5M

RELIABLE PARTNER **FOR YOUR SPACE BUSINESS**

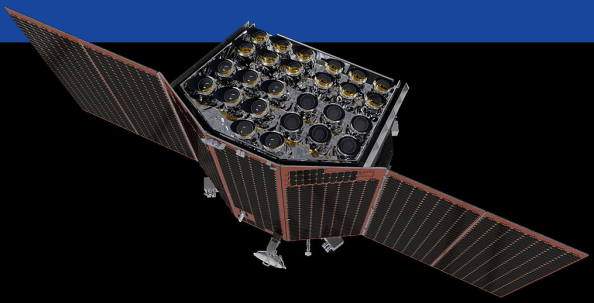
SPACE
DIVISION

we transform complex requirements
into flight-ready solutions



www.**5M.cz**

RELIABLE PARTNER **FOR YOUR SPACE BUSINESS**



- IN SPACE BUSINESS **SINCE 2013**
- 30+ DIFFERENT **TECHNOLOGY DEVELOPMENT PROJECTS**
- PARTICIPATION ON **5 MISSIONS**
- COOPERATION BUILT TO SPEC, **BUILT TO PRINT OR COENGINEERING**

Qualification of shielding applied to structural panel for JUICE (2014-2016, Follow up with flight HW delivery to ADS)

PLATO Service Module Sandwich Panels (2020-2023)

ROSE-L Secondary Structure Sandwich Panels (from 2023)

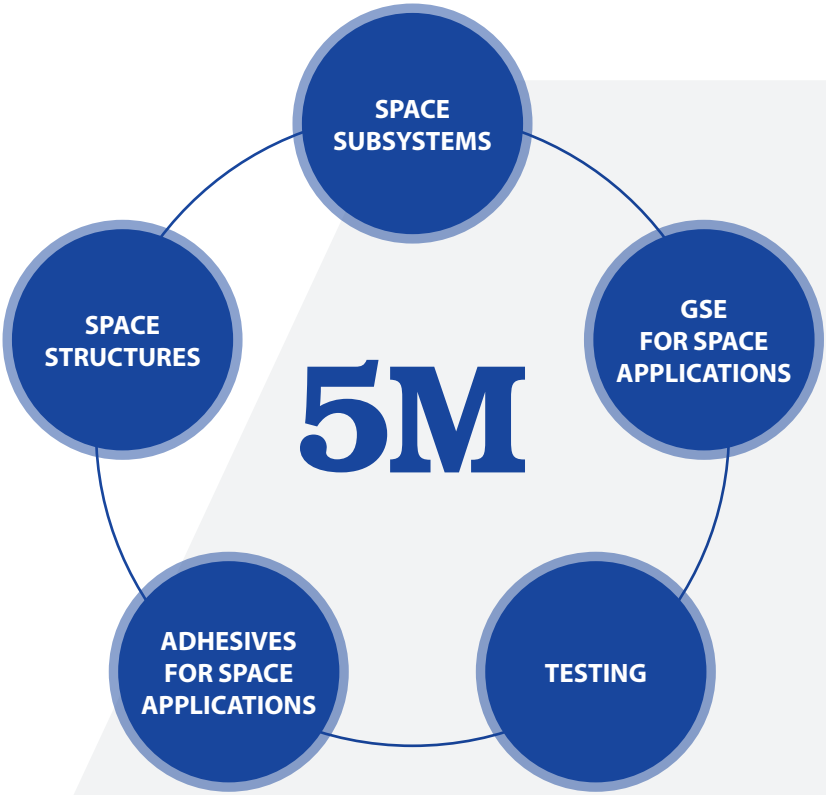
LISA CFRP Panels (from 2026)

VEGA Dispenser Sandwich Panels (from 2015)

REFERENCES

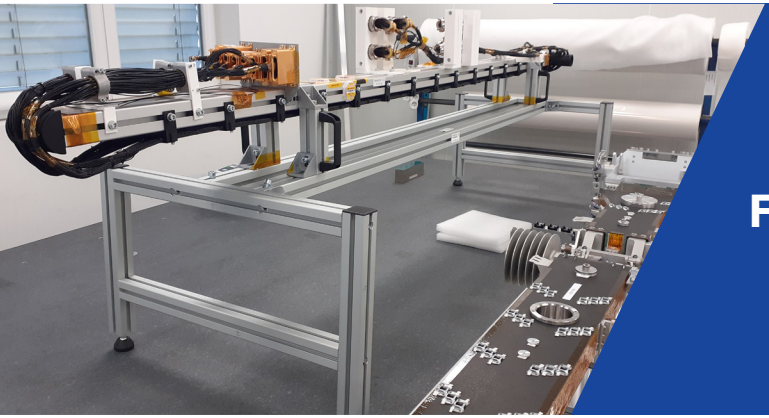
esa · ThalesAlenia Space · OHB · AIRBUS DEFENCE & SPACE · SAB Aerospace

5M SPACE ACTIVITIES



- SPACE **SUBSYSTEMS**
  Solar arrays, radiation shielding
- GSE **FOR SPACE APPLICATIONS**
  Design and manufacturing of testing GSE and MGSE
- **TESTING**
  ESA approved testing for allowables
- ADHESIVES **FOR SPACE APPLICATIONS**
  Qualified foil and paste adhesives
- SPACE **STRUCTURES**
  CFRP parts and sandwich panels based on prepreg or LF Technology

COMPETENCES



DESIGNED
FOR MISSION
SUCCESS

COMPONENTS **MANUFACTURING**

- Manufacturing of individual parts for manufacturing of complex structures

INTEGRATION OF **COMPONENTS TO SUBSYSTEM**

- Harness integration
- Flexible components integration
- Metallic parts integration to CFRP sandwiches
- Qualified riveting and fastening processes
- Structural bonding and mechanical fastening under 3D
- Laser tracker assisted assembly

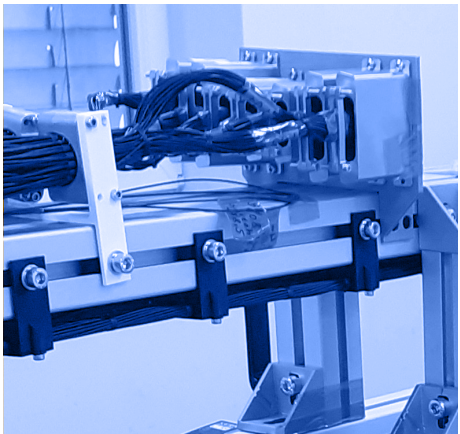
FUNCTIONAL TESTING **OF ASSEMBLIES**

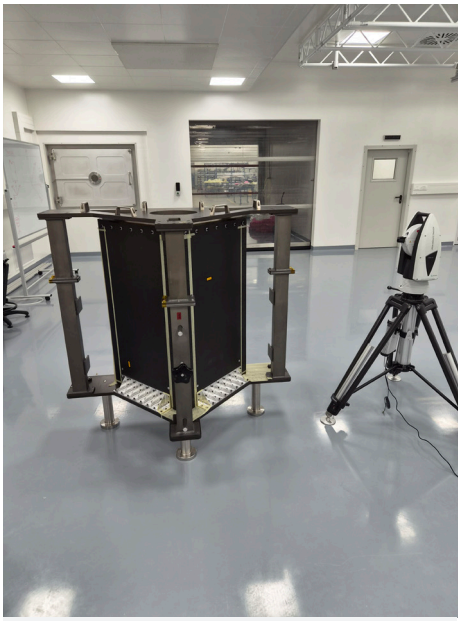
- Flexible solar array horizontal deployment
- Yoke deployment kinematic
- Solar array vertical deployment (zero-g)
- Static test of dispenser structure in cooperation

DESIGN AND MANUFACTURING **OF MGSE OR GSE**



YOKE assembly and harness integration

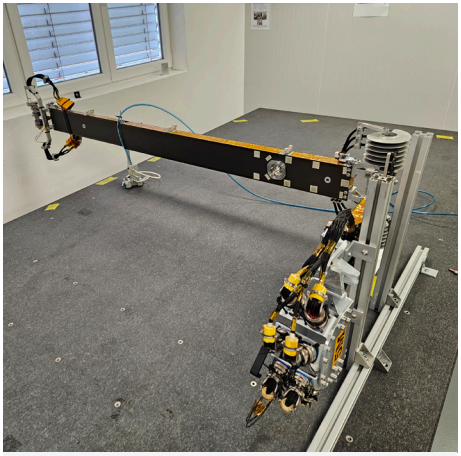




VEGA laser Tracker asisted assembly



YOKE deployment test

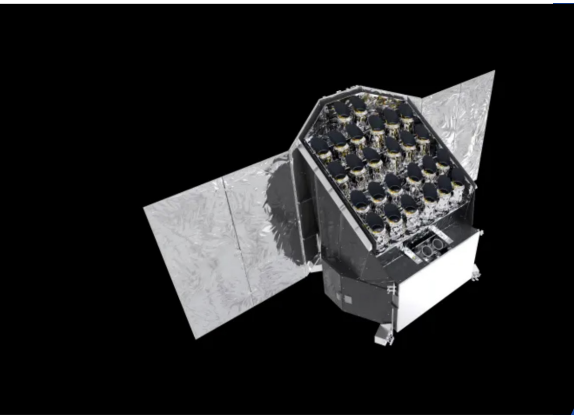


YOKE deployment test



Flexible Solar Array System deployment test

SPACE STRUCTURES



STRENGTH
BEYOND
EARTH

SANDWICHES

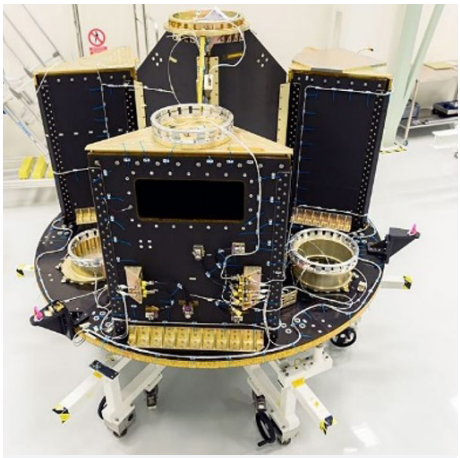
- Spacecraft CFRP panel production in autoclave and/or out of autoclave processes
- Testing – travellers and proof loads
- Inserts potting
- Assembly



PLATO Service Module sandwich panels



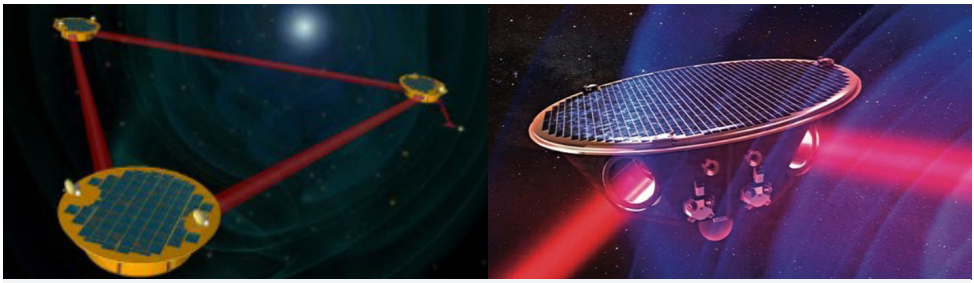
ROSE-L secondary structure sandwich panels



VEGA Dispenser sandwich panels



PLATO mission sandwich panels

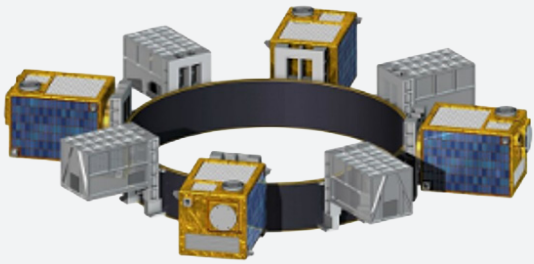


CFRP sandwich panels for LISA mission



ROSE-L mission sandwich panels

SPACE STRUCTURES



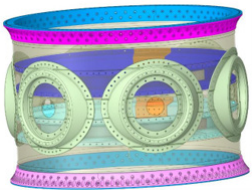
PRECISION
TAKES
SHAPE

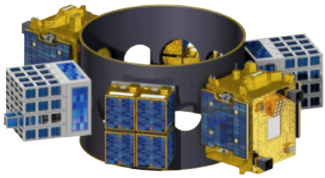
TUBES **AND 3D SHAPES**

- Design and manufacturing of tubular structures made of thermosetting or thermoplastic prepregs
- 3D shapes such as cleats made of prepregs



VEGA cleat for Tower Module

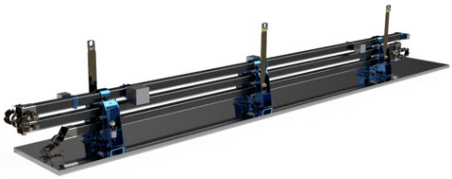




Ariane 6 Dispenser structure model

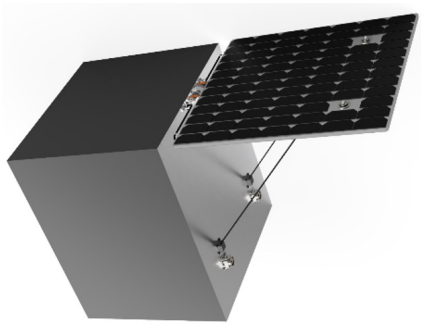
PROFILES

- Qualification of 5M composite technology for space applications (Pultrusion, LF Technology, Prepreg Lay Up)
- Qualification of 5M structural pull-winded profile for Mag Boom at JUICE mission
- Assembly with metalic fittings and interfaces



Mag Boom for Juice Magnetometer Experiment

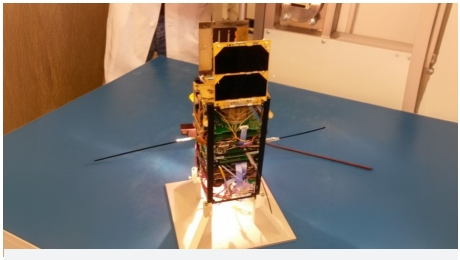
RIGID SOLAR ARRAYS



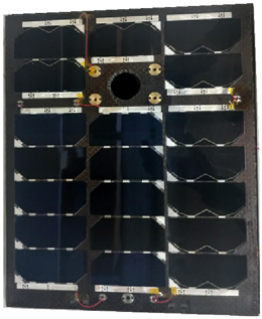
POWERING
SMALL
SATELLITES

DEPLOYABLE AND BODY MOUNTED
SOLAR ARRAY FOR MINI AND SMALL SATELLITES

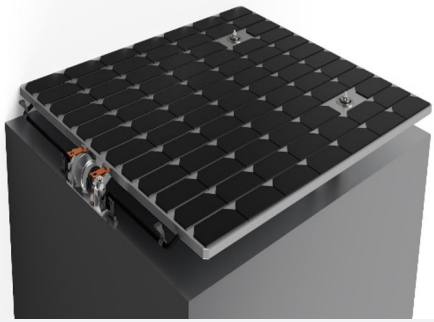
- Customer-based production
- Different concepts: deployable and body-mounted solar arrays
- Power range: 50 – 1000 W
- Various solar cells of module type adaptation (GaAs, Silicone, based on restriction possible suppliers from EU, USA and China)



VZLUSAT1 - 1st Sucessfully Flying Solar Array (2017)

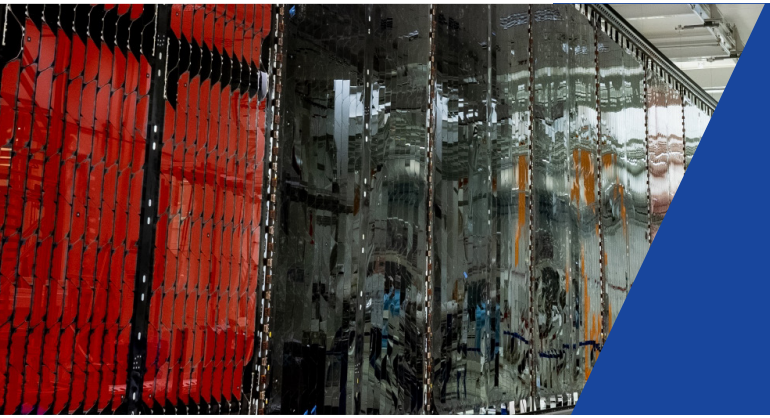


Example of the solar array for mini or small satellite



Example of the design for 100 W rigid deployable solar array

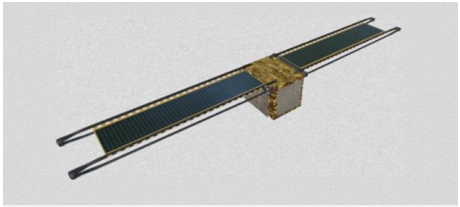
FLEXIBLE SOLAR ARRAYS



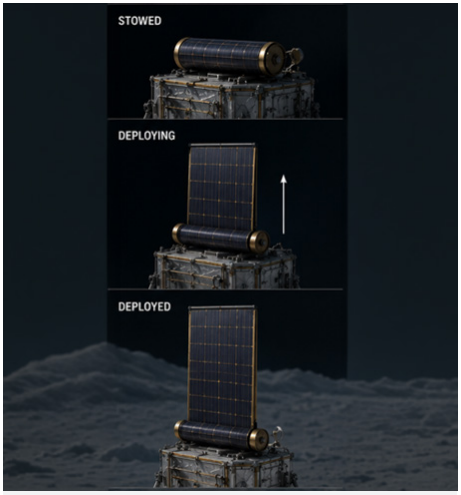
ROLLABLE
SOLAR
POWER

FOR MEDIUM AND BIG SATELLITES **IN COOPERATION WITH TAS-F**

- Customer oriented production
- For medium and large spacecraft architectures, where deployed area and stowed volume are critical
- Power range: 500 W - 35000 W



Scale-down of Flexible Solar Array

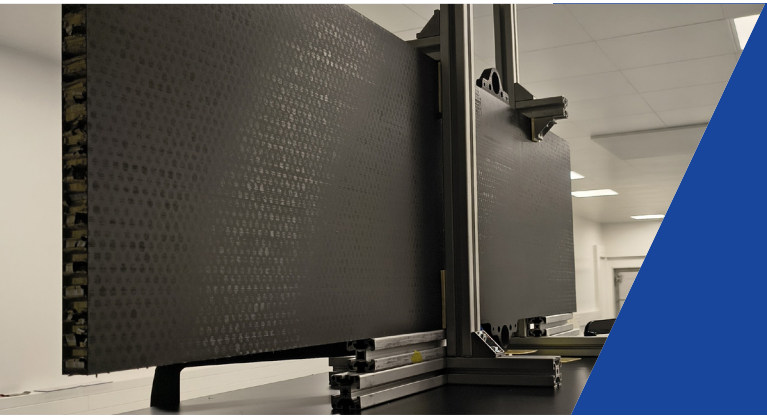


Concept for Rollable Solar Arrays for L4 Enceladus



Mechanical subsystem of Flexible Solar Arrays System

ADHESIVES FOR SPACE APPLICATION



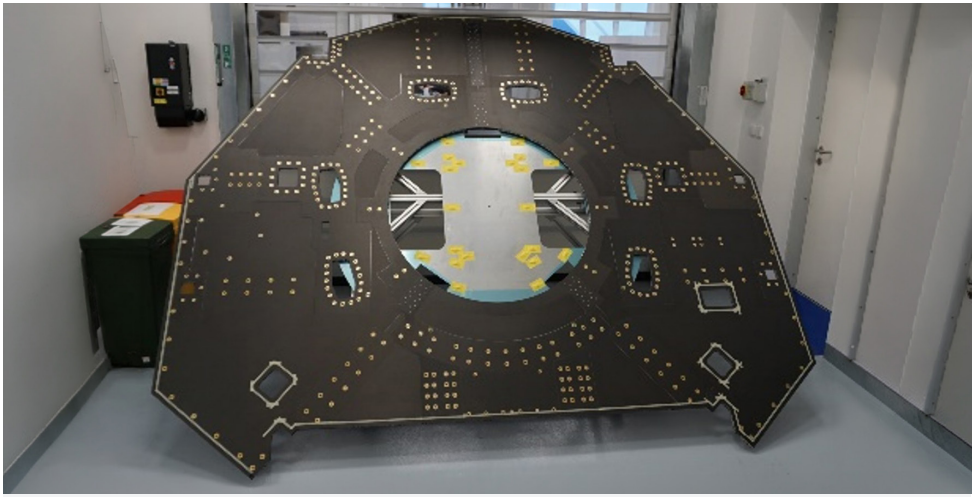
BONDS
BEYOND
EARTH

SEVERAL **SPACE QUALIFIED ADHESIVES** WERE DEVELOPED:

- Foil adhesives
- Paste adhesives for structural bonding of thermosets and thermoplastics
- Non-structural paste adhesives for general bonding of flight hardware

RESIN SYSTEMS **FOR SPACE**

- LF Technology resin systems
- Resins for prepreg manufacturing



Top panel for Service module Plato - foil adhesive aplication (Letoxit KFL 120)

FACILITY



DELIVERING
QUALITY
AT SCALE

Production space of 17 000 m² from which 3 000 m² with controlled temperature and air filtration.

MAIN **PRODUCTION EQUIPMENT**

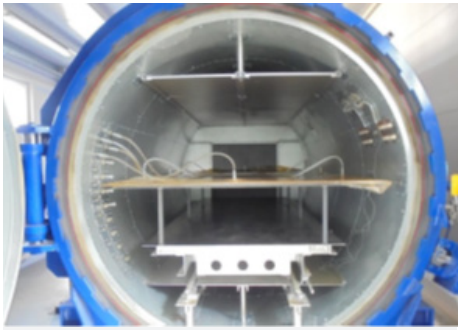
- 10 pultrusion lines
- Hydraulic presses
- Autoclaves
- Prepreg cutters
- Laser positioning system
- Cleanrooms ISO 8 (500 m² + 150 m²) - equipped with crane (4 tons) and granite tables



Granite table (3.9 x 1.8 m)



Clean room with crane (4 t)



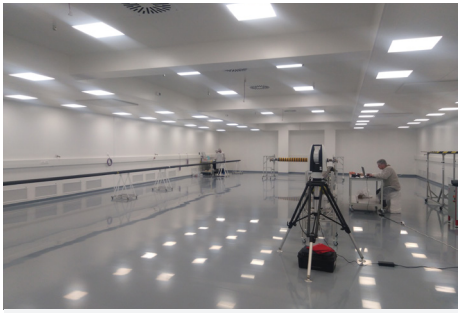
Autoclave (2.1 x 4 m)



Hydraulic press (1.7 x 3 m)



Prepreg cutter (1.8 x 3.1 m)



Cleanroom ISO 8 (500 m^2)



Clean room - Zero-g simulation GSE



R&D lab

TESTING



CONFIDENCE
THROUGH
TESTING

CERTIFICATIONS

Certified

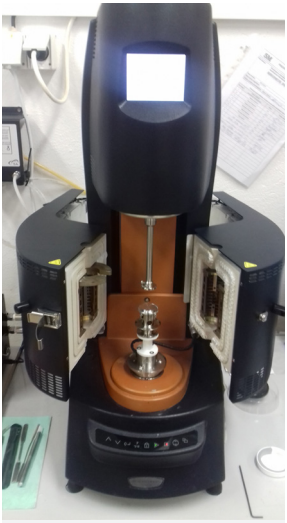
DIN 6701 A1	IRIS (railway industry)	IATF 16949 (automotive)	AS 9100 (copyright Lloyd's Register LRQA)
ISO 9001 : 2015	POA PAR 21.G EASA 748/2012 (aviation)		

Implemented

CSN EN ISO 14001 (environmental protection)	CSN EN ISO 18001 (safety management)	Approved supplier for ČD	Approved supplier ACR (NATO 49926)



CTE measurement



Rheometer



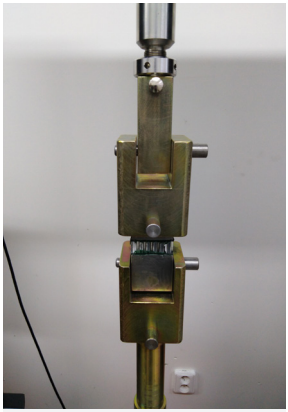
Portable 3D laser tracker



Tensile testing machine



Cellspot Photoluminescence device



Sandwich flat-wise test

TESTING

- Mechanical properties of composites, sandwiches and inserts
- Thermal cycling and thermal vacuum cycling
- Non-destructive methods (ultrasound, thermography)
- Thermal analysis (DSC, DMA and TGA)
- Curing characteristics (rheometry)
- Coefficient of thermal expansion (dilatometry)
- Precise 3D measurement



Proof-load test on panel

Accepted testing facility for design allowables by ESA

Test	Standard	RFA document	Project
Tensile properties	ASTM D3039	P20134-5M-D00-RFA-008	PLATO
Inter laminar shear strength	ASTM D2344	P20134-5M-D00-RFA-009	PLATO
Coefficient of thermal expansion	ASTM E228	P20134-5M-D00-RFA-010	PLATO
Dynamic mechanical analysis	ASTM D7028	P20134-5M-D00-RFA-011	PLATO
Differential scanning calorimetry	ASTM D3418	P20134-5M-D00-RFA-017	PLATO
In-plane shear strength	ASTM D3518	P20134-5M-D00-RFA-026	PLATO
Compressive properties	ASTM D3410 EN 2850	ROSE-RFA-5M-SC-006	ROSE-L
Flatwise tensile strength	ASTM C297	P20134-5M-D00-RFA-012	PLATO
Long beam flexure	ASTM D7249	P20134-5M-D00-RFA-015	PLATO
Core shear properties	ASTM C393	P20134-5M-D00-RFA-024	PLATO
Edgewise compressive strength	ASTM C364	P20134-5M-D00-RFA-027	PLATO
Pull out test	ECSS-E-HB-32-22A	P20134-5M-D00-RFA-020	PLATO
Shear test	ECSS-E-HB-32-22A ASTM F606	P20134-5M-D00-RFA-021	PLATO
Bending test	ECSS-E-HB-32-22A	P20134-5M-D00-RFA-030	PLATO
Adhesive single lap shear strength	ASTM D5868	P20134-5M-D00-RFA-025	PLATO
Peel strength of adhesive bonds	ASTM D903	P20134-5M-D00-RFA-031	PLATO
Cyclic thermal (vacuum) testing	ECSS-Q-ST-70-04C	P20134-5M-D00-RFA-028	PLATO
NDI – ultrasound (phased array)	Internal procedure ISO 9712	P20134-5M-D00-RFA-022	PLATO
NDI – thermography (flash)	Internal procedure ASTM E2582	P20134-5M-D00-RFA-023	PLATO

RELIABLE PARTNER **FOR YOUR SPACE BUSINESS**



5M s.r.o was founded in the year 1992. Nowadays, it has about 250 employees, where around 40 of them work at SPACE division. 5M has a wide range of customers in space applications, aircraft manufacturing as well as in public transport (trains, trams, buses). The whole company is certificated under AS/EN9100 system of quality management.

SPACE division of 5M is a trusted partner for demanding space applications, delivering advanced composite and structural solutions for the most challenging missions. We specialize in the development and manufacturing of high-performance solar array structures, lightweight sandwich panels, deployable booms, and other customized composite components.

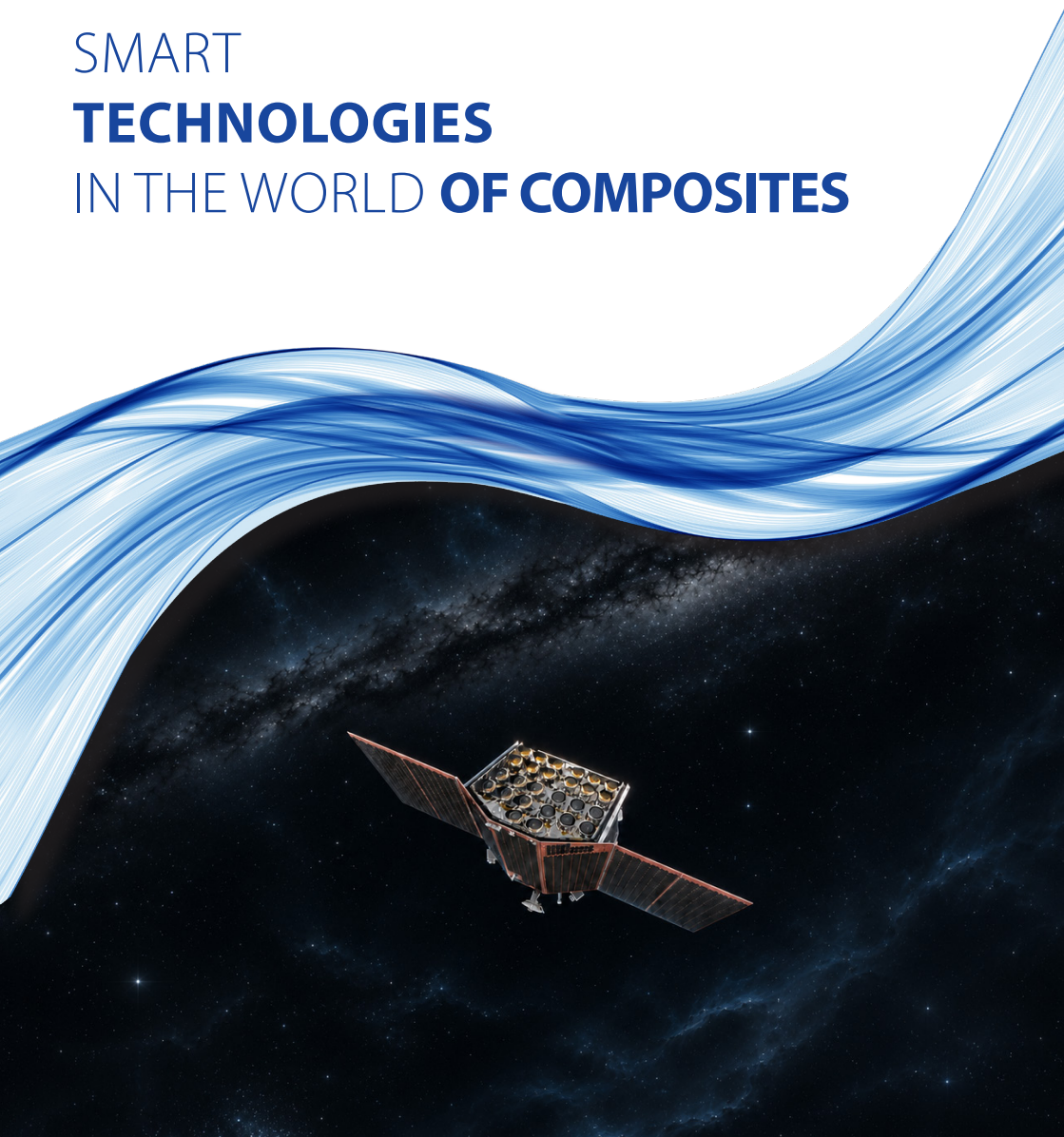
We offer flexible cooperation through both Build-to-Print and Build-to-Specification approaches, enabling us to manufacture precisely according to customer designs or provide comprehensive engineering and development support from initial requirements to the final flight-ready product.

Combining extensive engineering expertise, advanced manufacturing technologies, and a commitment to precision and reliability, we help our customers transform complex requirements into flight-ready solutions.

5M

5M

SMART
TECHNOLOGIES
IN THE WORLD **OF COMPOSITES**



5M

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TECHNOLOGIES
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