

Łukasiewicz
Institute
of Aviation

AVIATION TECHNOLOGIES



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GENERAL COMPANY INFORMATION

Łukasiewicz Research Network - Institute of Aviation is one of the most modern research institutions in Europe, with traditions dating back to 1926. The Institute closely cooperates with the world's tycoons of the aviation industry and institutions from the space industry. The strategic research areas of the Institute are aviation, space and unmanned technologies. Tests and services for domestic and foreign industry in the field of metallic and composite materials, additive, remote sensing, energy and mining technologies are also carried out here. Łukasiewicz Research Network - Institute of Aviation is made up of seven research centers:

- AVIATION TECHNOLOGIES CENTER
  develops technologies dedicated to aircraft design, aerodynamic research and aircraft certification.

- SPACE TECHNOLOGIES CENTER
  conducts research and development in the field of space propulsion, space transportation, satellite testing and remote sensing.

- UNMANNED AERIAL VEHICLE TECHNOLOGIES CENTER
  conducts research and development in the field of drones and anti-drone systems.

- MATERIALS AND STRUCTURES RESEARCH CENTER
  offers materials and structural components testing in a wide range of loads and temperatures. Thanks to a large number of certified test stands it is a regional leader in fatigue and strength testing.

- COMPOSITE TECHNOLOGIES CENTER
  delivers composite technology solutions and composite material tests for the aerospace industry.

- ENGINEERING DESIGN CENTER
  is an engineering alliance between General Electric Company Polska Sp. z o.o. and Łukasiewicz Research Network – Institute of Aviation. The Center offers design, research and development services in the fields of aviation, gas power and renewable energy.

- ENGINEERING SERVICES CENTER
  provides mechanical and thermal engineering support to strategic research and development projects.



OFFER

The main area of activity of Łukasiewicz Research Network - Institute of Aviation in aviation technology is to provide research and development services and to support the development of industry. Theoretical, design and computational and laboratory activities are the elements that distinguish the Institute among global leaders. High-class infrastructure, experienced staff and young talents ensure desired quality and allow us to deliver breakthrough solutions.

Aviation technology offerings:

- Experimental and computational research in the field of aerodynamics.
- Design of metallic and composite aerostructures.
- Design and testing of avionic equipment.
- Design of aircraft engine components.
- Research on advanced propulsion systems (BLI, RDE).
- Aircraft design.
- Support in the aircraft certification process.
- R&D sources for air transport systems.
- Design of hybrid propulsion systems.

AERODYNAMICS

The Department of Aerodynamics at Łukasiewicz Research Network - Institute of Aviation has qualified scientific and technical staff, as well as wide scientific and research experience in conducting expertise in aerodynamics and flight mechanics for both civil and military aircraft and helicopters. The scope of activity of the Department includes research and development for the economy and industry sectors, especially for:

- Aviation.
- Automotive.
- Construction.
- Energy.
- Space Technology.
- Shipbuilding.
- Defence industry.
- Railway.
- Sports.

The structure of the Aerodynamics Department includes:

- Aerodynamic Research Laboratory.
- Computational Aerodynamics Division.
- Acoustics Division.

AERODYNAMIC RESEARCH LABORATORY (ACCREDITATION no. AB129)

As part of its activities, the Laboratory conducts unique on a national and international scale scientific work and research and development in applied aerodynamics. The Laboratory is equipped with 4 wind tunnels, including the largest tunnel in central and eastern Europe. Its infrastructure is among the most advanced facilities in the field of aerodynamics in the world. The conducted experiments enable the design and optimization of new and existing aircraft structures. Modernizations carried out in the Laboratory respond to international market demand in the field of fluid mechanics and the high demands of economic and industrial sectors.

The scope of work includes:

- Aerodynamic testing for Polish and foreign aviation industry.
- Research activities on applied aerodynamics as part of the European Framework Programs.
- Market research services for domestic and foreign customers, close cooperation with aviation industry tycoons, technical universities and R&D units.

The Aerodynamic Research Laboratory has implemented:

- Quality Management System in accordance with the requirements of the PN-EN ISO 9001:2015 standard.
- Laboratory Management System compliant with the requirements of the PN-EN ISO/IEC 17025:2018-2 standard supported by Accreditation Certificate No. AB 129 granted by the Polish Center of Accreditation.
- Internal Control System Criteria.
- The technical results obtained in the Laboratory are recognized by both the International Standard Organization ISO and by the International Laboratory Accreditation Cooperation ILAC.

The Aerodynamic Research Laboratory has held the Accreditation Certificate since October 22, 1997 No. AB 129 issued by the Polish Center of Accreditation.





INFRASTRUCTURE OF THE AERODYNAMIC TESTING LABORATORY

The Laboratory has modern measuring equipment which allows to conduct unique, highest level tests.

Pressure measurements	DTC Initium	pressure measurements up to 512 points at a frequency of up to 500 Hz
Weight measurements	Aerodynamic weighing set	measurement of forces up to 14 000 N and torques up to 3 000 Nm
Visualization measurements	3D PIV - DANTEC DYNAMICS	measurement using image anemometry in the speed range 0-90 m/s and 0.2-1 Ma

Two modern multi-channel DTC Initium by Measurements Specialies systems (formerly Pressure Systems Incorporated) are used for pressure measurements for up to 512 points (256 channels each) at a frequency of up to 650 Hz for each channel. Weight measurements are carried out using different types of aerodynamic scales differentiated by design, number of measuring axes, measuring range and mounting method.

The latest measurement system in the Laboratory is a multi-channel National Instruments system employing PXIe architecture based on 18-slot PXIe-1085 enclosure with throughput up to 12 GB/s controlled by PXIe-8135 with NI 8260.

The enclosure contains multi-channel measurement cards with PXIe architecture used to determine voltages, currents, temperatures, accelerations and forces.

The Laboratory performs visualization of airflows of tested objects by measuring the two-dimensional velocity field of the flowing air in low and high velocities tunnels using the imaging anemometry technique - PIV. The Laboratory is equipped with PIV: 2D2C (2D - two dimensions, 2C - two in-plane velocity components), 2D3C(2D - two dimensions, 3C - three in-plane velocity components, Stereo-PIV) and 3D3C (3D - three dimensions, 3C three components of velocity in volume - volumetric measurements). PIV 3D measurement is performed by the Dantec Dynamics AS, purchased in 2013, based on the specialized Dantec Dynamics DualPower laser 425-10 PIV with 425 mJ at 532 nm per cavity and 10 Hz with optical arm 2000 mm long, with a Dantec Dynamics HiSense 610 camera set equipped with Canon's excellent lenses and the latest Dynamic Studio 4.10 software.



The Laboratory is equipped with 4 wind tunnels:

LOW SPEED WIND TUNNEL T-3 (5 M)

Modernized in 2015, the T-3 low-speed wind tunnel with closed circulation, continuous-flow, open-ended measuring zone with a diameter of 5 meters and 6.5 meters length. Dimensions, motor power (5.6 MW) and air speed (100 m/s) allow to rank the T-3 tunnel among the world's leading low-speed wind tunnels.

In addition, the T-3 wind tunnel is equipped with an innovative secondary flow system with diameters of SF400, SF150, SF80, SF50 allowing to obtain additional air flow with a maximum mass flow rate of 45 kg/s, 6kg/s, 2 kg/s, 1kg/s respectively and Underpressure Installation. The SF80 and SF50 installations also allow the working medium temperature to be increased to 270°C. Unique installations allow internal flow testing of aircraft engine components or their models under simulated take-off and landing conditions with elevated outlet gas temperatures.



Parameter	Value
Diameter	5 m
Length	6,5 m
Test gas	air
Maximum speed of working medium	100 m/s
SF400 max flow rate	45 kg/s
SF150 max flow rate	6 kg/s
SF80 max flow rate	2 kg/s
SF50 max flow rate	1 kg/s
SF80, SF50 max air flow temperature	Controlled up to 270°C
Maximum underpressure instalation rate of IPP	up to 3 kg/s

The following objects can be tested in the T-3 tunnel:

- Aircraft models with wingspan up to 4 m.
- Non-streamline objects up to 3 m in height.
- Objects with a cross-section (perpendicular to the flow direction) of up to 2.5 m².
- Rotor models up to 3 m diameter.







TRISONIC WIND TUNNEL N-3

The unique N-3 Trisonic Wind Tunnel is in operation since 1965. The tunnel is a blow-down type with partial recirculation of the flow and it can operate in three speed regimes i.e. sub-, peri- and supersonic (range of achievable Mach numbers Ma = 0,2-2,3). The tunnel is fed from two spherical tanks of compressed air with a total volume of 2880 m³ and a maximum pressure of 7 atm. Air is compressed by compressors with a total power of up to 2MW, properly cleaned and dried. The average operating time of the tunnel is:

- For supersonic Mach numbers about 3 minutes.
- For transonic Mach numbers about 5 minutes.
- For subsonic Mach numbers M = 0.3-0.5 to several minutes.

The measurements are made in a measuring chamber with a cross-section of 0.6 x 0.6 m, which classifies the tunnel as the largest and fastest facility in Poland.

Parameter	Value
Test section parameters-height x width	0,6 m x 0,6 m
Test section parameters-length	1,5 m
Test gas	air
Velocity range	Ma = 0,2–2,3

The scope of the N-3 tunnel testing activity:

- Pressure and weight tunnel testing of aircraft models, measurement of their aerodynamic characteristics and pressure distributions.
- Measurement of aerodynamic loads on aircraft model components such as wings, horizontal and vertical stabilizers, control surfaces, suspensions, etc.
- Measurement of hinge moment of the rudder components.
- Tests on the limits of buffeting onset and intensity over a wide range of flow rates.
- Visualization of flow with the following methods: picture anemometry (PIV), oil and Schlieren's (monochrome and color).
- Tunnel tests of aerodynamic characteristics of profiles.
- Pressure transient measurements with oscillatory excitation system.







WIND TUNNEL T-1 (1,5 M)

The T-1 is a low-speed, closed-circuit, continuous flow wind tunnel with an open test section with 1.5 m diameter and 2.4 m length. Maximum speed of the working medium is 45 m/s.

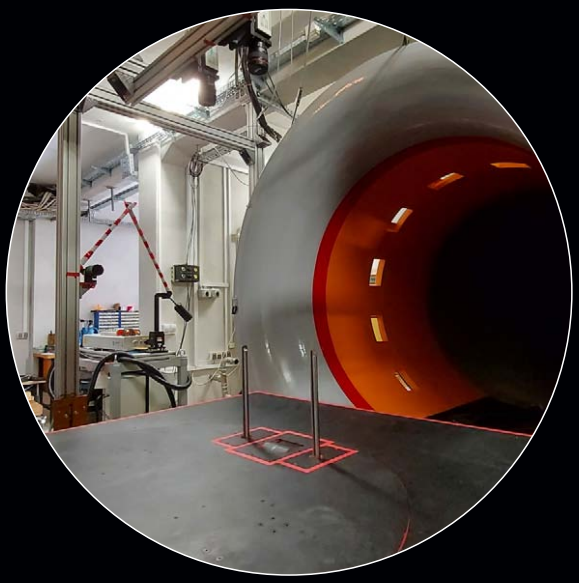
The scope of the T-1 tunnel testing activity is:

Parameter	Value
Test section dimensions-diameter	1,5 m
Test section dimensions-length	2,4 m
Test gas	air
Wind speed	45 m/s

The scope of the T-1 tunnel testing activity concerns:

- Weight and pressure distribution tests of models of aircrafts, helicopters, rail vehicles, wheeled vehicles and their components.
- Optimization of flap geometry and position.
- Hinge-moment optimization for ailerons and tail units.
- PIV 3D tufts and minitufts with UV - light flow visualization.
- Smoke flow visualization.







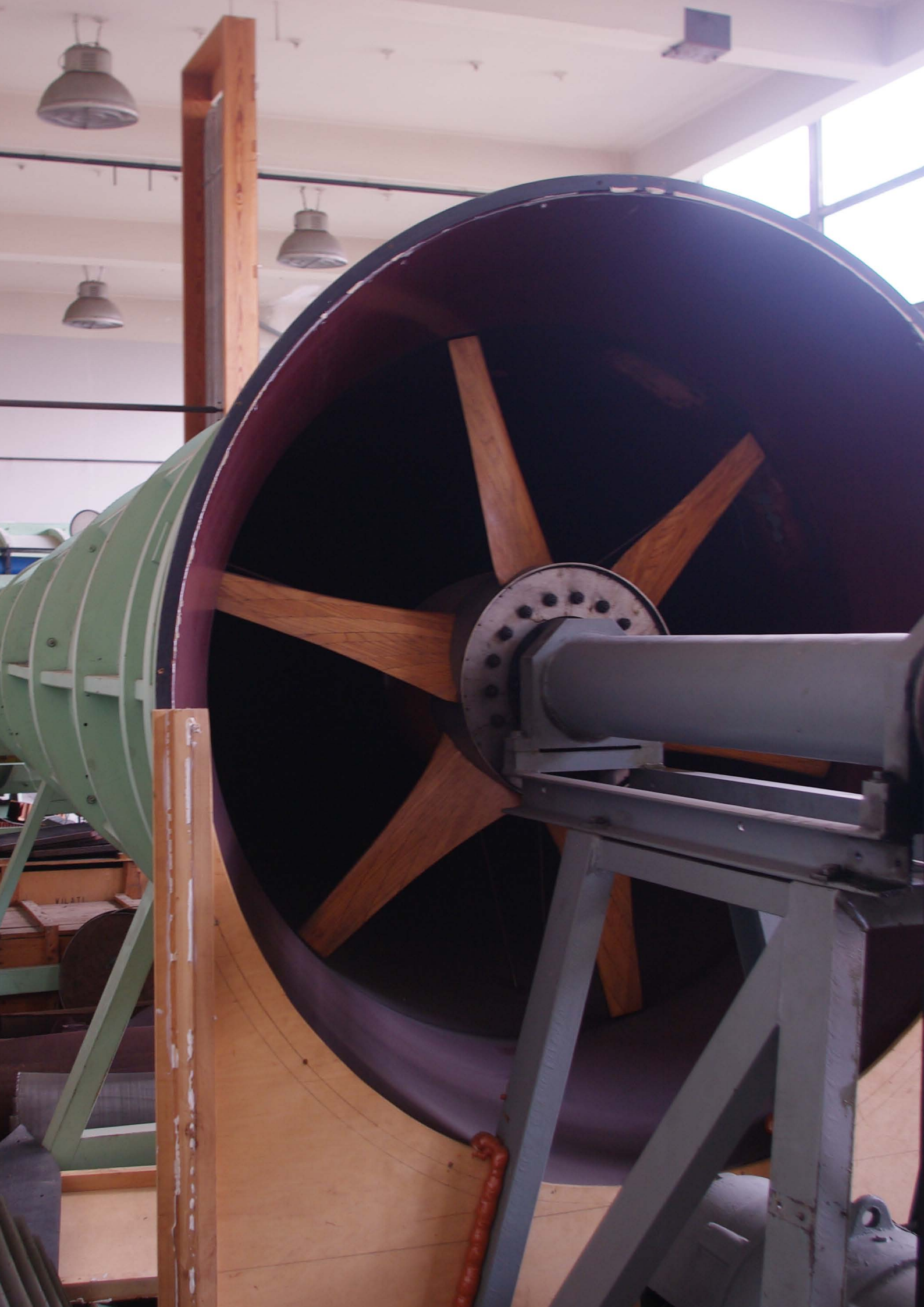
LOW TURBULENCE WIND TUNNEL TMT

The TMT Low Turbulence Wind Tunnel is an atmospheric, open-circuit tunnel with two linked, closed, rectangular test sections. The tunnel is equipped with two DC motors of 5.1 kW and 64 kW used depending on the set measuring speed of the working medium.

The scope of the TMT tunnel testing activity concerns:

- Weight and pressure distribution tests of models of aircrafts, helicopters, rail vehicles, wheeled vehicles and their components.
- Optimization of flap geometry and position.
- Hinge-moment optimization for ailerons and tail units.
- PIV 3D tufts and minitufts with UV - light flow visualization.
- Smoke flow visualization.

Parameter	Value
Rear test section parameters-height x width	0,5 m x 0,65 m
Rear test section parameters-length	1,3 m
Front test section parameters-height x width	1,75 m x 2,28 m
Front test section parameters-length	1,3 m
Test gas	air
Rear test section parameters-max speed	85 m/s
Front test section parameters-max speed	8 m/s
Adjustable turbulence intensity in the range	0.1%<τ(tau) τ(tau)<0,03%



COMPUATIONAL AERODYNAMICS DIVISION

Computational Aerodynamics Division at Łukasiewicz - Institute of Aviation is a leading Polish center for design work and analysis using computational methods and techniques (CFD). The laboratory employs high-class specialists in numerical aerodynamics and design and optimization of aircraft structures. Research works and design projects are performed using proprietary and commercial software.

Design and optimization

The basic tools for design and optimization are those developed and implemented in the laboratory:

- Methodology of parametrization of objects for design and optimization of their aerodynamic properties.
- A multi-criteria and multi-disciplinary design and optimization methodology based on genetic algorithms and metamodels.
- Experiment design methodology.

Main scope of activities:

- Building parametric models of objects for testing and optimization (profile, wing, air inlet, nozzle, etc.).
- Airfoil design.
- Multicriteria and multidisciplinary design of aircraft and its components.
- Aerodynamic design of flow channels.
- Aerodynamic design of the helicopter rotor.
- Design of propellers, wind turbine rotors, etc.

Analyses

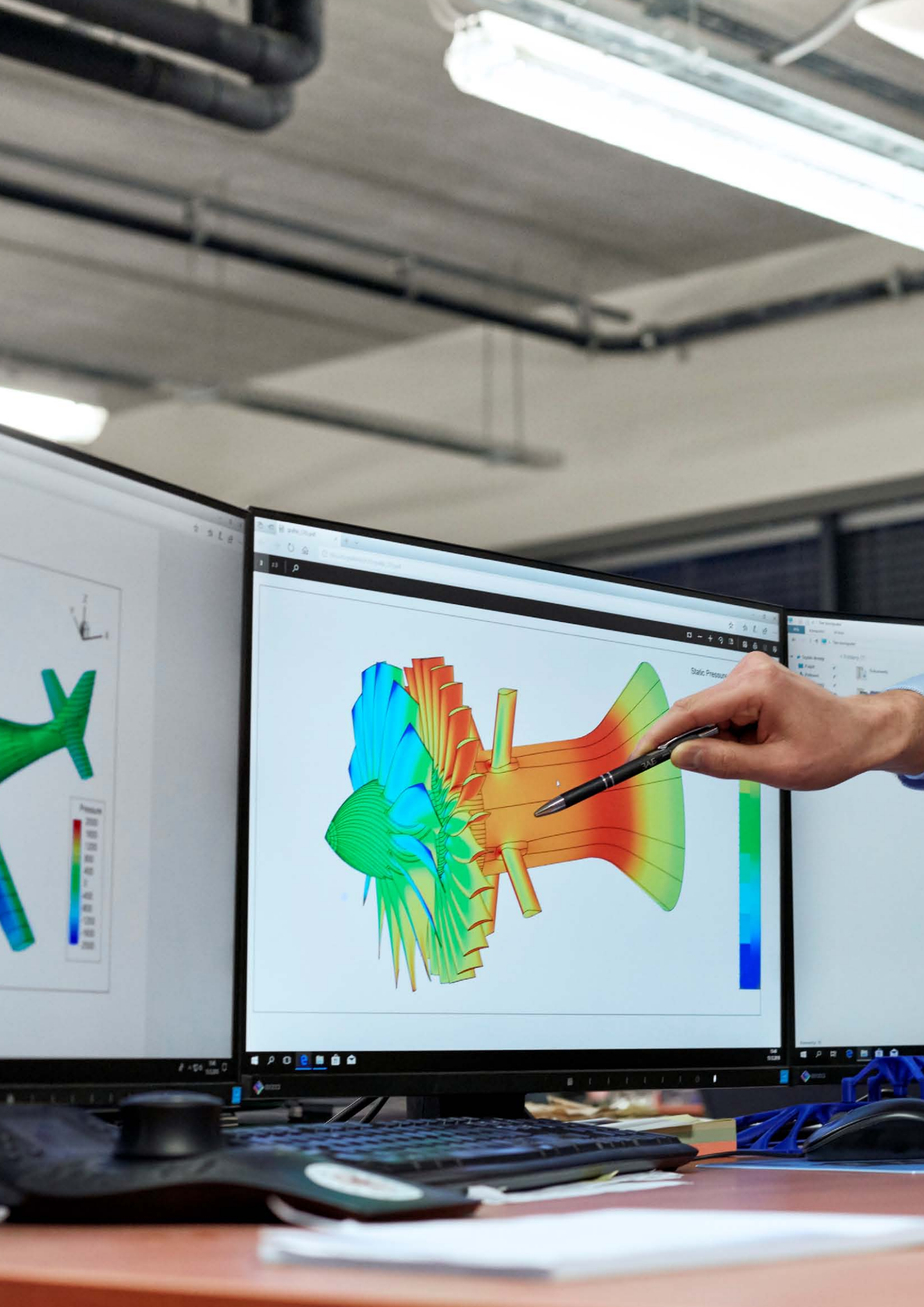
Own, academic as well as commercial software is used for computational flow simulation.

Main scope of activities:

- Airflow simulation of the aircraft and its components.
- Airflow simulation of the helicopter and its components and interference with the environment.
- Non-stationary flows with time-varying geometry of the flow area.
- Simulation of fully three-dimensional airflow of the working helicopter rotor (in progressive flight and in hover) based on the URANS solution.
- Modeling of interaction between the medium and the rotor blade structure (blade oscillations and deformations).
- Simulation of duct flows (e.g. air inlet).

ACOUSTICS DIVISION

Acoustics Division at Łukasiewicz - Institute of Aviation develops technologies of numerical and experimental assessment of noise generated by aircraft components such as propellers and rotors, flap mechanization systems, landing gear, etc. Methods of identifying noise sources and optimizing designs for noise minimization are successfully developed.



AVIATION CONSTRUCTIONS

Łukasiewicz Research Network - Institute of Aviation specializes in designing composite and metal structures of aircraft as well as technological instrumentation for their production. Moreover, the Institute conducts performance analyses, load analyses and modernization projects of currently used aircraft. Experience of the design team allows for the implementation of projects that go beyond the aviation industry and proposing optimal solutions taking into account specific customer requirements.



Aviation Construction Department offer in the field of design and numerical analysis includes:

- Metal structures
- Composite Structures:
  - Aerospace glass and carbon composite structures.
- Technological instrumentation:
  - Molds for making composite structures.
  - Mounting instruments.
- Additional equipment in currently used aircraft and helicopters.

THE DESIGN PROCESS IS CARRIED OUT IN CATIA SOFTWARE

Strength analyses of composite and metal structures.

STRENGTH ANALYSES ARE PERFORMED WITH ANSYS SOFTWARE

Work is being performed under the approval of the AP 270 Design Organization (ADOA) issued by the European Aviation Authority EASA and quality management systems ISO 9001:2015, AQAP 2110:2016.


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TRANSPORT SYSTEMS

Long-term experience of Łukasiewicz Research Network - Institute of Aviation's scientists enables the provision of wide range of research and services in the area of transport systems. The Institute is the coordinator of development projects and it took part in many important EU projects.

The scope of Łuksiewicz - Institute of Aviation's work on transportation systems includes:

- Preparation of forecasts and strategies for the development of air transport, including integration strategies of air transport with the general transport system (intermodal network - with other available means of land, water transport).
- Development of forecasts and strategies for an intermodal transport network serving urban and extended urban (up to regional) mobility with the participation of air transport (Urban Air Mobility).
- Quantitative and qualitative studies on passenger and freight transport market.
- Modeling and design of passenger and freight transport systems.
- Development of safety and security elements in air transport.
- Analysis of technical and economic aspects of construction, planning and operation of aircraft.
- Work in the field of aircraft design, including calculation of aircraft performance, aircraft mass and balance calculations and analyses, calculations of loads.
- Development of continuing airworthiness documents, including the Operations Manual in Flight, Maintenance Manual, Service Bulletins.
- Work on aircraft testing, including development of ground test programs and flight tests programs and conducting ground and flight tests.
- Work on aircraft certification, including development of programs for certification, analyses of compliance with certification requirements, Fulfillment Sheets and other documents required in the aircraft certification process.

Łukasiewicz Research Network - Institute of Aviation also offers construction of demonstrators of technologies and prototypes. This includes activities relating to the construction of all types of demonstrators of technologies, demonstration plant, prototypes, testing equipment and technology related to aviation in its broadest sense:

- Prototyping of components, parts, fuselages, equipment and mechanical structures, static, electrical structures, automation, both in aerospace and workshop technologies.
- Construction of all technology demonstrators: iron birds, glass birds, demonstrators of power systems, mechanization systems, etc.


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DESIGN, PRODUCTION AND MAINTENANCE ORGANIZATION

DESIGN ORGANIZATION

Design Organization at Łukasiewicz Research Network - Institute of Aviation deals with carrying out systemic multidimensional solutions and implements aircraft design work in the aerospace market in accordance with their scope of approval. The Design Organization was established on 9 August 2007 and approved by the Civil Aviation Authority and the European Aviation Safety Agency (EASA) on 4 September 2008 (EASA approval No. AP270). Safety scope is strictly formalized and controlled by the Civil Aviation Authority (CAA).

Scope of Approval:

The Design Organization, acting in accordance with alternative procedure PART 21A.14(b), shall implement specific design practices, taking into account the requirements of PART 21 and related acceptable means of compliance (AMC) and advisory material (GM), in terms of:

- Type Certificate 21A.14(b).
- Supplemental Type Certification 21A.112 B(b).
- Repairs 21A.432 B(b).

Applicable airworthiness requirements:

- CS-23.

Authorization for:

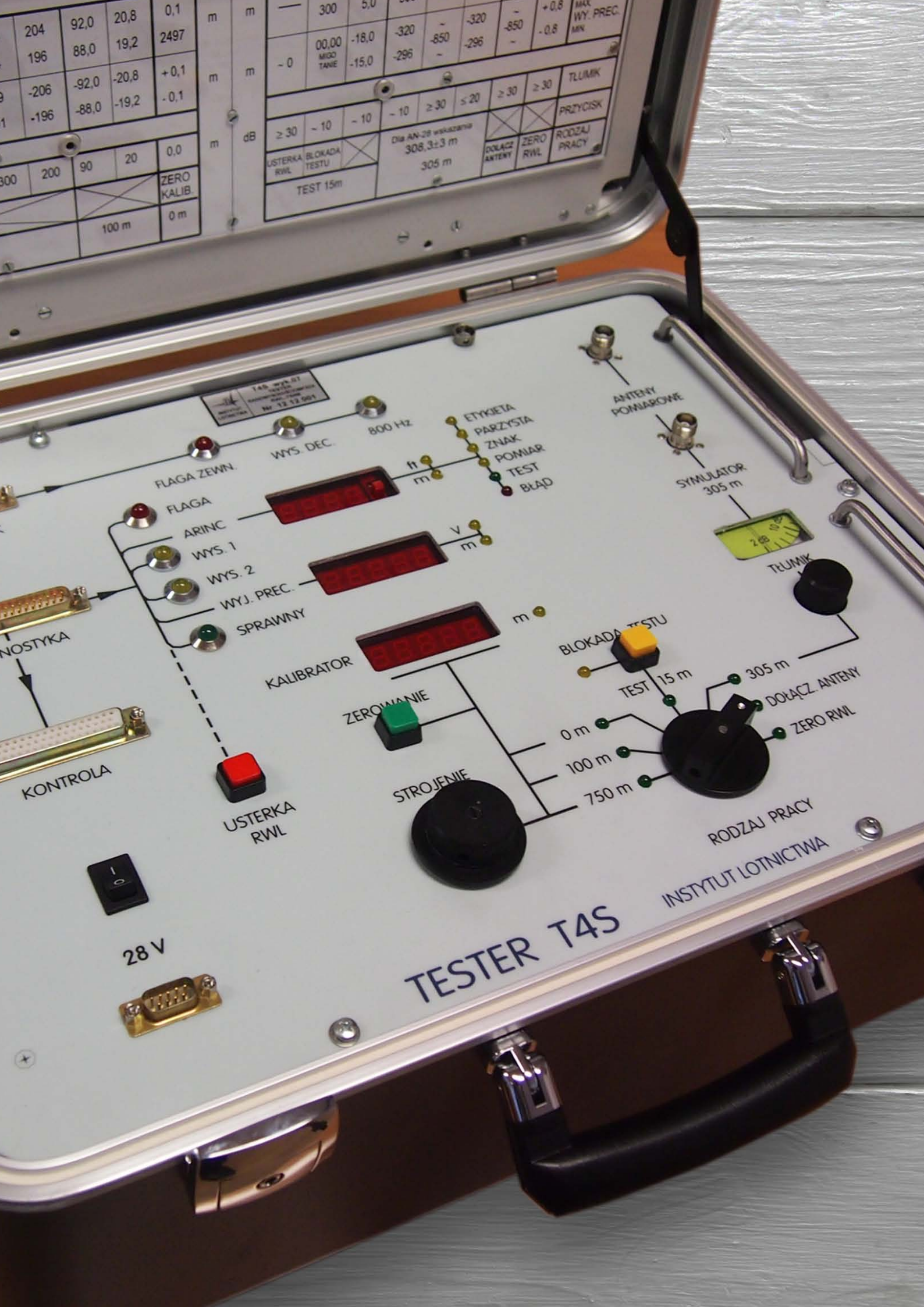
- Activities within the scope of approval under the supervision of the Agency.

Projects for which type certificate has been applied for:

- Aircraft I-23 - Type Certificate EASA.A.200
- Type Certificate No. BB-215 - GILC.

Projects carried out under the supervision of the organization:

- Aircraft I-31 P - design, prototype realization supervision, stand tests, ground and flight tests, certification process.
- Aircraft I-31 T - design, prototype realization supervision, stand tests, ground and flight tests, certification process.
- Aircraft An-2 with the ASz-62IR-16E engine - design of modifications, supervision over implementation of changes, stand tests, ground and flight tests, certification process.
- Aircraft FLARIS LAR-1 - ground and flight tests.
- Other expert and project tasks for national and European aviation entities.


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ARINC
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WYS. 2
WYJ. PREC.
SPRAWNY
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NOSTYKA
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BLOKADA TESTU
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Łukasiewicz Research Network - Institute of Aviation provides services in the area of design of such elements as:

- Wheeled and skid-mounted landing gears for aircrafts and helicopters.
- Shimmy dampers and anti-resonance single- and two-stage shock absorbers for landing gear.
- Landing gear integration elements.
- Test stands for ABS systems.
- Actuators and locks.
- Wheels and high-energy brakes.
- Unmanned aerial vehicle (UAV) landing gears.
- Technology Demonstrators.
- Electric brakes for UAVs.

PRODUCTION ORGANISATION

Certificate of Approved Production Organisation of Łukasiewicz Research Network - Institute of Aviation No PL.21G.034 (Part 21).

The Production Organisation was approved by the Civil Aviation Authority under Regulation (EC) No 216/2008 of the European Parliament and of the Council and Commission Regulation (EC) No 1702/2003 in accordance with Annex (Part 21), Section A, Subpart G, and is authorized to manufacture products, parts and appliances included in its list of approvals, and to issue certification of production in the form of EASA FORM 1.

Currently, the product range manufactured by the Production Organisation of Łukasiewicz Research Network - Institute of Aviation includes:

In terms of EASA approval:

- For PZL M28 Bryza and Skytruck aircraft:
  - Fuel gauge PPM-1, PPM-1B (including analogue-digital indicators, digital indicators, electronic blocks, transmitters and fuel level indicators).
  - Fuel level indicators SN1C/5.
  - BRO-2 lighting blocks.
- For I-23 aircraft:
  - SR/2 low fuel level indicators.






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MOD 1
Skalowanie kompletu PPM-1(B)
złącze K1 – wiązka W1
MOD 2
Diagnostyka kompletu i BEPPM-1(B)
złącze K1 – wiązka W1
MOD 3
Diagnostyka WPC-1(B) i WPD-1(B)
złącze K2 – wiązka W2 lub W4
MOD 4
Diagnostyka WPAC-1(B)
złącze K2 – wiązka W3 lub W4
W1
W2
W4
K1
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TEST
REG.
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MOD 2
MOD 3
MOD 4
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Other products (ISO/AQAP):

- For the PZL M28 Bryza aircraft:
  - Radio altimeter RWL-750M (including analogue servo indicators and electronic blocks).
  - TPPM-1 fuel gauge testers.
  - Radio altimeter testers.
- For the PZL-130 Orlik aircraft:
  - Radio altimeter RWL-750M/O.
  - SR/2 low fuel level indicators.
  - Automatic rudder trimmer - ATSK.
- For PZL W3 Sokół helicopter:
  - Radio altimeter RWL-750M (including analogue servo indicators and electronic blocks).
  - Torque meter testers.

MAINTENANCE ORGANIZATION

Certificate of Approved Maintenance Organization of Łukasiewicz Research Network – Institute of Aviation No. PL.145.062 (EASA Part-145).

The Maintenance Organization is approved by the Civil Aviation Authority by virtue of Regulation (EC) No 216/2008 of the European Parliament and of the Council and Commission Regulation (EC) No 2043/2003 under Division A of Annex II (Part-145) and is authorized:

- In terms of approval C: for maintenance of products, parts and appliances listed in its approval list, and to issue a certificate in the form of EASA FORM 1.
- In terms of approval B2: the scope of the Maintenance Organization services was extended to include research and perform air tests of piston engines of the companies: Continental Motors and Lycoming Engines.






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instytut lotnictwa

AVIONICS

The Avionics Department of Łukasiewicz Research Network - Institute of Aviation conducts scientific and research, and design-construction works, as well as small-batch production in the field of equipment and avionic systems, measuring and diagnostic equipment and installations and electric systems of aircraft, helicopters and unmanned aerial vehicles.

Avionics Department offers design and construction services in the field of:

- Systems related to the movement of aircraft and RPAS in civil space, in all phases of flight.
- Avionic systems, in particular stabilization and classic, indirect and automatic aircraft control, RPAS, satellites and other control systems.
- Avionic equipment for movement parameter measurement (e.g. CDA, radio altimeter), spatial location (e.g. INS, AHRS) and operational parameters (e.g. fuel gauge).
- Mathematical modeling of aircraft flight dynamics.
- Design of microprocessor systems as scalers dedicated for systems and measuring equipment, stabilization, control and diagnostic systems, with particular emphasis on aircraft avionic equipment, RPAS, satellites as well as other devices and system components that require a platform computation to implement numerical algorithms.
- Rapid prototyping of avionic equipment, its assembly and certified production for a commercial user.
- Tests of resistance and strength against mechanical effects and climate of control equipment and technical installations.
- Expert reports, testing and evaluation of aviation equipment, systems and installations completed with a certificate of compliance with aviation standards and regulations: RTCA, ARINC, MIL, TSO.
- Prototyping and small-batch production of precision devices: measuring, indicating and diagnostic units.

The Avionics Department provides expert reports, testing and evaluation of aircraft equipment, systems and installations completed with a certificate of compliance with aviation standards and regulations: RTCA, ARINC, MIL, TSO. It has at its disposal a workshop base enabling to make prototypes and small-batch production of precision devices: measuring, indicating and diagnostic units. It is equipped with stands and apparatus enabling comprehensive examination of the equipment and products.

The products developed and manufactured by the Avionics Department can be found in the equipment of many Polish aircraft and laboratories. The following devices deserve a special attention:

- Aircraft fuel gauges: Iryda, M28 Bryza/Skytruck and W-3 Sokół helicopter.
- RWL-750M radio altimeters used in Iryda, Bryza aircrafts and the Anaconda helicopter.
- Torque meter assembly used on the W-3 Sokół helicopter.
- Signaling and lighting systems, used in Iryda, Skytruck aircrafts.
- Autonomous control system of an unmanned aeroplane.
- RAC analogue-digital recorder (for recording analogue and/or digital data, recording data from a GPS receiver, storage of recorded values in the internal memory and reading the stored data on a personal computer).
- Transient waveform generators GPPA-3, GPPA-4, electrostatic discharge generators GWE-2.
- AROS autonomous fatigue load recorder, testers of: TRS 6113-2 radio station, TPPM-1 fuel gauge, T4S radio altimeter, UD-100M torque meter, equipment and MRT-3 radionavigation systems.


TECHNOLOGY AVIATION TRAINING
SP-SZAM


instytut lotnictwa
HMS
ULTRALEKKI

CRW-13 DIGITAL RADIO ALTIMETER
ELECTRONIC BLOCK (2500 FT)

Features:

- Digital height signal processing based on FFT algorithm.
- The transceiver is installed together with the antennas.
- Installation without antenna cables and shock-absorbing frame.
- Low height enables installation in low fuselage profiles.

The CRW-13 has an analogue output and ARINC 429 for interfacing with GPWS, TCAS, Autopilot.

Specification:

- Dimensions without flange: 3.15 "W x 1.77 "H x 7.09 "L (80 x 45 x 180 mm).
- Weight: 1.05 kg.
- Power supply: 14 V DC / 0.5 A nominal up to 28 V DC / 0.3 A.
- Altitude: 55,000 ft.
- Operating temperature range: -45°C to +60°C.
- Transmitter output: 150 mW FMCW, 100 Hz modulation.
- Operating frequency: 4300 ±20 MHz.
- AID height: 2 ft to 20 ft (0.6 m to 6 m).
- Accuracy: ±2 ft or ±2% from 0 to 500 ft, ±3% from 500 to 2500 ft.



RWL-750M RADIO ALTIMETER AA-E7
ELECTRONIC BLOCK (750 M)
AA-E4 ELECTRONIC BLOCK (2500 FT)

Features:

- AA-E4 can operate with the AA-W4 indicator, up to 2500 ft.
- AA-E7 can operate with the AA-W7 indicator, up to 750 m.
- It is compatible with two S67-2002 antennas (Sensor Systems).
- It requires AA-R4 shock-absorbing frame.
- It has analogue output and ARINC 429 for interfacing with GPWS systems, TCAS, Autopilot.

Specification:

- Dimensions: 3.58 "W x 3.46 "H x 10.04 "L (91 x 88 x 255 mm).
- Weight: 1.9 kg.
- Power supply: 27.5 V DC ±20% 0.7A nominal.
- Altitude: 55,000 ft.
- Temperature: -45°C to +60°C.
- Transmitter output: 250 mW FMCW , 100 Hz modulation.
- Frequency: 4300 ±20 MHz.
- AID height: 20 ft to 60 ft (6 m to 19 m).
- AA-E4 accuracy: 2 ft or ±3% from 0 to 500 ft, ±3% from 500 to 2500 ft.
- AA-E7 accuracy: 0.6 m or ±3% from 0 to 100 m, ±3% from 100 to 750 m.



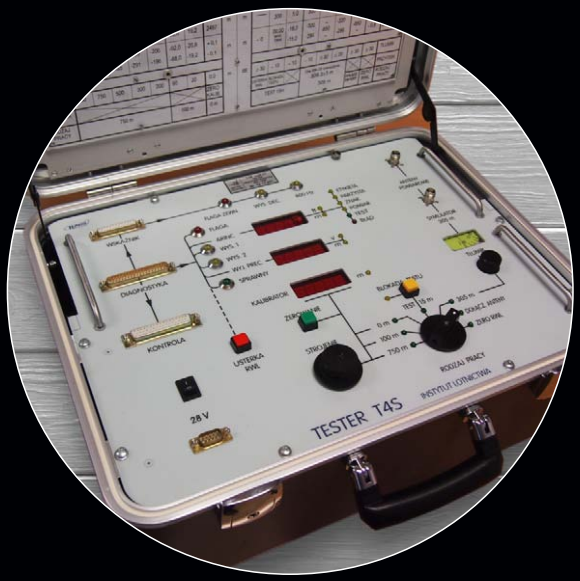
T4S RADIO ALTIMETER TESTER

Features:

- The T4S radio altimeter tester can be easily connected to the RWL-750M radio altimeter via two antenna couplers.
- The 1000 ft radio altitude simulator includes a precision delay line from Teledyne.
- Simulator attenuation is manually set to measure radio altimeter sensitivity with an accuracy of 2 dB.
- It is also possible to connect the simulator directly to the transmit/receive block.
- The simulator can also be used for checking other radio altimeters operating in the 4.3 GHz band. Built-in adjusted calibrator generates signal of the differential frequency, it is fed via the radio altimeter diagnostic cable of RWL-750M and allows to check the decision altitude, the set altitude and data on the altitudes transferred to the EECPS.
- All outputs of RWL-750M: ARINC 429, precision analogue output, outputs of indicators are decoded, measured and displayed.
- The set altitude, decision altitude and FCS Warn (efficiency signal) are monitored.
- Using the tester, the RWL-750M tester indicator can also be checked.
- The radio altimeter tester is designed to work with all versions of RWL-750.

Specification:

- Dimensions: 18.42 "W x 13.86 "H x 8.27 "L (468 x 352 x 210 mm).
- Weight: 26 lbs (11.8 kg).
- Power supply: 27.5 V DC ±20%, 0.15 A nominal.



ATSK - AUTOMATIC RUDDER TRIMMER FOR PZL-130 ORLIK AIRCRAFT

The Automatic Rudder Trimmer (ATSK) is designed to automatically trim the rudder of an airplane. It improves airplane flight characteristics and increases safety and comfort of the pilot. Structurally, it is a single device with three connectors, which based on input data concerning values of engine operating parameters, speed and configuration of the airplane generates signals which control the trimmer deflection of the rudder.

Basic technical data:

- 182 + (50) x 126 x 66.5 mm.
- Weight: 800 g ± 100 g (excluding connectors and harnesses).
- Power supply: 27.5 V DC.
- Current consumption: < 0.5 A without current in loads.
- Operating temperature range: –35 ÷ +70° C.
- Survival temperature range: –55 ÷ +85° C.
- Working conditions: ATSK operates in any spatial position of the aircraft.
- Standby time: no more than 60 s from the moment the power is applied.
- Storage conditions:
  - Recommended temperature range +10 ÷ +30°C.
  - Humidity < 80%.
- Environmental qualification:
  - According to DO-160.
  - According to NO 06-A-101.



SKYLAB - AVIONICS AND ON-BOARD SYSTEMS LABORATORY

The Laboratory is part of the Engineering Design Center (EDC) - the center of Łukasiewicz Research Network - Institute of Aviation. It specializes in testing avionic devices and systems. On 22 testing stands data concentrators that collect information from aircraft instrumentation and cockpit displays can be tested, among others. The laboratory is equipped with precise control and measurement devices that enable automated, remote and safe testing of electronics. The laboratory has a certificate of compliance with the AS 9100D (EN9100:2016), which is a guarantee of meeting the highest quality standards in the aviation industry.



ENVIRONMENTAL TESTING OF AIRCRAFT

Łuksiewicz Research Network - Institute of Aviation runs Environmental Testing Laboratory, which is part of the Avionics Department. The Laboratory holds the Laboratory Accreditation Certificate No. AB 132 confirming compliance with the requirements of the standard. PN-EN ISO/IEC 17025:2005 certificate was issued by the Polish Center of Accreditation. The scope of accreditation includes testing of resistance and strength to mechanical and climatic stresses and functional testing of products. The Avionics Department holds the authorization of the Manufacturing Organization and Maintenance Organization approved by the Civil Aviation Authority under Regulation (EC) No 216/2008 of the European Parliament and of the Council and Commission Regulation (EC) No 1702/2003 in accordance with Annex (Part 21), Section A, Subpart G which authorize the manufacture of the products, parts and appliances listed in its list of approvals, and the issue of an EASA FORM 1 manufacture certificate.

Laboratory Testing Capabilities:

- Tests of resistance and strength to sinusoidal and random vibrations.
- Mechanical impacts resistance and strength tests.
- Vibration resistance and strength tests in combination with temperature and/or relative humidity.
- Low and high temperature resistance tests.
- Tests of resistance to temperature cycling.
- Resistance to changes in temperature and atmospheric pressure testing.
- Resistance to condensation deposits (frost and dew) testing.
- Tests of resistance to increased humidity.
- Dust resistance testing.
- Corrosion resistance test (salt spray).
- Precipitation resistance tests.
- Solar radiation resistance tests.

The Environmental Testing Laboratory has the infrastructure to test the finished product in terms of mechanical and climatic testing after the production stage.


SECURE
THE FUTURE
IMV
750
RT
OTECNICA

IMV SHAKER I250/SA4M-CE
WITH MEDALLION II CONTROLLER

- Vibration frequency: 5 - 2500 Hz.
- Maximum amplitude of displacement: 50 mm.
- Maximum force: 40 kN.
- Maximum acceleration:
  - for sinusoidal vibrations: 500 m/s²,
  - for random (rms) vibrations: 140 m/s²,
  - for impacts: 800 m/s².

- Additional equipment:
  - sliding table with dimensions: 750 x 750 mm,
  - head-expander with dimensions: 700 x 700 mm,
  - head-expander with a diameter: 610 mm.

ENVIRONMENTAL CHAMBER (FOR TESTING VIBRATIONS AT TEMPERATURES) CLIMATS 1200 H 70/5 TYPE WITH SPIRALE 3 CONTROLLER

- Workspace dimensions: 1000 x 1100 x 1100 mm (1200 l).
- Temperature range: -70°C ÷ +180°C.
- Speed of temperature change: 5°C/min.
- Humidity range: 20% ÷ 95%.

THERMOBAROCHAMBER CLIMAS 1000 FCV 70/1 TYPE WITH SPIRALE VS CONTROLLER

- Workspace dimensions: 1000 x 1000 x 1000 mm (1000 l).
- Temperature range: -70°C ÷ +180°C.
- Pressure range:
  - from atmospheric to 10 hPa without temperature control,
  - from atmospheric to 50 hPa with temperature control,
  - from atmospheric to 1070 hPa.

ENVIRONMENTAL CHAMBER CLIMATS 4000 H 70/4G WITH SPIRALE 3 CONTROLLER

- Workspace dimensions: 2000 x 1900 x 1060 mm (4000 l).
- Temperature range: -70°C ÷ +180°C.
- Humidity range: 20% ÷ 95%.

ENVIRONMENTAL CHAMBER EXCAL 7728-HE WITH SPIRALE3 CONTROLLER

- Workspace dimensions: 900 x 950 x 900 mm (770 l).
- Temperature range: -90°C ÷ +200°C.
- Speed of temperature change: 17°C/min
- Temperature range from -55°C to +180°C.
- Humidity range: 20% ÷ 95%.





SALT SPRAY TEST CHAMBER SF/CCT/VH TYPE WITH EUROTHERM CONTROLLER

- Workspace dimensions: 850 x 2000 x 1000 mm (1700 l).
- Temperature range: from ambient temperature to +60°C. (with humidity) and up to +70°C (without humidity).
- Tests according to standards: MIL STD-810E, ISO 6270-2, DIN 50.02, ASTM 13117.
- Humidity range:
  - 50% to 95% at 20°C.
  - 30% to 95% at 30°C.
  - 15% to 95% at 60°C.

RAIN TEST CHAMBER SWT 600/800 TYPE WITH SIMPATI CONTROLLER

- Workspace dimensions: 1810 x 1800 x 1800 mm (5800 l).
- Rotary table diameter: 600 mm.
- Possible testing according to: IPX1, IPX2, IPX3, IPX4, IPX5, IPX6 and IPX6K.

SUNEVENT SUN/1000 SOLAR SIMULATION CHAMBER WITH SIMPATI CONTROLLER

- Workspace dimensions: 1000 x 1000 x 1000 mm (1000 l).
- Irradiation module:
  - Metal halide lamp: 2500 W.
  - Irradiation intensity: 400-1125 W/m².
  - Light range: 280-3000 nm.

DUST CHAMBER ST 2000U WITH SIMPATI CONTROLLER

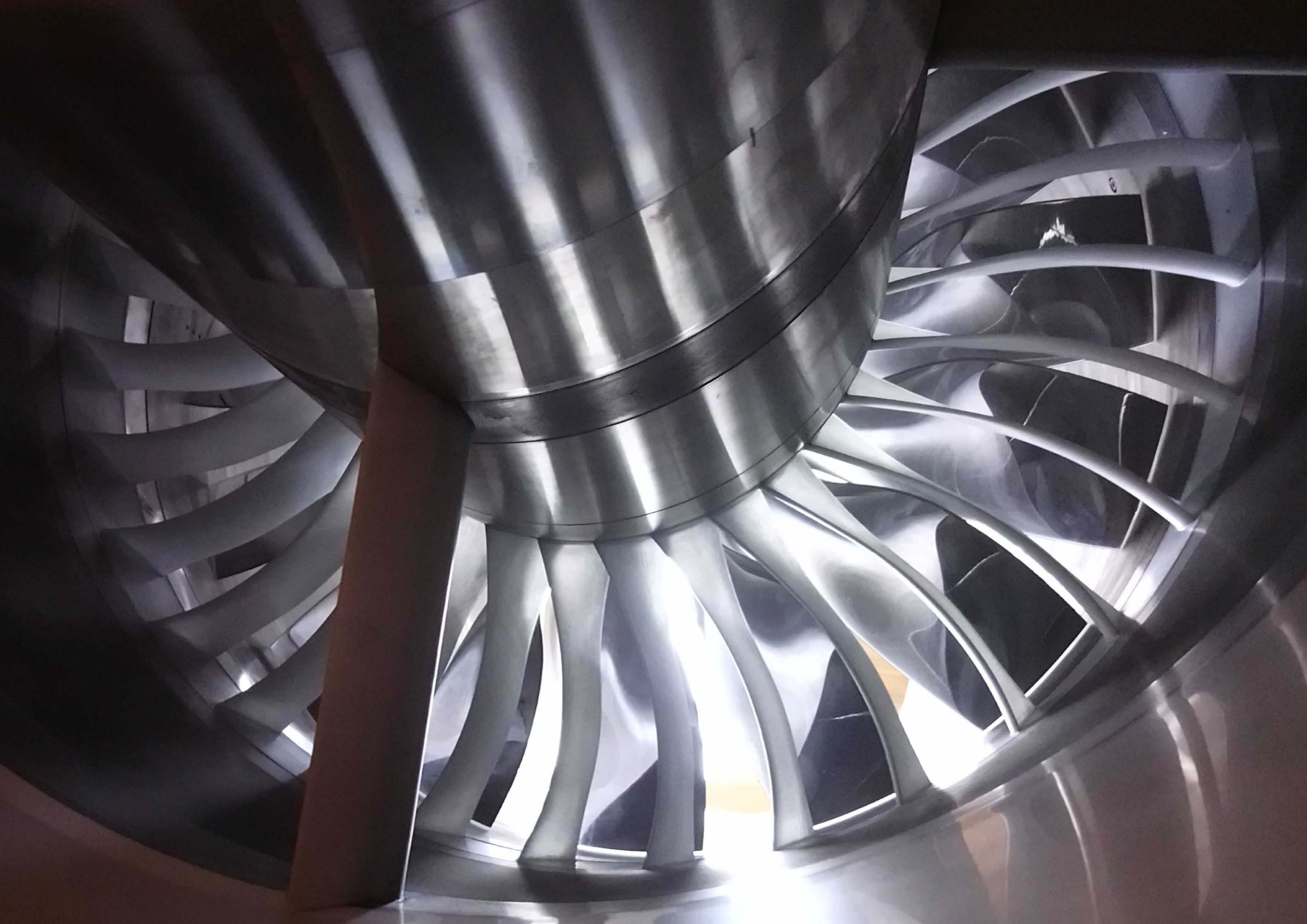
- Workspace dimensions: 1000 x 1900 x 950 mm (1800 l).
- Dust capacity: 5 kg of dry talcum dust.
- Test temperature up to 55°C and according to DIN EN 60529.

RAPID DECOMPRESSION STATION

Description:

- Dimensions of the chamber in which the test object is placed: 770 x 800 x 800 mm (490 l).
- Pressure changes from a value of 746.7 hPa to a pressure between 467 and 90 hPa.
- Pressure change time not more than 15 ms.



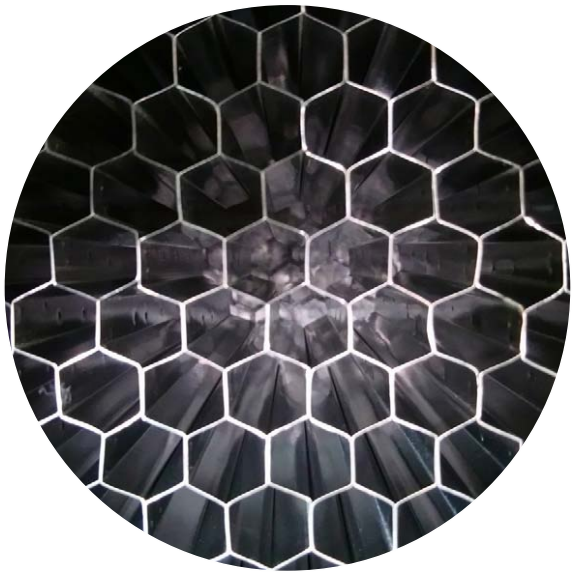


ENGINES AND PROPULSION

The Aircraft Propulsion Department at the Łukasiewicz Research Network - Institute of Aviation offers an advanced infrastructure for measurement and research works in the areas of:

- Dynamometer testing of hybrid propulsion systems with up to 200 kW total power (with future option of extending to 600 kW).
- Trial and testing of low-pressure axial compressors, test bench with a low-speed fan for distortion-tolerant fan testing.
- Tests of aircraft piston engines (Continental and Lycoming) in a Part 145 maintenance organization at the aircraft piston engine testing station certified and accredited by ULC (No. PL.145.062).
- Expert opinions on aircraft piston engine accidents for SCAAI and acting as a court expert.
- Modeling of complex propulsion systems (hybrid systems), simulation of propulsion system steady states (at design and non-design points) and transient states. Development of dynamic propulsion system models.
- Flow tests with precise (± 1%) mass flow rate measurement.
- Testing of isolated rotors on a Whirl Tower type stand.
- Balancing of up to 500 kg rotating elements for all industries.
- Pane puncture resistance tests according to UIC-651 Card and PN-EN 15152-2007 Standard.





HYBRID PROPULSION LABORATORY

In 2022, it is planned to complete the construction of a hybrid propulsion laboratory, which consists of an electric motor dynamometer and a piston engine dynamometer. At Łukasiewicz - Institute of Aviation, it will be the first research stand for testing hybrid propulsions for aviation applications, which meets the aviation market's research needs.

ELECTRIC MOTOR DYNAMOMETER

Mechanical specification of the electric motors that can currently be tested:

- Torque meter 1: max torque 100 Nm, max speed 12 000 rpm, max mechanical power 125.67 kW.
- Torque meter 2: max torque 500 Nm, max speed 7 000 rpm, max mechanical power 366.5 kW.
- Future torque meter option: max 1000 Nm, max speed 7 000 rpm, max mechanical power 650 kW.
- Approximate maximum motor dimensions: a cylinder 52 cm long and 32 cm in diameter (the engine mount and frame can be modified for larger motors).

Electrical specification of the electric motors that our inverters can support:

- Inverter 1: rated current 200 A, peak 400 A (60sec), max supply voltage 700 VDC.
- Inverter 2: rated current 700 A, peak 800 A (60sec), max supply voltage 450 VDC.

The stand is equipped with a battery simulator with the following main specification:

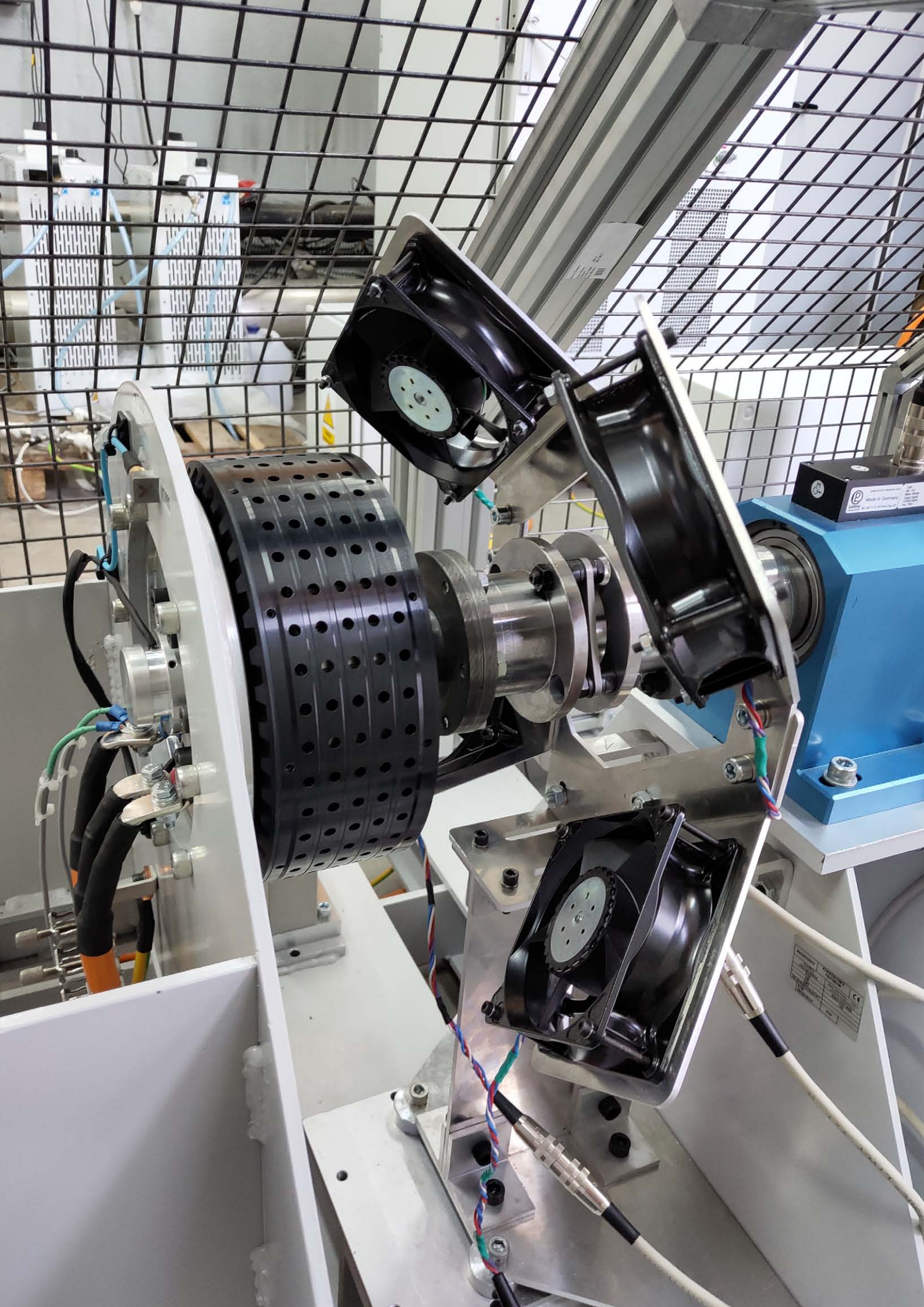
- Simulator power supply 3x400 VAC, continuous power 80 kW, instantaneous 120 kW (60 sec), regulated output voltage 24-800VDC, rated current +/- (bidirectional) 267 A, peak current +/- (bidirectional) 400 A, the ability of quick prototyping the required energy storage capacity and conducting long-term DC tests.

Liquid cooling of motors/inverters:

- Water cooler 1 - max heat capacity 5 kW.
- Water cooler 2 - max heat capacity 10 kW.

Availability of testing with customer's inverters:

- No single inverter powered directly from a DC bus in the electric motor + generator configuration can by loaded in excess of 380 kW electric power.
- No single inverter powered directly from a 3x400 VAC grid in the electric motor + generator configuration can by loaded in excess of 650 kW electric power.





PISTON ENGINE DYNAMOMETER

The stand for aircraft piston engine testing in various operating conditions, and to determine:

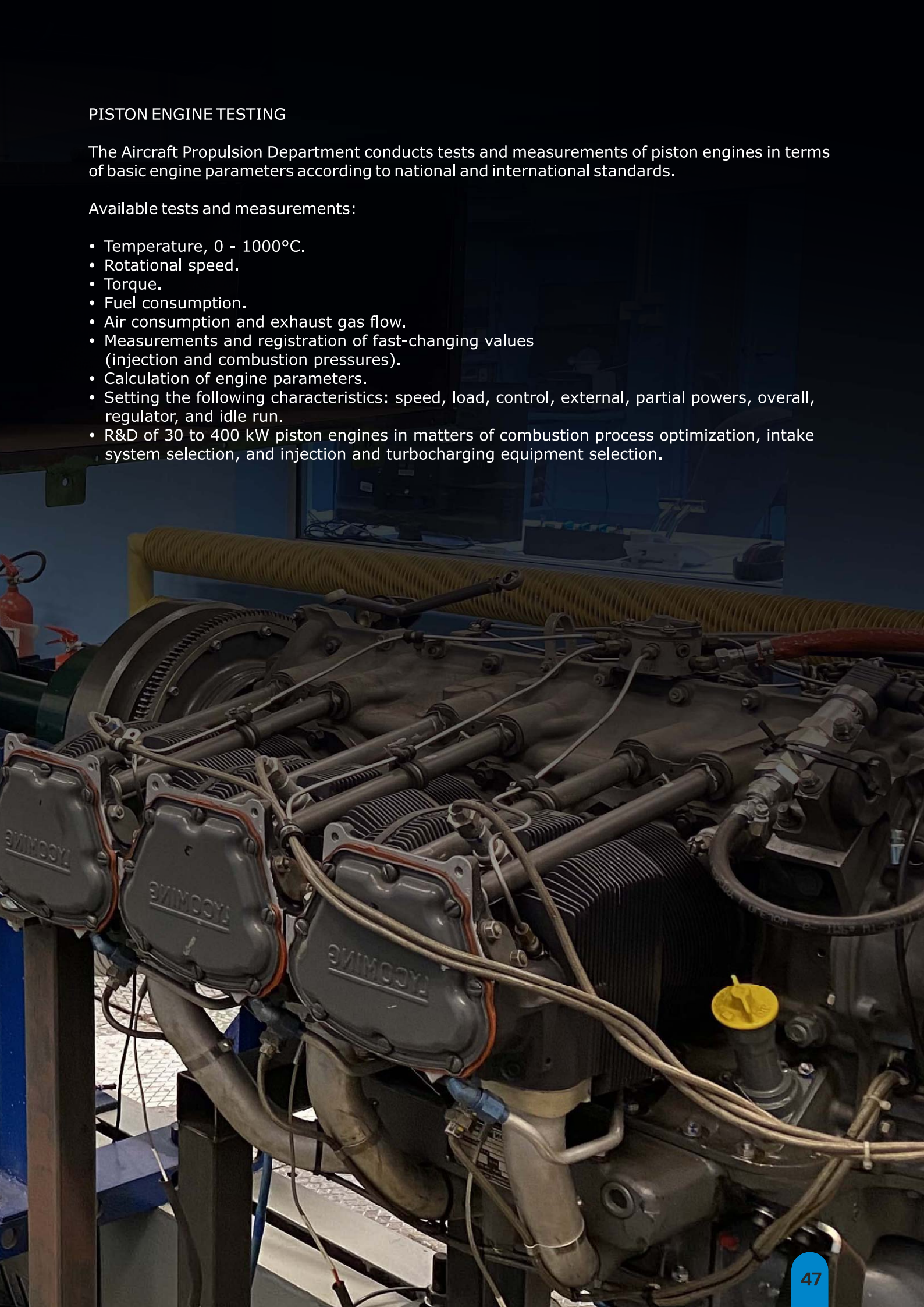
- Hourly and specific fuel consumption.
- Torque waveform as a function of speed in steady states.

PISTON ENGINE TESTING

The Aircraft Propulsion Department conducts tests and measurements of piston engines in terms of basic engine parameters according to national and international standards.

Available tests and measurements:

- Temperature, 0 - 1000°C.
- Rotational speed.
- Torque.
- Fuel consumption.
- Air consumption and exhaust gas flow.
- Measurements and registration of fast-changing values (injection and combustion pressures).
- Calculation of engine parameters.
- Setting the following characteristics: speed, load, control, external, partial powers, overall, regulator, and idle run.
- R&D of 30 to 400 kW piston engines in matters of combustion process optimization, intake system selection, and injection and turbocharging equipment selection.





BLI TEST STAND

The Aircraft Propulsion Department has a low static pressure fan test stand. At the stand, the impact may be tested of disturbed flow at the fan inlet (compressors with low static pressure) on its efficiency, mechanical properties, vibrations, and stable stall margin). The stand has been designed so enable the input of virtually any disturbance at the inlet, axisymmetric and non-axisymmetric alike.

The test stand is vertical (the axis of rotation is perpendicular to the ground). The height of the test stand is ca. 5 m. It consists of an inlet lemniscate followed by an inlet duct. The single-stage fan is driven by an electric motor. Behind the fan section, there is an exhaust duct closed with a throttling cone, which enables mass airflow regulation. The desired speed profile is obtained with a variable porosity distortion screen. The fan stator was 3D-printed and can be easily replaced with another (e.g. non-axisymmetric).

The test stand is equipped with aerodynamic and aeromechanical sensors.

The aerodynamic instrumentation includes:

- 5-hole pressure probes with a thermocouple (mounted on a rotating measuring ring) for measuring the flow velocity and inflow stream direction.
- Hot-wire thermoanemometric probes (constant temperature probes - CTA) mounted on a sliding measuring ring.
- High accuracy temperature sensors (can be mounted on a sliding measuring ring).
- Static pressure ports and static pressure scanners capable of measuring at 40 points.
- Piezoelectric pressure sensors for detecting the start of rotor blade stall.
- Environmental conditions monitoring station (humidity, ambient temperature).
- Fully automated traverse ring for 360-degree rotation and radial insertion of 4 different probes in the flow the ring can be fitted to any flow station (inlet, before disturbance screen, before rotor, between rotor and stator and after stator).
- Instrumentation for real-time measurement of blade tip timing/blade tip clearance (BTT/BTC). Instrumentation based on laser probes (light probe type).

ROTATING DETONATION TEST LABORATORY

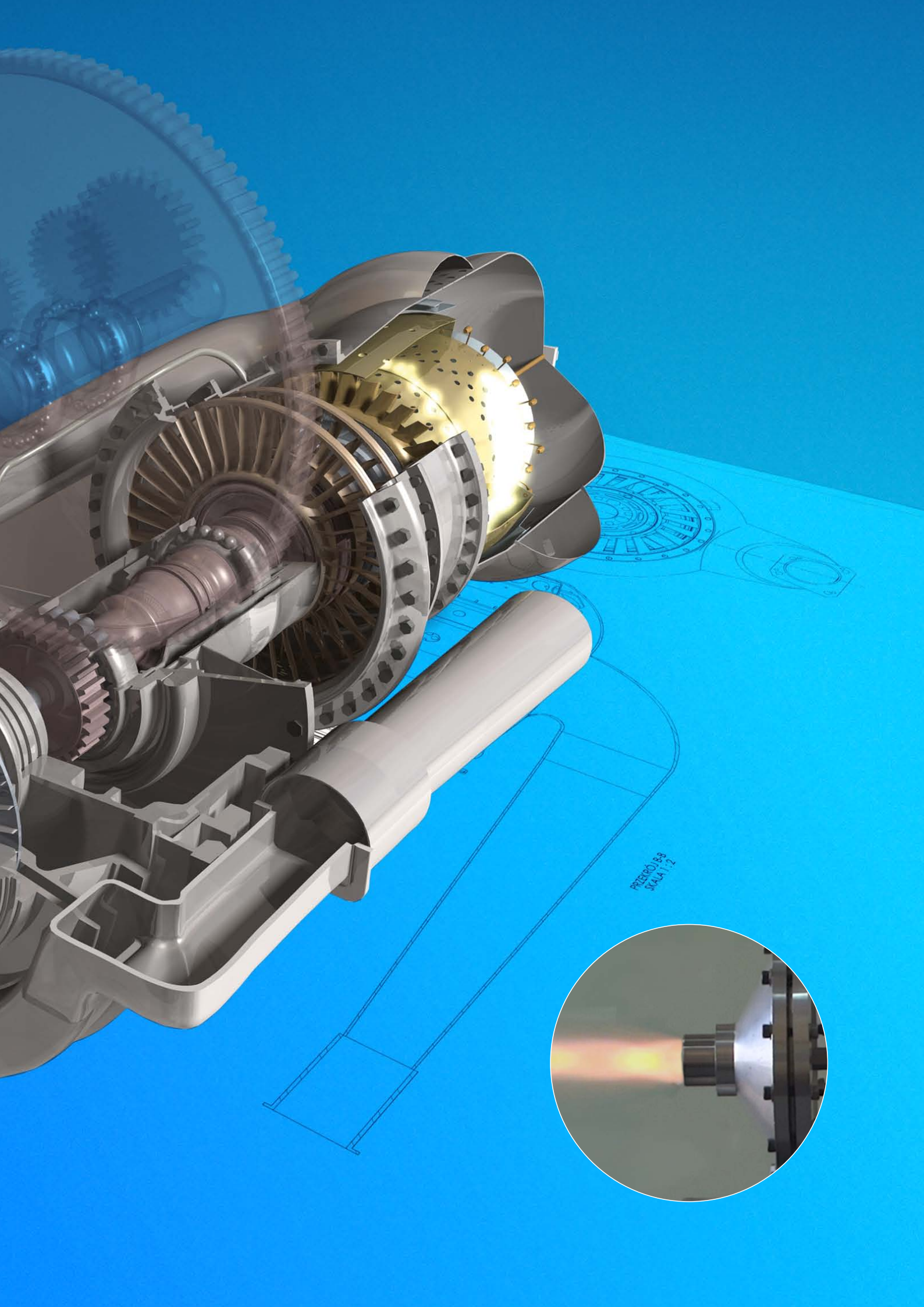
Detonation is a type of combustion, whereby a supersonic exothermic front propagates through a mixture of fuel and oxidant. In this way, it drives the shock wave directly in front of it.

The development of research on the application of detonation combustion in engines opens up a number of new possibilities both in the engine design methods and in obtaining higher efficiency.

In the Łukasiewicz Research Network - Institute of Aviation, two automated laboratory stands were built for detonation tests of combustion chambers and small rocket engines.

Over the last decade, Łukasiewicz - Institute of Aviation has conducted intensive research on the use of detonation combustion in various engines, including hydrogen and kerosene fueled turbine engines, methane and oxygen fueled rocket engines, and rocket-ramjet engines in the mixed cycle. Recently, research has been carried out on the use of liquid propellants in a rocket engine, as well as on an aviation kerosene fueled ramjet engine.




PRZEKRÓJ B-B
SKALA 1 : 2

FLOW CHECK LABORATORY

This is the laboratory for flow checks with precise (± 1%) measurement of air mass flow rate and flow pulsation in the tested objects. The laboratory conducts flow checks of elements such as incandescent tubes of combustion chambers, cooled blades of gas turbines, collectors, etc. based on measurements of the air volume flow and its pressure and temperature. The laboratory is equipped with modern research equipment, including Panametrics ultrasonic flow meters, air filter, equalizing chamber, temperature, pressure, and air humidity measurement circuits, recording system for the above-mentioned parameters. Range of measured air flow: 10-6500 m³/h with accuracy 2% over the entire measuring range.

The stand is equipped with 3 independent air flow forcing sources:

1. MAWENT WPW-28 / 14TH FAN

- Flow rate 6500 m³/h.
- Max pressure 0.2 bar.

2. AIRPOL C COMPRESSOR

- Flow rate 1200 m³/h.
- Max pressure 2.5 bar.

3. ROOTS COMPRESSOR

- Flow rate 6500 m³/h.
- Max pressure 0.7 bar.

The flow rate is measured with ultrasonic flow meters in three measuring ranges:

- Small - up to 180 m³/h.
- Medium - up to 1300 m³/h.
- Large - up to 6500 m³/h.

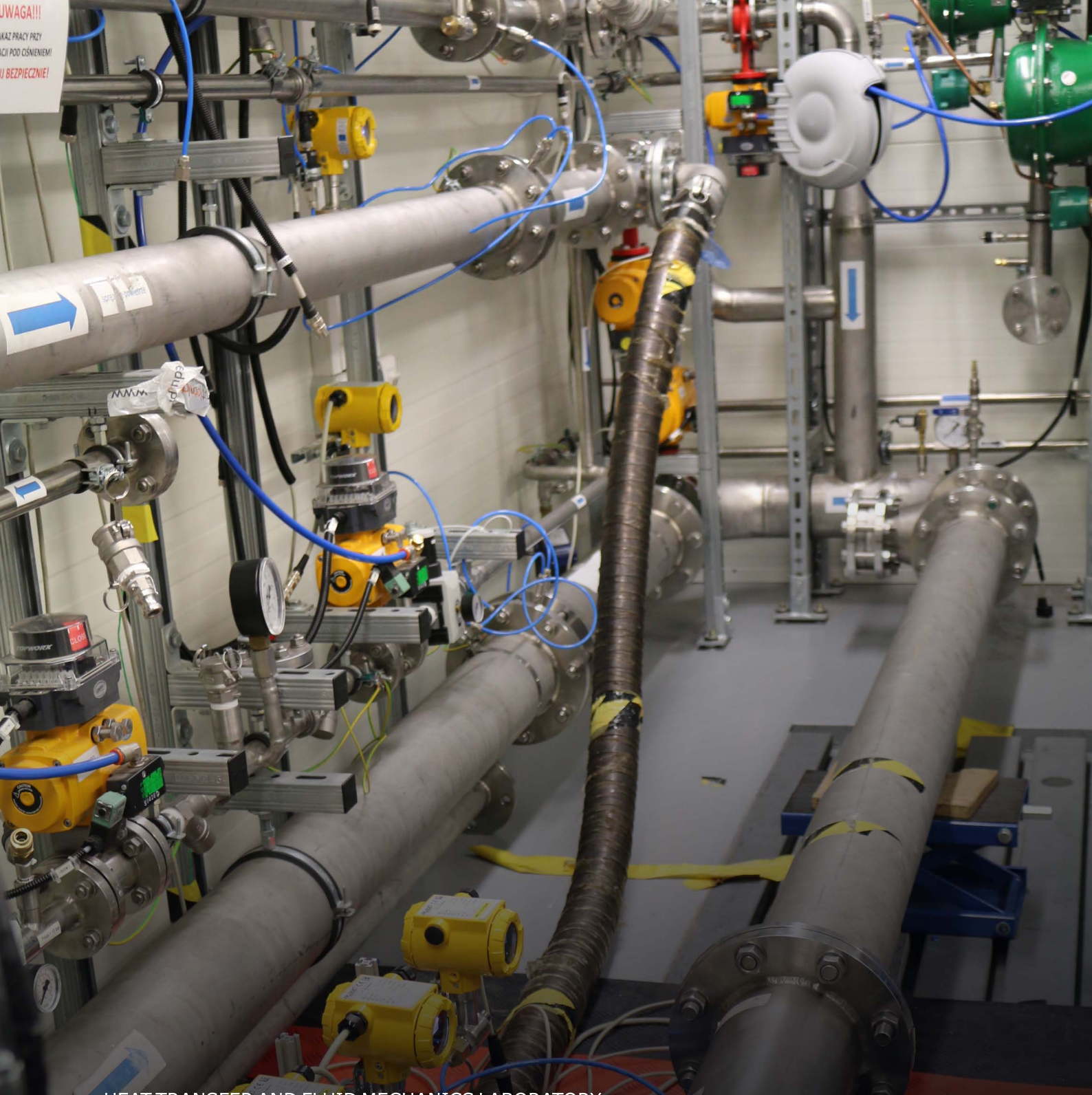
Pressure transducers with the following ranges are used to measure pressure:

- 0-300 mbar.
- 0-700 mbar.
- 0,9-1,4 bar (abs).
- 0-20 mbar, 800-1100 mbar (abs).

T/H converters with the following ranges are used to measure temperature and humidity:

- From -30 to 105°C / 0 to 100%.

In order to precisely control the flow rate, the installation is equipped with two remote-controlled, precise HiMod Seven DN250 knife gate valves with electric drive. Additionally, the blower flow can be controlled by changing the Roots blower's rotational speed with an inverter.
The test stand has a PCI-6259 measurement card (32 input voltage channels, analog outputs for control (gate valves, vent, blower, and compressor inverters)) installed.
Flow parameters can be controlled, and test parameters visualized and recorded with the control and measurement application created for the needs of the test stand. Łukasiewicz - Institute of Aviation also has universal measurement cards that enable recording of many more channels, and the above-mentioned application allows the use of any National Instruments drivers. At Customer's request, the application can be easily adjusted to the measurements.



HEAT TRANSFER AND FLUID MECHANICS LABORATORY

This laboratory is part of the Engineering Design Center (EDC) - the center of Łukasiewicz Research Network - Institute of Aviation. As the only place in Poland and one of the few in Europe, using modern measurement methods, the laboratory conducts comprehensive research for the development of technologies related to the cooling of aerospace and industrial turbine engine components.

Modern control and measurement base with the possibility of multi-stream supply of measurement stands is unique on a national scale. High-end laboratory equipment allows engineers to obtain precise measurements of many parameters, in particular: temperature, humidity, pressure, flow, velocity and three-dimensional turbulence level.

We conduct research in areas related to Film Cooling and Impingement Cooling using baro-sensitive paint. We carry out projects related to instrumentation of engine components, i.e. designing and manufacturing of pressure rakes, pressure and temperature sensors installation.

We have also developed technologies for registering the temperature of the components of the high-pressure turbine in infrared.

WHIRL TOWER STAND

The "Whirl Tower" stand for testing insulated rotors is available at the Aircraft Propulsion Department in the Łukasiewicz Research Network - Institute of Aviation. The stand can be used to test helicopter or gyroplane rotors by simulating hovering conditions. Such tests can provide valuable information on dynamic balance, noise, aeroelastic stability, vibration, and performance as well as the rotors' structural integrity.

The measurement data acquisition system was developed based on National Instruments components and a measurement application developed in the LabView environment. In addition to data recording and visualization from the measurement application, also the overall pitch of the main rotor blades can be controlled. The stand is controlled by a control panel that is independent of the measurement data acquisition system.

"Dynamic Tracking and Balancing" is a system for dynamic tracking and balancing of rotor blades. It is based on fast-changing phenomena. It consists of a high-speed ViewWorks camera, National Instruments hardware, and a dedicated measurement application for image recording and image analysis in the LabView environment.

Main parameters of the test stand:

- Electric motor, 315 kW (410 HP).
- Rated speed 750 RPM, torque 4046 Nm.
- Speed adjustable up to max. 2000 RPM (more speed, less torque).
- Real-time measurement and data acquisition system - basic measured values: torque, power consumed by rotor, rotational speed, rotor thrust, vibration level.
- Dynamic blade tracking and balancing (ViewWorks high speed camera system).
- Option to change test heads (we have 2 semi-rigid test heads with 3 and 2 blades, and a swing suspended head).
- Adaptable original hub/head (e.g. helicopter or gyroplane) to the test stand.
- Automatic change of the blade root angle.
- The use of an electric motor makes it possible to measure, for example, noise of the main rotor blade tip.


GOŚKA3

SCHENCK BALANCER

Rotating elements are balanced in the Aircraft Propulsion Department. The institute provides services to the domestic industry on Schenck's hl4 UB and H1B balancers.

HL4 UB machine parameters	
Rotor weight, max.	1,5-500 kg
Diameter, max. (D1)	1600 mm
Diameter of the pins	12-200 mm
Distance between supports (L1)	U/BU 3000 mm
Min. attainable residual unbalance per kg	1/0,1 gmm
Rotor drive	BU; U
Drive power	7,5 kW
Energy source	400 V±10%, 2Ph, 50 Hz
CAB 803 measuring device	Vector visualization network connection
Options	
Machine bed extension	1000/2000/3000 mm
Spare rollers	100-200 mm

H1B machine parameters	
Rotor weight, max.	15 kg
Diameter, max. (D1)	
Diameter of the pins	6-30/30-70 mm
Distance between supports (L1)	6-600 mm
min. attainable residual unbalance per kg	0,1 gmm
Rotor drive	BU
Drive power	200 W
Energy source	400 V±10%, 3Ph, 50 Hz
CAB 803 measuring device	





PNEUMATIC CANNON

The Aircraft Propulsion Department has a mobile pneumatic cannon that can fire a 1 kg projectile with diameter ca. 100 mm at speeds up to 400 km/h. The stand is used for certification tests of rail vehicles in terms of glass puncture resistance in accordance with requirements of the UIC 651 Card. The customers are manufacturers of rail vehicles and manufacturers of glass panes.

Cannon parameters:

- Barrel caliber: 125 mm.
- Max sub-caliber round diameter: 105 mm.
- Max projectile velocity: ca. 400 km/h.
- Projectile velocity measurement accuracy: ca. ±0.5 %.
- Projectile velocity accuracy: ca. ±0.5 %.
- Adjustment range of the barrel axis height from the ground: 1.5-2.2 m.
- Standard shells currently used: 1 kg and 20 g.

Scope of provided services:

- Tests of railway windshields in accordance with:
  - UIC-651 Card.
  - PN-EN 15152-2019 Standard.
- Tests to verify the structure strength.
- Fast camera recording.



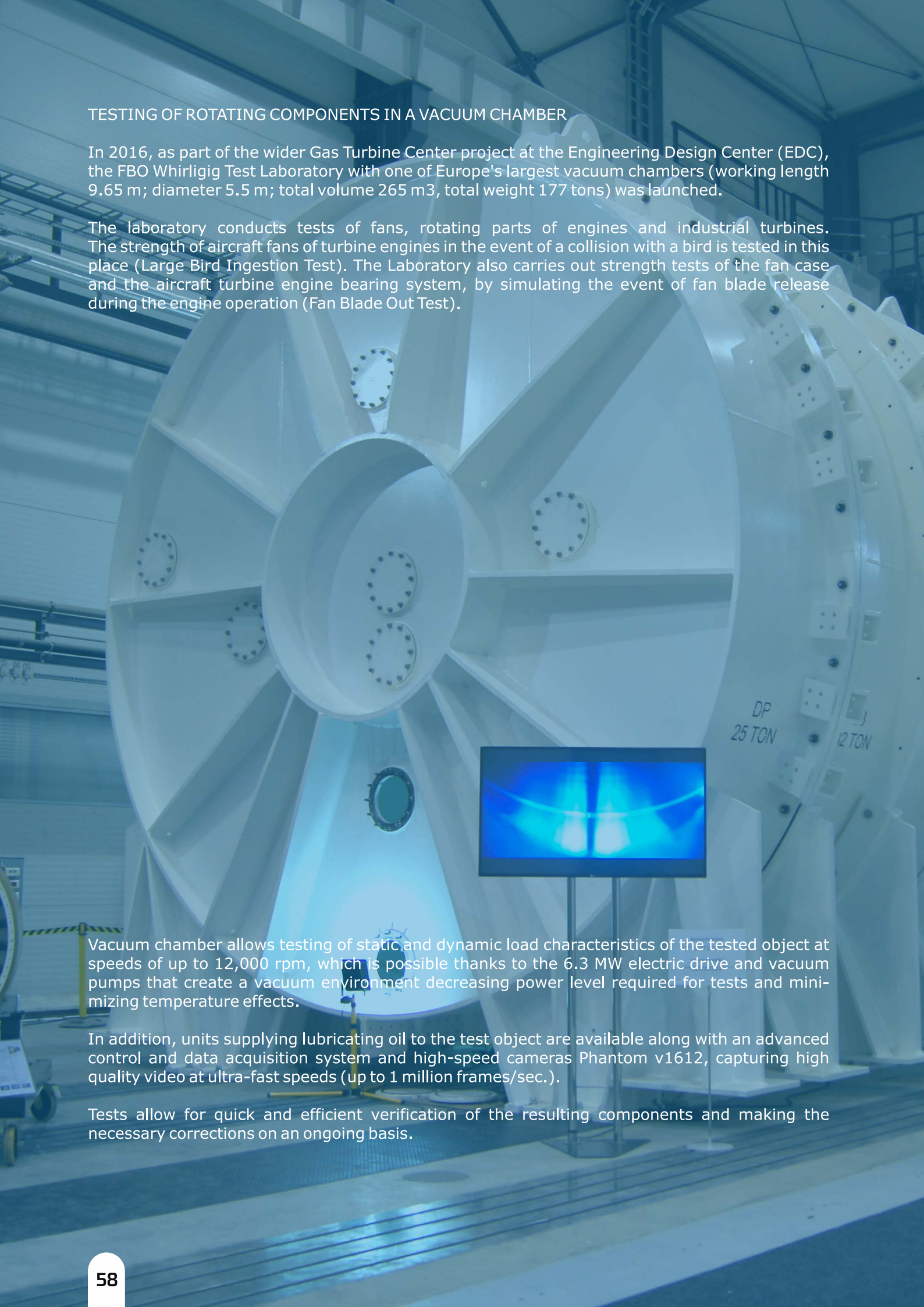
Advantages:

- Mobile.
- Adjustable height.
- Adjustable angle.
- Reproducible results.

TESTING OF ROTATING COMPONENTS IN A VACUUM CHAMBER

In 2016, as part of the wider Gas Turbine Center project at the Engineering Design Center (EDC), the FBO Whirligig Test Laboratory with one of Europe's largest vacuum chambers (working length 9.65 m; diameter 5.5 m; total volume 265 m3, total weight 177 tons) was launched.

The laboratory conducts tests of fans, rotating parts of engines and industrial turbines. The strength of aircraft fans of turbine engines in the event of a collision with a bird is tested in this place (Large Bird Ingestion Test). The Laboratory also carries out strength tests of the fan case and the aircraft turbine engine bearing system, by simulating the event of fan blade release during the engine operation (Fan Blade Out Test).



Vacuum chamber allows testing of static and dynamic load characteristics of the tested object at speeds of up to 12,000 rpm, which is possible thanks to the 6.3 MW electric drive and vacuum pumps that create a vacuum environment decreasing power level required for tests and minimizing temperature effects.

In addition, units supplying lubricating oil to the test object are available along with an advanced control and data acquisition system and high-speed cameras Phantom v1612, capturing high quality video at ultra-fast speeds (up to 1 million frames/sec.).

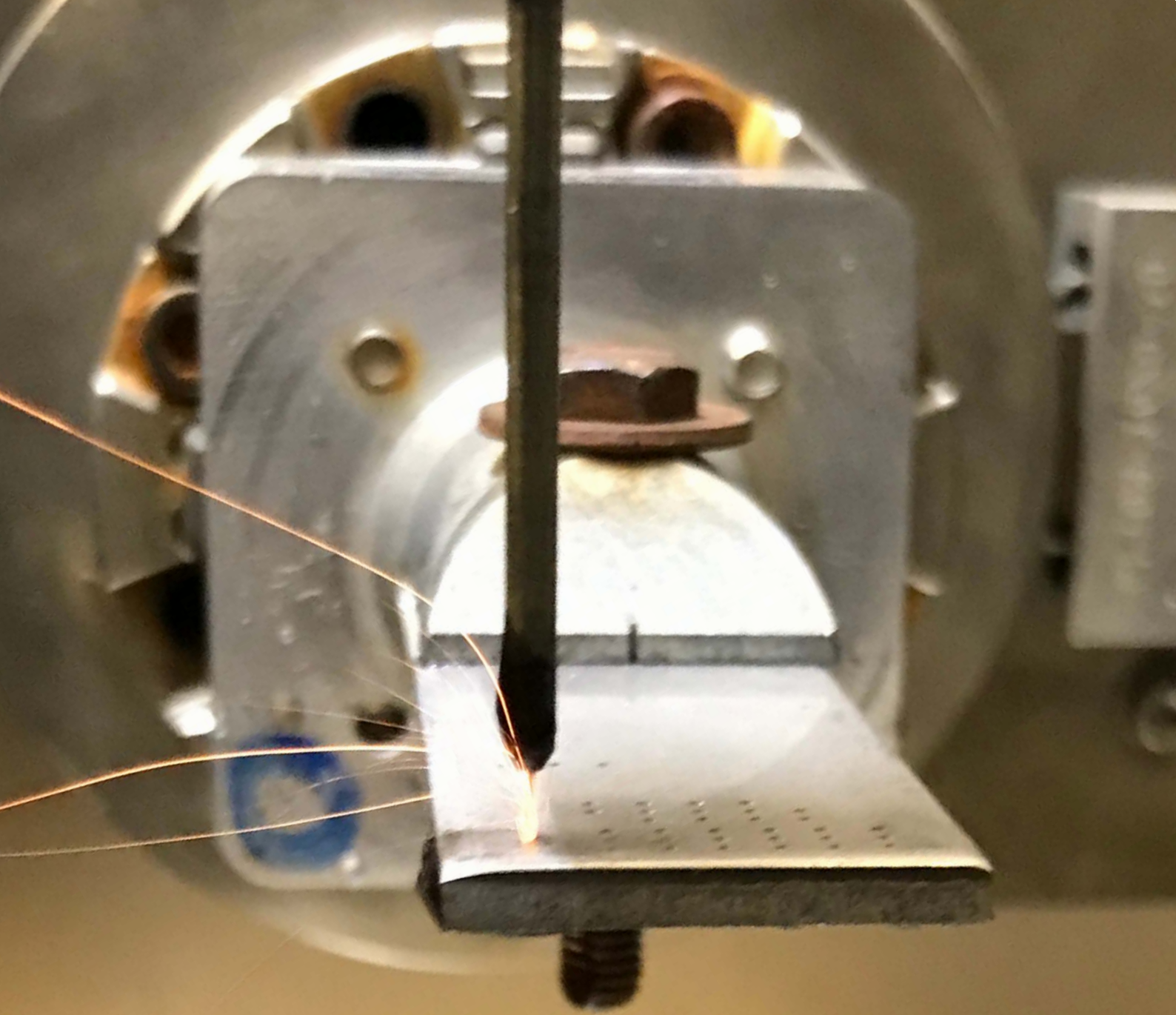
Tests allow for quick and efficient verification of the resulting components and making the necessary corrections on an ongoing basis.



LABORATORY OF ADDITIVE TECHNOLOGIES

The Laboratory is part of the Engineering Design Center (EDC), the center of Łukasiewicz Research Network - Institute of Aviation. It specializes mainly in additive manufacturing technology of 3D metal objects - DMLM (Direct Metal Laser Melting), using a laser to melt ultra-thin layers of powdered metal. The most popular materials used in this technology are: titanium and aluminum alloys; stainless, surgical and tool steels; nickel superalloys such as In718 and cobalt and chromium superalloys. Objects obtained by this method have fine, dense and homogeneous properties.

The laboratory is equipped with the latest DMLM printer manufactured by Concept Laser from GE Additive group - M2 Cusing Multilaser. It is the second generation of the well-known version of M2 Classic with a workspace of 250 x 250 x 350 mm and laser power of up to 2 x 400 W. The machine has several measurement systems for continuous monitoring of product quality, repeatability and safety of the printing process. The high-end equipment enables engineers to carry out continuous research projects related to additive technology and produce real prototypes of aircraft engines parts, whose development and introduction to production is constantly worked on.



MANUFACTURING TECHNOLOGIES LABORATORY

The Laboratory is part of the Engineering Design Center (EDC), the center of Łukasiewicz Research Network - Institute of Aviation. It is an important bridge between the teams of engineering companies designing, among other things, cooled high-pressure turbine parts for aircraft engines with manufacturing facilities.

Precision EDM Drilling Stand

With the ability to prototype precision EDM processes for bores with diameters from 0.2 mm to 5 mm, it enables optimum design solutions that are a compromise between the expectations of designers and technological constraints occurring in production. The laboratory can make both round and shaped bores. The working area allows the machining of workpieces with dimensions 300x300x300 mm.

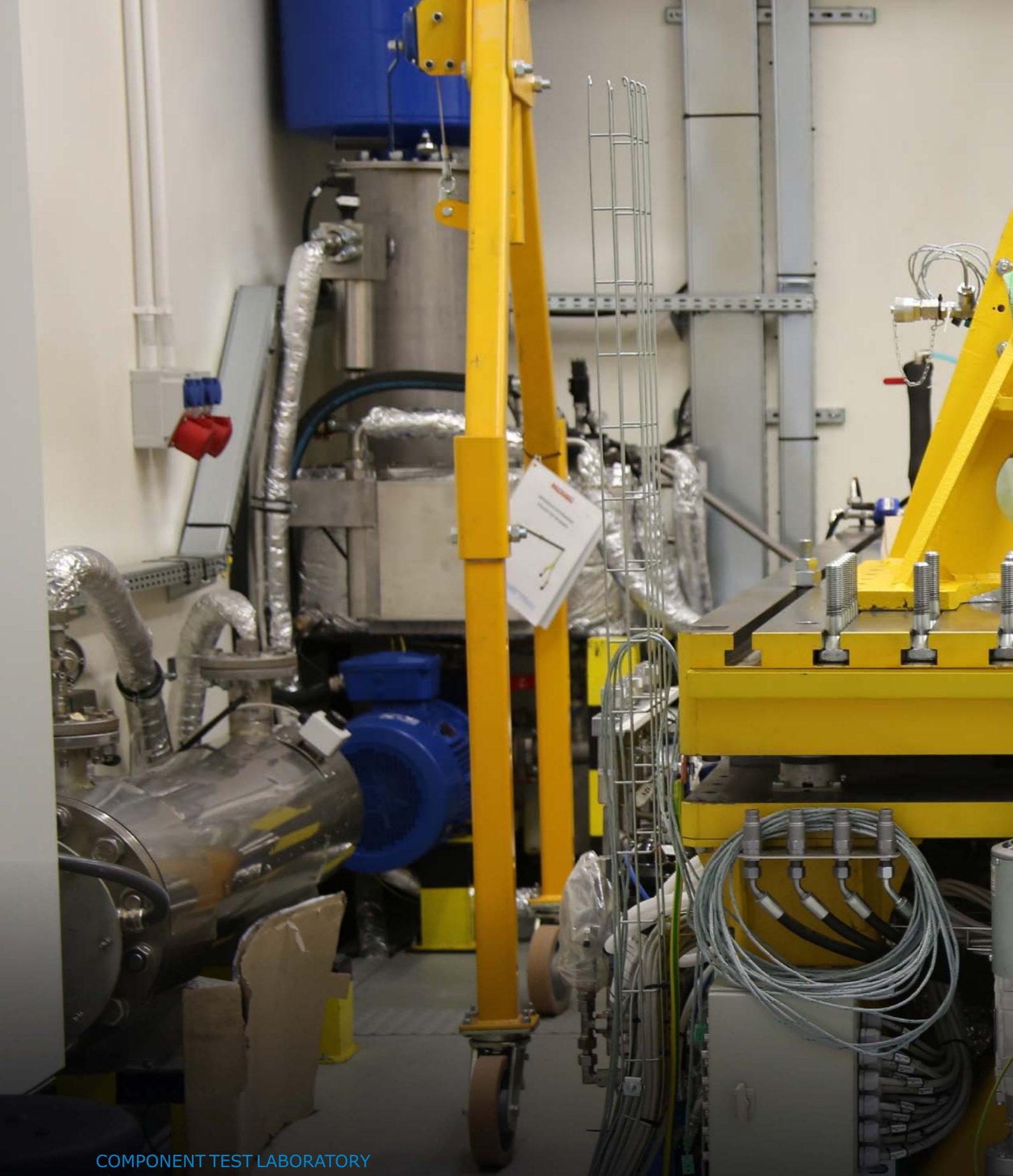
Test stand for the analysis of micro-geometry and surface condition

The laboratory, using the Alicona system, also performs geometry measurements, analysis of surfaces and scanning of components such as injectors.



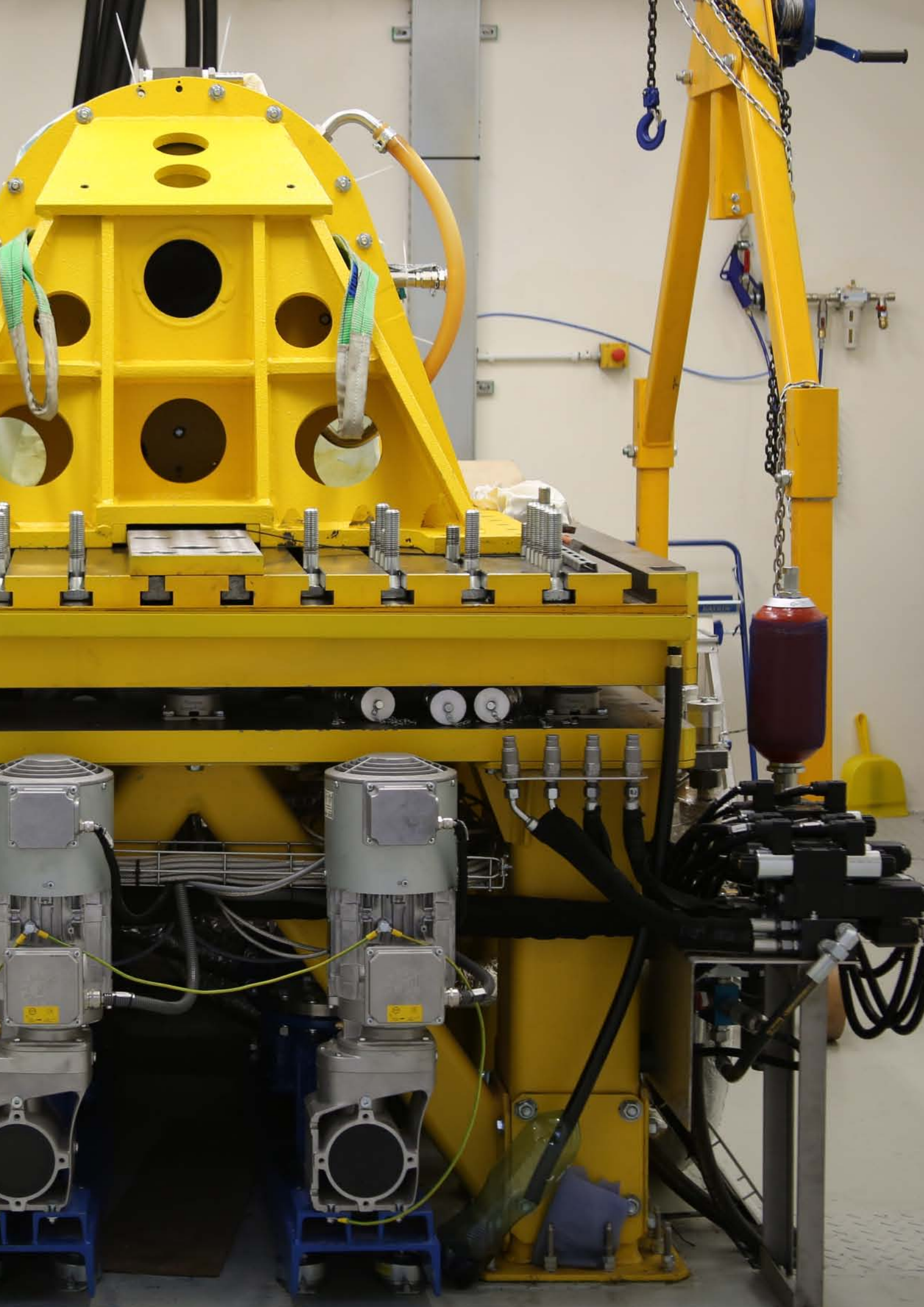
MATERIALS TECHNOLOGY LABORATORY

The Laboratory is part of the Engineering Design Center (EDC), the center of Łukasiewicz Research Network - Institute of Aviation and is one of the best equipped facilities in Poland and European Union in the field of failure analysis.
The main tasks of the Laboratory are material and failure analyses of components for commercial engines, gas turbines, steam turbines, compressors and reciprocating engines, or wind turbines. The laboratory supports analyses in the fields of aviation, oil and gas processing, energy and related areas.
The laboratory is accredited according to the PN-EN ISO/IEC 17025:2018-02 standard for selected testing methods: hardness measurement, coating thickness measurement, non-destructive testing (penetration).



COMPONENT TEST LABORATORY

Engineering Design Center (EDC) – the center of Łukasiewicz Research Network - Institute of Aviation offers three test stands for carrying out durability and functional tests of objects rotating at speeds up to 52000 rpm. Infrastructure of the Laboratory allows simulation of flight conditions such as hot oil supply (120 l/min, 40 bar, 150°C), applying forces and pressurizing with cold and hot air (2 kg/s, 8 bar, 500°C). Advanced control and data acquisition system gives the possibility to perform tests in either manual or automatic mode, while recording at frequencies up to 25 kHz the operating parameters such as temperature, pressure, flows, vibrations, deformations and speeds.



LANDING GEARS TESTING

Łukasiewicz Research Network - Institute of Aviation is a leading center of excellence for design and testing of landing gear in Poland. Landing gears of most airplanes and helicopters produced by Polish manufacturers have been designed and tested by the Landing Gear Department and Landing Gear Laboratory respectfully, which offer a set of comprehensive engineering services, such as: design, analysis, research and supervision of prototypes.

Landing Gear Laboratory performs tests of the landing gears, brakes, friction materials, shock absorbers, dampers, and other mechanical devices tests for energy dissipation; static and dynamic strength; fatigue; dynamic and functional characteristics; impact load resistance. Tests can be made for number of industries: aviation, automotive, general industrial (CS, FAR, EASA, MIL, AP, PN EN ISO9001, PN EN ISO17025, AQAP 2110 regulations/standards compliant). Landing Gear Laboratory is accredited by the Polish Center for Accreditation (Certificate No. AB 131).

Measurement range (according to the accreditation):

- Force, range: 0.1 up to 400 kN.
- Displacement, range: 0.05 up to 2400 mm.
- Relative strain, range: 10 up to 15000 μm/m.
- Rotational speed, range: 10 up to 20000 rpm.
- Acceleration, range: 0 up to 200 m/s^2.
- Pressure, range: 0 up to 60 MPa.
- Temperature, range: -40 up to 1084°C.

Methods:

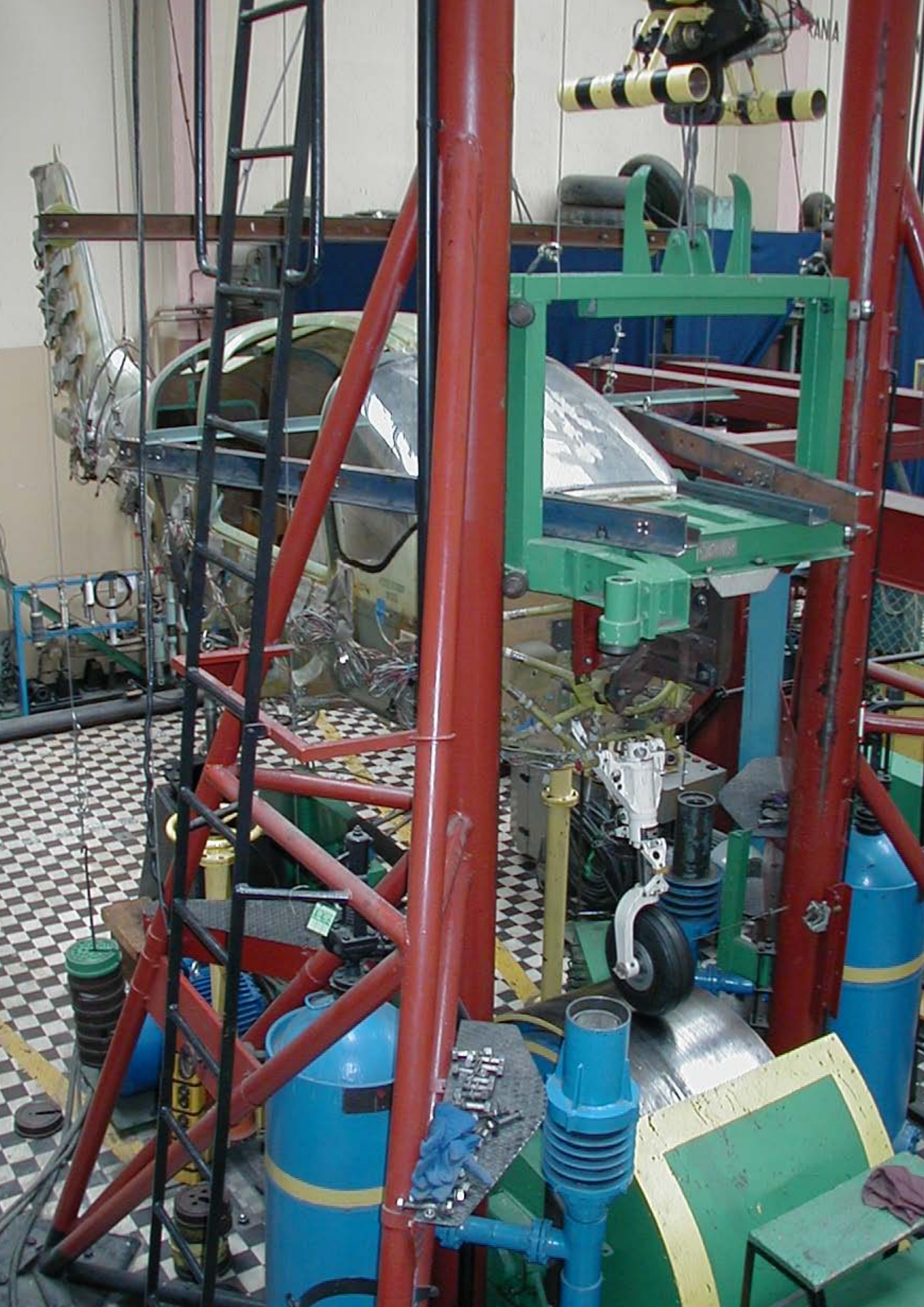
- Electrical based measurements.
- Thermography using FLIR SC645 (beyond accreditation).
- Fast camera measurements using Phantom VEO 410L (beyond accreditation).

Scope of testing:

- Aircraft landing gears.
- Brakes.
- Friction materials.
- Shock absorbers.
- Dampers.
- Energy absorption.
- Static and dynamic strength.
- Fatigue.
- Dynamic and functional characteristics.
- Resistance to shock loads.

Industries:

- Aviation, automotive, general industry.



3T DROP TESTS STAND WITH DRUM

Test stand is used for landing gear amortization testing in life-like conditions. Testing capabilities of the test stand include taxiing, shimmy, obstacle passing, brake, and wheel tests on the changeable inertia rotating drum. Test stand can be used in aviation, automotive and industrial tests.

Stand specification:

- Maximum mass of test object including mounting parts 3T (it can be extended to 6.5T for wheel testing).
- Maximum vertical force 118 kN.
- Drum maximal rotational speed 800 rpm.
- Drum maximal peripheral speed 58.6 m/s.
- Diameter / Width: 1400 mm/530 mm.
- Drum moment of inertia (adjustable):
  - I1 = 294 kgm².
  - I2 = 550 kgm².
  - I3 = 588 kgm².
  - I4 = 843 kgm².

Scope:

- Drop tests.
- Shimmy tests.
- Obstacle run tests.
- Brake tests.
- Wheel roll-on tests.

10T DROP TESTS STAND

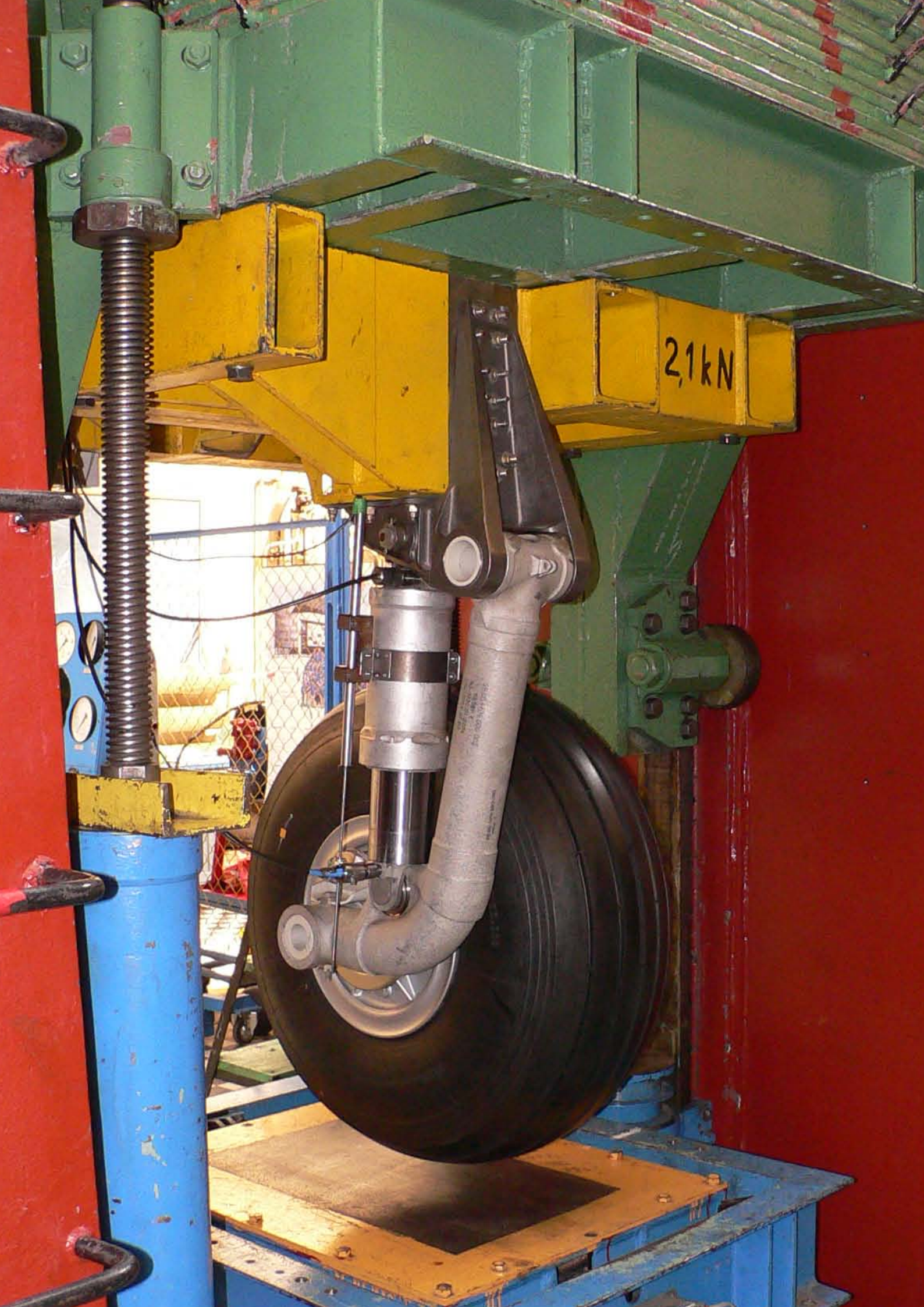
Test stand is used for landing gear amortization testing in life-like conditions. Testing capabilities of the test stand include impact test on dampers, shock absorbers, springs, etc. As well as tests determining the ability to absorb energy i.e. crash tests.

Stand specification:

- Maximum mass of test object including mounting parts 10T.
- Maximum forces in drop tests:
  - Vertical force 392 kN.
  - Horizontal force 196 kN.
  - Side force 157 kN.
- Maximum buffer pressure (lift) 3 MPa.
- Maximum wheel spin up velocity 111 m/s.
- Maximum free fall velocity up to 8 m/s – varies on test object height.

Scope:

- Drop tests.
- Wheel static tests.
- Functional tests.


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ZAWIESZONYM

UNIVERSAL STATIC TESTS STAND

Test stand is used for carrying out the static, strength, and functional tests of parts and the whole mechanical assemblies. Test stand can also be used as universal mounting platform due to the modularity of equipment used.

Stand specification:

- Platform dimensions 6.6 x 2.4m.
- Maximum compressive forces 20T – 5 lines.
- Maximum tensile forces 20T – 5 lines.

Scope:

- Static tests.
- Functional tests.
- Modular mounting/resarch platform for various tests.

40/20T PRESS

The press is used for quasistatic and low velocity tests of landing gears, wheels, materials, and other mechanical devices. System allow to make force-displacement characteristics in biaxial load states. Tests stand can be used in determining characteristics of various test objects such as: shock absorbers, dampers, material samples and more. Way of the mounting objects gives possibilities non-aviation object tests.

Stand specification:

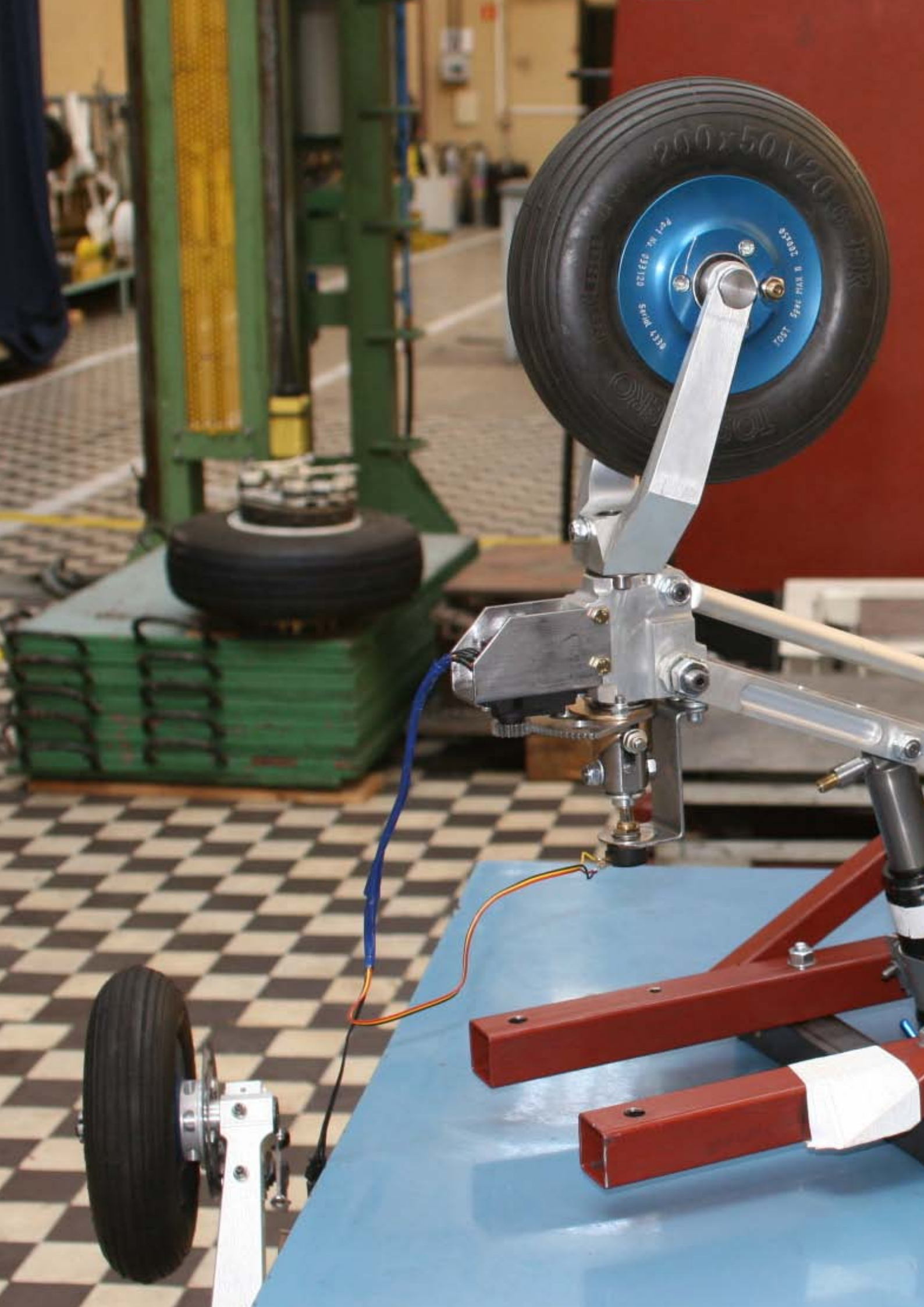
- Vertical force up to 392 kN.
- Horizontal force up to 196 kN.
- Total vertical displacement 400 mm.
- Vertical velocity up to 300 mm/min.
- Horizontal velocity up to 600 mm/min.
- Horizontal work area 800 x 760 mm.
- Vertical work area 190 up to 2000 mm.
- Two modes of operation: force or displacement control (continuous or step).
- Full force and displacement acquisition (and up to 8 external analogue signals).

Scope:

- Static tests.
- Force-displacement characteristics.
- Characteristics of shock absorbers, dampers, material characteristics.
- Wheel static tests.









IL-68 FRICTION MATERIALS STAND

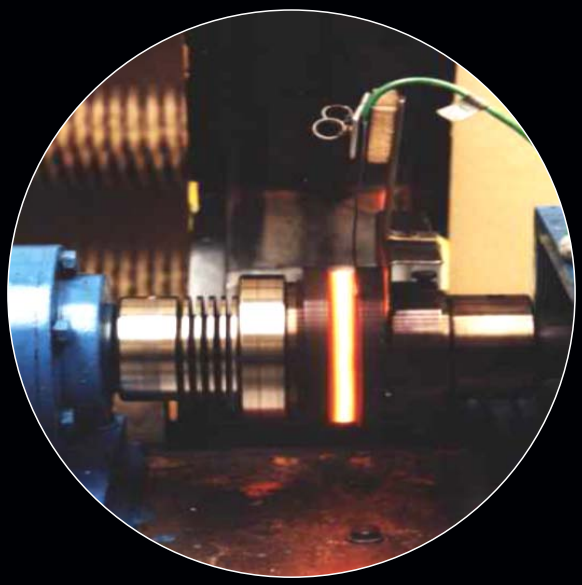
IL-68 tests stand allows to recreate phenomena occurring on friction surfaces of tested materials simultaneously measuring and recording number of parameters characterizing of the friction pair interaction (torque, braking force, temperatures, etc.). Also thermal endurance tests of friction materials (e.g. brake pads) are possible.

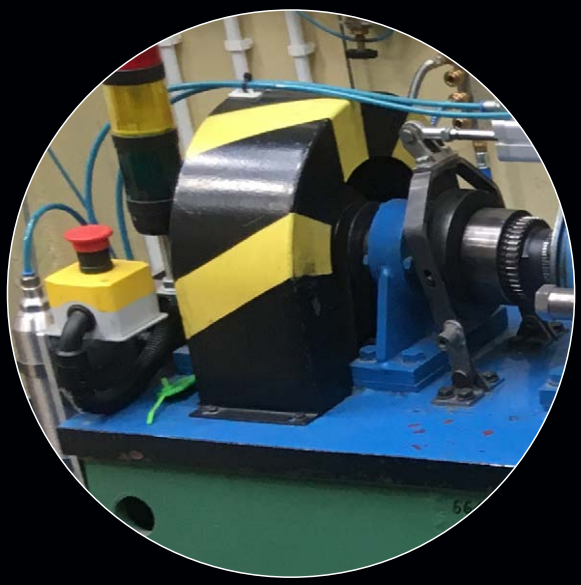
Stand specification:

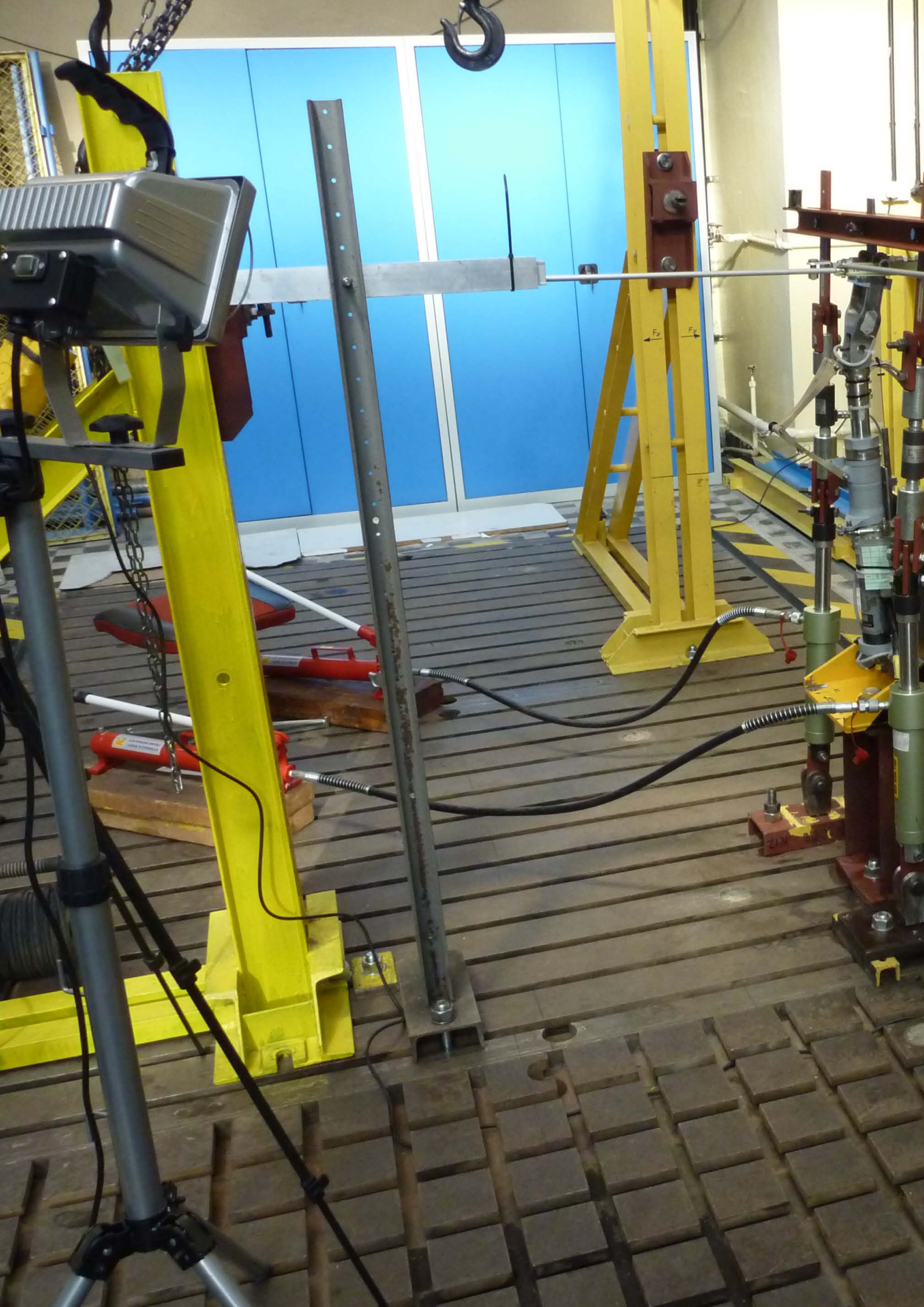
- Maximum drive shaft rotation velocity 9000 rpm.
- Moment of inertia (adjustable) 0,154 up to 1,54 kgm^2 (0,098 kgm^2 step).
- Maximum load on the surface of the samples specimens 5,88 kN.

Scope:

- Friction materials wear.
- Friction pair behaviour (parameters):
- ◦ Braking torque.
- ◦ Braking force.
- ◦ Temperature.
- Thermal endurance tests.





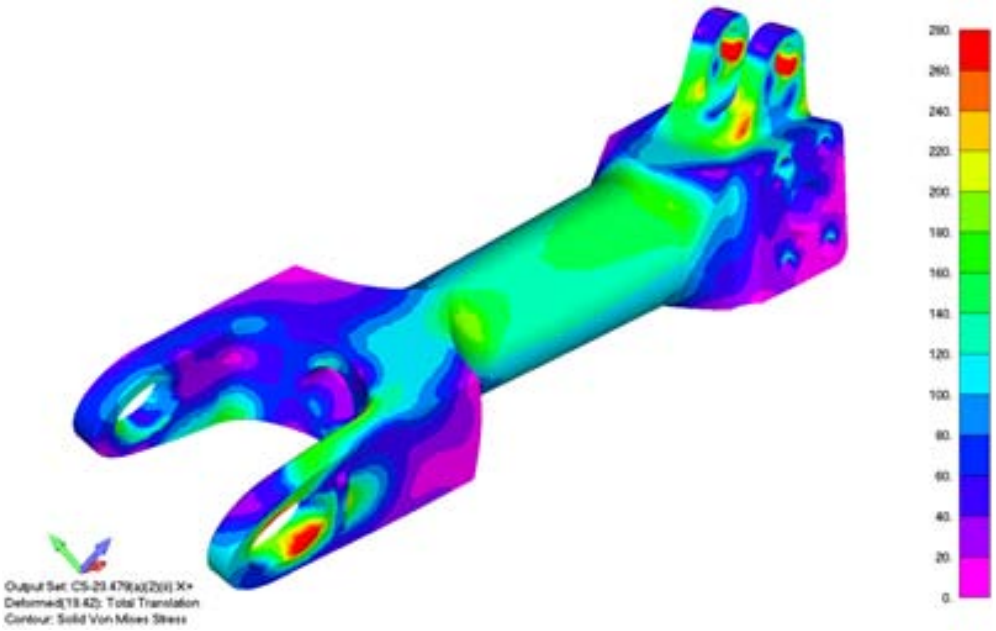

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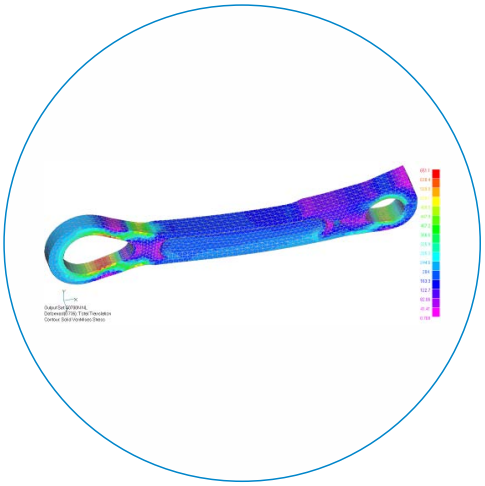
ENGINEERING SERVICES AND DESIGN AREAS

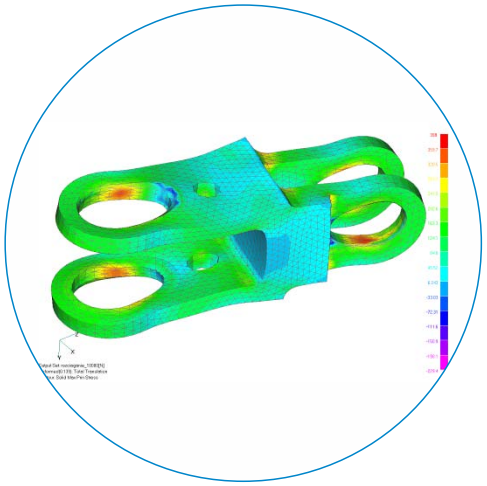
The scope of services includes:

- Aircraft and helicopter wheel and skid landing gear.
- "Shimmy" and anti-resonance dampers – single and double acting.
- Landing gear shock absorbers, actuators and locks.
- Test stands.
- ABS (Anti-Locking Systems) for aircraft brake systems.
- Wheels and high energy brakes.
- UAV landing gears.
- Technology demonstrators.
- Electric brakes for UAVs.
- Evaluation of the design process according to the aviation requirements.
- Design processes are aided by CAD 3D SOLID EDGE system – compatible with UNIGRAPHICS and CATIA systems.
- Other custom solutions tailored for the customer needs.









ANALYSES

Scope of analysis:

- Static and dynamic loads on aircraft landing gear components and other structures.
- Shimmy vibration analyses.
- Analyses of stiffness, strength and flexibility of components or entire landing gears and other structures (including composite).
- Optimization and integration of landing gear components and other structures, braking systems, shock absorbers.
- Phenomena accompanying the braking process (dynamics, thermal phenomena, vibrations).
- Assessment of durability of landing gear components and other structures using analytical and experimental methods.
- Numerical analyses of energy- absorbing materials
- Design and analyses of energy-absorbing lattice structures made using additive manufacturing (3D printing).
- Numerical simulations of landing gear drop tests.
- Analyses are performed using MSC NASTRAN / PATRAN, FEMAP / NASTRAN and HYPERWORKS packages, dynamic analyses using LS-DYNA.

VIBRATION AND ACOUSTIC TESTS

Laboratory of Vibration Tests operating within Łukasiewicz Research Network - Institute of Aviation carries out resonance tests of aircraft and other objects, including non-aviation applications to determine the dynamic properties of the test object structure or its elements.

In addition, based on the results of the aircraft resonance tests, numerical analyses of aeroelasticity are carried out to determine velocities and forms of flutter, as required by aviation regulations.

The Laboratory also performs vibration tests, acoustic tests and measurements of other quantities and parameters characterizing the operation and allowing to diagnose the condition of a machine, plant, vehicle or aircraft under the operating conditions.

The Laboratory performs both tasks commissioned by external clients and its own research and projects tasks carried out at the Institute.

All laboratory equipment is portable, so it is possible to make testing at a location agreed with the client.

TESTING OF THE AEROELASTIC PROPERTIES OF AIRCRAFT

Łukasiewicz Research Network – Aviation Institute boasts over 40 years of experience in resonance tests of aircraft, having tested several dozens of types of aircraft, gliders and helicopters and their components manufactured by domestic and foreign aviation industry. The Laboratory also conducts dynamic and aeroelastic analyses, including flutter analysis as required by aviation regulations.

The data for these analyses come from the results of resonance tests or the results of calculations obtained by using the finite element method (FEM). Results of tests and analyses carried out at Łukasiewicz Research Network - Aviation Institute are recognized by both Polish and foreign aviation authorities.

Scope of tests:

- Resonance tests of aircraft.
- Determination of velocity and form of flutter based on the results of resonance tests.
- Calculation of free vibrations and flutter using the finite element method (FEM).
- Preparation of the flutter flight test program.
- Support for flutter flight tests.
- Support for certification of new or modified aircraft.

Software:

- MSC.Nastran.
- JG2 (IPPT PAN).
- ZAERO (ZONA Technologies Inc.).
- SAF (Subsonic Aerodynamic Flutter).
- MSC.Patran, Siemens FEMAP.


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VIBRATION PROPERTIES TESTING

The Vibration Testing Laboratory performs vibration testing and resonance tests of structures, devices and their components not only from the aviation industry, but also from other fields of technology, such as automotive, energy, railways and space industry. Measurements are carried out using a multi-channel data acquisition system via acceleration sensors. The tests are performedunder operating conditions of the device or after excitation of the object with sinusoidally varying force, a random force or a force pulse.

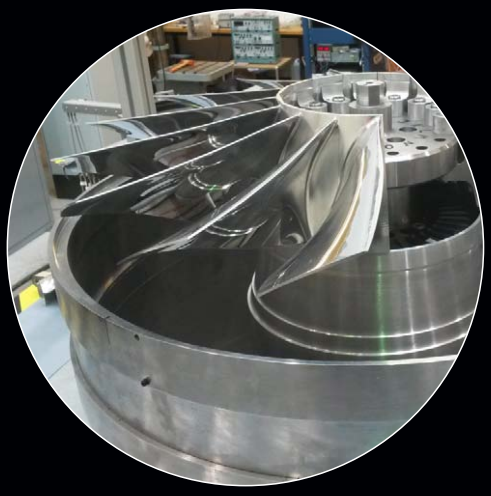
The tests include both small objects, such as axial compressor blades and large objects, e.g. elevated landings, where the dynamic properties of the structure are checked, as well as the impact of landing helicopters on the building, its equipment and people occupying it.

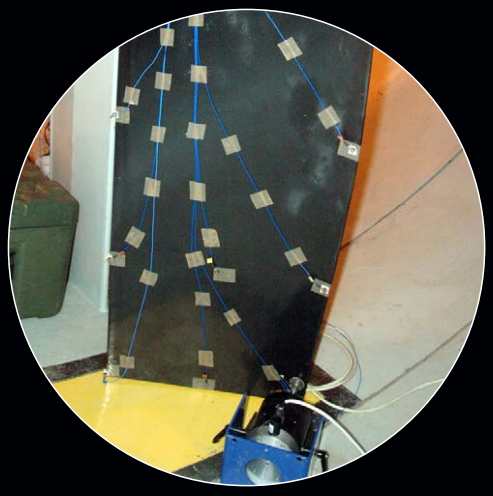
Scope of services:

- Measurement and analysis of vibrations.
- Resonance tests of structures - measurement of modal parameters: frequency, generalized mass, damping, form of natural vibrations.
- Tests of object response to force impulse excitation.
- Tests of response of the object to the excitation by a random signal (noise).
- Testing of vibrations of the object on the vibrating table.
- Calculation and verification of vibration properties of structures.

Equipment:

- Multi-channel analyzers and recorders (up to 256 channels in total, sampling to 204 kHz).
- Polytec PSV 500 3D laser vibrometer (non-contact vibration measurement).
- Acceleration sensors: (weight: 0.3-210 grams; frequency range: 0.5 Hz to 40 000 Hz; range of measured accelerations: 0,001 g to 1000 g).
- Modal hammers (from 4.8 grams: 222 N, up to 5.5 kg: 22 kN).
- Electrodynamic inductors (maximum force: 1600 N).








HEMS
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ACOUSTIC TESTS

The Vibration Testing Laboratory also offers measurements in the field of acoustics. The method of locating sound sources using a so-called acoustic camera is primarily used. The acoustic test offer also includes a method for determining sound power levels of noise sources on the basis of sound intensity measurements according to ISO 9614-1 and ISO 9614-2, and the determination of sound levels and occupational noise exposure in the working environment by measuring the sound pressure level according to EN ISO 9612.

Scope of Tests:

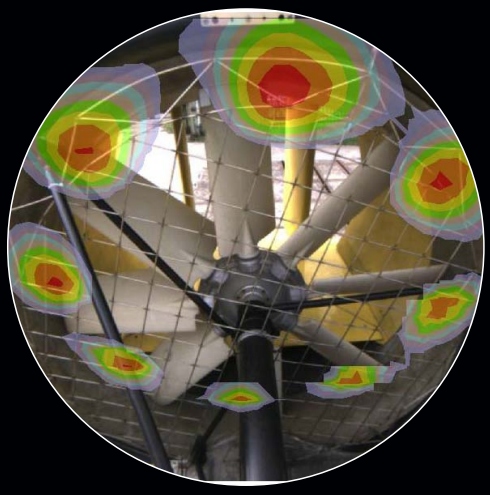
- Localization of the sound sources.
- Determination of the sound power level.
- Measurement of the sound intensity.
- Measurement of the sound pressure level.

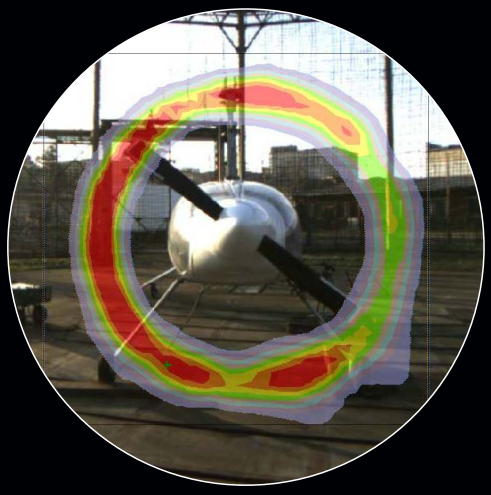
Equipment:

- MicrodB HDCamV2 acoustic camera (36 microphones).
- G.R.A.S. 50AI-L current probe.
- G.R.A.S. 40LS surface microphone (2.5 mm thick).
- Free field microphones 1" PCB 377 B02.
- Portable sound and vibration analyser SVAN 912AE.

IN-SERVICE TESTING

Moreover, the test offer of the Laboratory comprises the measurements of operational vibrations of machines, equipment or vehicles in their operating conditions. The data acquisition system used for this purpose allows measurement of vibrations at multiple points (up to 256 channels) with appropriate sensors as well as measuring and recording other physical quantities needed for monitoring operation and the evaluation of condition of the device under test. Inputs for voltage sensors (+/-10V), ICP/IEPE and strain gauge bridges (1/4-, 1/2-, and full bridge) are available.
The high sampling rate of the measuring system (up to 204 kHz) enables testing of fast-changing phenomena, such as collisions with the test structure of objects fired from compressed air gun, or transients states such as starting or braking of the devices.





COMPOSITE TECHNOLOGIES

DEVELOPMENT OF MANUFACTURING TECHNOLOGY OF COMPOSITE STRUCTURES

Łukasiewicz Research Network - Institute of Aviation is equipped with advanced technological facilities to develop new technologies and to produce prototype structures of composite materials. As part of the research work for designed structural solutions, technologies are developed and manufactured prototypes of structures are subjected to further tests.

The Institute offers the following services:

DEVELOPMENT OF CURING PROCESS FOR THERMOSETTING PREIMPREGNATES AUTOCLAVE AND OUT OF AUTOCLAVE TECHNOLOGY. AUTOMATED FIBER PLACEMENT TECHNOLOGY DEVELOPMENT

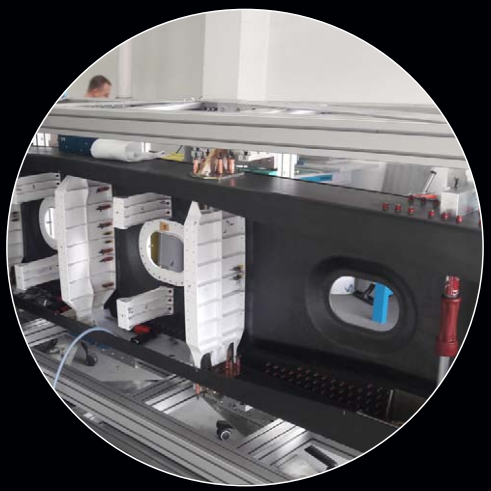
- Efficient environment for *automated fiber placement* at Łukasiewicz - Institute of Aviation created for the development of advanced industrial methods of manufacturing parts from composite materials.
- Implemented methodology to validate the quality of work conducted.
- Processes developed for manufacturing thermoplastic, thermosetting structures and automatic fiber application for the infusion process.

BLADDER MOLDING AND INFUSION TECHNOLOGY

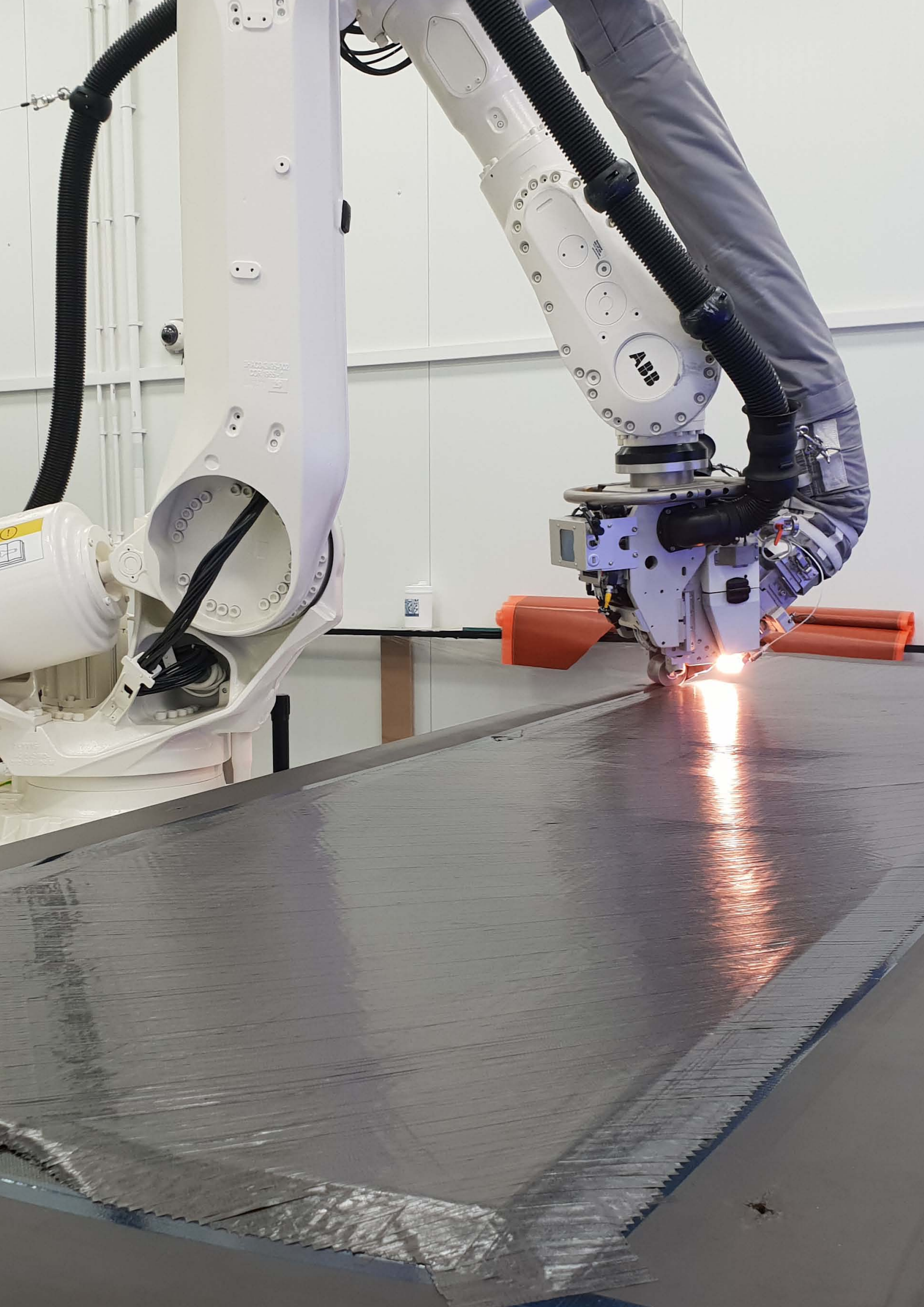
- Design of manufacturing processes in bladder molding and infusion technologies with focus on the optimization and integration of composite parts.
- Modern apparatus allowing for efficient prototyping of manufacturing processes.

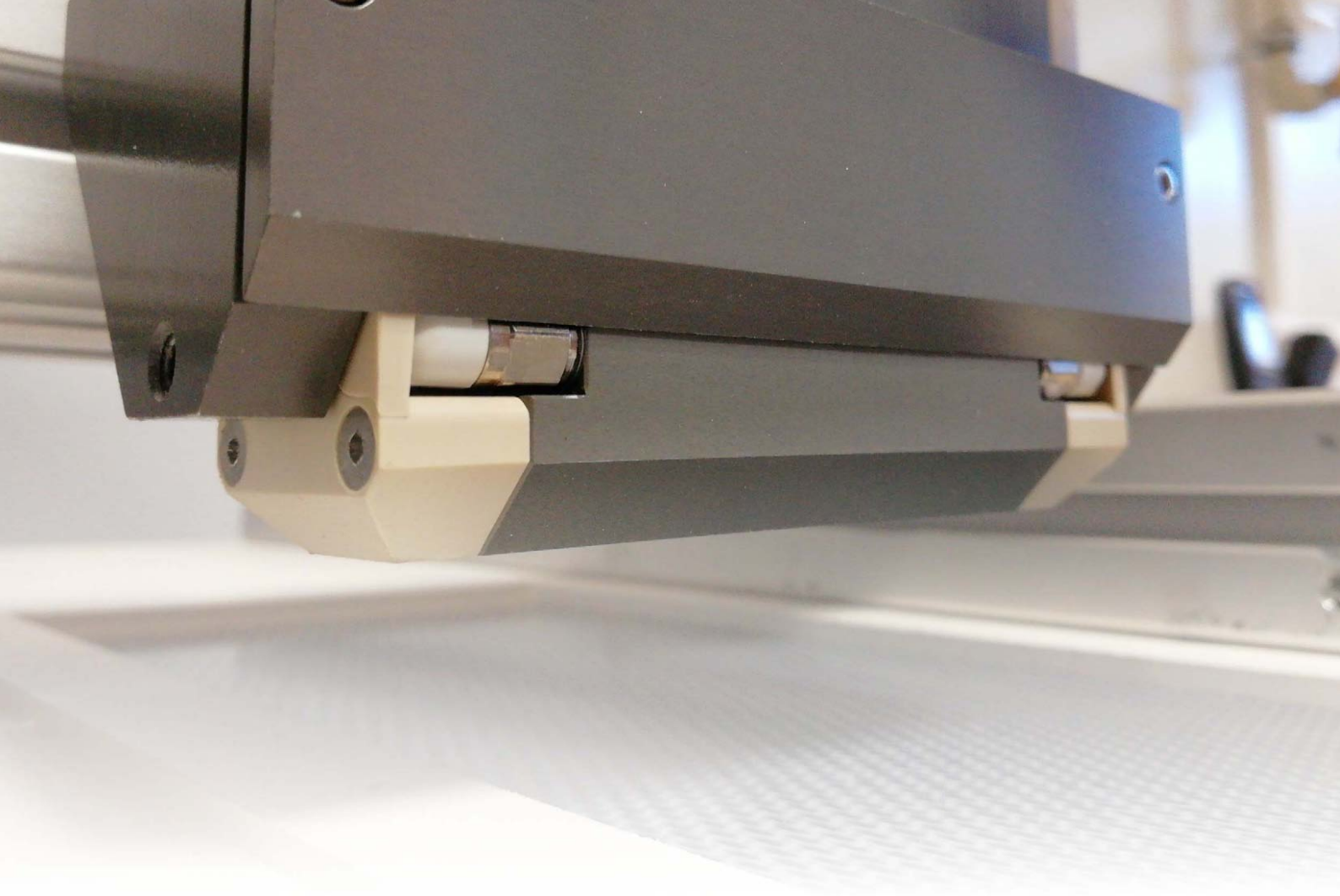
DESIGN AND MANUFACTURE OF MOLDS AND MOUNTING DEVICES OF COMPOSITE STRUCTURES

- Many years of experience in preparing the manufacturing process of composite parts made of preimpregnates.
- Design and manufacture of high temperature molds for out of autoclave and autoclave processes.
- Preparation of the assembly process of parts and components.






ABB



THERMOPLASTIC COMPOSITE TECHNOLOGIES

For over 30 years, thermoplastics have been winning the technology market for commercial applications in both civil and military constructions with particular emphasis on aircraft. In response to the ongoing growth of interest in composite materials with thermoplastic matrix, Łukasiewicz Research Network - Institute of Aviation has been continuously involved in the development of this area.

The institute offers the following services:

CONSOLIDATION TECHNOLOGY OF THERMOPLASTIC PREIMPREGNATES REINFORCED WITH CARBON OR GLASS FIBER

- Development of consolidation processes for thermoplastic preimpregnates based on non-destructive and laboratory testing.

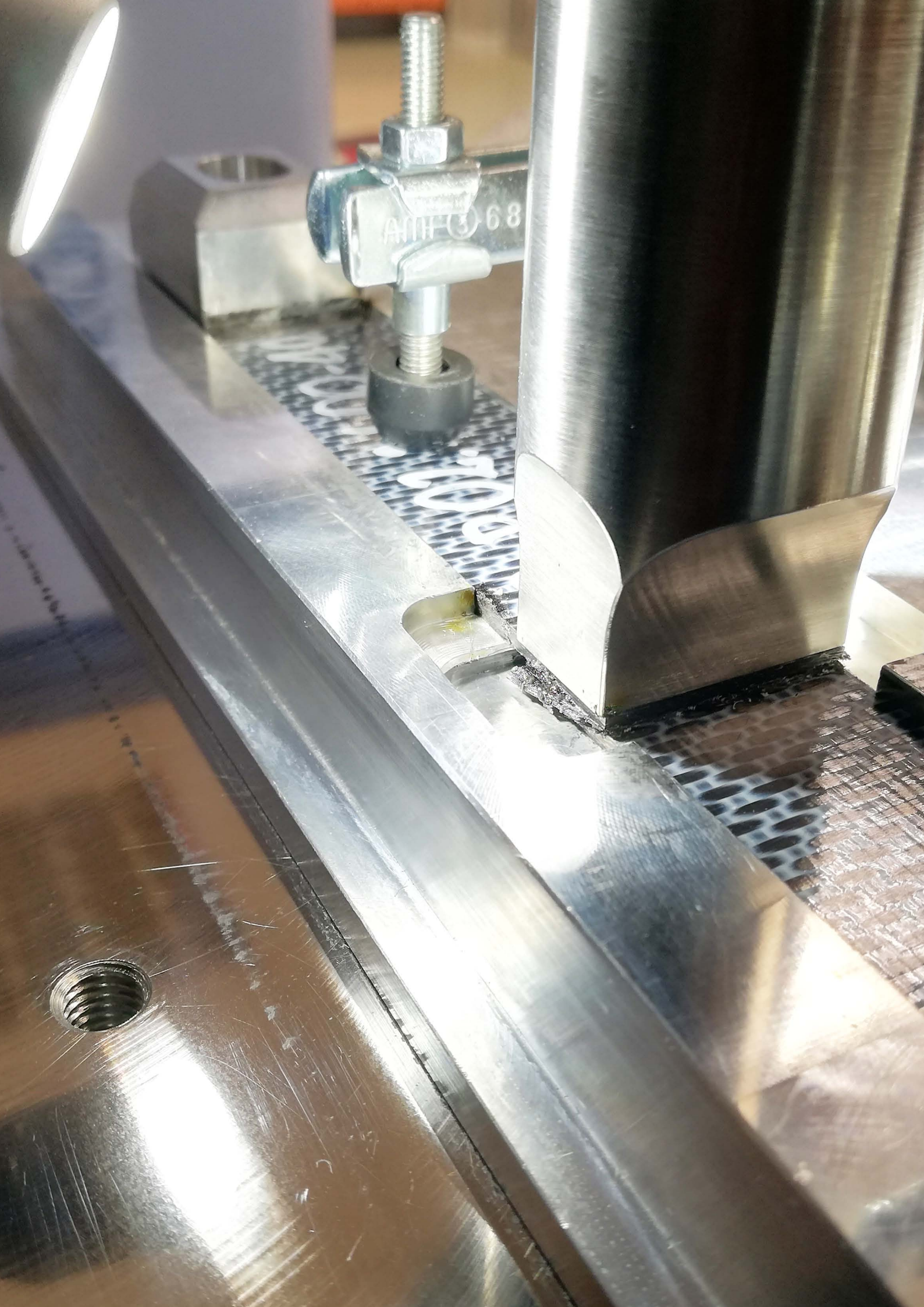
TECHNOLOGIES OF THERMOFORMING OF PARTS

- Modeling of composite molding process using PAM COMPOSITES - PAM FORM.
- Tooling design, modeling of flexible forming elements - silicone stamps using ABAQUS software.
- Manufacture of prototype composite parts by thermoforming on a press.

JOINING OF THERMOPLASTIC COMPOSITES

- Development of welding technology of thermoplastic composites in electrofusion and ultrasonic welding.
- Development of adhesive technology, adhesive selection and surface preparation methods.

Composites Technology Center, operating within Łukasiewicz Research Network - Institute of Aviation has a material base for PEEK TC 1200, PAEK TC 1225 and PPS TC 1100.

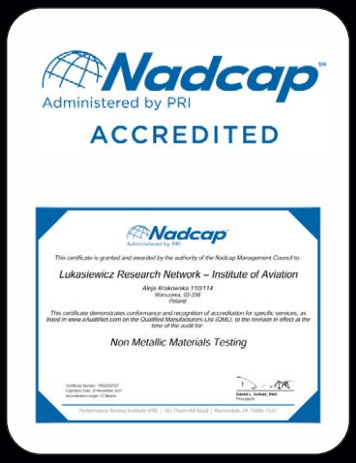


QUALIFICATION TESTING OF COMPOSITE MATERIALS

Łukasiewicz Research Network - Institute of Aviation has a high potential in the field of tests on composite materials. The Composite Testing Laboratory performs comprehensive tests of composite materials dedicated to aviation structures. Tests are carried out with the use of modern research equipment in accordance with the international standards. **The Composite Testing Laboratory has the PCA and NADCAP accreditation for non-metallic materials testing.**

The scope of the Institute's offer includes the following services:

- Qualification tests of composite materials.
- Damage tolerance assessment.
- Static and fatigue tests, max load up to 250 kN.
- Tests in the temperature from -130 °C to 315 °C.
- Digital image correlation, use of strain gauges and extensometers.
- Research with the use of standardized fixtures and custom designed, directed to individual customers' needs.
- Impact resistance test; simulated energy range from 0.59 J to 1800 J.
- Thermal analysis: DMA, DSC, TGA, FTIR.
- Preparation of samples: cutting, grinding, drilling, tabbing conditioning.



LAMINA TESTS

Tension	ASTM 3039
Compression	ASTM D3410, ASTM D6641
Shear	ASTM D3518, ASTM D5379, ASTM D7078
Interlaminar shear	ASTM D2344
Three-point bending	ASTM D790
Mode I, Mode II and Mixed Mode Fracture Toughness	ASTM D5528, ASTM D6115; ASTM D7905; ASTM D6671

LAMINATE TESTS

Open Hole Compression	ASTM D6484
Open Hole Tensile	ASTM D5766
Compression After Impact	ASTM D7136, ASTM D7137

BOLTED JOINTS

Bearing Response	ASTM D5961
Pull-Through	ASTM D7332

ADHESIVE TESTS

Shear Test	ASTM D1002, ASTM D5656, ASTM D3528
Peel Resistance	ASTM D3167, ASTM D1781

CORE MATERIALS AND SANDWICH STRUCTURES

Compresion	ASTM C365
Core Shear	ASTM C393, ASTM C273
Flatwise Tensile	ASTM C297
Long Beam Flexure	ASTM D7249

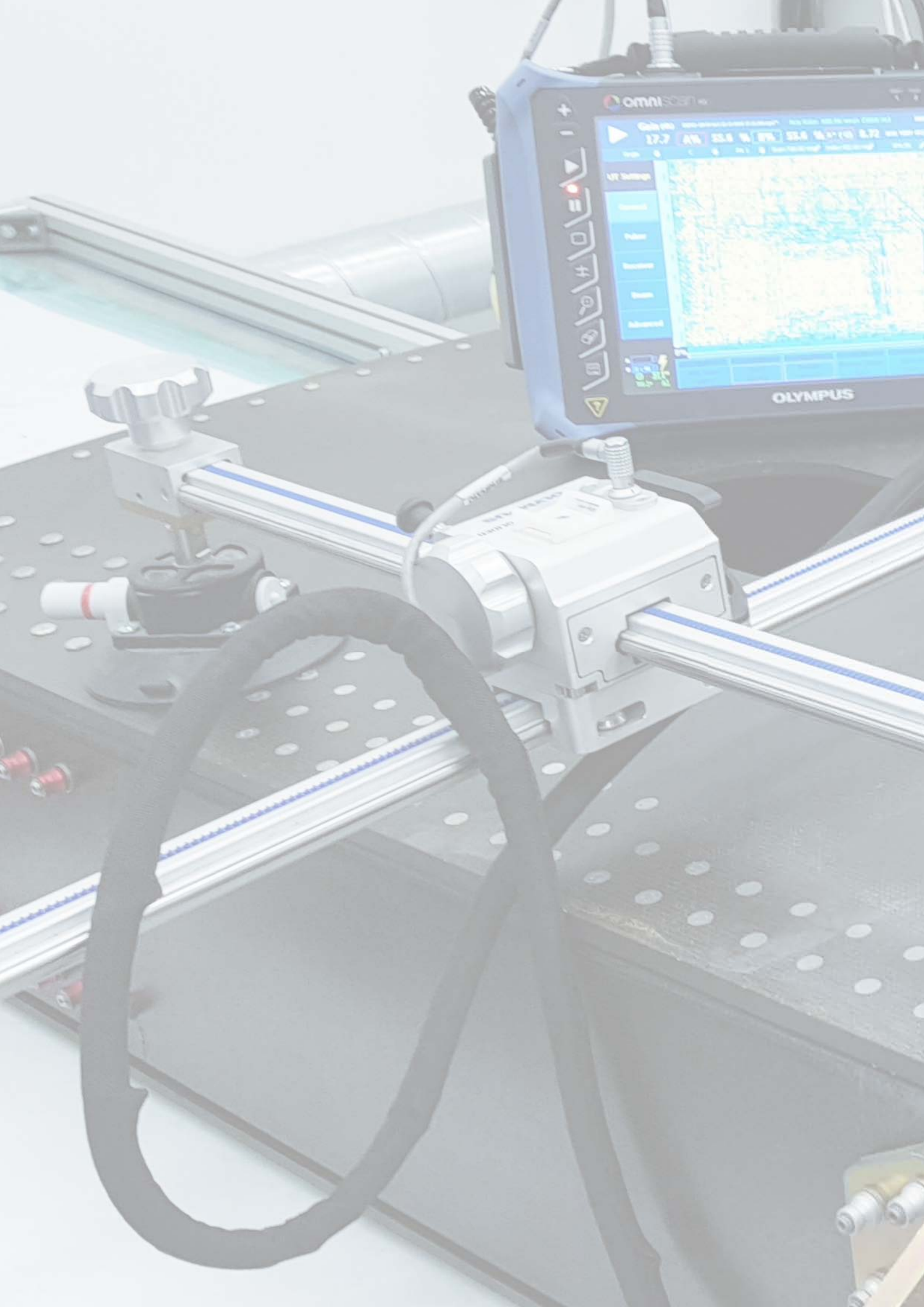
PHYSICO-CHEMICAL TESTS

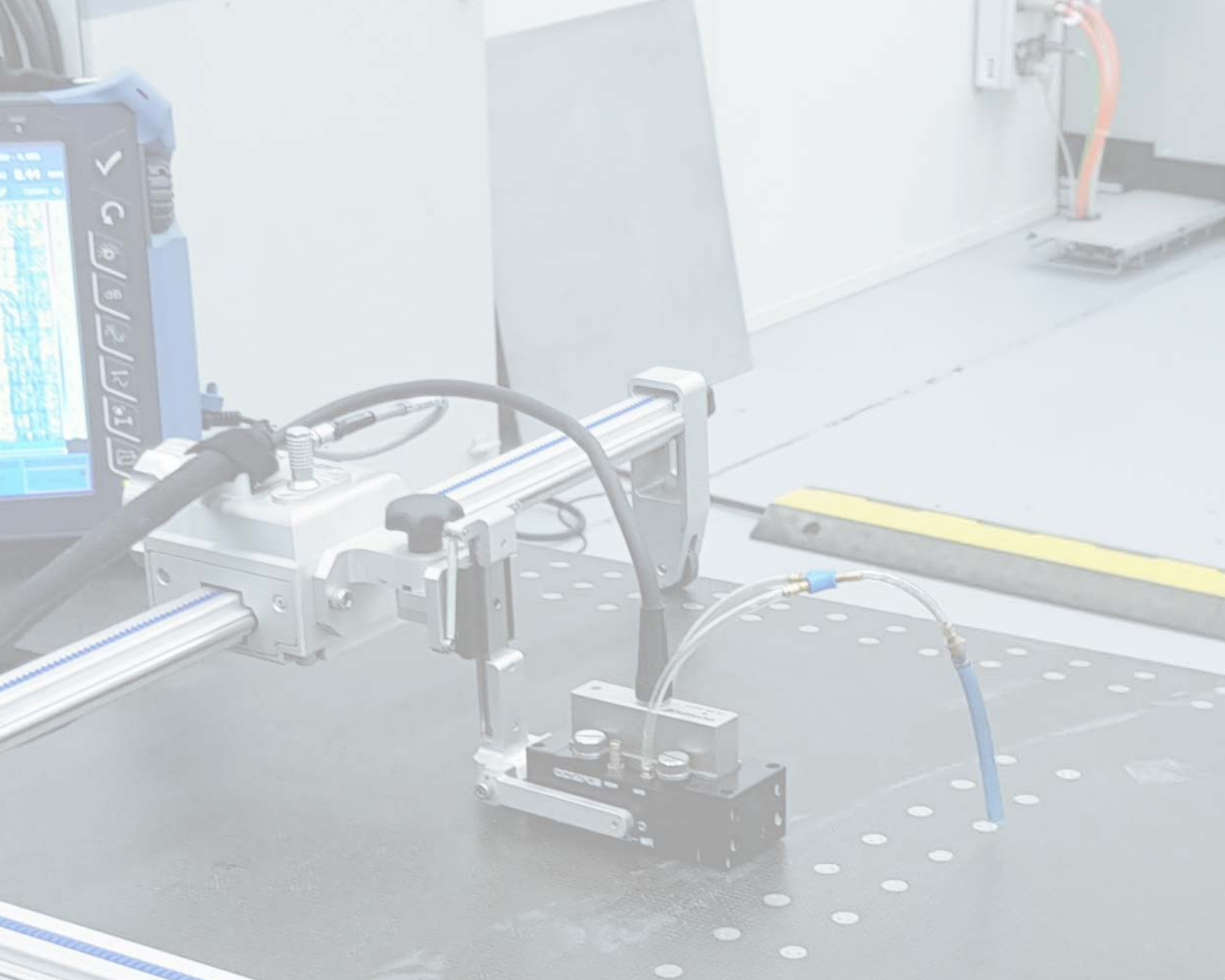
Testing of uncured prepregs (gel time, resin flow, resin content)

Fiber volume	ASTM D3171
Glass transition temperature	ASTM E1640, ASTM D7028
Enthalpy of Fusion and Crystallization	ASTM D3418
Thermogravimetry	ASTM E1131

NON-DESTRUCTIVE TESTS, MICROSCOPIC ANALYSIS

Ultrasonic testing of laminates
Visual analysis
Microscopic measurement of porosity


OLYMPUS



NON-DESTRUCTIVE TESTING AND QUALITY CONTROL PROCESSES

All manufacturing work is subject to quality control. The quality control process includes documentation and material control, process control and product control. Scope of the quality control is adjusted each time to the specificity of the work in progress.

The institute offers the following services:

- Ultrasonic testing of composite structures using phased array (C-scan) conventional technique.
- Low-frequency testing of composite structures by bond testing (C-scan) technique, tap testing (woodpecker, hammer).
- Thermographic testing of composite structures (active thermography).
- Visual inspection of composite structures.
- Comprehensive development of methodologies for non-destructive testing of composite structures.
- Calibration plate design.
- Detection of defects like: delamination, cracks, porosity, foreign bodies.

DEVELOPMENT OF COMPREHENSIVE QUALITY CONTROL PROCESSES OF COMPOSITE STRUCTURES

- Defining the procedures for recording production and quality control activities for each manufacturing stage of composite aerospace structures.
- Defining the scope of destructive testing - "witness" samples.
- Geometric control of tooling and structures using a 3D laser scanner.

REMOTE SENSING

An important area of activity of Łukasiewicz Research Network - Institute of Aviation is widely understood remote sensing, including development, integration and calibration of modern systems for data acquisition by means of multispectral techniques and tool development for mechatronic and automated systems to meet the needs of air missions. Modern technical background and experience of the employed specialists enable the implementation of interdisciplinary ventures.

Remote sensing is developed in two basic directions: development of measuring tools and optoelectronic systems (hardware) and creating integrated, system solutions (software and algorithmics) for the needs of modern aviation. Implementation of IT projects, with particular emphasis on creating management support applications, automation and optimization of processes in various branches of the economy, thus contributing directly to the country development.

Specialists working in the field of remote sensing are engaged in the creation of tools that enable ongoing monitoring of air, missile and satellite missions. The projects are undertaken in the field of data transmission, its archiving and advanced analyses and visualization.

Based on aerial photographs, map studies and 3D models are created, which are the basis for further urban-planning work and modern management of urban space. The solutions developed so far, funded among others by the European Commission (EC) and National Fund for Environmental Protection and Water Management support the work of foresters and farmers. In addition, the use of aerial and satellite data in public administration units is strongly promoted. Cycles of trainings in the acquisition and processing of geodata and the creation of feed layers for Spatial Information Systems (SIP) are part of the offer.

Expert knowledge in areas:

- IT - programming, creation of advanced Spatial Information Systems.
- Advanced algorithmics, integration and processing of large data sets with particular emphasis on aerial and satellite images.
- Development, integration and calibration of modern data acquisition systems including multispectral techniques.
- Measurement of spectral signatures of objects, spectral curve analysis, information extraction about biophysical parameters of objects, based on spectral data.
- Advanced visualization of geodata with special emphasis on 3D modeling and integration of vector, raster and descriptive data.
- Precise positioning with GNSS/INS.







COOPERATION

The globalization of industry and the research market requires interaction with specialists from around the world. Knowledge-based management and increasing number of international projects enable the joint creation and conduct of research and the exploitation of its results for the purposes of aviation.

Łukasiewicz Research Network - Institute of Aviation extensively cooperates for the development ofaviation technologies with many universities, scientific institutions, research centers and industrial laboratories from Poland, Europe, USA and Canada.

INDUSTRIAL AND SCIENTIFIC COOPERATION

Łukasiewicz research Network - Institute of Aviation Institute cooperates on the domestic and foreign market with many industrial organizations (both multinational corporations and small and medium-sized domestic enterprises), technical universities, scientific institutes and knowledge transfer centers.



USA AND CANADA

GENERAL ELECTRIC	HONEYWELL
PRATT & WHITNEY	OHIO STATE UNIVERSITY
COLLINS AEROSPACE	

EUROPE

AIRBUS	ISSNOVA
AIRBUS HELICOPTERS	CESA
GE AVIO AERO	TAI
LEONARDO HELICOPTERS	EREA

POLAND

AIRBUS POLAND S.A.	WARSAW UNIVERSITY OF TECHNOLOGY
POLSKIE ZAKLADY LOTNICZE SP. Z O.O.	MILITARY UNIVERSITY OF TECHNOLOGY
POLSKA GRUPA ZBROJENIOWA	BIALYSTOK UNIVERSITY OF TECHNOLOGY
MILITARY AVIATION WORKS – WZL1	RZESZOW UNIVERSITY OF TECHNOLOGY
PRATT & WHITNEY KALISZ	AIR FORCE INSTITUTE OF TECHNOLOGY
EUROTECH	MILITARY INSTITUTE OF AVIATION MEDICINE
SZEL-TECH	CIVIL AVIATION AUTHORITY
P.W.METROL	PIT RADWAR
ULTRATECH	WB ELECTRONICS
ZAKŁADY LOTNICZE MARGAŃSKI&MYSŁOWSKi S.A.	WZL NR2 SA

PUBLIC-INDUSTRIAL PARTNERSHIP

Since 2000, Łukasiewicz Research Network - Aviation Institute has been developing cooperation with the world engineering industry leader General Electric. The two organizations have jointly established one of the largest engineering centers in Europe, where jobs are offered for teams of engineers with a wide range of competencies.

CORPORATE CLIENTS

Łukasiewicz - Aviation Institute is recognized by many major companies operating in the aviation industry.

Since 2004, the Institute has been cooperating with the leading engine manufacturer Pratt&Whitney company. Research services are performed in the Institute's research center specialising in materials and structures testing. The center was established as part of the implementation of offset programs related to the purchase by Poland of American F-16 aircraft.
The reason for holding such responsible and important research at the Institute was its many years of experience in this field. Tests on materials and aeronautical structures have been conducted since the Institute's inception in 1926.

RESEARCH PARTNERS

The scientific staff of Łukasiewicz Research Network - Aviation Institute has been recruited from a wide range of universities, colleges and universities of technology. For decades, the Institute's main staffing facility has been Warsaw University of Technology, with which the Institute collaborates on many joint research projects and in national associations.

Łukasiewicz – Aviation Institute also cooperates with foreign universities. Important, scientific cooperation was established, among others, with the Ohio State University (Columbus, Ohio, USA). Both institutions have found it beneficial to carry out the activities in the area of: scientific cooperation, scientific exchange of students, lecturers and researchers (lectures, studies, research), organizing workshops, symposia, etc. on topics of common interest, joint publications, scientific materials and literature and technical cooperation. Polish-American Science and Technology Conference held since 2000 is the result of this cooperation.

RESEARCH PROJECTS

Łukasiewicz Research Network - Aviation Institute coordinates and participates in many international consortia in the framework of projects announced by the European Commission (Clean Sky 2, SE SAR) and the European Defence Agency and carries out national research projects under the National Center for Research and Development and the National Science Center.

Taking part in European programs, Łukasiewicz - Aviation Institute cooperates with scientific institutions, companies and the most important aerospace concerns on the continent.

Projects conducted in research consortia help develop future technologies for aviation.

A List of selected current and past projects under the Clean Sky 2, SESAR Horizon 2020, NCBiR, NCN programs and those based on own statutory funds:

EUROPEAN PROJECTS:	NATIONAL PROJECTS	OWN PROJECTS
AEROFAST	Unmanned helicopter for special tasks	Composite wing caisson for ILX-34 aircraft
CESAR	ILX-27	Composite rotor blades for ILX-27 helicopter
CHRZĄSZCZ	INNOLOT 2	
COAST	ISSLOT	
COMROTAG	MOSUPS	
DREAM	Development and implementation of new generation constructional technological and materials solutions for the main rotor and airframe elements of helicopter PZL W-3A Sokół	
ESTERA	Turbo-prop aircraft of new generation ILX-34	
ERA	TECHMATSTRATEG	
FORSAT/FORROT /FORJET 2035		
HELIX		
HIGHTRIP		
HISAC		
IMOTHEP		
LATTE		
MARENCO		
NACRE		
SAT-AM		
SAT Rdmp		
STARLET		
TFAST		
TRAIL		
TURBO-REFLEX		
WINGPLUSE		
X-TEAM D2D		
ADLAND		
RASTAS SPEAR		

INTERNATIONAL AVIATION ASSOCIATIONS

Łukasiewicz - Institute of Aviation is a member of global research and technical organizations. Within their structures, it undertakes actions aimed at strengthening the position of the Polish sector of research:

- ACARE - Advisory Council for Aeronautics Research in Europe.
- AHS - American Helicopter Society.
- AIAA - American Institute of Aeronautics and Astronautics.
- ASD - Aerospace and Defense Industries Association of Europe.
- CEAS - Council of European Aerospace Societies.
- EASN - European Aeronautics Science Network.
- EREA - European Research Establishments in Aeronautics.
- IAA - International Academy of Astronautics.
- ICAS - International Council of the Aeronautical Sciences.
- IFAR - International Forum on Aeronautical Research.
- STAI - Supersonic Tunnel Association.
- ICAF - International Committee on Aeronautical Fatigue.

NATIONAL AVIATION CLUSTERS AND ASSOCIATIONS

Within the framework of national cooperation, the Institute also belongs to a number of national organizations active in the aviation industry:

- AVIA-SPLot Sieć Porozumienia Lotniczego.
- AERONET – Dolina Lotnicza.
- Federacja Firm Lotniczych Bielsko.
- Klastry Polskie.
- Polska Izba Gospodarcza Zaawansowanych Technologii.
- Polska Platforma Technologiczna Lotnictwa.
- Polskie Towarzystwo Naukowe Silników Spalinowych.
- Stowarzyszenie Polskiego Przemysłu Lotniczego.
- Śląski Klaster Lotniczy.
- Związek Pracodawców Przedsiębiorstw Przemysłu Obronnego i Lotniczego.
- Sektorowa Rada ds. Kompetencji dla przemysłu lotniczo-kosmiczne


EDC

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