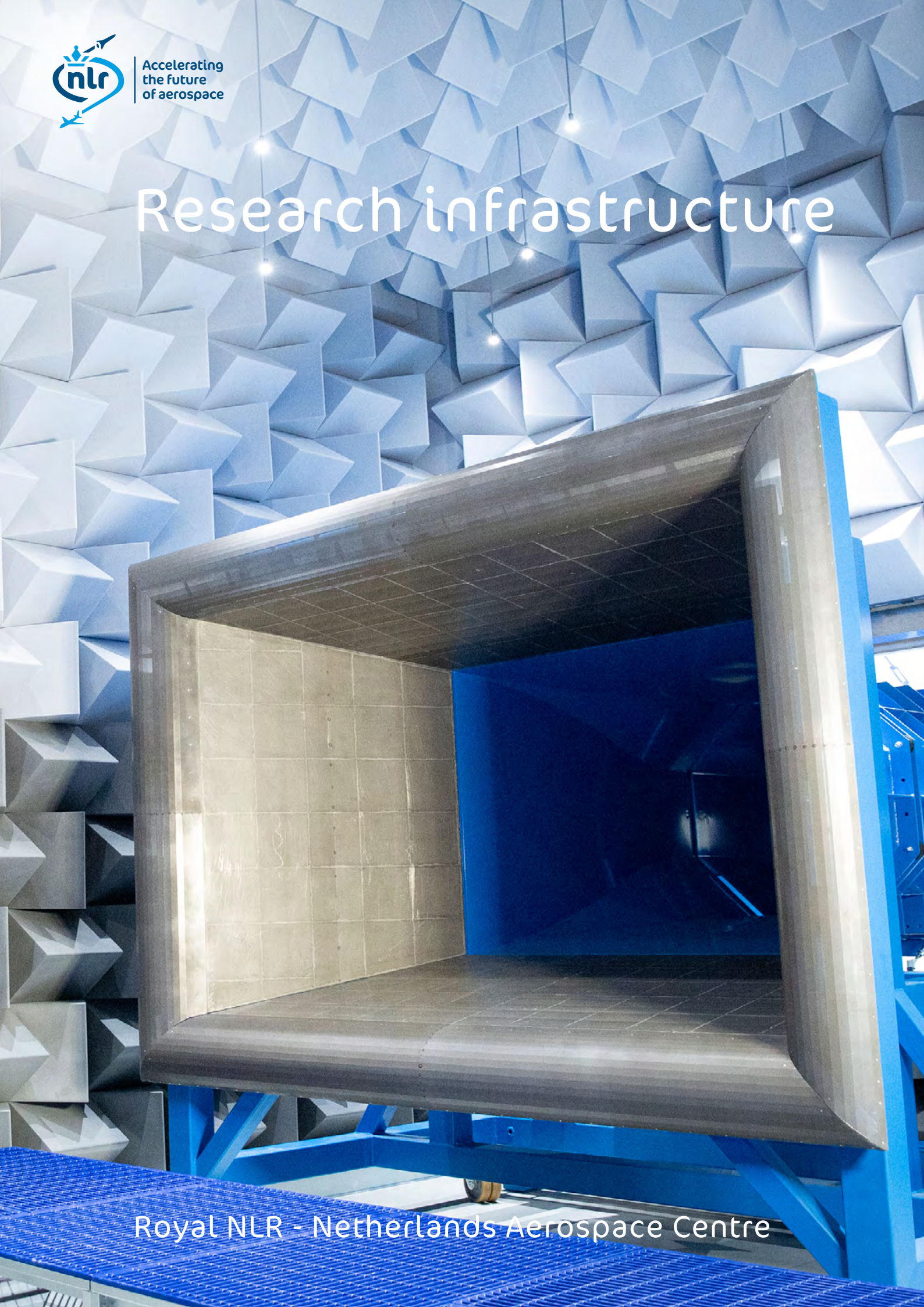
Accelerating the future of aerospace

Research infrastructure

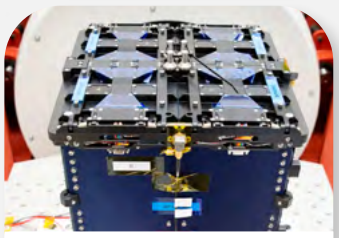


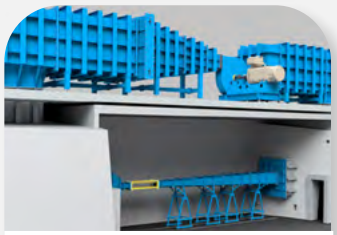
Royal NLR - Netherlands Aerospace Centre

Netherlands Aerospace Centre

Research infrastructure

NLR's research infrastructure comprises a diverse range of facilities and equipment, forming the foundation of our applied research. Our state-of-the-art facilities are accessible to companies and other research institutions, allowing for collaborative innovation. In this brochure we present a modest part of our extensive facilities for aviation, defence and space applications with which we can support your research projects and R&D activities.





Automated Composites Manufacturing (ACM3)

The ACM3 Field lab (Automated Composites Manufacturing, Metal Manufacturing and Maintenance) is a world-class facility that offers high-tech equipment and expertise for the development of lightweight products. Its primary focus is on paving the way for automated manufacturing of advanced composite structures, with a strong emphasis on supporting the composites industry and companies that are looking to adopt these materials.

By bringing together the collective research capabilities of leading research centres, universities, and specialised businesses, the facility creates a unique ecosystem that enables collaboration, innovation, and knowledge-sharing.is a well-equipped, state-of-the-art field facility that makes high-tech equipment available for the development of lightweight products. It serves to prepare the way towards automated manufacturing of advanced composite structures, largely in support of the 'composites' industry, but also of enterprises, which are new to this material. The facility brings together the complementary research capabilities of research centres, universities and specialised small enterprises and industries. The facility provides dedicated support to companies developing lightweight systems using composite materials and/or metal. NLR offers comprehensive support throughout nearly all phases of product development, ranging from concept studies and material screening to detailed design preparation and concept creation. The centre also offers repair services and full-scale prototyping capabilities, allowing companies to bring their ideas to life. To facilitate seamless operation, users can choose to receive training or hire an experienced NLR operator to assist with equipment operation.

Main features

EQUIPMENT FOR MANUFACTURING COMPOSITE COMPONENTS

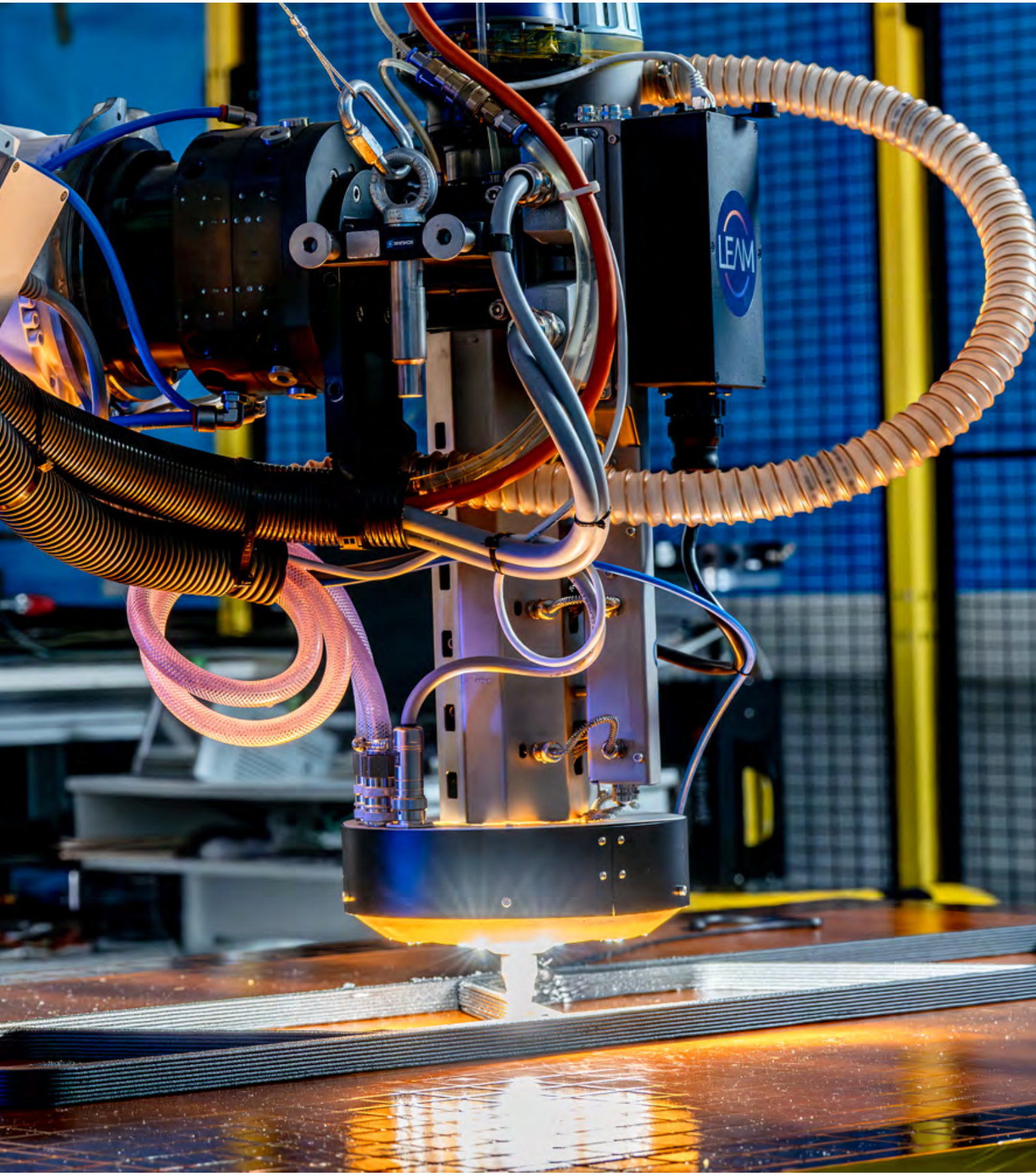
- Preform cell
- Resin transfer moulding station
- Eurocarbon overbraiding machine
- Induction welding
- Automated fibre placement machine
- Autoclave
- Heated press
- Large curing oven

EQUIPMENT FOR ANALYSIS AND CHARACTERISATION

- Rheometer
- Differential scanning calorimeter (DSC)
- Thermogravimetric analysis (TGA)
- Supporting software
- Non destructive inspection (NDI)

EQUIPMENT FOR ADDITIVE MANUFACTURING

- Laser Powder Bed Fusion (LPBF)
- Blown Powder Directed Energy Deposition (manufacturing & repairs)
- Sinter-based fused filament fabrication
- Materials laboratories and research & testing facilities
- Large scale additive manufacturing


LEAM

Metal Additive Manufacturing Centre (MAMTeC)

The NLR Metal Additive Manufacturing Technology Centre (MAMTeC) covers more than 50 years of materials experience in aerospace applications, technology development and product innovation. NLR can help you develop the process more efficiently, from optimised parameters, post-processing approaches, evaluation of mechanical properties, design optimisation and process simulation through to the qualification and certification of metal–additive manufacturing (AM) products.

NLR works on AM process optimisation, assesses material properties, designs components and builds parts up to the level of full-scale prototypes.

Main features

- Laser Powder Bed Fusion (LPBF)
- Blown Powder Directed Energy Deposition (manufacturing & repairs)
- Sinter-based fused filament fabrication
- Materials laboratories and research & testing facilities
- Large scale additive manufacturing

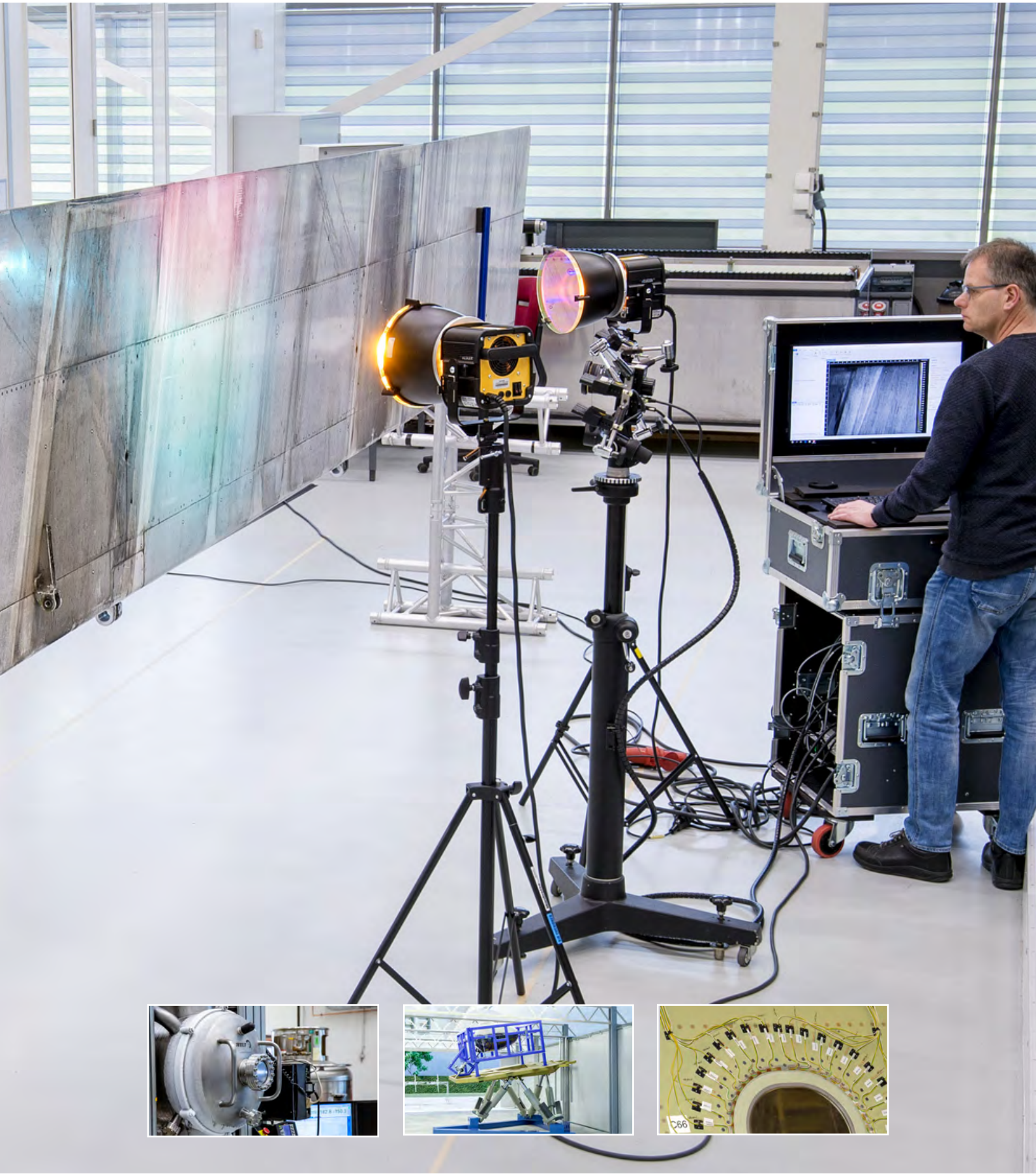
Thermal Vacuum Facility

Materials and equipment used in aerospace applications have to meet a wide range of special requirements, mainly due to the specific environment in which aircraft and spacecraft have to perform reliably and safely. NLR's extensive capabilities and expertise in the field of airworthiness certification is complemented with state-of-art research infrastructure for aerospace systems performance and airworthiness compliance testing.

At the Thermal Vacuum facility (TVL), we conduct tests for applications involving extreme temperatures and/or vacuum. We also develop cooling systems for aerospace applications that require heat to be dissipated as efficiently as possible.

Main features

- **Thermal Vacuum chamber:** for testing products under high vacuum.
- **Temperature chamber:** to conduct tests from -150°C to 300°C, with the option of adjusting temperatures by 35°C per minute.



Test House Structures and Materials

NLR acts as a one-stop-shop for “Non-Standard” testing and certification of aircraft parts, structures and materials. The Test House facilitates inspection, testing, characterisation and failure analysis. This can be done on material level, coupon level, component level or full-scale level.

We can assist you in manufacturing and machining your test articles and help you to set up a test plan. Our simulation, engineering, manufacturing and machining capabilities enable us to provide you with the best tooling and test setup structure:

- Standardised tests, material qualification, certification tests, or tests made fit for your purposes
- Mechanical or environmental testing
- Materials of the test articles: ceramic, composite or metal
- Sizes: small up to full scale

Main features

MECHANICAL TESTING

- Coupon and materials testing static, fatigue and damage tolerance testing according to international standards or customer specifications. Materials testing, evaluation and qualification programs.
- Ambient, (deep-) cryogenic or elevated temperatures; dry, wet or chemically enhanced. Chemically enhanced ranges from (toxic) oil and gas related substances to (liquid) hydrogen.
- Panel and component testing Large complex component testing, shear / compression buckling, fatigue and damage tolerance testing, curved fuselage panel testing.
- Ambient, cryogenic or elevated temperatures; dry or wet. Full scale testing, certification or research Load spectrum generation, rig design, testing and inspections of aircraft parts like moveables up to full wings or tails. Ambient, cryogenic or elevated temperatures; dry or wet

ENVIRONMENTAL TESTING

- Testing of materials and systems under various environmental conditions.
- High/low temperature, humidity, salt spray, decompression, altitude and waterproofness testing.
- Vibration, shock, acceleration, electric and acoustic environmental tests

MATERIAL EVALUATION

Failure analysis, materials failure and corrosion analysis, metallurgical services and forensic engineering. Material failure analysis is performed mostly both post-mortem but also in-situ.
Non destructive inspection fully automated C-scans, submerged and squirter mode, single beam and phased array, Eddy current, ultrasound, dye penetrant, thermographic, shearographic, 3D structured light and magnetic inspection.

MEASURING, CONTROL AND CALIBRATION

Calibration according to ISO 17025 of test machines or equipment, measuring and control technology.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Electro Magnetic Compatibility Facility

Materials and equipment used in aerospace applications have to meet a wide range of special requirements, mainly due to the specific environment in which aircraft and spacecraft have to perform reliably and safely. NLR's extensive capabilities and expertise in the field of airworthiness certification is complemented with state-of-art research infrastructure for aerospace systems performance and airworthiness compliance testing.

At the Electro Magnetic Compatibility facility (EMC facility), aerospace electronics (avionics) are assessed for electromagnetic compatibility (EMC). This means that the avionics in question must not cause electromagnetic interference to other systems while at the same time being sufficiently immune to Electromagnetic Interference (EMI) from the environment.

The EMC facility conducts electromagnetic emission measurements and immunity tests on various electronic systems. These EMC tests are usually conducted in the Semi-Anechoic Chamber (SAR). The SAR is equipped with radio frequency energy absorbers, high-quality filters for mains power, water supply and an exhaust extraction system.

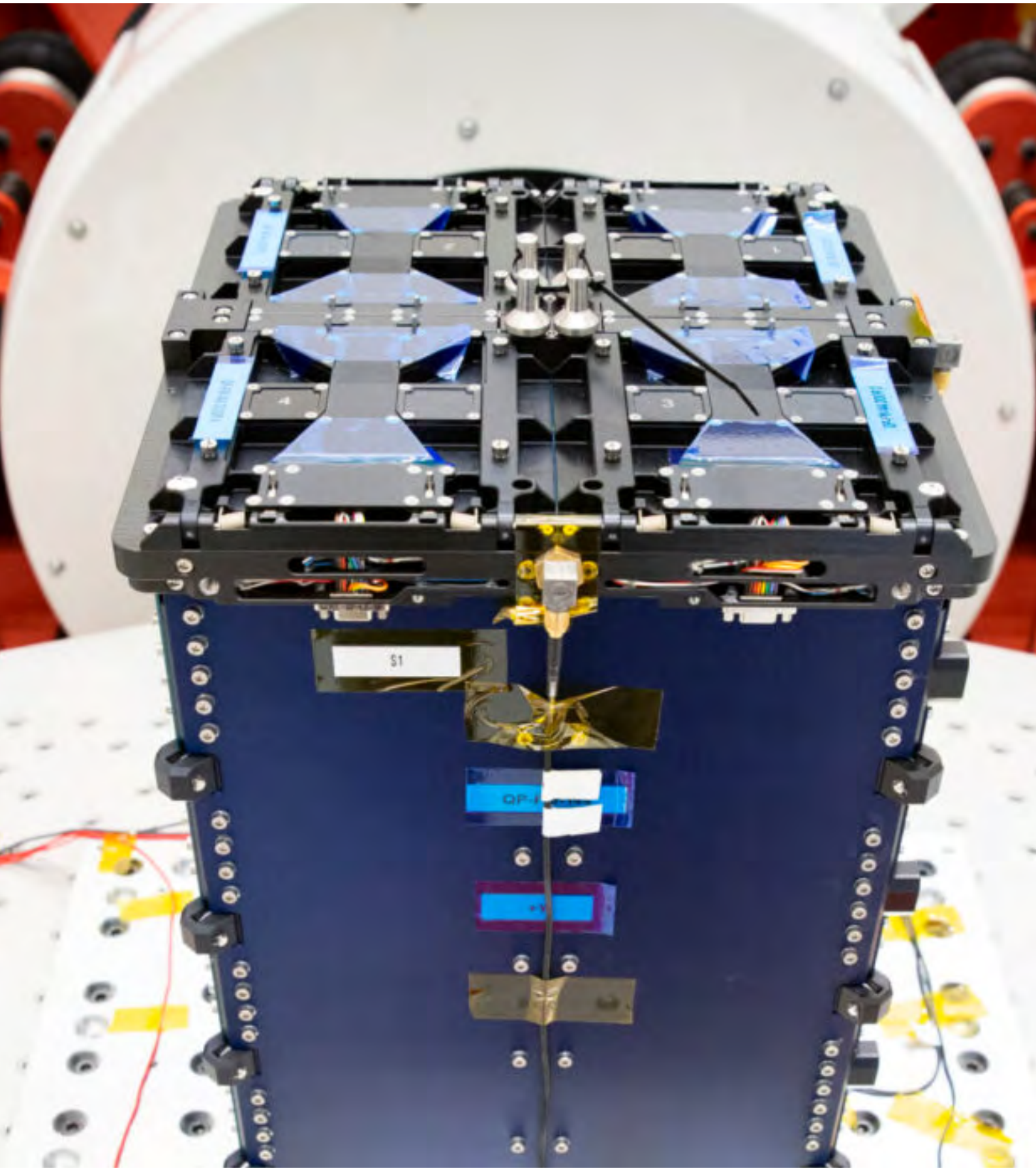
Research facility for, among others, the verification of research projects:
- Modelling, simulation and analysis of the EMC characteristics of cables (crosstalk and transmission impedance);
- Analysis of potential electromagnetic interference on aircraft and airports.

EMC tests can also be conducted on the helicopter platform annex Open Area Test Site (OATS) at the NLR site or on the customer premises. NLR's EMC facility is listed in the Council for Accreditation (RvA) register for conducting EMC tests according to ISO-17025.

Main features

GENERAL
- Immunity tests due to the (indirect) effects of lightning.
- Immunity tests due to high field strengths caused by high-power transmitters such as radars (High Intensity Radiated Fields).
- Emission measurements according to civil and military standards.
- On-site EMC measurements and HIRF tests according to customer specifications.

TECHNICAL
- Crosstalk measurements according to IEC 61935-1
- Surface transfer impedance Triaxial method measurements according to CEI-IEC 62153-4-3
- Surface transfer impedance Line injection method measurements according to CEI-IEC 62153-4-6
- Shielded screening attenuation measurements according to CEI-IEC 62153-4-4
- In-situ EMI test to customer specifications
- Helicopter platform annex Open Area Test Site (OATS) for emission measurements and antenna calibrations
- Variable frequency AC power source (9 kVA) for power quality tests.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Vibration and Shock Test Facility

Materials and equipment used in aerospace applications have to meet a wide range of special requirements, mainly due to the specific environment in which aircraft and spacecraft have to perform reliably and safely. NLR's extensive capabilities and expertise in the field of airworthiness certification is complemented with state-of-art research infrastructure for aerospace systems performance and airworthiness compliance testing.

Main features

The Vibration and Shock Test Facility (VST) houses three vibration testing systems:

- TIRAvib Shaker 50350
- LDS V810 Shaker-sliptable combination
- LDS V875 Shaker-sliptable combination

The VST facility is one of NLR's environmental test facilities, covering test requirements regarding vibrations and shocks.

Energy Management

Membrane Research

THETA I

Energy to Propulsion Test Facility

HYDRA II

Hydrogen Production Pilot Plant

DEWAR

Cryostat

Solar Park

DNW wind tunnels

NLR Drone centre

NLR MARKNESSE

Hydrogen energy transition infrastructure

ENERGY SOURCE
- **Sunspace Solar park**
- High voltage grid connection

ENERGY CONVERSION E > H2
- **Hydrogen Production Pilot Plant** (a cooperation with Roger Energy), providing a local supply of (green) gaseous hydrogen, liquid hydrogen and methanol and high TRL validation capabilities.

H2 STORAGE AND (RE)FUELLING
- Commercial storage tank of 40m3 liquid hydrogen (at the Energy to Propulsion Test Facility)
- Co-designed/manufactured local LH2 storage ground vessel: **DEWAR**

ON-BOARD FUEL TANK
- Design, manufacturing and testing of composite LH2 storage solutions for aircraft applications
- Deep cryogenic (20K) material and structures testing: **Cryostat**
- Co-designed/manufactured local LH2 storage flying tank (in the HYDRA II drone)

ENERGY CONVERSION H2 > E
- Advanced power electronics and wiring infrastructure
- Best of class thermal control and cooling solutions: E**nergy management**
- Membrane health monitoring and maintenance research: **Membrane Research**
- Fuel cell testing in controlled environment: **THETA I**

AIRCRAFT PROPULSION SYSTEM
- Dedicated airfield and airspace with facilities for operation and testing of GH2/LH2 powered drones: NLR Drone Centre and HYDRA II
- **Energy to Propulsion Test Facility** (EPTF)
  - Power train ground testing, currently up to 2MW
    - Electric, hydrogen-electric
    - Battery, gaseous/liquid hydrogen and e-methanol energy storage solutions
    - Functional component and full system performance testing
    - Ground testing and moving platform testing of full systems
  - Mechanical testing of liquid hydrogen tanks
    - In situ LH2
    - Dynamic loads
    - Slosh testing

Aeroacoustic Wind Tunnel

The NLR Aeroacoustic Wind Tunnel (NLR-AWT) is a state-of-the-art facility dedicated to researching the sources of aero-acoustic noise and developing techniques to reduce aircraft noise. Our research focuses on the early development phase (low Technology Readiness Level) or aims to improve existing systems. Additionally, we develop advanced measurement methods to identify and quantify noise sources. To gain a deeper understanding of complex airflows, we employ various flow measurement techniques, including Particle Image Velocimetry (PIV) with helium-filled soap bubbles and hotwire measurements, which enable us to map airflow patterns both qualitatively and quantitatively.

The NLR-AWT is designed to researching the noise production characteristics of various materials and shapes. The tunnel's unique design features a closed circuit that flows into an 'anechoic chamber', which is lined with foam wedges that absorb over 99% of all sound waves above lower bass notes (200 Hz). The facility can accommodate a wide range of model sizes and configurations, from scaled-down versions to full-scale models and partial models. Recent projects have included the development of advanced measurement techniques, noise testing of landing gear and wind turbines in the open jet configuration, and aerodynamic testing such as probe calibrations in the closed test section.

Main features

- Closed circuit wind tunnel, powered by two 180kW axial fans, with open jet and closed test sections
- Large anechoic room (9 x 8 x 6 m), completely covered with 0.5 m foam wedges yielding more than 99% absorption at above 200 Hz
- In the frequency range from 200 Hz to 20,000 Hz, the anechoic room is in accordance with ISO 3745:2017
- Wind speeds of up to 100 m/s can be achieved in the open jet configuration and up to 120 m/s in the closed test section 0.8×0.6 m2
- The flow uniformity in the open jet is within 0.1% at the measurement location and turbulence intensity is in the order of 0.1%
- Background Overall Sound Pressure Levels (OASPL) at 1m distance of the nozzle that are ranging from 58dB(A) at Ma=0.1 to 80dB(A) at M=0.2
- Low free stream turbulence level in the closed test section (0.01-0.02% @ 20 m/s, 0.02-0.03 @ 60 m/s and 0.04-0.06% @ 100 m/s)
- Different types of microphones, a microphone array for source location and variable pressure measurement systems
- Various dynamic acquisition systems (up to 200 kHz) for acoustic or other unstable measurements
- Lasers, high speed cameras and double frame cameras for flow visualisation techniques
- A balance for measuring aerodynamic forces
- Hotwire apparatus for measuring turbulence levels


ATTILA
Advanced Testbed for Tiltrotor Aeroelastics

Advanced Mechanical Manufacturing Facility

Our Advanced Mechanical Manufacturing Facility specialises in high-tech, high-spec lightweight structural concepts for wind tunnel models in metal, laminates, and composites. We offer a comprehensive range of services, including product design, topology optimisation, production concept assessment, and manufacturing of prototype structures, smart wind tunnel models, and small production runs. By utilising 3D printing technology (metal additive manufacturing), we can enhance product performance thanks to the freedom of design and the ability to create complex internal structures that minimise weight while maximising performance with advanced materials.

Our wind tunnel models are engineered to be highly advanced and instrumented with cutting-edge sensor systems, enabling testing in a wide range of environments, including subsonic, transonic, ambient, cryogenic, and icing conditions. These models feature advanced smart technologies, including remote controls, rotating systems, and turbine-powered simulators, as well as sophisticated components such as carbon composite blades and precision instrumentation. With the added capability of telemetry systems, balances, and pressure rakes, these models provide unparalleled data acquisition and analysis capabilities.

NLR boasts a legacy of over 50 years in wind tunnel balance design and manufacturing, with a proven track record of delivering high-quality solutions for wind tunnels globally. Our extensive experience with various types of wind tunnel models and wind tunnels worldwide has given us a deep understanding of the importance of creating efficient and cost-effective wind tunnel models that meet the specific needs of our clients. We deliver smart wind tunnel models with unparalleled functionality, designed to minimise wind tunnel occupation time and optimise test data acquisition.

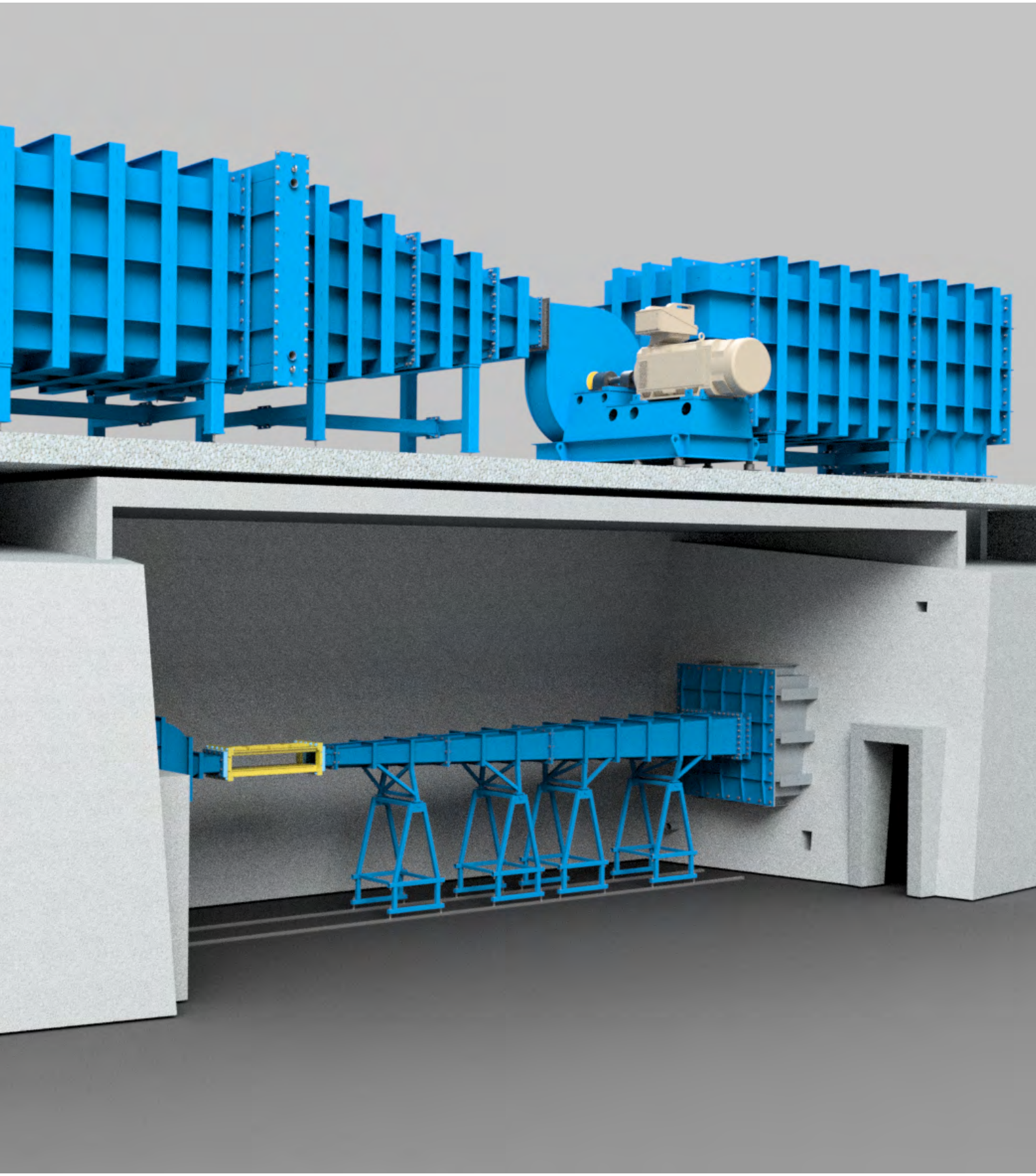
Main features

NLR designs and manufactures wind tunnel main balances for internal or external use, operating under various conditions, including pressurized and cryogenic environments. Our design process uses Finite Element Methods to optimise performance and ensure exceptional accuracy.

NLR also offers force measurement solutions to enhance the functionality of your smart wind tunnel model. We develop integrated force measurement solutions for control surfaces and complete six-component rotating shaft balances for propeller force measurements. Our rotating shaft balances can be equipped with onboard electronics for signal conditioning or data acquisition, as well as contactless data transfer via telemetry systems.

We deliver smart models containing:

- Local force and moment balances
- Air driven jet engine simulators
- Air driven propellers in metal or composite
- Remote controls for (angular) adjustment of control surfaces, for low or high speed
- Remote controls for specials like parachutes, refueling hose and drogues
- Rapid prototyping parts to create parts with internal structures such as pressure tubing
- Six component rotational balances including telemetry systems for data and power transmission from rotating to static domain
- Implementation of extensive amounts of static pressure taps and/or dynamic pressure transducers



Flow Duct Facility

The Flow Duct Facility (NLR-FDF) contributes to research on noise reduction techniques to reduce aircraft noise. The research is carried out during the early development phase (low TRL) or to improve existing systems. The research is conducted during the early development phase (low TRL) or to improve existing systems. The FDF is a closed-loop wind tunnel for testing sound in turbine simulation at flow dimensions and speeds. Upstream and downstream of the test section, anechoic chambers are positioned to accurately measure sound levels.

The Flow Duct Facility (FDF) is suitable for measuring sound absorption (e.g. liners), insertion loss and small-scale high-speed aerodynamic measurements. . For this facility, advanced measurement methods have been developed to determine the properties of sound-absorbing materials, such as measurements of acoustic impedance and measurements to determine the sound absorption of liners.

In addition, we map qualitative and quantitative complex air flows using various flow measurement techniques such as particle visualization (PIV), velocity measurements with scanned pitot tubes, and hot-wire measurements.

The NLR-FDF is used to serve aircraft manufacturers and their suppliers. Wind tunnel operators and small and medium-sized enterprises can also utilize this facility. Research projects in this facility focus on the dynamic interaction of sound and (liner) materials, and air resistance measurements of various substrates and sound-absorbing materials

Main features

- A closed-loop wind tunnel
- Test section of 0.15 x 0.3 m (bxh)
- Wind tunnel speeds up to Mach 0.8 (274 m/s)
- Multiple speakers for generating sound, high amplitude and wide frequency range from 200 to 6000 Hz.
- Various types of microphones and pressure measurement systems
- Various dynamic acquisition systems (up to 200 kHz) for acoustic or other instable measurements
- Lasers and high-speed cameras for flow visualization techniques
- Boundary layer probes for measuring boundary layers
- PIV equipment for visualizing aerodynamic and aero-acoustic flow phenomena


nlr
Pilot
in
Command

NLR Drone Centre

The NLR Drone Centre provides a dedicated environment for conducting (experimental) flight tests, evaluations, and demonstrations of Unmanned Aircraft Systems (UAS) and sensor applications, as well as facilitating UAS concept development. The NLR Drone Centre in Marknesse has its own restricted airspace with the necessary authorisations and exemptions to facilitate these activities. It offers developers, manufacturers and business users, both civil and military, the opportunity to carry out test flights needed to take advantage of the opportunities offered by UAS developments.

NLR conducts its own research into new operational procedures and applications for unmanned aerial vehicles and develops unmanned aerial vehicles for research programmes. This includes large UAS and equipment of an experimental nature.

Main features

Restricted airspace
Only aircraft and pilots who fulfil all the statutory requirements may fly in Dutch airspace. The NLR Drone Centre has an extensive dispensation: for example, it is permitted to fly prototypes that do not yet meet all the requirements. The airspace above the NLR Drone Centre is closed to other users, and the territory is also a restricted and closed area. Herewith fulfilling a significant need for drone development and the technology it requires, such as detect-and-avoid sensors that prevent drones from coming too close to other air traffic.

- Closed airspace EHR66 (0 to 1500 ft / 3500 ft) with permanent BVLOS and airport arrangements
- Landing runway of 325 x 15 m
- DigiCity: an operational simulated urban environment (16 shipping containers in flexible configurations)

NLR has a varied air fleet of more than 30 drones, mostly designed or built in-house, which are or have been used for research projects. The current fleet consists of:

- Fixed-wing aircraft from 1 to 150 kg
- Helicopters (head rotor with tail rotor) from 5 to 100 kg
- Multi-rotor systems from 1 to 60 kg
- Hybrid fixed-wing multi-rotor aircraft up to 25 kg

Avionics Prototyping Environment (APERO)

The Avionics Prototyping Environment for Research and Operations (APERO) is a versatile and transportable research flight simulator designed to facilitate a range of applications, including avionics display design and evaluation, demonstration of innovative cockpit concepts, part-task training exercises, and networked flight simulation scenarios.

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Among other things, APERO can be used to test and evaluate:

- New aircraft and cockpit designs
- New systems and procedures for more economical flying
- New flight procedures for quieter take-offs and landings

Main features

NLR develops all APERO software in-house, ensuring flexibility and ease of modification. Our 'Hardware-In-The-Loop' approach incorporates real aircraft systems into the simulation environment, providing a highly realistic experience. Additionally, APERO can be interfaced with other simulators, including NARSIM air traffic control simulator and other aircraft simulators.

The following aircraft can be simulated by APERO:

- AIRBUS A320/A330/A340
- Boeing 747-400
- Fokker 100
- Cessna Citation II
- Experimental aircraft


Schiphol

ATM Real-time Simulator (NARSIM)

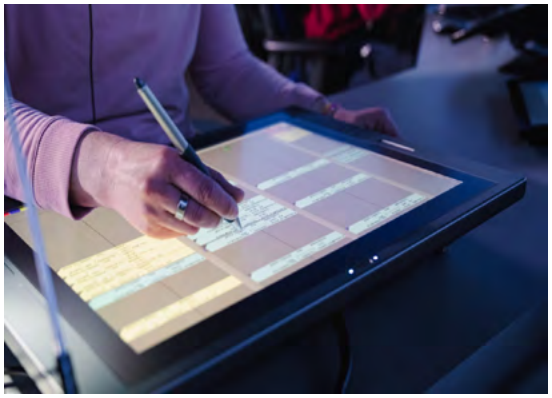
NARSIM is a real-time, human in the loop (HITL) Air Traffic Control (ATC) simulator capable of simulating the full working environment and working conditions of air traffic controllers in detail. As such, it provides a platform for training, validation and conducting research in a controlled environment on all aspects of air traffic control and the air traffic controller. These facilities are used for research and development of new user-interfaces, user-interaction, ATC system support, new and revised concepts of operation and development & assessment of ATC training and its effectiveness.

The experimentation facilities at NLR are equipped with realistic Air Traffic Controller Working Positions (CWP), simulator (pseudo) pilot and supervision positions and support more than 50 actors to participate simultaneously in one large simulation spanning multiple centres. On the other side of the spectrum, NARSIM's scalability also allows for small-scale prototyping with one working position for detailed analysis and interaction.

NARSIM is developed in-house by NLR and therefore has a high degree in configurability, flexibility, interoperability and adaptability. NARSIM simulates air traffic control platforms of all major manufacturers (also concurrently in one simulation). Connections to a range of external systems, such as flight simulators, are also supported.

NLR's facilities consist of the following components:

- NARSIM radar; an environment with 25+ radar controller working positions.
- NARSIM tower; a 360° projection system with 9 tower controller working positions.
- NARSIM remote tower; a research set-up for remote tower concepts with 2 controller working positions.
- More than enough pseudo pilot positions, physically separated from the controllers.



Main features

NARSIM TOWER FACILITY

The NARSIM Tower facility uses a 360 degrees field-of-view projection screen, 11m in diameter and 4.5m high, equipped with a laser projection system that results in eye-like resolution and an immersive experience of looking out of a control-tower on an airport. With room for 9 controller working positions setup for different roles, NARSIM Tower is one of the largest tower research simulators in Europe. The tower visual system can simulate realistic weather conditions, such as bad visibility, snow and rain and also supports day and night view on a multitude of airports. All current and modern tower controller system support tools are available such as radar surveillance systems, multilateration ground radar, flight data processing and its UI's, safety nets, stopbar and light control panels, A-SMGCS (Advanced Surface Movement Guidance and Control Systems) tools, voice communication systems and electronic flight strips (EFS).

NARSIM Tower has a proven track record and has been used as a validation platform in European ATM research (SESAR) by research centres and ANSPs but also as a training platform in the training of new Air Traffic Controllers or in the conversion training introducing new operational subsystems. The system supports the simulation of all types of traffic (fixed wing air traffic, helicopters, drones, ground vehicles, etc.) typically found in an airport environment.

NARSIM RADAR FACILITY

The NARSIM Radar facility consists of a 25+ radar controller working positions. Each working position can act as a tactical, planner or feeder position for controlling upper-airspace en-route, area control or approach and terminal area traffic. The radar working positions can be run to emulate (in both hardware and software) any ATC platform such as iCAS/iTEC (INDRA), AAA (LVNL), MADAP system (EUROCONTROL), ATCAS P2 (DFS), TopSky (Thales) and others. Our customers include LVNL, MUAC (EUROCONTROL), LFV, DFS, AustroControl and several military ANSP's. The underlying system is a trajectory based operations (TBO) system with the following main features:

- Enhanced Mode-S (e.g. for Pilot Selected Level)
- ADS-C/CPDLC (e.g. Extended Projected Profile, EPP)
- Planning and support tools like arrival management (AMAN/XMAN), interval management (IM), time-based separation (TBS), optimized runway delivery (ORD)
- Coordination tools like SYSCO/OLDI
- Safety net systems like Short Term Conflict Alert (STCA) and Medium Term Conflict Alert (MTCD) and monitoring aids (MONA).

NARSIM REMOTE TOWER FACILITY

The NARSIM Remote Tower environment can be used for remote tower research and training; both single airport and multiple airport operations are supported. The system consists of nine 4K HD screens in 120 degrees arc to simulate the view from remote cameras on one or several airports at the same time. The two controller working positions are equipped with three 5K screens each, a touch screen for voice communication and (simulated) Pan-Tilt-Zoom camera operation and can be equipped with the same tools and systems as full NARSIM Tower.

NARSIM SOFTWARE PLATFORM

The NARSIM software platform is the foundation for both the radar and tower facilities and is designed as a client-server architecture for scalability, flexibility, interoperability and above all adaptability. The NARSIM platform is equipped with several tools to support the creation and validation of advances scenarios. NARSIM runs on a single host or (for large simulations) on multiple servers, even in parallel with other simulations. NARSIM uses consumer (COTS) hardware and requires relatively low bandwidth and CPU.

During a simulation, NARSIM records many system and human performance metrics that can be used in the post-processing and analysis phase. There are also applications available for the preparation, design and setup of simulations (for NARSIM Radar, Tower and Remote-Tower) as well as the post-processing and analysis of results.

NARSIM COMMUNITY

The NARSIM software platform is shared with partners in a NARSIM User Community. These partners operate their own NARSIM set-ups for their specific research and training needs and also actively participate and contribute to support the development of NARSIM. NLR also offers services to support partners that acquire the NARSIM software platform.


PH-LAB


PH-LAB

Research aircraft: Cessna Citation II

NLR's research aircraft are essential for testing new flight procedures and technologies. NLR operates two research aircraft: the Cessna Citation II and the electric Pipistrel Velis Electro.

The Cessna Citation II research aircraft offers opportunities to perform a wide variety of flight test applications. Extensive modifications have turned this pressurised, twin-engined business jet into a versatile airborne research platform. Flight test topics range from aerodynamics, flight mechanics, zero-gravity, atmosphere, airborne remote sensing and flight test methods, to system tests, air traffic management, avionics, alternative fuel, and flight inspection.

Main features

AIRCRAFT FEATURES:

- A separate electrical system dedicated to powering onboard test equipment
- An additional stand-alone 3000 psi hydraulic system
- Provisions on fuselage for mounting an external pod
- Numerous facilities in cockpit and cabin for accommodating test equipment
- An antenna box on top of the fuselage that can accommodate multiple antennas
- Underwing panels configured for antenna installation
- A noseboom with alpha/beta vanes or five-hole probe
- A fuselage fairing accommodating a forward facing optical glass
- Several metal plate inserts that can replace existing windows and can accommodate flight test equipment.

FLIGHT TEST INSTRUMENTATION:

- Inertial Reference System
- Digital Air Data System
- GPS high-accuracy positioning system (phase tracking)
- Multi-channel digital data acquisition and recording system (general aircraft state parameters are real-time available in cabin)
- Iridium SATCOM
- Liquid Water Content sensor
- Humidity sensor
- Telemetry system
- Digital integrated avionics system in cockpit, offering opportunities to test new experimental display formats in flight.

GENERAL:

- Home base: Rotterdam The Hague Airport (NL)
- A maximum payload of 1400 kg (incl. Crew), range upto 3000 km, endurance of 5.30 hours, max speed of 840 km/h (Ma 0,705) and maximum operating altitude of 13000m (FL 430)
- Can be operated single-pilot IFR/VFR, allowing display and/or procedure evaluations by the customer from the right hand seat
- As EASA part 21 holder, NLR has the autonomy to modify aircraft systems
- The aircraft is operated in partnership with TUDelft.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PH-NLX
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Research aircraft: Pipistrel Velis Electro

NLR's research aircraft are essential for testing new flight procedures and technologies. NLR operates two research aircraft: the Cessna Citation II and the electric Pipistrel Velis Electro.

The Pipistrel Velis Electro is the first electrically powered aircraft to be certified in Europe in 2018. NLR has had this aircraft since the end of 2020, which is deployed as part of the Living Lab Electric Flight (LLEF). This is a virtual knowledge centre in which NLR and other relevant parties aim to easily exchange knowledge and experience in the field of sustainability.

The Pipistrel is one of NLR's test platforms on which innovative technology can be tested and demonstrated in a low-threshold manner. For NLR, the research with the Pipistrel Velis Electro is an important step in gaining knowledge of and experience with the behaviour and properties associated with an electrically powered aircraft.

Main features

- All-electric single-engine propeller aircraft
- Two lithium batteries connected in parallel, each with an energy content of 11 kWh
- The aircraft can fly for about 50 minutes consecutively
- The two-seater is primarily intended to train pilots
- Home base: Rotterdam The Hague Airport (RTHA)

Royal Netherlands Aerospace Centre

NLR is a leading international research centre for aerospace. Its mission is to make air transport safer, more efficient, more effective and more sustainable. Bolstered by its multidisciplinary expertise and unrivalled research facilities, NLR provides innovative and comprehensive solutions to the complex challenges of the aerospace sector.

NLR's activities span the full spectrum of Research, Development, Testing & Evaluation (RDT & E). Given NLR's specialist knowledge and state-of-the-art facilities, companies turn to NLR for validation, verification, qualification, simulation and evaluation. They also turn to NLR because of its deep engagement with the challenges facing our clients. In this way, NLR bridges the gap between research and practical applications, while working for both government and industry at home and abroad.

Royal NLR stands for practical and innovative solutions, technical expertise and a long-term design vision, regarding their fixed wing aircraft, helicopter, drones and space exploration projects. This allows NLR's cutting-edge technology to find its way also into successful aerospace programmes of OEMs like Airbus, Boeing and Embraer.

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