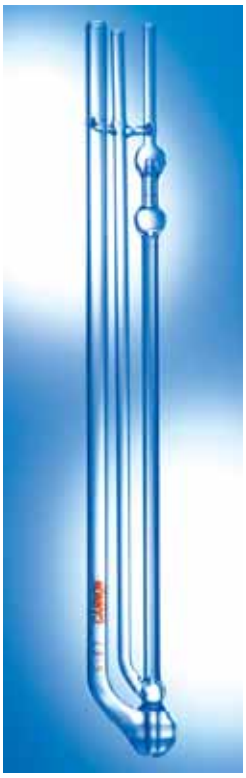
Specifications for Shortened Form BS/IP/SL(S) Suspended Level Viscometers

Size	*Approx. Constant, mm^2/s^2 (cSt/s)*	*Viscosity Range, mm^2/sec (cSt)*	*Calibrated BS/IP/SL(S) Series*
1	0.0008	1.05 minimum*	9724-F50
2	0.003	2.1† to 3	9724-F53
3	0.01	3.8‡ to 10	9724-F56
4	0.03	6¤ to 30	9724-F59
5	0.1	20 to 100	9724-F62
6	0.3	60 to 300	9724-F65
7	1.0	200 to 1000	9724-F68
8	3.0	600 to 3000	9724-F71
9	10	2000 to 10 000	9724-F74

* 1 320 seconds minimum flow time.
† 600 seconds minimum flow time to 1000 seconds.
‡ 380 seconds minimum flow time to 1000 seconds.
¤ Ranges in centistokes represent flow times of 200 to 1000 seconds for all other sizes.

Suspended Level & Reverse Flow BS/IP Viscometers

ASTM D 445, ASTM D 446, ISO 3104, ISO 3105



9724-G10 Series

BS/IP/MSL Miniature Suspended Level Viscometers

For measurement of kinematic viscosity of transparent Newtonian liquids according to ASTM D 445 and ISO 3104. Specifications conform to ASTM D 446 and ISO 3105.

Provided with certificate of calibration and instruction sheet.
See page 24 for significance of expanded uncertainty.

- Minimum sample volume 4 mL. Require liquid bath depth of 305 mm (12 inches).
- Holder is not supplied. For holder, see 9726-M99 on page 37.

Specifications for BS/IP/MSL Miniature Suspended Level Viscometers

Size	Approx. Constant, mm^2/s^2 (cSt/s)	Viscosity Range, mm^2/sec (cSt)*	Calibrated Series BS/IP/MSL
1	0.003	0.6 to 3	9724-G10
2	0.01	2 to 10	9724-G13
3	0.03	6 to 30	9724-G16
4	0.1	20 to 100	9724-G19
5	0.3	60 to 300	9724-G22
6	1.0	200 to 1000	9724-G25
7	3.0	600 to 3000	9724-G28

* Ranges in centistokes represent flow times of 200 to 1000 seconds.

9724-G50 Series

BS/IP/RF U-Tube Reverse Flow Viscometers

For measurement of kinematic viscosity of opaque Newtonian liquids according to ASTM D 445 and ISO 3104. Specifications conform to ASTM D 446 and ISO 3105.

Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.

- Minimum sample volume 7 mL. Require liquid bath depth of 280 mm (11 inches).
- Holder is not supplied. For holder, see 9726-N45 on page 37.

Specifications for BS/IP/RF U-Tube Reverse Flow Viscometers

Size	Approx. Constant mm^2/s^2 (cSt/s)	Viscosity Range mm^2/sec (cSt)*	Calibrated BS/IP/RF U-Tube Series
1	0.003	0.6 to 3	9724-G50
2	0.01	2 to 10	9724-G53
3	0.03	6 to 30	9724-G56
4	0.1	20 to 100	9724-G59
5	0.3	60 to 300	9724-G62
6	1.0	200 to 1000	9724-G65
7	3.0	600 to 3000	9724-G68
8	10	2000 to 10 000	9724-G71
9	30	6000 to 30 000	9724-G74
10	100	20 000 to 100 000	9724-G77
11	300	60 000 to 300 000	9724-G80

* Ranges in centistokes represent flow times of 200 to 1000 seconds.

CANNON® Vacuum Viscometers

ASTM D 2171

9724-H50 Series

Cannon-Manning Vacuum Viscometers

Cannon-Manning Vacuum Calibrated CMVC Series

For measurement of viscosity of highly viscous materials such as asphalt cement at 60°C (140°F) according to ASTM D 2171. Applicable to materials with viscosity range of 0.036 to 80 000 poise. Vacuum of 300 mm Hg is applied to small arm with timing bulbs; two bulbs are incorporated to extend viscosity range of viscometer.

- Minimum sample volume 6 mL. Require liquid bath depth of 180 mm (7.1 inches).
- Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.
- Holder is not supplied. For holder, see 9726-N15 on page 37.

Cannon-Manning Vacuum Calibrated CMVC-RO Series

Same as 9724-H50 series, but with permanently attached round metal holder, for hole 51 mm (2 inches) in diameter.

Specifications for Cannon-Manning Vacuum Viscometers

Size	Viscosity range, poise	Approx. constant poise/second at 300 mm Hg vacuum	
		Bulb B	Bulb C
4	0.036 to 0.8	0.002	0.0006
5	0.12 to 2.4	0.006	0.002
6	0.36 to 8	0.02	0.006
7	1.2 to 24	0.06	0.02
8	3.6 to 80	0.2	0.06
9	12 to 240	0.6	0.2
10	36 to 800	2	0.6
11	120 to 2400	6	2
12	360 to 8000	20	6
13	1200 to 24 000	60	20
14	3600 to 80 000	200	60

Size	Calibrated CMVC Series	Calibrated CMVC-RO Series
4	9724-H50	9724-L50
5	9724-H53	9724-L53
6	9724-H56	9724-L56
7	9724-H59	9724-L59
8	9724-H62	9724-L62
9	9724-H65	9724-L65
10	9724-H68	9724-L68
11	9724-H71	9724-L71
12	9724-H74	9724-L74
13	9724-H77	9724-L77
14	9724-H80	9724-L80

9724-R50 Series

Asphalt Institute Vacuum Viscometers

Asphalt Institute Vacuum Calibrated AIVC Series

Similar to 9724-H50 series, but with graduated capillary instead of two timing bulbs.

- Minimum sample size 3 mL. Require bath depth of 180 mm (7.1 inches).
- Note: For sizes 400R and 800R, the "roofing" design is normally used for segment B, which extends the viscosity range to 1 400 000 and 5 800 000 poise, respectively. See ASTM D 2171, Table X2.
- Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.
- Holder is not supplied. For holder, see 9726-N15 on page 37.

Asphalt Institute Vacuum Calibrated AIVC-RO Series

Same as 9724-R50 series, but with permanently attached round metal holder, for hole 51 mm (2 inches) in diameter.

Specifications for Asphalt Institute Vacuum Viscometers

Size	Viscosity range, poise	Approx. constant poise/second at 300 mm Hg vacuum		
		at B	at C	at D
25	42 to 800	2	1	0.7
50	180 to 3200	8	4	3
100	600 to 12 800	32	16	10
200	2400 to 52 000	128	64	40
400R	9600 to 1 400 000	500	250	160
800R	38 000 to 5 800 000	2000	1000	640

Size	Calibrated AIVC Series	Calibrated AIVC-RO Series
25	9724-R50	9724-T50
50	9724-R55	9724-T55
100	9724-R60	9724-T60
200	9724-R65	9724-T65
400R	9724-R70	9724-T70
800R	9724-R75	9724-T75

CANNON® Vacuum Viscometers & Viscometer Holders

ASTM D 2171

9724-W50 Series

Cannon Modified Koppers Vacuum Viscometers

Calibrated MKVC Series

For measurement of viscosity of asphalts at 60°C (140°F) in accordance with ASTM Standard D 2171. Applicable to materials with viscosity range of 42 to 200 000 poise. Two-piece design, with sample reservoir and calibrated capillary. Vacuum of 300 mm Hg must be applied to top of capillary tube.

- Minimum sample volume 2 mL. Require liquid bath depth of 178 mm (7 inches).
- Provided with certificate of calibration and instruction sheet. See page 24 for significance of expanded uncertainty.
- Holder is not supplied. For holder, see 9726-N30.

Specifications for Cannon Modified Koppers Vacuum Viscometers

Size	*Viscosity range, poise*	*Approx. constant poise/second at 300 mm Hg vacuum*		
		at B	at C	at D
25	42 to 800	2	1	0.7
50	180 to 3200	8	4	3
100	600 to 12 800	32	16	10
200	2400 to 52 000	128	64	40
400	9600 to 200 000	500	250	160

Size	*Calibrated MKVC Series*
25	9724-W50
50	9724-W55
100	9724-W60
200	9724-W65
400	9724-W70

Viscometer Holders

Removable Holders for Cannon Viscometers

All CANNON viscometer holders fit holes 51 mm (2 inches) in diameter. Rubber holders are made of neoprene rubber. Plastic holders are self-aligning and hold the viscometer firmly by means of a spring clip. Metal holders are also self aligning, and are constructed of chrome-plated machined brass. All metal holders are provided with a handle.

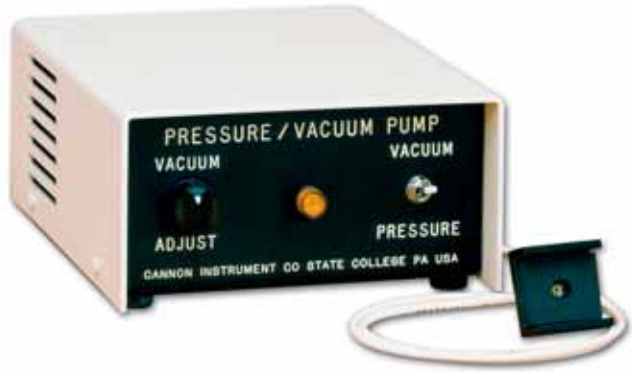
Viscometer Holder Selection Chart

Viscometer	*Type of Holder*		
	Plastic	*Rubber*	*Metal*
Cannon-Fenske Routine	H100	H110	H113
Cannon-Fenske Opaque	H100	H110	H113
Cannon-Ubbelohde	H101	H120	H131
Ubbelohde	—	—	H130
Cannon-Manning Semi-Micro	H100	H110	—
Cannon-Ubbelohde Semi-Micro	H101	H120	H131
Cannon-Ubbelohde Dilution	H101	H120	H131
Cannon-Ubbelohde Four-Bulb Shear Dilution	H101	H120	H131
Zeitfuchs® Cross-Arm	—	H115	H132
BS/IP/SL Suspended Level	—	—	H133
BS/IP/SL(S) Suspended Level	—	—	H133
BS/IP/MSL Miniature Suspended Level	—	—	H133
BS/IP/RF U-Tube Reverse Flow	—	H142	—
Cannon-Manning Vacuum	—	H140	—
Asphalt Institute Vacuum	—	H140	—
Modified Koppers Vacuum	—	H141	—
Cannon-Ubbelohde Filter Stick	—	H142	—

Catalog Numbers For Viscometer Holders

Holder	*Catalog #*
H100	9726-M50
H101	9726-M70
H110	9726-M53
H113	9726-M79
H115	9726-M95
H120	9726-M73
H130	9726-M82
H131	9726-M76
H132	9726-M98
H133	9726-M99
H140	9726-N15
H141	9726-N30
H142	9726-N45

CANNON® Viscometer Accessories



CANNON® Pressure/Vacuum Pump

Designed for use in laboratory applications where an inexpensive, compact source of low level pressure/vacuum is required. Especially well suited for filling viscometers and pipettes or for filtration. A must for glass capillary viscometry using high-viscosity liquids. The CANNON Pressure/Vacuum Pump operates quietly on a 120 volt AC supply to produce a continuous pressure of 35 psi or an adjustable, continuous vacuum of 0 to 20 inches of mercury. Front panel features include a toggle switch with pressure/vacuum/off positions, vacuum adjustment knob and an indicating pilot light. Fused circuits and a grounded plug ensure safe operation. The Pressure/ Vacuum Pump is provided with a multiple fittings kit and polyurethane tubing. Other fittings for custom applications may be specially ordered.

IBF Bath Oil

IBF is an ideal bath oil for CANNON heated baths with applications at ambient termperature and above. IBF Bath Oil contains an oxidation inhibitor which reduces tendency to darken at higher temperatures. Viscosity is 36 cSt at 40°C, 5.6 cSt at 100°C. Use below 135°C (275°F).

Nochromix® Cleaning Compound

- Rinses Clean Without Leaving Residue

Nochromix is an inorganic oxidizer, completely free of metal ions. It is used for preparation of glassware cleaning solution that avoids metal residue. This is beneficial in trace analysis, enzymology, tissue culture work, and other applications. Supplied in 1½ oz. sealed packets. Each packet makes 5 pints (2.37 L) of solution by dissolving in 9 lb (5-pint bottle) of concentrated sulfuric acid. Nochromix is classified as a hazardous material and special shipping regulations apply.

Solid Rubber Micro Stoppers

Tapered from 6 mm top diameter to 2 mm bottom diameter. Length 20 mm. For use with all suspended-level viscometers and Cannon-Fenske Opaque (CFO) viscometers sizes 25-450. For CFO sizes 500 and above, order part # P11.3110.

Silicone Bath Oils

- Ideal for Automatic Viscometers

These silicone bath oils are clear, colorless liquids that can be used as heat transfer media in CANNON automated viscometers and some high-temperature CANNON baths where IBF fluid (see catalog entry, this page) is not effective. Three viscosity grades of silicone bath fluid are available for different temperature/viscosity ranges (see order information below).

Please note: In CANNON Automatic Viscometer baths (see pages 6-7), the following silicone oils are recommended: 9726-L30 for use from 25 to 100°C, 9726-L33 for use from 80 to 135°C, 9726-L36 for use from 135 to 150°C.

CANNON® Pressure/Vacuum Pump Specifications

Overall Dimensions:	187 x 146 x 76 mm high (7.4 x 5.75 x 3 inches)
Shipping Weight:	1.4 kg (3 lb)

Order Information

Catalog #	*Item Description*
9726-L96	Pressure/Vacuum Pump, 120 volts, 60 Hz, 150 watts
9726-L20	IBF Bath Oil, 22.7 L/6 Gal Container, to 135°C
2903-A40	Nochromix, Box 10 packets
9726-N98	Stopper, Black, Package of 12
9726-L30	Silicone Bath Oil, 18 liter (4.7 gal) container, 10 cSt at 25°C, for use at 100°C*
9726-L33	Silicone Bath Oil, 18 liter (4.7 gal) container, 20 cSt at 25°C, for use at 135°C*
9726-L36	Silicone Bath Oil, 18 liter (4.7 gal) container, 50 cSt at 25°C, for use at 150°C*

* *Also available in one gallon containers.*

Capillary Viscometers - How Do You Clean Them?

Clean viscometers are essential if precise and accurate measurements are to be made. Because CANNON receives a significant number of requests for advice about cleaning methods, we offer the following instructions as a guide to cleaning most glass capillary viscometers.

Removing the test sample from the viscometer

The first step in cleaning is to remove the bulk of the test sample. For low viscosity liquids, the viscometer may be turned upside down and allowed to hang while the test sample drains into a trough. For high viscosity liquids, the sample may have to be drawn out under vacuum. The material remaining in the viscometer must then be removed by flushing with a suitable solvent. Distilled water is an obvious choice for aqueous solutions. Petroleum-based lubricants and asphalts can usually be dissolved with light naphtha, heptane, octane, highly aromatic solvents, and many other petroleum-derived solvents. Varsol® is a commercial solvent that works very well for this purpose. For some types of samples it may be difficult to find a suitable solvent.

Highly viscous samples will not easily pour from the instrument nor do they respond well even under vacuum. The best approach is to lower the viscosity by heating the instrument in an open oven or with a stream of hot air. Simply inverting the instrument and suspending it in an open oven over a receptacle to catch the sample usually works well. Another method is to draw the bulk of the sample out while the instrument is at an elevated temperature in a constant temperature bath. This method works particularly well for certain viscometers (such as the Zeitfuchs® Cross-Arm viscometer), as the entire cleaning can be performed while the viscometer remains fixed in the constant temperature bath. CANNON often places viscometers in an open aluminum oven (2" wide x 7" long x 5" deep) maintained at an elevated temperature during the cleaning procedure.Even after the bulk of a viscous sample has been removed from the instrument, dissolving the rest of it may pose a considerable problem. We have found that a mixture of octane isomers is especially effective in removing the last traces of high viscosity standards from viscometers.

Drying the viscometer after cleaning

The viscometer must be completely dry before another sample is loaded. Highly volatile solvents are recommended for cleaning since any remaining solvent will evaporate quickly after the sample has been flushed from the viscometer. Often, however, the best choice of solvent for the material in the viscometer is not especially volatile. In this case, a second highly volatile solvent, which will dissolve the first solvent, can be used for the final step in cleaning. Acetone is commonly used as the second solvent because of its high volatility and its ability to dissolve traces of petroleum solvents and water.

A low velocity stream of clean air will be sufficient to evaporate remaining traces of a volatile solvent, but be aware that rapid evaporation of these solvents can cool the surface of the glass to such an extent that humid air may be brought below the dew point, causing a film of water to form on the inner surfaces of the viscometer. Heating the air being drawn into the instrument or heating the glass itself will usually overcome this problem.

Cleaning insoluble deposits from viscometers

Capillary viscometers are often used to measure materials which leave stains or significant deposits of material insoluble in normal cleaning solvents. The most common approach for removing this material involves filling the instrument with a chromic acid cleaning solution and allowing the instrument to soak in the acid for up to 24 hours. Chromic acid solutions are strongly oxidizing and will convert many materials to a soluble form. Chromic acid will not attack the borosilicate glass of the viscometer and thus will not alter the calibration constant. *Proper procedures must be followed when using and discarding chromic acid since it is a hazardous material.* A commercially manufactured oxidizing reagent (Nochromix®) is available from CANNON (see page 38). Nochromix® is chromium-free and may be substituted for chromic acid solutions.

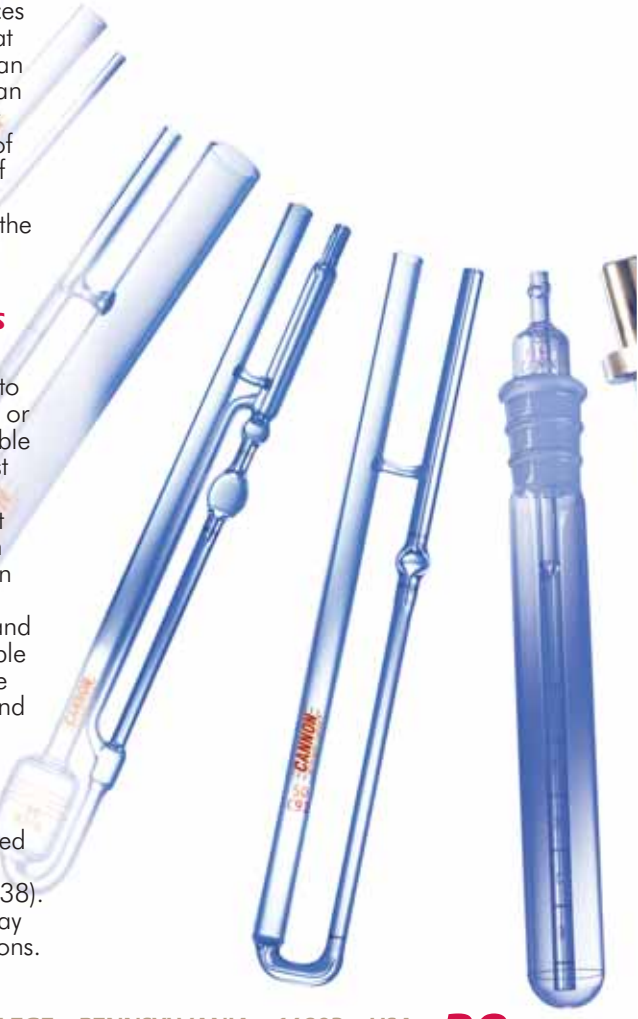
Beware of glass cleaners with a high pH. Changes in viscometer calibration as great as 20% have been observed due to the prolonged use of alkaline cleaning solutions. If alkaline cleaning solutions with a pH greater than 10 have been used, the viscometer calibration should be verified to ensure that there has not been a significant change.

Insoluble particles stuck in the capillary of a viscometer can sometimes be dislodged by using an ultrasonic cleaner.

If you are encountering a special cleaning problem, we urge you to contact us for assistance.

Varsol is a registered trademark of the Exxon Company.

Nochromix is a registered trademark of Godax.



CANNON® Kinematic Viscosity Thermometers

ASTM D 445, ISO 3104, ASTM E77

Celsius Thermometers

Mercury-in-glass thermometers* conforming to ASTM Standard E-1. For total immersion of mercury column, but not the emergent stem. Length approximately 305 mm, stem diameter 6.5 to 8 mm. Calibrated at two temperatures on main scale and at ice point. With certificate of calibration. Subdivisions 0.05°C.

Kinematic Viscosity thermometers with ice point and ±1.5°C range

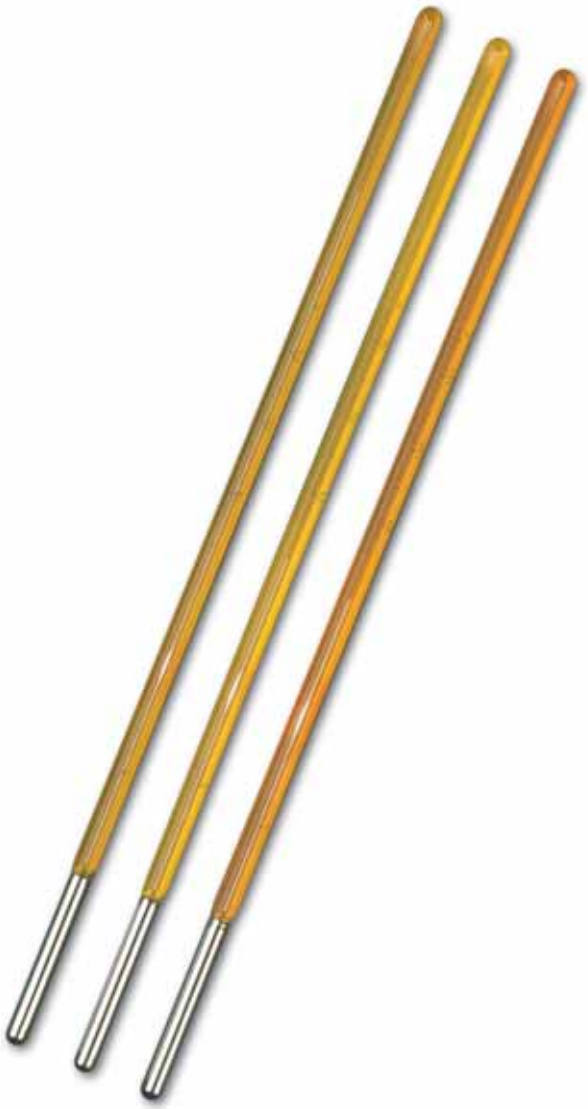
Catalog #	*Item Description*
9311-K05	ASTM 28C, Kinematic Viscosity Thermometer, 37.8°C
9311-K07	ASTM 29C, Kinematic Viscosity Thermometer, 54.0°C
9311-K10	ASTM 44C, Kinematic Viscosity Thermometer, 20.0°C
9311-K20	ASTM 45C, Kinematic Viscosity Thermometer, 25.0°C
9311-K30	ASTM 46C, Kinematic Viscosity Thermometer, 50.0°C
9311-K40	ASTM 47C, Kinematic Viscosity Thermometer, 60.0°C
9311-K42	ASTM 72C, Kinematic Viscosity Thermometer, –18.0°C
9311-K45	ASTM 73C, Kinematic Viscosity Thermometer, –40.0°C
9311-K47	ASTM 74C, Kinematic Viscosity Thermometer, –53.9°C
9311-K50	ASTM 110C, Kinematic Viscosity Thermometer, 135.0°C
9311-K60	ASTM 118C, Kinematic Viscosity Thermometer, 30.0°C
9311-K65	ASTM 120C, Kinematic Viscosity Thermometer, 40.0°C
9311-K70	ASTM 121C, Kinematic Viscosity Thermometer, 100.0°C
9311-K77	ASTM 126C, Kinematic Viscosity Thermometer, –26.1°C
9311-K81	ASTM 127C, Kinematic Viscosity Thermometer, –20.0°C
9311-K84	ASTM 128C, Kinematic Viscosity Thermometer, 0.0°C
9311-K88	ASTM 129C, Kinematic Viscosity Thermometer, 93.0°C
9728-C60	ASTM 132C, Kinematic Viscosity Thermometer, 150.0°C

Fahrenheit Thermometers

Mercury-in-glass thermometers reference after you insert it (see below). Similar to 9311-K10 series, but scaled in degrees Fahrenheit. With certificate of calibration. Subdivisions 0.1°F.

Kinematic Viscosity thermometers with ice point and ±3.0°F range

Catalog #	*Item Description*
9311-L10	ASTM 28F, Kinematic Viscosity Thermometer, 100°F
9311-L17	ASTM 29F, Kinematic Viscosity Thermometer, 130°F
9311-L24	ASTM 30F, Kinematic Viscosity Thermometer, 210°F
9311-L31	ASTM 44F, Kinematic Viscosity Thermometer, 68°F
9311-L38	ASTM 45F, Kinematic Viscosity Thermometer, 77°F
9311-L45	ASTM 46F, Kinematic Viscosity Thermometer, 122°F
9311-L52	ASTM 47F, Kinematic Viscosity Thermometer, 140°F
9311-L59	ASTM 48F, Kinematic Viscosity Thermometer, 180°F
9311-L66	ASTM 72F, Kinematic Viscosity Thermometer, 0°F
9311-L73	ASTM 73F, Kinematic Viscosity Thermometer, –40°F
9311-L80	ASTM 74F, Kinematic Viscosity Thermometer, –65°F
9311-L87	ASTM 110F, Kinematic Viscosity Thermometer, 275°F
9311-L94	ASTM 118F, Kinematic Viscosity Thermometer, 86°F
9311-L97	ASTM 128F, Kinematic Viscosity Thermometer, 32°F
9311-L98	ASTM 126F, Kinematic Viscosity Thermometer, –15°F
9311-L99	ASTM 129F, Kinematic Viscosity Thermometer, 200°F



*Incurs additional shipping charges due to mercury.

CANNON® Thermometers/Timers

ERTCO-HART RTD High Precision Digital Thermometer

- **Designed with Metrology Laboratory and Industrial Laboratory Applications in Mind**

This new bench top thermometer is an RT metrology unit that is highly accurate over a range of –183.000 to +850.000°C. Easily programmable to match any platinum probe characteristics.

Temperature may be displayed in °C, °F, K, or ohms. Battery backup ensures saving of setup information and probe constants when power is turned off. RTD probes must be purchased separately (see Accessories).

Available accessories include platinum RTD probes, an IEEE Computer Interface and Data Acquisition Software.

Digi-Sense® ThermoLogR Thermometer

This rugged digital thermometer provides output in °C or °F at the touch of a button. The display options permit monitoring of current, minimum and maximum temperature readings. Up to 1,000 readings may be logged in real time. A CAL button enables field calibration of the meter. A Hold feature allows temporary retention of a reading. Powered by two AA batteries or an optional AC adapter.

Temperature probes must be purchased separately. Probes in 10" and 1.5" lengths are available. Also available is an AC adapter.

Electronic Stopwatch

This Stopwatch is useful for determining the flow times of glass capillary viscometers.

Furnished with 1.5-volt battery (Eveready 357 or equivalent), 1-m (39-inch) lanyard, and calibration certificate traceable to the NIST. Battery provides up to 3 years continuous operation.

Precision® Petroleum Instruments Time-It Digital Timer

Solid state precision timer is highly accurate (to 0.004%) and reliable — ideal for kinematic viscosity testing. Large digital display and oversized buttons for quick response and actuation. Much more rugged than stop watches — count on years of durable use. Elapsed time accumulated to 9,999.9 seconds in 0.1 second increments or 999.99 minutes in 0.01 minute increments.

ERTCO-HART RTD High Precision Thermometer Specifications

Resolution:	0.001°C up to 100.009°C; 0.01°C from 100.01°C to 850.00°C
Accuracy:	± 0.015 full range
Display:	8 digit alphanumeric LED
Temperature Scale:	°C, °F, K, or ohms
Calibration Certificate:	NIST traceable
Probe Connections:	5-pin DIN, 1 spare connector included with meter
Probe:	One 4 wire 100 Ω Pt RTD (not included)
Probe Range:	–183 to +300°C
Computer Interface:	RS-232, 300-2400 baud
Voltage:	115 VAC, 60 Hz
Shipping Weight:	1.8 kg (4 lbs)

Digi-Sense® ThermoLogR Thermometer Specifications

Range:	–200°C to 1210°C (–328°F to +2210°F)
Resolution:	Four significant digits
Accuracy:	± 0.03°C (0.06°F)
Probes:	3-pin type
Display:	0.4" H for top LCD; 0.2" H for bottom LCD
Power:	Two AA batteries or optional AC adapter
Battery Life:	Approximately 500 hours
Low Battery Indicator:	Yes
Dimensions:	84 mm wide x 158 mm high x 30 mm thick (3.3" x 6.2" x 1.2")
Shipping Weight:	0.5 kg (1 lb)

Order Information

Catalog #	Item Description
9728-X50	ERTCO-HART RTD High Precision Digital Thermometer, 115V
9728-X55	ERTCO-HART RTD High Precision Digital Thermometer, 230V
9728-X51	ERTCO 6" RTD Probe (3/16" diameter)
9728-X52	ERTCO 12" RTD Probe (1/4" dia.)
9728-X53	ERTCO Digital Thermometer IEEE Computer Interface
9728-X54	ERTCO Digital Thermometer Data Acquisition Software
9371-W35	Time-It, Digital Timer
8788-T56	Stopwatch, 10 hr in 1/100 sec.
9728-X70	Digi-Sense ThermologR Thermometer
9728-X71	Probe, 1.5" L x 3/16" diameter (for 9728-X70)
9728-X72	Probe, 10" L x 3/16" diameter (for 9728-X70)
9728-X73	Adapter, 115V AC (for 9728-X70)

CANNON® Viscosity Standards

CANNON certified viscosity standards provide kinematic viscosities (in cSt or mm²/s), densities (in g/mL) and viscosities (in cP or mPa·s) at many temperatures, ranging from –55°C to 150°C. All CANNON viscosity standards, are traceable to the NIST (National Institute of Standards and Technology) and are prepared in CANNON's ISO 9001-registered, and A2LA-accredited laboratory.

Most viscosity standards supplied by CANNON are hydrocarbon oils. Most of the lower viscosity standards consist of mineral oil base stocks, while others are made from polyalphaolefins. The higher viscosity standards are polybutenes. In general, these standards are Newtonian liquids (that is, the viscosity is independent of the shear stress or shear rate). Some deviation from true Newtonian response may occur when measurements are made with high viscosity standards at high shear rates. Frequently the heat developed at high rates of shear can cause the standard to appear non-Newtonian when in fact the viscosity has been lowered by "viscous heating." In addition to hydrocarbon standards, CANNON offers silicone standards for calibrating rotational viscometers. **Note:** Silicone viscosity standards should NOT be used for other types of viscometers.

Customers can use CANNON hydrocarbon standards for calibrating their own glass capillary viscometers using the ASTM D 445 and ASTM D 446 Methods.

Custom Blends

If you need a standard at a temperature or viscosity not available in a stock standard, please call CANNON to discuss the blending of a custom standard to your temperature and viscosity specifications. Because of the large number of factors involved, we must quote individually for each custom standard. To help us serve you better, when ordering custom standards please state the acceptable viscosity (or kinematic viscosity) range and temperature(s) required. If you also require density data, please state this when ordering. Custom standards are subjected to the same stringent quality controls as the stock standards listed in our catalog.

Container Sizes for CANNON Viscosity Standards

CANNON supplies viscosity standards in a variety of container sizes (see Conversion Table below). Most standards are also available in 4-oz containers. The default container size for most standards is the 500 mL bottle. When ordering a non-default size, use the chart to determine the catalog number suffix (EXAMPLE: the catalog # for the N35 general purpose standard in a 1 Liter container would be 9727-C37.032).

The default size container for flash point standards is 200 mL. The N2700000 (SP) standard is supplied in 55 mL bottles.

Unit Conversions and Container Sizes

Metric Units	*U.S. Customary Units**	*Catalog # Suffix*
120 mL	4 oz. Size	.004
500 mL	Pint Size	.016
1 Liter	Quart Size	.032
4 Liters	Gallon Size	.128
20 Liters	5-Gallon Size	.5

* *(conversions are approximate)*

A Note About Viscosity Values

The tables on the following pages provide nominal values for viscosity standards supplied by CANNON Instrument Company. Please note that actual values will vary slightly from lot to lot; the amount of variation is dependent on the type of standards. Formulations are subject to change at any time. If your application requires materials in close conformity with published nominal values, please contact CANNON Instrument Company to obtain the viscosity values associated with the current formulation.

CANNON Instrument Company has received ISO/IEC 17025-1999 accreditation for technical competence in the field of calibration through A2LA. The accreditation covers the calibration of glass capillary viscometers, the determination of kinematic and dynamic viscosity (including that of viscosity standards and the viscosity certification of customer samples), and the provision of calibration services for viscometers and kinematic viscosity thermometers in accordance with ISO/IEC 17025-1999.

CANNON® CVCO Series Certified Viscosity Check Oils

ASTM D 445, D 5293, D 4684, D 4052

New!

Certified Viscosity "Check Oils" for SAE Target Viscosities

CANNON Instrument Company has released a new line of viscosity check oils specifically designed for verification of SAE target viscosities per ASTM D 445, D 5293, and D 4684.

The CVCO (Certified Viscosity Check Oil) series includes formulated commercial engine oils with certified values for kinematic viscosity in mm^2/s (cSt) at 40 and 100°C, cranking viscosity in mPa·s (cP) at old and new SAE J300 specification temperatures, pumping viscosity in mPa·s (cP) at SAE J300 specification temperatures, and density in g/mL at 15°C.

These new materials are available in 1 L (Qts) and 3.8 L (1 Gallon) sizes.

The oils enable users to "check" the performance of their Cold-Cranking Simulator, Mini-Rotary Viscometer, and Kinematic Viscometers by measuring commercially-available formulated engine oils. Viscosity values for the check oils will be at typical blend targets. Custom check oils with customer-specified blend targets may also be requested. Precision of the new check oils will be equivalent to the existing CANNON standard lines. CANNON will provide all necessary calibration certification with all Viscosity Check Oils.

Consult the table for order information for each CVCO formulation and container size.

CVCO – CANNON Viscosity Check Oils

Catalog #	ASTM Method	Temp., °C	Typical Viscosity
CVCO-5W30	D445	40	58 cSt
9727-S00.032 (1 L)	D445	100	11 cSt
9727-S00.128 (3.8 L)	D5293	-25	2500 mPa·s
	D5293	-30	4600 mPa·s
	D4684	-35	17,000 mPa·s
	D4052	15	0.85 g/mL
CVCO-10W30	D445	40	70 cSt
9727-S01.032 (1 L)	D445	100	11 cSt
9727-S01.128 (3.8 L)	D5293	-25	2800 mPa·s
	D5293	-25	5700 mPa·s
	D4684	-30	21,000 mPa·s
	D4052	15	0.88 g/mL
CVCO-15W40	D445	40	100 cSt
9727-S02.032 (L)	D445	100	14 cSt
9727-S02.128 (3.8 L)	D5293	-15	3800 mPa·s
	D5293	-20	7200 mPa·s
	D4684	-25	30,000 mPa·s
	D4052	15	0.88 g/mL

CANNON Instrument Company ... Coming to a Trade Show Near You!

CANNON Instrument Company is represented internationally at conferences, trade shows, and expositions including PITTCON, STLE, Gulf Coast and Lubrication Excellence. We are frequently in attendance at ASTM D 02, asphalt, and laboratory equipment-related trade shows. Check our web page (www.cannoninstrument.com) for an updated trade show schedule.

CANNON® General Purpose Viscosity Standards

The Table below provides kinematic viscosity values for the General Purpose Viscosity Standards from CANNON Instrument Company. CANNON certified standards are useful for calibration and verification procedures for all types of viscometers, including glass capillary viscometers, rotational viscometers, falling ball viscometers, cup viscometers, and others. Calibration or verification with a certified viscosity standard helps to ensure the reliability of measurements made with any viscometer.

For information on CANNON's available in-house testing services please see the inside back cover of this catalog.

Table 1 • Kinematic Viscosity in mm^2/s (Centistokes)

Catalog Number	*Viscosity Standard*	*20°C 68°F*	*25°C 77°F*	*37.78°C 100°F*	*40°C 104°F*	*50°C 122°F*	*60°C 140°F*	*80°C 176°F*	*98.89°C 210°F*	*100°C 212°F*	*SUS 100°F*	*SUS 210°F*
9727-C10	N.4†	0.47	0.45	0.41	0.40	—	—	—	—	—	—	—
9727-C15	N.8†	0.74	0.70	0.61	0.60	—	—	—	—	—	—	—
9727-C20	N1.0†	1.3	1.2	1.0	0.97	0.91	—	—	—	—	—	—
9727-C22	N2	2.9	2.6	2.1	2.0	1.7	—	1.1	0.95	0.93	—	—
9727-C25	S3*	4.6	4.0	3.0	2.9	2.4	—	1.5	1.2	1.2	—	—
9727-C27	N4	6.7	5.8	4.2	4.0	3.2	—	1.9	1.5	1.5	—	—
9727-C30	S6	11	8.9	6.0	5.7	4.4	—	2.4	1.8	1.8	—	—
9727-C31	N7.5	14	12	8.0	7.5	5.8	—	3.1	2.3	2.3	—	—
9727-C32	N10	21	17	11	10	7.3	—	3.5	2.5	2.4	—	—
9727-C34	N14	30	25	15	14	10	—	5.0	3.5	3.4	—	—
9727-C35	S20	44	34	20	18	13	—	5.6	3.9	3.8	100	—
9727-C36	N26	57	46	27	25	18	—	7.9	5.3	5.2	130	—
9727-C37	N35	87	66	35	32	21	—	8.5	5.4	5.3	170	—
9727-C38	N44	110	86	48	44	30	—	12	7.7	7.5	220	—
9727-C40	S60	160	120	60	54	35	—	12	7.7	7.5	280	—
9727-C41	N75	200	150	82	75	50	—	19	12	12	380	—
9727-C42	N100	330	230	110	97	60	—	19	11	11	500	—
9727-C43	N140	400	300	160	140	90	—	31	19	18	720	—
9727-C45	S200	550	400	200	180	110	—	35	22	20	925	105
9727-C46	N250	770	570	280	250	160	—	51	30	29	1300	140
9727-C47	N350	1000	720	340	310	190	—	55	34	32	1570	160
9727-C48	N415	1400	990	470	420	250	—	77	43	41	2180	200
9727-C50	S600‡	1700	1300	590	520	310	—	93	51	50	—	240
9727-C51	N750	2600	1900	850	750	440	—	130	68	66	—	—
9727-C52	N1000	3400	2400	—	940	550	350	150	—	80	—	—
9727-C53	N1400	5100	3600	—	1400	820	510	220	—	120	—	—
9727-C55	S2000	8300	5300	1900	1600	800	—	160	75	72	—	360
9727-C56	N2500	8400	6000	—	2500	1500	950	430	—	230	—	—
9727-C57	N4000	20000	12000	—	3400	1600	850	290	—	120	—	—
9727-C58	N5100	28000	18000	—	5100	2500	1300	420	—	170	—	—
9727-C60	S8000	41000	25000	8000	6700	3200	—	530	—	215	—	—
9727-C61	N10200	58000	36000	—	10200	4900	2500	775	—	300	—	—
9727-C62	N15000	77000	47000	—	13000	6100	3000	980	—	360	—	—
9727-C63	N18000	103000	64000	—	18000	8500	4300	1320	—	500	—	—
9727-C65	S30000	—	79000	27000	22000	11000	—	1700	—	630	—	—

* cSt value at –40°C/–40°F (70) also provided

† Incurs additional shipping charges due to low flash point

‡ SFS value at 122°C (150) also provided

CANNON® General Purpose Viscosity Standards

Dynamic Viscosity Values

Quality/Traceability

The Table below provides dynamic viscosity values for the General Purpose Viscosity Standards from CANNON Instrument Company. Viscosities for all standards sold by CANNON are based on the National Institute of Standards and Technology (NIST) value of 1.0016 mPa·s (centipoise) for water at 20°C (68°F).

All CANNON viscosity standards meet the precision specifications of ASTM D 445/446 and ISO 3104/3105, and are traceable to the NIST (National Institute of Standards and Technology). CANNON viscosity standards are manufactured and/or certified in CANNON's ISO 9001:2000 registered and A2LA-accredited laboratory. A2LA has accredited CANNON for technical competence in the field of calibration (certificate number 1262.01). The accreditation includes the determination of kinematic and dynamic viscosity (including that of viscosity standards and customer samples) in accordance with ISO/IEC 17025-1999. All calibrations are based on the master viscometer procedures detailed in ASTM D 2162.

CANNON has been delegated by NIST to provide U.S. national measurement standards and to issue calibration and measurement certificates for certified liquid viscosity reference standards.

Table 2 • Dynamic Viscosity in mPa·s (Centipoise)

Catalog Number	*Viscosity Standard*	*20°C 68°F*	*25°C 77°F*	*37.78°C 100°F*	*40°C 104°F*	*50°C 122°F*	*60°C 140°F*	*80°C 176°F*	*98.89°C 210°F*	*100°C 212°F*	*SUS 100°F*	*SUS 210°F*
9727-C10	N.4†	0.32	0.30	0.28	0.27	—	—	—	—	—	—	—
9727-C15	N.8†	0.64	0.60	0.52	0.51	—	—	—	—	—	—	—
9727-C20	N1.0†	0.93	0.86	0.72	0.70	0.62	—	—	—	—	—	—
9727-C22	N2	2.2	2.0	1.6	1.5	1.3	—	0.85	0.66	0.65	—	—
9727-C25	S3	3.9	3.3	2.5	2.4	1.9	—	1.2	0.90	0.90	—	—
9727-C27	N4	5.2	4.5	3.3	3.1	2.5	—	1.4	1.1	1.1	—	—
9727-C30	S6	10	8.0	5.3	5.0	3.8	—	2.0	1.5	1.5	—	—
9727-C31	N7.5	11	9.5	6.3	5.9	4.5	—	2.4	1.7	1.7	—	—
9727-C32	N10	21	16	9.5	8.8	6.3	—	2.9	2.1	2.0	—	—
9727-C34	N14	24	20	12	11	8.2	—	3.8	2.7	2.6	—	—
9727-C35	S20	37	29	17	15	11	—	4.6	3.0	3.0	100	—
9727-C36	N26	47	37	22	20	14	—	6.2	4.1	4.0	130	—
9727-C37	N35	75	56	30	27	18	—	7.1	4.5	4.4	170	—
9727-C38	N44	92	71	39	36	24	—	9.5	6.0	5.9	220	—
9727-C40	S60	141	104	52	47	30	—	10	6.4	6.2	280	—
9727-C41	N75	160	125	68	61	41	—	16	9.5	9.2	380	—
9727-C42	N100	283	202	95	84	52	—	16	9.5	9.2	500	—
9727-C43	N140	340	250	130	120	74	—	25	15	14	720	—
9727-C45	S200	460	330	160	145	90	—	25	16	14	925	105
9727-C46	N250	650	480	230	210	130	—	41	23	23	1300	140
9727-C47	N350	830	600	280	250	150	—	40	26	24	1570	160
9727-C48	N415	1200	830	390	350	210	—	62	34	33	2180	200
9727-C50	S600‡	1500	1100	490	440	260	—	75	41	40	—	240
9727-C51	N750	2200	1600	710	620	370	—	100	55	53	—	—
9727-C52	N1000	2900	2000	—	800	460	280	120	—	65	—	—
9727-C53	N1400	4300	3000	—	1200	680	420	180	—	92	—	—
9727-C55	S2000	7300	4700	1700	1400	700	—	140	62	59	—	360
9727-C56	N2500	7100	5100	—	2100	1200	780	350	—	180	—	—
9727-C57	N4000	17000	11000	—	2900	1400	730	250	—	100	—	—
9727-C58	N5100	25000	16000	—	4500	2100	1100	360	—	140	—	—
9727-C60	S8000	33000	20000	7000	5900	2800	—	450	—	200	—	—
9727-C61	N10200	52000	32000	—	9000	4200	2100	660	—	250	—	—
9727-C62	N15000	68000	41000	—	11000	5400	2600	840	—	320	—	—
9727-C63	N18000	92000	57000	—	16000	7500	3800	1140	—	420	—	—
9727-C65	S30000	—	71000	23000	20000	9300	—	1400	—	540	—	—

† Incurs additional shipping charges due to low flash point.

‡ SFS value at 122°C (150) also provided

High-Viscosity & Low Temperature Viscosity Standards

ASTM D 2170/2171, ASTM D 2983, ASTM D 3829/4684

High-Viscosity Standards

These standards are furnished in a range of viscosities and temperatures which are of particular interest in asphalt viscosity determinations and the determination of the viscosities of polymers. See ASTM D 2170 and D 2171.

See Table 3 for approximate viscosities. Exact values are supplied with each standard. All data are traceable to the NIST.

Table 3 • High-Viscosity Standards

Catalog Number	Viscosity Standard	Approximate Viscosity in mPa·s (cP)					Kinematic Viscosity mm^2/s (cSt)	
		20°C/ 68°F	25°C/ 77°F	40°C/ 104°F	60°C/ 140°F	135°C/ 275°F	60°C/ 140°F	100°C/ 212°F
9727-E10	N600†	—	1100	—	160	17	200	—
9727-C52	N1000*	2900	2000	800	280	—	350	80
9727-E15	N2000†	—	4900	—	380	21	440	—
9727-C57	N4000*	17 000	11 000	2900	730	—	850	120
9727-E20	N8000	—	20 000	—	1400	—	1600	—
9727-C62	N15000*	68 000	41 000	11 000	2600	—	3000	360
9727-E25	N30000	130 000	80 000	—	4700	—	5400	—
9727-E27	N62000	—	200 000	—	13 000	—	—	1600
9727-E29	N150000	—	420 000	—	24 000	—	—	3000
9727-E30	N190000	900 000	520 000	140 000	33 000	—	—	4000
9727-E35	N450000	—	1 600 000	—	100 000	2350	—	—
9727-E40	N2700000	—	5 300 000	—	340 000	—	—	—
9727-E42	N2700000SP Dynamic Shear Rheometer (DSR) standard at 52, 58, 64, 70, & 76°C							

* *Additional data provided with these standards are listed in Tables 1 and 2.*

† *Additional data provided at 135°C.*

Low-Temperature Standards

For Low Temperature Gear Oils (SAE 70W, 75W, 80W and 85W). Also for ATF fluids. See ASTM D 2983.

Catalog Number	Viscosity Standard	Table 4 • Low-Temperature Viscosity Standards
9727-G10	N27B	Viscosities in centistokes/centipoise at –40°F (24,000/20,000), –30°F (12,000/10,000), –20°F (6100/5200), –15°F (4500/4000), –10°F (3500/3000), and 0°F (2000/1700)
9727-G12	N27C	Viscosities in centistokes/centipoise at –40°F (45,000/40,000), –30°F (22,000/20,000), –20°F (12,000/10,000), –15°F (8000/7000), –10°F (6100/5000), and 0°F (3500/3000)
9727-G15	N115B	Viscosities in centistokes/centipoise at –20°F (160,000/140,000), –15°F (110,000/95,000), –10°F (75,000/65,000), 0°F (37,000/30,000), +10°F (20,000/17,000), and +20°F (12,000/9500)
9727-G25	N60B	150,000 mPa·s (cP) at –55°C
9727-G30	N120B	150,000 mPa·s (cP) at –40°C
9727-G35	N480B	150,000 mPa·s (cP) at –26°C
9727-G40	N1400B	150,000 mPa·s (cP) at –12°C
9727-G45	N2B*	Jet Fuel standard, 8 mm^2/s (cSt) at –20°C
9727-G50	N74B	3400 mPa·s (cP) at 0°C
9727-G55	N38B	3100 mPa·s (cP) at –10°C
9727-G60	N25B	8000 mPa·s (cP) at –25°C
9727-G65	N14B	17,000 mPa·s (cP) at –40°C

* *Incurs additional shipping charges due to low flash point*

For CANNON Mini-Rotary Viscometer (CMRV) (see ASTM D 3829 and ASTM D 4684).

Catalog Number	Viscosity Standard	Table 5 • Approximate Viscosity in mPa·s (Centipoise)
9727-T10	N105B	CMRV viscosity standard, 30,000 mPa·s (cP) at –20°C; 56,200 mPa·s (cP) at –25°C
9727-T20	YS-30	Exhibits yield stress of 70 Pa ±35 Pa at –30°C
9727-T25	YS-35	Exhibits yield stress of 70 Pa ±35 Pa at –35°C

CANNON® CCS Viscosity Standards

CANNON CL Standards provide certified dynamic viscosity data (in cP or mPa·s) at temperatures from –5°C to –35°C. These standards are used to calibrate the CANNON Cold-Cranking Simulator (CCS) oil testing (see ASTM D 5293 and SAE Specification J300).

Table 6 • Dynamic Viscosity in mPa·s (Centipoise)

Catalog Number	*Viscosity Standard**	*–5°C*	*–10°C*	*–15°C*	*–20°C*	*–25°C*	*–30°C*	*–35°C*
9727-N02	CL080	—	—	—	—	—	—	800
9727-N04	CL090	—	—	—	—	—	—	1200
9727-N06	CL100 (CL10)	—	—	—	—	—	900	1700
9727-N07	CL110	—	—	—	—	—	1400	2500
9727-N08	CL120 (CL12)	—	—	—	—	800	1600	3200
9727-N09	CL130	—	—	—	—	1500	2700	4800
9727-N10	CL140 (CL14)	—	—	—	800	1600	3300	7000
9727-N11	CL150	—	—	—	1200	2500	4500	8000
9727-N12	CL160 (CL16)	—	—	—	1200	2500	5500	11000
9727-N13	CL170	—	—	1100	1800	3500	6200	11000
9727-N14	CL190 (CL19)	—	—	900	1800	3500	7400	17200
9727-N16	CL200	—	—	1200	2400	4300	7400	13000
9727-N18	CL220 (CL22)	—	—	1300	2500	5000	11000	25000
9727-N20	CL240	—	—	1700	3400	6000	10000	20000
9727-N22	CL250 (CL25)	—	900	1800	3500	7300	15900	33000
9727-N24	CL260	—	1200	2500	4400	7200	14000	—
9727-N26	CL280 (CL28)	—	1300	2500	5000	9300	21000	50000
9727-N28	CL300	—	1700	3500	6000	11000	18000	—
9727-N30	CL320 (CL32)	—	1800	3500	7300	15900	32000	—
9727-N31	CL340	—	2500	4200	7000	12000	—	—
9727-N32	CL380 (CL38)	1600	2900	5800	13000	26000	—	—
9727-N33	CL420	—	5000	8500	15000	—	—	—
9727-N34	CL480 (CL48)	2300	4500	9500	21000	—	—	—
9727-N35	CL530	—	5900	10000	18000	—	—	—
9727-N36	CL600 (CL60)	3700	7300	15600	—	—	—	—
9727-N37	CL680	—	9500	—	—	—	—	—
9727-N38	CL740 (CL74)	6000	12000	—	—	—	—	—
9727-N43	Set of 14	Set of CCS-2050/2100 Low Temp Standards (includes CL10, CL12, CL14, CL16, CL19, CL22, CL25(2), CL28, CL32, CL38, CL48, CL60, & CL74)						
9727-N42	Set of 8	Set of CCS Low Temp Standards (includes CL14, CL19, CL22, CL25, CL28, CL32, CL48, & CL74)						

* CL Standards nomenclature has changed. The previous standard names are indicated in parentheses.

> "NIST will delegate responsibility for U.S. national standards for certified liquid viscosity reference standards to the CANNON Instrument Company."
>
> James R. Whetstone, Chief
> Process Measurements Division/Chemical Science and Technology Laboratory
> National Institute of Standards and Technology
> January 6, 2003

CANNON® Cup Viscosity Standards

Table 7 • Certified Data at 25°C

Catalog Number	Viscosity Standard	Kinematic viscosity mm^2/s (cSt)	Zahn Cup		Shell Cup		Ford Cup	
			Size	Drain time, sec	Size	Drain time, sec	Size	Drain time, sec
9727-W10	C6	8.9	— —	— —	1 2	52 20	— —	— —
9727-W12	C10	17	1 —	45 —	2 2¼	35 22	1 —	70 —
9727-W15	C20	34	1 2 —	60 24 —	2 2½ 3	64 40 24	2 — —	42 — —
9727-W20	C35	66	2 — —	33 — —	2½ 3 3½	74 46 32	2 3 —	64 35 —
9727-W25	C60	120	2 —	48 —	3½ 4	57 36	3 4	58 36
9727-W30	C100	230	3 4	27 21	4 5	68 36	4 —	64 —
9727-W35	C200	460	3 4	47 36	5 6	72 29	5 —	40 —
9727-W40	C350	850	4 5	62 37	6 —	53 —	5 —	72 —
9727-W45	C600	1300	5	54	—	—	—	—

Viscosity Standards for Zahn, Shell, & Ford Cups

Approximate values are shown in Table 7. Exact values calculated from the equations in Table VIII are supplied with each standard.

For more information on cups, contact Cannon Instrument Company.

Table 8 • Ranges of Viscosity Cups

Cup Number	Equations‡ where t = Time of flow, seconds ν = kinematic viscosity, mm^2/s	Drain time seconds		Kinematic viscosity centistokes	
		min	max	min	max
Zahn Cups (See ASTM D 4212)					
1	ν = 1.1 (t – 29)	35	80	5	60
2	ν = 3.5 (t – 14)	20	80	20	250
3	ν = 11.7 (t – 7.5)	20	80	100	800
4	ν = 14.8 (t – 5)	20	80	200	1200
5	ν = 23t	20	80	400	1800
Shell Cups (See ASTM D 4212)					
1	ν = 0.226 (t – 13)	20	80	2	20
2	ν = 0.576 (t – 5)	20	80	10	50
2½	ν = 0.925 (t – 3)	20	80	20	80
3	ν = 1.51 (t – 2)	20	80	30	120
3½	ν = 2.17 (t – 1.5)	20	80	40	170
4	ν = 3.45 (t – 1)	20	80	70	270
5	ν = 6.5 (t – 1)	20	80	125	520
6	ν = 16.2 (t – 0.5)	20	80	320	1300
Ford Cups (See ASTM D 1200)					
1	ν = 0.49 (t – 35.0)	55	100	10	35
2	ν = 1.44 (t – 18.0)	40	100	25	120
3	ν = 2.31 (t – 6.58)	20	100	49	220
4	ν = 3.85 (t – 4.49)	20	100	70	370
5	ν = 12.1 (t – 2.00)	20	100	200	1200

‡ While the equations in Table VIII are widely used, the equation ν = at - b/t is often more applicable, especially at low flow times and low kinematic viscosity.

Equations for Zahn, Shell, & Ford Cups

Equations for conversion of kinematic viscosity or viscosity into other viscometric units are given here. All data must be at 25°C. Note that the equations apply only between the minimum and maximum drain times shown.

Need SAE Viscosity Check Oils? See page 43!

CANNON® Viscosity Standards & Flash Point Reference Materials

High-Temperature Standards

For High-Temperature High-Shear Viscometer measurements at 150°C and $10^6 s^{-1}$ shear rate.
See ASTM D 5481.

Catalog Number	Viscosity Standard	Table 9 • High-Temperature Standards
9727-U50	HT39	2.0 mPa·s (cP) at 150°C, 4.7 mPa·s (cP) at 100°C
9727-U55	HT75	2.7 mPa·s (cP) at 150°C, 7.0 mPa·s (cP) at 100°C
9727-U60	HT150	3.7 mPa·s (cP) at 150°C, 10.5 mPa·s (cP) at 100°C
9727-U65	HT240	5.0 mPa·s (cP) at 150°C, 15.4 mPa·s (cP) at 100°C
9727-U70	HT390	7.0 mPa·s (cP) at 150°C, 23.5 mPa·s (cP) at 100°C
9727-U92	HTNN-1	Non-Newtonian standard, 3.6 mPa·s (cP) at 150°C and $10^6 s^{-1}$
9727-U94	HTNN-2	Non-Newtonian standard, 3.1 mPa·s (cP) at 150°C and $10^6 s^{-1}$

Viscosity Standards for Thomas®-Stormer® Viscometer

The KREBS UNIT (KU) is often used for THOMAS-STORMER Viscometers.

Table 10 • Certified Data at 25°C			
Catalog Number	*Viscosity Standard*	Viscosity (Centipoise)	Krebs Unit (KU)
9727-Y10	S200(KU)	400	64
9727-Y15	N350(KU)	750	79
9727-Y20	K400(KU)	940	84
9727-Y25	S600(KU)	1060	88
9727-Y30	N1000(KU)	2000	106

Silicone Viscosity Standards for Rotational Viscometers

CANNON silicone standards are intended for calibration of Brookfield type rotational viscometers, such as the 2020 Series Rotary Viscometers (page 51) offered by CANNON. Viscosity data at 20, 23, 24, 25, 26, 27, and 40°C is provided. CANNON has been granted ISO 9001 registration for the manufacture and certification of viscosity standards, including the silicone standards listed here.

Viscosities for all silicone standards sold by CANNON are based on the National Institute of Standards and Technology (NIST) value of 1.0016 mPa•s (centipoise) for water at 20°C (68°F). All silicone standards are traceable to the NIST. Silicone standards are sold in 500 mL bottles.

Note: *The listed silicone standards are intended for use with rotational viscometers only. Silicone standards are not recommended for glass capillary viscometers (including vacuum viscometers), metal cup-type viscometers (such as ISO, Zahn, Ford, Shell, and Fisher cups), or any other viscometers providing kinematic viscosity – CANNON hydrocarbon-based oil standards should be used for these types of viscometers.*

Table 11 • Silicone Viscosity Standards		
Catalog Number	Viscosity Standard	Approximate Viscosity mPa·s (Centipoise) 25°C (77°F)
9727-Z10	RT5	4.9
9727-Z14	RT10	9.4
9727-Z18	RT50	48
9727-Z22	RT100	96
9727-Z26	RT500	480
9727-Z30	RT1000	960
9727-Z34	RT5000	4800
9727-Z38	RT12500	12000
9727-Z42	RT30000	29000
9727-Z46	RT60000	58000
9727-Z50	RT100000	97000

Flash Point Reference Materials

CANNON Instrument Company can now provide Flash Point Reference Materials for calibrating Flash Point Testers. A total of six different standards are available for the following ASTM methods: ASTM D 56, ASTM D 92, and ASTM D 93. The data provided for each standard includes the average flash point for the lot and the standard deviation observed from 20 tests in 10 different laboratories. Nominal flash points for the various standards are shown in the accompanying table. The four standards with lower flash points are made from high purity alkane materials, while the two standards with higher flash points are made from narrow distributions of decane oligomers. Flash Point Standards are sold in 200 mL bottles (155 g).

Table 12 • Flash Point Reference Materials				
Catalog Number	*Product ID*	*ASTM D 56 Nominal Flash Point (°C)*	*ASTM D 92 Nominal Flash Point (°C)*	*ASTM D 93 Nominal Flash Point (°C)*
9727-A10	FPRM10*	50	–	55
9727-A15	FPRM11*	66	–	72
9727-A20	FPRM14	–	116	113
9727-A25	FPRM16	–	137	132
9727-A30	FPRM2D	–	163	155
9727-A35	FPRM4D	–	224	218

*Incurs additional shipping charges due to low flash point

CANNON® Digital Paddle Viscometers

ASTM D 7226, ASTM D 224

- Designed for non-homogenous materials including marine fuels, emulsions, suspensions, residual oils, slurries, foods, and other materials
- NEW water-cooled model available
- Temperature Control to 0.1°C at 25, 40, 50, 80, and 100°C
- Rugged and Lightweight
- Meets ASTM D 7226 Precision Specifications

New!

CANNON Digital Paddle Viscometer.

The CANNON Digital Paddle Viscometer has been designed to accurately measure the viscosity of asphalt emulsions, suspensions, marine fuels, residual oils, slurries, paints and similar materials between 30 and 30,000 centipoise (mPa·s) at temperatures of 25°C, 40°C, 50°C, 80°C, and 100°C (see temperature specifications for temperature associated with each model). Meets ASTM D 7226 for asphalt emulsion testing. Available in two models (standard and water-cooled), the Digital Paddle Viscometer can also be used for other applications consistent with its temperature control and viscosity measurement capabilities, including the ASTM D 244 consistency test. Ideally suited for field use, the Digital Paddle Viscometer can determine the viscosity of lubricating oils, marine fuels and other liquids, yielding results with an accuracy of five percent or better for most materials—better than that required by ASTM D 445 for residual oils at 50°C.

Novel Design Features

The Digital Paddle Viscometer consists of a base, adjustable heated tray assembly, two sample cups, head unit, and two paddles (high and low viscosity), each with a one-hundred-fold range. A digital display on the front panel of the head unit indicates viscosity in centipoise (cP or mPa·s), or centistokes (cSt or mm^2/s) and Saybolt Furol Seconds if a known density value is input by the operator prior to testing. The digital display also indicates the temperature, duration of test, and test status. Test data can be transferred to the optional label printer via an RS232 connector.

An Automated Alternative

The Digital Paddle Viscometer has been designed to provide a cost-effective and automated alternative to older, labor-intensive and less precise instrumentation and methodologies. Test data has been found to correlate well with the Saybolt viscometer method.

Running the Test

To test a sample, the operator fills a sample cup to the fill line, places the cup in the insulated tray assembly, and raises the tray to lock it in the test position. One touch on the keypad initiates the test. Most tests can be completed in less than 15 minutes. No operator supervision is required after the test has begun. When the test is complete, viscosity is automatically calculated and displayed. Cleaning is quick and convenient; just detach the paddle and remove the sample cup from the holder.

Safety Features

The unit performs an automatic self-test of display, memory, analog-digital converter function, and power supply voltage levels on startup. A thermostat in the heater cup senses any over-temperature fault condition and removes power from the heater until the temperature drops to a safe level. If the control RTD is disconnected, power to the heater cup is cut off. If the motor shaft and attached paddle are immobilized, power to the motor is removed.

Digital Paddle Viscometer Specifications

Dimensions:	191 mm wide x 235 mm deep x 451 mm high (7.5 x 9.5 x 17.75 inches) [150 mm rear clearance required]
Weight:	7.7 kg (17 lbs)
Shipping Weight:	12.3 kg (27 lbs)
Viscosity Range:	30 to 30,000 cP (100-fold range dependent on paddle selection)
Viscosity Accuracy:	±10% from 30-3000 cP; 10% from 300-30,000 cP
Test Temperatures:	Standard Model: 40°C, 50°C, 80°C, 100°C Water-Cooled Model: 25°C†, 40°C, 50°C, 80°C, 100°C
Temperature Accuracy:	±0.1°C
Operating Conditions:	15°C to 30°C, 15 to 95% relative humidity, non-condensing
Power Requirements:	100 to 120V, 50/60 Hz, 120W; 200 to 240V, 50/60 Hz, 120W

Order Information*

Catalog #	*Item Description*
9725-F70	Digital Paddle Viscometer, 115V, 50/60 Hz
9725-F75	Digital Paddle Viscometer, 230V, 50/60 Hz
9725-F71	Water-Cooled Digital Paddle Viscometer, 115V, 50/60 Hz
9725-F76	Water-Cooled Digital Paddle Viscometer, 230V, 50/60 Hz
P17.4123	Julabo F200 Recirculating Cooler for Water-Cooled DPV, 115V, 50/60 Hz
P17.4124	Julabo F200 Recirculating Cooler for Water-Cooled DPV, 230V, 50/60 Hz

* Please specify exact voltage and frequency when ordering.
† Julabo F200 Recirculating Cooler recommended; contact CANNON for required specifications

CANNON® Model 2020 Rotary Viscometer

- Accurate Digital Viscometer
- Multiple Spindles and 18 Speeds
- Displays Viscosity Directly in cP or mPa·s
- Simple Operation

The CANNON Model 2020 Rotary Viscometers provide a convenient, low cost means for the determination of viscosity. These easy-to-use instruments measure the viscous drag of a liquid against a rotating spindle. A digital readout displays viscosity directly in centipoise (shown as cP) or milliPascal-seconds (shown as mPa·s). No calculations are required — just select spindle and speed, press the Motor On switch, and read the viscosity from the front panel display.

Model 2020 Rotary Viscometers are available in two types. The low viscosity LV-2020 model measures viscosity from 1* to 2,000,000 centipoise. The medium viscosity MV-2020 model measures viscosity from 100* to 13,000,000 centipoise. Both models allow measurement at 18 speeds ranging from 0.3 to 100 rpm. By choosing the proper speed/spindle combination, any viscosity within the range of the instrument can be measured. Measurements can also be made using the same spindle at different speeds to determine the rheological properties of a material at different shear rates. Viscosity measurements are taken four times per revolution.

The Model 2020 viscometers include a sophisticated display that shows the viscosity, % torque, and the speed/spindle in use. When the Auto Range button is pressed, the maximum (100%) torque viscosity attainable using the selected spindle at the selected speed is shown. A Select knob allows rapid scrolling through the available speed or spindle selections.

Model 2020 Rotary Viscometers come complete with appropriate spindles, viscometer stand, guard leg, and carrying case. The LV-2020 is provided with four spindles. The MV-2020 is provided with six spindles. An optional #1 spindle may be purchased for the MV-2020.

Specifications

Spindle Speeds (rpm):	0.3, 0.5, 0.6, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 10, 12, 20, 30, 50, 60, 100
Accuracy:	±1.0% full scale range in use
Repeatability:	±0.2% full scale range in use
Operating Range:	LV-2020 measures viscosities between 1* and 2,000,000 cP MV-2020 measures viscosities between 100* and 13,000,000 cP

See the last text paragraph above for recommended options.

Size, Weight, and Power Requirements

Gross Weight:	9 kg (20 lb)
Net Weight:	7.7 kg (17 lb)
Shipping Container Dimensions:	40 cm wide x 25 cm high x 38 cm deep (19 x 10 x 15 inches)
Power:	115 VAC or 230 VAC, 50/60 Hz, 20 watts (please specify voltage when ordering)

Order Information

Catalog #	*Item Description*
9725-B10	LV-2020 Rotary Viscometer, 115V, 50/60 Hz
9725-B15	LV-2020F Rotary Viscometer, 230V, 50/60 Hz
9725-B20	MV-2020 Rotary Viscometer, 115V, 50/60 Hz
9725-B25	MV-2020F Rotary Viscometer, 230V, 50/60 Hz

* In the LV-2020, use of the optional UL Adaper is recommended for viscosities below 15 cP. In the MV-2020, use of the optional #1 spindle is recommended for viscosities between 100 and 400 cP. With the optional UL Adapter, the MV-2020 can measure viscosities down to 6.7 cP.

CANNON® Rotary Viscometer Accessories

UL Adapter Kit

UL Adapter Kit

The UL Adapter allows measurement of viscosities down to 1 cP with the LV-2020 and 6.4 cP with the MV- 2020. Only 16 mL of sample are required for this accessory. The coaxial cylinder geometry of the unit provides well defined shear rates for detailed sample analysis. A water jacket enables temperature control of the sample. The UL Adapter Kit comes complete with sample chamber, spindle, water jacket, attachment hardware, and storage case.

Order Information

Catalog #	*Item Description*
P17.1721	UL Adapter Kit

CANNON Small Sample Adapter Kit

The Small Sample Adapters permit testing of samples with volumes from 2 to 16 mL (the actual volume depends on the viscosity range of the sample and viscometer model in use). The coaxial cylinder geometry provides defined shear rates. A water jacket enables temperature control of the sample.

The Small Sample Adapter Kit comes complete with one sample chamber and spindle, water jacket, attachment hardware, and storage case. Consult the Range Table for assistance in selecting the most appropriate Adapter model and spindle combination for your application.

CANNON Small Sample Adapter Kit

Thermosel

Provides control of sample temperature up to +300°C. Programmable Controller offers single set point or up to 10 programmable set points. Supplied with spindle, reusable stainless steel sample container and five disposable aluminum sample chambers. The Thermosel provides a stable, precisely controlled temperature environment for accurate, reproducible results. Please specify desired viscosity range when ordering (max. 200K cP for LV-2020, max. 3.3M cP for MV-2020).

Small Sample Adapter Kit Range Table

Part #	*Viscometer Type*	*Desired Range*	*Sample Volume*	*Chamber*	*Spindle*
P17.1710	LV	3-10K cP	8 mL	SC4-13R	SC4-18
P17.1711	LV	30-100K cP	10.5 mL	SC4-13R	SC4-31
P17.1712	LV	60-200K cP	11.5 mL	SC4-13R	SC4-34
P17.1713	LV	120-400K cP	4.2 mL	SC4-8R	SC4-16
P17.1714	LV	800-1.6M cP	16 mL	SC4-13R	SC4-25
P17.1715	MV	50-170K cP	8 mL	SC4-13R	SC4-21
P17.1716	MV	250-830K cP	10.5 mL	SC4-13R	SC4-27
P17.1717	MV	500-1.7 M cP	3 ml	SC4-7R	SC4-15
P17.1718	MV	500-1.7M cP	11.5 mL	SC4-13R	SC4-28
P17.1719	MV	1M-3.3M cP	13 mL	SC4-13R	SC4-29
P17.1720	MV	1.25M-4.2M cP	2 mL	SC4-6R	SC4-14

Please contact CANNON for information on accessories for the Model 2020 Rotary Viscometer.

Order Information

Catalog #	*Item Description*
P17.1704	Thermosel System, 115V
P17.1705	Thermosel System, 230V

Thermosel Viscosity Ranges cP(mPa•s)

Spindle: / *Sample Vol.:* / *Shear Rate (sec⁻¹)†:*	*SC4-18* 8mL 1.32N	*SC4-31* 10mL .34N	*SC4-34* 95mL .28N	*SC4-21* 8mL .93N	*SC4-27** 10.5mL .34N	*SC4-28* 11.5mL .28N	*SC4-29* 13mL .25N	*HT-DIN-8* 1** 13mL .25N
for LV-2020	3-101K	30-100K	60-200K	N/A	N/A	N/A	N/A	N/A
for MV-2020	N/A	N/A	N/A	50-170K	250-830K	500-1.7M	1K-3.3M	N/A

†Spindle SC4-18 1.32 x 10 (rpm) - 13.2 sec-1; N/A = Not applicable for historical reasons. However, it is possible to use any spindle/chamber combination with any torque range. Digital viscometers/rheometers will atuomatically calculate viscostiy; *Optional disposable SC4-27D spindle is available in quantities of 100, Part #SC4-27D-100. Requires special chuck/closer, Part #SC4-DSY, for attachment to viscometer; **The 81 spindle, Part #HT-DIN-81, works in a HT-2 or HT-2DB chamber.

CANNON INSTRUMENT COMPANY • 2139 HIGH TECH ROAD • STATE COLLEGE • PENNSYLVANIA • 16803 • USA
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High-Temperature High-Shear Viscometers

ASTM D 5481, ASTM D 4741, CEC L-36-A-90, IP370, SAE J300

CANNON High-Temperature High-Shear (HTHS) Capillary Viscometer

- Measures 15 to 20 Samples per Hour
- One-Button Operation - Load Sample, Set Pressure, and Press "Start"
- Reduced Role for Operator Enhances Repeatability and Reproducibility
- Variable Temperature and Shear Rate for Research Applications

The CANNON® High-Temperature High-Shear Capillary Viscometer (HTHS Series II) is designed to determine the viscosity of engine oils and other oils under conditions of high shear at high temperatures. The HTHS is capable of testing at 1.4 x $10^6 s^{-1}$ at 150°C and meets all precision specifications of ASTM D 5481 and SAE J300. The Series II design incorporates simple one-button operation — just load samples, set pressure, and press the Start button. The reduced operator role enhances repeatability and reproducibility. If desired, variable shear rates (± 30 percent of the shear rate specified in ASTM D 5481) may be obtained by altering the test pressure (variable from 75 to 500 psi). The viscosity range of 2-7 mPa·s can be extended to more than 20 mPa·s with custom configuration. Contact CANNON for more information.

Oil samples are first introduced into the viscometric cells at the top of the HTHS. The oils then flow through small glass capillaries under pressure to achieve the desired shear rate. The five viscometric cells in the instrument may be operated in rapid succession. A digital stop-clock measures flow (efflux) time within 0.01 seconds. Flow times, temperature, and pressure are all displayed digitally. Data can then be analyzed with the computer software and test results displayed and printed.

Components

The (HTHS Series II) viscometer is supplied with a digital temperature control system (variable from 30°C to 150°C), a digital pressure measuring system, automatic timer, and the High Shear Viscosity Calculator — a stand-alone software package for Windows® to perform HTHS data analysis and output.

High Temperature Standards

Please refer to the table below for information on HT series oil standards for High-Temperature High-Shear Viscometer measurements at 150°C and $10^6 s^{-1}$ shear rate. For HTHS Standards order information, see page 49

Ravenfield "Tapered Plug" HTHS models now available

- 1-2 percent repeatability
- Onboard viscosity calculator
- Compatibility with DR Autosampler

The BS/C and BE/3 Tapered Plug high-temperature high-shear viscometers from Ravenfield provide high-temperature high-shear testing of engine lubricants according to ASTM D 4741, CEC L-36-A-90 and IP370 as specified by SAE J300 and ACEA. ASTM D 4741 is aligned with ASTM methods D 4683 (TBS) and D 5481.

Model BS/C is designed to measure at temperatures from 40°C to 180°C and shear rates from 100,000 to 1,500,000 reciprocal seconds. This flexibility makes it a useful tool for many high-shear research applications.

The BE/3 base model is also available for SAE J300 testing.

Ravenfield "Tapered Plug" HTHS

HTHS Specifications

Size:	521 mm wide x 387 mm deep x 686 mm high (20.5 x 15.25 x 27 in)
Weight:	40.5 kg (89 lb)
Operating Conditions:	10%-90% RH non-condensing. Installation category II; Pollution degree 2
Compliance:	CE Mark: EMC directive (89/336/EEC); Low voltage directive (73/23/EEC); HI-POT (1900 VDC, 60 sec.)
Shipping Weight:	75 kg (165 lbs)
Computer Requirements:	Computer not included. Please contact CANNON for specifications.

HTHS Order Information

Catalog #	*Item Description*
9728-C35	Model HTHS Series II, 115 volts, 50/60 Hz, 500 watts
9728-C40	Model HTHS Series II-F, 230 volts, 50/60 Hz, 500 watts

For HTHS Standards order information, see page 49

Ravenfield "Tapered Plug" HTHS Order Information

Catalog #	*Item Description*
9728-C52	Ravenfield BS/C Tapered Plug HTHS 115V
9728-C53	Ravenfield BS/C Tapered Plug HTHS 230V
9728-C50	Ravenfield BE-3 Tapered Plug HTHS 115V
9728-C51	Ravenfield BE-3 Tapered Plug HTHS 230V
9728-D54	Ravenfield DR Auto-Sampler 115V
9728-D55	Ravenfield DR Auto-Sampler 230V

CANNON® CCS-2100

Automatic Thermoelectrically-Cooled Cold-Cranking Simulator

ASTM D 5293, SAE J300

CANNON Thermoelectrically-Cooled Cold-Cranking Simulator

- Cooled by Built-in Solid-State Thermoelectric Modules
- Powerful VISCPRO® for Windows® Software
- Fully Automatic Operation
- Improved Precision Over Earlier Models

CANNON Thermoelectrically-Cooled Cold-Cranking Simulators measure the apparent viscosity of oils at temperatures from –35°C to –5°C within a viscosity range of 1500 mPa·s to 27,000 mPa·s. The CCS-2100 combines automatic sample loading, computer-controlled operation, and solvent-free cleaning to permit completely unattended operation. No further operator involvement is required after initial loading of the sample table and identification of samples. The CCS-2100 will automatically test up to 30 samples at one time, calculate their viscosities, and record the results, freeing the operator for other tasks. Improved temperature management of the rotor/stator eliminates the need for grouping the samples by temperature of analysis, as was necessary in older CCS models. In addition, a thermoelectric sample warming cycle greatly improves the sample flushing process. The CCS-2100 meets all the requirements of ASTM D 5293 and SAE J300.

The CCS-2100 consists of a patented thermoelectrically-cooled rotor/stator, a Sample Table with capacity for 30 oil samples, and an integral CCS Series II Controller. The rotor/stator cell is attached to a vacuum system and a metering constant-displacement injection pump. The rotor/stator cell is cleaned by purging the previously measured sample with a portion of new sample prior to measuring its viscosity. Purged sample is drawn into a waste receiver by the vacuum system. Rotor speed is measured by a high resolution digital encoder. A proprietary software program then converts this data to sample viscosity. Viscosity calculations are based on test data and rotor/stator calibration information stored by the software. User interface options include an instrument calibration routine, configuration of test cycles, and multiple means of processing test data including save, print, and export via the RS-232 serial port for LIMS capture.

Required Accessories

A chiller capable of cooling water to 5°C is required. Supplied with the CCS-2100 is a Julabo FE500 Recirculating Cooler. The CCS requires a computer (not supplied) with the Windows® 98/NT®/XP® operating system.

CCS-2100 Specifications (except for Waste Receiver)

Dimensions:	711 mm (28 inches) high x 333 mm (13-1/8 inches) wide x 645 mm (25-3/8 inches) deep (add at least 100 mm (4 inches) to depth for installation)
Weight:	46 kg (102 lbs.)
Shipping Weight:	Approximately 136 kg (300 lbs)
Electrical:	CCS-2100: 115 volts AC ±10%, 60 Hz, 1000W CCS-2100F: 230 volts AC ±10%, 50 Hz, 1000W
Operating Conditions:	15-30°C, 10%-90% RH non-condensing, Installation Category II, Pollution degree 2
Computer:	Computer not included. Please contact CANNON for specifications.
Compliance:	CE Mark: EMC directive(89/336/EEC); Low voltage directive (73/23/EEC); HI-POT (1900 VDC, 60 sec.)
Sample Volume:	40-50 mL required

Waste Receiver Specifications

Dimensions:	216 mm (8.5 inches) high x 267 mm (10.5 inches) x 305 mm (12 inches) deep
Weight:	8.2 kg (18 lbs)

Julabo® FE500 Recirculating Cooler Specifications

Dimensions:	572 mm (22.5 inches) high x 305 mm (14 inches) wide x 457 mm (18 inches) deep
Weight:	38.2 kg (84 lbs)
Working Temperature Range:	–20 to +40°C
Display:	LED, actual/setpoint values
Display Resolution:	0.1°C
Temperature Setting:	Keypad
Safety:	Audible high/low temperature warning, freezing protection
Temperature Stability:	±0.5°C
Cooling Capability:	450 Watts @ 5°C

Order Information

Catalog #	*Item Description*
9728-E46	CCS-2100 Automatic CCS, 115V, 60Hz, 1000W
9728-E47	CCS-2100F Automatic CCS, 230V, 50/60Hz, 1000W

CANNON® CCS-2050

Semi-Automatic Thermoelectrically-Cooled Cold-Cranking Simulator

ASTM D 5293, SAE J300

CANNON Thermoelectrically-Cooled Cold-Cranking Simulator

- Cooled by Built-in Solid-State Thermoelectric Modules
- Improved Precision Over Earlier Models
- Semi-Automatic Operation (After Sample is Loaded No Further Operator Interaction Required)
- Extended Range – 1500 to 27,000 mPa·s (cP)
- Needs No Solvent Cleaning

CANNON Thermoelectrically-Cooled Cold-Cranking Simulators measure the apparent viscosity of oils at temperatures from –35°C to –5°C within a viscosity range of 1500 mPa·s to 27,000 mPa·s. The CCS-2050 speeds up a traditionally labor-intensive test procedure by computer control of instrument calibration, rotor speed sensing, test cycles, data calculation, and report generation. However, unlike the fully-automatic CCS-2100, the CCS-2050 requires that an operator be present to load each sample individually. Improved temperature management of the rotor/stator eliminates the need for grouping the samples by temperature of analysis, as was necessary in older CCS models. In addition, a thermoelectric sample warming cycle greatly improves the sample flushing process. A new type of sample holder eliminates the risk of spillage found in older models of the semi-automatic CCS. The CCS-2050 meets all the requirements of ASTM D 5293 and SAE J300.

The CCS-2050 consists of a patented thermoelectrically-cooled rotor/stator and an integral CCS Series II Controller. The rotor/stator cell is attached to a vacuum system and a metering constant-displacement injection pump. The rotor/stator cell is cleaned by purging the previously measured sample with a portion of new sample prior to measuring its viscosity. Purged sample is drawn into a waste receiver by the vacuum system. Rotor speed is measured by a high resolution digital encoder. A proprietary software program then converts this data to sample viscosity. Viscosity calculations are based on test data and rotor/stator calibration information stored by the software. User interface options include an instrument calibration routine, configuration of test cycles, and multiple means of processing test data including save, print, and export via the RS-232 serial port for LIMS capture.

Required Accessories

A chiller capable of cooling water to 5°C is required. Supplied with the CCS-2050 is a Julabo FE500 Recirculating Cooler (see specifications on page 54). The CCS requires a computer (not supplied) with the Windows® 98/NT®/XP® operating system.

Mini-Volume Sample Injection Kit for the CCS-2050

While CCS instruments normally require 40-50 mL of sample for a test, this kit allows a CCS measurement to be made on as little as 5 to 10 mL of sample. A Luer-Lok® adapter and syringe (and associated fittings) enable users of the CCS-2050 to manually inject a small amount of sample. A switch allows the injection pump to be temporarily bypassed while the manual injection is made.

CCS-2050 Specifications (except for Waste Receiver)

Dimensions:	711 mm (28 inches) high x 333 mm (13-1/8 inches) wide x 645 mm (25-3/8 inches) deep (add at least 100 mm (4 inches) to depth for installation)
Weight:	40 kg (88 lbs.)
Shipping Weight:	Approximately 120.5 kg (265 lbs)
Electrical:	CCS-2050: 115 volts AC ±10%, 60 Hz, 1000W CCS-2050F: 230 volts AC ±10%, 50 Hz, 1000W
Operating Conditions:	15-30°C, 10%-90% RH non-condensing, Installation Category II, Pollution degree 2
Computer:	Computer not included. Please contact CANNON for specifications.
Compliance:	CE Mark: EMC directive(89/336/EEC); Low voltage directive (73/23/EEC); HI-POT (1900 VDC, 60 sec.)

Waste Receiver Specifications

Dimensions:	216 mm (8.5 inches) high x 267 mm (10.5 inches) x 305 mm (12 inches) deep
Weight:	8.2 kg (18 lbs)

Order Information

Catalog #	*Item Description*
9728-E42	CCS-2050 Semi-Automatic CCS, 115V, 60Hz, 1000W
9728-E43	CCS-2050F Semi-Automatic CCS, 230V, 50/60Hz, 1000W

CANNON® CMRV-5000 Mini-Rotary Viscometer

ASTM D 4684, ASTM D 3829, ASTM D 6821, ASTM D 6896, SAE J300

- Self-Contained Air-Cooled Unit—Thermoelectric Temperature Control
- Measures Yield Stress and Viscosity for Drive Line Lubricants and Engine Oils
- Meets Latest SAE J300 Specifications for Low-Temperature Pumpability
- High-Performance Rotors with Carbon Fibre Shafts in Five Removable Cells for Easy Cleaning
- Meets Requirements of ASTM D 4684, ASTM D 3829, ASTM D 6821*, and ASTM D 6896

* Requires optional drive line rotor kit.

The CANNON CMRV-5000 Mini-Rotary Viscometer is designed to measure yield stress and viscosity of drive line lubricants and new and used automotive engine oils over a temperature range of –5°C to –40°C, meeting ASTM D 4684, D 3829, D 6821 and D 6896 requirements. The CMRV instrument determines pumping viscosity in accordance with the latest SAE J300 specifications.

Innovative Design

The CANNON CMRV-5000 provides a new level of benchtop performance in a sleek, self-contained, thermoelectrically maintained system. No accessory refrigeration units or heat exchangers are required for this innovative redesign of the reliable CANNON Mini-Rotary Viscometer series.

Reliable Operation

Like its predecessor units, the CMRV-5000 provides reliable and accurate temperature control, meeting all requirements of the relevant methods. High-performance rotors are manufactured with carbon fibre shafts, minimizing heat transfer in and out of the test cells. The CMRV-5000 contains five viscometric cells machined to tight tolerances to fit the thermostated aluminum block. The cells are removable to facilitate sample handling and cleaning of cells and rotors. A Plexiglas cover includes a molded inlet port for tubing from the dry gas purge regulator, which assists in maintaining a frost-free environment around the cells during the cooling phase of the test. A built-in microprocessor controls temperature throughout the precisely controlled cooling cycle. At the conclusion of the cycle, the viscosity and yield stress are determined using an electronic timing mechanism coupled to a pulley wheel assembly that measures rotor rotation as constant torque is applied.

Powerful Software

Data from yield stress and viscosity tests is saved to a computerized database by the VISCPRO® software forWindows® 98/NT®/XP®. VISCPRO® is pre-programmed to enable temperature cycles for each SAE-specified oil grade, including 0W, 5W, 10W, 15W, 20W, and 25W (ASTM D 4684), as well as temperature calibration options at either –20 or –25°C. VISCPRO also has the termperature programs preconfigured for all the ASTM methods mentioned above. The Profile Designer feature permits custom configuration of unique cooling profiles (temperature over time). Up to four CMRV-5000 units can be controlled by a single PC using the optional multi-unit interface kit.

CE

New! COMPACT DESIGN

CANNON CMRV-5000 Viscometer

CMRV-5000 Mini-Rotary Viscometer Specifications

Dimensions:	284 mm wide × 396 mm deep × 617 mm high (11.2 × 15.6 × 24.3")
Weight:	23 kg (50 lbs)
Shipping Weight:	32 kg (70 lbs)
Operational Temperature:	80°C to -40°C
Operating Conditions:	15°C-30°C, 10%-90% RH non-condensing; Installation category II, Pollution degree 2
Compliance:	EMC directive (89/336/EEC); Low voltage directive (73/23/EEC) HI-POT (1900 VDC, 60 sec.)
Computer Requirements:	Computer not included. Please contact CANNON for specifications.
Electrical:	CMRV-5000: 115V AC ± 10%, 50/60 Hz CMRV-5000F: 230V AC ± 10%, 50/60 Hz

Order Information

Catalog #	*Item Description*
9728-R26	CMRV-5000 Mini-Rotary Viscometer, 115V, 50/60 Hz
9728-R27	CMRV-5000F Mini-Rotary Viscometer, 230V, 50/60 Hz
P52.4506	Replacement Rotor Assembly for CMRV-4500/5000
P52.4536	DL Carbon Rotor
P52.5019	Replacement Removable Cell Assembly (CMRV-4500)
P52.5058	Air Filter (CMRV-5000)
P52.5060	Drive Line Rotor Kit (CMRV-5000)

CANNON INSTRUMENT COMPANY • 2139 HIGH TECH ROAD • STATE COLLEGE • PENNSYLVANIA • 16803 • USA
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CANNON® CMRV-4500 & Accessories

- Thermoelectrically-Cooled with Enhanced Temperature Control and Test Precision
- Measures Yield Stress and Viscosity
- Nine-Cell Capacity/Carbon Fibre Rotor Shafts

Like the CMRV-5000, the CANNON CMRV-4500 Mini-Rotary Viscometer is designed to measure yield stress and viscosity of drive line lubricants* and new and used automotive engine oils over a temperature range of –5°C to –40°C, meeting ASTM D 4684, D 3829, D 6821*, and D 6896 requirements.

* *Requires optional drive line rotor kit.*

Instrument Description

The CMRV-4500 contains nine small rotary viscometers within a thermostated aluminum block. The CMRV-4500 is cooled with built-in thermoelectric modules, eliminating the need for methanol-based external refrigeration devices. The CMRV-4500 uses a compact air/water heat exchanger that circulates a mixture of coolant water and antifreeze through the instrument to cool the hot side of the thermoelectric cells. The result is a quiet, low-maintenance system without potentially hazardous refrigerants. Solid-state thermoelectric cooling provides superb temperature uniformity for all nine test cells, removing temperature gradients not only from the left to the right side of the block, but also from front to back and top to bottom. A dry gas purge includes a side-mounted flow meter with a needle-valve adjustment, the resultant dry air flow to the test environment helps improve precision and avoid condensation around the test cells.

CANNON CMRV-4500
Mini-Rotary Viscometer

Accessories for Models CMRV-4500 & CMRV-5000

Multi-Unit Interface Kit

The Multi-Unit Interface Kit enables a single PC to control up to four CMRV-4500 or four CMRV-5000 instruments with a single computer.With this kit an operator can simultaneously run and monitor completely different cooling profiles on each instrument, track and display data for each instrument, and perform yield stress and viscosity tests on samples in as many as 36 viscometric cells. The Interface Kit comes with an RS-232/485 Converter, AC Power Adaptor, Interconnect wires, and Configuration instructions.

Thermometers/Cell Caps

Thermometers appropriate for ASTM D 4684 and ASMT D 3829 tests are available from CANNON®(see Order Information below). Cell caps for enhanced temperature control are included with each instrument. Replacement caps may also be ordered.

CMRV- 4500 Mini-Rotary Viscometer Specifications

Dimensions	317 mm wide x 260 mm deep x 489 mm high, including thermometer (12.5 x 10.25 x 19.25 inches)
Weight:	18.6 kg (41 lbs)
Shipping Weight:	27 kg (60 lbs)
Electrical:	CMRV- 4500, 115 volts, 50/60 Hz, 1100 watts, CMRV- 4500F, 230 volts, 50/60 Hz, 400 watts
Operating Conditions:	10%-90% RH non-condensing. Installation category II; Pollution degree 2
Compliance:	CE Mark: EMC directive (89/336/EEC); Low voltage directive (73/23/EEC); HI-POT (1900 VDC, 60 sec.)
Computer Requirements:	Computer not included. Please contact CANNON for specifications.

Heat Exchanger Specifications

Dimensions	470 mm wide x 348 mm deep x 340 mm high (18.5 x 13.7 x 13.4 inches)
Weight:	31.8 kg (70 lbs)
Shipping Weight:	36.3 kg (80 lbs)
Electrical:	CMRV- 4500, 115 volts, 50/60 Hz, CMRV- 4500F, 230 volts, 50/60 Hz

CMRV-4500 Order Information

Catalog #	*Item Description*
9728-R22	CMRV-4500 Mini-Rotary Viscometer, 115V/60Hz
9728-R23	CMRV-4500F Mini-Rotary Viscometer, 230V/50Hz
P51.1015	CMRV Cell Caps (Rotor Collar Set/9, Delrin)
9728-R65	CMRV Thermometer, –45°C to +30°C, ± 0.2°
9728-R70	CMRV Thermometer, 0°C to +105°C, ± 1°
9728-R40	CMRV Multi-Unit Interface Kit (Domestic), 115V, 50/60 Hz
9728-R45	CMRV Multi-Unit Interface Kit (Foreign), 230V, 50/60 Hz
P52.4537	ASTM D 6821 Drive Line Rotor Kit (CMRV-4500)

CANNON® TE-BBR Thermoelectric Bending-Beam Rheometer

ASTM D 6648

CANNON® Thermoelectric Bending-Beam Rheometer

- Meets or Exceeds ASTM D 6648, AASHTO T313, and SHRP Provisions for Flexural Creep Testing of Asphalt Binders
- Precise, Repeatable Data
- Environmentally-Friendly Thermoelectric Cooling (No External Refrigeration or Refrigerants Required)
- Graphical Software for Windows® XP®
- Cooling to –36° Celsius in most Laboratory Environments

The CANNON® Thermoelectric Bending-Beam Rheometer performs low-temperature flexural creep stiffness measurements on asphalt binders as specified in current ASTM D 6648, AASHTO and SHRP methodology.

The TE-BBR achieves temperatures from ambient to –36° Celsius using the latest in Peltier technology. Bath fluid, which does not circulate outside the TE-BBR, is cooled by solid-state cooling modules surrounding the bath. Heat is dissipated from the hot side of the thermoelectric modules by circulating a mixture of water and antifreeze through an Air/Water Heat Exchanger. This arrangement facilitates rapid cooling and eliminates costly and potentially hazardous refrigerants.

The TE-BBR is capable of controlling temperature within 0.03° Celsius, a precision far exceeding the requirements of current flexural creep test methodology for asphalt binders. The instrument measures specimen beam deflection to within 0.155 microns (1550 Angstroms) and force to within 0.147 milliNewtons (0.015 grams). The TE-BBR will measure specimen beam loads from 0 to 450 grams.

Data acquisition is accomplished internally with information transferred to a host computer via a standard RS-232 interface. The Windows® XP® software allows computer control and viewing of parameters through a graphical interface. Reports and graphs can be printed on any Windows-compatible printer. The operational firmware is ungradable – updates or changes may be downloaded via computer.

The TE-BBR controls air pressure with four pneumatic pressure regulators, permitting the operator to adjust main input line pressure, air bearing pressure, and pressure supporting the loading shaft for a "zero" condition and a "load" condition.

A magnetic stirring bar at the bottom of the bath vessel circulates bath fluid to ensure uniform temperature distribution throughout the bath. The speed of the stirring bar rotation is adjustable.

New Crack Seal Option!

Allows for flexural creep testing of 0.5" thick specimens. Excellent for characterizing crack seal "creep" under load at cold temperatures. Kit includes modified beam support, thin and thick beam for calibration, and all necessary installation hardware and documentation. Support adapter design permits testing of both 0.25" and 0.5" beams.

TE-BBR Specifications

Size:	610 mm wide x 540 mm deep x 610 mm high (24 x 21.3 x 24 inches) including Load Unit [add at least six inches to rear measurements to allow for air flow and rear cable/tubing connections]
Bath Volume:	5 liters (1.33 gallons)
Weight:	54.5 kg (120 lbs)
Shipping Weight:	61.4 kg (135 lbs)

Air/Water Heat Exchanger Specifications

Size:	420 mm wide x 540 mm deep x 470 mm high (16.5 x 21.3 x 18.5 inches) [add at least six inches to front and rear measurements to allow for air flow and rear cable/tubing connections]
Weight:	52.7 kg (116 lbs)
Shipping Weight:	59 kg (130 lbs)
Electrical:	100V, 50/60 Hz, 1700 watts; 120V, 50/60 Hz, 1700 watts; 220V, 50/60 Hz, 1700 watts; 240V, 50/60 Hz, 1700 watts
Computer Requirements	Computer not included. Please contact CANNON for specifications.

Order Information*

Catalog #	*Item Description*
9728-V30	TE-BBR, 120V, 50/60 Hz
9728-V35	TE-BBR-F, 240V, 50/60 Hz
P44.0675	Crack Seal Option

* Licensed from the Pennsylvania State University

[Specify exact line voltage when ordering]

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CANNON® TE-BRR Accessories

BBR Precision Calibration Kit

BBR Precision Calibration Kit

- Compatibility with ASTM D 6648-01
- Newly Designed High-Precision Gage Block
- Precision-Cut Stainless Steel Beam
- NIST-Traceable Calibration Certificates for each Component
- Convenient, Rugged Carrying Case

The BBR Precision Calibration Kit offers the user increased confidence in the calibration of the CANNON Bending-Beam Rheometer by providing greater test measurement accuracy, precision and verification. Individual calibration certificates (NIST-traceable) are included for each component — the newly designed high-precision gage block, the precision-cut stainless steel confidence (thin) beam, the ¼"-thick compliance beam, and all weights. The calibration kit allows full use of the increased resolution available with the new microprocessor controller for the CANNON BBR and TE-BBR. The weight set permits verification of rheometer calibration per ASTM D 6648-01 methodology. A convenient, rugged carrying case protects all components of the kit. The BBR Precision Calibration Kit can be used with all CANNON BBR and TE-BBR instruments. The complete kit includes: ASTM D 6648-01 method, gage block, thin beam, thick beam, four 100-gram weights, two 2-gram weights, tweezers, and calibration certification.

BBR D 6648 Update Kit

CANNON now supplies an update kit for Bending-Beam Rheometer models purchased before December of 2001. The kit ensures compatibility with ASTM D 6648-01 by providing for verification of load and deflection values. The Update Kit includes a pair of calibrated 2-gram weights with calibration certification. The Kit also includes separate containers for each of the weights and a tweezers for handling of weights to avoid contamination.

Silicone Rubber Mold for BBR

The Silicone Rubber Mold simplifies the procedure for making asphalt beams for testing in the CANNON Bending-Beam Rheometer. Because asphalt does not adhere well to the silicone rubber, hot asphalt poured into the mold cavity can be easily released from the mold after cooling. As a result, there is almost no cleanup required, and beams are formed with very clean corners and surfaces.

The Silicone Rubber Mold consists of an aluminum frame, two rubber mold inserts, a thick sheet of silicone rubber, glass plate, two thin plastic backup sheets, and two clamps.

SHRP Dynamic Shear Rheometer Accessories

DSR Temperature Probe

The DSR temperature probe measures temperatures between 0°C and 80°C in the sample area of dynamic shear rheometers, such as those specified for use by SHRP. The probe consists of a tiny thermistor mounted within a thin 25 mm disk made of silicone rubber. When the probe is inserted between the plates of a dynamic shear rheometer and the probe wires are connected to an accurate ohmmeter, temperatures may be measured to an accuracy of ± 0.05°C. Supplied with a calibration certificate and instructions for use.

SHRP Dynamic Shear Rheometer Accessories

DSR Standard

CANNON Instrument Company offers DSR viscosity standard N2700000SP at 52, 58, 64, 70, & 76°C for users of Dynamic Shear Rheometers.

Order Information

Catalog #	*Item Description*
9728-V60	Complete Calibration Kit (Gage Block, Thin Beam, Thick Beam, Four 100-gram Weights, Two 2-gram Weights, Calibration Certification, ASTM D 6648-01, and Carrying Case)
9728-V63	BBR D 6648 Update Kit (Set of Two 2-gram Weights, Tweezers, and Calibration Certification
9728-V40	Silicone Rubber Mold for the Bending-Beam Rheometer
9728-V95	DSR Temperature Probe
9727-E42	N2700000SP Dynamic Shear Rheometer (DSR) Standard @ 52, 58, 64, 70, & 76°C

CANNON® DVR 1000 Series Digital Vacuum Regulators

ASTM D 2171

- Solid-State Components—Contains No Mercury
- Preset for Vacuum Viscometry per ASTM D 2171
- Horizontal or Vertical Configuration
- Convenient Keypad Controls

The CANNON DVR 1000 Series Digital Vacuum Regulators are designed for precise measurement and control of vacuum at 300 mm Hg below atmospheric pressure. Unlike other vacuum regulators, the solid-state DVR-1000 and DVR-1500 models use no mercury.

The DVR meter displays the amount of vacuum in mm/Hg or one of nine other units of measurement selected using a keypad on the meter.

In asphalt laboratories the Digital Vacuum Regulator (DVR) may be used in conjunction with Cannon-Manning, Asphalt Institute, and Modified Koppers vacuum viscometers for measurement of highly viscous materials such as asphalt cement at 60°C (140°F) according to ASTM D 2171. The DVR is also useful in other laboratory systems where accurate measurement and control of vacuum is required.

Two basic versions of the DVR are available. The DVR-1500 is equipped with an internal vacuum pump and does not require an external vacuum source. The DVR-1000 uses the customer's in-house vacuum system.

The internal set points for the instrument gauge are preset at CANNON to regulate vacuum at 300 ± 0.5 mm Hg below atmospheric pressure (the vacuum required by ASTM D 2171). These set points may be altered to fit the user's specific needs within the DVR's operating range of 28 to 410 mm Hg below atmospheric pressure.

Both the DVR-1000 and DVR-1500 are available in either horizontal or vertical configurations (the horizontal version will support the weight of a constant temperature bath like the CANNON CT-1000 or CT-2000).

The instrument housing is made of durable enameled steel and is supported on non-slip rubber feet.

The CANNON DVR 1000 Series Digital Vacuum Regulators

DVR 1000 Series Specifications	
Dimensions:	470 mm wide x 458 mm deep x 172 mm high (18.5 x 18 x 6.75 inches) [in the horizontal position]
Weight:	20 kg (45 lbs)
Range:	Preset at 300 mm Hg below atmospheric pressure, but may be adjusted to accurately control from 28 mm to 410 mm Hg below atmospheric pressure
Reading Accuracy:	± 0.05% of reading ± the least significant digit (includes combined effects of linearity, repeatability, hysteresis, and temperature) [NIST certification is supplied]
Vacuum Regulation Accuracy:	± 0.5 mm Hg (as required by ASTM D 2171)
Operating Temperature:	0 to 40°C (32 to 104°F)
Upper/Lower Safety Limit:	746 mm Hg below atmospheric pressure

Order Information

Catalog #	*Item Description*
9726-T20	DVR-1000H (DVR without vacuum pump, horizontal orientation, 120V, 100 watts)
9726-T23	DVR-1000HF (DVR without vacuum pump, horizontal orientation, 240V, 100 watts)
9726-T25	DVR-1000V (DVR without vacuum pump, vertical orientation, 120V, 100 watts)
9726-T27	DVR-1000VF (DVR without vacuum pump, vertical orientation, 240V, 100 watts)
9726-T60	DVR-1500H (DVR with vacuum pump, horizontal orientation, 120V, 175 watts)
9726-T63	DVR-1500HF (DVR with vacuum pump, horizontal orientation, 240V, 175 watts)
9726-T65	DVR-1500V (DVR with vacuum pump, vertical orientation, 120V, 175 watts)
9726-T67	DVR-1500VF (DVR with vacuum pump, vertical orientation, 240V, 175 watts)

CANNON® Pro-Pak Distillation Packing

CANNON Pro-Pak Distillation Packing

- Ideal for Laboratory and Pilot Scale Distillation Columns
- High Efficiency Design
- Unique Wetting Properties
- Atmospheric and Reduced Pressure Distillation Applications

Pro-Pak is a high efficiency distillation column packing with unique wetting properties. Applications range from laboratory and pilot plant distillation columns to those used in small manufacturing plants. Pro-Pak is self wetting, so equilibrium time is reduced — distillations can be stopped and started without lengthy delay. The entire surface of the packing is available for mass transfer, contributing to its high efficiency. The shape of the packing eliminates interlocking and makes filling and emptying the column as easy as pouring water.

Pro-Pak is formed from metal ribbon through which more than 1000 tiny holes per square inch have been punched. As the points of the die push through the metal, jagged burrs are formed on the reverse side of the ribbon. Pro-Pak's self-wetting properties derive from a rectangular network of capillaries on the surface of the metal, produced by the combined effect of the holes in the ribbon and the roughness of the burrs. These properties ensure that Pro-Pak stays wet in service in the distillation column and retains its high efficiency. Because the surface area of the packing remains effective under low liquid loadings, high column efficiency is maintained at vapor velocities very much lower than the flooding velocity.

Pro-Pak can be used for both atmospheric and reduced pressure distillations down to 10 mm Hg condenser pressure. As the operating pressure decreases, efficiency increases. The HETP (height equal to a theoretical plate) varies from 0.5 inch to 1.4 inch in a 1-inch diameter column, depending on operating pressure and reflux rate.

The large surface area made effective by the wettability of Pro-Pak allows for efficient mass transfer between the liquid and vapor phases. The surface area is approximately 576 square feet per cubic foot for the 0.16-inch size and 372 square feet per cubic foot for the 0.24-inch size. The packing factor is 693 for the 0.16-inch size and 420 for the 0.24-inch size.

High free space is especially important in vacuum distillation (for reduction of pressure drop) and in extractive distillation and absorption (where high liquid or vapor loading is common). Pro-Pak has high free space: 94% for the 0.16-inch size and 96% for the 0.24-inch size. Because of its high free space, Pro-Pak has a high flood rate.

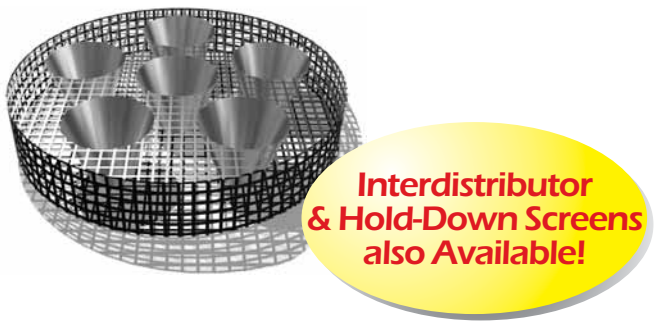
In addition to type 316 stainless steel packing, listed below, Pro-Pak is also available in Monel, nickel, and other metals on special order. Discounts are provided for bulk quantities.

CANNON manufactures special interdistributor screens and hold down screens that provide optimum efficiency for Pro-Pak columns. These screens are manufactured on a custom basis to fit any specified column diameter.

Our Pro-Pak technical bulletin contains additional information. A free sample of Pro-Pak can also be supplied. Please contact CANNON to receive a free copy of the Pro-Pak bulletin and a sample of the packing.

Order Information

Catalog #	*Item Description*
3947-A20	316 Stainless Steel Packing, 0.16-inch. 1 L
3947-A30	316 Stainless Steel Packing, 0.16-inch. cubic foot
3947-A60	316 Stainless Steel Packing, 0.24-inch. 1 L
3947-A70	316 Stainless Steel Packing, 0.24-inch. cubic foot



Tanaka® Scientific Ltd. Flash Point Testers

ASTM D 56, ASTM D 92/P36, ASTM D 93/IP34, ISO 2719, ISO 2592

CANNON Instrument Company is the exclusive distributor in the United States and Canada for Tanaka Automatic Petroleum Testers. Tanaka instruments available from CANNON include Flash Point Testers, Cloud and Pour Point Testers, Distillation Tester, and others.

Tanaka Scientific Limited was founded in 1901, making it one of the earliest suppliers of scientific instruments in Japan. For many years Tanaka has been a leader in the automation of petroleum test methods. The user friendliness and high reliability of Tanaka instruments have allowed the company to capture an impressive share of the market for petroleum testers in Japan and North America. For example, 90% of the automated flash point testers sold in Japan and Korea are manufactured by Tanaka.

Outstanding Features of Tanaka Flash Point Testers include:

Ease of Operation

Operation of all Tanaka Flash Point Testers is simple – just select a test mode and enter the expected flash point. The instrument automatically executes the test, freeing the operator to do other lab work. The instrument follows the exact procedures specified in the test method. Completion of the test cycle is signaled by audible beeps. The test result is shown on the front panel display. An RS-232C connection is available for LIMS data transfer or a printer. For those desiring data storage functions, an optional software package is available.

Interchangeable Ignition Sources

The gas ignition flame is automatically lit with an electric pilot coil when a test is initiated (all models). In addition, in the ATG-7 and APM-7 the electric pilot coil can be used as an electric ignition source if electric ignition is preferred. It takes only a few minutes to switch from gas to electric ignition.

Single Action Setting

After setting the test cup in the instrument, just lower the arm assembly into the test cup to set all the necessary components for the test, i.e., the test cup lid, temperature sensor, flash detector, ignition source, and stirrer (all models).

Traceable Temperature Calibration

By simply setting a traceable thermometer next to the PT-100 temperature sensor and running a regular flash point test to record the thermometer readings, the user can perform a fully traceable temperature calibration (all models).

Modular Design

Tanaka Flash Point Testers consist of a control unit and a test unit. The same control unit can be used with any one of three test units: Pensky-Martens Closed Cup, Cleveland Open Cup, and Tag Closed Cup flash point testers (with an optional Changeover Unit). The test unit may also be placed as much as three meters away from the control unit.

Safety Features

All Tanaka Flash Point Testers automatically shut off whenever several error conditions occur, including continuous burning, defective components, or detection of a flash point greatly in excess of the estimated flash point. The error is reported by audible buzzer and flash point display. Additionally, the ACO-7 instrument is equipped with a metallic shutter that covers the test cup automatically when a sustained fire is detected.

Asphalt Version Cleveland Open Cup

When testing the flash point of bitumen, a surface film often forms which needs to be skimmed off to obtain the correct test result. An asphalt version of ACO-7 with an automatic surface skimmer is available.

Draft Protection Shield Cover

Both the APM-7 and ATG-7 have a tinted acrylic cover which not only ensures the flame integrity but reduces the glare from the electric igniter.

Tanaka® Scientific Ltd. Flash/Softening Point Testers

ASTM D 56, ASTM D 92/P36, ASTM D 93/IP34, ISO 2719, ISO 2592

Model ATG-7 Tag Closed Cup Flash Point Tester

The ATG-7 automates the Tag Closed Cup (TCC) flash point test. Ease of operation has been improved by employing an arm assembly that allows easy one-handed setup. The flash detector, a low-mass thermocouple, is reliable and easy to maintain. An acrylic windshield serves as protection from drafts. The bath liquid is automatically exchanged after a test, providing quick cooling.

Model APM-7 Pensky-Martens Closed Cup Flash Point Tester

The APM-7 automates the Pensky-Martens Closed Cup (PMCC) flash point test. The cup cover and stirrer are installed on a swing arm assembly for easy one-hand setup. The flash detector is a reliable and easy-to-maintain low mass thermocouple. An acrylic windshield provides draft protection. Quick cooling is facilitated by a high velocity fan.

Model ACO-7 Cleveland Open Cup Flash Point Tester

The ACO-7 automates the Cleveland Open Cup (COC) flash point test. Dual electric pilots turn the gas flame on and off automatically. Easy-to-maintain ionization rings serve as flash detectors. Quick cooling is provided by a high velocity fan.

ASP-5 Automated Softening Point Tester:

- Softening Point Testing per ASTM D 36
- Photoelectric Sensing Mechanism
- Wide Zone Detection

The ASP-5 Softening Point Tester automates the softening point test by Ring-and-Ball method (ASTM D 36) for bitumen and similar substances. A photoelectric device with a wide light beam is employed to assure a reliable automatic detection of softening point. The unit detects the falling ball even if the ball falls with some angle. Exact temperature rise rate can be attained not only with water bath, but also with glycerin bath by the precise heater control. Equipped with a safety shutdown.

Model ATG-7 Specifications

Test Standards:	ASTM D 56, etc.
Range:	Ambient to 95°C. The ATG-7 requires a source of cooling liquid. For temperatures down to ambient, tap water is suitable.
Ignition source:	Gas flame with electric pilot or electric coil (interchangeable)
Size/Weight:	230 mm wide x 480 mm deep x 385 mm high. Weight: 21.5 kg.
Power:	500 W
Gas Supply:	LP gas or natural gas (max. pressure 9.8 kPa)

Model APM-7 Specifications

Test Standards:	ISO 2719, ASTM D 93/IP34 (procedures A & B), etc.
Range:	40 to 370°C
Ignition source:	Gas flame with electric pilot or electric coil (interchangeable)
Size/Weight:	230 mm wide x 480 mm deep x 385 mm high. Weight: 24 kg.
Power:	700 W

Model ACO-7 Specifications

Test Standards:	ISO 2592, ASTM D 92/P36, etc.
Range:	80 to 400°C
Ignition source:	Gas with 2 pilot electric coils
Size/Weight:	230 mm wide x 455 mm deep x 385 mm high. Weight: 20 kg.
Power:	1000 W

An ACO-8 Asphalt Version with automatic surface film skimming is available.
A 6-position carousel unit for multiple-sample automated testing is also available.
Contact CANNON for more information.

Model ASP-5 Specifications

Test Standards:	ASTM D 36
Range:	Ambient to 200°C
Detector:	Light Projector: Cylindrical Lamp Light Receiver: Photo-diode array
Temp Sensor:	PT-100 in Stainless Steel Sheath
Size/Weight:	Control Unit: 230mm wide x 455 mm deep x 110mm high, 6 kg Test Unit: 230mm wide x 380mm deep x 270mm high, 7 kg

Order Information

Catalog #	*Item Description*
P89.0053	ATG-7 Tag Closed Cup Flash Point Tester
P89.0052	APM-7 Pensky-Martens Closed Cup Flash Point Tester
P89.0054	ACO-7 Cleveland Open Cup Flash Point Tester
P89.0273	ASP-5 Automated Softening Point Tester

Tanaka® Scientific Ltd. Automatic Petroleum Testers

ASTM D 6045/D 156, ASTM D 6045/D 1500, ASTM D 1209, ASTM D 1544,
ASTM D 86/D 850/D 1078, ASTM D 6749/97/2500, ASTM D 611

ACL-2 Colorimeter for Petroleum Products:

- Tri-Stimulus Method
- High Accuracy

The ACL Colorimeter was designed for automatic Saybolt/ASTM Color measurement of petroleum products utilizing the Tri-Stimulus method. No subjective judgment, plus full capability of easy and precise calibration, assures a high level traceability required by ISO 9000 series programs. Combination of high speed 16 bit A/D converter and a low drift receiver assures extremely high accuracy. Test standards ASTM D 6045, JIS K2580.

AD-6 Automated Distillation Tester:

- Fully Self-Contained
- Cooled by Peltier Technology-CFC Free!

The AD-6 Distillation Tester automatically performs distillation test of petroleum products as well as narrow boiling range samples. Eco-friendly tester using a Peltier system which does cooling/heating of the condenser as well as cooling of the cylinder compartment. All necessary electronics and mechanics are contained in one casing. Test standards ISO 3405, ASTM D 86, D 850.

MPC Series Automatic Pour/Cloud Point Testers:

- Better Precision than Manual Methods
- Consecutive Determination of CP/PP

Mini Pour/Cloud Point Tester (MPC) series has been designed for automatic determination of Pour Point and Cloud Point with small specimen size and shorter test cycle time while securing better test precision than conventional manual methods. The unit executes a CP determination and then PP determination consecutively. In addition to the liquid-cooled model MPC-102L, the air-cooled model MPC-102A is also available. Multiple-test versions with 3 and 6 test heads is available. Test standards for pour point: ASTM D 6749, D 97, ISO 3016 and others. Test standards for cloud point: ASTM D 2500, ISO 3015 and others.

AAP-5 Automated Aniline Point Tester:

- Tests Transparent and Opaque Samples
- Easy Cleaning

The AAP-5 Aniline Point Tester automates the aniline point test of petroleum products. The unit is capable of covering a wide range of samples including transparent samples as well as dark/opaque samples. Safety Feature: A bottle top dispenser can be connected to the measuring cell for directly delivering aniline without a manual pipetting operation. Removable measuring cell allows for weighing of viscous samples that are solid at ambient temperature. The measuring cell can be cleaned without disassembly.

Unit fits easily inside a fume hood.Test standards ISO 2977, ASTM D 611.

Model ACL-2 Specifications

Test Standards:	ASTM D 6045, etc.
Color Series:	Saybolt Color (ASTM D 6045/ D 156); ASTM Color (ASTM D 6045/ D1500); Platinum-Cobalt Color (ASTM D 1209); Gardner Color (ASTM D 1544)
Light Source:	Halogen Bulb
Light Receiver:	Fast response Silicon Photo Cell
Size/Weight:	400mm wide x 400mm deep x 190mm high, 12.2 kg

Model AD-6 Specifications

Test Standards:	ASTM D 86/D850/D1078, etc.
Temp Range:	RT to 300°C/400°C (fuel oil); RT to 200°C /400°C (ASTM D 850/ D 1078)
Temp Measurement:	PT 100 Probe
Dist. Rate:	From 2.0 to 9.0ml/min with 0.5 increments
Size/Weight:	400mm wide x 520mm deep x 710mm high, 55 kg

Model MPC-102A/L Specifications

Test Standards:	ASTM D 6749/97/2500 etc.
Temp Range:	MPC-102L (liquid cooled): +5°C to –40°C with tap water of 20°C, +51°C to –65°C with cooling liquid of –35°C MPC-102A (air cooled): +51°C to –30°C (in 25°C ambient)
Size/Weight:	230mm wide x 480mm deep x 385mm high, 20 kg

Also available with 3 or 6 test heads

Model AAP-5 Specifications

Test Standards:	ASTM D 611, etc.
Range:	Ambient to 170°C
Temp Sensor:	PT-100 in Stainless Steel Sheath
Heater:	Immersion Heater in Stainless Steel Sheath
Test Mode:	Single or Repeated Determinations
Size/Weight:	Control unit: 230mm wide x 455mm deep x 105mm high, 7 kg Test unit: 230mm wide x 350mm deep x 580mm high, 8 kg

Tanaka® Order Information

Catalog #	*Item Description*
P89.0011	ACL-2 Colorimeter for Petroleum Products
P89.0266	AD-6 Automated Distillation Tester
P89.0267	MPC-102A (Air-cooled) Automatic Pour/Cloud Point Tester
P89.0271	MPC-102L (liquid-cooled) Automatic Pour/Cloud Point Tester
P89.0270	AAP-5 Automated Aniline Point Tester

(other versions available-Contact CANNON for technical details)

CANNON INSTRUMENT COMPANY • 2139 HIGH TECH ROAD • STATE COLLEGE • PENNSYLVANIA • 16803 • USA
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Tanaka® Scientific Ltd. Automatic Petroleum Testers

ASTM D 6371, ASTM D 189, ASTM D 4530

AFP-102 Automated CFPP Tester:

- Thermoelectric Cooling
- Reliable Meniscus Detection

The AFP-102 Cold Filter Plugging Point Tester automatically executes the Cold Filter Plugging Point test method. Use of a thermo-electric device for sample cooling/heating has made this tester methanol-free. Upper and lower meniscus detectors are mounted on a holder that slides back and forth to engage the pipette. This allows ease of operation and reliable detection under conditions when the pipette is frosted. Test methods ASTM D 6371, IP309. AFP-202 with two testers also available.

ACR-6 Carbon Residue Tester:

- Programmable Burning Specs
- Testing per ASTM D 189, ISO 6615

The ACR-6 Conradson Carbon Residue Tester automates the evaporation process of the amount of carbon residue left after evaporation and pyrolysis of an oil, and is intended to provide some indication of relative coke-forming propensities. Optimum heater output for the prescribed burning process is programmed easily prior to the test. Ignition is determined by sheathed thermocouple. Test standards ASTM D 189, IP 13, ISO 6615.

ACR-M3 Micro Carbon Residue Tester:

- ASTM D 4530, ISO 10370
- Excellent Repeatability and Reproducibility
- Vinyl Laminated Trap for Easier and Safer Removal
- One-Button Operation
- Superb Temperature Control

The ACR-M3 is used for the determination of the amount of carbon residue formed after evaporation and pyrolysis of petroleum material under conditions specified in ASTM D 4530, and is intended to provide some indication of the relative coke forming tendency of such materials. The ACR-M3 offers precise control of test conditions, and requires smaller samples and less operator involvement than previous models. Up to twelve samples may be tested simultaneously, including a control sample.

Model AFP-102 Specifications

Test Standards:	ASTM D 6371, etc.
Range:	RT to –60°C (The lowest temperature varies with the chiller liquid temperature and ambient temperature)
Temp. Control:	By step or linear. Linear cooling rate can be programmed.
Sequence Control:	By a built-in micro processor
Size/Weight:	350mm wide x 550mm deep x 480mm high, 27 kg

An AFP-202 (two-position) model is also available. Contact CANNON for more information.

Model ACR-6 Specifications

Test Standards:	ASTM D 189, etc.
Heating Device:	Nichrome coil heater (side and bottom)
Igniting Device:	Pilot burner system. LP gas or city gas. Lit manually.
Time Monitor:	Ignition time (from start to ignition) Burning time (from ignition to heating start)
Size/Weight:	Control unit: 250mm wide x 360mm deep x 190mm high, 7.5 kg Oven unit: 190mm wide x 260mm deep x 440mm high, 5.5 kg

Model ACR-M3 Specifications

Test Standards:	ASTM D 4530
Heating Range:	Up to 500°C
Flow Meter:	0.1 to 1L/min
Flow Rate:	Automatically regulated at 150ml/min and 600ml/min according to the ASTM Method
Safety:	Tester stops operation when secondary pressure is less than 80kPa Automatic heat shutdown when unit reaches 550°C
Size:	350 mm wide x 390 mm deep x 460 mm high (14 x 15.4 x 18.1")
Weight:	21 kg (46 lb)

Tanaka® Order Information

Catalog #	*Item Description*
P89.0272	AFP-102 Automated CFPP Tester
P89.0057	ACR-6 Carbon Residue Tester
P89.0133	ACR-M3 Micro Carbon Residue Tester

Tanaka® Scientific Ltd. Current & New Products

ASTM D 323, ASTM D 4294, ASTM D 2622, ISO 20884, JIS K2541-7

AVP-30D Automatic Vapor Pressure Tester:

- Automates Reid Vapor Pressure test
- Demi-Size Bombs for Easy Handling

The AVP-30D series Automated Vapor Pressure Tester carries out the Reid Vapor Pressure Test. Easily toggles between display in kPa and kgf/cm^2 units. A water level monitor enhances safety. The unit can communicate with external computers. Compact size bombs allow easier handling, yet yielding the same test results compared to the heavy full size bombs. Unit available in 2, 3, or 4 Demi-size bombs. Specify number when ordering. Test methods ASTM D 323, IP69, ISO 3077.

RX-360SH X-Ray Sulfur Meter:

- Measure Sulfur Content Easily
- Rapid Testing

The RX-360 X-Ray Sulfur Meter determines total sulfur in petroleum products, such as gas oil, fuel oil, crude oil, and naphtha, using energy dispersive X-ray fluorescence method, which is accurate, non-destructive, economical and quick. Measurement range of 0-6.00 wt%. This unit is for single samples. A 12-sample version is available. Test standards ASTM D 4294, ISO 8754.

WDXRF Sulfur Analyzer FX-700

The WDXRF Sulfur Analyzer FX-700 from TANAKA uses dispersive X-ray technology to detect sulfur in oil content of a 3-4 mL sample. The FX-700 uses a gas-filled proportional counter to detect the presence of sulfur in quantities of as little as 1 ppm.

The front panel display provides test status, sample name, raw count data, and sulfur content. Data from the last 50 tests are stored in RAM. The FX-700 includes a built-in thermal type printer and an RS-232C 1 channel port for optional output to the user's Laboratory Information Management System (LIMS).

The FX-700 satisfies the specifications of the ASTM D 2622, ISO 20884, and JIS K2541-7 methods.

The Sulfur Analyzer is a stand-alone unit. No external PC is required for operation.

Model AVP-30D Specifications

Test Standards:	ASTM D 323
Type:	2, 3, or 4 Demi-size bombs
Measuring Range:	0 to 196kPa (2kgf/cm2)
Shaking:	By "see-saw" movement with angular movement of ±15 degrees and interval of 6 sec
Size/Weight:	400mm wide x 600mm deep x 720mm high, 50 kg

Model RX-360SH Specifications

Test Standards:	ASTM D 4294, etc.
Number of Tests:	One (High Precision)
Sample Volume:	5 - 20 ml
Measuring Range:	0.00 - 6.00wt%
Measuring Time:	10 - 300 sec with a 10 sec increment. 1 - 99 times.
X-Ray Source:	X-ray tube rated 7KV-150mA
Size/Weight:	Test Head: 420mm wide x 350mm deep x 140mm high, 12.5 kg. Power Supply: 80mm wide x 160mm deep x 60mm high, 1 kg

12-position carousel model also available

Model FX-700 Specifications

Type:	Bench-Top type Wavelength Dispersive X-ray Fluorescence Analyzer for Sulfur in Oil
Test Standards:	ASTM D 2622, ISO 20884, JIS K2541-7
Specimen Volume:	3 to 4ml
Sample Cup:	Made of Paper, disposable type
Measuring Range and Precision:	0-990 ppm; LOD: Approx. 1ppm
X-Ray Tube:	Air Cooled Small X-ray Tube
Power Requirements:	Approx. 40W
Detector:	Gas Filled Proportional Counter
Optical Pass:	Helium Gas
Typical Measurement Time:	300 sec for S-k and 300 sec for Background from 60 sec to 990 sec, selectable
Display:	Test status, Sample Name, Raw Count Data, Sulfur Contents, etc are displayed on LCD.
Safety Shutdown:	When chassis is opened while X-ray source is ON, warning buzzer beeps and High Voltage for X-ray tube shuts off.
Printer:	Built-in, Thermal type
Data Output:	RS-232C 1 channel
Data Storage	Last 50 test data are stored in RAM
Power:	100, 120, 220 or 240VAC, 500W
Dimensions:	W600 x D500 x H520 mm (24 x 20 x 20.5 inches)
Weight:	60 kg (27 lbs)

Tanaka® Order Information

Catalog #	Item Description
P89.0096	AVP-30D2 Auto. Vapor Pressure Tester (2-bomb)
P89.0097	AVP-30D3 Auto. Vapor Pressure Tester (3-bomb)
P89.0098	AVP-30D4 Auto. Vapor Pressure Tester (4-bomb)
P89.0094	RX-360SH X-Ray Sulfur Meter
P89.0386	WDXRF Sulfur Analyzer FX-700

CANNON® Software VISDISK®/VISCPRO®

VISDISK Version II Now Available!

- Now with Graphing Capability
- Simple User Interface
- Includes with Intrinsic Viscosity Calculations!
- W. A. Wright Blending Method and the ASTM D 341 Chart Blending Method
- Interpolation Programs Which Allow the Estimation of Kinematic Viscosity, Viscosity, and Density at any Temperature if Values are Known at Two or More Temperatures
- Conversion between Saybolt Universal Seconds (SUS) and Saybolt Furol Seconds (SFS) Units and Centistokes
- VI Determination from Kinematic Viscosity Data at any Two Temperatures (Fahrenheit or Celsius)
- Many other functions for CANNON equipment

VISDISK® for Windows® is a software tool uniquely designed to perform a variety of calculations associated with viscosity determination.

VISDISK users can perform mathematics associated with blending of oils, viscosity interpolation, determination of VI (viscosity index), kinematic viscosity conversions and many other rheological functions.

VISDISK for Windows® can also display tables with ISO VG Lubricant Specifications and SAE Viscosity Grades for Engine Oils.

Context-sensitive On-line Help and a concise user's guide make VISDISK easy to use. Data entered into the program can be saved and reloaded. The program works equally well under Windows® 98, NT®, and XP®.

The software is shipped with a CANNON mouse pad.

Computer Requirements

Computer requirements for VISDISK are modest: a computer capable of running Windows® 98, NT®, or XP®, VGA or better monitor, CD-ROM drive, and a hard disk with 2 megabytes available disk space.

VISCPRO®/CAV Software Upgrade

CANNON customers currently operating the Cannon Automatic Viscometer (CAV) with DOS software may now purchase the VISCPRO® controlling software for Windows® 98, NT®, and XP®. VISCPRO is a comprehensive computer program that has been designed to provide a uniform Windows interface for operation of the CAV 2000 Series (pages 6-7), the PolyVISC® (page 12) and future CANNON instruments.

New Features Available with the VISCPRO® Software Include:

- Options for defining parameters for sample drop timing, determinations, washing and drying
- Viscosity index matching and analysis modules
- ASCII output of data to text files and/or serial port(s)
- A sample database and Database Manager with powerful functions for managing and archiving sample data.

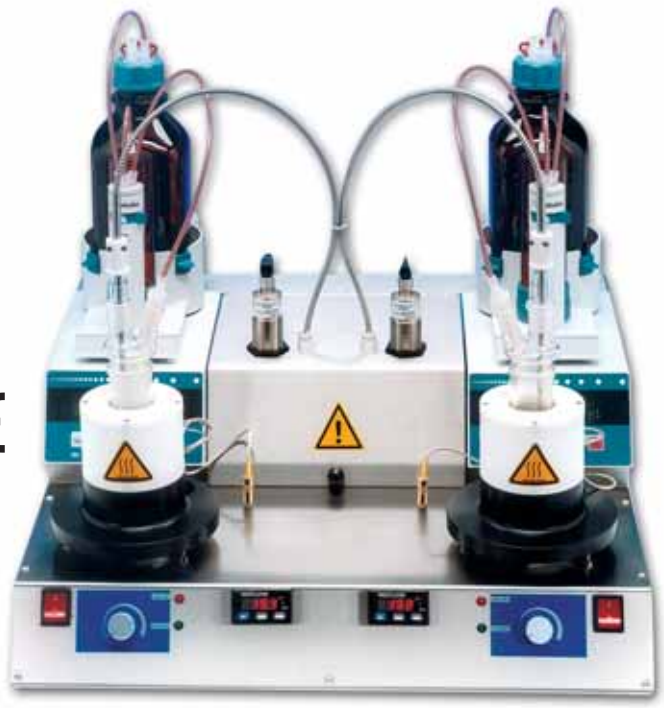
Upgrade packages will be configured for each existing CAV instrument according to original configuration records. Contact CANNON for more information on obtaining a VISCPRO upgrade for your existing CAV unit.

Order Information

Catalog #	*Item Description*
9726-X15	VISDISK Version 2.0 Viscosity Calculation Tools for Windows®
	VISCPRO® /CAV Software Upgrade

Zematra® Automated Stability Analyzer

ASTM D 7060



Zematra® ASA Automated Stability Analyzer

- For Process Monitoring of Residual Refinery Streams and Fuel Oils
- Determines the P-Value and the Po/Fr_{max} of Residual Fuel Oils
- Complies with Shell Methods SMS 1600 and SMS 2715
- Uses Modern Fiber Optics Techniques for Improved Detection

The Automated Stability Analyzer (ASA) enables the operator to predict with a high level of certainty the compatibility of blend components and to meet blend specifications more efficiently and economically. Maximum flocculation ratio at infinite dilution is reported to the nearest 1 unit. The Po/FR_{max} ratio is also reported according to SMS 2715.

The ASA integrates two titration units. An operator prepares oil samples dissolved in 1-methylnaphthalene in several different ratios. Resultant specimens are then automatically temperature-controlled and dosed with cetane until flocculation is detected by the optical sensor. Test data are processed by the controlling computer to determine peptizing (available solvency) power of the oil.

Automated Stability Analyzer Benefits

The Automated Stability Analyzer manufactured by Zematra® uses the latest fiber optic techniques to greatly improve detection of the flocculation point and repeatability of the results. Because the unit is automatic, manpower requirements are minimal and repeatability is improved. Windows®-based software performs all calculations. Data from previous runs may be easily accessed and processed using the supplied Dataview software.

Operating Principles

Asphaltenes consist of aromatic and naphthenic ring compounds, containing nitrogen, sulfur, and oxygen molecules, which exist in oil as a colloidal suspension. The asphaltenes in a sample of residual fuel oil become unstable after injection of a measured quantity of cetane. The point of instability (asphaltene flocculation point) is determined by measuring the reflection of light by the asphaltenes which have precipitated on the glass surface of an Optrode device. The stability reserve (P-value) is then automatically calculated on the basis of the measured quantity of cetane required to reach the point of instability. The significance of the stability parameter has been extended to residual products in refinery processes. The P-value of an oil sample provides information on stability and stability reserve required for refinery process (e.g., thermal cracking) control purposes.

Configuration

The Automated Stability Analyzer consists of the analyzer, Dosimat top units, reaction cells, fiber optical sensors, interface card, software for Windows, and a computer running Windows® NT®, 2000 Professional, or XP®. The complete system is CE marked.

Automated Stability Analyzer Specifications

Size:	550 mm wide x 520 mm deep x 550 mm high (with Dosimat units) (21.7 x 20.5 x 21.7 inches)
Weight:	27 kg (60 lbs)
Electrical:	115 V/ 60 Hz, 1000 watts 230 V/ 50 Hz, 1000 watts
Temperature Control:	±1°C
Shipping Weight (incl. computer):	105 lbs (48 kg)
Volume Weight:	187 lbs (85 kg)
Computer Requirements:	Computer not included. Please contact CANNON for specifications.

Zematra® ASA Order Information

Catalog #	Item Description
P88.0001	Automated Stability Analyzer, 115V, 60 Hz
P88.0002	Automated Stability Analyzer, 230V, 50 Hz

CANNON INSTRUMENT COMPANY • 2139 HIGH TECH ROAD • STATE COLLEGE • PENNSYLVANIA • 16803 • USA
800-676-6232 • 814-353-8000 • Fax: 814-353-8007 • cannon@cannoninstrument.com • www.cannoninstrument.com

CANNON® General Apparatus

ASTM D 1200, ASTM D 4212, ASTM D 5125

EZ® Viscosity Flowcups

EZ = Equivalent Zahn; 3% Guaranteed tolerance; complies with and exceeds ASTM D 4212.

Oils used to standardize EZ Cups are produced in accordance with ISO 9001. The EZ Cup formula for each cup of the series matches the applicable ASTM formula in D 4212 at the recommended calibration level. Drain time conversion tables are provided with each EZ Cup.

Viscosity Flow Cups can be calibrated, and a Certificate of Calibration provided by CANNON, for an additional fee.

Order Information:

Catalog #	*Item*	*No.*	*Range (seconds)*	*Range (centistokes)*
9735-E50	EZ Viscosity Cup	1	40-60	10-36
9735-E60	EZ Viscosity Cup	2	20-60	19-156
9735-E70	EZ Viscosity Cup	3	12-60	64-596
9735-E80	EZ Viscosity Cup	4	10-60	79-784
9735-E90	EZ Viscosity Cup	5	10-60	161-1401

Thomas® Uncalibrated Viscosity Flow Cups

Ideal for measuring low viscosity liquids. Liquid flow time may be converted to centistokes. Flow cup stand incorporates tripod design with heavy aluminum ring and adjustable legs. Includes level for optimum results. High quality aluminum flow cups are precision machined with stainless steel orifice insets. Uncalibrated flow cups can be calibrated by CANNON at customer's request.

a. 9734-Y05, 4mm cup conforms to DIN 53211.

b. 9735-A12, A15, A18, A21, and A24 Ford Cups conform to ASTM D 1200.

c. 9735-A27, A30, A33, and A36, ISO cups conform to DIN/ISO 2431; BSEN 535, 1991; ASTM D 5125.

d. 9735-A40, Flow cup stand holds all flow cups - includes level for optimum results.

Stirring Block Thermostat 15.5 (VARIOMAG®)

Designed for 100 mL laboratory flasks and 150 mL beakers. Corrosion-resistant stirring/heating block includes side heating element distribution to reduce temperature gradient. Remote control unit for adjustment of block performance.

Optional block bore holes between 16 and 57 mm in diameter. Optional cooling ducts for more rapid cooling of block to ambient temperature.

See SPS on page 13.

Stirring Block Thermostat Specifications:

Stirring points:	15
Stirring point distance:	65 mm
Bore holes (diameter/depth):	57.5/48 mm
Stirring volume per point:	1-150 mL
Stirring power:	40W
Speed:	100-1000 rpm
Dimensions (W x D x H):	295 x 445 x 110 mm
Weight (stirring drive):	approx. 20 kg
Control temperature range:	to +199°C
Heating power:	1100W
Operating voltage:	115V or 230V (see catalog #)
Housing material:	Aluminum
Protection (DIN 40050):	IP 31
Environment:	–10 to +56 at 80% humidity
Mains voltage/frequency:	115V or 230V (see catalog #)

Order Information

Catalog #	*Item*
9728-X15	Stirring Block Thermostat 15.5, 115V AC, 50/60 Hz
9728-X17	Stirring Block Thermostat 15.5, 230V AC, 50/60 Hz

Order Information

Catalog #	*Item*	*Type*
9734-Y05	DIN 4mm Cup	a
9735-A12	Ford Cup, No. 1	b
9735-A15	Ford Cup, No. 2	b
9735-A18	Ford Cup, No. 3	b
9735-A21	Ford Cup, No. 4	b
9735-A24	Ford Cup, No. 5	b
9735-A27	ISO Cup, No. 3	c
9735-A30	ISO Cup, No. 4	c
9735-A33	ISO Cup, No. 5	c
9734-Y36	ISO Cup, No. 6	c
9735-A40	Flow Cup Stand	d

CANNON® CAV Sample Vials/Bath Manifold

CAV sample vials/holders
CAV and other vial options, see pages 6-10

CAV Sample Vials/Holders

Designed for use with CANNON Automatic Viscometers, CAV sample vials are available in glass and plastic. Cellulose Acetate Propionate vials are transparent. The Polypropylene vials are translucent.

Reusable metal vial adapters act as a sleeve to hold the vials in the CAV sample trays. Consult the tables below for order information and specifications. Free samples of all vials are available upon request. Contact CANNON for more information.

CANNON® Model 3VM and 4VM Vacuum Manifolds

- Designed for use with CANNON baths
- Convenient vacuum distribution

With manual valves for applying vacuum or pressure to capillary-type viscometers. Designed for use with 9726-T20 through -T67 Vacuum/Pressure Regulators and Cannon-Manning, Asphalt Institute, or Modified Koppers vacuum viscometers (see 9724-H50, -R50, -W50 Series). Integral brackets permit mounting on Cannon bath covers. Two models are available: the 4VM has four valves and is intended for use with the CANNON CT-1000, CT-1000HT, and CT-2000 baths, and the 3VM has three valves and is intended for use with the CANNON CT-500/518 baths.

Includes 10-foot length of rubber vacuum tubing 9726-V23, ¼-inch bore x ⅝-inch o.d., for connection to vacuum/pressure regulator. Housing is epoxy-coated aluminum, overall 330 mm wide x 70 mm deep x 229 mm high (13 x 2.75 x 9 inches).

Vacuum Manifolds Specifications

Shipping Weight:	2.3 kg (5 lb)

CAV Standard Sample Vials/Adapter Order Information*

Catalog #	*Item Description*
P61.3661	Single-dipped CAV Sample Vial‡, 2.35 x 0.90 x 0.02", 60 x 23 x 0.50, Cellulose Acetate Propionate
P61.3662	Double-dipped CAV Sample Vial, 2.52 x 0.85 x 0.08", 64 x 22 x 2.0, Cellulose Acetate Propionate
P61.3663	Polypropylene vials, 2.43 x 0.94 x 0.047", 62 x 24 x 1.2, Polypropylene
9717-V01	Glass CAV Sample Vial, 2.42 x 0.94 x 0.057", 62 x 24 x 1.45, Glass
P62.1073B	Sample Vial Adapter, 2.25 x 1.0 x 0.025", 57 x 25 x 0.635, 316ss

CAV Low Volume Application Vial/Adapter Order Information

Catalog #	*Item Description*
P61.3660	Low-volume Sample Vial*, 2.35 x 0.64 x 0.03", 60 x 16 x 0.76, Polypropylene
P61.3658	Low-volume Sample Adapter Sleeve*, 2.38 x 1.0 x 0.17, 60 x 25 x 4.3, Aluminum

* Low Volume Application Vial/Adapter requires low volume viscometer tubes in CAV bath.

‡ Not recommended for applications above 80°C.

Vacuum Manifold Order Information

Catalog #	*Item Description*
9726-V05	4VM Vacuum Manifold for CT-1000 Bath
9726-V10	3VM Vacuum Manifold for M1, H-1A, and CT-500 Baths
9726-V23	Neoprene Vacuum Tubing, ¼ x ⅝, 10 ft

CANNON® Products & Services Index

Continued next page...

CANNON® Products & Services Index

Registered Trademarks

Trademarks	Owned By
AIRBATH	CANNON Instrument Co.
CAV-2000	CANNON Instrument Co.
CANNON	CANNON Instrument Co.
Digi-Sense	Cole-Parmer Instrument Co.
Ertco	Eveready Thermometer Co.
IBM	International Business Machines
Julabo	Julabo Labortechnik Gmbh
Kynar	Elf Atochem
Luer-Lok	Becton Dickinson Consumer Products
miniAV	CANNON Instrument Co.
MS-DOS	Microsoft Corp.
Mylar	DuPont Teijin Film
Nochromix	Godax
PolyVISC	CANNON Instrument Co.
Precision	Precision Scientific, Inc.
Pro-Pak	CANNON Instrument Co.
Pyrex	Corning Glass Works
Ravenfield	Ravenfield Designs, Ltd.
SAE	Society of Automotive Engineers
Solo	Solo Cup Operating Corporation
Stormer	Arthur H. Thomas Co.
Tanaka	Tanaka Scientific Limited
Teflon	E.I. duPont de Nemours & Co., Inc.
Thomas	Arthur H. Thomas Co.
Variomag	H+P Labortechnik GmbH
Varsol	ExxonMobil
VISCPRO	CANNON Instrument Co.
VISDISK	CANNON Instrument Co.
Windows	Microsoft Corp.
Zeitfuchs	CANNON Instrument Com
Zematra	Zematra B.V.

CANNON® Commitment to Quality & to You!

CANNON® Viscosity Testing Services

Three Testing Options

Standard:*

Via fax within five working days except for multiple-day tests (results within three test cycles). Formal report via mail.

Rush Standard:*

Via fax within 24 hours of sample receipt at CANNON's loading dock except for multiple-day tests (results within one test cycle). Formal report via mail.

Certification:

D445 results via mail within four weeks of sample receipt. Results are NIST-traceable.

* *Turnaround times for exceptional samples may be extended. CANNON will advise of any anticipated delays prior to beginning the test.*

THREE OPTIONS—Your choice!

1) Standard Service*

Sample testing per ASTM methodology with fast, accurate results.

Call CANNON at 1-814-353-8000 to request information and our Test Authorization Form. All submitted materials must include the customer's MSDS.

Our testing lab offers five separate ASTM tests for viscosity measurements on fuels and lubricants:

- Kinematic Viscosity per ASTM D 445 at any temperature between –30°C and +150°C
- High Temperature High Shear Viscosity per ASTM D 5481 at 150°C and 100°C
- Cranking Viscosity per ASTM D 5293 (specify temperature)
- Pumping Viscosity per ASTM D 4684 (specify temperature)
- Borderline Pumping Temperature and/or Pumping Viscosity per ASTM D 3829 (specify temperature

2) Rush Standard Service*!

Cannon® has inaugurated a Rush Service for even faster viscosity testing.

Customers sending us samples for viscosity testing will be able to receive test results within a day for most tests. The fast testing service is available by request on all Standard Service ASTM tests (listed above) for an additional 50 percent surcharge over regular test rates.

* *certification not included*

3) D 445 Certification Service

Certified kinematic viscosity and viscosity determinations—Tests are performed using glass capillary viscometers as per ASTM D 445. This service provides traceable results developed from multiple-test determinations using the same rigorous testing used to certify Cannon's viscosity standards.

Periodic Testing Discounts Available!

For information on our quality programs see page 1.

Email: service@cannoninstrument.com
Fax: 1-814-353-8007
Phone: 1-814-353-8000

CANNON's testing laboratory is ISO 9001:2000 registered through Underwriters Laboratories for viscosity certification of customer-supplied materials. Goods and services for which CANNON Instrument Company is ISO 9001:2000 registered:

- SIC Code 3823 (US): Industrial Instruments for Measurement, Display, and Control of Process Variables; and Related Products.
- The manufacture and certification of viscosity standards and the viscosity certification of customer-supplied materials.
- The provision of calibration services for viscometers and kinematic viscosity thermometers.

The company has received ISO/IEC 17025-1999 accreditation for technical competence in the field of calibration through A2LA.

ISO 9001 REGISTERED

UL REGISTERED FIRM

CANNON INSTRUMENT COMPANY
REGISTERED TO ISO 9001:2000
CERTIFICATE NUMBER A1080

A2LA ACCREDITED
1262.01

CANNON-Certified Viscosity Reference Materials

Sample Report of Calibration

Acknowledged as providers of viscosity standards by the American Petroleum Institute in 1959 and subsequently as such by ASTM for almost 50 years. API began a program in 1924 to provide three standards to the industry and at the end of 1958 this program was discontinued. CANNON-certified Reference Materials fully comply with ASTM D 445 Section 8.

Accredited in accordance with ISO/IEC 17025 by A2LA (the American Association for Laboratory Accreditation) dedicated to "one test accepted everywhere, one accreditation accepted everywhere."

Indicates unique Lot Number indentifier for quality assurance purposes.

Specifies when the material was tested.

Provides product identification information.

Provides multiple temperatures for most standards. Temperatures expressed in both °C and °F.

Supplies KV values with precision to the fourth significant digit.

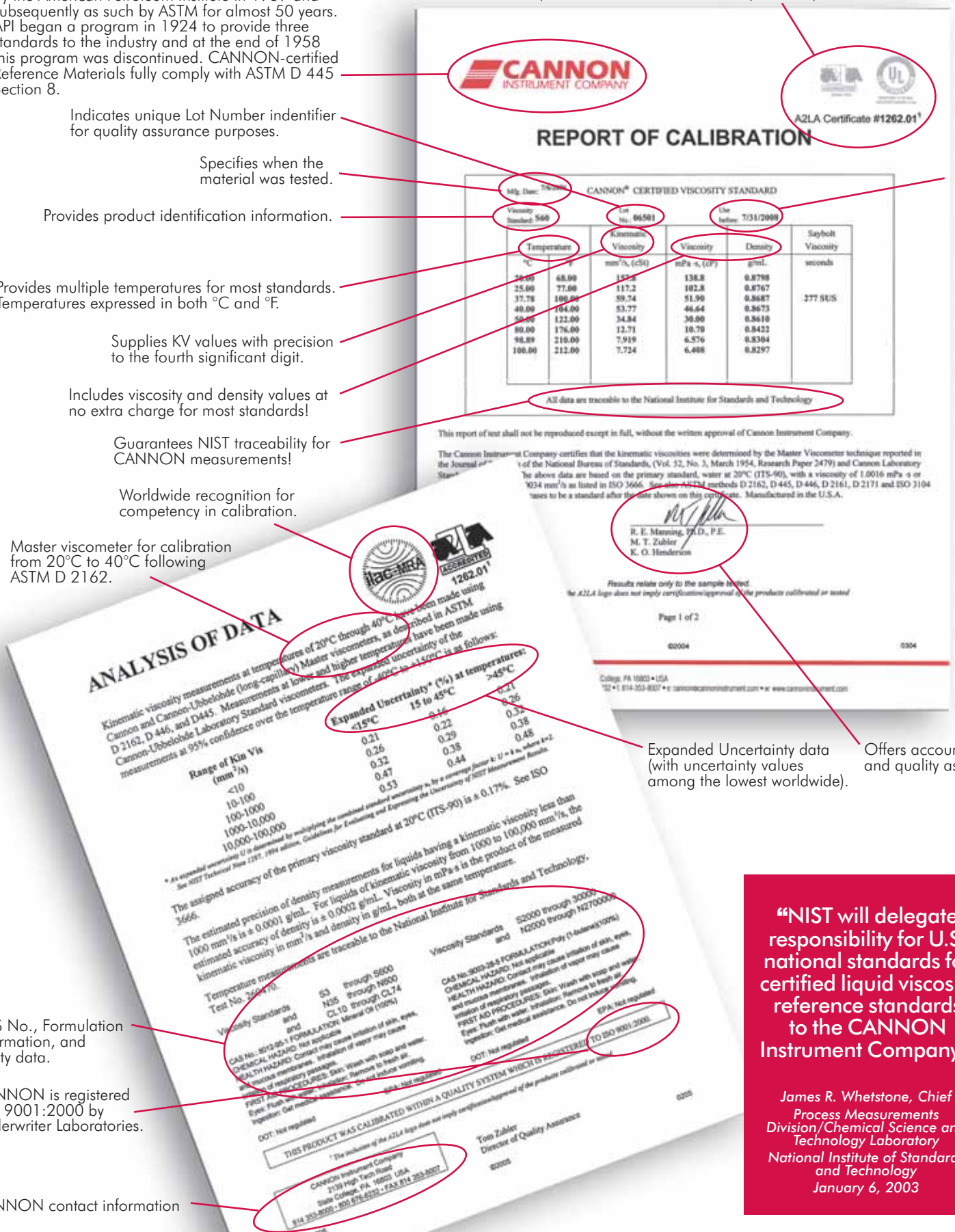
Includes viscosity and density values at no extra charge for most standards!

Guarantees NIST traceability for CANNON measurements!

Worldwide recognition for competency in calibration.

Master viscometer for calibration from 20°C to 40°C following ASTM D 2162.

Includes Expiration Date for confidence; guaranteed 18-month shelf life.


CANNON INSTRUMENT COMPANY

A2LA Certificate #1262.01[1]

REPORT OF CALIBRATION

CANNON® CERTIFIED VISCOSITY STANDARD

Mfg. Date: 7/6/2006
Viscosity Standard: S60
Lot No.: 06501
Use before: 7/31/2008

Temperature °C	Temperature °F	Kinematic Viscosity mm²/s, (cSt)	Viscosity mPa·s, (cP)	Density g/mL	Saybolt Viscosity seconds
20.00	68.00	157.8	138.8	0.8798	
25.00	77.00	117.2	102.8	0.8767	
37.78	100.00	59.74	51.90	0.8687	277 SUS
40.00	104.00	53.77	46.64	0.8673	
50.00	122.00	34.84	30.00	0.8610	
80.00	176.00	12.71	10.70	0.8422	
98.89	210.00	7.919	6.576	0.8304	
100.00	212.00	7.724	6.408	0.8297	

All data are traceable to the National Institute for Standards and Technology

This report of test shall not be reproduced except in full, without the written approval of Cannon Instrument Company.

The Cannon Instrument Company certifies that the kinematic viscosities were determined by the Master Viscometer technique reported in the Journal of ... of the National Bureau of Standards, (Vol. 52, No. 3, March 1954, Research Paper 2479) and Cannon Laboratory ... The above data are based on the primary standard, water at 20°C (ITS-90), with a viscosity of 1.0016 mPa·s or ...0034 mm²/s as listed in ISO 3666. See also ASTM methods D 2162, D 445, D 446, D 2161, D 2171 and ISO 3104 ...uses to be a standard after the date shown on this certificate. Manufactured in the U.S.A.

R. E. Manning, Ph.D., P.E.
M. T. Zubler
K. O. Henderson

Results relate only to the sample tested.
The A2LA Logo does not imply certification/approval of the products calibrated or tested

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ANALYSIS OF DATA

Kinematic viscosity measurements at temperatures of 20°C through 40°C have been made using Cannon and Cannon-Ubbelohde (long-capillary) Master viscometers, as described in ASTM D 2162, D 446, and D445. Measurements at lower and higher temperatures have been made using Cannon-Ubbelohde Laboratory Standard viscometers. The expanded uncertainty of the measurements at 95% confidence over the temperature range of 40°C to ±15°C is as follows:

Range of Kin Vis (mm²/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
10,000-100,000	0.53	0.44	0.48

* As 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

The assigned accuracy of the primary viscosity standard at 20°C (ITS-90) is ± 0.17%. See ISO 3666.

The estimated precision of density measurements for liquids having a kinematic viscosity less than 1000 mm²/s is ± 0.0001 g/mL. For liquids of kinematic viscosity from 1000 to 100,000 mm²/s, the estimated accuracy of density is ± 0.0002 g/mL. Viscosity in mPa·s is the product of the measured kinematic viscosity in mm²/s and density in g/mL, both at the same temperature.

Temperature measurements are traceable to the National Institute for Standards and Technology, Test No. 249470.

Viscosity Standards S3 through S600 and N35 through N600 and CL10 through CL74

CAS No.: 8012-95-1 FORMULATION: Mineral Oil (100%)
CHEMICAL HAZARD: Not applicable
HEALTH HAZARD: Contact may cause irritation of skin, eyes, and mucous membranes. Inhalation of vapor may cause irritation of respiratory passages.
FIRST AID PROCEDURES: Skin: Wash with soap and water. Eyes: Flush with water. Inhalation: Remove to fresh air. Ingestion: Get medical assistance. Do not induce vomiting.
EPA: Not regulated
DOT: Not regulated

Viscosity Standards S2000 through S60000 and N2000 through N2700000

CAS No.:9003-28-5 FORMULATION:Poly (1-butene)(100%)
CHEMICAL HAZARD: Not applicable
HEALTH HAZARD: Contact may cause irritation of skin, eyes, and mucous membranes. Inhalation of vapor may cause irritation of respiratory passages.
FIRST AID PROCEDURES: Skin: Wash with soap and water. Eyes: Flush with water. Inhalation: Remove to fresh air. Ingestion: Get medical assistance. Do not induce vomiting.
EPA: Not regulated
DOT: Not regulated

THIS PRODUCT WAS CALIBRATED WITHIN A QUALITY SYSTEM WHICH IS REGISTERED TO ISO 9001:2000.

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

Tom Zubler
Director of Quality Assurance

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P/O 5208

Expanded Uncertainty data (with uncertainty values among the lowest worldwide).

Offers accountability and quality assurance!

CAS No., Formulation information, and safety data.

CANNON is registered ISO 9001:2000 by Underwriter Laboratories.

CANNON contact information

"NIST will delegate responsibility for U.S. national standards for certified liquid viscosity reference standards to the CANNON Instrument Company."

James R. Whetstone, Chief
Process Measurements Division/Chemical Science and Technology Laboratory
National Institute of Standards and Technology
January 6, 2003