



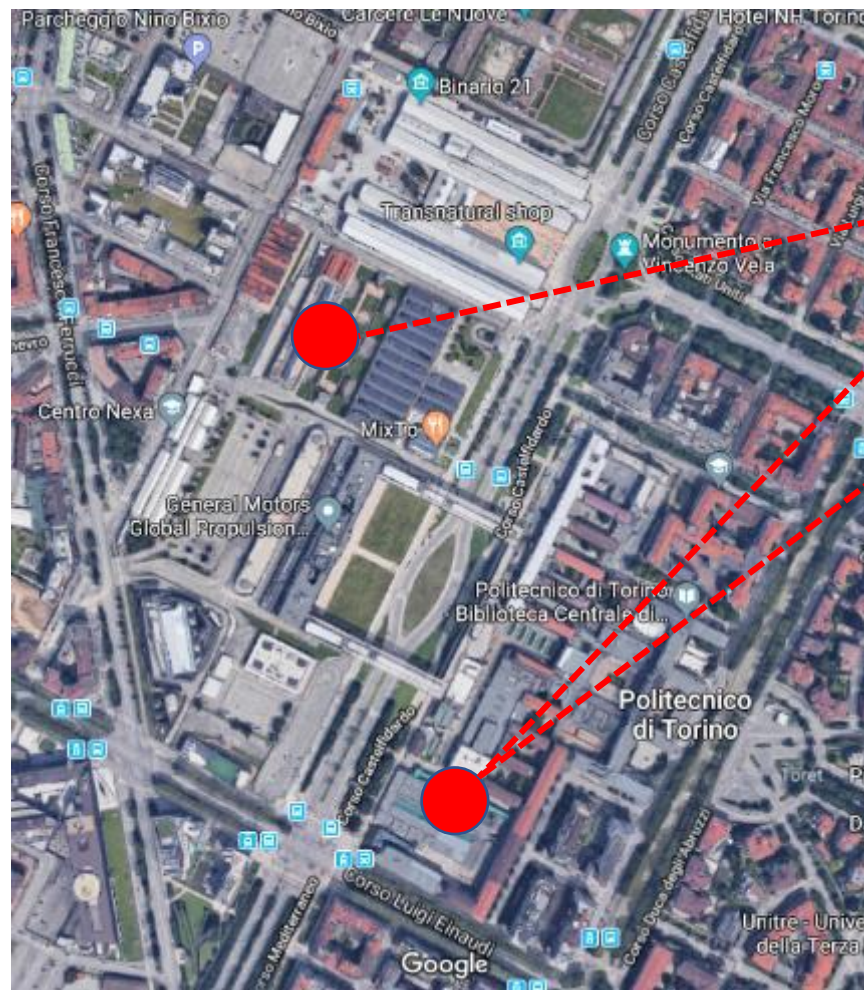
POLITECNICO DI TORINO


J-TECH @POLITO

J-Tech@PoliTo
Advanced Joining Technologies

Our mission

- J-Tech@POLITO is a research center for advanced joining technologies funded by Politecnico di Torino and Regione Piemonte, Italy.
- DynLab, an existing laboratory at Politecnico di Torino, benefitted from Regione Piemonte funds in collaboration with J-TECH@POLITO
- Our mission is to provide advanced expertise and technology transfer on joining materials and processes, modelling of joints, testing and monitoring of joined components.
- We are available for outsourced research, problem solving, project management, custom hands-on training and custom lecturing activity for companies and SMEs.
- Our activity is a fruitful collaboration among Departments –DIMEAS (Dept. of Mechanical and Aerospace Engineering), DISAT (Dept. of Applied Science and Technology), DIGEP (Dept. of Management and Production Engineering) – in a multi-disciplinary cooperative approach.



Laboratories	m2
DynLab 	141
J-TECH@POLITO (ground floor)	78
J-TECH@POLITO (CT-scan, underground)	112



Virtual Tour:

https://youtu.be/bS_f5g82hDY

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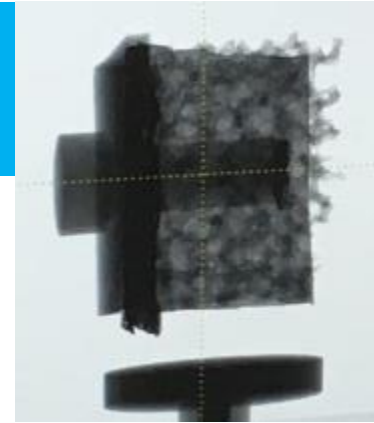
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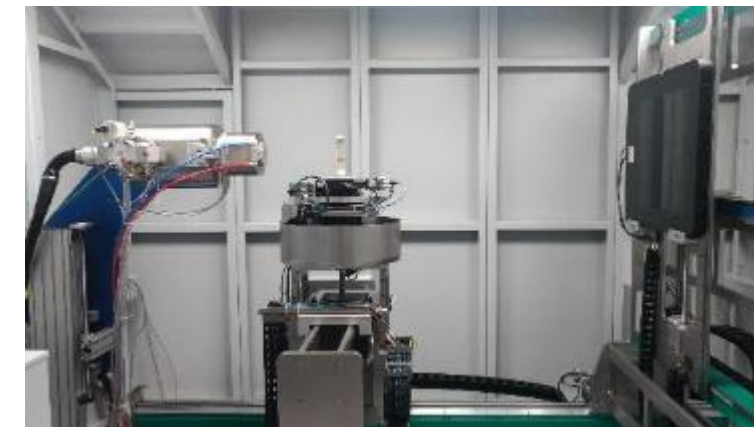


X-Ray Computer Tomography

Reference person:
luca.goglio@polito.it



- **X-Ray Computer Tomography-Custom built by Fraunhofer-Institut für Keramische Technologien und Systeme IKTS- Dresden, Germany**
- **Open microfocus X-ray tube:** maximum operating voltage 300 kV
- **Detector:** 2000 pixel x 2000 pixel , size 400 mm x 400 mm
- **Resolution:** about 5 μ m
- **Walk-in CT chamber:** 3500 mm x 2500 mm x 2500 mm (L x W x H)
- **4 axis manipulation system:**
 - ✓ Sample manipulation xyz
 - ✓ Sample rotation full range 0-360° continuous rotation
- **Sample size:** max 500 mm x 500 mm x 500 mm (L x W x H)
- **Sample weight:** max 100 kg
- **Tensile/compression/bending test during X-ray tomography: max load 10 kN :** the sample can be rotated in the beam path to do tomography at the selected force level



X-ray tube

Manipulation stage

Detector



Universal mechanical testing device for in-situ test

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Laser / Arc Welding station with 6-axis articulated robot (ABB)

for:

- Programming with Virtual Simulator (RobotStudio @ABB software)
- Suitable for most metal alloys
- Suitable for exploiting different welding processes

- Six axis anthropomorphic robot with a payload of 16 kg, equipped with:
- High power diode laser (spot 0.6 mm)
- Surface hardening & surface low temperature treatments head
- Rectangular Spot laser (2 mm width) head
- Cold metal transfer (CMT) arc welding head.

Main features:

LASER source (Laserline-Optoprim):

- Fiber-coupled diode laser source
- Up to 4 kW power
- Custom power and temperature profiles
- On-line power and temperature control

ARC source (Fronius - mod. TPS 400i):

- MIG with CMT (Cold Metal Transfer)
- WAAM (Wire Arc Additive Manufacturing)
- Surface cladding



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Laser heat treatments on surfaces, with 6-axis articulated robot

For:

- Laser hardening of steels
- Surface conditioning of metal alloys and ceramics
- Heat treatment on flat and curved surfaces

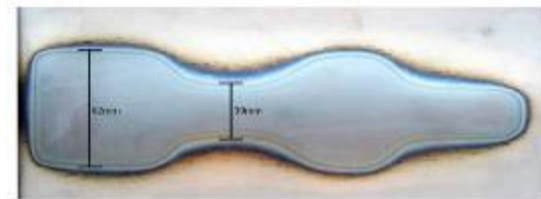
Main features of the equipment:

LASER source (Laserline-Optoprim):

- Fiber-coupled diode laser source
- Up to 4 kW power
- On-line power and temperature control
- Power and temperature customised profiles
- regular and variable spot-width



Regular spot-width

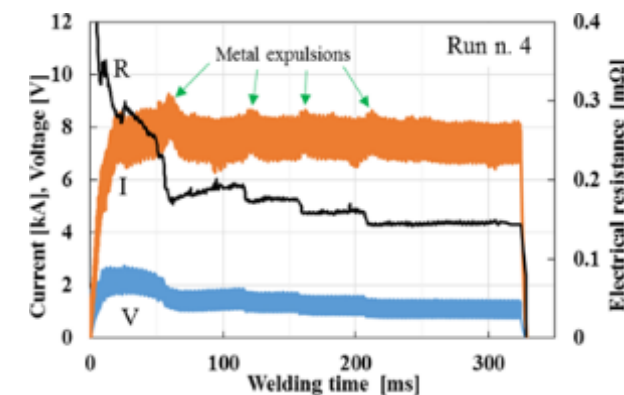
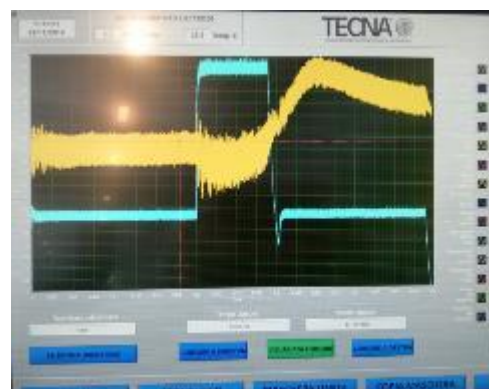


Variable spot-width

Resistance Spot Welding (RSW) station (Tecna)

Main features :

- Industrial medium frequency direct current resistance
- current from 1 to 4 kHz up to 200 kVA power
- 1242 daN at 6 bar
- Welding at constant current, power or energy
- on-line monitoring of current, voltage, electrical resistance, spot temperature, electrode displacement



Reference persons:
franco.lombardi@polito.it
pasquale.russospena@polito.it

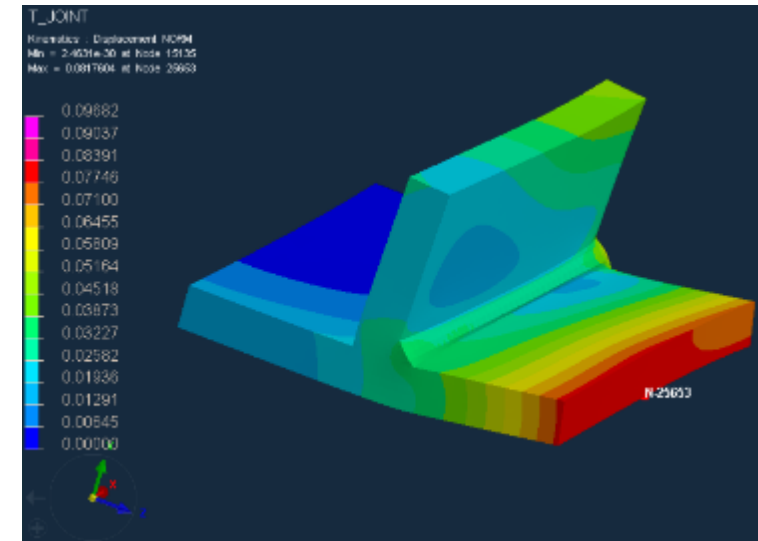
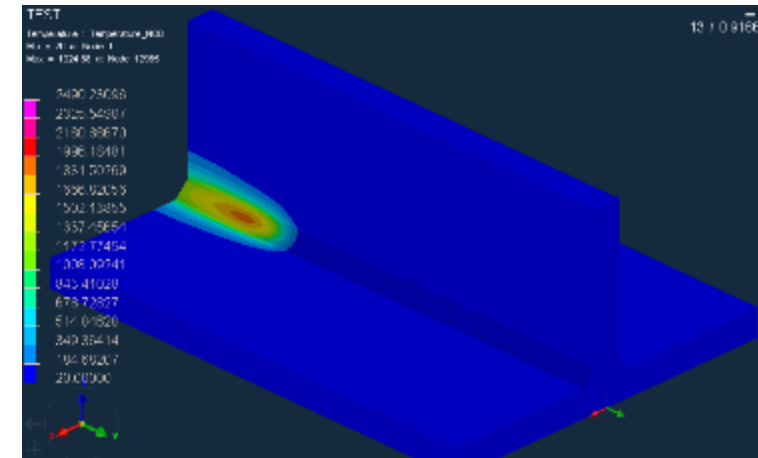
FEM numerical simulation of welding processes

Feasibility studies and evaluation of:

- Laser welding (Sysweld® by ESI- Visual_Weld)
- Arc welding (Sysweld® by ESI- Visual_Weld)
- Friction stir welding (Sysweld® by ESI- Visual_Weld)
- Resistance spot welding process (SORPAS® by Swantec)
- Distortion analysis (Sysweld® by ESI- Visual_Assembly)

Analysis and evaluation of:

- Welding parameters and procedures
- welding sequences
- Distribution of residual stresses
- Joint microstructure
- Temperature distribution
- Nugget size
- Workpiece distortion
- Clamping and fixturing



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Welding station for Friction Stir Welding (FSW)

Welding of low- and high-strength metal alloys (Al, Steels, Ti, Cu, ...)

Main features of the FSW machine

(Stirtec):

- Gantry structure - 2 axes motion (X,Z)
- 600 Nm torque
- 100 kN vertical force (Z axis)
- 50 kN horizontal force (X axis)
- Linear welds (butt, lap, T-joint)
- Spot welding (FSSW)
- Gas shielding (Argon)
- On-line monitoring and control of process parameters (torque, force, tool plunge and displacement, ...)

- Friction Stir Welding with a high-load capacity
- CNC control and high precision sensors to manage the welding parameters in real-time.



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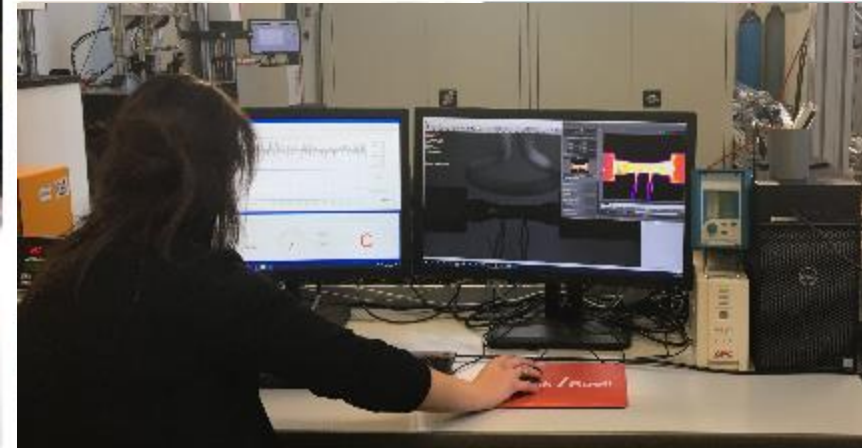
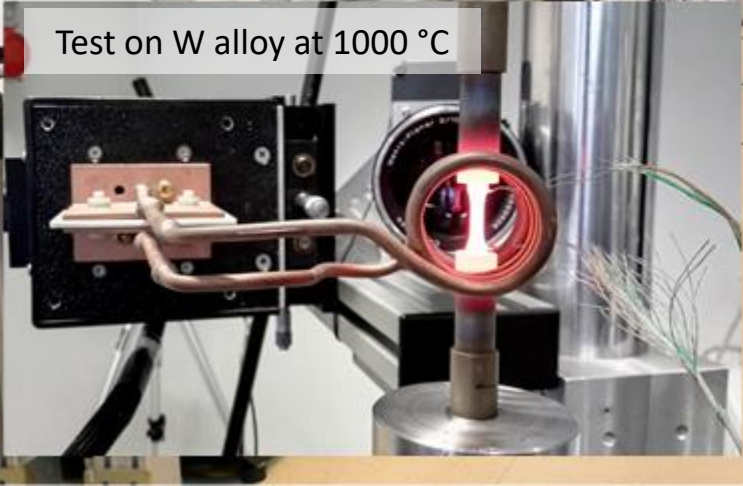
Split Hopkinson Bars

Reference person: lorenzo.peroni@polito.it



SHPB speed test with
induction heating &
IR measurement

Test on W alloy at 1000 °C



- Split Hopkinson Bars with high speed visible and infrared cameras fast data acquisition systems to evaluate the mechanical response of materials with test durations less than a millisecond

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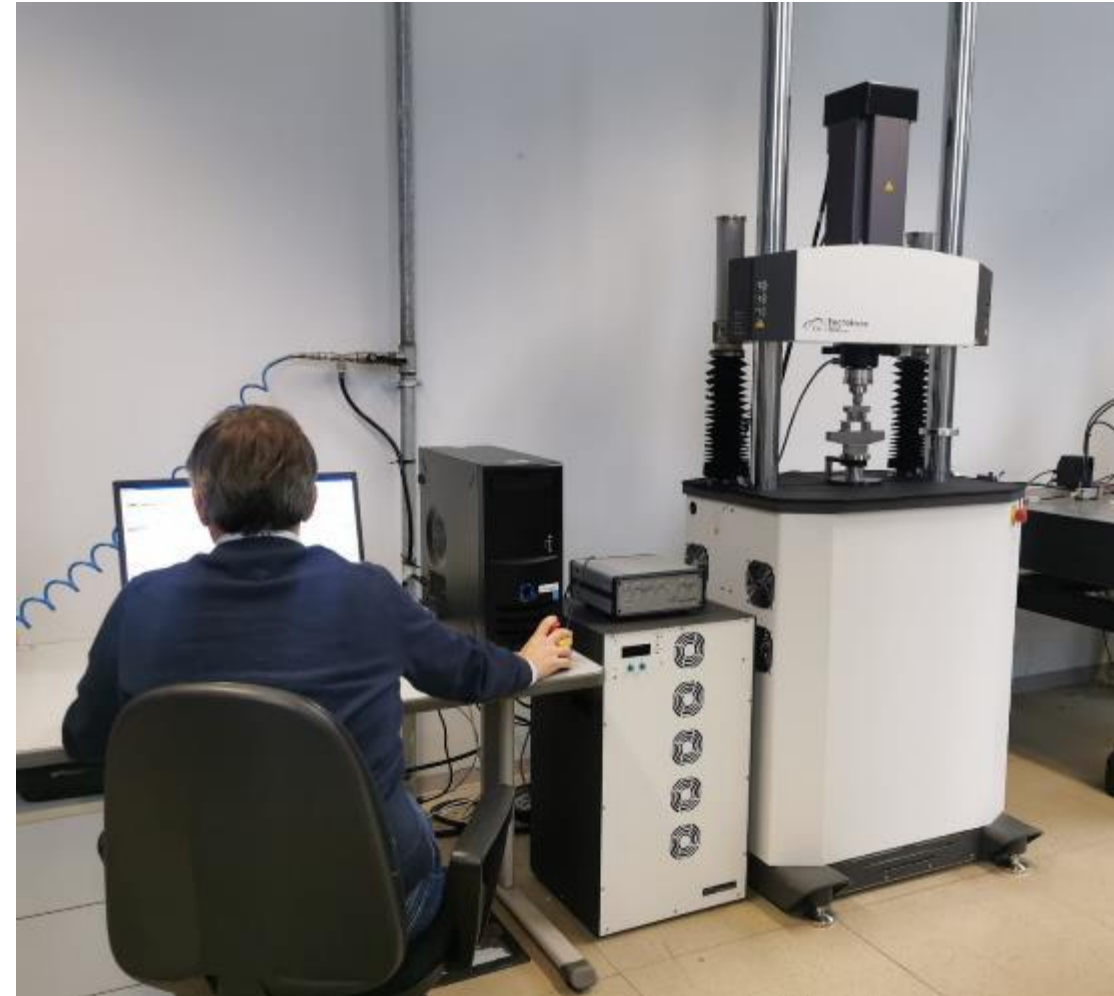
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Axial-torsional fatigue tests

Reference persons: davide.paolino@polito.it, raffaele.ciardiello@polito.it

- **Electrodynamic testing machine for combined axial-torsional fatigue tests**
 - **Electroforce 3550 (TA Instruments):**
 - maximum axial load 15 kN,
 - torsional moment 70 Nm,
 - load frequency 50 Hertz



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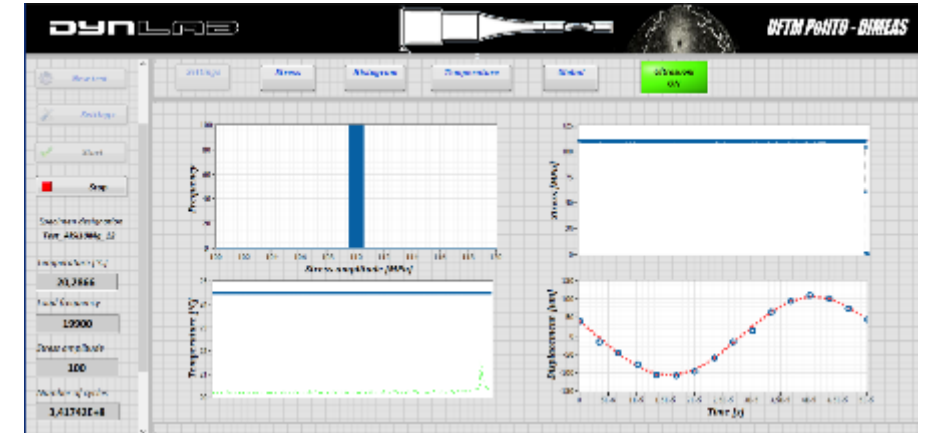
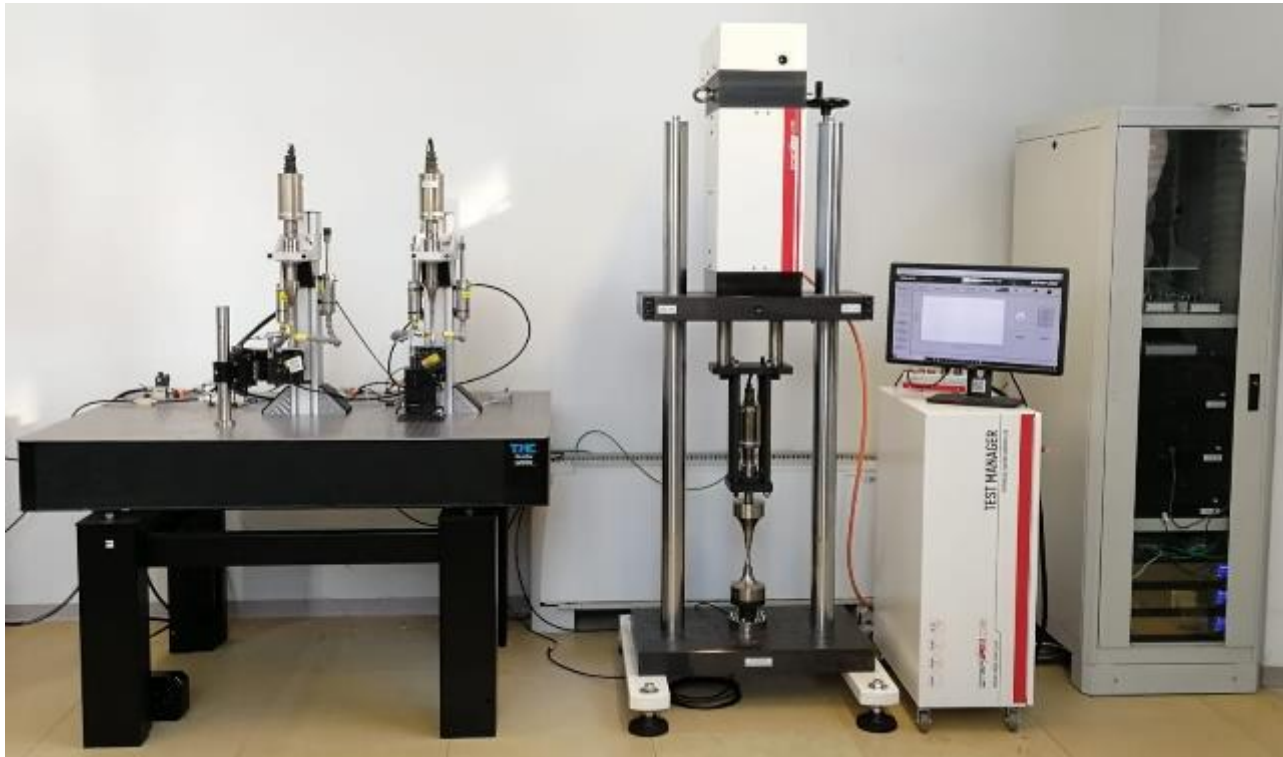
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Very-High-Cycle Fatigue

Reference persons: davide.paolino@polito.it, andrea.tridello@polito.it

- Ultrasonic testing machines (UFTMs) for Very-High-Cycle Fatigue tests up to 10 billion cycles at room and high temperature



UFTM control system



Test on AM specimen:
stress and temperature
control

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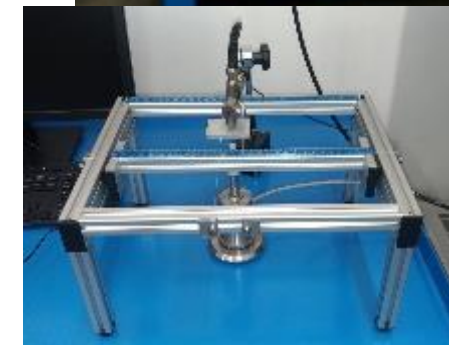
Impulse Excitation Technique non-destructive test

Reference persons: davide.paolino@polito.it, frediano.demarco@polito.it

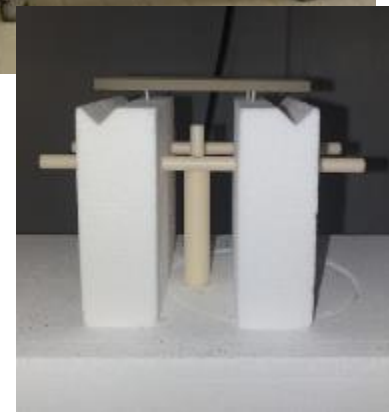
- IET [Impulse Excitation Technique] RFDA HT1600 (IMCE)
- Non-destructive test based on Impulse Excitation Technique for measurement of Young modulus, shear modulus, Poisson ratio and internal friction/damping, up to 1600 °C
- quality control tool by comparing resonant frequencies.
- *Test temperature range: room temperature up to 1500°C*
- *heating/cooling rate: 1 – 5 °C.*
- *working atmosphere : inert gas/air*
- *dilatometer: range 5 mm, resolution LVDT 100 nm, Temperature resolution 0.1 °C, force 0.65 – 0.8 N*

For:

- elastic properties: Young's modulus, shear modulus, Poisson's ratio and internal friction/damping (ASTM C 1259, ASTM E 1876);
- investigate the material crystal structure (phase transformations, point defects, dislocations, etc.);
- measure deterioration of mechanical properties due to irradiation, fatigue, thermal shock cycles, etc.
- determine a "fingerprint" of frequencies and their damping complex part



RT test equipment



HT test equipment

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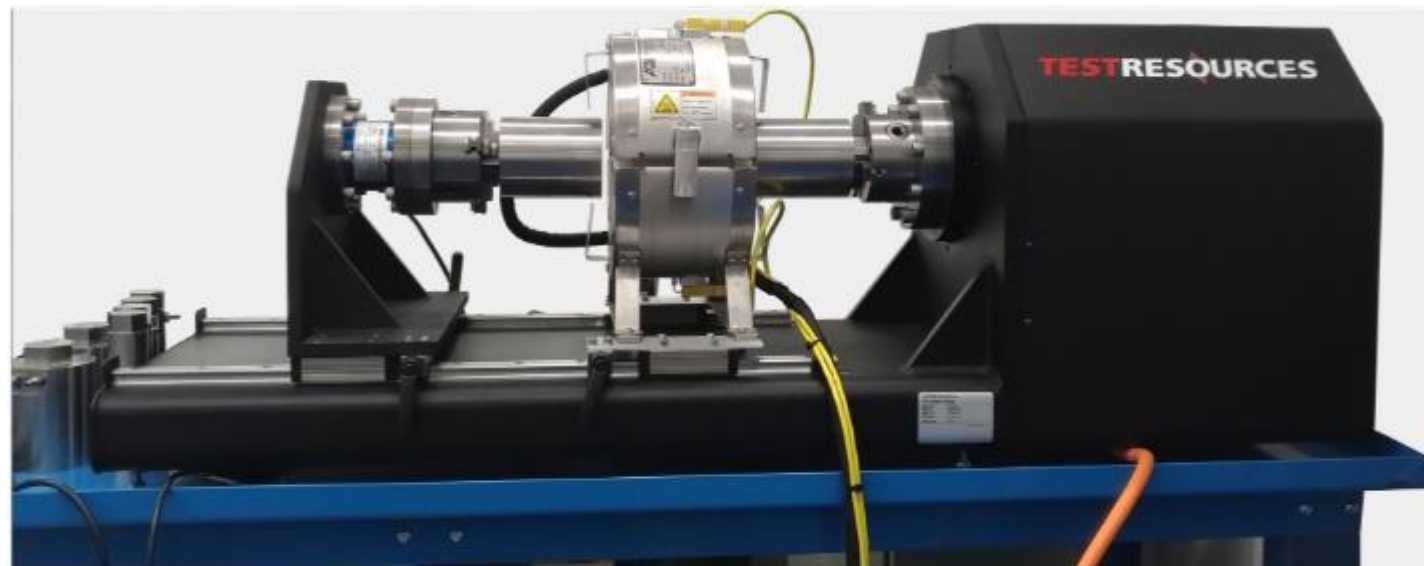
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- Torsion test equipment (160Q Universal torsion test machine - Test Resources, USA)
- Torsion Test System Designed for High Temperature Tests.

- *Static torque: 2 Nm to 500 Nm*
- *Test temperature range: room temperature up to 800°C*
- *Speed at full load: 2 RPM*
- *Angular resolution: 4 arcmin*
- *Travel: continuous rotation clockwise and counterclockwise*
- *ATS heating system: up to 800°C*



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- Thermography analysis with thermal camera and a low power laser source can perform non-destructive, reliable tests of welded joints the weld quality and the on-line monitoring of the welding process.

Non-contact NDT weld-inspection and welding-monitoring

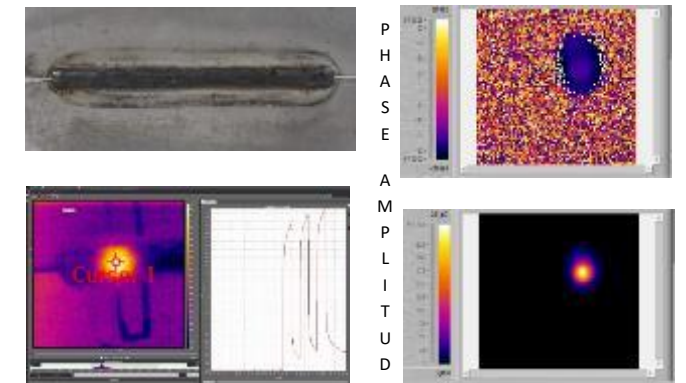
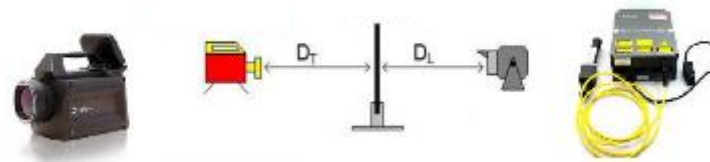
- *On-line and off-line NDT for welded joint inspection*
- *Passive thermography*
- *Active thermography (Pulsed and Lock-in)*



Passive

Equipment:

- ❖ FLIR A6751sc (up to 1500 °C)
- ❖ Power laser – IPG – 50 W
- ❖ System integrator (DES)



Active

High Temperature Chamber Furnace Gero: HTF 18/27 (Carbolite)

- *Max Temperature: 1800°C*
- *Litre capacities: 27 l*
- *Working Atmosphere: air*
- *PID Temperature control:
3216P1*
- *Heating element: MoSi2*

Vacuum furnace (XVAC Series) High Temperature Material Test Furnace System

- *Max Temperature: 1700°C*
- *Working Atmosphere: Inert gas /
Vacuum*
- *Minimum Pressure (vacuum): 5 x
10⁻⁶ mbar*

For:

- *Joining&thermal treatments; sintering*
- *Post weld heat treatments*
- *hydrogen induced cracking*
- *stress relieving*





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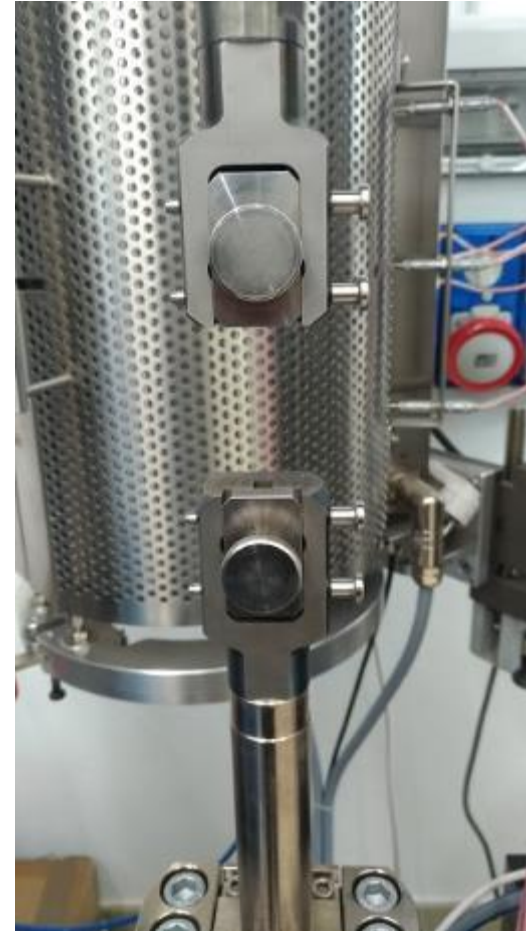
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Universal tensile/compression machine

Reference person: frediano.demarco@polito.it

- **Universal tensile/compression machine: Z050 THW (ZwickRoell)**
- **Max load 50 kN**
- **Equipped with Xtens 2-220 HP contactless high precision laser extensometer 0,7 microns resolution**
- **T test range: room temperature to 1200 °C (3- zone furnace)**
- **Working atmosphere : inert gas/air**



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Field Emission Scanning Electron Microscopy

Reference persons: davide.paolino@polito.it, andrea.tridello@polito.it

- **Field Emission Scanning Electron Microscope, MIRA3 XMH (Tescan):**
 - Max Magnification: 500,000X
 - Emitter: Schottky-FEG
 - Resolution: up to 1nm
- **EDX system, AZtecLive Standard con rivelatore Ultim MAX 40 (Oxford):**
 - Active area: 40 mm²
 - Detectable elements: Be – Cf
- **EBSD system, AZtecHKL Standard con rivelatore Symmetry (Oxford):**
 - Indexing speed: 4500 pps
 - Image resolution: 1244x1024 pixels



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