

This document contains Space Composite Structures DENMARK and supplier Proprietary Background Information. This data is privileged and/or confidential and may not be disclosed to a third party without the prior written permission of Space Composite Structures DENMARK.

This document is part of ISO 9001:2015 quality management system.

©2022 Space Composite Structures DENMARK

SCSDK HERITAGE

Launch – Launched - Deployed

Any estimates stated in this document might be subject of change when the final quote is given.

This document does not constitute any obligation on behalf of Space Composite Structures DENMARK (SCSDK) or subsidiaries nor will SCSDK be liable for any expenses incurred by the third parties unless the written agreement hereto is available at the time of consideration

Index

Annex 1: Space Composite Structures DENMARK	2
Quality	2
Annex 2:.....	3
Relevant heritage.....	3

CONFIDENTIAL

Annex 1: Space Composite Structures DENMARK
Quality



CERTIFICATE

This is to certify that:



Space Composite Structures Denmark ApS
Hestehaven 21J
5260 Odense
Denmark

Applies a management system in accordance with:
TUV NORD Scandinavia AB certification scheme and

EN ISO 9001:2015

Regarding the extent and scope:

Design, development, production, verification, assembly, and
sales of structures for space and ground applications.

The validity of this certificate is assured through annual surveillance audits.

Certificate No: 5749-3027890-01
Audit report number: 202109241150-731
Certified by:

Jonas Jönstrand
Management System Certification
TUV NORD Scandinavia AB
Helsingborg, 2021-10-04

Valid from: 2019-09-05

TUV NORD Scandinavia AB
www.tuvnord.se

Valid until: 2022-09-04



Annex 2:
Relevant heritage

COMPOSITES & BONDING – THE HIGHLIGHTES

Customer: RAL University (ESA/NASA)

Mission: James Webb Space Telescope

Task: design, manufacturing, bonding, testing.

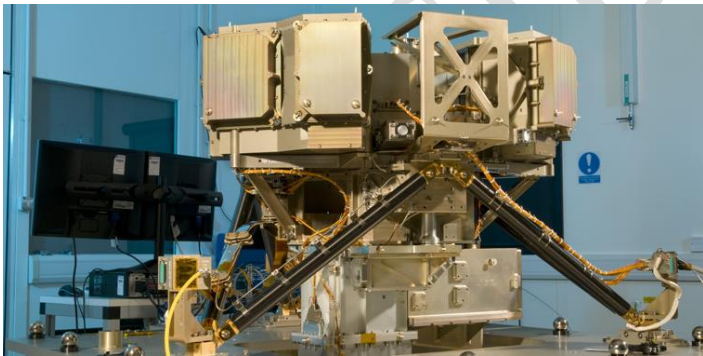
Year: 2013 - 2016

Status: deployed

Invar/CFRP CTE=0 struts for hexapod structure on Mid Infrared Sensor on JWST, ESA contribution.
The contract extended to thermal shroud struts



Hexapod struts shipped in formation



SCSDK struts integrated on the instrument



Threaded fitting struts for Thermal Shroud

Customer: WEIBEL Scientific

Mission: Ground Radar

Task: design, manufacturing, bonding, coating, test of Radar axle.

Year: 2016

Status: deployed

Delivered. Examples of large diameter precision CFRP structures catering for filament winding & adhesive bonding with large metallic rings: here shown radar elevation axle with bonded metallic interfaces and after-machining of interface holes for tight tolerances. Estimated TRL6 (current temperature spec is in line with MIL-810G requirements)



Figure 1 BASELINE: Monolith filament wound cylinder, example of Central tube similar size item



Figure 2 After-machining of bonded structure to achieve tight tolerances

Customer: DTU Space

Mission: ARIEL

Task: Filament winding, bonding, coating, test of instrument bi-pods.

Year: 2019 and on

Status: Scheduled for launch 2025

On-going. SCSDK is support to development and manufacturing of instrument bi-pods. The solution is based on SCSDK product BLACK STRUTS, 100% CFRP solution (see elsewhere in this document)

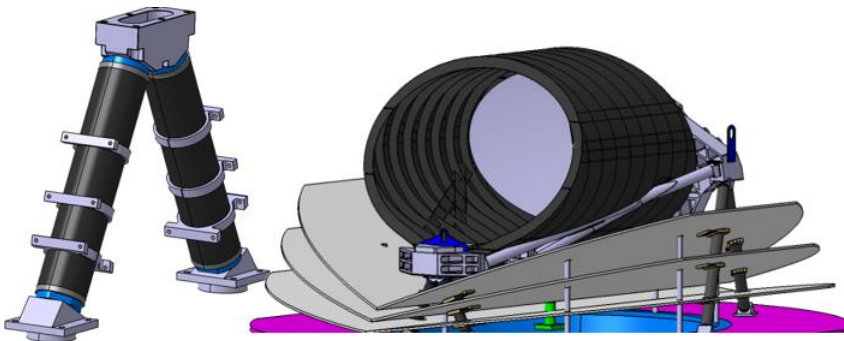


Figure 3 ARIEL Instrument Alu/Alu panels and Bi-pods. Bi-pod struts are SCSDK unique product Black Struts



Figure 4 Breadboard Struts after breadboard test campaign

Customer: THALES ALENIA SPACE - FRANCE

Mission: COPENNICUS

Task: Filament winding, bonding, coating, test of instrument bi-pods.

Year: 2020 and on

Status: Scheduled for launch 2023

On-going. SCSDK is contracted for design, development and manufacturing of instrument bi-pods



Figure 5 This project requires struts for bipods in Carbon Fiber / Epoxy & Glass Fiber / Epoxy + Titanium



Figure 6 Bondline breadboards after the test campaign

Customer: ESA

Mission: ESA study HIGH PERFORMANCE CFRP STRUTS – BLACK STRUTS, CORE TECHNOLOGY PROGRAM (Threaded version for ARIEL)

Task: Design, Filament winding, bonding, no-cut-fibers-hole winding, verification

Year: 2019 and on

TRL6 delivered. TRL7 on-going. **Showcasing filament winding of no-cut-fiber-hole**

Commercial Proposal

• • •

- Used on spacecraft, generally as part of a lattice structure
- Been around for multiple decades to reduce mass
- Struts have the following components:
 - CFRP tube
 - Metallic fittings
- Fittings bonded to tube using epoxy adhesive
- Fittings are typically aluminum, titanium or steel
- Fittings represent up to 90% of the strut's overall mass

Goal of the project: develop, manufacture and test 100% CFRP strut, no metal, affordable, very low CTE/CME, no broken fibres, and save more than 30% of mass

Results achieved, new struts, Black Struts beats the reference struts in all performance aspects and achieve +50% mass savings

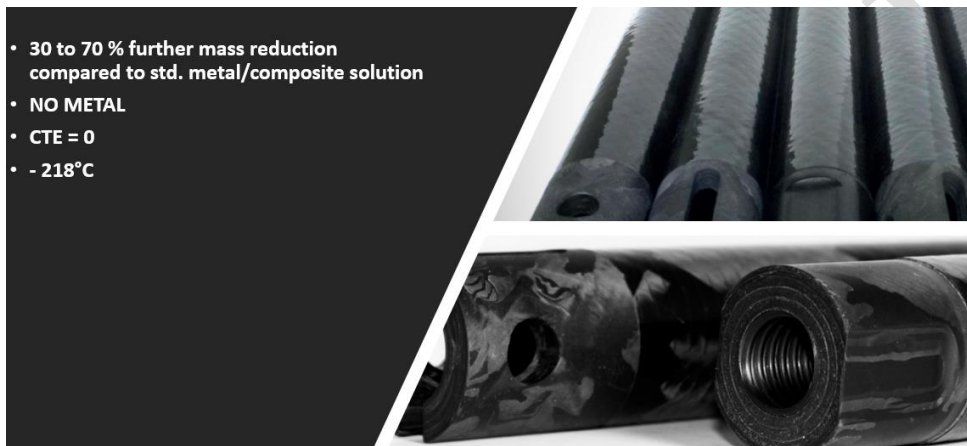


Figure 7 Close up on pin holes: no-cut-fibers



Figure 8 The whole strut has a mass of one equivalent INVAR metallic fitting

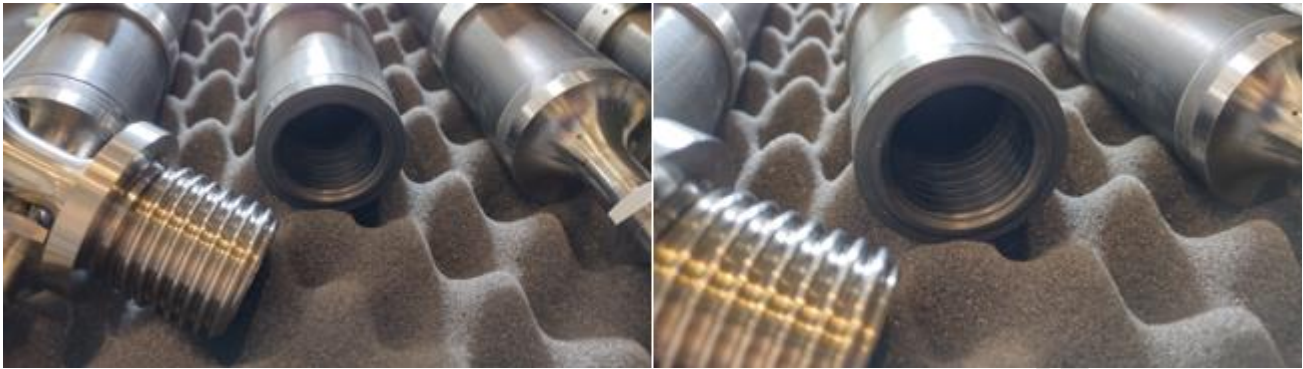


Figure 9 BLACK STRUTS, size Ø47, threaded fitting in action for ARIEL mission

Customer: Omnisys Instruments

Mission: ARCTIC WEATHER SATELLITE

Task: Design, manufacturing, test of entire instrument structure

Year: 2021 and on

Status: Scheduled for launch 2023

SCSDK is responsible for detailed design on component level and all manufacturing & test of entire instrument for Arctic Weather Satellite

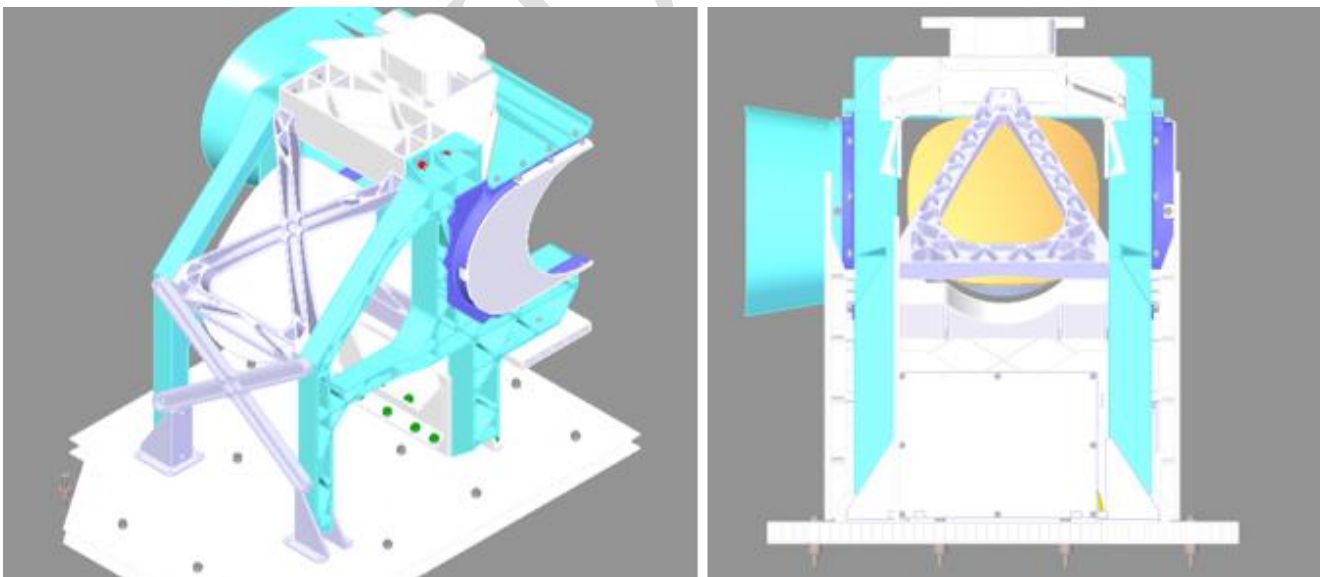
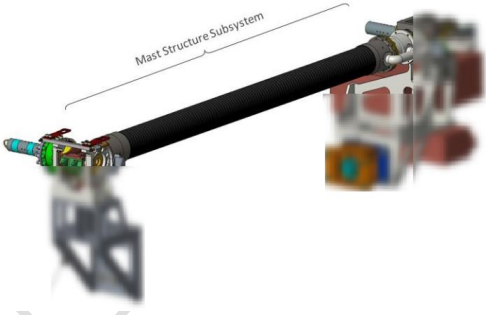
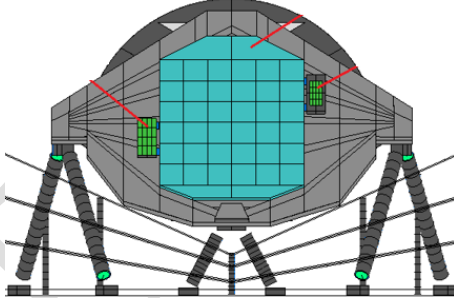
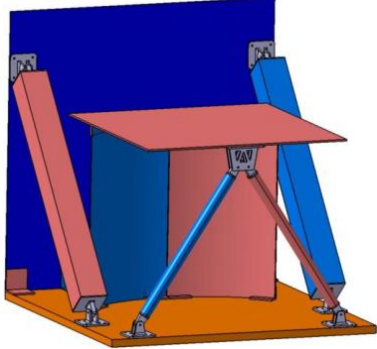
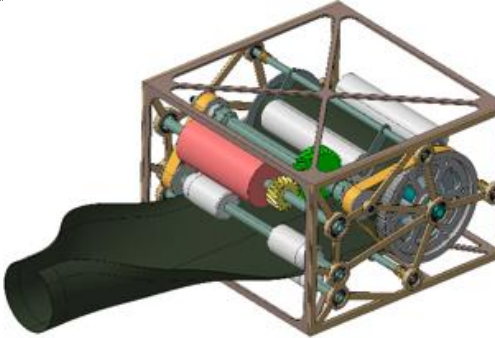


Figure 10 Arctic Weather Satellite Structure

The List

Contract Name (Role)	Description	Year	Funding	Results (Direct & Indirect), and Lessons Learned	Illustrations
Instrument struts, manufacturing	CFRP/Invar struts, manufacturing, JWST mission TRL9	2013	NASA	CTE = 0 struts, tested to -256C Launched 2021	
Mast Structure Subsystem	Mars Sample Fetch Rover Robotic Arm, CFRP/Titanium	On-going	ESA	Heritage design and manufacturing (Solar Orbiter & JUICE booms) Launch 2024	
Instrument boom, manufacturing	CFRP/Titanium boom sections for Solar Orbiter mission, manufacturing TRL9	2015	ESA	Delivered according to the spec Launched 2020	
Central Tube struts, design & manufacturing	Alu/C(G)FRP struts, design and manufacturing TRL9	2010 - 2017	IAI	Delivered according to the spec Launched since 1991	
Instrument Struts, design & manufacturing	Titanium/CFRP struts, design and manufacturing, ExoMars mission TRL8	2014-2017	ESA	Delivered according to the spec, very demanding manufacturing Launch postponed	
Anisogrid structure, design & manufacturing	Low cost manufacturing of Anisogrid structure TRL3	On-going	ESA	Several prototypes in different pattern/size	

Contract Name (Role)	Description	Year	Funding	Results (Direct & Indirect), and Lessons Learned	Illustrations
High performance struts, design & manufacturing	CFRP/CFRP struts, design and manufacturing TRL6	Ongoing	ESA	100 % CFRP struts, CTE=0, CME=0, 60% mass savings	
Instrument Bi-pods, design & manufacturing	CFRP/CFRP/Metallic struts, design and manufacturing for ARIEL mission TRL6	Ongoing	ESA	Low CTE, shall survive 50 Kelvin, high thermal conductivity Launch 2023	
Novelty techniques for CFRP Structures NDI – Manufacturing & testing	CFRP/CFRP/Metallic struts, design and manufacturing, void placement & Ultrasonic NDI	Delivered	ESA	Correlation between voids & NDI	
HF.VHF Tubular Deployable Antenna, design and manufacturing	Development, manufacturing and test of deployable compact flexible tubular antenna arm	Delivered	ESA	Proven manufacturability for Titanium and CFRP solution	
Instrument BiPods, Mechanical & Thermal	CFRP/GFRP/Metallic struts, design and manufacturing for COPERNICUS mission TRL6	Ongoing	ESA	Mechanical & Thermal Capabilities	

Commercial Proposal

• • •

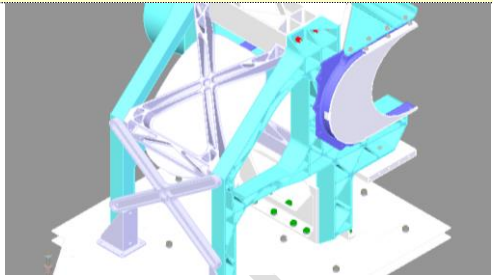
Contract Name (Role)	Description	Year	Funding	Results (Direct & Indirect), and Lessons Learned	Illustrations
Instrument Structure Complete	Detailed design on component level and all manufacturing & test of entire instrument	Ongoing	ESA	Mechanical & Thermal Capabilities CFRP panel, alu structure, assembly, test	



Figure 11 Inhouse manufacturing from left: Filament winding of CFRP tube, digital controlled CNC, struts in bonding jig



Figure 12 ISO 8 soft wall cleanroom (installed in October 2018), mainly for bonding, cleaning & contamination control purposes

Machined parts in aluminum

Customer: AIRBUS (France)

Mission: METOP SG

Task: design, manufacturing 123 assemblies, coating (Black Paint & Kapton tape), heaters bonding, test.

Year: DELIVERED 2017 / 2018

Status: deployed

Delivered. STM Units mimic METOPSG scientific instruments in mass, centre of gravity and thermal behavior meaning that SCSDK has designed, manufactured, verified by test and delivered a high number of flight-spec components and assemblies without rejects. Solutions used: high precision machining of 7075 Aluminium components ordered and controlled supplier in Slovenia, Kapton tape & Aeroglaze Black paint ordered and controlled supplier in Denmark, implementation of thermal control (bonding of heaters), final assembly, test & inspection done in-house @ SCSDK

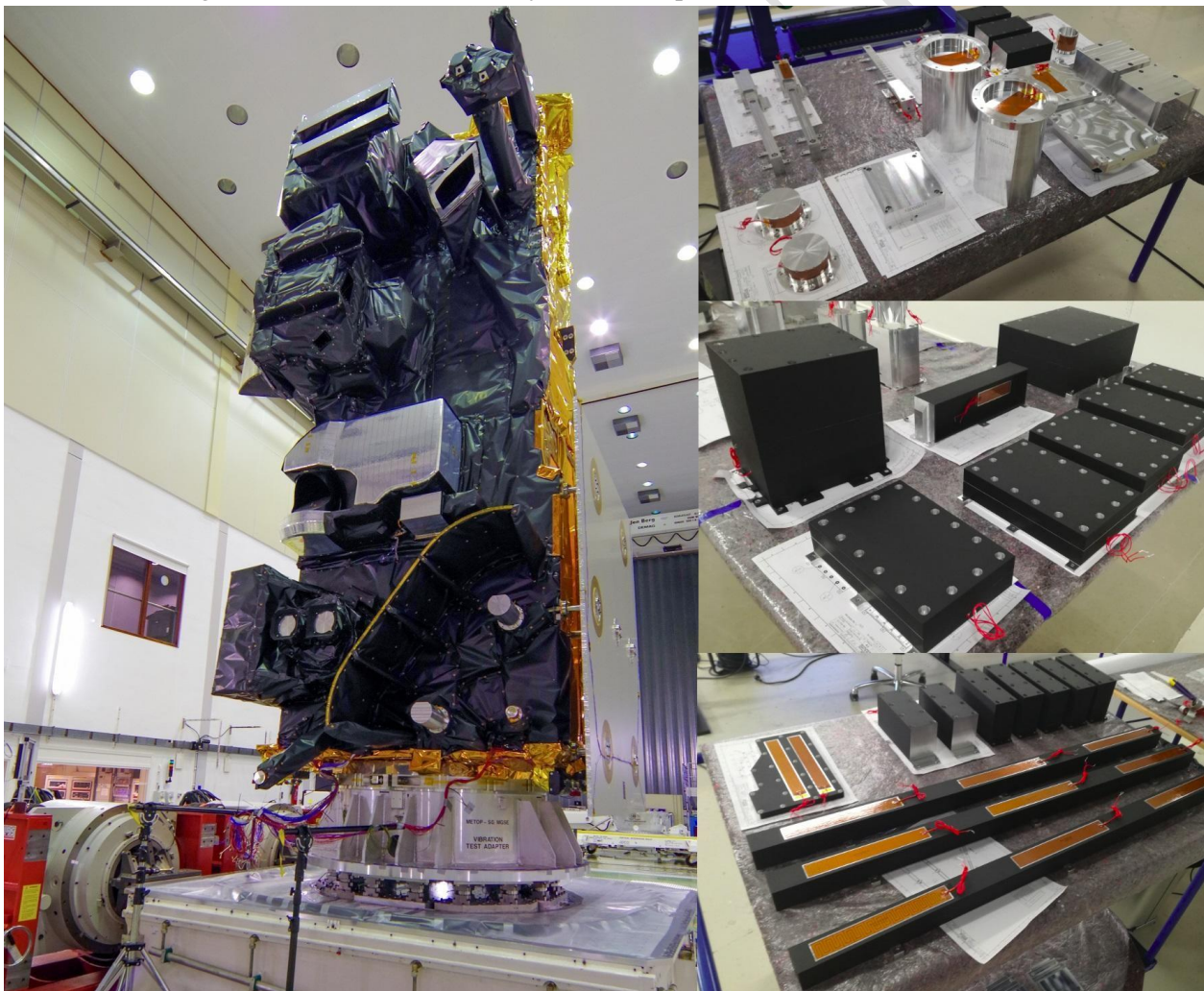


Figure 13 STM Units mimics real Scientifics instruments (Photo: European Test Services B.V & SCSDK)

Mechanical Ground Support Equipment

Customer: LUSOSPACE (Portugal)

Mission: SENTINEL 5

Task: design, manufacturing, coating, assembly, test.

Year: DELIVERED 2021

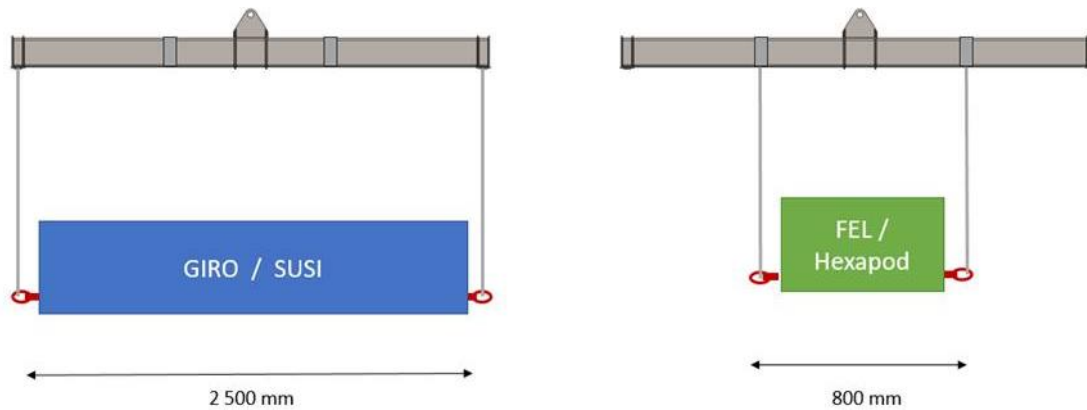


Figure 14 Lifting device, adjustable load width, for hoisting various types of Sentinel 5 Optical Equipment with weights up to 500 kg

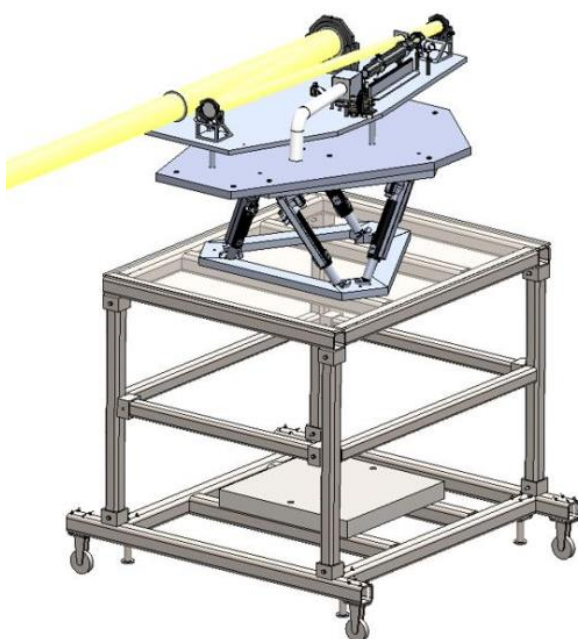


Figure 15 Dolly for transporting 800 kg radiance equipment for Sentinel 5

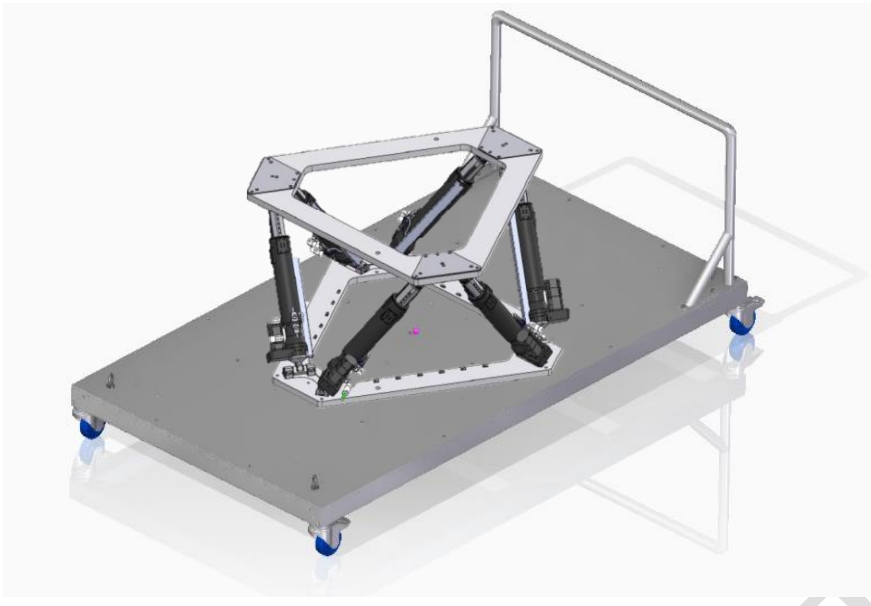


Figure 16 Multipurpose dolly for transporting Sentinel 5 equipment of up to 500 kg

Customer: AIRBUS (France)

Mission: Solar Orbiter

Task: (Design only)

Year: 2012

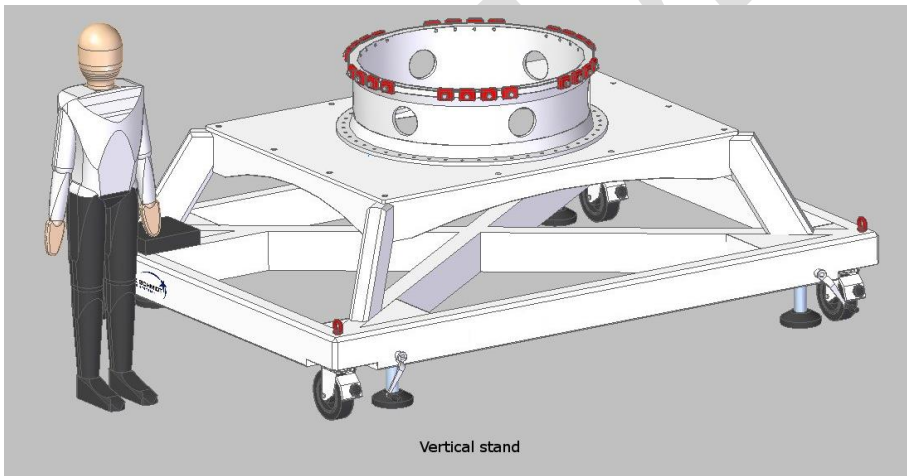


Figure 17 Vertical stand: lateral movement only

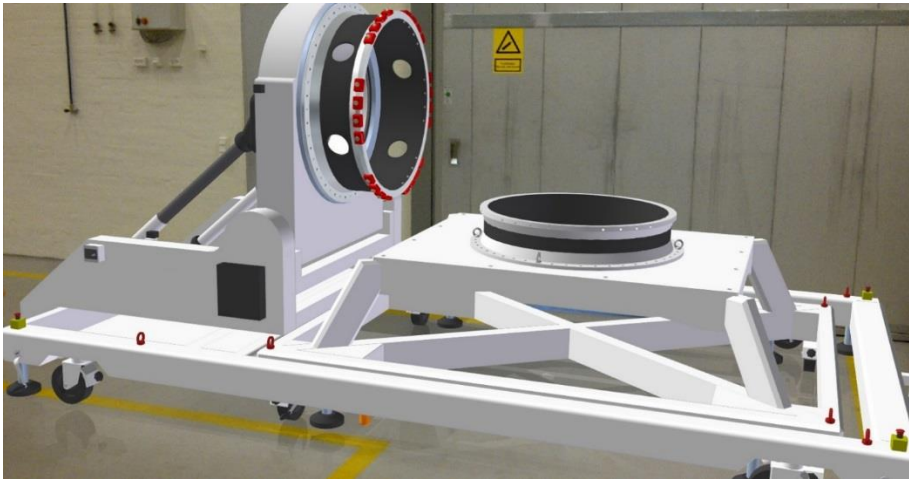


Figure 18 Multi-Purpose trolley with corresponding Vertical Stand