✓ Alma-Sistemi MGSE team is able to develop all the design phases of all MGSE different typologies, starting from the proposal up to the Critical Design Review according to ESA ECSS standards.

✓ The team provides supervision to all Manufacturing, Assembly, Integration and Test activities up to the item delivery and covering warranty period.

✓ Alma-Sistemi has a list of trusted supplier for the manufacturing of the MGSEs at both national and European level.

✓ The Team technical experience can cover requirements relevant to various Clean Room Class (from ISO8 to ISO5) and to the Interplanetary Contamination Control.

✓ ALMA Sistemi is certified ISO9001:2015 for mechanical engineering
✓ ALMA Sistemi MGSE team is able to manage and support the design and of various typologies of Mechanical Ground Support Equipment for Space programs at both instrument and satellite level.

✓ Team experience matured during the design and development of the past projects is relevant to the various typology of MGSE:

- Transport Container (for satellites and payloads)
- Fixed and tiltable trolleys for payload
- Satellite stand
- Lifting and Hoisting Equipment's
- Alignment jig
- Adaptors for vibration test and thermal test
- Special Scaffolding to support the satellite integration
- Special trolleys for particle accelerometers
ALMA Sistemi Srl – MGSE Department structure

Program Manager & Senior Engineer
Giovanni Manoni

PA/QA Manager
Roberto Filippone

System & Mechanical Engineering
Filiberto Pacitti

Thermo-structural Analysis
Renza Santilli

Mechanical Design
Matteo Ricci
Matteo Gerbino

Electrical Design
Roberto Filippone

Documentation & CADM
Fabio Troiani
Engineering and documentation support to industrial contracts in the frame of European Space Agency programmes:

- **MeteoSat Third Generation (MTG) Spacecraft Transport Container** – Customer: Thales Alenia Space, Cannes, France.
- **MTG Platform Transport Container** – Customer: OHB Sistema GmbH, Bremen, Germany.
- **MTG Platform Radiator Tilting Stands** – Customer: OHB Sistema GmbH, Bremen, Germany.
- **EnMAP Mechanical Ground Support Equipment** – Kayser-Threde GmbH, Munich, Germany.
- **ExoMars Rover Transport Container** – Airbus Defence & Space, Stevenage, UK.
ALMA Sistemi Srl – MGSE contracts

Participated industrial contracts as subcontractor for mechanical design, analysis and documentation according to ESA ECSS standards

✓ MetOp-2G MicroWaveSounder Mechanical Ground Support Equipment - Airbus Defence & Space, Portsmouth, UK
✓ MetOp-2G Scatterometer MGSE– Airbus Defence & Space GmbH, Friedrichshafen, DE
Ongoing industrial contracts with ALMA Sistemi either as prime or subcontractor

✓ **NeoSat Solar Array Transport Container** – customer: Thales Alenia Space Cannes SA, FR (delivery phase). ALMA Sistemi role: mechanical engineering and analysis, documentation according to ESA ECSS standards and supervision of manufacturing and test activities.

✓ **NeoSat Satellite Transport Container** – customer: Thales Alenia Space Cannes SA, FR (manufacturing phase). ALMA Sistemi role: mechanical engineering and analysis, documentation according to ESA ECSS standards and supervision of manufacturing and test activities.

✓ **Spoke Cryostat Module trolley and stand** – European Spallation Source, SE (prototype completed and accepted; series production started). ALMA Sistemi role: Turn-in key system.
The following MGSE has been designed:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration Base Plate</td>
<td>IBP</td>
</tr>
<tr>
<td>Turn-over Trolley</td>
<td>TOT</td>
</tr>
<tr>
<td>Lifting Beam</td>
<td>LBB</td>
</tr>
<tr>
<td>Horizontal Lifting Hoist</td>
<td>HLH</td>
</tr>
<tr>
<td>Rotary Lifting Hoisting</td>
<td>RLH</td>
</tr>
<tr>
<td>Instrument Transport Container</td>
<td>ITC</td>
</tr>
<tr>
<td>Thermal Vacuum Adapter plate</td>
<td>TVAP</td>
</tr>
</tbody>
</table>
**ALMA Sistemi Srl – MGSE accomplishments**

**MetOp-2G MicroWaveSounder Mechanical Ground Support Equipment**

MWS Integration Base Plate made in AA: CAD, FEM model and displacement result
ALMA Sistemi Srl – MGSE accomplishments

MetOp-2G MicroWaveSounder Mechanical Ground Support Equipment

MWS HLH Horizontal Lifting Hoist made in AISI 304: CAD MODEL
ALMA Sistemi Srl – MGSE accomplishments

MetOp-2G MicroWaveSounder Mechanical Ground Support Equipment

MWS HLH Horizontal Lifting Hoist: FEM model and stress analysis result
**MetOp-2G MicroWaveSounder Mechanical Ground Support Equipment**

Thermal Vacuum Adapter plate made in honeycomb with skins made in CFRP and AA honeycomb core
MetOp-2G Lifting and Handling Devices for Satellite

Satellite lifting device and its remote command and control equipments (preliminary design development for the proposal)
ALMA Sistemi Srl – MGSE accomplishments

**MetOp-2G Scatterometer MGSE**

*Airbus Defence & Space GmbH, Friderishafen, DE*

Multy-Purpose Trolley made in Stainless steel: CAD model
ALMA Sistemi Srl – MGSE accomplishments

MetOp-2G Scatterometer MGSE

Airbus Defence & Space GmbH, Friderishafen, DE

Multy-Purpose Trolley FEM model and deformation result
**ALMA Sistemi Srl – MGSE accomplishments**

**MetOp-2G Scatterometer MGSE**

*Airbus Defence & Space GmbH, Friderishafen, DE*

Multy-Purpose Trolley: CAD model
MetOp-2G Scatterometer MGSE

Airbus Defence & Space GmbH, Friderishafen, DE

Multy-Purpose Trolley
Transport & Storage Container for Scatterometer payload
Overall dimension during transportation phase are **3200 x 2300 x 1700** (L x W x H)
Transport container FEM and inner over-pressure analysis result
ALMA Sistemi Srl – MGSE accomplishments

MetOp-2G Scatterometer MGSE

Airbus Defence & Space GmbH, Friedrichshafen, DE

Transport Container
**Neosat Solar Array Transport Container**

**Thales Alenia Space Cannes SA**

**SATC External and internal view**

SATC overall dimension are 6000x 2438 x 3500 (L x W x H)
Neosat Solar Array Transport Container
ThalesAleniaSpace Cannes SA

FEM Model & Stress Analysis
For the container has been computed the necessary thermal power to maintain the inner temperature equal to 20°C considering the required external environment

\[ Q_{(\text{hot case})} \approx 720 \times 1.25 = 1005W; \quad Q_{(\text{cold case})} = 1000 \times 1.25 = 1225W \]

In addition a trade off to compute the thermal inertia is generally performed to evaluate the goodness of the walls thermal insulation

<table>
<thead>
<tr>
<th>Inner temperature</th>
<th>External temperature</th>
<th>Thermal inertia</th>
<th>Thickness of polyurethane</th>
</tr>
</thead>
<tbody>
<tr>
<td>20±10°C</td>
<td>-40°C</td>
<td>~2.5h</td>
<td>0.1m</td>
</tr>
<tr>
<td>20±20°C</td>
<td>-40°C</td>
<td>~5.6 h</td>
<td>0.1m</td>
</tr>
<tr>
<td>20±30°C</td>
<td>-40°C</td>
<td>~11.2 h</td>
<td>0.1m</td>
</tr>
<tr>
<td>20±10°C</td>
<td>+60°C</td>
<td>~2.2h</td>
<td>0.1m</td>
</tr>
<tr>
<td>20±20°C</td>
<td>+60°C</td>
<td>~3.8h</td>
<td>0.1m</td>
</tr>
<tr>
<td>20±30°C</td>
<td>+60°C</td>
<td>~6.2h</td>
<td>0.1m</td>
</tr>
</tbody>
</table>

Thermal analysis trade-off result (Thermal inertia)
Neosat Satellite Transport Container

Thales Alenia Space Cannes SA
ALMA Sistemi Srl – MGSE accomplishments

Neosat Satellite Transport Container

ThalesAleniaSpace Cannes SA
Neosat Satellite Transport Container
ThalesAleniaSpace Cannes SA
ALMA Sistemi Srl – MGSE accomplishments

Neosat Satellite Transport Container

ThalesAleniaSpace Cannes SA
ALMA Sistemi Srl – MGSE accomplishments

Neosat Satellite Transport Container

Thales Alenia Space Cannes SA
**ALMA Sistemi Srl – MGSE accomplishments**

**Neosat Satellite Transport Container**
ThalesAleniaSpace Cannes SA
Neosat Satellite Transport Container

ThalesAleniaSpace Cannes SA

Dimension:
L x W x H = 13,0 x 5,4 x 4,2 mt.
Transport Container
Unload operations at Cannes' harbor
Cryostat trolley for particle accelerometer

European Spallation Source
Tools and software CAD Computer-Aided Drafting

- Autodesk AutoCAD (2D)
- Autodesk Inventor (3D)
- Siemens Solid Edge (3D)
- Dassault Systems Solidworks (3D)
- PTC Creo (3D)

Above CAD files are readable/compatible with Catia V5 and with STEP ISO 10303-21
Tool and software for Thermo-Structural analysis (FEM Finite Element Method)

• Strand7 *

• ANSYS

Both programs are compatible with MSC Nastran

Other tools for CADM and documentation: MS Office, MS Project, Adobe pdf, Smartdraw.

Note: Strand7 is commercialized in Italy as Straus7
Main Customer Companies/Agencies

ESA

Thales Alenia Space (F)

Airbus Defence & Space (DE, UK)

OHB (DE)

Garofoli (I)

Elital (I)

European Spallation Source (SE)
ISO 9001:2015

MANAGEMENT SYSTEM CERTIFICATE

Certificato no./Certificate No.: Z9717-2018-IAQ ETA ACCREDIA
Data prima emissione/Initial date: 29 aprile 2019
Validità/Validity: 25 aprile 2019 - 29 aprile 2022

Si certifica che il sistema di gestione di: /This is to certify that the management system of:

ALMA SISTEMI S.r.l. - Sede Legale e Operativa
Via dei Nasturzi, 4 - 00012 Guidonia Montecelio (RM) - Italy
e i siti come elencati nell’Appendice che accompagna questo certificato / and the sites as mentioned in
the appendix accompanying this certificate:

È conforme ai requisiti della norma per il Sistema di Gestione Qualità/
has been found to conform to the Quality Management System standard:
ISO 9001:2015

Questa certificazione è valida per il seguente campo applicativo:
Realizzazione di prodotti e servizi di Ingegneria ad alto valore aggiunto
(Ed. 34)

Realization of engineering products and services with high added value
(Ed.: 34)

Loc. e Data/Loc. and date:
Winnetca (HS), 29 aprile 2019

Per l’Emissione di Certificazione/
For the Certification Body
DNV GL – Business Assurance
Via Energy Park, 16 - 20871 Winnetca (HS) - Italy

Zeno Bortoni
Management Representative

Le modalità del presente Certificato è su base di quanto risulta dalle condizioni contenute nel contratto di Certificazione.
Lack of fulfillment of conditions as set out in the Certification Agreement may render this Certificate invalid.

DNV GL Business Assurance S.p.a., Via Energy Park, 16 - 20871 Winnetca (HS) - Italy, tel. +39 02 8892 905, www.dnvgl.it