

TMF TESTING SYSTEM

Combined Thermal and Mechanical Load Testing

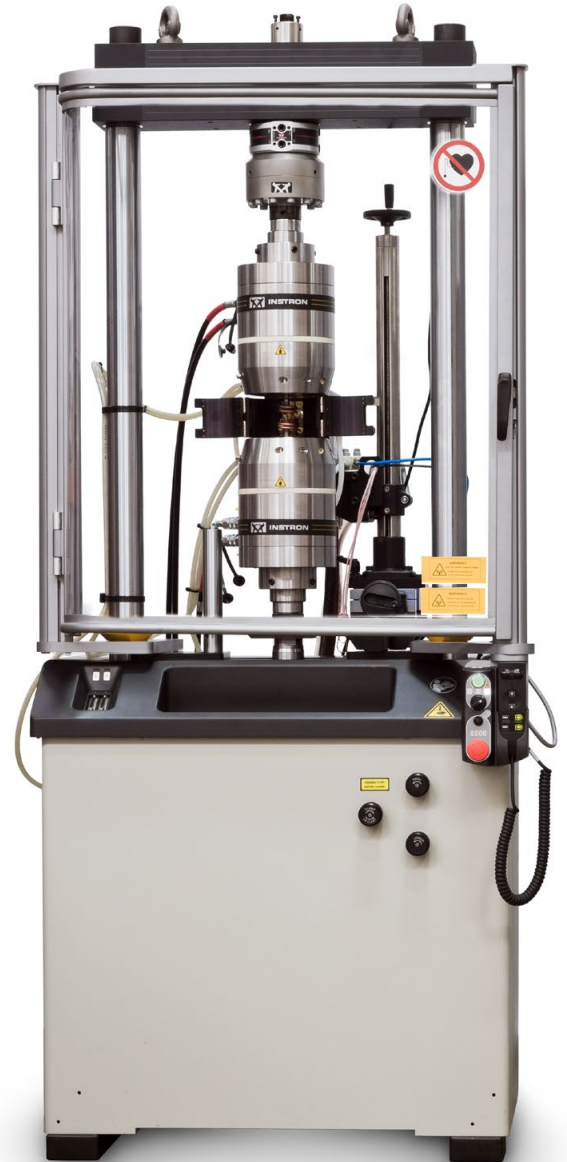
Instron Thermomechanical Fatigue (TMF) testing system is a modified 8801 servohydraulic test frame that provides effortless analysis of combined thermal and mechanical loading cycles of high-performance materials. Instron offers servohydraulic or a unique servoelectric actuators depending on your application integrated with specifically designed components and accessories. Expert integration of a wide range of technologies has resulted in a reliable machine proven to increase data accuracy, improve repeatability and ability to perform tests in compliance with international standards.

FEATURES

- High capacity loading frame maximizes lateral and axial stiffness during reverse stress testing
- High stiffness load frame with force capacity of ± 100 kN (± 22 kip) or ± 250 kN (± 56 kip)
- Induction heating with specimen heating rates up to 50°C/s
- Precision-aligned load string with the actuator in the lower base
- Standard servohydraulic actuator for added flexibility
- Choice of hydraulic configuration and dynamic performance to suit the application
- Optional backlash free, all-electric actuator delivers precise slow speed control with virtually silent operation and no hydraulic infrastructure requirements (8862-TMF)
- An integrated high-temperature extensometer with low contact force
- Multi-coil induction system
- Choice of internal or enclosed external cooling solution
- Precision work head mount for induction coil adjustment
- Collet head grip for improved alignment and tubular specimen cooling
- AlignPRO alignment fixture and supporting software are provided as standard to ensure precision load string alignment
- Dedicated and highly automated TMF Software Package
- Full system integration with Instron electronics
- Updated furnace controller and software provide a more intuitive experience

CONTROLLER AND SOFTWARE

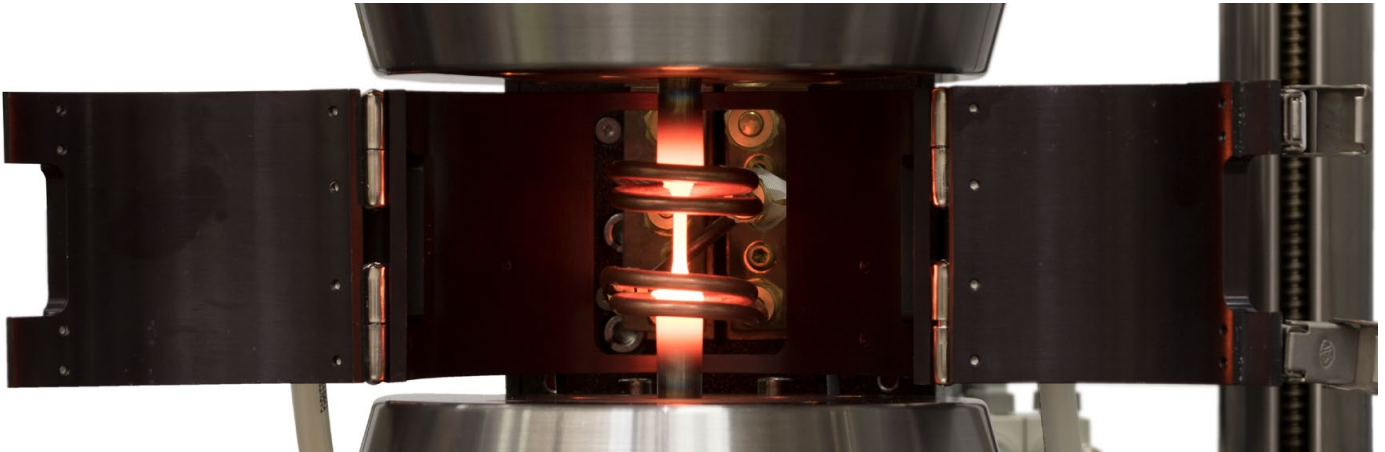
The TMF system is supplied with a dedicated TMF software package and fully integrated Instron 8800MT digital controller that provides a quick and easy experience in conducting tests in accordance to international standards, including ASTM E2368 and ISO 12111. The integrated TMF software provides additional automation in conducting TMF testing. High specification Eurotherm 2704 is used for temperature control.



THERMOMECHANICAL FATIGUE TESTING

Materials exhibit different behaviors under cyclic thermal loading, similar to cyclic mechanical loading in fatigue. Applications where materials are subject to high thermal gradients require additional testing on top of typical static and fatigue tests. These components may be exposed to thermomechanical fatigue (TMF), where they experience cyclic mechanical and thermal loading under service conditions. Contributions of creep and fatigue to the TMF damage in structural integrity under combined thermal and mechanical loading cycles are monitored and analyzed in order to ensure safe operating conditions for the duration of the component's life cycle.

TMF testing machines help characterize material properties under cyclic mechanical and thermal loading, which contributes to the material selection process for different applications where components are exposed to combined thermal and mechanical loading profiles, including the hot section components in gas turbine generators and jet engines. It also allows engineers to better predict the life cycle of components under these conditions and confirm that computer simulation models correctly predict material behavior under TMF.



TMF APPLICATIONS AND RESEARCH AREAS INCLUDE:

- Characterization of materials under combined thermal and mechanical loading cycles
- Effects of different loading phases on materials
- TMF crack initiation in superalloys for gas turbines generators
- TMF life prediction of hot section components in jet engines

WHY CHOOSE INSTRON?

Instron Thermomechanical Fatigue (TMF) testing systems provide a fully integrated, turnkey solution for analysis of combined thermal and mechanical loading cycles on high-performance materials. The furnace controller has been updated recently to provide a more intuitive experience, better performance, and more accurate temperature control. Expert integration of proven products has resulted in a complete, user-friendly system perfect for simulating these conditions and measuring material performance.

BENEFITS

- An external cooling collar is available that offers better performance in cooling rates and minimizing extensometer disturbances
- Multi-coil induction head allows more complex coil designs that optimize the coupling between coils and specimen to improve heating rates and specimen temperature gradients
- Integrated extensometer provides an intuitive strain measurement system that is mounted onto the machine, with minimal setup time and roller mount for quick and precise adjustment of extensometer position
- Precision work head mount for induction coil adjustment, allowing easy and precise movement of the induction system to fit specimen size
- AlignPRO Mechanical alignment fixture is extremely important. As an integrated package with strain gauged specimen and software for measurement of specimen bending, it provides full angularity and concentricity adjustment and instructions to how to adjust real time to give the peace of mind that the load string is properly aligned
- Full system integration with Instron electronics, updated furnace controller package and dedicated TMF Software Package provides an intuitive user experience including testing in compliance with ASTM E2368 and ISO 12111

FUNCTIONALITY AND CAPABILITY

Instron TMF systems are designed to guarantee machine performance and test accuracy, ensuring that you can trust your data is of the highest quality. Collaboration with industry and continuous improvements have helped us to continuously develop and refine new features, creating a truly optimized package for TMF testing.

- Multi-coil induction head allows for easy optimization of temperature gradient
- External cooling collar to maximize specimen for cooling uniformity over the gauge length
- Collet grips available as standard to support internal cooling of tubular specimens



USABILITY AND REPEATABILITY

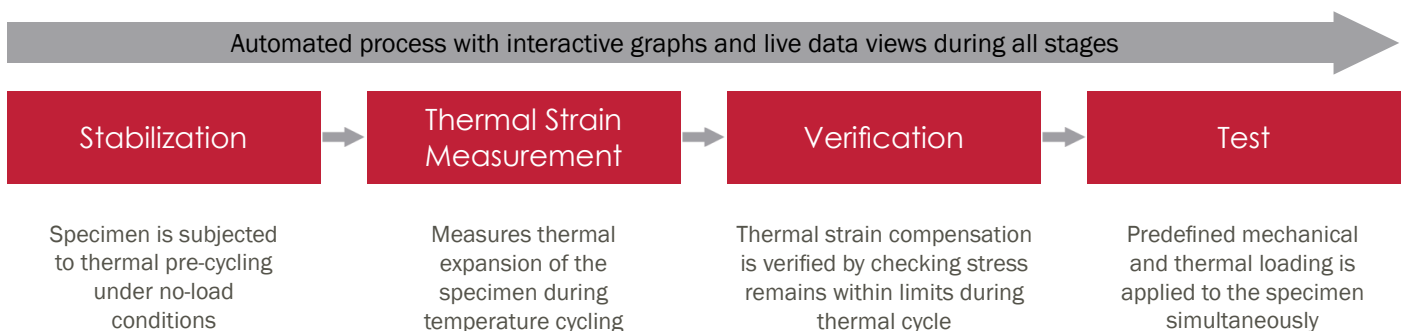
Test reproducibility and ease-of-use are key factors to consider when comparing TMF systems and integrated Instron systems are designed to guarantee both. Below is a selection of key features that will help to ensure your system is easy to use and produces the most repeatable data.

- A high-temperature extensometer with a low contact force and high positioning repeatability mounting bracket with forced cooling
- Backlash-free servo-electric actuator option for low strain rate specifically designed testing
- Precision work head mount with axial and radial adjustment of the induction coil



DEDICATED TMF SOFTWARE

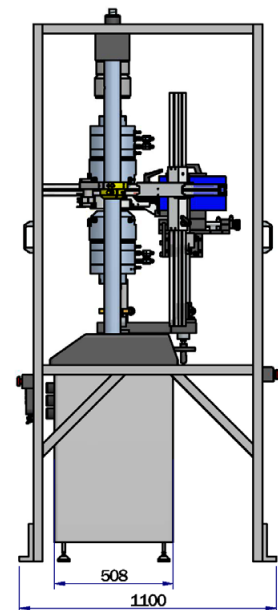
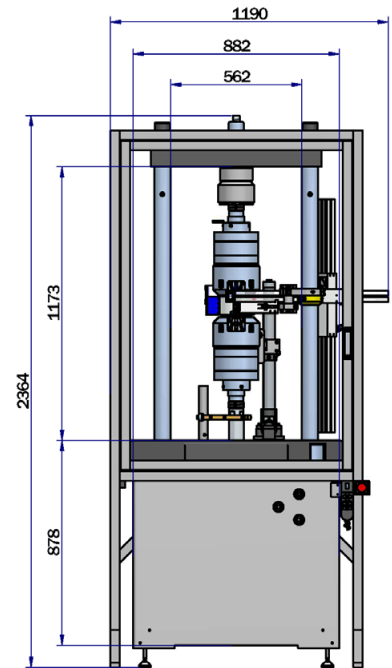
Our purpose-designed TMF software makes it quick and easy for you to conduct tests in accordance with international standards, including ASTM E2368 and ISO 12111. After setting up the test method, an automated process can execute four stages of the test: Stabilization, Thermal Strain Measurement, Verification, and Test, with no need for manual calculations or use of third-party software. Carrying out the full test within one piece of dedicated software saves time and reduces the chance of human error.



FRAME SPECIFICATIONS

		8801-TMF	8862-TMF
Daylight Opening (Maximum Between Table and Crosshead)	mm	1403	1515
	in	55	60
Dynamic Load Capacity	kN	±100	±100
	kip	±22	±22
Actuator Stroke (Total)	mm	150	200
	in	6	8
Configuration	Twin-Column High-Stiffness Load Frame with Actuator in Lower Table		
Lifts and Locks	Hydraulically-Powered Lifts and Locks		
Load Cell	Patented ¹ Dynacell™ Fatigue-Rated Load Cell Mounted to Upper Crosshead with Capacity to Suit Actuator		
Load Weighing Accuracy	±0.5% of Indicated Load or ±0.005% of Load Cell Capacity (1-100%), Whichever is Greater		
Hydraulic Pressure Supply (Required)	bar	207	N/A
	psi	3000	
Frame Stiffness (At 1 m Daylight)	kN/mm	390	595
Frame Weight (Approximate guidance only)	kg	900	1100
	lb	1984	2425

1) US Patent Number 6508132



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