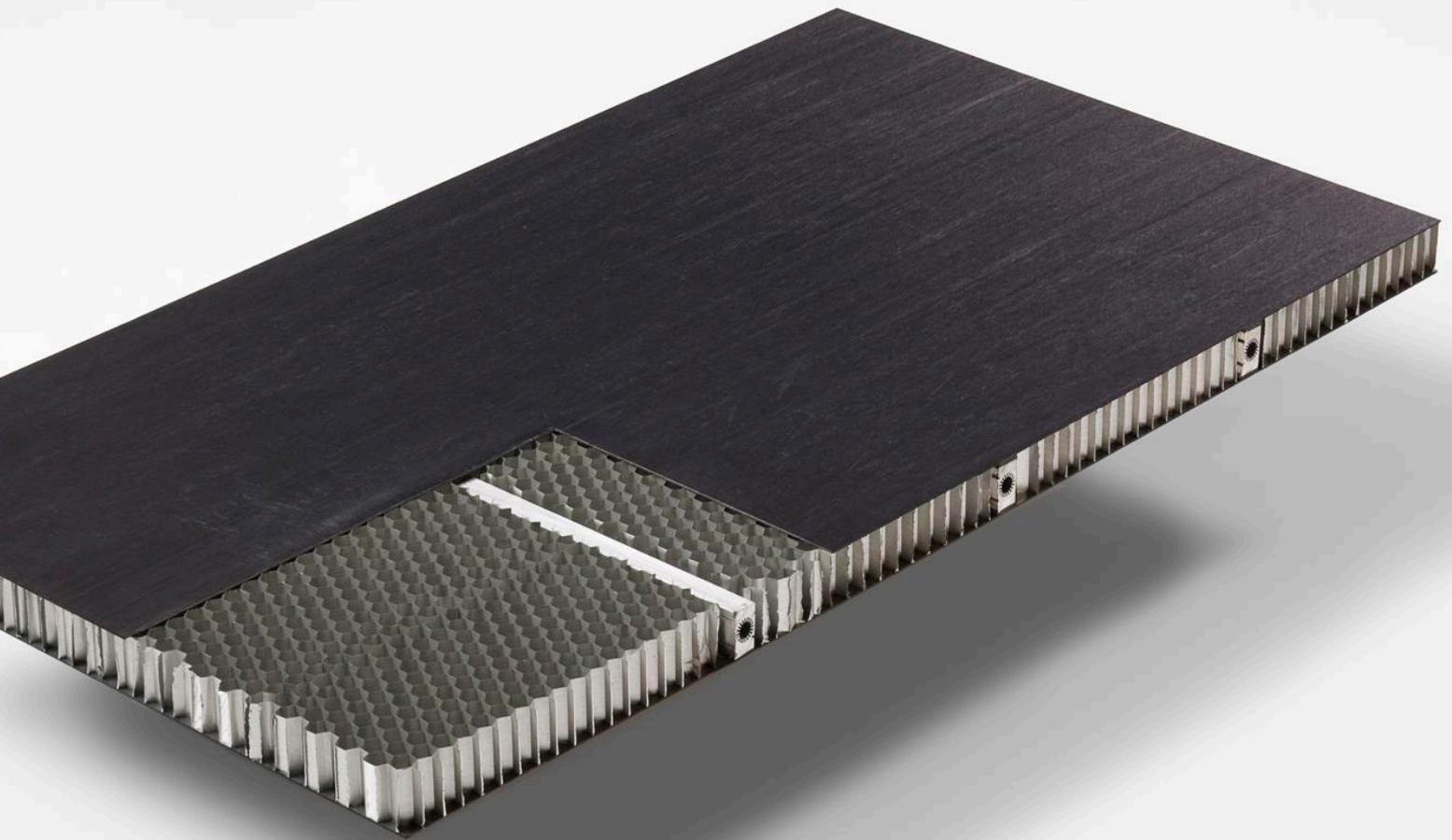




Dedicated to innovation in aerospace

# Lightweight conductive composite structures

PRODUCTS & SERVICES



High thermally conductive composites save weight while improving thermal stability & power dissipation

You need to save mass and volume of your spacecraft structure and want to increase its mechanical and thermal stability as well as its power dissipation. NLR's Smart Carbon Fiber Reinforced Polymer composite (CFRP) products do meet these requirements.



### WHAT YOU NEED

Structures that are:

- Lightweight
- Thermally conductive
- Thermally stable
- Less voluminous
- Incorporate heat pipes in CFRP panels

### WHAT WE DELIVER

- The design of conductive CFRP structures (thermal, structural, EMC)
- Modelling of CFRP space structures (V5r20, Fibersim, RTM-Worx, MSC Nastran)
- Thermal analysis of composite materials (ESATAN, Matlab, Abaqus, CFD)
- Conductivity testing of carbon fibre panels (in-plane and out-of-plane)
- Manufacturing of the product

### OUR CAPABILITIES

NLR has extensive experience in CFRP design and manufacturing until full scale prototype development. For development of space products this experience is combined with the large heritage in thermal system design. Apart from the skills of our Qualified R&D and Test engineers the following facilities are available at NLR:

- Automated Fibre Placement Facility
- Autoclaves and ovens
- Resin Transfer Moulding Machine
- Heated press (1000 kN)
- Electronically controlled cutting machine for sheet materials
- Non-Destructive Inspection e.g. C-scan facility
- Equipment for characterization of composites (Rheometer, Differential Scanning Calorimeter (DSC), Thermogravimetric Analysis (TGA) and permeameters)
- Thermal Vacuum Chamber (with IR-window and IR-camera)
- Thermal cycling chamber

### CFRP RADIATOR PANELS

NLR developed a conductive CFRP radiator panel with embedded heat pipes. Replacing aluminium face sheets with CFRP face sheets in heat pipe radiator panels reduces mass and increases the

mechanical stability. The CTE (Coefficient of Thermal Expansion) mismatch between aluminium and carbon, which creates high stresses, is compensated by using an intermediate layer, ply-angle optimisation, and a special gluing procedure. The heat pipe panel has been subject to thermal cycling tests between -60°C and +70°C where it showed no performance degradation.

### CFRP ELECTRONICS BOXES

Using conductive CFRP for electronic boxes gives a clear advantage in terms of weight and thermal stability compared to the current aluminium housings. The 'Same Qualified RTM' (SQRTM) technology has been applied to manufacture a complex structure with high conductive pitch fibres, using prepregs instead of dry reinforcements. This resulted in better handling and the possibility to use space qualified prepreg materials. The demonstrator was able to dissipate 3 times the amount of power compared to an aluminium equivalent on a weight basis. This technology is ideal for electronics boxes with high stability demands like T/R modules or struts.



### PRODUCTS & FEATURES

- CFRP Radiator panels with embedded heat pipes
- Conductive Electronics boxes
- Thermally conductive and mechanical stable structures