Display and Graphics Commonality Standard

International Space Station Program

January 30, 2001  Baseline

Russian Space Agency

Canadian Space Agency

Agence spatiale canadienne

European Space Agency

Japanese Space Agency

National Aeronautics and Space Administration
Space Station Program
Johnson Space Center
Houston, Texas
ISS Display and Graphics Commonality Standard

January 31, 2001

Prepared by

Amy R. Speth, Book Manager
IDAGS

Approved by

Granville Pennington
Chairman, IDAGS Panel

Jean-Francois Clervoy
Co-Chairman, IDAGS Panel

Charles H. Armstrong
IDAGS Development Team

Benoit Marcotte, Director Operations Engineering
Canadian Space Agency

M. Wolff, Panel Member
European Space Agency

H. Kitahara, Panel Member
National Space Development Agency of Japan

Tamara Ilina, Panel Member
Rocket Space Corporation-Energia

T. Akutsu, Panel Member
National Space Development Agency of Japan

Vasili Cherkashin, Panel Member
Gagarin Cosmonaut Training Center

Jean-François Clervoy, Panel Member
ISS Flight Crew

Sergey Brunnikov, Pavel Member
Rocket Space Corporation - Energia

Rose Lindsey, Panel Member
NASA - Payloads

John Maca, Panel Member
NASA - CDDT

/s/ Paul Iademarco
Paul Iademarco
NASA - DQA
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SECTION 1

INTRODUCTION

1.1 PURPOSE..............................................................
1.2 SCOPE...................................................................
1.3 INTERNATIONAL PARTNERS ROLES AND RESPONSIBILITIES.
This document specifies standards and guidelines to be used in the development of displays for International Space Station (ISS) (Ref. Section 6). This document serves to coordinate the efforts of procedure, graphic, and display development to generate cohesive and integrated products for use in real-time operations and training. Commonality shall be achieved through common display look and feel.

This standard also can be used as reference material during the development of control center displays.

1.1 PURPOSE
The purpose of the ISS Display and Graphics Commonality Standards (DGCS) is to document the standards utilized in design and implementation of displays and graphical products used by International Space Station crew members and ground control centers.

1.1.1 This document contains standards written as either “shall” or “should.” Statements written as “shall” represent standards to which all display designers must adhere, if applicable. If the standards are not applicable to a display, simply ignore the standard. Waivers are not necessary in this case. Some standards are necessary for good design, but may be too restrictive in some situations. These standards are stated as “shoulds.” Even though a standard has been stated as a “should,” the designer is expected to follow the “should” standard under most circumstances.

1.2 SCOPE
This document shall apply to all onboard displays being produced for ISS operations or produced by other organizations in support of ISS operations. If there is a conflict with other ISS program-level documentation, SSP 50313 shall take priority for standards or guidelines which pertain to onboard displays directly used by the flight crew, the flight control team, or the training personnel supporting the ISS Program. In addition, reference drawings and graphics reference materials, which are used for crew, including products developed by partners, shall be developed in compliance with the standards and guidelines contained in this document. All configuration control boards managed by ISS Operations are required to implement these guidelines in the execution of their configuration management responsibilities of these materials. Products currently developed are exempt from compliance to these standards. However, all new products and major revisions to the user interface shall adhere to these standards. Commercial Off-the-Shelf (COTS) software products are also exempt.

1.2.1 This document establishes the single source of top level, graphical, and nomenclature related standards on displays to be used in all phases of development for onboard crew displays, reference drawings, and other graphical reference material. The Integrated Display and Graphics Standards (IDAGS) Panel shall provide for configuration management of this document. Any proposed changes in or deviations from this document or to the standards presented must be submitted to the IDAGS Panel for review and approval as defined in Section 3.3, Change Control Process for Standards.

1.2.2 The core of each section of the document contains the proposed standard and, if the International Partners’ standard differed from the proposed common standard, a sub-section for each partner is provided. This sub-section contains the partner’s current implementation. The
final version of the document will consist of a core document containing the internationally agreed standards.

1.3 INTERNATIONAL PARTNERS ROLES AND RESPONSIBILITIES
Each ISS partner is responsible for the display development of his segment or module. The displays should be developed according to the standards of the developer and within the framework of the agreements contained in the Display and Graphics Commonality Standard, SSP 50313. The developer is responsible for all changes, including the quality, completeness, and timeliness of any changes.
SECTION 2

APPLICABLE DOCUMENTS

2.1 APPLICABLE DOCUMENTS ........................................2-Error! Bookmark not defined.
2.2 REFERENCE DOCUMENTS ........................................2-Error! Bookmark not defined.
SECTION 2.0
APPLICABLE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

The following documents include specifications, models, standards, guidelines, handbooks and other special publications. The current issue of the following documents is identified in the Program Automated Library System (PALS) (http://issa-www.jsc.nasa.gov/cgi-bin/dsql+/ORAP?-h+palshome) or Payload Integrated Library System (PILS) (http://sspweb.jsc.nasa.gov/pils/payload.cfm). The documents listed in this paragraph are applicable to the extent specified herein. Inclusion of the applicable documents herein does not in any way supersede the order of precedence identified in Paragraph 1.2 of this document.

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SECTION 3

DISPLAY AND GRAPHIC DEVELOPMENT
OPERATIONAL CONCEPT

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SECTION 3.0
DISPLAY AND GRAPHIC DEVELOPMENT OPERATIONAL CONCEPT

3.1 GENERAL PRINCIPLES AND RATIONALE

Crew members and Flight Controllers will utilize a common display style for all segments and all systems of the vehicle. In addition to this common set of displays, flight controllers will have additional tools to allow for viewing and processing of data. Refer to Section 6.

a) Ops concept for procedure access from displays and vice versa.

b) Ops concept for interoperability between laptops.

3.1.1 Displays and Procedures

Displays and procedures are closely related products and must be developed together. Procedures will follow the layout of the onboard payload and system displays, but maintain compliance with the procedure standards. Nomenclature used in these products must match and the organization of one product must complement that of the other.

Procedure and display nomenclature should be consistent not only across a discipline but also across all the displays. Operations nomenclature is used on displays to assure that labels match terms used in flight procedures. Operations nomenclature, rules and definitions shall be in accordance with SSP 50254, Operations Nomenclature. A list of agreed-upon abbreviations and acronyms is in the Operations Nomenclature document.

3.1.2 ISS Computer Displays

ISS computer displays must then be reviewed and approved by the IDAGS Panel prior to being integrated onto a platform. This can be achieved during partners project reviews. The IDAGS Panel will check the display for consistency with other similar displays, a look and feel consistent with other displays, and assurances by the Integrated Display and Graphical Standards Development Team (IDAGSDT) or the International Partner that the proper integration has been performed and the process for developing the display has been followed.

3.2 PARTNER SPECIFIC IMPLEMENTATION

3.2.1 NASA Deviation

The PCS and MCC-H shall utilize the same "top level" graphical displays for ISS operations. Displays below this level of detail may be different, where necessary. Some displays provided in the MCC-H may not be provided on the PCS.

3.2.1.1 Development of Graphical Products and Procedures

Development of graphical products and procedures for the ISS should utilize a team consisting of all of the users of the graphical product including, but not limited to, the procedures developer, flight crew, flight controllers for the affected system(s), training personnel, and other system experts. This team then creates a preliminary graphical product based on the integrated experience of the group. It is important that the graphical product be prototyped and evaluated several times in order to converge on the best product.

3.2.2 RASA Deviation

The basic set of displays is to be designed and tested on the ground (formats reference library). This supports in-flight display design capability. The display has to reflect the system operation and functioning, its structure, and location (interior or exterior of the module, on which plane, and behind which panels). Both the intersystem and intermodule interface should be accounted for. Depending on the system’s complexity, one or several formats are being designed (for...
each system’s function). If more than one display is available from the system button, a menu window appears giving the user a choice of which display to launch. Displays should not be overloaded with information. If there is no possibility to fit all the information within one display, the display is to be split in two levels. The upper level contains the basic data on monitoring and control. The lower level includes a set of detailed displays which are called by selecting on the object buttons or <<Details>> of the upper level display. The general philosophy for detailed displays is to use graphical schematic formats. On request from the ground control, the crew may either correct the existing display or create their own display, whichever is the most appropriate in the current situation.

Figure 3-1 Russian Display Design Process
3.2.2.1 RASA Capabilities

This capability supports the following functions:
1. Moving objects within the display.
2. Duplicating objects.
3. Relocation of information to another display.
4. Deletion of objects.
5. Block functions (selection, relocation, copying, resizing, and reorienting of blocks).
6. Filtering of information inside the display.

Multi-window interface support consists of the following:
1. Selection of display's fragments (scrolling).
2. Resizing of the window.
3. Scaling of the window.

These enable the user to monitor several parameters from different formats simultaneously.

3.2.3 ESA-Columbus Approach Deviation

ESA-Columbus has up to three Portable Work-Station (PWS) laptops, which can be used inside ESA-Columbus, one hook-up point is also provided ESA-Columbus-external in the Node2. Interfaces during parallel use of PWSs are procedural by the crew.

ESA-Columbus Flight Monitoring and Control Displays (MCDs) on the PWS provide the monitoring and control capabilities for the nominal ESA-Columbus systems. They are based on the COTS tool SAMMI. Other displays, like the Master Time Line (MTL) and Automated Crew Procedures (ACP) viewers, Message Panel and Time Display Panel are also part of the ESA-Columbus display set.

The development of ESA-Columbus MCD nominal system displays and procedures is performed at system level by the ESA-Columbus prime contractor. Verification is by review and utilization/dedicated tests during ESA-Columbus ground testing, with participation of ESA operations, flight crew, and training representatives at dedicated events.

ESA-Columbus displays and procedures for monitoring and control of the vital ESA-Columbus systems (used during activation/deactivation and for critical/vital ESA-Columbus) are provided by NASA on the ISS PCS laptops (one hook-up point is inside ESA-Columbus), based on requirements from the ESA-Columbus developer, and implemented according to the NASA approach.

3.2.4 NASDA Deviation

JEM has three laptop Computers: System Laptop Terminal (SLT), Payload Laptop Terminal (PLT), and RMS Laptop Terminal (RLT). Each terminal provides crew interface for only JEM system, payloads, or RMS. Basically, NASDA displays are built on a GUI tool, SAMMI. The displays are to be designed and tested on the ground. The display has to reflect the system functioning, its structure, and physical location. Depending on the segment's or system's complexity, one or several hierarchical displays are provided.

Space Station Integration and Promotion Center (SSIPC) will have dedicated displays apart from the JEM flight displays.
Displays related to payloads and training is TBS.

3.2.5 CSA Deviation
The MSS Operations Center (MOC) shall utilize the same “top level” graphical displays for the MSS operations. Displays below this level of detail may be different, where necessary. Some displays provided in the MOC may not be provided on the PCS.

3.3 CHANGE CONTROL PROCESS FOR STANDARDS
All display products developed for ISS Operations must comply with the standards defined in this document to be approved for use in the training and execution of ISS flight operations. All configuration control boards managed by MO&UCB shall use these standards as the overall, top level requirements for the presentation, interaction, and layout of displays. Any proposed deviations to this standard which may be due to either single, unique requirement, or a generic modification, shall be jointly approved by MO&UCB through the following processes.

3.3.1 Requests for Deviations
Requests for deviations from ISS DGCS should be submitted using the form found in Appendix G of this document.

3.3.2 Flight Specific and/or Single, Unique Deviations
If a proposed deviation is for a single flight or a single, unique application, the change request should be submitted to the appropriate configuration management control board responsible for management of the products affected. The change request should clearly identify the specific standard which is related to the deviation. Explanation and rationale for why this is not a generic change to the standards shall also be included. The managing control board is responsible for reviewing and deciding on the technical merit of the proposed deviation. The board’s decision is to be included as part of the documentation for the proposed deviation. This documentation is then forwarded to IDAGS Panel for review and final disposition.

3.3.3 Generic Deviations or Changes to the Standards
If a proposed deviation is applicable to multiple flights or is generic in nature, the change request should be submitted to the appropriate configuration management control board responsible for management of the products affected. The change request should clearly identify the specific standard which is related to the deviation and technical rationale explaining why the deviation is required. The managing control board is responsible for reviewing and deciding on the technical merit for the proposed deviation. The board’s decision is to be included as part of the documentation for the proposed deviation. This documentation is then forwarded to the IDAGS Panel for review and final disposition. All approved multi-flight deviations will be added to the references to the applicable flights.
Section 4

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SECTION 4.0
LAYOUT

4.1 GENERAL PRINCIPLES AND RATIONALE
All displays shall conform to a common, general layout convention to allow ease of navigation and to clarify functional and physical relationships between displayed items.

4.2 GENERAL WINDOW CHARACTERISTICS
Unix/Solaris based windows are designed with general Motif characteristics. All user interface software (displays, environment configuration, and interaction methodologies) developed must follow a number of human-computer interface guideline documents. At the highest level, all user interface software must attempt to be compliant with the accepted industry standard in X-Window user interface style, the Open Software Foundation (OSF) Motif Style Guide. All X-Window based non-Commercial Off-the-Shelf (COTS) user interfaces will follow the conventions defined in the OSF/Motif Style Guide unless other overriding standards are defined in this document. COTS building toolkits can be used if the end product adheres to the general guidelines in this document (Ex. Labview, web-based interface). Sections of this document are not intended to violate the conventions defined in the Motif Style Guide, rather, they are intended to provide more guidance for the display designer and builder when working on display designs. All Microsoft based non-COTS user interfaces shall follow the conventions defined in Microsoft unless other overriding standards are defined in this document.

Display designers shall strive to build aesthetically pleasing displays that are more conducive to long hours of use. Displays shall be balanced with symmetrical, easy to read layouts. Subsections of displays shall be equally spaced and not jammed together when space is available. Lines and components shall have equal distance between them so there is no misinterpretation as to what title or label applies.

4.2.1 NASA General Window Characteristics Deviation

4.2.2 RASA General Window Characteristics Deviation
X-Window Library.

4.2.3 ESA-Columbus General Window Characteristics Deviation

4.2.4 NASDA General Window Characteristics Deviation

4.2.5 CSA General Window Characteristics Deviation

4.3 WINDOW SIZE
The maximum physical window size is platform dependent; 800 x 600 for the IBM 760ED (Early PCS) and 1024 x 768 for the IBM 760XD (PCS).

The maximum allowable window size is implementation dependent and may be less than the maximum physical size if there are persistent windows that consume display space. Persistent windows are defined as windows that are always on the display in a fixed location (cannot be moved) and are forced to be on top of all other displays (cannot be covered up). An example of
a persistent window is a dedicated Caution and Warning window which is always at the top of the display and always on the top of other displays.

The default size of a display window should be determined by the content to be displayed and may not be larger than the maximum allowable window size. For example, a display window depicting part of a system or block may only require a window space of 100 x 200 pixels. The actual space available within the window for display objects will be less due to window manager overhead (borders and title bar).

4.3.1 Window Resize
Nominally, all windows may be resized except for persistent windows and dialog windows. Windows with resize capability will conform to one of the following behaviors.

Integrated  The display contents (objects contained in the display) automatically scales proportionately with the display window frame size. The display window frame height-to-width ratio will be retained during resize operations.

Independent  The display contents and window frame may be resized independent of each other. The display contents height and width may be resized independently of each other or may be resized such that the height-to-width ratio is maintained. The display window frame height and width are independent of each other. If the window size is smaller than the display content size, a mechanism must be available to scroll or pan within the window.

Window only  The display contents size remains fixed and the display window frame is resized. The display window frame height-to-width ratio may be either independent or proportional. If the window size is smaller than the display content size, a mechanism must be available to scroll or pan within the window.

Any display window that allows display content to be resized will have a uniquely defined minimum height and minimum width required to maintain legibility.

4.3.1.1 NASA Window Resize Deviation
4.3.1.2 RASA Window Resize Deviation
4.3.1.3 ESA-Columbus Window Resize Deviation
ESA-Columbus follows general Window Resize, using exclusively the “Window only” behavior.

4.3.1.4 NASDA Window Resize Deviation
JEM PCS’s provide "Window only" resize capability only due to SAMMI restriction.

4.3.1.5 CSA Window Resize Deviation

4.4 OBJECT SIZE
An object must be sized so that it is easily discernible.
4.5 WINDOW PLACEMENT
A default location on the display screen can be specified for each window. If a default location is not specified, then the location will be decided by the operating system window manager. The default window arrangement (for windows without a default location) should cascade rather than tile.

The general philosophy for window placement is that, where applicable and possible, a pop-up or detailed window shall default to a location that does not obscure associated data on the referencing display. In general, there should be no loss of information if a window does cover the associated data on the parent display (e.g., the obscured data will appear on the detailed window). Realization of this philosophy may be dependent on the implementation and constraints imposed by the display software architecture.

4.6 WINDOW CONTROL/DECORATION
All display windows shall include standard decorations to allow closing, resizing, iconification, and movement of the display. This is the standard method any user will invoke to manage a display window without requiring additional controls. If any window closure may result in closing the base software application, then an acknowledgment to the window is necessary.

4.6.1 NASA Window Control/Decoration Deviation

4.6.2 RASA Window Control/Decoration Deviation
The RASA displays follows the same control means except close (quit). They use the escape key to quit/close a window versus the window manager menu.

4.6.3 ESA-Columbus Window Control/Decoration Deviation
This is applicable for viewing only, for some ESA-Columbus/DASA displays. For non-critical displays, windows acknowledgment is not implemented for window closure.

4.6.4 NASDA Window Control/Decoration Deviation
Dialog windows (ex. confirm window) of JEM displays do not have decorations. JEM RLT does not have decorations for window resize.

4.6.5 CSA Window Control/Decoration Deviation

4.7 WINDOW TITLES
Window titles, shown in the title bar area, reflect the appropriate operations nomenclature for a block, subsystem, module, location, or other functional unit of the vehicle. Window titles shall correspond to associated navigation buttons that call the display (i.e., the name of the button that calls a display must have the same name as the called display). Where necessary, abbreviations consistent with Operations Nomenclature standards may be applied to window titles and/or navigation button labels.

A display's window title bar shows the following:

RPCM_N1RS1_A
Window size and title length should be coordinated such that, at the default window size, the entire window name may be read.

The **Home Page** Title bar shall include a label indicating the appropriate version of the **Home Page**. See Figure 4-1.

![Figure 4-1 Home Page Title Bar (typical)](image)

4.7.1 **NASA Window Titles Deviation**

4.7.2 **RASA Window Titles Deviation**

4.7.3 **ESA-Columbus Window Titles Deviation**

The ESA MCD title bar area is divided in two sections. The first part is generated automatically by the development tool. This part contains the MCD-MDB (Mission Database) name incl. short identifier. In the second part ESA follows general window titles. Where window size and title length can not be coordinated such that the second part can be read (Command and Data Window), the window title is in the upper left corner of the MCD.

The MCD version number is not part of each MCD title. It is defined by the MDB version included in the title of the MCD home page only. Even if a single MCD is revised, the generation process on ground requires a new MDB version, such that the version of each MCD is uniquely identified by this MDB version.

4.7.4 **NASDA Window Titles Deviation**

NASDA basically follows general window titles. Flight numbers are not applied for JEM because JEM PCS displays are not replaced in flight by flight. Window titles of the JEM RLT are not always the same as the names of buttons which call the window.

4.7.5 **CSA Window Titles Deviation**

4.8 **HOME FUNCTION**

The Home Page shall be functionally accessible with a single action at any time.

4.8.1 **NASA Home Button Deviation**

This requirement does not apply to detailed windows that are automatically called up or to command windows.

This button shall change color to correspond to the highest class event that is in alarm. When there are no active Emergency, Warning, or Caution events, the Home button color is gray (the standard navigation button color).

4.8.2 **RASA Home Button Deviation**

The RASA Home button is on the Events window window and is always accessible.
4.8.3  ESA-Columbus Home Button Deviation

4.8.4  NASDA Home Button Deviation
JEM SLT has a Home function which leads to the JEM home page. It is possible to navigate among JEM module displays without going back to Homepage on JEM SLT. JEM RLT does not have this button because JEM RMS Home Page is always in the bottom of the displays.

4.8.5  CSA Home Button Deviation

4.9  TOOLBARS
Toolbars provide multiple buttons to the user in order to accomplish a given set of tasks. The tasks available are dependent on the toolbar they are associated with. Generic categories of functions include caution and warning, systems interfaces, user tools, or a combination of these.

The internationally agreed standard of the time shown on the toolbar is:

   GMT:  ddMmmyy hh:mm:ss
   for example  GMT:  13Nov01 23:03:28

4.9.1  NASA Toolbars Deviation
At present, three such toolbars have been identified for use in display windows - the alarm toolbar (used to handle Caution & Warning), the user toolbar (used to access applications beyond the scope of "pure displays"), and the system toolbar (used to view more details regarding a specific system). See Figure 4-2.

The alarm toolbar is discussed in detail in the Caution & Warning section of this document. On the Home Page, this toolbar includes a single message line to indicate the oldest unacknowledged alarm message.

On the toolbar message line and C&W summary, hh:mm:ss only will be shown on each message line. But the C&W log time format for each item will retain the whole time information.
The Greenwich Mean Time (GMT) associated with a Caution & Warning message shall appear directly beneath and aligned vertically with the current GMT shown near the upper right corner of the alarm toolbar.

The user toolbar is shown on the left side of the Home Page (Figure 4-2). This toolbar has a “Cmd Log” button to view the log of sent commands and an “Error Log” button to view the log of past errors.

Other displays also provide a “Clone” button to duplicate the current display (Figure 4-2a). The “Clone” button allows the user to open a second copy of a display. This button shall only be provided on displays that have more than one accessible overlay (e.g., Node 1:C&DH and Node1:ECLSS). Once a display is opened, it can be brought to the front of layered displays that are covering it when the user selects the navigation button for that display. The only way to invoke a copy of the display is by use of the “Clone” button.

A given display can only show one system layer at a time. If a user wishes to view both the Node1: ECLSS layer and the Node1:C&DH layer at once, then he or she must open the Node1 display, select either the ECLSS or C&DH layer, clone the Node 1 display, and then select the other system layer on the clone.
The system toolbar is shown on the right side of the Home Page (Figure 4-2). On the Home Page, this bar allows the user to access summary displays for each system. On the module level displays, the toolbar provides access to system overlays for that module. These overlays are shown within the same window.

4.9.2 RASA Toolbars Deviation
RASA currently uses a GMT format of ddmmyy hh:mm:ss with mm being numeric. RASA will continue to use this format until the next major update.

RASA does not need a clone button because a new window appears when a button is selected.

4.9.2.1 The alarm toolbar is a separate event display. The events display is covered in the C&W section of the DGCS.

4.9.2.2 System toolbar - available on homepage

4.9.2.3 User toolbar - available on homepage.

4.9.3 ESA-Columbus Tool Bars Deviation
ESA-Columbus has no tool bars. The main applications are activated by buttons and/or menus. The APM Caution and Warning functions will be available on the PCS (see Section 11).
4.9.4 **NASDA Tool Bars Deviation**

JEM SLT tool bars are shown in Figure 4-4.

4.9.4.1 **Alarm Tool Bar.** JEM PCS does not have Alarm toolbar. The JEM Caution and Warning functions will be available on the NASA PCS; but there is JEM Local C&W Summary button on user toolbar on JEM SLT.

4.9.4.2 **Module Tool Bar.** JEM module tool bar is provided on upper side of subsystem tool bar.

4.9.4.3 **Subsystem Tool Bar.** JEM subsystem tool bar is provided on the right side.

4.9.4.4 **User Tool Bar.** APV, MPV, and miscellaneous button exists on the user tool bar.

4.9.4.5 NASDA has implemented a standard of using hundreds of days (Julian date) for GMT. NASDA will continue to use this format until the next major update per the exclusion clause.

The format of SLT and RLT is DDD/HH:MM:SS.

Current GMT. JEM SLT shows the current GMT at the lower left corner, and RLT at the upper right corner.

4.9.4.6 **Clone Button.** JEM PCS’s do not have the Clone button, because NASDA PCS’s do not provide two windows at the same time.

![Figure 4-4 JEM SLT Toolbar](image-url)
4.9.5  CSA Tool Bars Deviation
CSA tool bar is consistent with the NASA tool bar.

4.10  GRAPHICAL LAYOUT
Across multiple systems and across different knowledge levels, there can be developed a visually consistent set of graphical products. Guidelines for producing visually consistent graphical products include a common layout, flow directions, and common icons. This section provides guidelines on flow directions and a common layout. Appendix C of this document provides a list of common icons.

Items of high criticality, such as Caution & Warning lights, shall be placed near the top of the display to indicate their relative importance. Items that control the appearance of the display, such as buttons providing navigation to accessible system overlays, shall be placed near the edge of the display.

4.10.1  International Partner Deviation
4.10.1.1  NASA Graphical Layout Deviation

4.10.1.2  RASA Graphical Layout Deviation

4.10.1.3  ESA-Columbus Graphical Layout Deviation
ESA-Columbus is using MOD drafting standards as a guideline. Symbols, icons, and text will be used as appropriate.

4.10.1.4  NASDA Graphical Layout Deviation
NASDA is using MOD drafting standards as a guideline. Symbols, icons, and text will be used as appropriate.

4.10.1.5  CSA Graphical Layout Deviation
CSA is using MOD drafting standards as a guideline. Symbols, icons, and text will be used as appropriate. Robotic arm physical representation does not reflect true arm position due to its reconfigurable nature.

4.10.2  Guidelines for Common Layout
At each step in the process of creating graphics for drawings, schematics, displays, etc., the developer must determine how much information can be presented within the physical constraints of each product. For example, how big a piece of paper is available for a drawing or how big is the monitor for a display. The following hierarchy provides a graphics developer with a set of choices for presenting information in a graphical form. The organization hierarchy does not describe a sequential process for creating training graphics or displays. When developing a graphic product, the developer needs to decide which of the following conventions to use at each step in the process of creating training graphics, displays, etc.

4.10.3  Display Organization Hierarchy

a. Physical Template Convention. Information is presented in a spatial orientation according to the preferred view convention as defined section 4.10.4. All blocks and parts are placed in their actual physical location within the modules.
b. Partially Physical Template and Partially Functional Flow Convention. Display of modules still follows the preferred view. The blocks and parts that perform functions within the modules are not in their respective physical locations. The blocks and parts are oriented in the module in order to show system functions. The guidelines for producing functional drawing should be followed (i.e., information flow top to bottom, left to right, etc.) when possible.

c. Functional Flow Convention. The outline and orientation of the modules is not shown. The blocks and parts are oriented in order to show system functions. The guidelines for producing functional drawing must be followed (i.e., information flow top to bottom, left to right, etc.).

d. No Convention. The outline and orientation of the modules is not shown. The blocks and parts are oriented on the display in order to show system functions. The guidelines for producing functional drawings are not followed (i.e., information flow top to bottom, left to right, etc.). Organization of blocks and parts is driven solely by visual simplicity.

4.10.4 Hierarchy of ISS Functional and Physical Divisions

Graphical products such as displays and schematics can be developed using varying levels of detail. In order to establish guidelines to standardizing the level of detail contained in a particular graphical product, a hierarchy from more general to more specific must be used. The terminology used to describe these levels is contained below. This terminology is not intended to alter the nomenclature of any hardware.

HIERARCHY OF ISS FUNCTIONAL AND PHYSICAL DIVISIONS

- Super-system
- Station
- Segment
- Module
- System
- Subsystem
- Block
- Part

Super-System - An organization which includes the orbital station, other space vehicles, and ground facilities.

Station - A group of segments (or modules) that are combined to form a complete orbital complex.

Segment - A number of modules that can be logically grouped together by form, function, or program responsibility. Examples include the Russian Segment (RS) and the United States On-orbit Segment (USOS).

Module - A single structural element that provides significant additional functionality to the station. Usually contains multiple systems and may be pressurized or unpressurized. Examples include FGB, SM, Node 1, Node 2, and SO Truss.
**System** - A collection of components that perform unique functions supporting activities in a module, segment, or in the entire station. Some systems may interface across the larger super-system. Examples include the Electrical Power System (EPS), the Thermal Control System (TCS), etc. (was “subsystem” in previous designations).

**Subsystem** - A collection of blocks that work together to perform a function within a system. One example is the fire detection and suppression components of ECLSS. A part of a system, for example part of a system limited by a given module, is also called a subsystem.

**Block** - Sometimes referred to for manufacturing purposes as an assembly. A grouping of parts to perform a function for a subsystem. A block is generally connected to control signals, electrical supply, thermal support, or other environmental support services to perform its job.

**Part** - Sometimes referred to for manufacturing purposes as equipment. The individual pieces that are assembled together to form a block. Examples include a single valve, a controller card, a pump, latch, etc.

**4.10.5 Physical Representation - Preferred View Convention**

A guideline to develop a common layout for physical representation and ensure spatial consistency is a preferred viewing convention from which isometric or orthographic projections can be derived.

In order to provide visual consistency when representing the view of the ISS modules, it is necessary to provide an orientation of the ISS on the figures that follow these four principals (see Figure 4-5 and 4-6):

a) Zenith or port or aft at the top.
b) Aft or starboard on the left.
c) Nadir or starboard or forward at the bottom.
d) Port or forward on the right.
Figure 4-5  Zenith or Port or Aft at the top, Nadir or Starboard or Forward at the bottom,
The previous graph can also be interpreted this way:

**Figure 4-6** Aft or Starboard on the left, Port or Forward on the right

Preferred View convention applied to Figure 4-7:

1. Isometric

**Figure 4-7** Isometric
2. Isometric with cutaway plane, Figure 4-8

![Isometric Cutaway](image)

3. Orthographic, Figure 4-9

![Orthographic](image)
From Figure 4-9, a template was derived from the preferred view convention (orthographic map) to produce Figure 4-10:

Figure 4-10 Derived Template

4.10.6 Conventions for Two-Dimensional Representations
All products shall comply with the following conventions regarding spatial references, orientations, and means of depicting various views.

4.10.7 ISS Vehicle Coordinate System and Reference Orientation
The coordinate system to be used shall be the ISS vehicle coordinate defined as a right-handed Cartesian, body-fixed coordinate system, in accordance with SSP-30219. The origin of the coordinate reference frame is located at the geometric center of the mid-ship truss section, Integrated Truss Segment (ITS), S0. The positive directions of the coordinate system are based on an ISS flight orientation of 0, 0, 0 LVLH, where LVLH is defined here:

Local Vertical-Local Horizontal (LVLH) coordinate system (see Figure 4-11). The positive Z-axis is pointing toward the nadir. The positive Y-axis points perpendicular to the orbital plane as the vector cross product of the radius and the velocity vector. The positive X-axis is the horizontal projection of the velocity vector which is a vector product of the y and z unit vectors which define the local horizontal axis.
Displays shall identify which Euler angle sequence is being used.

4.10.8 Mapping of Three-Dimensional Surfaces

Three conventions have been selected to map internal and external surfaces. These conventions are defined as follows (see Figure 4-13):

a. Cylindrical – Provides continuity along the surface. Useful to illustrate wiring connections or piping along surfaces.

b. Combined Orthographic – Provides simultaneous views of external surfaces on both vertical (Nadir/Zenith) and horizontal (Port/Starboard) planes. Useful to create a layout with the greatest number of modules and their proper connectivity in a single view.

c. Stabilization Planes – Provide orthographic views of the four lateral surfaces of a module shown with the same orientation as seen by an internal observer standing on the deck, facing forward. See Figure 4-12.
The reference position for the station deployable structures shall be defined by paragraphs 4.10.9 through 4.10.12.
4.10.9 Articulated Structures
Articulated structures – such as parts of the truss, solar arrays, etc., change position as the ISS orbits the Earth. This makes it necessary to establish a fixed point for depicting these structures in graphic materials. The following conventions shall be applied:

a) The US Electrical Power System shall be oriented such that the plane of the solar arrays are perpendicular to the direction of the zenith.

b) The US Thermal Control System radiators shall be oriented vertically in relation to the Station truss segment.

c) All Russian segment power systems shall be oriented such that the plane of the solar arrays are perpendicular to the direction of the zenith with the modules’ active side toward zenith.

4.10.10 Modules Not in a Perpendicular Plane
When representing out-of-plane modules, the following priorities should be followed:

a) Forward/Aft should be mapped to Preferred View convention (i.e., Forward/Right and Aft/Left).

b) Port/Starboard should be mapped to the Preferred View convention (i.e., Port/Top and Starboard/Bottom).

4.10.11 Applied Examples of the Mapping Conventions
Pressurized modules are split and flattened to provide a two-dimensional representation (Figure 4-14).

Module is split along this line

Figure 4-14 Module Split
4.10.11.1 **Cylindrical Mapping Convention**

Regions of the module, such as the overhead area and the forward endcone, may be labeled as necessary. Racks and standoffs may be depicted as rectangles. Hatches may be shown as well. Each of these items, if shown, should be labeled per the interior location coding standards. In addition, module endcones may be represented as angled sections at each end of the module outline. An example of proper labeling for Node 1 is shown in Figure 4-15.

![Figure 4-15 Labeling](image)

4.10.11.2 **Additional Conventions for Cylindrical Mapping**

In some cases, it may be preferable to slightly distort the module’s shape to indicate interfaces to adjoining modules. This may be particularly useful when more than one pressurized module is shown on a single display (or other graphical product). A node module outline may then be shown in either of the below configurations:

Vertically-aligned truss segments, such as Z1, shall be similarly flattened as shown in Figure 4-16 which shows that forward locations shall be shown to the right.
Split truss along this line

Figure 4-16  Vertical Truss Alignment
Horizontally-aligned truss segments, such as S0, shall be split and flattened as shown in Figure 4-17.

Again, the forward face is shown to the far right.
4.10.11.3 **Combined Orthographic Mapping Convention**

The shape shown to the right indicates all six faces of the node. In this case, the upper left face corresponds to the Zenith direction, the upper right corresponds to the Port direction, the lower left corresponds to the Nadir direction, and the lower right corresponds to the Starboard direction.

![Figure 4-18 Orthographic Mapping](image)

4.10.11.4 **Example of Preferred View Convention applied to Exterior Views**

Exterior views are defined as those graphics depicting the Station – or some of its segments - as seen from outside their bounding volume (Figure 4-19). This is sometimes called a "bird’s-eye-view." It is a visual eye point depicting the current Station configuration enabling the display viewer to assess the exterior configuration and attitude from a global or external viewpoint. (Also see Figure 4-7.)

![Figure 4-19 Exterior Point of View](image)
4.10.12 Examples of Multiple Conventions Applied

Using the Preferred View convention, the Combined Orthographic mapping convention and the Articulated Structures convention results in the following Figures 4-20a & b:

The following shows the flexibility in the rules:

Figure 4-20a Port Side Pointing Up

Figure 4-20b Port Side Pointing to Left
4.11 FUNCTIONAL REPRESENTATION - FLOW DIRECTION

Functional display layouts are most often seen in system (vs. topological) displays. A functional layout may show the flow of information, heat, power, fluid, logic, or any other media within one or more systems. For example, a Summary display describing the status of the Command and Data Handler system will utilize a functional layout to show the relationship between the system’s many parts.

Displays shall not provide misleading or incorrect information regarding location of equipment. Items on the display shall correctly reflect whether components and resource routing (pipes and wires) are internal or external to pressurized modules. Any exceptions to this must be clearly noted on the display.

Where not physically misleading, the flow of data, power, fluids, logic, etc., shall be from left to right and top to bottom.

When looking at diagrams that illustrate functions, the logic flow needs to be consistent across all graphics products. The following set of guidelines are provided to ensure this consistency (Figures 4-21a, 21b, 21c, and 21d).

- Potential Flow – left to right, top to bottom

![Figure 4-21a Potential Flow](image-url)
- Power Distribution - power sources on left and loads on the right.

![Power Distribution Diagram](Figure 4-21b)

- Control Hierarchy - left to right and top to bottom

![Control Hierarchy Diagram](Figure 4-21c)
- Signal Flow
  - Left to Right
  - Clockwise loop
  - Feedback below forward path

Figure 4-21d  Signal Flow

4.11.1 NASA Functional Representation - Flow Direction Deviation

4.11.2 RASA Functional Representation - Flow Direction Deviation

4.11.3 ESA-Columbus Functional Representation - Flow Direction Deviation
Topological ESA-Columbus displays are flattened following the mapping conventions in section 4.10.10. See also example in section 5.2.3.

4.11.4 NASDA Functional Representation - Flow Direction Deviation
NASDA follows the general requirements except currently deviated displays.

4.11.5 CSA Functional Representation - Flow Direction Deviation
Application of flow direction guidelines subject to space constraints on the display window.
4.12 FLOW BETWEEN DISPLAYS
When two or more (typically topological) displays address the flow of data, power, fluids, logic, etc., within a system or location, the two displays shall show a natural flow of these interfaces.

For example, the C&DH overlays for the FGB and Node 1 displays are organized as shown in Figure 4-22.

![Figure 4-22 C&DH for FGB and Node 1](image)

Data bus interfaces between the two modules are shown such that they flow from one to the other when the two displays are shown side-by-side. Note that the data buses meet at a point outside the gray-filled outlines of the modules, indicating that this is an external connection. Internal connections would be shown as within the module outlines.

4.12.1 NASA Flow Between Displays Deviation

4.12.2 RASA Flow Between Displays Deviation

4.12.3 ESA-Columbus Flow Between Displays Deviation

4.12.4 NASDA Flow Between Displays Deviation
Two or more topological displays cannot be shown on the SLT at one time.

4.12.5 CSA Flow Between Displays Deviation
MSS displays depict flow of a single functional string of a subsystem only. MSS displays do not depict flow between subsystems.

4.13 DISPLAY REGIONS
Separate functional regions of the display shall be labeled appropriately with a “Graphical Location Identifier” (GLI) so that the user may find a region within the display. GLIs should be
left justified. For example, regions of a display may be labeled “PMCU 1 State Transitions,” “PMCU 2 State Transitions,” etc. See Figure 4-23, Functional Regions.

Functional regions of a display may be indicated by placing a gray filled rectangle behind all of the relevant graphics, parameters, and labels as indicated in the example below. See Figure 4-23.

Where appropriate, interfaces between functional blocks may be depicted using lines and arrows.

Grouping, bordering, or boxing of data refers to placing a rectangle around an object or group of objects. Bordering can be used to:

- Group a set of related text input or text data fields;
- Group a set of related graphic images or icons;
- Emphasize a single graphic image or icon in a group of images or icons.

Techniques for grouping data include:

- Separation of groups of information in an area using blanks, spacing, lines, color coding.
- The default color for thin line borders shall be black;
The default color for solid fill boxes shall be a subtly contrasting shade of gray; single line borders should be used for text and low density display areas. Solid fill boxes should be used for complex graphical areas and/or dense display areas.

If it is desirable to indicate a logical group of functional components within a schematic, this logical grouping shall be indicated using either a dashed line or a solid fill gray box.

4.13.1 NASA Display Regions Deviation

4.13.2 RASA Display Regions Deviation

4.13.3 ESA-Columbus Display Regions Deviation

4.13.4 NASDA Display Regions Deviation

NASDA follows general display regions except that color is used to indicate the corresponding medium which is being measured.

4.13.5 CSA Display Regions Deviation

4.14 UNINSTALLED EQUIPMENT AND FUNCTIONS

Some displays may contain data or other references to hardware or software that is not yet installed for a particular ISS stage. If the hardware or software, although not present, must be shown on the display, then it shall be associated in a region that clearly indicates the items are not yet installed.

Parameter fields that, if shown, are not active for a given version should be filled with light gray. The user shall be presented with annotations which allow him to tell when an option is unavailable (i.e., "grayed out"). Unavailable objects on a display which are currently not implemented may be statically drawn, but should be obviously disabled by either "graying out" the graphic object, or enclosing static text between two asterisks.

Only those display regions that are selectable shall be shown with a three-dimensional button appearance. If a region will not be selectable until a future version, then the region shall not appear as a button until the applicable later version.

4.14.1 NASA Uninstalled Equipment Functions Deviation

4.14.2 RASA Uninstalled Equipment Functions Deviation

4.14.3 ESA-Columbus Uninstalled Equipment Functions Deviation

4.14.4 NASDA Uninstalled Equipment and Functions Deviation

JEM SLT displays all JEM segments and components regardless of JEM real configuration. But data areas in uninstalled components are always displayed as un-updated data. JEM RLT grays out the data of uninstalled components.

4.14.5 CSA Uninstalled Equipment Functions Deviation
4.15 TEXT
Mixed case (upper and lowercase) letters shall be used for all labels. A similar style font and font size shall be used on each display when depicting terms or labels with similar levels of importance. This rule also applies to similar items or components on the display.

Operations Nomenclature standards apply to all text. Words in labels and titles should be spelled out (not abbreviated) when at all possible, unless the abbreviation is more commonly used than the word(s). If a word cannot be spelled out, use the standard acronym or abbreviation found in SSP-50254, Operation Nomenclature document. Use mixed (upper and lower) case letters with text and sentences. Only acronyms should use all upper case letters.

If necessary, text may be shown vertically to fit in constrained regions. See Figure 4-24.

![Vertical Text Example](image)

Figure 4-24 Examples of Vertical Text.

Cyrillic font may be used to provide Russian acronyms where a transliterated acronym is not feasible.

4.15.1 Schematic Text
This standard may be revised as improvements in software are realized. This standard is for schematic text.

Programs and fonts may be used to support a schematic drawing to ensure compatibility of processes so all International Partners can view the files. If using MicroStation, use ‘Font 1’ for English text and ‘Font 143’ for Cyrillic text. If using AutoCAD, use ‘Romans’ for English and ‘Cyrillic’ for Russian.

‘Romans’ is a san serif font and is a single-strong font. ‘Cyrillic’ is a serif font similar to Times New Roman. Text height shall be 0.1 inch on all drawings (minimum). Text width shall be 1 for level 1a drawings. Text width shall be .75 for all other drawings.

4.15.2 International Partner Deviation
4.15.2.1 NASA Text Deviation
To maximize readability when at full size and reduced size, all text must be shown in san serif font. For most applications, a minimum of Helvetica 12 point shall be used with 14 point preferred. Helvetica 16 may be used for special emphasis of labels that designate regions of the display, major system components, physical locations, etc. Exceptions may be made for font point sizes to be 10 point, but only when used for non-critical, static labels, like dimensional units of footnotes/legends.

The spacing between lines of related text should be 0.5 of upper case letter height. Spacing between headings and text should be 0.6 to 1.0 of upper case letter height. For optimal legibility, characters on a line should be separated by a minimum of one pixel or 20 percent of character width (whichever is greater). See NASA-STD-3000, Vol. IV. The space between the tallest character of a lower line should not be less than one stroke width from a character above it that projects below the line. Interline Spacing refers to the amount of spacing reserved between the baseline of one line of text and the top of the next line of text. The default Interline Spacing shall be single space.

4.15.2.2 RASA Text Deviation
RASA uses the Alt8x13 font. This font supports English and Russian.

4.15.2.3 ESA-Columbus Text Deviation
ESA uses Helvetica Bold (sans serif) for all text/numbers on MCDs, Courier Bold for dynamic data in data fields (SAMMI constraint). The Size 12 or Size 10 is used (Size 8 used in exceptional cases to avoid undue abbreviations; this size is still good readable on the high resolution laptop screen).

The Ops Nomenclature as defined in the ISS Operational Nomenclature NASA JSC - SSP 50254 (with Appendix TBD - ESA-COLUMBUS Operations Nomenclature) will be used on the MCDs. Parsing is applied in the MCD layout such that the full Ops Nomenclature name can be unambiguously deduced top-down for each item and function on an MCD.

4.15.2.4 NASDA Text Deviation
NASDA text font and spacing are restricted with SAMMI. For most displays of JEM SLT, Helvetica Bold 14 point shall be used. In some JEM SLT displays, 10 point is used. For JEM RLT displays, Helvetica and courier Bold more 12 point shall be used. Applicability of the Operations Nomenclature Standard is TBD. NASDA does not follow schematic text standard.

4.15.2.5 CSA Text Deviation
CSA text standards are consistent with NASA deviations.

4.16 BUTTONS
Buttons are controls used to navigate between displays, control display behavior, and select or send commands to the vehicle.

Buttons are usually shown as rectangles with shading to provide a three-dimensional appearance (see Figure 4-25). Bottom and right edges of buttons are shown darker than the button fill color, while top and left edges are shown lighter than the button fill color. However, it may be desirable to produce buttons that have unique shapes.
Buttons shall be clearly labeled, either on the button surface or just outside the button edge, to indicate the display to which the button navigates or the command issued by selecting that button.

4.16.1 Command Buttons

In order to easily differentiate the buttons used to send commands from the buttons used to navigate from display to display, the following convention will be used:
Command buttons will have rounded corners. See Figure 4-26.

Other buttons will have square corners except when some unique shapes (different from the above) are desired in some special cases.

Command buttons are defined according to one of the following criteria:
1. A single action on the button results in a signal sent out from the operator workstation to a station system.
2. When, for safety reasons, 2 button actions by the operator are required before an actual command is sent out as described above, the first button to be selected will be considered to be a command button.
3. When a command requires 2 actions - selection and confirmation - to be sent, the first action button used for the selection is considered to be a command button. This rule includes the case where several commands can be selected in sequence before they are sent together with one unique confirmation button action. However, this rule doesn't apply to the buttons used to select a set of parameters defining a configuration message. In which case they act more like a telemetry input field rather than a command button.

4.16.1.1 NASA Command Button Deviation

NASA Training uses rectangular buttons only (tool limitation) with static text or symbol.

4.16.1.2 RASA Command Button Deviation

RASA also uses an oval button for control related navigation.

4.16.1.3 ESA-Columbus Command Button Deviation

ESA-Columbus uses rectangular buttons only (tool limitation) with static text or symbol. Different background colors are used for different button types.
4.16.1.4 NASDA Command Button Deviation
Due to SAMMI restrictions, JEM RLT will use parentheses to differentiate between command and navigation buttons. Command buttons will have parentheses. Navigation buttons will not. JEM SLT uses rectangular buttons only due to SAMMI restriction.

4.16.1.5 CSA Command Button Deviation

4.16.2 Navigation Buttons
Navigation buttons are defined according to the following criteria:
Navigation buttons are rectangular in shape. Navigation button will include an appropriate label to indicate the display to which the button navigates. This label shall match the title of the display. Due to the restrictive size of buttons versus display title area availability, destination displays may add a more definitive title than what appears on the selecting button. This allows a button to show abbreviations or acronyms and the requested display to be enhanced with the total title spelling out the abbreviation or acronym. An example navigation button is shown below in Figure 4-27. This button navigates to the "DDCU 4B" display. The display navigated to could be titled "DDCU 4B" or "DDCU 4B, Direct Current-to-Direct Current Converter Unit 4B." Buttons can contain either graphic icons or text. If graphics/icons are used, they must be labeled with enough information to identify what it is or does.

![Figure 4-27 Navigation Button (typical)]

Buttons may contain icons (preferred) and/or labels and data fields to group related data and to clarify the function of the button. All buttons shall be clearly labeled to indicate the effect of selecting the button. There may be slight differences depending on the display building tool kits used.

4.16.2.1 NASA Navigation Button Deviation
4.16.2.2 RASA Navigation Button Deviation
RASA also uses an oval button for control related navigation.

4.16.2.3 ESA-Columbus Navigation Button Deviation
ESA-Columbus uses rectangular buttons only (tool limitation) with static text or symbol. Different background colors are used for different button types.

4.16.2.4 NASDA Navigation Button Deviation
4.16.3.5 CSA Navigation Button Deviation
4.16.3 **Radio Button**  
Note that the following covers standards to be applied to all radio buttons, in general. (Figure 4-28)

![Mapping](image)

**Figure 4-28 Radio Buttons**

Radio buttons should be used to:
1. Present a group of, from two to eight, mutually exclusive options to the user for changing the state of an object. This change of state is not processed until an associated button is selected.

2. Less frequently, to allow the user to control the initiation of a dialog that is not task-sequence dependent, but is mutually exclusive of other task dialogs.
   a. Unavailability of options should be shown by graying out the radio button label text.
   b. A unique radio button shall be presented for every option; each should be presented on a single line.
   c. Radio buttons shall be listed in some logical order, such as expected frequency of use.
   d. If no logical basis for ordering exists, an alphabetical listing shall be used.
   e. A single radio button should be set by the application, at all times.

4.16.3.1 **Appearance**  
The display designer can specify the number of buttons and the corresponding text labels and title, size, location, and arrangement.
   a. Individual radio buttons shall be recognizable by the presence of a diamond shaped indicator, to the left of the radio button label.
   b. Only one indicator in the set of buttons is illuminated at a time.
   c. The indicator color, when inactive, shall match the background color of the button. The indicator color, when active, shall be a highly contrasting color (from the button background) and may be representative of some meaningful color coding scheme.

4.16.3.2 **Size**  
The size of a radio button grouping depends on the number of options within the grouping.
   a. A radio button grouping should include from two to eight displayed options.
b. Either a horizontal format or a vertical format should be used for displaying two buttons.

c. A vertical format should be used for displaying more than two buttons.

4.16.3.3 Location
Radio buttons can be located anywhere within a display.

4.16.3.4 Labels and Titles
a. Radio button grouping titles shall be located in a consistent fashion above the groups they describe.

b. The relationship of the title to the group should be clearly discernible.

c. Each title should be separate and distinguishable from the body of the information beneath it.

4.16.4 Radio Button Deviations
4.16.4.1 NASA Radio Button Deviation

4.16.4.2 RASA Radio Button Deviation

4.16.4.3 ESA-Columbus Radio Button Deviation
ESA-Columbus uses rectangular buttons only (tool limitation) with static text or symbol. Different background colors are used for different button types.

4.16.4.4 NASDA Radio Button Deviation
The maximum number of radio buttons for JEM RLT is four.

4.16.4.5 CSA Radio Button Deviation

4.17 POWER ON/OFF STATE INDICATIONS
Power state is defined as the state of a device providing or not providing power to the unit represented by the icon. The corners of the icon will display the power state. When the device is closed (powered), the corners of the icon will be displayed in green. When the device is open (unpowered), the corners of the icon will be black.

Operational status is defined as the indication whether the unit represented by the icon is in normal operation or whether it is under a caution or warning. When in a nominal operational status, (power state provided by the unit and no caution and warning indication) the inner field of the icon will be dodger blue. When the unit is under a warning, the inner field will be red. Under a caution, the field will be yellow. When the unit is powered, but not operating, the inner field will be gray. For example, if two pumps get power at the same time, but only one is actually operating, the pump that is operating will have green corners and an inner field of dodger blue. The pump that is not operating will have green corners and an inner field of gray. When the unit is not powered, the inner field will be gray. If communication with a device providing the power state and operational status is lost, the inner field will be cyan.
4.17.1 NASA Power On/Off State Indications Deviation

Buttons and indicators (not raised boxes) may be used to represent power state and operational status. See Figure 4-29.

The color of the triangular corners represents the power state of the RPC (or unavailability of this information due to the lack of communication).

<table>
<thead>
<tr>
<th>RPC Corners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power State</td>
</tr>
<tr>
<td>On</td>
</tr>
<tr>
<td>Off</td>
</tr>
<tr>
<td>Unknown</td>
</tr>
</tbody>
</table>

The color of the inside area represents the power state and/or operational status (health) of the hardware/equipment (or unavailability of this information due to the lack of communication).
<table>
<thead>
<tr>
<th>Hardware/Equipment (inside area)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPC Power State</td>
</tr>
<tr>
<td>On</td>
</tr>
<tr>
<td>On</td>
</tr>
<tr>
<td>On</td>
</tr>
<tr>
<td>Off</td>
</tr>
</tbody>
</table>

Where there is no independent telemetry provided to indicate the power state of the hardware, the power state of the RPC will be used for both RPC and hardware.

4.17.2 RASA Power On/Off State Indications Deviation
RASA will have icons without corners, but will put a frame or line outside the button. Borders around the icon are used to indicate power on/off, icon colors indicate device status.

4.17.3 ESA- Columbus Power ON/Off State Indications Deviation
No dynamic status indication on buttons (tool limitation). Dynamic status data fields are placed next to buttons.

4.17.4 NASDA Power On/Off State Indications Deviation
JEM SLT buttons will not have corners and the button color is reflected power state (On: Dodger blue, Off: Gray). When C&W happened, the color of buttons change to Yellow (Caution) or Red (Emergency & Warning) which are shown in Figure 4-30.

Figure 4-30 JEM SLT Power On/Off State Indication

JEM RLT buttons look similar to NASA indications but have a three dimensional appearance as shown in figure 4-31.
4.17.5 CSA Power ON/OFF State Indications Deviation

CSA Power ON/OFF State Indications follow NASA Power ON/OFF State Indications.

4.18 TOOL TIPS

Utilization of tool tips is permissible.

4.18.1 NASA Tool Tips Deviation

Currently, NASA is not developing a tool tip capability.

4.18.2 RASA Tool Tips Deviation

RASA has a status/help window at the bottom of the screen. To get brief Help about an icon or a button, the user is required to select the icon or the button. There are two ways to select an object:

- To make cursor jump to the object using the arrow keys.
- To click left mouse button just near to the button, or the icon, or on the icon if it is not a button.

Context information window comes at the program start up. User can iconify that window. To get it back, the user is required to double-click on the icon. User cannot quit Context info window.
4.18.3 ESA-Columbus Tool Tips Deviation
There will be context-sensitive help on display level, but no tool tips.

4.18.4 NASDA Tool Tips Deviation
NASDA does not have Tool Tip function.

4.18.5 CSA Tool Tips Deviation

4.19 DYNAMIC CURSOR
The utilization of dynamic cursor is permissible.

4.19.1 NASA Dynamic Cursor Deviation
NASA PCS Displays currently does not have this capability.

4.19.2 RASA Dynamic Cursor Deviation
RASA currently does not have this capability.

4.19.3 ESA-Columbus Dynamic Cursor Deviation
Not provided by tool.

4.19.4 NASDA Dynamic Cursor Deviation
NASDA does not change cursor due to SAMMI restrictions.

4.19.5 CSA Dynamic Cursor Deviation

4.20 COLORS
Use of color should be limited to a set of well chosen colors. The identified colors should be used repetitively to maintain consistency across content areas and across displays. The color standards and definitions have been extracted from several industry and government standards documents as listed in Section 2.0.

An important factor to consider when selecting colors is the contrast among colors. This is needed to ensure that each color is easily discriminated from the others. Although contrast is an important consideration, it should not be used without regard to other important factors such as convention or standard, inherent meaning and consistency across displays. The color selections also need to be evaluated for shades of gray discrimination for black and white printouts. In the case of gases and fluids, color will also be accompanied when possible with an alphanumeric character inside or adjacent to the tank or pipe containing the fluid to indicate the material or substance.

All displays shall conform to color usage specifications outlined in this section and Appendix B. Red and yellow are reserved for use with emergency, warning, and caution notification. Red is reserved for indicating an alarm message or parameter limit violation indicative of an emergency or warning condition. Yellow is reserved for indicating an alarm message or parameter limit violation indicative of a caution condition.
Digital and textual data values may reflect caution and warning limit status using the following color coding.

<table>
<thead>
<tr>
<th>Status</th>
<th>Foreground Color</th>
<th>Background Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>Caution</td>
<td>Black</td>
<td>Yellow</td>
</tr>
<tr>
<td>Warning</td>
<td>White</td>
<td>Red</td>
</tr>
<tr>
<td>Emergency</td>
<td>White</td>
<td>Red</td>
</tr>
</tbody>
</table>

Table 4-1  Caution & Warning Status Colors

Graphical elements also shall utilize the color codes included in the appendices of this document.

Training graphical products which deviate from the colors prescribed in Appendix B must include a legend which documents the color usage.

4.20.1 NASA Colors Deviation
Off scale high and low are indicated by turning the data field red.

4.20.2 RASA Colors Deviation

4.20.3 ESA-Columbus Colors Deviation
ESA-Columbus MCD's follow general colors, in few cases using the "best match" of available tool-colors. Other displays as per APM FHCI standard.

4.20.4 NASDA Colors Deviation
Some displays of SLT and RLT have more than nine colors. On SLT, the same label of fluid and gases are displayed outside of the pipe and some are not displayed.

4.20.5 CSA Colors Deviation

4.21 ATTENTION SYMBOL
The attention symbol, an exclamation mark inside a yellow triangle (See Figure 4-32a), is used anytime it is desired to attract the user's attention based on some operational criteria. In particular, there are four cases:
• Denoting an out of configuration state or change in configuration
• Denoting an out of operational limits condition
• Providing additional troubleshooting information for C&W enunciated failures (i.e. ancillary cues)
• As an indication for the user to navigate to a more detailed level display for more information.

In the first three cases, the attention symbol will be positioned next to a telemetry data field. In the fourth case, the attention symbol will be positioned near a navigation button indicating to the user that information that should be looked at can be found by navigating to the next display.

Guidelines:
If the attention symbol is used to indicate that the user should navigate to a lower level display, the display should avoid sending the user to a page full of parameters on which there is no obvious indication of what drove the attention symbol.

![Figure 4-32 Attention Symbol](image)

This symbol is used for many items, including (but not limited to) switches, valves, data buses, power feeds, and health status indicators.

For example, the attention symbol is used to indicate that a Remote Power Controller (RPC), or switch, has tripped open. Rather than continuously showing the trip flag for all RPCs on any display, the attention symbol is used to indicate that the switch has tripped.

![Figure 4-33 RPC Detailed Parameters](image)

By selecting the RPC button, the user may view the RPCs detailed parameters to further investigate the trip (Figure 4-33).
The attention symbol will be shown as long as the parameter to which it refers is in the off-nominal state.

4.21.1 NASA Attention Symbol Deviation
NASA follows general Attention Symbol. For the NASA PCS implementation any parameters driving an attention symbol must be included in the same DDCT (Display Data Control Table) as the display on which the attention symbol will appear. This is especially true in the navigation case as unless the parameter is in the DDCT, there will be no way for the PCS to detect the condition.

4.21.2 RASA Attention Symbol Deviation
RASA does not use the attention symbol.

4.21.3 ESA-Columbus Attention Symbol Deviation
Attention symbol is not supported. Replaced by data quality indication, see Section 10.3.3.

4.21.4 NASDA Attention Symbol Deviation
JEM SLT uses the attention symbol to indicate event occurrence (include C&W) and RPC trip. There are no functions of showing detail information by clicking region of attention symbol. When clicking the RPC button, the commanding window (RPC Open/Close) is displayed. JEM RLT does not have an attention symbol.

JEM RLT does not use button type RPCs.

4.21.5 CSA Attention Symbol Deviation
CSA uses Attention Symbols for RPCs and Colored Icons and Advisory Messages in lieu of Attention Symbol, otherwise consistent with NASA Attention Symbol Deviation.

4.22 LIMITS
TBD.

4.22.1 NASA Limits Deviation
The limit manager application is a utility that interfaces with the ISP data server. The purpose of the application is to indicate data values that are approaching or exceeding limits as defined in a user defined input file. The limit manager includes an interface that allows the operator to change the predefined ranges as the program is executing. Changes made are resident only on the local ISP data server. Therefore, changes made to ground display limits will not be reflected on PCS displays and changes made to PCS display limits will not be reflected on the ground display limits.

The user may access the limit manager by left-selecting on the parameter field of interest. A menu appears giving options to plot the value or to view the limit manager. Selecting the “Limits” option opens the Limit Manager application with the parameter limits of interest shown.

When the limit manager is first started, the application uses a predefined input file that is loaded at program startup. Once the limit manager starts, the values defined in the data file can be changed or deleted, and undefined values can be added. The user interface to the limit manager is available via the popup menu that appears when the left mouse mouse button is pressed.
over a data field. When the Limit option is selected, the window appears as shown in Figure 4-34.

![Figure 4-34 Limit Manager](image)

The name of the PUI is shown at the top of the window, and the current limits defined for the PUI are shown in the text area. By selecting the Add, Replace, or Delete buttons, these current limits can be changed. When the Add button is selected, the following window appears (Figure 4-35). A similar window appears for the Replace button.

![Figure 4-35 Add Limit](image)

The operator can define the kind of limit, the indicator associated with the range, and the color to be shown when the PUI value falls into the defined range. The value used as a limit threshold and a description of the limit is entered at the bottom of the window. The OK button will enter this range into the text area of the limit manager window, and the Cancel button will ignore any inputs in the window before closing the window.
4.22.2 RASA Limits Deviation
RASA is not using this functionality for the crew. It is technically possible using unique technical interfaces but this capability is usually done by ground control.

4.22.3 ESA-Columbus Limits Deviation
The PWS Monitoring Limits application provides a tabular display of limit sensed HK-data with the monitoring parameters. The crew can enable/inhibit the limit sensing and select between two predefined (soft-high) limit sets. Actual changes of limits are controlled from ground.

4.22.4 NASDA Limits Deviation
JEM SLT limit manager window shown in Figure 4-36 is opened by clicking the data label (button) of limit check data of Figure 8-1 in paragraph 8.1.4. There is no PUI on limit manager window. The event inhibit flag, current limit set (only for analog value), and current limit value (only for analog value) are displayed. NASDA SLT provides crew the capabilities to enable/inhibit the event detection and to change the limit set and limit value. JEM RLT is TBS.

![SLT Limit Manager](image)

Figure 4-36 SLT Limit Manager

4.22.5 CSA Limits Deviation
CSA is using the standards Limits Manager provided by PCS.
4.23 MENUS
The word "menu" implies a list of choices, normally presented in the graphic form. The flexibility of an X-Window type system allows options to be presented using other graphics, like selection lists, or rows of pushbuttons. The intent of these guidelines shall be applicable to most graphic presentations providing lists of options.

Menu selection systems require careful task analysis to ensure that all functions are supported conveniently and that terminology is chosen carefully and used consistently.

Accept only one selection from each menu at a time. Multiple selections should generally not be allowed within each menu tree. Also, keep the selections in a single column and make the pointing area for selection as large as reasonably possible.

Provide a way to exit the menu without making a choice. This guideline is important in designing any menu, regardless of its complexity, but a "quick escape" method is particularly important. Frequently, the designer may want to give the user more than one exit option on a menu, such as one to go to another menu or screen, and one to leave the application completely. Example:

- Moving the cursor out of the menu.
- Providing options to quit or return to a previous screen.

Put a meaningful title on top of all lists and as pull-down menu categories. Menu navigation can be facilitated by providing a name that categorizes the options in the menu in a meaningful way. Strip and horizontal menu bars that stay on the screen throughout the life of an application will not need a title. A menu title may also describe the level of the menu in a menu hierarchy. For example, the title "Main Electronic Mail Menu" describes both the level of the menu and its contents.

Choose an organizing principle for the menu options. If there is no obvious organizing principle, choose to list items in alphabetic or numeric order. Organizing principles include:

- Expected frequency of use.
- Logical sequence of operations (task chronological order).
- Alphabetic or numeric order.

Usually, there will be a logical frequency of use or order to the list, and, when using icons, one of these two methods should always be used. If there is no logical order, list them vertically and alphabetically to make them easier to scan. This is especially important when there are a large number of menu options, such as more than eight.

To facilitate scanning, divide menu items into logical groups. If necessary, visually divide long lists after every fifth option. As a rule, organize a menu hierarchy according to the tasks users will perform, and organize the options in a way to minimize user search time. If the menu options consist of more than single words, attempt to limit the number of options to between five and eight. If a menu contains more than eight to ten options, there is probably more than one category of information contained in it, and it should be broken up into two or more menus.

Use words for menu options that clearly and specifically describe what the user is selecting. Use simple, active verbs to describe menu options. Sometimes, the active verb on a menu
choice is "implied." For example, listing the available fonts the user can pick from actually names things rather than actions on those things. The implied action verb in this case is "choose one" or "pick one." Top-level menus, used for application navigation, may also be used. The implied verb in this case would be "go to." The selection of words for a menu screen should follow these principles:

- Use words that clearly describe the options and are distinct from one another.
- Use common English words rather than computer jargon. Spell out words completely.
- Use simple, active verbs to tell users what actions will result from their choice. Users are selecting from a menu because they want to do something. In English, only verbs can be used to describe actions. Do not try to mix the use of nouns and verbs.
- Be sure that the option to leave the menu describes the consequences of its selection completely. Reserve such words such as "quit" for cases in which the user will be transferred completely out of the application.
- Describe the options using parallel construction. For example, if single words are used to describe each option, use the same part of speech for all the options. Action verbs are preferable.

If icons are used, ensure that they unambiguously identify the meaning of the user's options.

Display the menu options in mixed (upper and lower) case letters to provide more information at a faster rate. Text should only be displayed in upper case when it is an acronym.

Menus should be interactive and require a positive action on the part of the user. Mouseovers should be avoided.

4.23.1 NASA Menus Deviation

4.23.2 RASA Menus Deviation

4.23.3 ESA-Columbus Menus Deviation

4.23.4 NASDA Menus Deviation

JEM RLT has up to 17 menu options.

4.23.5 CSA Menus Deviation.
SECTION 5

DISPLAY ORGANIZATION AND HIERARCHY

5.1 GENERAL PRINCIPLES AND RATIONALE

5.2 TOPOLOGICAL/STRUCTURE DISPLAYS

5.2.1 NASA Topological/Structure Displays Deviation

5.2.2 RASA Topological/Structure Displays Deviation

5.2.3 ESA-Columbus Topological/Structure Displays Deviation

5.2.4 NASDA Topological/Structure Displays Deviation

5.2.5 CSA Topological/Structure Displays Deviation

5.3 HOME PAGE

5.3.1 NASA Home Page Deviation

5.3.2 RASA Home Page Deviation

5.3.3 ESA-Columbus Home Page Deviation

5.3.4 NASDA Home Page Deviation

5.3.5 CSA Home Page Deviation

5.4 SYSTEM DISPLAYS

5.4.1 NASA System Displays Deviation

5.4.2 RASA System Displays Deviation

5.4.3 ESA-Columbus System Displays Deviation

5.4.4 NASDA System Displays Deviation

5.4.5 CSA System Displays Deviation

5.5 TASK DISPLAYS

5.5.1 NASA Task Display Deviation

5.5.2 RASA Task Display Deviation

5.5.3 ESA-Columbus Task Display Deviation

5.5.4 NASDA Task Display Deviation

5.5.5 CSA Task Displays Deviation

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5.6.2 RASA Detailed Display Deviation

5.6.3 ESA-Columbus Detailed Display Deviation

5.6.4 NASDA Detailed Display Deviation

5.6.5 CSA Detailed Display Deviation

5.7 DISPLAY NAVIGATION

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SECTION 5.0
DISPLAY ORGANIZATION AND HIERARCHY

5.1 GENERAL PRINCIPLES AND RATIONALE
There are three major types of displays: topological/structure, system, and task. Some displays may be accessed via topological or system displays. These system displays are organized in a hierarchy to define increasing levels of detail (Figure 5-1). Task displays may also be accessed from a pull-down menu on the user tool bar.

![Diagram of Display Organization and Hierarchy]

5.2 TOPOLOGICAL/STRUCTURE DISPLAYS
Topological displays (Figure 5-2) provide information grouped by location - US Lab, Node 1, P6, etc. A topological display shows the shape of the segment (P6, FGB, etc.) as a gray outline filling the majority of the display window. These are "module" displays. The proportion shape for the module should not change when navigating to other displays of the same module. The size may change, but not the proportion.

It is possible that other topological displays may portray more than one segment. For example, a single display may show data for the entire starboard truss in a topological format.
Module displays provide system overlays to allow the user to view details of a particular system's blocks in that location (Figure 5-3). These overlays are accessible via system buttons on the right side of the display.
Module displays should contain navigation buttons for adjacent module displays. For example, a button near the left (aft) side of the Node 1 display provides navigation to the FGB display.

5.2.1 NASA Topological/Structure Displays Deviation

5.2.2 RASA Topological/Structure Displays Deviation
5.2.3 ESA-Columbus Topological/Structure Displays Deviation

ESA-Columbus topological displays will show the shape of the ESA-Columbus element as a gray outline filling the majority of the display window. The module display provide subsystem overlays, which is actually a new display but with the same background, to allow the user to view details of a particular subsystem components in the module. These overlays will be accessible via subsystem buttons on the right side of the display. An example of an ESA-Columbus related topological display is shown in Figure 5-6a. The display shows the main components of the ECLSS and their location in the module.

In specific cases deviating topological views are used. E.g. most DMSS equipment is accommodated in the Starboard Cone. To provide a good overview, the starboard end-cone is
tilted into the display plane and provides a front view on the cone with the DMS equipment, shown in Figure 5-6b.

Topological MCDs serve primarily for a topological system overview and include generally only selected overview status data that are representative for the overall system status.
5.2.4 NASDA Topological/Structure Displays Deviation
JEM RLT is TBS.

5.2.5 CSA Topological/Structure Displays Deviation
Displays may be reflective of the actual position of those elements that move.

5.3 HOME PAGE
The Home Page is defined as the top most or initial display used in beginning from and navigating to other displays. In most cases, the Home Page is always displayed and available on-screen to users.

The Home Page display should indicate status of the module (or modules) and provide navigation to other displays.

The Home Page should provide a graphical depiction of the module’s (or modules’) physical layout.
Figure 5-7  NASA Home Page

Figure 5-8  RASA Home Page
5.3.1 NASA Home Page Deviation

5.3.2 RASA Home Page Deviation

5.3.3 ESA-Columbus Home Page Deviation
The ESA-Columbus system home page, which is equivalent to other partners’ home pages, is the topmost synoptic display which is displayed when the Monitoring and Control Display (MCD) application is started or de-iconized, respectively. Navigation from one synoptic display to another is performed via navigation buttons or the MCD navigation menu. These features are described in more detail in Section 5.7.3.

5.3.4 NASDA Home Page Deviation
JEM SLT home page as shown in Figure 5-10 is the top of the JEM display hierarchy. JEM RLT is TBS.

5.3.5 CSA Home Page Deviation
5.4 SYSTEM DISPLAYS

5.4.1 NASA System Displays Deviation

System display (Figure 5-11) provide data organized by the functional vehicle system and often include many physical regions of the vehicle. Each system shall have a summary display available from the Home Page. This summary shall provide general vehicle-wide (i.e., including IP segments) system status information and the ability to navigate to related displays.

Figure 5-11  C&DH System Display (typical)
5.4.2 RASA System Displays Deviation

5.4.3 ESA-Columbus System Displays Deviation
ESA provides ESA-Columbus system displays as both topological and functional overview displays for all ESA-Columbus Systems. From these overview displays, navigation is provided to lower level functional displays as described in section 5.7.3.
Figure 5-13  Functional TCS Display for ESA-Columbus (typical)
5.4.4 NASDA System Display Deviation
JEM SLT systems displays as shown in Figure 5-14 provide data organized by the functional JEM system and often include many physical regions of the JEM. JEM RLT is TBS.

![Figure 5-14 JEM ECL System Display (typical)](image)

5.4.5 CSA System Displays Deviation
CSA provides MSS Systems Home Displays. E.g., SSRMS, MBS, and SPDM.

5.5 TASK DISPLAYS
Task displays are uniquely configured to assist the user in performing particular actions. Task oriented displays may be used when a particular task is repetitious (performed frequently) or is complex and time critical involving several systems or disciplines. A task display may be useful in simplifying the procedure to be used by reducing the number of displays and the amount of searching required to execute a complex procedure.

To determine whether a task-oriented display is necessary or redundant to existing system or discipline displays, a procedure using existing displays should be drafted and discussed with the various system or discipline experts and display/procedure users. If this team finds that there is a clear advantage to the development of a task-oriented display in addition to the displays present for system monitoring and commanding, then a task-oriented display may be developed. See Figure 5-15.
5.5.1 NASA Task Displays Deviation
Integrated task displays are accessed via a “task” button on the user toolbar. System specific task displays may be associated with, and accessible from, both topological and system displays. For example, a Lab Activation display may be accessible from the Lab display, and a Power Load Shed display may be accessible from the EPS Summary.

5.5.2 RASA Task Displays Deviation

5.5.3 ESA-Columbus Task Displays Deviation
ESA-Columbus task displays are not provided as synoptic displays.

5.5.4 NASA Task Displays Deviation
JEM SLT does not provide Task Display. JEM RLT is TBS.

5.5.5 CSA Task Displays Deviation
5.6 DETAIL DISPLAYS

These segment and summary displays provide further navigation to more detailed displays for individual functions, blocks, and other components. It is possible to navigate to a single display via multiple unique paths. Figure 5-16 shows an example hierarchy. Note that the user may navigate to the "MDM N1 Primary" display in two ways - once via the C&DH Summary display and again through the Node 1: C&DH overlay.

![Diagram of display hierarchy](diagram.png)

The user navigates from one display to another by means of navigation buttons, gray raised buttons included on other displays.

5.6.1 NASA Detailed Display Deviation

5.6.2 RASA Detailed Display Deviation

5.6.3 ESA-Columbus Detailed Display Deviation

The level of detail on the MCDs is adequate to provide the commands and status information required to perform crew procedures related to the operations of the nominal ESA-COLUMBUS system, irrespective whether these are implemented as manual procedures, ACPs, or executed by the crew in online communication with ground control or autonomously according to predefined flight rules. Each remote command needed for nominal ESA-COLUMBUS system operations as well as for failure recovery by the crew is provided on MCDs.
The user can also navigate to this level and any other APM display through the pull-down navigation menu from the MCD main panel.

5.6.4 NASDA Detailed Display Deviation

JEM SLT does not have subsystem summary displays, so there is one path to navigate details windows. JEM RLT is TBS.

5.6.5 CSA Detailed Displays Deviation

5.7 DISPLAY NAVIGATION

Navigation from one display to another can be performed via navigation buttons, command buttons (when such a button allows commanding and navigation), or menu items.

A. From the Home Page, the user may single click on a navigation button in the system toolbar to call a summary display for that system. Alternatively, clicking on a module or truss icon calls a summary topological display for that segment.

B. Navigation buttons will be provided on each tier of the display hierarchy to link related displays together.

C. All navigation buttons shall be appropriately labeled to indicate the display destination. This button may be textual or graphical.

D. Navigation buttons shall function unconditionally to the system status.

E. A method should be provided to access a hierarchical menu of all displays.

F. A method should be provided to list windows currently open.

G. Navigation buttons or graphical elements can be used to navigate to adjacent modules.

H. Navigation from a higher level to a lower level graphical display shall maintain orientation unless there is proper rationale for doing otherwise.

I. For a series of equal level displays which can call each other, the group of navigation buttons that are located on each display shall be in the same order.
J. A navigation button should be indicated to be inactive if it will not provide an action.
K. The display should be consistent when grouping/ordering items and buttons. If items are presented in specific manner, then this convention should be continued through the display tree of similar displays.
L. The inactive and active status of navigation button should not normally be determined by telemetry. Deviations must be specifically approved.

5.7.1 NASA Display Navigation Deviation
NASA does not provide the following capabilities:
A method should be provided to access a hierarchical menu of all displays.
A method should be provided to list windows currently open.

5.7.2 RASA Display Navigation Deviation

5.7.3 ESA-Columbus Display Navigation Deviation
On ESA-Columbus provided laptops, or so called Portable Work Stations (PWS), display navigation starts on the Root Display. The Root Display as shown in Figure 5-18 will be displayed on the laptop after successful execution of the boot-up sequence and start of the Date and Time Group (DTG) and the Crew Notification. The function related DTG Panel and System Message Panel will be displayed in reserved areas and fixed positions on the screen. They will not be overlaid by other application windows.

From the Root Display, other applications, e.g., Procedure Viewer, Monitoring and Control Displays, can be started via the ESA-Columbus Segment Menu. This menu can be activated by clicking with the right mouse button on the Root Display window. Alternatively, the applications can be started automatically (can be specified in a dedicated start-up file), but will be iconized.

Figure 5-18 ESA-Columbus Portable Work Station Root Display
The MCDs are structured in a top-down hierarchy tree following the ESA-Columbus System breakdown. Figure 5-19 provides an overview of the generic hierarchy and structure of ESA-Columbus MCDs. Top level is the ESA-Columbus Home Page, from which appropriate paths lead to the S/S Overview MCDs and from there to more detailed displays. The further breakdown of functional MCDs on Assembly/Unit level is to the detail of automated or manual crew procedures. The actual number of levels and individual MCDs will vary for the different systems.

Navigation to a desired MCD is provided in the following basic ways:
- using the "Synoptics" menu on the main panel of the home page and of overview MCDs, which allows to pre-select and call the selected MCDs directly.
- using the "Navigation" menu on the main panel of the home page and overview MCDs, which cascades down the lowest MCD level.
- using the system bar on the right side of the home page and overview MCDs to call MCDs of a different ESA-Columbus system
- using internal navigation buttons on the MCDs which directly call a predefined MCD.

![Image of ESA-Columbus Display Hierarchy](image)

Figure 5-19  ESA-Columbus Display Hierarchy
5.7.4 NASDA Display Navigation Deviation
JEM SLT has no subsystem summary display. The element button is always displayed, so it is able to move one element display to another without going back to the Home Page. JEM RLT is TBS.

NASDA does not provide the following capabilities:
A method should be provided to access a hierarchical menu of all displays.
A method should be provided to list windows currently open.

5.7.5 CSA Display Navigation Deviation
Consistent with NASA deviations.
SECTION 6

OPERATIONS NOMENCLATURE, ODF PROCEDURES AND DISPLAYS

Actions in work. Not included in CR4248.
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SECTION 7

Section Baselined for CR4248. Proposal submitted for next CR.
USE of SYMBOLS, GRAPHICS, and Icons

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SECTION 7.0
USE OF SYMBOLS, GRAPHICS, AND ICONS

7.1 GENERAL PRINCIPLES AND RATIONALE
Various graphic designations are used in the flight and training documentation to display different diagrams and operational procedures. The basic principles of their display and usage should be applied when using the conventional graphic designations.

Conventional graphic designations are the means of conveying information about a system’s function and structure. Electrical, hydraulic and other system elements, as well as the connections between them, are conventionally displayed by graphic designations. Conventional graphic designations should be clear in understanding or without double meaning, they should not be identical to other designations with already assigned meaning.

7.2 SYMBOLS
Conventional graphic designations used in training documentation should be called graphic symbols.

Conventional graphic designations used in onboard displays should be called icons.

Icons may be an exact copy of a graphic symbol or its simplified image.

In any case, the following rule should be followed:

If an icon exists, then this image should be used in all other ISS documentation. E.g., in the flight and training documentation.

7.2.1 Graphical Symbols
Graphic symbols are drawn like schematic signs whose form does not necessarily correspond to the real configuration of the displayed elements (or parts). Geometric elements which make up the graphic symbols (such as squares, circles, triangles and etc.), should be connected to one another not only geometrically, but also in the proper proportion. It is accepted to proportionally and simultaneously enlarge or reduce the size of all graphic symbols. It is accepted to display graphic symbols of elements which are integral parts of the designations of other elements, reduced in size in comparison with other elements. Graphic symbols are displayed in the position in which they are displayed in the present standard (Appendix C) but can be used in any orientation.

7.2.1.1 NASA Graphical Symbols Deviation

7.2.1.2 RASA Graphical Symbols Deviation

7.2.1.3 ESA-Columbus Graphical Symbols Deviation
Some icons appearing in Columbus documentation will have a different appearance than the corresponding display icon. (This is due to application of other standards for documentation preparation previously performed.)

7.2.1.4 NASDA Graphical Symbols Deviation
NASDA SLT and RLT provide no indication for disconnected equipment. Backup components are identified by the label of the icon on NASDA SLT.

7.2.1.5 CSA Graphical Symbols Deviation

7.2.2 Icons
Icons will be simple, clear, and easy to understand symbols. Icons can be used simply as a symbol of an object or function that cannot be manipulated, or as a symbol on which the user can directly act (e.g., selecting the icon to open or move applications or files). An icon can change in shape and color over time if that change adds useful information to the user in an intuitive manner. The object or action that the icon represents should be visible in the icon. This guideline has two implications:

(1) The size of the icon should be large enough for the user to perceive the representation and discriminate it from other icons and no smaller than 20 x 20 pixels, and

(2) The representation should be pictographic whenever possible. To the greatest extent possible, icons should be accompanied by a text label, especially when the icons do not closely resemble the symbolized object or action. A dashed line forming the outline of an icon means it is a secondary item or component.

The “system tool bar” shall contain only the systems icons as shown in C2.12 of Appendix C.

Interaction with an icon shall be accomplished by selecting the icon itself, not by selecting any additional label associated with the icon. See Section 4.16 for button guidelines.

7.2.2.1 NASA Icons Deviation
An "X" placed over an icon or symbol means the equipment has been identified as being failed.

7.2.2.2 RASA Icons Deviation

7.2.2.3 ESA-Columbus Icons Deviation
Restrictions due to already selected commercial display building toolkit will apply.

7.2.2.4 NASDA Icons Deviation
SLT has some restrictions for using colored icons because of SAMMI restrictions. The SLT subsystem tool bar provides only a text label instead of icon, label, and tool tip. SLT does not use a dashed line for secondary components. JEM RLT is TBS.

7.2.2.5 CSA Icons Deviation

7.3 PROCEDURE FOR INCORPORATING CHANGES AND ADDITIONS TO GRAPHIC SYMBOLS AND ICONS
Graphic symbols and icons may be changed and supplemented during onboard system development, ground tests and flight operations. Graphic symbols and icons are updated via change requests which are submitted by the international partners, the IDAGS Board members. Only the graphical material in the Change Request that needs updating is updated. The Change Request, which includes only those pages of Appendix C requiring changes, should be issued
together with the accompanying list of graphical symbols or icons which replace those in the original version, or which should be incorporated in the updated version. This Change Request should contain a brief description of the incorporated changes and their rationale.

Partners should try to develop diagrams based on the conventional graphic designations and icons, listed in this standard (Appendix C). When partners need a more detailed level of training diagrams than those covered by the standards, the use of graphic symbols of their own countries’ standards is approved. However, training documentation that defines the meaning of these graphic symbols should accompany any such diagram.

7.4 METERS

Meter symbols, such as bar graphs, filling tank symbols, and thermometers, must include appropriate labels (typically above, below, or to the left) to indicate the parameter depicted. In most cases, a digital value will be shown near the meter (typically below or to the left).

Minimum and maximum values for the meter should be labeled. Color standards apply to all meters.

Color standards apply to all meters. When a parameter’s background color indicates an off-nominal status, the associated bar meter changes its fill color in the same way. For example, in Figure 7-1, if a fluid’s temperature exceeds a warning limit, the temperature parameter field shows a red background and the associated thermometer’s fill color will be red.

7.4.1.1 NASA Meters Deviation

7.4.1.2 RASA Meters Deviation

7.4.1.3 ESA-Columbus Meters Deviation

7.4.1.4 NASDA Meters Deviation

The color of meters in NASDA SLT is not changed because of SAMMI restrictions. JEM RLT is TBS.

7.4.1.5 CSA Meters Deviation

7.4.2 Fixed Scale Linear Meters

7.4.2.1 Application
Fixed-scale linear meters are used as an on-screen graphical representation of hardware devices that depict data along a scale in which the pointer moves along the scale and the scale remains stationary. Fixed-scale linear meters are designed to present quantitative data where the magnitude of the end-points and the scale increment permit the full scale to be displayed within the maximum size allowed. Unlike bar charts and line plots, only a single dynamic data value is tied to this graphic. See Figure 7-1.

7.4.2.2 Appearance
The display can specify the text labels associated with the meter, the length of the meter, and the increment of the scale, as well as its orientation (horizontal or vertical). Fixed-scale linear meters can optionally contain a data output field, displaying the current scale value. Fixed-scale linear meters can optionally show a fill color associated with the current scale value within the meter.

a. If threshold limits are shown, the color change associated with exceeding a threshold shall apply to the entire meter, up to the value displayed.

b. Threshold indicators shall be displayed if limits are shown.

7.4.2.3 Size
The length of the meter is dependent on the range of values depicted and the increment between individual values.

a. The minimum length of a fixed-scale linear meter should be 2 inches.

b. The maximum length of a fixed-scale linear meter should be 6 inches.

7.4.2.4 Location
A fixed-scale linear meter can be used anywhere within a display.

7.4.2.5 Labels and Titles
In addition to each fixed-scale linear meter having a label, each group of fixed-scale linear meters can have a title that describes the function of the grouping.

a. The titles shall be located in a consistent fashion below the data groups they describe.

b. The relationship of the title of the group should be clearly discernible.

c. Each title should be separate and distinguishable from the body of information above it.
7.4.3.1 NASA Fixed Scale Linear Meters Deviation

7.4.3.2 RASA Fixed Scale Linear Meters Deviation

7.4.3.3 ESA-Columbus Fixed Scale Linear Meters Deviation

7.4.3.4 NASDA Fixed Scale Linear Meters Deviation
Fixed Scale Linear Meters cannot change the threshold limits (they are displayed by color coding) reflecting current limits due to SAMMI restrictions.

7.4.3.5 CSA Fixed Scale Linear Meters Deviation

7.5 STATUS LIGHTS
For some enumerated parameters, such as mode indicators, it may be desirable to emulate the appearance of hardware panel lights in a separate window. Given an appropriate parameter label to the left, a series of rectangles may be used to indicate different possible states. A labeled rectangle will change its appearance to indicate the value of the parameter.

7.5.1 NASA Status Lights Deviation
7.5.2 RASA Status Lights Deviation

7.5.3 ESA-Columbus Status Lights Deviation
ESA-Columbus does not use status lights on symbols or icons (tool restriction).

7.5.4 NASA Status Lights Deviation
JEM SLT does not have status lights.

7.5.5 CSA Status Lights Deviation

7.6 LINE TYPE CODING

Line types are defined to distinguish between: power lines, fiber optic lines, MIL-Bus lines, LANs, etc. When it is important to note the type of data bus, be it a twisted-shielded pair or optical-coupled, an icon representing that function will be associated somewhere with the transmission line.

Line type is a graphic code and appears as shown in Figure 7-2. Thick, solid lines (2 pixels) represent data transmissions. Thin, solid lines (1 pixel) show power distribution. Dashed lines (1 pixel) are for video connections. When using the line type convention, the display designer shall be consistent within a subsystem. Whenever a meaning has been associated with a line type, the meaning shall be obvious either by explicitly drawing a legend on the display, or providing a legend on a help pop-up.

| Thick, solid lines (2 pixels) | data transmissions |
| Thin, solid lines (1 pixel)   | power distribution |
| Dashed lines (1 pixel)        | video connections  |

Figure 7-2 Line Types

(figure will be altered. Description of dashed line will be changed to “Backup sets.”)

7.6.1 NASA Line Type Coding Deviation.

7.6.2 RASA Line Type Coding Deviation.
RASA Uses dashed lines to show backup sets (pipes, data links, buses, devices, etc.)

7.6.3 ESA-Columbus Line Type Coding Deviation.
ESA-Columbus Ops schematics will following drawing tool conventions. For displays, ESA follows general Line Type Coding.

7.6.4 NASA Line Type Coding Deviation.
JEM SLT Line Type coding is as follows in Figure 7-3.

| Thick, solid lines | Power Distribution |
| Thin, solid lines  | Data Transmission (primary) |
| Thin, solid lines  | Data Transmission (secondary) |
7.6.5 **CSA Line Type Coding Deviation.**

### 7.7 LINES AND PIPES

Within a schematic, electrical and data resource pathways shall be represented by lines. These lines shall be made visually distinct by use of the appropriate coding method. See Figure 7-3.

- Schematics that display lines or pipes that cross shall be shown as line or pipe images that overlap.
- Schematics that display lines that cross and connect, shall be shown with a circle at the intersection which is four pixels larger (two on each side) than the line, and has a black fill color.
- Schematics that display pipes that cross and connect, shall be shown with a circle at the intersection which is four pixels larger (two on each side) than the pipe, and has the same fill color as the pipe.

Pipes shall be labeled with their contents per Appendix B.

**Direction of Flow Indication**

Arrows used with lines to show direction of flow shall be placed on the line to prevent overcrowding of displays. When several arrows are used in groups of parallel lines or lines in close proximity to each other, the arrows shall be aligned in a symmetrical manner. If the display is too detailed to allow the aligning of arrows, the arrows shall be staggered or offset enough to prevent them touching or running together and confusing the user. Figure 7-4 shows the arrangements.
7.7.1 Line Specific

A. Lines that cross and do not connect shall be shown as lines images that overlap. See Figure 7-5.

![Figure 7-5 Lines Crossing and Not Connecting](image)

B. Lines that are perpendicular and non-crossing should not use a black filled circle. Lines that cross and connect, shall be shown with a circle at the intersection. The circle shall be four pixels larger (two on each side) than the line and filled with the color black. See Figure 7-6.

![Figure 7-6 Lines and Pipes](image)
D. Lines that intersect to form T-junction or Y-junction do not require use of a circle. See Figure 7-7.

![Preferred] ![Acceptable] ![Preferred] ![Acceptable]  

Figure 7-7 Intersecting T-Junction and Y-Junction Lines

7.7.1.1 NASA Lines and Pipes Deviation

7.7.1.2 RASA Lines and Pipes Deviation

7.7.1.3 ESA-Columbus Lines and Pipes Deviation

ESA-Columbus Ops schematics will following drawing tool conventions. For displays, ESA follows general Line Type Coding.
7.7.1.4 **NASDA Lines and Pipes Deviation**
JEM SLT displays have no circle at line or pipe intersections. NASDA uses the following method to indicate lines that cross and do not connect. See Figure 7-8

![Figure 7-8 NASDA Lines deviation](image)

7.7.1.5 **CSA Lines and Pipes Deviation**

### 7.8 ACTIVE LINE CONVENTIONS
When a line is used as an indicator, then

a) If there is no active parameter associated with a line, then it will be always present with a normal line width and will be black in color.

b) When information indicating the active status of a line is present, the color of that line shall follow the normal color convention.

7.8.1 **NASA Active Line Conventions Deviation**

7.8.2 **RASA Active Line Conventions Deviation**

7.8.3 **ESA-Columbus Active Line Conventions Deviation**
ESA-Columbus does not use active lines. ESA uses lines as static background only. The colors of the lines follow the normal color conventions.

7.8.4 **NASDA Active Line Conventions Deviation**

7.8.5 **CSA Active Line Conventions Deviation**

### 7.9 VALVES
Valves are represented by two or more triangles sharing a common point. A two-way valve (allowing forward or reverse direction flow) is depicted as a “bow tie” combination of two triangles. A three-way valve, controlling fluid flow through a T intersection is shown as three triangles. See Figure 7-9.

The valve icon may be placed on top of a button to allow access to a more detailed popup window.

All valves must be clearly labeled with appropriate operations nomenclature.
Modifiers may be placed on the top of this symbol to indicate the method by which the valve is actuated. Certain symbols can be additive to represent multi-controls. E.g., a ‘manual T-cross’ could be placed on top of the solenoid symbol to represent a manual override capability of a solenoid valve. See Figure 7-10. Valve modifiers can be found in Appendix C.

The triangular portions of the valve are filled white when flow is not allowed by the valve. If the valve allows fluid to flow along a path, that path is shown by filling the applicable triangular sections with the color code for the associated fluid. See Figure 7-11.

A modulating valve is valve which can be nominally between the open and closed state to allow active control of the flow rate.

For three-way modulating valves, i.e. valves that nominally vary their position between Flowthru and Bypass, the three-way mix valve icon will be used to display the Flowthru, Bypass, Indeterminate, and Modulating positions. The term "Modulating" or "Mod" will replace "InTrans" in the telemetry field; the three-way mix valve icon will display all valve legs highlighted with the appropriate fluid color to indicate flow in all directions. See Figure 7-12.
If a valve’s position is indeterminate, the valve shall be filled with white, and a question mark shall be shown over the valve icon. See Figure 7-14.

![Figure 7-14 Indeterminate Valve](Image)

The valve icon should be placed next to associated pipes such that the edge of the valve is flush with the connected pipe. When the valve allows flow, the valve icon will be filled with the same color used to fill the pipe. See Figure 7-15.

![Figure 7-15 Valve Placement](Image)

If a valve can be set to variable positions, a data field may be placed near the valve to indicate the measured valve position. See Figure 7-16.

![Figure 7-16 Measured Valve Position](Image)
7.9.1 NASA Valves Deviation

7.9.2 RASA Valves Deviation

7.9.3 ESA-Columbus Valves Deviation
Valve status in ESA-Columbus displays cannot be animated with fill pattern. The status is shown in a text field next to the valve (typically below or to the left). The valve symbols are shown as per Appendix C.

7.9.4 NASDA Valves Deviation
Because of SAMMI restrictions, in JEM SLT, the triangular positions of the valve are filled with the icon background color when flow is not allowed by the valve. The valve fill color is black regardless of fluid type. The valve icon does not change in transition between open and close positions. If a valve position is indeterminate, a question mark is shown without the valve icon.

7.9.5 CSA Valves Deviation
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COMMAND WINDOW

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SECTION 8.0
COMMAND WINDOW

8.1 GENERAL PRINCIPLES AND RATIONALE
Sending commands to the ISS is one of the fundamental purposes of the ISS displays. Most, if not all, commands sent by the ISS flight crew or ground controllers will be through a command window. The basic philosophy behind each command window is that it contains enough telemetry information to safely send a command and monitor its response.

Generic telemetry display arrangements should follow the order of top to bottom, left to right.

8.1.1 NASA General Principles and Rationale Deviation

8.1.2 RASA General Principles and Rationale Deviation

8.1.3 ESA-Columbus General Principles and Rationale Deviation

8.1.4 NASDA General Principles and Rationale Deviation
JEM SLT status windows as shown in Figure 8-1 contain buttons located at right side of status data area to open a command window which includes command buttons related with the status data. JEM RLT is TBS.
8.1.5 CSA General Principles and Rationale Deviation

8.2 COMMAND DISPLAY STRUCTURE AND LABELING

Within the ISS C&DH architecture there are “One Step” and “Two Step” commands. A one step command means that the user only needs to send a single command (sometimes in conjunction with using an “Execute” button) in order for the intended action to be performed.

A two step command requires that two separate commands be executed (each of which may also require the use of an “Execute” button) prior to the intended action being performed. The two step commands are designed to prevent an operator from accidentally executing an action, however, there are different terms for describing the two steps which should be used depending on the nature of the action. Generally the use of the terms is decided by the time criticality of the action. These should be used as display labels for the commands.

Rules for naming commands:

The term “Fire” shall not be used in the context of executing commands and shall be reserved only for a physical fire onboard the Space Station or for the “firing” of thrusters. This is to
prevent confusion on the displays and within the procedures. The label on the command button shall be the name of the action being performed.

When used for commanding, the term “Arm” shall only be used when an immediate action is enabled or an action is to be performed within a specified time from the moment of arming. If the hardware design permits, each “Arm” command should have an associated “Disarm” command if there is not an automatic disarming function associated with the action after a specified period of time.

Generally, the term “Arm” is used in a 2 step command when an action is being performed which is time critical with respect to the “Arm” and the operator is expected to only have the action available for a short period of time. It is the kind of action where the action command is expected to be sent immediately after the arm command. “Disarm” is obviously necessary so that the action command cannot be sent if it is no longer required. Most systems of this nature have been designed such that the action command can only be “Armed” for a short period of time before automatically returning to a safe state.

The term “Enabled” shall be used when allowing automatic processes (such as software routines) to operate or when allowing the specified action to occur whenever commanded.

The term “Inhibit” shall be used when preventing a command from being executed or an action from being performed.

“Enable” will be used for all the other cases. In some cases, commands may usually be in an “enabled” state and the action command may be sent at will only to be “inhibited” as required for special circumstances such as maintenance. Therefore there may be no time criticality associated with this terminology.

Use on Displays:

Labels such as “Ena Off” or “Arm Inh” for commands can be confusing as the object and action can be misinterpreted and should be avoided. Therefore the standard for labeling commands is as follows (with a couple of examples):

In the display region near the command, use a display label to identify the function of the commands when parsed appropriately such as “Flux Capacitor” then “Charge”. Then next to that label include the appropriate command buttons for arming and disarming labeled as “Arm” and “Disarm,” etc. as required. These buttons are then followed by the button labeled with the name of the action which actually sends the command which has been “armed.”

In the example below, the command to enable the Departure Response Software is armed, then the actual command to “Enable” the software is sent with the “Enable” button. (Although the “Inhibit” command does not need to be “armed” prior to sending, the format of the commands above it is retained for symmetry of the display. This display could have also had an “Execute” button which would need to be used with all the command buttons on this display.)

Please note the placement of the telemetry feedback at the top of the display. It is placed such that the confirming cue for the action to be taken on this page is the first item the operator sees when opening this window. The operator can then immediately assess the state of the system to be commanded and can therefore easily verify that the system is in the required configuration.
Whenever using feedback telemetry which is an enumerated state, such as “Arm”, “Disarm,” “Ena,” “Inh,” etc. it is preferable to use the appropriate word or abbreviation rather than an “X” or blank showing in the field next to a label.

In Figure 8-2, we can see that we are commanding either the primary or secondary departure response software. The operator will arm or disarm and enable and inhibit the software as required in the procedure. Note the status of the command being armed or not is situated immediately next to the commands for immediate feedback.

Procedural Example:

PCS

<table>
<thead>
<tr>
<th>sel PMA2 Departure Response SW</th>
<th>PMA2 Departure Response SW</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Secondary NCS’</td>
<td></td>
</tr>
</tbody>
</table>

√ Departure Response SW - Inh

‘Enable’

<table>
<thead>
<tr>
<th>cmd Arm</th>
</tr>
</thead>
<tbody>
<tr>
<td>√Arm State - Arm</td>
</tr>
<tr>
<td>cmd Enable</td>
</tr>
<tr>
<td>√Departure Response SW - Ena</td>
</tr>
</tbody>
</table>

Anything which can be done to clarify the relationship between the arm/disarm buttons and their associated action button is encouraged. See Figure 8-3.
There are other terms in addition to “Arm,” “Disarm,” “Enable,” and “Inhibit” which must be used according to the rules as defined in the Appendix A - “Definition and Use of Standard Terminology” in order to prevent confusion and minimize the number of similar terms being used for identical functions.
An Execute button is used to add an additional level of protection to a command. Any command details page on which an Execute button appears requires its use for all commands on the display. An Execute button may be used at the discretion of the display designer; however, in the following case it is required:

- For Criticality 2 or 3 commands on displays that are not protected with a laptop-provided “Are you sure?” or similar prompt.

The cases where an Execute button is recommended to be used are:

- Any command page that has on it a set of commands that are intended to be accessed randomly in procedures (the display is not a task-oriented display with buttons laid out in a unique sequence to support the task), may use an “execute” button to allow the user to verify the selection of a command prior to sending it.

- If a command is loaded into a buffer for verification prior to sending or “incorporating.”

**Command Talkback**

If information is available relative to the condition or state of a system being commanded, then a field should be provided near the command button to display that information.

**8.2.1 NASA Command Windows Deviation**

A typical NASA command window is shown below in Figure 8-4. NASA Command windows are accessed by selecting an icon or button.

![Sample Command Window](image)

**Figure 8-4 Sample Command Window**

**8.2.1.1 Command Window Format**
Each command window will have the standard windows control features (minimize, close, etc.) located at the usual location at the top of the window. Command windows labeling will be ‘parsed’ or broken down into parts to provide unambiguous but easy to read labels.

8.2.1.2 Command Window Areas

Each command window can be separated into four general areas:

Area 1: Control Button Area. Control buttons are to be grouped logically and should have, at the least, a command and its ‘opposite.’ For example, if there is an ‘on,’ there should be an ‘off,’ and if there is an ‘open’, a ‘close’ is necessary. The ‘positive’ command should come first (i.e., ‘on’, ‘open’). Command buttons should be grouped in columns to enhance procedure flow operations. However, to allow efficient use of window space, the display may be designed with several columns. This design still allows a sequential flow of action down each column without the necessity of scrollbars.

Talkbacks. Associated, near the command buttons, in logical order, should be a field to provide feedback as to the condition or state of the block, so that the resulting actions of a command are easily visible and understood. For example, next to the fan ‘On’ and ‘Off’ buttons, there should be a telemetry field able to show, at a minimum, ‘ON’ and ‘OFF.’ This is so that the operator can see the state of the fan before commanding (e.g., the fan is ‘OFF’) and after commanding (e.g., the fan is ‘ON’). It is preferred that when able, words such as ‘ON’, ‘OFF’, ‘OPEN’, and ‘CLOSED’ should be used in these talkbacks. When necessary to use a binary condition, such as an RPC tripped status, the capital letter ‘X’ shall be used. (See Section 10.6, Boolean.)

Area 2: Additional Telemetry Area. Additional telemetry to provide information necessary for system monitoring and for situational awareness during commanding can be placed in this area. For example, fluid pressures might be needed before making the decision to open a valve. Careful selection of parameters should be made to ensure that only the minimum, essential telemetry is presented.

Area 3: Navigation Area. Navigation buttons provide the capability to quickly access related systems’ telemetry and commanding (e.g., navigation to Pump B commanding can be available from the Pump A commanding page). Additionally, commands and telemetry for ‘utility functions’ related to an ORU (e.g., electrical power or data buses) can be easily accessed.

Area 4: Execute Area. This area of the command window contains the Execute button (if one is necessary) and a window showing commanding message traffic (if possible).

8.2.2 RASA Command Windows Deviation

A typical Russian Command Window is shown below in Figure 8-5. Commands using the Russian Segment Laptop may be issued from any hierarchical level: module, system, functional display, or detailed display. For example, a generic command window with all available module commands is accessible from the module-level display by selecting a button labeled “Commands.” Also, when a particular system’s commands are needed, the user can navigate to the particular system-level display and select a commands button, which produces a command window with all available system commands. Finally, each block-level icon can also be used to navigate to a command window listing commands for that subsystem/block.
Figure 8-5a  CM Command
Figure 8-5b  CM COTP Command
8.2.2.1 RASA Command Window Areas
Each command window can be separated into four general areas:

Area 1: Command List Area. This gives a list of all available commands for the level of commanding selected (i.e., all module commands are displayed when the command window was accessed from the module-level display). Additionally, the user can type the first letters command name to quickly get to the desired command.

Area 2: Parameter Name and ID Area. After a command in the command list is highlighted, its name and engineering description of the command (ID) is displayed.

Area 3: Execute Area. This area of the command window contains the Execute button to execute the desired command and timer line for displaying of waiting time for command check message.

Area 4: The Status line provides command feedback as a check to the issue command.

8.2.3 ESA-Columbus Command Windows Deviation
ESA-Columbus follows the general commanding principles. Commands to ESA-Columbus nominal systems will be “One Step” commands. “Two step” ESA-Columbus commands are in principle possible from ESA-Columbus displays, but typically provided for critical ESA-Columbus vital system controls from ESA-Columbus displays on the PCS laptop.
ESA-Columbus uses combined command-data windows with separate fields for commands and relate data. A typical example is shown in Figure 8-7 below. The command Data window is divided in three areas:

- Top - Left: Command Selection Box
- Top - Right: Positive Feedback Data
- Middle: Detailed Data
- Bottom - Right: Close Button
- Bottom - Left: optional button which opens extra MCD with more detailed data

Commands are implemented as “Selection List” with one or multiple commands options. The selection lists are exclusive, only one command can be selected. Button for command confirmation and cancel are provided below the selection list: Confirmation is always required for the execution unless the command is canceled. The confirmation button is always labeled “OK” (tool restriction).

![Figure 8-6 Example of ESA-Columbus Data and Command Window](image)

Figure 8-6 Example of ESA-Columbus Data and Command Window (data are from a random preview simulation and are not meaningful)

**8.2.4 NASA Command Windows Deviation**

A typical NASA Command Window is shown below in Figure 8-7. Basically, commands using the JEM Laptop are issued from any hierarchical level: module, subsystem, or detailed display. When a particular subsystem’s commands, e.g., mode transition, are needed, the user can navigate to the particular subsystem-level display and select a command button. When a particular assembly/ORU command is needed, the user can navigate to the particular assembly/ORU-level status display and select a command button labeled “Cmd.”

JEM SLT command window includes an “Execute” button. Basically, all commands will be issued when the user pushes the execute button. Some windows include a “Restriction” button, which provides a window listing condition that the commands are rejected by JCP software. The “Ovr’d” (Override) button provides a capability for crew to force to execute the command by overriding the software inhibit.
In case a command is hazardous, a command confirmation window, as shown in Figure 8-8, appears, when the crew selects the command.

![Command Window](image)

Figure 8-7  JEM SLT select type Command Window

The feedback telemetry data is displayed at the left side of the parent “Cmd” button.

If the command is failed, e.g. a communications error, the command response is shown in a Command Response window.

![Hazardous Command Confirmation](image)

Figure 8-8  JEM SLT Hazardous Command Confirmation Window

JEM RLT is TBS.

8.2.5  CSA Command Window Deviation

MSS sub-system or unit commands or command windows may be separated from the functional state, status or condition fields for that sub-system or unit.

The MSS uses 3 step commands for executing actions that result in robotics manipulator motion or end effector payload release, in compliance with the hazard analysis’s approved by the ISS Safety Review Panel. Other commands for executing actions that result in end effector motion are also implemented as 3 step commands for commonality in end effector operation.

The MSS uses ‘Confirm’ or ‘Cancel’ as the valid choices for the 2nd step of its 3 step commands.

There is no ‘Disable’ or ‘Disarm’ type specific commands beyond the 2nd step of a 3 step command. Applying the brakes or Safing, whichever appropriate, via a hardware display and
control panel, renders this capability. If this capability were available via a specific command, it
would be named using a different label then ‘Disable’ or ‘Disarm’.

For the MSS, the use of ‘Ena’ and ‘Inh’ for the terms Enabled and Inhibit respectively, is
reserved for indicating that a sub-system is operating as a result of a third step of a 3 step
command.

8.3 TEMPLATE COMMANDS
Many commands to be sent are templates. This means that some portion of a command
structure is not instantiated and is left for the operator to provide in real time. In general, the
format of a template command should follow a logical flow from top to bottom of the display. By
ordering the display in this manner, it will be intuitive to the operator what actions are necessary
before commands are executed.

Each portion of the display should have a distinct graphical location identifier (GLI) if more than
one template command exists on the display. For each template command, the first field
following the GLI will be the feedback data that indicates the current status of the item being
commanded, if it is required to be evaluated prior to executing the template command. Otherwise,
the feedback value should follow the command button. Exceptions would include
command pages called from an overview type display that already contains the status
information and would be redundant to have that information repeated at the top of the new
display. An example of a display where this would be true would be a task oriented (integrated
or system specific) display which is called from an overview display on the recognition of a
particular condition. Then it may be determined that it would be redundant to repeat the data at
the top and the display would begin with the first item according to the written procedure and
end with the appropriate feedback for the task.

The list of data input fields where the operator will enter the required values are positioned
vertically under the telemetry feedback in procedural order. Each data input field shall be
clearly labeled such that an operator can understand what values may be entered. If more than
one data field is required, subsequent data fields will be left justified with respect to the first data
input field. A command button will be directly below the data input field(s) and will be labeled
“Set.” It is assumed that the GLI will clearly define the template command such that additional
labeling on the command button will not be required. (However, it is expected that in some
cases other verbs may be used if clearly more descriptive of the action to be taken.) In the case
that a data input field uses a quick-pick list or pull down menu, it is important that the list does
not partially cover the “Set” button to avoid inadvertent selection of the button when choosing an
entry. An example of multiple template commands on a page is shown in Figure 8-9a.

In cases where there exists a buffer for the data, a command button labeled “Load” will be
included between the data input fields and the “Set” button. If feedback for the buffered value is
provided to the laptop, this buffered value should be displayed directly beneath the “Load”
button. An example of the template command window with a buffer is shown in Figure 8-9b.

Data input fields may be input by either manual entry or as a choice from a “quick-pick” list or
pull down menu. When procedures refer to data to be input, the word “pick” is used with respect
to a quick-pick list and “input” is used for data to be manually typed into the data input field.
Data input fields will be rendered as 3-D recessed fields to be distinguished from telemetry. The command button(s), data input fields, and associated labeling shall all be placed together or otherwise delimited to unambiguously indicate that they are grouped together.

Procedural example:

```
PCS sel Fan_Speed

Fan Speed
Fan 1

Actual Speed
Required Speed
rpm

cmd Set
√Actual Speed - 700
```

```
input Required Speed - 700

cmd Set
√Actual Speed - 700
```
Figure 8-9b  Example of Fan Speed with Buffer

Procedural example:

PCS sel Fan_Speed

<table>
<thead>
<tr>
<th>Fan_ Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan 1</td>
</tr>
</tbody>
</table>

input Required Speed - 700

<table>
<thead>
<tr>
<th>cmd</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>√</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speed Buffer</th>
<th>rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td></td>
</tr>
</tbody>
</table>

cmd Set

<table>
<thead>
<tr>
<th>Actual Speed</th>
<th>rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Required Speed</th>
<th>rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speed Buffer</th>
<th>rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actual Speed</th>
<th>rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Required Speed</th>
<th>rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speed Buffer</th>
<th>rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actual Speed</th>
<th>rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Required Speed</th>
<th>rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speed Buffer</th>
<th>rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td></td>
</tr>
</tbody>
</table>
8.3.1 **NASA Template Commands Deviation**

8.3.2 **RASA Template Commands Deviation**

8.3.3 **ESA-Columbus Template Commands Deviation**
ESA-Columbus will not use template commands for ESA-Columbus nominal system displays.

8.3.4 **NASDA Template Commands Deviation**
SLT Template command window example is shown in Figure 8-10. The command is executed with the ‘Execute’ button, instead of ‘set’.

![Figure 8-10 Example of SLT Template Command Window](image)

8.3.5 **CSA Template Commands Deviation**
For MSS displays, the feedback data that indicates the current status of the item being commanded does not necessarily appear as the first field following the GLI, even when it needs to be evaluated before executing the template command. The feedback data may not even appear on the command window.

The MSS does not necessarily use the ‘set’ label for a button used to issue a template command. The ‘Load’ button label for the MSS is used to command the target processor to acquire data from an auto sequence set up template command and is not used to populate a template command data buffer in the PCS.

The MSS does not necessarily use ‘quick pick list’ or ‘pull down menus’ for operator entry into data input fields and does not necessarily use the ‘input’ label to identify the fields where data can be entered manually.
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STATION MODING

9.1 GENERAL PRINCIPLES AND RATIONALE

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STATION MODING

9.1 GENERAL PRINCIPLES AND RATIONALE
ISS moding and commanding support is one of the fundamental purposes of the Crew - Laptop Interface. The Interface should provide:

- Onboard systems monitoring
- Control support

The required high quality of interface dictates the necessity of combining on one Laptop screen the above mentioned different functions.

The monitoring is realized by displays (formats).

To provide integrated evaluation of onboard systems work, the possibility of simultaneous monitoring of several systems (one or few ISS modules) should be realized.

Multilevel access to different control functions (from station moding down to procedure starting and command sending) should be provided.

The control interface should be simple and similar for the different functions (commands, procedures, etc.).

The control interface should foresee enabling/disabling of each control function.

Figure 9-1  Mode Display (typical)
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SECTION 10

TELEMETRY

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SECTION 10.0
TELEMETRY

10.1 GENERAL PRINCIPLES AND RATIONALE
Telemetry data fields must provide the user with an easy and quick way to identify the parameters. Icons can be used to identify parameters to enhance usability.

10.2 DATA FIELDS
10.2.1 Labels
When the same list of parameters is used on several displays, nomenclature, and geometrical order shall be preserved unless there is proper rationale for doing otherwise. (This is typical for overviews versus detailed displays.) When similar data parameter fields are used on the same display, they shall be alike in shape and size to prevent an unbalanced look and feel of the displays.

Parameters must be labeled with proper operations nomenclature and showing units as applicable. A label's proximity to an item must make the subject of the label unambiguous. Parameter labels shall be shown to the left of or above the parameter. (Figure 10-1). Labels shall retain the following characteristics:
- Labels shall be left justified.
- It is allowable to put similar parameters or units on top of a column or on the right of the line of data with the same units instead of labeling each line of data.
- Labels shall be located to the left of the value field columns when multiple parameters are shown in a column.
- Parameter labels may be shown below the parameters in a few cases.
- Words should be spelled out rather than abbreviated whenever possible.

![Figure 10-1 Data Fields (typical)](image)
The portion of the label identifying the units of the parameter shall be left justified against the right side of the data value field they are labeling. Units are not to be shown to the left of the parameter value field except for multiple column tables of values. Numbers within data value fields shall be right justified with sufficient width to show the longest possible parameter value (consider negative signs and decimal points). Consideration must also be given to the size of data quality indicators. Text within data value fields should be center or left justified with sufficient width to show the longest possible word. Where multiple parameter value fields are arranged in a column, they should be arranged such that their decimal points align vertically.

10.2.1.1 NASA Data Fields Deviation

10.2.1.2 RASA Data Fields Deviation

10.2.1.3 ESA-Columbus Data Fields Deviation
The X symbol will not be used. The vertical alignment of the decimal points is not possible, the values are automatically right justified (tool restriction). Where reasonable, the same number of decimal digits will be used to retain decimal point alignment in data columns. The two-characters for out-of-limit specification are appended (by the tool) without left-shift of the data values.

10.2.1.4 NASDA Data Fields Deviation
NASDA conforms to the Standard except for some Display development toolkit dependencies. JEM RLT is TBS.

10.2.1.5 CSA Data Fields Deviation

10.3 DATA QUALITY INDICATIONS
Standard character flags are used to indicate the quality of data displayed. A data quality indicator must be provided for each parameter shown in text form and for each icon indicating a parameter value.

Text parameter fields incorporate the data quality indication within the box defining the parameter field (Figure 10-2). The rectangle defining the parameter field changes color based on the parameter’s data quality. When two spaces are provided, the first provides room for out-of-limits flags, and the second space is reserved for data availability (Static, Missing, Dead) indications. When a single space is provided, the highest priority out-of-limits or data availability flag is shown. See Table 10-1 for the priority of indications (this table is showing indications in descending priority).
If a parameter has taken on a value which is undefined, the telemetry field shall show a black “Error” on a white field (if abbreviation is necessary, “Err”). This indicates that although good data is flowing between the onboard computer and the object providing the data, the data is in error. If used in a table format where a "□" or "X" is used to indicate that the labeled condition is true, then a black "?" shall be used.

Data quality indications for icons and other graphical items are shown (when data quality is not nominal) next to the graphical item. The data quality indicator is shown in a rectangle filled with the corresponding data quality color.

Data quality indicators should be used when ever possible and necessary. Examples of possible data quality indicators are identified in Table 10-1. Displays which have parameters that do not have data quality indicators must indicate that they do not have these indicators.
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Status</th>
<th>Field Color</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>(blank)</td>
<td>Nominal</td>
<td>White</td>
<td>In normal range and status is nominal</td>
</tr>
<tr>
<td>M</td>
<td>Missing</td>
<td>Purple</td>
<td>Parameter not found in dictionary, or not being published if in dictionary.</td>
</tr>
<tr>
<td>D</td>
<td>Dead</td>
<td>Purple</td>
<td>Parameter in dictionary, but no initial data received.</td>
</tr>
<tr>
<td>S</td>
<td>Stale</td>
<td>Cyan</td>
<td>Parameter Data not being updated. Usually associated with LOS.</td>
</tr>
<tr>
<td>H</td>
<td>Off-scale high</td>
<td>White</td>
<td>Parameter value greater than sensor range. (Yellow if caution Limit exceeded, Red if Warning or emergency limit exceeded)</td>
</tr>
<tr>
<td>L</td>
<td>Off-scale low</td>
<td>White</td>
<td>Parameter value less than sensor range. (Yellow if caution Limit exceeded, Red if Warning or emergency limit exceeded)</td>
</tr>
<tr>
<td>↑</td>
<td>Out of limits high</td>
<td>White</td>
<td>Parameter value greater than upper limit of nominal range. (Yellow if caution Limit exceeded, Red if Warning limit exceeded)</td>
</tr>
<tr>
<td>↓</td>
<td>Out of limits low</td>
<td>White</td>
<td>Parameter value less than lower limit of nominal range. (Yellow if caution Limit exceeded, Red if Warning limit exceeded)</td>
</tr>
<tr>
<td>↑↓</td>
<td>Out of limits indeterminate</td>
<td>White</td>
<td>Value outside nominal range. (Yellow if caution Limit exceeded, Red if Warning limit exceeded)</td>
</tr>
</tbody>
</table>

Table 10-1  Data Quality Indicators
In the case of textual/numerical data, the data quality indicator is shown in the data field to the right of the applicable parameter. For icons representing parameter values, the data quality flag's proximity to an icon must make the subject of the flag unambiguous.

Russian segment telemetry may provide some unique indicators ("Normal" and "Valid" flags) for data quality (Figures 10-3 and 10-4). Although these may be handled in a different way for flight 3A and beyond, these parameters will be shown as separate fields. The "Normal" flag indicates whether the parameter is within or outside a set of boundaries, but it does not indicate which limit (upper or lower) was violated. The "validity" flag indicates whether the parameter is currently being updated.

“Normal” and “Valid” flags shall not be shown on main displays (displays other than popups), but will instead be shown on detail popup windows. The “main” display shall provide an attention symbol to indicate that a parameter’s “Normal” or “Valid” flag shows a bad state. The attention symbol then cues the operator to view the details popup window.
10.3.1 NASA Data Quality Indications Deviation

NASA uses the ‘^’ and ‘v’ instead of up and down arrows. NASA does not support the data quality indicator for icons.

10.3.2 RASA Data Quality Indications Deviation

RASA telemetry provides the indicators of an underline beneath a data parameter to represent the data as being ‘out-of-limits’ low. A line above the data parameter indicate the data is ‘out-of-limits’ high. An accompanying message may provide more information about these types of problems.

An example of this is shown below:

47 Equals out-of-limit  - Low

125 Equals out-of-limit  - High

Data quality indicators are defined as shown in Table 10-2.

<table>
<thead>
<tr>
<th>Line above data</th>
<th>Out of limits high</th>
<th>White (Yellow if caution Limit exceeded, Red if Warning limit exceeded)</th>
<th>Parameter value greater than upper limit of nominal range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line below data</td>
<td>Out of limits low</td>
<td>White (Yellow if caution Limit exceeded, Red if Warning limit exceeded)</td>
<td>Parameter value less than lower limit of nominal range.</td>
</tr>
<tr>
<td>Lines above and below</td>
<td>Out of limits indeterminate</td>
<td>White (Yellow if caution Limit exceeded, Red if Warning limit exceeded)</td>
<td>Value outside nominal range.</td>
</tr>
</tbody>
</table>

Table 10-2 Russian Data Quality Indicators
10.3.3 ESA-Columbus Data Quality Indications Deviation
For on orbit, any data acquisition problem is reported within the system (System Message Panel). ESA-Columbus MCDs do not provide data quality indications.

10.3.4 NASDA Data Quality Indications Deviation
JEM SLT shows a black “unknown,” if a parameter value is undefined. JEM SLT does not provide data quality indicator for icons. NASA uses the ‘^’ and ‘v’ instead of up and down arrows. Data quality indicators on JEM SLT are defined as shown in Table 10-3. JEM RLT is TBS.

<table>
<thead>
<tr>
<th>Status</th>
<th>Text</th>
<th>Field Color</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal</td>
<td>Black</td>
<td>White</td>
<td>In normal range and status is nominal</td>
</tr>
<tr>
<td>Stale</td>
<td>Black</td>
<td>Cyan</td>
<td>Parameter Data not being updated by communication loss between data source and SLT</td>
</tr>
<tr>
<td>Off-scale</td>
<td>Black</td>
<td>Cyan</td>
<td>Parameter value greater or less than sensor range.</td>
</tr>
<tr>
<td>Out of limits high</td>
<td>Black if caution Limit exceeded, White if Warning limit exceeded</td>
<td>Yellow if caution Limit exceeded, Red if Warning limit exceeded</td>
<td>Parameter value greater than upper limit of nominal range</td>
</tr>
<tr>
<td>Out of limits low</td>
<td>Black if caution Limit exceeded, White if Warning limit exceeded</td>
<td>Yellow if caution Limit exceeded, Red if Warning limit exceeded</td>
<td>Parameter value less than lower limit of nominal range</td>
</tr>
</tbody>
</table>

Table 10-3  JEM SLT Quality Indicators

10.3.5 CSA Data Quality Indicators Deviation
CSA follows NASA deviations. MSS video graphics overlays do not provide data quality indicators.
10.4 BOOLEANS

All Boolean (on/off, enable/inhibit, activate/deactivate, 1/0, etc.) software status should be indicated with an appropriate operations name, as shown in Figure 10-5.

For indication of a Boolean condition state, a symbol filling a telemetry field or box located next to an explicit condition description is often preferred because the presence or absence of the symbol will be more eye catching than alphanumeric information or a word filling the telemetry field in both cases.

For example,

auto antenna 1 control enabled
auto antenna 2 control enabled

is preferred to

auto antenna 1 control enabled
auto antenna 2 control disabled
This is particularly true when several condition states are listed in a column. The operator recognizes more easily:

than

When these symbols are preferred, the following rules will be followed:

1. ✓ will be used when the label describes a potential nominal condition.
2. X will be used when the label describes a condition which is not expected during nominal operation.
3. In both cases, the presence of ✓ or X will indicate that the label is true.
4. The label will describe the condition in a very explicit manner such that the presence of the symbol will indicate a clear positive answer (yes) to the question: Is the 'label' true?

For that purpose, the label will use simple and clear words compliant with the Operational Nomenclature. When the label indicates a negative condition, it will avoid the combination of negative particle followed by positive words. For example 'Invalid' will be preferred to 'Not Valid'.

In general, the use of Boolean symbols ✓ or X will enter in one of the three following categories:

1. Operator input field:
Selection of items or conditions by the operator among a list of optional choices will be indicated using ✓. Controls opn this function are referenced in section 4.16, Radio Buttons.

2. Telemetry system status field:
When a display presents the status of given equipment or software and only two possible conditions exist, ✓ or X will be used following the above mentioned rules. For example, the table summarizing the Built-In-Test conditions of a system fits into this category. Depending on the way the test conditions are described by the labels, an all nominal status would be reflected by all ✓ or all .
For example:

ORU 1 B.I.T Good
is equivalent to

ORU 1 B.I.T. Anomaly

item 1
item 2
item 3

3. Telemetry task status field:
On task oriented displays, the successful completion of a step can be identified by ✔. A blank
would mean that the task is in work.
In some cases the operator will be directed to check the presence of ✔ after a certain delay
beyond which he/she would assume that the task could not be nominally completed.
In some other cases the system will detect by itself the failed task condition. The display would
then look like the following:

<table>
<thead>
<tr>
<th></th>
<th>Completed</th>
<th>Failed</th>
</tr>
</thead>
<tbody>
<tr>
<td>task 1</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>task 2</td>
<td></td>
<td>✗</td>
</tr>
<tr>
<td>task 3</td>
<td>✔️</td>
<td></td>
</tr>
</tbody>
</table>

When the same system status may reflect a nominal and expected condition during some
operation and an off-nominal and unexpected condition during some other operation, the unique
Boolean symbol used will be the ✗ to remind to the operator the potential off-nominal condition
(Figure 10-6).

The key rule the operator has to remember is that whether he/she sees ✔️ or ✗, the condition
described by the label is true. However, as opposed to the ✔️, the ✗ will
attract his/her attention as an unexpected condition may exist.

10.4.1 NASA Booleans Deviation

10.4.2 RASA Booleans Deviation

10.4.3 ESA-Columbus Booleans Deviation
ESA-Columbus will use word state code. E.g., OPEN, CLOSE, GOOD, BAD, ARMED, DISABLED, to indicate condition status.

10.4.4 NASDA Booleans
JEM SLT uses word state code. E.g., OPEN, CLOSE, GOOD, BAD, ARMED, DISABLED, to indicate condition status. JEM RLT is TBS.

10.4.5 CSA Booleans Deviation

10.5 TEST RESULTS
Results of Built-In Test (BIT) and other automated test functions should be indicated as “Pass” or “Fail.”

10.5.1 NASA Test Results Deviation

10.5.2 RASA Test Results Deviation

10.5.3 ESA-Columbus Test Results Deviation

10.5.4 NASDA Test Results Deviation
On the NASDA SLT, the results of BIT is indicated as Normal/Failure instead of Pass/Fail. RLT indicates it as Normal/Error.

10.5.5 CSA Test Results Deviation
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SECTION 11

CAUTION & WARNING

11.1 GENERAL PRINCIPLES AND RATIONALE

11.2 INTERNATIONAL PARTNER SPECIFIC GENERAL METHODOLOGY

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11.2.2 RASA General Methodology Deviation

11.2.3 ESA-Columbus General Methodology Deviation

11.2.4 NASA General Methodology Deviation

11.2.5 CSA General Methodology Deviation

11.3 CAUTION & WARNING INDICATORS

11.3.1 NASA Caution & Warning Indicators Deviation

11.3.2 RASA Caution & Warning Indicators Deviation

11.3.3 ESA-Columbus Caution & Warning Indicators Deviation

11.3.4 NASA Caution & Warning Indicators Deviation

11.3.5 CSA Caution & Warning Indicators Deviation

11.4 CAUTION AND WARNING SUMMARY

11.4.1 NASA Caution and Warning Summary Deviation

11.4.2 RASA Events Display Deviation

11.4.3 ESA-Columbus Caution and Warning Summary Deviation

11.4.4 NASA Caution and Warning Summary Deviation

11.4.5 CSA Caution and Warning Summary Deviation

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Figure 11-9 Inhibit Window
Figure 11-10a
Figure 11-10b
SECTION 11.0
CAUTION AND WARNING

11.1 GENERAL PRINCIPLES AND RATIONALE

The most important features of the Caution & Warning interface are:

a. Quick and easy way to silence tones.
b. Rapid access to C&W information (message, nature of problem).
c. Do the above without excessive navigation or losing displays currently in use.
d. Quick access to procedures.
e. Do the above with either function keys or mouse (for redundancy and to not show preference for the use of function keys or the use of the mouse).
f. The process of filling out the C&W message page is TBD. (This principle/standard is currently in conflict between the partners and is not part of the baseline.)

In the event there are multiple levels of advisory messages, the developer will supply nomenclature and descriptions for those class designations.

11.2 INTERNATIONAL PARTNER SPECIFIC GENERAL METHODOLOGY

11.2.1 NASA General Methodology Deviation

1. The PCS Caution and Warning System shall enunciate all Caution and Warning events provided to it by the Command and Control MDM.
2. The PCS Caution and Warning System shall illuminate the Home Page button on the Alarm Tool Bar an appropriate color (Yellow for Cautions, Red for Warnings and Emergencies) except while the user is currently at the Home Page of the display hierarchy.
3. The PCS Caution and Warning System shall light up the module and system in which the event occurred on the PCS Home Page with the appropriate color.
4. Upon the user selecting the module and the appropriate system, the affected blocks/icons/parameters will be lighted with the appropriate color continuing down to the lowest level indication of the C&W event on the PCS.
5. The “Alarm Tool Bar” (C&W buttons and message line) shall be at the top of the Home Page and the segment displays. The Alarm Tool Bar shall be visible during all display activities (Viewing, commanding, etc.) and will not be “covered” by other displays. The Alarm Tool Bar will maintain a consistent size at all times (no resize capability). (The Alarm Tool Bar shall also be “floating” such that upon annunciation of a C&W event, the tool bar will appear at the top of any other display which is currently active. The Alarm Tool Bar can be moved to any other location on the PCS screen in order to view any telemetry data which might be covered up by the tool bar.)
6. The message line on the Alarm Tool Bar shall display the oldest unacknowledged event sorted by event criticality (class 1 higher than 2, class 2 higher than 3).
7. Only Emergency, Warning, and Cautions (E, W, and C) shall be displayed on the summary by default. If it is desired to view Advisories (A), then: (1) from the C&W Summ, select “Advisories” “On,” or (2) from the C&W Summ select “Filter”/”Class”/”All” or “Filter”/”Class”/”Advisories.”
8. A user selectable “Sort” feature is available which can display the oldest message at the top, if desired.
9. Closing and reopening the summary shall return to the default configuration. Defaults cannot be changed by the user.
Onboard Plan and Procedures

10. The display shall have the capability to be manipulated with the “sort” and “filter” options. These options shall be implemented on a COPY of the message listing. The main C&W summary window shall maintain the single configuration outlined herein.

11. The following sort capabilities shall be available to the user:
   - Time (newest top, newest bottom, default to newest bottom)
   - Location
   - Subsystem
   - Status

12. The following filter capabilities shall be available to the user:
   - Class (E, W, C, A, or All)
   - Location (Node 1, Lab, etc.)
   - Time (from current time, last 12 hr, last 24 hr, and since XX:XX)
   - Status (All, In Alarm, RTN, Ack, Unack)
   - None (the default condition)

13. Sort and Filter functions shall be designed to mimic similar functions in a Windows-based operating system. The Sort and Filter functions shall be modifiable from header toolbar selections based on class, time, etc.

14. The Filter select button shall be labeled “Filter Out.” The selections within the filter out list will then be removed from the active display. The display of what is actively filtered shall be unambiguous to the user (flashing highlight, color change, etc.).

15. When Filter is “active,” new (incoming) messages shall be displayed in an unfiltered state. The filter only applies to “existing” messages.

16. The C&W Summary shall list the status (Alarm or Norm, five characters), class (E, W, C, or A), Acknowledged status (X or blank), Message text, and time (DDD/HH:MM:SS). Inhibited events will not be shown, but suppressed events shall be.

17. A single select and hold, or a right select, on a message line shall bring up a menu with options to Acknowledge, Suppress, Enable, or Inhibit the message, as well as clear individual event Yellow Brick Road mapping for the selected event.

18. The user shall have the capability to acknowledge (ACK) each message in the header. The header shall list the oldest message that has not been acknowledged. Acknowledgment shall not silence the tone or change the event counter.

19. a) The C&W buttons on displays shall mimic behavior of the Master Alarm Light Panel (MALP) panel.
   
   b) A single select on an Alarm Tool Bar C&W button that is illuminated shall issue a Command to Silence an Event Tone.

   c) A right select of a non-illuminated Class 1 alarm button shall issue the appropriate Command to Manually Activate Class 1 Alarm.

   c) Cancel manual alarm.

20. Event counters shall be displayed next to Caution and Warning buttons on PCS displays for (1) number of events “In Alarm” and (2) Unacknowledged. The In-Alarm event counters reflect the number of enabled or suppressed events currently in alarm, and decrement as event “Return to Normal” conditions occur. The Unacknowledged event counters display the current number of Unacknowledged events in the active C&W Log.

21. Class I (Emergency) events shall have the capability to bring up dedicated displays for Emergency (Rapid) Depressurization and Fire, and Toxic Spill.

22. The PCS shall provide the capability to determine Event Code numbers for all C&W events. This function shall also provide the ability to sort by system, subsystem, segment, block, and class.
23. The PCS shall provide the capability to display all currently Inhibited or Suppressed events. This capability shall include a common sort/filter capability as defined for the Summary Page.

24. The PCS shall have a dedicated Robotics Advisory Summary Page that reflects the capabilities of the C&W Summ, but provides for rapid use by the SSRMS operator during periods of robotic operations.

11.2.2 RASA General Methodology Deviation
RASA uses a single button to silence any alarm tone.

RASA has the capability to navigate to alarm displays directly from the current display.

RASA Events window is always at the top and cannot be overlapped by other displays. The principle of displaying C&W data is the following:

1. Event driven
2. priority
3. Automatically called window containing the C&W information.
4. The format may be manually opened by selecting the <Display> field from the window containing the C&W information.
5. The windows may be opened by clicking on the corresponding C&W button.
6. Bringing up of the necessary display with Emergency (Fire, dP/dt, ATM) related data.
7. An additional button is provided for Advisory messages.
8. Registration in the general list of C&W.

11.2.3 ESA-Columbus General Methodology Deviation
ESA-Columbus C&W parameters are monitored and reported to the ISS system level by the ESA-Columbus vital system. Processing is performed by the PCS Caution and Warning System, following the NASA General Methodology.

11.2.4 NASDA General Methodology Deviation
The SLT Caution and Warning System shall display JEM Caution and Warning events. The JEM RLT is TBS.

1. The SLT Caution and Warning System shall illuminate the C&W button on the user Tool Bar on the left side of the Tool Bar with an appropriate color (Yellow for Cautions, Red for Warnings and Emergencies).
2. Upon the user selecting the element and the appropriate subsystem, the affected ORU's/icons/parameters will be lighted with the appropriate color continuing down to the lowest level indication of the C&W event on the SLT.
3. A C&W summary including Emergency, Warning, and Cautions (E, W, and C) shall be displayed when the user pushes the C&W button. The returned-to-normal C&W is deleted from the summary.
4. The C&W Summary on the SLT shall list the class (E, W, C, or A), message text, and time. (DDD/HH:mm:ss) Inhibited events will not be shown.
5. Upon the user selecting the module and the appropriate system, the affected blocks/icons/parameters will be lighted with the appropriate color continuing down to the lowest level indication of the C&W event on the JEM SLT.
6. The newest message shall be shown at the top of the summary by default.
11.2.5 CSA General Methodology Deviation

11.3 CAUTION & WARNING INDICATORS
On a display containing an object in alarm, the object is illuminated. For example, a smoke detector that has announced a fire is illuminated red (Figure 11-1).

![Figure 11-1 Smoke Detector in Alarm](image)

11.3.1 NASA Caution & Warning Indicators Deviation
The Home Page provides cues to indicate the displays required to obtain further information on an anomaly. When an alarm event occurs, the Caution and Warning toolbar is lit with the appropriate color (yellow for caution, red for warning or emergency) as shown in Figure 11-2.

In addition, the light for that alarm class is lighted the same color. The location of the alarm is indicated by coloring the associated segment with the alarm’s associated color, and the affected system button on the system toolbar is colored appropriately. The examples below show the ECLSS system button first in nominal state, then in caution, then in warning or emergency.

![Figure 11-2 ECLSS Button in different states](image)

Note that the colors yellow and red are reserved exclusively for the indication of caution & warning events except when yellow is used on the attention icon (reference section 4.21, Attention Symbol).
By selecting the lighted module or system button, the user may view additional information regarding the alarm. For example, if the user selects the lighted Node 1 module, the Node 1 display is shown (Figure 11-4). If the alarm event is in this module, then the appropriate system button is lighted. If the alarm is not in this module, then the system button is not lighted.
The user may select the lighted system icon to view information regarding the system's components in that module (Figure 11-5).
Selecting the Node 1 icon from the Home Page calls up a display depicting Node 1. Selecting the ECLSS system icon takes the user to Node 1 Environmental Control and Life Support System status display.

11.3.2 RASA Caution & Warning Indicators Deviation
RASA can delete alarms out of the C&W list.

11.3.3 ESA-Columbus Caution & Warning Indicators Deviation
The ESA-Columbus C&W indication is performed by the PCS Caution and Warning System, following the NASA method.

11.3.4 NASDA Caution & Warning Indicators Deviation
JEM RLT is TBS

11.3.5 CSA Caution & Warning Indicators Deviation
11.4 CAUTION AND WARNING SUMMARY

The user may access a listing of all event messages by selecting the "C&W Summ" button above the alarm toolbar (Figure 11-6). The resulting window allows the user to view the event logs for Emergency, Warning, Caution, and Advisory. Messages can be sorted and searched by time, system, class, and location. The text shown below the toolbar and to the left of the ACK button is the oldest unacknowledged message sorted by highest event class from the caution & warning server. For example: a class one event will be displayed versus a class 2 even though the event times are identical. No ranking of criticality within a C&W class will be performed (all class 1 events are the same priority, all class 2 events are the same priority, etc.). Once the user selects the ACK button with the left mouse button, the message becomes acknowledged, and the next unacknowledged message is displayed. The text is color coded to reflect the level of emergency/warning/caution of the message.

Below this area is the listing of all caution & warning messages registered with the summary page. These messages can be sorted by status, time, system, and module location. Each message also displays a color coded background to reflect the level of emergency/warning/caution, contains a time stamp, and indicates whether or not the message has been acknowledged.
The messages in the summary window can be sorted, filtered, suppressed, or inhibited.

When the "Sort By" button is selected, a pulldown menu appears to select the sort criteria. Messages can be sorted by oldest message on top, newest message on top, level of urgency, location, and status.

Messages can be filtered to show message class, location, time, or all emergency/warning/caution (EWC) messages. Only messages meeting the criteria will be shown in the message area. When the "Filter Out" button is selected, a pulldown menu appears to select the filter criteria. The filter should only act on current events, new events should not be actively filtered.

The "Advisory" button toggles between showing advisory messages with EWC messages (ON) or only EWC messages (OFF). The label below the advisory button indicates the state of the Advisory button.

With each of these buttons, messages are still being logged in the caution & warning server. This message area will show only those messages of interest to the operator, the use of the buttons has no effect on the server.

The "Enable" window allows the operator to fully reactivate (automatic logging and annunciation) any suppressed or inhibited messages. The Enable window will appear requesting the message code to be enabled (Figure 11-7). After the operator enters the message code, the Execute button must be selected to send the command to the C&C MDM. The description of the message, and the status of the enable request, is shown in the text area. The Close button removes this window.

The "Suppress" button is used to stop specified messages enunciating by tone and light. When the Suppress button is selected, the window, Figure 11-8 appears with the Arm and Close button selectable. The Disarm and Fire buttons become sensitive after the Arm button is selected.

The action of suppressing a message requires two steps. The Arm button must be selected followed by the Fire button. The status of the command is shown in the Command Status text area below the message code. The suppress command can be canceled by selecting the Disarm button before the Fire button is selected. To remove the window, the Close button is selected.
The "Inhibit" button is used to stop all annunciation and logging of the specified C&W event. An inhibited message will not be registered with the caution & warning server and, therefore, will not be displayed on the summary page or in the log file. An example of the use of the inhibit command would be to ignore messages from a component that has failed (Figure 11-9). The window interface for inhibiting a message is similar to that of suppressing a message.

The "Log Menu" allows the operator to view log files of messages. The options available via a pulldown menu are: Merged Log - showing all caution & warning messages, Emergency Log - showing only emergency level messages, Warning Log - showing only warning level messages, Caution Log - showing only caution level messages, Advisory Log - showing all non-EWC level messages, and Robotics Log. The Robotics Log is a place holder and will not become active until flight 6A.

11.4.1 NASA Caution and Warning Summary Deviation
11.4.2 RASA Events Display Deviation

The Events window is always at the top and cannot be overlapped by other displays. See Russian Events Display, Figures 11-10a and 11-10b.

The Events display will be similar to the C&W toolbar on the US displays on the following items:

- Buttons for Fire, dP/dt, ATM, Warning and Caution:
  1. When active, the buttons will change to the color for respective class of event.
  2. There will be a 'Home' button on the far right side of the window.
  3. Clicking on the 'Home' button at anytime will bring the Home Page to front of the screen.
  4. There will be a space for GMT just to left of the 'Home' button.

![Figure 11-10a](image)

![Figure 11-10b](image)

The following are areas where RASA is not common with NASA:

1. Sound off (button with icon «crossed speaker»): command to sound off generated by the button click.
2. Advising (button with exclamation mark): the button changes color upon advisory event.
3. Events revision: upon push the button with icon «magnifier» pop up the window.
4. RS Mode: placed on the right of Russian Flag.
5. Station Mode: placed on the right of RS Mode.
6. Language switch: upon EN/ RU button click change text from English to Russian and vice versa.
7. Ground link state: Icon to indicate current AOS/LOS state and field for displaying the time remaining to the beginning of AOS/LOS.
8. Ecliptic state: Icon to indicate current Day/Night state and field for displaying the time remaining to the beginning of Day/Night.
9. Alarm handling: When alarm message comes, the priority is kept.
   a) For example, if during Caution handling Warning message come Warning window placed over Caution window. If during Warning handling come Caution message only Caution button change color the Caution window does not pop up. If click this button, Caution window pop up.
   b) When Emergency message come needed display pop up.
   c) When Caution or Warning message come window with this message pop up.
      Necessary display pop up manually from this window.
   d) When Advisory message come the button changes color only.
11.4.3 **ESA-Columbus Caution and Warning Summary Deviation**
The ESA-Columbus C&W Summary processing is performed by the PCS Caution and Warning System, following the NASA method.

11.4.4 **NASDA Caution and Warning Summary Deviation**
JEM Local C&W Summary window is on user tool bar. JEM C&W Summary window has no filter or sort function. There are C&W messages which occurred at that time. Message includes class, subsystem, detail information, and time of occurrence. JEM local C&W enable/inhibit function is provided with the SLT limit manager window described in Section 4.22.4. SLT does not provide a suppress or log function. JEM RLT is TBS.

11.4.5 **CSA Caution and Warning Summary Deviation**
SECTION 12
ONBOARD PLAN and PROCEDURES VIEWERS

Actions in work. Not included in CR4248.
SECTION 13

LAPTOP OPERATING SYSTEM CONFIGURATION AND FEATURES

13.1 GENERAL PRINCIPLES AND RATIONALE
13.2 HOT KEYS

13.2.1 NASA Hot Keys Deviation
13.2.2 RASA Hot Keys Deviation
13.2.3 ESA-Columbus Hot/Function Keys and Keyboard Controls Deviation

13.2.4 NASA Hot Keys Deviation
13.2.5 CSA Hot Keys Deviation

13.3 TASK BAR

13.3.1 NASA Task Bar Deviation
13.3.2 RASA Task Bar Deviation
13.3.3 ESA-Columbus Task Bar Deviation
13.3.4 NASDA Task Bar Deviation
13.3.5 CSA Task Bar Deviation

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Table 13-2 RASA Hot Keys (not otherwise defined in the standard)
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SECTION 13.0
LAPTOP OPERATING SYSTEM CONFIGURATION AND FEATURES

13.1 GENERAL PRINCIPLES AND RATIONALE

13.2 HOT KEYS AND CURSOR CONTROL DEVICES
Hot key functions/cursor control devices shall be provided to allow expedited access to critical displays. Table 13.1 shows the hot-key standards and each International Partners’ deviation or addition to the standard.

<table>
<thead>
<tr>
<th>Function / Hot Keys</th>
<th>Windows 95</th>
<th>Solaris CDE</th>
<th>Solaris OW</th>
<th>Standard</th>
<th>NASA Deviation/Addition</th>
<th>RASA Deviation/Addition</th>
<th>NASDA SLT Deviation/Addition</th>
<th>NASDA RLT Deviation/Addition</th>
<th>NASDA PLT Deviation/Addition</th>
<th>ESA Deviation/Addition</th>
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<td>Enter or Space</td>
<td>Enter or Space</td>
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<td>C&amp;W tool bar &amp; summary</td>
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<td>F11</td>
<td>NA</td>
<td>NA</td>
<td>TBS</td>
<td>NA</td>
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<tr>
<td>C&amp;W tool bar only</td>
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<td>Alt F11</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<td></td>
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<tr>
<td>Close active window</td>
<td>Alt F4</td>
<td>Alt F4</td>
<td>Alt F4 or Esc</td>
<td>Double L-click</td>
<td>Double R-click</td>
<td>Double L-click</td>
<td>Alt F4</td>
<td>Double L-click or Alt F4</td>
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<tr>
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<td>Tab/↑↓</td>
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<td>Tab Tab</td>
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<td>- Highlight title menu</td>
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<td>Alt F9</td>
<td>Alt F10</td>
<td>Alt F4</td>
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<td>Cntl R</td>
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*Including scrolling

Laptop Operating System
27 Jan 00
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<td>Cntl L</td>
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Table 13.1  Hot Key Table
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<th>Solaris OW</th>
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<td>Close Active Window</td>
<td>Close Active Window; Close Decoration controls</td>
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<td>selectable objects in</td>
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</tbody>
</table>

Table 13-2, Hot Key Table listed by Hot Key

13.2.1 NASA Hot Keys Deviation
Additional hot keys shall be reserved for navigation to the ODF/OSTP Crew Interface (OOCI) components: Manual Procedure Viewer (MPV), Automated Procedure Viewer (APV), and Onboard Short Term Plan (OSTP) viewer. These hot key designations are TBD.
### 13.2.2 RASA Hot Keys Deviation

<table>
<thead>
<tr>
<th>Action</th>
<th>Hot Keys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action menu</td>
<td>F10</td>
</tr>
<tr>
<td>Level Navigation: Down</td>
<td>Enter; Left mouse button click</td>
</tr>
<tr>
<td>Level Navigation: Up</td>
<td>Esc; Right mouse button double click</td>
</tr>
<tr>
<td>Moving within display</td>
<td>$\leftarrow, \uparrow, \rightarrow, \downarrow$; Mouse cursor</td>
</tr>
<tr>
<td>Object choice within display</td>
<td>$\leftarrow, \uparrow, \rightarrow, \downarrow$; Left mouse button click during mouse cursor is near object</td>
</tr>
<tr>
<td>Object moving within display with large step</td>
<td>Shift+Left mouse button drag and drop</td>
</tr>
<tr>
<td>Object moving within display with small step</td>
<td>CapsLock+Left mouse button drag and drop</td>
</tr>
<tr>
<td>Object copy within display</td>
<td>Alt-D</td>
</tr>
<tr>
<td>Object cut and paste to new place within display</td>
<td>Ctrl-D</td>
</tr>
<tr>
<td>Scrolling</td>
<td>Drag by Left mouse button</td>
</tr>
<tr>
<td>Graphic/text switching</td>
<td>Ctrl-G</td>
</tr>
<tr>
<td>List sorting/filter</td>
<td>Ctrl-S</td>
</tr>
<tr>
<td>Field ordering for sorting</td>
<td>Alt-S</td>
</tr>
<tr>
<td>Window menu</td>
<td>Alt-W</td>
</tr>
<tr>
<td>Data Base Saving</td>
<td>F2</td>
</tr>
<tr>
<td>Fill field from menu</td>
<td>Alt-F3</td>
</tr>
<tr>
<td>Field edit</td>
<td>F3</td>
</tr>
<tr>
<td>Window close disabling</td>
<td>Ctrl-F4</td>
</tr>
<tr>
<td>Open new window</td>
<td>F4</td>
</tr>
<tr>
<td>Take data for copying</td>
<td>Ctrl-F8</td>
</tr>
<tr>
<td>Take data for reference</td>
<td>F8</td>
</tr>
<tr>
<td>Copy data to all active field records</td>
<td>Ctrl-F9</td>
</tr>
<tr>
<td>Refer or copy data to active field</td>
<td>F9</td>
</tr>
<tr>
<td>Deleting</td>
<td>Ctrl-Y</td>
</tr>
</tbody>
</table>

Table 13-2 RASA Hot Keys
(not otherwise defined in the standard)
13.2.3 **ESA-Columbus Hot/Function Keys and Keyboard Controls Deviation**

The supported keyboard switch action commands are as indicated in Table 13-3:

<table>
<thead>
<tr>
<th>Task/Object</th>
<th>Action</th>
<th>MS-Windows Key Combination</th>
<th>OSF/MOTIF Window Manager Key Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navigate</td>
<td>Start, Begin</td>
<td>HOME</td>
<td>HOME</td>
</tr>
<tr>
<td>Navigate</td>
<td>End</td>
<td>END</td>
<td>END</td>
</tr>
<tr>
<td>Navigate</td>
<td>Previous</td>
<td>PGUP</td>
<td>PGUP</td>
</tr>
<tr>
<td>Navigate</td>
<td>Next</td>
<td>PGDOWN</td>
<td>PGDOWN</td>
</tr>
<tr>
<td>Navigate</td>
<td>Previous</td>
<td>LEFT</td>
<td>LEFT</td>
</tr>
<tr>
<td>Navigate</td>
<td>Next</td>
<td>RIGHT</td>
<td>RIGHT</td>
</tr>
<tr>
<td>Navigate</td>
<td>Previous</td>
<td>UP</td>
<td>UP</td>
</tr>
<tr>
<td>Navigate</td>
<td>Next</td>
<td>DOWN</td>
<td>DOWN</td>
</tr>
<tr>
<td>Navigate</td>
<td>Next</td>
<td>TAB</td>
<td>TAB</td>
</tr>
<tr>
<td>Action</td>
<td>Cancel</td>
<td>ESC</td>
<td>ESC</td>
</tr>
<tr>
<td>Action</td>
<td>Accept</td>
<td>ENTER</td>
<td>ENTER</td>
</tr>
<tr>
<td>Action</td>
<td>Confirm/Acknowledge</td>
<td>ALT+RETURN</td>
<td>ALT+RETURN</td>
</tr>
<tr>
<td>Task</td>
<td>Rapid Shutdown</td>
<td>SHIFT+F4</td>
<td>N/A</td>
</tr>
<tr>
<td>Task</td>
<td>Stop Application</td>
<td>ALT+F4</td>
<td>ALT+F4</td>
</tr>
<tr>
<td>Task</td>
<td>Warm Boot</td>
<td>CTRL+ALT+DEL</td>
<td>STOP+A</td>
</tr>
<tr>
<td>Navigation</td>
<td>Next Application</td>
<td>ALTT+TAB</td>
<td>N/A</td>
</tr>
<tr>
<td>Navigation</td>
<td>Previous Application</td>
<td>ALTT+ESC</td>
<td>N/A</td>
</tr>
<tr>
<td>Navigation</td>
<td>Task List</td>
<td>CTRL+ESC</td>
<td>N/A</td>
</tr>
</tbody>
</table>

N/A = Not Applicable

Table 13-3  Keyboard Switch Action Commands
The keyboard navigation bindings are as indicated in Table 13-4:

<table>
<thead>
<tr>
<th>Virtual Key (OSF/MOTIF)</th>
<th>Keyboard Binding</th>
</tr>
</thead>
<tbody>
<tr>
<td>KTab, KBackTab</td>
<td>&lt;Tab&gt; MShift &lt;Tab&gt;</td>
</tr>
<tr>
<td>KMenu, KMenuBar, KCancel</td>
<td>&lt;F4&gt;, &lt;F10&gt;, &lt;Escape&gt;</td>
</tr>
<tr>
<td>KUp, KLeft, KDown, KRight</td>
<td>&lt;<em>&gt;, &lt;</em>&gt;, &lt;_&gt;</td>
</tr>
<tr>
<td>KNextFamilyWindow, KPreviousFamilyWindow</td>
<td>MAlt KTab, MAlt KBackTab</td>
</tr>
<tr>
<td>KNextWindow, KPreviousWindow</td>
<td>MAlt &lt;F6&gt;, MAlt MShift &lt;F6&gt;</td>
</tr>
<tr>
<td>KNextField, KPreviousField</td>
<td>MCtrl KTab, MCtrl MShift KTab</td>
</tr>
<tr>
<td>KNextPane</td>
<td>&lt;F6&gt;</td>
</tr>
</tbody>
</table>

Table 13-4 Keyboard Navigation Bindings

The Hot/Fixed Function Keys (FFKs) defined for the APM are listed in Table 13-5. The standard mapping of FFK’s to functions shall be applicable to all keyboards, even if the function is not provided, e.g. the Caution and Warning key shall always be allocated F11 and shall not be used for any other purpose.

<table>
<thead>
<tr>
<th>Fixed Function</th>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open C&amp;W Window</td>
<td>Rightmost Function Key, presumably F11</td>
</tr>
<tr>
<td>Go to Element Application Menu</td>
<td>F2</td>
</tr>
<tr>
<td>Help</td>
<td>F1</td>
</tr>
<tr>
<td>Cancel</td>
<td>ESCAPE</td>
</tr>
</tbody>
</table>

Table 13-5 Fixed Function Key
13.2.4 NASDA Hot Keys Deviation
For the SLT, a green border around a button indicates the button is the active field for use with hot keys.

<table>
<thead>
<tr>
<th>Function Hot Keys</th>
<th>NASDA RLT Deviation/Addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Show Message</td>
<td>F11</td>
</tr>
<tr>
<td>Summary Windows</td>
<td></td>
</tr>
</tbody>
</table>

Table 13-6 NASDA RLT Hot Keys

13.2.5 CSA Hot Keys Deviation

13.3 TASK BAR
A Windows-style Task Bar should list available applications (including displays), as well as all application windows currently open. The task bar should provide an “auto-hide” capability so that it appears only when the cursor is placed on a specific edge of a display area.

13.3.1 NASA Task Bar Deviation
NASA does not use the task bar.

13.3.2 RASA Task Bar Deviation
RASA does not use a task bar.

13.3.3 ESA-Columbus Task Bar Deviation
ESA-Columbus does not use a task bar.

13.3.4 NASDA Task Bar Deviation
NASDA does not use a task bar

13.3.4 CSA Task Bar Deviation
CSA does not use a task bar.
APPENDIX A

DEFINITION AND USE OF STANDARD TERMINOLOGY

The following appendix defines rules for uses of standard terminology for certain functions. Definitions of certain terms not already covered in previous sections will be covered in this appendix.

Abort - Used only to cease operations during which an emergency situation has occurred where the situation is time-critical and the result of continuing the operation will result in injury to personnel or damage hardware. The term “terminate” may be used for all other cases. For payloads, the term ‘abort’ shall not be used. Payloads uses ‘terminate’ or ‘stop’.

Activate – Initiate a software or hardware function to begin operation of a particular subsystem. The activate function should include multiple automated subactivities that encompass more than enabling or powering a routine or device.

For example, in the case of activating the Common Berthing Mechanism (CBM):
1) Clears the values of certain parameters in the MDMs CBM software
2) Selects the appropriate CBM RT based on the activate command and enables it on the 1553 bus
3) Begins cyclic communication with the CBM's master controller by sending a 1553 command to the CBM
4) Enables RT FDIR for the CBM RT after establishing comm with the CBM master controller

Active/Standby – Used to refer to equipment where any number can be selected as active and the rest are therefore in standby.

Animation – Any change in state. For example, on a display, if a graphic symbol changes color or appearance, it is considered animated.

Arm – 1. Used in a 2-step command when an action is being performed that is time critical with respect to the “Arm” and the operator is expected to only have the action available for a short period of time. It is the kind of action where the action command is expected to be sent immediately after the arm command. “Enable” will be used for all the other cases. 2. The hardware portion of a robotic system composed of joints and booms that effects translational and rotational motion.

Authorize – Use Enable, Arm, On.

Auto or Automatic – Being performed by a machine or a system, no human interaction required.

Auto Sequence - Usually used to identify the type of trajectory a robot/payload moves along. When a robot/payload moves through an “auto sequence,” it moves from point to point in space without the operator being in the control loop. The sequence is defined by the series of points in the trajectory, each point being composed of a position (X, Y, Z), and attitude (Pitch, Yaw, Roll). Points are either start points, pause points, fly-by points, or last points. The start and last points
are always pause points. When the trajectory achieves a pause point, it stops until the operator takes a positive action to continue the trajectory (usually via the "proceed button" on the DCP or GUI).

BIT - Built-in Test –
Acceptable forms of BIT:
- Active BIT - meaning crew action is necessary to execute the test function. The button shall be labeled "Active BIT."
- Passive BIT- meaning that the test is run automatically without crew involvement and the results displayed at the completion of the test or when the BIT detects a fault. (This label will replace any previous labels associated with "cyclic" or continuous BITs.)
- Detailed BIT - meaning the Active BIT executed is of a more detailed nature. (This label replaces "extended" BITs.)

Block – A grouping of parts to perform a function for a subsystem. An assembly is generally connected to control signals, electrical supply, thermal support, or other environmental support services to perform its job. Examples include an MDM, a pump package assembly (PPA), a remote power control module (RPCM), latch assembly, and a controller panel assembly (CPA).

Button - a 3D object which allows you to control a system or display with a single mouse click.

Cancel – Design the display to use “Off,” “No,” or “Inhibit” instead. Cancel closes the window without making any changes. Deviation - Robotics, cancel is used to halt a process.

Cartesian - Six degree-of-freedom space defined by three orthonormal directions (right-handed set of three mutually perpendicular vectors), and three Euler sequence angles in the “pitch, yaw, roll” sequence.

Common / or Equivalent Same - Terms used to denote the results of comparisons with other robotic systems elements. A common system component can be either equivalent to its counterpart, or the same as its counterpart. When two systems produce the same result using different hardware, software, or similar techniques, they can be said to be equivalent. When it is not possible to distinguish one components from the another components, the components that are indistinguishable are the same. In the Robotics appendix, similar is used to mean same.

Confirm – Do not use – Design the display to use “Yes” instead. For payloads: do not use as a button name. The use of 'confirm' is allowed in payload labels.

DCP - Acronym for “Displays and Control Panel,” a hardware panel containing switches and light-emitting-diode (LED) indicators for issuing and monitoring critical robot commands.

Dead - Parameter in dictionary, but no initial data received.

Delta and Error - Delta = Target - Current; Error = Current - Target

Enable/Inhibit – Enable is used when allowing automatic processes (such as software routines) to operate or when allowing the specified action to occur whenever commanded. There may be no time criticality associated with this terminology. Inhibit is used when preventing a command
from being executed or an action from being performed. Nomenclature used in telemetry fields for feedback may read enable(ed)/inhibit(ed) or if space is limited, ENA/INH.

**End Effector / Tool Effector** - The hardware at the tip of a robot used to connect to or service a Tool payload. An end effector (EE) that also includes a latch is called a latching end effector (LEE). Both EE and LEE are used with large robots intended for gross translations. “Tool” is a term for the end effector used with small, dexterous robots intended for close-in, servicing tasks.

**Euler Sequence:**
- **Pitch:** Pitch is positive when rotated in a right-handed manner around the Y-axis
- **Yaw:** Yaw is positive when rotated in a right-handed manner around the Z-axis
- **Roll:** Roll is positive when rotated in a right-handed manner around the X-axis

**Inhibit** – Used when preventing a command from being executed or an action from being performed.

**Fire** – Do not use (unless referring to a physical fire or the “firing” of thrusters).

**Frame of Resolution (FOR)** - Reference frame associated with the end effector or payload: The origin of the FOR is the Point of Resolution (POR), or the point around which rotations will occur. The Display Frame uses the axes of the FOR to compute the Euler Sequence Angles.

**Graphical Location Identifier (GLI)** - A label on a display used to denote a particular display region. GLI’s are referred to in procedures to direct an operator to a particular portion of the display. A label to denote a location on a display identified in procedures to direct the operator to that particular portion of the display.

**Graphic Symbol** - Conventional graphic designations used in training documentation.

**Hardware** - The hardware in a robotic system is composed of the workstation panels, video monitors, laptops, trackballs, mounting racks, etc.; arm; and end effectors / tools. Hardware (grapple fixtures) on the payload to be maneuvered; ready-to-latch microswitches; and cameras can be considered robotic hardware when assigning alert categories to feedback generated by these pieces.

**Icon** - Conventional graphic designations used in onboard displays.

**Inhibit** – Used when preventing a command from being executed or an action from being performed.

**KVC** - Acronym for “Kinematic Verification Check,” a software routine that can verify that the intended automatic sequence will not encounter “kinematic obstacles” when the robot is commanded along the automatic sequence trajectory.

**Load** – Used as a command button label on a button used for sending data for a template command to a buffer prior to the command being sent (a second step is required for command execution - see “Set”).

**Limit-Sensed Parameters** - Parameters whose values are monitored by computer software that compares the current value of the parameter with upper- and/or lower- allowable limits, or boolean logicals; violations of these limits are brought to the attention of the operator.

Manual Jog - Moving a robot/payload one axis at a time. For example, translating in the X-direction, then in the Y-direction, then rotating in pitch, rather than in all three at once. (ERA does not have hand controllers that allow multi-direction commands.)

Missing - Parameter not found in dictionary, or not being published if in dictionary.

Mode – 1. Primarily used in terms of software configuration at the system level or above.
2. Robotic systems can be controlled by a variety of inputs and can move in a variety of ways. For example, the operator may control robot motion with hand controllers or single switches, and the robot may move in an all-joint-coordinated fashion, a single-joint-at-a-time fashion, change just the pitch joint plane, etc. A “mode”, or “mode of operation,” designates the type of input required by the operator and the type of motion output by the robotic system. For example, the SSRMS has a mode called the “FOR Auto” mode. It requires the operator to select the automatic sequence to be used and to press the “proceed” button on the DCP. The robot, in response, will move the FOR through a series of all-joint-coordinated points.

Module – A single structural element that provides significant additional functionality to the station. Usually contains multiple systems and may be pressurized or unpressurized. Examples include FGB, SM, Node 1, Node 2, and SO Truss.

Nominal - In normal range and status is nominal

OCAS - Acronym for “Operator Commanded Automatic Sequence,” a two point auto sequence; the start point is the robot’s current position, and the last point is operator-definable via display input.

Out of limits indeterminate - Value outside nominal range.

Out of limits high - Parameter value greater than upper limit of nominal range.

Out of limits low - Parameter value less than lower limit of nominal range.

Off-scale low - Parameter value less than sensor range.

Off-scale high - Parameter value greater than sensor range.

Operator - The person who closes the loop in the robotic control system.

Part – The individual pieces that are assembled together to form a block. Examples include a single valve, a controller card, a pump, latch, etc.

Pause - Used when an operation is to be either nominally or off-nominally stopped or canceled and may be resumed from that point in the process.

Primary/Backup – Used when referring to the logical state or designation of equipment where only one can be logically selected as the Primary and all others selected as backup. In the case where the backup is running in a powered state, it can be referred to as “Hot” backup and when it is not powered or not receiving supporting data from the Primary equipment such that it can
immediately begin to assume the Primary Functions it is referred to as "Cold" backup. Exceptions are: For the Node 1 MDMs, one is considered Primary and the other is considered Secondary. For the C&C MDMs, one is considered Primary, another Backup and the third is Standby.

Relocatable - A term to signify that an automatic sequence can be performed from more than one robot base location.

RSAD - Acronym for “Robotic Situational Awareness Displays,” a suite of displays providing the operator with predictive displays, hand controller steering displays, single joint drive assistant displays, “bird’s-eye-view” displays, etc.

Segment – A number of modules that can be logically grouped together by form, function, or program responsibility. Examples include the Russian segment and the American segment.

Set – Used as a Command button label for a button used to send a template command.

SODF - Acronym for “Systems Operations Data File,” the collection of U.S. System ODF procedures and reference information. An ODF procedure is a set of instructions used by the onboard crew, ground controllers, and the on-orbit procedures executor software to fulfill tasks needed to operate and maintain station systems, payloads, and attached vehicles under both nominal and off-nominal conditions.

State – The physical configuration (On/Off, Open/Close, etc.) at the subsystem level or below.

Station - A group of segments (or modules) that are combined to form a complete orbital complex.

Stale - Parameter Data not being updated. Usually associated with LOS.

Status – A qualitative assessment of the overall condition or health of the system at any level.

Stop - Used specifically with hardware and is defined as the cessation of motion in moving parts (hardware). E.g., a mechanism is commanded to “stop.” For payloads, ‘stop’ should be generally used in cases where there is a pair of buttons labeled ‘start’ and ‘stop’ (e.g., a search that you might want to stop as soon as you found the file of interest.) Definition under review.

Subsystem – A collection of blocks that work together to perform a function within a system. One example is the fire detection and suppression components of ECLSS.

Super-System – An organization that includes the orbital station, other space vehicles, and ground facilities.

System – A collection of components that perform unique functions supporting activities in a module, segment, or in the entire station. Some systems may interface across the larger super-system. Examples include the electrical power system (EPS), the thermal control system (TCS), etc. (was "subsystem" in previous designations). NASA uses subsystems to express “system.” For example, “EPS” on SLT, “MA” and “SFA” on RLT are subsystems.

Definitions 27 Jan 00 Appendix A-5
**Telerobot** - A robotic system controlled from a remote location. ISS external robots are controlled remotely from workstations located inside the modules.

**Terminate** - Used when an operation is to be either nominally or off-nominally stopped or canceled and will result in the operation having to restart from the beginning. E.g., software routines may be terminated.

**Quick Pick List** - A pull down menu that allows the operator to select from a predefined list the desired value instead of entering it manually.

**Vernier** - A rate slower than coarse rate. Selected to ensure that when the brakes are applied the robot and payload will stop before hitting structure or an obstacle.

**Widget** – A widget is a user display object, e.g., a Pushbutton or Menubar. It represents a block of program code (a library function) that is grouped together to provide a single-user interface abstraction. The term is associated with X-Windows. (MSFC-STD-1956, Huntsville Operations Support Center Common User Interface Standard, page A-23, 3/95)
APPENDIX B

COLORS

B.1 GENERAL PRINCIPLES AND RATIONALE. Colors should be used sparingly. Use of color shall be limited to a set of well chosen colors. The identified colors shall be used repetitively to maintain consistency across content areas and across displays. Colors should not be used as the sole means of identification of a part or subsystem.

B.2 COLOR STANDARDS. The color standards and definitions have been extracted from many several industry and government standards documents as listed in Section 2.0. A specific exception is the use of industry standard hazardous materials (Haz-Mat) coding and color affiliations which were not deemed pertinent as compared to existing display and drawing accepted color coding. An example is the use of Haz-Mat red for flammable material while display conventions use red to indicate an alarm message or parameter limit violation indicative of an emergency condition, warning, or danger. Colors are chosen from the X-Windows palette and are referenced by the Red-Green-Blue (RGB) values for each color identified. The following guidelines shall be adhered to when using color for the ISS graphics.

a) Colors shall not be used as the sole means of identification of a status of a part or subsystem. Information on the event or element status shall be redundant, using either labels or other graphical change. Video overlays are not governed by this rule.

b) Colors used for object identification shall be fully redundant, colors used for object comparison shall be at least partially redundant, colors shall be non-redundant for video applications only.

c) Colors shall be used only to convey meaning and will not be used for decoration or aesthetic purposes.

d) When assigning color to an object, the minimum size of that object shall be 0.02391 inches in both the x and y directions.

e) The default background color for all displays shall be gray.

f) Colored objects shall not be displayed over filled areas using the same color.

g) Objects colored with highly saturated colors shall not be placed within close proximity one inch of one another. The side by side color combinations to avoid are TBS as follows:

h) Red/Green
i) Red/Blue
j) Yellow/Blue
k) Yellow/Magenta
l) Green/Blue(All power icons have this combo)

g) Color assignments shall not conflict with standard associations.
h) No more than nine colors, including white and black, excluding shading, shall be used for any one display. Optimum use should be limited to five or fewer colors.

NASDA Colors. Some displays of SLT and RLT have more than nine colors.

h) An important factor to consider when selecting colors is the contrast among colors. This is needed to ensure that each color is easily discriminated from the others. Although contrast is an important consideration, it should not be used without regard to other important factors such as convention or standard, inherent meaning and consistency across displays. The color selections below were also evaluated for shades of gray discrimination for B/W printouts.

NASDA Colors. On SLT, the same label of fluid and gases are displayed outside of the pipe and some are not displayed.

i) The following colors are reserved:

1. Red (255, 0, 0) is reserved for indicating an alarm message or parameter limit violation indicative of an emergency condition. Other colors must be at least 30 point radial distance from red.

2. Yellow (255, 255, 0) is reserved for indicating an alarm message or parameter limit violation indicative of a caution condition except for the attention symbol. Other colors must be at least 30 point radial distance from yellow.

j) The following colors and definitions in Table B-1 have been assigned for the specific applications as defined below. The RGB values are provided to ensure exact definition of the color and shade intended for these applications.

k) Color usage for Training Graphics
Color usage guidelines for training graphics are defined in Appendix J.

At a minimum, the following rules shall apply.
1. Color usage should be consistent between displays and training graphics.
2. Each training schematic shall include a legend showing color usage.
3. Color usage should be consistent within each schematic.
4. Where possible, color usage should be consistent across the entire ISS Program.

l) **Training Graphics** - While the use of colors for graphical products will adhere as much as possible to the color standards, these standards are not as strict. For training graphics, all colors may be used without restrictions, except for Red - 255, 0, 0, [Green - 0, 255, 0] (Why is green restricted?), and Yellow - 255, 255, 0 which are to be used for Caution and Warning.

Training products will use a legend on each drawing to avoid any confusion about what each color on each drawing is being used for. Within each ISS System, the use of colors on training graphic products will be consistent. However, across different ISS Systems there are not enough colors available to avoid duplication of color usage or follow the color codes in this appendix.
<table>
<thead>
<tr>
<th>Color</th>
<th>Color</th>
<th>R</th>
<th>G</th>
<th>B</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquamarine, Med</td>
<td></td>
<td>102</td>
<td>205</td>
<td>170</td>
<td>Under Review - Air , RASA uses white</td>
</tr>
<tr>
<td>Bisque 3</td>
<td></td>
<td>205</td>
<td>183</td>
<td>158</td>
<td>Agree - Ammonia</td>
</tr>
<tr>
<td>Black</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Agree - Text, labels, borders, symbols, titles, and generally unrestricted. Used for indicating the power-off state (see section 4.17) of the respective ORU. Also used to represent Vacuum</td>
</tr>
<tr>
<td>Blue 4</td>
<td></td>
<td>0</td>
<td>0</td>
<td>139</td>
<td>Under Review - Caution and Warning toolbar background, NASDA will verify</td>
</tr>
<tr>
<td>Blue, Dodger</td>
<td></td>
<td>30</td>
<td>144</td>
<td>255</td>
<td>Under Review - Used for indicating the nominal operational status (see section 4.17) of the respective ORU. Also used to indicate the active condition of a line. RASA will verify</td>
</tr>
<tr>
<td>Blue, Light</td>
<td></td>
<td>173</td>
<td>216</td>
<td>230</td>
<td>Used to represent Polymethyl Siloxane on Russian Displays (Can we pick Light Blue for a non-toxic generic coolant?)</td>
</tr>
<tr>
<td>Blue, Light</td>
<td></td>
<td>173</td>
<td>216</td>
<td>230</td>
<td>Freon (Can we pick one of these three colors for freon based coolant?) Also used as fill color for the Solar Arrays to distinguish them from background</td>
</tr>
<tr>
<td>Blue, Royal</td>
<td></td>
<td>65</td>
<td>105</td>
<td>225</td>
<td>Agree - Water</td>
</tr>
<tr>
<td>Brown</td>
<td></td>
<td>165</td>
<td>42</td>
<td>42</td>
<td>Agree - Generic Toxic coolant; e.g., Ethylene Glycol</td>
</tr>
<tr>
<td>Brown, Sandy</td>
<td></td>
<td>244</td>
<td>164</td>
<td>96</td>
<td>Agree - Nitrogen (Tetroxide?) (Can we use this just for N2 and dark green for oxidizer for N2O4?)</td>
</tr>
<tr>
<td>Cyan</td>
<td></td>
<td>0</td>
<td>255</td>
<td>255</td>
<td>Under Review - Used to indicate the parameter in question is unknown within the PCS application (PUI is invalid) or PCS has not received data from the ISP. Also used to indicate that the PCS connection to the MDM has been lost. Crews reported hard to differentiate between other blues. Crew to propose. NASA wants to use Cyan.</td>
</tr>
<tr>
<td>Gray, Light</td>
<td></td>
<td>211</td>
<td>211</td>
<td>211</td>
<td>Agree - Used primarily in ground based simulators and trainers as a background color meaning unavailable or inactive within the simulation, background</td>
</tr>
<tr>
<td>Gray 51</td>
<td></td>
<td>130</td>
<td>130</td>
<td>130</td>
<td>Under Review - Baselayer module color</td>
</tr>
<tr>
<td>Gray 67</td>
<td></td>
<td>171</td>
<td>171</td>
<td>171</td>
<td>Under Review - Subsection background to distinguish the subsection from the rest of the display. Also used to indicate the non-active status of a device (See section 4.17)</td>
</tr>
<tr>
<td>Gray 83</td>
<td></td>
<td>212</td>
<td>212</td>
<td>212</td>
<td>Under Review - Window background and navigation button color</td>
</tr>
<tr>
<td>Green</td>
<td></td>
<td>0</td>
<td>255</td>
<td>0</td>
<td>Agree - Generally means good/nominal status. Used for indicating power-on state of the respective ORU or as an aliveness indication for RPCMs, used for ready-to-latch indicators for when the latch is within the latching envelope.</td>
</tr>
<tr>
<td>Green, Dark</td>
<td></td>
<td>0</td>
<td>105</td>
<td>0</td>
<td>Agree - Oxidizer other than oxygen</td>
</tr>
<tr>
<td>Green 4</td>
<td></td>
<td>0</td>
<td>139</td>
<td>0</td>
<td>Under Review - Oxygen</td>
</tr>
<tr>
<td>Color Description</td>
<td>RGB Values</td>
<td>Hex Values</td>
<td>Notes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------</td>
<td>------------</td>
<td>----------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green, Light (also called palegreen 2)</td>
<td>144 238 144</td>
<td>#80E080</td>
<td>Agree - Helium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magenta</td>
<td>255 0 255</td>
<td>#FF00FF</td>
<td>Agree - Ionizing Radiation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olive Drab</td>
<td>107 142 35</td>
<td>#6B8E24</td>
<td>Agree - Mixed gas &amp; liquid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>255 165 0</td>
<td>#FFA500</td>
<td>Agree - Used to draw operators attention to an important condition, but not critical, for the user to be aware of. Such as advisory annunciation; alerting the operator to the fact that there are currently, hazardous moving parts, payload alerts. Also used to represent Hydrogen.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orchid, Dark</td>
<td>153 50 204</td>
<td>#9932CC</td>
<td>Used primarily in ground based simulators and trainers as a background color indicating which malfunctions are active within the simulation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pink</td>
<td>255 192 203</td>
<td>#FFC0CB</td>
<td>Used to represent Triol on Russian Displays. Can we not use a generic coolant color for this (after we pick one)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pink, Hot</td>
<td>255 105 180</td>
<td>#FF69B4</td>
<td>Hydrazine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pink, Light</td>
<td>255 182 193</td>
<td>#FFD700</td>
<td>FC40 Coolant (Can we pick one of these three colors for freon based coolant?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plum</td>
<td>221 160 221</td>
<td>#E5B4E5</td>
<td>Carbon dioxide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purple</td>
<td>160 32 240</td>
<td>#9B3F5E</td>
<td>Missing, dead, invalid, or Commfault status condition (the PCS connection to the MDM has been lost.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>255 0 0 0</td>
<td>#FF0000</td>
<td>Used as background color for icons and data output fields for Emergency or warning conditions annunciated by the Emergency, Caution and Warning System. Also used to indicate Off scale high/low or out of critical limits status indicators (Red H or L next to out of limits values in data output fields).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Violet</td>
<td>238 130 238</td>
<td>#F585F5</td>
<td>FC72 Coolant (Can we pick one of these three colors for freon based coolant?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>255 255 255</td>
<td>#FFFFFF</td>
<td>Background color fill for nominal state data output fields, and text on red and black fields</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>255 255 0</td>
<td>#FFFF00</td>
<td>Used as background color for icons and data output fields for Caution conditions annunciated by the Emergency, Caution and Warning System. Also used in the Caution or Attention symbol: out of operational limits status indicator</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table B-1  Colors
APPENDIX C
ICONS and GRAPHIC SYMBOLS

C.1 GENERAL PRINCIPLES AND RATIONALE

The following guidelines should be used when developing or using icons and symbols. Detailed requirements for Icon and Symbol development are defined in Section 7.

Icons will be simple, clear, easy to understand symbols.
Icons can be used simply as a symbol of an object or function that cannot be manipulated or as a symbol on which the user can directly act (e.g., selecting the icon to open or move applications or files.)
Icons representing components with directional implication (e.g., a blowing fan, a thruster) on schematic displays can be rotated in order to show the correct direction of action or flow. Conversely, icons used in a schematic drawing or display implying direction of flow or action shall be placed properly to reflect the direction of flow.
An icon can change in shape and color over time if, without adding complexity to the symbol, that change adds useful information to the user in an intuitive manner.
The object or action that the icon represents should be visible in the icon. This guideline has two implications: (1) the size of the icon should be large enough for the user to perceive the representation and discriminate it from other icons, and (2) the representation should be pictographic whenever possible.
To the greatest extent possible, icons should be accompanied by a text label, especially when the icons do not closely resemble the symbolized object or action.
To the extent that it does not clutter or cause distortion of the icon, icon labels should be incorporated into the icon itself.
Icons and graphical symbols depicted in these tables may be used in mirror image or rotated in any direction. Graphic symbols may be scaled up or down.
Icons for specific applications that are not defined in Appendix C can be defined by the user. They must, however, comply with the generic standards set forth in Appendix C and should not conflict with current icons.
### C.1.1 Icon Family Legend

The following legend of letters (Code Number) identifies the families to which each icon belongs:

- C = Communication
- E = Electrical
- F = Fluids
- G = Generic
- K = Computers
- L = Logic
- M = Mechanical
- S = Sensors
- NE = New Events
- NM = New Modes
- NS = New Station
- NY = New Systems
- R = Robotics

### C.2 DISPLAY ICONS AND GRAPHIC SYMBOLS

#### C.2.1 Communication

<table>
<thead>
<tr>
<th>English Name</th>
<th>Russian Name</th>
<th>Icon</th>
<th>Schematic</th>
<th>Comments</th>
<th>In use</th>
<th>Code Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antenna, Phase Array</td>
<td></td>
<td>![Icon]</td>
<td>![Schematic]</td>
<td></td>
<td></td>
<td>C1</td>
</tr>
<tr>
<td>Antenna, Dish/Parabolic</td>
<td>Параболическая упр. антенна</td>
<td>![Icon]</td>
<td>![Schematic]</td>
<td></td>
<td>**</td>
<td>C2</td>
</tr>
<tr>
<td>Antenna, Dipole</td>
<td>Дипольная антенна</td>
<td>![Icon]</td>
<td>![Schematic]</td>
<td></td>
<td></td>
<td>C3</td>
</tr>
<tr>
<td>Antenna, GPS</td>
<td><img src="image1" alt="Image" /></td>
<td>This symbol represents a GPS antenna and its electronics. The triangle represents the antenna portion of the ORU and the box represents the electronics package of the ORU.</td>
<td>C4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antenna, Helix</td>
<td><img src="image2" alt="Image" /></td>
<td></td>
<td>C24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antenna, Horn</td>
<td><img src="image3" alt="Image" /></td>
<td></td>
<td>C5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antenna, Horn, Steerable</td>
<td><img src="image4" alt="Image" /></td>
<td>(ISS S-Band High Gain) Icon signifies international symbol for a steerable horn antenna.</td>
<td>C6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antenna, Omni-Directional</td>
<td><img src="image5" alt="Image" /></td>
<td>(ISS S-Band Low Gain)</td>
<td>C7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audio Terminal Unit (ATU)</td>
<td><img src="image6" alt="Image" /></td>
<td>This symbol represents the Audio Terminal Unit used on the ISS. The symbol is based on the control panel of the ATU.</td>
<td>C25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automatic Frequency Control</td>
<td><img src="image7" alt="Image" /></td>
<td>Icon signifies international symbol for automatic frequency control.</td>
<td>C8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter Type</td>
<td>Icon Description</td>
<td>Notes</td>
<td>Reference</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>-----------------------------------</td>
<td>-----------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Band-Pass Filter</td>
<td>Icon signifies international symbol for a band-pass filter.</td>
<td>C9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Band-Pass Filter with Variable Center Frequency</td>
<td>Icon signifies international symbol for a band-pass filter with variable center frequency.</td>
<td>C10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Band-Pass Filter with Variable Pass-Band, Selectivity Control</td>
<td>Icon signifies international symbol for a band-pass filter with variable pass-band with selectivity control.</td>
<td>C11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Band-Stop Filter</td>
<td>Icon signifies international symbol for a band-stop filter.</td>
<td>C12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Band-Stop Filter, Variable</td>
<td>Icon signifies international symbol for a band-stop filter with variable control.</td>
<td>C13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiber Optic</td>
<td>Icon signifies international symbol for fiber optics.</td>
<td>C14 C26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency Multiplier</td>
<td></td>
<td>C29</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency Divider</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Icon</td>
<td>Description</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPS Receiver</td>
<td>Icon symbolizes “triangulation” for position from signals from 4 satellites. GLONASS receiver, Global Navigation System similar to GPS.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harmonic Generator</td>
<td>Icon signifies international symbol for a harmonic generator.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Headset</td>
<td>Icon signifies international symbol for a headset.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-Pass Filter</td>
<td>Icon signifies international symbol for a high-pass filter.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antenna, Kurs</td>
<td>Kurs radar docking system antenna. Looks like a Kurs antenna.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Matching Unit</td>
<td>Shows an interface for lower level sensors and systems that run on non-1553 protocol to convert to 1553 protocol. Heavy exterior outline with dashed internal lines symbolize 3 channel nature of devices, with a special communication link between the three units that is not dependent upon exterior 1553 connections.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microphone</td>
<td>Icon signifies international symbol for a microphone.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recorder</td>
<td>Icon signifies international symbol for a speaker.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Strength Attenuator</td>
<td>Icon signifies international symbol for a single strength attenuator.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Under review*
### Video Camera, Fixed Mount

<table>
<thead>
<tr>
<th>Video Camera, Fixed Mount</th>
<th>Камера</th>
<th>Also Camcorder</th>
<th>C21 M31</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F3D:43</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>CSA Deviation</em>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C22</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C23</strong></td>
<td></td>
<td></td>
<td>Under review</td>
</tr>
</tbody>
</table>

### Audio Tape Recorder

<table>
<thead>
<tr>
<th>Video Tape Recorder (VTR)</th>
<th>Видео Магнитофон</th>
<th></th>
<th>C22</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>G8H:6&quot;</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C23</strong></td>
<td></td>
<td></td>
<td>Under review</td>
</tr>
</tbody>
</table>

### C.2.2 Electrical

<table>
<thead>
<tr>
<th>English Name</th>
<th>Russian Name</th>
<th>Icon</th>
<th>Schematic</th>
<th>Comments</th>
<th>In use</th>
<th>Code Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternating Current</td>
<td>Переменный ток</td>
<td><img src=".../images/simple_square.png" alt="Image" /></td>
<td><img src=".../images/schematic.png" alt="Image" /></td>
<td>Icon signifies international symbol for alternating current.</td>
<td>E1</td>
<td></td>
</tr>
<tr>
<td>Amplifier</td>
<td></td>
<td><img src=".../images/triangle.png" alt="Image" /></td>
<td><img src=".../images/schematic.png" alt="Image" /></td>
<td>Icon signifies international symbol for an amplifier.</td>
<td>E2</td>
<td></td>
</tr>
<tr>
<td>Amplifier - Converter</td>
<td></td>
<td><img src=".../images/triangle.png" alt="Image" /></td>
<td><img src=".../images/schematic.png" alt="Image" /></td>
<td>Icon symbolizes amplifier and encoder.</td>
<td>E39</td>
<td></td>
</tr>
<tr>
<td>Icon</td>
<td>Description</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E3</strong></td>
<td>Batteries are depicted with this symbol. When possible the leads will be shown vertical. The large line indicates the positive terminal of the battery. Icon signifies international symbol for a battery.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E40</strong></td>
<td>This symbol represents a pressurized single battery cell used on the ISS. MOD Standard symbol for a pressurized ISS battery cell. The boundary indicates that it is a pressurized vessel and not a free-breathing battery.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E41</strong></td>
<td>Icon symbolizes battery circuit symbol.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E44</strong></td>
<td>This symbol designates a complete negative return electrical bus. MOD standard symbol for a complete negative return electrical bus. The rectangle indicates it is a complete bus and the RTN indicates return.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E45</strong></td>
<td>This symbol designates an incomplete electrical bus. The remainder of the bus is shown in other places. MOD standard symbol for an electrical bus.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E4 Under review</strong></td>
<td>Icon too similar to Signal Generator. Needs redesign.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E46</strong></td>
<td>Symbol represents current being measured and integrated over time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E46</strong></td>
<td>Icon symbolizes the charging cycles (charging/discharging) of the battery.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circuit Breaker</td>
<td>![Circuit Breaker Icon]</td>
<td>Icon signifies international symbol for a circuit breaker.</td>
<td>E5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------</td>
<td>----------------------------------------------------------</td>
<td>----</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coil</td>
<td>Катушка</td>
<td>Icon signifies international symbol for a coil.</td>
<td>E6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communications Unit</td>
<td>![Communications Unit Icon]</td>
<td>Icon symbolizes interface from crew input command to solar array orientation system. Command given to rotate solar array drive motor.</td>
<td>E48A, E48B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Connectors     | ![Connectors Icons]    | A) Male connector  
B) Female connector  
C) De-matable connector  
D) Permanent connection | E43A, E43B, E43C, E43D, E49 |
| Control Rectifier Diode | ![Control Rectifier Diode Icon] | Icon signifies international symbol for a control rectifier diode.  
Original ESA input is also the international standard. This icon will be fixed before printing. | E7 |
| Converter, AC/DC | Преобразов. Пер./Пост. | ![Converter Icon] | Icon signifies international symbol for an AC/DC converter.  
Add ESA deviation | E8A, E8B |
<table>
<thead>
<tr>
<th>Converter, DC to DC</th>
<th>Преобразов. Пост./Пост.</th>
<th><img src="image_url" alt="Converter Icon" /></th>
<th>Icon symbolizes the function of the unit to monitor the current and the feedback control to the system.</th>
<th>Add ESA deviation E9A E9B E50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Converter Controller</td>
<td><img src="image_url" alt="Converter Controller Icon" /></td>
<td>Icon symbolizes the function of the unit to monitor the current and the feedback control to the system.</td>
<td>First icon symbolizes transistor and diode contained within the unit. These components work as a switching function to regulate the solar array output voltage. The second icon is taken from the EPS drawing from the MIR EPS for the same unit. —but the icon is not totally understood.</td>
<td>E52</td>
</tr>
<tr>
<td>Current Regulator</td>
<td><img src="image_url" alt="Current Regulator Icon" /></td>
<td>Icon symbolizes the function of the unit to monitor the current and the feedback control to the system.</td>
<td>This symbol represents a current-regulated power supply. The arrow should always point up. MOD Drawing Standard for a current source</td>
<td>E53A E53B</td>
</tr>
<tr>
<td>Current Source</td>
<td><img src="image_url" alt="Current Source Icon" /></td>
<td>This symbol represents a current-regulated power supply. The arrow should always point up. MOD Drawing Standard for a current source</td>
<td><img src="image_url" alt="Current Source Icon" /></td>
<td>E54A E54B</td>
</tr>
<tr>
<td>Dangerous Voltage</td>
<td>Опасное напряжение</td>
<td><img src="image_url" alt="Dangerous Voltage Icon" /></td>
<td>Icon signifies international symbol for dangerous voltage.</td>
<td><img src="image_url" alt="Dangerous Voltage Icon" /> E10</td>
</tr>
<tr>
<td>Current Ideal Source</td>
<td><img src="image_url" alt="Current Ideal Source Icon" /></td>
<td><img src="image_url" alt="Current Ideal Source Icon" /></td>
<td><img src="image_url" alt="Current Ideal Source Icon" /></td>
<td>E55</td>
</tr>
<tr>
<td>Current Stabilizer</td>
<td>Symbol</td>
<td>Description</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>Q</td>
<td>![Symbol]</td>
<td>Symbolizes purpose of unit which is charging batteries for transport vehicles. Unit not fully understood. Maybe a better icon.</td>
<td>E56</td>
<td></td>
</tr>
<tr>
<td>Direct Current</td>
<td>![Symbol]</td>
<td>Icon signifies international symbol for direct current. Add ESA Deviation</td>
<td>E11</td>
<td></td>
</tr>
<tr>
<td>Filter Unit, Electrical</td>
<td>![Symbol]</td>
<td>Icon symbolizes a filter (capacitor).</td>
<td>E57</td>
<td></td>
</tr>
<tr>
<td>Fuse</td>
<td>![Symbol]</td>
<td></td>
<td>E58A E58B</td>
<td></td>
</tr>
<tr>
<td>Lamp Light Assembly</td>
<td>![Symbol]</td>
<td></td>
<td>E12</td>
<td></td>
</tr>
<tr>
<td>Field Effect Transistor</td>
<td>![Symbol]</td>
<td>Icon signifies international symbol for a field effect transistor.</td>
<td>E13</td>
<td></td>
</tr>
<tr>
<td>Fixed Capacitor</td>
<td>![Symbol]</td>
<td></td>
<td>E14</td>
<td></td>
</tr>
<tr>
<td>Fluorescent Light</td>
<td>![Symbol]</td>
<td></td>
<td>E15</td>
<td></td>
</tr>
<tr>
<td>Fuse with LED indicator</td>
<td>![Symbol]</td>
<td></td>
<td>E59</td>
<td></td>
</tr>
<tr>
<td>Ground, Earth</td>
<td>![Symbol]</td>
<td>Icon signifies international symbol for an earth ground.</td>
<td>E60</td>
<td></td>
</tr>
<tr>
<td>Ground, Frame</td>
<td>Корпус или шасси</td>
<td>Icon signifies international symbol for a frame or chassis ground.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------</td>
<td>----------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Heater</strong></td>
<td>Нагреватель электрич.</td>
<td>Heaters are designated using the standard heater icon. Heaters are enabled or disabled. Icon signifies international symbol for a heater. Resistance heater was chosen over heater icon currently. ROS: Äll USOS: TCCS, CDRA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Add ESA and NASDA deviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Action: Develop new icon.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Inverter</strong></td>
<td>Инвертор</td>
<td>Icon signifies international symbol for an inverter.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E17</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lamp, Lighting,</strong></td>
<td></td>
<td>E18</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>** Light(GL A) **</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lamp, Indicator</strong></td>
<td>Лампа</td>
<td>E19</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>** **</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Light Emitting Diode (LED)</strong></td>
<td></td>
<td>Icon signifies international symbol for a light emitting diode (LED).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Add ESA deviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Icon</td>
<td>Description</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>Light, Indicator, Status</td>
<td><img src="image" alt="Light Icon" /></td>
<td>Icon symbolizes the function of the unit. It calculates the delta between where the sun is and where the arrays are and sends commands to the motor drive unit to rotate the array.</td>
<td>E62</td>
<td></td>
</tr>
<tr>
<td>Logic and Control Unit</td>
<td><img src="image" alt="Logic Icon" /></td>
<td></td>
<td>E63</td>
<td></td>
</tr>
<tr>
<td>Metal Oxide Semiconductor Field Effector Transistor</td>
<td><img src="image" alt="Metal Oxide Icon" /></td>
<td>A motor driven system is depicted with this icon. Icon signifies any motor driven system.</td>
<td>E88A, E88B</td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td><img src="image" alt="Motor Icon" /></td>
<td></td>
<td>E21</td>
<td></td>
</tr>
<tr>
<td>Motor, Three phase, AC</td>
<td><img src="image" alt="Motor AC Icon" /></td>
<td>Icon signifies international symbol for a three phase AC motor.</td>
<td>E64</td>
<td></td>
</tr>
<tr>
<td>Motor, Three phase, Brushless, DC</td>
<td><img src="image" alt="Motor DC Icon" /></td>
<td>Icon signifies international symbol for a three phase brushless DC motor.</td>
<td>E65</td>
<td></td>
</tr>
<tr>
<td>Optical Combiner</td>
<td><img src="image" alt="Optical Combiner Icon" /></td>
<td></td>
<td>E67</td>
<td></td>
</tr>
<tr>
<td>Optical Receiver</td>
<td><img src="image" alt="Optical Receiver Icon" /></td>
<td></td>
<td>E68</td>
<td></td>
</tr>
<tr>
<td>Optical Splitter</td>
<td><img src="image" alt="Optical Splitter Icon" /></td>
<td></td>
<td>E69</td>
<td></td>
</tr>
<tr>
<td>Optical Transmitter</td>
<td><img src="image" alt="Optical Transmitter Icon" /></td>
<td></td>
<td>E70</td>
<td></td>
</tr>
<tr>
<td>Icon Description</td>
<td>Image</td>
<td>Reference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------</td>
<td>-----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opti-Coupler with Amplifier</td>
<td>![Image]</td>
<td>E71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opti-Coupler with Transistor</td>
<td>![Image]</td>
<td>E72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase Detector</td>
<td>![Image]</td>
<td>E22, E73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polarized Capacitor</td>
<td>![Image]</td>
<td>E74A, E74B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photodiode</td>
<td>![Image]</td>
<td>E23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potentiometer</td>
<td>![Image]</td>
<td>E75A, E75B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power source, Electrical, Single solar cell</td>
<td>![Image]</td>
<td>E24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Push-button,</td>
<td>![Image]</td>
<td>E25A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Icon Description</td>
<td>Image</td>
<td>Reference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>-------</td>
<td>-----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Push-button, Momentary, Off</td>
<td><img src="image1.png" alt="Image" /></td>
<td>E26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Push-button, Three Contact</td>
<td><img src="image2.png" alt="Image" /></td>
<td>E27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Push-button, Three Contact, Momentary</td>
<td><img src="image3.png" alt="Image" /></td>
<td>E28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectifier, General</td>
<td><img src="image4.png" alt="Image" /></td>
<td>E76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remote Bus Isolator</td>
<td><img src="image5.png" alt="Image" /></td>
<td>E77A, E77B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistor</td>
<td><img src="image6.png" alt="Image" /></td>
<td>E78A, E78B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistor, Variable</td>
<td><img src="image7.png" alt="Image" /></td>
<td>E79A, E79B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Icon signifies international symbol for a resistor.*
<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Signal Amplifier Icon" /></td>
<td>Icon symbolizes amplifier. Standard electronic symbol for amplifier.</td>
</tr>
<tr>
<td><img src="image2" alt="Solar Array Icon" /></td>
<td>The icon symbolizes the photovoltaic cells (diodes) of the array. It also portrays the function the array performs which is converting solar energy into electrical energy.</td>
</tr>
<tr>
<td><img src="image3" alt="Solar Array Drive Icon" /></td>
<td>Icon represents the motor drive to rotate the array.</td>
</tr>
<tr>
<td><img src="image4" alt="Spotlight Icon" /></td>
<td>Icon symbolizes the various charging currents the unit uses to charge the battery.</td>
</tr>
<tr>
<td><img src="image5" alt="Static (data) Converter Icon" /></td>
<td>Icon symbolizes the unit converting voltage to 3 phase for the motor.</td>
</tr>
<tr>
<td><img src="image6" alt="Storage Battery Current Converter Icon" /></td>
<td>Icon symbolizes Sun in field of view of sensor. Slits in sensor represent physical and functional characteristics of the sensor.</td>
</tr>
<tr>
<td><img src="image7" alt="Switch, Multipole Icon" /></td>
<td>Add Robotics deviation (R4) Light VLU</td>
</tr>
</tbody>
</table>

**Appendix C-15**
<table>
<thead>
<tr>
<th>Icon Description</th>
<th>Icon</th>
<th>Icon Description</th>
<th>Icon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch, Open</td>
<td>![Switch icon]</td>
<td>Switch icon is used to denote a switch is open. The switch icon may be placed within a button to indicate that more detailed data and commands may be accessed by selecting the switch.</td>
<td>NASDA does not have contacts on switch</td>
</tr>
<tr>
<td>Switch, Closed</td>
<td>![Switch icon]</td>
<td>Switch icon is used to denote a switch is closed.</td>
<td>NASDA does not have contacts on switch</td>
</tr>
<tr>
<td>Switch, Manual, Contact/Momentary</td>
<td>![Switch icon]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch, Manual, Latching contact</td>
<td>![Switch icon]</td>
<td>Dots indicate latching.</td>
<td></td>
</tr>
<tr>
<td>Switch, Manual, Momentary, Dual Control</td>
<td>![Switch icon]</td>
<td>Triangles indicate momentary.</td>
<td></td>
</tr>
<tr>
<td>Thermistor</td>
<td>![Thermistor icon]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transformer (Power Converter)</td>
<td>![Transformer icon]</td>
<td>Also Power Converter. Power converters are depicted with this symbol. Icon signifies international symbol for a transformer. Converters are considered to be “On” or “Off” in</td>
<td></td>
</tr>
<tr>
<td>Transformer, RF</td>
<td>Трансформатор</td>
<td>their operation.</td>
<td>E36</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------</td>
<td>-----------------</td>
<td>-----</td>
</tr>
<tr>
<td>Transistor, NPN, or PNP</td>
<td>Транзистор</td>
<td>Icon signifies international symbol for a NPN or PNP transistor.</td>
<td>E89A, E89B, E89C</td>
</tr>
<tr>
<td>Utility Outlet</td>
<td></td>
<td>Util Out is a class that draws a Utility Output socket, a ring with 7 holes inside. Note: recommended minimum diameter of 30.</td>
<td>E37</td>
</tr>
<tr>
<td>Variable Inductor</td>
<td></td>
<td>Icon signifies international symbol for a variable indicator.</td>
<td>E38</td>
</tr>
<tr>
<td>Wire/Cable, connecting</td>
<td></td>
<td>Graphics that display lines, etc., that connect shall be shown with a circle at the intersection. The circle should have the same fill color as the line or pipe.</td>
<td>E90</td>
</tr>
<tr>
<td>Wire/Cable, crossing</td>
<td></td>
<td>Wires are shown as straight, thin black lines. Graphic images of lines that cross shall be shown as images that overlap. Multiple wires may be bundled as cables to prevent clutter on the display.</td>
<td>E91</td>
</tr>
<tr>
<td>Zener Diode</td>
<td></td>
<td>Icon signifies international symbol for a Zener diode.</td>
<td>E92</td>
</tr>
</tbody>
</table>
C.2.3 Fluid

Pipes are shown as thick lines filled with the appropriate color or name to indicate the fluid within the pipe. Graphics that display lines that connect shall be shown with a circle at the intersection, which is four pixels larger than the line, and have the same fill color as the line or pipe:

<table>
<thead>
<tr>
<th>English Name</th>
<th>Russian Name</th>
<th>Icon</th>
<th>Schematic</th>
<th>Comments</th>
<th>In use</th>
<th>Code Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accumulator</td>
<td>Аккумулятор</td>
<td><img src="image" alt="Accumulator Icon" /></td>
<td><img src="image" alt="Accumulator Schematic" /></td>
<td>Accumulators contain two separated fluids. Accumulators may be shown using the tank icon. The accumulator icon should indicate both fluids, separated by a bladder. Any associated quantity measurements should be shown in text format only, or with a separate bar meter.</td>
<td>Add NASDA deviation</td>
<td>F1A F1B</td>
</tr>
<tr>
<td>Air/Water Separator</td>
<td></td>
<td><img src="image" alt="Air/Water Separator Icon" /></td>
<td><img src="image" alt="Air/Water Separator Schematic" /></td>
<td>Separator takes water and separates it into a water and an air line. Icon signifies a motor driven separator that takes one line and separates it into two lines.</td>
<td>Add NASDA deviation</td>
<td>F2</td>
</tr>
<tr>
<td>Bellows Tank</td>
<td></td>
<td><img src="image" alt="Bellows Tank Icon" /></td>
<td><img src="image" alt="Bellows Tank Schematic" /></td>
<td>USOS: Condensate Water Tank</td>
<td>F3</td>
<td></td>
</tr>
<tr>
<td>Blower</td>
<td></td>
<td><img src="image" alt="Blower Icon" /></td>
<td><img src="image" alt="Blower Schematic" /></td>
<td>Blower indicates air circulation. Icon signifies international symbol for a blower.</td>
<td>F4</td>
<td></td>
</tr>
<tr>
<td>Burst Diaphragm</td>
<td></td>
<td><img src="image" alt="Burst Diaphragm Icon" /></td>
<td><img src="image" alt="Burst Diaphragm Schematic" /></td>
<td>Icon signifies international symbol for a burst diaphragm.</td>
<td>F5</td>
<td></td>
</tr>
<tr>
<td>Carbon Dioxide Removal Assembly (CDRA) and Vozdukh</td>
<td></td>
<td><img src="image" alt="Carbon Dioxide Icon" /></td>
<td><img src="image" alt="Carbon Dioxide Schematic" /></td>
<td>The bed which removes the carbon dioxide is regenerated by exposing it to vacuum. ROS: Воздух</td>
<td>F102</td>
<td></td>
</tr>
<tr>
<td><strong>Choke, Flow Restrictor</strong></td>
<td>Дроссель</td>
<td>Allows a fluid to go through a small area and reduce speed. Icon signifies a line and the way that it is collapsed in. Depicts cross section of line with reduced radius.</td>
<td>F6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
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<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Commode/Urinal</strong></td>
<td></td>
<td>A single icon was selected for the commode and urinal since the units are co-located. ROS: ACY Icon signifies what the urinal looks like. Used for fluid waste. ROS: Urinal.</td>
<td>F95</td>
<td>F125</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Compensator</strong></td>
<td></td>
<td></td>
<td>F96</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Compressor</strong></td>
<td>Компрессор</td>
<td>A motor driven compressor used to compress a fluid. Icon signifies a motor driven system with the international abbreviation for compressor.</td>
<td>F7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Condensation Collector</strong></td>
<td></td>
<td>Used to collect condensate from the air or the systems.</td>
<td>F97</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Diaphragm Pump</strong></td>
<td></td>
<td></td>
<td>F8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Diffuser, Out</strong></td>
<td></td>
<td>Takes air from a line and diffuses it out into the area. Icon signifies the scattering into different directions.</td>
<td>F9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Diffuser, with filter</strong></td>
<td></td>
<td>Takes a fluid in to a system from different areas and puts it into a filter to block the possible contaminants. Icon signifies the filter and the fluid coming in from different areas.</td>
<td>F10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EDV tank</strong></td>
<td></td>
<td>This symbol shows generic shape of tank and the three inlet/outlets. Icon signifies the lines coming in and out and the three quick disconnects that can be used. Tank is used to</td>
<td>F99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric Conductivity Sensor</td>
<td>Датчик электропроводности</td>
<td><img src="image" alt="Icon" /></td>
<td>that can be used. Tank is used to store water and then the water can be used from the EDV. The CW/Cs fill the EDVs. ROS: ЕДВ</td>
<td>F11</td>
<td></td>
<td></td>
</tr>
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<td>----------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Electrolyzer</td>
<td>Электролизер</td>
<td><img src="image" alt="Icon" /></td>
<td>This illustrates the breakdown of water, by electrical means, into H2 and O2. ROS: Электролиз</td>
<td>F12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elektron/Electrolysis Unit</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td></td>
<td>F100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan, Animated</td>
<td>Вентилятор</td>
<td><img src="image" alt="Icon" /></td>
<td>Used to circulate air in an area. Icon signifies the fan blades and also the major housing.</td>
<td>F13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan, Right direction of flow</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td>To have air go to the right of the fan. Icon signifies the right arrow to show the direction of flow.</td>
<td>F14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan, Left direction of flow</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td>To have air go to the left of the fan. Icon signifies the left arrow to show the direction of flow.</td>
<td>F15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan, Inward direction of flow</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td>To have air go into the page or inward to the fan. Icon signifies the fan and the international symbol for inward.</td>
<td>F16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan, Outward direction of flow</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td>To have air go out of the page or outward of the fan. Icon signifies the fan and the international symbol for outward.</td>
<td>F17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan, Down direction of flow</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td></td>
<td>F18</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fan, Up</strong></td>
<td></td>
<td></td>
<td><strong>F19</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fire Extinguisher</strong></td>
<td></td>
<td></td>
<td><strong>F20</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Filter</strong></td>
<td>Фильтр</td>
<td></td>
<td><strong>F21A</strong> <strong>F21B</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(fine) A</td>
<td>(coarse)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Filter, Gaseous Contaminants</strong></td>
<td></td>
<td></td>
<td><strong>F104</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Filter, H2O (desiccant)</strong></td>
<td></td>
<td></td>
<td><strong>F105</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flex Hose (Corrugated)</strong></td>
<td></td>
<td></td>
<td><strong>F22</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flow Indicator</strong></td>
<td>Индикатор сквозняка</td>
<td></td>
<td><strong>F23</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flowmeter, Heat transfer agent</strong></td>
<td>Датчик расхода теплоносите</td>
<td></td>
<td><strong>F24</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To be used in Fire Suppression. Icon signifies a basic look of what the CO2 tank looks like.

Used to take away contaminants in a system. Filters dust and debris. Icon signifies the crosses of a filter. This type of filter removes particulates. USOS: HEPA, MCA filters

Shading of box after filter is less dense, illustrating the removal of contaminants. ROS: ФВП, БМП USOS: TCCS

Shading of box after filter is less dense, illustrating the removal of humidity (water). ROS: Воздух USOS: CDRA

A line that is used where a hard line can not be used or where you will have to stow the line. Icon signifies the line and then the flex of the line. Physically resembles a flexible hose ROS: Ventilation equipment USOS: Connections between vestibules

Indicates the way that the flow of the fluid is going. Icon indicates an arrow in the direction of flow.

Add NASDA Deviation

Add NASDA Deviation

Action: Develop new icon.
<table>
<thead>
<tr>
<th>Вид элемента</th>
<th>Название</th>
<th>Описание</th>
<th>Номер</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Coil</td>
<td>Tube, maybe even flexible tube, that can be three dimensional.</td>
<td></td>
<td>F25</td>
</tr>
<tr>
<td>Gas Analyzer (general)</td>
<td>Газоанализатор</td>
<td>ROS: ГА USOS: MCA</td>
<td>F26</td>
</tr>
<tr>
<td>Heat Exchanger</td>
<td>Теплообменник</td>
<td>Heat Exchangers are used throughout the Thermal Control System to effect heat interchange between internal water coolant loops and external ammonia coolant loops. The icon shows the loops involved in the heat transfer passing through a box representing the heat exchanger exterior. Generally, one loop is shown criss-crossing the other, indicating the multiple thermal interfaces between the loops. There is no attempt to represent the actual number of passes involved. The entry and exit points of each loop at the box boundary can be varied as needed. The use of flow direction arrows can further be used to depict the heat exchanger as counterflow or parallel flow type.</td>
<td>F27A</td>
</tr>
<tr>
<td>Heat Exchanger, Air-Air</td>
<td></td>
<td>Typical of finned heat exchanger. ROS: Воздух/ЖКТА</td>
<td>F28A F28B</td>
</tr>
<tr>
<td>Heat Exchanger, Air-Liquid</td>
<td></td>
<td>ROS: Воздух/ЖКТА USOS: AAA</td>
<td>F29A F29B</td>
</tr>
<tr>
<td>Heat Exchanger, Air-Liquid (condensing)</td>
<td>A</td>
<td>Same as regular Air-Liquid Heat Exchanger, but drops of liquid represent condensing function. USOS: CCAA</td>
<td>F30A</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>---</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Heat Exchanger, Liquid-Liquid</td>
<td>A</td>
<td></td>
<td>F31A</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td></td>
<td>F31B</td>
</tr>
<tr>
<td>Heat Exchanger Unit with natural cooling</td>
<td>A</td>
<td></td>
<td>F107A</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td></td>
<td>F107B</td>
</tr>
</tbody>
</table>
| Heat Exchanger with natural heating | ![Diagram](Image) | A for liquid  
B for air (gas) | F108A  
F108B |
|------------------------------------|------------------|-----------------|-----------|
| Heat Exchanger with forced heating by liquid | ![Diagram](Image) | A for liquid  
B for air (gas) | F109A  
F109B |
| Heat Exchanger with forced heating by air (gas) | ![Diagram](Image) | A for liquid  
B for air (gas) | F110A  
F110B |
| Heat Exchanger with forced heating by electric current | ![Diagram](Image) | A for liquid | F111A  
F111B |
<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Pipe</td>
<td>As a fluid come from different directions into one system. Icon indicates the flow from different directions converging on one system.</td>
<td>F32</td>
</tr>
<tr>
<td>Inlet</td>
<td>A fluid can either come in or out of the system. Icon indicates that the flow can be either coming in or dispersing out.</td>
<td>F33</td>
</tr>
<tr>
<td>In/Out</td>
<td>Icon signifies one line going into two lines. Icon indicates that the flow can be either coming in or dispersing out.</td>
<td>F34</td>
</tr>
<tr>
<td>Ionator</td>
<td>Icon indicates the bellows that would be in the system. A Bellows will slow down the flow of the fluid.</td>
<td>F35</td>
</tr>
<tr>
<td>Liquid Flow Regulator</td>
<td>Icon signifies the arrows that are going into the different directions.</td>
<td>F36</td>
</tr>
<tr>
<td>Metal Bellows</td>
<td>Icon indicates the bellows that would be in the system. A Bellows will slow down the flow of the fluid.</td>
<td>F37</td>
</tr>
<tr>
<td>Outlet</td>
<td>A fluid is dispersed into a larger area. Icon signifies the arrows that are going into the different directions.</td>
<td>F38</td>
</tr>
<tr>
<td>Pipes</td>
<td>Pipes creates and draws pipes connected in an acrylic graph. Pipes can be used in segments to indicate piping is required</td>
<td>F39</td>
</tr>
<tr>
<td>Portable Breathing Apparatus</td>
<td>This icon was copied from one of the NASA ECLSS level 1B drawings and represents the actual equipment. Used for when the air is not suitable for crew breathing. Icon indicates what the Portable Breathing Apparatus looks like. Gas mask tied to oxygen bottle.</td>
<td>F40</td>
</tr>
<tr>
<td><strong>Pressure Differential Sensor</strong></td>
<td><strong>Датчик перепада давления</strong></td>
<td><img src="image" alt="Icon" /></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Pressure Regulator</strong></td>
<td><strong>Регулятор давления</strong></td>
<td><img src="image" alt="Icon" /></td>
</tr>
<tr>
<td><strong>Pressure Relay</strong></td>
<td></td>
<td><img src="image" alt="Icon" /></td>
</tr>
<tr>
<td><strong>Pressure Sensor, Low Pressure Warning Indicator</strong></td>
<td><strong>Сигнализатор давления</strong></td>
<td><img src="image" alt="Icon" /></td>
</tr>
<tr>
<td><strong>Pressure Sensor Unit</strong></td>
<td></td>
<td><img src="image" alt="Icon" /></td>
</tr>
<tr>
<td><strong>Pump</strong></td>
<td><strong>Насос</strong></td>
<td><img src="image" alt="Icon" /></td>
</tr>
<tr>
<td><strong>Pump, Centrifugal</strong></td>
<td><strong>Насос</strong></td>
<td><img src="image" alt="Icon" /></td>
</tr>
<tr>
<td><strong>Pump, Centrifugal, Animated</strong></td>
<td><strong>Насос</strong></td>
<td><img src="image" alt="Icon" /></td>
</tr>
</tbody>
</table>

**Icons and Graphic Symbols**

15 Jan 00

Appendix C-26
<table>
<thead>
<tr>
<th>Equipment</th>
<th>Description</th>
<th>Icon</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump, Condensation Evacuation</td>
<td>Насос откачки конденсата</td>
<td>![ icons ]</td>
<td></td>
</tr>
<tr>
<td>Pump, Positive Displacement</td>
<td>Насос</td>
<td>![ icons ]</td>
<td>USOS: CDRA</td>
</tr>
<tr>
<td>Pump, Manual</td>
<td>Насос ручной</td>
<td>![ icons ]</td>
<td></td>
</tr>
<tr>
<td>Purification Column Unit</td>
<td>БКО</td>
<td>![ icons ]</td>
<td>This is a special device used in the НДА-Э. Its functionality cannot be represented by any of the standard valve symbols. This icon is physically representative of actual hardware. ROS: CPB-K</td>
</tr>
<tr>
<td>Quick Disconnect</td>
<td>Быстроразъёмное соединение</td>
<td>![ icons ]</td>
<td>Represents both halves of the quick disconnect. No ball bearing indicates not self-sealing.</td>
</tr>
<tr>
<td>Quick Disconnect, Self Sealing</td>
<td>Быстроразъёмное соединение</td>
<td>![ icons ]</td>
<td>Represents both halves of the quick disconnect. (Russian icon) Circle is physically representative of bearing inside that blocks flow.</td>
</tr>
<tr>
<td>Radiation Heat Exchanger</td>
<td>Радиационно-теплообменный</td>
<td>![ icons ]</td>
<td></td>
</tr>
<tr>
<td>Radiator, Coil Pipe</td>
<td>Змеевик Радиатор</td>
<td>![ icons ]</td>
<td>Fluid pipe; two-dimensional heat transfer device.</td>
</tr>
<tr>
<td>Receiver, Chamber</td>
<td>Ресивер</td>
<td>![ icons ]</td>
<td></td>
</tr>
<tr>
<td>Reductor</td>
<td>Редуктор</td>
<td>![ icons ]</td>
<td></td>
</tr>
<tr>
<td>Refueling Device</td>
<td>Заправочное приспособление</td>
<td>![ icons ]</td>
<td>Action: Develop new icon.</td>
</tr>
<tr>
<td>Regenerator</td>
<td>![Image]</td>
<td>![Image]</td>
<td>F98</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------</td>
<td>----------</td>
<td>-----</td>
</tr>
<tr>
<td>Sealed Connector</td>
<td>![Image]</td>
<td>![Image]</td>
<td>F57</td>
</tr>
<tr>
<td>Screen, Debris</td>
<td>![Image]</td>
<td>![Image]</td>
<td>F58</td>
</tr>
<tr>
<td>Solid Fuel Oxygen Generator</td>
<td>ТГК</td>
<td>![Image]</td>
<td>The solid fuel oxygen generator has a characteristic shape. The major crew interface is the handle on the front. ROS: ТГК F122</td>
</tr>
<tr>
<td>Tank</td>
<td>![Image]</td>
<td>![Image]</td>
<td>Tanks are depicted as circles or ellipses filled with the appropriate color to indicate the fluid contained. Tanks may behave like bar meters, filling from the bottom to indicate tank quantity or pressure. In this case, the minimum and maximum quantity values should be labeled (similar to bar meter labeling). F59</td>
</tr>
<tr>
<td>Tank, animated fluid level</td>
<td>Бак. емкость</td>
<td>![Image]</td>
<td>The Bellows of a tank is used to reduce the moving of the fluid. Icon indicates a tank with a bellows located within. F60</td>
</tr>
<tr>
<td>Tank, Bellows</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>Tank, Buffer or Diaphragm</td>
<td>Бак</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>TCCS</td>
<td>БМП</td>
<td>![Image]</td>
<td>БМП and TCCS have three filtering stages which are represented by the three boxes. The second stage of the All is regenerable, using heat and vacuum as stimuli. The TCCS second stage is also regenerable, but is not F106</td>
</tr>
<tr>
<td>Icon</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image1.png" alt="Thermal Plate Icon" /></td>
<td>Indicates cold plate.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image2.png" alt="Thruster Icon" /></td>
<td>Typical symbols for a thruster nozzle. For Energia symbol, assumption was that arrow indicated gimballing nature of Main Engines, versus fixed attitude control thruster. Crew input was that the big heavy arrow of the GCTC/DT icon symbolized the prime function of such engines-orbit correction/reboost, and was thus preferred.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image3.png" alt="Thruster with Gimbal Drive Icon" /></td>
<td>Dashed nozzle shows the fact that main engines may be gimbaled by the drives at different angles. Also showed with rotating arrow.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Thruster, Orbit Correction/Main Engine | Двигатель коррекции орбиты | Typical symbols for a thruster nozzle. For Energia symbol, assumption was that arrow indicated gimbaling nature of Main Engines, versus fixed attitude control thruster. | F66A  
F66B |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tubing showing direction of flow</td>
<td></td>
<td>Icon shows a solid pipe. A pipe that is used for the transfer of a material or fluid.</td>
<td>F115</td>
</tr>
<tr>
<td>Tubing with connector</td>
<td></td>
<td>Icon shows the connection of the two pipes. A connector between two pipes used to mate them.</td>
<td>F116</td>
</tr>
<tr>
<td>Turbine</td>
<td></td>
<td>This icon is stylized indicating only flow and output. The output arrow is also integrated into the shape of the turbine to indicate that the whole assembly's function is to provide power output. NOTE: by reversing the power arrow (white), the turbine can indicate a compressor.</td>
<td>F67</td>
</tr>
<tr>
<td>Vacuum Outlet</td>
<td></td>
<td>Icon indicates the arrows going outward</td>
<td>F126</td>
</tr>
<tr>
<td>Wash Fountain</td>
<td></td>
<td>Graphic representation of water washing hands.</td>
<td>F135</td>
</tr>
</tbody>
</table>

**Icons and Graphic Symbols**  
15 Jan 00  
Appendix C-30
<table>
<thead>
<tr>
<th>Water Conditioning Unit</th>
<th>БК БКВ</th>
<th><img src="icon.png" alt="Icon" /></th>
<th>This is a special device used in the system. Its functionality cannot be represented by any of the standard valve symbols. This icon is physically representative of actual hardware.</th>
<th>F136</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Separator</td>
<td>A</td>
<td><img src="icon.png" alt="Icon" /></td>
<td>Separates water from systems and puts it in a line. Icon indicates the flow through a separator and shows the line that the water goes in. Air/liquid mixture enters on left port. Water exits at top port and air exits to the right. USOS: CCAA</td>
<td>F137A F137B</td>
</tr>
</tbody>
</table>
# VALVES

<table>
<thead>
<tr>
<th>English Name</th>
<th>Russian Name</th>
<th>Icon</th>
<th>Schematic</th>
<th>Comments</th>
<th>In Use</th>
<th>Code Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve, Generic Two-way</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td></td>
<td>A &quot;T&quot; symbol is placed on top of the valve to show it is manually controlled.</td>
<td></td>
<td>F68</td>
</tr>
<tr>
<td>Valve, Generic Three-way</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td></td>
<td></td>
<td></td>
<td>F69</td>
</tr>
<tr>
<td>Manual</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td></td>
<td></td>
<td>F71</td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td></td>
<td></td>
<td>F72</td>
<td></td>
</tr>
<tr>
<td>Piccolo Tube</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td></td>
<td></td>
<td>F114</td>
<td></td>
</tr>
<tr>
<td>Pneumatic</td>
<td>Клапан пневмоничес</td>
<td><img src="image" alt="Icon" /></td>
<td></td>
<td>Icon indicates the valve relief. Used to relieve the pressure of the line.</td>
<td></td>
<td>F73</td>
</tr>
<tr>
<td>Pressure Relief (Safety)</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td></td>
<td>Icon indicates the valve relief. Used to relieve the pressure of the line.</td>
<td></td>
<td>F74A, F74B</td>
</tr>
<tr>
<td>Pyrotechnical</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td></td>
<td>This symbol represents a valve which is pyrotechnically operated. An 'N.O' or and 'NC' placed above the symbol indicates whether it is normally open or normally closed. MOD standard symbol for a pyro valve.</td>
<td></td>
<td>F75</td>
</tr>
<tr>
<td>Quick opening</td>
<td></td>
<td><img src="image" alt="Icon" /></td>
<td></td>
<td></td>
<td></td>
<td>F76</td>
</tr>
<tr>
<td>Regulating</td>
<td>Клапан регулирующий</td>
<td><img src="image" alt="Icon" /></td>
<td></td>
<td></td>
<td></td>
<td>F77</td>
</tr>
<tr>
<td>Solenoid, Latching</td>
<td>![Solenoid Icon]</td>
<td>Rectangle indicates solenoid. Dotted line indicates latching.</td>
<td>F78</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solenoid, Non-latching</td>
<td>![Solenoid Icon]</td>
<td></td>
<td>F79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Ball</td>
<td>![Ball Valve Icon]</td>
<td>Ball valves are used in many parts of the External Active Thermal Control System and the Internal Active Thermal Control System. These valves, in different configurations, perform various functions from simple isolation to three-way mixing. Icon graphically depicts the rotatable ball with appropriate passage(s) inside a housing which includes appropriate inlet(s) and outlet(s).</td>
<td>F80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Ball, Motor controlled</td>
<td>![Motor Controlled Ball Valve Icon]</td>
<td></td>
<td>F81</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Bypass</td>
<td>![Bypass Valve Icon]</td>
<td></td>
<td>F82A F82B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Check, Temperature controlled</td>
<td>![Temperature Controlled Check Valve Icon]</td>
<td>Bimetallic flow control device. This is a special valve used in the CCAA. Its functionality cannot be represented by any of the standard valve symbols. This icon is physically representative of actual hardware. USOS: CCAA</td>
<td>F83</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Check (Reverse Valve)</td>
<td>![Reverse Check Valve Icon]</td>
<td>This depicts a valve that resists reverse flow.</td>
<td>F127A F127B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Drain</td>
<td>Клапан дренажный</td>
<td>B</td>
<td>F84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Gas Trap</td>
<td>Bypass :</td>
<td>A</td>
<td>F85A F85B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Non-Standard</td>
<td></td>
<td></td>
<td>F128</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Non-Standard, ПИКО</td>
<td></td>
<td></td>
<td>F129</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Plate, Manual (open)</td>
<td></td>
<td></td>
<td>F86 F130</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Plate, Manual (closed)</td>
<td></td>
<td></td>
<td>F87</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Plate, Perforated, Manual (open)</td>
<td></td>
<td></td>
<td>F88 F133</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Plate, Perforated, Manual</td>
<td></td>
<td></td>
<td>F89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual operated. It is shown in the closed position.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>---------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Valve, Plate, Manual/Motorized (closed)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This symbol designates a manual/motorized plate valve in the closed position. NASA/MOD Standard symbol for a configurable plate valve. The 'T' designates that it is manually operated and the motor indicates that it can also be motor driven. It is shown in the closed position.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F132</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Valve, Plate, Perforated, Manual/Motorized (closed)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This symbol designates a manual/motorized perforated plate valve in the closed position. NASA/MOD Standard symbol for a configurable perforated plate valve. The 'T' designates that it is manually operated and the motor indicates that it may also be motor driven. It is shown in the closed position.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>F134</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Valve, Reverse (Special purpose Diverter)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Обратный клапан</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Action: Develop new icon.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Valve, Select 1W/2W (NASDA)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2WCL :</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1WCL :</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>F91A F91B</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Valve, Selector</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F92</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Action: Develop new icon.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, with Interfaced on Both Sides of Bulkhead</td>
<td>Manual handles are drawn off to the sides to illustrate that only one handle is accessible from a particular side. USOS: MPEV</td>
<td>F112</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve, Motor with Motor on One Side and Manual Interfaces on Both Sides of Bulkhead</td>
<td>Manual handles are drawn off to the sides to illustrate that only one handle is accessible from a particular side. ROS: КДВ</td>
<td>F113</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vent, Overboard, Non-propulsive</td>
<td>Vents fluids/air overboard. Non-propulsive has an equal distribution at 180 degrees. Icon signifies a pipe that is at 180 degrees along the hatch.</td>
<td>F93</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vent, Overboard, Propulsive</td>
<td>Vents fluids/air overboard. The propulsive vents do not have equal distribution. Icon signifies a pipe that goes overboard but does not vent equally.</td>
<td>F94</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**C.2.4 General (Indicators/Meters)**

<table>
<thead>
<tr>
<th>English Name</th>
<th>Russian Name</th>
<th>Icon</th>
<th>Schematic</th>
<th>Comments</th>
<th>In Use</th>
<th>Code Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrowhead</td>
<td></td>
<td><img src="image1.png" alt="Arrowhead Icon" /></td>
<td><img src="image2.png" alt="Schematic" /></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bar Graph, Horizontal</td>
<td>Шкала горизонтальн</td>
<td><img src="image3.png" alt="Bar Graph Icon" /></td>
<td><img src="image4.png" alt="Schematic" /></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Icons and Graphic Symbols 15 Jan 00 Appendix C-36
<table>
<thead>
<tr>
<th>Icon/Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bar Graph, Vertical</strong></td>
<td>Used to show command data directly on the drawing. Fields in the symbol allow the PUI, description, range etc. to be specified.</td>
</tr>
<tr>
<td><strong>Big Bite Bubble</strong></td>
<td>This symbol is used to reference another part of the drawing.</td>
</tr>
<tr>
<td><strong>Circle Zone Reference</strong></td>
<td>This symbol is used to reference another part of the drawing. Used when power or data lines are routed to a separate area of the drawing.</td>
</tr>
<tr>
<td><strong>Center Point</strong></td>
<td>Used to show the center of mass of an object when showing its physical characteristics. Standard symbol</td>
</tr>
<tr>
<td><strong>Continue</strong></td>
<td>Continuation of chart or diagram.</td>
</tr>
<tr>
<td><strong>Control Panel, Generic</strong></td>
<td>Icon signifies international symbol for a principal control panel.</td>
</tr>
</tbody>
</table>

**Icons and Graphic Symbols**

15 Jan 00

Appendix C-37
<table>
<thead>
<tr>
<th>Cow Shed</th>
<th>![Cow Shed Icon]</th>
<th>Used for switch labeling.</th>
<th>G8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Details</td>
<td>![Details Icon]</td>
<td></td>
<td>G9</td>
</tr>
<tr>
<td>Fire Hole</td>
<td>![Fire Hole Icon]</td>
<td>Physically resembles US fire holes. USOS: Panels</td>
<td>G20</td>
</tr>
<tr>
<td>Galley, Food Warmer</td>
<td>![Galley, Food Warmer Icon]</td>
<td>Combination of symbols for eating utensils, heating element, and a snowflake (for refrigerator).</td>
<td>G21</td>
</tr>
<tr>
<td>Galley, Refrigerator</td>
<td>![Galley, Refrigerator Icon]</td>
<td>Combination of symbols for eating utensils, heating element, and a snowflake (for refrigerator).</td>
<td>G22</td>
</tr>
<tr>
<td>Gauge</td>
<td>Манометр</td>
<td>Physically resembles a gauge. To show a pressure sensor that can be read off of a gauge, combine this icon with icon for pressure sensor. ROS: MB</td>
<td>G10</td>
</tr>
<tr>
<td>Huge Telemetry Bubble</td>
<td>![Huge Telemetry Bubble Icon]</td>
<td>This symbol is used to show telemetry data directly on the drawing. Fields in the symbol allow the PUI, description, range etc. to be Specified</td>
<td>G23</td>
</tr>
<tr>
<td>Meters Meter symbols, such as bar graphs, filling tank symbols, and thermometers, must include appropriate</td>
<td>![Meters Icon]</td>
<td>Color standards apply to all meters. When a parameter's background color indicates an off-nominal status, the associated bar meter changes its fill color in the same way. For example, if a fluid's temperature exceeds a warning limit, the temperature parameter field shows a red background and the associated thermometer's fill color will be red.</td>
<td>G11A G11B</td>
</tr>
<tr>
<td>Icon</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Meter, Panel, Analog" /></td>
<td>Temperature, °C 47.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="RPC" /></td>
<td>This symbol represents one of the 5 types of RPCMs used on the ISS. NASA/MOD standard symbol for an RPCM. Five different symbols are used, with different RPCM type, ID, # of RPCs and current ratings.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Switch Trip Alarm Indicator" /></td>
<td>Appears when the sequence/process is operating.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Process Indicator" /></td>
<td>Activates segments based on time in a sequence.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telemetry Diamond</td>
<td>X X</td>
<td>This symbol is used to reference a telemetry table. A letter in the left half of the diamond designates the table and the number in the right half of the diamond designates the row of the table.</td>
<td>G26</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----</td>
<td>-------------------------------------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Telemetry Table Reference</td>
<td></td>
<td>Symbol used on the telemetry table. Referenced by the telemetry diamond. A letter is placed in the diamond.</td>
<td>G27</td>
</tr>
</tbody>
</table>
## C.2.5 Computers

<table>
<thead>
<tr>
<th>English Name</th>
<th>Russian Name</th>
<th>Icon</th>
<th>Schematic</th>
<th>Comments</th>
<th>In Use</th>
<th>Code Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus Coupler</td>
<td></td>
<td><img src="image" alt="Bus Coupler Icon" /></td>
<td><img src="image" alt="Bus Coupler Schematic" /></td>
<td>A bus coupler is a connector that joins 2 1553 busses together. This representation of a connector should use a line thickness as per the type of bus it is connecting (and defined elsewhere). It uses a non-strait line to further emphasize the distinction between the two sides of the connector; this can also be used to indicate male/female sides.</td>
<td></td>
<td>K2</td>
</tr>
<tr>
<td>Channel Selector with Logic Control</td>
<td></td>
<td><img src="image" alt="Channel Selector Icon" /></td>
<td><img src="image" alt="Channel Selector Schematic" /></td>
<td>Use to symbolize a location where more than one logical channel can be selected. Icon signifies international symbol for a channel selector with logic control.</td>
<td></td>
<td>K17</td>
</tr>
<tr>
<td>Computer, One Channel</td>
<td>Компьютер 1 канал</td>
<td><img src="image" alt="Computer Icon" /></td>
<td><img src="image" alt="Computer Schematic" /></td>
<td></td>
<td></td>
<td>K3</td>
</tr>
<tr>
<td>Computer, 3 Channel</td>
<td>Компьютер 3 канала</td>
<td><img src="image" alt="Computer Icon" /></td>
<td><img src="image" alt="Computer Schematic" /></td>
<td></td>
<td></td>
<td>K4</td>
</tr>
<tr>
<td>Control Links</td>
<td></td>
<td><img src="image" alt="Control Links Icon" /></td>
<td><img src="image" alt="Control Links Schematic" /></td>
<td>Used to indicate the data bus connecting to an ORU. Used for connection indication to MDM.</td>
<td></td>
<td>K5</td>
</tr>
<tr>
<td>Data Bus Arrowhead</td>
<td></td>
<td><img src="image" alt="Data Bus Arrowhead Icon" /></td>
<td><img src="image" alt="Data Bus Arrowhead Schematic" /></td>
<td>Used to indicate the data bus connecting to an ORU. Used for connection indication to MDM.</td>
<td></td>
<td>K19</td>
</tr>
<tr>
<td>Data Bus Arrowhead</td>
<td></td>
<td><img src="image" alt="Data Bus Arrowhead Icon" /></td>
<td><img src="image" alt="Data Bus Arrowhead Schematic" /></td>
<td>Arrow head used to indicate the direction of data on a 1553 databus. Arrow filled in with MOD standard pattern for 1553 databus.</td>
<td></td>
<td>K20</td>
</tr>
<tr>
<td>Data Bus Corner</td>
<td></td>
<td><img src="image" alt="Data Bus Corner Icon" /></td>
<td><img src="image" alt="Data Bus Corner Schematic" /></td>
<td>Used to indicate a layout change and not a connection point. Indicates bus layout change on drawing for space issues.</td>
<td></td>
<td>K21</td>
</tr>
<tr>
<td>Data Bus Joint</td>
<td></td>
<td><img src="image" alt="Data Bus Joint Icon" /></td>
<td><img src="image" alt="Data Bus Joint Schematic" /></td>
<td>Indicates the data bus splits in two directions. T used to indicate branching of data bus.</td>
<td></td>
<td>K22</td>
</tr>
<tr>
<td>Icon/Graphic Symbol</td>
<td>Description</td>
<td>Action/Note</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Bus Crossover</td>
<td>Indicates crossover point of multiple data busses. Cross used to indicate crossover data bus.</td>
<td>K23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discrete Output Card</td>
<td>DO is a class that draws a trapezoid with a rectangle inside and a data line from the bottom of the rectangle down past the trapezoid.</td>
<td>K6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information Flow</td>
<td>Icon signifies international symbol for an input.</td>
<td>K7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input</td>
<td>Icon signifies international symbol for an input.</td>
<td>K7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laptop</td>
<td>IBM ThinkPad 760ED, 760 XD View of a laptop to signify ports where a laptop can potentially plug in. Differentiation achieved by labeling with US, RS, CHECCS, etc.</td>
<td>K8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EtherNet Data Line</td>
<td>Differentiates from 1553. Non-1553 EtherNet data line.</td>
<td>K9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Bus, 1553</td>
<td>Major data bus line. 1553 data bus line.</td>
<td>K10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MDM (Microprocessor)</td>
<td>Used to symbolize onboard computer. MDMs are indicated with the quadrilateral symbol.</td>
<td>K11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MDM (Microprocessor)</td>
<td>Used to symbolize onboard computer. MDMs are indicated with the quadrilateral symbol. Trapezoidal shape signifies ‘tiered’ architecture of microprocessors. Heavy exterior outline with dashed internal lines symbolize 3 channel nature of devices, with a special communication link between the 3 units that is not dependent upon exterior 1553 connections. When icon has a bold</td>
<td>K12</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
### Monitor

| Monitor | Монитор | ![Monitor Icon](image) | Icon signifies a general symbol for a television or computer monitor. |

### Network Channel Controller

| Network Channel Controller | Контроллер сетевых каналов | ![Network Controller Icon](image) | Icon signifies splitting of input to multiple outputs, and vice versa. A number (L) symbolizes that this splits input busses into (L) outputs. Splits a bus in two and extends it to get around the limitations of bus length and amount of terminals. |

### Output

| Output | ![Output Icon](image) | Icon signifies international symbol for an output. |

### Sampling Unit

| Sampling unit | ![Sampling Unit Icon](image) | Icon signifies international symbol for a sampling unit. |

### Terminal Switching Unit

| Terminal Switching Unit | Коммутатор согл.режист | ![Terminal Unit Icon](image) | |

### C.2.6 Logic

<table>
<thead>
<tr>
<th>English Name</th>
<th>Russian Name</th>
<th>Icon</th>
<th>Schematic</th>
<th>Comments</th>
<th>In use</th>
<th>Code Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate, AND</td>
<td></td>
<td><img src="image" alt="Gate Icon" /></td>
<td><img src="image" alt="Gate Schematic" /></td>
<td>In use. Code number.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate, NAND</td>
<td></td>
<td><img src="image" alt="Gate Icon" /></td>
<td><img src="image" alt="Gate Schematic" /></td>
<td>In use. Code number.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English Name</td>
<td>Russian Name</td>
<td>Icon</td>
<td>Schematic</td>
<td>Comments</td>
<td>In use</td>
<td>Code Number</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------</td>
<td>------</td>
<td>-----------</td>
<td>----------</td>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>Actuator</td>
<td></td>
<td>![Actuator Icon]</td>
<td>![Actuator Schematic]</td>
<td>An electromechanical device used for actuation. It could be a motor or an electromagnet. The arrow out will point to the object the actuator acts upon. In one case an input arrow is used when it is necessary to indicate where the activation is coming from.</td>
<td>M13: Develop new icon.</td>
<td></td>
</tr>
<tr>
<td>Bearing</td>
<td></td>
<td>![Bearing Icon]</td>
<td>![Bearing Schematic]</td>
<td></td>
<td>M14</td>
<td></td>
</tr>
<tr>
<td>Component</td>
<td>Description</td>
<td>Action</td>
<td>Page</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bevel Drive</td>
<td>Cross section of gear train.</td>
<td></td>
<td>M15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulkhead Connector</td>
<td></td>
<td></td>
<td>M16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulkhead Penetrator</td>
<td></td>
<td></td>
<td>M17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulkhead Penetrator with Valve</td>
<td></td>
<td></td>
<td>M18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulls Eye (Berthing Target)</td>
<td>Bulls Eye is a class that draws 3 filled or unfilled concentric circles.</td>
<td>Action: Develop new icon.</td>
<td>M1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cap</td>
<td>Illustrates sealing off of flow</td>
<td></td>
<td>M2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBM (USOS Dock Mechanism)</td>
<td>CBM is a class that draws the Common Berthing Unit icon. CBM is a circular mechanism with 14 retractable latches, used to connect Space Station modules.</td>
<td></td>
<td>M3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Moment Gyro (CMG)</td>
<td>This symbol represents an ISS Control Moment Gyro. The shape represents the actual shape of the CMG's.</td>
<td></td>
<td>M4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Drive (gear train)</td>
<td>Cross section of gear train.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gamah Fitting</td>
<td>Gamah fittings are used to connect fluid lines to other fluid lines and to components throughout the Thermal Control and Environmental Control and Life Support Systems. These connectors are threaded and are not self-sealing.</td>
<td></td>
<td>M19</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A Gamah Fitting is a non-self-sealing, keyed, threaded fitting used to join line segments, or a line segment to a component. Both the male and female portions of the fitting include hex flats to facilitate tool use in assembly and disassembly. The icon carries the sense that the fitting is threaded by including the depiction of. The parts of the icon on either side of the hex are indicated larger diameter than the tubes connected by the fitting, identifying the Gamah as a multi-part item, separate from the line (not just a nut somehow appearing on a line). The icon is simplified in that neither the keying provisions nor the second hex flats are indicated.

<table>
<thead>
<tr>
<th>Icon Description</th>
<th>Icon Image</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gamah Fitting, Threaded</td>
<td></td>
<td>M20</td>
</tr>
<tr>
<td>Grid</td>
<td></td>
<td>M5</td>
</tr>
<tr>
<td>Grill</td>
<td></td>
<td>M6</td>
</tr>
<tr>
<td>GyroDyne / Gyro SpinUp</td>
<td></td>
<td>M7</td>
</tr>
<tr>
<td>Hatch, Edge On View</td>
<td></td>
<td>M8A</td>
</tr>
<tr>
<td>Hatch, Front View</td>
<td></td>
<td>M8B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M9</td>
</tr>
</tbody>
</table>
**Mesh**

Mesh is a class that draws a filled or unfilled rectangular mesh (checkerboard). It is used in ATU.

**Panel**

Panel is a class that draws a filled or unfilled rectangle panel background with nuts at each corner.

**Reflector**

Symbolizes a reflection. Reflector

**Spring**

**Spring, Extension**

**Spring, Torsion**

**Spring, spiral**

**Torque Limiter, Mechanical**

Icon signifies international symbol for a mechanical torque limiter.

---

### C.2.8 Sensors

<table>
<thead>
<tr>
<th>English Name</th>
<th>Russian Name</th>
<th>Icon</th>
<th>Schematic</th>
<th>Comments</th>
<th>In Use</th>
<th>Code Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angular Rate Sensor</td>
<td>Датчик OPT-M</td>
<td><img src="image" alt="Angular Rate Sensor Icon" /></td>
<td><img src="image" alt="Angular Rate Schematic" /></td>
<td>Angular Rate Sensor, 3 orthogonally mounted gyroscopes) Omega common symbol for Angular rate. Disk symbolizes the gyroscopic principle on which this sensor is based.</td>
<td>S1</td>
<td>S18</td>
</tr>
<tr>
<td>Sensor Type</td>
<td>Description</td>
<td>Icon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angular Rate Sensor, Integrating</td>
<td>Integrating Angular Rate Sensor, 4 mutually redundant gyroscopes. Omega common symbol for Angular rate. Disk symbolizes the gyroscopic principle on which this sensor is based. Integral sign symbolizes that this sensor directly provides an integrated angular rate.</td>
<td>S2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Navigation (GLONASS)</td>
<td>The sensor that thermally looks for the edges of the earth to help estimate attitude with respect to the earth.</td>
<td>S3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrared Horizon Sensor</td>
<td>The sensor that thermally looks for the edges of the earth to help estimate attitude with respect to the earth.</td>
<td>S4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnetometer</td>
<td>Icon symbolizes the 3 orthogonally mounted electromagnets that determine attitude with respect to earth’s magnetic field. Magnetometer for attitude estimates.</td>
<td>S5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate Gyro Assembly</td>
<td>The shape of the symbol is similar to the ring laser gyro portion of the RGA. A Laser device, the three Cartesian coordinates to indicate that measurement is done on the three axes and the Omega sign to indicate that measurement is done on angular momentum. On the first icon the three “rings” represent each of the three RLGs used for the measurement.</td>
<td>S6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor</td>
<td>Sensors are shown as small rectangles with an appropriate capital letter to designate the sensor type. These icons are used at different levels of detail.</td>
<td>S7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensor Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D - Dew point</td>
<td>Pressure</td>
</tr>
<tr>
<td>P - Delta</td>
<td>Pressure</td>
</tr>
<tr>
<td>F - Flow rate</td>
<td></td>
</tr>
<tr>
<td>H - Position</td>
<td></td>
</tr>
<tr>
<td>I - Current</td>
<td></td>
</tr>
<tr>
<td>P - Pressure</td>
<td></td>
</tr>
<tr>
<td>Q - Quantity</td>
<td></td>
</tr>
<tr>
<td>R - Rate</td>
<td></td>
</tr>
<tr>
<td>T - Temperature</td>
<td></td>
</tr>
<tr>
<td>V - Voltage</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensors</th>
<th>15 Jan 00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix C-48</td>
<td></td>
</tr>
<tr>
<td>Icon Type</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Sun Sensor, Fixed Head</td>
<td>Солнечный датчик, 251K&lt;br&gt;Fixed head sun sensor for attitude estimates. Icon symbolizes sun in field of view.</td>
</tr>
<tr>
<td>Sun Sensor, Scanning</td>
<td>Солнечный датчик, 251K&lt;br&gt;Scanning sun sensor for attitude estimates. Icon symbolizes sun in field of view. Circular arrow differentiates function from a fixed sun sensor.</td>
</tr>
<tr>
<td>Smoke Detector</td>
<td>Датчик дыма&lt;br&gt;Yellow indicates smoke; red indicates fire.</td>
</tr>
<tr>
<td>Smoke Detector, Animated</td>
<td>Датчик дыма&lt;br&gt;Yellow indicates smoke; red indicates fire.</td>
</tr>
<tr>
<td>Star Mapper</td>
<td>Стар Маппер для оценок ориентации. Constellation icon symbolizes lining up set of stars (Star Mapper) within the center of the field of view.</td>
</tr>
<tr>
<td>Star Sensor, Animated</td>
<td>БОКЗ звезд. датчик&lt;br&gt;Icons symbolizes lining up a specific star within the center of the field of view. Star tracker for attitude estimates</td>
</tr>
<tr>
<td>Strain Gauge Assembly</td>
<td>Wheatstone Bridge</td>
</tr>
<tr>
<td>Tachometer</td>
<td>Счетчик&lt;br&gt;Icon signifies international symbol for a tachometer.</td>
</tr>
<tr>
<td>Thermostat</td>
<td>Терморегулятор&lt;br&gt;Icon signifies international symbol for a thermostat.</td>
</tr>
</tbody>
</table>
# C.2.9 Events

<table>
<thead>
<tr>
<th>English Name</th>
<th>Russian Name</th>
<th>Icon</th>
<th>Schematic</th>
<th>Comments</th>
<th>In Use</th>
<th>Code Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advisory</td>
<td>Уведомление</td>
<td>![Icon]</td>
<td>![Schematic]</td>
<td>![Comments]</td>
<td>![In Use]</td>
<td>NE or Ev1</td>
</tr>
<tr>
<td>ATM (Atmospheric Contamination)</td>
<td>Атмосфера</td>
<td>![Icon]</td>
<td>![Schematic]</td>
<td>![Comments]</td>
<td>![In Use]</td>
<td>NE or Ev2</td>
</tr>
<tr>
<td>Caution</td>
<td>Оповещение</td>
<td>![Icon]</td>
<td>![Schematic]</td>
<td>![Comments]</td>
<td>![In Use]</td>
<td>NE or Ev3</td>
</tr>
<tr>
<td>dP/dT</td>
<td>Разгерметизация</td>
<td>![Icon]</td>
<td>![Schematic]</td>
<td>![Comments]</td>
<td>![In Use]</td>
<td>NE or Ev4</td>
</tr>
<tr>
<td>Events Details</td>
<td>Просмотр событий</td>
<td>![Icon]</td>
<td>![Schematic]</td>
<td>![Comments]</td>
<td>![In Use]</td>
<td>NE or Ev5</td>
</tr>
<tr>
<td>Fire</td>
<td>Пожар</td>
<td>![Icon]</td>
<td>![Schematic]</td>
<td>![Comments]</td>
<td>![In Use]</td>
<td>NE or Ev6</td>
</tr>
<tr>
<td>Ground Connection</td>
<td>Связь с Землей</td>
<td>![Icon]</td>
<td>![Schematic]</td>
<td>![Comments]</td>
<td>![In Use]</td>
<td>NE or Ev7</td>
</tr>
<tr>
<td>Home Button</td>
<td>Дом</td>
<td>![Icon]</td>
<td>![Schematic]</td>
<td>![Comments]</td>
<td>![In Use]</td>
<td>NE or Ev8</td>
</tr>
<tr>
<td>Light/Shade</td>
<td>День/Темнота, анимированный</td>
<td>![Icon]</td>
<td>![Schematic]</td>
<td>![Comments]</td>
<td>![In Use]</td>
<td>NE or Ev9</td>
</tr>
<tr>
<td>Navigation Tree</td>
<td>Навигационное дерево</td>
<td>![Icon]</td>
<td>![Schematic]</td>
<td>![Comments]</td>
<td>![In Use]</td>
<td>NE or Ev10</td>
</tr>
<tr>
<td>Help Function</td>
<td>Флаг РС</td>
<td>Icon</td>
<td></td>
<td>NE or Ev11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
<td>------</td>
<td>-----</td>
<td>------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch, English/Russian</td>
<td>Ключ En/Ru</td>
<td><img src="image" alt="Flag Icon" /></td>
<td><img src="image" alt="En Icon" /></td>
<td>NE or Ev12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn Off Beep stop</td>
<td>Отключение звука</td>
<td><img src="image" alt="Beep Icon" /></td>
<td></td>
<td>NE or Ev13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warning</td>
<td>Предупреждение</td>
<td><img src="image" alt="Warning Icon" /></td>
<td></td>
<td>NE or Ev14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## C.2.10 Modes

<table>
<thead>
<tr>
<th>English Name</th>
<th>Russian Name</th>
<th>Icon</th>
<th>Schematic</th>
<th>Comments</th>
<th>In Use</th>
<th>Code Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASCR (Crew Rescue Mode)</td>
<td>Спасение экипажа</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NM1</td>
</tr>
<tr>
<td>EVA, Crew</td>
<td>ВКД</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NM2</td>
</tr>
<tr>
<td>Gyro SpinUp</td>
<td>Раскрутка гиродинов</td>
<td></td>
<td></td>
<td>Symbolizes spinning momentum wheel seen perpendicular to its outer gimbal. Gyrodine/Control Moment Gyroscope</td>
<td></td>
<td>NM3</td>
</tr>
<tr>
<td>Initial Attitude</td>
<td>Выставка БИНС</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NM4</td>
</tr>
<tr>
<td>Microgravity</td>
<td>Микрогравитация</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NM5</td>
</tr>
<tr>
<td>Proximity Operations (Docking Target)</td>
<td>Стыковочные операции</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NM6</td>
</tr>
<tr>
<td>Reboost</td>
<td>Маневр</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NM7</td>
</tr>
<tr>
<td>Refuel</td>
<td>Дозаправка</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NM8A, NM8B</td>
</tr>
</tbody>
</table>

Icons and Graphic Symbols

15 Jan 00
Appendix C-52
<table>
<thead>
<tr>
<th>Standard</th>
<th>Стандартный</th>
<th><img src="image" alt="Image" /></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Survival Mode</td>
<td>Выживание станции</td>
<td><img src="image" alt="Image" /></td>
<td></td>
</tr>
</tbody>
</table>

|  |  |  | NM9 |
|  |  |  | NM10 |
# C.2.11 Station

<table>
<thead>
<tr>
<th>English Name</th>
<th>Russian Name</th>
<th>Icon</th>
<th>Schematic</th>
<th>Comments</th>
<th>In Use</th>
<th>Code Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Транспорт. корабль</td>
<td>NS1</td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
<td></td>
<td>NS1</td>
<td></td>
</tr>
<tr>
<td>Стыковоч. отсек</td>
<td>NS2</td>
<td><img src="image3" alt="Image" /></td>
<td><img src="image4" alt="Image" /></td>
<td></td>
<td>NS2</td>
<td></td>
</tr>
<tr>
<td>СМ</td>
<td>NS3</td>
<td><img src="image5" alt="Image" /></td>
<td><img src="image6" alt="Image" /></td>
<td></td>
<td>NS3</td>
<td></td>
</tr>
<tr>
<td>FGB</td>
<td>NS4</td>
<td><img src="image7" alt="Image" /></td>
<td><img src="image8" alt="Image" /></td>
<td>**</td>
<td>NS4</td>
<td></td>
</tr>
<tr>
<td>FGB correct</td>
<td>NS5</td>
<td><img src="image9" alt="Image" /></td>
<td><img src="image10" alt="Image" /></td>
<td></td>
<td>NS5</td>
<td></td>
</tr>
<tr>
<td>MPLM Icon</td>
<td>NS6</td>
<td><img src="image11" alt="Image" /></td>
<td><img src="image12" alt="Image" /></td>
<td>MPLM Icon shows the MPLM module.</td>
<td>NS6</td>
<td></td>
</tr>
<tr>
<td>P6 Icon</td>
<td>NS7</td>
<td><img src="image13" alt="Image" /></td>
<td><img src="image14" alt="Image" /></td>
<td>P6 Icon depicts the P6 module.</td>
<td>NS7</td>
<td></td>
</tr>
<tr>
<td>Node 1</td>
<td>NS8</td>
<td><img src="image15" alt="Image" /></td>
<td><img src="image16" alt="Image" /></td>
<td>**</td>
<td>NS8</td>
<td></td>
</tr>
<tr>
<td>FGB SB</td>
<td>NS9</td>
<td><img src="image17" alt="Image" /></td>
<td><img src="image18" alt="Image" /></td>
<td></td>
<td>NS9</td>
<td></td>
</tr>
<tr>
<td>PMA1 Icon</td>
<td>NS10</td>
<td><img src="image19" alt="Image" /></td>
<td><img src="image20" alt="Image" /></td>
<td>PMA1 Icon depicts the PMA 1 module.</td>
<td>NS10</td>
<td></td>
</tr>
</tbody>
</table>
### PMA2 Icon

PMA2 Icon depicts the PMA 2 module. NS11

### PMA3 Icon

PMA3 Icon depicts the PMA 3 module. NS12

### SM SB

SM SB **NS13

### US Lab Icon

US Lab Icon depicts the US Laboratory Module. NS14

### Z1 Icon

Z1 Icon depicts the Z1 module. NS15

## C.2.12 Systems

<table>
<thead>
<tr>
<th>English Name</th>
<th>Russian Name</th>
<th>Icon</th>
<th>Schematic</th>
<th>Comments</th>
<th>In Use</th>
<th>Code Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECLSS</td>
<td>СЖО</td>
<td><img src="image" alt="ECLSS Icon" /></td>
<td><img src="image" alt="ECLSS Schematic" /></td>
<td></td>
<td></td>
<td>NY1A NY1B</td>
</tr>
<tr>
<td>EPS</td>
<td>CЭП</td>
<td><img src="image" alt="EPS Icon" /></td>
<td><img src="image" alt="EPS Schematic" /></td>
<td></td>
<td></td>
<td>NY2A NY2B</td>
</tr>
</tbody>
</table>

Icons and Graphic Symbols 15 Jan 00 Appendix C-55
<table>
<thead>
<tr>
<th>Category</th>
<th>Code</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>C&amp;DH</td>
<td>БВС</td>
<td><img src="image1" alt="Diagram" /></td>
<td>NY4A NY4B</td>
</tr>
<tr>
<td>C&amp;T</td>
<td>БРК</td>
<td><img src="image2" alt="Diagram" /></td>
<td>NY5A NY5B</td>
</tr>
<tr>
<td>ИТС</td>
<td></td>
<td><img src="image3" alt="Diagram" /></td>
<td>NY6</td>
</tr>
<tr>
<td>MCS (GNC/P)</td>
<td>СУДН</td>
<td><img src="image4" alt="Diagram" /></td>
<td>NY7 Ship's wheel agreed on at Montreal meeting.</td>
</tr>
<tr>
<td>ODU Unified Thruster System</td>
<td></td>
<td><img src="image5" alt="Diagram" /></td>
<td>NY8 Action: Develop new icon</td>
</tr>
<tr>
<td>Robotics</td>
<td></td>
<td><img src="image6" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>TCS</td>
<td>СОТР</td>
<td><img src="image7" alt="Diagram" /></td>
<td>NY9A NY9B</td>
</tr>
</tbody>
</table>
### C.2.13 Robotics Icons

<table>
<thead>
<tr>
<th>English Name</th>
<th>Russian Name</th>
<th>Icon</th>
<th>Schematic</th>
<th>Comments</th>
<th>In Use</th>
<th>Code Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto Sequence Switch Hot</td>
<td>ВКД</td>
<td><img src="image" alt="Icon" /></td>
<td></td>
<td>When an auto sequence can be commanded to start, stop, pause, proceed, etc., via hardware switch, the Auto Sequence Switch Hot icon shall be displayed in the auto mode window.</td>
<td></td>
<td>R1</td>
</tr>
<tr>
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<td>Hardware joints shall be represented with the Joint symbol. The name of the joint appears in its abbreviated form (ST, SY, SP, etc.) in the top of the circle, the units (e.g., deg) in the bottom. The center box is a text field for joint angles, etc.</td>
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<td>Onboard Short Term Plan Viewer</td>
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PCS Portable Computer System
PDGS Power/Data Grapple Fixture
PDRP Payload Display Review Panel
PDU Power Distribution Units
PGSC Payload General Support Computers
PI Principal Investigator
PLMDM Payload Multiplexer/Demultiplexer
PLT Payload Laptop Terminal
PMA Pressurized Mating Adapter
POCB Payload Operations Control Board
PODF Payload Operations Data File
POIF Payload Operation Integration Function
POR Point of Resolution
PPA Pump package assembly
PUI Program Unique Identifier
PVU TBS
PWS Portable Work Station
RHC Rotational Hand Controller
RIC Rack Interface Controller
RLT RMS Laptop Terminal
RPC Remote Power Controller
RPCM Remote Power Controller Module
RS Russian Segment
RASA Russian Space Agency
RSAD Robotic Situational Awareness Displays
SLT System Laptop Terminal
SM Service Module
SODF U.S. Systems Operations Data File
SRMS Shuttle Remote Manipulator System
SSFP Space Station Freedom Program
SSIPC Space Station Integration and Promotion Center
SSRMS Space Station Remote Manipulator System
TCCS Trace Contaminant Control System
TCS Thermal Control System
TDRSS Tracking and Data Relay Satellite System
THC Translational Hand Controller
USOS United States On-orbit Segment
VDU Video Distribution Unit
APPENDIX F

ISS Graphics Training Products
Development Manual

This manual was created separate from the Display and Graphics Commonality Standards (DGCS) through NASA and GCTC concurrence. It was added as an addendum to the DGCS as of 7 Jun 99. It has been reviewed and accepted by the ITCB and is proposed to add to the baselined document with full International Partner approval.
INTERNATIONAL TRAINING CONTROL BOARD APPROVAL NOTICE
INTERNATIONAL SPACE STATION PROGRAM
ISS GRAPHICS TRAINING PRODUCTS DEVELOPMENT MANUAL

CONCURRENCE

William C. Brown, Member
National Aeronautics and Space Administration

Klaus Damian, Member
European Space Agency

Kevin E. Delaney, Member
Canadian Space Agency

Evgeny I. Zhuk, Member
Russian Space Agency

Chikara Harada, Member
National Space Development Agency of Japan

Claudio Canu, Participant
Agenzia Spaziale Italiana
ISS Graphics
Training Products
Development Manual

International Space Station Program

Basic
January 8, 1999

National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas

Gagarin Cosmonaut Training Center
Star City, Russia
ISS Graphics Training Products
Development Manual

Basic

This joint document between the NASA Space Flight Training Division and the GCTC Training Department was developed by


28.08.98

Vasily Cherkashin/GCTC
Training Department Project Lead


8/38/98

James T. Ruszkowski/NASA
Training Division Project Lead

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## Contract NAS9-20000

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PREFACE

The ISS Graphics Training Products Development Manual was prepared by the Space Flight Training Division, Mission Operations Directorate (MOD), Lyndon B. Johnson Space Center (JSC), National Aeronautics and Space Administration (NASA).

Questions concerning the technical content of this document should be directed to the NASA Drawing Project Lead, James T. Ruszkowski, 281-244-7541, DT121.
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1.0 INTRODUCTION

1.1 PURPOSE

The need for consistency across national training products is critical because the International Space Station (ISS) is an international effort. When creating training documentation, there will naturally be issues because each international partner has a different language, and there are national peculiarities in the use of technical terms and symbols. Graphics is one of the primary tools that will be used to improve communications during training.

The ISS Graphics Training Products Development Manual defines the basic requirements, principles, and processes that must be used when developing graphics for ISS crew training. International crewmembers under the ISS program will use the products throughout their training period.

This document was produced jointly by Russian and American specialists in compliance with the ISS Display and Graphics Commonality Standards (DGCS). Its provisions apply to all training graphics products produced by both partners for use by crewmembers during ISS program training.

The objectives for graphics products used in the training process are as follows:

a. To help crewmembers understand the physical aspect of the topic being discussed.

b. To help crewmembers form a mental image of the onboard system or scientific hardware, its operation, and capabilities.

The graphics used for training may be different from onboard graphics due to differences in purpose and objectives. The developers should strive to ensure visual consistency in compliance with the principles stated in the DGCS and in this document.

1.2 SCOPE

The graphics products for crew training should provide sufficient information for the crewmember to be familiar with the basic design principles of the spacecraft, each of its systems, the major components of each of the systems, the basic operations from the crew perspective, and the primary response for off-nominal situations. Basic operations will include the major modes of operation. It is intended that graphics products will be used as a reference throughout the training cycle, including to the highest level of crew proficiency on specific systems or operations.

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1The term “onboard systems” will be used further in text. This term includes scientific hardware for which graphics will be developed.
1.3 ROLES AND RESPONSIBILITIES

Each partner is responsible for developing graphics products on the modules and systems contained within that partner’s segment. The graphics products will be developed in accordance with guidelines and national traditions of the developing partner’s training organization and in compliance with agreements contained in this joint guideline. Updates to the graphics products are the responsibility of the initial developer, who must also ensure that the translated portion of the training manual is properly updated.
2.0 HIERARCHY OF ISS FUNCTIONAL AND PHYSICAL DIVISIONS

Graphical products such as displays and schematics can be developed using varying levels of detail. In order to establish guidelines to standardize the level of detail contained in a particular graphical product, a hierarchy from more general to more specific must be used. The terminology used to describe these levels is contained below in the Hierarchy of ISS Functional and Physical Divisions. This terminology is not intended to alter the nomenclature of any hardware.

These terms are also defined in the ISS Display and Graphics Commonality Standards (Section 4.10.3) and are included here because they are essential tools in the development of graphics products. They are essential because they are the foundation of the Diagram Level Definitions provided in Section 10.

Hierarchy of ISS Functional and Physical Divisions:
- Super-system
- Station
- Segment
- Module
- System
- Subsystem
- Block
- Part

Table 2-1 lists the proposed definitions for the Hierarchy of ISS Functional and Physical Divisions.
### Table 2-1. Definitions for the Hierarchy of ISS Functional and Physical Divisions

<table>
<thead>
<tr>
<th>Division</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Super-system</td>
<td>An organization that includes the orbital station, other space vehicles, and ground facilities.</td>
</tr>
<tr>
<td>Station</td>
<td>A group of segments (or modules) that are combined to form a complete orbital complex.</td>
</tr>
<tr>
<td>Segment</td>
<td>A number of modules that can be logically grouped together by form, function, or program responsibility. Examples include the Russian segment and the American segment.</td>
</tr>
<tr>
<td>Module</td>
<td>A single structural element that provides significant additional functionality to the station. Usually contains multiple systems and may be pressurized or unpressurized. Examples include FGB, SM, Node 1, Node 2, and SO Truss.</td>
</tr>
<tr>
<td>System</td>
<td>A collection of components that perform unique functions supporting activities in a module, segment, or in the entire station. Some systems may interface across the larger super-system. Examples include the electrical power system (EPS), the thermal control system (TCS), etc. (was “subsystem” in previous designations).</td>
</tr>
<tr>
<td>Subsystem</td>
<td>A collection of blocks that work together to perform a function within a system. One example is the fire detection and suppression components of ECLSS. A part of a system, for example part of a system limited by a given module, is also called a subsystem.</td>
</tr>
<tr>
<td>Block</td>
<td>Sometimes referred to for manufacturing purposes as an assembly. A grouping of parts to perform a function for a subsystem. A block is generally connected to control signals, electrical supply, thermal support, or other environmental support services to perform its job. Examples include an MDM, a pump package assembly (PPA), a remote power control module (RPCM), latch assembly, and a controller panel assembly (CPA).</td>
</tr>
<tr>
<td>Part</td>
<td>Sometimes referred to for manufacturing purposes as equipment. The individual pieces that are assembled together to form a block. Examples include a single valve, a controller card, a pump, latch, etc.</td>
</tr>
</tbody>
</table>
3.0 BACKGROUND

When ISS crewmembers study the design and configuration of the ISS and its onboard systems and science hardware, visual aids are an effective means of providing the following:

a. Clear and rapid comprehension of the subject matter.

b. Strong memorization of the subject matter.

c. Basic skills to perform typical actions and activities within the scope of the functions assigned to the crew for the operation and maintenance of an onboard system.

d. Certainty that the underlying theory of the standard operating procedures are mastered, including off-nominal situations.

In the initial phase of training, when the visual aids serve to illustrate text information, they must conform to the same didactic principles that apply to the presentation of the training material (from the general to the specific, and from the simple to the complex) and must be presented to the student in a specific order. In the final phase of training, the visual aids must provide the student with an overall concept of the design and structure of the onboard system and the functional interrelation of its components.

The process of creating visual aids generally includes the following steps:

a. Analysis of the design of the object.

b. Analysis of the characteristics of the object.

c. Analysis of the operating modes of the object, including off-nominal situations.

d. Analysis of the crew’s functions.

e. Analysis of the standard operating procedures and maintenance of the object.

f. Validating the types and number of visual aids needed to study an object, and to support its operation and maintenance.

g. Determining the sequence for presenting the visual aids.

h. Selecting and validating the design principles (structure) of various types of visual aids.

i. Standardization of the symbols used to develop visual aids.

j. Developing the visual aids, from the schematic of the object to the integrated control schematic of the object.

3.1 GENERAL REQUIREMENTS FOR TRAINING MANUAL VISUAL AIDS

Visual aids are a component part of the training manual and must be integrated into the manual’s contents, thus presenting a united format with the text. Drawings, technical figures, schematics, tables, and photographs are classified as visual aids for training manuals. Training manual visual aids must satisfy the following basic requirements:

a. Visual aids must ensure the clear and rapid comprehension of the subject matter.
b. Only those visual aids that clarify or supplement the text must be included in the manual.

c. The number of visual aids must be adequate to clarify the accompanying text.

d. Visual aids may be incorporated in the text, at the end of a section, or in an appendix of a training manual.
   1. Incorporate visual aids close to the corresponding text in the text of a training manual.
   2. Insert aids at the end of a section.
   3. Create an appendix to the training manual for visual aids.

e. Visual aids, if there are more than one, are numbered within the section using Arabic numerals. The visual aid number consists of the section number and a one-up number for visual aids, separated by a period; for example: “Fig. 1.1.” All visual aids must be referenced in text.

f. Visual aids of each appendix are enumerated separately using Arabic numerals with the appendix designator added before the number; for example, “Figure A.3.”

g. The heading of the visual aid may consist of two parts:
   1. A one-up number and a short visual aid title.
   2. Explanatory text; for example, a list of item parts.

h. It is permitted to use colorization of component parts of an item; if possible, the color should correspond to the color in the item itself.

i. Take into account which colors to use because the possibility of B&W printing or copying. Appendix B of the DGCS states, “Colors shall not be used as the sole means of identification of a status of a part or subsystem. Information on the event or element status shall be redundant, using either labels or other graphical change.”
4.0 DRAWINGS

A drawing is a projection or view image of the objects to scale on a specific medium (paper, tracing paper, film, etc.). Graphic representations such as dots, dashes, segments of curved lines, symbols, and graphic designations are used to create the drawing.

The drawings are used to depict the design (structure) of space hardware and its parts, the layout (configuration) of the blocks and parts, and the restraints and translational gear. In other words, whenever a crewmember must obtain precise quantitative information, these elements are usually borrowed from the developer’s design documentation for the item of space hardware.

The following types of drawings are commonly used as visual aids:

a. Overall view drawing

b. Dimensional outline

c. Conceptual drawing

d. Schematics

4.1 OVERALL VIEW DRAWING

An overall view drawing is a drawing that defines the structure of the item (ISS, system, block, etc.) and the interaction of its basic components. It also explains the operating principle of the item (see Figure 4-1).

An overall view drawing must contain the following elements:

a. An image of the item (views, profiles, cross-sections) with labels and text, as required, to comprehend the design (structure) and the interaction of its components and the item’s operating principle.

b. Designators or names for the item’s components that clarify the operating principles. Numerical designations are used as designators and component names. Required explanatory notes are given in a legend to the drawing or in the main text of the training manual. An item component designator or name must not be placed on the component itself. It is placed on a line in the background of the drawing; the other end of the line connects to the component.

c. Required dimensional, mounting, and installation dimensions and dimensions that simplify clarification of the form of the part elements.

The overall view drawing is simplified as much as possible. The item components are depicted simply (contour shapes are permitted) so long as the design of the item, the interaction of its components, and the operating principle are comprehended.
4.2 DIMENSIONAL OUTLINE

The **dimensional outline** is a drawing that has a (simplified) contour image of the item with the overall installation and mounting dimensions (see Figure 4-2).

The dimensional outline should contain the least number of views sufficient to provide a thorough representation of the exterior outlines of the item, of positions of protruding parts, and the parts and blocks that make up the component.

The items are pictured as simply as possible in the dimensional outline, so that the extreme positions of moving, extensible, or hinged parts or panels on loops, etc., are visible. The dimensional outline gives the overall dimensions of the item and installation and mounting dimensions; if necessary, the outline gives the dimensions that define the position of protruding parts.

![Figure 4-1. Overall view drawing](image-url)
4.3 CONCEPTUAL DRAWING

The conceptual drawing defines the geometric shape (outlines) of an item and provides the coordinates that show the location of its components. The coordinates of the center of mass may also be shown (see Figure 4-3).

The coordinates show the location of FGB components in a structural coordinate system \((X_{\text{CT}}, Y_{\text{CT}}, Z_{\text{CT}})\).

During independent flight, the FGB uses a body-based axis coordinate system \((X_{\text{CB}}, Y_{\text{CB}}, Z_{\text{CB}})\) emanating from the center of mass. The system has the following coordinates for the variation with the solar arrays folded:
<table>
<thead>
<tr>
<th>Center of mass coordinates, mm</th>
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<tbody>
<tr>
<td>X</td>
</tr>
<tr>
<td>-3.994</td>
</tr>
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</table>

### 4.4 SCHEMATICS

#### 4.4.1 GRAPHIC SYMBOLS

Graphic symbols are graphic representations of schematic elements. The symbols are created in compliance with the principle for standardization of graphic symbols by the countries participating in the ISS program. The symbols, grouped in tabular form by type and purpose, specify the following:

a. Designators for flow direction of power, liquid, and gas and the direction and change in movement (straight line, reverse course, etc.).

b. Designators for mechanical link lines used in hydraulic, pneumatic, and electrical schematics.

c. Common graphic symbol elements (i.e., device, hardware) and their full and separate view.

d. Common graphic symbol elements used in electrical (circuit) schematics.

e. Common graphic symbol elements used in electrological schematics.

f. Common graphic symbol elements used in hydraulic schematics.

g. Common graphic symbol elements used in pneumatic schematics.

h. Common graphic symbol elements used in kinematic schematics.

Graphic symbols may be unique to specific systems or they may be used for several systems simultaneously.

Appendix C of the ISS Display and Commonality Standards contains a list of accepted graphic designators that should be used when developing schematics to be used for crew training.

#### 4.4.2 BASIC REQUIREMENTS FOR SCHEMATICS

Schematics are developed without regard to scale. However, the ratio of the sizes of the graphic symbols of interactive parts on the schematic should approximately correspond to the actual ratio of the dimensions of these parts in the component.

The graphic symbols of parts and blocks and the connections should be placed on the schematic so as to best represent the structure of the item and the interaction of its components.

Schematics should have as few breaks and overlaps in the connecting lines as possible. Individual parts constituting a functional group or block may be set apart on the schematic with a dashed/dotted line, thus indicating the name of the functional group or block.
One type of schematic may depict individual parts of another type of schematic that have a direct impact on the operation of the type of circuit (for example, a circuit schematic may show mechanical or hydraulic elements).

The schematic may show other parts and blocks that are not part of the item depicted on the schematic. The parts are shown because they are necessary to the understanding of the item and its principles of operation. The graphic symbols of such parts and blocks are set apart with a dashed/dotted line, and the location of these components is indicated in the caption or heading. If these parts and blocks cannot be graphically set apart, then these parts and their connections are depicted using dashed lines.

### 4.4.3 TYPES AND FORMS OF SCHEMATICS

The forms of schematics are designated according to their basic purpose:

a. Block schematics

b. Functional schematics

c. Principal schematics

d. Combined schematics

A combined schematic is one which includes two or more types; for example, block and functional schematics.

The following is a list of the various types of schematics, depending on the type of parts or blocks and the connections in a system:

a. Electrical (circuit) schematics

b. Electrical schematics

c. Logic schematics (TBD)

d. Hydraulic schematics

e. Pneumatic schematics

f. Kinematic schematics

g. Combined schematics

A combined schematic is one which includes two or more types of schematics, such as an electrical and a hydraulic schematic.

### 4.4.3.1 Block Schematics

Refer to the level 1 schematic definitions in Section 10.

A block schematic describes the basic functional parts of an onboard system. It describes the purpose and interdependence of the parts and the role of the crew in operating the system. The functional parts are depicted as rectangles or graphic symbols on the schematic.
The basic components of the onboard system are usually depicted without regard to their actual configuration and details.

The graphic structure of a schematic should provide the clearest representation of the sequence of interaction of the functional parts of the onboard system. It is suggested that the lines of connection be indicated by arrows to show processes that occur within parts.

Block schematics are used to provide a general introduction to an onboard system.

4.4.3.2 Functional Schematics
See the level 2 schematic definitions in Section 10.

A functional schematic explains the specific processes occurring within individual functional parts of an onboard system or within the onboard system as a whole, the role of the crew, and the basic parts for monitoring and controlling the system.

Functional schematics should show all the blocks, functional parts, functional groups, and component parts required to explain the processes occurring in the onboard system, and also to show the connections between these blocks and the component parts.

Blocks and parts of the system and also the connections between them are represented by graphic symbols in the schematic. Individual blocks and parts may be depicted as rectangles.

The functional process is usually depicted left to right and (or) from top to bottom (refer to Creating Visually Consistent Graphics, Section 9).

The functional schematic may also give technical data on the functional blocks and parts (next to the graphic symbols or in the free field of the schematic).

The schematic may also contain explanatory headings, schematics, or tables that indicate the time sequence of a process, and also show the parameters at typical points (values of currents and voltages, gas and fluid pressure, mathematical relationships, etc.).

Functional schematics are used to study the operating principles of an onboard system without regard to the details and particulars.

4.4.3.3 Principal Schematics
See the level 3 schematic definitions in Section 10.

A principal schematic defines the full complement of blocks and the connections between them, usually offers a detailed description of the operating principles of the onboard system, and may reflect the scope and content of monitoring and control of data as the crew interacts with the system in both nominal and off-nominal modes.

4.4.3.3.1 Guidelines for Electrical (Circuit) Schematics
Electrical schematics are developed to show the components in their deenergized state.
The graphic symbols used to represent a system should be properly situated in the schematic so that the schematic is easy to read. At the same time, they should satisfy the requirement for showing the electrical connections with the shortest lines and fewest intersections.

As a rule, parts, blocks, and networks are arranged on the schematic in parallel horizontal and vertical straight lines without regard to their actual position. The arrangement is generally from top to bottom, left to right.

The schematic may use graphic symbols and simplified outlines to depict the individual mechanical, hydraulic, and optical parts and blocks that are functionally related to the electrical parts or blocks in the component.

The following parts of a schematic may be set apart by dashed/dotted lines:

a. Groups of structurally unified parts or blocks.

b. Functional groups of parts that together perform a specific function in the component.

If a schematic repeatedly shows identical parts and blocks, it is permissible to fully illustrate just one part or block, and to depict the rest simply as rectangles.

Parts and blocks may be depicted in the schematic using the following methods:

a. Combined - Separate parts and blocks are depicted together.

b. Spaced apart - Separate parts or blocks of a component are depicted in different places in the schematic so that the individual circuits of the component are represented most clearly (for example, a winding and relay contact set may be shown separately, at different points in the schematic). This method allows several parts of a component to be represented with their mechanical linkage; i.e., with a dotted line indicating their appurtenance to one part.

c. Line by line - The graphic symbols of the parts or their components that make up one circuit are shown in sequence one after the next along a straight line, and separate circuits are shown in rows that form parallel (horizontal or vertical) lines.

4.4.3.3.2 Guidelines for Electro Logical Schematics

The electrological schematic shows the logical command of the system by discrete commanding signals. This schematic is usually used to depict relays of the electrical system.

The graphic design of the schematic should provide a clear and obvious representation of the sequence of control actions (commands) in the onboard system.

It is suggested that the route of a command be indicated with arrows on the connecting lines.

The parts and blocks are depicted by graphic symbols. The schematic should represent the parts and blocks of the system in the deenergized (initial) state.

The graphic symbols should be arranged properly in the schematic so that the schematic is easy to read and has the fewest intersections.
The parts and blocks are ordinarily arranged in parallel, horizontal, and vertical straight lines in the schematic.

Individual mechanical, hydraulic, and optical parts and blocks functionally related to electrical parts and blocks may be depicted by graphic symbols or simplified outlines on the schematic.

The schematic may give technical data for blocks of a circuit (near the graphic symbols or in the free field of the schematic).

The schematic may contain explanatory headings or captions and schematics or tables that indicate the time sequence of commands (processes). It may also indicate parameters at typical points (values of currents, voltages, mathematical relationships, etc.).

**4.4.3.3.2 Guidelines for Hydraulic and Pneumatic Schematics**

The parts and blocks are depicted by graphic symbols. The parts and blocks may be represented as schematic sections. The locations of the graphic symbols in the schematic should be determined by their functional capabilities. Locations are also determined by the sequence of the processes occurring, the ease of reading the schematic, and the necessity for depicting connections between functional parts. The shortest lines and the fewest intersections should be used. The parts and blocks may be arranged on the schematic in the same way the parts and blocks are arranged in the component.

If a schematic repeatedly shows identical parts and blocks, it is permissible to fully illustrate just one part or block, and to depict the rest simply as rectangles.

The parts and blocks of the circuit are depicted in the deenergized state.

Individual parts of the circuit or the entire circuit may be shown in a selected operating position, with the corresponding mode indicated in the field of the schematic.

It is acceptable to indicate the flow direction of the working medium on the communication lines.

**4.4.3.3.4 Guidelines for Kinematic Schematics**

The kinematic schematic should represent the collection of mechanical parts and their connections that are designed to execute, regulate, control, and monitor prescribed motions of effectors. Kinematic connections (mechanical and non-mechanical) that are provided within the effector and between separate pairs, circuits, and groups must be depicted. Connections to the source of motion must also be depicted.

All parts on the schematic are represented by graphic symbols or simplified outlines.

If a component consists of several identical mechanisms, the mechanical schematic may be given for one, and a simplified version given for the others.

The relative positions of the parts and blocks on the mechanical schematic should correspond to the initial, intermediate, or working position of the effectors of the component (mechanism). The positions of effectors that are the subject of the schematic may be explained in a caption.
the position of a part changes while the component is in operation, then its extreme positions may be shown by thin dashed/dotted lines.

The ratio of the sizes of the graphic symbols of interactive parts on the schematic should approximately correspond to the actual ratio of the dimensions of these parts in the component.

The mechanical schematic of a component indicates the following:

a. The name of every kinematic group of parts, taking into account its primary functional purpose (for example, feed drive).

b. The basic characteristics and parameters of the kinematic parts that determine the motions of the effectors of the component.

c. Onboard labels for the crew (instructions, cautions and warnings, explanations).
5.0 TECHNICAL DRAWINGS

A technical drawing is a type of visual aid that depicts a space object (orbital station, separate modules, blocks, etc.). It includes both an external view and a cross-section, the design of the object, the functional stages, and so on.

When creating a technical drawing, it is acceptable to deviate from the scale standards; however, the actual proportions (relative dimensions) of the subject depicted must be strictly observed.

The image may be created on the axonometric axes, with directions that closely approximate the direction of the axes selected by the axonometric projection or in the plane.

A technical drawing is created to clearly represent the design of an object. The purpose of the drawing is also to support the process of learning the construction principles, the onboard system hardware, the functional links with other onboard systems, and the sequence and rules for the crew controlling and operating the onboard system (see Figures 5-1, 5-2, and 5-3).

*Figure 5-1. FGB ventilation (view of stabilization plane I)*
Figure 5-2. FGB (location of electric supply system and location of solar arrays)

Figure 5-3. FGB (location of electric supply system blocks and location of electric supply system storage batteries and automatics on plane I)
6.0 GRAPHS

A graph is a graphic image that clearly shows the functional relationship of some quantities.

Graphs use either a right-angled or a polar coordinate system.

In a right-angled coordinate system, the values of the quantities that are related to the given functional relationship will fall on the axes as a scale (see Figure 6-1).

Graphs that provide information to show the functional relationship do not need to have a scale. In this case, the coordinate axes will end with arrows indicating the direction of growth for the quantity value.

An independent shift will be shown on the horizontal axis (x-coordinate).

![Figure 6-1. Right-angled coordinate system](image-url)
In a polar coordinate system, the initial reading angle (angle 0) must be on the horizontal or vertical axis (see Figure 6-2). A positive direction for angular coordinates must correspond to a counterclockwise rotational direction.

![Figure 6-2. Polar coordinate system](image_url)
When creating a graph using a right-angled (spatial) three-coordinate system, the functional relationship is depicted in an axonometric projection (see Figure 6-3).

![Figure 6-3. Axonometric projection](image-url)
The values of the shifting quantities are shown on the coordinate axes in linear or non-linear form; for example, in logarithmic scales of the image (see Figure 6-4).

Figure 6-4. Values of shifting quantities shown on coordinate axes

The scale for each direction of the coordinates may be different.

As a scale for the quantity values depicted, the coordinate axes should be separated at graphic intervals by dashed lines, a coordinate grid, or a combination of the coordinate grid and dashed lines.

The distance between the dashed lines and the coordinate grid lines is selected taking into consideration the purpose of the graph and the readability.

The quantity values should be shown together with the grid or dashed lines. Zero will be indicated one time at the intersection point of the scales if it is the initial point of the scale. The frequency for placing numerical values and intermediate scale values is selected taking into consideration the schematic’s ease of use.

Designators of changed quantities in a graph without scales will be placed close to arrows that end the axis; in graphics with scales, they will be placed in the center of the scale at the outside.

Units of physical quantities may be placed as follows:

a. Placed at the end of the scale between the last and next to last numbers of the scale.
b. Placed together with the name of the changed quantity, following a comma.

c. Placed at the end of the scale following the last number together with the designator of the changed quantity as a fraction. The numerator will be the changed quantity designator, and the denominator will be the unit designator. An example would be a graph of force versus area that would have a numerator in pounds and an area of square inches written as lbs/in².

The graph may have a label that explains the functional relationship that is depicted.
7.0 TABLES

A table is a list of information and numerical data. The content of the table is shown in a specific system and is distributed using graphs. The method for creating a table is shown in Figure 7-1.

![Figure 7-1. Method for creating a table](image)

Column headings and subheadings are placed at the top of the table, and the row headings are placed in side boxes. Headings for table columns and rows must begin with capital letters. Column subheadings that are part of the heading must begin with small letters. If the column subheading has a separate meaning, it should begin with a capital letter. Headings should be in singular form.

Tables are numbered using Arabic numerals within the section numbering. If there is only one table in the document or section of the document, it does not need to be numbered, and the word “Table” does not need to be written. Tables for each appendix must be numbered separately. Use Arabic numerals with a letter prefix to indicate the appendix (for example, “Table B.1”).

Above the top left corner of the table, the label “Table” must appear with a one-up number. The word “Table” must begin with a capital letter (for example, “Table 1.2”). It is not underlined. If the table has a title, it is written on the same line as the “Table . . .” label. The table title must be written in small letters (first word is capitalized). The title should be short and should completely describe the table contents. When referencing the table in text that has a number, the word “table” must be abbreviated using small letters (for example, “see tbl. 1.2”).

The table columns must be numbered only if they are referenced in text.
8.0 PHOTOGRAPHIC TRAINING MATERIAL

8.1 BACKGROUND

Photographic training materials include images of components that are produced using photographic technology. The materials are developed for crew training.

If necessary, the component dimensions may be written on the image. Designators that specify the component blocks and parts also may be written on the image.

A component may be shown in both a static position and a dynamic position (illustrating a process) using photographic training materials. In the latter case, a group of images is used to simulate the dynamic process.

Photographic training material may be used for the following components:

a. Exterior of the station, segment, and modules.

b. Interior of a module.

c. Aft panel space of a module.

d. Technical component (block, part, etc.) or a complete technical component.

e. Non-technical component (cosmonaut clothing, medical support equipment, onboard food menus, etc.).

f. Images of people and their body parts.

g. Collection of various components (for example, a cosmonaut in a flight suit against the background of a module interior, working with a specific assembly, etc.).

Photographic training material may illustrate the following types of processes:

a. Sequence of operations when working with a system or a separate component.

b. Sequence for maintenance on a system or separate component.


Depending upon the exposure, photographic training material can be divided into the following categories:

a. General layout

b. Intermediate layout

c. Large-scale layout

d. Detail

Photographic training material may be in black and white or color. Color images are useful when the colors of the components are necessary to distinguish them from similar components.
8.2 BASIC REQUIREMENTS FOR DEVELOPING PHOTOGRAPHIC MATERIALS

a. Photography of components on a module must be taken with the standard cable connections and standard positions for effectors.

b. If the position of the component or its blocks and parts can change, it is required to show the most critical position.

c. Packages and other components in packing must be shown in stowed and extended states.

d. The lighting while photographing a component must minimize shadow. Specks of light from the flash should be avoided as much as possible. To set a component apart from others, the use of localized lighting is permitted.

e. When photographing components outside the station, the use of an artificial background is required. The background must be neutral and must not be the same color and saturation level as the component. The background must not contain any extraneous parts.

f. The selection of the photography camera angle is based on the objective of the graphic presentation and whether one to three sides of a three-dimensional component are visible. Therefore, it is necessary to calculate the center of the optical interest and, if necessary, concentrate the student’s attention on it.

g. Component panels with connectors and also cable must be photographed in such a way that the contact area of the connectors is clearly visible.

h. When photographing crewmembers, it is necessary for them to be dressed in the standard equipment that corresponds to the situation illustrated.

i. To illustrate a process, photographs are used that connect a single subject.

j. A group of photographs may also be used to statically illustrate different sides or elements of a component.

k. It is desirable that objects are photographed in a manner that clarifies size; i.e., a ruler or other object whose size is commonly understood should be included in the photo as a reference.

l. The color used for text or drawings on a photo should be very clear. Photographic material should be post-processed to reduce light effects from camera flashes and to reduce shadows, which will hide important information, such as labels on the hardware.
9.0 CREATING VISUALLY CONSISTENT GRAPHICS

This section is intended to define a generic concept, the guidelines, and a method for the production of visually consistent graphics products. Attributes that make a drawing visually consistent include flow directions, common layout, and common icons. Figures 9-1 to 9-17 illustrate the steps to creating visually consistent graphics.

9.1 GENERIC CONCEPT

Using the generic concept, a visually consistent set of graphics products can be developed across multiple systems and across different knowledge levels.

![Diagram showing the generic concept of visually consistent graphics across systems and required knowledge levels.](image-url)

**Figure 9-1.** Generic concept
The following examples (from the U.S. ISS program) illustrate this concept across users and across systems.
9.2 SPECIAL TEMPLATE DEVELOPMENT METHODOLOGY

One of the guidelines in the ISS Display and Graphics Commonality Standards document (Section 4.10.4) addresses spatial consistency. Use of the preferred view convention ensures spatial consistency. From the convention, isometric or orthographic projections can be derived. This convention is not a requirement for all ISS graphics products. It is intended to be used as a first approach when starting the process of developing a drawing.

When looking at graphics material, it is sometimes hard for users to orient themselves to which way is up, down, left, or right. If a convention is not used, then students have to reorient themselves when looking at different graphics products.

![Preferred view convention diagram](image)

**Figure 9-2. Preferred view convention**
Figure 9-2 can also be interpreted as shown in Figure 9-3.

Designation of ISS modules can be done in a way consistent with the following conventions:

a. Zenith or port or aft at the top.

b. Aft or starboard on the left.

c. Nadir or starboard or forward at the bottom.

d. Port or forward on the right.

Figure 9-3. Preferred view convention - another interpretation
The preferred view convention can be enhanced by integrating the Russian method of using a coordinate system based on “stabilization planes.”
Two mutually perpendicular planes, intersecting along the longitudinal axis, describe the stabilization plane.
A display of the stabilization plane for any ISS module, when viewed from inside facing the forward section, would appear:

a. Down (floor) - First stabilization plane.
b. Left (port) - Second stabilization plane.
c. Up (ceiling) - Third stabilization plane.
d. Right (starboard) - Fourth stabilization plane.

Figure 9-4. Coordinate system based on stabilization planes (Russian method)
9.3 STEPS USED TO DEVELOP THE PREFERRED VIEW CONVENTION

1. The development started with this view of the ISS (preferred view).

![Diagram showing the preferred view convention]

Figure 9-5. Step 1 in the development of the preferred view
2. This next step simplified the ISS as follows:

![Diagram of ISS with simplified view]

Figure 9-6. Step 2 - Simplification of the ISS
3. The next step produced the orthographic view:

![Orthographic view illustration]

Figure 9-7. Orthographic view (top) to preferred view (bottom)

In Figure 9-8, a template was derived from following the preferred view convention:
Figure 9-8. Template
9.4 INFORMATION PRESENTATION GUIDELINES

When looking at diagrams that illustrate functions, the logic flow needs to be consistent across all graphics products. Figures 9-9 to 9-12 illustrate the guidelines that will ensure this consistency (for more information, see Section 4.11 of the ISS Display and Graphics Commonality Standards).

Figure 9-9. Potential flow - Left to right, top to bottom

Figure 9-10. Power distribution - Power sources on left and loads on the right
Figure 9-11. Control hierarchy - Left to right and top to bottom

Figure 9-12. Signal flow - Left to right, clockwise loop, and feedback below forward path
9.5 STEP BY STEP DRAWING DEVELOPMENT METHOD

The following method for producing visually consistent products across all ISS systems is suggested (see Figures 9-13 to 9-16). The first step is to produce a drawing that shows the relationships among the functions within a system.

Figure 9-13. Step 1 - Show relationships among the functions within a system
The second step in the drawing development process is to produce a drawing that shows the blocks and parts that make up each function within a system. One additional visual tool that may be included is color, which can provide an excellent method of linking the blocks and parts in this second drawing to the functions they performed in the first drawing.

![Figure 9-14. Step 2 - Show blocks and parts that make up each function within a system](image)

Because a drawing of this type can be laid out in many different ways, for all drawing developers, a common starting point is needed to ensure visual consistency. A graphics tool described previously in this section is recommended to provide both a common layout and a spatial framework.

The following image of the ISS is the graphics tool (template) (Figure 9-15).

![Figure 9-15. ISS Graphics Tool](image)

Using the template and then following the “Diagram Level Definitions” in Section 5 results in common layouts.

The next step is to map the drawing developed in step 2 (parts and blocks showing the functions that make up a system) into the template.
An additional benefit of the structured approach of showing system function within each module is that it allows the instructor to teach the interactions, or lack of interactions, that take place across multiple modules. For example, a Thermal Control System (TCS) instructor can show that the TCS is a distributed system within the U.S. modules. At the same time, the instructor can show that all Russian modules have their own TCS.
9.5.1 Summary

Figure 9-16 illustrates the three steps in the drawing development method.

9.6 BASIC TEMPLATE USAGE GUIDELINES

The template is intended to form the foundation for creating a set of visually consistent graphics. It does not restrict the drawing developer from producing graphics that do not follow the template.

The entire template can be used as a whole, in groups of modules, or one module at a time. If a system affects only two modules, those two modules are all that need to be shown in the diagram. However, to provide the user with a visual reference, a template icon should be used with the modules affected by the system clearly indicated (see Figure 9-17).
Figure 9-17. Use of template icon
10.0 SCHEMATIC LEVEL DEFINITIONS FOR ISS TRAINING

The primary purpose of the “Schematic Level Definitions” is to provide a tool for developers to produce schematics with the correct level of detail. If followed, the level 1 schematic definition will produce schematics with a low level of detail, and level 2 and level 3 will produce schematics with progressively more detail.

NASA and GCTC, at the TIM held the week of 9/8/97 at JSC, agreed that drawings need to be categorized in different levels of detail. In order to ensure consistency and to guide drawing developers, each level of detail for drawings (diagrams) needs to be clearly described.

The schematic level definitions provide guidance for three different levels of drawing (schematic) detail. These diagram level definitions are an important tool in the drawing development process. Without detail level definitions that are clear to all developers, it will be extremely difficult to produce consistent drawings (schematics) for all the different ISS systems (see Appendix C).

10.1 LEVEL 1 - BLOCK SCHEMATICS

A level 1 schematic shows spatial and/or functional information about a super-system down to a level of detail including its systems and their subsystems. A single level 1 schematic will generally focus on one system’s role in the ISS’s capability. Not all blocks inside the system or subsystem need to be included, and detail inside blocks is not generally shown. If a system extends across multiple modules, then multiple sheets may be produced for each module. In this case, connectivity across modules must be annotated.

10.1.1 Three Types of Level 1 Schematics

a. Type 1A - Schematic shows the function of a given system. The schematic does not have to show spatial orientation.

b. Type 1B - Schematic shows the major processes and functions that a system performs within modules. Modules have the correct spatial orientation. System and subsystem representation inside each module are functionally correct, but not generally spatially correct. The 1B schematics are block schematics (see Section 4) within a spatial template (see Section 9). - all 1B diagrams use a standard Flight 8A station configuration template.

c. Type 1C - Schematic is either a 1A or a 1B schematic with dependencies. Schematics Module functional overviews may show a single system which includes software, electrical, or other system dependencies. These overviews are designated 1C. Color may be used to show these dependencies.

10.2 LEVEL 2 - FUNCTIONAL SCHEMATICS

A level 2 schematic shows all blocks of the major processes and system functions represented in level 1. The schematics must show the function of each block. These level 2 schematics are functional schematics (see Section 4). If a template is used, then the schematic is a functional schematic within a spatial template (see Section 9).
If a system goes across multiple modules, then multiple single module schematics may be produced; (i.e., a schematic is produced for each single ISS module (SM, FGB, NODE, LAB, etc.).) If this is done, then the connectivity across modules must somehow be annotated.

Blocks may be functionally connected without showing all the physical detail of the connections.

10.2.1 Three Types of Level 2 Schematics

a. Type 2A - System Functional Overview - Schematic shows the function of a given system. The schematic does not have to show spatial orientation.

b. Type 2B - Module Functional Overview - Schematic is a functional schematic within a spatial template. All type 2B schematics use a standard template as their foundation.

c. Type 2C - Schematic is either a 2A or a 2B schematic with dependencies. Schematics include software, electrical, or other system dependencies. Color may be used to show these dependencies.

10.3 LEVEL 3 - PRINCIPAL SCHEMATICS

A level 3 schematic adds all block detail and connectivity. The level of detail should show connectivity between all functional parts of the blocks. These level 3 schematics are principal schematics (see Section 4).

Like level 2, this schematic can be done on the entire template but will most likely be done one module at a time. At this level of schematic, there may be only one subsystem represented per schematic. For example:

ECLSS may show three subsystems of ECLSS on a single level 1 or 2 schematic, but on these level 3 schematics that might not be possible because of the amount of detail. (do the right thing).

Also at this level, you should provide as much information as possible on the processes taking place within the blocks detail. For example, flow rates, inlet and outlet temperatures and pressures, voltage level, amperage, etc., should be shown.

10.3.1 Three Types of Level 3 Schematics

a. Type 3A - System Functional Overview - These Schematic shows the function of a given system. The schematic does not have to show spatial orientation.

b. Type 3B - Schematic is a functional principal schematic (see Section 4) within a spatial template (see Section 9). All 3B diagrams use a standard 8A template as their foundation.

c. Type 3C - Schematic is either a 3A or a 3B schematic with dependencies. Schematics include software, electrical, or other system dependencies. Color may be used to show these dependencies.

For order for graphics products to be of value, they must correspond to specific training objectives. Table 10-1 maps the different schematic levels described in this section to the different levels of training detail from Section 2 (the Hierarchy of ISS Functional and Physical...
Divisions), to the training objectives taught at each level, and then to the questions that are answered at that training level.
### Table 10-1. Schematic levels mapped to levels of training

<table>
<thead>
<tr>
<th>Schematic level</th>
<th>Training level detail</th>
<th>Training objectives</th>
<th>Questions answered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Super-system, Station, Segment, Module, <strong>System Overview</strong></td>
<td>Identify the major functions performed by the system. Identify the subsystems within the system. Identify the system interfaces to other systems.</td>
<td>Overall system purpose, major components, major subsystems, major interfaces, functional interfaces, functional constraints, impact of loss of function on flight operations.</td>
</tr>
<tr>
<td>Levels 1 and 2LEVEL 1 &amp; 2</td>
<td>Super-system, Station, Segment, Module, <strong>Subsystem Overview</strong></td>
<td>Identify the function(s) of the subsystem. Describe the capabilities/constraints of the subsystem. Describe the subsystem interfaces to other system/subsystems.</td>
<td>Subsystem purpose, what blocks are in each module, functionality, interfaces, operational constraints, redundancy, and impact of loss of function on the systems operations.</td>
</tr>
<tr>
<td>Levels 2 and 3LEVEL 2 &amp; 3</td>
<td>Super-system, Station, Segment, Module, <strong>Subsystem, Block Overview</strong></td>
<td>Identify the function(s) of the block. Identify the block interfaces to other systems, subsystems, and blocks. Describe the capabilities and operational constraints of the block.</td>
<td>Block purpose, operational capabilities and constraints, interfaces, failure impacts, FDIR capabilities.</td>
</tr>
<tr>
<td>Level 3</td>
<td>Super-system, Station, Segment, Module, <strong>Subsystem, Block, Part Overview</strong></td>
<td>Identify and describe the parts associated with the block including the sensors/effectors. Explain the purpose of every part in block operations. Describe the impact of part failures on the block.</td>
<td>Systems/subsystem sensors at a part level. Block operational principles, performance and part failure impact on block operations.</td>
</tr>
</tbody>
</table>
11.0 UPDATING GRAPHICS PRODUCTS

11.1 REASONS FOR UPDATES

Graphics products must be updated if any of the substantial information contained in them changes. This includes changes in the design of a system or component as well as changes in the operations. Changes in operations might involve a change in the crew responsibilities and activities with respect to the monitoring and control of the system. If during the practical phase of the training program or during the onboard operational phase, any incorrect information or lacking information within the graphics product is identified, this is also a basis for updating the product. Changes in the use of specific acronym or terminology may also prompt the need to update the graphics product.

11.2 PROCESS FOR UPDATES

Updates to a graphics product must be initiated by the management or the system expert responsible for the maintenance of the graphics product. The technical content of the changes must precisely correspond to documentation approved by the program; this includes design drawings and flight data file products.

The changes are made only to that graphics product of the whole set that is affected. A “change package” must be issued that contains the affected graphics product pages as well as a cover page identifying those drawings that are being replaced in the original set and those that are to be inserted into the set. An example of a change package is included in Appendix A. This change package should provide a brief description of the changes that were made and the rationale for making them. The cover page of the change package must also include reference to the source of changes and the signature of the expert who made the changes and the manager who approved them. The change package will be submitted electronically to the other partners for incorporation into the final document.
## APPENDIX ACRONYMS AND ABBREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS</td>
<td>Atmosphere Control and Supply</td>
</tr>
<tr>
<td>C&amp;DH</td>
<td>Command Data Handling</td>
</tr>
<tr>
<td>CBT</td>
<td>Computer Based Training</td>
</tr>
<tr>
<td>CMP</td>
<td>Configuration Management Plan</td>
</tr>
<tr>
<td>CPA</td>
<td>Control Panel Assembly</td>
</tr>
<tr>
<td>DCN</td>
<td>Drawing Change Notice</td>
</tr>
<tr>
<td>DGCS</td>
<td>Display and Graphics Commonality Standards</td>
</tr>
<tr>
<td>DT</td>
<td>Training Division Mail Code</td>
</tr>
<tr>
<td>ECLSS</td>
<td>Environmental Control and Life Support System</td>
</tr>
<tr>
<td>EPS</td>
<td>Electrical Power System</td>
</tr>
<tr>
<td>ETCS</td>
<td>External Thermal Control System</td>
</tr>
<tr>
<td>EVA</td>
<td>Extravehicular Activity</td>
</tr>
<tr>
<td>FDS</td>
<td>Fire Detection and Suppression</td>
</tr>
<tr>
<td>FGBC</td>
<td>Functional Cargo Block</td>
</tr>
<tr>
<td>GCTC</td>
<td>Gagarin Cosmonaut Training Center</td>
</tr>
<tr>
<td>GNC/P</td>
<td>Guidance, Navigation, and Control/Propulsion</td>
</tr>
<tr>
<td>IDAGS</td>
<td>Integrated Display and Graphics Standards Panel</td>
</tr>
<tr>
<td>ISS</td>
<td>International Space Station</td>
</tr>
<tr>
<td>ISSSH</td>
<td>International Space Station Systems Handbook</td>
</tr>
<tr>
<td>ITCS</td>
<td>Internal Thermal Control System</td>
</tr>
<tr>
<td>JSC</td>
<td>Johnson Space Center</td>
</tr>
<tr>
<td>MDM</td>
<td>Multiplexer/Demultiplexer</td>
</tr>
<tr>
<td>MOD</td>
<td>Mission Operations Directorate</td>
</tr>
<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
</tr>
<tr>
<td>ORU</td>
<td>Orbital Replacement Unit</td>
</tr>
<tr>
<td>PPA</td>
<td>Pump Package Assembly</td>
</tr>
<tr>
<td>PTT</td>
<td>Part Task Trainer</td>
</tr>
<tr>
<td>RPCM</td>
<td>Remote Power Control Module</td>
</tr>
<tr>
<td>S&amp;M</td>
<td>Structures and Mechanical</td>
</tr>
<tr>
<td>SM</td>
<td>Service Module</td>
</tr>
<tr>
<td>SSTF</td>
<td>Single System Training Facility</td>
</tr>
</tbody>
</table>
TCS       Thermal Control System
TDSP      Training Development Support Plan
WRM       Water Recovery and Management
APPENDIX B SIGNATURE REQUIREMENTS AND THE DCN PROCESS

B.1 SIGNATURE REQUIREMENTS

For all drawings created by the U.S., there will be four signatures. Those signatures are:

a. DT Instructor who created the drawing.

b. DT Group Lead. This is the group lead for the instructor who created the drawing.

c. DF Flight Controller who reviewed the drawing for technical accuracy.

d. DF Group Lead. This is the group lead for the DF flight controller who reviewed the drawing.

For the Russian drawings, the signature process is still TBD.

B.2 DRAWING CHANGE NOTIFICATION (DCN) PROCESS

a. Page A-2 - “Drawing Change Record” will provide all users with a synopsis of all drawing changes that have taken place. This form will be updated each time a new “Drawing Change Package” is published. The drawing user will be able to use this “Drawing Change Record” to go back and make sure that his/her set of drawings is up to date.

b. Pages A-3 and A-4 - “Drawing Change Package” will be used to notify all drawing users with information about each change to the complete list of drawings. The changes will be referred to as Drawing Change Notices (DCNs). For U.S. drawings, this drawing change package will be approved by the DT Project Lead and the DT Division Chief. For Russian drawings, the approval process is TBD.

c. Page A-5 - “ISS Drawing Change Requirement” will be filled out by anyone who wants to make a change to a drawing. After this form is filled out, it needs to be mailed to the respective Drawing Project Manager. For Russian drawing changes, this form should be submitted to GCTC/V. Cherkashin. For U.S. drawing changes, this form should be submitted to NASA/JSC/DT121/J. Ruszkowski.
# ISS Graphics

## May 1998

### Drawing Change Notices

<table>
<thead>
<tr>
<th>DCN</th>
<th>Date</th>
<th>Change Details</th>
</tr>
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<tr>
<td>DCN-1</td>
<td>6/18/98</td>
<td>Remove drawing ECLS1A-OV-8A</td>
</tr>
<tr>
<td>DCN-2</td>
<td>6/30/98</td>
<td>Add drawings CDH2A-PMCU-8A (Rev 2) and CDH2A-GNC-8A (Rev 2)</td>
</tr>
<tr>
<td>DCN-3</td>
<td>6/31/98</td>
<td>Remove drawing CT1A-OV-8A (Rev 1) and replace with CT1A-OV-8A (Rev 2)</td>
</tr>
</tbody>
</table>
ISS Graphics

U. S. Drawing Changes

DCN-1
June 1998
Prepared by:

____________________________
DT121/J. Ruszkowski
NASA Drawing Project Lead

Approved by:

___________________________
DT/F. Hughes
NASA Training Division Manager
ISS GRAPHICS

DCN-1

June 2, 1997

DRAWING CHANGE INSTRUCTION SHEET

Remove and replace the following drawings:

ECLS1A-OV-8A
CDH1A-CW1-8A
CT1A-0V-8A

Add the following new drawings:

CT1A-RSOV-1R
CT2A-SM-TLM-1R
<table>
<thead>
<tr>
<th>ISS Drawing Change #</th>
<th>ISS Drawing Change Requirement</th>
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<td></td>
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<table>
<thead>
<tr>
<th>Drawing Title:</th>
</tr>
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</table>

<table>
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<tr>
<th>Reference Documentation (vendor drawing, ISSSH document, etc.):</th>
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<table>
<thead>
<tr>
<th>Operational Need</th>
<th>Shuttle Flight:</th>
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<tbody>
<tr>
<td>Date:</td>
<td></td>
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<table>
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<tr>
<th>Soyuz Flight:</th>
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<table>
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<th>ISS Increment:</th>
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<table>
<thead>
<tr>
<th>Description of Change:</th>
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((use continuation page if necessary)

<table>
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<tr>
<th>Justification for Change:</th>
</tr>
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((use continuation page if necessary)

<table>
<thead>
<tr>
<th>Impact of Non-Incorporation:</th>
</tr>
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</table>

(Use continuation page if necessary)

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</table>

<table>
<thead>
<tr>
<th>Signature/Organization/Date</th>
<th>ISS Crew Member:</th>
<th>Project Lead:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(NASA - DT121/J. Ruszkowski)</td>
<td>(GCTC - V. Cherkashin)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Change Initiator</th>
<th>Date</th>
<th>Change Initiators Immediate Supervisor</th>
<th>Date</th>
</tr>
</thead>
</table>

Mail Completed form to the respective Project Lead. Changes to Russian Drawings should be mailed to GCTC/ V. Cherkashin. Changes to United States drawings should be mailed to NASA/JSC/DT121/J. Ruszkowski.
APPENDIX C  ISS TRAINING SCHEMATIC NAMING CONVENTION

To assist in the documentation and tracking of these schematics, a numbering system was derived from ANSI Y32.16 (Panel Reference Designations). This in combination with definitions from the ISS Schematics Meeting held on 11-18-97 created the following pattern.

C.1 SYSTEM

a. For the U.S.-produced schematics, the ISS has been broken into the following systems:

   1. CDH - Command and Data Handling
   2. CT - Communications and Tracking
   3. ECLS - Environmental Control and Life Support
   4. EPS - Electrical Power System
   5. GNC - Guidance, Navigation, and Control
   6. SM - Structural and Mechanical
   7. TCS - Thermal Control System
   8. ROBO - Robotics

b. For the Russian-produced schematics, the following additional system is used:

   1. ÑÓÁÊ - Onboard Complex Control System Command Matrix

Note: For this naming convention, the ampersand (&) usually present in some of these system names has been left out. For example, C&DH is simplified to CDH.
C.2 SCHEMATIC LEVEL

All schematics have a level designation that indicates that amount of detail provided in each drawing. The definitions for these different levels are provided in Section 10 of this document.

C.3 DEPENDENCY

By definition, schematics at levels 1C, 2C, and 3C will show not only the function of a system but also the C&DH, EPS, or TCS dependencies. In the naming convention, schematics that show the C&DH dependencies of the system will have an additional “C” following the schematic level in the title. Schematics that show the EPS dependencies of the system will have an “E” following the schematic level in the title. Schematics that show the TCS dependencies of the system will have a “T” following the schematic level in the title.

C.4 COMPLETE STATION OR ELEMENT

This portion of the naming convention is intended to show the users how much of the Station is visible.

a. ISS - The system’s role (based on schematic level) in both U.S. and Russian elements.

b. US - The system’s role (based on schematic level) in a U.S. module or modules.

c. RS - The system’s role (based on schematic level) in a Russian module or modules.

C.5 OVERVIEW, MODULE, OR SUBSYSTEM

If the schematic provides an overview of a system, then an “OV” will be in this portion of the drawing name. If the schematic shows information about a specific module, one of the following module designators will be in this portion of the schematic name (these are US and Russian segment designators all other partners will need to develop designators to represent their respective modules):

a. LAB - U.S. Laboratory

b. N1 - U.S. Node 1

c. AL - U.S. Airlock

d. SM - Russian Service Module

e. FGB - Russian FGB

If the schematic shows information about a specific subsystem, a subsystem designator will be in this section of the drawing name. Subsystem designations come in many different forms. Here are some examples from the ECLS schematics:

a. ACS - Atmosphere Control and Supply

b. FDS - Fire Detection and Suppression

c. WRM - Water Recovery and Management
C.6 STATION INCREMENT

For the initial training products, most of the drawings provide information about each system through ISS increment 8A.

Table C-1 provides examples of how this naming convention has been used:

**Table C-1. Use of naming convention**

<table>
<thead>
<tr>
<th>System</th>
<th>Level</th>
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APPENDIX D COMMON GRAPHICAL TERMS

The Russian and American sides use many terms that have different meanings for each partner. It is essential to have a list of commonly used graphics terms to produce drawings that have the same level of detail based on common graphics rules.

**Block**
A grouping of separate parts into a group to form a single structure to perform a function for a subsystem. A block is generally connected to control signals, electrical supply, thermal support, or other environmental support services to perform its job. Examples include a Multiplexer/Demultiplexer (MDM), a Pump Package Assembly (PPA), a Remote Power Control Module (RPCM), a latch assembly, and a Controller Panel Assembly (CPA).

**Connection line**
Line segment that indicates a connection between functional parts of an article.

**Dimensional drawing**
A drawing that shows a contour (outline) representation (simplified) of the article with dimensional, installation, and connectivity sizes.

**Drawing**
A scale projection or image of objects on a certain medium (paper, tracing paper, film, etc.) using graphical images such as points, straight and curved lines, symbols, and conventional graphical designations.

**Electrical schematic**
A diagram that shows the functions of systems using electricity.

**Electro logical schematic**
A diagram to show the logical control of a system with discrete control signals. This diagram is primarily used to depict electrical relay systems.

**Functional group**
A collection of separate parts performing a unique function in the component that are not combined into a single structure (amplifier, modulator, generator, etc.).

**Functional part**
A part, functional group, or device that performs a unique function.

**Functional schematic**
Explains the specific processes occurring within individual functional parts of an onboard system or within the onboard system as a whole, the role of the crew, and the basic components for monitoring and controlling the system.
General view drawing  A graphic that defines the structure of the article (ISS, system, block, etc.) and the interaction of its basic components and explains the principle of operation of the article.

Graph  A graphic that clearly shows functional relationship between some values.

Graphic symbols  Graphic representations of diagram elements created in compliance with the principle for standardization of graphic symbols by the International Partners in the ISS program; grouped in tabular form by type and purpose.

Graphic training material  A collection of drawings, technical drawings, diagrams, tables, and photographs that are related by the information they contain or the procedures they describe; used in the crew training process; employs various guidelines and symbols in its development.

Hydraulic schematic  A diagram that shows the functions of systems using liquids.

Kinematic schematic  A diagram that shows the kinematic functions of mechanical objects at the block or part level.

Module  A single structural element that provides significant additional functionality to the ISS; usually contains multiple systems and may be pressurized or unpressurized. Examples include FGB, SM, Node 1, and S0 Truss.

Part  Separate component elements that perform a unique function and cannot be separated into parts that have an independent functional purpose. Examples include a single valve, a resistor, a controller card, a pump, a latch, etc.

Photographic training material  Images of objects produced using photographic technology and that are intended for use in the crew training process.

Pneumatic schematic  A diagram that shows the functions of systems using gases.
**Principal (complete) schematic**
Defines the full complement of an onboard system parts and their interrelationships; usually offers a detailed description of the operating principles of the onboard system, scope, and content of monitoring and control data as the crew interacts with the system in both nominal and off-nominal modes.

**Schematic**
A graphic that uses conventional graphical symbols to show electrical, hydraulic, and other components of the article and their interrelationships.

**Segment**
A number of modules that can be logically grouped together by form, function, or program responsibility. Examples include the Russian segment and the American segment.
This paragraph appears twice in the original.

**Spatial drawing**
A spatial drawing provides the correct physical location of objects to a particular level of detail. For example, within the ISS or one of its segments, systems and subsystems are located in their respective modules.

**Station**
A group of segments (or modules) that are combined to form a complete orbital complex.

**Structural schematic**
A diagram that identifies the main functional parts of an onboard system, their purpose, interrelationships, and the crew involvement in the system operation.

**Subsystem**
A collection of blocks, functional groups and parts that function together to perform a function within a system. One example is the fire detection and suppression components of the Environmental Control and Life Support System (ECLSS).

**Super-system**
An organization that includes the orbital station, other functionally connected space vehicles, and also ground facilities.

**System**
A collection of blocks, functional groups, or parts that function together to perform a unique function supporting activities in a module, segment, or in the entire ISS. Some systems may interface across the larger super-system. Examples include the Electrical Power System (EPS), the Thermal Control System (TCS), etc.

**Table**
A list of information and numerical data compiled in columnar format; uses a specific system.
Technical drawing
Type of graphic that depicts a space object (orbital station, separate modules, block, etc.) including both an external view and a cross-section, its design, functional stages, and so on. When creating a technical drawing, it is acceptable to deviate from the scale standards; however, the actual proportions (relative dimensions) of the object depicted must be strictly observed.

Template
A template is a drawing that provides a consistent means for showing how ISS modules are arranged. The template will normally be an orthogonal view, but isometric templates are permitted. Standard rules will define how views of modules may be reoriented or otherwise distorted.

Theoretical drawing
Identifies a geometrical shape (outline) of the article and the coordinates of its main components. The center of mass coordinates may also be shown.
APPENDIX E  GRAPHIC SYMBOLS

The following guidelines should be used when developing and using symbols for figures and drawings:

a. Symbols must be clear and easy to comprehend.

b. Symbols may change their shape and color if it helps the user gain additional information and if the symbol does not become complicated.

c. The object or function represented by the symbol must be unique. This provision has two requirements:
   1. The size of the symbol must be adequate to determine its purpose and to distinguish it from other symbols.
   2. Whenever possible, the symbols must be pictographic in form.

d. Only when possible, must symbols be accompanied by textual markers, especially if the symbol represents an object or function that is not sufficiently symbolic. In those cases when the symbol itself does not become distorted, the textual markers should be placed inside the symbol.

New symbols must be submitted using the change request process to the ISS Integrated Display and Graphics Standards (IDAGS) Panel for inclusion into the “ISS Display and Graphics Commonality Standards (DGCS).”
APPENDIX F  U.S. AND RUSSIAN DRAWING EXAMPLES

This appendix provides examples of different ISS diagrams that have been created using the guidelines in this document. Observe the following in the examples:

a. Schematic Naming Convention from Appendix C

b. Schematic Level Definitions from Section 10

c. Template usage and using the template as an icon from Section 9.6

The following schematics are included in this appendix as examples:

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APPENDIX G

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APPENDIX H

PAYLOAD DISPLAY DESIGN STANDARDS AND GUIDELINES

NASA Deviation

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SECTION H1.0
INTRODUCTION

H1.1 PURPOSE
This appendix serves as a guide for the design of payload displays. It contains guidelines and standards for designing displays that:
− minimize crewmember training,
− minimize the number and severity of crewmember errors,
− provide rapid recovery from errors, and
− enhance productivity and science return.

This appendix supports the evaluation of onboard ISS payload displays which shall be reviewed and approved prior to crew training and flight. The International Partner (IP) authority responsible for approving payload displays will check the display for consistency with other payloads and correlation with procedures. In the U.S., this authority is the Payload Display Review Panel (PDRP).

H1.2 SCOPE
This appendix, which supplements the ISS Display and Graphics Commonality Standards (DGCS), shall apply to all onboard ISS payload displays. Unless otherwise stated, Appendix H shall take precedence over all guidelines and standards provided in Commercial Off-the-Shelf (COTS) software products reference material.

Appendix H contains information unique to payload displays. Payload Developers (PD) should refer to the parent document (DGCS) of this appendix for guidance on overall design concepts and guidelines. This appendix contains information unique to payload displays.

H1.3 PAYLOAD DESIGN CONSIDERATIONS
ISS payload displays must be designed to enhance crewmember productivity and achieve scientific objectives. To develop displays that meet these goals, it is important to have an understanding of the crewmembers as payload users, and the payload operations environment.

The ISS onboard payload displays will be operated by a rotating complement of crewmembers from many different countries. The crewmembers will have varying degrees of English proficiency and varying degrees of experience with software.

ISS crewmembers will have minimal pre-launch training, a long interval between training and flight, and a large number of diverse payloads to operate. In addition, retention of the payload training is uncertain with long duration spaceflight, particularly when payload displays may not be used on a regular basis. For these reasons, use of displays should be intuitive and common across payloads.

ISS software will be hosted on a variety of computer platforms. The primary vehicle displays run under Solaris (UNIX), the Manual Procedures Viewer (MPV) software runs under Windows, and payload software built by developers all over the world may run on a variety of different platforms. Given that crewmembers will frequently move among these diverse operating systems, adherence to display standards to achieve a common "look and feel" is paramount to a safe and usable onboard environment.
H1.4 PAYLOAD DISPLAY DEVELOPMENT PROCESS

Payload display development is typically the responsibility of the individual PD team. For U.S. payloads and payloads flying under a U.S. Science Program, the Payload Display Review Panel (PDRP) acts as a mentor to payload developers, assisting them through the payload display development process. This process is documented in the Payload Operations Data File (PODF) Management Plan, Annex 5 SSP58700-ANX5. International payloads are encouraged to follow a similar process to ensure usable, common displays. The list below shows the recommended display development process steps for payload developers. This list is intended as a guide only.

1) Review applicable display standards and guidelines.
2) Obtain rapid prototyping tool.
3) Receive display development training and guidance.
4) Perform operations requirements analysis to support display development.
5) Submit early products for review and discussion.
6) Develop preliminary displays and procedures.
7) Submit early displays/prototypes for review.
8) Update/iterate displays and procedures based on the review.
9) Submit product when mature and support crewmember usability testing.
10) Update displays and procedures based on results from testing.
11) Deliver final displays and procedures.
12) Receive approval for training/flight.
13) Support training.
14) Support integration.
SECTION H2.0
DISPLAY DESIGN

The following section is under review by IDAGS for inclusion in the parent document. (Sect. 5 Display Organization & Hierarchy)

H2.1 GENERAL PRINCIPLES AND RATIONALE
All onboard displays should be based on a complete operations requirements analysis. Display layout and groupings, and choice of widgets, icons, and objects should be driven by operational requirements. Display layouts should follow operational flows, and should allow task completion with the minimum number of actions. The goals of minimizing the number of crewmember actions and providing uncluttered displays (i.e., containing only information relevant for task execution) must be balanced. The standards and general guidelines that follow are provided to facilitate this balance, and to aid in the development of an efficient, usable Human Computer Interface (HCI).

H2.1.1 Usability (move changes to Section 3.1.1)

a) The user interface appearance, interaction, and results should be consistent across tasks and applications.

b) The user interface should facilitate error-free operations. Should errors occur, the user interface should facilitate quick recovery.

c) Software-provided reference materials should be readily accessible to the crewmembers.

d) Within system limitations, user feedback should be provided with minimal delay for the following cases:
   - Input has been made to the interface (local feedback)
   - Process has been initiated
   - Process has been completed or terminated

e) If a delay in processing time occurs, notification of the delay shall be provided to the crewmembers.

f) The display should have an indication that it is alive (i.e., not frozen). An example indication is the display of a Greenwich Mean Time (GMT) clock.

H2.1.2 Information Organization

a) The primary window should contain the primary focus for the crewmembers when the application is started. Supplemental or secondary information should be provided, via secondary windows or dialog boxes, upon crewmember request only.

b) Each display should contain only the information, in the proper format, that is relevant to the current task. Information layering, via secondary windows or dialog boxes, should be implemented to provide supplemental information in support of the primary window (e.g.,
specify options available to the crewmember or to provide details about information displayed on the primary window).

c) Information layering should be used to limit display data to that needed for a specific task. For most displays, information should be layered no deeper than four layers.

d) Crewmembers should be able to see where they are in the task flow.

e) Crewmembers should have access to any level at any time via a clear navigational path.

f) Crewmembers should be able to return to the initial task display with a single action (e.g., via a navigational aid).

g) Information should be logically grouped according to purpose, function, or sequence of use (e.g., either a left-to-right or top-to-bottom orientation).

h) Information/display objects that are to be used together should be placed in close proximity on the screen.

i) Headers, titles, and labels should be used appropriately throughout the displays.

j) Schematics should show components in the actual physical representation relative to other components (e.g., if A is on top of B, it should be shown that way in the schematic).

k) The orientation of schematics should be consistent among displays, procedures and training materials.
SECTION H3.0
DISPLAY ORGANIZATION AND HIERARCHY

H3.1 GENERAL PRINCIPLES AND RATIONALE
For payload developers using Windows NT/Windows (at a minimum Windows 95) operating systems, the displays should reflect the Microsoft Windows “look and feel.” Displays running under UNIX should be designed with general Motif characteristics (per the Open Software Foundation/(OSF) Motif Style Guide). If there is a conflict between the standards defined in this appendix and the Microsoft Windows and Motif Style Guides, the standards in this section will take precedence. COTS building toolkits (e.g., Labview) can be used if the end product adheres to the general guidelines in this document.

H3.1.1 Window Management
Payload tasks can often involve working with many different types of information, contained in more than one window or view. There are different display techniques that can be used to manage a set of windows. For payload displays, these techniques include the Single Document Interface (SDI) and the Multiple Document Interface (MDI). An SDI consists of only one display with dialog boxes for commanding and option selection. An MDI consists of more than one display in addition to dialog boxes for commanding and option selection. Refer to the “Windows Interface Guidelines for Software Design” for more information regarding the characteristics of SDI and MDI window management.

H3.1.2 Window Types
Window types are classified according to the kinds of information to which they provide access. These types are primary and secondary windows. The primary window provides a starting point and top level information to begin payload operations. It also provides an interface to access secondary windows. Secondary windows provide specific details about the objects and actions included in the primary window and are used to specify parameters. Secondary windows appear within the workspace of the primary window and have a title bar and window decorations similar to the primary window. An example of a secondary window within a primary window is depicted in Figure H3-1.
H3.1.2.1 Dialog Boxes

A dialog box is a secondary window used to issue commands, gather information, provide feedback, and deliver messages (Figure H3-2). Dialog boxes that gather information are typically displayed after choosing a particular menu item or a command button. Message dialog boxes provide feedback and are used to ask questions, confirm actions, and warn of problems. A dialog box that confirms a crewmember’s action is called a confirmation dialog box (Figure H3-3). Refer to Section H3.2.1.1 for information on dialog box title bars and Section H5.1.2 for information on confirmation dialog boxes.
a) The name in the title bar of the dialog box should be consistent with the name of the menu option or push button used to display the dialog box.

b) Related items within the dialog box should be grouped (Figure H3-2).

c) The “OK” button shall be used when a message requires no choices to be made, but only an acknowledgement.

d) The “OK”, “Cancel” button pair shall be used when a message requires selection of options which do not include commands.

e) The “Yes”, “No” button pair should be used when a message is phrased in the form of a question. However, if these choices are unclear, label the buttons with the name of specific actions (e.g., “Save” and “Delete”).

f) The message provided in confirmation dialog boxes should be structured as a question (i.e., ‘Do you want to…’, ‘Are you sure you want to…’).

g) The consequences of confirming an action should be explained.

   Example: Are you sure you want to delete this file? This file will be permanently removed from your hard drive.

h) The default choice for an exit confirmation dialog box shall be “No.”
i) An icon shall not be used in a confirmation dialog box.

j) The information icon can be used on information dialog boxes. Refer to Section H4.3.4.

k) The shortcut key assigned to the “Cancel” button should be the Escape key. No alt-key should be assigned.

H3.2 U.S. STANDARD PAYLOAD LAYOUT

To achieve cross-payload consistency, a standard payload layout has been defined (Figure H3-4). The sections that follow describe the required and optional components of the standard payload layout. For color standards and additional icons for displays, refer to Appendix B and Appendix C respectively.

![Figure H3-4  Standard Payload Layout](image)

**H3.2.1 Required Components**

Some components in the standard payload layout are required on all payload displays. These components are the title bar, time field, primary button panel, Exit button, workspace, and access to the software version number. The following sections discuss the standards and guidelines associated with each component.

**H3.2.1.1 Title Bar**

The title bar identifies each display and contains the navigation path used to get to the display (Figure H3-4). Title bars indicate to the crewmember the current location within a set of displays at a glance.
a) All payload displays shall have a title bar containing a title.

b) Title bar titles shall be in title case (i.e., initial capitalization of all major words).

c) Title bar titles shall be left justified.

d) The title bar of the primary window shall always be visible.

e) The primary window title shall be the payload name completely spelled out and followed by the approved short name or acronym in parenthesis.

f) The secondary window title shall represent the navigation path, where each item in the navigation path is separated by a colon and two spaces. Because the title of the primary window is always visible, there is no need to repeat the short payload name in the navigation path.

Example: If the button labeled ‘Setup’ is clicked, then the ‘Equipment’ button on the Setup window is clicked, the window that appears would be titled: “Setup: Equipment”.

g) Tab labels shall not be included in the navigational path of the display title.

h) The title of a confirmation dialog box to exit the payload software shall be “Exit”.

i) The title of a confirmation dialog box shall be “Confirm”, followed by a short descriptor.

Example: “Confirm Downlink” would be the title of a confirmation dialog box within the Downlink function.

j) The title of an error dialog box shall only contain a short descriptor.


H3.2.1.2 Time Field

GMT format standards are described in Section 4.9.

a) The GMT shall be visible on all primary payload displays in the upper right-hand corner below the menu bar, if one is provided (Figure H3-5).

b) The GMT field shall be preceded by the label “GMT: " with one or two spaces between the colon and the field.

c) The GMT label shall appear as a static label on the background.

d) The time/date information shall appear on a flat non-dimensional field with a white background and no border.

H3.2.1.3 Primary Button Panel

The right-hand side of the standard payload layout contains the primary button panel (Figure H3-4). The purpose of this button panel is to provide access to functions that crewmember
needs frequently or quickly. The use of a button panel is consistent with vehicle displays and is beneficial for accurate cursor control in microgravity.

a) The primary button panel shall contain buttons that represent the primary functions of the payload.

b) Primary buttons should be navigation buttons (i.e., bring up windows within the workspace). Commanding should be done inside secondary windows.

c) Secondary or supplementary functions shall be accessed through a cascading button group on the primary button panel, menu items in a menu bar (Section H3.2.2.3), or buttons within the workspace.

d) The primary buttons should appear in a logical sequence.

e) The primary buttons should be grouped by function using the spacing shown in Figure H3-4 (i.e., less space between buttons within a group, and more space between the button group and other buttons).

f) The primary buttons should include icons selected from Appendix C if the functions can be easily represented as icons. Refer to Section H4.3.4 for further information on icons.

g) Primary button labels shall be used, even when icons are included.

h) Primary button icons shall appear to the left of the labels if icons are used.

i) Payloads that display system-like information (e.g., Electrical Power System) shall use the same icons as the system displays.

j) Payload buttons that display system-like information shall be labeled with the payload name followed by the system name.

Example: “EXPRESS EPS” would be used to label an electrical power system display for EXPRESS.

k) The order of system-like buttons shall be the same as the order specified in the DGCS for system buttons.

l) Shortcut keys (i.e., Alt + key) shall be assigned to all buttons on the primary button panel.

m) Shortcut key assignments within an application shall not be duplicated or violate the standards in Section 13.2.

**H3.2.1.4 Required Button**

Within the primary button panel, Exit is the only required button (Figure H3-4).

a) An Exit button shall be included in the primary button panel to exit the payload software.

b) The Exit button shall be labeled “Exit”.
c) The Exit button shall have Alt + "x" as the shortcut key.

d) The Exit button shall be placed at the extreme bottom of the primary button panel (i.e., not just the last button in the sequence).

e) The exit icon shall be used on the Exit button. Refer to Section H4.3.4

H3.2.1.5 Workspace
The large area to the left of the primary button panel is referred to as the workspace (Figure H3-4). The secondary windows appear in this area.

H3.2.1.6 Software Version
The version number of each piece of software shall be available for viewing to maintain compatibility between the ground and onboard software. Two methods for viewing version information are through an "About" dialog under Help, or by right clicking on the payload logo in the workspace (Figure H3-4).

H3.2.2 Optional Components
Each payload will have different operational requirements that determine display content. Based on these operational requirements, optional areas within the standard payload layout have been defined. Optional areas include the alert bar, payload status area, menu bar, optional primary buttons and the status bar. This section addresses the standards and guidelines associated with each of these areas. If these areas are not included, the space should not be allocated within the display.

H3.2.2.1 Alert Bar
Most payloads will use dialog boxes or the status bar for presenting messages to the crewmembers. However, some complex payloads need to present messages that do not require crewmember action, but do require crewmember acknowledgement. In these cases, an alert bar is included as a component on the payload display (Figure H3-5). Refer to Section H6 for information about payload alerts.

a) The alert bar shall be located in the top left portion of the display area below the menu bar if one is provided.

b) The alert bar should have a drop-down text field.

c) The alert bar shall have an acknowledge button to the right of the text field with a counter field.

d) The alert bar text field shall contain the oldest unacknowledged alert message and the GMT when the message occurred.

e) The alert message in the text field shall be left justified and the GMT shall be right justified.

f) The alert message and the GMT within the text field shall be separated by a minimum of two spaces to visually distinguish each at a glance.

g) The alert bar text field shall have a white background and a sunken (etched in) appearance.
h) Alert bar text shall be bolded to enhance readability.

i) Sentence case shall be used in alert bar text.

j) The alert shall fit within the text field and be viewable without using a horizontal scroll bar.

k) The text field shall drop-down to a maximum of five viewable lines.

l) If there are more than five unacknowledged alerts, a vertical scroll bar shall be used.

m) The alert currently displayed in the text field of the alert bar shall not be repeated in the drop-down list.

n) Wrap around text shall not be used in the alert bar text field.

o) An acknowledge button, labeled “ACK”, shall appear to the right of the text field and include a counter field with a white flat background.

p) The ACK button counter field shall display the total number of unacknowledged alerts.

H3.2.2.2 Payload Status Area

The payload status area is a display area reserved for rack or payload critical information that is required to be displayed at all times (Figure H3-6). This area is never hidden by secondary windows or dialog boxes.

a) A payload status area shall be included only if the payload has data that must be visible to the crewmember at all times.

b) A payload status area should be visually grouped/separated from the rest of the display through borders or spacing.

c) The telemetry fields within the payload status area should have a white, flat background with no border.
H3.2.2.3  Menu Bar
The menu bar appears across the top of a display below the title bar (Figure H3-6). The menus displayed in the menu bar present a list of actions/options that provide supplemental or duplicate functions from the actions/options provided in the primary button panel. If the function is duplicated from the primary button panel, the menu name and the button label should be consistent with each other. Each menu contains a vertical list of choices in drop-down form. Refer to Section 4.23 for further information about menus.

H3.2.2.4  Optional Primary Buttons
This section addresses the physical attributes for the optional buttons that can appear on the primary button panel. These buttons are Home, Setup, Log, and Help (Figure H3-4). For further information concerning the Setup, Log, and Help functions, refer to Section H5.

H3.2.2.4.1 Home
a) A Home button returns to the first in a series of displays that provide the payload status at a glance.

b) The Home button shall be located at the top of the primary button panel.

c) The label for the Home button is not restricted to the word “Home” (e.g. “Health & Status”).

H3.2.2.4.2 Setup
a) The Setup button should be located near the top of the primary button panel since it is typically one of the first functions performed.

b) The Setup button shall be labeled “Setup”.

c) The Setup button shall use Alt + “s” as the shortcut key.

H3.2.2.4.3 Log
a) The Log button should be located near the bottom of the primary button panel, above the Help and Exit buttons.

b) The Log button shall be labeled with the payload name or abbreviation and the word “Log” or “Logs” if there is more than one log file.

c) The Log button shall contain the log icon. Refer to Section H4.3.4.

d) The Log button shall use Alt + “l” as the shortcut key.

H3.2.2.4.4 Help
a) The Help button should be located immediately above the Exit button.

b) The Help button shall be labeled “Help”.

c) The Help button shall contain the help icon. Refer to Section H4.3.4.

d) The Help button shall have Alt + “h” as the shortcut key.
H3.2.2.5 Status Bar

A status bar is used to present messages that are supplemental and do not require a response (Figure H3-7). The status bar may be separated into two to four panels that represent different types of messages. For example, the first panel could be used for instructional prompts (e.g., “Enter password”) and second panel may be used for feedback (e.g., “Downlink completed”).

a) The status bar shall be included only if the payload is providing messages that do not require a crewmember response.

b) The status bar should provide ample feedback to the crewmember about the functioning of the payload.

c) The status bar field shall have a white background and a sunken (etched in) appearance.

d) The text in the status bar shall be bolded to enhance readability.

e) Sentence case shall be used for messages in the status bar.

f) The status bar shall not have a vertical scroll bar to view previous messages.

Figure H3-7 Status Bar

H3.3 ESA Payload Display Template

If a web-based application is being developed for an ESA payload, it should follow the template shown in Figure H3-8. This template takes advantage of the user’s familiarity with Web interaction style, as well as the availability of a vast array of development environments for creating and delivering Web based displays and content. This template also allows for integrated procedures.
The main operational feature supported by the ESA web-based template is a direct mapping of the operations support requirements established in the initial payload operations analysis phase to functions available at the laptop. This is accomplished by dividing the Web page into frames. Number of frames, content, and size, will be optimized for the current task at hand. However, location and orientation of the main services are fixed, as per illustration above (e.g., procedures on the left, main display on the right). Application of this template will also facilitate the process of achieving coherence between procedures and displays.

Frame content will feature task transparent hyperlinks as established in the analysis phase. Optionally, the operator will also be able to call up any available service of his/her choice, on an as-needed basis. Navigation in the ESA web-based template will be supported by a ‘toolbar’ frame from which all operations support services are accessible.

The buttons on the toolbar call up the following services:

- **ODF**: ODF procedures for the payload
- **RefDocs**: Payload reference/supporting documentation
- **Displays**: Task and (sub)rack displays
- **Science**: Visualization of, and interaction with, payload

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*Figure H3-8  Example of a Web based integrated P/L display*

Payload Display Design 8 Sept 00  Appendix H-15
data displays, including video (where applicable)

P/L Log  Access to required payload logs (where P/L is the payload name – e.g., BDPU Log)

Setup  Setup of the payload and its operations support interface

Help  Help on both payload and display topics, in HTML format
SECTION H4.0
DISPLAY AND CONTROL OBJECTS

H4.1 GENERAL PRINCIPLES AND RATIONALE
There are some basic display components that will be used across payload displays. This section identifies those components with standards about their usage, functionality, and physical attributes. These standards are another method for maintaining commonality across payloads. The figures in this section were developed in Visual Basic and do not preclude the use of Motif objects.

H4.2 COMMON CONTROLS
Controls are graphic objects on payload displays that provide interfaces for the crewmembers to navigate, input data, change settings, and send commands. This section will identify how these controls should be used. (propose to move H4.2.1-H4.2.6 to 4.16. Rename display and control objects)

H4.2.1 Check Boxes
A check box is a control used to turn independent attributes or states on and off (Figure H4-1). Any number of check boxes can be set, including none. Check boxes are usually square and have text with or without iconic (picture) labels. The “on” setting is indicated by a marked box.

a) Check boxes shall only be used for option setting/selection (i.e., not for commanding, navigating, or changing modes).

b) Check boxes should be used when setting six or less independent attributes.

H4.2.3 List Boxes
A list box is a scrollable list from which one or more items can be selected or viewed (Figure H4-2). The three primary types of list boxes are as follows:

- Single selection - A list box that presents a scrollable list from which only one item can be selected.

- Multiple selection - A list box that presents a scrollable list from which more than one item can be selected at a time.

- Drop-down - A list box that presents a single selection list box that drops down from an entry field. A drop-down list box should be used when display space is limited.
H4.2.4 Combination or Combo Box

A combination or combo box is a combination of a list box and a text entry field. There are two types of combo boxes: simple and drop-down (Figure H4-3). The simple combo box is an entry field with a selection list below it. The drop-down combo box is an entry field with a down arrow button to its right, which when clicked, drops the selection list down. For each type of combo box, the list box allows only single selections. In addition, the combo box allows manual entry of a selection.

a) Simple combo boxes should be used when the list contains greater than four items. If there are four or fewer items, use radio buttons.

b) Drop-down combo boxes should be used instead of simple combo boxes when space is limited.

H4.2.5 Spin Box (Spinner/UpDown Control)

A spin box is a one line entry field with up and down arrows at one end (Figure H4-4). Values in the entry field can be updated by either clicking the arrow buttons to increment/decrement the value displayed, or by typing in a value. Spin boxes are best used for applications with limited screen space, and for setting predictable, customary, or consecutive values with the cursor.

a) Spin boxes shall be used for entering numeric values only.

b) The arrow buttons should appear to the right side of the entry field.

b) Spin boxes should be used when there are ten or fewer values. If there are more than ten values, a combo box or slider should be used instead (Sections H4.2.4 and H4.2.6).
H4.2.6 **Slider**

A slider is a scale that allows a value to be selected from a continuous range of values (Figure H4-5). An indicator (e.g., arrow pointer) shows the current setting. The slider selects one value or point from a continuous range of values or points.

a) Slider labels shall mark the low, intermediate, and high ends of the operable limits of the scale.

b) Slider tick marks should be provided with consistent increments at consistent intervals.

c) Slider labels shall give the proper units of measure.

d) If the range of values is greater than ten, or if an exact value must be entered, a data field showing the value at the pointer shall be provided.

H4.2.7 **Radio/Option Button**

A radio/option button shall be used to select mutually exclusive settings, not for commanding or navigating (Figure H4-6). Only one radio button in a group can be selected at a time. Radio buttons are usually round in Windows or diamond shaped in Motif. Refer to Section 4.16.3 for additional standards.
H4.2.8 Momentary Push Button
A momentary push button is a control used for commanding or navigating. Refer to Section 4.16 for additional standards and examples. For standard button colors, refer to Appendix B.

a) A momentary push button shall be used for commanding or navigating.

b) The default push button should be indicated with a dashed outline or rectangle box around the button.

c) When selected, the push button should appear as a momentary depression.

d) The color for buttons shall be the standard background color.

H4.2.9 Toggle Button
A toggle button is a control used to set states. It can be represented as a push button or a graphical switch.

a) The labels on toggle buttons shall remain constant (i.e., should not switch or change).

b) When selected, the toggle push button should appear as depressed until deselected.

c) The color for buttons shall be the standard background color.

The following section is under review by IDAGS for inclusion in the parent document.

H4.2.10 Fields
Fields provide an area to view, enter, and edit data.

a) Fields that are editable shall have a white background and a sunken (etched in) appearance.

b) Fields that are not editable (e.g., telemetry) shall have a white, flat background with no border.
c) The field shall be labeled on top or to the left of the data field, followed by a colon and a minimum of one space (e.g., “Pressure: psi”).

d) When feasible, field labels should provide cues beside the label in parenthesis (Figure H4-6).

e) If all data within a group have the same unit of measure, the unit shall appear after the graphical location identifier (GLI) in parenthesis (Figure H4-5, “Fan Speed (rpm)”).

f) If all data within a group do not have the same unit of measure, each data item shall include the unit of measure.

g) When filling in a form-like display, the ability to use the Tab key to advance to the next field and Shift+Tab to return to the previous field should be provided.

h) The ability to directly place the cursor into the entry field should be provided.

i) Fields should not require case-sensitive entries unless required by the operating system or COTS application.

j) When an entry field is used for input of a restricted set of values, crewmember input should be validated immediately and feedback provided.

k) If the entry field contains multiple lines, text wrap around should be provided for each line.

l) Single line fields shall be sized to accept the full entry.

H4.2.11 Tab Window
A tab window provides a set of related displays within a single window (Figure H4-7).

a) Tab windows shall only be used when the tabbed displays are functionally related.

b) Tabs shall have a 3-dimensional appearance.

c) Only one row of tabs should be used.

d) The active tab shall be clearly indicated.
H4.3 DATA DISPLAY

H4.3.1 Color
Specific standards and uses of color for ISS displays are described in Section 4.20 and Appendix B.

H4.3.2 Text
Arial or Helvetica font shall be used on payload displays. Specific standards for text may be found in Section 4.15.

H4.3.3 Labels
Labels are necessary to identify objects that the crewmembers will interact with while operating a payload. Refer to Section 4.13 and Section 10 for further information.

a) All display and control objects shall be labeled.

b) Labels of input and output objects shall be followed by a colon and a minimum of one space.

c) GLIs shall not be followed by a colon.

d) Button labels shall remain static.

e) Button labels should be limited to one word or line. If more than one line of text must be used, then the lines of text within the button label shall be center aligned.

f) Field labels should be limited to one word or line. If more than one line of text must be used, then the lines of text within the label should be left justified with each other.

g) For command buttons, the label should include a verb.
Example: Save, Terminate, Initiate Shutdown

h) Controls that involve the selection of options should not include a verb.

i) GLIs should not begin with a verb.

Example: Use “Laptop Comm” as a label instead of “Select Laptop Comm”

j) All displays and menu items should be named to facilitate recognition.

H4.3.4 Icons
Icons should follow the standards and guidelines outlined in Section 7, Appendix C, and Appendix H. Payload icons found to be unique (i.e., not represented by an existing icon in the DGCS) must be submitted for approval and inclusion in Appendix C. Payload icons that can be used on primary buttons (Figure H4-8) and dialog boxes (Figure H4-9) are shown below.

![Primary Button Panel Icons](image1)

Figure H4-8 Primary Button Panel Icons

![Dialog Box Icons](image2)

Information Icon  Payload Alert Icon  Payload Caution Icon

Figure H4-9 Dialog Box Icons

H4.3.5 Attention Symbol
Payload displays shall not use the attention symbol (Figure H4-10). Refer to Section H6 for other methods of alerting the crewmembers.

![Attention Symbol](image3)

Figure H4-10 Attention Symbol
SECTION H5.0
COMMON PAYLOAD FUNCTIONS

H5.1 CROSS-PAYLOAD COMMONALITY
To achieve cross-payload commonality, which results in increased productivity onboard, payload display functions that are common across payloads should be designed in the same way. This allows crewmembers to very quickly perform common functions, regardless of the type of payload or software platform. The high-level functions described in this section have been identified as common to many payloads. The standards and guidelines in each category should be followed to ensure that cross-payload commonality is achieved. Some common functions identified include indication of processing delays, confirmation of actions and commands, experiment setup, data capturing, and downlink.

H5.1.1 Indication of Processing Delay
Some payload functions such as initializing an experiment or saving files will require a processing delay. The crewmember should be provided feedback concerning the length of the delay. The following list provides the standards and guidelines for indicating processing delays.

a) A short processing delay (e.g., one to five seconds) shall be indicated (e.g., with a “busy” cursor, status bar message, or progress bar). ESA-Columbus and NASDA cannot support this requirement due to software limitations.

b) If a significant processing delay (e.g., greater than two minutes) is expected, then a text message explaining the long delay should accompany the progress indicator.

c) All processes involving a delay greater than five seconds should have a mechanism for canceling the process (e.g., “Cancel” button, “Stop” button).

H5.1.2 Confirmation of Actions
It is important that all functions that are critical or that could result in errors or lost productivity be safeguarded against accidental activation. Refer to Section H3.1.2.1 for further information on dialog box standards.

a) A confirmation dialog box shall be used as the payload equivalent to “two-step” commanding.

b) The following functions shall be safeguarded with a confirmation dialog box:
− Controls which exit an application (i.e., Exit button and ‘x’ in primary window decorations);
− Controls associated with critical functions; and
− User actions that could result in unintended negative consequences (e.g., loss of data).

H5.1.3 Experiment Setup
Many experiments have a common function known as experiment setup (Figure H5-1). This function provides for the input of data items such as crewmember identification, session number, and condition.
a) Whenever the crewmember is required to enter information for setting up an experiment, the information shall be grouped together in a setup function and controlled by a “Setup” button on the primary button panel.

b) The setup dialog box shall contain all of the experiment setup information to be entered (e.g., crewmember identification, trial number, etc.).

c) Fields for entering crewmember identification shall be labeled “Crew ID”.

d) “Crew ID” should be the first parameter listed in the Setup dialog box when used.

e) Input of experiment setup information should be accomplished using controls that do not require free form typing (e.g., drop-down lists).

f) If the setup parameters are shown as status information on the main display, they shall appear above of the workspace in the Payload Status Area (Section H3.2.2.2).

H5.1.4 Help/Online Assistance (Propose to move to section 4.18. Rename Help/Online Assistance)
Assistance should always be quickly accessible and easily understood from within the payload display. There are three basic types of help: context sensitive, non-context sensitive, and tooltips.

H5.1.4.1 Context Sensitive Help
Context sensitive help is on-line assistance that provides information about a particular object and its context. It answers questions such as “What is this?” and “Why would I use it?” The Help information provided is specific to the object selected or the display currently active. For example, the “What’s This?” command, available in most Help drop-down menus and associated buttons, pop-ups, etc., provides context sensitive help.
a) Context sensitive help should be provided where possible.

b) Help should be available for all error messages generated by the payload software.

H5.1.4.2 Non-context Sensitive Help

Non-context sensitive help provides general help information that is not specific to the display object or active window currently open. It is typically a searchable document of information, and the content is very similar to the information found in a help manual. An example of a Help File is shown in Figure H5-2.

Figure H5-3 Help Button on the Primary Button Panel

Figure H5-4 Help on Menu Bar
Tooltips

An additional type of help that can be provided is tooltips. Tooltips are small informational pop-up windows that appear when the cursor is placed over a display object.

a) Tooltips should be available for every push button.

b) Tooltips should explain the function of the button in greater detail than the button label.

Log Files

Several types of log files will be accessible by onboard crewmembers. One type resides in the manual procedure viewer (MPV) on the station support computer (SSC). These log files are accessed through a link within MPV and are for crewmembers to make annotations as requested by the payload.

A second type of log file is a paper log. Crewmembers can record the same type of information on these paper logs as they do in MPV log files. Use of paper log files is discouraged.

A third type of log file, accessed through payload displays, is one that automatically captures and records data events that are generated by the payload hardware and software (Figure H5-5). These automatically captured and recorded log files should be provided and used where crewmembers will be requested to review the history surrounding an event (or troubleshoot a problem with the payload). A payload may automatically record all events into one log file, or multiple log files. Automatically captured and recorded log file use is strongly encouraged.

a) If a log file is used, it shall be accessed through a log button on the primary button panel.

b) If there are multiple logs, they should be accessed via a cascade menu, where the individual logs cascade from the log button on the primary button panel.

c) If a payload generates any alert and/or caution to the crewmember, a log file shall be provided.

d) Files that have been downlinked should be recorded in a log file, which includes filename, file location (folder), and sent date and time.

e) Log files shall be formatted as a table (i.e., columns of data).

f) Columns within the log files shall be labeled to facilitate recognition.

g) If an alert bar is used, a column to indicate acknowledged or unacknowledged messages shall be provided.

h) If a payload annunciates caution (Class 3) messages, a column indicating the class shall be provided.
i) Log files shall have GMT, in the proper format, as the first column of data.

j) Log files shall have the capability of being sorted by any column.

k) The default sort shall be based on the GMT from newest to oldest.

l) Log files should be read only (i.e., not modifiable).

![Log File Table]

**Figure H5-5  Log File**

<table>
<thead>
<tr>
<th>GMT</th>
<th>ACK</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>22Jul99 10:01:43</td>
<td>X</td>
<td>Flashcard is full</td>
</tr>
<tr>
<td>22Jul99 09:47:30</td>
<td></td>
<td>Batch downlink has failed</td>
</tr>
<tr>
<td>22Jul99 09:47:28</td>
<td>X</td>
<td>Laptop comm has been interrupted</td>
</tr>
<tr>
<td>22Jul99 09:42:12</td>
<td>X</td>
<td>Flashcard is 90% full</td>
</tr>
<tr>
<td>22Jul99 07:19:33</td>
<td></td>
<td>Temperature sensor 1 is out of limit high</td>
</tr>
</tbody>
</table>

**H5.1.6 Data Downlink**

Data downlink will be primarily commanded from the ground and will be affected by communication opportunity, Acquisition of Signal (AOS), and available bandwidth. Thus, downlink should be a passive activity for the crewmembers. Downlink capabilities for each payload will vary depending on the planning requirements defined by the payload developer in the Payload Data Library (PDL).

a) Data files to be downlinked shall be configured by the payload developer to be ready for downlink without crewmember intervention (e.g., automatically entered into a downlink list).

b) If a crewmember is required to view a list of downlinked files, the following information should be included: filename, file location (folder), and associated GMT time stamp.

c) An open downlink display shall not be a requirement for file downlink to occur.
SECTION H6.0
PAYLOAD ALERTS

H6.1 GENERAL PRINCIPLES AND RATIONALE
Payloads may generate alerts and/or cautions (Class 3) related to the functioning of the payload hardware and software. Alerts are defined in this appendix. Cautions are defined in the Pressurized Payloads Interface Requirements Document SSP57000 and approved by the Payload Safety Review Panel.

H6.1.1 Payload Alerts
There are two types of payload alerts. The first type of alert only requires crewmember acknowledgement. An example of an alert that only requires acknowledgement is “Flashcard 90% full”. The second type of alert requires crewmember action to continue nominal operations or prevent the loss of science or hardware. An example of an alert that requires an action would be “Flashcard is full. Replace card to continue data collection.” Refer to Section H3.2.2.1 and H3.1.2.1 for further alert bar and dialog box requirements.

a) Payload alerts that only require acknowledgement should be presented in an alert bar.

b) Payload alerts that require crewmember action to continue nominal operations or prevent the loss of science or hardware shall be shown in a modal popup dialog box in the center of the display. These alerts shall not be repeated in the alert bar.

c) Payload alerts in popup dialog boxes should clearly describe the error condition and should provide guidance.

d) Payload alerts shall be logged into a log file if one is being provided.

e) Orange, as defined in Appendix B, shall be used to indicate a payload alert on data field and icon backgrounds.

f) On alert dialog boxes, the payload alert icon Shall be used (Section H4.3.4).

g) If an alert bar is used, the oldest unacknowledged alert shall be presented in the text field of the alert bar.

h) When the “ACK” button in the alert bar is clicked, the alert shall be acknowledged and disappear from the alert bar text field.

i) When an alert appears in the alert bar, the counter shall increment the number of unacknowledged alerts. When an alert is acknowledged, the counter shall decrement.

H6.1.2 Payload Cautions
Some payloads may issue Class 3 cautions.

a) Class 3 cautions shall be allowed only when approved by the Payload Safety Review Panel.
b) Class 3 cautions shall appear in a modal popup dialog box in the center of the display and shall not be repeated in the alert bar.

c) The dialog box that appears as a result of a Class 3 caution should clearly describe the error condition and should provide guidance.

d) Class 3 cautions shall be logged into a log file if one is being provided.

e) Class 3 caution dialog boxes shall be accompanied by the payload caution icon. Refer to Section H4.3.4.
SECTION H7.0

ACRONYMS

The following section is under review by IDAGS for inclusion in the parent document.

AOS  Acquisition of Signal
COTS  Commercial Off-the-Shelf
ESA  European Space Agency
GLI  Graphical Location Identifier
GMT  Greenwich Mean Time
HCI  Human-Computer Interface
HTML  Hypertext Markup Language
IDAGS  Integrated Display and Graphics Standards
IP  International Partner
ISS  International Space Station
MDI  Multiple Document Interface
MPV  Manual Procedures Viewer
NASDA  National Space and Development Agency of Japan
ODF  Operation Data File
PD  Payload Developer
PDL  Payload Data Library
PDRP  Payload Display Review Panel
PODF  Payload Operations Data File
POIF  Payload Operation Integration Function
SDI  Single Document Interface
SSC  Station Support Computer
SECTION H8.0
REFERENCES

Payload Developer Resources (documents, links, icons, etc.) may be found at the PDRP website: http://payloads.msfc.nasa.gov/pdrp/

Information from the following documents was used in the development of this document and may be helpful to display developers.


Flight Crew Operations Concept (JSC 27099, Rev. 2). NASA Johnson Space Center.


PCS Command and Data Software Interface Definition Document (JSC 27439). NASA Space Station Program Office.

Payload IRD (SSP 57000). NASA Johnson Space Center.


U.S. Payloads Display Management and Process Plan (SSP 50319)

The following additional documents may also be useful to payload developers in display design.


