

# Structures



Together  
ahead. **RUAG**

# Your one stop shop for lightweight structures

RUAG Space is the leading European supplier of lightweight structures. The experience we have gained in more than four decades of space activities enables us to make our space and non-space customers more competitive.

RUAG Space designs, manufactures, assembles and tests high precision and dimensionally stable structures. These structures can be used as satellite backbone, or as an instrument platform for mounting optical or other instruments.

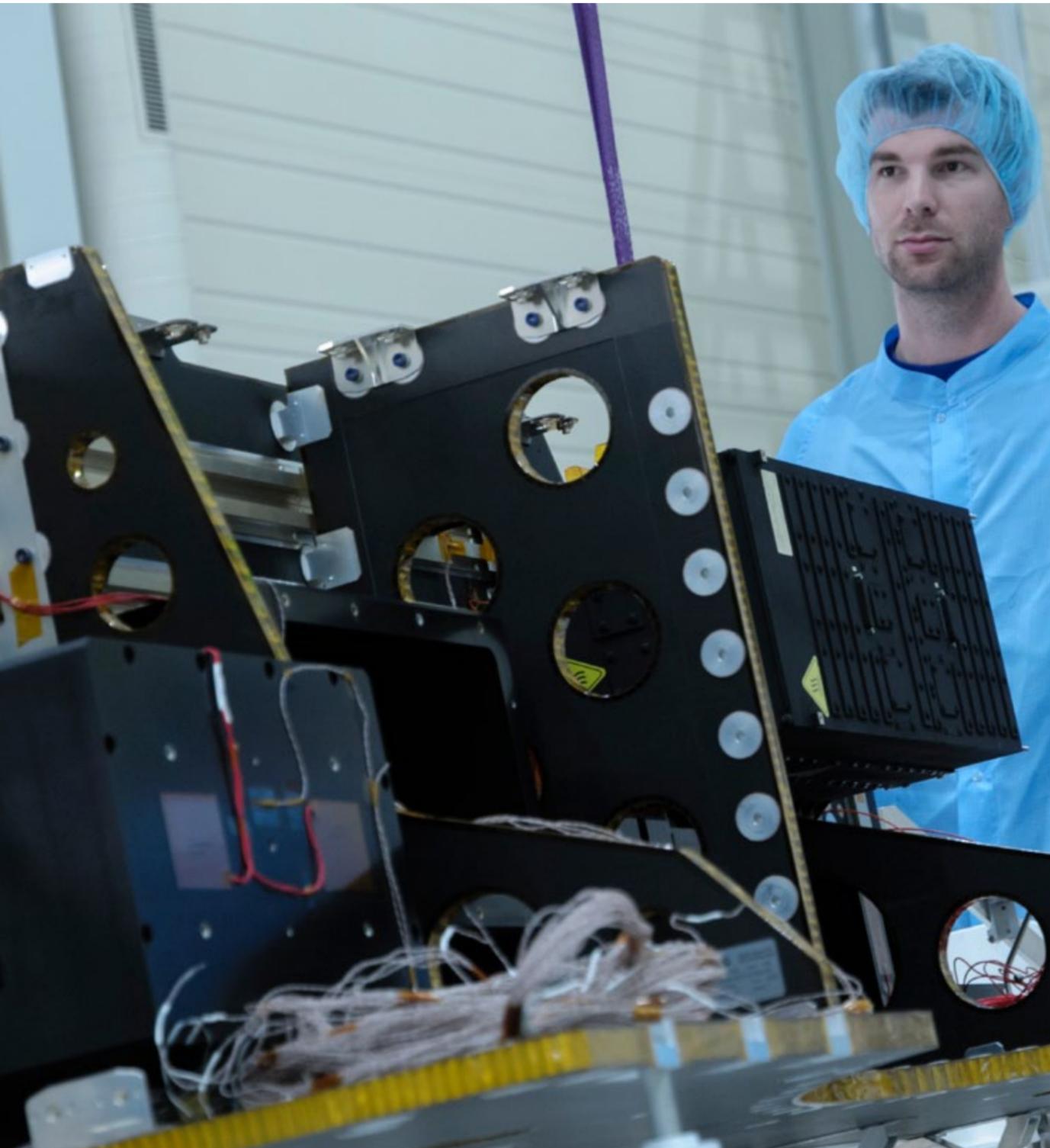
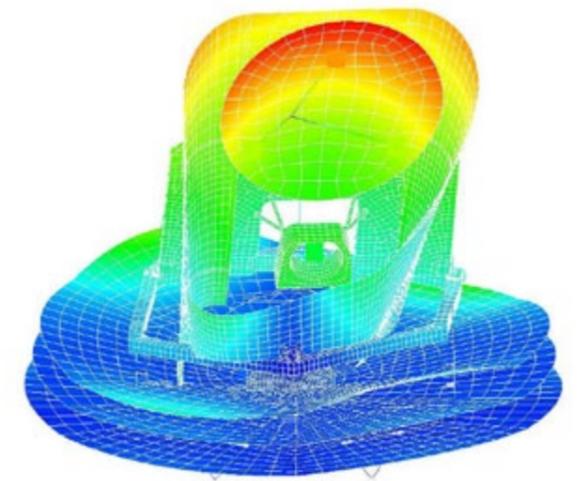
Developing products for application in space requires excellent engineering skills as well as perfect understanding of the customers' needs during the complete development process. Our experts are committed to your success from the initial definition of requirements to the launch of your mission.

Design, manufacturing, integration and test all take place in one location, in our facilities in Zurich, Switzerland. This allows efficient communication and a single point of contact to our customers.

RUAG Space has qualified many different products and processes. This enables our customers to save costs by selecting off-the-shelf components with help of our experienced engineering staff.

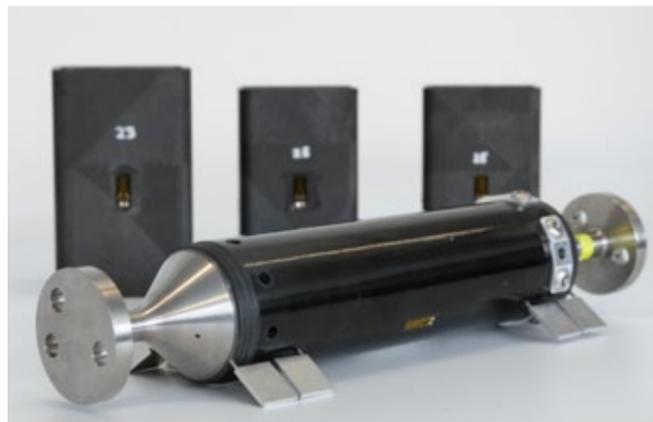
## Engineered for extreme conditions

Spacecraft Structures with delicate instruments on board not only have to withstand harsh loads during launch, but face extreme temperatures and temperature variations as well as vacuum conditions while in space. The Structures also have to be as light as possible in order to save fuel. RUAG Space has the know-how available to design structures for those conditions.



# From standard products ...

With our involvement in more than 50 missions over the past 40 years RUAG Space has built up a substantial heritage and a large portfolio of qualified state of the art components and subsystems. RUAG's customers save time and money by selecting one of these components rather than engineering it from scratch.



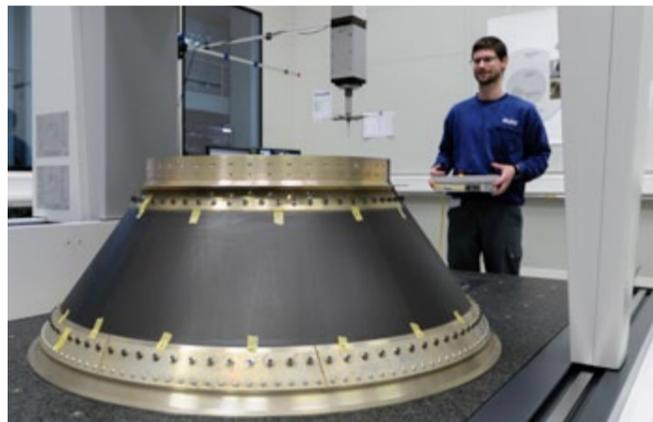
### Struts

RUAG Space sets the benchmark with more than 500 struts of different geometries in space. Our engineers support you in the design of your strut and help you save time and money by finding a pre-qualified strut design whenever possible.

If required we also support you in the design, assembly and test of your complete truss structure. Our manufacturing processes and know-how include hand lamination as well as filament winding for standard or complex geometries. Material choices are made to fit your needs.

### Cones and Cylinders

The Launch Vehicle Adapter Ring (LVA) is part of the primary satellite structure and forms the interface to the launcher. From the LVA, the primary structure can consist out of cylinders and/or cones that are made of aluminium or CFRP. RUAG Space uses manufacturing processes that include filament winding for monolithic structures as well as carbon fibre sandwich structures with hand layup.



### Qualification and Heritage

RUAG Space has gained large experience in designing and manufacturing cylinders and cones as primary satellite structures. Our customers benefit from this experience, they save engineering costs by choosing an existing geometry. RUAG Space has built cylinders and cones for the ESA projects Solar Orbiter, SmallGeo, Sentinel 1 & 3, Lisa Pathfinder and others. Proven processes and experienced staff in our facilities in Zurich, Switzerland ensure outstanding manufacturing precision and quality.

# ... to tailor made solutions

RUAG's customers demand a high degree of flexibility as a result of changes in the specifications that often occur in a late stage of the project. With the design, manufacturing and test all on one site, RUAG Space has short communication lines and is able to implement these changes to meet the customer request.



The backbone of every spacecraft is a lightweight structure that holds different types of equipment including the mission's payload, avionics, propulsion and power subsystems in place. Aluminum panels with integrated heat pipes as well as CFRP panels in free form shapes are fully designed manufactured and tested at RUAG Space.

### Custom made lightweight panels

Because each mission is different each structure has different technical specifications. This requires a high degree of engineering in the beginning of the project and efficient manufacturing and assembly towards the end. RUAG has experience in designing complex panels with a wide range of properties. Integration of cold or hot bonded inserts as well as surface mounted or integrated heat pipes are our daily business. Over the years a large database of qualified components materials has been built up and is available at RUAG.

### 3D free form shapes

With its involvement in the ESA project "Intermediate Experimental Vehicle" (IXV) RUAG has built expertise in complex 3D free form structures. The IXV cold structure is a 4.2 m x 2.2 m carbon fibre sandwich aeroshell with over 1300 inserts made of carbon, aluminium, titanium and invar. The structure is capable of withstanding an 80 tons parachute load during re-entry.

### Complete Hybrid Structures

Our daily business at RUAG is to design highly accurate panels for optimal performance taking into account mass, stiffness and temperature constraints. Hybrid structures that consist out of various types of panels with different material properties are optimised by placing load introduction in a way that the above design criteria are met.

# From engineering ...

In order to meet deadlines, specifications and stay within the given budget for spacecraft development, close cooperation between customers and suppliers is a must. RUAG's customers value our know-how, flexibility and support throughout the whole project, from the pre-engineering phase to the successful launch and completion of their mission.



## Quality

The repeatability in satellite structures is relatively low and each structure needs to be first time right. At RUAG Space there is zero tolerance for mistakes. Our structures are made in Switzerland and fully designed, manufactured, assembled and tested in Zürich close to the top European engineering institutes.

## Early involvement

By getting RUAG's engineers involved as early as possible in the project, customers benefit the most from our experience. RUAG's engineers work with you to understand the real design drivers behind your requirements. They then design to meet those requirements.

## Project Management

One of the key drivers for being successful in space is state of the art project management. RUAG's project managers are able to manage complex projects. They identify risks in the early phases of a project and manage them till the end.

## Qualified supplier base

Part of ESA's mission is to shape the development of Europe's space capability and ensure that it's investment in space continues to deliver benefits to the European member states and beyond. As a result RUAG has built up a qualified supplier base throughout Europe from which our customers can benefit.

## Intellectual Property

Leading-edge technologies developed for space programs often form the basis for innovative solutions on Earth. Protecting our customers' sensitive know-how is our daily business.

## Know how retention

Space programs run over many years and customers require documentation of the highest standards as well as traceability of components and decisions made throughout the project.

# ...to manufacturing, assembly, integration & test

Manufacturing lightweight CFRP structures not only requires dedicated equipment on site, since many components are handmade it is also essential to have well trained and qualified staff. RUAG's manufacturing staff have many years of experience in manufacturing and all the manufacturing processes are well documented.

## Manufacturing Facilities

RUAG Space in Zürich has all the manufacturing capabilities for large lightweight structures available on site. From autoclaves capable of handling structures up to 4 meters wide and 6 meters long to power presses and an adhesive bonding laboratory. Several CNC machining centres and a paint workshop are also available on site and together with the local engineering and on-site testing facilities RUAG is able to provide an efficient one-stop shopping concept to its customers.

## Testing

In order to guarantee 100% success testing and test engineering is a vital part of our value chain. Two different test rigs are available for static load tests of large structures (up to 15 by 15 meters) axial and lateral loads of over 2000 kN and bending moments of over 6500 kNm can be applied.

## Cleanroom Facilities

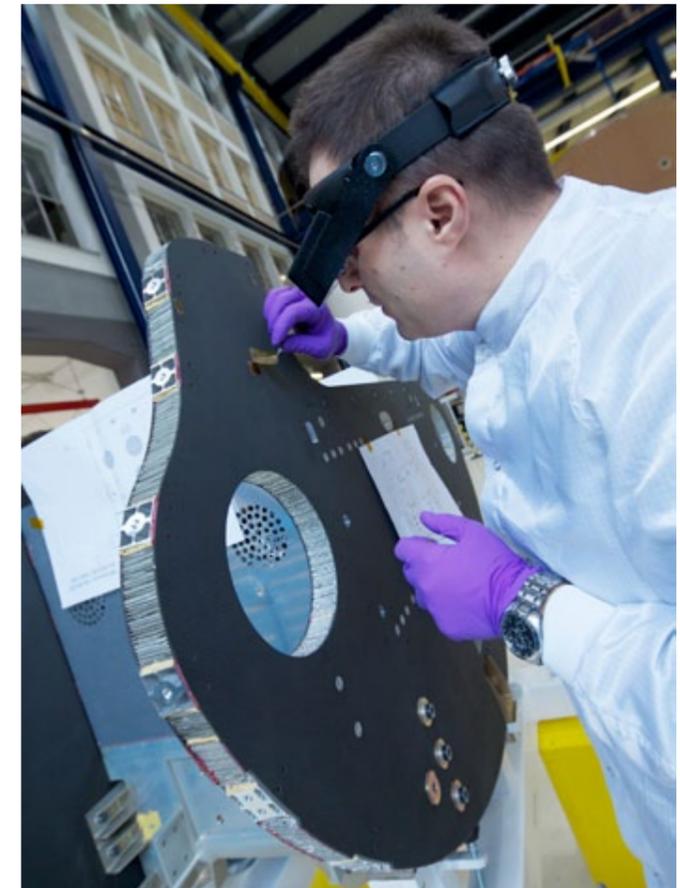
RUAG Space has a variety of assembly and clean room facilities available in Zürich that meet the standards for today's manufacturing and assembly spacecraft structures.

## Optional AIT at RUAG

In order to avoid unnecessary shipment of complete structures, RUAG Space offers its customers, apart from the panel manufacturing also on-site assembly integration and test. Thermal protection hardware can also be applied to the structure if required.

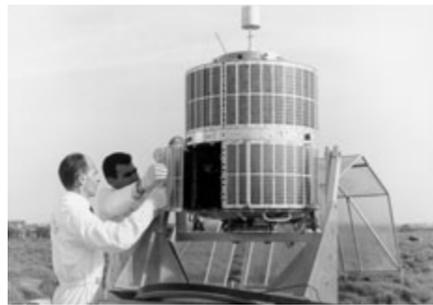
## Qualifications

RUAG Space is an EN9100 qualified company and has a process-integrated Product Assurance department. Furthermore a comprehensive product assurance plan tailored to the customer's needs is established and closely monitored.



# From ESRO-1 ...

Since the beginning of the European space activities, RUAG has been designing and manufacturing lightweight structures and dimensionally stable platforms for many missions of the European Space Agency (ESA) as well as for commercial telecommunication satellites. With this vast experience in space applications RUAG also enables customers in other markets to effectively differentiate themselves from their competition.



## ESRO-1

ESRO-1 A & B were the first two research satellites of the European Space Research Organization (ESRO) which was founded in 1964. ESRO was later merged with the European Launcher Development Organization (ELDO) into the European Space Agency ESA. At that time still known under the name Contraves, today's RUAG Space was responsible for the Satellite Structure of both ESRO satellites as well as for the stabilizing system, the thermal subsystem and for mechanical testing. The ESRO-1 satellites were launched in 1968 and 1969.

## Automated Transfer Vehicle

ESA's ATV is an unmanned space transporter which supplies the International Space Station (ISS), with propellant, water, air, payloads, and experiments. ATVs can also reboost the station into a higher orbit. RUAG Space developed and built the structures for the ATV's propulsion module. This aluminium framework comprises all load-bearing components for accommodating the propulsion system and the avionics. The framework also includes shielding to protect the ATV against meteorite impacts and space debris. In addition to the propulsion module structure, RUAG Space was also responsible for constructing the cargo racks which accommodate the solid payloads inside the ATV's Integrated Cargo Carrier.



## Planck

The European Space Agency's Space Telescope Planck explored the cosmic microwave background radiation from 2009 to 2013. Planck's telescope structure was developed and built by RUAG Space, originated in Zurich. To shield Planck's extremely sensitive detectors from heat, the telescope had to be thermally decoupled from the rest of the satellite by special struts made from fiber-glass. In addition, three protective shields, which were also developed by RUAG Space, were mounted between the two modules. Another protective shield from RUAG Space was the so-called baffle that prevented disruptive stray light from reaching the telescope mirrors.



# ... to IXV



## SmallGeo

SmallGeo is a general-purpose small geostationary satellite platform that enables European industry the opportunity to play a significant role in the commercial telecom market. RUAG Space was responsible for the complete engineering and manufacturing of the satellite platform for SmallGeo. In addition, the full Structural and Thermal Model test campaign was done under the responsibility of RUAG Space. The satellite structure of SmallGeo consists of a Central Tube and a high number of different CFRP structural panels and aluminium radiators, many of them with a high degree of complexity.



## Sentinel-1

The Sentinel-1 mission is a polar-orbiting radar satellite. It is part of the European Union's environmental monitoring programme Copernicus. For Sentinel-1 RUAG Space developed and manufactured the primary satellite structure as well as the structure for the Synthetic Aperture Radar (SAR).



## EarthCare

EarthCare is an environmental satellite of the European Space Agency (ESA). The objective of the EarthCare mission is to make global observations of clouds, aerosols and radiation. For EarthCare RUAG Space was responsible for the engineering, manufacturing and test of the full carbon satellite base platform structure. With the use of heavy duty panels, extensive use of titanium fittings, a heavy core central cylinder and 14 carbon fibre struts RUAG was able to meet the high requirements in terms of thermal stability and co-alignment of the two main instruments (the Atlid-laser and the cloud profiling radar).



## Intermediate Experimental Vehicle (IXV)

The Intermediate eXperimental Vehicle (IXV) is an European Space Agency (ESA) experimental re-entry vehicle intended to validate key technologies for reentry from low earth orbit, consolidating the knowledge necessary for the development of any future European reentry system. RUAG Space was responsible for the so-called cold structure, a complex 4.2 m x 2.2 m carbon fibre 3D free form structure. A sandwich aeroshell with more than 1300 inserts made of carbon, aluminium, titanium and invar. The structure is capable of withstanding an 80 metric tons parachute load during re-entry.

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