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**DV-I, II, III Series, DV2T and DV3T Viscometers/Rheometers:
 Installation Qualification,
 Operation Qualification,
 and
 Performance Qualification
 Procedure**

3Qs008

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This guideline for IQ,OQ,PQ is offered as a supplement to the “Installation” section of this manual. Some customers have particular requirements for validation. It is hoped that this guideline will assist in meeting those needs. You may also contact Brookfield AMETEK for a more detailed document, or on-site IQ,OQ,PQ service conducted by a Brookfield AMETEK representative.

All Brookfield AMETEK instrumentation should be unpacked, assembled and operated according to the instrument operating instructions. Recommendations for installation, operation and performance qualification appear below.

IQ:	<p>INSTALLATION QUALIFICATION</p> <ul style="list-style-type: none"> - Inspect package for shipping damage. - Confirm that all components have been supplied as detailed in the Operating Manual and Packing List. - Assemble lab stand as shown in manual. - Mount viscometer/rheometer head to assembled lab stand as shown in manual. - Verify appropriate spindle set (LV #1-#4)(RV/HA/HB #2-#7).
OQ:	<p>OPERATION QUALIFICATION</p> <ul style="list-style-type: none"> - Level viscometer/rheometer using adjustable feet. - Remove shipping cap on spindle coupling nut. - Power on the Viscometer/Rheometer and follow instructions displayed to complete autozero. - Perform oscillation check as described on following page.
PQ:	<p>PERFORMANCE QUALIFICATION</p> <ul style="list-style-type: none"> - Verify calibration using a minimum of one calibrated viscosity standard fluid according to the procedure described below. - Centipoise reading should be within the value stated on the fluid \pm the instrument accuracy and the fluid accuracy as defined below.

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Successful completion of installation, operation and performance procedures as described above confirm that the Brookfield AMETEK Digital Viscometer/Rheometer is operating properly and to specification. **In the event that any of the above steps cannot be performed satisfactorily, please contact Brookfield AMETEK or the dealer from whom you purchased the equipment.**

Oscillation check

This check verifies the mechanical condition of the sensing mechanism in the viscometer/rheometer. Auto-zero the instrument according to directions in the manual. Do not attach the spindle; the display should show 0.0% torque. The tolerance for this and all tests is $\pm 0.1\%$. Gently grasp the viscometer/rheometer's lower shaft coupling and lift slightly. Slowly rotate it until the display % reads 10%-15%, then release.

NOTE: For LV units only, the oscillation check should be $0.0\% \pm 0.2\%$.

DV2T Viscometer and DV3T Rheometer also have an option under the Device Setting tab, which instructs the user how to perform the Oscillation Checks.

Operational and Calibration Check

Determining Measurement Accuracy

All Brookfield AMETEK instruments are guaranteed to be accurate to within 1% of the *Full Scale Range* (FSR) in use. The FSR is simply the maximum viscosity that can be measured with any spindle/speed combination. Select a specific spindle and rotational speed. To determine the resulting FSR, consult the manual of the instrument. The % display will show 100% and the cP display will show the FSR that can be measured under current choice of spindle and speed. 1% of this value is the measurement accuracy under these conditions.

Calibration Check for LV (#1-3) and RV, HA, HB (#1-6) Brookfield Spindles

NOTE: The LV #4 (64) and RV, HA, HB #7 (07) spindles have been omitted from this procedure. Brookfield AMETEK does not recommend the use of these spindles to perform a calibration check on your instrument. Reasons pertain to the small amount of spindle surface that makes contact with the viscosity standard, the difficulty of establishing the immersion mark precisely and the need for precise temperature control at 25°C in the immediate vicinity of the spindle.

In principle, all Brookfield AMETEK rotational viscometer/rheometers are calibrated torque meters. Brookfield AMETEK offers a variety of viscosity calibration fluids that enable one to check the calibration and linearity of the instrument over its operating torque range of 10%-100% torque.

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Any spindle and any one of several calibration fluids may be used to perform a calibration check. We recommend using one spindle and one fluid while taking measurements at multiple speeds. This enables multiple calculations of viscosity throughout the torque range of the instrument: one at low torque, one at medium torque and one at high torque. The FSR, and consequently the instrument accuracy in terms of centipoise, will be different at each speed.

The calibration fluid must be transferred into a 600 mL low form, Griffin beaker (without creating any bubbles) and, on LV and RV models, the instrument Guard Leg must be used. See the manual for a description of the use of the Guard Leg. The beaker, fluid, spindle and Guard Leg must be stabilized at 25.0°C (±0.1°C) before the calibration check can be performed.

The example below shows typical calibration results using an LV #3 spindle with a calibration fluid whose actual viscosity is 5,120 cP; the calibration check might look like the table below. At each speed a different torque is sensed allowing the automatic computation of viscosity. The allowable error is the sum of 1% of the FSR plus 1% of the actual value of the calibration fluid. The lower and upper viscosity limits, indicating acceptable calibration, equal the actual value of the fluid, in this case 5,120 cP; ± the allowable error.

RPM	MIN cP	MAX cP (FSR)	1% of FSR	% Torque	cP READING	ALLOWABLE ERROR
12	1,000	10,000	100	51.2	5120	± 151
6	2,000	20,000	200	25.5	5100	± 251
3	4,000	40,000	400	12.7	5080	± 451

Remember, the total allowable error when conducting a calibration check is the sum of 1% of the FSR plus 1% of the actual value of the calibration fluid itself. The instrument reading must be within the limits defined by the actual viscosity value of the calibration fluid ± the allowable error at each speed. The spindle, speeds and fluid you use may be different from these.

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Calibration Test Results

A Fluid Value from Certificate cP	B 1% of Fluid Value cP	C Instrument Model	D Spindle	E RPM	F FSR cP (depress and hold AUTORANGE key)	G 1% of FSR cP	H % Torque	I Viscosity cP

Interpretation of Calibration Test Results

The viscosity reading should equal the **cP** value on the fluid standard to within the combined accuracies of the Viscometer/Rheometer and the viscosity standard as calculated below:

Low Limit = A – (B + G)	Reading I	High Limit = A + (B + G)	Pass or Fail

Any reading outside these limits may indicate a Viscometer/Rheometer problem. Contact the Brookfield AMETEK technical sales department or your local authorized Brookfield AMETEK dealer with test results to determine the nature of the problem.

NOTE: A calibration workbook in Microsoft Excel format may be downloaded from www.brookfieldengineering.com/support/calibration. This workbook contains several worksheets, which greatly simplify use of the tables above. Instructions for use and troubleshooting guide are also included.

Brookfield AMETEK recommends repeating this calibration check periodically to insure Viscosity accuracy and calibration. We suggest every thirty days but your operating procedures may dictate otherwise.

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