Servo-Pneumatic Universal Testing Machine CRT-UTM-NU



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Rapid determination of modulus, permanent deformation and fatigue of bituminous mixtures using cylindrical specimens that are cored from the highway or prepared in the laboratory

BRIEF INTRODUCTION

This machine is a development of the NAT which was developed by Keith Cooper and Professor Steven Brown at the University of Nottingham. The use of a high precision servo-pneumatic valve in conjunction with a low-friction actuator and sophisticated data acquisition and control, results in a performance that is equal to many servo-hydraulic systems.

Accurate, digitally generated waveforms are applied by the actuator producing repeatable stress variations in test specimens that are simulative of those in a road pavement due to moving traffic. The actuator is double-acting allowing both compressive and tensile forces to be applied. A triaxial cell system is available for the measurement of the resilient modulus of unbound materials.

KEY FEATURES

- Low cost dynamic loading universal test system ideally suited to testing asphalt and unbound granular materials
- Double acting low friction actuator with integral stroke transducer
- Utilises high performance ceramic spool servo-valve
- High quality stainless steel frame
- Issued with UKAS accredited certificate of calibration for EN 12697-24; EN 12697-25, EN 12697-26
- Accessories available to perform a range of standard and non standard test methods
- Can be supplied with standard software to perform EN, ASTM and AASHTO test methods and universal software with which to design non standard test routines

KEY USES

- Assessment of resistance to permanent deformation (rutting)
- Measurement of stiffness modulus
- Assessment of resistance to fatigue cracking
- Resilient modulus of unbound materials
- Mix design

TEST METHODS INCLUDE

ASPHALT

Modulus

- EN 12697-26 Annex C
- ASTM D4123
- AASHT0 TP31
- AASHTO TP62

Permanent Deformation

• EN 12697-25 Method A & B

Fatigue

• EN 12697-24 Annex E

Simple Performance Tests

• Dynamic Modulus; Flow number NCHRP9-19; NCHRP9-29

UNBOUND MATERIALS

- AASHTO T307 (previously TP46)
- NCHRP 1-28A

SYSTEM ELEMENTS

The CRT-UTM-NU is comprised of:

- A rigid stainless steel test frame with adjustable height cross-head
- A precision servo-valve with ceramic spool
- Pneumatic actuator with low friction seals and integral stroke transducer
- Load transducer (±20kN capacity)
- Servo-amplifier for PID control of servo-valve

- Acquisition and control system includes:
- » Signal conditioning for load transducer, thermocouples, displacement transducers
- Multifunction high speed, 16bit analogue to digital, 16bit digital to analogue input-output card for closed loop computer control of system (National Instruments)
- » Thermocouples
- Pneumatic fittings including filtering, pressure regulator and tubing

Servo-Hydraulic Universal Testing Machine CRT-UTM-HYD



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A new generation of Universal Testing Machine combining state of the art technology with proven reliability and precision for research and standard testing

BRIEF INTRODUCTION

The Servo-Hydraulic Universal Testing Machine (CRT-UTM-HYD) is a well designed, inexpensive machine specifically developed for the testing of materials used in pavement construction.

A motorized, adjustable crosshead reduces the time between test setups. The programmable temperature cabinet provides the possibility to perform frequency/temperature sweeps. Accurate waveforms are digitally generated and applied by the actuator producing repeatable conditions that are simulative of those created by moving or static vehicles. The actuator is double-acting allowing both compressive and tensile forces to be applied. Various systems are available for the measurement of the modulus of unbound materials.

KEY FEATURES

- Designed to perform a range of tests on asphaltic paving materials, sub-grade soils and granular sub-base materials
- Double acting fatigue rated hydraulic actuator with integral stroke transducer
- Utilises Star servo valve with 'Sapphire Technology'
- Motorised adjustable lower crosshead with automatic • hydraulic frame clamping
- Integral programmable temperature controlled cabinet •
- Issued with UKAS accredited certificate of calibration for • EN 12697-24; EN 12697-25, EN 12697-26
- Accessories available to perform a range of standard and non standard test methods
- Can be supplied with standard software to perform EN, ASTM and AASHTO test methods and universal software with which to design non standard test routines

TEST METHODS INCLUDE

ASPHALT

Modulus

- EN 12697-26 Annex C
- **ASTM D4123**
- AASHT0 TP31
- AASHT0 TP62

Permanent Deformation

- EN 12697-25 Method A & B

Chinese Tests

Bending; Creep; Splitting Test

Simple Performance Tests

Dynamic Modulus; Flow number NCHRP9-19; NCHRP9-29

SYSTEM ELEMENTS

The CRT-UTM-HYD is comprised of:

- A rigid stainless steel loading frame
- An externally mounted fatigue rated hydraulic • actuator with Star servo valve
- A sophisticated data acquisition and control system •
- An integral temperature controlled cabinet -20 to 30°C with double glazed viewing door
- A motorised adjustable lower crosshead with • automatic hydraulic frame clamping
- Load transducer (±25kN capacity)

- Acquisition and control system includes:
- » Signal conditioning for load transducer, thermocouples and displacement transducers
- Servo-amplifier for PID control of servo-valve »
- Multifunction high speed, 16bit analogue to » digital, 16bit digital to analogue and digital input-output card for closed loop computer control of system (National Instruments)

KEY USES

- Assessment of resistance to permanent deformation (rutting)
- Measurement of stiffness modulus
- Assessment of resistance to fatigue cracking
- Resilient modulus of unbound materials
- Mix design

UNBOUND MATERIALS

- AASHTO T307 (previously TP46)
- NCHRP 1-28A

- EN 12697-24 Annex E
- Fatique

Servo-Pneumatic Universal Testing Machine CRT-UTM-NU Servo-Hydraulic Universal Testing Machine CRT-UTM-HYD

SPECIFICATIONS	CRT-UTM-NU	CRT-UTM-HYD
Maximum Load	Electronically limited to 12.5kN @ 7 bar	25kN
Load Transducer	±20kN	±25kN
Actuator Stroke	30mm	50mm
Frequency	0 to 30Hz	0 to 70Hz
Electrical Supply ¹	220-240 Volts 50Hz @ 13A	3 Phase 415 Volts 50 Hz @ 16A
Compressed Air	7-10 bar at 600 L/min	7 bar @ 100 L/min
Dimension mm (WxDxH)	Frame 360x400x740 Control Box 360x280x140	Cabinet 1000x1300x2400 Power Pack 630x580x890
Working space required mm (WxDxH)	825x1650x2100 when fitted in cabinet CRT-TCC	1100x2300x2600
Estimated Weight	Frame 30kg Control box 6kg	Cabinet 680kg Power Pack 60kg
PC	Required (Please enquire for minimum spec)	Required (Please enquire for minimum spec)

¹ others available upon request

SOFTWARE

- User friendly, intuitive and reliable Windows software developed using LabVIEW
- Standard test software available to meet specific EN, ASTM and AASHTO test methods
- Universal test software for the development of test methods using static, sinusoidal, haversine, square, triangular with user selected frequencies and data collection rates
- Stored test data can be imported into a spreadsheet package to be analysed by the user
- Utilities are included for transducer check, diagnostic routines and calibration



Calibration & Maintenance

Calibration, Annual Service and Maintenance Contracts are available for this device. UKAS accreditation to satisfy typed testing as described in EN 13108. Please enquire for further details.

Note: This device should be checked and calibrated annually.

Accessories

Accessories are not included in the price of the main device and may be purchased separately if required.



CRT-TCC Temperature controlled cabinet for CRT-UTM-NU

The temperature can be controlled to 0.2° C over the range -10° C to $+60^{\circ}$ C using a P.I.D. digital temperature controller, the CAL3200. Forced air over the heater and cooling fins and through the air duct in the rear wall ensures a uniform temperature throughout the cabinet. Defrost water drains via a pipe on the back of the cabinet to a heated tray underneath the cabinet where the water will evaporate. The cabinet also features an over temperature device which will switch off the fans, heating, cooling and illuminates a warning light if the set temperature is exceeded. The front door is double-glazed and contains a heating element to ensure that the glass door remains clear. When testing asphalt good temperature control is essential. Test data shows that a 1% change in temperature can cause up to 10% variation in stiffness results.



CRT-IT-SET Test System

Indirect tensile stiffness modulus measurement system to perform EN 12697-26 (Annex C)

- Sub-frame for 100mm and 150mm Ø specimens, Specimen alignment jig
- Loading strips and displacement transducer yoke for 100 & 150mm Ø specimens
- 2* CRT-ITLV AC LVDT displacement transducer ±0.25mm range
 - CRT-CALCR. Calibration check ring for checking accuracy of load and displacement transducers used in Indirect Tensile Stiffness Modulus test
 - Setup jig
 - Crosshead with linear bearings
 - 1* 7mm spanner
 - Test software to meet latest standard specifications

CRT-FAT-SET

Indirect tensile fatigue measurement system to perform EN 12697-24 (Annex E)

- Requires CRT-IT-SET Sub-frame
- 2* CRT-SPTLVDT displacement transducer ±1.0mm range
- On specimen fatigue clamping frame for 100mm Ø specimens
- Setup jig
- 1* 7mm spanner
- Test software to meet latest standard specifications



CRT-ITSMFAT-SET

Indirect tensile stiffness modulus and fatigue measurement system to perform EN 12697-26 (Annex C) and EN 12697-24 (Annex E)

- Sub-frame for 100mm and 150mm Ø specimens
- Specimen alignment jig
- Loading strips and displacement transducer yoke for 100 & 150mm Ø specimens
- 2* CRT-ITLV AC LVDT displacement transducer ±0.25mm range
- CRT-CALCR. Calibration check ring for checking accuracy of load and displacement transducers used in Indirect Tensile Stiffness Modulus test
- 2* CRT-SPTLVDT displacement transducer ±1.0mm range
- On specimen fatigue clamping frame for 100mm Ø specimens
- Setup jig
- Crosshead with linear bearings
- 1* 7mm spanner
- Test software to meet latest standard specifications

Accessories (cont)



CRT-PD-SET

Dynamic and static creep measurement system to perform EN12697-25 (Method A)

- 1* 100mm platens (top and bottom) with holders
- 1* 150mm platens (top and bottom) with holders
- 2* CRT-PDLV. AC LVDT displacement transducer ±5.0mm range
- Test software to meet latest standard specifications



CRT-TP31

Resilient modulus test system to perform AASHTO TP31 and ASTM D4123 for 100mm and 150mm \emptyset samples up to 80mm thick

- Stainless steel test frame with guides to maintain upper and lower loading strips parallel
- 12.7 mm wide loading strips with contact faces shaped to fit 100mm Ø specimens
- 19.0 mm wide loading strips with contact faces shaped to fit 150mm Ø specimens
- Machined tolerances +/- 0.1mm and +/- 0.01mm where parts are mating.
- 2* CRT-ITLV AC LVDT displacement transducer ±0.25mm range
- 2* CRT-SPTLVDT displacement transducer ±1.0mm range
- · Brass and steel LVDT clamps and adjusters for vertical and horizontal diametral measurement
- CRT-CALCR Calibration check ring for checking accuracy of load and displacement transducers used in Indirect Tensile Stiffness Modulus test
- Integral LVDT yoke
- LVDT adjusters
- Test software to meet latest standard specifications
- Haversine load pulses at standard frequencies
- Applies required load for selected number of load applications
- Captures outputs from load and displacement transducers
- · Calculates maximum load, recoverable deformation, Poisson's ratio and resilient modulus

CRT-T307

Triaxial system to perform AASHTO T307 for 200mm high x 100mm Ø specimens of unbound materials

- Triaxial cell with internally mounted load cell. Base adaptor with no-volume change valves
- Pressure range 0-500kPa
- Machined tolerances +/- 0.1mm and +/- 0.01mm where parts are mating
- Pneumatic system with vacuum for specimen set-up and software controllable cell pressure
- 100mm membrane stretcher
- Pressure transducer
- LVDTs to meet test specification
- Hard rubber dummy specimen
- Porous top cap
- 2* Porous discs
- 3* '0' rings for sealing 100mm membranes
- Cell pressurisation system including digitally controlled voltage pressure converter, pressure transducer, vacuum source and vacuum adjustment
- 3* Rubber membranes for 100mm Ø specimens
- Test software to meet latest standard specifications

CRT-UNIVSOFT

Facilitates the design of test routines that can include multiple wave types, test stages and methods of data acquisition

CRT-COMP-650

Standard air compressor (up to 7bar and 600 L/m) for supply of air to CRT-UTM-NU

CRT-FT06-AIRDRYER

Air dryer with 600 L/s flow rate and 3°C dew point



CRT-T307+

Triaxial system to perform AASHTO T307 for 200mm high x 100mm \emptyset and 150mm high x 300mm \emptyset specimens of unbound materials - used only with CRT-UTM-HYD

- Triaxial cell with internally mounted load cell
- Base adaptor with no-volume change valves
- Pressure range 0-500kPa
- Machined tolerances +/- 0.1mm and +/- 0.01mm where parts are mating
- Cell pressurisation system including digitally controlled voltage pressure converter, pressure transducer, vacuum source and vacuum adjustment
- 1* 100mm Membrane stretcher
- 1* 150mm Membrane stretcher
- Pressure transducer
- 2* CRT-PDLV Permanent deformation displacement transducer ±5.0mm range
- 1* 100mm by 200mm Hard rubber dummy specimen
- 1* 150mm by 300mm Hard rubber dummy specimen
- Porous top cap for 100 mm specimens
- Porous top cap for 150 mm specimens
- 2* Porous discs for 100mm specimens
- 2* Porous discs for 150mm specimens
- 4* '0' rings for sealing 100mm membranes
- 4* '0' rings for sealing 150mm membranes
- 4* Rubber membranes for 100mm Ø specimens
- 4* Rubber membranes for 150 mm Ø specimens
- 1* 100mm base plate
- 1* 150mm base plate
- Test software to meet latest standard specifications

CRT-PRESTRIAX-SET



Dynamic and static creep measurement system with confining stress to perform EN 12697-25 (Method B)

- System to produce adjustable confining stress 100mm and 150mm Ø specimens in axial tension or compression
- Triaxial cell with accurate pressure regulator, pressure indicator and all pneumatic fittings
- Pressure range 0-500kPa
- 100mm Ø platens with '0' rings for sealing membranes
- 150mm Ø platens with '0' rings for sealing membranes
- Platens are M.S. grade 070M20 case hardened to 750HV to a depth after grinding of at least 0.5mm. They are surface ground and polished.
- 2* CRT-PDLV. Permanent deformation displacement transducer ±5.0mm range
- 3* 100mm Ø x 100mm neoprene membranes
- 3* 150mm Ø x 200mm neoprene membranes
- Test software to meet latest standard specifications

CRT-SPTLV



Test system to perform dynamic modulus according to AASHTO TP62 / Simple Performance Test

- 2* Clip-on CRT-SPTLVDT displacement transducer ±1.0mm range
- 4* Clip-on LVDT holders, 24 targets
- LVDT stud placer unit
- LVDT stud placer top plate
- 1* upper platen 100 SPT
- 1* lower platen 100 SPT
- 2* 100mm dia. X 0.5 PTFE disc
- 1* araldite glue
- Pneumatic fittings
- Test software to perform Dynamic modulus for permanent deformation