Anton Paar

Dynamic Shear Rheometers for Asphalt

SmartPave Series

SmartPave: Dynamic Shear Rheometers (DSR)

The requirements for asphalt binder and bitumen, especially with regards to their elasticity and flexibility, have increased significantly in recent years. Particularly in road construction, new asphalt concepts are being constantly developed to withstand the heavy strains caused by ever-increasing traffic volume. However, traditional test methods are often not sufficient to characterize these innovative and mainly polymer-modified materials.

So that modern asphalt and bitumen products meet the high requirements placed on them, there's a need for high-performance instruments to investigate and analyze these products in both quality control and during product development. The SmartPave 92 and SmartPave 303 dynamic shear rheometers are able to analyze unmodified as well as modified asphalt binder and bitumen in a wide temperature range, either according to standards or with classic rheological methods.

Our dynamic shear rheometers have proven themselves worldwide for decades due to numerous innovative technologies like the EC motor, the Toolmaster™ automatic tool recognition system, and the most accurate Peltier temperature control for dry sample thermostatting available. This guarantees unrivaled accuracy, convenience, and ease of use in asphalt and bitumen rheology.

Find out more

SmartPave 92
SmartPave 92 is designed especially for the demands of quality control and routine measurements in asphalt test labs.

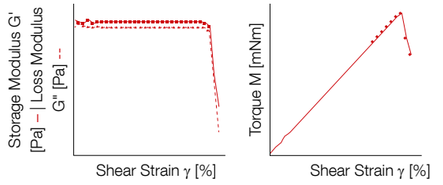
SmartPave 303
SmartPave 303 is built for the highest measurement demands.

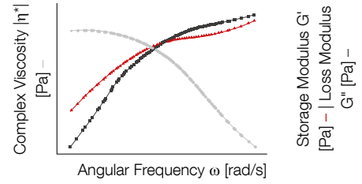
MCR 503 Power
With the MCR 503 Power modular compact rheometer rounding out the portfolio, our rheometers meet all the needs emerging from state-of-the-art asphalt and bitumen analysis.

Standards		
For standard asphalt tests	Advanced asphalt tests	For extensive asphalt tests in research and development
AASHTO, ASTM, DIN EN, FGSV, IS, SATS, GOST, and AGPT specifications		
Temperature range		
-5 °C to +200 °C	-50 °C to +220 °C	-160 °C to +1,000 °C
The right choice for you		
Designed for the daily lab routine	Upgradeable to all standard rheological tests	Full rheological characterization of all materials from liquid to solid

Asphalt and Bitumen Testing

Asphalt binder and bitumen testing with the SmartPave series

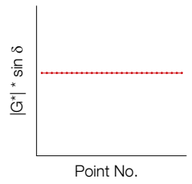


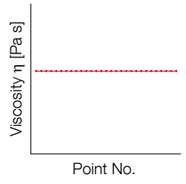


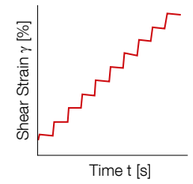
DSR tests on solid bitumen and asphalt mortar samples
Characterize materials from the glassy to the molten state over a large temperature range, enabling precise determination of transition temperatures and relaxations. In dynamic mechanical analysis (DMA), the temperature and mechanical behavior of solids can be investigated using a variety of available fixtures such as solid circular (SCF), rectangular (SRF), or parallel-plate systems.

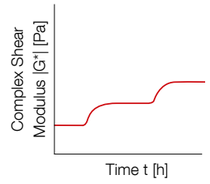
Full rheological characterization including master curves
Conduct all standard rheological tests on bitumen and asphalt binders in both rotational and oscillatory modes, including flow curves, three-interval time tests (3ITT), amplitude and frequency sweeps, temperature tests, and master curve generation.

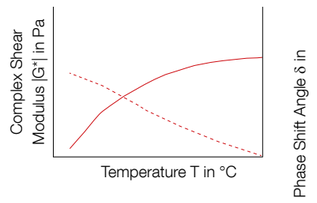
SmartPave 303		✓
MCR 503 Power	✓	✓











Superpave performance grading according to AASHTO T315 / ASTM D7175
Classify asphalt binders by their rated performance within a temperature range of 6 °C to 88 °C, based on the conditions in which they are typically used – including environmental factors and pavement temperatures.

Viscosity determination of asphalt binder according to AASHTO T316 / ASTM D4402 / DIN EN 13702
Use standard testing methods for viscosity determination of asphalt binder with a rotational viscometer or rheometer to research the processability of asphalt binders in a temperature range of 60 °C to 180 °C.

Multiple stress creep recovery (MSCR) according to AASHTO T350 / ASTM D7405 / DIN EN 16659
Determine the rutting performance of modified asphalt binder by measuring the percent recovery and non-recoverable creep compliance of modified asphalt binders.

Rheological property determination of GTR-modified (ground tire rubber) asphalt binders (AASHTO draft)
Asphalt binders can be blended with ground tire rubber (GTR) to beneficially modify the properties of the pavement in highway construction. Determine the temperature-dependent rheological properties in an appropriate temperature range with a special DSR setup based on a concentric cylinder Peltier-controlled temperature device.

Determination of temperature-dependent rheological behavior of asphalt binders according to DIN EN 14770
In addition to the existing standard methods, we offer various Peltier-controlled temperature devices that cover a wide temperature range. Expand the range of measurement options for investigating the temperature-dependent rheological properties of asphalt binders, which are relevant to their use in applications such as road construction.

SmartPave 92	✓	✓	✓		
SmartPave 303	✓	✓	✓	✓	✓
MCR 503 Power	✓	✓	✓	✓	✓

SmartPave 92 and SmartPave 303

Fully automatic temperature calibration
Temperature accuracy and stability are crucial in asphalt testing. Properties of asphalt binders are highly sensitive to changes in temperature. The smallest temperature deviations result in vast differences in the measuring results. We offer unique fully automatic temperature calibration and verification routines in the RheoCompass software.

The most accurate Peltier temperature control
Temperature has the biggest influence on the rheological investigation of asphalt binders and bitumen. SmartPave 92 and SmartPave 303's unique temperature control unit is the first Peltier heating system with heating elements above and below the sample. Temperature gradients are completely eliminated and the heating and cooling rates are very fast. Test times are reduced almost by half, while reproducibility is improved. Due to the unrivaled asphalt chamber, there is no water flow around the sample. This provides a completely dry sample environment

Toolmaster™ – Automatic tool recognition and configuration
Toolmaster™ is the only completely contact-free automatic tool recognition and configuration system for rheometers. It recognizes measuring systems and temperature control units as soon as these are connected to the rheometer so you don't need to enter any data manually.

Easy-to-use software
The user-friendly rheometer software has been designed specifically for the needs of the asphalt industry. The software consists of predefined, step-by-step instructions for all test types as defined by international asphalt binder specifications.

The best measuring geometry for your needs
Depending on the test method, a large selection of measuring systems – parallel plate, cone-plate, and concentric cylinder systems – are available.

Easy fitting of measuring systems
QuickConnect provides ease-of-use when changing between measuring systems. The quick-fitting coupling allows one-handed connection of the measuring systems and ensures fast, convenient system changes without a screwing mechanism.

A clear view of your sample
TruRay is a unique lighting concept included in SmartPave 92 and SmartPave 303, giving a clear view of the sample and measurement surface. This is especially useful for the correct and precise filling of the measuring gap.

Over 25 years of experience in one motor
The reimagined EC motor of the SmartPave 303 – a permanent magnet synchronous motor (PMSM) – deploys a frictionless, synchronous movement of the rotor, enabling the most sensitive and, therefore, most precise movements. Whether investigating solids or low-viscosity liquids, your results are accurate across a wide viscosity range.

Accessories for SmartPave 92 and SmartPave 303

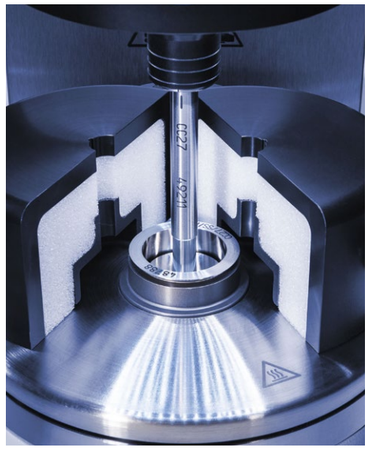
The most accurate temperature control: Temperature has the biggest influence on rheological investigations of asphalt binders and bitumen. For this reason, we offer a wide range of Peltier temperature devices with excellent heating and cooling characteristics.

Peltier temperature control for parallel-plate systems (P-PTD 220) and hood for up to 220 °C (H-PTD 220)

- Truly Peltier-temperature-controlled hood
- Temperature range: -50 °C to +220 °C
- Smallest temperature gradients ≤0.1 °C according to AASHTO T315
- Dry sample area; no water or gas flow around the sample
- Sliding rail for easy access and sample trimming, with 360° view
- Recommended for all standard applications on bitumen and asphalt binder according to international asphalt binder specifications

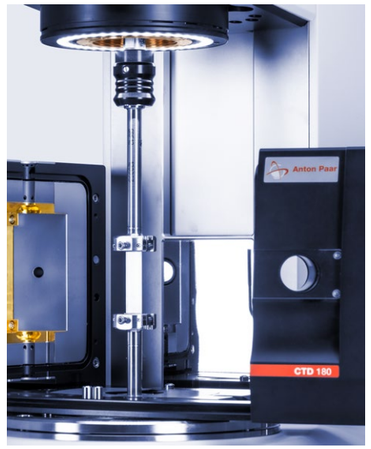
Air-cooled Peltier temperature control for parallel-plate systems (P-PTD 220/AIR) and hood for up to 200 °C (H-PTD 200/AIR)

- CoolPeltier™: Peltier temperature control with built-in air-counter-cooling option that requires no additional fluid circulator for counter-cooling
- Temperature range: -5 °C to +200 °C
- Smallest temperature gradients ≤0.1 °C according to AASHTO T315
- Dry sample area; no water or gas flow around the sample
- Sliding rail for easy access and sample trimming, with 360° view
- Recommended for all standard applications on bitumen and asphalt binder according to international asphalt binder specifications



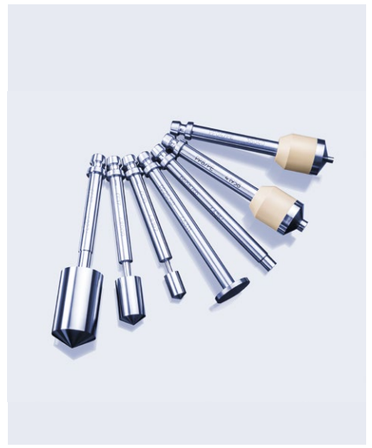
Peltier temperature control for concentric-cylinder systems (C-PTD 180/AIR)

- Temperature range: 0 °C to +180 °C
- No vertical temperature gradients in the sample due to patented thermal transfer system (US Patent 6,240,770, 1999)
- CoolPeltier™: Peltier temperature control with built-in air-counter-cooling option that requires no additional fluid circulator for counter-cooling
- Suitable for rheological standard applications according to international asphalt binder specifications as well as for GTR-modified (ground tire rubber) asphalt binder with particle sizes up to 2 mm (mesh 10)



Peltier-based convection-temperature-control system (CTD 180)

- Temperature range: -20 °C to +180 °C
- Rectangular (SRF) and cylindrical solid torsion (SCF) fixtures for dynamic mechanical analysis (DMA)
- Humidity option available



Measuring systems

- Parallel-plate: PP04 / PP08 / PP25 (other diameters on request)
- Cone-plate: Different diameters and angles on request
- Concentric-cylinder: CC10 / CC17 / CC27 (other diameters on request)
- Special concentric cylinders for GTR-modified (ground tire rubber) asphalt binder testing: CC10SP / CC17SP

	SmartPave 92	SmartPave 303	MCR 503 Power
Specifications			
Bearing design	Air, fine-pored carbon		
Motor design	Electronically commutated (EC) – permanent magnet synchronous motor		
Displacement transducer design	High-resolution optical encoder		
Normal force measurement design (US Pat. 6167752, 1996)	×	360° capacitive sensor, non-contacting, fully integrated in bearing	
Working mode	Combined motor transducer (CMT)		
Minimum torque (rotation)	0.4 µNm	5 nNm	100 nNm
Minimum torque (oscillation)	0.4 µNm	1 nNm	50 nNm
Maximum torque	125 mNm	215 mNm	300 mNm
Minimum angular velocity[1]	0 rad/s	0 rad/s	0 rad/s
Maximum angular velocity	157 rad/s	314 rad/s	200 rad/s
Maximum speed	1,500 min^{-1}	3,000 min^{-1}	2,100 min^{-1}
Minimum frequency[2]	2 x 10^{-5} Hz	2 x 10^{-8} Hz	2 x 10^{-8} Hz
Maximum frequency[3]	100 Hz	200 Hz	200 Hz
Normal force range	×	-50 N to +50 N	-70 N to +70 N
Dimensions (W x H x D)	380 mm x 660 mm x 530 mm	453 mm x 725 mm x 673 mm	453 mm x 775 mm x 673 mm
Weight	33 kg	48 kg	50 kg
Three-point support of device (three robust feet for tool-free, one-hand alignment)	✓	✓	✓
Three-point support for mounting of measuring cells (wobble prevention, no misalignment after changing of cells)	✓	✓	✓
Maximum temperature range[4]	-50 °C to +400 °C	-160 °C to +1,000 °C	-160 °C to +1,000 °C
Virtually gradient-free temperature control (horizontal, vertical)	✓	✓	✓
Temperature gradient ≤0.1 °C according to AASHTO and ASTM	✓	✓	✓
CoolPeltier™ Peltier system with built-in cooling option that does not require additional accessories for counter-cooling	-5 °C to +200 °C	-5 °C to +200 °C	-5 °C to +200 °C
Pressure cell	up to 150 bar	up to 1,000 bar	up to 1,000 bar
SafeGap™ normal force limiter during gap setting	✓	×	×
TruRay™ dimmable illumination of sample area	✓	✓	✓
RheoCompass software			
Asphalt standard operation procedures (SOP) with regular updates	✓	✓	✓
Fully automatic temperature calibration	✓	✓	✓
Test and analysis designer	✓	✓	✓
Report designer (with all test information for export and print)	✓	✓	✓
Managed lab multiple clients and servers	○	○	○

	SmartPave 92	SmartPave 303	MCR 503 Power
Applications			
AASHTO T315 / ASTM D7175 / GOST R58400.10 (SHRP-Test/Superpave PG)	✓	✓	✓
AASHTO T316 / ASTM D4402 DIN EN 13302 & 13702 / GOST 33137 (Rotational Viscosity)	✓	✓	✓
AASHTO T350 / ASTM D7405 DIN EN 16659 / GOST R58400.6 (MSCR-Test)	✓	✓	✓
AASHTO T391 (LAS-Test) / GOST R58400.7	×	✓	✓
AASHTO T404	✓	✓	✓
AASHTO TP123	×	✓	✓
ASTM D7552	×	✓	✓
GOST 58400.9	×	✓	✓
FGSV TPB StB Part 2A FGSV TPB StB Part 2B FGSV TPB StB Part 4 FGSV TPB StB Part 5	✓	✓	✓
AGPT/T125 Stress Ratio of Bituminous Binder	×	✓	✓
AGPT/T192 Viscosity of RAP Binder	✓	✓	✓
AGPT/T194 Aging Resistance of Bitumen Using PAV and DSR	✓	✓	✓
Master curves	○	✓	✓
Measurement of rubber-modified bitumen	×	✓	✓
Low-temperature measurements -50 °C parallel plate	×	✓	✓
Low-temperature measurements -20 °C (torsion)	×	✓	✓

The DSR is among others part of the following asphalt binder specifications: AASHTO M320, AASHTO M332, ASTM D6373, ASTM D8239, AGPT/T190, GOST R58400.1-2019, IS 15462, IS 73.

Trademarks: SmartPave (016731556), RheoCompass (9177015)

✓ Included ○ Optional × Not available

1) In controlled shear stress (CSS) mode. In controlled shear rate (CSR) mode depending on measuring point duration and sampling rate.
2) Theoretical value (duration per cycle = two years)
3) Higher frequencies are possible using multi-wave functionality (942 rad/s (150 Hz) or even higher, depending on measuring system and sample)
4) Depending on used temperature device

Reliable. Compliant. Qualified.

Our well-trained and certified technicians are ready to keep your instrument running smoothly.

Maximum uptime | Warranty program | Short response times | Global service network

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