KING REFRIGERATION
LOW TEMPERATURE LABORATORY INSTRUMENTS

# King BLB

## King Brookfield Liquid Bath

**ASTM D2983 | IP 267 | DIN 51398**


## Principle

**Low-Temperature Viscosity:** The low-temperature viscosity of ATF's, gear oils, hydraulic oils and other fluid lubricants is measured by a rotational viscometer (historically a Brookfield Viscometer) after 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

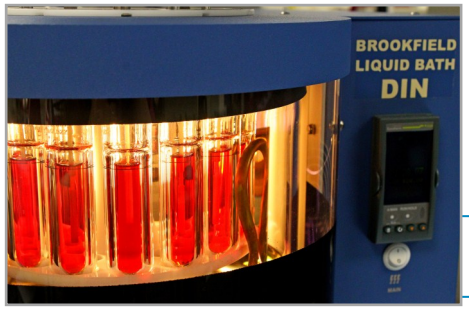
Low-temperature studies by automobile manufacturers began in the 1950s due to the failure of automatic transmissions in cold temperatures. In 1971, a procedure was written and accepted as ASTM D2983. The original technique used a Balsa wood block to hold samples in a cold air cabinet. The samples were removed from the cabinet and tested with a rotational, bench-top Brookfield Viscometer. In the mid-1990s, Tannas developed and patented the SimAir™ Test Cell for use in a constant temperature liquid bath to dramatically improve the test operation, usability, and precision.

## Innovation

The SimAir™ Technique, in combination with the BLB and a top-mounted viscometer, allows for the use of a small, bench-top, constant temperature liquid bath for ASTM D2983. SimAir™ Test Cells provide proper sample temperature control and operate independently to increase productivity and accuracy. According to Theodore Selby, the original developer of the Brookfield Viscosity method, the patented SimAir™ Test Cell represents "the first major method improvement since the development of the method 45+ years ago!"**

## Features

- Allows sample measurement while remaining in the liquid bath at temperature with a top-mounted viscometer (sold separately).
- Capable of measuring over broad temperature ranges (±0.1°C control):
  - **BLB 701 Model:** +30°C to –40°C (86°F to –40°F)
  - **BLB 702 Model:** +30°C to –70°C (86°F to –94°F)
  - **BLB-DIN Model:** +30°C to –55°C (86°F to –67°F)
- Programmable control for DIN testing. Manual temperature control for ASTM testing.




- Fully self-contained hermetic refrigeration system—no external units or controllers needed.
- Top heater and internal system provides a continuous blanket of dry air over samples to reduce or eliminate moisture buildup (gas source not included).
- *CE* rated with safety features that include a high pressure cutout, high temperature shutdown, and a low level shutdown.

Each BLB model offers users a small bench-top footprint, a large illuminated viewing window, and a twelve (12) sample Test Cell Carousel.

**ASTM D2983**
**IP 267**
Low-Temperature Viscosity

**DIN 51398**
Low-Temperature Viscosity
(*German Institute for Standardization Method*)

## Common Applications

- Automatic Transmission Fluids
- Gear Oils
- Torque & Tractor Fluids
- Hydraulic Oils
- Automotive & Industrial Oils
- Fuels

**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.

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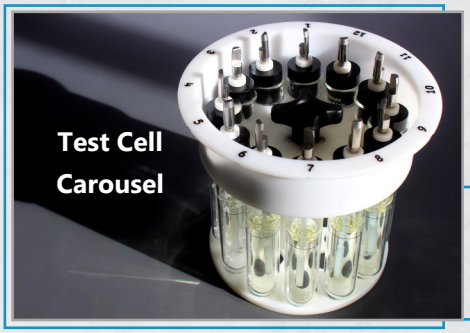
## King BLB701 and BLB702 | ASTM D2983


The use of liquid baths has long been accepted as an effective alternative to the original cold air cabinet developed with the procedure in the 1950s. Programmable liquid baths have been utilized but can be problematic due to their sizable refrigeration system requirements, differences observed in higher viscosity fluids caused by rapid & forced cooling rates, and the need to batch process the samples being analyzed.

The development of the patented SimAir™ Test Cell allows the 'constant' temperature King BLB baths to closely simulate the sample cooling profiles of a cold air cabinet during the 16-hour soak period. This provides greater adaptability, increased sample through-put and improved precision over air bath and programmable liquid bath techniques. The Viscometer mounted on top of the bath easily attaches to the SimAir™ Spindle via a Quick Connector for viscosity measurements at the end of the designated soak period, while the sample remains at temperature in the liquid bath.

Since meniscus levels can fluctuate depending on sample type and temperature, the large viewing window allows the operator to properly align the Spindle immersion mark to the meniscus of the sample according to the test method requirements.




The BLB Test Cell Carousel accommodates twelve (12) samples, allows convenient alignment of each cell to the appropriate test position, and holds both SimAir™ and DIN glassware.

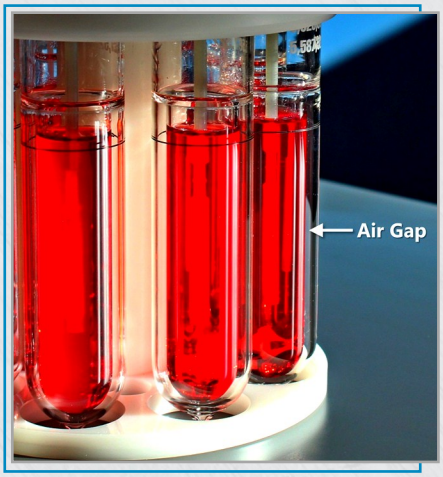
## King BLB-DIN | DIN 51398


Similar to ASTM D2983, the German Standard DIN 51398 determines apparent viscosity of gear oils and related fluids at low-temperature with the rotational Brookfield viscometer. The procedures differ with respect to cooling rates as the ASTM method calls for a rate consistent with the original air bath over a 16-hour period, whereas the DIN method specifies a 1°C/min. cooling rate. There is no established correlation between the two procedures, but viscosity measurements differ due to these cooling rates.

The King BLB-DIN bath model can be adjusted to run either test method by utilizing the SimAir™ Test Cell for ASTM D2983 and the single-wall DIN glassware for DIN 51398. With programmable control and a digital display to 0.01°C, the King BLB-DIN bath meets the 1°C/min. cooling profile down to -55°C.

The DIN glass Stators are available from King Refrigeration. Refer to the DIN method for related hardware and proper usage.

# SimAir™ Test Cell Innovation for ASTM D2983




The use of the Brookfield low-temperature test procedure for over a half-century highlights the significance of this test on the performance of fluids at low-temperatures. However, a desire to simplify the test procedure arose due to the inherent temperature control problems of cold air cabinets. Heat distribution of the air within the bath created difficulties with sample warming during the transfer from the air bath to the viscometer. This required duplicate sample runs to ensure proper rotor speed determination.

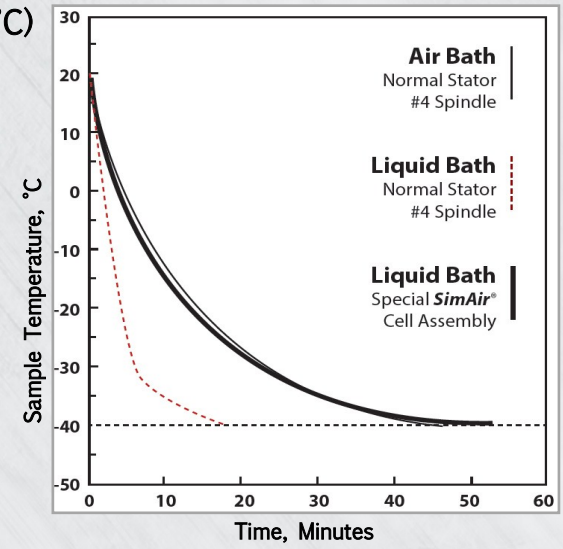
The patented SimAir™ Test Cells offer simple, precise, and more efficient data acquisition and are used exclusively in the 'constant' temperature King BLB and Tannas SB+2 liquid baths. The SimAir™ Glass Stator design incorporates an insulating chamber between two glass walls to simulate the cooling profile of the original cold air cabinet, upon which the method was based. As each Test Cell functions with its own independent cooling profile, they can be added or removed at any time without affecting the other samples, thus increasing productivity, ease-of-use, and eliminating the need to run batch sample tests.

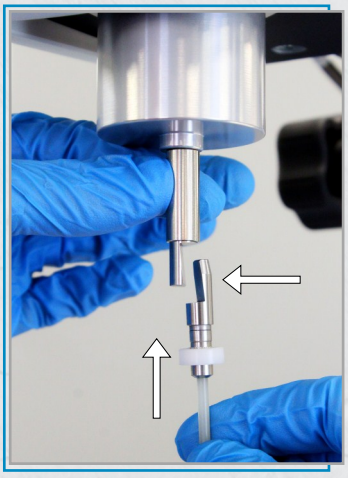
As the use of liquid baths require the top of the Stator and Spindle to be exposed above the liquid bath level, the fully-insulated SimAir™ Spindle is constructed of a composite plastic material to prevent any source of heat entering the interior of the stator and thus warming the sample during the soak period which could alter its viscosity.

## Air Bath vs. Liquid Bath Cooling Comparison (-40°C)

Using the SimAir™ Test Cell, the sample is immersed in a liquid bath held at the exact temperature desired for final analysis. With no bath cooling program, the SimAir™ cell modifies heat transfer to the sample and simulates the cooling influence of the air bath – permitting the sample to develop the same viscometric characteristics as in the air bath at cooling rates of greater than 60°C/hour.

As graphed, comparison of a single wall stator and #4 spindle to the SimAir™ Cell reveals the effectiveness of a constant temperature liquid bath in simulating air bath results when using the SimAir™ Test Cell.



## SimAir™ Quick Connector

Included with the purchase of the King BLB models and SimAir™ Test Cell Assembly are the SimAir™ Quick Connectors. The Coupling Top and Sleeve are included with the bath purchase. The Coupling Bottom is included with the SimAir™ Spindle.

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

- Dramatically reduces fluid disturbance to enhance test precision
- Reduces viscometer wear
- Eliminates cross threading
- User friendly & saves time

## Parts & Accessories

100235: Tannas D2983 SimAir™ Test Cell Assembly
*(Includes: SimAir™ Glass Stator, Spindle Support, Coupling Bottom, & SimAir™ Spindle Assembly)*

100236: SimAir™ Glass Stator
170018: DIN Glass Stator
100019: Brookfield LVDV1 M Digital Viscometer
100005: Brookfield LV-DV2T Viscometer
170033: Spindle Storage Block
170028: Test Cell Holding Rack
350190: Desiccant Assembly
550175: Desiccant Media

**Additional SimAir™ Parts:**

100231: SimAir™ Spindle Assembly
*(Includes: Spindle, Spindle Sleeve, & Spindle Collar)*

100236: SimAir™ Glass Stator
100257: Sleeve Coupling
100258: Coupling Top
100256: Coupling Bottom
100226: Spindle Support

Contact King Refrigeration for additional spare parts and reference oils to run ASTM D2983 or DIN 51398.

## Instrument Specifications

| | |
|---|---|
| **Dimensions** (W x D x H) | Benchtop: 42 x 53 x 66 cm<br>(16.5 x 21 x 26 inches) |
| **Weight** | ~68 kg \| (150 lbs.) |
| **Voltage** | **BLB 701:** 220 VAC, Fused: 10 amp.<br>**BLB 702:** 220 VAC, Fused: (2) 10 amp.<br>**BLB-DIN:** 220 VAC, 12 amp. max startup<br>6 amp. nominal running |
| **Frequency** | 50 or 60 Hz., Single-Phase |
| **Cooling Capacity** | 600 Watts at 0°C \| 300 Watts at –40°C \| 100 Watts at –70°C |
| **Heating Capacity** | 600 Watts |
| **Temperature Range** | **BLB 701:** +30°C to –40°C (86°F to –40°F)<br>**BLB 702:** +30°C to –70°C (86°F to –94°F)<br>**BLB-DIN:** +30°C to –55°C (86°F to –67°F) |
| **Temperature Control** | ±0.1°C \| Digital readout to 0.01°C for BLB-DIN |
| **Bath Cooling Rate** | **BLB 701:** 20°C/ hour average<br>**BLB 702:** 30°C/ hour average<br>**BLB-DIN:** 60°C/ hour average |
| **Refrigerant** | R410A (BLB701) \| R507 HFC / R508B (BLB702 & DIN) |
| **Compressor** | 1/3 horsepower |
| **Viewing Window** | ~41 x 23 cm \| 16 x 9 inches |
| **Testing Capacity** | Twelve (12) sample carousel |
| **Bath Size** | ~3.8 liters (1 gallon) |
| **Bath Design** | Methanol or Ethanol within Dewar flask |
| **Cabinet Material** | Powder Coated Aluminum |
| **Safety** | High pressure cutout \| High temperature limit<br>Low Level Indicator \| Very Low Level Safety Shutdown<br>CE Mark |
| **Shipping Weight** | ~122 - 136 kg \| (270 - 300 lbs.) |
| **Shipping Dimensions** (W x D x H) | 81 x 76 x 104 cm<br>(32 x 30 x 41 inches) |

## Additional KING REFRIGERATION Precision Laboratory Instruments

### Kinematic Viscosity (KV Bath)

- ASTM D445, D2170, D6074 | IP 71
- ISO 3105 | DIN 51550 | JIS K2283
- Low & high temperature models available

### Mini-Rotary Viscometer (MRV TP-1)

- ASTM D3829, D4684, D6821
- Determines borderline pumping temperatures
- Direct Refrigeration Technology

### CP610 (Cloud & Pour Point)

- ASTM D97, D2500, D5853 | IP 15, 219, 441
- ISO 3015, 3016 | DIN 51597 | JIS K2269
- Low temperature liquid bath

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