



MATERIALS AND STRUCTURES RESEARCH CENTER

STRUCTURES TESTING SUBDIVISION

STRUCTURAL TESTS

Static and fatigue tests:

- static and fatigue tests of complete structures or components,
- functional tests of unloaded and loaded structures including load, displacement and strain measurements,
- stiffness evaluation,
- static and quasistatic tests of turboengine shafts or other axially symmetric structures (tension/torsion loads), also at elevated temperatures,
- testing of composite structures.

Dynamic tests:

- high-cycle resonance fatigue tests and vibration resistance tests (e.g. of turbine blades),
- impact hammer modal tests of structural elements.

Other tests:

- low-revolution wear testing of fan blades and discs - test rig "Windmill",
- high-energy impact tests of structures using an air gun (diameter of projectiles up to 220 mm, weight - up to 15 kg, velocity - up to 300 m/s) with high speed camera recording and strain measurement.

OPERATIONAL TESTS

Strain gauge measurements:

- strain gauge measurements of flight loads,
- stress and strain measurements in constructions, facilities, machines, etc,
- load, strength and fatigue analysis.

Equipment:

Real-Time Controller NI CompactRIO-9022 and Simultaneous Bridge Module NI 9237.

Vibration measurements and analysis:

- flight vibration measurements,
- vibration measurements of vehicles, floating objects,
- laboratory measurements of vibration,
- vibration measurements of civil engineering constructions,
- vibration measurements of working machines, rotating equipment, installations,
- vibration analysis,
- vibro-acoustic analysis,
- vibration isolation of machines and equipment,
- vibroacoustic diagnostic.

Equipment:

- 24 simultaneously sampled vibration-optimized analog inputs at up to 102.4 kS/s.

Noise measurements:

- environmental noise measurements,
- aircraft noise measurements (inside and outside the aircraft),
- noise measurements of machinery and equipment,
- traffic noise measurements.

DESIGN AND ANALYSIS SERVICES

The range of services includes:

- analysis of isotropic and composite structures (including aircraft structures, windshields and others) subjected to foreign object impact with the use of LS - DYNA, including bird strike simulations (ALE and SPH methods),
- fatigue analysis of aircraft structures, including load spectra development (based on the in-service load measurement),
- developing test specifications for static and fatigue tests of aircraft structures,
- crack propagation analysis of metallic structures (2D & 3D) with the Finite Element and Boundary Element Methods (ANSYS 10, FRANC2D, FRANC3D, AFGROW, NASGRO),
- designing test rigs for the purposes of the Structural Testing Laboratory including strength analysis with the use of the Finite Element Method,
- static Finite Element Analysis (linear, nonlinear),
- comprehensive research services, from test rig design and coordination of test rig manufacturing conducted by approved subcontractors to the final test report.

MISSION

MSRC's mission is to implement the latest technologies in strength testing of materials and subassemblies of aircraft engines as well as other structures operating under heavy mechanical loads at a broad range of temperatures. These technologies are to serve the purpose of creating innovative, safe and competitive solutions in the area of transport and industrial production in Poland and all over the world. What sets us apart from our competitors is our standards-driven service excellence, state-of-the art research stations, and focus on cost and labor effectiveness.

The MSRC specializes in conventional as well as non-standard strength testing of materials and structures subject to extreme conditions. To provide a fuller array of services the Center has recently established a machining workshop, which prepares specimens for strength and fatigue testing.

Main MSRC's clients are representatives of the machine industries, including in particular:

- aeronautical industry including engine
- producers,
- food processing industry,
- automotive industry,
- chemical industry,
- rail industry,
- power industry.



Achieving Competitive Excellence

The United Technologies Operating System



MATERIALS TESTING SUBDIVISION

MATERIAL TESTS

Mechanical testing of metallic materials

- static strength tests (tension, compression, bending) - 14 test rigs (MTS 810, Instron servohydraulic),
- Low Cycle Fatigue tests (LCF), strain or load controlled - 26 test rigs (MTS 310, MTS 810, Instron servohydraulic),
- High Cycle Fatigue tests (HCF) - 26 test rigs (MTS 310, MTS 810, Instron servohydraulic),
- creep tests, Stress Rupture - 36 test rigs (creeps), including 14 with lift to cycle tests (LCF Long Dwell).

NON-DESTRUCTIVE TESTS

Offer:

- tests of full structures, components and their elements,
- detection and definition/diagnostics of technological and exploitation defects,
- detection of defects such as: material discontinuities - external and internal (blisters, cracks, inclusions, delaminations, laps, cold shuts, leaks, welded joints defects, etc.),
- development of methodologies and test programs at different stages of the production process in the industrial, field and laboratory environments,
- temporary tests and non-standard non-destructive condition diagnostics, including preparation of manuals and technical documentation,
- development and organisation of training courses.

Magnetic tests

Scope:

- detection of surface and subsurface defects of ferromagnetic materials.

Equipment:

Defectoscope yoke Y6 Magnaflux, Parker, Bycosin magnets, fluorescents and black magnetic ink Magnaflux, UV and white light, magnetic indicator strips, references.

Ultrasonic tests

Scope:

- detection of internal material discontinuities and identification of locations, configurations and sizes of discontinuities,
- ultrasonic thickness measurements.

Equipment:

GE Inspection Technologies Phasor XS defectoscope with technical probes and references, Thickness Gage PVX.

Penetrant tests

Scope:

- detection of open surface discontinuities of non-porous materials: metallic and non-metallic.

Equipment:

Magnaflux penetrants, UV and white light, light meters, references.

Visual tests

Scope:

- detection of surface discontinuities and shape defects of the elements using optical instruments,
- assessment of the surface quality,
- quality control after repair.

Equipment:

Equipment used for fiber endoscope testing (OLYMPUS IF-4D, camera Olympus, monitor JVC).

Eddy current tests

Scope:

- testing of materials with electrical conductivity,
- detection of surface and subsurface defects, coating thickness measurements, comparative structural studies.

Equipment:

GE Inspection Technologies Phasor 3d and Institute Dr Förster defectoscopes with sets of specialized probes and references for defects, conductivity and the corrosion degree.

Radiographic tests

Scope:

- detection of internal material defects,
- volumetric testing of objects,
- testing of glued, welded and soldered joints,
- verification testing of assemblies, testing of electronic components and subassemblies.

Equipment:

Computer Tomograph system v|tome|x L240 GE Inspection Technologies.

X-ray diffraction testing

Scope:

- measurement of residual stresses in the samples provided by the client,
- measurement of stresses at points of construction, facilities, etc,
- measurements of stress "in situ".

Equipment:

X-ray diffractometer Xstress3000 with a goniometer G2.

MATERIAL PROPERTIES TESTS

Capabilities:

- testing of materials structure,
- testing of materials surface including chemical composition analysis,
- fractography tests,
- material properties measurements.

Fractography - SEM:

- testing of metallic and non-metallic specimens,
- very high resolution images of a sample surface.

Scope:

- **Material tests:** surface observations using SE and BSE detectors, determination of the coating thickness.
- **Microscope fracture examinations:** detection of contaminants, microcracks, crack sources, quantitative examinations of the structure of fractures and determination of material homogeneity.

Equipment:

Scanning Electron Microscope Zeiss EVO 25 MA with BSE and SE detectors.

Chemical composition analysis - EDX

Scope:

- chemical composition analysis of specimens,
- material identification,
- identification of contaminants,
- determination of the relative element concentration on the specimen's surface.

Equipment:

EDX detector: XFlash 5010 Bruker, energy resolution 125 eV.

Surface roughness tests

Equipment:

Surface roughness tester Mitutoyo SurfTest SJ-301.

Metallography:

Scope:

- metallographic qualitative and quantitative tests, such as grain size evaluation, non-metallic inclusion size, phase volume fraction, coating thickness.

Metallographic specimens preparation:

Equipment:

- cutting machine with the functions of manual and automatic cutting, cooled by water,
- mounting press for specimens with max diameter Φ 40 mm.
- grinding-polishing machine capable of preparing up to 6 samples at a time.

Microstructure analysis

Equipment:

Metallographic microscope Neophot 2, magnification range 50x - 2000x.

Toughness tests

Equipment:

Portable Hardness Tester Mitutoyo and Innovatest Hardness Tester

Impact tests:

- tests can be conducted at elevated temperatures in the range of -196°C \pm 40°C ,
- Charpy impact tests can be performed on standard $10 \times 10 \times 55$ mm as well as on reduced specimens of $7.5 \times 10 \times 55$ mm and $5 \times 10 \times 55$ mm.

We are able to prepare specimens for tests in the machining workshop (according to ASTM standards or other standards requested by the client).

Equipment:

Pendulum Charpy Impact Tester.

PREPARATION OF SPECIMENS

Scope:

- preparation of specimens for:
 - strength tests (Static Tension, Creep, Impact, Stress Rupture),
 - fatigue tests (low and high cycle fatigue).
- machining of tough materials used in aircraft engines, e.g. nickel or titanium alloys,
- specimens are machined according to international standards (e.g. ASTM) and according to specifications provided by the client.

Equipment:

- lathe CNC AVIA Turn 35,
- milling machine CNC 3 axing FNE 40 N,
- shaft grinder RUP 280 \times 500,
- flat grinder FSG I 640-ADII,
- wire EDM machine BP-09d,
- wire EDM CNC machine Mitsubishi BA8,
- two-column band saw PTS 400.