Anton Paar

Dynamic Shear Rheometers for Asphalt

SmartPave

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 the 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 is 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 102 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.

Anton Paar 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 unrivalled accuracy, convenience, and ease of use in asphalt and bitumen rheology.

SmartPave 92

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

For standard asphalt tests according to: AASHTO, ASTM, DIN EN, FGSV, IS, SATS GOST, and AGPT specifications

Temperature range:
-5 °C to 200 °C

Designed for the daily lab routine

SmartPave 102

SmartPave 102 is the instrument which meets the highest measurement demands.

For standard asphalt tests according to: AASHTO, ASTM, DIN EN, FGSV, IS, SATS GOST, and AGPT specifications

Temperature range:
-30 °C to 120 °C

Upgradeable to all standard rheological tests

MCR 502S

With the modular compact rheometer **MCR 502S** rounding off the portfolio, Anton Paar rheometers meet all the needs emerging from state-of-the-art asphalt and bitumen analysis.

For extensive asphalt tests in research & development

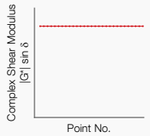
For standard asphalt tests according to: AASHTO, ASTM, DIN EN, FGSV, IS, SATS GOST, and AGPT specifications

Temperature range:
-160 °C to 1000 °C

Full rheological characterization of all materials from liquid to solid

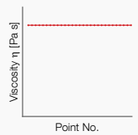
Asphalt and bitumen testing

Asphalt binder and bitumen testing with the SmartPave series:



Superpave performance grading according to AASHTO T315 / ASTM D7175

Classify asphalt binders relative to their rated performance in a temperature range from 6 °C to 88 °C related to the conditions under which they are used, including environmental conditions and pavement temperatures.



Viscosity determination of asphalt binder according to AASHTO T316 / ASTM D4402 / DIN EN 13702

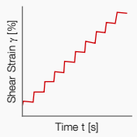
Use standard testing methods for viscosity determination of asphalt binder with a rotational viscometer/rheometer to research the processability of asphalt binders in a temperature range from 60 °C to 200 °C.

The dynamic shear rheometers (DSR) from Anton Paar are especially designed for the needs and demands of the asphalt industry.

All relevant asphalt binder and bitumen standards can be covered with SmartPave 92, SmartPave 102, and MCR 502S.

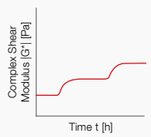
The RheoCompass Software: New Paths for Asphalt and Bitumen Testing

RheoCompass is a navigation tool that gives you the complete overview as well as the exact insights you require. Designed for intuitive use, the client–and-server-based RheoCompass enables application-oriented template filtering, customized test and analysis definitions, highly simplified data retrieval, a fully automatic and fast temperature calibration and verification routine, and much more.



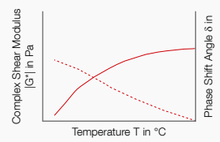
Multiple stress creep recovery (MSCR) according to AASHTO T350 / ASTM D7405 / DIN EN 16659

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)

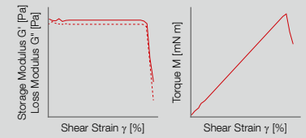
Asphalt binders can be blended with ground tire rubber (GTR) to beneficially modify the properties of the pavement in highway construction. Determine the temperature-dependent rheological properties in an appropriate temperature range with a special DSR setup based on a concentric cylinder Peltier-controlled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



Determination of temperature-dependent rheological behavior of asphalt binders according to DIN EN 14770

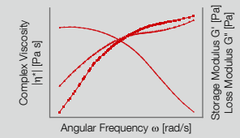
In addition to the existing standard methods Anton Paar offers various Peltier-controlled temperature devices which cover a wide temperature range. Enhance measurement possibilities to determine the temperature rheological properties of asphalt binders which are essential for their use i.e. in road construction.

Advanced asphalt binder and bitumen testing:



DSR tests on solid bitumen and asphalt mortar samples

Characterize materials from the glassy to the molten state over a large temperature range and consequently determine the material's transition temperatures and relaxations precisely. With a dynamic mechanical analysis (DMA) the temperature and mechanical behavior of solids is investigated with a variety of available fixtures such as solid circular (SCF), rectangular fixtures (SRF), or parallel-plate systems.



Full rheological characterization including master curves

Conduct all standard rheological investigations on bitumen and asphalt binders in rotation and oscillation mode like flow curves, 3 interval time tests (3ITT), amplitude sweeps, frequency sweeps, temperature tests, master curves, etc.

SmartPave 92 and SmartPave 102

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. Anton Paar offers 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 102'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. You can work in a completely dry environment. The annoying noises made by water circulators and blocked water filters are things of the past.

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

When changing between measuring systems, QuickConnect provides great ease-of-use. 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 only available for SmartPave 92 which gives you a clear view of the sample and measurement surface. This is especially useful for the correct and precise filling of the measuring gap.

25 years of experience in one motor

The air-bearing-supported synchronous EC motor deploys a frictionless synchronous movement of the rotor inside that enables 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 102

The most accurate temperature control

Temperature has the biggest influence on rheological investigations on asphalt binders and bitumen. For this reason, Anton Paar offers a wide range of Peltier temperature devices with excellent heating and cooling characteristics.

Peltier temperature control for parallel-plate systems (P-PTD 200) and hood for up to 120 °C (H-PTD 120)

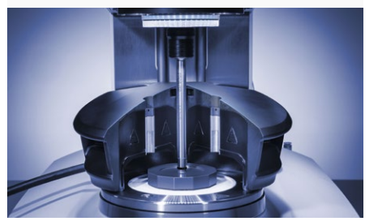
- Truly Peltier-temperature-controlled hood (US Patent 6,571,610)
- Temperature range: -30 °C to 120 °C
- Smallest temperature gradients <0.1 °C according to AASHTO T315
- Dry sample area; no water or gas flow around the sample
- Sliding rail for easy access and sample trimming
- Recommended for all standard applications on bitumen and asphalt binder according to international asphalt binder specifications

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

- Truly Peltier-temperature-controlled hood (US Patent 6,571,610)
- Temperature range: -40 °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
- Recommended for applications on bitumen and asphalt binder in an extended temperature range

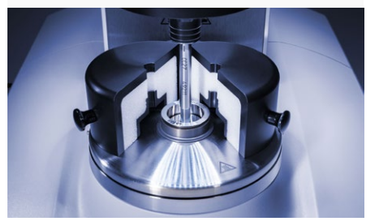
Air-cooled Peltier temperature control for parallel-plate systems (P-PTD 200/AIR) and hood for up to 200 °C (H-PTD 200/AIR)

- 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
- Recommended for all standard applications on bitumen and asphalt binder according to international asphalt binder specifications
- Available for SmartPave 92 only



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)
- 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) fixture 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

Specifications

Specifications	Unit	SmartPave 92	SmartPave 102	MCR 502S
Bearing	-	Air	Air	Air
EC motor (brushless DC) with high-resolution optical encoder	-	✓	✓	✓
Rotation mode	-	✓	✓	✓
Oscillation mode	-	✓	✓	✓
Direct strain, amplitude controller	-	✓	✓	✓
Direct stress, amplitude controller	-	✓	✓	✓
Maximum torque	mNm	125	200	300
Minimum torque, rotation	nNm	1 µNm	5	100
Minimum torque, oscillation	nNm	1 µNm	2	50
Angular deflection, set value	µrad	1 to ∞	0.5 to ∞	0.05 to ∞
Step rate, time constant	ms	100	5	5
Step strain, time constant	ms	100	10	10
Step time (rate, strain), 99 % of set value (all samples)	ms	100	30	30
Minimum angular velocity [1]	rad/s	10^{-4}	10^{-8}	10^{-9}
Maximum angular velocity	rad/s	157	314	220
Minimum angular frequency [2]	rad/s	10^{-4} [3]	10^{-7} [3]	10^{-7} [3]
Maximum angular frequency	rad/s	628	628	628
Minimum speed (CSS/CSR)	rpm	10^{-3}	10^{-7}	10^{-8}
Maximum speed	rpm	1500	3000	2100
Normal force range	N	-	0.01 to 50	0.01 to 70
Normal force resolution	mN	-	1	1
Dimensions	mm	380 x 660 x 530	678 x 444 x 586	753 x 444 x 586
Weight	kg	33	42	47
Toolmaster™, measuring system	-	✓	✓	✓
Toolmaster™, measuring cell	-	✓	✓	✓
QuickConnect for measuring systems, screwless	-	✓	✓	✓
Electronic trim lock for the measuring system	-	✓	✓	✓
Virtually gradient-free (horizontal, vertical) temperature control	-	✓	✓	✓
Temperature gradient < 0.1 °C according to AASHTO and ASTM	-	✓	✓	✓
Maximum temperature range [4]	°C	-40 to 400	-160 to 1000	-160 to 1000
CoolPeltier™, Peltier system with built-in cooling option that does not require additional accessories for counter-cooling	°C	-5 to 200 [5]	-5 to 200	-5 to 200
Actively Peltier-controlled hood, Peltier technology	°C	-5 to 200 [5]	-40 to 200	-40 to 200
Concentric-cylinder Peltier temperature control	°C	5 to 150 [5]	-30 to 200	-30 to 200
Peltier-based convection oven, does not require LN_2 for cooling	°C	×	-20 to 180	-20 to 180
Pressure Cell	bar	×	○	0 to 1000
Automatic gap control/setting (AGC/AGS)	-	✓	✓	✓
TruGap™ for in-place measurement and control of the gap	-	×	○	○
SafeGap™, normal force limiter during gap setting	-	✓	×	×
TruRay™, dimmable illumination of sample area	-	✓	×	×
TReady™	-	×	○	○

Specifications	Unit	SmartPave 92	SmartPave 102	MCR 502S
TruRate™	-	×	○	✓
TruStrain™	-	×	✓	✓
Advanced Lift Drive Control (velocity profiles, tack, squeeze)	-	×	✓	✓
Normal force (normal force read/control)	-	×	✓	✓
Raw data (LAOS, waveform, ...)	-	×	○	✓

Specifications	SmartPave 92	SmartPave 102	SmartPave 502S
RheoCompass software			
Asphalt standard operation procedures (SOP)	✓	✓	✓
Fully automatic temperature calibration	✓	✓	✓
Test Designer	✓	✓	✓
Report Designer	✓	✓	✓
Managed lab, multiple clients and server	○	○	○
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 TP101-UL (LAS-Test) / GOST R58400.7	×	✓	✓
FGSV AL 720 BTSV FGSV AL 721 (Constant Shear Rate) FGSV AL 722 (Temperature Sweep) FGSV AL 723 (MSCR-Test)	✓	✓	✓
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	○	✓	✓ [6]
Measurement of rubber-modified bitumen	×	✓	✓
Low temperature measurements-30°C parallel plate	×	✓	✓
Low-temperature measurements -20°C (torsion)	×	✓	✓

Legend: ○ optional × not available ✓ included

[1] Dependent on measuring point duration and sampling time practically any value can be achieved
[2] Set frequencies below 10^{-4} rad/s are of no practical relevance due to the measuring point duration > 1 day
[3] Theoretical value (duration per cycle = 2 years)
[4] Depending on temperature device used
[5] System temperature, sample temperature may vary. For measurements at very high or low temperatures a calibration in the sample gap is recommended.
[6] Analysis package required

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