



# GCTS

TESTING SYSTEMS

*Accuracy Is The Underlying Strategy*

## Advanced Pavement Testing Systems

GCTS is committed to designing accurate testing systems by integrating innovative software engineering with advanced hardware.



ISO  
9001:2015  
Certified

**AMPT-15**  
Asphalt Mixture Performance Tester  
www.gcts.com





## Company Vision

GCTS is internationally renowned for its high quality testing systems and client care. The design approach GCTS has utilized emphasizes the importance of the customer's needs. It is this approach that has dictated the level of success we have achieved to this date.

GCTS does not just offer testing equipment; we provide complete solutions for advanced material characterization. All of our systems are proudly designed and manufactured in the United States of America.

Our systems are designed to maximize client productivity by acquiring and processing testing data, then presenting the results in a simple and coherent format.

## GCTS: Global Presence



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# Asphalt Mixture Performance Tester

## AMPT-15

- Low-cost solution to perform dynamic complex modulus, flow number, and flow time tests
- Electro-hydraulic digital servo control
- Quiet operation
- Temperature control from  $-10^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$
- 19 kN static axial load capacity
- 17 kN dynamic axial load capacity
- 50 mm stroke
- 250 kPa confining pressure capacity
- Frequencies up to 25 Hz (70 Hz servo valve)
- Easy-to-use software and electronics
- Meets the NCHRP 9-19, 9-29, AASHTO T 378, T342, & R 84 testing standards
- Optional fixtures for range of asphalt tests



## Specifications

Axial Load Capacity	19 kN
Confining Pressure Capacity	250 kPa
Maximum Frequency	25 Hz
Stroke	50 mm
Temperature Range	$-10^{\circ}\text{C}$ to $70^{\circ}\text{C}$

## Accessories

1. Testing fixtures for dynamic complex modulus, flow number, flow time, indirect tension, beam flexural fatigue, resilient modulus, direct tension, semi-circular bending, and Texas overlay tests

For more accessories, please contact GCTS.

## Description

The GCTS Asphalt Mixture Performance Tester (AMPT-15) was designed to easily and efficiently perform a large range of asphalt performance tests. This self-contained system is capable of performing dynamic modulus, flow time, and flow number tests, as well as other tests using optional fixtures.

All tests can be performed at a large range of temperatures and frequencies to simulate traffic loading and environmental conditions. When performing dynamic modulus tests, the entire master curve can be generated for each tested specimen.

This testing system is completely self-contained and wirelessly transmits testing data directly to a computer. The confining cell is on an automatic lift that can be raised with the press of a button. All testing procedures are completely automatic and computer-controlled, requiring no input from the operator after the initial setup. This allows tests to be run very quickly, making it one of the most productive systems on the market.

The AMPT-15 can be fitted with an optional assembly for the performance of beam flexural fatigue tests. This assembly attaches directly to the tabletop of the system and utilizes the same hardware, keeping this an entirely stand-alone system. All test results are also transmitted directly to a computer and analysis of the data is performed using our advanced software.

# Asphalt Pavement Tester

## APT-100E

- Economical solution for advanced asphalt pavement testing
- Dynamic complex modulus, flow number, flow time, indirect tension, beam flexural fatigue, resilient modulus, and direct tension tests all possible using this system
- Precise, accurate, quiet, and compact
- Frequencies up to 70 Hz
- Temperature control from  $-10^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$
- Complete turn-key system
- Meets most recent AASHTO, ASTM, and European testing standards



## Specifications

Static Load Capacity	100 kN
Dynamic Load Capacity	85 kN
Maximum Frequency	70 Hz
Vertical Daylight Opening	1,000 mm
Horizontal Daylight Opening	400 mm
Temperature Range	$-10^{\circ}\text{C}$ to $60^{\circ}\text{C}$

## Accessories

1. Testing fixtures for dynamic complex modulus, flow number, flow time, indirect tension, beam flexural fatigue, resilient modulus, and direct tension tests

For more accessories, please contact GCTS.

## Description

The GCTS Asphalt Pavement Tester (APT-100E) is the most affordable testing system on the market that offers a complete assortment of dynamic testing procedures for asphalt concrete. All equipment is offered in a modular fashion, so the user can select only the required testing modes.

Fixtures are available to allow the APT-100E to perform dynamic modulus, resilient modulus, beam fatigue, direct tension, indirect tension, flow number, and flow time tests. Advanced software and electronics create a complete turn-key system for each test, as all testing procedures are computer-controlled.

The APT-100E includes a specially designed dynamic actuator for frequencies up to 70 Hz with minimal friction for improved accuracy. The included environmental chamber has a large front viewing window, allowing for visual evaluation during testing. This chamber has temperature control better than  $0.2^{\circ}\text{C}$ .

As a completely self-contained unit, all necessary components, including an environmental chamber, A/C compressor, hydraulic pump, and electronics, are integrated into the single system.



Integrated Hydraulic Pump



# Servo-Hydraulic Asphalt Testing Machine

## ATM-025/100

- Advanced testing for Hot Mix Asphalt (HMA) and unbound materials
- Dynamic complex modulus, flow number, flow time, indirect tension, beam flexural fatigue, and resilient modulus tests
- Electro-Hydraulic Digital Servo Control
- Frequencies up to 70 Hz
- Modular design with easy to use software and electronics
- Meets the newest AASHTO (Superpave), ASTM and European (EN-12697-24,25,26) standards
- Complete turn-key system



## Specifications

	<u>ATM-025/100</u>
Dynamic Load Capacity	25 kN / 100 kN
Stroke	100 mm / 100 mm
Vertical Opening	1,200 mm / 1,200 mm
Horizontal Opening	600 mm / 600 mm
Temperature Range	-18°C to 80°C

## Description

The GCTS ATM-025/100 is a modular testing system that can be configured to test asphalt in a variety of modes. The system includes an environmental chamber which houses the optional accessories required to perform dynamic complex modulus, flow number, flow time, indirect tension, beam flexural fatigue, and resilient modulus tests.

The fully Integrated Digital Servo Controller has an embedded microprocessor capable of performing all test functions, even if the Windows computer is turned off. It provides automatic dynamic control mode switching between any connected transducer or calculated parameter. This controller also conditions all transducers used in the ATM-025/100 system. The universal input boards also include digital gain control for automatic range setting. This digital controller is capable of updating the control loop at up to 6 kHz, as is required for high fre-

quency dynamic tests. The GCTS controller has several adaptive compensation techniques to improve the control precision without user intervention. Adaptive control allows the system to precisely match the desired cyclic stress amplitudes throughout the tests.

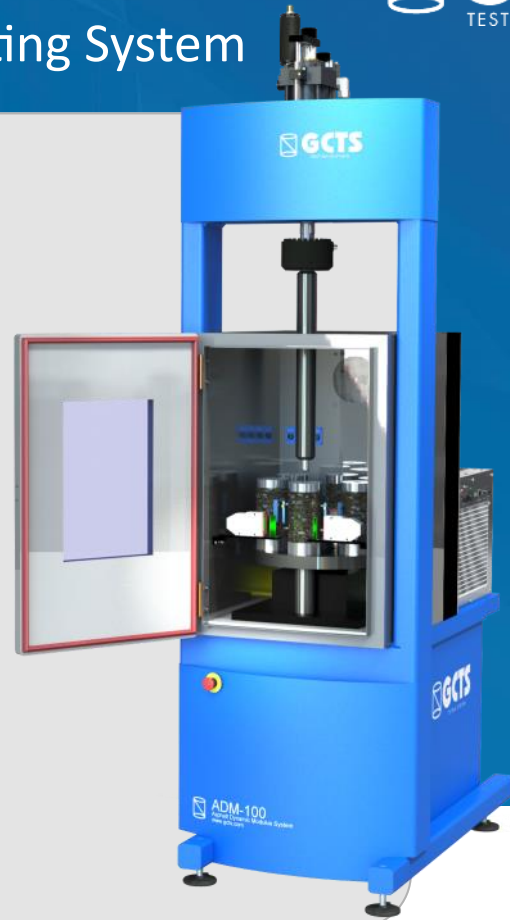
The ATM 025/100 includes a sliding drawer to easily remove and install test specimens, minimizing the time the environmental door is open. GCTS offers platens for unconfined dynamic modulus, triaxial cells for testing 100 mm (4 inch) diameter specimens cored out of a 150 mm (6 inch) specimens, indirect tension and beam flexural fatigue fixtures. The above devices comply with the applicable requirements of AASHTO, ASTM and European (EN-12697-24,25,26) specifications for testing bituminous mixtures.



# Automated Dynamic Modulus Testing System

## ADM-100

- Completely automatic dynamic modulus system
- Reduced testing costs
- Obtain full Master Curve on up to six specimens without user intervention
- Fast and easy specimen loading
- Electro-hydraulic digital servo control
- Frequencies up to 80 Hz
- Temperature control from  $-15^{\circ}\text{C}$  to  $80^{\circ}\text{C}$
- Capable of performing other tests, such as direct and indirect tension, beam fatigue, and more



## Specifications

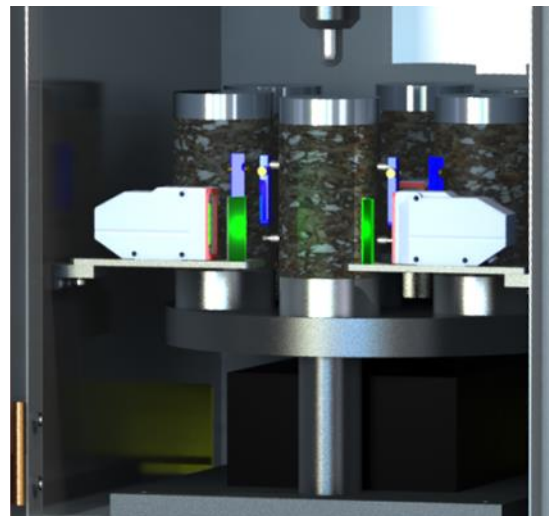
Dynamic Load Capacity	25 kN
Static Load Capacity	100 kN
Stroke	100 mm
Vertical Opening	1,200 mm
Horizontal Opening	600 mm
Temperature Range	$-15^{\circ}\text{C}$ to $80^{\circ}\text{C}$
Deformation Sensor	30 mm range 0.5 micron repeatability

All deformation measurements are made using two non-contact optical micrometers. These sensors can measure deformations using any axial gauge length and can account for any permanent deformations experienced by the specimen during testing. By using these sensors, the specimens can be rotated into position for testing and can be set up for measurements without needing to open the environmental chamber door. Since the door does not need to be opened during testing, the operator does not need to wait for the temperature in the chamber to equilibrate between tests at the same temperature. In addition, tests can be run without the operator present, allowing tests to run overnight.

## Description

The GCTS Automated Dynamic Modulus Testing System (ADM-100) is designed to dramatically increase the productivity of asphalt testing laboratories. This machine allows a full master curve to be developed for up to six specimens at once without any input from the operator after the initial setup.

This machine includes a rotating table that can fit up to six specimens. During the test, each specimen will rotate into position below the loading piston, so the operator does not need to open the door to the environmental chamber and reposition the specimen. This eliminates the time needed to stabilize the temperature after the door has opened and allows the test to be performed while the operator is away, making the time needed to perform and complete the test less than two days.



# Beam Flexural Fatigue Testing System

## BFFA-5

- Advanced testing for Hot Mix Asphalt (HMA) to determine the pavement fatigue life
- Stand-alone apparatus with a compact design, does not require an Asphalt Testing Machine
- Electro-pneumatic or electro-hydraulic digital servo control
- Frequencies up to 60 Hz
- Complete turn-key system
- Meets the newest SHRP, AASHTO (Superpave), ASTM and European (EN-12697-24,26) standards



## Specifications

Dynamic Load Capacity	5 kN (10 kN optional)
Stroke	5 mm
Deformation Sensor	±1 mm range
	0.5 micron repeatability
Temperature Range	-4°C to 60°C

## Accessories

1. Synthetic Beam Specimens
2. 4-Point Beam Fatigue CATS software

For more accessories, please contact GCTS.

## Description

The GCTS Stand-Alone Beam Flexural Fatigue Apparatus (BFFA-5) is an advanced Hot Mix Asphalt (HMA) testing system used to determine the fatigue life of the pavement layer. The fatigue life is an important indicator of the field performance of the asphalt subject to repeated flexural loading. The fatigue test on the asphalt beam can be conducted in two modes: constant strain/deflection or constant stress/load; both utilizing haversine, sine, square, triangular, or user-defined. The constant strain mode is recom-

mended for thinner pavement layers (<5" thickness); while in thicker pavements (>5" thickness) constant stress loading simulates the field conditions more closely. The BFFA-5 can perform the fatigue test in both modes at frequencies up to 60 Hertz.

The BFFA-5 stand-alone apparatus is a self-contained system featuring cradle support for the asphalt beam, clamps with controlled clamping force, LVDT, load cell and servo-controlled pneumatic or hydraulic actuators. The BFFA-5 is controlled with a GCTS Signal Conditioning and Control Unit (SCON Unit) which is interfaced with Windows™ Computer Aided Testing Software (CATS). The software automatically obtains the fatigue life parameters such as: initial stiffness, maximum tensile stress/strain, phase angle, dissipated energy per cycle, flexural stiffness, and number of repetitions to failure.

The system also supports the GCTS ECH-30CS Environmental Chamber as an optional attachment. This chamber is capable of controlling the specimen temperature throughout the test. The environmental chamber control accuracy is better than  $\pm 0.5^{\circ}\text{C}$ . Temperatures of  $-15^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$  ( $-30^{\circ}\text{C}$  with liquid Nitrogen boost) can be achieved with this option.



# Hamburg Wheel-Tracking Tester

## HWTT-100

- Accommodates cylindrical or slab specimens
- Stainless steel construction
- Water bath with temperature control up to 70°C
- Software for automatic determination of Stripping Inflection Point (SIP), number of passes to SIP, number of passes to failure Nf, and other calculated parameters
- Meets AASHTO T 324 and EN 12697-22 Testing Standards
- Available Superpave Gyratory Compactor (GRC-20) for specimen preparation



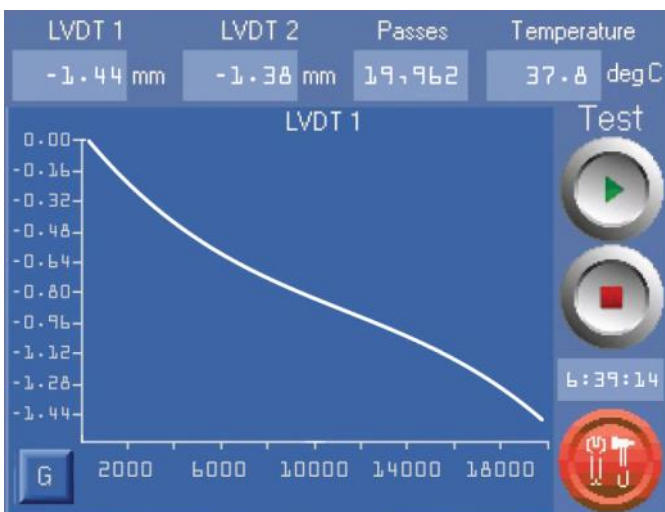
## Specifications

Load Capacity	705 N ( $\pm 4.5$ N)
Temperature Control	70°C ( $\pm 1.0^\circ\text{C}$ )

## Description

The GCTS Hamburg Wheel-Tracking Tester (HWTT-100) is used to test submerged, compacted Hot Mix or Warm Mix Asphalt specimens as per the AASHTO T 324 Standard. The device consists of a reciprocating wheel that is rolled over the specimens while measuring the rate of permanent deformation.

A constant load of  $705 \text{ N} \pm 4.5 \text{ N}$  is applied to the specimens with a sinusoidal wheel speed of 1 ft/sec in a constant temperature controlled water bath at temperatures up to  $70^\circ\text{C} (\pm 1.0^\circ\text{C})$ . A LVDT jig is used for continuous measurement of permanent deformation along the path of the rolling wheel.

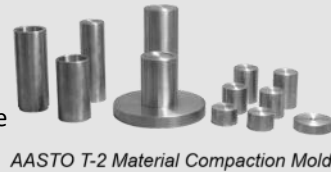


HWTT-100 Software Test Screen

# Resilient Modulus Testing System

## MRT-050/100/200/300

- Electro-Hydraulic (Electro-Pneumatic for MRT-050) Digital Servo Control
- Complete turn-key system
- Easy to use software for automatic test performance
- Meets AASHTO, SHRP and ASTM standards
- Triaxial cells for specimens from 71 mm (2.8 in.) to 150 mm (6 in.) diameter
- Available indirect tension fixtures to perform ASTM D4123 and SHRP P-7



## Specifications

MRT-	050	100	200	300
Load Capacity	14 kN	22 kN	45 kN	100 kN
Stroke	50 mm	50 mm	100 mm	100 mm
Max. Diameter	75 mm	75 mm	100 mm	150 mm
Max. Height	190 mm	190 mm	250 mm	375 mm

## Accessories

1. NCHRP 1-28 specified LVDT CLAMPS
2. Calibration Hardware
3. Additional platens & required sensors for smaller specimens to meet AASHTO T-307 specifications
4. Unsaturated option for suction controlled tests

For more accessories, please contact GCTS.

## Description

The GCTS Resilient Modulus Testing System (MRT Series) boasts a modular design that allows the system to be configured to test soil in a variety of modes. This system is based on the GCTS SCON Digital Signal Conditioning and Controller and can be supplied with a pneumatic or hydraulic loader.

The GCTS Resilient Modulus software features built in AASHTO, SHRP, and NCHRP test sequences and the capability to specify user-defined sequences. Contact stress is automatically adjusted according to each procedure as selected. Available waveforms include haversine, sine, square and triangular, along with a user-defined waveform selection. Optional peak and valley compensation ensures proper and quick matching of the load parameters. Real-time displays of the prescribed versus actual dynamic load and the dynamic deformation measurements by each sensor are always present.

The deformation ratio of the two sensors,  $R_v$  (to ensure that the two deformation sensors are in agreement), and resilient modulus,  $M_r$ , are also calculated in real-time. During export, curve fitting is done to match the results to models that predict  $M_r$  as a function of  $\sigma_m$ ,  $\sigma_d$ , and cell pressure (CP). Four different functions are calculated automatically, as required by AASHTO and NCHRP procedures.

The MRT-300 can test specimens with a 70 mm, 100 mm, or 150 mm diameter, although it is recommended to use a smaller system for 70-mm diameter specimens, such as the GCTS Electro-Pneumatic Resilient Modulus System (MRT-50). All standard systems include the required dual external deformation sensors with supports and internal/external load cell.

This GCTS Device is a sound and well-integrated system designed to perform Resilient Modulus tests, as well as standard triaxial (static and dynamic) tests and other, more complex tests, such as Complex Modulus tests.

# GCTS Asphalt Specimen Preparation Equipment

## ACD-150

### Pressure-Controlled Coring Machine

The GCTS ACD-150 allows for either force or stroke control, which optimizes feeding rates during coring. This allows for precise specimens to be made, even if the material is not homogeneous. Diamond coring barrels are available for different specimen types, diameters, and lengths.

- 150 to 4,200 rpm spindle speeds
- 1.5 HP motor
- Automatic down feed mechanism with 250 mm travel
- Stiff frame to eliminate specimen ridges
- Drilling rate controlled by pressure and speed



## RLS-100

### Specimen Lab Saw

The RLS-100 is designed to easily and efficiently prepare rock, asphalt, or concrete specimens. This system can accommodate specimens with a diameter of up to 175 mm and the cutting blade spins at up to 800 rpm.

The RLS-100 has an automatic specimen advancing mechanism, allowing for complete automation. The advance rate can be set from 230 mm/hour up to 340 mm/hour. Power comes from a 1 HP electric motor, with a 3 HP motor available upon request.



## RSG-500

### Specimen Grinder

The GCTS RSG-500 provides the final step to prepare test specimens with parallel and flat ends according to ASTM, ISRM, and AASHTO standards. The grinder is driven by a heavy-duty 2 HP electric motor. A diamond grinding cup wheel is provided, along with a precise turntable to rotate the specimen exactly 180 degrees to ensure parallel faces. Holding fixtures for 25 mm to 150 mm diameter specimens are provided. The RSG-500 also includes an automatic feed to move the specimen across the grinding wheel and a vortex tube for specimen surface cooling during dry grinding.





# GCTS Asphalt Testing Accessories

## GPF-100

### Automatic Positioning Fixture

The GCTS GPF-100 was designed for easy and accurate extensometer holder positioning on the cylindrical asphalt specimens used in Dynamic Modulus tests. With the GPF-100 and the specially designed extensometer holding pins, the need for labor-intensive effort is eliminated and the preparation time is reduced to a fraction of the time that is typically required.

The pin holder front face includes a recess to avoid squeezing the epoxy out while it is pressed against the sample. These pins, together with the GPF-100 fixture, provide the most accurate method of affixing the axial strain measurement sensors for dynamic testing.

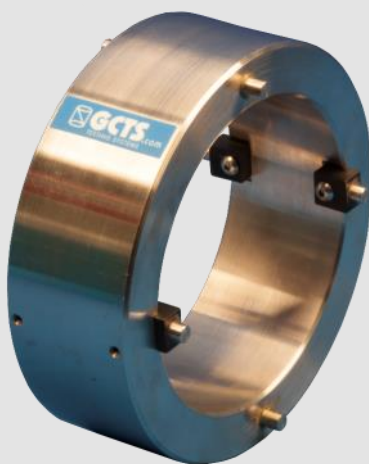


## CAL-100

### Calibration Specimens

The GCTS CAL-100 Calibration Specimens provide repeatable results for various tests to ensure accurate calibration of the testing system and allow for effective training without the risk of damaging a real specimen. Both metallic and polymer specimens are available. Calibration specimens can be used for Beam Fatigue, Dynamic Complex Modulus, and Indirect Tension Tests.

Application	Nominal Modulus
BFFA (Low Stiffness)	110 MPa
BFFA (High Stiffness)	250 MPa
Dynamic Modulus	2,100 MPa
Indirect Tension (Low Stiffness)	3,100 MPa
Indirect Tension (High Stiffness)	37 GPa

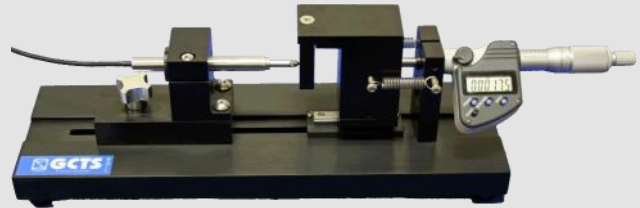


# GCTS Asphalt Testing Accessories

## DCD-25

### LVDT Calibration Device

The GCTS LVDT Calibration Device provides a very simple and easy-to-use technique to accurately calibrate a wide variety of LVDTs. The DCD-25 features spring loaded linear displacement to prevent system compliance when reversing directions. The readout is available in both SI and English units. The device has an adjustable mounting bracket that can accommodate LVDTs of most sizes. It provides a calibration range of 25 mm (1 inch) with 0.001 mm (0.00005 inch) resolution.

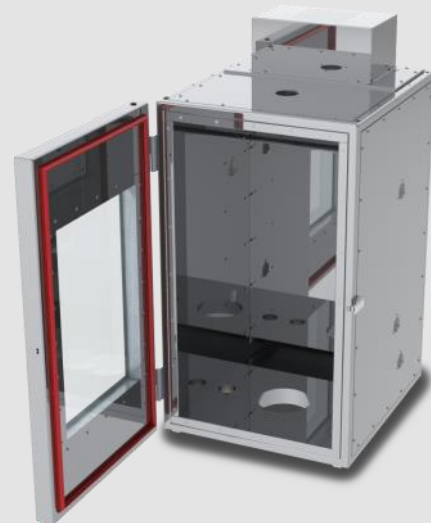


## ECH Series

### Environmental Chambers

The GCTS Environmental Chambers are temperature control devices capable of accommodating the testing fixtures for soil, asphalt, rock, and other construction materials while maintaining the temperature of the specimen with an accuracy of 0.5°C. The chambers have a viewing window in the front for visual monitoring of testing procedures.

GCTS offers multiple environmental chambers with a variety of temperature ranges from -30 °C to +150 °C. The standard models include a cooling unit for temperature control down to -15 °C. The chambers can be upgraded with liquid nitrogen for cooling down to -30 °C.



## Installation and Training

GCTS has a highly knowledgeable and professional staff who are capable of training your system operators regardless of the operator's level of familiarity with the systems.

Our training staff has decades of experience ranging from commercial to high-level research. They will guide your operators step by step to ensure they are fully comfortable with the entire testing process. Our team is also available to help with system installation and maintenance. Short courses are also periodically offered at GCTS facilities. Please contact GCTS to schedule an appointment.



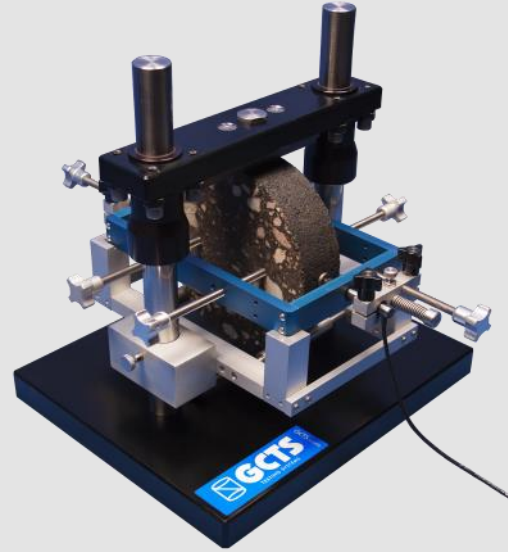
# GCTS Asphalt Testing Machine Modules

## IDT-150A

### Indirect Tension Module

The IDT-150A module can be used with any other asphalt testing system to perform indirect tension tests on cylindrical Hot Mix Asphalt specimens. This module can also be used to perform creep compliance tests, and can also perform tests in all temperature conditions provided by the GCTS Environmental Chambers.

This module meets SHRP-PO7, ASTM D4123, NCHRP 1-28, EN12697-24 & 26 testing standards.



## APU-AASH62

### Dynamic Complex Modulus Module

The APU-AASH62 Dynamic Complex Modulus Module can be used with any other asphalt testing system to perform dynamic complex modulus tests on cylindrical Hot Mix Asphalt specimens. This module can also be used to perform tests in all temperature conditions provided by the GCTS Environmental Chambers.

This module meets AASHTO TP 62, ASTM D3497, and EN 12697-25 testing standards.

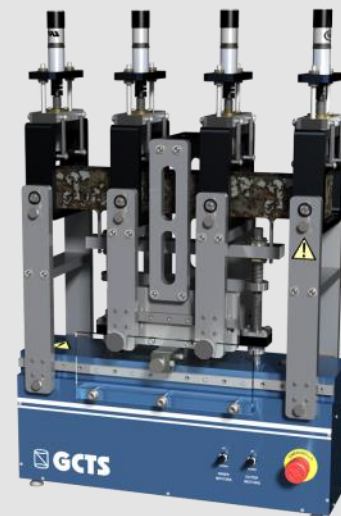


## BFF-5

### Beam Flexural Fatigue Module

The BFF-5 Beam Flexural Fatigue Module can be used with any other asphalt testing system to perform beam fatigue tests on Hot Mix Asphalt specimens. This module can also be used to perform tests in all temperature conditions provided by the GCTS Environmental Chambers.

This module meets AASHTO T 321, SHRP M009, EN 12697-24, and EN 12697-26 testing standards.





# GCTS Asphalt Testing Machine Modules

## DTA-100

### Direct Tension Module

The GCTS Direct Tension Module for Asphalt Specimens (DTA-100) includes a set of upper and lower crossheads with angle brackets designed to test asphalt specimens with a diameter of 100 mm. This fixture can be used for direct tension, torsion, and shear tests on asphalt specimens.

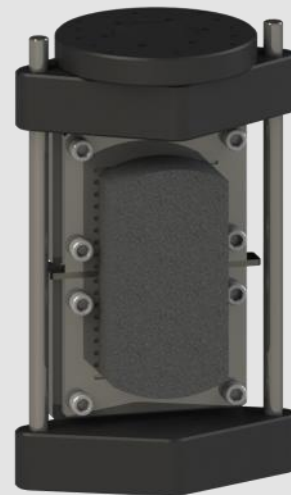
An epoxy kit is required to secure asphalt specimens to the angle brackets. This fixture was designed to be used with the GCTS ATM-025/100 system.



## AMPT-TXOVR

### Texas Overlay Module

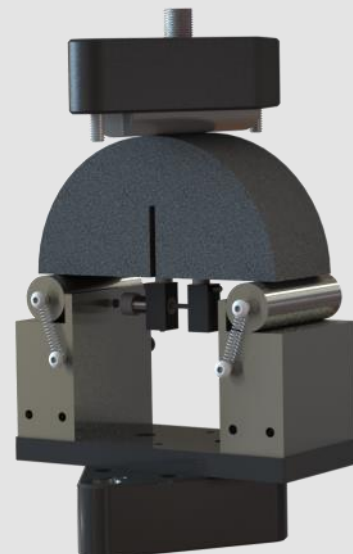
The GCTS Texas Overlay Module (AMPT-TXOVR) can be used with any GCTS Asphalt Testing System to perform Texas Overlay Test according to Tex-248-F. Includes specimen platens and loading plates to perform tests while keeping the specimen aligned. Also includes specimen preparation plate and spacer bar. An epoxy kit is required to secure asphalt specimens to the fixture.



## AMPT-SCB

### Semi-Circular Bending Module

The GCTS Semi-Circular Bending Module (AMPT-SCB) can be used with any GCTS Asphalt Testing System to perform semi-circular bending tests as required by AASHTO TP124, AASHTO TP105 and ASTM D8044.



# Wireless Automatic Data Acquisition Unit

## DataCube

- Portable data acquisition unit
- Communicates with mobile device via Bluetooth
- Four total sensor inputs for strain gauges, load cells, pressure transducers, and other DC / SG sensors
- Store up to 10,000 data points per input channel
- Universal Data Acquisition software compatible with iOS (8+), Android (4.4+), and Windows 10 (FCU Version 1709+) devices.
- Powered by AA batteries or Micro USB connector
- Available applications for a variety of test equipment, including:
  - Consolidation, direct shear, point load, unconfined compressive strength, and more



## Specifications

Resolution	16-bit
Max. Sensor Inputs	Four (4) DC/SG
Max. Acquisition Rate	100 samples per sec.
Operating Temp. Range	0°C to +50°C
Temperature Stability	+/- 0.0025% F.S.



## Description

The GCTS DataCube is a four-channel, wireless data acquisition unit. This system can accept load cells, pressure transducers, LVDTs, or other analog input signals (strain gages and AC sensors require signal conditioning, sold separately). Each channel features digital offset and gain, 16-bit resolution, and an anti-alias filter.

A wireless device (Android, Apple, or Windows) must be connected to the DataCube via Bluetooth™ to begin recording data. Once the DataCube begins recording data, the user can disconnect their device. At any time, the user can reconnect their device to view current data or, when the test is over, collect all recorded data. This is ideal for long term tests as the user will not need to be at the system constantly taking readings. The data can then be easily send to an email in a spreadsheet attachment.

Various mobile applications are available for specific tests, including consolidation, direct shear, indirect tension, point load, and unconfined compressive strength. Please contact GCTS for a current list of applications.

# Digital Signal Conditioning and Control Unit

## SCON-1400/1500/3000

- 16 or 24 bit A/D resolution and 100 kHz conversion rate with track-and-hold
- Adaptive digital servo control with Windows™ interface software
- Accepts Universal Digital Signal Conditioning modules for load cells, LVDTs (AC and DC), pressure sensors, or other analog input signals
- Internal and external temperature monitoring



### Specifications

Specifications	SCON-1400	SCON-1500	SCON-3000
Resolution	16 bit	16 bit	24 bit
Max. Analog Inputs	4 AC, 4 DC/SG	8 Universal	23 Universal*
Max. Analog Outputs	4 (max. 2 servo outputs)	4	23 Universal*
Microprocessor	800 MHz	850 MHz	3.4 GHz
Maximum Control Loop Rate	4,000 Hz	4,000 Hz	10,000 Hz
Max. Power	0.4 kW	0.4 kW	1.0 kW
Interface	Wi-Fi, USB, TCP/IP	Wi-Fi, USB, TCP/IP	Wi-Fi, USB, TCP/IP

### Description

The GCTS SCON units are complete and self-contained modules that feature integrated microprocessor-based digital servo controllers, a built-in function generator, data acquisition, and digital I/O unit.

By utilizing state-of-the-art Universal Signal Conditioning boards, these systems can accept load cells, pressure transducers, LVDTs, thermocouples, or other analog input signals. Each channel features digital offset and gain and an anti-alias filter. This system also includes “track-and-hold,” which ensures the converted values from all attached sensors represent a single instant in time, eliminating any data skew from delays in the A/D converter.

The signal conditioning electronics are fully digital with settings directly manipulated by the software. Different equipment configurations are saved, which makes it very easy to change any sensor. The digital settings are also protected, eliminating the chance of accidental modifications to sensor calibrations and amplifications. In

addition, the systems incorporate automatic sensor recognition that will automatically load the correct sensor setup upon connecting or changing of a transducer. This system also allows for easy creation of virtual sensors based on existing ones with a smaller calibrated range.

Included with these systems is the GCTS CATS Standard Software that is compatible with all versions of Windows™. The standard systems also include calculated inputs from one or several analog channels that can be directly servo controlled or monitored in real time. Any system sensor can then be used to provide advanced servo control with on-the-fly, bumpless transfer, switching between any connected transducer or calculated inputs.

The newest SCON system, the SCON-3000, can wirelessly communicate with the controlling computer, allowing a user with a laptop computer to freely move around the laboratory while remaining in control of the testing system.

\*Inputs and Outputs are interchangeable. The total number of inputs and outputs must be less than or equal to 23.



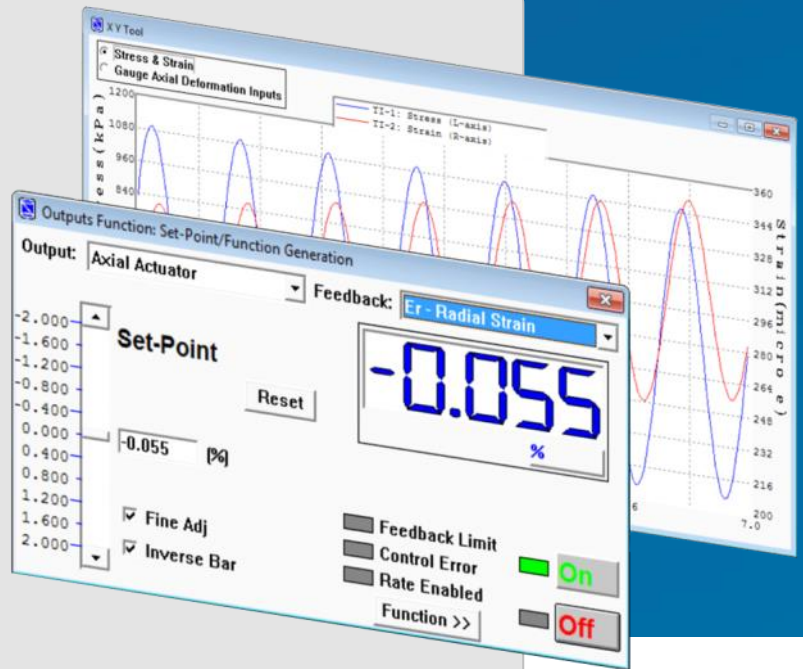
SCON-3000



# Advanced Computer Aided Testing Software

## CATS-ADV

- Advanced servo control from any system sensor or calculated variable
- On-the-fly, bumpless transfer and adaptive compensation
- Advanced digital temperature control
- Automatic frequency sweeps
- Independent and synchronized control of up to 10 outputs
- Complete units library including SI, metric, English and user-defined units
- Real-time graphics of input channels
- Remote monitoring of test through networks
- Application programs include Indirect Tension, Beam Flexural Fatigue, Dynamic Complex Modulus, Resilient Modulus, and more



## Description

The GCTS Advanced Windows™ compatible software, coupled with SCION electronics, is the most advanced Geotechnical testing software available today. This software has simplified the operation of our instruments, allowing the user to directly program test-calculated parameters in the units of interest based on the specimen's dimensions. These parameters are calculated in real-time and are available for display, graph and control. Since GCTS signal conditioning

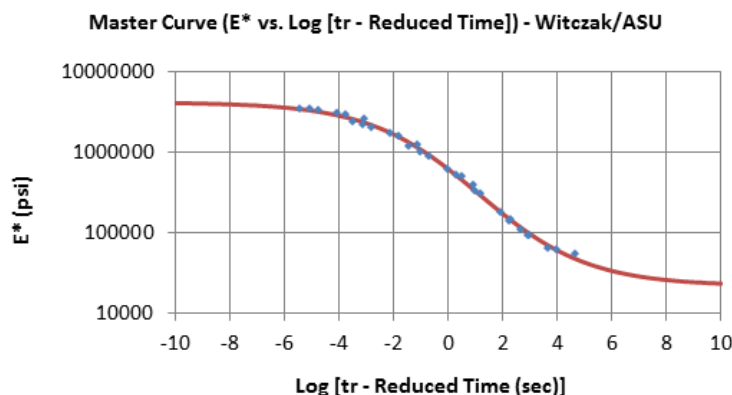
electronics are fully digital, optimization and calibration settings are software controlled. Alternate equipment configurations can be easily saved within the software so that the software can quickly recognize when a sensor has been changed and update with the new settings. All the offset and gain settings are managed by our computer software, reducing the possibility of accidentally changing the sensor calibration. The CATS software includes a digital filter on the

sensor inputs to assist in eliminating noise from the digital signal.

All of our testing systems have been designed to take full advantage of our software and electronics so that all test stages can be automatically performed with minimal user intervention.

The Universal test module of the CATS Advanced software is a very versatile and powerful module that allows the user to establish any test procedure that they wish. It allows the user to simultaneously control up to 10 outputs (synchronous or asynchronous) in any phase, and allows the user to run unlimited phases or test programs.

GCTS offers many application software modules to perform specific test procedures (Triaxial, Direct Shear, Resonant Column, and more), and each module includes the Universal Module to program user-defined tests.

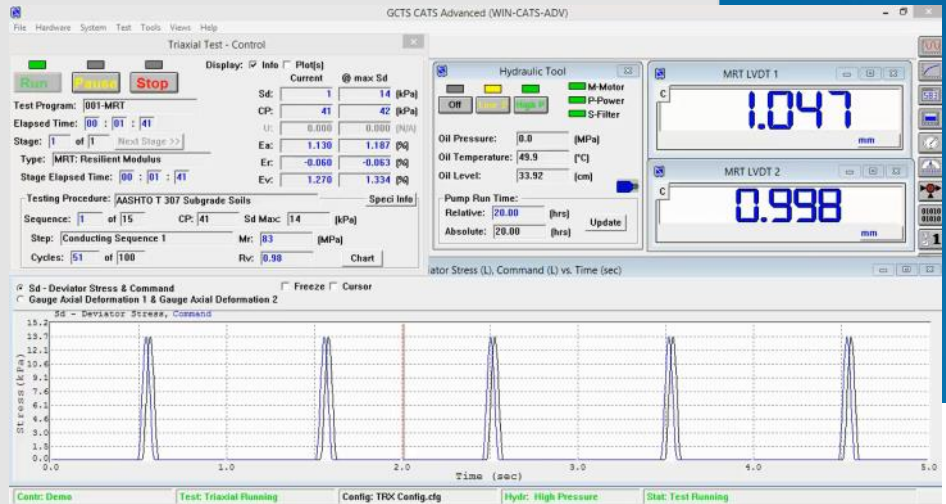


Automatic Master Curve Generation

# Application Software Modules

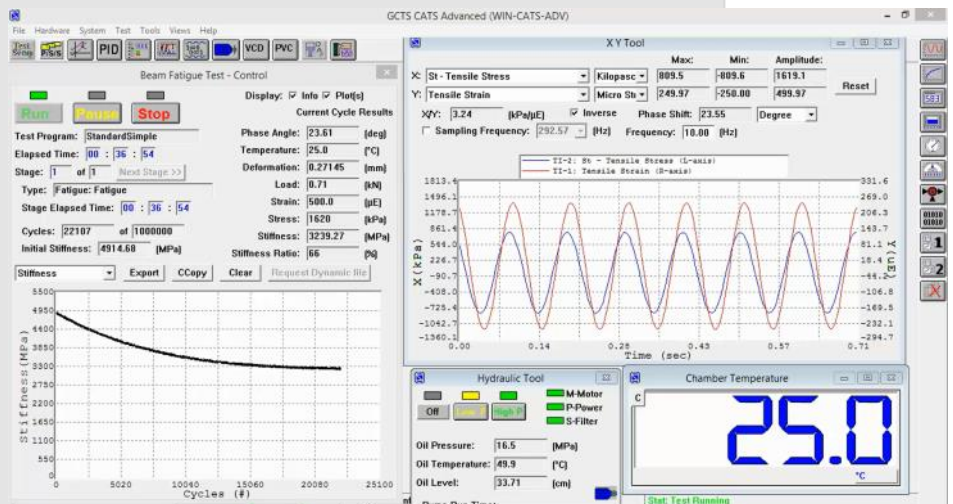
## CATS-IDT

The GCTS Indirect Tension software module allows the user to perform Creep Compliance, Fatigue, Resilient (Stiffness) Modulus, and Tensile Strength tests using an Indirect Tension Apparatus (either American or European standard apparatus). While the user can configure and set up the test to be performed according to a single standard, the software will automatically calculate and display the results for all other available standards.



## CATS-BFF

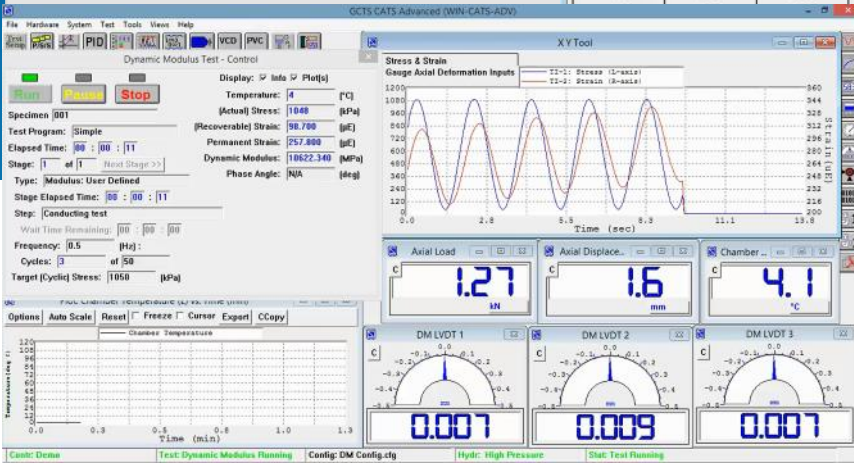
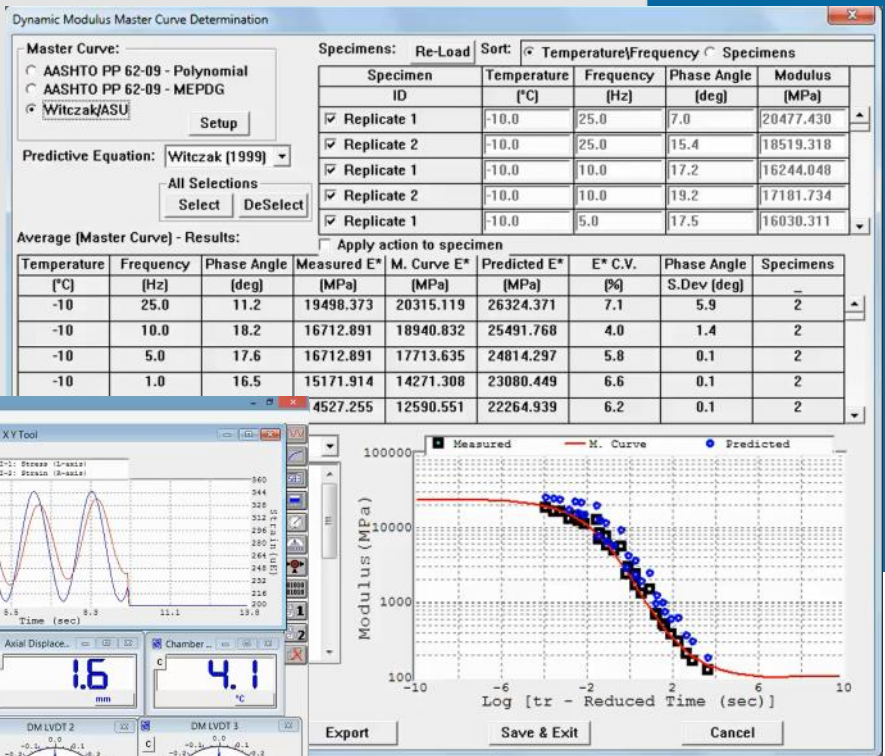
The GCTS Beam Flexural Fatigue software allows for automatic execution and control of a long-term fatigue test with relative ease and flexibility. The fatigue test on the asphalt beam can be conducted in two modes: constant strain/deflection or constant stress/load.



# Application Software Modules

## CATS-DCM

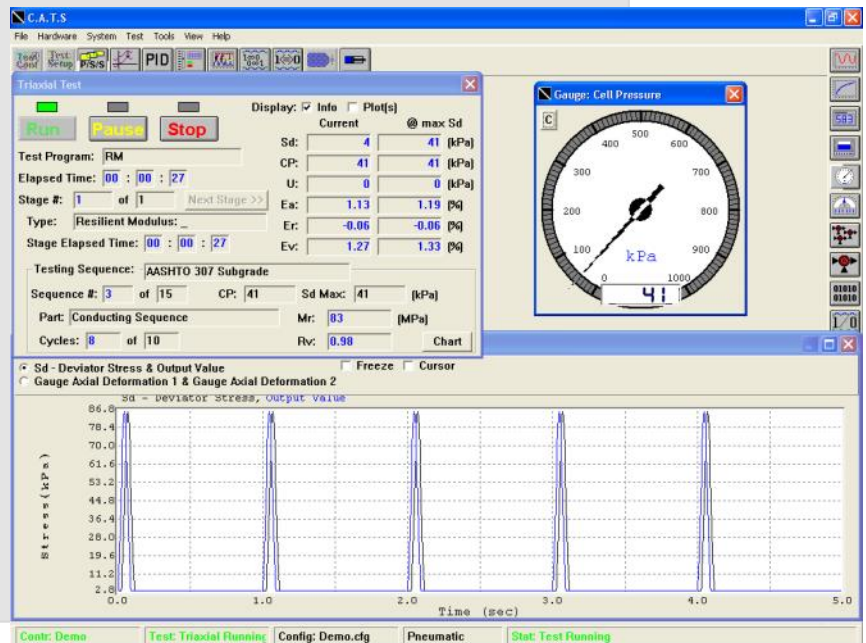
The GCTS Dynamic Complex Modulus software allows for automatic test execution for one or multiple tests. Each individual test can be programmed for different temperatures and frequencies, as well as the number of replicates at each temperature and frequency pair. This program includes a function solver to automatically obtain the master curve from the test data.



## CATS-TRX-MRT

The GCTS Resilient Modulus Software automatically performs resilient modulus tests. This software can control all stages of testing, including user-defined, custom stages. The user can also select different waveforms for testing, including sine, haversine, and triangular.

During testing, there is on-the-fly measurement of  $R_v$  (to ensure that the two deformation sensors are in agreement) and  $M_r$ . During export, curve fitting is done to fit the results to models that predict  $M_r$  as a function of  $\sigma_m$ ,  $\sigma_d$ , and cell pressure.





# GCTS App for iPhone & iPad

## gTest

- Remote monitoring of test status in real-time
- Facilitates transducer and test setup
- Improves productivity and time efficiency
- Alerts if test system reaches warning/abort limits
- Secure encrypted data transmission
- Interface screens for triaxial, direct shear, creep and other GCTS CATS test modules



## Description

GCTS has developed gTest for the iPhone/iPad. gTest is a remote monitoring application that is used to display test status in real-time. Current test information can be displayed digitally or graphically from any location. Sensor outputs, hydraulic power supply status, cycle count, and other general test progress can be accessed through a local wireless network or through the internet at remote locations.

The gTest app can be used to facilitate transducer setup where a view of the computer screen might be obstructed, as the test specimen may be placed inside an environmental chamber or some other hard-to-reach place. This application also allows the user to move freely around the testing system and check every one of the test sensors to ensure they are properly working and set at their right position. gTest improves productivity and eliminates requirement for a second person to set up and start a test.

The gTest app can also be run from remote locations via the Internet, allowing the

user to monitor test status without having to physically be in front of the test system. This convenient application gives the user the freedom to go back to their office (or home) and be able to continuously monitor the test system performance. Test program sequencing mistakes and glitches in the hydraulic or pneumatic pressure supplies can be detected at their onset, allowing for timely corrective action. With this app, one person can manage multiple test systems even if they are located in different rooms.

This application is also a great tool for university labs. While inexperienced students are performing their own experiments, the lab instructor can easily monitor their progress. Student test program errors and abnormal test results can be quickly noticed by a supervisor, prompting the student for appropriate action.

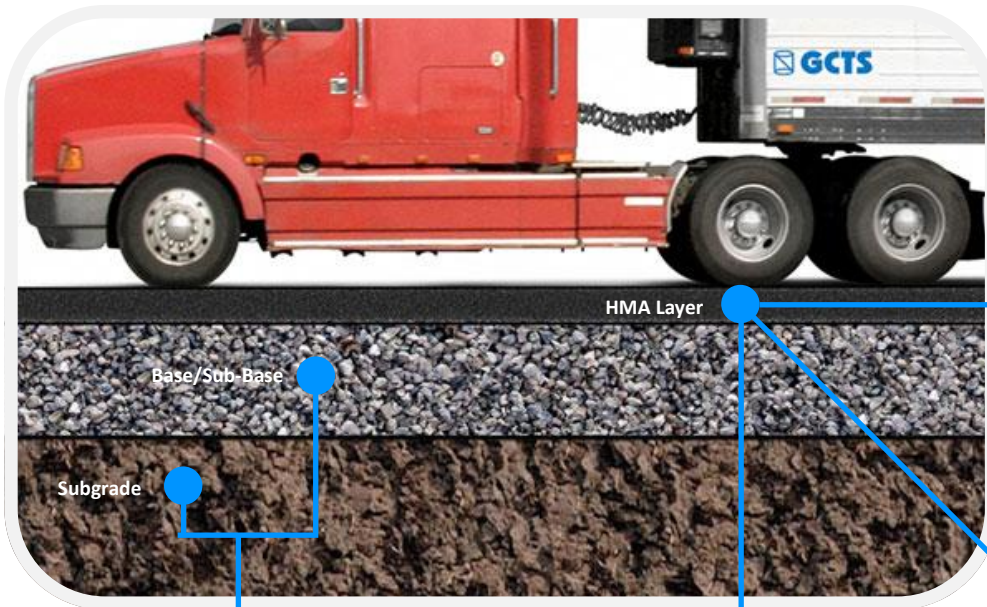
Transmitted data is securely encrypted, providing access to only pre-authorized personnel. If desired, the user can give access to GCTS support engineers allowing for remote service and real-time system optimization.

The gTest application software includes all of the different test mode interface screens offered by GCTS CATS test software modules. Each one offers an automatic screen setup to monitor and graph relevant test data for each particular test mode.





# Advanced Pavement Performance Tests



**Beam Flexural Fatigue**

SHRP M-009, AASHTO T 321, AASHTO TP3, EN 12697-24 & 26



**Resilient Modulus**

AASHTO T 307, NCHRP 1-28, SHRP P46  
ASTM D3999-1 & D5311



**Dynamic Complex Modulus**

AASHTO T 342, NCHRP 9-29, ASTM D3497, EN 12697-25

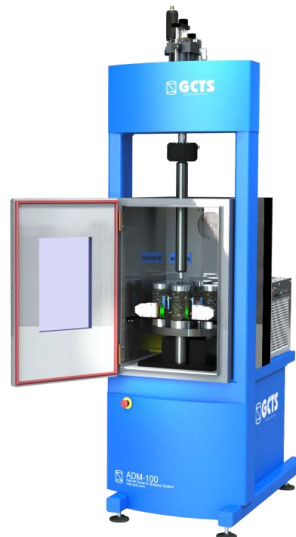


**Indirect Tension**

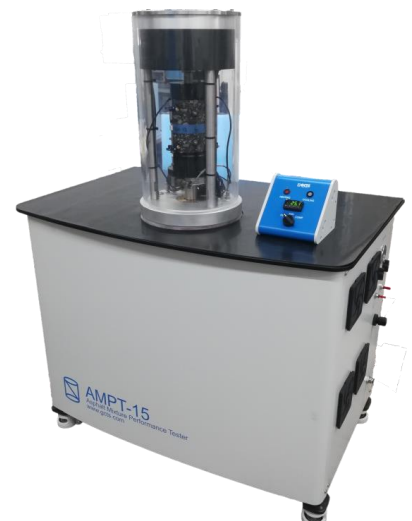
SHRP P07, ASTM D4123, NCHRP 1-28, EN 12697-24 & 26



**MRT-300**



**ADM-100**



**AMPT-15**

# Notes

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## Useful Conversions

### LENGTH

- 1 in = 2.54 cm
- 1 in = 0.0254 m
- 1 ft = 0.3048 m
- 1 ft = 30.48 cm
- 1 cm = 0.3937 in
- 1 m = 3.281 ft
- 1 km = 0.62137 mi

### AREA

- 1 in<sup>2</sup> = 6.4516 cm<sup>2</sup>
- 1 in<sup>2</sup> = .00064516 m<sup>2</sup>
- 1 ft<sup>2</sup> = 0.09290 m<sup>2</sup>
- 1 ft<sup>2</sup> = 929.03 cm<sup>2</sup>
- 1 ft<sup>2</sup> = 144 in<sup>2</sup>
- 1 cm<sup>2</sup> = 0.155 in<sup>2</sup>
- 1 m<sup>2</sup> = 10.7638 ft<sup>2</sup>
- 1 m<sup>2</sup> = 1550 in<sup>2</sup>

### VOLUME

- 1 in<sup>3</sup> = 16.387 cm<sup>3</sup>
- 1 in<sup>3</sup> = 16.387x10<sup>-6</sup> m<sup>3</sup>
- 1 ft<sup>3</sup> = 0.028317 m<sup>3</sup>
- 1 ft<sup>3</sup> = 28316.8 cm<sup>3</sup>
- 1 ft<sup>3</sup> = 1728 in<sup>3</sup>
- 1 cm<sup>3</sup> = 0.06102 in<sup>3</sup>
- 1 m<sup>3</sup> = 35.315 ft<sup>3</sup>
- 1 m<sup>3</sup> = 61023 in<sup>3</sup>

### FORCE / MASS

- 1 kg = 9.807 N = 0.009807 kN
- 1 kg = 2.205 lb
- 1 lb = 4.448 N = 0.004448 kN
- 1 kN = 224.82 lb
- 1 kN = 101.98 kg
- 1 ton (USCS) = 2000 lb = 8.896 kN
- 1 ton (SI) = 1000 kg = 2205 lb
- Note:  $g = 9.807 \text{ m/sec}^2 = 32.2 \text{ ft/sec}^2$

### PRESSURE

- 1 kg/cm<sup>2</sup> = 98.07 kPa
- 1 psi = 6.895 kPa
- 1 psf = 0.04788 kPa
- 1 tsf (USCS) = 95.76 kPa
- 1 ton/m<sup>2</sup> (SI) = 9.807 kPa
- 1 kN/m<sup>2</sup> = 1 kPa
- 1 atm = 101.33 kPa
- 1 atm = 33.93 ft of H<sub>2</sub>O

### UNIT WEIGHT

- 1 kN/m<sup>3</sup> = 6.366 lb/ft<sup>3</sup>
- 1 kN/m<sup>3</sup> = 0.102 Mg/m<sup>3</sup>
- 1 lb/ft<sup>3</sup> = 0.1571 kN/m<sup>3</sup>
- 1 Mg/m<sup>3</sup> = 9.807 kN/m<sup>3</sup>
- 1 ton/m<sup>3</sup> (SI) = 9.870 kN/m<sup>3</sup>
- 1 kN/m<sup>3</sup> = 0.102 ton/m<sup>3</sup> (SI)
- 1 kN/m<sup>3</sup> = 0.003183 ton/ft<sup>3</sup> (USCS)

### METRIC PREFIXES

- micro (μ) - 10<sup>-6</sup>
- milli (m) - 10<sup>-3</sup>
- centi (c) - 10<sup>-2</sup>
- deci (d) - 10<sup>-1</sup>
- hecto (h) - 10<sup>2</sup>
- kilo (k) - 10<sup>3</sup>
- Mega (M) - 10<sup>6</sup>
- Giga (G) - 10<sup>9</sup>

### COMMON EQUIVALENTS

- 1 ft<sup>3</sup> of water = 62.4 lbf
- 1 gal of water = 8.34 lbf
- 1 m<sup>3</sup> of water = 1000 kg
- 1 m<sup>3</sup> of water = 9.81 kN
- $\gamma_{\text{concrete}} \approx 150 \text{ lb/ft}^3$
- 1 kPa = 10.2 cm of water
- 1 gal (USCS) = 231 in<sup>3</sup>

### TEMPERATURE

- °F = 1.8 (°C) + 32
- °C = (°F - 32) / 1.8
- °R = °C + 459.69
- K = °C + 273.15

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