



# DEVELOPMENT AND TEST CENTRE FOR THE AEROSPACE INDUSTRY

# THE NUMBER ONE ADDRESS FOR STRUCTURAL AND MATERIAL TESTING IN THE AEROSPACE INDUSTRY

A strong aviation industry requires a performance-capable and reliable partner who can be relied on completely for the development of aircraft structures and components commencing with an idea and through to serial production.



IMA Dresden is an internationally recognised and accredited partner of the aviation industry and supports the development departments of manufacturers and suppliers throughout the entire development of a product in order to verify its durability, function, and safety.

For this purpose, IMA engineers test, simulate or compute the respective design and structural groups of an aircraft or helicopter such as e.g. fuselages, supporting constructions, tail units, landing gears, engines, and interior components). With such tests, we offer possibilities to experimentally examine different influences on the strength, to compare material use and design principles, and to verify calculation methods.

You can rely on us: our laboratories are certified according to DIN EN 9100, accredited according to ISO 17025 an accredited according to NADCAP for material testing and inspection of metals and non-metallic materials. This therefore ensures that we can always provide tailor-made solutions for a wide range of structures and test requirements.

#### IMA Dresden – and it works:

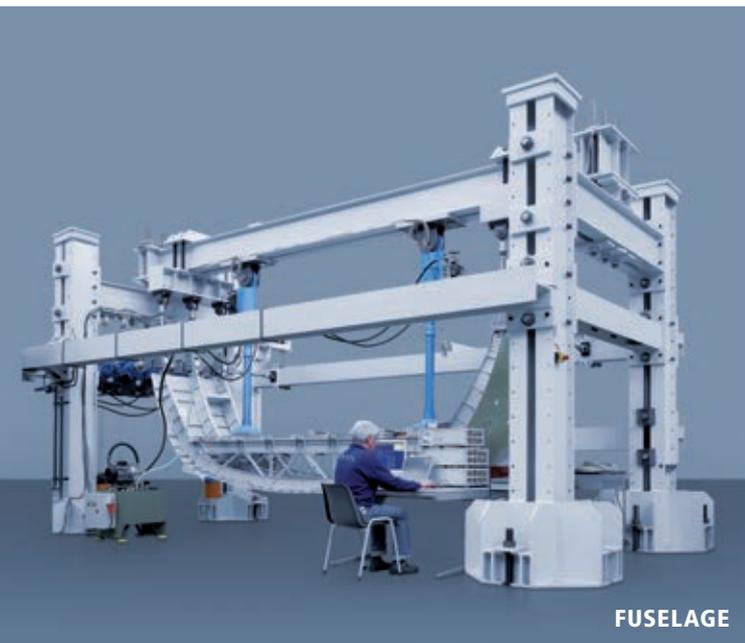
- Material testing
- Structure and component testing
- Non-destructive testing
- Electrical testing
- Materialography and damage analysis
- Simulation and strength verification
- Software systems for test and laboratory data

### FROM MATERIAL TO MAJOR TEST – EQUIPPED FOR A LONG DISTANCE



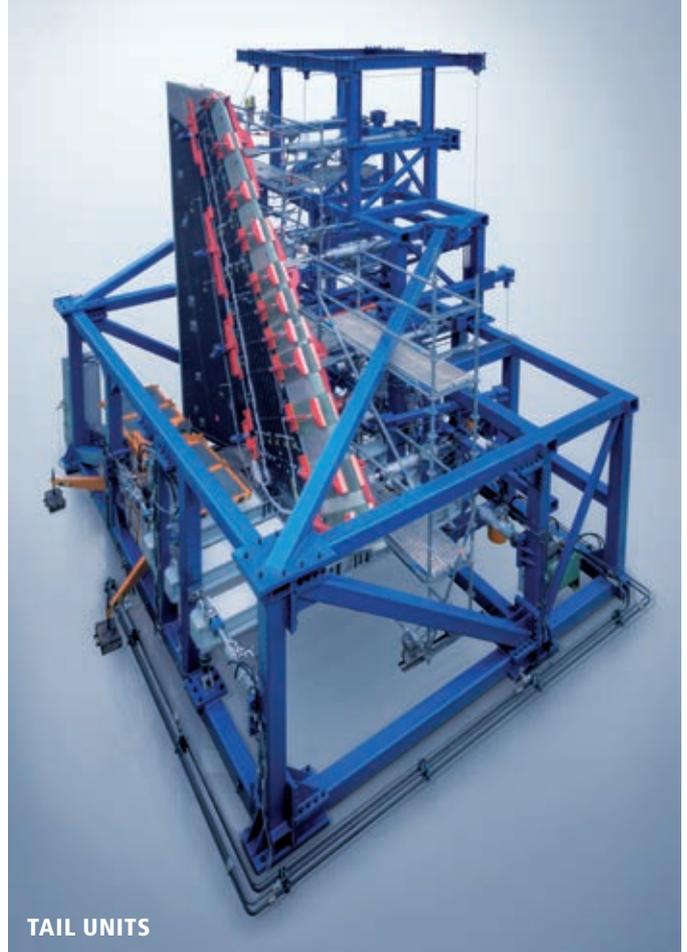
# IN FOCUS: AIRPLANE STRUCTURES

Small damages as a result of fatigue or external factors are no taboo in lightweight aviation construction, but much more a part of the damage tolerance of the safety concept and an important area within the spectrum of our experiments. We investigate when and where damages take place, how they grow, which residual stability remains and how a structure subject to cyclical loads reacts after an impact.



FUSELAGE

Depending on the characteristics and properties of the test body, the material and the framework or boundary conditions which affect the structural unit, we will jointly create a test programme with you and then support you for selecting the correct load parameters and characteristic values such as, for example, natural frequencies. We also provide certification trials for the new approval processes. Once the entire approval process has been finalised, an aircraft model can be produced reliably and safely over many years. Improvements to the material or manufacturing technologies therefore continuously flow into the production process. In order to verify that modifications on the structures continue to demonstrate the fulfilment of the approval requirements, we can provide qualification trials and development trials for you. In this case we can provide you with the opportunity to satisfy service life statements or to test new designs on structural units. Repair solutions can also be tested for durability, resistance and strength.



TAIL UNITS



COMPLETE AIRCRAFTS (FULL SCALE)



STRUCTURES AND WINGS



AIRCRAFT FUSELAGE SECTIONS

## TAIL UNITS

Tail unit and rudder structures play a central role in the development and qualification of modern aircraft systems. Questions relating to optimum technical solutions hereby play a major role in the context of development and approval certification trials for metallic, fibre composite and hybrid structures. Based on our extensive experience, we can provide our customers with solutions which are tailored specifically to the questions you have.

## FUSELAGE

The aircraft fuselage, also called the cell, is a permanent development field – modern jointing technologies, material substitutions or novel requirements regarding fuselage geometry and fuselage design lead to new technical concepts. We can hereby provide tailor-made experimental and numerical solutions in qualification and development processes – from individual structural components to fuselage shells up to, and including, the whole cell.



## STRUCTURAL ELEMENTS (STRINGER, PANELS, FITTINGS)

Whether stringer, frames or panels – we utilise standard testing machines, which we have aligned with special adapters for the respective task, for implementing individual trials or series of tests. For individual and complex trials, we can design and construct special testing equipment. We have performance-capable measurement and control technologies available for static and dynamic trials. Utilising insulated chambers enables us to implement tests under temperature influences between -55 °C and +90 °C.

## STRUCTURES AND WINGS

IMA Dresden has been executing static trials, fatigue tests and trials to determine the damage tolerance on wings and their subcomponents such as high-lift systems (flaps, slats, ailerons) for many years. In addition, IMA Dresden inspects and tests wings structures for utilising JET propulsion systems (pylons) and tests the function and safety of the entire landing flap systems. Tests on flap tracks enable us to simulate different flap settings and all loads, which can occur with the maximum permissible take off weight.

## AIRCRAFT DOORS

Irrespective of whether passenger doors or cargo doors, composite technology or cast aluminium- we can provide statements for service life, strength and resistance with our product development trials and approval tests. We hereby provide endurance tests, damage tolerance tests, fail-safe examinations and static tests up to a differential pressure of 2 DeltaP.

## AIRCRAFT FUSELAGE SECTIONS

Instead of time-consuming and cost-intensive barrel tests, we can provide the optimal test procedure, the shell test. Rather than examining the whole fuselage cross sections, we hereby examine curved cut-outs (shells) and therefore create the necessary boundary conditions. The multi-axial and continuously applied cyclic loads on the flat landing gears precisely create reality: the pressure difference between the cab and the environment and mass-related and movement-related tensile, compressive and shear stresses or loads.

## WINGS / FOILS

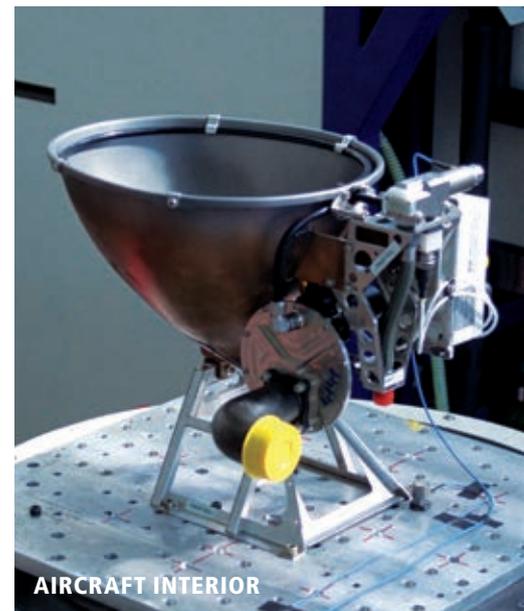
As the supporting main element, the wing/foils must assume the aerodynamic loads or loads from the propulsion unit thrust. This therefore results in particularly high demands on reliability and safety for the wings. This applies, among others, for the verification for the detection of static and dynamic load-bearing capability as well as the damage tolerance behaviour.

## COMPLETE AIRCRAFTS (FULL SCALE)

An essential integral part of any aircraft development is the approval trial on the fuselage sections or the complete cell. The know-how of our engineers for such demanding tasks is based on a long-standing tradition. We were commissioned with the complete development for the fracture trials and the fatigue tests on the wing surfaces of the Fairchild Dornier Do 328JET and the barrel test for the Do728JET model in 1993. IMA Dresden combines all the necessary competencies for complete cell trials and experiments: In accordance with customer's requests, we can take on the complete trial development process from planning through to implementation and including comprehensive documentation. We have halls available which are equipped with clamping foundations and sufficiently dimensioned hydraulic and pneumatic infrastructure for large whole cell trials and experiments.

## IN FOCUS: COMPONENTS

We not only implement computational and theoretical but also experimental simulations for static and dynamic loads on your component, develop test concepts and individual testing devices and elements for load introduction. From the dimensioning and design to the verification of stability our test and calculation engineers cooperate intensively – in terms of reliable results and in accordance with the respective required safety concept.



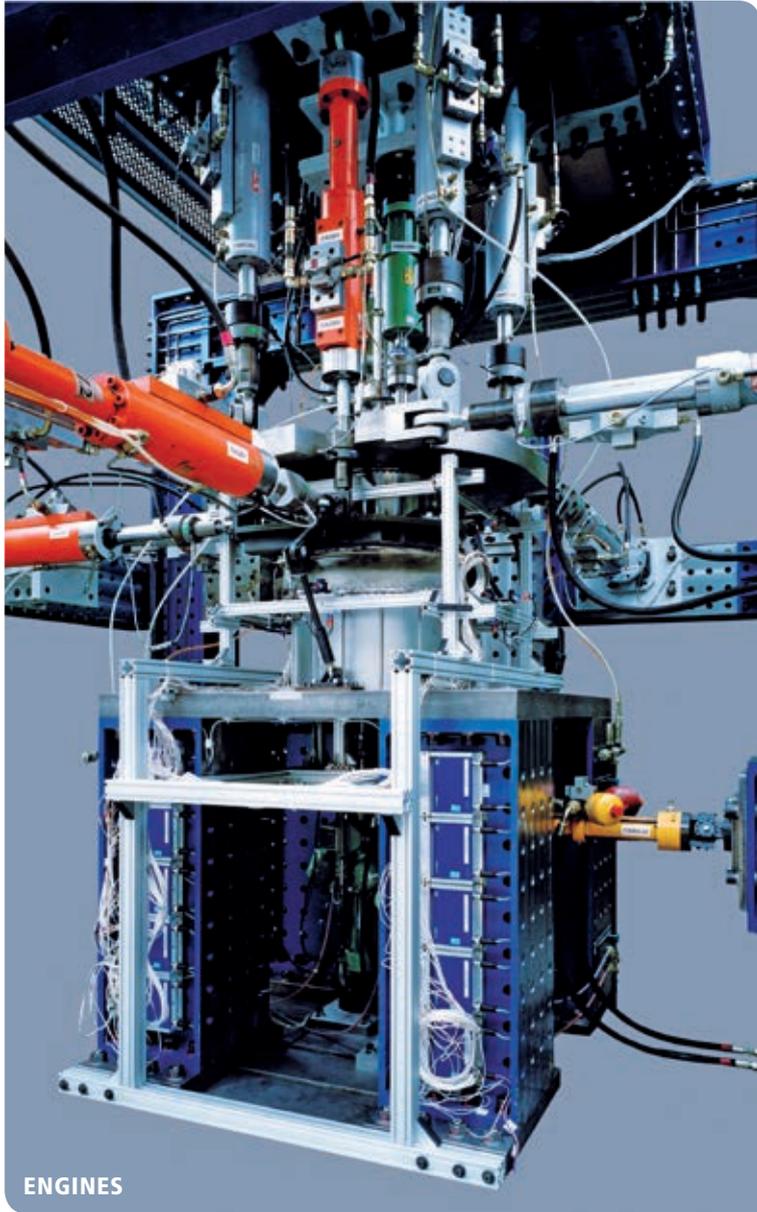
### LANDING GEAR SYSTEMS

Irrespective of whether this is the main chassis gear, nose landing gear or support landing gear (nose landing gear, centre landing gear or main landing gear) – our tests support you with the approval and development of chassis systems or their individual structural components. To experimentally determine the service life of chassis systems, we provide static trials and dynamic fatigue trials in which the loads that occur during operation can be simulated in a realistic manner. These include, for example, maximum descent and landing speeds with maximum loading of the aircraft or the simulation of all landing procedures and other chassis or landing gear loads which occur during the service life of an aircraft. Our strength, resistance and endurance trials provide you with security for the approval process and, with our expertise and experience, we can assist you to improve your landing gear and to qualify it according to the valid approval regulations (EASA, FAA, ...), irrespective of small aircraft, regional jets or large aircraft.

### ENGINES

We can develop a testing concept for every engine or propulsion component according to our customer's requirements and/or the aviation approval authorities. This mainly also includes the dimensioning of the load introduction structures which simulate the properties or characteristics of the other attachments in the real engine. Materials are often substituted in this case e.g. titanium by steel. We can draw on our extensive experience in this field, not only in design and computation but also with the definition and monitoring of the manufacturing process.

Which loads must be assumed? In particular: How can they be introduced into the structure? These are the central issues which our engineers have to consider. The designed experimental set-ups ensure that the applied forces are distributed correctly. Against the backdrop of economic testing, this means initially that replacement structures (dummy structures) have to be implemented where samples are also elements which are complex systems. Secondly, these dummies must be very close to the original components as far as their strength, resistance and rigidity are concerned.



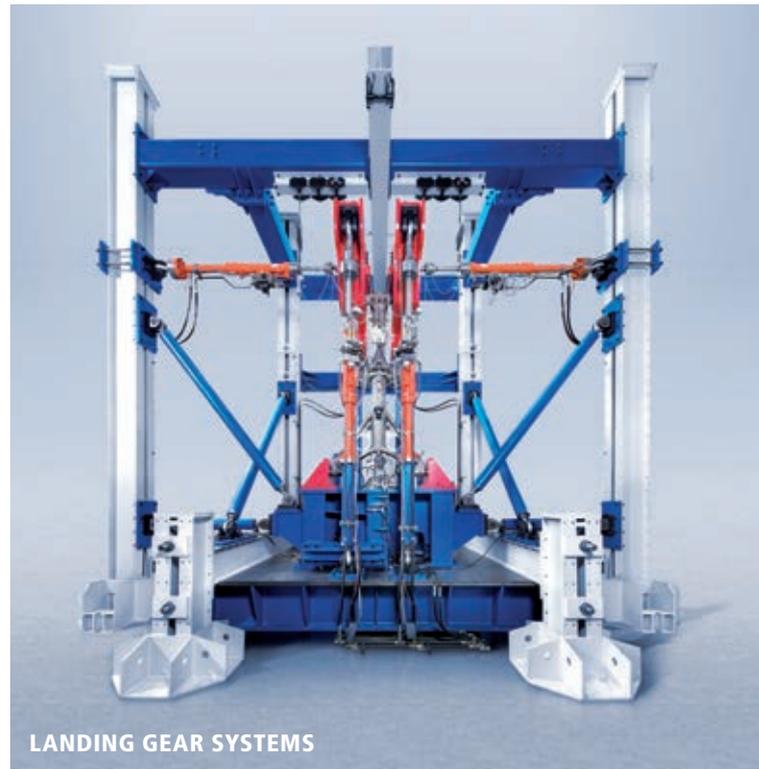
ENGINES

We can provide scalable systems and adapt them optimally to the respective requirements for measuring and controlling all relevant parameters during the trials. We regularly measure forces, deformation, elongation and strain on the engine components.

Static and dynamic load introduction is possible in the structures. The load or stress components can be forces, temperatures and internal pressure. A test installation was recently put into operation in which the engine component was additionally loaded with forces at 400° C and under an internal pressure of 14 bar. We utilise diverse software solutions for the evaluation and processing of experimental and trial data. We can provide our customers with the measurement data in appropriate formats which satisfy their requirements. Non-destructive testing procedures enable us to detect damage and document its behaviour during the tests.

## AIRCRAFT INTERIOR

IMA Dresden executes static and dynamic qualification tests on all types of cabin interiors and attachments. These can range from luggage racks to aircraft kitchenettes up to, and including, complete relaxation cabins for flight attendants and pilots. Customer-specific material requirements and concepts for load distribution can also be considered here. This enables a particularly flexible and fast test execution, also for very large cabin interiors or attachments with a weight of several tons.



LANDING GEAR SYSTEMS

We can provide a complete service for all experimental tests, examinations and studies:

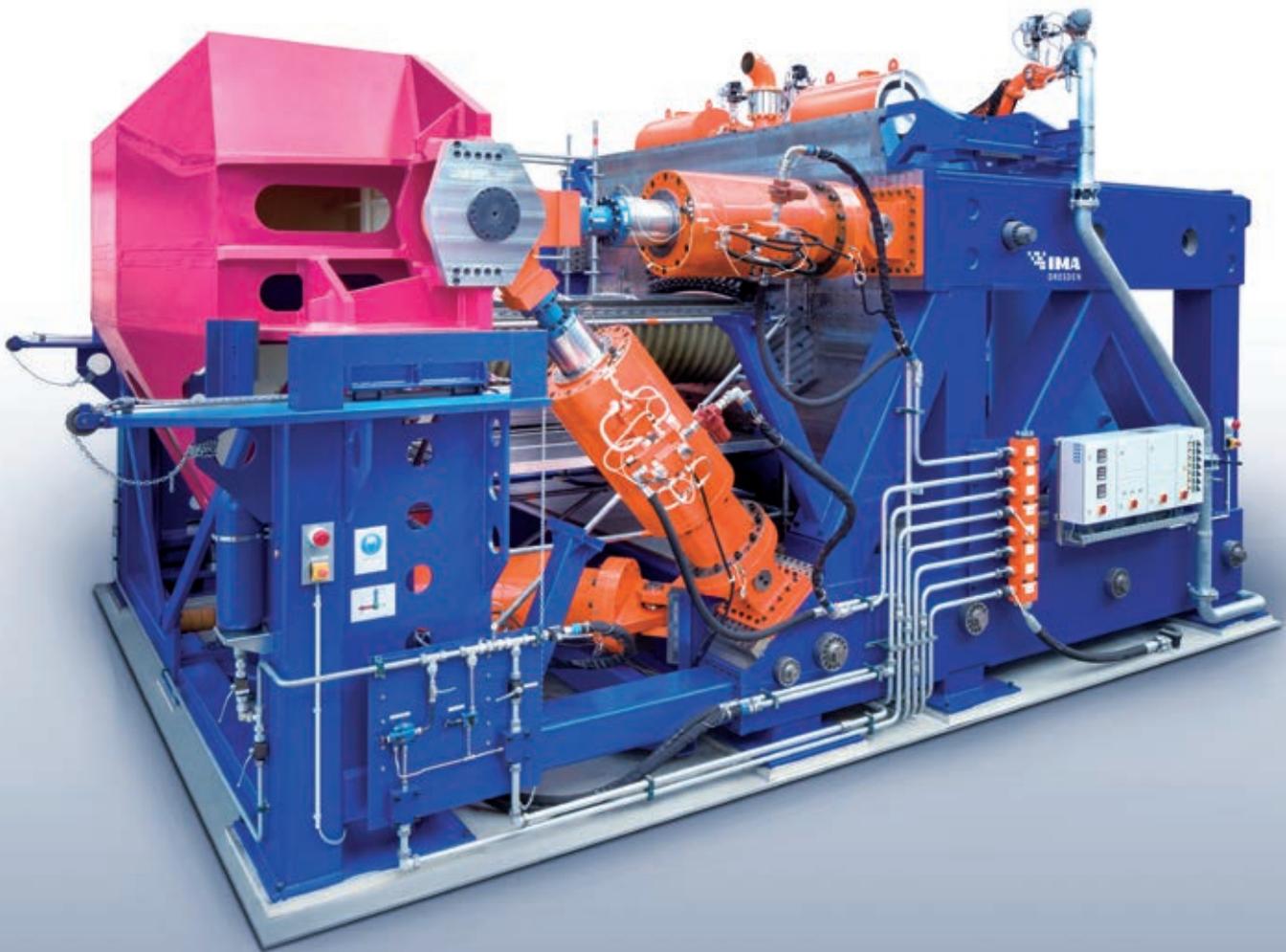
- Test consultancy, advice for approval process and development of the test concept
- Project Management
- Logistics Services
- Designing and setting up the test facility, implementation of the trial
- Inspection, non-destructive testing, measurement value recording
- Assembly and dismantling the test object
- Creating test reports

and also

- Introducing prior damage (e.g. impact)
- Strength and resistance verifications and simulation
- On-site service

## IN FOCUS: AIRCRAFT FUSELAGE SECTIONS

If someone mentions “IMA Panels”, then they mean the testing sample whose test has made a special name for the IMA engineers in recent years. In place of complex and expensive barrel tests we offer you an optimized concept: the fuselage panel test.



Instead of time-consuming and cost-intensive barrel tests, we can provide the optimal test procedure, the shell test. Rather than examining the whole fuselage cross sections, we hereby examine curved cut-outs (shells) and therefore create the necessary boundary conditions. The multi-axial and continuously applied cyclic loads on the flat landing gears precisely create reality: the pressure difference between the cab and the environment and mass-related and movement-related tensile, compressive and shear stresses or loads.

Depending on the location in the fuselage, various, quasi-homogeneous sectional load conditions occur. Whether shells made of aluminium, CFC, FML or GLARE<sup>®</sup>, whether

upper, lateral or lower shells, whether start-up phase, flight at maximum height or landing – our shell tests simulate every required relevant load. Our systems are designed as modular and can therefore be adjusted to different geometries for the fuselage shells.

Our test bench enables examinations on shells from all areas of the fuselage. We can therefore simulate internal pressure and the resulting circumferential loads, tensile and pressure loads in the longitudinal direction as well as thrust loads. Distributed longitudinal and thrust loads or stress e.g. from transverse force and fuselage bending can therefore be simulated in the circumferential direction.

# STARTING POINT: MATERIALS AND CONNECTIONS

As a manufacturer or processor of materials, we will provide you with comprehensive engineering expertise regarding resistance, strength and reliability studies on standardised samples up to, and including, complex components.



3D COORDINATE MEASUREMENT



## MATERIAL STRENGTH BY EXPERIMENT

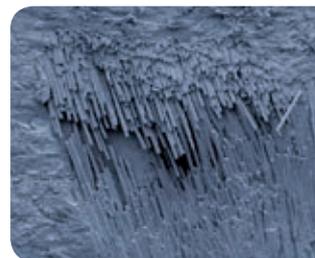
We will assume the comprehensive determination for your metals and non-metals material parameters as well as evaluating the loading capacity of metallic materials, jointed connections or hybrid material combinations.

Depending on the requirement, these tests can be executed at low and high temperatures as well as under media influence. We determine the lifetimes and character of adhesives, of welded and other mechanical joint connections and determine and analyse the inter fibre breakage behaviour of FRP and we test friction and strength for static and cyclical demands. Finally, we offer you acceptance and approval tests for materials and monitor your manufacture. Flexible accreditation by DAkkS allows us to inspect materials in accordance with diverse standards and to develop new testing procedures.

We have extensive standard testing technology resources and experience in the design, construction and operation of special test benches for material and component testing processes. Please feel free to contact us when you require a special solution for your testing requirements. Our experienced engineers will always be pleased to advise and support you. Starting with consulting, test planning and manufacturing samples through to testing and on to the finished test report and supporting you moreover with the optimisation process.

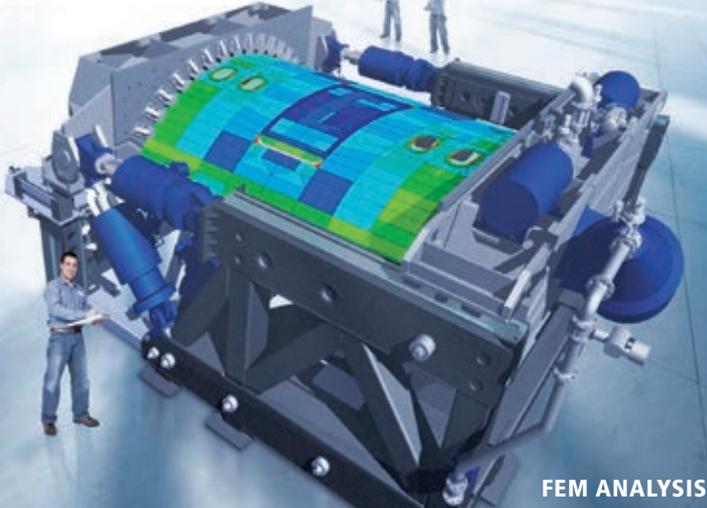
## MATERIALOGRAPHY

Countless new products are based on new materials and innovative manufacturing processes, whose success would not have been possible without materialography, i.e. the visual representation and evaluation of inner microstructures, the associated improvement of material properties, optimisation of processes and quality assurance in production. Whether the objective is quality assurance, damage analysis or research and development, in our accredited materialography laboratories we examine both metallic and non-metallic materials of different compositions using the appropriate qualitative and quantitative characterisation procedures. This includes the test preparation process and the use of all microscopic methods from light to electron microscopy for the analysis, evaluation and documentation of microscopic research results. The investigations can be supported and supplemented by further materials analysis, technological and physical procedures on request.



Verifying the reliability and safety of the material for the service life of a component with a wide variety of types of load is a demanding task – for us it is a core competence.

# THE FULL SERVICE TEST CENTER



## DAMAGE ANALYSIS

Is it because of an unfavourable distribution of forces? Lacking characteristics of the material or technology? Improper heat treatment, overstressing, friction or wear? Our experienced engineers can assist you to explore undesirable damage phenomena down to the last detail – for example by means of materialography and acoustic damage detection.

## NON-DESTRUCTIVE TESTING

The interdisciplinary area of Non-Destructive Testing at IMA Dresden examines structures and components in the test phase and in real use in cases of damage. Moreover, it examines when and where damage occurs, how it develops and how a structure reacts to cyclic loads after an impact. Delaminations, material deviations, tears or foreign material that has entered are made visible, allowing conclusions to be drawn about materials, technology, processes, operation and optimisation. Our qualified inspectors offer extensive experience in planning, coordinating and implementing large-scale testing and inspection activities, from coupon testing to across-the-board permanent monitoring of technical equipment.

In our own laboratories, but also at your premises, we can make statements regarding the quality of your test item. Our test personnel are qualified according to the ISO 9712 and EN 4179 standards and offer many procedures that allow non-destructive testing. We work according to German and international standards and guidelines (DIN, ASTM, ISO, etc.), or in accordance with factory settings.

For this we use the very latest testing techniques and tailor-made testing concepts. Alongside the traditional methods that make use of manual testing, we also use special procedures such as the immersion technique, the phased array technique on CFK, GFK und GLARE<sup>®</sup> and the four-frequency rototest. Our specialists in non-destructive testing will help you with the most suitable procedure for your Needs.

## FEM ANALYSIS

Experienced calculation engineers from the fields of statics, operational strength and dynamics are on hand to optimise your product by scaling its mass and form on the basis of FE analysis. We determine stresses and deformations, examine the stability behaviour, obtain static, operational and permanent strength verifications, evaluate natural modes and resonances, and analyse and assess damage.

## STRENGTH EVALUATIONS

IMA Dresden is there for you, with high-performance technology, ready to analyse the stress and reliability of components and structures using the finite elements method and carry out strength tests. We make statements about the safety of designs, in the form of static strength verification, operational strength verification, fatigue strength verification and drive comfort investigations on the basis of calculated and measured stresses. The complete knowledge on strength assessment is also available for

measuring data analysis and the creation of test loads for strength tests. We calibrate our calculations against our own measuring results, optimise masses and shapes for both static and dynamic behaviour, and analyse and assess damage.

## ELECTRICAL TESTING IN LOW-VOLTAGE RANGE

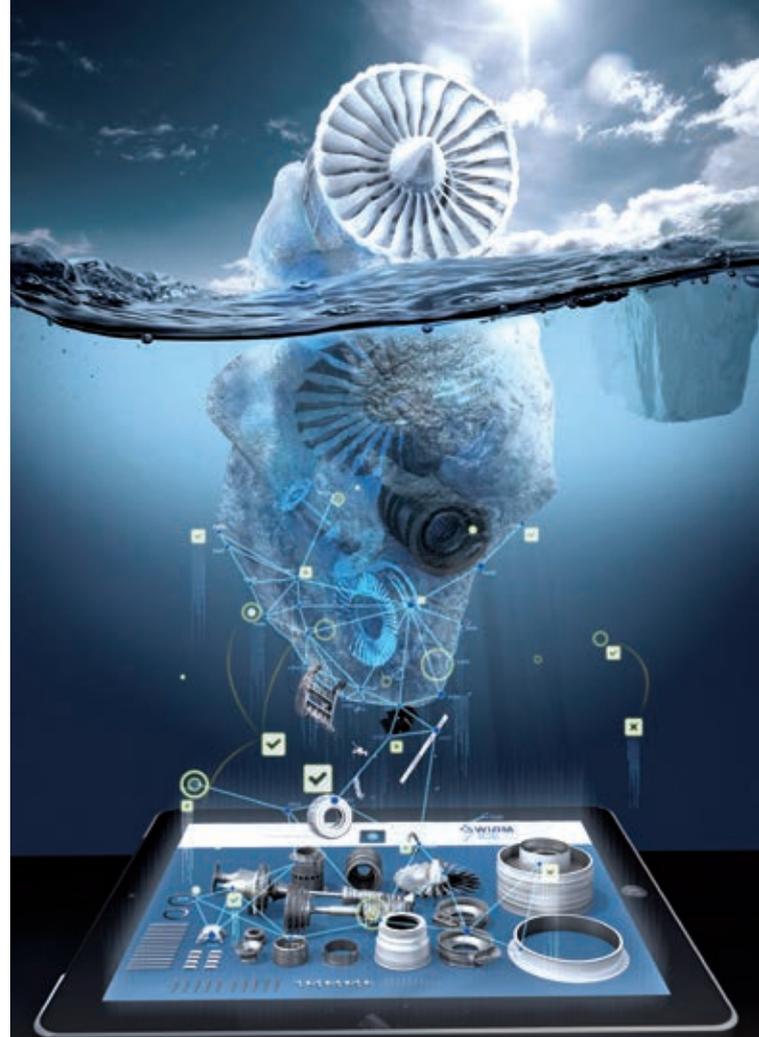
Whether you need short-circuit, short-time withstand current capacity, switching capacity or continuous current testing, with its in-house transformers IMA Dresden can offer testing services with test currents of up to 25,000 A, alternating current at 1,000 V and 20,000 A, and direct current at 1,100 V. In spacious modern testing facilities, test currents are SPS-controlled and data such as the current-voltage curves and temperatures are recorded. The modern high-performance test bay offers versatile test applications up to 25,000 A, such as switching capacity, performance, electrical endurance and short-circuit testing.

## AVIATION-SPECIFIC NON-DESTRUCTIVE TESTING TRAINING COURSES

IMA Dresden holds several courses every year on non-destructive testing procedures. In cooperation with EFW Elbe Flugzeugwerke GmbH and Testia GmbH, aviation content is taught at the training centre in Dresden, based on material from the NANDTB. The training is focused on future-oriented topics: the requirements of a maintenance company and specific aspects of component testing, knowledge of materials and approval tests. Another plus is that new developments in aviation, such as manufacturing processes, materials and test methods, are continually being incorporated.

## WIAM® FATIGUE RIFEST

WIAM® fatigue RIFEST is software for the design process and component stress analysis, and displays the guideline-compliant strength test results at verification points for non-welded and welded components according to FKM Guidelines, 2012 edition. The guidelines apply to machine components and was first developed in 1994 under the management of IMA Materialforschung und Anwendungstechnik GmbH.



## FIND INFORMATION, MANAGE DATA, NETWORKING KNOWLEDGE: WIAM® ICE

The structuring, processing and management of information helps to ensure expert technological know-how in the long term, streamline processes and thus increase quality and efficiency. The standard WIAM® ICE product promotes the flow of knowledge, simplifies areas of complexity and ensures added value and innovative strength. Having originated in the field of Material Sciences, the generic WIAM data model can now manage all kinds of knowledge and information. With WIAM® ICE, you can record, research, link, visualise, compare and evaluate diverse data easily and clearly.



## BENEFIT FROM THE COMPETENCE OF IMA DRESDEN FOR YOUR MATERIALS TESTING.

As an independent test provider we guarantee reliable results and strict confidentiality. Our credo of thinking and acting like our customers was not carelessly formulated. It contains an earnest pursuit of engineering perfection, which merges intelligent solutions with sustainable usable result at fair prices. This, of course, also includes the flexibility to respond to all kinds of request and, in doing so, to provide peak performances which are not possible elsewhere. Each of our employees bears a portion of this responsibility.

Please do not hesitate to contact us for any questions or inquiries at [ima@ima-dresden.de](mailto:ima@ima-dresden.de)



## CONTACT

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### PHOTO CREDITS

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