

Transport Container for Small Satellites

Introduction

Astro- und Feinwerktechnik Adlershof GmbH has acquired special knowledge by delivering the framework of various companies and organizations who work in the development of small satellite. In addition to orders for developing and manufacturing units to be deployed in outer space, we have also received a number of orders for implementing GSE (ground support equipment) solutions in the areas of handling and transportation technology. In the following we will present our experiences on the basis of selected examples.

1. Container system

The development of a construction kit allows the individual adaptation to the dimensions of the satellite. The container system provides transport for highly sensitive devices. Interchangeable frames for accommodating different kinds of objects make it possible for a container to serve different transport needs. The weight of the transported goods varies from a few kilograms, such as single pieces of equipment, to hundreds of kilograms when transporting satellites.

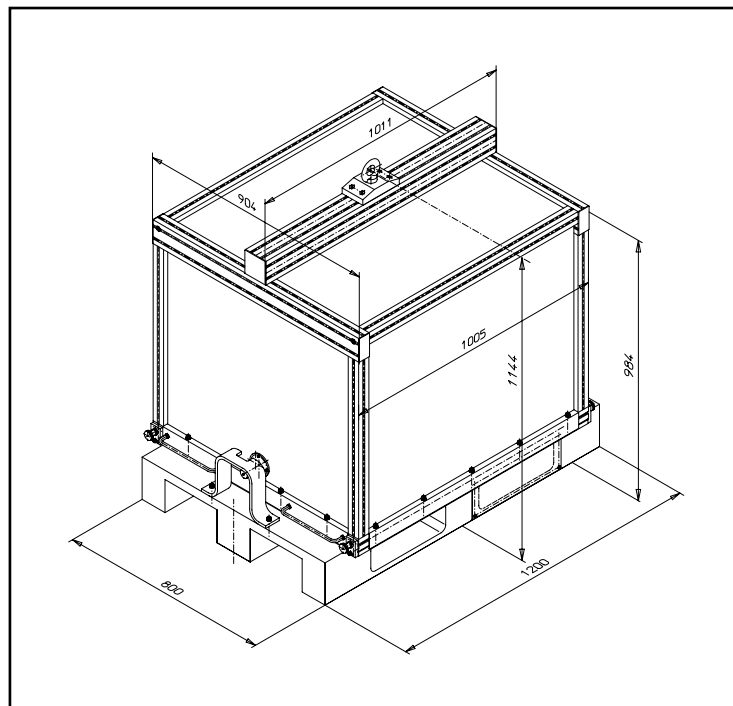


Illustration 1: Structure of a system container.

Common to all container types is the construction with two main subassemblies: the base plate assembly and a cover. The hermetic inner space of the container with a sweeping apparatus for cleaning the atmosphere with a defined gas, vibration reduction during satellite transport as well as a data logger for recording certain data during transport are standardized for all types.



The containers are constructed as pressureless vessels. This type of construction permits significantly easier and more flexible design in terms of dimensions. Special installations clean and dehumidify air entering the container as a result of pressure compensation.

To be suitable for a wide range of transport conditions, Euro-/ISO-pallets of different sizes are integrated into the base plate, enabling optimal adaptability to existing transport systems such as lift trucks and fork lifts. The container also has eyelet bolts for appropriate sling transport via crane. Rugged handles permit manual handling when necessary, for example in laboratory areas (illustration 2+3).

In addition to designs based on customer-specific dimensions, further value is in the considerably lower acquisition and transportation costs as well as in reduced organizational overhead required for air transport.

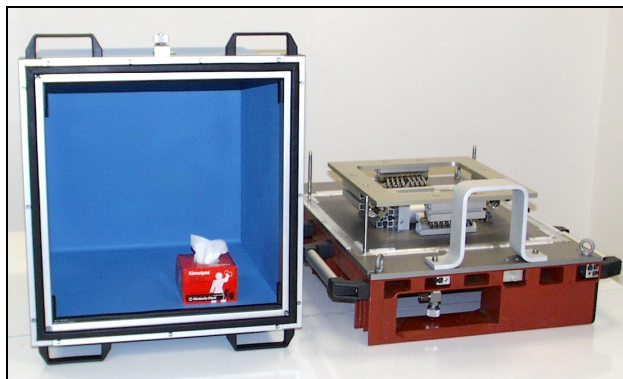


Illustration 2: Container for transporting the MAROC-TUBSat



Illustration 3: Container for the LAPAN-TUBSat

2. Container for small satellites

In 2001 a framework, conducted by DLR (German Aerospace Research Center), the BIRD-satellite for earth observation has been developed in the Institute of Space Sensor Technology and Planetary Exploration in Berlin-Adlershof. In this context Astro- und Feinwerktechnik Adlershof GmbH had developed a transport-container for the BIRD-satellite. This container was furthermore used for the DLR-TUBSat, a cooperation of DLR and TU Berlin. Based on this experience Astro- und Feinwerktechnik Adlershof GmbH developed transport-containers for the MAROC-TUBSat, which was developed by the Centre Royal de Teledetection Spatiale/Morocco and TU Berlin and for the LAPAN-TUBSat, developed by the Indonesian Space Agency LAPAN and TU Berlin.

The different missions under special atmospheric conditions put high demands on the container concerning humidity, temperature and pressure variation. Therefore the inner space of the container provides suitable transport atmosphere through gas sweeping, which is necessary for hermetic containers.

Sweeping the container is performed with a defined gas by means of a suction valve assembled on the cover and a molecular sieve on the outlet. Air is slowly discharged from the inside, creating container atmosphere which is dust-free and dry. Due to valveless discharge, pressure compensation is guaranteed when atmospheric pressure differences occur or when different altitudes (land or air transport) cause changes in air pressure.



The container is an unpressurized vessel. For air transport this means it is much easier to obtain the necessary licensing. It also means less weight, which equates to substantial savings in acquisition and transport.

A plastic pallet enables transport via wagon, lift truck and fork lift while guaranteeing a secure upright position even on uneven ground. It also complies with the standards of cleanliness (smooth, easy-to-clean surfaces) required in satellite laboratory environments. This minimizes introducing dust into clean-room conditions.

Depending on requirements, the base plate has three or four wire spring dampers which dampen nearly equally in all three directions due to their inclined arrangement (Illustration 4+5). The screw-down assembly frame on the dampers is replaceable. This allows quick assembly when adapting to different satellite interfaces.

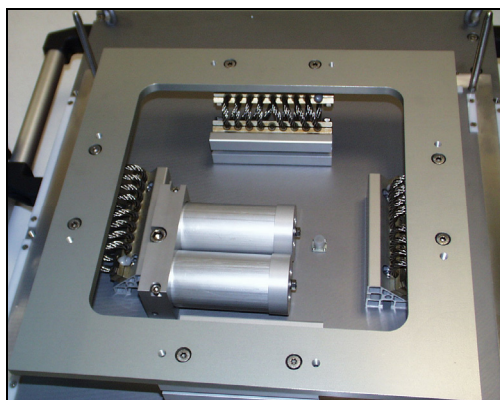


Illustration 4: Base Plate and assembly frame

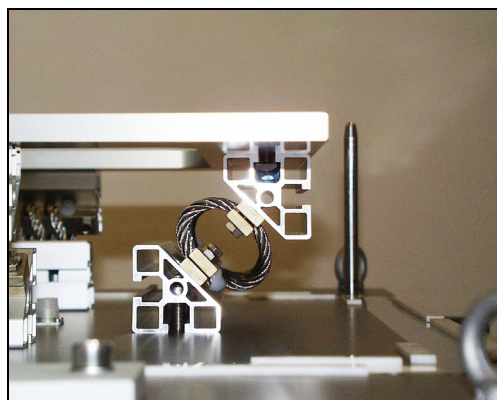


Illustration 5: Wire dampers on the base plate

The cover – an aluminum alloy sandwich construction enclosed by a frame structure – provides maximum mechanical protection with a minimum of mass. The frame takes the burden of weight so that the container can be lifted by one eyelet bolt with a crane (Illustration 1). This makes it possible to adjust to different centers of gravity during transport by moving the eyelet bolt horizontally. The different mass distributions resulting from different centers of gravity can thus be counterbalanced to avoid inclined positions from the crane hook. An additional harness is unnecessary.

To complete this container solution, a data logger records temperature and mechanical impact during transport.

For special modifications please do not hesitate to contact us.

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