AIRWORKS // Space Capabilities

Monfalcone – 01.10.2014

Engineering & manufacturing expertise to support the development of flight space hardware and ground systems.
In traditional cultures, AIR is seen as a universal power or a pure substance. According to ancient Greek philosophy AIR is the element in relationship with imagination and thought, focusing on ideas which have not materialized yet.

WORKS

Our Facts.

Engineering Advanced Systems
Combining vast design skills with a thorough knowledge of manufacturing, we help organizations develop outstanding technologies for Space, Defence, Wind Power and other demanding domains.

**CAPABILITIES**

- **“Turn-key” Contracts**: design, development, qualification, manufacturing, testing and delivery of Structures and MGSE from customer specifications.

- **Special Jigs & Tools**: electro-mechanical systems for complex, highly precise manufacturing operations and special environments (ISO5 clean rooms, vacuum, management of optical elements, etc).

- **Mechanical Engineering Work Packages**: mechanical design & analysis, structural calculations (ECSS, static, sine random, shock), load analysis, opto-mechanics, test to FEM correlations, support with reporting & documentation.

- **Manufacturing Work Packages**: structural assemblies & parts, through proven manufacturing partners.
DEFENCE SYSTEMS

Airframes for reconnaissance, surveillance & weapon training UAS
Payload Mechanics

WIND TECHNOLOGIES

Rotorblades for Wind Turbines
Development of Proprietary Technologies

SPACE

Structures for Satellite Bus, Instruments, Reflectors, Experiments.
MGSE
Ground Systems (Telescopes, Antennas)

AVIATION

Engineering of Aero-Structures
Mechanisms
Engineering of Cabin Interiors
A team of 40 people skilled in solving complex design and manufacturing problems.

Business Specialties (Space):
AIT steps involving very high tolerances, precise machining, risk-sharing partnerships with main contractors on STM & GSE (engineering WPs, design & build WPs).
AIRWORKS ORGANIZATION

OUR COMPANY AT A GLANCE

- **2 Offices**: Rome (Cnt. Italy) & Gorizia (North. Italy) –
- **Current Capacity**: 30000 hours / year –
- **Main Businesses**: Defence, Aerospace, Wind Power –

SUBSIDIARIES

A2Wind GmbH: München (Germany), Wind Power –
- **Shareholders**: Airworks (50%), IABG mbH Group (50%) –
- **Web**: [www.a2wind.net](http://www.a2wind.net)

BUSINESS MANAGEMENT

- **Sales**: s.picinich@air-works.eu
- **Rome Office**: a.targusi@air-works.eu
- **Gorizia Office**: m.tarnold@air-works.eu
- **Wind Power**: s.picinich@air-works.eu
WHAT WE DO

Development

Knowledge
- Contractor for design & build projects –
- Structures from specification to production –
- Implementation of composites –
- Manufactured Prototypes –
- Research Programmes –

Expertise
- Space Systems. MGSE –
- Military Drones –
- Technologies for Wind Power, Blades –
- Aerospace Structures & Kinematics –

Design

Knowledge
- Conceptual Design –
- Detailed Design (3D, 2D) –
- Material & Process Selection –
- Aerostructures, Primary & Secondary –
- Space Structures & Instruments –
- Opto-Mechanical Design –
- Mechanisms –

Software
- Catia V5, including Composites –
- Inventor, Solidworks –

Analysis

Knowledge
- FE analysis –
- Structural Dynamics & Aeroelasticity –
- Strength & Stability –
- Multidisciplinary Optimization –
- Fatigue & Damage Tolerance –
- Kinematical Simulation (Multibody) –
- Test Correlation Analysis –

Software
- Nastran / Hyperworks / Fortran –
- ModeFRONTIER –
Test-Proof Designs

Passing GL Certification with our 45 meter wind turbine blade design in Baoding (20/02/2012)
Projects
The Environmental Mapping and Analysis Program (EnMAP) is a German hyperspectral satellite mission that aims at monitoring and characterising the Earth’s environment on a global scale.

OHB System is EnMAP prime contractor to DLR

Airworks has signed a contract with OHB System to design and manufacture a highly specific MGSE.

Airworks is responsible to provide OHB System with the complete set of high-precision mechanisms and tools for the assembly and testing of the imaging instrument.

Project funded from the German Ministry of Education and Research (Bundesministerium für Bildung und Forschung) under reference number 50 EP 0801.
Precision Installation Tools

OHB System (2014)

**AIRWORKS Tasks**

*Installing mirrors and prisms into the imaging instrument of EnMAP spacecraft is an operation of outstanding accuracy.*

Airworks is responsible for the design, manufacture, testing and commissioning of the two positioning mechanisms (PITs) that will integrate the Telescope Assembly and the Spectrometer.

**Telescope PIT (TA-PIT)**

- Load capability up to 5 kg
- Pre-positioning of the Mirror Holder with very high accuracy (meas. orthogonality error in all axes: ≤ 5 µm over 500 mm travel), then comprehensive tools for fine adjustment.
- Manual actuation
- Position is measured with incremental linear encoders (accuracy 1 µm) and measurement probe
- Designed for ISO 5 cleanliness grade
Precision Installation Tools
OHB System (2014)

Telescope PIT (TA-PIT)
- 3 main axes for pre-positioning, further 7 degrees of freedom for fine adjustment
- Installation of the mirrors can be seamlessly switched from controlled mode (micrometers) to fully manual
- Isostatic mount principle to connect the Mirror Holder to the PIT
Precision Installation Tools
OHB System (2014)

**Spectrometer PIT (SPEC-PIT)**

- Accurate installation of payloads up to 30 kg
- Very high stiffness under service loads (\(< 20 \mu m\) at the Payload Holder)
- Electrical actuation of the 3 main axes
- Incremental linear encoders (1 \(\mu m\) accuracy)
- Pre-positioning of the Mirror Holder with high accuracy (requirement: \(\leq 0.2 \text{ mm}\) over 500 mm travel in all axes), then 7 degrees of freedom for fine positioning
- Controlling via console
- Designed for ISO 5 cleanliness grade
Precision Bonding Jigs
OHB System (2014)

AIRWORKS Tasks
The imaging instrument of EnMAP spacecraft consists of several mirrors and prisms that require extremely precise bonding to the supports. Airworks is responsible for the design and manufacture of the bonding jigs (13 items).

MAIN CHALLENGES
- Ensure bonding in a stress free state, by design
- Very accurate positioning of the optical elements (autocollimator, pentaprism, micrometers, etc)
- Monitor the stability of the optical elements pre, post and during curing using cameras
- Support the final metric and optical measurements of the optical assemblies
- Designed for ISO 5 cleanliness grade
Precision Bonding Jigs
OHB System (2014)
Multipurpose Equipment

OHB System (2014)

AIRWORKS Tasks

A multipurpose frame is required to support the EnMAP spectrometer during integration, optical testing, thermal vacuum testing, transport, lifting and handling.

Airworks is responsible for the design, manufacture, testing and commissioning of the Frame.

Integration Base Frame

- Multipurpose item supporting several assembly and testing operations
- Design compatible with vacuum and ISO 5 cleanliness grade. Polished stainless steel.
- Very high stiffness (displacement < 30 µm at the Instrument feet)
- Isostatic mount
- Legs accommodating ±12.5 mm fine adjustment in all axes
- Mechanical interfaces to approximately 20 OGSE and MGSE items (high precision)
Multipurpose Equipment
OHB System (2014)

Integration Base Frame & Turnover Lifting Trolley
Multipurpose Equipment

OHB System (2014)

Support to Zero-G optical test

Handling on wheels
Accessory Items

Support Brackets, Risk Mitigation Telescope, Purging & Storage Containers for Optical Elements, Bare Mirror Handling Tools

Purging & Storage Container (Optical Elements)

ENMAP Risk Mitigation Telescope
Ground & Test Support

AIRWORKS has extensively supported ground operations on eROSITA through several MGSE sub-systems.

*eROSITA*

MPE / 2010 -12
Design of thermal insulation –
Test set-up design –
Design of MGSE –
Handling & test procedures –

*eROSITA Vibration Test Frame*

*eROSITA Clean Tent & Purging Device*
Engineering Packages

Sentinel 4 OIM Structure

OHB System (2014)

AIRWORKS Task

Subcontractor to OHB System for the structural analysis of the Optical Instrument Module Structure (phase B & C)

- Evaluation of structural requirements
- Establishment of detailed structural design
- Optical Instrument FEM
- Structural analysis, stress analysis, dimensional stability analysis
- Support OIM Structure test qualification
- Participation to major milestone reviews
Spacecraft Design

Since start, AIRWORKS has served Space Integrators by supporting the development of the satellite mechanical and structural designs.

Cosmo - Skymed 2nd Generation
Thales Alenia Space (2011-12)

Mechanical Design
Design and manufacturing optimization of the Frame (primary structure) –
Design and manufacturing optimization of the MacroTiles (secondary structure) –
Design of the brackets of the Fixed Hold and Release Mechanisms (FHRM) –
Design of the Radiating Board assy including the FRP chassis –
Harmonization of the 3D structural models with the Harness/Piping requests –
2D drawings and Interface Control Drawings (ICD) –

Mechanical Analysis
Generation of FE models –
Structural and thermo-elastic sizings –
Sine analysis in the frequency domain (accelerations, forces, stress) –
Notching masks –
Random analysis in the frequency domain –
Dynamic analysis vs. structural tests correlation –
Facilities & Instruments

AIRWORKS provides comprehensive design, analysis or turn-key development services up to prototypes for ISS experiments, at system or sub-system level.

The PK4 Experiment
Kayser-Threde GmbH (2012)

AIRWORKS Tasks:
- Review of the existing analysis documentation
- Consolidation of the applicable mech. requirements
- Upgrade PK4 facility FE models to latest designs
- Thermo structural calculations (ground / on orbit)
- Justification of the facility: intact & failsafe launch set up
  - Modal analysis
  - Random analysis
  - Shock response analysis
  - Test correlation analysis
- FE model tuning to measured dynamic response
- Burst– pressure strength check
  - Containment analysis
  - De - / Repressurization analysis
  - Joint check including fatigue
- Structural analysis reports for CDR with ESA
MAIN CHALLENGES:
High dimensional stability (10 μm) under extreme thermal impact (10kW).
High accuracy manufacturing, assembly and co-alignment of mirrors

Optomechanics
Since year 2010, AIRWORKS has been supporting the development of new optical systems for different industrial applications.

EUVL Grazing Incidence Collectors
Media Lario Technologies (2010-12)

Support to Opto-Mechanical Design
Mechanical design and configuration control of the Collectors –
Development of the mirror cooling system –
Materials compatibility with plasma, EUV light, vacuum –
Design of permanent and demountable joints –
Design of the Heat Exchangers –
Design of adjustable supports systems for mirrors –
Design of jigs and tools –

Analytical and Experimental Development
1D Simulations of the cooling system –
Experimental fluidodynamics, Measurements. 1D model calibration –
Optomechanics

AIRWORKS has been the selected partner by MEDIA LARIO TECHNOLOGIES to support the development & optimization of the Single Aperture Multispectral Sensors System. Unveiled in April 2012, the sensors outperform most of current available systems in the market.

SAMSS (2010 -12)

**AIRWORKS Tasks:**
- Conceptual module mechanical design
- Technology feasibility
- Mathematical optimization of the mechanical design
- Maximize stability of the optical response in operation
- Compliance with assembly and alignment requirements
- Compliance with maximum weight requirements
- Thermo-structural strength
- Design of flight and lab modules
- Design of tools
- Design and manufacturing documents

**Capabilities of the Multispectral Modules:**
- Suited for Airborne, UAV, Security and Space
- Compatibility with MIL-STD-810G
- Compatibility with cooled and uncooled detectors
- Optical design for a dual detectors scheme
- Available cold stop position
- Available beam splitter position
Large Size Telescope (LST)
Mechanical assessment of the LST Concept –
Structural analysis under seismic loads –
Concept evaluation under combined environmental LCs –
Displacement processing for performance analysis –
Optimization of the structural design –
Highly complex problems, involving different disciplines and multiple objectives, require not only engineering understanding but also a systematic approach through process automation and mathematical optimization.

This is our know-how.

**Capabilities**
- Engineering process automation
- CAE software integration
- Statistical data analysis
- Single & multi-objective optimization
- Optimization based on analytical & exp. models
- Robust design

**Offering**
- Optimization-based product design
- Development of automated engineering processes for the customer
- Integration of customer analytical models (CAE) with experimental data

**Applications:** Instruments, Space, Power plants, Structures
+Plus

Samples from the full technology range
Defence systems

An outstanding experience with unmanned technologies enables specialized services to comprehensively optimise UAS, air defence and underwater systems

LCAT UAS Platform (2013)

**AIRWORKS Tasks:**
- Engineering contractor for the development of a family of UAS –
- Responsible for the airframes & the mechanisms –
- Design (from preliminary stage to manufacturing drawings) –
- Optimization w.r.t. manufacturing costs and flight range –
- Manufacturing support –
- Certification –
- Liaisoning with other sub-system level contractors –

**SELEX-ES**

**MIRACH 200 (2010)**
- Thermal analysis (Avionics),
- Static structural analysis of the UAS body, load application,
- FEA, Certification Reports.

**CAPABILITIES**

- **Airframes and Platforms as Turn-Key Subsystems:**
  - design, engineering, tooling, materials, testing, certification, prototypes, industrialization, serial production.

- **Prototype Optimisation in terms of Performance / Cost Targets:**
  - structure, materials, processes.

- **Engineering Packages:**
  - mechanical design & analysis, fatigue, structural dynamics, aeroelastic calculations, mechanical loads, thermal analysis, certification assistance (STANAG, etc)
SELEX ES Asio B: Optimization of the Airframe

SELEX ES Spyball: Optimization of the Airframe

SELEX ES Falco: Optimization of the Airframe with new materials
Complete structural assessment (FE models, Strength, Aeroelasticity)
Structural certification documents

SELEX ES Falco EVO: Structural analysis & documentation

SELEX ES Crex: Optimization of the Airframe
Contacts

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