ACCESSORIES FOR STANDARD VISCOMETERS/RHEOMETERS

A.6 Small Sample Adapter

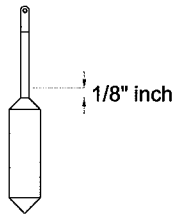
SC4 Series Spindle Factors and Shear Rates

Spindle Factors are listed as constants related to the Viscometers rotational speed. Spindle Factors are traditionally used to convert the torque value on a Dial Reading Viscometer to a centipoise value. Divide the given constant by the speed in use to obtain the Spindle Factor for that spindle/speed combination. This Spindle Factor is then multiplied by the Viscometer's dial reading to obtain viscosity (in centipoise). *For example:* the Spindle Factor for an SC4-21 spindle and 13R chamber on an RV Viscometer is given as 500/N (see the following SC4 Series Sindle Factors and Shear Rates Table). The Viscometer's rotational speed (RPM) is represented by N. If the measurement is being made at 20 RPM, the Spindle Factor is 500/20, or 25. Multiply all Dial Viscometer readings made with this spindle/speed combination by 25 to obtain viscosity in centipoise.

Spindle/ Chamber	Sample Size (mL)	LV	RV	HA	HB	Shear Rate (sec^{-1})
SC4-14/6R	2.1	1172/N	12.5M/N*	25M/N	100M/N	0.40N
SC4-15/7R	3.8	468.8/N	5000/N	10M/N	40M/N	0.48N
SC4-16/8R	4.2	1200/N	12.8M/N	25.6M/N	102.4M/N	0.29N
SC4-18/13R	6.7	30/N	320/N	640/N	2560/N	1.32N
SC4-21/13R	7.1	46.88/N	500/N	1000/N	4000/N	0.93N
SC4-25/13R	16.1	4800/N	51.2M/N	102.4M/N	409.6M/N	0.22N
SC4-27/13R	10.4	234.4/N	2500/N	5000/N	20M/N	0.34N
SC4-28/13R	11.0	468.8/N	5000/N	10M/N	40M/N	0.28N
SC4-29/13R	13.5	937.5/N	10M/N	20M/N	80M/N	0.25N
SC4-31/13R	9.0	300/N	3200/N	6400/N	25.6M/N	0.34N
SC4-34/13R	9.4	600/N	6400/N	12.8M/N	51.2M/N	0.28N

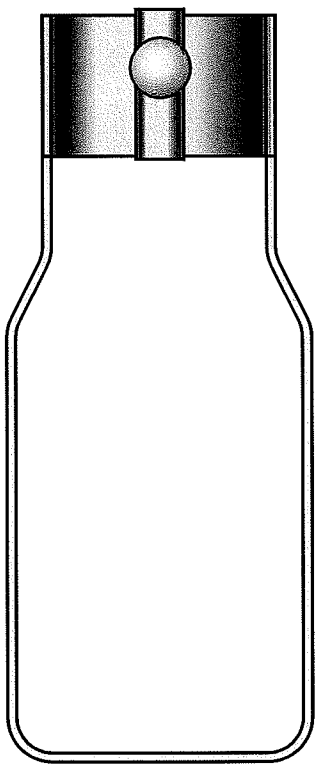
*N = RPM M = 1000

The values for the sample size (mL) were adjusted slightly in 2005. If unsure, check the fluid level in the chamber to verify that the spindle shaft is covered 1/8-inch above the point where the cone and shaft come together.

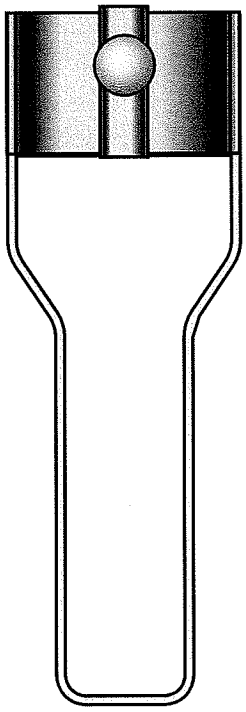


The calibration of the Brookfield Viscometer/Rheometer is determined using a 600 ml Low Form Griffin Beaker. The calibration of LV and RV series instruments includes the guard leg. The beaker wall (for HA/HB instruments) or the guard leg (for LV/RV instruments) define what is called the "outer boundary" of the measurement. The spindle factors for the LV, RV, and HA/HB spindles were developed with the above boundary conditions. The spindle *factors* are used to convert the instrument torque (expressed as the dial reading or %Torque value) into centipoise. Theoretically, if measurements are made with different boundary conditions, e.g., without the guard leg or in a container other than 600 ml beaker, then the spindle factors found on the Factor Finder cannot be used to accurately calculate an absolute viscosity. Changing the boundary conditions does not change the viscosity of the fluid, but it does change how the instrument torque is converted to centipoise. Without changing the spindle factor to suit the new boundary conditions, the calculation from instrument torque to viscosity will be incorrect.

Practically speaking, the guard leg has the greatest effect when used with the #1 & #2 spindles of the LV and RV spindle sets (Note: RV/HA/HB #1 spindle is not included in standard spindle set). Any other LV (#3 & #4) or RV (#3 - #7) spindle can be used in a 600 ml beaker with or without the guard leg to produce correct results. The HA and HB series Viscometers/Rheometers are not supplied with guard legs in order to reduce the potential problems when measuring high viscosity materials. HA/HB spindles #3 through #7 are identical to those spindle numbers in the RV spindle set. The HA/HB #1 & #2 have slightly different dimensions than the corresponding RV spindles. This dimensional difference allows the factors between the RV and HA/HB #1&#2 spindles to follow the same ratios as the instrument torque even though the boundary conditions are different.



RV Guardleg



LV Guardleg

The recommended procedures of using a 600 ml beaker and the guard leg are difficult for some customers to follow. The guard leg is one more item to clean. In some applications the 500 ml of test fluid required to immerse the spindles in a 600 ml beaker is not available. In practice, a smaller vessel may be used and the guard leg is removed. The Brookfield Viscometer/Rheometer will produce an accurate and repeatable torque reading under any measurement circumstance. However, the conversion of this torque reading to centipoise will only be correct if the factor used was developed for those specific conditions. Brookfield has outlined a method for recalibrating a Brookfield Viscometer/Rheometer to any measurement circumstance in More Solutions to Sticky Problems, Section 3.3.10. It is important to note that for

many viscometer users the true viscosity is not as important as a repeatable day to day value. This repeatable value can be obtained without any special effort for any measurement circumstance. But, it should be known that this type of torque reading will not convert into a correct centipoise value when using a Brookfield factor if the boundary conditions are not those specified by Brookfield.

The guard leg is a part of the calibration check of the Brookfield LV and RV series Viscometer/ Rheometer. Our customers should be aware of its existence, its purpose and the effect that it may have on data. With this knowledge, the viscometer user may make modifications to the recommended method of operation to suit their needs.