

# Direct Cool II

Scanning Brookfield Technique | Gelation Index  
Low-Temperature Viscosity

**ASTM D5133, D7110, D8210, D2983 - Proc. D**

## Methods

The Direct Cool II is the latest model in the SBT® instrument line utilizing Thermoelectric Cooling. This model is a second generation of the first non-liquid SBT® bath introduced in 2007, the legacy SBT Direct Cool, designed to eliminate the use of flammable bath mediums. The DC II offers a small, dual-position, bench-top footprint, making it ideal for any laboratory setting.

The Direct Cool II performs the two SBT® tests **ASTM D5133** and **D7110**, the temperature-scanning technique for measuring apparent viscosity of fresh, sooted, or highly oxidized engine oils at low temperatures and automatically generating the critical *Gelation Index* for identifying low-temperature pumpability problems leading to engine failure. Developed and made available exclusively by Tannas, the SBT® Technique determines the susceptibility of engine oils to flow-limited and air-binding behaviors under slow cooling conditions – providing continuous rheological data over a broad temperature range (+90°C to below -40°C) – and has been included in numerous automotive engine oil specifications since the 1990's.

Additionally, the multi-purpose Direct Cool II can be used for running the automated low-temperature viscosity test for ATF, hydraulic fluids and gear oils per the new **ASTM D2983, Procedure D** technique. The dual-position design allows operators to test two samples simultaneously, or the ability to run a reference sample alongside an unknown sample as indicated in the ASTM method.

## Features

- Thermoelectric Module Cooling (TMC) eliminates flammable bath mediums.
- Small, Dual-position, bench-top footprint.
- Functions with new all-digital TAV-IIIIM SBT® Viscometer model.



- SBT® Automation Package (w/Laptop) offers capability to operate up to four, 2-place Direct Cool II units simultaneously and independently.
- Integrated pre-heating: Heats samples up to 90°C prior to prescribed cooling profile.
- Programmable Temperature Controller maintains bath temperature within  $\pm 0.1^\circ\text{C}$  to  $-40^\circ\text{C}$ .
- Universal Power capability (110-240VAC, 50/60 Hz)
- Internal automatic dry air system removes moisture that accumulates during the test.
- Built-in touchscreen for easy-access to temperature control settings and bath operations.



### **ASTM D5133 JPI-5S-56-99 SH/T0732**

Continuous viscosity measurement of engine oils throughout cooling profile of  $1^\circ\text{C}/\text{hour}$  from  $-5$  to  $-40^\circ\text{C}$ .

Required for :

- ILSAC GF-2 through GF-6 (A&B), dexos®, and IFC® Engine Oil Specifications.
- API 'SL', 'SM', 'SN' and 'SP' categories for modern engine oils.

### **ASTM D7110**

Continuous viscosity measurement of *used* and *soot*-containing engine oils throughout cooling profile of  $3^\circ\text{C}/\text{hour}$  from  $-5$  to  $-40^\circ\text{C}$ .

### **ASTM D2983 - Proc. D**

Thermoelectric cooling and programmable temperature control per method. Call Tannas for details.



# SBT<sup>®</sup>: ASTM D5133 & D7110

## Low-Temperature Pumpability & Gelation Index

The Direct Cool II (DC II) was designed to provide highly reliable temperature ramping and control from 90°C to -40°C without the use of a liquid bath medium. It incorporates thermoelectric heating and cooling to modulate temperatures of the samples according to the specific ASTM test methods along with a touchscreen display.

The DC II accommodates two all-digital Tannas TAV-IIIIM Viscometers for collecting viscometric data for determining low-temperature viscosity and gelation tendency details on each sample. The system allows for the prescribed cooling rates of 1°C and 3°C/hour from -5°C to -40°C per the test methods with temperature stability within ±0.1°C. The DC II is a direct replacement for the legacy non-liquid SBT Direct Cool model and the previous liquid baths, Tannas SB+4 and SB+8.



## Principle

The SBT<sup>®</sup> technique measures apparent viscosity of fresh, sooted, or highly oxidized engine oils at low-temperatures. It determines the susceptibility of engine oils to flow-limited and air-binding responses during slow cooling conditions by providing continuous rheological data over a broad temperature range.

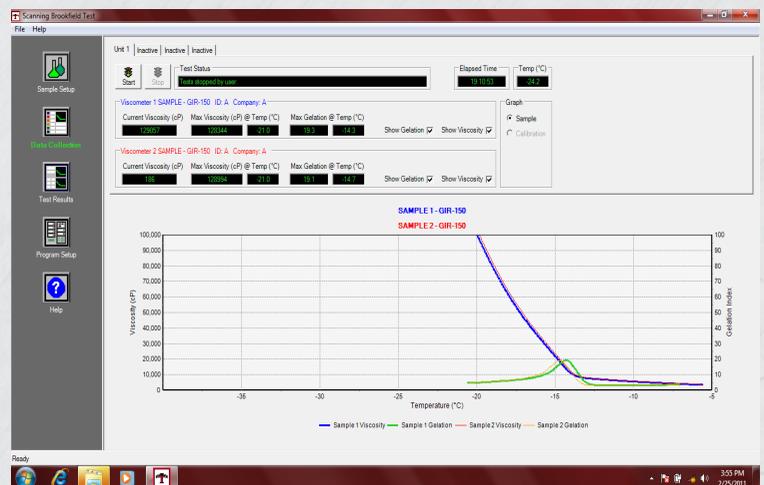
Viscometric data obtained from this technique provides essential insights regarding the effects of base oils, wax content, VI Improvers, Pour Point Depressants, and other additives on the pumpability and gel structure of engine oils, fuels, and other liquid petroleum products.

## History

The harsh winter of 1980 contributed to numerous engine failures from gelled oil. Savant Labs developed the SBT<sup>®</sup> method to understand structure formation in gelation-susceptible engine oils and the conditions that can lead to catastrophic air-binding failures in engines. Tannas introduced the patented SBT<sup>®</sup> in the mid-1980s and began manufacturing and marketing liquid cooling bath models. The legacy SBT<sup>®</sup> Direct Cool was introduced in 2007 as a non-liquid bath alternative, culminating in the DC II introduced in 2020. The SBT<sup>®</sup> test has been included in OEM factory fill and in several automotive engine oil specifications since the early 1990's.

## Innovation

The SBT<sup>®</sup> offers the most complete analysis available of the low-temperature rheological properties of engine oils and liquid petroleum products, and is the only technique capable of generating the *Gelation Index*. Tannas has continually improved the test design, functionality and safety. The Direct Cool II is the latest model in the SBT<sup>®</sup> instrument line incorporating Thermoelectric Module Cooling (TMC), built-in touchscreen control, and the ability to both pre-heat and precisely cool two samples simultaneously.



## Low Temperature Viscosity: ASTM D2983 - Procedure D

In addition to the SBT<sup>®</sup> test, the multi-purpose Direct Cool II model can be used for running the automated low-temperature viscosity test for ATF, hydraulic fluids and gear oils per the ASTM D2983, Procedure D technique. The DC II runs two samples simultaneously and is equipped with integrated pre-heating and cooling capabilities for operator-free transition between these two operational steps.



### Principle

The low-temperature viscosity of ATF's, gear oils, hydraulic oils and other fluid lubricants is measured by a rotational viscometer after pre-heating the sample and cooling to a predetermined temperature for 16 hours. Earlier techniques resulted in errors caused by gelation and other forms of non-Newtonian responses to torque and spindle speed.

### History

Low-temperature studies by automobile manufacturers (OEMs) began in the 1950s due to the failure of automatic transmissions under cold temperatures. The original technique used a cold air cabinet set at the designated temperature to condition the samples for 16-hours.<sup>1</sup> Each sample was placed in a Balsa wood block, removed from the cabinet at the end of the cooling period, and carried to a bench-top rotational viscometer for the viscosity determination. Based on this development, a procedure was written and accepted as ASTM D2983 in 1971. In the mid-1990s, Tannas developed and patented the SimAir<sup>®</sup> Test Cell for use in a constant temperature liquid bath, dramatically improving the test operation, usability and precision. The SimAir<sup>®</sup> technique was written into the method as Procedure C in 2007. More recently, the method was revised to permit use of thermoelectrically cooled systems with automation features, known as Procedure D.

### Innovation

Originally designed for running SBT<sup>®</sup> tests, the DC II was found to effectively and conveniently run the new D2983, Procedure D method with integrated pre-heating - meeting the parameters and automation features called for in the procedure while providing double the testing capacity of other such instruments running Procedure D. The versatile DC II model offers a small, bench-top footprint capable of meeting several critical low-temperature pumpability tests on a wide range of fluids; engine oils, ATFs, hydraulic fluids, and gear oils.

### Quick Connect

Included with the purchase of the DC II model for D2983 testing are the Quick Connectors. The Coupling Top and Sleeve are included with the bath purchase. The Coupling Bottom is included with the Spindle.

The design of the Quick-Connect spindle-coupling accessory allows the swift attachment or removal of the Spindle from the viscometer shaft.



<sup>1</sup>Society of Automotive Engineers (SAE) reference paper: Selby, T.W. (1960). "Automatic transmission fluid viscosity and its effect on transmission performance," SAE Transactions, **68**, pp. 457-467.

## Parts & Accessories

### Direct Cool II Instrument:

102000: 110-240 VAC, 50/60 Hz Power

### ASTM D5133 & D7110:

- 102500: SBT® DC II Automation Package
- 100022: SBT® Viscometer (TAV-IIIIM)
- 160022: SBT® Direct Cool Stator
- 102127: SBT® Direct Cool Adapter Assembly
- 160011: SBT® Direct Cool Rotor
- 100031: Female Hook
- 100032: Male Hook
- 160500: SBT® Oil Package
- 030007: GIR-150 (Quart)
- 200920: Laptop Computer
- 300195: Desktop Computer

### ASTM D2983

- 100005: LV-DVT Viscometer
- 170033: Spindle Storage Block
- 160021: Viscometer Adapter - D
- 100257: Sleeve Coupling
- 100258: Coupling Top
- 100256: Coupling Bottom
- 100260: SimAir Spindle
- 100052: Spindle Sleeve Assembly

### All Applications

- 040045: VarClean Cleaner
- 040013: LNP-5 Calibration Fluid (1/2 gal)

Contact Tannas Co. for additional spare parts and reference oils to run ASTM D5133, D7110, and D2983.

## Instrument Specifications

<b>Dimensions</b>	Bench-top: 37(w) x 61(d) x 69(h) cm (14.5 x 24 x 27 in)
<b>Weight</b>	~25 kg (55 lbs.)
<b>Voltage</b>	110-240 VAC
<b>Frequency</b>	50/60 Hz.
<b>Advanced Features</b>	Thermoelectric Module Cooling eliminates liquid medium Self-contained pre-heating capability to 90°C
<b>Cooling Capability</b>	+90°C to -40°C (± 0.1°C stability) Average greater than 60°C/hour cool rate
<b>Test Methods &amp; Specifications</b>	ASTM D5133, D7110, <i>Gelation Index</i> ILSAC GF-2 to GF-6 (A&B) and dexos™ API <i>SL, SM, SN &amp; SP</i> ASTM D2983 - Proc. D China National Standard: GB-11121, SH/T0732;
<b>Testing Capacity</b>	One or two test samples per unit Data-link up to four units with laptop
<b>Safety</b>	Inherent over-temperature measurement/protection/ alarm. CE Mark
<b>Shipping weight &amp; dimensions</b>	~114 kg (250 lbs.) approx. ~81 x 76 x 104 cm (32 x 30 x 41 inches) approx.

## Additional TANNAS CO. Precision Laboratory Instruments



### Tannas Foam Air Bath (TFAB)

- ASTM D892, D6082, D1881, D7840, IP146
- Non-liquid bath
- 24°C to 150°C range



### Noack S2® Volatility Test

- ASTM D5800, Proc. D, CEC L-40
- Phosphorus Volatility
- non-Wood's metal heating system



### TBS 3000 HTHS Viscometer

- ASTM D4683, D6616, CEC L-36, IP370
- High-Temperature, High-Shear (HTHS)
- 80°C, 100°C, 150°C testing



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