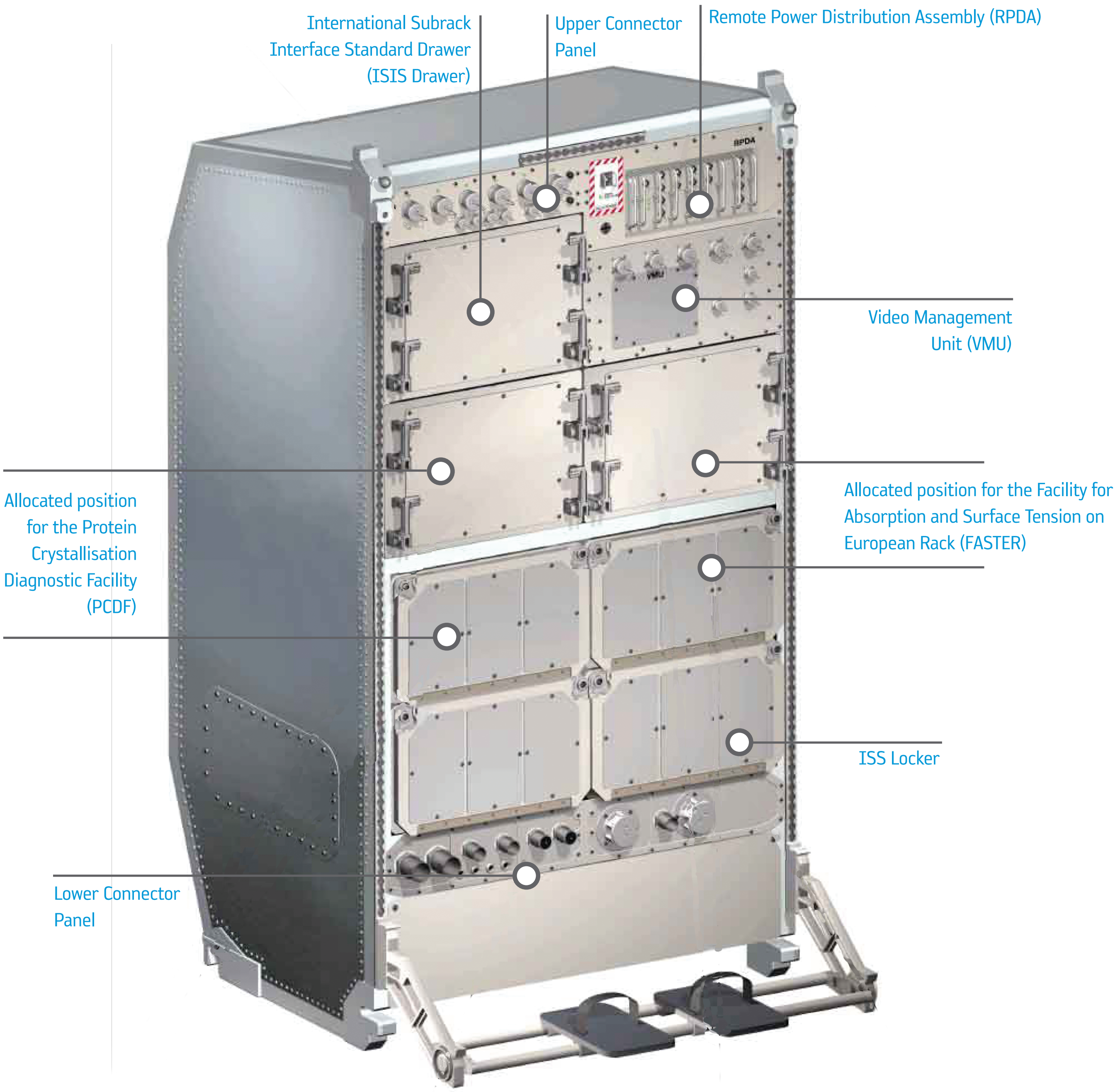
→ EUROPEAN DRAWER RACK (EDR)

Multi-discipline flexible experiment carrier in Columbus

The European Drawer Rack provides a modular capability for subrack payloads in International Subrack Interface Standard (ISIS) drawers and ISS Lockers accommodated in an International Standard Payload Rack (ISPR). The picture shows the EDR configuration with two payloads installed (FASTER and PCDF).

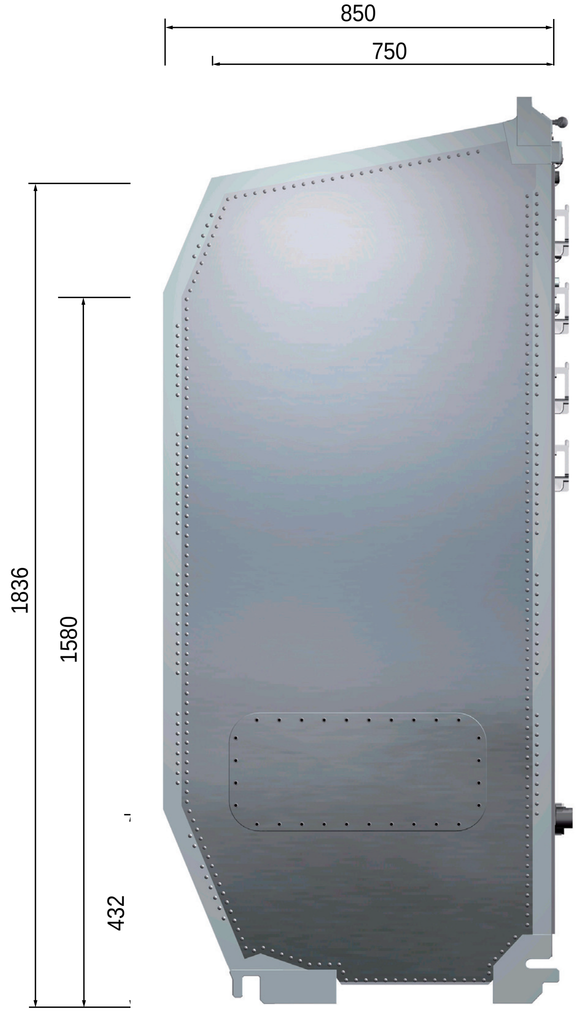


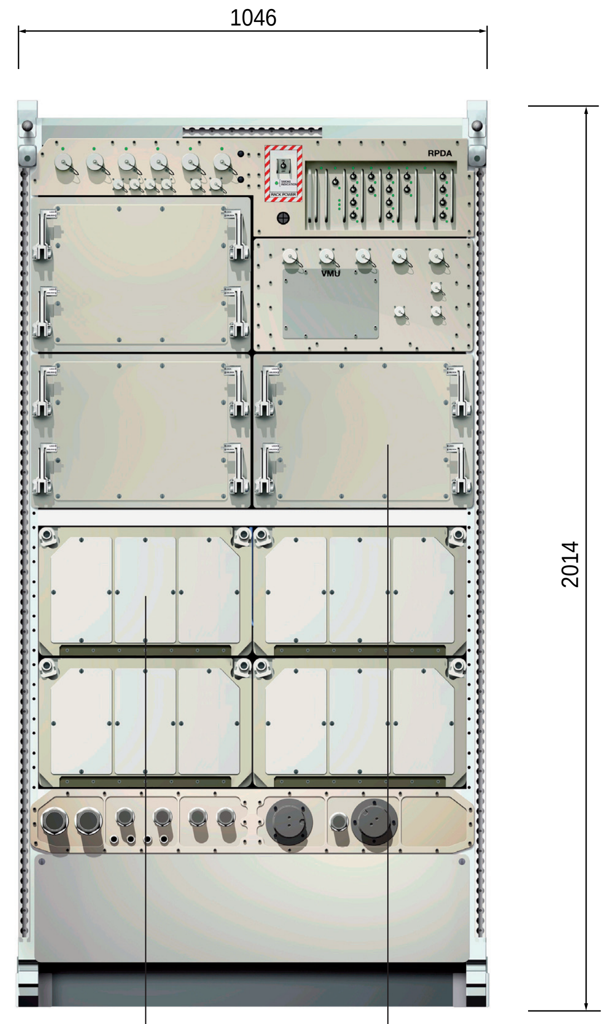
esa	PROJECT:	International Space Station	
TITLE: European Drawer Rack		DOCUMENT N°: ESA-HSO-COU-010	REV. 2.0

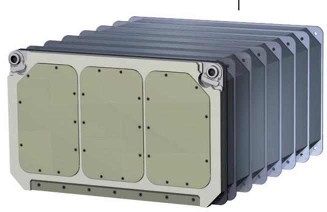
Facility Description

The European Drawer Rack provides a flexible experiment carrier for a large variety of scientific disciplines, and provides the accommodation and resources to experiment modules housed within standardised drawers and lockers called International Subrack Interface Standard (ISIS) drawers and ISS Lockers. This approach allows a quick turn-around capability, and provides increased flight opportunities for the user community wishing to fly payloads that do not require a complete rack. Currently, the European Drawer Rack facility can accommodate up to 3 drawers, and up to 4 lockers. The overall design of the facility is optimised for the parallel accommodation of three to four payloads, i.e. an average payload size of 2 drawers/lockers, but both larger and smaller payloads may be accommodated.

The resource management covers the monitoring of resource allocations to individual payloads, but is not intended to perform dynamic resource management and/or process control for individual experiments. It is assumed that the payloads will have their own intelligence and processing capability. Only in exceptional circumstances may a limited process control capability be provided to payloads.







ISS Locker

ISIS Drawer

Specifications

POWER

The Power Distribution Unit receives 120 Vdc and distributes 120 Vdc and 28 Vdc to payloads (and sub-systems).
An International Sub-rack Interface Standard drawer receives: 120 Vdc from the Power Distribution Unit with 10 A max. current.
The drawers and are also connected to 28 Vdc, 10 A max. current. However, each 28 Vdc drawer outlet is doubled with a 28 Vdc front panel outlet.
Five 28 Vdc (10 A max. current; 280W per outlet max.) outlets at the front of the rack (primarily for ISS Lockers).
Complete payload complement is limited to 2200 W maximum 600 W auxiliary power available to payloads (manual switch-over).

DATA HANDLING AND COMMANDING OF PAYLOADS

802.3 ETHERNET (for each International Subrack Interface Standard drawer).
RS 422 (for each International Subrack Interface Standard drawer).
Lockers have access to 4 ETHERNET connectors on the Utility Distribution Panel (one per locker).
1 RS 422 connector on the Utility Distribution Panel (alternative to ETHERNET but slower data transfer rate).
Communications protocol used is EXPRESS Rack protocol.
4 connectors for thermister voltages on the Utility Distribution Panel (for direct acquisition of four temperatures).
4 connectors for digital status signals. Capability to send up to 4 direct digital commands.
Columbus Laboratory ancilliary data (e.g., Columbus time, Loss of Signal data, Global Positioning System data, microgravity levels - TBC) are available via the EXPRESS Rack protocol.

VIDEO AND HIGH-RATE DATA

8 National Television System Committee (NTSC) connectors (1 at the back of each ISIS drawer and 5 at the Video Management Unit front panel)3 x 1355 (spacewire) serial line connectors on the Video Management Unit front panel.
Real-time down-link will be limited by Columbus Laboratory resources; downlink capacity has an average 2 Mbps with a maximum of 32 Mbps.
Up to 72 Gbytes mass memory for image/data storage.

Data compression for down-link data uses JPEG standard (with selectable compression rate).
Laptop computer can display video data.

THERMAL CONTROL

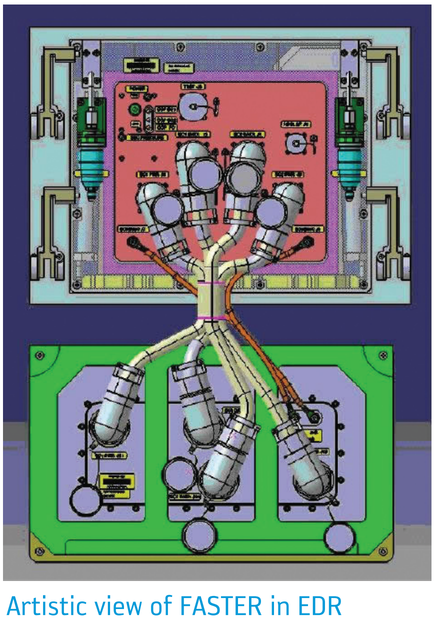
Air cooling and water cooling available (payload complement thermal load dissipation is limited to 2200 W).
Air cooling 700 W max. (for the payload complement). Interacts with the Columbus Laboratory primary water loop.
Single drawer/locker max. airflow rate is 1500 litres/minute (air cooling).
2 sets of water connectors (inlet and outlet) at the Utility Distribution Panel. Max. cumulative heat load on both inlet and outlet sets is 2000 W. Primary water loop directly routed to payloads.

LAPTOP COMPUTER

Primary interface between flight crew and the European Drawer Rack.
All capabilities necessary for monitoring and control of the European Drawer Rack.
Display of health and status of the facility, and scientific video images.

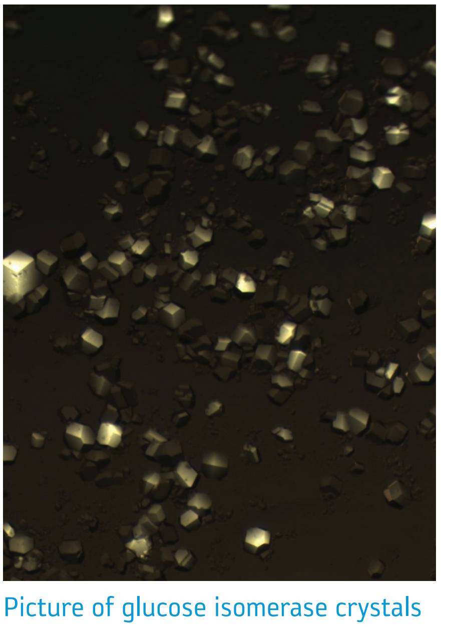
FIRE DETECTION, CAUTION AND WARNING

Primary fire detection via smoke detector (for European Drawer Rack and air-cooled payloads). Payloads are advised to have additional parameter monitoring.
Non air-cooled payloads must use parameter monitoring for fire detection.
All payloads must provide adequate monitoring and control of any other condition of relevance to payload safety.



Artistic view of FASTER in EDR

The Protein Crystallisation Diagnostic Facility (PCDF)



Picture of glucose isomerase crystals

Operations and Utilisation

ACCOMMODATION & TRANSPORT

A set of drawers and lockers for the first payload complement was procured by the European Space Agency, and made available to users. Subsequently, users will be required to procure their own drawers/lockers.

The current baseline is that drawers and lockers are normally transported unpowered to the International Space Station by the Multi Purpose Logistics Module (MPLM). The American Express Transport Rack can be used to upload and download drawers.
Lockers requiring power during transportation are accommodated in the Space Shuttle middeck.

OPERATIONAL CONCEPT

Although the European Drawer Rack can support any combination of automatic and interactive modes of experiment execution, all payloads will be encouraged to operate as much as possible in a fully autonomous mode (due to restrictions in both up-link command capability and available crew time).

In order for the European Drawer Rack to be fully flexible with respect to the configuration of different payload complements, it is necessary that the “intelligence” for operation of the payload is delegated to the individual payload itself, with the facility mainly providing the resource allocation, together with the initiation and monitoring of the individual payload operations. This flexibility is achieved through a software and communications architecture that allows the on-orbit upload and reconfiguration of both the carrier and payload software. The major element of the carrier software is the European Drawer Rack timeline that consists of:

- A master timeline for the overall scheduling of experiment and carrier related sequences;
- Software sequences dedicated to the control of individual subsystems and experiments.

UTILISATION SCENARIO

The utilisation scenario for the European Drawer Rack relies upon a high degree of cooperation between the supporting ground facilities. These include the Facility Responsible Centre that is in overall charge of the facility, together with the User Home Bases, from which each user will support their own individual experiment(s).

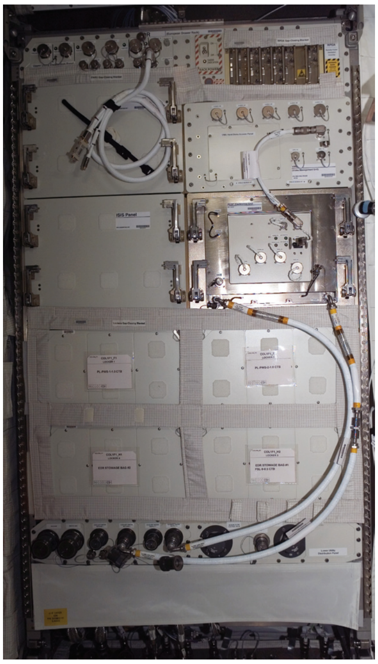
The master timeline will be derived from the European Drawer Rack operations plan that is defined by the Facility Responsible Centre together with the involved User Home Bases. The main objective of the operations plan is to match the required resources with those available from the Columbus Laboratory to maximise the number of experiments that can operate concurrently.

SCHEDULE

The European Drawer Rack was launched on 7 February 2008 into space inside the European Columbus Laboratory. Experiments for accommodation in the European Drawer Rack are

- The Facility for Adsorption and Surface Tension on European Rack (FASTER);
- The Protein Crystallisation Diagnostics Facility (PCDF).
- The Electro Magnetic Levitator (EML).

The flexible carrier design of the European Drawer Rack allows shorter mission preparation times than the “classical” multi-user facilities, and provides a quick delivery and return of mission products. Thus, in parallel with the operation of the on-board payload complement, the preparation and test of new payloads/experiments will be conducted on the ground, and subsequently transported to orbit for integration into the on-board European Drawer Rack. This approach aims at reducing payload preparation times.



EDR on board of the ISS