A World of Improved Measurement Apparatus for Low Temperature Brookfield Viscosity Determination

- Meets ASTM D2983 Requirements of Note 1 and Note 7
- Replaces the Cold Air Chambers and the Balsa Wood Carrier
- Liquid Bath Offers Greatly Improved Data Precision
- One or Two Independent Bath Models Available
- Operating Temperature +20° to -55°C
- Can Operate at Two Temperatures Simultaneously
- Full Visibility of Immersed Sample
- Model Available for Simultaneous D5133 and D2983
- Compact, Space Saving Bench Models

ASTM D2983

ASTM D5133

LAWLER
MANUFACTURING CORPORATION

The oil industry has experienced difficulties for over 3 decades with the inherent poor precision i.e., poor reproducibility and repeatability of data associated with the ASTM D2983 test method for low temperature Brookfield viscosity of oils. During this time period temperature controlled cold air chambers have been used nearly universally.

Note 1 - "Mechanically refrigerated liquid baths have been used for Brookfield viscosity determination. A European procedure, CEC-L18-A-80, describes the use of some. However, a liquid bath should not be used for sample conditioning in Test Method D2983 **unless it can duplicate the sample cooling rates outlined in Appendix X3. The main advantage of a liquid bath over an air bath is more precise temperature control. Liquid baths are available that maintain the selected test temperature within 0.1°C of the set point for the 16-h-soak period."*

ASTM D2983 test procedure, as currently practiced, suffers from several method problems which compound the poor precision experienced. The most obvious problem is the removal of the sample from cold air chamber to measure its viscosity while held in a balsa wood insulating carrier. The balsa wood carrier is not a sufficiently effective insulator to prevent sample temperature upset during transport and viscosity measurement .

No Balsa Wood Carrier Needed

Davis[1] reported that there is as much as a 0.6°C temperature increase of the sample during the viscosity measurement process. This temperature increase may decrease the viscosity by as much as 20%. Since viscosity of a non-Newtonian oil is strongly temperature dependent, it is obvious that this is a major contributor to the method's poor precision.

There are at least two advantages of a liquid bath over the traditional cold air chamber. One is the inherent superior temperature stability of a liquid bath. The second is the ability to measure the viscosity while the sample is still immersed in the temperature controlled liquid bath. The latter, obviously, removes the problem of sample temperature upsets when using the air chamber.

Note 1 of the method (see above left) allows the use of a liquid bath **IF** the bath meets the cooling profile as specified in Appendix X3 of the method. The complex formula in this appendix is essentially a thermodynamic expression of how a liquid sample cools when immersed in a constant temperature cold air chamber. Empirical data has shown that the initial cooling profile must carefully follow this formula for the liquid bath to give the same results as the air chamber.

Note 7 of the method (see above right) allows the measurement of the Brookfield viscosity while the sample is immersed in the temperature controlled liquid bath.

The combination of Note 1 and Note 7 clearly allows the use of a properly programmed and temperature controlled liquid bath for measuring Brookfield viscosity. These two notes also suggest that better data precision is possible with such a liquid bath.

**Note 7 - "If the laboratory is equipped with a low-temperature liquid bath capable of maintaining test temperature within ±0.06°C and on which the Brookfield viscometer can be conveniently mounted, a cell may be removed from the cold cabinet after 15 1/2 h and placed in the liquid bath at test temperature for 30 min. The Brookfield viscosity can then be directly measured on the sample in the cell in the liquid bath without haste and without fear that the sample will warm up as it does in the cell carrier. An insulated spindle is needed if this procedure is used."*

[1] Davis,J.E. " Improved Techniques for Measuring Low Temperature Brookfield Viscosity of SAE 75W-90 Gear Lubricants" STLE Lubrication Eng., Vol.44,3, 247-250. March 11, 1988.

Lawler Programmable Liquid Baths


Close up of the Bath

Three programmable models are available. Operating temperature range is +20° to -55°C. Programming temperature controller is capable of controlling two baths simultaneously. This allows operating two baths at two independent temperatures with independent start, stop, and duration times. Temperature control is within ±0.05°C.

The bath is an unsilvered Dewar jar holding approximately 3 liters of bath medium. The illuminated jar allows full visibility of the test samples to facilitate the proper positioning of the viscometer spindle immersion mark. The 10 samples are held in a turntable so that each sample, in turn, may be positioned under the Brookfield viscometer.

The liquid bath is programmed such that the sample cooling rate equals the cooling rate experienced by a sample when immersed in the constant low temperature air chamber. Six cooling profiles for the typical testing temperature programs are supplied as standard. Additional profiles for specified test temperatures are supplied on request.

All three models offered by Lawler are mechanically refrigerated using ozone friendly refrigerants.

Available Programmable Liquid Bath Models


LB-76-2

Model LB-76 is a very small foot-print bench model with one programmable, full visibility bath holding 10 samples. The approximate dimensions of the bench top, space saving Model LB-76 are (LWH) 22 x 22 x 26 inches (56 x 56 x 66 cm).

ASTM D2983


LB-76

Model LB-76-2 is a larger, more efficient version of Model LB-76 having two identical, full visibility liquid baths. Each bath is independently controlled, and can operate at different test temperatures. Each can be started at independent times. This feature allows the simultaneous measurements at two temperatures. This model saves valuable lab space now occupied by two much larger floor model cold air chambers. The total sample capacity of Model LB-76-2 is 20 (ten per bath). The approximate dimensions of the bench top Model LB-76-2 are (LWH) 34 x 27 x 26 inches (87 x 69 x 66 cm).

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Combination Brookfield Viscosity and Scanning Brookfield Viscosity Baths

Model LSB-98 is a dual function liquid programmable bath combining the features of Model LB-76 with the needs of ASTM D5133 Scanning Brookfield Test. A common refrigeration system and a common programmable controller offer versatility and "two-instruments-in-one" economy. Two baths are provided. One full visibility liquid bath identical to Model LB-76 with a 10 sample capacity. The other, a liquid bath holding two Scanning Brookfield viscometers. Each bath is independent of the other, allowing operation on an independent schedule. The dimensions of the bench top Model LSB-98 are (LWH) 34 X 27 X 34inches (87 X 69 X 87cm).

ASTM D2983

ASTM D5133

Excellent Data Reproducibility

A major oil company[2] performed ASTM D2983 test on 56 duplicate ATF samples using Lawler Model LB-76 Liquid Programmable Bath. The average variability between the duplicate samples was ±1.13% of mean. This compares very favorably to the method's stated precision of 11.8%. The key factor in this improved precision is the superior temperature control of the sample as its viscosity is being measured. Correlation between air chamber results and Model LB-76 bath results is excellent.

[2] "Improved Brookfield Viscosity Measurement of ATF's is Reported."Lubricants World, p. 24, Dec. 1994.

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