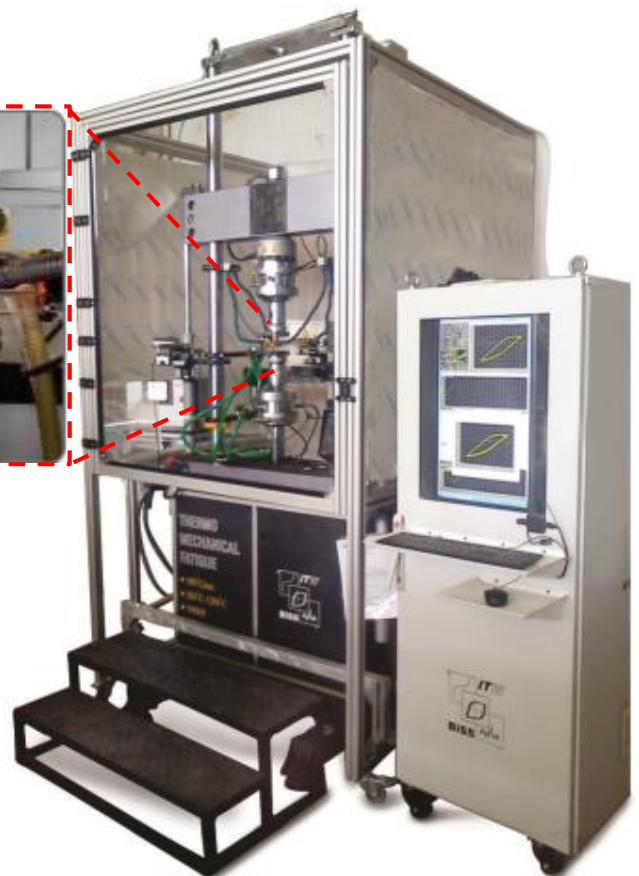


Thermo-mechanical fatigue (TMF) testing is a complex and demanding strain controlled testing under programmable temperature variations. BiSS model UT-06-0XXX offers a comprehensive solution for TMF testing that enables simulating of synchronised heating and cooling of specimens combined with mechanical loading with real time thermal strain compensation[‡]. TMF test systems are useful to test the operational efficiency and reliability of material used in turbine components and structures when subjected to simultaneous changes in temperatures and load under laboratory controlled environment.

BiSS TMF test system includes an in house built state of the art 2370 series digital servo controller like all other BiSS systems. The 2370 multi station digital servo controller used with BiSS TMF test system envisages independent induction heating* and cooling through compressed air and also allows multi zone temperature tracking[†]. MTL32 proprietary algorithms used with the BiSS controllers permit precision heating rates up to 20 °C/s and cooling up to 10 °C/s.

Applications

- Axial low cycle fatigue
- Thermal cycling
- Thermo mechanical cycling with independent phase control
- Provision for thermal compensated axial strain control and thermal cycling with phase control
- Testing of solid and tubular specimens of stainless steel, ferritic steels and their welds



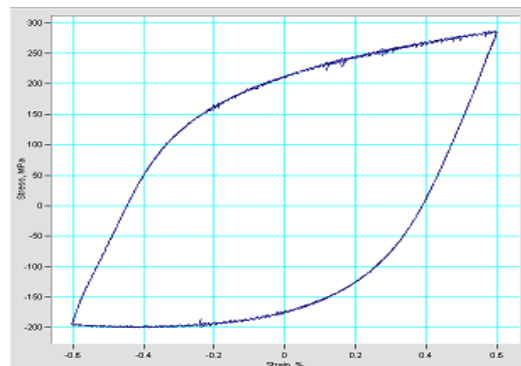
[‡]Real time thermal strain compensation: mount extensometer on to the specimen and set strain to zero. Vary temperature of the specimen, extensometer readout doesn't change and still reads zero.

*Induction heating: delivers superior performance to conventional control schemes where heat control is designated to induction heater

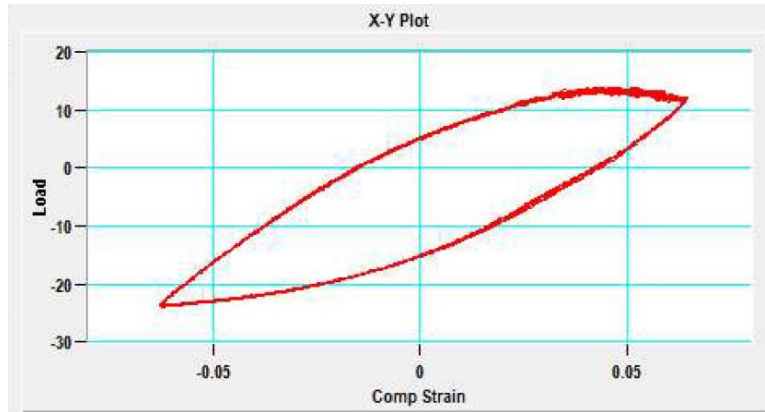
[†]Multi zone temperature tracking: multi point thermocouple based temperature tracking with guaranteed uniformity across multi zones available at premium pricing.

Standard features

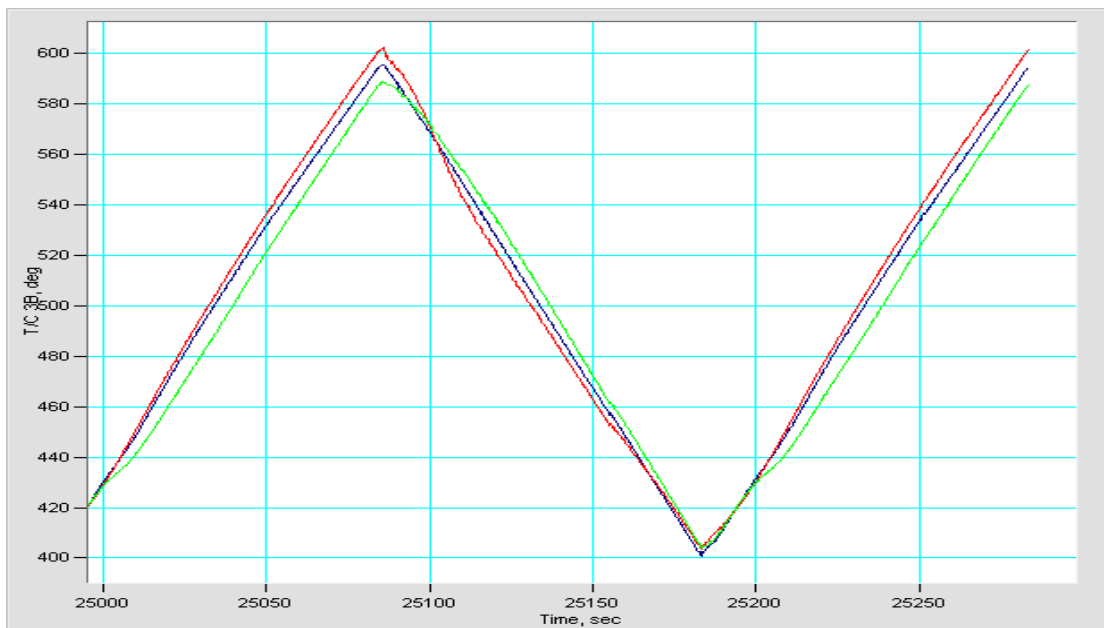
- Fully integrated standalone systems
- 100 to 600 kN force ratings
- Digital servo controlled induction heating and pneumatic air cooling
- Self-aligning, self-locking, zero backlash water cooled hydraulic grips to test threaded and tubular samples
- Thermocouple based/non-contact type temperature measurements available
- Encoder based actuator displacement measurements with 0.1 μm resolution
- 1 μm resolution High Temperature extensometer rated for 1200 $^{\circ}\text{C}$ operations
- Real time thermal strain compensation
- Digital servo controller for synchronous control and data acquisition
- In compliance with ASTM E2368 and ASTM E606
- User friendly application software
- In phase and out of phase waveform generation (Temperature with respect to mechanical Strain)
- Graphical representation of graphs and results
- Auto data acquisition settings depending on test frequency to ensure sufficient data points to calculate various parameters
- Option to save test profiles
- Provision for stroke and strain limit settings ensuring safety to the gauges and the system
- Offline post processing program to analyze results in MS Excel.



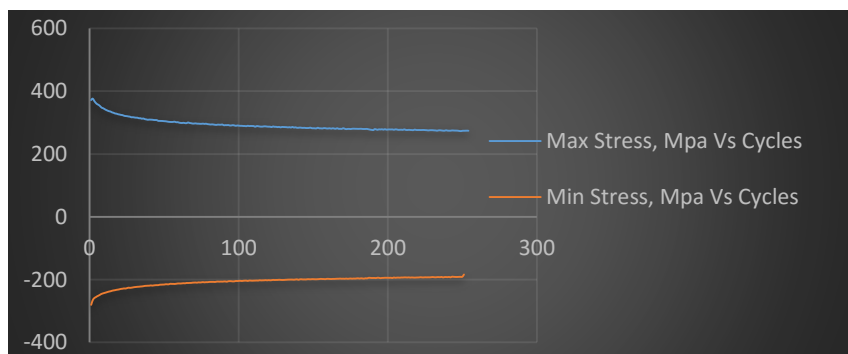
Stress vs. Strain with out-of-phase thermal and mechanical cycling



Stress vs. Strain with In-phase thermal and mechanical cycling



Temperature uniformity distribution across the 25mm Gauge Length sample during thermal cycling



Peak Stress Vs Cycle Graph

Specifications

Model	UT-06-0025	UT-06-0050	UT-06-0100	UT-06-0150	UT-06-0200	UT-06-0250	UT-06-0300	UT-06-0500	UT-06-0600
Load Frame	AC-01-0025	AC-01-0105	AC-01-0110	AC-01-0115	AC-01-0120	AC-01-0125	AC-01-0130	AC-01-0150	AC-01-0160
Force Rating	25 kN	50 kN	100 kN	150 kN	200 kN	250 kN	300 kN	500 kN	600 kN
Configuration	2 Column								
Column Clearance ¹	400 mm		600 mm						
Max. Vertical Daylight ²	1200/1500 mm								
Min. Vertical Daylight ³	300 mm								
Stiffness ⁴	> 600 kN/mm								
Height	3000	3700 mm							
Width	900 mm	1000 mm	1000 mm	1250 mm	1300 mm	1300 mm	1400 mm	1500 mm	1550 mm
Depth	900 mm	1150 mm	1150 mm	1200 mm					
Actuator	Servo-hydraulic/Servo-electric (Servo-electric actuators follow same model number with suffix E: For example: AC-02-0125E indicates a 25kN servo-electric actuator, maximum capacity limited to 200kN)								
Model No.	AC-02-0125	AC-02-0150	AC-02-2110	AC-02-0215	AC-02-0220	AC-02-0225	AC-02-0230	AC-02-0250	AC-02-0260
Force Rating	25 kN	50 kN	100 kN	150 kN	200 kN	250 kN	300 kN	500 kN	600 kN
Stroke	up to 50/100 mm	up to 150 mm							
Drive	Servo-Hydraulic/Servo-Electric								
Min. Speed Rating ⁵	0.001 mm/Hour								
Max. Speed Rating ⁵	up to 500 mm/min								
Encoder Resolution	0.1 µm								
Load cell	AC-06-0035	AC-06-0040	AC-06-0045	AC-06-0050	AC-06-0055	AC-06-0056	AC-06-0060	AC-06-0065	AC-06-1000
Digital Controller	Model 2370 MS is configured with the system								
Extensometer	High temperature extensometer with Model AC-07-11XX configured with the system								
Induction Heater	Model AC-09-3002								
Power Rating	2 kW to 12 kW								
Operating Temp.	up to 1200								
Mounting	Slider mount with vertical and radial adjustments								
Heating rates	1°C/s to 100 °C/s – depends on sample gauge diameter and sample material								
Cooling rates	Up to 10 °C/s								
Temperature Measurement									
Contact Type ⁶	K type thermocouple								
Uniformity	within +/-10 °C during TMF cycling guaranteed for 20 mm gauge length specimen								
Spot Welder	Model AC-07-109								

¹Custom column clearance available up to 750 mm. ²Vertical daylight measured between crossheads. ³Custom vertical daylight available up to 2000 mm. ⁴Frame stiffness is measured at half the vertical daylight. ⁵Min and max speed rating: Indicative of servo-electric actuators. ⁶R type thermocouple measurements available as options – standard length of 1 m..