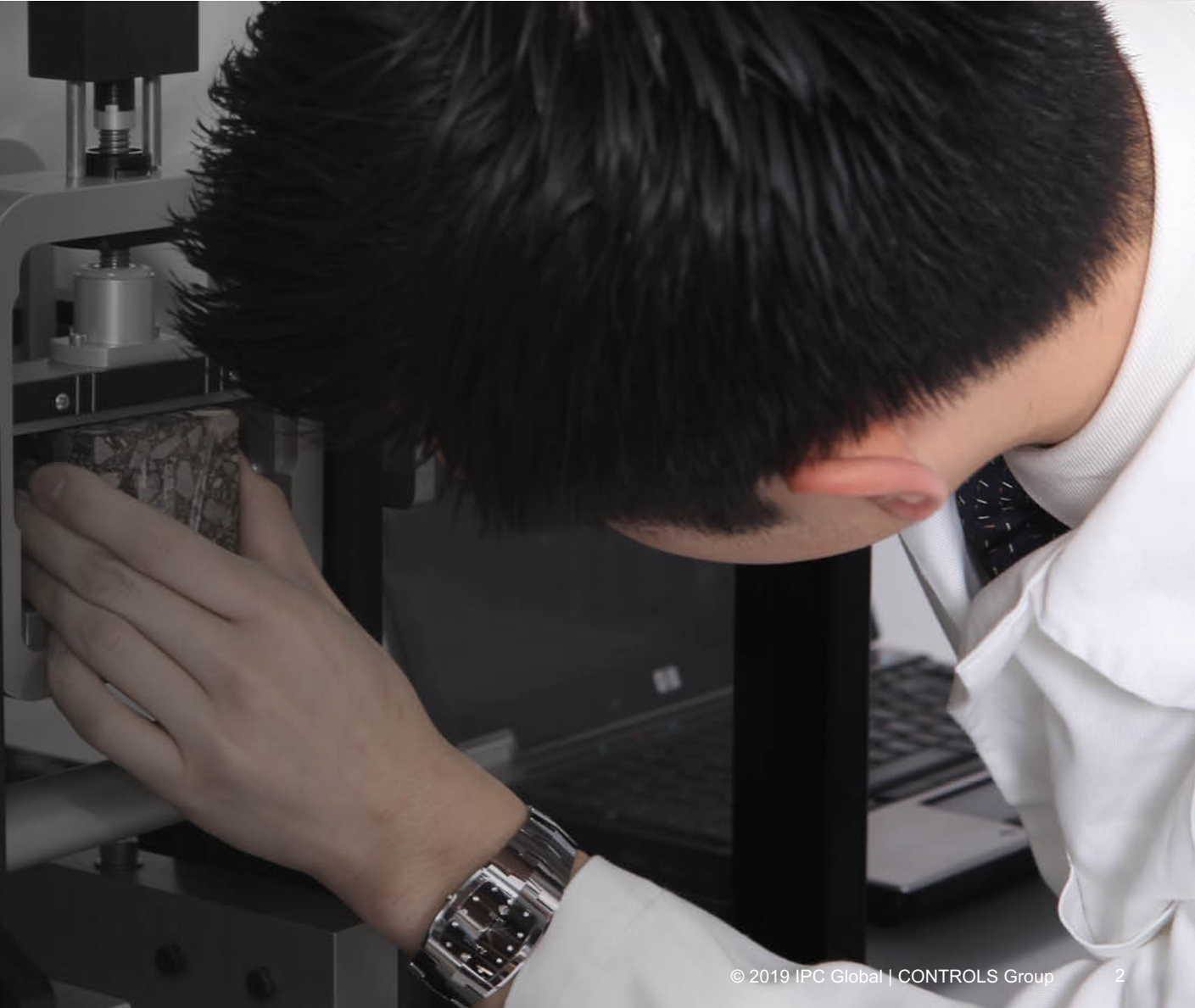




Advanced Pavement Testing Solutions

Presenter

Moving from basic empirical to Advanced Mechanistic Pavement Materials Testing for optimised performance based pavement design





1981

Established

1990

First asphalt testing equipment developed

25 years

Leaders in Asphalt Testing Equipment

2014

Became part of the CONTROLS Group

2017

Launch of new IPC Global | Controls Group division

IPC Global Worldwide

Emphasis on testing asphalt and other road construction materials



“*The Researcher’s Choice for Advanced Asphalt Testing Equipment*”

IPC Global Worldwide

1500+

Systems to
Customers in
100+ countries

200+

IPC Global Systems
to **customers** in
100+ countries

100+

Countries with
exclusive
distributors



Why Test?



- To determine how a mix will perform:
 - Rutting
 - Cracking
- To characterize materials
- To establish structural design
- To perform QC/QA tests
- To identify inferior mixes
- To carry out forensics

Why New Tests?



- 1** Big improvement in materials (e.g. polymer modified bitumen). Increased use of RAP, RAS & Crumbed Rubber.
- 2** Traditional tests are not able to simulate real road behavior.
- 3** Need to develop tests to better represent real traffic loads and obtain fundamental material properties.
- 4** Real loads are cyclic and dynamic.

Traditional Tests

Vs

Performance Tests

Test conditions (load, speed, temperature) not related with real conditions.

Test conditions (load, speed, temperature) simulate in close way the real ones.

Tests are “empirical”: there is no direct relation with real on-site Asphalt behavior.

Tests are “performance related”: the measure parameters are the same parameters measured on site.

Inability to foresee Asphalt behavior from traditional test results.

It is possible to foresee the Asphalt behavior and to fully characterize the road.

Example of Traditional Test

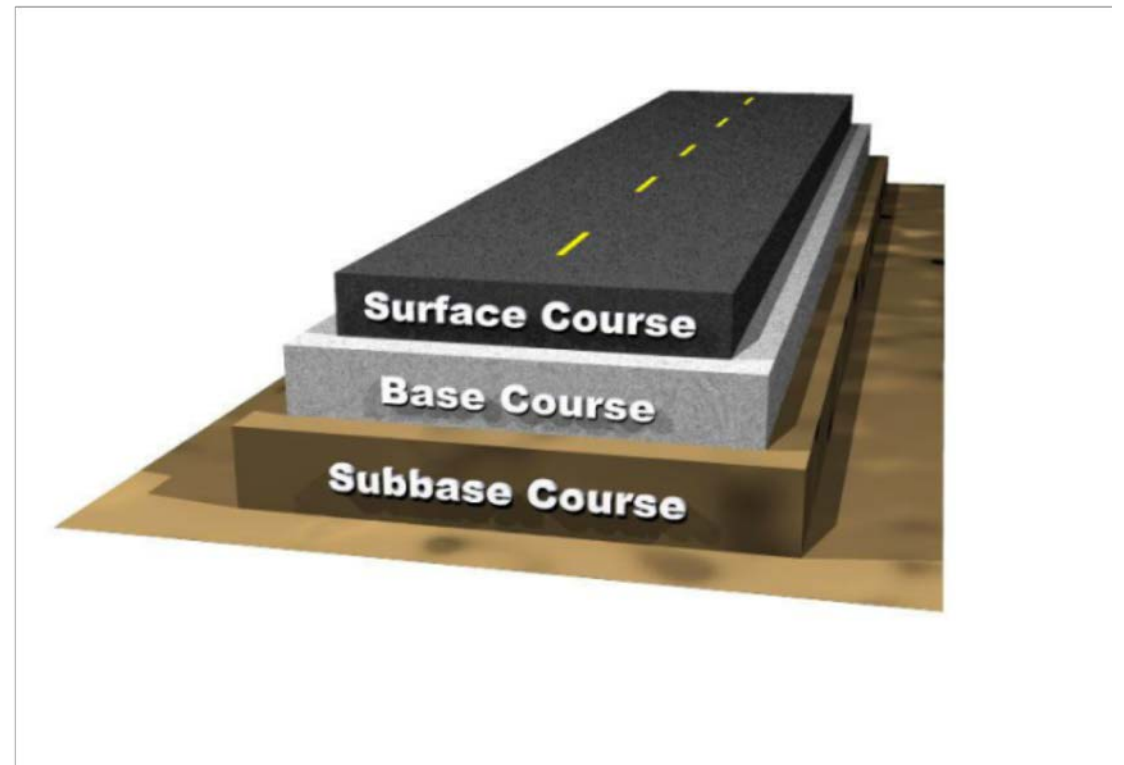
Marshall Compaction & Resistance

- Test procedure defined by EN12697-34 and ASTM D6926 & D6927.
- Sample is compacted by impact compaction (50 or 75 blows each face).
- Two parameters are measured:
 - Stability: maximum load along a diametrical compression of the sample at 60°C
 - Flow: deformation of the specimen corresponding to the stability



Performance Based Tests — Advantages

- Simulate real behavior of asphalt pavements
- Cover a wide range of application (force, duration, repetition) and temperatures, simulating traffic effect and environmental conditions
- Able to evaluate the visco-elasto-plastic behavior of asphalt
- From laboratory testing it is possible forecast of pavement behavior



Limitation of Traditional Tests

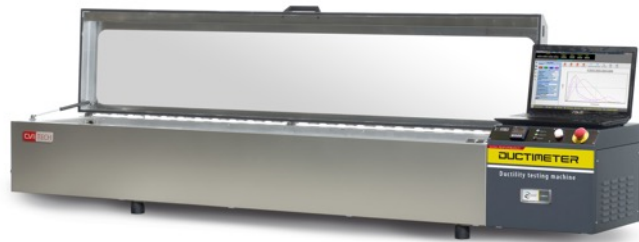
- These tests do not give design parameters for the roads
- Both tests are nowadays considered as classification tests only
- The national specifications of the road administrations give limits of acceptability of bituminous layers of the road on the basis of these test results
- It is not possible to evaluate the road behavior from these tests

Performance Based Pavement Design Laboratory

>> Binder testing equipment also available



Binder Testing Equipment



Ductimeter



Automatic Ring and Ball Apparatus



PIVOT



Bending Beam Rheometer [BBR]



Rolling Thin Film Oven [RTFO]



Pressure Aging Vessel [PAV]



Vacuum Degassing Oven [VDO]



Rotational Viscometer [RV]



Dynamic Shear Rheometer [DSR]

Sample Preparation

Mixing



Compacting



Cutting



Coring



Importance of Specimen Preparation

A Critical Factor in Asphalt Testing

- Specimen preparation is paramount regardless of what material you are testing or the sophistication of your testing systems.
- Precise and accurate materials analysis can only be achieved with high quality specimens.
- Testing poor quality specimens will produce misleading results and therefore waste valuable time and resources.
- Specimen preparation should ideally match the same conditions as how the pavement will be constructed in the field.
- Lab prepared specimens needs to have the same particle orientation, air void distribution and density homogeneity as field samples.
- IPC Global | Controls Group manufactures a full range of precise specimen preparation devices that ensure that you begin your testing with the best possible specimens

Mixing

Asphalt Mixer

- Most of Performance Based tests require large batches of samples (wheel tracking, gyratory compactor, dynamic testing)
- To increase test repeatability, it is necessary to assure high uniformity of the mix
- Mixing requires high operability and reduced safety risks for the operator
- Precise mix settings allow full adaptation to any type of mix (coarse, fine, mastic asphalt)



Asphalt Mixer

- Double wall container with PID controlled heating element, mixing temperature up to 250°C
- Double helical horizontal mixing shaft, same mixing action as in asphalt plant
- Mixing speed control, 15 to 35 rpm
- Motorized tilting mixing container (easy to download the mixture)
- Fast connection for fume exhaust pipe
- Mixing capacity up to 30 liters



Compaction

Range of Asphalt Mix Compactors

Slab Compactor



Gyratory Compactor



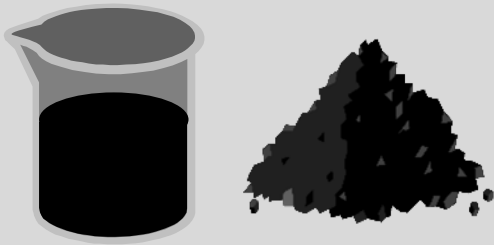
Shearbox Compactor



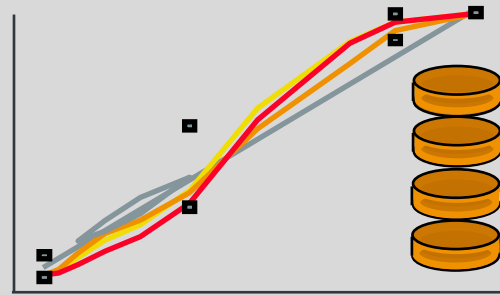
Gyratory Compactor

Steps of Superpave Mix Design

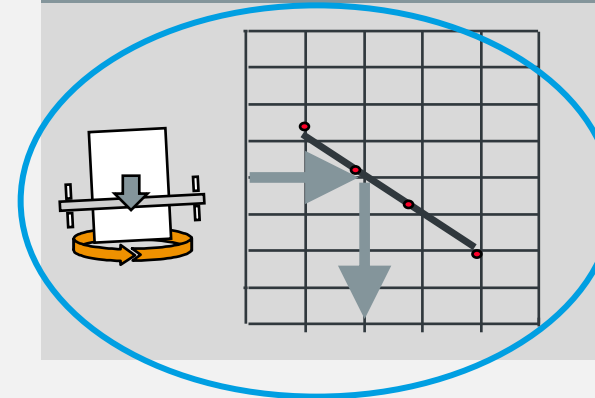
1. Materials Selection



2. Design Aggregate Structure



3. Design Binder Content

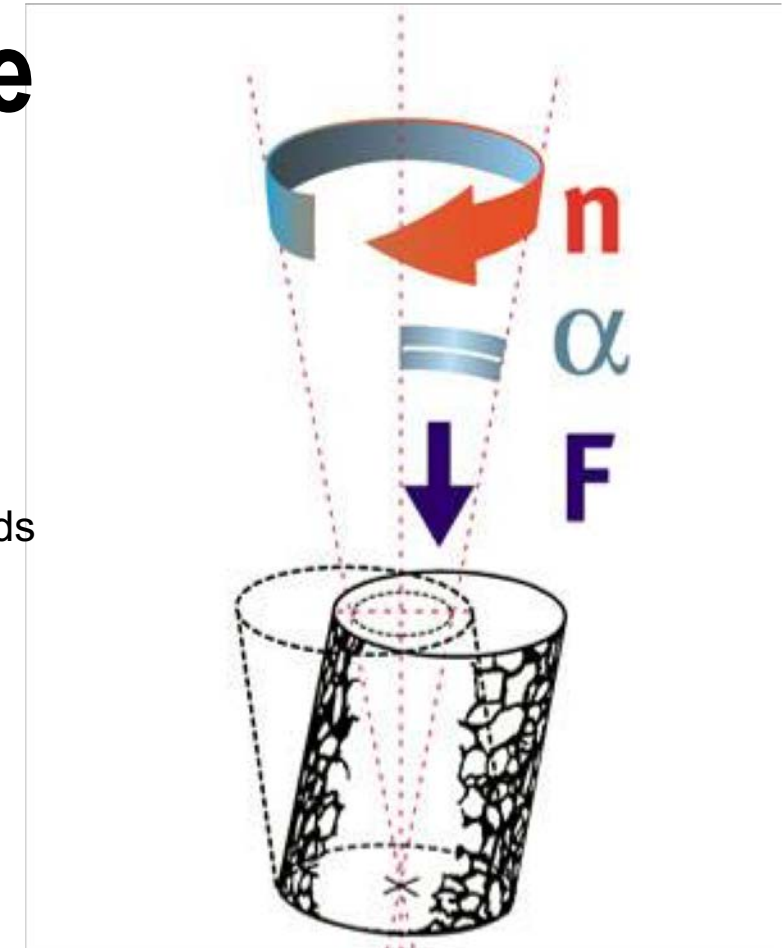


4. Mixture Performance Testing



Gyratory Compaction – Principle

- A hot asphalt sample is compacted with double effect
- Constant vertical force and shearing action
- It simulates on-site compaction
- Conforming both to European EN and American ASTM, AASHTO Standards





Gyratory Compaction Advantages

The double action compaction simulates the real on-site compaction effect

Continuous measurement of the volumetric properties of the mix.

Fast test and compact testing machine make it suitable for both Mix Design and Quality Control, also in mobile laboratories.

Gyratory Compaction — Applications



- **Laboratory verification** of the mix conformity to contractor's technical specifications for QC
- **On-site real-time verification** during paving operations
- **Mix design procedure** for the project of asphalt mixes
- **Preparation of cylindrical samples** for mechanical testing with precise dimensional and volumetric characteristics



Range of Gyrotory Compactors

Gyrocomp



- Portable model for QC/QA purposes, small and lightweight.
- Fully conforming both to EN, ASTM and AASHTO
- Pneumatically operated, mechanical adjustment of vertical load, rotating speed and gyratory angle (between 0.7 and 1.4°).

Galileo



- Reference machine for both QC/QA and research applications.
- Completely electro-mechanical machine, with automatic control of vertical force, rotating speed, angle (0 to 3° - as option), gyratory rate.
- No air compressor required

Gyrocomp

- Portable Gyrotory Compactor small and lightweight
- Conforming both to EN 12697-31, ASTM D6925 and AASHTO T312
- Pneumatically operated, allowing mechanical adjustment of vertical load, rotating speed and gyratory angle (between 0.7 and 1.4°)





- Brand new product from IPC Global | Controls Group, including many ground breaking technologies.
- Reference Gyrotory Compactor for both Quality Control and Research purposes.
- Completely electromechanically operated, no need of compressed air.

Galileo and Galileo Research



- ✓ Completely electromechanical machine
- ✓ Double control model
- ✓ Automatic control of vertical pressure and rotating speed
- ✓ Load measurement directly by load cell
- ✓ Vertical pressure up to 1000 kPa (150mm) or up to 2200 kPa (100mm)
- ✓ Angle adjustable from 0 to 3°
- ✓ Test duration up to 9999 cycles
- ✓ Adjustable speed from 5 to 60 rpm
- ✓ Complete with stand

Main Features (both models)



- ✓ Mechanical setup of the gyratory angle, then displayed on control panel
- ✓ Optional shear measurement by torquemeter
- ✓ Optional motorized extruder
- ✓ Optional active PC software



Galileo Features



- ✓ Closed loop automatic angle adjustment during the test
- ✓ Possibility to automatically set the zero angle at the end of the test
- ✓ Integrated shear measurement, PC software and extruder
- ✓ User defined setting of gyratory angle with the possibility to define custom test patterns



Galileo Research Features

Galileo Benefits

✓ Flexible & convenient

- User defined closed loop control of rate of gyration & axial load
- Easy installation with single-phase power
- Quick, simple & low maintenance from total electro-mechanical system (EmS)

✓ Safe

- Inter-locked safety screen
- Easy mould insertion on low friction surfaces
- Automatic mould lift function
- Orbital systems that allows for light yet hardy moulds



Galileo Benefits

✓ Efficient & productive

- Simultaneous compaction & extrusion of previous specimen
- Quick, easy & clear adjustments with colour 7" 16:9 control panel
- Ultimate convenience with integrated extruder & balance (optional)
- Continuous Shear Stress measurement (optional)

✓ Highly accurate

- Precision engineered, extremely rigid frame & robust loading mechanism for high accuracy & long life
- Ultimate parallelism with unique recirculating-ball linear guides
- Superior load control from piston mounted load-cell
- Sensorless vectorial inverter for mould rotation





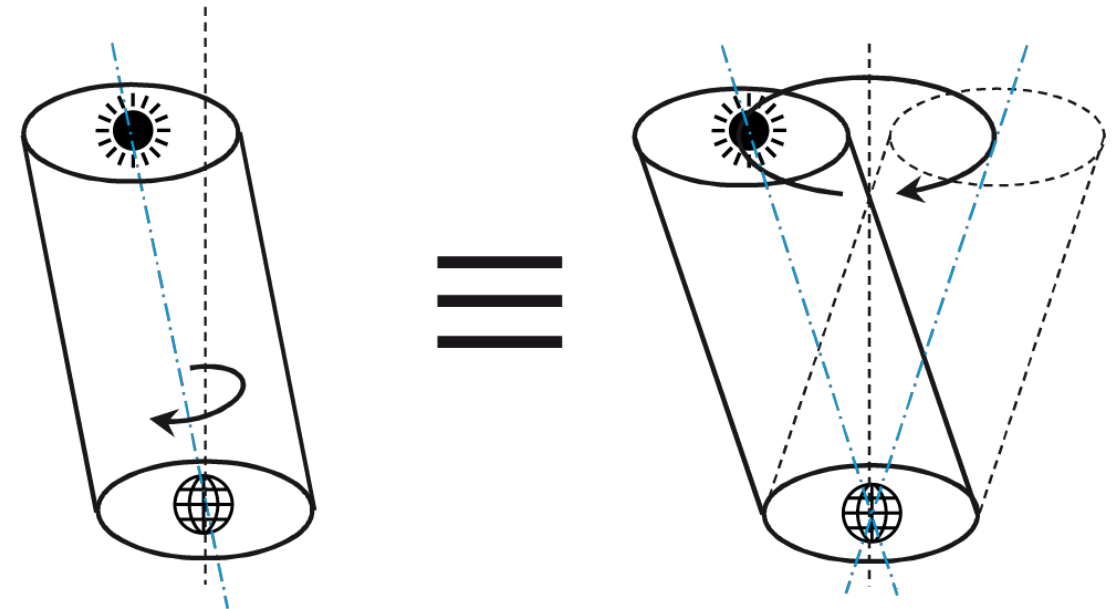
Galileo Research Benefits

In addition to the Galileo Standard's benefits, Galileo Research also includes the following benefits:

- ✓ Allows total flexibility with user defined closed loop control of gyratory angle
- ✓ Totally parallel sample faces with zero-angle test-end function
- ✓ Automatic results and data saving on PC or USB plus Windows data analysis and processing

Orbital Motion System

- Orbital is the unique and ingenious (patent pending) system at the heart of Galileo Gyrotory compactors, based on the elementary resolution of the gyrotory motion conforming, to use a well known example, to the Galileo theory that the earth rotates around the sun.
- “Orbital” system delivers highly accurate and repeatable test results, together with stiffness and angle stability values that fall comfortably within the limits defined in EN 12697-31, ASTM D6925 and AASHTO T312.



New EmS Actuator

- EmS Electromechanical Servoactuation – no need of pneumatic connection or hydraulic power supply.
- It is mounted on recirculating ball horizontal linear guides of the upper carriage for high precision parallelism factor between upper and lower plates.

**No need of
pneumatic
connection or
hydraulic
power supply**



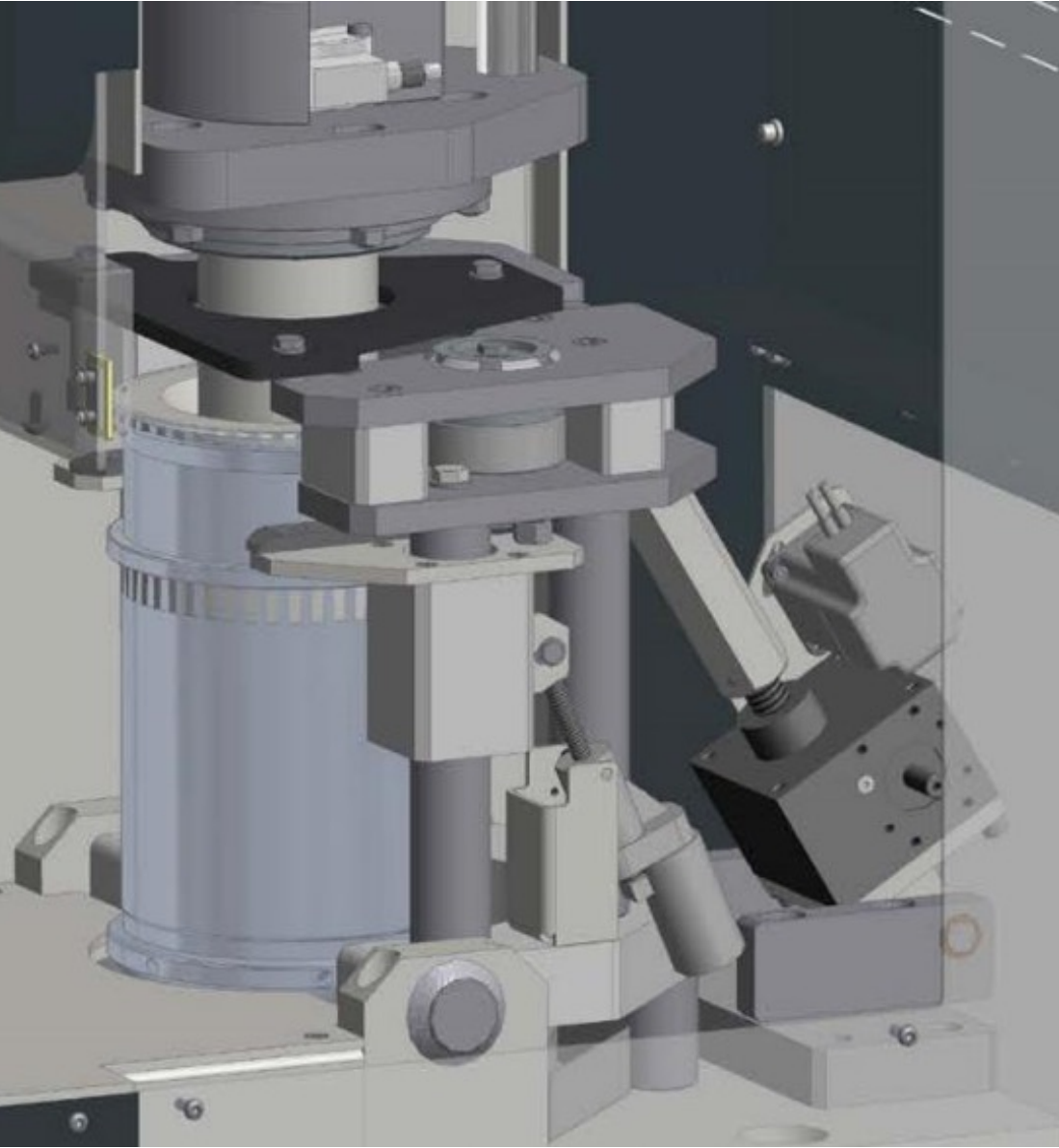
EmS

**Electromechanical
Servoactuation
technology**

New Mould Lifting System

- Safe and easy mould insertion and extraction with automatic lifting.
- The system ensures low effort for operator safety and higher productivity.





New Shear Measuring System

- For Research purposes – continuous, direct and integrated Shear measurement system with high precision torquemeter eliminating the influence of clearance and frictions, to obtain the net value of shear force.
- This measure doesn't affect in any way the precision and the repeatability of angle setting.

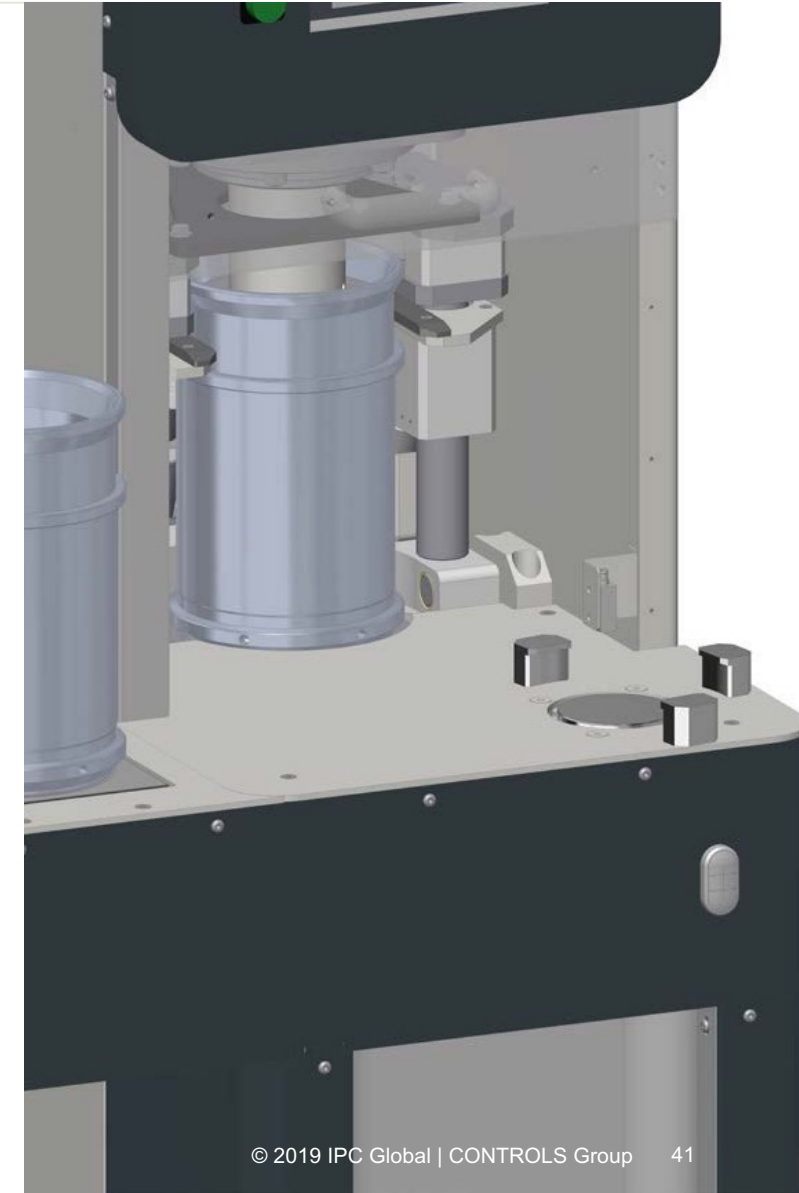
New Angle Setting System

- Closed loop automatic angle adjustment during the test using position transducer and stepper motor.
- The system recovers the minimum clearances and minor strains independently from vertical load, with possibility to apply zero angle at the end of the test.



New Integrated Balance

- Integrated balance in the Gyrotory Compactor stand, allows weighing of the sample within the machine.
- The system automatically calculates the mix density without the need of manual weight input.



Slab Compactors

Slab Compactor

- Simulating the compaction given by full-size roller
- Able to compact slabs with maximum size 500x400mm and maximum thickness 120mm
- Fully automatic compaction procedure
- Optional heated roller, heated base and vibrating unit



Slab Compactor

- Two models available:
 - Standard model, controlled by a 8" colour touchscreen controller, for compaction procedure following ASTM D8079 and EN 12697-33
 - Advanced model, controlled by a 21" all-in-one touchscreen PC, allowing user-defined compaction procedure
- Compacted slabs can be used for Wheel Tracking tests or cut to beams for 4-Point Bend fatigue tests.



Shearbox Compactor

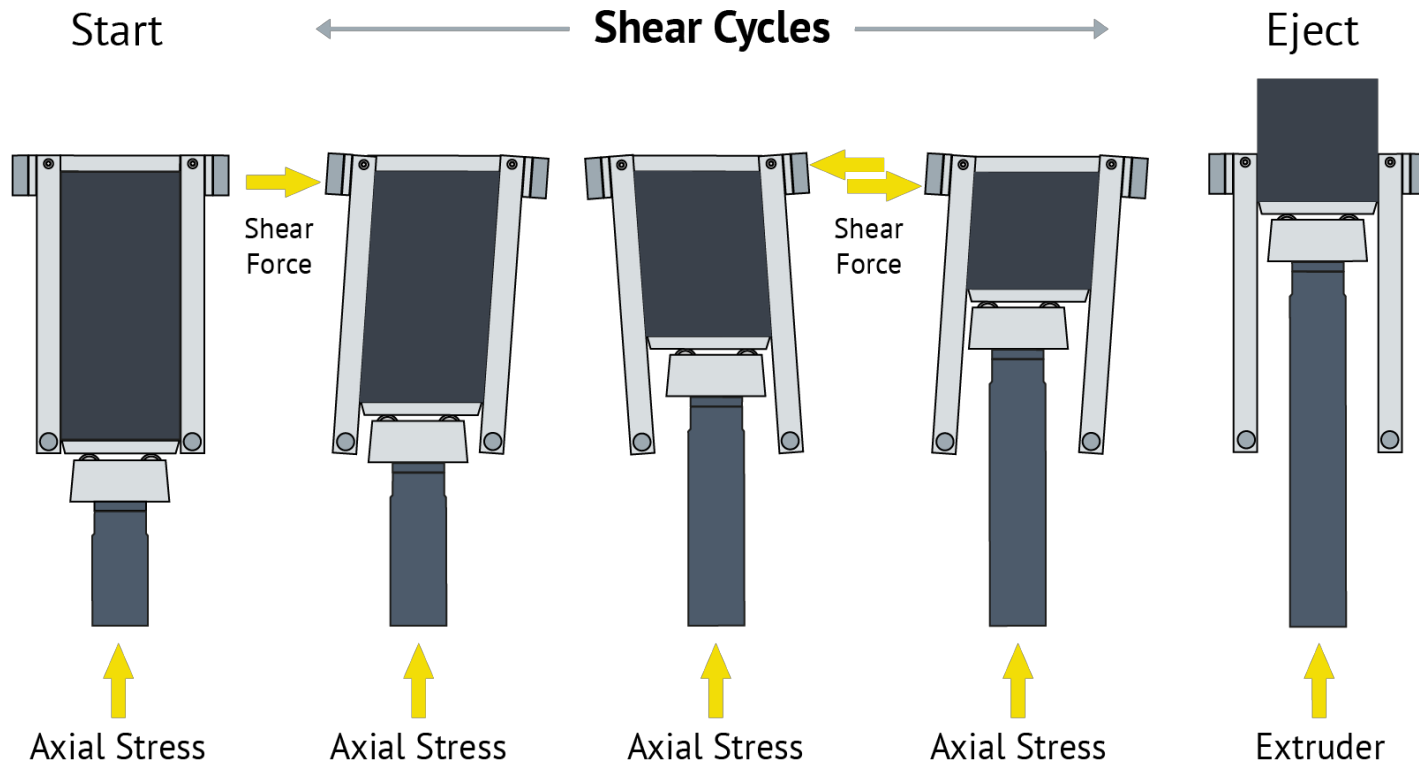
Shearbox Compactor

PReSBOX

- The PReSBOX compactor is a collaborative development between IPC Global and Pioneer Road Services
- The unique shearing action closely replicates the conditions under which asphalt is placed in the field and allows to compact homogeneous and accurate asphalt prisms.
- Suitable for preparing multiple cylinders or beams
- Meets ASTM D7981



PReSBOX Working Principle



PreSBOX Benefits

- Allows **rapid and repeatable production of asphalt prisms** in the laboratory, with minimal operator involvement.
- **Produces prisms with uniform air void distribution**, uniform particle distribution and particle orientation closely resembling field compaction.
- PC interface for user entry of compaction parameters and graphic display of data. e.g.:
 - Test termination conditions of height, density, air-voids or cycles
 - specimen height, vertical stress, shear stress and air voids per.
- Provides an **accurate measure of the workability of a material** (relative compaction effort) needed in the field to achieve a target void content – a critical performance-related mix characteristic.
- Asphalt prisms prepared in the PreSBOX compactor may then **be cored or sawn to produce multiple cylindrical or prismatic specimens with excellent repeatability**.
- Meets **ASTM D7981–15 Compaction of Prismatic Asphalt Specimens** by Means of the Shear Box Compactor.

PreSBOX Samples

Four standard fatigue beams or four cores from one prism





Specifications

- Shearing Motion Electrically driven, fixed at 4 degrees
- Load Capacity Pneumatic, user defined up to 2MPa
- Specimen Size 450mm x 150mm
- Specimen height – user definable between 120mm and 185mm
- PC interface for user entry of compaction parameters and graphic display of data
 - specimen height, vertical stress, shear stress and air voids per cycle
- Supplied with asphalt distribution chute and levelling accessories
- Note that the PReSBOX compactor requires a clean, dry air supply at 800-900kPa
- Integrated specimen extruder

PReSBOX Heater (optional)

Prominent researchers claim a heated mould can reduce perimeter stresses and so greatly improve the uniformity of stress distributions within the asphalt sample during Shearbox compaction and therefore provide a better representation of the site-compaction conditions of hot mix asphalt.

- Designed to efficiently and uniformly heat PReSBOX asphalt moulds to closely match the temperature of the HMA 120°C.
- The integrated electrical heater & circulation fan provide high temperatures and continuous air flow to ensure the mould is uniformly heated.
- It can be easily placed on top of the asphalt mould with the guides centering the heater in the correct position.
- For operator safety a warning light clearly illuminates when the heater is hot.



Sample Cutting

Cutting Machine

Autosaw II

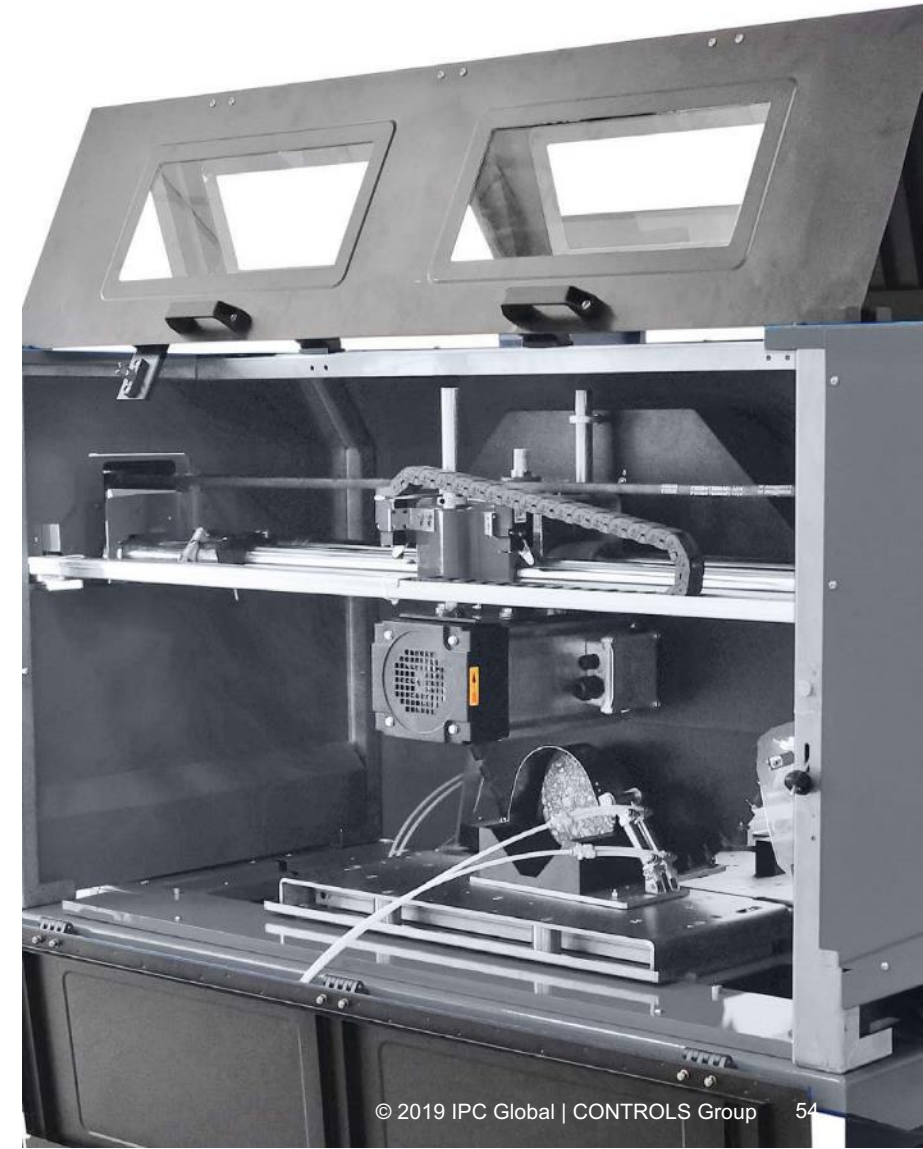
- Autosaw II is our second generation fully automated asphalt sawing system with integrated clamping system.
- Autosaw II allows for fast and easy cutting of rectangular beams, trapezoidal prisms, overlay test specimens, semi-circular specimens, and trimming of cylindrical specimens.
- Autosaw II is the only cutting machine on the market available with a full-protection cabinet



Autosaw II

Advantages over Traditional Manual Asphalt Saws

- Micro-processor controlled with fully automated start/stop cut sequences allowing for perfect specimen cuts.
- Autosaw II jigs are fitted with pneumatic clamps which hold the specimen firmly in place as opposed to manual clamping systems used in traditional asphalt saws.
- The core docking jig for docking ends of cylindrical specimens features unique clamping mechanism. The jig cuts once face, then translates by a prescribed distance (150mm for AMPT specimens) and cuts the other end, ensuring perfectly parallel alignment.
- Adjustable cutting speed allows for optimal specimen finish and throughput.



Autosaw II

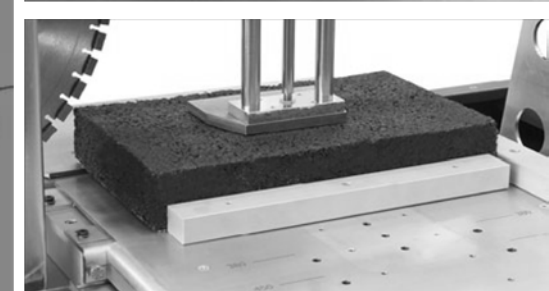
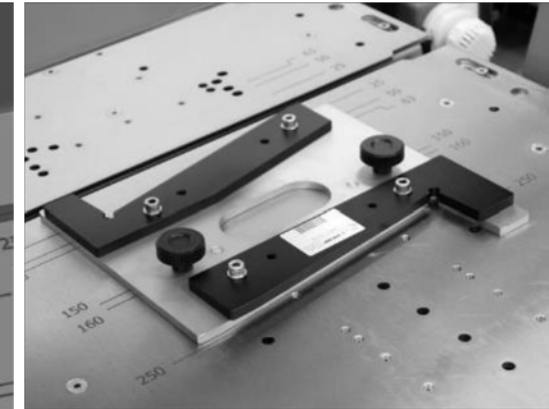
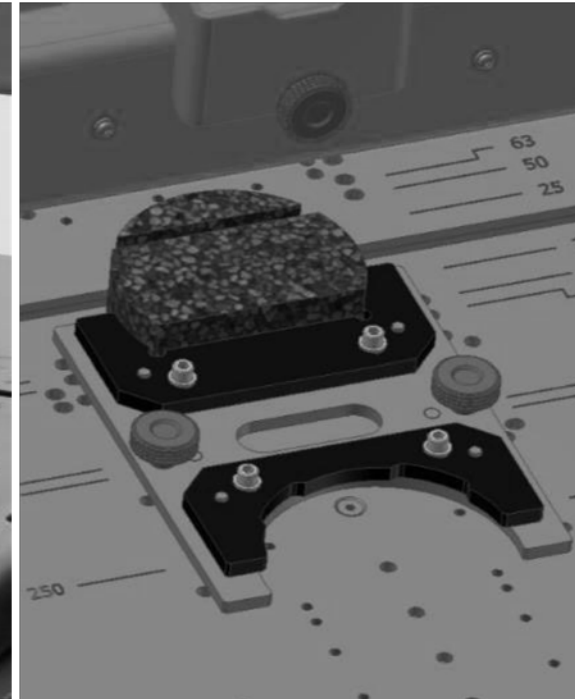
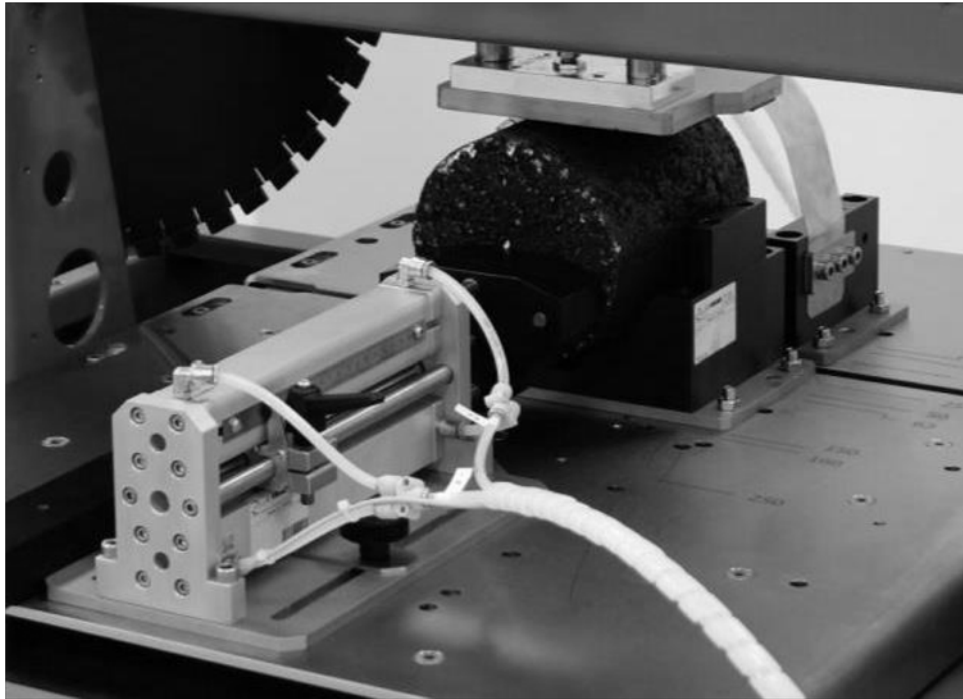
Benefits & Advantages

- **Automated and Safe**
 - Protection cabinet with interlock system ensures safety without operator intervention or the need for constant monitoring and protection from spray during cuts
 - Easy to use touch screen CPU control for quick setup, saving valuable laboratory time and resources
- **Superior Design**
 - Quick and easy specimen set-up
 - Clean operation and water containment for use within laboratory environments
 - Ergonomic design with ideal height and horizontal reach for safe material handling and optimal operator well-being
- **Value for Money**
 - Robust design provides accurate results while the stainless steel water tray ensures long life
 - Perfect specimens every time through the use of fixed position guides, reference blocks and pneumatic clamping system
 - Only requires air, water and power to operate

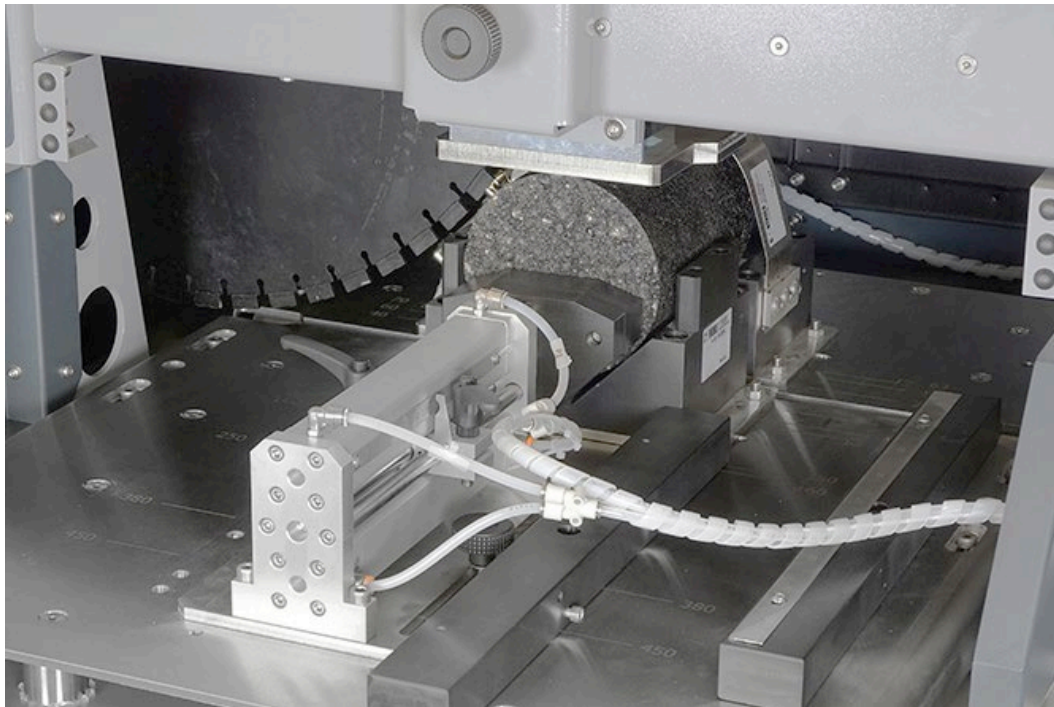
Autosaw II Accessories

Endless Possibilities

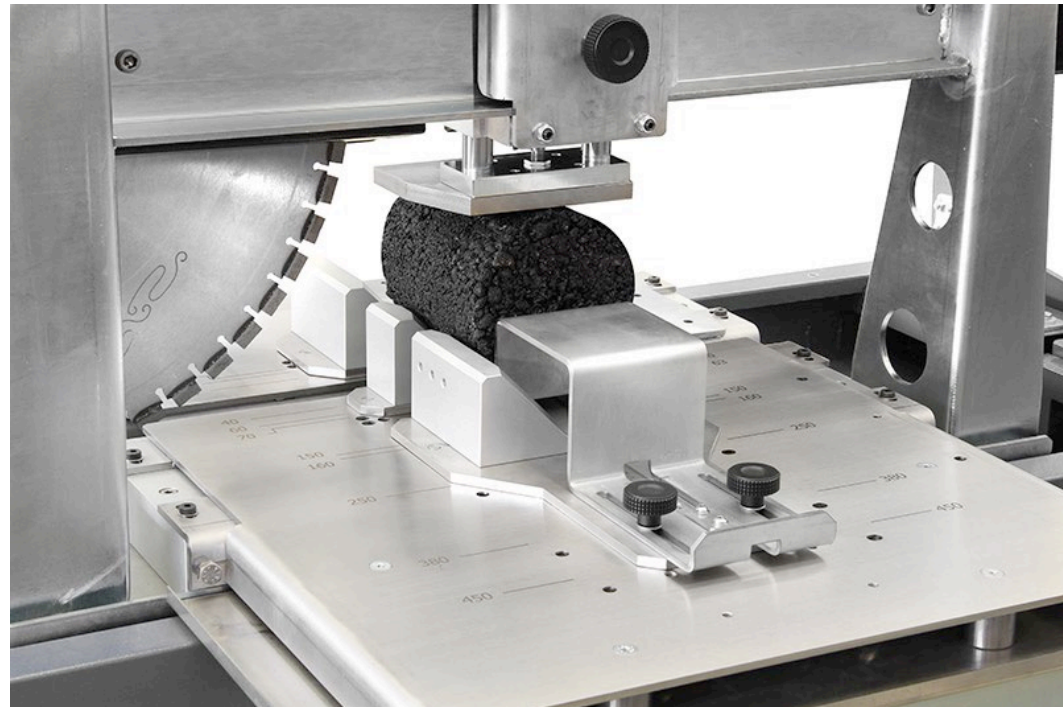
Easy to use reference blocks, jigs, and pneumatic clamping systems allow the system to be easily upgraded to suit the cutting requirements for any future testing standards.



Autosaw II Accessories



Core Docking Jig – Automatic

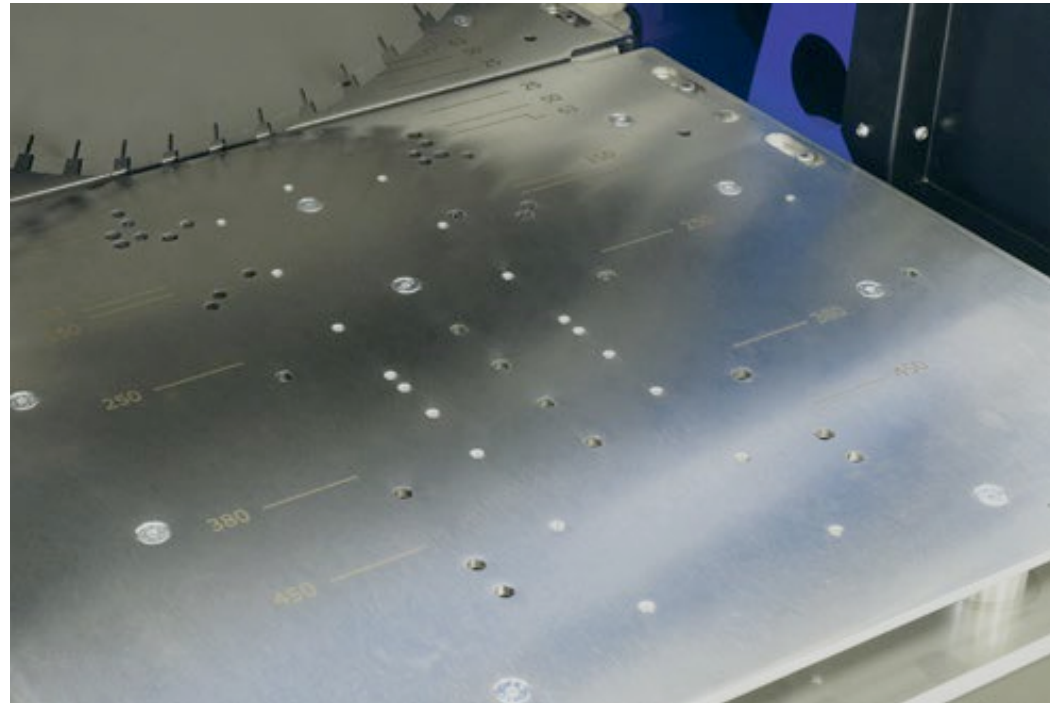


Core Docking Jig – Manual

Autosaw II Accessories

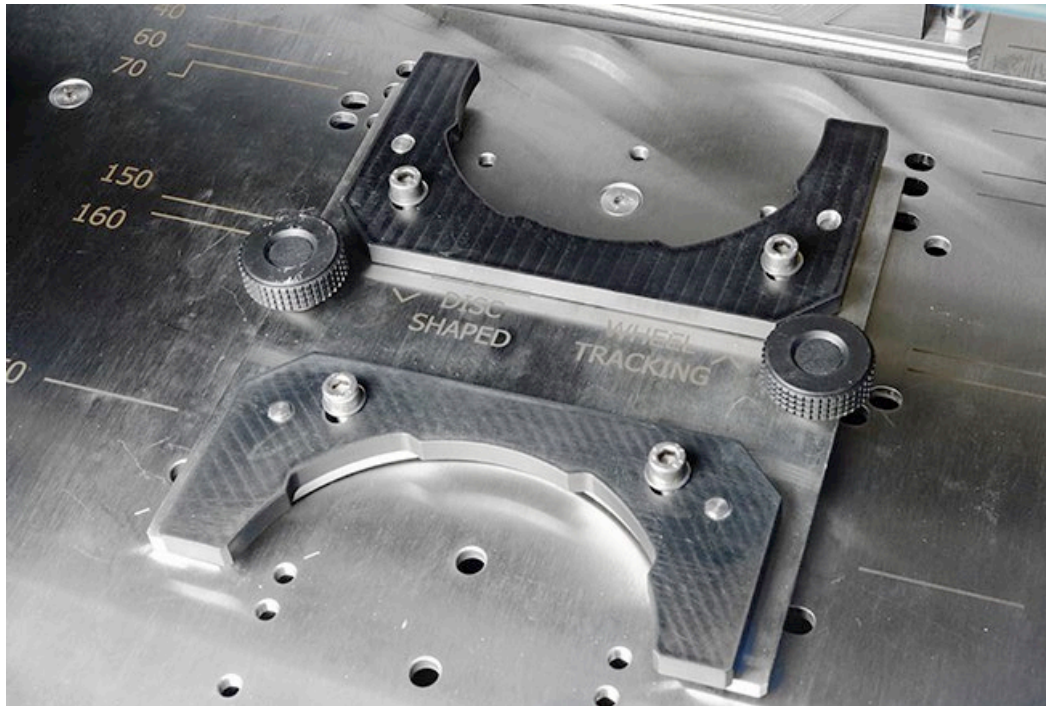


Prismatic sample clamp and reference blocks (standard)

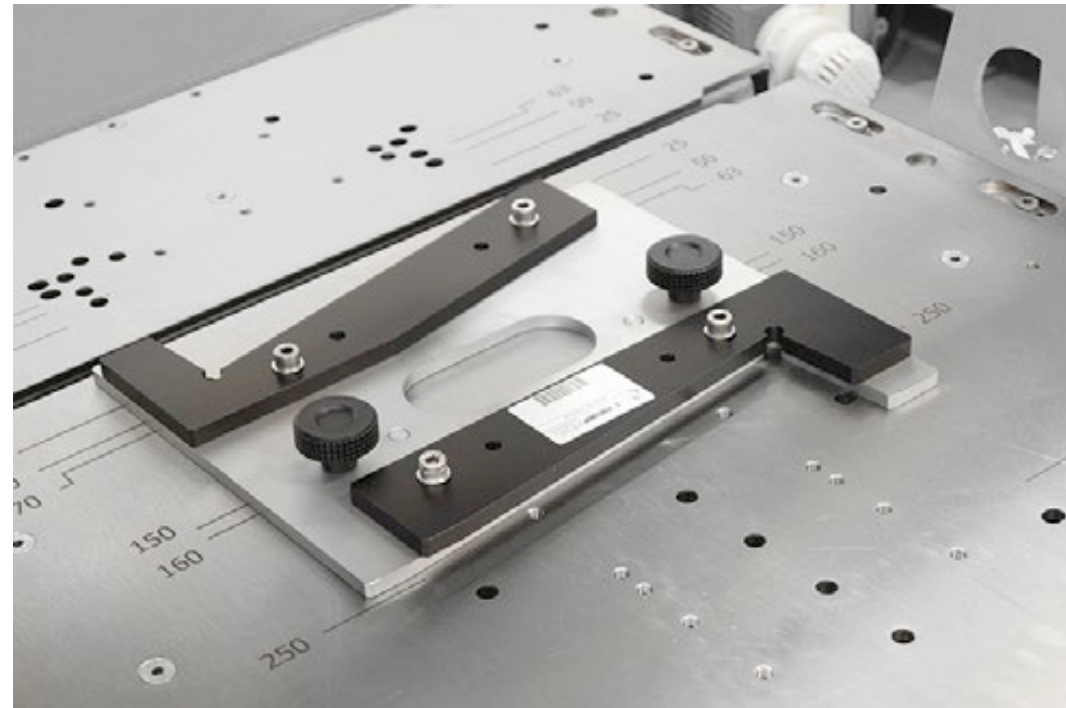


Integrated ruler and fixed position guides

Autosaw II Accessories



Overlay Test Specimen Jig



Trapezoidal specimen jig

Cutting Machine

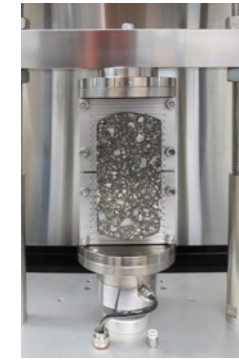
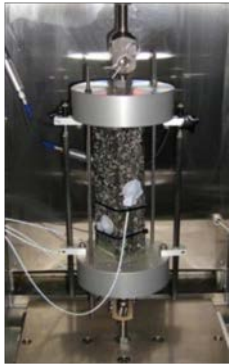
Multisaw

- Multisaw is a universal sawing system for fast, accurate cutting of beams from prisms and for trimming cylinders.
- The saw blade advances and retracts to the home position by a user-friendly hand wheel.
- Multisaw allows for manually-operated cutting of rectangular beams, trapezoidal prisms, overlay test specimens, semi-circular specimens, and trimming of cylindrical specimens.





Specimen Preparation with Autosaw II & Multisaw



Sample Coring

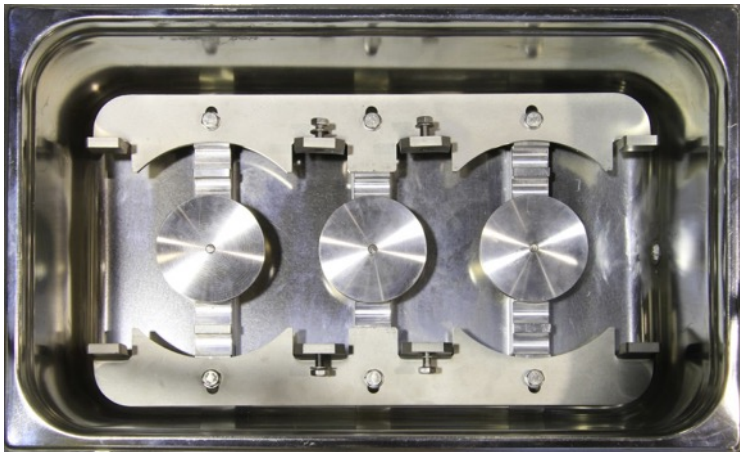
Advanced Asphalt Core Drill

Multi-Core Drill

- IPC Global | Controls Group's Multi Core-Drill has been designed and engineered for coring of asphalt specimens produced by IPC Global's PReSBOX , Servopac, Galileo, Gyrocomp and Multisize Slab-compactor as well as other slab and gyratory compactors.
- IPC Global | Controls Group's Multi Core-Drill allows users to prepare high quality specimens which is critical for obtaining accurate test results.



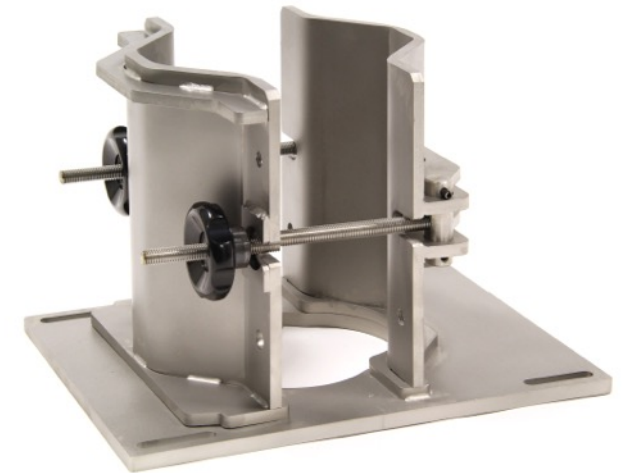
Multi-Core Drill Accessories



Specimens Tray

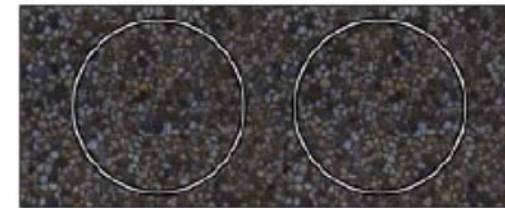


Transverse Coring Clamp



Clamp for cylindrical specimens

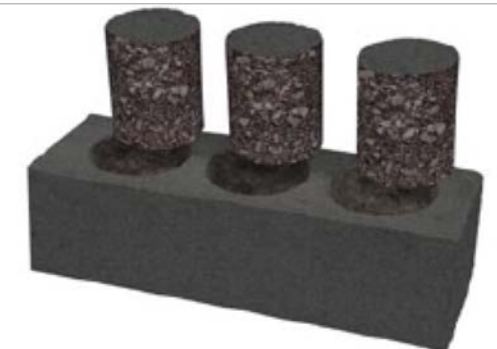
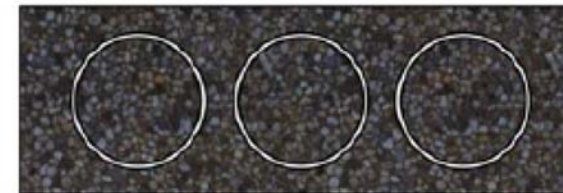
Specimen Sizes



Two 150mm specimens from slab compactor

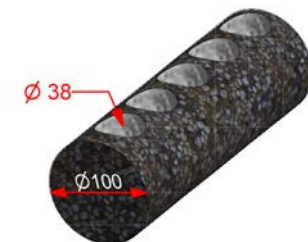
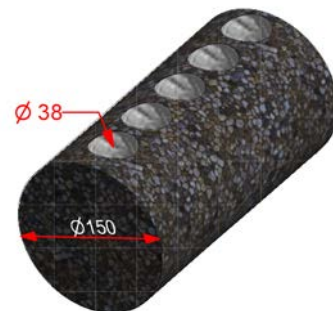
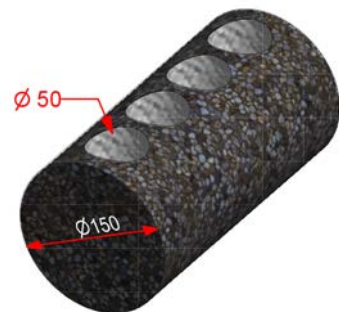
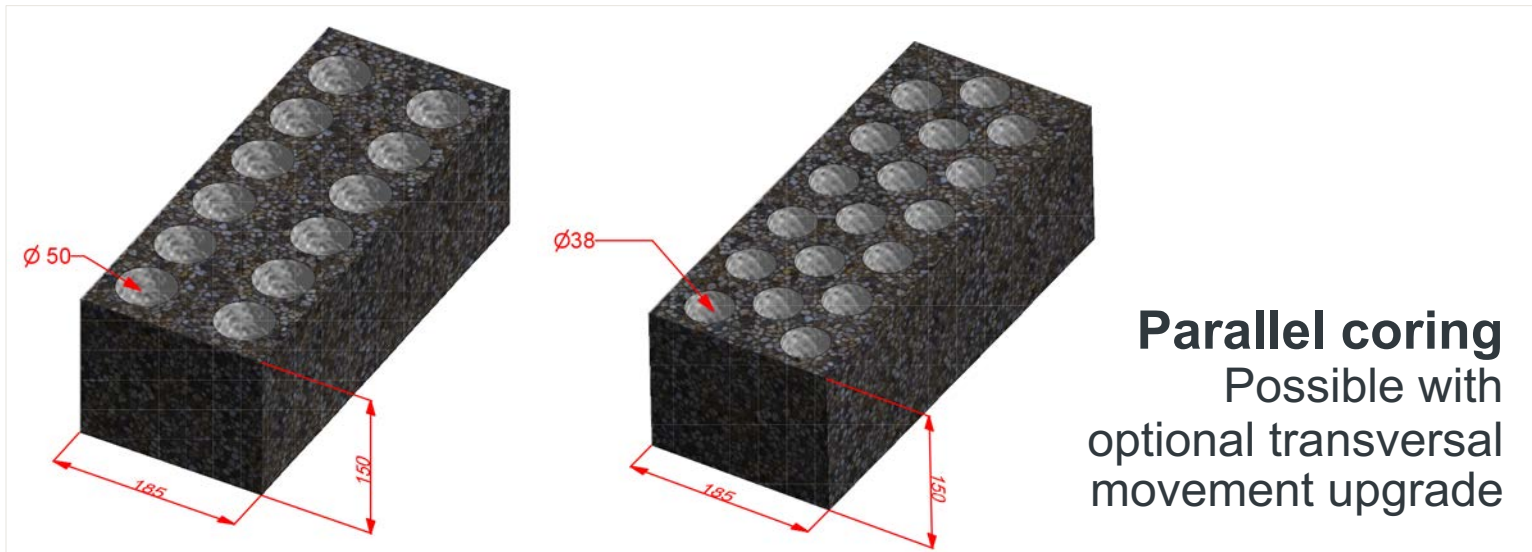
Specimen Diameter:
38mm, 50mm, 75mm, 100mm & 150mm

Specimen Height:
Cylindrical: 70 to 420mm
Prismatic: 120 to 420mm



Three 100mm specimens from slab compactor

Various samples and specimen diameters



Advanced Asphalt Core Drill

KOR-BIT

- IPC Global | Controls Group's KOR-BIT has been designed and engineered for coring of cylindrical asphalt specimens produced by IPC Global's Servopac, Galileo and Gyrocomp as well as other gyratory compactors.
- IPC Global | Controls Group's Multi Core-Drill allows users to prepare high quality specimens which is critical for obtaining accurate test results.

Specimen sizes

Specimen Diameter: 100mm or 150mm

Specimen Height: Cylindrical: 70 to 420mm

Cylindrical specimen from
Gyratory Compactor



Performance Based Tests on Asphalt Mix

Dynamic Testing Machines

Universal Testing Machines (UTM)



Compact Modular Asphalt Testers



Asphalt Mixture Performance Testers



Universal Testing Machines (UTM)

Universal Testing Machines (UTM)

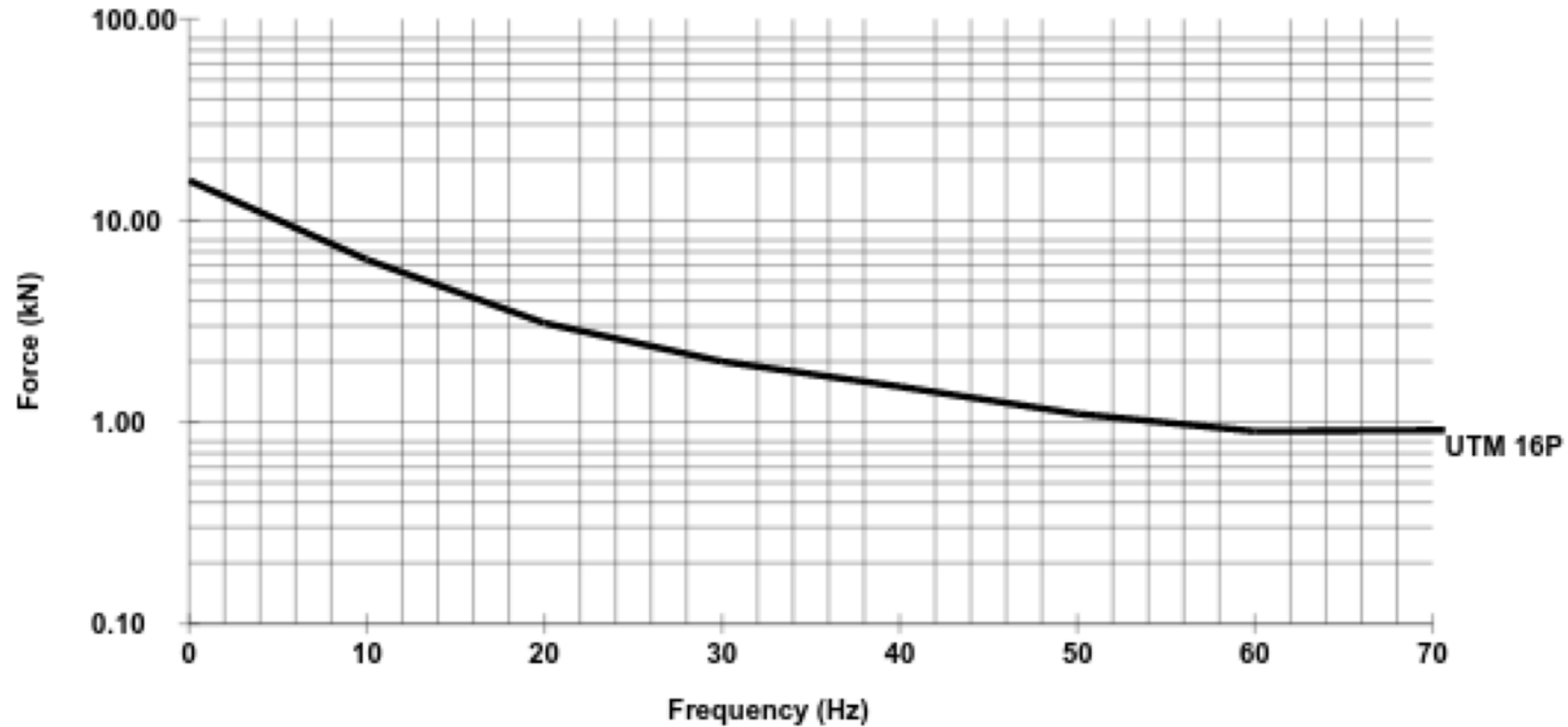
- **Researcher's choice**
 - The most powerful Testing System
- **Flexible**
 - Suitable for both asphalt and unbound material testing
 - Different models with different testing capacity, both pneumatically and hydraulically operated
 - Possibility to upgrade the UTM with different test jigs
- **Complete**
 - The widest range of applications and testing standards
 - Possibility to be completed by environmental cabinet from -50° to +100°C
- **One machine to perform all dynamic materials tests**

UTM-16P

- 16 kN servo-pneumatic actuator with built in (30 mm stroke) displacement transducer.
- 16 liter pneumatic reservoir, complete with pressure regulator and mist separator.
- +/- 20 kN load cell, with in-line signal conditioner.
- High frequency (up to 70Hz)*
- Lower cost
- Optional motorized crosshead available
- Ideally suited to asphalt and unbound granular materials testing

* Force limitations apply at high frequencies





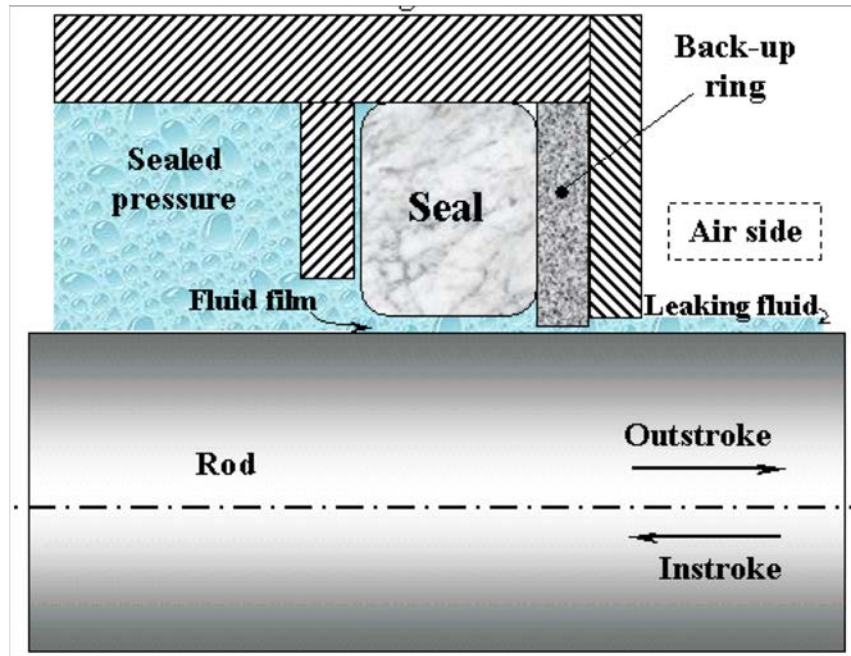
Force-Frequency Response of UTM-16P

UTM-30

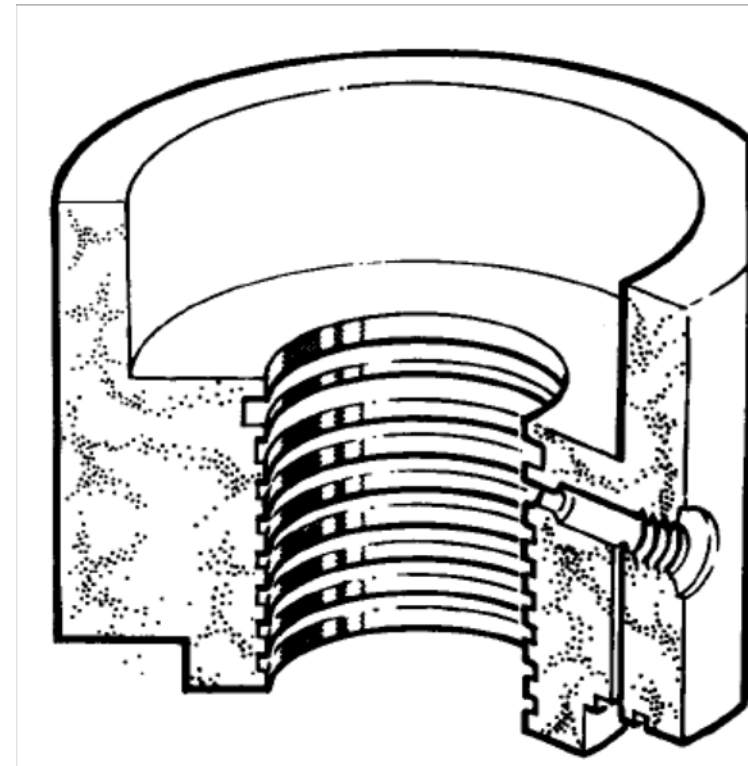
- Fixed upper crosshead.
- Motorized lower crosshead positioning.
- +/- 30 kN load cell, with in-line signal conditioning.
- Top loading actuator; 50 mm stroke with inbuilt displacement transducer.
2 Models will be available:
 - Advanced Labyrinth Actuator
 - Standard Tie-Rod Actuator
- 30 kN static, 30 kN dynamic (dynamic performance is amplitude and frequency dependent), high performance labyrinth bearing, double acting servo hydraulic, equal area type.
- 10 µm pressure line filter at actuator for ultimate contamination control.



Comparison between Labyrinth Bearing and Standard Actuators



Standard Actuator



Labyrinth Bearing Actuator

UTM-130

- Fully adjustable cross-head.
- Hydraulic lift cylinders for crosshead positioning (not fixed).
- Low profile precision load cell, +/-100 kN. Normalised output with in-line signal conditioning
- 130 kN static, 100 kN dynamic, double acting servo-hydraulic, equal area type with low friction.
- +/- 50 mm stroke
- Internal LVDT
- Dynamic response: 2 mm cyclic @ 10 Hz, 1 mm cyclic @ 20 Hz
- 10 µm pressure line filter at actuator for ultimate contamination control.
- XL version with increased width and special chamber available



Hydraulic Power Supply

- Supplied with pre-filtered oil
- High level filtration
- Remote starting and control via virtual pendant,
- Warning indicators for low oil, over temperature and dirty filter
- Water cooled or possible Air cooled options



Environmental Chambers

- Available in sizes to suit all IPC Global dynamic testing machines
- Standard temperature range -25°C to +70°C
- Extended temperature range from -50°C to +80°C / +100°C



Pneumatic Four Point Bending Apparatus

- AASHTO T321(ex-TP8): Fatigue life of compacted hot-mix asphalt (HMA) subjected to repeated flexural bending
- ASTM D7460: Determining Fatigue Failure of Compacted Asphalt Concrete Subjected to Repeated Flexural Bending
- EN 12697-24: Resistance to fatigue
- EN 12697-26: Stiffness



SCB Tester

- Complete stand-alone test system
- Motorised ram for precise and accurate test results
- 50kN Force capacity and load cell
- Testing Speed – 0.5 to 51 mm/min
- AASHTO TP124 (Illinois SCB) — Fracture Potential - Flexibility Index Test (FIT)
- ASTM D8044 (LSU SCB) — SCB Cracking Resistance Test



Compact Modular Asphalt Testers

Compact Modular Asphalt Testers

- **Simple** – The best option for standard testing on asphalt mixes
- **Modular** – it can be easily re-configured with a wide range of test kits to conduct tests on asphalt samples to numerous test standards
- **Fully integrated** reaction frame and triaxial confining cell option
- **Compact** Small footprint
- **All in one machine** – fully integrated servo-hydraulic dynamic testing machine with hydraulic power supply, refrigeration and triaxial cell that doubles as environmental chamber
- **One machine** to perform the most important tests on asphalt mixes

AsphaltQube – Electromechanical QC Asphalt Tester

Advanced Thermoelectric Refrigeration

Two systems available:

- Advanced - Water-cooled with integrated water-chiller delivering excellent temperature control from -10°C to +60°C;
- Standard - fan-cooled for temperatures between +2°C and +60°C.

Stainless steel construction

Easy and Versatile

- Interchangeable transducers and load cells with “plug & play” signal conditioners
- 8 BNC Raw signal outputs

EmS Technology

- New revolutionary Electromechanical Servoactuation +/-15kN
- very low noise & no oil required



Clarity in Results

Integrated Multi-Axis Control System (IMACS) and UTS software

Integrated Compressor (optional)

AsphaltQube

- **Simple** – The best option for standard testing on asphalt mixes
- **Modular** – it can be easily re-configured with a wide range of test kits to conduct tests on asphalt samples to numerous test standards
- **Fully integrated** reaction frame and triaxial confining cell option
- **Compact** – Small footprint
- **All in one machine** – fully integrated Electromechanical Servoactuation (EmS) +/-15kN dynamic testing machine with Thermoelectric environmental chamber
- One machine to perform the most important tests on asphalt mixes



AsphaltQube



- Improved dynamic performance compared to servo-pneumatic testing systems
- Perform high frequency fatigue to slow speed static testing with ease



AsphaltQube – Specifications

- Load Capacity 15kN dynamic, 10kN static
- Actuator Stroke 30mm (+/-15mm)
- Actuator Type EmS
- Triaxial Cell Confining Pressure 210kPa
- Analogue Outputs: 8 BNC connectors provide raw analogue outputs from the signal conditioners to permit the use of external data logging equipment
- Environmental Chamber Temperature Range 4 to 60°C
- Temperature Stability +/- 0.5°C



Ground Breaking Electromechanical Servoactuation (EmS)

- EmS improved dynamic performance compared to servo-pneumatic actuator
- No Hydraulic Power Supply:
 - Quick and simple installation without the complexity of a HPS
 - Clean and with no associated noise
 - No hydraulic oil or refrigerants
- Single phase electrical connection makes powering hassle free
- EmS greatly reduce maintenance costs.

Test Standards

- AASHTO T378 (TP79); AASHTO TP107 (S-VECD); AASHTO TP124; AASHTO T342 (TP62); AASHTO T321; AASHTO TP322 (TP9); AASHTO TP31
- AS2891.12; AS2891.13.1; AST 03:2000
- ASTM D4123; ASTM D7369 (NCHRP 1-28A); ASTM D7460; ASTM D8044; ASTM WK 26816 Reflective Cracking
- BS598-111; EN12697-24A; EN12697-24D; EN12697-24E; EN12697-25A; EN12697-25B; EN12697-26A; EN12697-26B; EN12697-26C; EN12697-26D; EN12697-26E; EN12697-44; EN13108-20;
- SCDUF; Tex-248-F

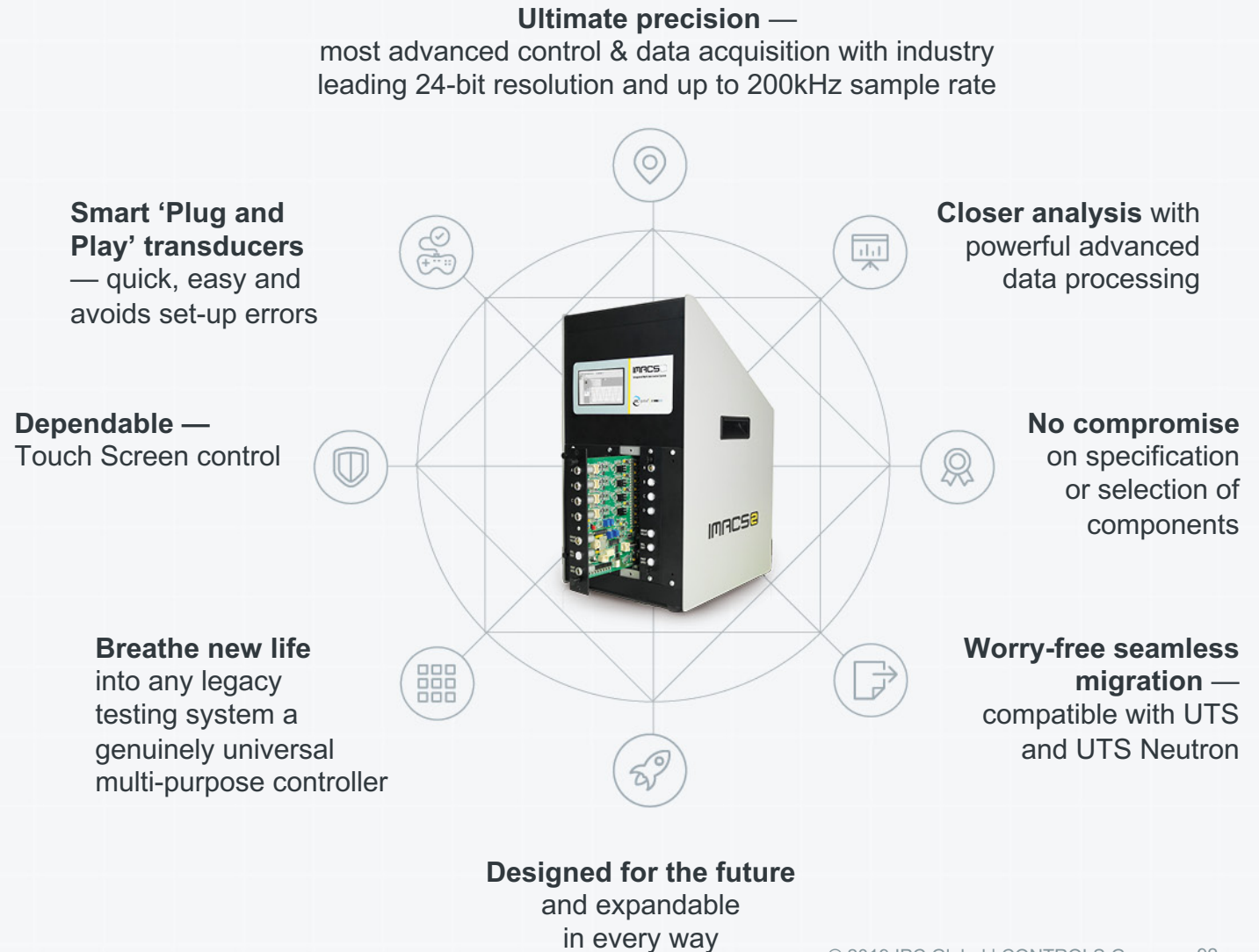
IMACS2 controller and UTS Neutron software

IMACSE²

The Ultimate Third Generation
Integrated Multi-Axis Control System
(IMACS)



The most advanced controller and data acquisition system in our industry



UTS **NEUTRON**

Dynamic Materials Testing & Analysis Software

More powerful than ever





ONE SOFTWARE
with customizable
interfaces for all
testing needs



THREE LICENCE LEVELS
to meet all user types:
Standards testing, Test editor
& Programmer



CONFIGURABLE ACCESS-RIGHTS
for any user type e.g. QC
operator, Laboratory manager,
Senior Engineer



Multiple and custom languages

UTS Neutron is set-up in multiple languages (including custom language configuration configurable test pages and robust reporting).

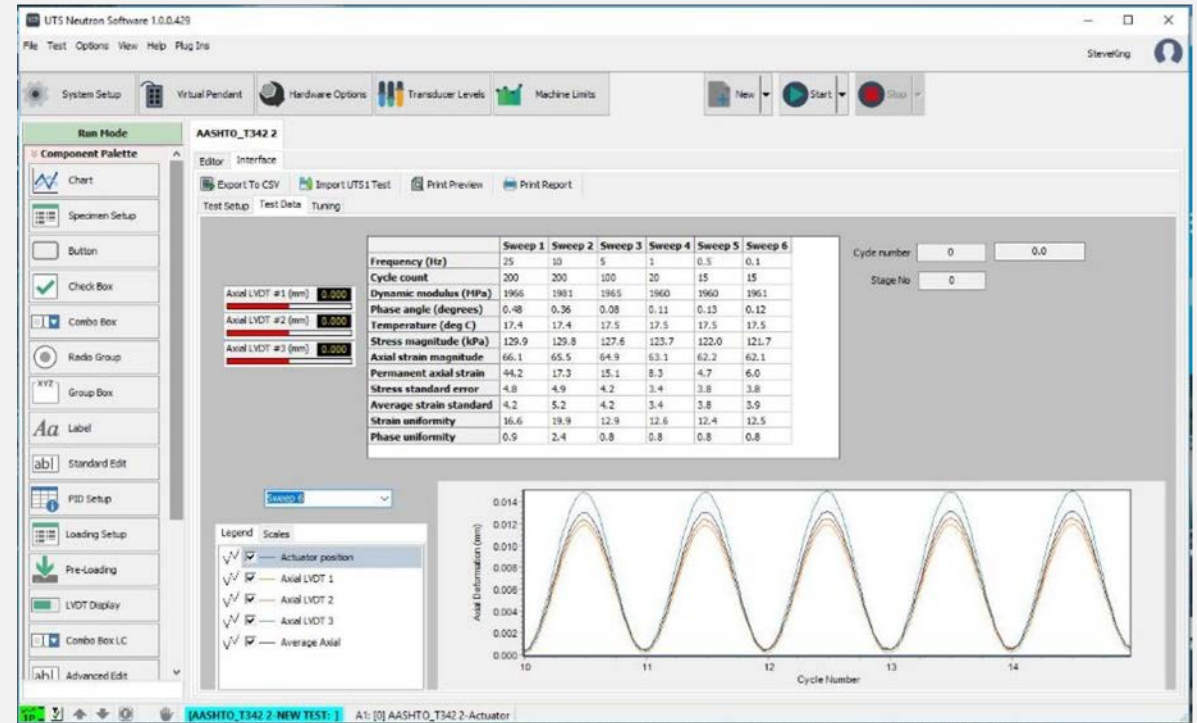


UTS NEUTRON ESSENTIAL Easy Testing to EN/ASTM/AASHTO



Easy Testing to EN/ASTM/AASHTO

- Familiar layout UTS based but enhanced and more intuitive.
- Library of pre-programmed test modules complying with the main international Standards e.g. EN/ASTM/AASHTO.
- Basic suite included with all IMACS2-based IPC Global dynamic testing machines.
- Simple interface for routine QC users who want to run a test with a few mouse clicks.
- Multiple-languages — supplied with English, Chinese, Polish and Spanish languages plus customized language configurator tool.
- Painless migration from IMACS to IMACS2. Users can import existing UTS data to generate new reports.
- Robust reporting and easy custom test creation.

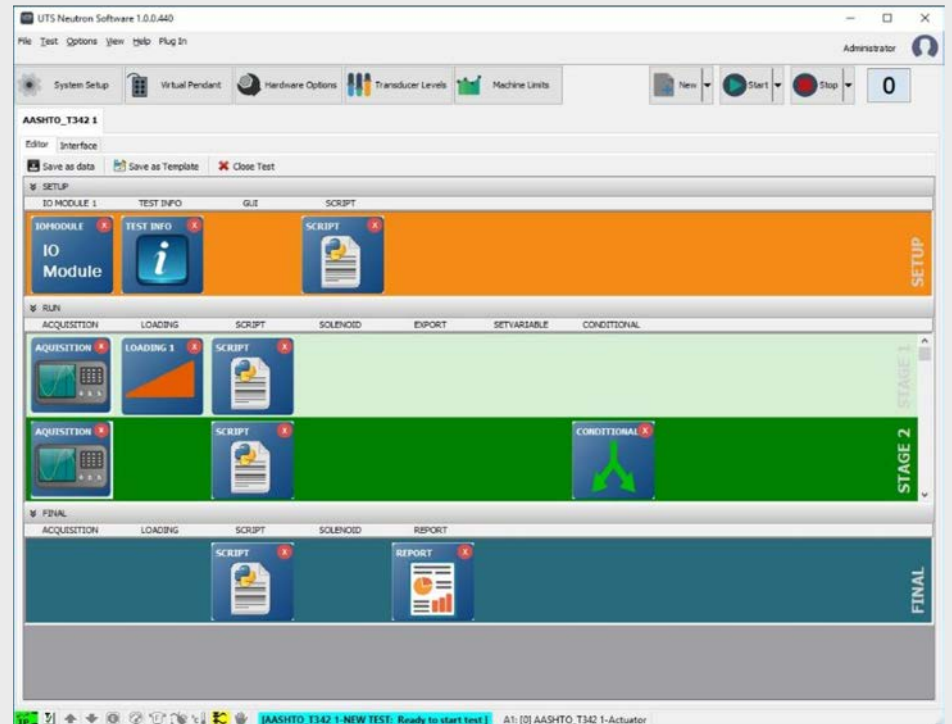


UTS NEUTRON PERFORMANCE Includes Graphical Test Editor



UTS NEUTRON ESSENTIAL plus

- Graphic step-by-step test editor.
- Edit and save user defined test sequences and procedures.
- Wizard feature — follow the step-by-step path to accomplish your tests edit goals. What could be simpler?
- Comprehensive graphic programming functions with in-built easy to use drag & drop icons.
- Possibility to edit & save user-defined test sequences and procedures.
- Robust reporting and easy custom test creation.



UTS NEUTRON DEVELOPER Advanced Test Creator

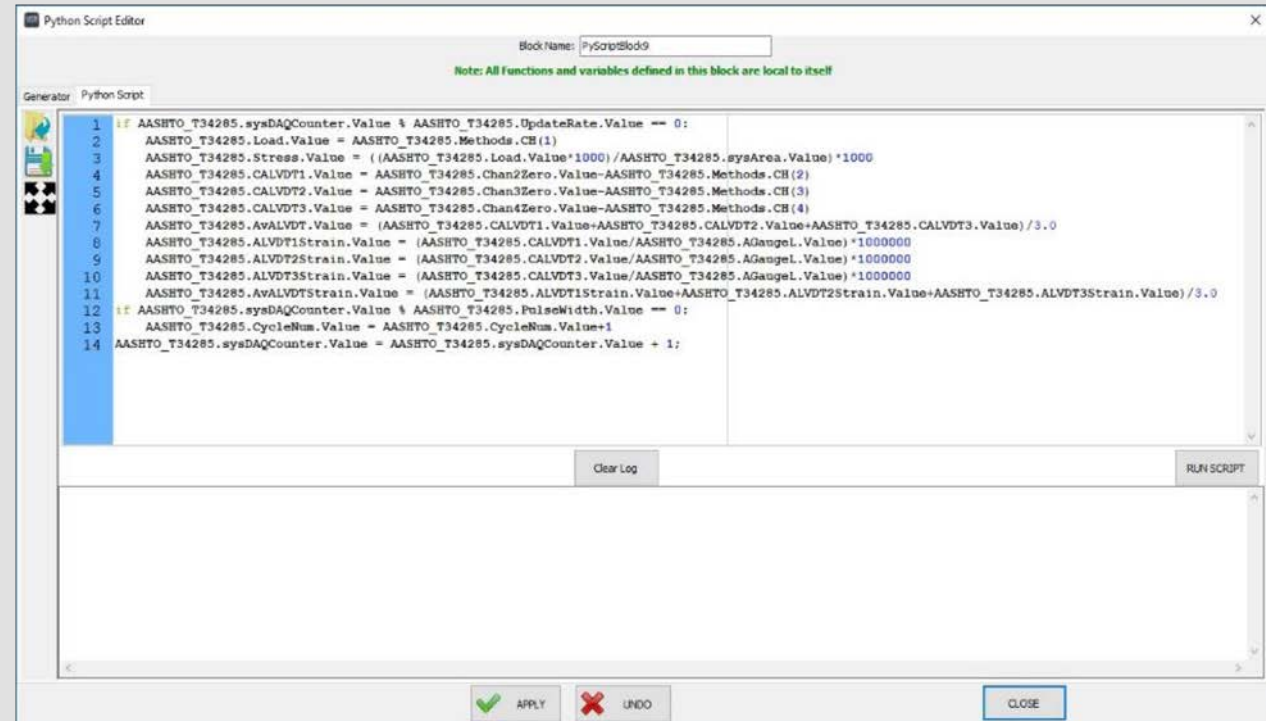


FOR PROGRAMMERS ONLY

UTS NEUTRON ESSENTIAL and PERFORMANCE *plus*

The power for advanced users looking for a totally open system with the facility to create tests from scratch or open, modify and save new tests from existing templates.

- Edit and save user defined test sequences and procedures.
- Wizard feature — follow the step-by-step path to accomplish your tests edit goals. What could be simpler?
- Comprehensive graphic programming functions with in-built easy to use drag & drop icons.
- Possibility to edit & save user-defined test sequences and procedures.
- Robust reporting and easy custom test creation.



Python Script Editor

Block Name: PyScriptBlock9

Note: All functions and variables defined in this block are local to itself

```

1  IF AASHTO_T34285.sysDAQCounter.Value % AASHTO_T34285.UpdateRate.Value == 0:
2  AASHTO_T34285.Load.Value = AASHTO_T34285.Methods.CH(1)
3  AASHTO_T34285.Stress.Value = ((AASHTO_T34285.Load.Value*1000)/AASHTO_T34285.sysArea.Value)*1000
4  AASHTO_T34285.CALVD1.Value = AASHTO_T34285.Chan2Zero.Value-AASHTO_T34285.Methods.CH(2)
5  AASHTO_T34285.CALVD2.Value = AASHTO_T34285.Chan3Zero.Value-AASHTO_T34285.Methods.CH(3)
6  AASHTO_T34285.CALVD3.Value = AASHTO_T34285.Chan4Zero.Value-AASHTO_T34285.Methods.CH(4)
7  AASHTO_T34285.AVALVD1.Value = (AASHTO_T34285.CALVD1.Value+AASHTO_T34285.CALVD2.Value+AASHTO_T34285.CALVD3.Value)/3.0
8  AASHTO_T34285.ALVD11strain.Value = (AASHTO_T34285.CALVD1.Value/AASHTO_T34285.AGaugel.Value)*1000000
9  AASHTO_T34285.ALVD22strain.Value = (AASHTO_T34285.CALVD2.Value/AASHTO_T34285.AGaugel.Value)*1000000
10 AASHTO_T34285.ALVD33strain.Value = (AASHTO_T34285.CALVD3.Value/AASHTO_T34285.AGaugel.Value)*1000000
11 AASHTO_T34285.AVALVD1strain.Value = (AASHTO_T34285.ALVD11strain.Value+AASHTO_T34285.ALVD22strain.Value+AASHTO_T34285.ALVD33strain.Value)/3.0
12 IF AASHTO_T34285.sysDAQCounter.Value % AASHTO_T34285.PulseWidth.Value == 0:
13 AASHTO_T34285.CycleNum.Value = AASHTO_T34285.CycleNum.Value+1
14 AASHTO_T34285.sysDAQCounter.Value = AASHTO_T34285.sysDAQCounter.Value + 1;
    
```

Clear Log

RUN SCRIPT

APPLY UNDO CLOSE

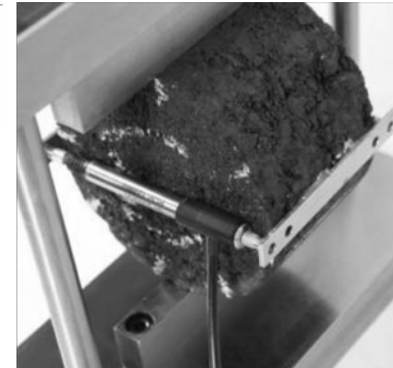
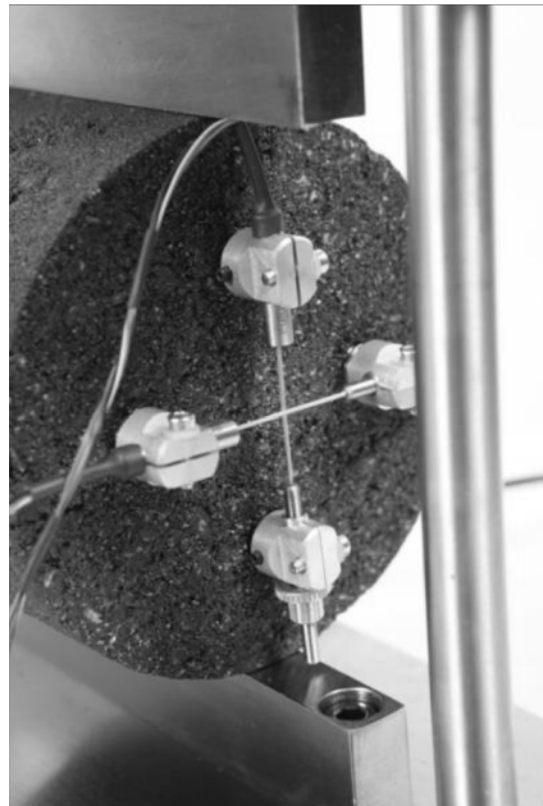
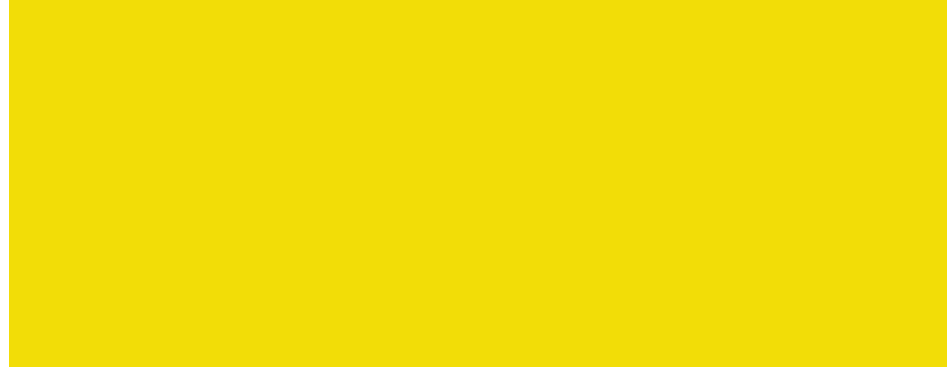
Test Accessories

UTM and Modular Asphalt Tester Accessories



Transducers

- A wide range of transducers for Force, Displacement, Temperature and Pressure
- In-line signal conditioning for versatility and convenience
- Any transducer can be allocated to any channel



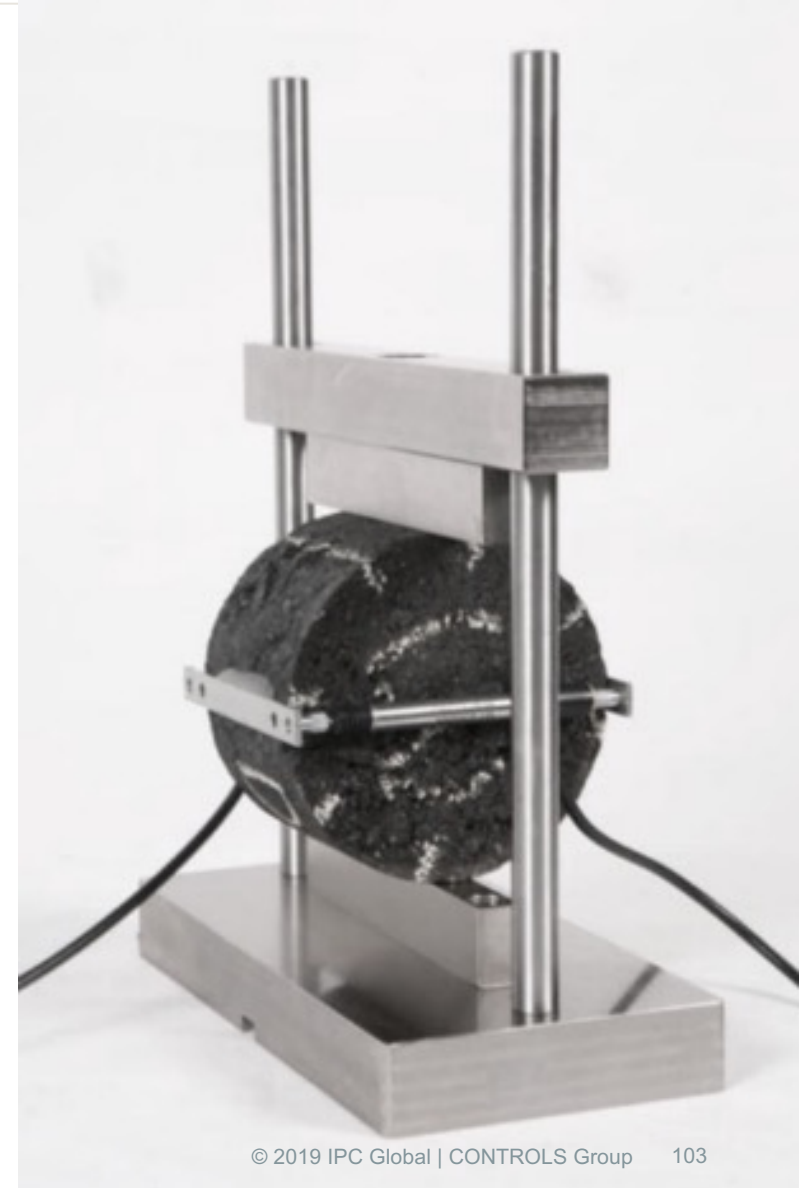
Indirect Tensile Jig

- 100 & 150mm diameter specimens
- Integrated LVDT holders
- Available with guided top platen for EN standards and unguided top platen
- ASTM D4123 / AS 289.1.13.1 / AASHTO TP31 / EN12697-26 / BS DD213: Resilient Modulus of Bituminous Mixtures
- Available for UTM's and Modular Asphalt Testers



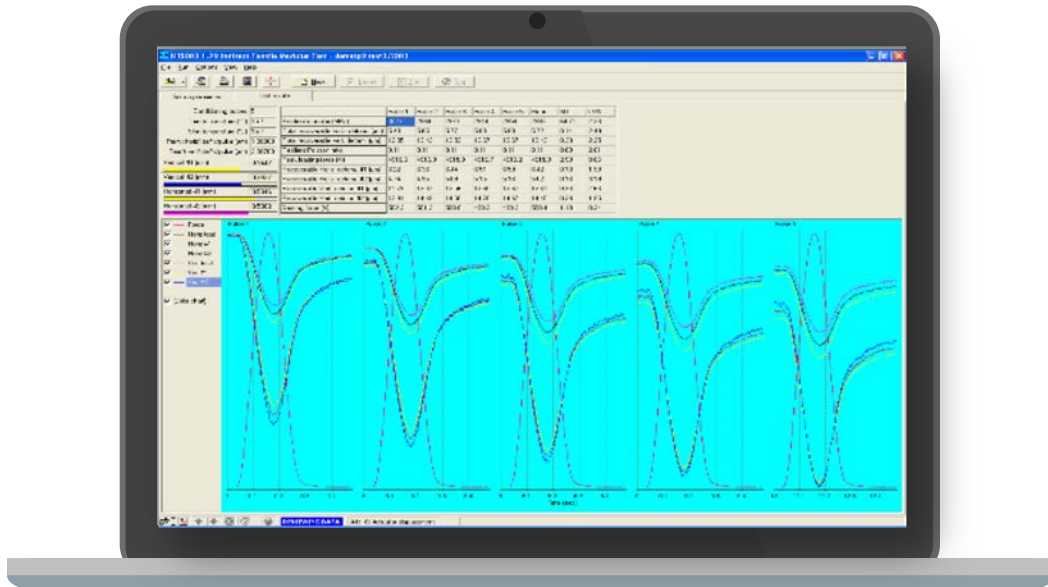
Indirect Tensile Jig

- 100 & 150mm diameter specimens
- Available with guided top platen for EN standards
- EN 12697-24E: Indirect Tension Test for Fatigue of Bituminous Mixtures
- Available for UTM's and Modular Asphalt Testers



Indirect Tensile Jig Setup

- AASHTO T322/TP9 & NCHRP 1-18A Appendix 1
- Creep Compliance and Strength of Hot-Mix Asphalt (HMA) using the indirect tensile test device



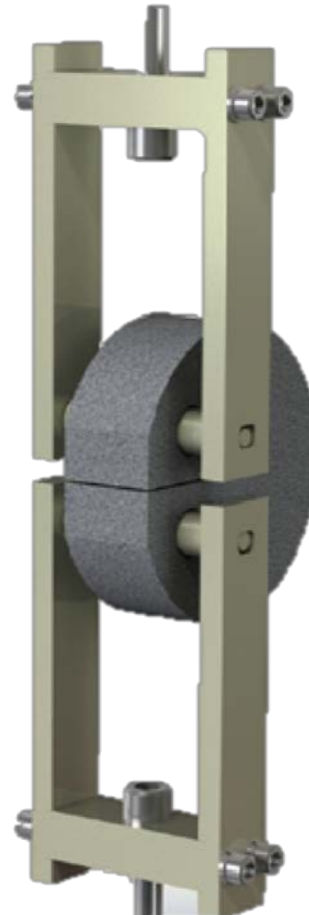
Crack propagation by Semi-circular Bending Test



- Attaches to Indirect Tensile Jig
- 150 mm dia. specimens
- For both UTMs and Modular Asphalt Testers
- Conforming to:
 - AASHTO TP124 (Illinois SCB) – Fracture Potential - Flexibility Index Test (FIT)
 - ASTM D8044 (LSU SCB) – SCB Cracking Resistance Test
 - EN 12697-44 – Crack Propagation
 - AASHTO TP105 – UTM-30 only

Disk-shaped Compact Tension Kit – UTM only

- Precision engineered from zinc plated steel for light weight
- Anti-corrosion finish
- Disk-shaped compact tension test jig is designed to obtain the fracture energy of 150mm diameter asphalt specimens
- Easy to set up for disk-shaped geometry
- Available for UTMs only



Four Point Bend

- Easily installed and removed
- Floating straight edge with on-specimen transducer
- Backlash free rotation and translation on all loading points
- Non-linear regression data fitting algorithms
- Motorized specimen clamps
- 50x50mm, 70x70mm, 60x63.5mm specimens
- Conforming to AASHTO T321, ASTM D7460, ASTM D8237, EN 12697-24C and EN 12697-26D



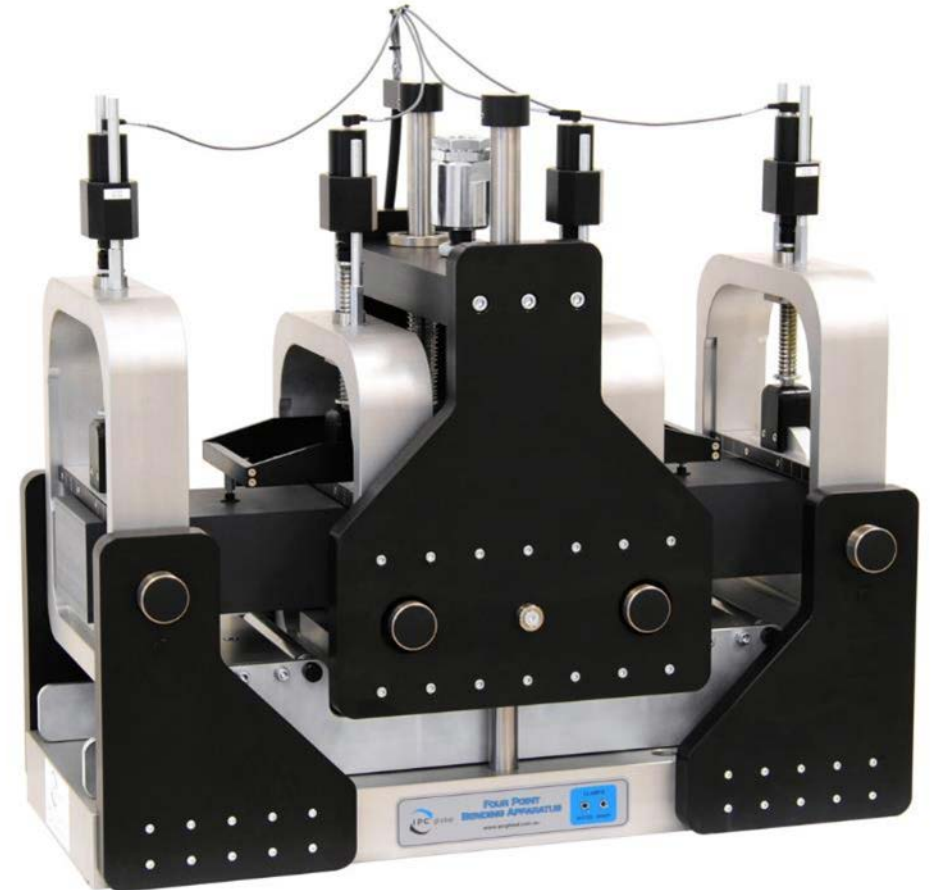
Four Point Bend

- Easily installed and removed
- Floating straight edge with on-specimen transducer
- Backlash free rotation and translation on all loading points
- Non-linear regression data fitting algorithms
- Motorised specimen clamps
- 50x50mm, 70x70mm, 60x63.5mm specimens
- Conforming to AASHTO T321, ASTM D7460, EN 12697-24C and EN 12697-26D



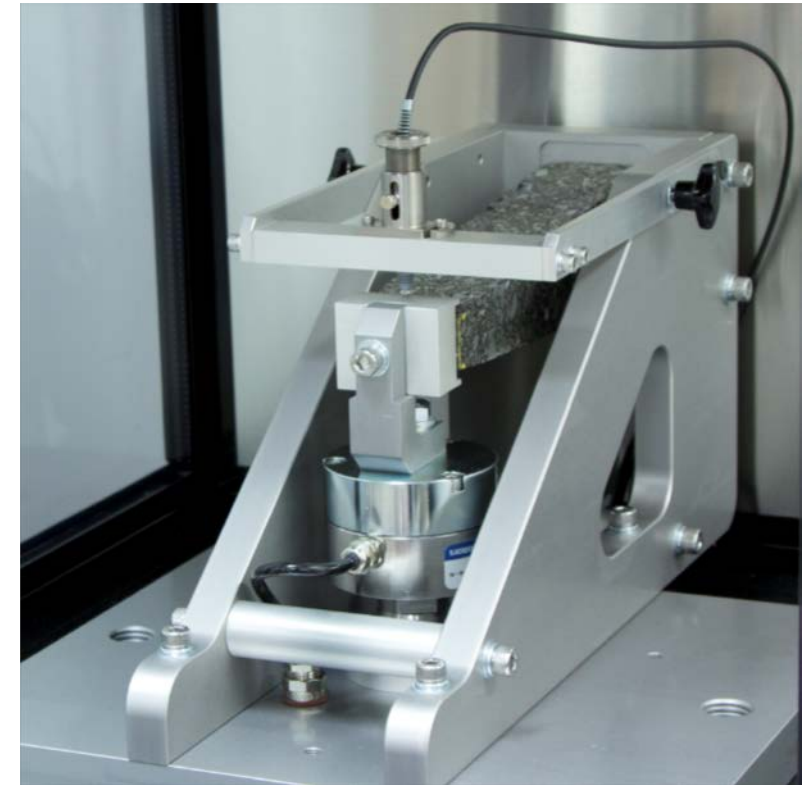
Extra- Large Four Point Bend

- For testing special large specimens
- “Floating straight-edge” on specimen transducer
- Backlash free rotation and translation on all load and reaction points
- Sinusoidal or haversine controlled strain or controlled stress loading
- Controlled force, motorized specimen clamping
- Non-linear regression data fitting ensures reliable determination of phase and modulus
- Can be used with UTM-130XL only



Trapezoidal Two Point Bend

- Excellent stiffness and alignment
- Easily installed and removed
- LVDT +/-0.5mm with ILC
- 50 or 25 mm specimens
- Conforming to EN 12697-24A and EN 12697-26A



Compression Test Jigs



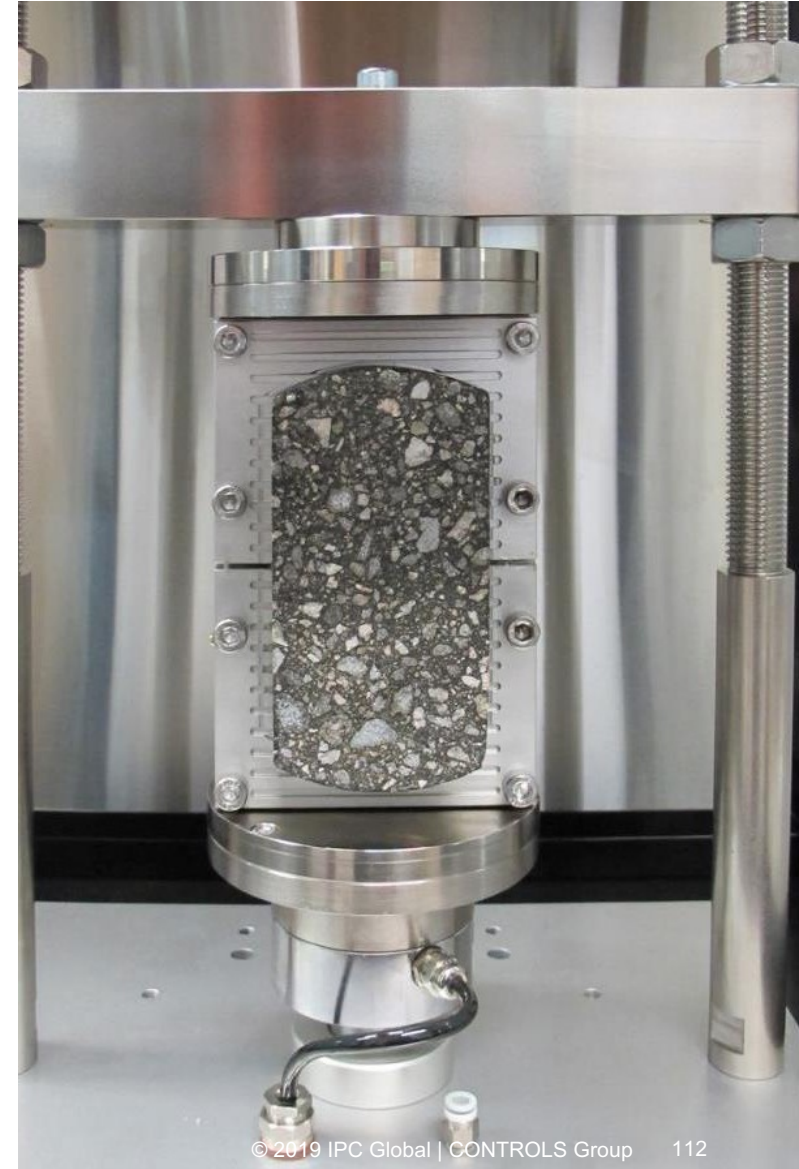
Permanent Deformation Dynamic
Creep - BS 598, AS 2891.12

Cyclic Compression - EN 12697-25A



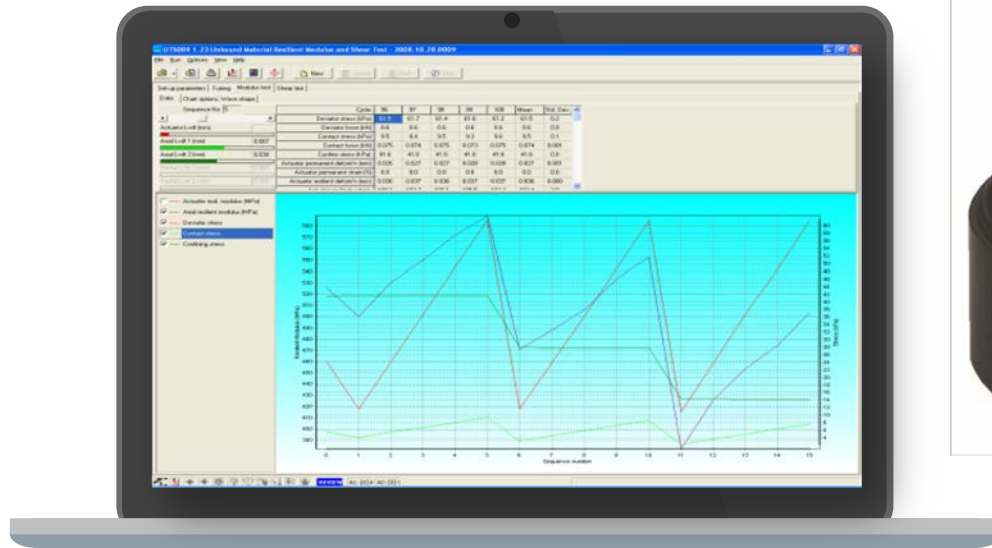
Overlay Test Kit

- Precision engineered for high stiffness and excellent alignment
- Designed for easy set up
- Linear guidance to ensure no rotation nor non-axial loading
- Available with Specimen Preparation kit
- Conforming to Tex-248F



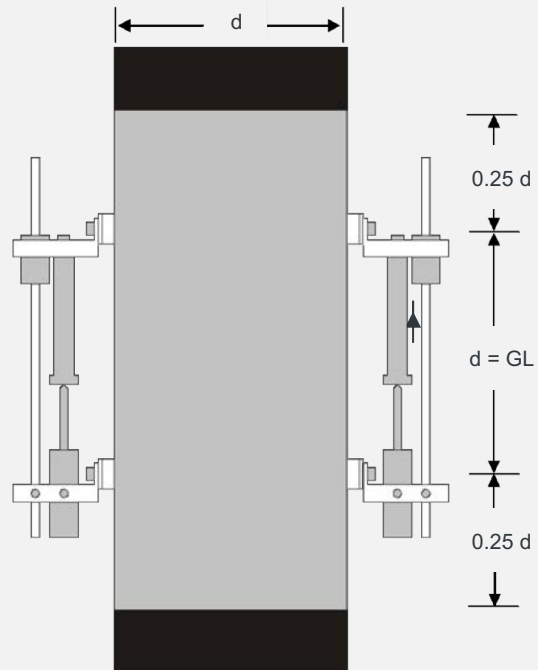
Universal Triaxial Cell – UTM only

- For Resilient modulus of soils and unbound granular materials
- Conforming to AASHTO T307 (ex-TP46)
- For UTMs only

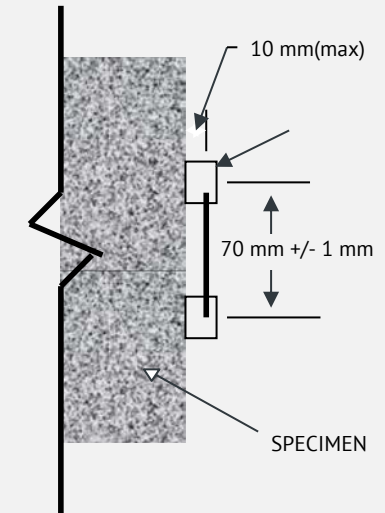


Dynamic Modulus of Hot-Mix Asphalt

AASHTO T342 (TP62)



AASHTO T378 (TP79)



Uniaxial Fatigue - Unconfined

- Provides better prediction of Fatigue
- Repeatable
- Shorter testing time than 4PB test — 3 hours
- Easy preparing sample
- Utilizes results from Dynamic Modulus includes it into S-VECD damage model
- Test standard AASHTO TP107



Small Diameter Dynamic Modulus and Uniaxial Fatigue

- Enables Dynamic Modulus, Flow Number and Uniaxial Fatigue Tests on small diameter specimens
- Perform tests on 38mm, 50mm & 75mm diameter specimens
- For 38mm dia. SVECD:
 - Max T 40°C is recommended
 - 110mm is minimum height to use AMPT LVDTs
 - Recommend vertical cores only on lab SGC specimens



Small Diameter Dynamic Modulus and Uniaxial Fatigue

- 150mm tall cores are rarely attainable from the field
- 38mm and 50mm diameter specimens can be cored horizontally from 150mm dia. Road core
- 4 x 38mm specimen from 150mm dia. Gyrotory cylinder
- Gluing time much shorter e.g. 16 hours reduced to 1 hour!
- Small scale specimen geometries performance is not significantly different than full-size in most cases
- Small-scale specimens are a viable alternative when full-size specimens are not feasible and will improve testing efficiency



Automatic Triaxial Cell – UTM only

- Automatic pneumatically operated lift cylinders that raise and lower the cell wall
- Fitted with pressure relief valve for greater safety
- Crystal clear heavy duty acrylic cell wall for maximum visibility of specimen
- Low friction loading shaft
- Ports for pressure and temperature transducers
- Ports for up to 3 (internal) on specimen transducers
- Cell pressure up to 275kPa
- Conforming to EN 12697-25B, NCHRP 9-19, NCHRP 9-29, AASHTO T378 (TP79)
- Suitable for UTMs only



Tensile Stress Restrained Stress Test (TSRST) Kit



- Self-aligning couplings for true axial alignment
- Invar Rods provide low thermal expansion for accurate displacement measurement
- Threaded rods to safely support specimen and fixture after fracture
- Available for servo-hydraulic UTMs with extended temperature -40°C environmental chambers with LN2 kits
- Suitable to AASHTO TP10-93 and EN 12697-46

Uniaxial Thermal Stress and Strain Tester (UTSST)



UTSST TSRST Upgrade Kit



UTSST TSRST Restrained Platens



Unrestrained Gluing Jig



Asphalt Mixture Performance Testers (AMPT)

AMPT – How was it developed

- Some of the most significant recent advances in asphalt mix evaluation have come from the USA
- Strategic Highway Research Program (SHRP) 1987
- Superpave Mix Design System 1992:
 - **Superior Performing Asphalt Pavements**
- Mechanistic-Empirical Pavement Design Guide – DARWin ME (formerly known as AASHTO MEPDG)

Superpave Design System



NCHRP



Asphalt Expert
Task Groups

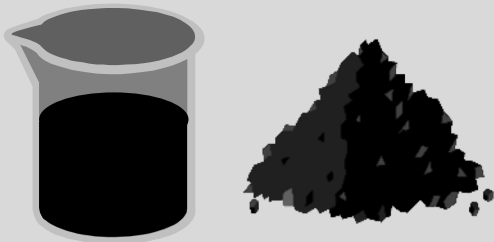


AASHTO

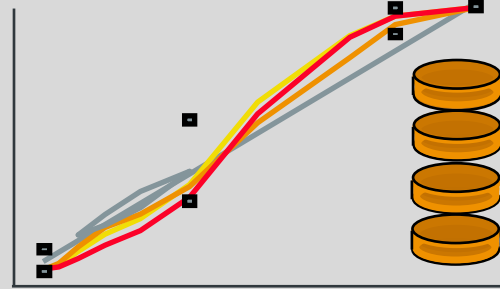
Superpave Evolution since 2000

Steps of Superpave Mix Design

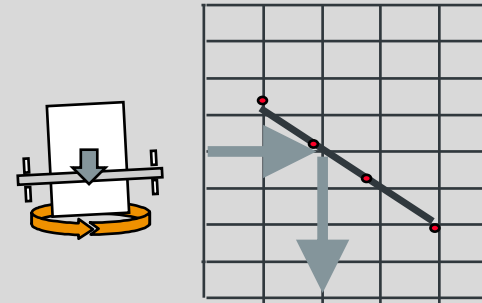
1. Materials Selection



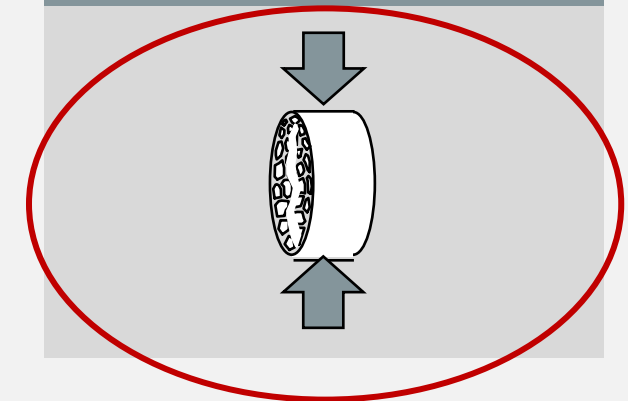
2. Design Aggregate Structure



3. Design Binder Content



4. Mixture Performance Testing



National Cooperative Highway Research Program (NCHRP) Projects

9-19:

Superpave
Support and
Performance
Models

9-29:

Simple
Performance
Tester for
Superpave
Mix Design

9-33:

Mix Design
Manual for
Hot Mix
Asphalt

Project 9-19 Correlation Study

Laboratory tests to real life performance



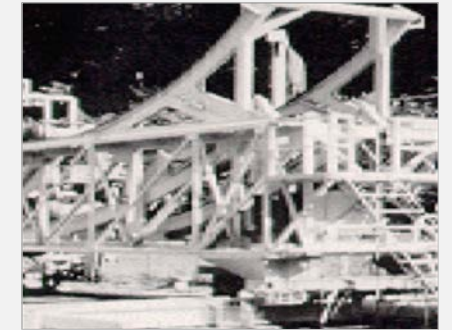
WesTrack



MnRoad



FHWA-ALF



Tests selected in NCHRP Project 9-19

**Dynamic
Modulus-E***

Flow number

- Repeated Load, permanent deformation

Flow time

- Static Creep Test

NCHRP 9-29 Asphalt Mixture Performance Tester (AMPT)

- Most important development tool specifically designed for HMA performance testing
- Characterizes asphalt mixtures
- Performance tests
 - Dynamic Modulus E^* – Strength
 - Repeated Load – FN Permanent deformation
 - Plus – Uniaxial fatigue, Overlay, Indirect Tensile, SCB, IRLPD, SVECD and Small Diameter Dynamic Modulus
- QA/QC testing tool
- Extensive US and International efforts to develop and implement



AMPT Pro – Researcher’s Choice

Lower Temperatures

- Significantly improved ECU & cell design
- -5°C to +70°C.
- Cools to +4°C in under 30 minutes.

Easy and Versatile

- Interchangeable transducers and load cells with “plug & play” signal conditioners
- 8 BNC Raw signal outputs

High performance

Labyrinth bearing hydraulic actuator +/-19kN



All-in-One Computer Control (optional)

Clarity in Results
The tried & tested IMACS.

Integrated Compressor (optional)

AMPT Pro Specifications

- **Load Capacity:** Static 19kN / Dynamic: 17kN
- **Actuator Type:** Labyrinth Bearing – Long life, higher frequencies and excellent through zero waveform fidelity
- **Frequency Range:** 0.01 to 70Hz sinusoidal loading
- **Actuator Stroke:** 30mm (+/-15mm stroke)
- **Improved ECU:** Temperature Range -5°C to +70°C* Rapid cooling
- **Confining Pressure:** 0 to 225kPa
- **Computer Control:** Integrated all-in-one touchscreen PC (optional)
- **Analogue Outputs:** 8 BNC connectors provide raw analogue outputs from the signal conditioners to permit the use of external data logging equipment
- **Air Compressor and Dryer Low noise:** integrated and automated (optional)
- **Dimensions:** 1,359 x 1,350 x 739mm (H x W x D)
- **Weight:** 275kg (including oil)

NCHRP 9-29 AMPTQube – Democratizing SuperPave tests

- An exciting development specifically designed for SuperPave performance testing
- Fully conformant to NCHRP 9-29, allowing for specimen instrumentation, installation, application of confining pressure and temperature equilibration in five minutes over the complete range of temperatures.
- Characterizes asphalt mixtures
- Performance tests
 - Dynamic Modulus E^* – Strength
 - Repeated Load – FN Permanent deformation
 - Plus – Uniaxial fatigue, Overlay, Indirect Tensile, SCB, IRLPD, SVECD and Small Diameter Dynamic Modulus
- QA/QC testing tool
- Extensive US and International efforts to develop and implement.



AMPTQube – AMPT tests accessible to everybody

ThermoElectric Temperature Control

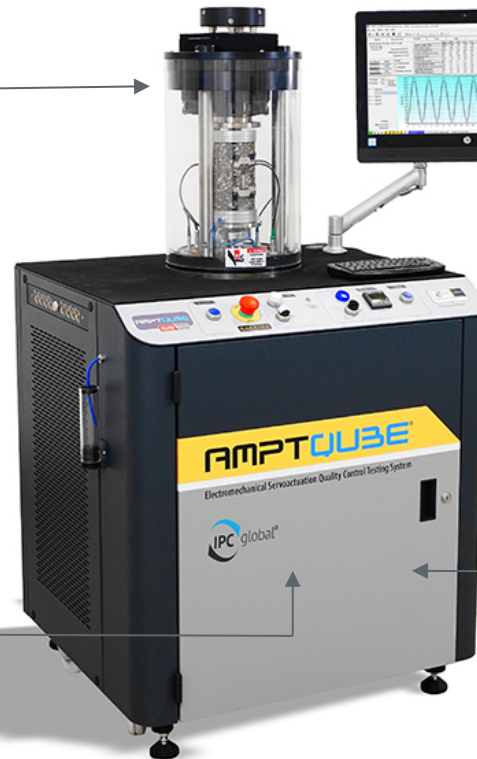
- High performance water-cooled thermoelectric temperature
- Range +2°C and +60°C

Easy and Versatile

- Interchangeable transducers and load cells with “plug & play” signal conditioners
- 8 BNC Raw signal outputs

EmS Technology

- New revolutionary Electromechanical Servoactuation +/-15kN
- very low noise & no oil required



All-in-One Computer Control (optional)

Clarity in Results
The tried & tested IMACS.

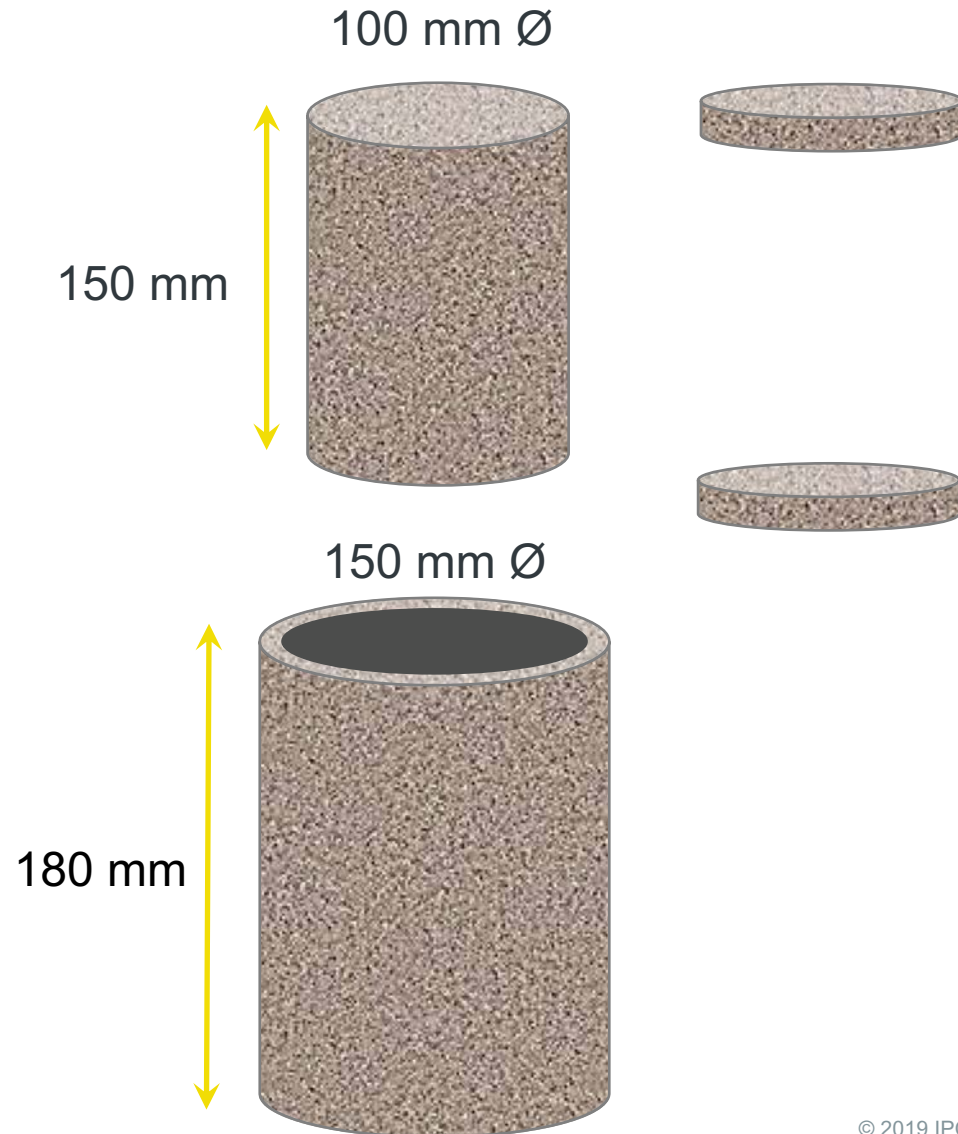
Integrated Compressor (optional)

AMPTQube Specifications

- **Load Capacity:** Dynamic 15kN / Static 10kN
- **Actuator Type:** Electromechanical Servoactuation (EmS)
- **Frequency Range:** Enough for SuperPave
- **Actuator Stroke:** 30mm (+/-15mm stroke)
- **Temperature range:** +2°C to +60°C°
- **Confining Pressure:** 0 to 225kPa
- **Computer Control:** Integrated all-in-one touchscreen PC (optional)
- **Analogue Outputs:** 8 BNC connectors provide raw analogue outputs from the signal conditioners to permit the use of external data logging equipment
- **Dimensions:** 1526mm x 832mm x 739mm (H x W x D)
- **Weight:** 200kg

Sample Preparation

- Dynamic Modulus E*
- Flow number/Flow time
- SVECD Uniaxial fatigue (130mm high)



Testing Made Easy – Dynamic Modulus

1



Attach 3 x pairs of 70mm gauge points

2



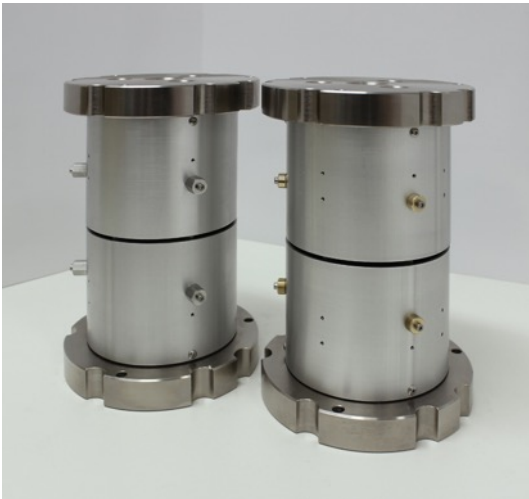
Fit 6 x LVDT clamps and 3 x LVDTs

3



Fit membrane (if required) and perform tests

Proving Ring & Gauge Point Fixing Jig



AMPTQube

- Uniaxial fatigue — SVECD
- Overlay test
- Semi-Circular Bend (SCB)
- Small Scale Specimens
- Indirect Tensile Dynamic Modulus
- One advanced machine to do the most important SuperPave performance tests.

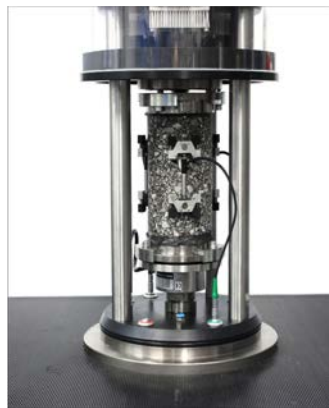
Test Standards

- NCHRP 9-29 SPT — Equipment Specification 3.0
- AASHTO T378 (TP79) — Dynamic Modulus and Flow Number for Hot Mix Asphalt
- AASHTO TPXX — Flow Number for Asphalt Mixtures
- Draft Stress Sweep Rutting (SSR)
- AASHTO TP107 — Damage Characteristic Curve from Direct Tension Cyclic Fatigue Tests on Asphalt Mixtures (SVECD)
- AASHTO TP116 — Rutting Resistance Using iRLPD
- AASHTO TP124 (Illinois SCB) — Fracture Potential of Asphalt Mixtures Using the Flexibility Index Test (FIT)
- AASHTO T342/TP62 — Dynamic Modulus of Hot-Mix Asphalt Concrete Mixtures (Limited temperature and force range)
- AMPT Indirect Tensile Dynamic Modulus Test
- ASTM D8044 (LSU SCB) — Cracking Resistance using Semi-circular Bend Test at Intermediate Temperatures
- ASTM WK 26816 — Cracking Using the Overlay Tester
- Tex 248-F Overlay Test — Reflective Cracking or Fatigue
- SCDUF — Simplified Continuum Damage Uniaxial Fatigue

AMPT Pro & DynaQube Performance Tests



Dynamic Modulus



Uniaxial fatigue



Flow number/Flow time



Overlay test



SCB



Small dia. Dynamic Modulus



Small dia. Uniaxial fatigue



Indirect tensile E*

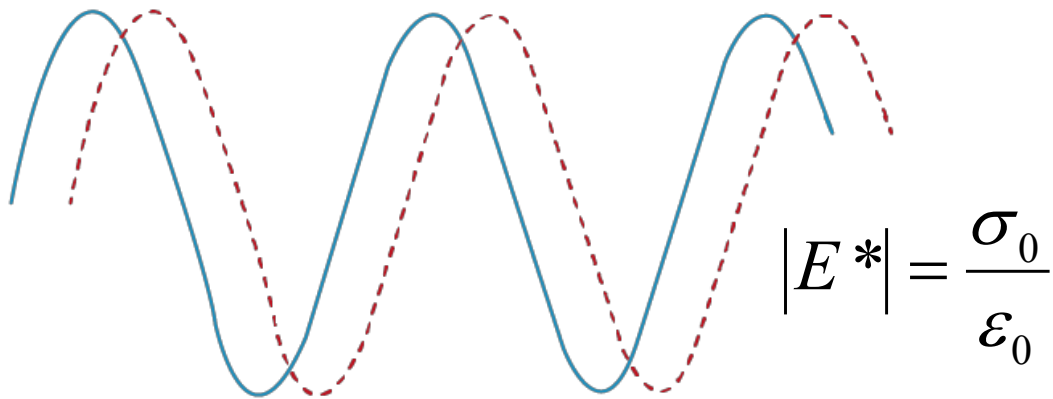


Stress Sweep Rutting (SSR)



iRLPD

Dynamic Modulus E^*



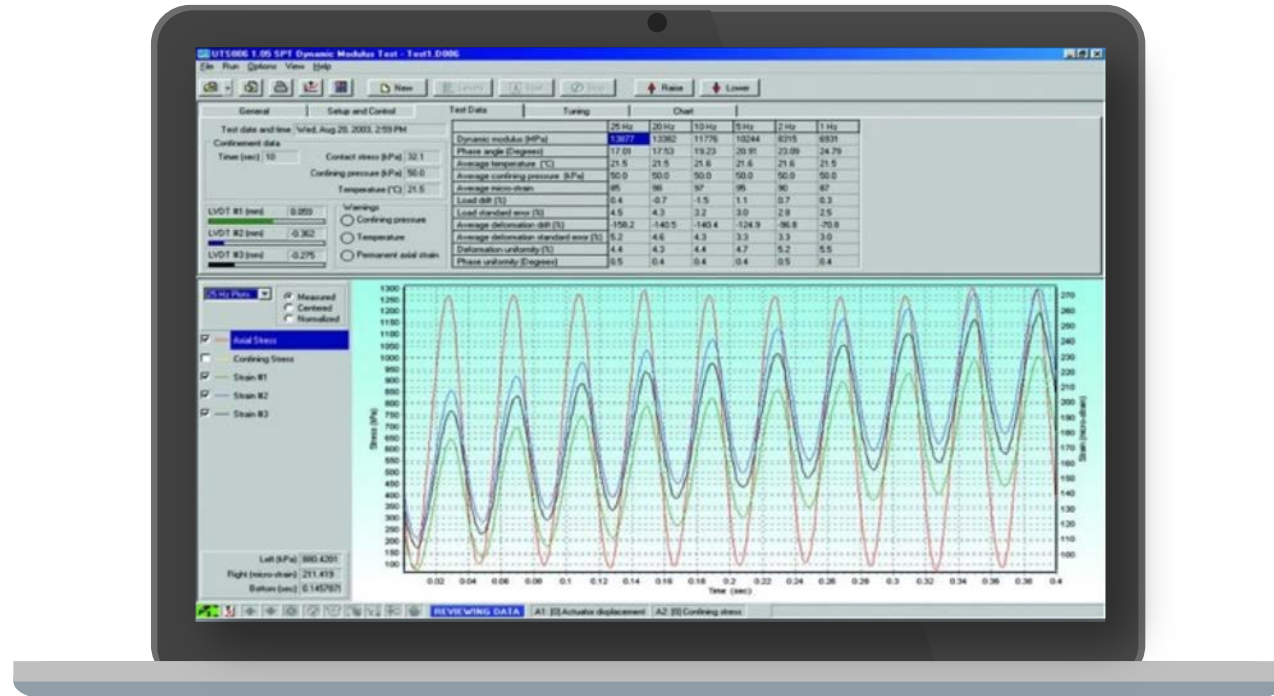
KEY — Stress - - - Strain

- ▶ Extremely valuable Performance Test
- ▶ Measures Fundamental Material Strength
- ▶ Important for evaluating novel materials e.g. PMA for innovative performance based Pavement Design

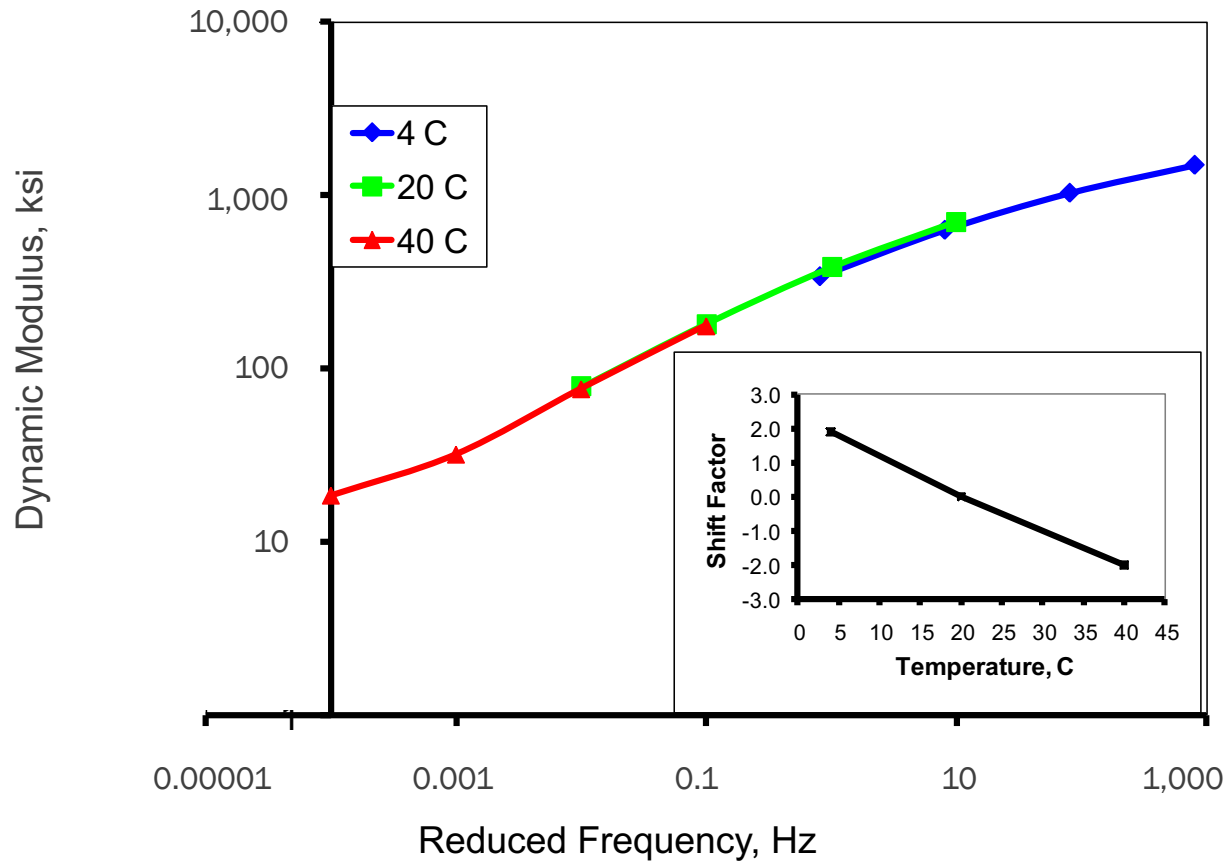


Dynamic Modulus E* Testing made easy

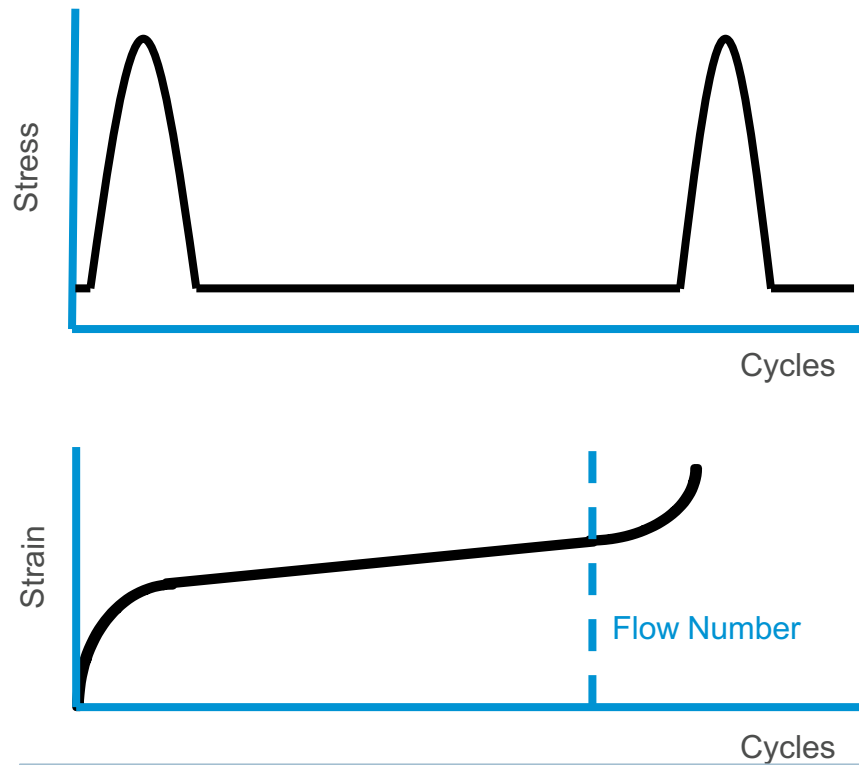
- Start at Lowest temperatures and from highest to lowest frequencies
- Then increase the temperature and again test from highest to lowest frequencies



Master Curve from time/temperature super-positioning



Flow Number / Flow Time



▶ Rutting – the higher the flow number the more resistant to rutting



Uniaxial Fatigue

- Provides better prediction of Fatigue
- Repeatable
- Shorter testing time than 4PB test — 3 hours
- Easy preparing sample
- Utilizes results from Dynamic Modulus includes it into S-VECD damage model
- Test standard AASHTO TP107



Overlay Test

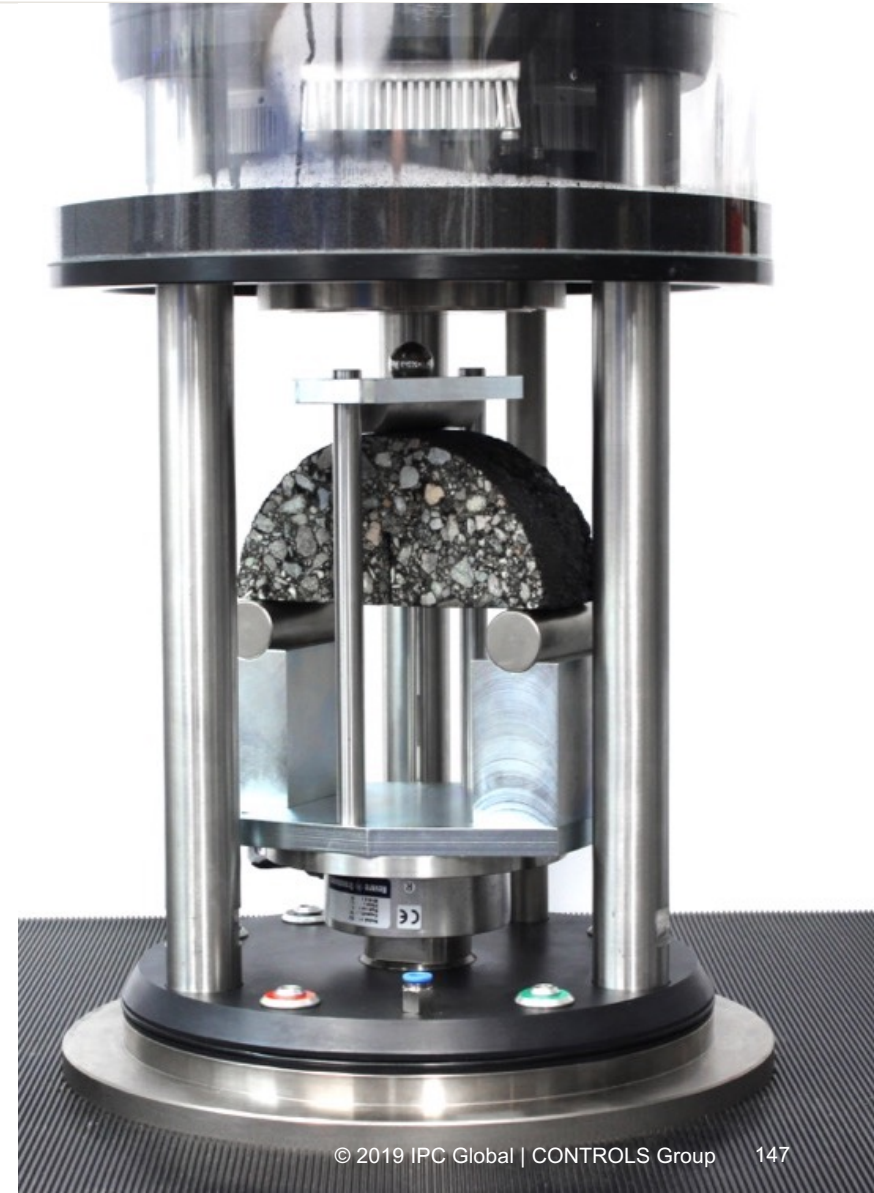
- Characterizes Fatigue cracking resistance.
- To determine the bottom-up cracking in overlays.
- To assess ability of overlays to resist reflective cracking
- Designed for easy set up
- Linear guidance to ensure no rotation nor non-axial loading
- Available with Specimen Preparation kit
- Conforming to Tex-248F and ASTM WK 26816



SCB – Semi-Circular Bend Test

Crack propagation properties

- 150 mm dia. Specimens
 - Notched depth 25mm, 32mm and 38mm; <3.5mm wide
 - AASHTO TP 124 (Illinois SCB) — Fracture Potential Using the Flexibility Index Test (FIT)
 - ASTM D8044 (LSU SCB) — Cracking Resistance using Semi-circular Bend Test at Intermediate Temperatures
- Also available for other equipment
- AASHTO TP105 – UTM-30 only



Small Diameter Dynamic Modulus and Uniaxial Fatigue

- Enables Dynamic Modulus, Flow Number and Uniaxial Fatigue Tests on small diameter specimens
- Perform tests on 38mm, 50mm & 75mm diameter specimens
- For 38mm dia. SVECD:
 - Max T 40°C is recommended
 - 110mm is minimum height to use AMPT LVDTs
 - Recommend vertical cores only on lab SGC specimens



Small Diameter Dynamic Modulus and Uniaxial Fatigue

- 150mm tall cores are rarely attainable from the field
- 38mm and 50mm diameter specimens can be cored horizontally from 150mm dia. Road core
- 4 x 38mm specimen from 150mm dia. Gyratory cylinder
- Gluing time much shorter e.g. 16 hours reduced to 1 hour!
- Small scale specimen geometries performance is not significantly different than full-size in most cases
- Small-scale specimens are a viable alternative when full-size specimens are not feasible and will improve testing efficiency



Draft Stress Sweep Rutting (SSR)

- Permanent deformation rutting model
- Accounting for deviatoric stress, load-time and temperature
- Resistance to rutting at various stress and temperature combinations
- Two temperatures – high (TH) and low (TL) at one confining pressure
- 200 Cycles for each loading block
- 0.4 second pulse
- Temp high 3.6 second rest, Temp low 1.6 second rest
- Confining stress held constant and three deviator stress levels
- Permanent axial deformation at each loading cycle measured from actuator
- No on-specimen transducers
- Used for **Balanced mix design** of asphalt



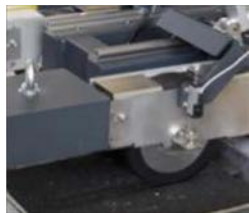
Indirect Tensile Method for Dynamic Modulus E^*

- Enables Dynamic Modulus testing on field cut cores
- Uses on-specimen loose-core LVDTs to measure horizontal and vertical strain.



Permanent Deformation by Wheel Tracking Test

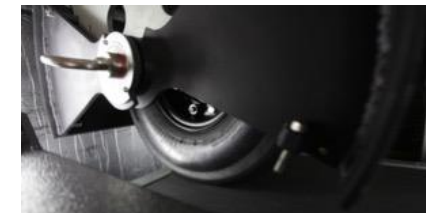
EN Wheel Tracker



Hamburg Wheel Tracker



AUSTRACK



Wheel Tracking

- A wheel is directly loading an asphalt sample with alternate movement
- Direct simulation of the permanent deformation development process
- Allowing to predict rutting susceptibility of a mix



EN Double Wheel Tracker



- Allowing to test two asphalt slabs at the same time
- Temperature conditioning performed in air, or as alternative in water
- Load applied by rubber covered wheel
- Completely automatic machine controlled by included laptop PC
- Conforming to EN 12697-22

Double Hamburg Wheel Tracker

- Allowing to test two asphalt slabs or four gyratory compactors samples
- Temperature conditioning performed in water only
- Load applied by steel wheel
- Completely automatic machine controlled by included laptop PC
- Conforming to AASHTO T324
- Optional protection doors available



AUSTRACK

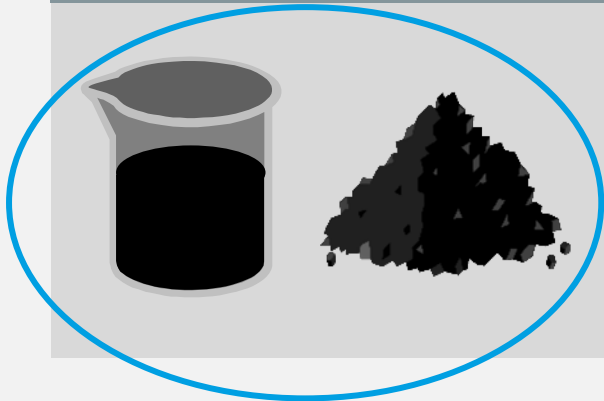
- Full scale wheel tracking at a fraction of the price of a full size APT
- Very close replication of real life loading conditions
- Laboratory scale
- Inexpensive to run i.e. materials handling and specimen production
- Combination slab compaction and wheel tracking in one machine
- Fully Automated Laser Rut Depth Measurement system allows AUSTRACK to be left unmanned for long periods of time.
- Full Scale, Extra Large and Large configurations
- Modular moulds enables researchers to built multi-layered pavement constructions to various depths



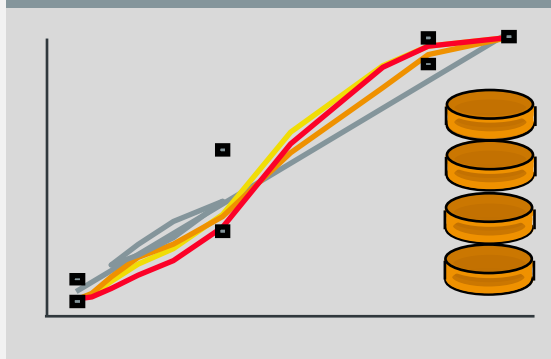
Performance Based Tests on Binder

Steps of Superpave Mix Design

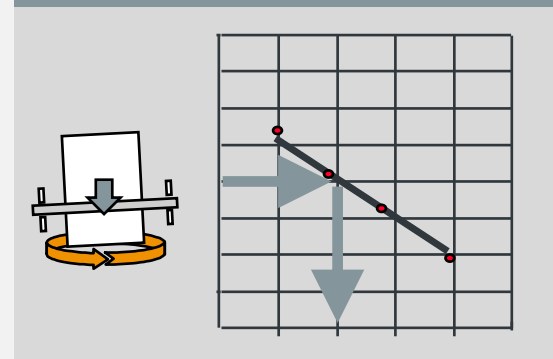
1. Materials Selection



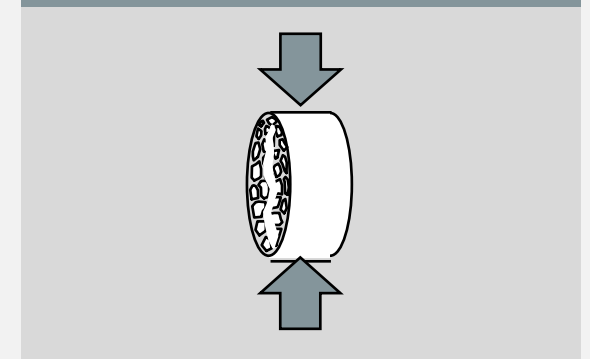
2. Design Aggregate Structure



3. Design Binder Content



4. Mixture Performance Testing



Performance Based Tests on Binder

- Following SHRP / SuperPave, binder response to loading depends on 3 parameters:
 - Age
 - Temperature
 - Rate of loading



Ageing

Short-Term Ageing (RTFO)



Long-Term Ageing (PAV)



Ageing

Asphalt binders undergo aging through the loss of volatiles (a.k.a. loss of light ends) and oxidation.

Two key ages are considered:

- Short-Term Ageing
 - During construction
 - Post construction to roughly two years
- Long-Term Ageing
 - Seven plus years of service



Short-Term Ageing

Rolling Thin-Film Oven (RTFO)

- Short-Term ageing is simulated by the combined effect on a binder sample of:
- Heat – oven working at 163°C
- Air – flow of air, 4000 ml per minute
- Time – Test duration 85 minutes (AASHTO T240)



Clean Bottle before loading

After loading

Coated bottle after testing

Short-Term Ageing

Rolling Thin-Film Oven (RTFO)

- Color touchscreen display showing in real-time all the test parameters (Temperature, Air Flow, Carriage speed, Test duration)
- Full conformity to temperature specifications
- Safety features: Automatic over-temperature switch, door switch, pilot lamp and alarm for door open with fan still running
- Door locking system allowing easy opening also with busy hands



Long-Term Ageing

Pressure Ageing Vessel (PAV)

- Long-Term ageing is simulated by the combined effect on a binder sample of:
- Heat – oven working between 90 and 110°C
- Pressure – Confinement at 2.1Mpa
- Time – Test duration between 20 hours (EN&ASTM) and 65 hours (EN only)



Long-Term Ageing

Pressure Ageing Vessel (PAV)



- Efficient heating system allowing the test temperature to be achieved in one hour, exceeding the Standards' specifications.
- Programmable pre-heating functions (up to 60°C) for time optimization
- User friendly software allows the operator to view in real time vessel temperature and pressure (set points and actual values) on the 6" color touch screen display
- CE and ASME certified pressure vessel.

Long-Term Ageing

Pressure Ageing Vessel (PAV)

Including safety features:



- Electrically locked top cover, to avoid direct exposure of the pressure vessel during the test
- Forced ventilation cooling system allowing quick cooling of sample rack and to avoid accidental burns
- 60°C pre-heating limit to avoid accidental burns during sample rack positioning
- Over temperature limit switch
- Over pressure relief valve

Long-Term Ageing – Sample Recovery

Vacuum Degassing Oven (VDO)

- The Vacuum Degassing Oven (VDO) is designed to remove air bubbles created during accelerated oxidative ageing of asphalt binder by the PAV. This final conditioning makes the aged binder suitable for further tests such as penetration, ductility, softening point, DSR, BBR and many more.
- Mandatory in ASTM PAV ageing procedure.
- Optional in EN procedure.



Long-Term Ageing – Sample Recovery

Vacuum Degassing Oven (VDO)

- The vacuum chamber can accept either eight 55x35 mm or four 70x45 sample containers, thanks to the double face sample holder.
- Other feature are:
 - Integrated vacuum pump
 - Vacuum monitored by transducer and controlled to 15 ± 1.0 kPa absolute pressure
 - Digital touch screen 6" display for temperature, vacuum, set points and actual values.



Binder after ageing

Residue from this conditioning practice may be used to estimate the physical and chemical properties of asphalt binders after several years of in-service ageing in the field, and to compare these properties to pre-conditioning test results of the same binders.

Tests such as:

- Penetration
- Ductility
- Softening Point
- Rheological tests (BBR/DSR)
- Viscosity and more...



Binder Testing

Penetration



Softening Point



Ductility



Penetration

PIVOT Fully Automatic Penetrometer

- Fully automatic operation. The entire test cycle (rapid approach, starting point determination, penetration and return to the initial position) is automatically performed by simply pressing the start button on the touch screen display.
- Rapid approach
- Penetration via contactless displacement transducer, with 0.01 mm resolution
- Wide 6" Touch screen color display with adjustable inclination
- Real time display of penetration/time curve
- Possibility to display and average up to six tests.



Penetration

PIVOT Fully Automatic Penetrometer

- Supplied complete with six sample cups 55x35 mm, one standard needle, one 50 g weight and one 150 g weight
- Can be completed with suitable water bath for tests performed at 25°C



Softening Point

Automatic Ring & Ball Apparatus

- Full automatic testing procedure for both test with water or glycerol as heating fluid
- Microprocessor controlled thermo-regulator allowing strict conformity to 5°C/min temperature rise defined by EN 1427 and ASTM D36
- Automatic detection of the softening point by infrared beams
- Large graphic display



Ductility

DUCTIMETER – High Performance Force Ductility Meter

- Able to perform ductility, elastic recovery and force ductility tests for deformation energy determination
- Four tension lines, 1,500 mm travel
- PC controlled with dedicated software
- Including Force measuring system up to 300N by load cells (not included)
- Speed range: from 5 to 100 mm/min
- Temperature range from 4 to 30°C with external chiller
- Elongation measurement by optical system
- On line graphics of load and displacement by PC



Ductility

DUCTIMETER – High Performance Force Ductility Meter



Research model available:

- Temperature range from -10 to +60°C $\pm 0.2^\circ\text{C}$
- Extensive use of stainless steel for frame, cover and tank
- Speed range: from 1 to 200 mm/min

Rheological properties of asphalt binders

Dynamic Shear Rheometer

- Performs the critical rheological characterization analysis required for SuperPave Performance Grade (PG) classification of asphalt binders.
- Predicts binders' performance at anticipated climatic conditions.
- DSR tests are conducted on unaged, RFTO aged and PAV aged asphalt binder samples.

- A thin asphalt binder sample is sandwiched between two circular plates.
- The lower plate is fixed while the upper plate oscillates back and forth across the sample to create a shearing action.



Rheological properties of asphalt binders

Dynamic Shear Rheometer

Two models are available, either manual or automatic, to perform:

- **SuperPave performance grading** according to AASHTO T315 and ASTM D7175
- **Viscosity determination of asphalt binder** according to AASHTO T316 and ASTM D4402
- **Multi Stress Creep Recovery (MSCR) determination** according to AASHTO T350 and ASTM D7405.



Binder Extraction

PAVELAB50 Automatic Extractor

BITUMAX Asphalt Binder Analyzer



Solvent extraction

PAVELAB50 Automatic extractor

- For fully automatic extraction of binder from a mix, including filler content, aggregate drying and solvent recovery
- Closed-loop system, allowing complete recycle and reuse of the solvent without any loss during test, drying and recovery phase
- No leaks of solvent in the laboratory environment, no need of solvent-protective cupboards or hoods
- Fast extraction: extraction and sample drying are performed within 55 minutes
- Suitable for use with trichloroethylene, perchloroethylene and methylene chloride



Solvent extraction

PAVELAB50 Automatic extractor

- Washing of asphalt sample (up to 3.5kg) with solvent and ultrasonic motion, with simultaneous heating and rotation of the drum lined with screening mesh
- High speed centrifuge for filler separation
- Automatic solvent recovery by distillation
- Optional fast connection for binder recovery for further tests
- Controlled by 7" touchscreen panel
- Version incorporating a 10kg balance for automatic binder content calculation
- Automatic sample drying after extraction



Ignition Oven

BITUMAX Asphalt Binder Analyzer

- The only bitumen extraction method not requiring the use of solvent
- Fully automatic test cycle with simultaneous display of all test parameters, including temperature, weight loss and percentage of binder
- High efficiency heating system with additional afterburner for complete combustion of exhaust fumes, no need of filters
- Fast test performance, full extraction is performed in less than 40 minutes



Ignition Oven

BITUMAX Asphalt Binder Analyzer

- Sample size up to 4.5kg
- Supplied complete with range of accessories for the test performance: double sample tray, fork to handle the pan, cooling cage and exhaust pipe (3m)
- The machine includes a 10,000 x 0.1g weighing system
- Closed-loop PID thermo-regulation for both oven and afterburner
- Possibility to connect an external balance
- Serial printer for automatic printout of test results at the end of the test is included





Q&A

GO