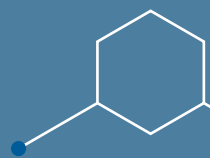
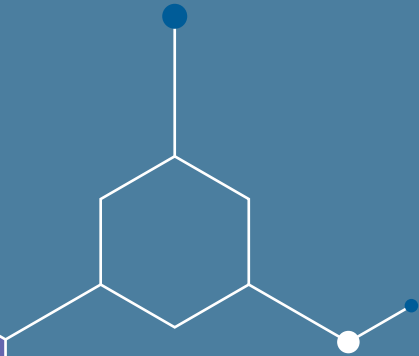


2014

PRODUCT
CATALOG

Viscometers & Rheometers
Texture Analysers
Powder Flow Testers



DV2T™ Viscometer

our most versatile continuous sensing viscometer

5-inch Full Color Touch Screen Display

- New User Interface
- Enhanced Controls
- Real Time Trend Indicator
- Supports Multiple Languages

Displayed Info:

- Viscosity (cP or mPa•s)
- Temperature (°C or °F)
- Shear Rate/Stress
- % Torque
- Speed/Spindle
- Step Program Status

Enhanced Security

- Customizable User Access
- Date and Time Stamp File
- Password Access
- Portable Log-in Settings

Built-in Options

- Timed Tests
- Data Averaging
- Programmable QC Limits/Alarms
- Customizable Speed/Spindle Lists
- Test Based User Instructions
- On Screen Data Comparison

Auto Range Showing

- Maximum viscosity measured with Spindle/Speed combination

USB PC Interface provides optional computer control and automatic data gathering capability



Convenient Bubble Level

Download custom test programs with PG Flash Software (included with instrument)

Accuracy: ±1.0% of range
- Displayed with test data

Repeatability: ±0.2%

Built-in RTD Temperature Probe

Internal Data Storage: 150 MB

What's Included?

Instrument

6 spindles (RV/HA/HB) (p45)
or 4 spindles (LV) (p45)

PG Flash Software ▶

RTD Temperature Probe

Spindle Guard Leg*

Lab Stand (Model G) (p50)

Convenience Pack

USB Flash Drive, Stylus, Cleaning Cloth, Screen Protectors

Carrying Case

*Not applicable to HA or HB torque models

Optional Accessories

RheocalcT Software ▶

Label Printer (p51)

Vane Spindles (p43 & 48)

Ball Bearing Suspension (RV/HA/HB) (p50)

Viscosity Standards (p52)

RV/HA/HB-1 Spindle (p45)

EZ-Lock Spindle Coupling System (p50)

Quick Action Lab Stand (p50)

Temperature Bath (p33-35)

Small Sample Adapter (p38)

UL Adapter (p40)

Thermosel (p36)

Helipath Stand with T-bar Spindles (p42)

Spiral Adapter (p44)

DIN Adapter (p44)

Quick Connect/Extension Links (p49)

MODEL	VISCOSITY RANGE cP(mPa•s)		SPEEDS (200 available)	
	Min.	Max.	RPM	Number of Increments
DV2TLV	1†	6M	.1-200	200
DV2TRV	100††	40M	.1-200	200
DV2THA	200††	80M	.1-200	200
DV2THB	800††	320M	.1-200	200

† 1 cP achieved with UL Adapter accessory. 15 cP on LV with standard spindles.

†† Minimum viscosity is achieved with optional RV/HA/HB-1 spindle.

M = 1 million cP = Centipoise mPa•s = Millipascal•seconds

PG Flash Software Included

PROGRAM GENERATOR SOFTWARE FOR CUSTOMIZING
TEST CRITERIA FOR ROUTINE PRODUCT QC

This exclusive Brookfield software allows you to create repeatable custom tests on your PC! Once the program (up to 25 steps) is created, it can be downloaded to a supplied USB flash drive and then uploaded to any DV2T Viscometer.



PG Flash allows users to create repeatable custom tests with all of the built-in options on the DV2T plus the addition of multiple program lines (up to 25 steps). Create the program on the PC and download to a USB Flash Drive. Upload the program from the USB Flash Drive to the DV2T.

RheocalcT Software Optional

GET TOTAL CONTROL OF YOUR INSTRUMENT AND TEST PARAMETERS

Automatically control and collect data with RheocalcT and a dedicated computer. RheocalcT can analyze data, generate multiple plot overlays, print tabular data, run math models and perform other time-saving routines. Up to five comparison data sets can be plotted and saved. Other features include:

- Wizards to guide you through the creation of common tests
- Secure 21CFR features including multiple logins, access levels, digital signatures, and data storage in a password-protected database
- Looping functions for repetitive tasks
- Averaging of collected data by step or whole test
- Math models: Bingham, Casson, Casson NCA/CMA, Power Law, IPC Paste, Herschel-Bulkley, Thix Index



DV2TCP

The DV2T is available in a Wells/Brookfield Cone & Plate Version
Must be ordered when instrument is first purchased. (p18)



DV2T EXTRA™ Viscometer

The “EXTRA” combines all the versatile viscosity testing capabilities of a DV2T with time and money-saving features such as a durable ball bearing suspension system, EZ-Lock Spindle Coupling, Quick Action Lab Stand and FREE Rheocalc T Software.

Small Sample Adapter™

for rheological evaluation where sample volume is limited

Standard Sample Chamber with embedded temperature probe provides direct temperature measurement of sample



Disposable Sample Chamber (Requires SSA-DCU Water Jacket)

Complete system shows the DV2T Viscometer and Small Sample Adapter with Circulating Water Bath for temperature control.



12.

What's Included?

1. Water Jacket
 2. Locating Channel Assembly
 3. Choice of one SC4 Spindle*
 4. Choice of one SC4 Sample Chamber*
 5. Insulating Cap
 6. Extension Link with Coupling Nut
- Storage Case (not shown)

*Specify when ordering

Optional Accessories

7. Embedded RTD temperature Probe in Chamber
 8. SC4-13RD-100 (100/box) Disposable Sample Chambers (p48) Requires special water jacket
 9. SC4-27D-100 (100/box) Disposable Spindles (p48)
 10. SSA-DCU Special Water Jacket and SC4-13RD Disposable Chambers (100/box)
 11. SSA27D-13RD-100 Includes SSA-DCU items (above) plus SC4-27D Disposable Spindles (100/box)
 12. Temperature Bath (p33-35)
 13. EZ-Lock Spindle Coupling (p50)
- For more info on Small Sample Adapter Accessory Kits visit our website.

The Small Sample Adapter provides a defined geometry system for accurate viscosity measurements at precise shear rates. Consisting of a cylindrical sample chamber and spindle, the Small Sample Adapter is designed to measure small sample volumes of 2 to 16 mL, and easily attaches to all standard Brookfield Viscometers/Rheometers.

Small Sample Adapter Viscosity Ranges cP(mPa•s)

MODEL	Spindle: SC4-18 Sample Chamber* SC4-13R(P) Sample Volume: 6.7mL Shear Rate (sec ⁻¹): 1.32N	Spindle: SC4-37 Sample Chamber* SC4-13R(P) Sample Volume: 9.0mL Shear Rate (sec ⁻¹): .34N	Spindle: SC4-34 Sample Chamber* SC4-13R(P) Sample Volume: 9.9mL Shear Rate (sec ⁻¹): .28N	Spindle: SC4-16 Sample Chamber* SC4-8R(P) Sample Volume: 4.2mL Shear Rate (sec ⁻¹): .28N	Spindle: SC4-23Z (316 s/s only) Sample Chamber* SC4-13R(P) Sample Volume: 16.1mL Shear Rate (sec ⁻¹): .22N	Spindle: SC4-21 Sample Chamber* SC4-13R(P) Sample Volume: 7.1mL Shear Rate (sec ⁻¹): .83N	Spindle: SC4-27(D) Sample Chamber* SC4-13R(P) Sample Volume: 10.4mL Shear Rate (sec ⁻¹): .34N	Spindle: SC4-15 Sample Chamber* SC4-7R(P) Sample Volume: 3.8mL Shear Rate (sec ⁻¹): .48N	Spindle: SC4-28 Sample Chamber* SC4-13R(P) Sample Volume: 11.0mL Shear Rate (sec ⁻¹): .28N	Spindle: SC4-29 Sample Chamber* SC4-13R(P) Sample Volume: 13.5mL Shear Rate (sec ⁻¹): .23N	Spindle: SC4-14 Sample Chamber* SC4-8R(P) Sample Volume: 2.1mL Shear Rate (sec ⁻¹): .40N
DV3TLV	1.2-30K	12-300K	24-600K	48-1.2M	192-4.8M	Not applicable for historical reasons. However, it is possible					
DV2TLV	1.5-30K	15-300K	30-600K	60-1.2M	240-4.8M	to use the above spindles with any of these instruments.					
LVDV-IP	3-10K	30-100K	60-200K	120-400K	800-1.6M	Digital Viscometers/Rheometers will automatically calculate					
LVDVE	3-10K	30-100K	60-200K	120-400K	800-1.6M	viscosity. Please contact Brookfield or an authorized dealer					
LVT	5-10K	50-100K	100-200K	200-400K	800-1.6M	if you require information on viscosity range.					
DV3TRV						20-500K	100-2.5M	200-5M	200-5M	400-10M	500-12.5M
DV2TRV						25-500K	125-2.5M	250-5M	250-5M	500-10M	625-12.5M
RVDV-IP						50-170K	250-830K	500-1.7M	500-1.7M	1K-3.3M	1.25K-4.2M
RVDVE		Not applicable for historical reasons.				50-170K	250-830K	500-1.7M	500-1.7M	1K-3.3M	1.25K-4.2M
RVT		However, it is possible to use the above				50-100K	250-500K	500-1M	500-1M	1K-2M	1.25K-2.5M
DV3THA		spindles with any of these instruments.				40-1M	200-5M	400-10M	400-10M	800-20M	1K-25M
DV2THA		Digital Viscometers/Rheometers will				50-1M	250-5M	500-10M	500-10M	1K-20M	1.25K-25M
HADV-IP		automatically calculate viscosity. Please				100-300K	500-1.7M	1K-3.3M	1K-3.3M	2K-6.7M	2.5K-8.3M
HADVE		contact Brookfield or an authorized dealer if				100-300K	500-1.7M	1K-3.3M	1K-3.3M	2K-6.7M	2.5K-8.3M
HAT		you require information on viscosity range.				100-200K	500-1M	1K-2M	1K-2M	2K-4M	2.5K-5M
DV3THB						160-4M	800-20M	1.6K-40M	1.6K-40M	3.2K-80M	4K-100M
DV2THB						200-4M	1K-20M	2K-40M	2K-40M	4K-80M	5K-100M
HBDV-IP						400-1.3M	2K-6.7M	4K-13.3M	4K-13.3M	8K-26.7M	10K-33.3M
HBDVE						400-1.3M	2K-6.7M	4K-13.3M	4K-13.3M	8K-26.7M	10K-33.3M
HBT						400-800K	2K-4M	4K-8M	4K-8M	8K-16M	10K-20M

M = 1 million K = 1 thousand N = RPM e.g. Spindle SC4-18 1.32 x 10 (rpm) = 13.2 sec⁻¹ cP = Centipoise mPa•s = Millipascal-seconds

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 automatically calculate viscosity.

* Examples

SC4-13R Sample Chamber

SC4-13RPY Sample Chamber with RTD temperature probe and cable to viscometer/rheometer

SC4-27 Stainless Steel Spindle

† Disposable chamber available in 13R size and requires SC4-45YD water jacket

SC4-13RP Sample Chamber with RTD temperature probe

SC4-13RD-100 Disposable Sample Chamber available in packages of 100

SC4-27D Disposable Spindle

Note: Hastelloy C available for some spindles/chambers - call for details

Removable Sample Chamber

The design of the Small Sample Adapter allows the sample chamber to be easily changed and cleaned without disturbing the set-up of the viscometer or temperature bath. This means that successive measurements can be made under identical conditions.

Temperature Control

The sample chamber fits into a water jacket so that precise temperature control can be achieved when the Brookfield circulating temperature bath is used. The stirring action of the rotating spindle, plus the small sample volume, helps to keep the temperature gradient across the sample to a minimum. Direct readout of sample temperature is provided using sample chambers with optional embedded RTD sensor connected to the DV-I Prime and DV2T Viscometers and the DV3T Rheometer. Working temperature range for the Small Sample Adapter is from 1°C to 100°C.

Cylindrical Geometry

The Small Sample Adapter's coaxial cylinder geometry provides extremely accurate viscosity measurements at defined shear rates.

Disposable Sample Chambers and SC4-27D Spindle

Disposable 13R chambers, for hard-to-clean materials, are available in a kit that comes complete with 100 chambers and special-sized water jacket (Part No. SSA-DCU). Additional disposable chambers can be purchased in quantities of 100 (Part No. SC4-13RD-100).

EZ-Lock Option

Small Sample Adapter is now available with special EZ-Lock spindle coupling for use on standard Brookfield Viscometers/Rheometers already equipped with the EZ-Lock feature.



Water jacket allows rapid and precise temperature control of sample

Sample chamber easily changed - slides into water jacket and locks in place

Simultaneous sample temperature measurement is possible by ordering embedded temperature probe in sample chamber

Optional disposable chamber also available

Helipath Stand™

designed for measurement of non-flowing substances



For viscosity/consistency measurement of gels, pastes, creams, putty, gelatin and other non-flowing substances.

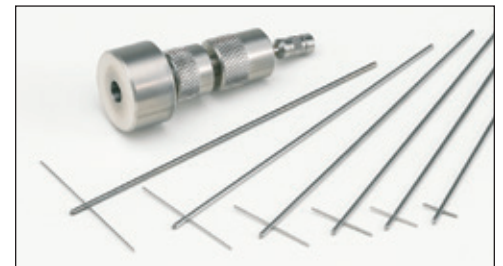
A Brookfield Viscometer or Rheometer is mounted on the Helipath drive motor and a T-bar spindle is attached to the viscometer using a special coupling. The drive motor slowly lowers or raises the viscometer so that the T-bar spindle creates a helical path through the test sample thus eliminating the problem of "channeling".

Compatible with standard Brookfield Viscometers and DV3T Rheometers

Simple to set up and clean

Provides a solution for hard-to-measure materials

Complete with drive motor, 6 T-bar spindles with coupling, case, lab stand, rod and base



The Helipath Stand can be used with any standard Brookfield Viscometer model, and is supplied complete with a set of six T-bar spindles and a special coupling.

EZ-Lock Option

Helipath Stand is now available with special EZ-Lock spindle coupling for use on standard Brookfield Viscometers/ Rheometers already equipped with the EZ-Lock feature. (p50)

Helipath Viscosity Ranges cP(mPa•s)

	DIAL, DV-E, DV-IP	DV2T	DV3T
LV Viscosity Range	156 - 3,120K	156 - 9,360K	156 - 9,360K
RV Viscosity Range	2K - 20M	2K - 100M	2K - 100M
HA Viscosity Range	4K - 40M	4K - 200M	4K - 200M
HB Viscosity Range	16K - 160M	16K - 800M	16K - 800M

** Maximum range shown is at 0.1 rpm K = 1 thousand M = 1 million cP = Centipoise mPa•s = milliPascal•seconds

Vane Spindles

for foods, cosmetics, sealants...

...for use with paste-like materials, gels and fluids where suspended solids migrate away from the measurement surface of standard spindles.

Minimal disruption of sample during spindle immersion

Keeps particles in suspension during testing cycle

Viscosity data includes complete flow curve analysis when software is used

Provides information on yield behavior at low rotational speeds

Follows industry recommendations on length/diameter ratios for vane spindles

3-piece spindle set for versatile range capability

Optional V-74 and V-75 spindles for even greater range capability and immersion into small size sample containers



Vane Spindle Ranges

SPINDLE	TORQUE RANGE	SHEAR STRESS RANGE (Pa)	VISCOSITY RANGE cP(mPa*s)
V-71	NOT RECOMMENDED FOR USE ON LV TORQUE		
V-72	LV	.188-1.88	104.04-1.04K
V-73	LV	.938-9.38	502-5.02K
V-74	LV	9.38-93.8	5.09K-50.9K
V-75	LV	3.75-37.5	1.996K-19.96K
V-71	RV	.5-5	262-2.62K
V-72	RV	2-20	1.11K-11.1K
V-73	RV	10-100	5.35K-53.5K
V-74	RV	100-1K	54.3K-543K
V-75	RV	40-400	21.3K-213K
V-71	HA	1-10	524-5.24K
V-72	HA	4-40	2.22K-22.2K
V-73	HA	20-200	10.7K-107K
V-74	HA	200-2K	108.6K-1.086M
V-75	HA	80-800	42.6K-426K
V-71	HB	4-40	2.096K-20.96K
V-72	HB	16-160	8.88K-88.8K
V-73	HB	80-800	42.8K-428K
V-74	HB	800-8K	434.4K-4.344M
V-75	HB	320-3.2K	170.4K-1.704M
V-71	5xHB	20-200	10.48K-104.8K
V-72	5xHB	80-800	44.4K-444K
V-73	5xHB	400-4000	214K-2.14M
V-74	5xHB	4K-40K	2.172M-21.72M
V-75	5xHB	1.6K-16K	852K-8.52M

Brookfield Vane Spindle Set

Includes V-71, V-72, and V-73 vane spindles. See the individual specifications in the spindle section. (p44)

Optional V-74 and V-75 spindles are smaller in size than V-73.

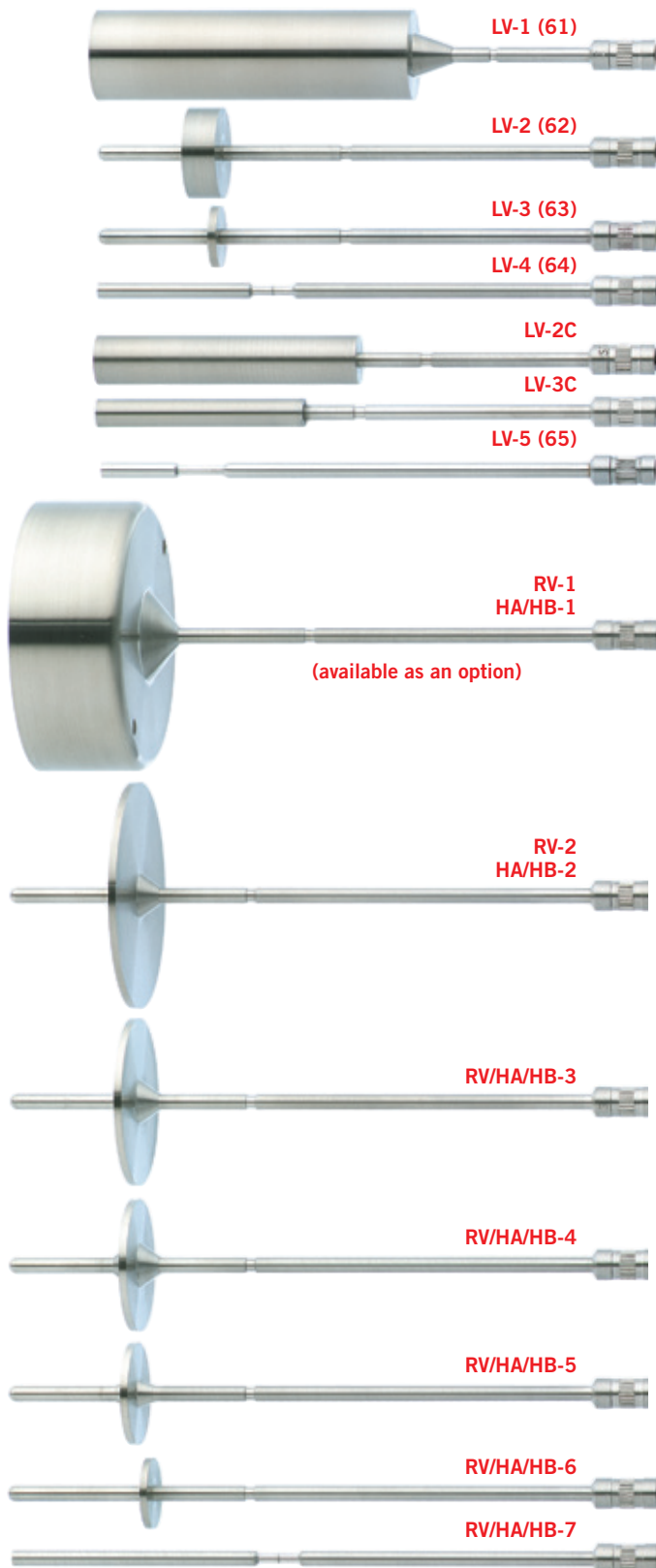
EZ-Lock Option

Vane Spindles are available with special EZ-Lock spindle coupling for use on standard Brookfield Viscometers/ Rheometers already equipped with the EZ-Lock feature. (p50)

Note: 1. 1 Pa = 10 dyne/cm² 2. Viscosity Range is given at rotational speed of 10 RPM
3. 5xHB is the highest torque range available 4. Not for use with DV-E Viscometers

M = 1 million K = 1 thousand Pa = Pascal
cP = Centipoise mPa*s = Millipascal*seconds

Spindles



LV Spindles cP(mPa•s)	
SPINDLE	RANGE*
LV-1 (61)	15 - 20K
LV-2 (62)	50 - 100K
LV-3 (63)	200 - 400K
LV-4 (64)	1K - 2M

LV-5 (65)	2K - 4M	LV-5 is an optional spindle designed to increase measuring range.
LV-2C	50 - 100K	
LV-3C	200 - 400K	

* Based on Standard LV speeds .3 - 60 rpm M = 1 million K = 1 thousand
 Note: LV-1 through LV-4 are supplied with LV instruments.
 LV-2C & LV-3C are optional "cylindrical spindles" offering geometry for calculating shear rates.
 LV and RV/HA/HB spindles are supplied in 302 stainless steel.
 Optional 316 stainless or teflon coated spindles are available

RV/HA/HB Spindles cP(mPa•s)			
SPINDLE	RANGE* RV SERIES	RANGE* HA SERIES	RANGE* HB SERIES
RV-1 **	100 - 20K	200 - 40K	800 - 160K
HA/HB-1 **	100 - 20K	200 - 40K	800 - 160K
RV-2	100 - 80K	200 - 160K	800 - 640K
HA/HB-2	100 - 80K	200 - 160K	800 - 640K
RV/HA/HB-3	100 - 200K	200 - 400K	800 - 1.6M
RV/HA/HB-4	200 - 400K	400 - 800K	1.6K - 3.2M
RV/HA/HB-5	400 - 800K	800 - 1.6M	3.2K - 6.4M
RV/HA/HB-6	1K - 2M	2K - 4M	8K - 16M
RV/HA/HB-7	4K - 8M	8K - 16M	32K - 64M

* Based on standard RV/HA/HB speeds .5-100 RPM. M = 1 million K = 1 thousand
 Note: LV and RV/HA/HB spindles are supplied in 302 stainless steel.
 Optional 316 stainless or teflon coated spindles are available
 ** This spindle available as an option



RV/HA/HB Spindle Set includes spindles #2 - #7 and is supplied with standard Brookfield Viscometers and Rheometers.

Spindle #1 is available as an option.

Spindle Rack is also available as an option with both LV and RV/HA/HB spindle sets.

Viscosity Standards

Brookfield Viscosity Standards provide a convenient, reliable way to verify the calibration of your Brookfield Laboratory Viscometer/Rheometer. Brookfield Viscosity Standards are

Newtonian, and they are available as either silicone or oil. Silicone fluids are less temperature sensitive than oil fluids.

Note: Brookfield recommends that all fluids be replaced annually

Silicone Viscosity Standards

These fluids are most commonly used to verify calibration of Brookfield Viscometers/Rheometers.

Accuracy: ±1% of viscosity value

Excellent temperature stability

Recommended for use with Brookfield and most other rotational viscometers

Most economical

Special viscosity values and temperature calibrations available upon request



VisCal Kit

The Brookfield VisCal Kit provides all the necessary items to verify calibration of your Viscometer/Rheometer. Includes Brookfield 600mL Beaker, 1 pint of Silicone Viscosity Standard, Dispensing Bottle for cleanup and Trapper Cleaning Agent.*

*Trapper Cleaning Agent available only in shipments within the USA



Plastic VisCal Kit

The Brookfield Plastic VisCal Kit provides all the necessary items to verify calibration of your Viscometer/Rheometer in a glass-free environment. Includes Brookfield 600mL Plastic Beaker, 1000ml of Silicone Viscosity Standard (5-12,500 cP) in a plastic bottle and a Brookfield-designed metal lid for anchoring beaker in the temperature bath.



General Purpose Silicone Fluids

Brookfield Part #	Nominal Viscosity cP (mPa•s)	Temp °C
5 cps	5	25.0°C
10 cps	10	25.0°C
50 cps	50	25.0°C
100 cps	100	25.0°C
500 cps	500	25.0°C
1000 cps	1,000	25.0°C
5000 cps	5,000	25.0°C
12500 cps	12,500	25.0°C
30000 cps	30,000	25.0°C
60000 cps	60,000	25.0°C
100000cps	100,000	25.0°C

High Temperature Silicone Fluids

Brookfield Part #	Nominal Viscosity cP (mPa•s)	Temp °C	Temp °F
HT30000	30,000	25.0°C	77°F
	9,000	93.3°C	200°F
	4,500	149.0°C	300°F
HT60000	60,000	25.0°C	77°F
	18,000	93.3°C	200°F
	9,000	149.0°C	300°F
HT100000	100,000	25.0°C	77°F
	30,000	93.3°C	200°F
	15,000	149.0°C	300°F

Special Order Silicone Fluids

For our customers needing a nonstandard viscosity or temperature range, our silicone fluids can be modified to meet most requirements.

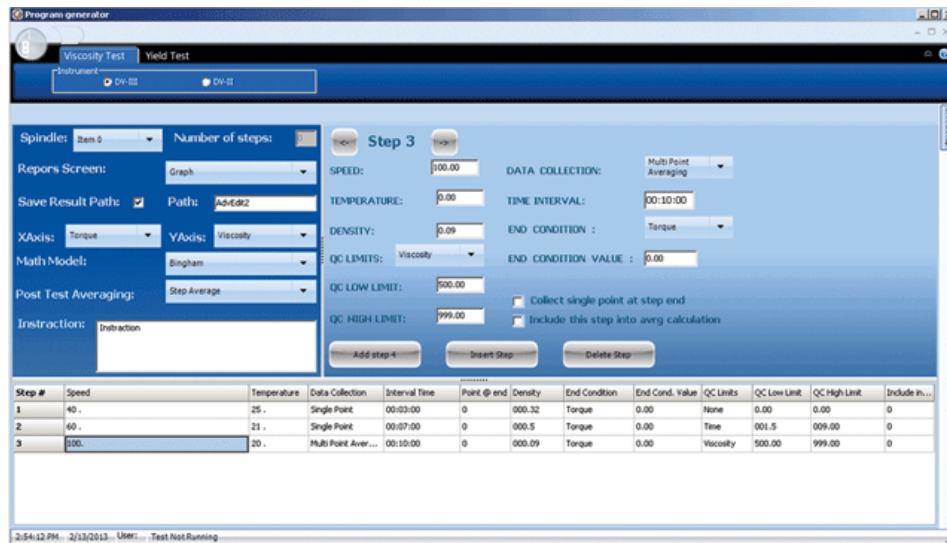
VISCOSITY BLENDS CALIBRATED AT 25°C (77°F)

- Minimum: 5 cP (mPa•s)
- Maximum: 60,000 cP (mPa•s)
- Blends will be within ±2% of requested value

TEMPERATURE CALIBRATIONS

- Minimum: 10°C (50°F)
- Maximum: 80°C (176°F)
- Minimum temperature increment: 2°C

PG Flash



Features & Benefits

- Programs can be created, saved, printed, and downloaded from a PC to the viscometer
- Great for Quality Control environments - programs can be created and downloaded by a QC supervisor to be later run by operators for consistency every time
- Created programs can:
 - Wait on key events (such as a pre-set % torque level)
 - Control instrument speed (shear rate) or temperature (with optional temperature controller)
 - Select the spindle in use
 - Select variable data collection intervals (print intervals)
 - Print customized messages and instructions for user interaction
- DVLoader supports up to 25 steps (commands)

Computer Requirements

Windows 2000 or above

500 MHz processor

256 MB RAM

USB port

1280x768 resolution display

Calibration and Calculation of kinematic and Newtonian viscosities of sample fluid: Proceed as directed in *Method I.25 (USP35)*

Add the following:

912 ROTATIONAL RHEOMETER METHODS

The principle of the method is to measure the force (torque) acting on a rotor when it rotates at a constant angular velocity (rotational speed) in a liquid. Rotational rheometers/viscometers are used for measuring the viscosity of Newtonian fluids, i.e., a fluid having a viscosity that is independent of the shearing stress or rate of shear, or the apparent viscosity of non-Newtonian fluids, which may exhibit different rheological behavior, depending on shear rate, shear stress, and temperature. The following procedures are used to determine the viscosity of Newtonian fluids or the apparent viscosity of non-Newtonian fluids. The calculated viscosity of Newtonian fluids should be the same (within experimental error), regardless of the rate of shear (or rotational speed). Given the dependence of viscosity on temperature, the temperature of the substance being measured should be controlled to within $\pm 0.1^\circ$, unless otherwise specified in the individual monograph. Unless otherwise directed in the individual monograph, use *Method I*.

METHOD I. SPINDLE RHEOMETERS (RELATIVE RHEOMETERS—SPINDLE VISCOMETERS)

Apparatus: In the spindle rheometer, the apparent viscosity is determined by rotating a cylinder- or disc-shaped spindle, as shown in *Figures 1* and *2*, respectively, immersed in a large volume of liquid.

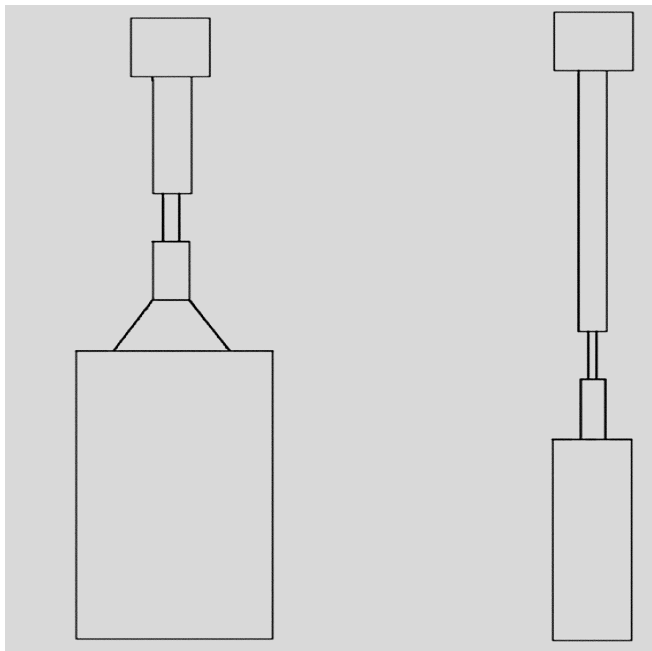


Figure 1. Cylinder-shaped spindles

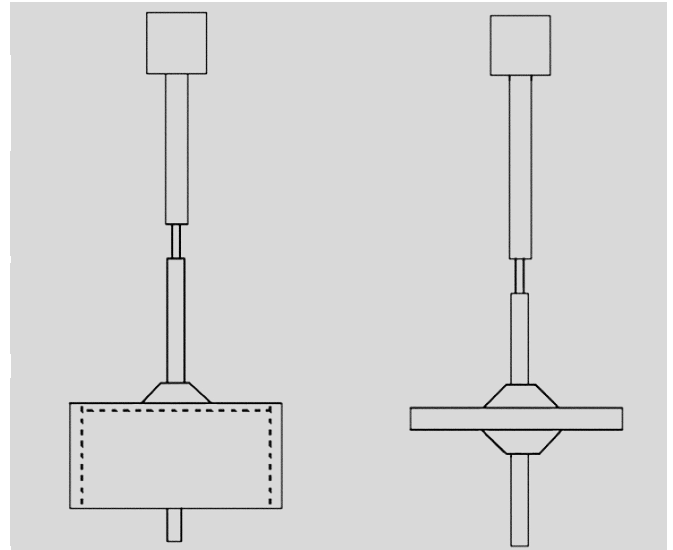


Figure 2. Disc-shaped spindles

Procedure: Under these test conditions the shear rate varies between the outer surface of the spindle and the inner surface of the beaker or cup containing the test substance. As a result, the following additional information must be described along with the measured viscosity:

1. Size and geometry of spindle
2. Angular velocity of the spindle
3. Inner dimensions of the test substance container
4. Temperature of the test substance

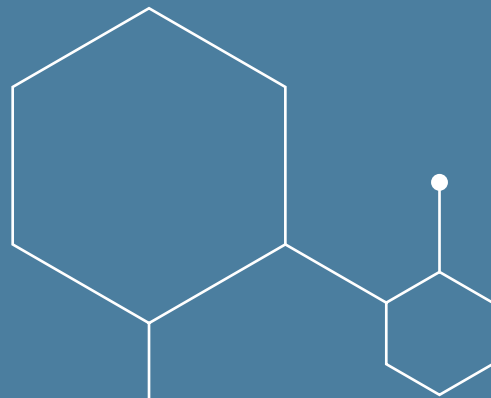
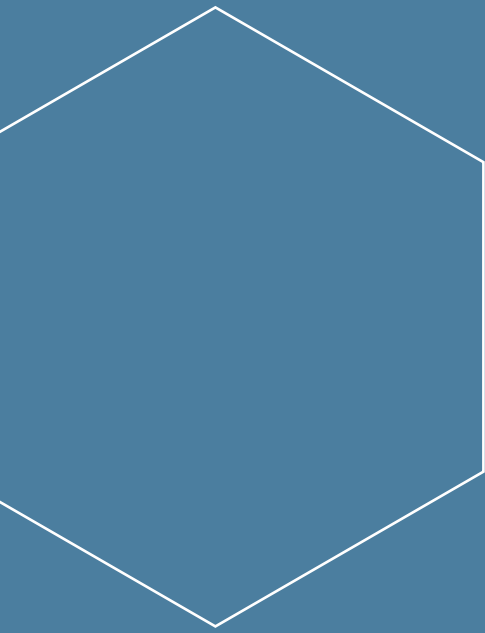
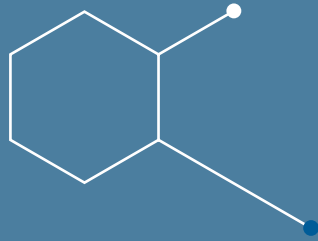
5. Use of instrument accessories, such as a spindle guard
The preparation of the test specimen, including its temperature equilibration, is specified in each individual monograph. Follow the instrument manufacturer's recommendations regarding sample loading, spindle selection, and rheometer operation.

Calibration: Select at least two calibration standards whose viscosities differ by an appropriate value within the viscosity range of the test substance under measurement for a particular rheometer configuration. Measure the apparent viscosities of each standard, as described above, at multiple rotational speeds.

A rheometer is deemed to be calibrated if the measured apparent viscosities are within $\pm 5\%$ of the stated values. Generally, calibration, operation, and cleaning of rheometers should be performed according to the recommendations of the instrument manufacturer.

METHOD II. CONCENTRIC CYLINDER RHEOMETERS

Apparatus: In the concentric cylinder rheometer, the apparent viscosity is determined by placing the liquid in the gap between the inner cylinder and the outer cylinder. Both controlled-stress and controlled-rate rotational rheometers are available commercially in configurations with absolute geometries (e.g., very small annular gaps between concentric cylinders) that can provide consistent meaningful rheological data for non-Newtonian fluids. Controlled-stress rheometers provide controlled-stress input and measurement of the resulting shear rate. Controlled-rate rheometers provide controlled-shear rate input and determination of the resultant shear stress, measured as torque, on the rotor axis. Concen-



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