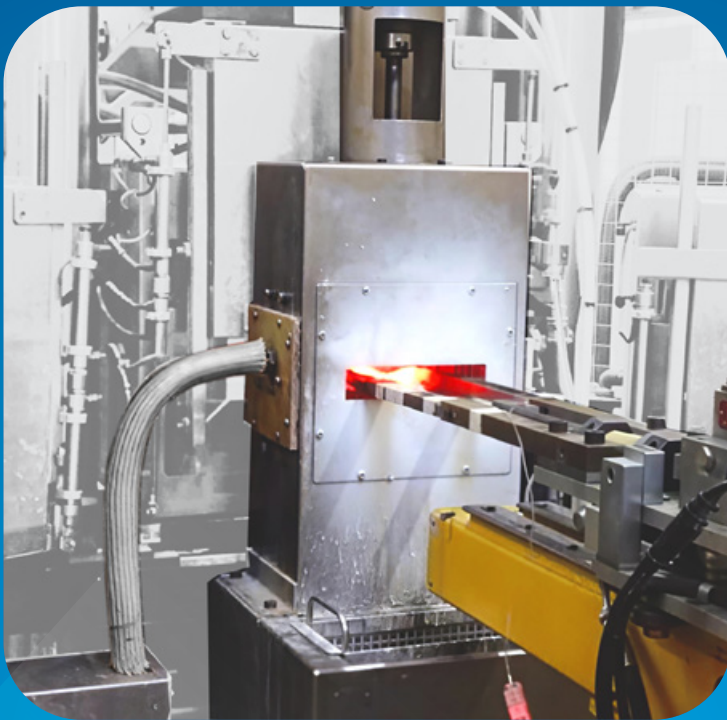


SERVOTEST

TEST AND MOTION SIMULATION



**THERMO-MECHANICAL METAL FORMING
PROCESS SIMULATORS**

ESTABLISHED
1958

INDUSTRY PIONEERS METALLURGY TESTING

The Thermo-Mechanical Treatment Simulator (TMTS) is a complex metal forming simulation system.

The first TMTS systems were developed in the 1980s in conjunction with the University of Sheffield & Hoogovens R & D. Since then multiple systems have been delivered to the world's leading industrial and academic research institutions.

BESPOKE THERMO-MECHANICAL TREATMENT SIMULATORS

The Thermo-Mechanical Treatment Simulator (TMTS) was developed by Servotest in conjunction with Hoogovens R & D, in order to meet all foreseeable needs of the Metallurgy testing industry in investigating the effects of thermal and deformation processes on the final properties of a given material.

TMTS is capable of simulating industrial thermo-mechanical processing steps (Single and multi-pass), integrating complex annealing procedures into the test procedures, and specimen analyses with (for instance) the Stress Relaxation or the Creep facility. The control system allows the user to predefine an individual test sequence of up to 99 process steps (segments), including 31 deformation steps, for each of the 4 samples which may be tested in a given sequence.

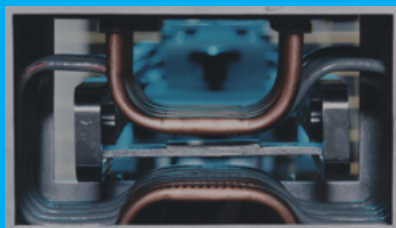
International service is reliably supplied through a series of satellite offices and partner organisations. Spare parts are stored and available locally to avoid long lead times for repairs and upgrades. Turnkey facilities including planning, updating, installation and maintenance are available and can be individually designed to suit specific needs.

SERVOTEST TMTS STANDARD SPECIFICATION:

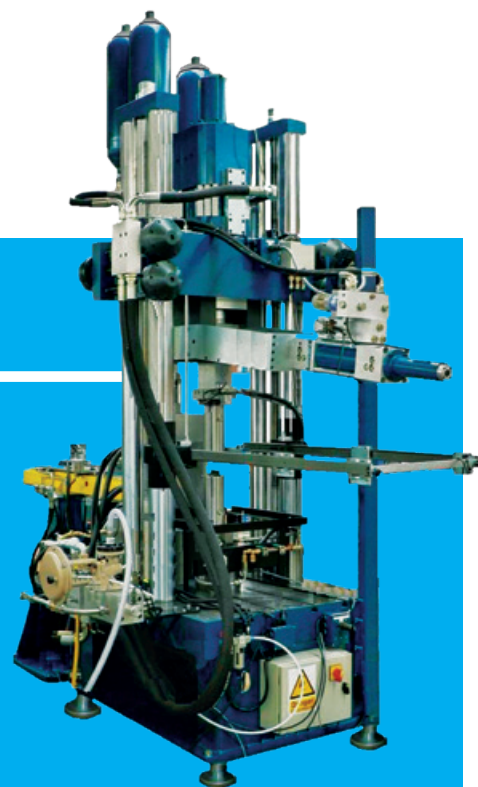
- 500 kN loading
- 3,000 mm/s displacement rate
- Induction heating
 - » Rapid controlled heating to 1,300 °C
 - » Uniform temperature distribution
 - » Minimal thermal gradient
- Controlled cooling via integrated
 - » Forced air
 - » Combined forced air & water mist
 - » Full quench <0.5 s post-deformation
- Fully-programmable operator-interface
- Large inexpensive specimens suitable for test coupon extraction
 - » Plane strain to 50 mm wide
 - » Axi-symmetric to Ø16 mm
- Tests include
 - » Uniaxial, plane strain, stress relax, creep, multi-stage

TMTS EXPERIENCE...

Discovery of new metal composites, material optimisation, and the need for modern simulation aids has driven the development of Thermo-mechanical Treatment Simulators. Over the past three decades Servotest Systems have accumulated considerable experience in the design, manufacture and installation of Metal Forging Test Machines.



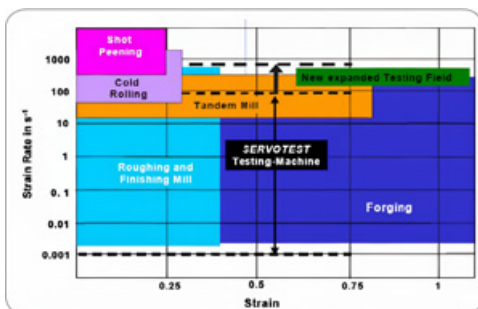
Advanced high-performance tools for industrial & academic research into process simulation.



TMTS SYSTEM BENEFITS

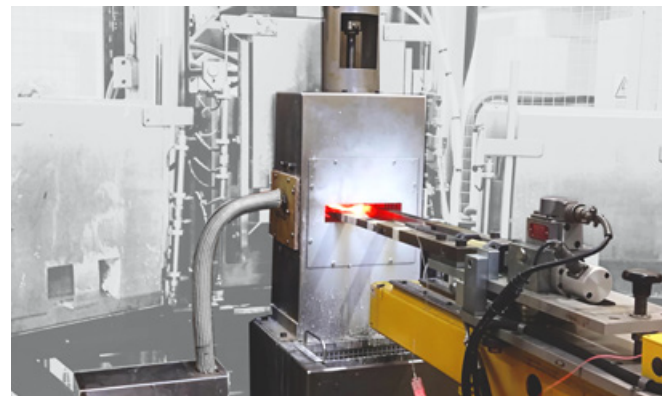
FLEXIBLE

- TMTS simulates the industrial situation without the need for extrapolation to higher strain rates and/or temperatures.
- The principle usage is to simulate hot and cold rolling - up to a strain rate of 100 s⁻¹ with 12 mm thick specimen, 200 s⁻¹ by testing half thickness. This machine provides an excellent way to obtain the experimental data that are necessary for the models on which modern rolling mills are run.
- Other uses include investigation into extrusion by extrapolation up to 4000 s⁻¹.
- Any materials can be investigated including Aluminium, Steel, Zinc, Nickel and Lead.
- The force and velocity are high enough to achieve these rates with 12 mm thick standard specimens, which means that the specimens are large enough to provide samples for hardness tests, tensile tests, and micro structural examination from the section which has been correctly deformed.
- The forced air cooling in the FTTU is controlled by a special servovalve using a hydraulic pilot stage to achieve the response necessary for accurate control during rapid cooling where rates approach 100°C per second.
- A range of tools for Plane Strain and Uniaxial samples are available in various materials, including Tungsten Carbide, Ceramic, and Nickel Based Super Alloy. For tool temperatures up to 700 °C the tool holders are fitted with cartridge heaters, and tool temperatures are controlled separately from the furnace temperature.



FAST THERMAL TREATMENT UNIT – (FTTU)

Speeds up the testing for aluminium, saving time and increasing throughput. A necessity for steel testing is to provide high rates of heating and cooling to obtain the required microstructure and to also save time.



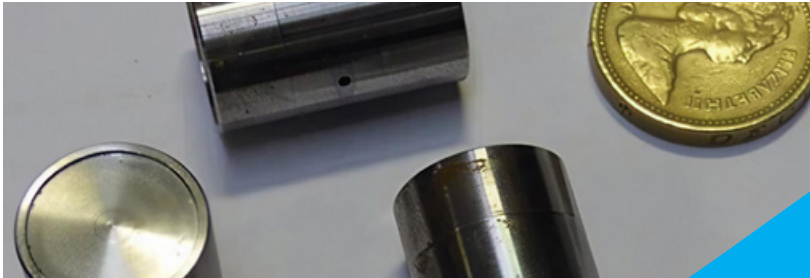
Additional benefits include:

- Easy programming.
- Fully automated testing.
- Simple to operate with user friendly Windows control panels.
- Up to 20 specimens per day throughput.
- Reproduces the process repeatedly to provide consistent results.
- The microstructural development of any multi-pass rolling sequence can be studied by quenching the specimen at intermediate stages of the simulation.

CHARACTERISATION POSSIBILITIES OF THE DEFORMED SAMPLES

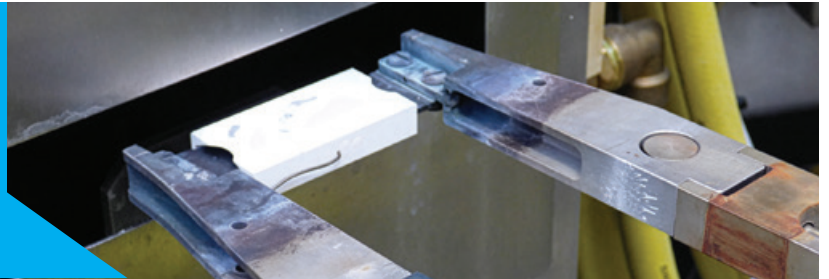
Microstructure analysis e.g. light microscopy, electron microscopy, Electrical Resistivity measurements, etc. Physical properties e.g. hardness, tensile strength, texture analysis, etc.

TEST SPECIMENS USED IN THERMO-MECHANICAL METAL-FORMING SIMULATION



CYLINDRICAL 'AXI-SYMMETRIC' SPECIMEN FOR FORGING SIMULATION

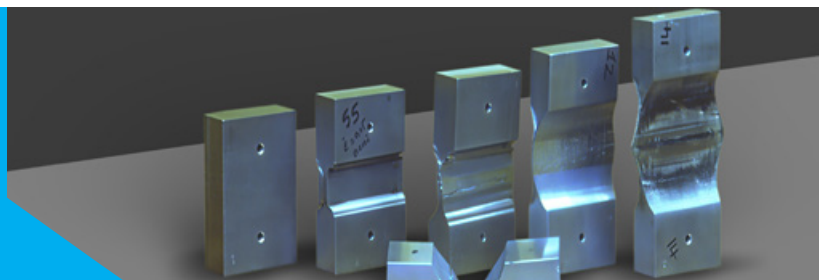
RECTANGULAR 'PLANE STRAIN' SPECIMENS FOR ROLLING SIMULATION



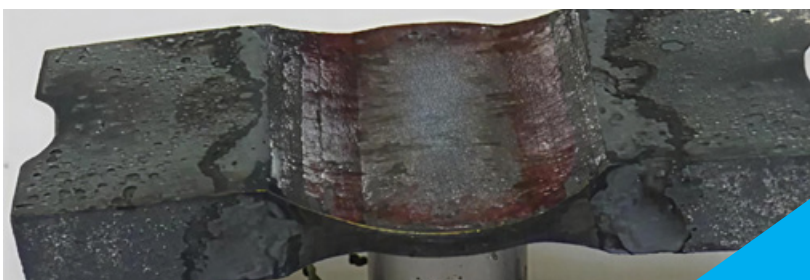
LARGE TEST SPECIMENS – AXI-SYMMETRIC, UP TO 16MM DIAMETER



PLANE STRAIN SPECIMEN FOR FORGING SIMULATION AND ROLLING SIMULATION



LARGE TEST SPECIMENS – PLANE STRAIN, UP TO 50MM WIDE



ARBITRARY STRAIN PATH (ASP)

Servotest's ASP II test system has been developed to provide advanced material characterisation for the next generation of metal forming simulations.

By reproducing complex deformation histories and non-linear loading paths, ASP II generates high-fidelity material data which can then be used with QForm® metal forming simulation software, enabling more accurate process design, optimisation, and validation.

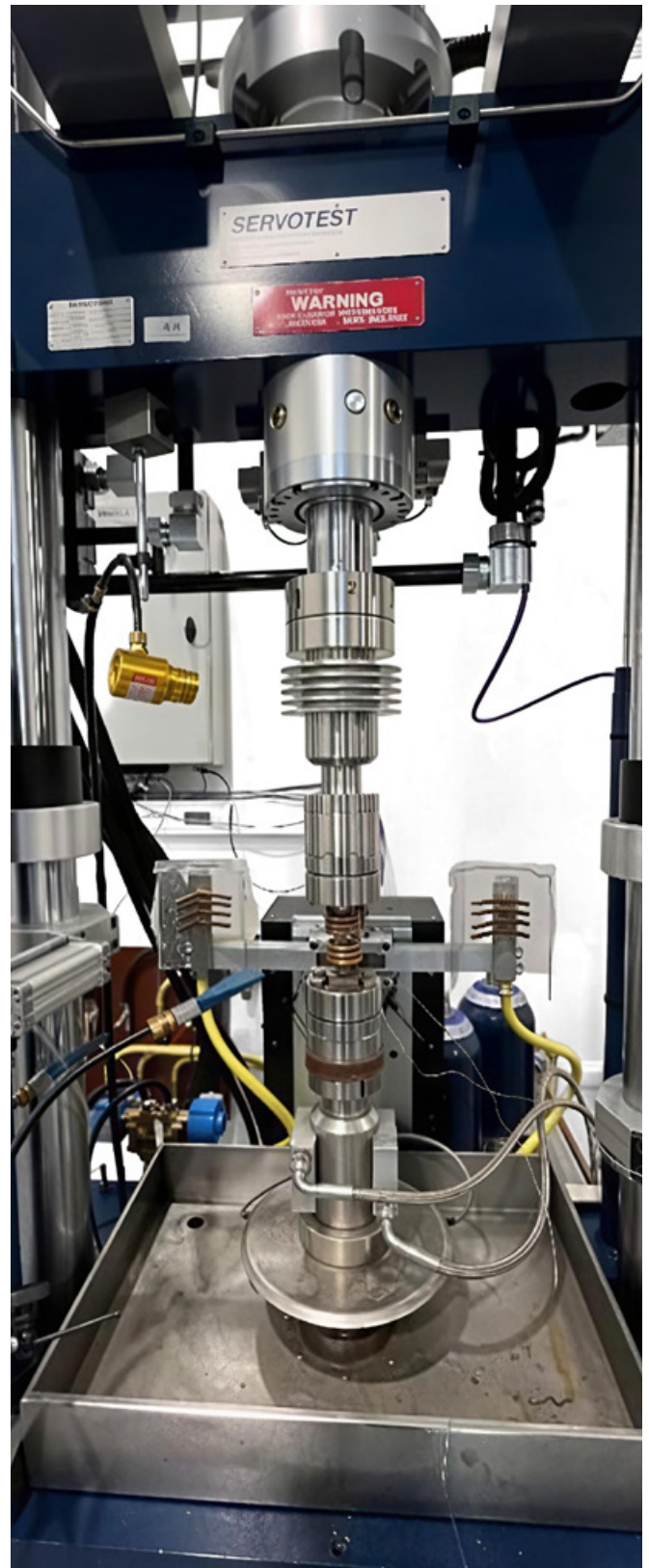
The software predicts material flow, forming loads, defect formation, tool loading, and final component geometry before production begins.

When combined with ASP II test data, engineers can:

- Develop highly accurate material models
- Improve simulation reliability
- Predict defects with greater confidence
- Reduce reliance on costly production trials
- Optimise process parameters earlier in development
- Validate simulation results against physical test data

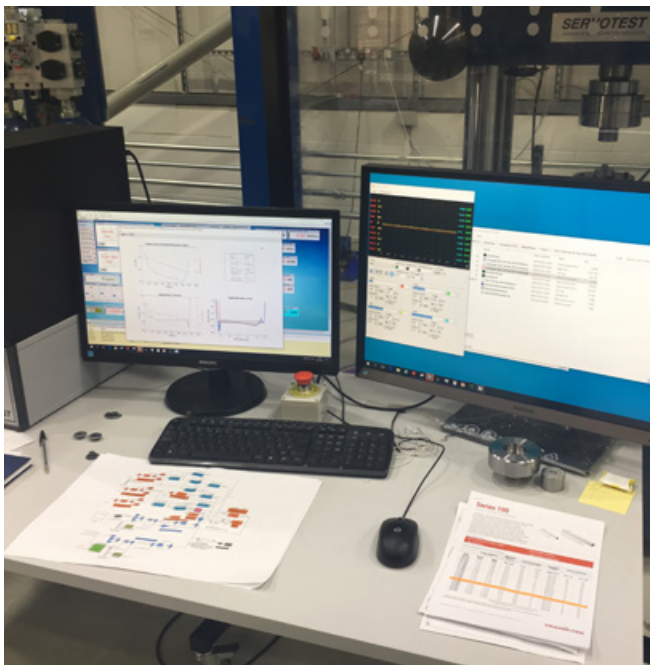
ASPII with QForm simulation software integration

- Fatigue rated to 100kN in Tension/Compression
- +/- 500 Nm Oscillatory or Continuous Rotation
- Up to 1300 deg C testing with excellent temperature gradient control
- Seamless control of the relative ratios of torsion and uniaxial deformation enables to run a variety of simulations from a single stroke deformation to multiple stroke deformation including cyclic. Each cycle provides capability of changing the amount of strain, dwell time, equivalent true strain rate and strain path.



COLD FORMING SIMULATION AND VALIDATION (CFS)

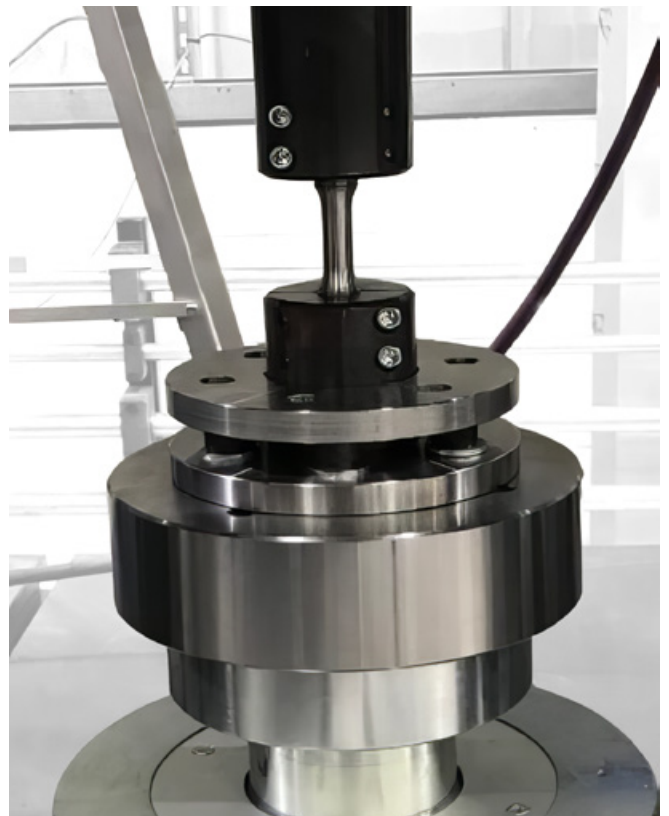
Servotest manufactures advanced servo-hydraulic test systems that generate the high-quality material data required for reliable cold forming simulations. Our systems enable researchers and manufacturers to accurately characterise materials designed for cold forming under realistic processing conditions and to select the most appropriate one for the application.



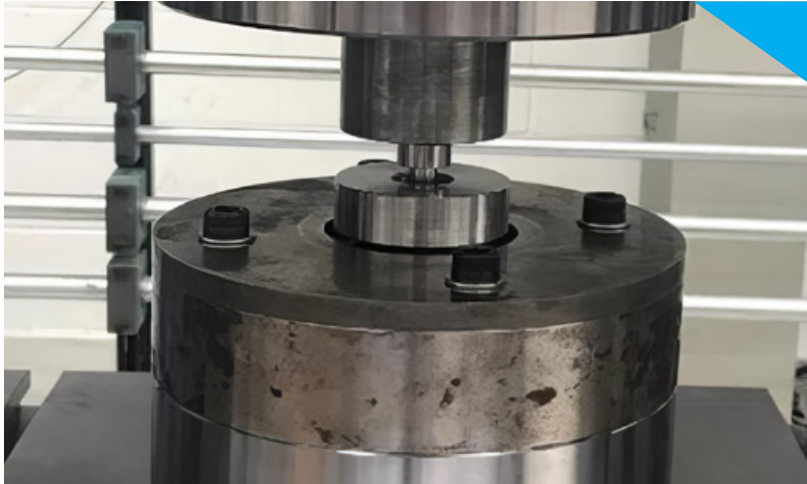
The Servotest CFS four-column material testing machine has been designed to allow the customer to perform uniaxial or cyclic compressive tests maintaining a high level of accuracy, providing continuous velocity and strain control as well as repetitive fatigue cyclic testing. The system rigidity is approximately 1mm deflection per 730kN applied, meaning there is a minimal machine compliance reducing the loss of applied load to the specimen. The machine's deflection is critical when calculating / operating in 'sample-height' control, offering a reliable and accurate control mode, resulting in a dramatically reduced margin of error during specimen testing.

Benefits for manufacturers

- Improve product quality: predict material behaviour, identify potential defects, and optimise forming parameters before production.
- Reduce development costs:
- Minimise physical prototypes and tooling iterations through accurate virtual process validation.
- Increase process understanding:
- Gain deeper insight into material flow, strain distribution, and forming loads under realistic conditions.
- Enhance simulation confidence: validate numerical models using experimentally derived material data and physical test results.



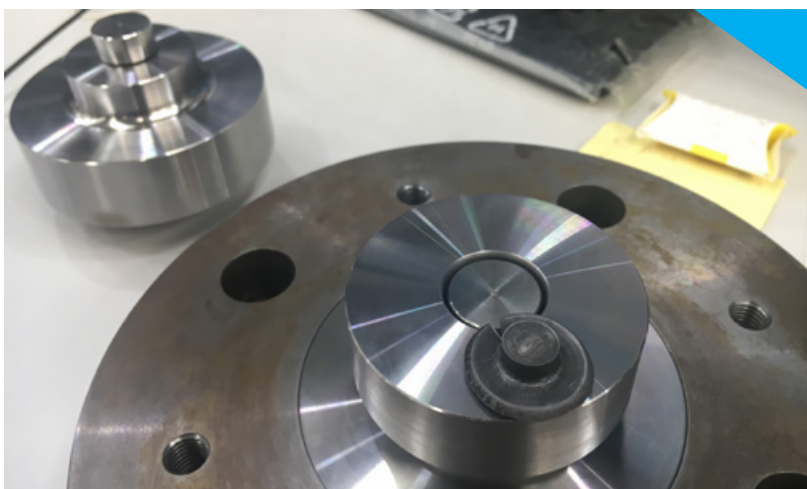
COMPRESSION AND FATIGUE CONFIGURATION



COMPRESSION TESTING
ASSEMBLY INSTALLED



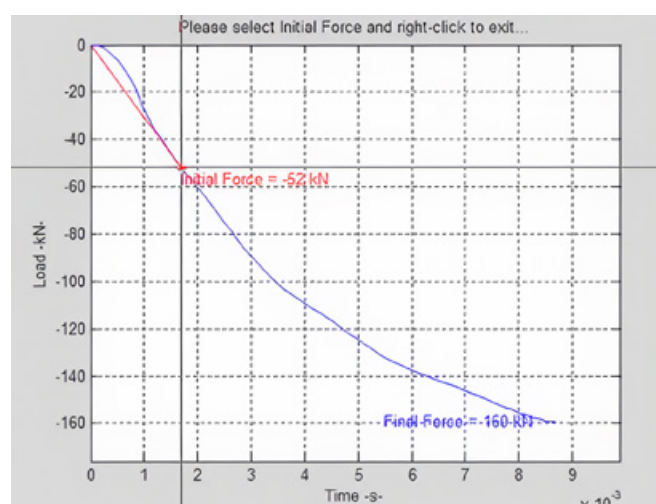
FATIGUE TESTING
ASSEMBLY POSITIONING



CFS FORMING DIE AND
PUNCH WITH AN EXAMPLE OF
A TESTED SPECIMEN

SERVOTEST CONTROLS AND SOFTWARE

Servotest provides advanced control systems and intuitive software designed to deliver precise, reliable, and efficient testing across a wide range of materials, component, and structural test applications. Combining high-performance digital controllers with flexible, user-friendly software, Servotest solutions enable accurate test execution, real-time data acquisition, and seamless system integration.



From standard fatigue and durability testing to complex multi-axis simulations, Servotest controls and software help laboratories and manufacturers maximize productivity, ensure data integrity, and achieve repeatable, high-quality results.



TMTS environment and test sequence

Segments of 8 possible types:

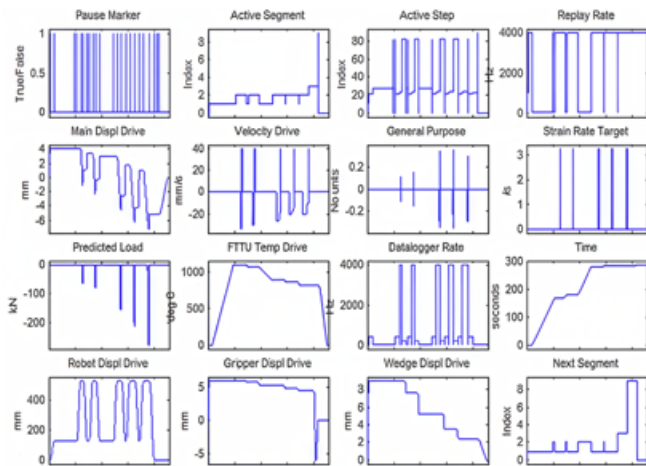
- Preheating furnace
- Lubrication
- Deformation
- Test furnace
- Thermocouple cut
- Annealing furnace
- Quenching

☒ Followed By Dwell

Dwell Type	Stress Relaxation
Strain Rate (1/s)	0
Duration (s)	100
Servo PID Integral TC (s)	1
Logging Rate (Hz)	1

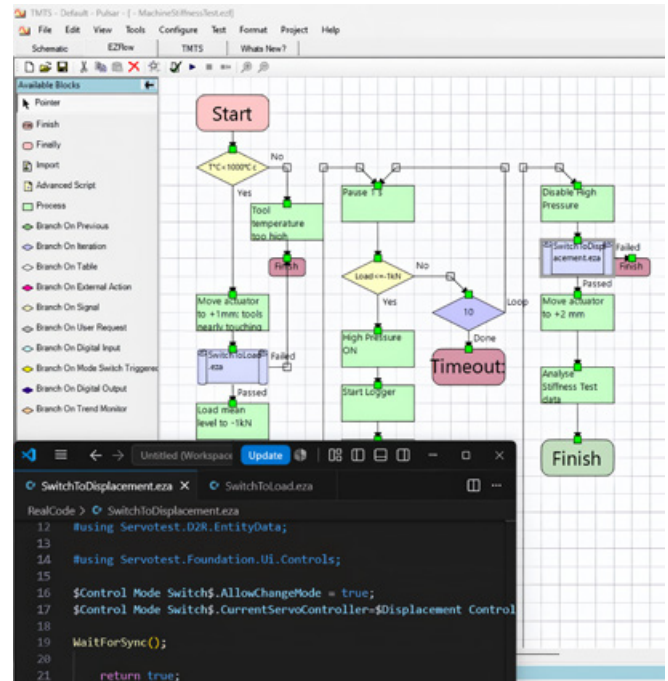
EZA (Advanced EZFlow)

EZA Advanced EZ Flow combines powerful test control with an intuitive graphical interface, making it easy to create, automate, and manage complex testing procedures.



Designed for efficiency and flexibility, it delivers precise control, streamlined workflows, and reliable data acquisition across a wide range of testing applications.

- Optional tool within EZFlow
- Programmed in C#
- Full access to Pulsar GUI & DSP
- Advanced users
- Requires training

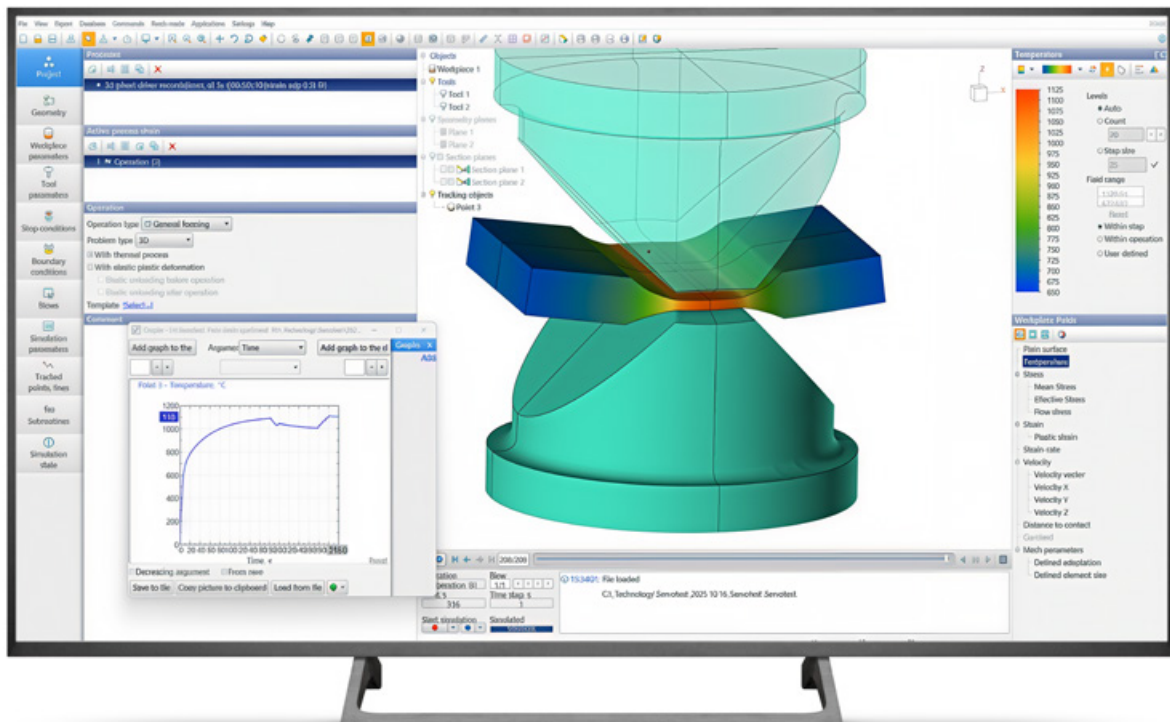


Applications

- TMTS
- Toolboxes
- Consultancy work

INTEGRATED QFORM SIMULATION SOFTWARE

Leverage FEMU (Finite Element Method Updating) simulation combined with AI-driven microstructure prediction to achieve significantly greater accuracy than traditional JMAK-based modelling approaches. By integrating experimental data with advanced simulation techniques, the system delivers deeper insight into material behaviour and transformation processes.



- Finite Element Method Updating (FEMU) based simulation with AI driven microstructure prediction – more accurate than traditional JMAK-type models
- Gain insights and "What If" capability using the validated model to predict outcomes under modified test conditions – test fewer samples, save time and improve consistency of your results.
- Phase transformation prediction, including critical temperatures such as Ac1, Ac3, Ms, and Mf.
- Generation of CCT (Continuous Cooling Transformation) and TTT (Time-Temperature-Transformation) diagrams derived from combined test and simulation data.
- Detailed analysis of microstructure evolution, linking simulation outputs directly with metallographic observations for enhanced model validation and process understanding.

SERVOTEST

TEST AND MOTION SIMULATION



Vibration test
Seismic qualification
Damper test machines
Linear actuators
Component test
4-post rigs
Civil seismic
Hydraulic power supplies
Real-time control
Tailored software
Distributed hardware
Bespoke operator interfaces

Automotive
Earthquake simulation
Civil structural test
Advanced control
Squeak and rattle
Steering test systems
7 & 8 -post rigs
2-post rigs
Civil structure
Durability test

Motorsport



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