

ALMA PROTECTIVE ENCLOSURES

Application

This products are part of the equipment for the ALMA (Atacama Large Millimeter/submillimeter Array), installed on the Chajnantor plateau in the Chilean Andes.

The ALMA antennas are optimised in order to operate in the millimeter/sub-millimeter wavelength range, providing to the antenna arrays the possibility of detecting the light coming from the coldest elements of the Universe (infrared light and radio waves).

ALMA operates at extreme environmental conditions (5000 m above sea level, very high thermal excursions and frequent quakes). For this reason any installed equipment must be carefully studied and optimized.

The ALMA enclosures are aimed at the protection of the cryogenic compressors and of the related electronic units for the antennas.

The cryogenic system is necessary for assuring the proper working mode of the low noise receivers, so it is mandatory to provide a long-term reliable protective equipment for it.

The main characteristics of these components are described in this document.



Summary

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1 References

This product was produced, tested and delivered by CECOM for "ESO" (European Southern Observatory - Chile). The references of contact persons for this work are available under request.

2 CECOM activities

CECOM carried out the following activities:

- Review of manufacturing drawings (engineering design and development of tools and equipments needed for the manufacturing).
- Optimization of the design for:
 - Mechanical performances
 - Assembling
 - Applied technologies
- Optimization of technical solutions for production and assembling
- Manufacturing of components, and management of the pressworking
- Assembling, welding, and painting
- Cleaning and special packaging
- Quality check:
 - Dimensional checks of components and assemblies
 - Electrical installation and functionality tests (with electronics and test specifications supplied by the Customer)

3 Materials and treatments

Used materials:

- Aluminium (light profile of the ICCU structure and inner components)
- Stainless Steel (OCU structure, inner components and sheets for all panels)
- Special thermal insulator (ICCU panels)
- Commercial electrical components for the thermal control system

All screwed parts are blocked by means of a suitable thread-locker, in order to guarantee the long-term stability of the product.

4 Manufacturing, assembling and testing

The design of the product was deeply studied by CECOM and optimized in order to improve the final performances, also assuring a straightforward and reliable assembling.

A particular care was applied for the following tasks:

- Mechanical preparation and assembling method ICCU panels.
- Stiffness and reliability of fasteners, locking and handling components.
- Easy and reliable installation/uninstallation of panels and carters.
- Stability of all assembled components, even when vibrations are induced and in case of thermal excursions.

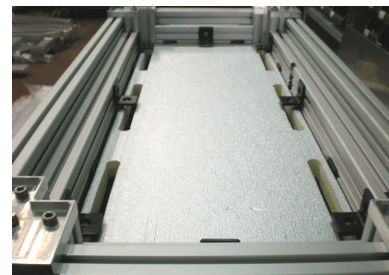
An important pressworking operation was carried out for some parts of these enclosures. A relevant example is represented by the hood (carter with slots). Due to the outdoor operation of this protective enclosure, the pile up of the snow could obstruct the slots aimed at the circulation of air, so the shape of this element is optimized in order to avoid this problem. From the mechanical point of view, the a great experience in pressworking and welding is required in order to obtain the final result. A detail of this component is shown in Fig. 1.



The OCU structure required a precise preparation of the parts, and a high care and experience on the welding, in order to minimize the deformations, thus allowing a straightforward assembling (Fig. 2).

One of the most critical points involved with the production of the ICCU enclosure is represented by the insulating panels. The insulating material was chosen and tested in order to maintain its properties also in the temperature and pressure conditions which are typical of the 5000m altitude.

The mechanical properties of this material show a critical dependence on the temperature, when a certain threshold is exceeded. The original solution for assembling would have led to unwanted deformations of the panels, so we carried out specific tests and, in agreement with the Customer, we changed the assembling cycle in order to prevent the insulation material from any alteration of its physical and geometric properties.



In both cases (ICCU and OCU assemblies) the painting plays a fundamental role for the reliability of the application. Powder coating was applied, with a painting cycle optimized in order to prevent the painted parts from any deformation or alteration of mechanical properties. This assured the proper working conditions and the long time operation, also guaranteeing the respect of all required specifications.

CECOM carried out also the installation of the electrical system, aimed at the thermal regulation of the ICCU enclosure, and the related electrical tests



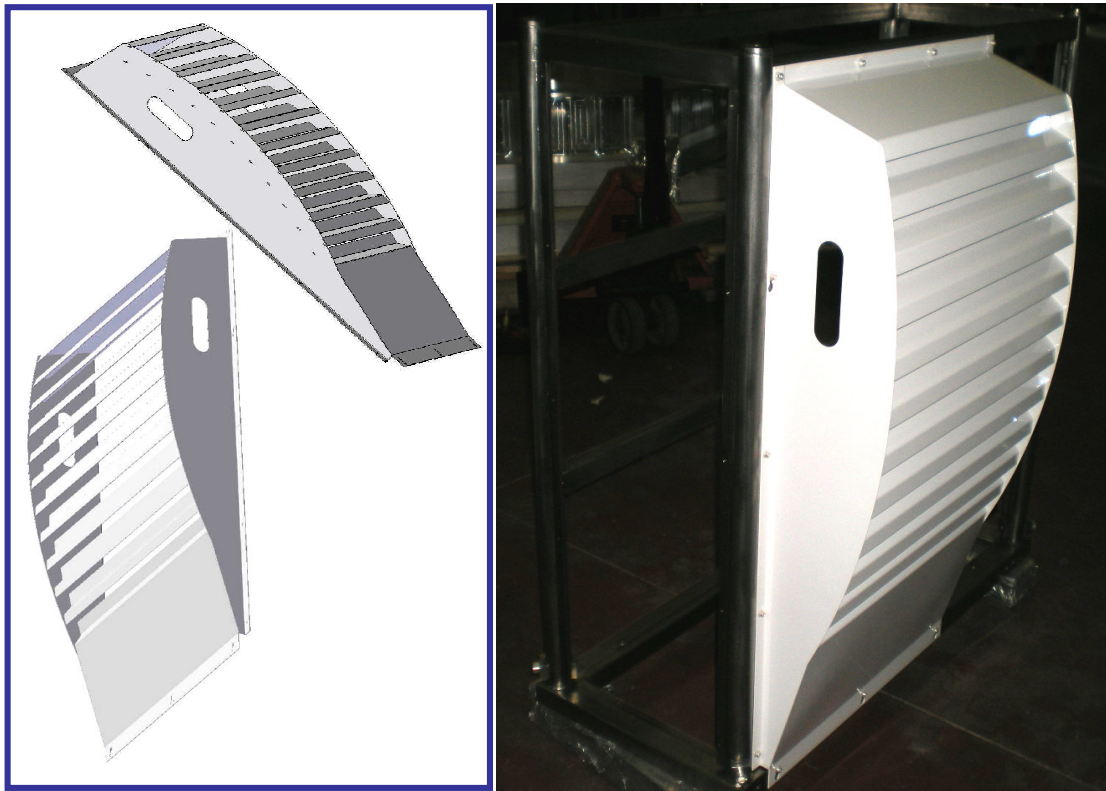


Fig. 1: OCU hood



Fig. 2: OCU details and assembly

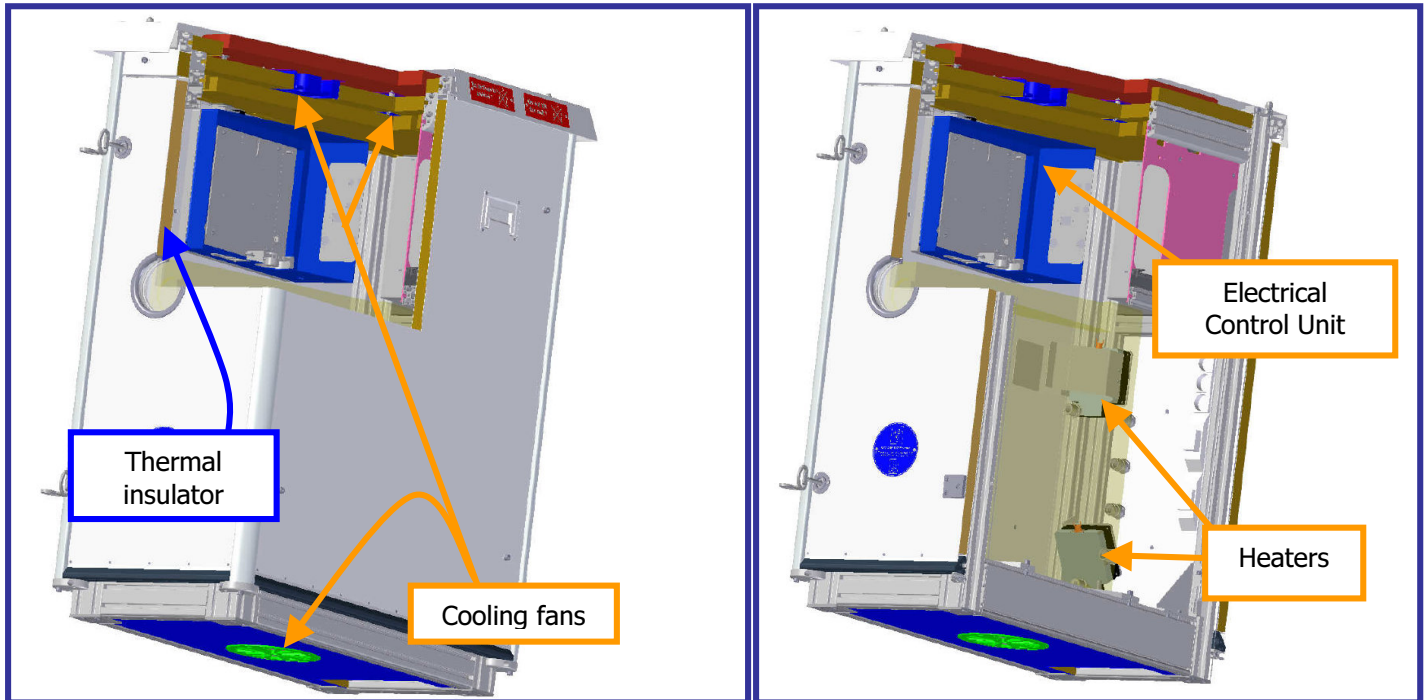


Fig. 3: ICCU details



Fig. 4: ICCU assembly