RUAG Space GmbH

Cryogenic Cluster Day
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Overview

- RUAG – brief introduction
- MLI – basic knowledge
- RUAG – Coolcat MLI
- Typical cryogenic project
- MLI cutting process
- Cryo applications
RUAG at a Glance

- Innovation driven international technology Group
- Sites in: CH, DE, AT, SE, HU, USA
- 7,700 Employees
- Joint stock company under private law since 1999
- Shareholder: The Swiss Confederation
Devisions

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RUAG Space at a glance

- Biggest European space product supplier to the industry
- 7 sites in 3 countries
- 1,100 employees
- Total revenue (2010): 220 mEUR
Super insulation

- Basic knowledge of MLI (super insulation)

Outer temperature 300 K and inner temperature 77 K:

- Without MLI: 5.5 W/m² (THISTA)
- With MLI: 0.8 W/m² (20 layer)
Super insulation

- Super insulation lay-up

Polyester foil with aluminium coating

Polyester Spacer
Super insulation

- Several effects lead to decrease the super insulation performance:
  - Decreasing vacuum conditions (residual gas pressure)
  - Inappropriate installation

H. Neumann (KIT)
Super insulation

- Vacuum quality below $10^{-4}$ mbar → MLI becomes feasible
- Decreasing vacuum conditions
  - Outgassing products
  - Leakage
  - Low pumping time
  - Residual gas pressure between the MLI single layers
Super insulation

- Proper designed & installed super insulation
  - Installation in a loose way (not too tight)
  - Uncompressed installation (mechanical load - weight)
  - Remove direct line of sight connection from outer to inner vessel
  - Installation technique
Coolcat super insulation from RUAG Space

- Standard super insulation material
  - COOLCAT roll and sheet material
  - COOLCAT tape

- Tailor made super insulation
Typical cryogenic super insulation project

1. Purchase order & CAD and/or super insulation specification input
2. RUAG 3D super insulation design
   - Optimized for:
     - Minimum boil-off
     - Minimum installation time
     - The usage of automated production
     - Repeatability
3. Production drawings
4. Work preparation
Typical cryogenic super insulation project

5. Super insulation production
   - Production
   - Finished product

6. Product assurance

7. Packing and delivery
Super insulation cutting processes

- Manual with scissors or knifes

- Fully automated with LASER cutting machine
LASER cut heat sealed edges

- Heat sealed edges with thin bridges from molten polyester → low conduction

- Benefit:
  - Single layers are held together → additional processes become redundant (e.g. sewing)
  - Reduced production cost → automated process
  - Improved handling → easy to assemble → save labour cost at the integration
  - Quick vacuum pumping → open edges
  - Institutional and practical evaluation
Cryo applications

- MRI
- HTS generators
- HTS cable
- NMR
- Physical experiments
- Liquid hydrogen storage
- RUAG super insulation

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Coming together is beginning.

Keeping together is progress.

Working together is success. (Henry Ford)