



6 C < @=B' DSR II RHEOMETER

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# The Bohlin DSR II - the world's favorite Asphalt Rheometer

Robust, easy to use and developed in close cooperation with SHRP researchers, the original Bohlin DSR set new standards in asphalt testing technology offering precise and accurate unattended operation. In fact, the Superpave test protocols for binders were developed using Bohlin instrumentation and the Bohlin DSR has remained the most commonly used rheometer at State & Federal DOTs, as well as industrial asphalt laboratories around the world. Today, over 60% of asphalt rheometers in use throughout the world are Bohlin rheometers, making Bohlin not only the preferred choice, but also the industry standard when it comes to measuring the rheology of asphalt binders.



Building on the technology and success of our original DSR, the Bohlin DSR II offers even greater ease of use and better performance within a compact integrated unit. Because it is designed for asphalt and is only sold into the asphalt industry, the DSR II is optimized specifically for asphalt. This means that it out-performs general purpose or adapted rheometers in terms of accuracy, throughput and ease of use.



## Maximized Sample Throughput

For QC testing, sample throughput is of paramount importance. Therefore, every feature of the DSR II design has been implemented with the goal of minimizing the time required to make each measurement. This includes loading the sample through to reaching thermal equilibrium, collecting the data and finally cleaning the unit. For example, the DSR II has been designed with measuring systems and gap setting which eliminate much of the operator time required when using conventional or modified general purpose rheometer units. Additionally, Bohlin's temperature control system offers rapid thermal equilibrium as well as extremely stable control. In practice, for the overall test sequence, the Bohlin DSR II achieves up to three times the throughput of a conventional rheometer.

## Temperature Control - Bohlin's patented design

Bituminous materials are extremely temperature sensitive with large variations in their material properties over just a fraction of a degree centigrade. It is typical to see a 20% change in modulus for only a 1°C change in temperature. Without accurate temperature control in a rheometer's design, this can lead to erroneous passing or failing of AASHTO PG graded materials with potentially disastrous commercial consequences.

For this reason, AASHTO specification T315-02 (6.1.2) states that temperature control may be by means of a liquid or a gas (as the heat transfer medium). By implication, this simply excludes systems which use heated enclosures to radiate heat onto the sample, where it is almost impossible to ensure the absence of temperature gradients. To fully optimize temperature control, the Bohlin DSR II incorporates a clean and easy to use system which completely immerses the sample in a temperature controlled liquid (patented). For testing bituminous materials, the Bohlin design out-performs all other types of temperature control including forced gas convection ovens and radiatively heated plates. This is because the relatively high thermal conductivity

of the liquid, which is in direct contact with the sample, allows for a much better heat transfer into the test specimen - **up to 25 times faster than other systems.**

Temperature gradients within the sample are completely eliminated and in order to achieve the required 0.1°C specified by AASHTO, the Bohlin DSR controls the sample temperature to 0.03°C or better. Because of the rapid heat transfer into the sample, thermal equilibrium (the time that the sample takes to react to the liquid temperature) is near instantaneous due to the intimate contact of the sample and the circulating liquid. This is important in optimizing throughput, as the long thermal equilibrium times of non-liquid based systems can mean that they take up to half an hour to properly equilibrate. This problem more than outweighs the often - and falsely - perceived benefit of the rapid set-point changes achievable with other types of control.

## Gap Setting - Simple and thermally stable

The DSR II gap can easily be changed to any desired value. For simplicity, both of the specification testing positions are clearly marked and can be easily selected. With most rheometer systems, the gap must be constantly reset during a day's testing and must be readjusted every time the temperature or the measuring systems are changed. The Bohlin DSR II addresses both of these issues, eliminating continual resetting of the gap to help optimize sample throughput and operator error. The DSR II measuring systems

are designed to be easily interchangeable. The unique coupling arrangement of the lower system together with quick fit upper systems ensure that the gap need not be reset whenever the upper or lower plates are removed or replaced. If necessary, samples can be loaded remotely onto the lower plate for convenience. On a general purpose rheometer, changes in temperature may affect the gap zero point due to thermal expansion of the measuring systems, which requires either rezeroing or the pre-programming of a motorised mechanical adjustment. To remove the need for any gap adjustments, the Bohlin DSR II features automatic expansion compensation (AEC) to keep the gap constant as the temperature changes.

## A Choice of Mechanical or Air Bearing

The DSR II is offered in two forms having either a Mechanical or an Air Bearing.

The **Mechanical Bearing** system offers a cost effective solution for Superpave testing and is especially suitable for applications where compressed air is not available. It exceeds all current AASHTO testing protocols. Mechanical Bearing units can also be upgraded to Air Bearing units if testing requirements change.

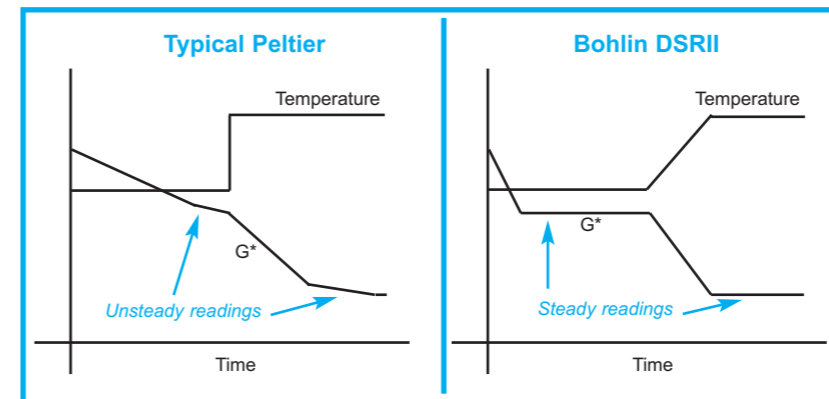
The **Air Bearing** version incorporates an air bearing to the same robust design as found on Bohlin's research grade rheometer units. It requires a supply of compressed air and is warranted to withstand even the most adverse industrial laboratory environments. It is ideally suited to specification testing, as well as having excellent research capabilities and longevity. The Air Bearing system used by Bohlin is impervious to dirt and other contaminants, as well as being extremely strong and robust.

## Software - AASHTO or Research

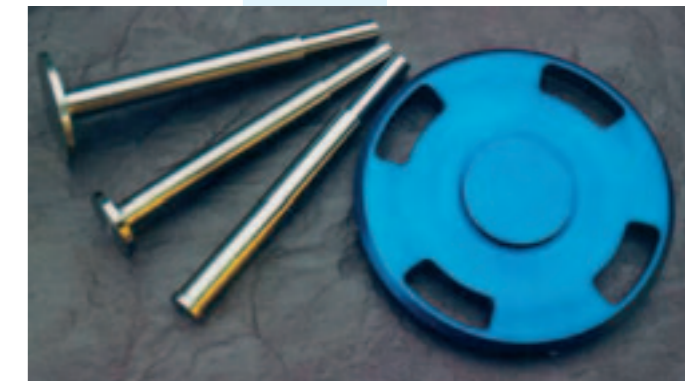
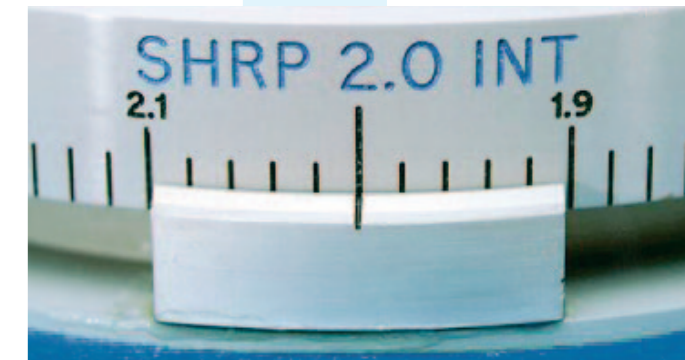
Easy to use, Windows driven software is standard for AASHTO specification and grade determination testing. To complement the AASHTO based software, a range of research grade software is available for use with the DSR II, enabling the instruments' capabilities to be expanded into a full research grade system.

The following tests and capabilities are available in the research grade software:

- Oscillation as a function of time, temperature, frequency and shear stress
- Viscosity as a function of shear rate, shear stress, temperature and time
- Creep and Creep Recovery - accumulated strain (for compliance measurement and analysis)
- Time Temperature Superposition and Viscoelastic Analysis



The diagram above demonstrates a key advantage of the Bohlin DSR II's temperature control. Despite the fact that a typical Peltier system appears to change setpoint in temperature very rapidly, the actual sample temperature, as evidenced by the modulus ( $G^*$ ) reading, responds very slowly. With the Bohlin DSR II principle, the  $G^*$  reading almost instantaneously tracks changes in temperature setpoint - giving a stable  $G^*$  reading much more quickly. This is the key to not only high throughput, but reliable data.



## Key Features at a Glance

- Designed specifically for Asphalt Testing
- Optimized for high throughput
- Meets & exceeds AASHTO designation T315 and meets all ASTM requirements
- Simple to use, proven design
- Precise and stable temperature control (patented)
- Rapid sample equilibrium to set temperature
- Significant reduction in need for regular re-calibration of temperature
- Pre set gaps for AASHTO tests
  - no zeroing necessary
- Automatic Expansion Compensation keeps gap constant with temperature
- Compact, integrated unit with small footprint
- Dedicated AASHTO specification software package including:
  - Pass/Fail medium temperature original binder test (T315-11)
  - Pass/Fail high temperature RTFO binder (T315-11)
  - Pass/Fail high temperature PAV binder (T315-11)
  - Linearity test (T315-12)
  - Grade determination test (R29-02)
- Optional research grade software