

In-Flight Maintenance Console Handbook

Mission Operations Directorate
Systems Division

Basic, Rev. E
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National Aeronautics and
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Lyndon B. Johnson Space Center
Houston, Texas

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In-Flight Maintenance Console Handbook

Basic, Rev. E

Prepared by

Original approval obtained

David Wisniewski, Book Manager
In-Flight Maintenance Group

Approved by

Original approval obtained

Victor Badillo, Lead
Mechanical Systems and In-Flight Maintenance Group

Original approval obtained

Jeffrey Kling, Manager
Mechanical, Booster, and
Maintenance Systems Branch

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

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PREFACE

This document has been prepared by the In-Flight Maintenance (IFM) console operators of the In-Flight Maintenance Group under the authority of the Mechanical, Booster, and Maintenance Systems Branch, Systems Division, National Aeronautics and Space Administration, Lyndon B. Johnson Space Center.

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PURPOSE

The purpose of this document is to provide the IFM console operator with a single detailed reference source to aid in efficient operation in the Mission Control Center during both simulations and real-time space shuttle missions. Included in this document are rationale and detailed descriptions of previously developed published IFM procedures, all pertinent information thought to be useful as console aids, off-console duties and procedures which support the console job, and guidelines for using other sources of reference.

SCOPE

Information provided in this console handbook addresses systems, procedures, and reference material intended to be used during space shuttle flights. Flight-specific information is provided in flight rules, cargo systems manuals, and other documents produced for each flight.

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IFM CONSOLE RESPONSIBILITIES

INTRODUCTION

The In-Flight Maintenance (IFM) console position was established to provide real-time mission support for IFM activity during Space Shuttle Program (SSP) flight operations in the Mission Control Center (MCC). In addition, the IFM console is responsible for crew equipment (including photography and television equipment) and its stowage. The IFM console is responsible to the Mechanical, Maintenance, Arm and Crew Systems (MMACS) Flight Control Room (FCR) position.

The prime responsibility of the IFM console position is real-time mission support to ensure that any IFM activity is executed in an accurate, safe, and timely manner. This encompasses both preconceived IFM procedures that reside in the Flight Data File (FDF) IFM checklist and the procedures that must be developed and validated real time to remedy unforeseen failures. For any IFM activity that occurs during flight operations, the IFM console operator acts as the center of coordination. It is the IFM position's responsibility to know the experts to consult; where to find applicable data; how to modify existing procedures or write new procedures; safety considerations; orbiter hardware configurations; tools, equipment available; and past flight history. All of these add up to create an accurate, safe, and timely execution of IFM procedures during real-time operations.

Accuracy, safety, and timeliness are of critical importance. Accuracy is ensured in the development process by making certain that all applicable personnel are given an opportunity to participate and provide inputs. The IFM operator has the responsibility to ensure that this process takes place. Safety considerations are built into the development process. The same personnel who provide inputs to ensure that the procedure is accurate are also ensuring that the procedure is safe. In addition to initial development, all new or updated IFM procedures are sent to the Mission Evaluation Room (MER) in the MCC for a technical and safety review. If possible, personnel from the MER arrange for validation and verification. Following MER concurrence, IFM procedures are prepared for uplink to the orbiter by the Flight Activities Officer (FAO). Prior to uplink, the procedures receive a total flight control team review, just as all uplink messages do. Finally, all procedures must be given approval by the Flight Director (FD) before transmission to the crew. Given the complex process, timeliness is important to ensure that IFM development takes place in a useful manner. Accurate, safe, and timely procedure development is all built into the console operator's certification training.

The IFM console operator also serves the flight control team with expertise in crew equipment, stowage, and photo/TV. This expertise consists of knowing the equipment and how it is used and knowing how the crew has been trained in its use. It also includes being familiar with all crew systems and photo/TV reference material, such as workbooks, FDF, equipment specifications, and engineering drawings. The IFM console operator must be thoroughly prepared to answer any and all questions and solve any problems that may arise regarding this equipment during flight operations.

Overall, the IFM console position's expertise consists of crew equipment systems knowledge, orbiter hardware configuration and access, tools and crew capability, in addition to past flight experience. This expertise is obtained through the console certifications training flow, study of past data, and actual console experience during both simulations and flight operations.

TITLE

COORDINATION

PURPOSE

During real-time mission operations, two types of IFM procedures are encountered. There are preconceived procedures, which reside in the FDF IFM Checklist, and unplanned procedures, which must be developed real time. Because of the difficulties of implementing IFM procedures real time, the IFM console has been established to act as the center of coordination for IFM activity.

Coordination is the IFM console operator's function in developing new IFM procedures as well as implementing existing procedures in the MCC. IFM is different from most other console positions in that it does not own an orbiter system. The IFM console position is not responsible for data, systems analysis, or systems orbiter hardware and does not perform constant data monitoring. Therefore, the IFM position is free to perform its role of coordination.

The complexity of the orbiter coupled with the large number of people involved in mission operations makes coordination a necessity. The ideas that spark IFM procedure development may come from anyone, but not everyone has all of the expertise necessary to create a procedural solution (including the IFM console). This is especially true where failures affect more than one orbiter system. For example, a problem with the KU-band antenna may require expertise from the INCO, MMACS, and EGIL consoles to create the best solution. Each of these positions may have ideas for an IFM procedure; without coordination, they may actually develop three very different, independent solutions, none of which may be the best solution. Therefore, the IFM console position has been established as a central point of coordination.

Coordination makes IFM a practical endeavor. The IFM console takes a potentially fragmented waste of time and turns it into a safe, accurate, and timely solution, through a team effort. IFM is the center of action for developing and implementing IFM procedures in the MCC. Ideas for IFM procedures must be formally processed and reviewed. Neither IFM nor any other position develops procedures autonomously. To be considered valid, a procedure receives input from and must be given a thorough review by the team for accuracy and safety.

The IFM console operator has expertise and tools that no other MCC position possesses for developing these procedures. It has the expertise regarding orbiter hardware, accessibility, tools and equipment, and past flight experience. Orbiter and payload systems expertise resides elsewhere and is consulted by IFM when such expertise is required. That consultation may involve MCC flight team orbiter/payload systems experts, interface with the engineering community through the MER, and raw data such as drawings, specifications, schematics, photographs, or other sources. The IFM console ensures that all pertinent data sources are utilized.

The MCC flight team is made aware of the current status either through MMACS or directly to the FD. This gives an IFM effort exposure to the whole MCC community. This exposure is important because it ensures that all personnel who may have pertinent contributions will be aware of an IFM procedure in development and may participate in that development.

The MMACS console is IFM's representative in the FCR. MMACS has the responsibility of keeping the MCC team current with an IFM activity. When called upon to explain the details of a proposed IFM procedure, MMACS has the option of deferring to IFM for clarity. In turn, IFM may and should defer to other console positions for clarity when appropriate.

The MMACS console has orbiter mechanical systems responsibilities, in addition to its IFM interface to the MCC flight team. MMACS must be aware of potential IFM situations. IFM routinely monitors various voice loops to maintain awareness of failures with a potential for IFM activity.

An element of coordinating IFM procedure development is prioritizing efforts. The IFM console may often become involved with several procedures simultaneously. When this occurs, there must be a clear order of preference so as to make the most efficient use of time and resources. Sometimes a priority may be assigned by the FD; other times the FD may request priority from the IFM console.

Setting priority may involve many considerations. A definite priority may be obvious, or it may be arbitrary. Obvious priorities are crew or vehicle safety, restoring critical orbiter functions, and restoring critical redundancy. IFM procedures that affect mission success are lower priority, but mission success procedures that require real-time development will often take priority over a mission-critical canned procedure (i.e., one that has been developed preflight), if the time frame permits. A procedure to restore a middeck experiment to an operational state can take precedence over a failure that affects critical function redundancy if that redundancy is not required until later in the flight, such as in the case of a CRT failing several days prior to entry. The CRT can wait while immediate attention can be focused on the experiment. There are not always obvious priorities. In these cases, a priority is established through mutual agreement among those working on the proposed IFM procedures. In some instances an IFM involving critical functions may require the operator to consult with the flight rules for aid in determining priorities.

MCC operations are the result of a team effort. For the team to work effectively, cooperation is required from everyone. When an IFM procedure is required, the IFM console must coordinate the effort properly so that all parties involved can cooperate to form a safe, accurate, and timely solution.

TITLE

STANDARD CONSOLE TOOLS

INTRODUCTION

The IFM console operator makes use of a standard set of console tools (hardware and software) in its support of space shuttle missions. These tools are a subset of those used by most positions in the MCC because it is not necessary for IFM to monitor or log real-time data.

DESCRIPTION

The IFM console operator uses the following multipurpose support room (MPSR) tools:

- Mission clock
- Digital Voice Intercommunications System (DVIS) (with FD talk capability)
- Digital TV displays - Used for uplink message review and channel attach for data observation
- TV-radio frequency (RF) channels and light valve channels (dedicated TV)
- Phone with offsite and long distance enabled
- Storage - Currently one locker, one file cabinet, three bookcases, and two tables
- Photocopier access
- Fax machine access
- Scanner – Used to scan paper images/photos into the PC using the PhotoShop software
- TV Camera – Set up to photograph small 3 dimensional objects and providing feedback to the TV monitor on the rack. Linking images to the PC can be done using the proshare software
- Video Cassette Recorders (VCR) (2) – Two VCRs with record and playback capability located on the rack
- 8 mm Cassette Recorder (1) – Also on the rack, the 8mm cassette recorder is used to playback 8mm video such as Orbiter systems video taken at Crew Equipment Interface Testing
- Personal Computer (PC) (2) – Used to develop procedure, maintain flt/sim logs, access to the Shuttle Drawing System (SDS), and the Boeing North America (BNA) connector analysis web page

- DEC Alpha Computers (2) – Used to access mission specific information and downlinked orbiter data
- Optical Disk Recorder (2) – Use to record images from the video rack, either from the camera, snappy, or video downlink

REFERENCE DOCUMENTATION

TBD

TITLE

CONSOLE INITIALIZATION

PROCEDURE

Log onto the Personal Computer (PC), JSCMODM and JSC domain passwords required. The PC is used to maintain an electronic flight or SIM log file. Access to Baseline Accounting and Reporting System (BARS), the Shuttle Drawing System (SDS)(Password Required), and the Boeing North America (BNA) Orbiter Electronic Notebooks are also available via the PC. The most current locker layout is obtained through the PC, using windows explorer. The PC is also the tool that is used to generate flight notes and to write any new IFM procedures as required, in addition to storing previously written "Hip pocket" procedures. The Crew Compartment Configuration Drawings (CCCD) can also be found on line. A hard copy of the CCCD is also kept on the bookshelf.

Log on to the Deck Alphas for access to the malfunction (MAL) procedures, in addition to the mission duration timeline and other mission specified data. The Deck Alphas also provide access to the Anomaly and Chit reporting systems. During a Sim the DEC Alphas can also be initiated with the current Sim pack information.

Log on to Digital Voice Intercommunication Subsystem (DVIS), by touching the screen, using the four-digit identifier for that particular DVIS. Once logged on select the appropriate communication loops.

During a mission, the TV monitor and VCRs on the Rack are turned on in preparation to record mission information. During a Sim the rack may not be used, depending on the type of Sim.

IFM APPLICATIONS

Since the IFM console operator does not monitor real-time data, there are few displays that are utilized. The most commonly used displays are:

On the PC the flight log is usually kept up so that current entries can be made as required. The BARS report may also be kept available for answering any manifesting/stowage type questions.

On the DEC Alphas the Mission Clock is kept on the screen. The Environmental, Emergency Consumables management (EECOM) window called the "MEGA ORBIT" is left up specifically to monitor orbiter functions. This window is not required but gives the IFM person insight to orbiter systems operations.

TITLE

DIGITAL VOICE INTERCOMMUNICATIONS SUBSYSTEM (DVIS)

INTRODUCTION

The DVIS system is the primary communication system within MCC. DVIS allows communication between flight control disciplines, MCC, and outside lines, as well as station calling. DVIS, via a touch sensitive screen, provides the user with the capability to select from 10 pages, each with 24 loops, any of which can be monitored. In addition, the DVIS system allows the user to customize any of the 10 pages by providing a loop directory from which desired loops can be chosen.

BACKGROUND INFORMATION

New DVIS users should read the DVIS Keypad User Training handout to learn how to operate the DVIS keypad.

DESCRIPTION

DVIS loops consist of TALK/LISTEN (TL), TALK/LISTEN/MONITOR (TLM), HIGH MONITOR (HM), MONITOR (M), PABX, and DIAL CALL modes. The loop description denotes the function of the selected loops. The following is a description of the types of DVIS loop functions:

- TL Provides talk and listen capability only for a loop selected with this mode. If any other loop with TALK mode capability is selected, this loop will automatically be deselected.
- TLM Provides talk, listen, and monitor capability for a loop selected with this mode. This mode is used when continuous monitor capability is needed on a loop. If another loop is selected for TALK, the previously selected loop with TLM mode will automatically deselect TALK and maintain monitor capability.
- M Provides monitor capability only for a loop selected with this mode. The loop cannot support the TALK function.
- HM Provides same function as M but the volume is louder.
- PABX Provides on- and off-site phone dialing capability for a loop selected with this mode.
- DIAL Provides the user with a DVIS-to-DVIS communication line that is independent of the CALL standard loops. This communication loop is primarily used for conversations between flight control team members that are not to be monitored by other users.

The IFM console has two DVIS keysets (keyset ID numbers 4251 and 4252). A splitter is available in the IFM locker behind the console if the four jacks provided on the console are not adequate. The following loops are considered mandatory for usage during IFM operations. Additional loops may be utilized as required.

AFD CONF	EECOM
A/G 1	EGIL
A/G 2	PAYLOAD
A/G UHF	PAYLOAD CONF
FD	PRIME OPS
IFM COORD	MER
MMACS	SPAN
MOCR SYS	

The IFM console is one of very few MPSR positions with TALK capability on the FD loop. Often loop conferences about IFM procedures involve direct IFM console interface with the FD.

REFERENCE DOCUMENTATION

DVIS Keyset User Training (June 1990).

TITLE

IFM CONSOLE SHIFT HANDOVER CHECKLIST

PROCEDURE

1. Log on-console time into console log
2. Review:
 - Console Log (chronology, handover notes, flight notes, and miscellaneous paperwork)
 - Anomaly Log
 - Execute packages/uplinked messages
 - MER chits
3. Monitor Alternate Flight Director (AFD) loop for start of Flight Control Team handover
4. Oral Briefing with off-going IFM, including:
 - Problems in work
 - Procedures in work
 - Status of video tape recorder (VTR) recordings
 - Chits in work
 - General status
5. Oral briefing to oncoming MMACS, including:
 - New problems since last shift
 - Procedures in work
 - Chits in work
 - General status
6. Post-handover;
 - Check console configuration/status
 - Prepare VTR tape for recording
 - Check MER for status of chits

TITLE

SHUTTLE CONNECTOR ANALYSIS NETWORK (SCAN)

PURPOSE

The Shuttle Connector Analysis Network (SCAN) is a set of hardware and software located in the IFM MPSR. SCAN provides information about the specific functions of conductor paths and circuit segments passing through a connector (pin or socket function). A SCAN printout provides the following types of information: associated orbiter system (SYSTEM), pin or socket number (TERM), function description (REMARKS), and circuit segment identifier (CIR-SEG). This information is often needed during the development of an IFM procedure involving wiring harnesses leading to crew module (CM) panels and controls (for troubleshooting purposes, or for producing workarounds for problems involving power or signal paths). The SCAN software produces information which relates connector pin or socket numbers to circuit segment identifiers (wire ID's). This can be related to a map of the connector face to determine which pin or socket is to be utilized in a procedure. This information is also valuable in identifying which wire should be accessed in a wire harness leading to a connector.

SCAN is utilized by input of a Rockwell reference designator. In most cases, the short form reference designator is sufficient (i.e., an area designation number, followed by a connector designator (P# or J#); for example, 30P128). In some cases, the short form will not work, so the full reference designator is required (i.e., 30V77W5Pxx).

GENERAL

An Integrated Schematic Index is located in the IFM Office, the DF Library, and on the IFM console. The Integrated Schematic volumes are available in the DF Library and beside the EGIL console in the MPSR.

PROCEDURE

It is necessary to have a reference designator as input. This information may be determined by researching the Integrated Schematic Index. This index will provide a drawing number and zone in the orbiter Integrated Schematics. The appropriate drawing is researched to determine the applicable connector, which may then be used as input to the SCAN. A display of the appropriate information is obtained, which may be forwarded to the printer for hard copy.

1. Utilize the Integrated Schematic Index (for the orbiter concerned), Control and Display (C&D) section, to find the applicable Integrated Schematic Drawing and Zone (DWG-ZN) number.
2. Utilize the specified Integrated Schematic drawing (for the orbiter concerned), and zone, to determine the applicable area and connector numbers.

3. Enter the area and connector numbers (XXPx . . . or XXJ . . . where XX = area number and x . . . = connector number) into SCAN.
4. Select printout from SCAN for a listing of pin or socket numbers (TERM) and associated circuit segment (CIR-SEG) identifiers (ID's).

REFERENCE DOCUMENTATION

1. IFM Checklist, Electrical Schematics section.
2. Integrated Schematic Index - Meas./Stim, C&D, Connectors (for appropriate orbiter).
3. Integrated Schematic (for appropriate orbiter).
4. SCAN Handbook.

TITLE

IFM CONSOLE REAL-TIME DOCUMENTATION MANAGEMENT

PURPOSE

This procedure defines the method for managing and cataloging documentation that arrives at the IFM console during real-time operations. Standard techniques are defined for keeping the information readily obtainable by all IFM console operators.

PROCEDURE

Information is kept in several forms on the IFM console during a mission. A combination of electronic files, binders, clipboards, and file folders are used to keep the amount of loose paper down to a minimum and allow ready retrieval of necessary information. At the start of a mission the first IFM console operator is responsible for setting up the mission log, which is kept on the PC. The mission log is a Microsoft Word file and is located on the D drive at: D:\fm*flt**flt*log, where *flt* is the mission designation and *flt*log is the mission log word file. The initial IFM operator will most likely have to create both the flight directory and mission *flt* log. At the end of each shift the IFM console operator will make a print out of that shift's log file and file it in the IFM console log book. Each copy of the log that is entered into the console logbook is to be signed by the off going console operator.

Before each flight, the lead IFM operator should ensure that the following items are cleaned of old flight and simulation data and are properly labeled and available for use.

IFM Log Binder - The IFM logbook binder is usually a three-ring binder with the following subdivisions:

- Chronology (contains a copy of the electronic log and copies of any flight notes that are written)
- Handover notes
- Hard copies
- Procedures written (each version or revision)
- MER chits

Execute Package Clipboard - This is a free-hanging clipboard on which the execute packages are kept. This clipboard is kept hanging on the side of the "rack" on the right side of the IFM console display area. Only final, distributed copies are retained, and these packages are kept throughout the flight. None are discarded until after landing. However, any package that contains IFM-pertinent procedures, information, etc., should be retained for the archive log.

Anomaly List/MER Chit List Clipboard - The MER chit list and attached data and the Anomaly List are kept on this free-hanging clipboard. During the mission, when a subsequent list arrives, the previous list may be recycled.

Miscellaneous Clipboard - This clipboard is used to store items such as preflight briefings, status reports, uplinked messages, etc.

BARS Reports - Prior to launch for each flight, the MER will provide a Baseline Account Reporting System (BARS) report via Email to the IFM lead console operator for the mission. It is the responsibility of the lead IFM console operator to save the BARS report to the mission directory on the D drive (D/Ifm/*flt*, where *flt* is the mission designation)

Modular Locker Layout - The most recent locker layout sheet should be attached to the right of the IFM console display area, on the side of the "rack", with the proper mission page exposed. This will aid in efficient determination of answers to stowage questions. The modular locker layout can be found on the PC in the following directory: From Windows Explorer go to the JSC Internal Web page, select "Org List". Next select "SP3-Crew Station Branch" from the list. This spawns another window in which you will next select "Crew Systems Integration Group (CSIG)". From the next window you will click on the appropriate flight number, i.e. STS-91. Once the appropriate flight has been selected a new window will pop up giving you the option of pulling up the modular locker layout for that flight.

Flight Data File - All FDF updates should be incorporated prior to launch. Any missing documents should be replaced by acquiring another copy or copying another at the reproduction room or MPSR copier. It is the IFM console operators responsibility to ensure that the most current FDF updates are incorporated.

Cargo Systems Manual - The cargo systems manuals (CSM's) for the current flight should be placed into a three-ring binder and should be available at the console for real-time reference. Upon completion of the mission, flight-specific CSM's should be recycled (unless designated for use on multiple flights), and generic CSM's should be stored in the IFM CSM file cabinet.

Photographic Equipment Stowage - See Modular Locker Layout above, or Crew Compartment Configuration Drawings (CCCD). See also the mission specific 2001 document.

Photographic Configuration Settings - See Photo/TV Check List and Flt Specific Supplement. See also cable routing diagrams.

Crew Worn/Carry-on Assembly - See Crew Worn/Carry-On Assembly drawings. Provided by Crew Systems Personnel.

Crew Compartment Configuration Drawing (CCCD) - The CCCD drawing's are located on the web at the following address:
http://jsc_Chab.jsc.nasa.gov/sf_intra/csigt/shuttle/scsig.htm.

TITLE

ACQUISITION OF SUPPLIES FOR CONSOLE

DESCRIPTION

There is no formal procedure for the acquisition of supplies for on console use. Any required supplies are obtained from the IFM office or the DF5 branch office. Adequate supplies are usually kept on console, in the locked storage cabinet.

TITLE

EVA CALLUP

PURPOSE

To define the procedure for contacting extravehicular activity (EVA) personnel for flight support.

INTRODUCTION

EVA personnel do not provide full-time support for flights on which there is no planned EVA activity but are on call for such missions. When a condition that may require a contingency EVA arises, the MMACS flight controller is responsible for EVA callup upon direction by the FD. MMACS will direct IFM to perform the callup.

Prior to each mission, a console manning document (STS-XX EVA Manning List and Plan) (Figure 1.10-1) is received from the EVA office. It is placed under the clear plastic cover on the IFM console for easy reference. This document will list shift, team roster, and beeper number. The EVA office should be contacted if this document is not received by the first prelaunch shift.

PROCEDURE

Upon notification to IFM by MMACS of the requirement to call in EVA, the EVA contact for the appropriate shift will be contacted by beeper number. Upon EVA contacting the IFM console, arrival time and personnel arriving will be noted in the log and forwarded to MMACS. The IFM console operator should briefly describe to EVA the problem requiring callup so that EVA may determine additional requirements for support.

STS-59 EVA MANNING LIST AND PLAN

The EVA team is on an “on call” basis in support of the mission. Execution of contingency EVA Space Radar lab antenna stow (tri-drive motor linkage disconnect, and forward and aft strut attachment) are part of the FRD agreement if conditions should arise.

Launch: April 7 (Thursday), 1994
 Window: 0607 – 1437 CST (1207 GMT)
 Scheduled launch time: 0707 (weather dependent)
 For a launch slip the launch time will decrease by 1 minute per day.
 Radar lab stow: FD 8
 Land KSC: FD10 (April 16, 1994)

Shift	Team roster	Beeper numbers
Execute:		
FCR	Tom Doeling	891-9269
Task	Randy McDaniel	891-9281
EMU	Keith Johnson	891-9270
Planning A		
FCR	Bob Adams	892-9283
Task	N/A	
EMU	Mike Ness	
Planning B		
FCR	Sue Rainwater	891-9284
Task	Wayne Wedlake	
EMU	N/A	

Please pick up your beepers at Celeste’s desk

cc: Celeste Halata, John Shimp, Mike Maher, Jeff Stone, Ronnie Rogers.

Figure 1.10-1. STS-59 EVA Manning List and Plan (example)

TITLE

SPACECRAFT ANALYSIS (SPAN)/MISSION EVALUATION ROOM (MER)/IFM
INTERFACE

INTRODUCTION

The SPAN provides a real-time interface between the Mission Operation Directorate (MOD) Flight Control Team (FCT) and the management representatives of Space Shuttle Program (SSP), International Space Station (ISS) Program, and MER. The SPAN also provides real-time interface through the Customer Support Room (CSR)/payload customer.

GENERAL

SPAN manages the Mission Action Requests (MARs) system, which are used as the official method to document the exchange of data between the FCT and SSP MER. MARs are generally referred to as Chits that may be initiated by MOD FCT, MER, and CSR. Chits are used as the official method for the FCT to exchange the following data:

- A. Provide a means of drawing upon expert technical knowledge and the assistance of specialist outside the FCT (other JSC and NASA organizations, contractors, etc.).
- B. Provide test data, hardware and software historical information, and maintenance information.
- C. Provide in depth, near real-time system performance, thermal, software, and loads analysis to the FCT by project elements including payload customers.
- D. Provide an interface and coordination for modification of flight objectives and changing the flight priorities.
- E. Document requests from customers for flight extensions or changes to flight plans that might affect flight activities and customers. Documenting requests in a Chit reduces confusion and ensures that everyone is operating to the same data set.
- F. Provide assessments and approval of non-standard operations by program/project elements.
- G. Provide means for the FCT to obtain safety reviews/assessments during flight operations.
- H. Provide means for FCT to obtain IFM reviews/assessments and procedures verification.
- I. Document agreements and traceability of onboard transfer items.

The SPAN manages the FCT anomaly log for SSP and ISS programs. The FCT anomaly log is shared with MOD officials.

SPAN provides technical and facility support as required:

- A. SPAN calls up technical team and facility support as needed, including Astronaut support for IFM reviews, procedure validation, etc.
- B. Manages and schedules Action Center Support
- C. Assist the FCT as determined by MOD Flight Director

IFM SPAN/MER coordination is needed when specific data is required to support real-time procedure development either from test, history, or analysis.

TITLE

REAL-TIME PROCEDURE DEVELOPMENT AND SAFETY CONSIDERATIONS

Note: The following information describes the process of developing IFM procedures real time in the MCC. It is intended as a guide for IFM console operators to ensure that IFM procedures fulfill the goals of being accurate and safe and that they are developed in a timely manner. This particular segment of the console handbook describes developing new IFM procedures real time. Other segments describe developing IFM procedures preflight and the IFM coordination process.

INTRODUCTION

All IFM procedures begin with the idea: Can it be fixed? This idea can come from anywhere or anyone. It may be the result of an actual failure or this question may be in someone's mind prior to any failures. Such is the nature of real-time mission operations. Console operators not only monitor system status but also must constantly be aware of possible failures. Foremost in an operator's mind is the next worst failure and what must be done should that failure occur. Thus, IFM ideas are often generated when no failure has occurred.

IFM is not always foremost in the mind of other console operators in the MCC, but it should always be foremost in the mind of the IFM console operator. The IFM console should maintain awareness of all orbiter/payload failures. This is accomplished by constantly monitoring appropriate loops and reading anomaly logs and flight plan updates. The operator must stay constantly alert to what is going on around the MCC. IFM provides a service to the entire MCC, not just the MMACS console. Because IFM is part of the MMACS multipurpose support room (MPSR), the operator cannot develop tunnel vision to the rest of the MCC.

The IFM console operator should not wait to be told to investigate an IFM possibility, and should keep the MMACS front room console operator cognizant of anything that is being worked. Voice traffic over the loops should be kept to a minimum. Extended conversations concerning failures should be conducted face-to-face when possible. During loss of signal (LOS) periods or slow periods, tour the back rooms and just talk with people. There are a lot of ideas that are not said over the loops or written down that run through the minds of other flight controllers that may spark an idea about the possibility of developing an IFM procedure.

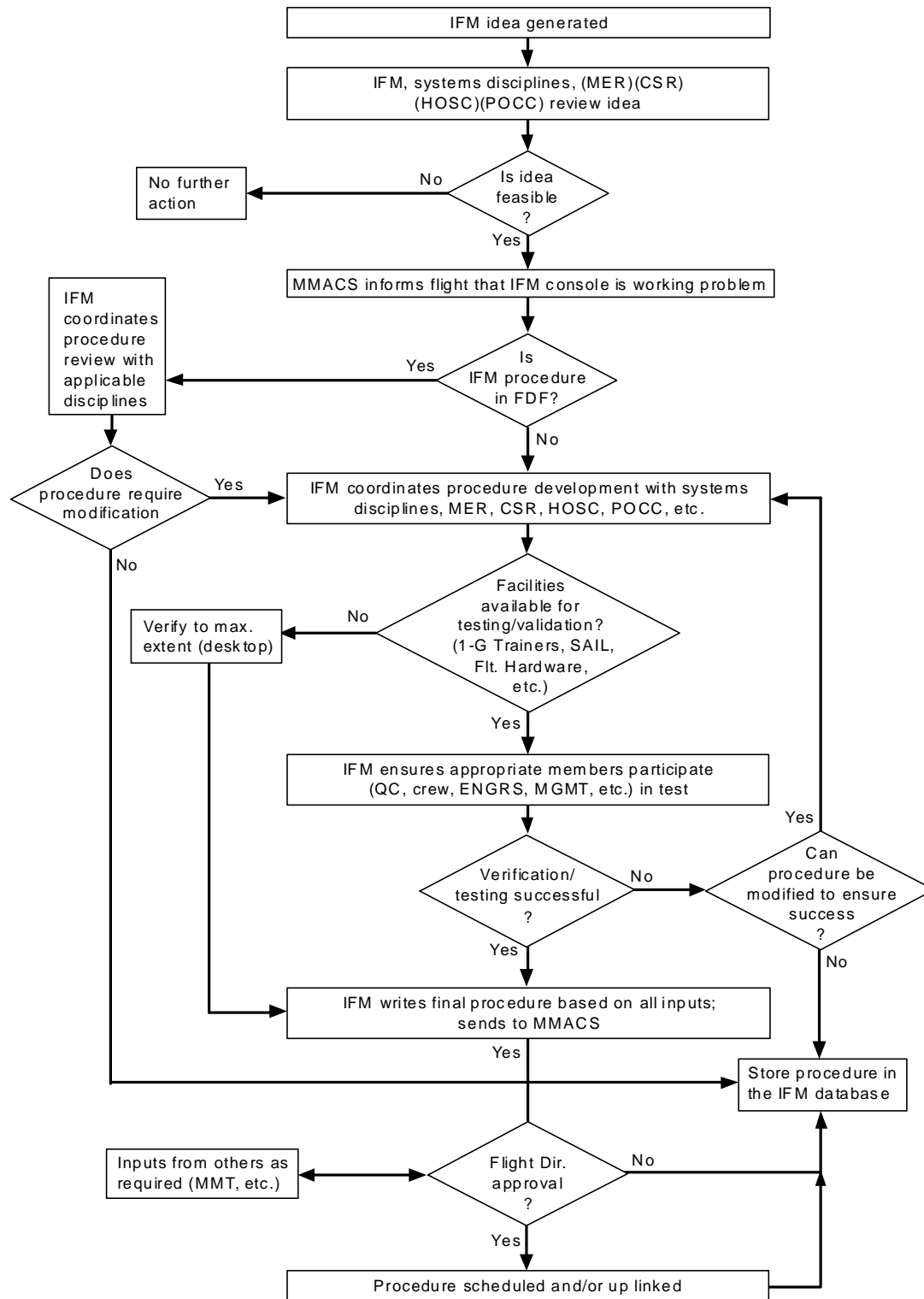
After developing the idea (Can it be fixed?), the IFM console must then go about the process of creating a workable solution. Using the resources available in the MCC, the IFM console can then go about developing an IFM procedure in real time in the following manner:

1. Analyze the IFM idea in terms of feasibility.
 - a. Risk assessment
 - (1) Crew accessibility
 - (2) Crew training on same/similar hardware
 - (3) Assessment of the following in terms of accomplishment versus gains in operational capability:
 - (a) Difficulty of accomplishment.
 - (b) Complexity of the task.
 - (c) Other risk factors; what are the unknowns?
 - b. Data requirements
 - (1) Is all pertinent data available to make a good decision about the safety and effectiveness of proposed fix?
 - (a) Is structure affected?
 - (b) Is the hardware isolated during the procedure?
 - Electrically
 - Physically
 - Fluids contained
 - Debris/contamination problem
 - (2) Has coordination been effected with appropriate people to obtain the data required to determine feasibility?
 - (3) Are the sources of the data reliable?
 - (a) Is the IFM database correct?
 - (b) Have Kennedy Space Center (KSC) technicians been consulted?
 - (c) Has the MER been used to its maximum extent (including safety, quality, and subsystem managers)?
 - (d) Has the problem been reviewed in detail with the Astronaut Office (e.g., SPAN astronaut representative)?
 - (e) Has the problem been thoroughly coordinated with flight team members?

- (f) Have other IFM engineers been consulted?
 - (g) Have Boeing – Huntington Beach contacts been utilized to the fullest?
 - (h) Do payloads people have enough information about their hardware for them to make a sound decision about an IFM procedure?
2. If a procedure is feasible, continue the process.
- a. Write a draft procedure. Ensure it is reviewed by:
 - (1) At least one other IFM engineer. If time permitting, the new IFM procedure is to be looked at by at least three IFM console operator shifts.
 - (2) Appropriate flight control team members.
 - (3) MER via MER chit (MER will call for appropriate engineering inputs/concurrence).
 - (4) Payload officer and customer support room (CSR) representative (for payload procedures).
 - b. Arrange for testing/validation of procedure in flight or flight-like hardware.
 - (1) MER coordination with SAIL for testing and use of engineering and development (E&D) facilities (vacuum chambers, for example).
 - (2) IFM coordinate with 9a for CCT, full fuselage trainer (FFT) testing.
 - (3) Ensure that all appropriate parties attend testing, particularly an Astronaut representative, subsystem manager, and flight team personnel, as required.
 - c. Are there other requirements or considerations?
 - (1) Is positive identification of the hardware (e.g., wires, fluid lines, connector pins) possible?
 - (2) What is the effect on surrounding hardware due to crew access?
 - (3) What physical and/or functional effect does an electrical IFM have on other electrical components?
 - (4) Has every reasonable safety precaution been aired and discussed with pertinent parties (e.g., FLIGHT, CAPCOM, other crew reps, and flight control team)?

- d. Write a final procedure based on all inputs/test results. All eyes review via a hardcopy, Jedi, and/or e-mail.
- e. Procedure approved and uplinked (procedure may be held pending future failures in some cases).

The preceding process is also useful for modifying existing IFM procedures. The entire real-time IFM development process is illustrated in the following flow charts.

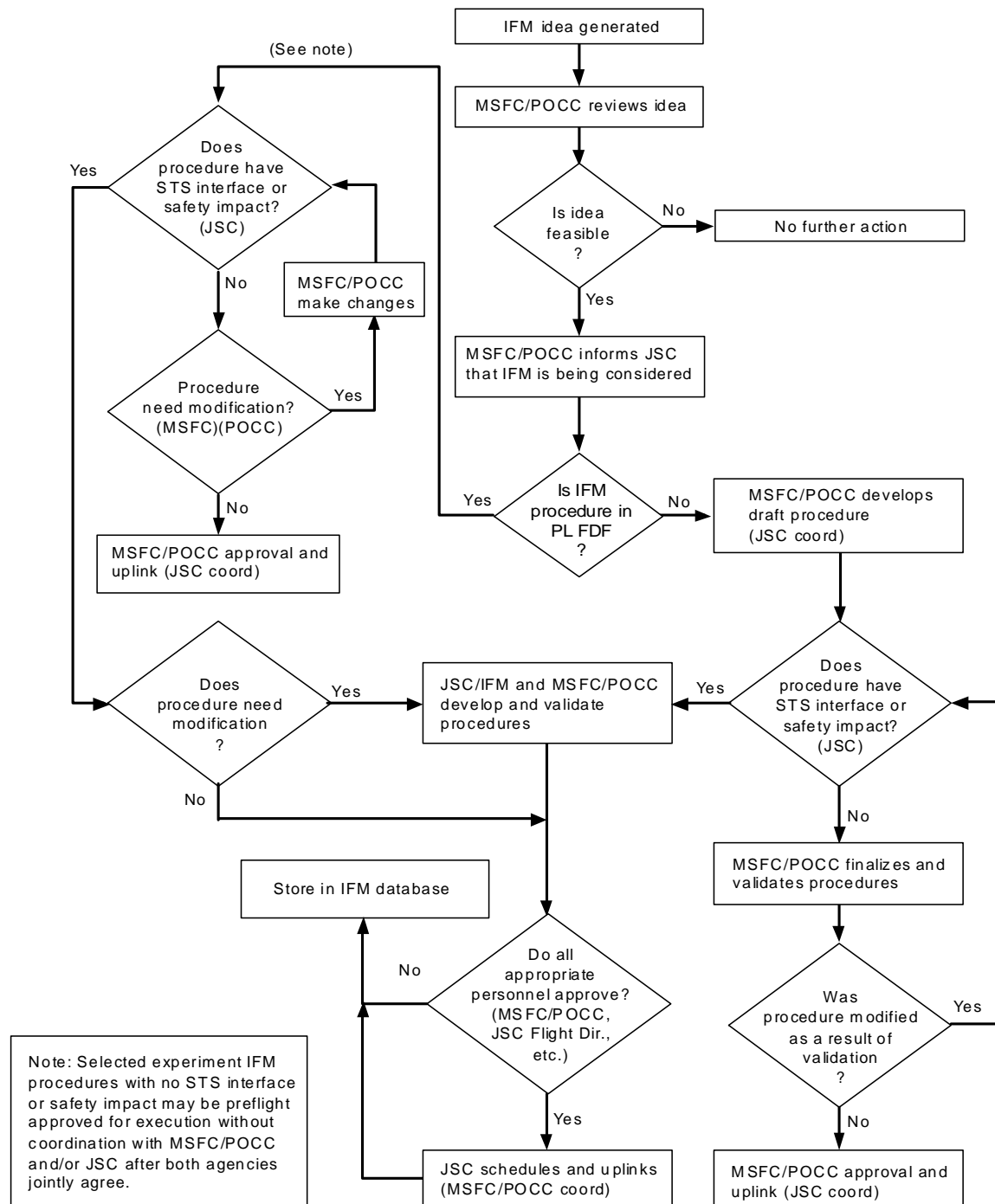


22673B_001.cnv

Figure 1.12-1. MCC IFM development

1.12-5

Verify that this is the correct version before use



22673B_002.cnv

Figure 1.12-2. Experiment IFM development

TITLE

WRITING IFM PROCEDURES

PURPOSE

IFM procedures are usually written on console during a mission or preflight. Real time IFM console procedures are written out of necessity due to a failure on board the orbiter. Preflight IFM procedures are written due to a possible expectation of a failure while on orbit. An example of this is the Space to Space Orbiter Radio (SSOR). This radio was known to have problems preflight and the IFM group was tasked with generating an IFM procedure to change out the radio should it hard fail. IFM procedures are written in such a way as to contain as much information as required to successfully perform the task. This section should provide some insight as to what type of information should be included in an IFM procedure.

DESCRIPTION

All IFM procedures, published or unpublished, should consider the following information:

1. **Objective** – Should state the objective of the procedure as concisely and accurately as possible, avoiding any confusion as to the purpose of the procedure.
2. **Crew Safety** – Crew safety should always be considered. When accessing panels or equipment be aware of the possibility of sharp objects that could cut, or glass objects that could break. Another item to look out for could be powered electrical circuits if performing an electrical IFM. If using a file or some instrument that could leave behind debris that could get into the eyes, food, etc. recommend using the vacuum cleaner for containment. Include a note in the procedure to warn the crew of any kind of potential hazards.
3. **Accessibility/location** – When writing any IFM the location should be called out on the procedure. For the tools the location is always given, as well as the location of all areas in the orbiter related to the IFM. The section on the left side of the procedure is used to call out area locations. When writing an IFM procedure, consideration should be given to the location the IFM is to be performed. Can the crew get to it? What other obstacles might be in the way? Can the required tools be used in the event of being in close quarters? And by the same token, in zero g's most areas are more easily accessible. If the Break Out Box (BOB) is to be used, the location of the nearest DC utility outlet should be listed. In determining the DC utility outlet to be used the Pre-routed cable diagrams should be consulted. The closest outlet may not be available and another may have to be used.

4. **Required equipment/tools** – The first section, after the objective of the procedure, is a listing of all the required tools that will be needed to complete the IFM, including the location of the tools. The tool location for any particular flight can be retrieved from the Modular locker layout. The location of a specific tool can be taken from the “TOOLS” section of the IFM Checklist. If the procedure calls out using the IFM Break Out Box, a diagram should be included as to how it should be set up.
5. **Time requirements** – The time required to perform an IFM on orbit is usually estimated by the IFM person writing the procedure. Based on their experience, the IFM person generally has an understanding of the length of time required to perform an IFM, and then adds an undetermined amount of extra time to ensure that the crew can perform the task. The flight director on your shift will always ask, in the event that an IFM procedure has to be performed, how long will the IFM take? This information is important in making changes to the flight plan. Should an IFM have to be performed other scheduled tasks will have to be fit in elsewhere in the mission.
6. **Procedure Steps** – Procedure steps are automatically numbered when entered into the procedure. The space in front of the step number allows documentation of the location at which the step will be performed. If steps are inserted, subsequent steps are renumbered automatically. Any step that references another step should make use of autonumbering. Copy the referred-to step number and paste into the referring step.
7. **Caution Box** – The caution box provides a location to advise the crewmember of required caution in the step or steps following. It should always be placed immediately ahead of the steps that require caution. It alerts the crew to conditions that may degrade the operational integrity of the system. When typing in the caution box, periods should end sentences that are followed by another sentence in the same step, but no period at the end of the step.

CAUTION
(CAUTION)

8. **Note Box** – The note allows the capability to provide information in advance of a step or steps for which that information may be useful. It should be placed immediately ahead of the steps for which the information applies.

NOTE
(NOTE)

9. **Warning Box** – The Warning box allows any required warning to be specified to the crew. It should always be placed immediately ahead of the steps for which a warning is required. It alerts the crew to a condition that will have consequences for crew safety or will cause permanent equipment damage if the condition is not corrected immediately.

WARNING
(WARNING)

10. **CRT Box** – The CRT box allows specification of the required data processing system (DPS) display for performing software actions. The required software actions will be placed in the same step following the box. Automatic step numbering occurs when the CRTBOX is entered into the procedure. The CRT number may also be specified, if needed, immediately after the 'CRT' location callout in front of the step number.

CRT 2. |(CRTBOX) |

11. **Task Heading** – For long, complicated procedures which may have several tasks, the Task Heading allows delineation between the different tasks, providing less confusion in the procedure. A Task title should be selected and entered here.

(TASK HEADING)

12. **References** – References from which information has been acquired in order to write the procedure should be listed here. References may be persons, positions, documents, drawings, etc. Original authors and any subsequent personnel responsible for updating the procedure should be included here, as well as the mission or simulation during which the procedure was written. Any other information that may be considered useful in the future should be listed here. This section is automatically placed on a separate page (last) for all procedures. It is not included in review printouts, and is not printed with the rest of the procedure.
13. **Verification Steps** – Any steps taken to verify the procedure should be listed here. This may include actual performance of the procedure during a mission, utilization of a facility to perform it, desktop discussion with system experts, etc. This section is automatically placed on the last page with references and is not normally printed.

Any IFM procedure that is written and published in the IFM Checklist should also have a detailed section written for the IFM console handbook. This detailed explanation of the procedure should include any and all information pertaining to the published procedure. Included are diagrams, schematics, date written, flight first used, type of failure, etc. It is the responsibility of the person that wrote the published procedure to write the detailed console handbook procedure. The detailed procedure is submitted to the IFM console handbook book manager for inclusion into the handbook.

Many times there are procedures written that do not get included in the IFM Checklist. These procedures are the result of a SIM case that came up, or the result of a piece of hardware that has shown to be less than reliable, such as the SSOR mentioned in the first paragraph. These procedures are called "Hip Pocket" procedures and are maintained on the "D" drive. All procedures of this type should be included in the alphabetical listing at: D/Ifm/Procedures. A template for writing IFM procedures are also included on the "D" drive at: D/Ifm/Procedures/Console Items/Pro_Template.doc. This template can be used or another Hip Pocket procedure can be saved off as another file and used.

TITLE

FINDING WIRING HARNESS AND CONNECTOR SIGNAL PATHS

PURPOSE

To find specific conductors/signal paths leading to line replaceable units (LRU's) or panel/switches.

PROCEDURE

1. Find wiring installation drawings for appropriate crew module area.
2. Find Ref Designator and list of connectors for desired LRU on wiring installation drawing.
3. If desired connector number known (from connector list), find Ref Designator ending in desired connector number in Orbiter Wiring Interfaces, vol. 1 or 2.
4. In Orbiter Wiring Interfaces document, determine appropriate DWG-ZN number (for specific connector) to locate conductor path(s) in the Integrated Schematic drawings.
5. Find desired signal path in the appropriate zone in the designated Integrated Schematic drawing.

As an alternative, SCAN can be utilized to list all signal paths through the connector, once the connector Ref Designator and number are determined in the above procedure. The SCAN listing will provide the following information:

SYSTEM

TERM (corresponds to pin or socket number on connector)

SIGNAL CODE REMARKS (purpose of signal path)

CIR-SEG (circuit segment identifier)

An alternative to SCAN is the Boeing North America (BNA) Florida Engineering web page, which can be accessed on the PC through Netscape (<http://p51.ksc.nasa.gov/>). There is a bookmark set that will take the IFM person directly to that web page. Once at this web page, access the orbiter specific electronic notebook. This section will allow you to obtain nomenclature, part number, wire size/function, Pin/Socket designation, and reference designator from one of the following options: (Depending on available information)

Connector Search (ex: 81P20)

Mating Reference Designator (ex: 83V75A12J9)

Wire ID Search (ex: T719A26)

IFM APPLICATIONS

Some procedures require accessing a connector(s) on an LRU. This procedure should provide information about the connector; for example, functions of signal paths passing through the connector, connector Ref Designators for wiring harnesses and LRUs, location of connectors on integrated schematics, etc.

Often, it is desirable to sever a signal path, remove power or a signal, or to bypass a failed circuit function (switch, relay, etc.). The SCAN listing provides the circuit segment identifier that may be utilized by the crewmember to determine which wire to cut in a wire harness.

Circuit segment identifiers can also be found in the wire harness assembly drawings. If a specific drawing is not readily available, it may be ordered through the DF library or MER.

REFERENCE DOCUMENTATION

1. Integrated Schematic Index - Meas./Stim, C&D, Connectors.
2. Integrated Schematics.

TITLE

RESEARCHING CONNECTOR TECHNICAL SPECIFICATIONS

PURPOSE

It is often necessary to determine the technical specifications of individual connectors (such as pin/socket size, connector map, etc.) in order to formulate an IFM procedure to alleviate failures of equipment associated with those connectors. This procedure allows determination of those specifications by identifying the connector so that the technical data desired may be found in the manufacturer's documentation.

PROCEDURE

1. Determine the Integrated Schematic drawing number in which the connector may be located. This may be done in the following ways:
 - a. If the connector is located on a panel, refer to the Integrated Schematic Index - Meas./Stim, C&D, Connectors. Find the appropriate panel in the C&D section. Read the DWG-ZN reference.
 - b. In the Space Shuttle Systems Handbook (SSSH) (for the appropriate system concerned), find the Integrated Schematic drawing reference in the Vendor Drawing References section (at the rear of each system section).
2. On the Integrated Schematic drawing, determine the orbiter area number and the connector reference designator (P# or J#) (ex., 83V77W4P21 or 83P21).
3. Find the connector reference designator (Harn Conn) in the Connector List section of the Integrated Schematic Index - Meas./Stim, C&D, Connectors.
4. Determine the connector part no. corresponding to the Harn Conn.
5. If the Drawing number is already known, the Shuttle Drawing System (SDS) can also be used to access electrical schematics. Other options in the SDS allow you to search for a particular part by name. Ex: Look up SSOR (Space to Space Orbiter Radio), this will give you a list of drawings to choose from.
6. Similar information can be found by going to the Boeing North America (BNA) web page, which can be accessed on the PC through Netscape (<http://p51.ksc.nasa.gov/>), providing the connector reference designator is known. Once at this web page, access the orbiter specific electronic notebook to get to the information needed. This software allows you to retrieve Connector pin/socket identification and characteristics.
7. Find the connector part no. (with its corresponding technical specifications) in the Rockwell International Systems Design & Parts, Electronic, Electrical, and Electromechanical (EEE), vol. I, Electrical and Electromechanical.

REFERENCE DOCUMENTATION

1. Integrated Schematic Index - Meas./Stim, C&D, Connectors
2. Integrated Schematics
3. Space Shuttle Systems Handbook (SSSH)
4. Rockwell International Systems Design & Parts, EEE, vol. I, Electrical and Electromechanical
5. Boeing North America (BNA) Engineering web page
6. Shuttle Drawing System (SDS) web page

TITLE

IFM FLIGHT RULES

PURPOSE

There is not a specific section in the STS Flight Rules governing IFM activity. Flight rules affecting IFM can be found in several sections, including the Flight Rules Annex for specific flights and payloads. They are usually specific to specific systems onboard the orbiter.

DESCRIPTION

The following Flight Rules are related to or involve IFM:

1. FLIGHT OPERATIONS RULES, A2-104, SYSTEMS REDUNDANCY REQUIREMENTS
2. FLIGHT OPERATIONS RULES, A2-105, IN-FLIGHT MAINTENANCE (IFM)
3. DEORBIT, A2-203, DEORBIT DELAY GUIDELINE
4. SPACEHAB OPERATIONS MANAGEMENT, A2-320, COMMAND AND DATA SYSTEM CONSTRAINTS
5. SPACEHAB OPERATIONS MANAGEMENT, A2-324, SPACEHAB IFM PROCEDURES
6. SPACEHAB OPERATIONS MANAGEMENT, A2-325, IFM PROCEDURES ON EXPERIMENTS WITH TOXIC HAZARDS
7. DATA PROCESSING SYSTEM (DPS), A7-109, IN-FLIGHT MAINTENANCE
8. GUIDANCE, NAVIGATION, AND CONTROL, A8-9, AFT STATION GNC REDUNDANCY
9. GUIDANCE, NAVIGATION, AND CONTROL, A8-1001, GO/NO GO CRITERIA
10. ELECTRICAL, A9-57, REUSABLE FUEL CELL
11. ELECTRICAL, A9-110, PREFLIGHT TEST BUS MANAGEMENT
12. ELECTRICAL, A9-157, AC POWER TRANSFER CABLE
13. MMACS, A10-209, PLBD RULE REFERENCE MATRIX
14. MMACS, A10-303, ANTENNA CONTINGENCY PROCEDURES
15. MMACS, A10-384, MAXIMUM NUMBER OF FILLED CWC
16. MMACS, A10-385, FILLED CWC STOWAGE MANAGEMENT

- 17 COMMUNICATIONS, A11-59, FM SYSTEM IFM GROUND RULES
18. COMMUNICATIONS, A11-66, LOSS OF ACCU
- 19 COMMUNICATIONS, A11-71, LOSS OF RECORDERS
20. ROBOTICS, A12-7, RMS IFM D&C KIT
- 21 ROBOTICS, A12-181, JETTISON SYSTEM CONSTRAINTS
- 22 LIFE SUPPORT, A17-351, WCS SEPARATOR
- 23 LIFE SUPPORT, A17-352, WCS URINE COLLECTIONS
24. LIFE SUPPORT, A17-405, VACUUM VENT SYSTEMS MANAGEMENT
- 25 LIFE SUPPORT, A17-452, WASTE WATER DUMP CAPABILITY
- 26 LIFE SUPPORT, A17-502, WASTE DUMP NOZZLE ICE FORMATION
- 27 LIFE SUPPORT, A17-503, WASTE WATER STORAGE
- 28 LIFE SUPPORT, A17-505, WASTE WATER DUMP NOZZLE TEMPERATURE
CONSTRAINT
29. LIFE SUPPORT, A17-704, CABIN/HFA-FAN
- 30 THERMAL, A18-1, SUPPLY WATER TANK
- 31 THERMAL, A18-52, SUPPLY/WASTE WATER CROSS-CONNECT
32. THERMAL, A18-58, SUPPLY WATER SYSTEM LEAK MANAGEMENT

TITLE

IFM CONSOLE SCANNER OPERATIONS

PURPOSE

The purpose of this section is to help the IFM console operator in becoming proficient in the use of the scanner located in the vicinity of the IFM console. The scanner can be used to scan into the computer photos, procedures, etc. that is already not accessible via the computer (PC). The PC designated, as "IFM2" is the computer that is set up to be used with the scanner. The following is a set of procedures for operating the scanner.

DESCRIPTION

1. Double click on the **HP Director** icon on the Windows desktop
2. Place item(s) to be scanned in the scanner above the IFM2 monitor
3. In the HP Director window, click on **Scan Picture**
4. The lamp warm up will take a minute to complete and perform a preview scan
5. The preview image may be cropped at this time using the eight black dots surrounding the image
6. After cropping is complete, click on the **Accept** button to perform the final scan and save the image to the HP Photo & Imagery Gallery.

Note: Default file format is .jpg

7. For further image editing, click on the **Image Editor** button
8. Save image

TITLE

VIDEO CAMERA OPERATIONS

PURPOSE

The IFM console SONY video camera is a tool that is used to capture an image of both two and three-dimensional objects. This object can be viewed on the rack monitor or saved as a file on the PC, or both. The following procedures have been put in place to help the IFM console operator in the use of the camera.

DESCRIPTION

1. To start with, the camera and lighting located with the camera have to be powered on. The power switch is located next to the camera.
2. Go to the "SONY" panel on the rack and activate the two power buttons, and also select the monitor power to on.
3. To send an image from the camera to the **rack monitor**, the source and destination have to be properly set. On the panel on the upper left side of the rack, select the destination to either "00", or "01", depending on which input line you want to use (A or B, which is selected on the monitor).
4. On the same panel select the source to be "00".
5. The object being viewed with the camera should now appear on the rack monitor.
6. To send the **image to the PC** (using Proshare), set the destination to "07" (Proshare)
7. Select the source to "00" (Video Camera).
8. On the IFM1 PC (only), go to: "Start"----"Programs"----"Proshare Conferencing"---- (Click on)
9. Next a window comes up welcoming you to Proshare Conferencing, Select Continue.
10. Two windows appear next: The conference manager and Video window. An image object being viewed should be in the Video window.
11. On the Video window click on the camera Icon (below image) to take a local snapshot.
12. Select the size required and click on "snap".
13. Next, save the image as a .bmp file. The image can be converted to a .jpg file later.
14. After the .bmp file is saved off you can save the file off as a .jpg file by selecting "LVIEW" from the tool bar. Do "file"----"open" and pull up the .bmp file, then save as a .jpg file, or whatever is required.

TITLE

RECORDING DOWNLINK

PURPOSE

The purpose of this section is to help the IFM console operator in setting up any of the recording devices (VCR, 8mm, ODR) to record downlink.

DESCRIPTION

1. Power on the recording device of choice, for these procedures the VCR will be used.
2. On the Deck Alpha computer go to the video pull down and select the "Commands" pulldown.
3. Next select the "IPS CMILP" pushbutton, and the CMILP window will come up.
4. On the CMILP #1 screen, select "00", shuttle downlink.
5. On the CMILP #2 screen, select "06", NASA television.
6. Depress the "OK" pushbutton.
7. To send CMILP #1 to VCR #1, Set the destination to "06" (VCR #1) and set the source to "01" (CMILP #1).
8. To send CMILP #2 to VCR #2, Set the destination to "08" (VCR #2) and set the source to "02" (CMILP #2).
9. When ready select "Record" for either downlink or NASA television, or both.
10. Set Rack monitor line A and B to VCR to view either downlink on one line and NASA TV on the other, to see what is being recorded.

TITLE

WRITING FLIGHT NOTES

PURPOSE

Flight Notes are used to relay information to the Flight Crew or Flight Director.

DESCRIPTION

Whenever an action needs to be performed by the crew, or a delta to a published procedure needs to be made that is to be worked by the crew, the flight note is the most practical method used to relay that information to the orbiter. For the most part the IFM group uses the flight note system to make changes to an already published IFM Flight Data File (FDF) procedure that the crew may have to perform on orbit. Although every published IFM procedure has been verified in some manner this does not preclude them from being incorrect or out of date. Change to the orbiter is an ever occurring process as new upgrades become implemented. Typically, new, full blown real time IFM procedures would normally get uplinked in the execute package, once approved by the MCC community. It is conceivable that in the future the Flight Note system could replace the current process of uplinking IFM procedures. The Flight Note system is faster, reduces the amount of paper copies required, and is easily accessible by other console positions.

To access the Electronic Flight Note (EFN) web site, go to

<https://ops1.jsc.nasa.gov/gateway>

From there select the required Mission or Sim that is applicable and corresponding STS users. Upon access you can create a new Flight Note, as well as review existing/current Flight Notes.

TITLE

WRITING POST FLIGHT REPORTS

PURPOSE

The Post Flight Report (PFR) documents all IFM activities conducted during a shuttle flight.

DESCRIPTION

Post Flight Reports are written and serve as a log/activity report for each mission. PFR's are written using the Microsoft word software and are kept in the following directory: D:\fm\PFRs\STSXXpfr.doc, where STSXXpfr.doc is the name of the PFR word file and "XX" designates the mission. The PFR should contain the IFM console operator for each shift and have a section on the bottom for signature. A hard copy of the PFR is turned in to the lead MMACS console operator for the mission. The body of the PFR should contain all information about any IFM activity performed during the mission, and the results. Also included should be any significant pre-flight activity that was performed to prepare for the impending mission. The following is an example of a PFR:

STS-99 IFM Post flight report			Feb. 23, 2000
Orbit 1	Orbit 2	Orbit 3	OJT
R. Barckholtz	J. Shimp	V. Badillo/S. Kiefer	S. Contella

To: DF52/Group Lead, Mechanical Systems
 From: Lead IFM Operator
 Subject: STS-XX Post Flight Report, OV-10X, (launch date) through (landing date)

MISSION SUMMARY
 No IFM Procedures were performed on this flight.

ORBITER SYSTEMS
 Orbiter Systems were nearly flawless. Few anomalies were written.

STOWAGE
 Answered P/TV questions on location of Image Intensifier, and Hot Mirror IR filters. CAPCOM asked about sleep station bags and liners. There are 4 sleep stations and 4 sleeping bags, each crewmember has his own liner.

PAYLOADS IFM ACTIVITY
 None.

MISCELANEOUS

- Coordinated with P/TV on procedure to adjust the EarthKam bracket.
- Almost all of the Hasselblad Data Modules had dead batteries in them. The Data Modules print information on the film, like time/date. Also the Modules are not Y2K compliant, reading 1900 instead of 2000. An anomaly was written, and suggestions were uplinked for work around to the date/time problem.
- The crew left the purge device installed during the (yellow) DTO 686. The device was removed and the DTO completed.
- An attempt was made to make some 3-D glasses, so the crew could view some images uplinked in 3-D. However the necessary materials were not on board.
- The Mission Events Timer had problems with digit segments intermittently going blank.
- EVA was called in early to support an early EMU checkout.

PREFLIGHT ACTIVITY

MAGR Changeout Procedure
 This procedure details replacement of a failed MAGR with a stowed spare. IFM developed the changeout procedure, which was later verified during the STS-99 CEIT. Not used.

Signatures:

TITLE

CR'S STANDARD CONSOLE PROCEDURES

PURPOSE

The purpose of this section is to implement a Change Request (CR) process to help manage/track the changes/updates to the IFM console handbook. The IFM book manager will keep track of each change/update that is to be made to the console handbook. Included is a copy of the CR form to be used for making changes. In the upper right hand corner of the CR form is a place for a CR tracking number that the IFM console handbook book manager will assign. This tracking number is recorded for reference. Any IFM team member can initiate a change to the IFM console handbook by first talking to the Book manager for the console handbook and being assigned a tracking number. The IFM team member then completes the changes/updates being made and attaches the CR to a hard copy and routes to the rest of the IFM Team for approval/redlines.

TITLE

FILE TRANSFERS TO FAO

PURPOSE

The Flight Activities Officer (FAO) is the person that the IFM group would send their procedures to for uplink to the crew once everyone has given their approval and all revisions have been made. This section provides a short summary of the procedure to forward the approved IFM to the FAO.

DESCRIPTION

1. On the PC desktop, click on "My Computer", maybe labeled "IFM" or "IFM2", depending on which of the two console PC's you are working on.
2. From the "u" drive (Flt on JSCMODM/data/FLT_SUPP) go to "Inbox".
3. Go to the directory labeled "FAO" (MATTS is the FAO MPSR position).
4. Drag or paste the IFM file to this directory, and notify MMACS when completed.

TITLE

ORBITER TOOLS FOR USE ON THE SPACE STATION DURING THE ASSEMBLY FLIGHTS

INTRODUCTION

Both the Space Shuttle Orbiter and the International Space Station have dedicated tool kits for crew use. The initial concept was for these tool kits to remain separate. This was to insure that tools were not accidentally left in the wrong modules, i.e. Station tools on the Orbiter or Orbiter tools on the Station. Of particular concern was that Orbiter tools not be left on the station during an emergency egress and therefore unavailable during an Orbiter emergency.

Due to stowage constraints and packaging the crew had trouble accessing the station tools during the initial assembly flight and requested the use of the Orbiter tools for these flights only. This led to a review of the Orbiter tools to determine what the tools redundancy was and if any tools would be considered critical.

The following list is a result of that review, and may be used by the IFM console operator in determining which tools can be transferred to Station for crew use.

DETAILS

All orbiter IFM tools must be returned to the Orbiter prior to hatch closure.

The tools listed below are required for procedures that have CIL rationale. Those tools followed by a (-R), have redundancy and can be preflight approved for transfer to station in the quantities listed.

- Tools that are required for procedure that have CIL rationale:

- Gray Tape -R (1 of 4)
- 5-amp. Fuses -R (3 of 5)
- CWS Contingency Power Cables
- Locker Tool -R (1 of 2)
- Connector Strap Wrench
- Driver Handle -R (1 of 2)
- Torque Wrench
- Breakout Box
- DC Power Cable -R (1 of 2)
- Power Screwdriver -R (1 of 1)
- 5/32" Allen Head Driver -R (1 of 3)
- Wire Cutters -R (1 of 2)
- Free Fluid Nozzle
- Y/Y Hose -R (1 of 2)

Only the tools listed below are not considered available for preflight authorized transfer to Space Station.

- Critical tools without redundancy:
 - CWS Contingency Power Cables
 - Connector Strap Wrench
 - Torque Wrench
 - Breakout Box
 - Free Fluid Nozzle

The IFM procedure from which the tools were taken, are:

1. CAUTION AND WARNING ELECTRONICS UNIT CONTINGENCY POWER (CIL)
2. CRYO TANK HEATER FUSE REMOVAL (CIL)
3. VACUUM VENT CONTINGENCY OPERATION (CIL)

TITLE

IN-FLIGHT MAINTENANCE (IFM) PROCEDURE COORDINATION

PURPOSE

The purpose is to outline real-time IFM procedure development and coordination between the Mission Control Center (MCC) disciplines.

GENERAL

An IFM procedure is defined as on-orbit hardware maintenance or repair action conducted by the crew in order to keep the orbiter or the payload in an operable state or to return to its original state/configuration. IFM includes any procedure that disconnects connectors/plugs, cuts wires, removes panels, replaces parts, and/or uses tools or orbiter resources for other than normal operations.

Some IFM procedures exist in the form of partial procedures that are termed "hip pocket" IFMs. A hip pocket IFM procedure is one in which some amount of work has been performed previously either during a training simulation or even a previous flight. Most hip pocket procedures are merely starting points for the IFM team to build a new procedure. Also these hip pocket IFM procedures should not be construed to be nearly complete requiring only minimal work to finish. IFM personnel keep track of all hip pocket IFM procedures and should be consulted for updates and procedure possibilities.

Before each Mission, MCC disciplines and/or payload customers should provide a list of potential IFM and malfunction procedures, applicable to any new hardware/payloads that will be flown (e.g., MEDS, OSVU, SH PL MAX DATA Recovery, etc.). This action provides preflight approval for uplink and eliminates the need for extensive real-time MCC coordination, since the Flight Director (FLIGHT), crew, and all disciplines involved will have previously approved the 482 (Crew Procedures Change Request). Procedures in this category will be part of the Orbiter Flight Data File (FDF) (e.g., IFM, PL OPS, ORB OPS C/L). All effort should be made to submit IFM procedures in a timely manner so that they can be thoroughly reviewed, published, and trained. Late inputs may be disapproved because there is insufficient time remaining before the flight to become familiar with the procedure. In this particular instance, the procedure or late 482 might be kept in the MCC IFM console in case is needed during real time ops.

IFM procedures are generally built to be work by a team of 2 crewmembers. The commander of each shuttle mission sets the requirement for which crewmembers must be trained in IFM procedures. All crews have designated at least 2 crewmembers but often the commander will require the whole crew to become familiar with IFM tasks. IFM and FAO keep a list of the IFM-trained crewmembers. It is preferred to only schedule the appropriately trained crewmembers for IFM activities.

BACKGROUND

1. REAL-TIME PROCEDURE COORDINATION

When a need to work an IFM procedure is identified by any flight controller, that controller will contact IFM on IFM COORD 1 and/or MMACS on MOCR SYS 1 to discuss the options prior to going to FLIGHT on the flight loop. After thorough discussions verify the need to work the procedure, either MMACS or the affected FCR discipline flight controller by mutual agreement will inform the flight director. If the procedure is already pre-flight approved, it will be given a cursory review by the flight control team to verify that there are no changes. If only a hip pocket IFM procedure or no procedure at all exists, much more work will be required. Flight controllers who possess a previous copy of a hip pocket IFM procedure should contact IFM to see if that particular procedure has been updated prior to offering it to the flight director and flight control team for review.

2. REAL-TIME PROCEDURE DEVELOPMENT

- a. If the need arises, IFM procedures are developed during the mission as a result of an unexpected anomaly. When it is determined that an Orbiter system or payload IFM procedure is required, the respective discipline representative(s) notifies IFM on the IFM COORD 1 and/or MMACS on MOCR SYS 1 and provides a brief summary of the complexity of the possible IFM required. IFM will assess whether a hip pocket procedure is available to begin the procedure-building process. Immediately following the identification of an IFM, the Orbiter Systems or respective payload customer representative(s), MMACS, IFM, Flight Activities Officer (FAO), and PAYLOAD SYSTEMS meet on the MOCR SYS 1 loop or the IFM COORD 1 loop as practical to assess the possibility, impact of the IFM on orbiter and experiment operations (see Figure 1.25-1 and Figure 1.25-2). Questions that need to be answered at this time include the following:
 1. What resources need to be allocated to the performance of the IFM procedure, including accessibility of hardware, likelihood to effectively perform the procedure, number of crewmembers (and if a specific one is required), special tools or equipment needed, and any special electrical/mechanical resources required from the orbiter?
 2. What is the priority/timeframe of the IFM procedure, including approximate time required, when it can be done, and when it cannot be done (constraints)?
 3. Who will develop the IFM procedure (IFM or the respective payload customer representative(s))?
 4. What level of procedure validation is required for the IFM procedure (ranging from desktop to flight hardware testing)?
 5. Has the crew been trained on hardware or a similar procedure?

If an orbiter interface or crew safety issue exists, IFM personnel will develop the procedure. Otherwise, the payload customers may develop and implement the IFM procedure or request that IFM develop or help develop the IFM procedure.

MMACS/IFM will inform the SPAN of the need to have support from the astronaut office to verify any new procedures.

- d. Following this assessment, the Flight Control Room (FCR) flight controller will brief FLIGHT on the IFM procedure and the impact it will have on operations. Based on this briefing, a call to the crew may be made to notify them of the IFM plan and when to expect it. This Air-to-Ground (A/G) communication will be made by CAPCOM.
- e. If the payload customer elects to develop the IFM procedure, MCC (disciplines involved) review and concurrence are still required.
- d. Once a preliminary IFM procedure has been developed, a copy will be provided to all disciplines involved, via a Flight Note, for review and comments. Also a Chit will be submitted to the MER for their awareness and concurrence. Once the procedure is finalized (based on all inputs) and approved, IFM will initiate the procedure verification with the hardware and appropriate personnel (e.g., astronaut office, engineering, safety, etc.) as required. If there are any inputs after the verification, they will be incorporated at this time.

The procedure will be submitted for a last review. The procedure verification process typically requires a 3-shift, 24-hour review cycle although that time may be shortened based on the complexity of the procedure. With FLIGHT concurrence, FAO will schedule the time for the crew to perform the procedure.

- e. The final procedure will be sent to the crew as an uplink message earlier than the crew schedule time. The crew will review the procedure and if they have any questions about it, they will be addressed at the crew convenience
- f. SPAN coordinates the implementation or development of the IFM procedure with the MCC Flight Control Team (FCT), including representatives from the astronaut office, payloads customer, safety, and engineering personnel, if required.
- g. If procedure is not part of the Orbiter FDF, IFM personnel will request access to the following items, in order of preference, to allow the team to make a timely and sound decision regarding the feasibility/safety of performing an IFM and to properly validate the procedure:
 - 1. Flight hardware
 - 2. Training hardware (engineering/backup unit)
 - 3. High-fidelity mockup

4. Photos of flight hardware
5. Schematics/drawings of electrical/mechanical interfaces

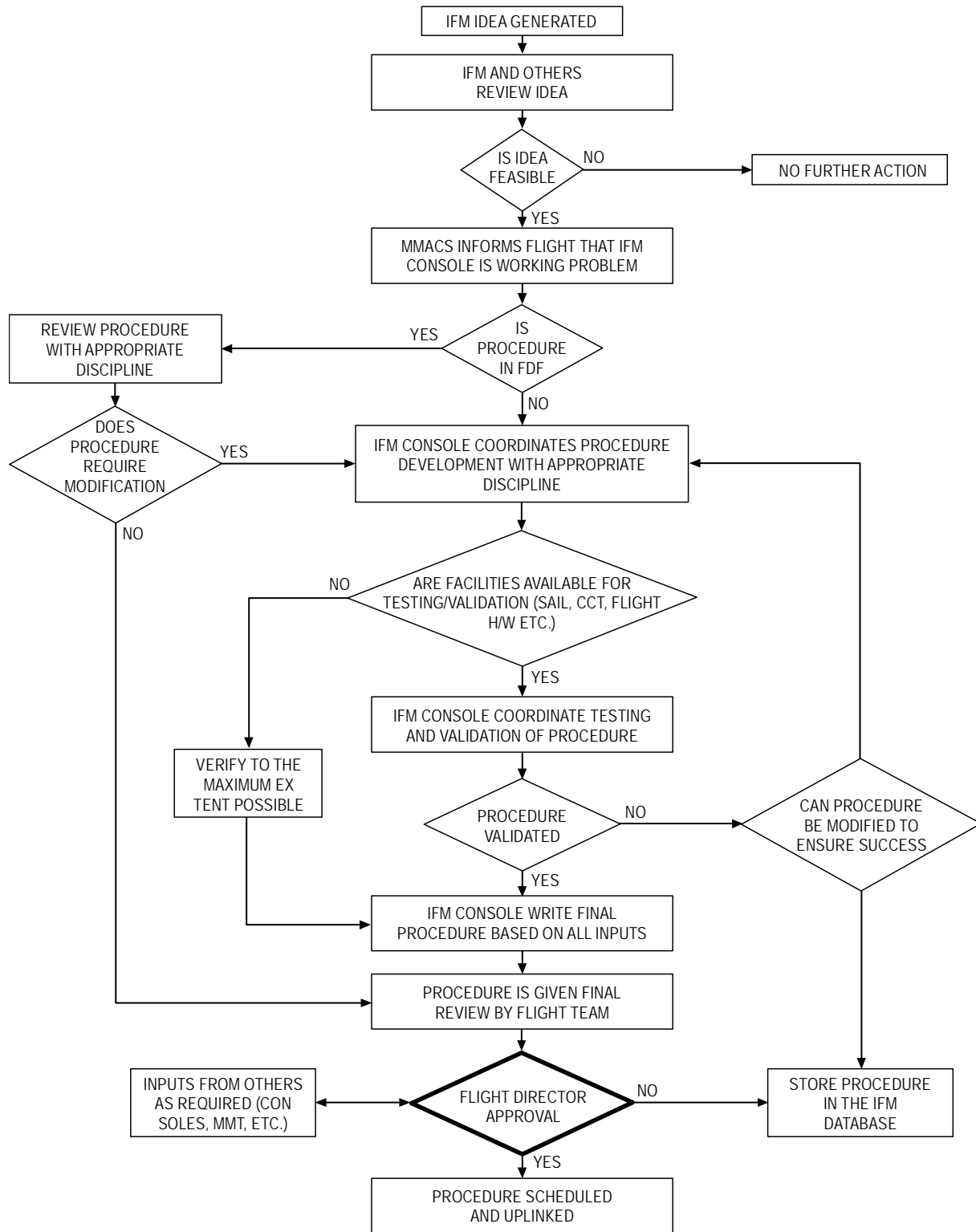
In addition, any videotape of the hardware being used (or of a preflight PL IFM procedure being performed) is also desired.

- h. The process of real-time MCC approval and, in some cases coordination, extends to any previously published IFM procedure. IFM procedures in the FDF are not standalone procedures but are reviewed in real time upon occurrence of the defined anomaly. However, some payload IFM procedures do not require real-time MCC approval before implementation, as detailed in the Flight Rules.
- i. IFM personnel determine the amount of MCC coordination, on the IFM COORD 1 loop, and validation necessary for each IFM procedure; including whether formal support is required. Procedure validation can be as simple as desktop review or as complex as utilizing backup flight hardware, SAIL or another Orbiter to test the proposed procedure.

REFERENCES

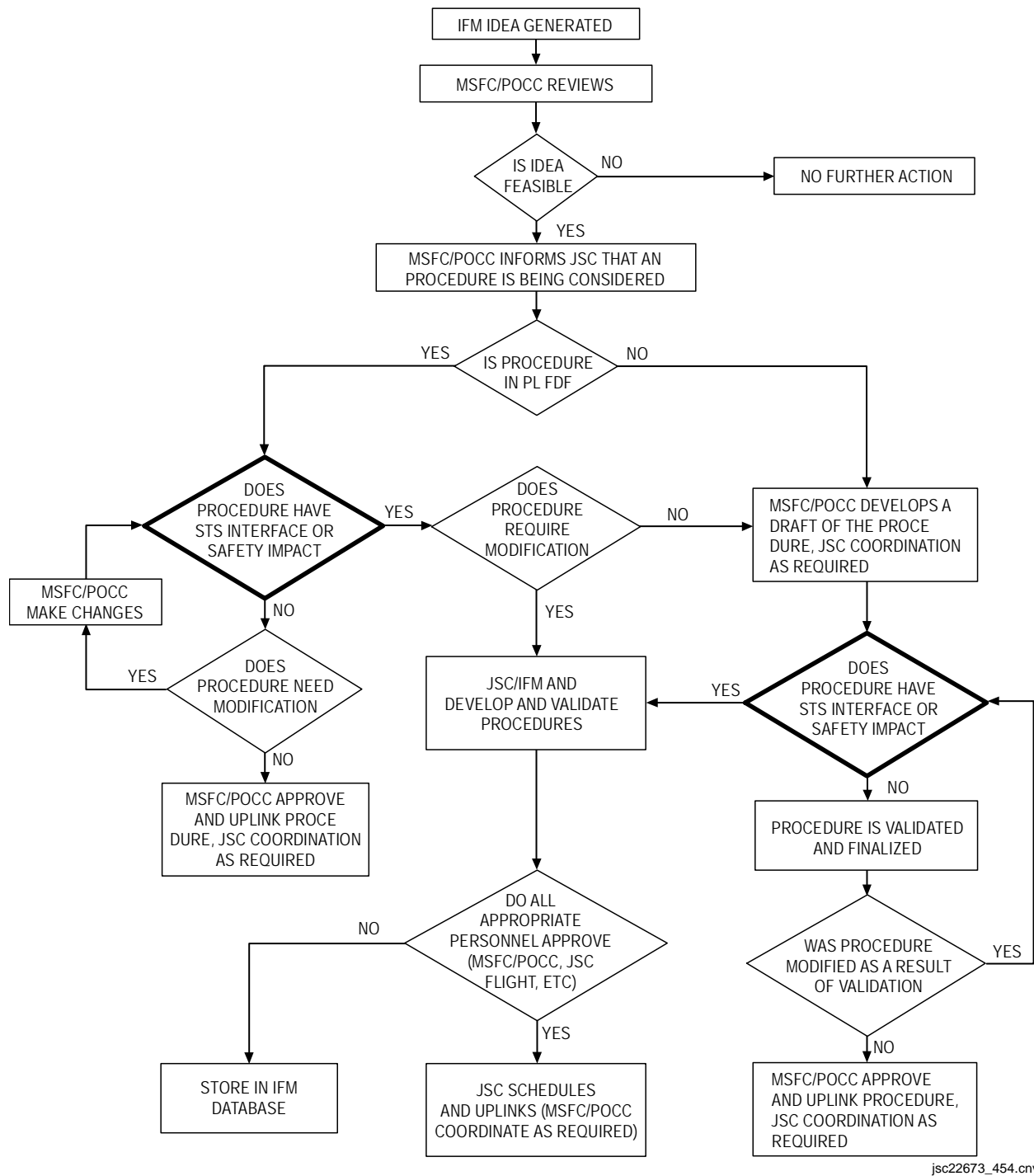
SFOC-FL0327, Rev. A

IFM 2101 Class



jsc22673_453.cnv

Figure 1.25-1. Basic Orbiter IFM Procedure Development



jsc22673_454.cnv

Figure 1.25-2. Basic Payload IFM Procedure Development

TITLE

CONSOLE DOCUMENTATION CHECKLIST

PURPOSE

The following is a list of the minimum console documentation that should be available to the IFM console operator in the MPSR. All the documents should be updated according to their respective control plans and should be verified as being up to date prior to launch of any space shuttle flight or integrated simulation. The following documentation can be accessed via the following media:

1. Mission Operations Directorate (MOD) Server Menu/E. MOD-Wide Applications/R. Flight Data File (FDF) Books
2. NASA organization web sites
3. Hardcopy documentation resources

CONSOLE DOCUMENT LIST

Orbiter Flight Data File (accessed via MOD Server Menu)

Contingency EVA Operation Checklist
Contingency Deorbit Prep Checklist
Cue Cards
Deorbit Prep Checklist
DPS Dictionary
EVA Checklist
IFM Checklist
Medical Checklist
Orbit Ops Checklist
Orbit Pocket Checklist
Payload Deploy Checklist
Payload Operations Checklist
Payload Systems/Data/Malfunctions Checklist
PDRS Operations Checklist
Photo/TV Checklist
Post Insertion Checklist
Reference Data Book
Systems Data Book
Systems Malfunction Procedures

Other Orbiter Documentation (MOD Server Menu or Hardcopy Documentation)

STS Operational Flight Rules (generic)
STS Operational Flight Rules Annex (all upcoming flights)
Space Shuttle Systems Handbook
Shuttle Operational Data Book (vols. I, II, III, and IV)

IFM Documentation (MOD Server Menu or Hardcopy Documentation)

IFM Console Handbook
IFM Tool Catalog
Orbiter Photo Books (all orbiters)

Other Documentation (Hardcopy Documentation)

All Vehicle D&C Procedural Nomenclature
Air Recirculation System (ARS) Description and Test History
Baseline Account Reporting System (BARS) Reports (4114, 4197, 4341, and 4373) (Located on the PC)
Cargo Systems Manual (CSM)
Crew Compartment Configuration Drawing (CCCD)
Crew Compartment LRU Specifications
Crew Systems Reference Manual (CSRM)
Crew Worn/Carry-on Assembly
EVA Tools and Equipment Reference Book
Flight Control Operations Handbook (FCOH)
ISS Tool Catalog
Flight Replaceable Fuses
Food Installation, Shuttle Food System
Goddard Space Flight Center (GSFC) Electrical Connector Specifications
Integrated Schematic Index - Orbiter Wiring Interfaces
Integrated Schematic Index - Meas./Stim, C&D, Connectors
Modular Locker Layout
Operations Maintenance Instruction (OMI) V5050
OV102 Fuse Book (vols. I, II, and III)
Photographic Equipment Configuration Settings
Photographic Equipment Stowage
Rockwell International Systems Design and Parts
Various Onboard Camera Manuals

TITLE

STOWAGE REFERENCES

INTRODUCTION

Stowage is the responsibility of Crew Systems (CS); however, the IFM MPSR console operator represents CS during a mission. A CS stowage point-of-contact remains on call during missions to support IFM. This means that IFM console personnel are responsible for stowage information during shuttle missions and for answering stowage questions posed by Flight Control team members, crews, etc.

The initial CCCDs for each flight are generated by Crew Station Integration from the Flight Requirements Document (FRD). To determine the quantity and volume of stowage space needed for crew clothing, hygiene articles, food, and other crew-related items, certain variables specified by the FRD are input into equations. Variables may include the number of crewmembers, the middeck payloads, and the mission duration. Other FRD information, such as the quantity, hardware, and cooling requirements of middeck payloads, detailed test objectives (DTOs), and detailed science objectives (DSOs), helps in the determination of the locker plan and in the stowage of supporting items. Several stowed materials are nominally standard for every flight and are always incorporated into the flight CCCD drawings.

Proposed changes to a flight's crew compartment manifest are presented at the weekly Orbital Configuration Control Board (OCCB). Changes that are approved by the board are incorporated into the CCCD as drawing change notices (DCNs). The delta time from OCCB approval stage to the CCCD DCN publication can be from 2 to 3 weeks. Since the Crew Systems group (DX3) is on an expedited mailing list for drawing changes, the DCNs are nominally delivered the same day of release.

Once a DCN has been published for a drawing update, changes are made to the Base-line Accounting and Recording System (BARS) database. The BARS database is a compilation of all orbiter hardware information, including the crew compartment stowed items and their flight manifests. The BARS database is maintained at Huntsville, Alabama on the IMIC mainframe. Entries to the BARS database are made here at JSC.

The Crew System/IFM groups receive a copy of the crew compartment hardware listing (BARS report) by way of electronic mail at L - 2 days. However, for flights that have late stowage or hardware changes, release of the BARS report can be delayed until several hours prior to launch. This file contains the stowage locations and quantities of all crew compartments stowed items for the flight. Crew Systems can provide IFM with this file prior to launch, should IFM not receive one. Note that this same data file is loaded into the PGSC stowage program; however, because of software limitations, not all data in the BARS report file is accessible to the crew.

Inputs to the flight-specific Reference Data book are developed early relative to the timing of CCCD DCNs. Three months prior to launch, the basic revision of the book is generated from the FRD and Modular Locker Layout and published by the FDF book

manager. At this time, the Modular Locker Layout is usually 50 percent TBDs. Crew Systems provides stowage list inputs to the FDF Ref Data book manager at L - 2 months (following the bench review) for the book's final revision. This is accomplished by referencing the flight-specific Modular Locker Layout, the Photo/TV Stowage Requirements, and the Camcorder Requirements List and by reviewing in detail every CCCD drawing for that specific flight. Crew Systems provides a second set of inputs (via another Locker Layout/Photo Camcorder list/CCCD scrub) to the Reference Data book manager at L - 1 month. These changes go into the errata pack. Note that CCCD DCNs sometimes trickle into the in-box several days after launch. As a result, the Ref Data book is not always up-to-date.

The CCCD and the L - 2 BARS report file are the most accurate stowage location documents available to console. Late hardware and stowage changes and human error have resulted in occasional inaccuracies. Crew worn/carry-on items are not listed in any of these documents but are accounted for in the Crew Systems Reference Manual (CSRM) deltas. Crewmembers have access to the FDF and the PGSC stowage program, but the software limits information retrieval.

REFERENCE DOCUMENTATION

There are several sources of cabin stowage information on console that may be utilized in determining stowage location during missions. They are as follows:

1. BARS Reports (nos. 4114, 4197, 4341, and 4373)
2. FDF, Flight-Specific Ref Data, Locker Stowage
3. CCCDs
4. Photographic Equipment Stowage, SP-SH-2001-XX (XX-mission number)
5. Food Installation, Shuttle Food System
6. Modular Locker Layout
7. Crew Worn/Carry-on Assembly

REFERENCE DESCRIPTIONS

BARS

The BARS reports are file listings; each sorted in a slightly different way, as follows:

- 4114 - Stowage is compiled alphabetically by *part number*, then numerically by part number for those part numbers that start with a number. Useful information is provided on *location, engineering nomenclature, and quantity*.
- 4197- Stowage is compiled *alphabetically and individually by stowage location*. *Quantity and engineering nomenclature* are provided.
- 4341- Stowage is compiled *alphabetically by hardware supplier*. The two-letter alpha identifier designates hardware supplier. Following the supplier, stowage is listed alphabetically and numerically by part number. *Engineering nomenclature/notes, quantity, and launch location* are provided.
- 4373- Stowage is compiled *alphabetically by stowage location, with all stowage in that location listed alphabetically and numerically following the location declaration*.

The BARS reports are placed in a three-ring binder upon receipt from the MER at the beginning of a mission.

FDF, FLIGHT-SPECIFIC REF DATA, LOCKER STOWAGE

CS provides a list of stowage to the Ref Data book manager for incorporation into the book for flight. This list is the only source of stowage information available to the crew onboard the orbiter. The list is developed very late, prior to launch, so as to be as accurate as possible. The IFM console will be provided with a copy of the list to be utilized on console. Stowage items are listed by location first, then in alphabetical order.

CCCD

The CCCD is produced by Orbiter Stowage Manager and consists of drawings and parts lists. A flight- specific CCCD is produced for each flight and is referred to as the "top level drawing." It designates actual crew compartment stowage for the flight (for example, mounting location for each locker, location of flight-specific experiment hardware, etc.). A generic CCCD breaks that stowage down into finer detail (for example, locker cushion configuration, and stowage items that are configured in the same manner in a locker, etc., regardless of flight).

The flight-specific CCCD provides various views of the cabin, depicting equipment installation, stowage, cable routing, panel installation, etc. Each of these items is provided with a unique item number and short description. Associated with the drawings is an item list which provides the following information: *item number, sheet/zone* (location on the drawing), *location, installation instruction number, source number, nomenclature, part number, and quantity required*. This flight-specific CCCD is most useful for determining stowage location. The generic CCCD provides information in a

similar manner as the flight-specific. As stated above, it provides configurations, stowage, etc., which do not change from flight to flight. However, since actual stowage varies with each flight, this portion of the CCCD is not as useful as the flight-specific for actual locations.

The IFM console library contains both flight-specific and generic CCCD. Updates (PCNs, additions, and lists of obsolete drawings) are received frequently. They should be incorporated into the document as soon as possible, with attention paid to mission applicability prior to deleting obsolete drawings or flight-specific drawings.

A software version of the CCCD may also be acquired from the Crew Station Integration Group by going to their web page located at:

<http://www-sa.jsc.nasa.gov/FCSD/CSB/csig/csig.htm>.

From this web page there are several options available related to the CCCD or of different flights, present and past?

PHOTOGRAPHIC EQUIPMENT STOWAGE, SP-SH-2001-XX

The JSC Orbiter Photographic and Television Working Group develop the Photographic Equipment Stowage document. It is a mission-specific document that lists the following information.

Stowage contents of:

- DTV Camcorder Bag
- Camcorder Bag
- 35/70mm camera bag
- 35mm camera bag
- 70mm camera bag
- Binocular bag
- Camera accessory bag
- Camera brackets bag
- General purpose bag
- Locker A17
- Other camera equipment lockers
- Miscellaneous locker stowage

Film Summary
Film Loading Verification Matrix
Camera Bag Labels

The Photo/TV Training Group prior to flight provides this document to the IFM console.

FOOD INSTALLATION, SHUTTLE FOOD SYSTEM

The MER Flight Crew Equipment personnel prior to launch provide the Food Installation document to the IFM console. The Modular Locker Layout is a single-sheet flight-specific description of locker and volume stowage that is published by Orbiter Stowage Manager. It is updated and distributed on a periodic basis and provides a quick

reference to stowage locations for specific flights. The information is based on the latest CCCD. The IFM console is provided a copy by CS.

CREW WORN/CARRY-ON ASSEMBLY

The Crew Worn/Carry-on Assembly document is provided to the IFM console by CS prior to launch. It documents all items worn or carried on the orbiter by each crewmember. The list documents the following classification of items for each crewmember:

1. Clothing
2. Helmet/comm equipment
3. Eyeglasses
4. Kneeboards
5. Waste containment devices
6. Watches/recorders/calculator

TITLE

ORBITER PHOTO BOOKS

PURPOSE

Photos stored in these books become very useful when generating an IFM procedure. They allow the IFM console operator to visually see a specific area that an IFM may need to be performed. These photos are also useful in that the MMACS operator or Flight director might like to have a look at a specific area onboard the orbiter that may be related to an IFM currently in progress by the IFM group.

INTRODUCTION

The photograph books at the IFM console are a very important source of Crew Module configuration information. There is one set of photo books for each of the four orbiters. Each set consists of photos usually taken at the crew equipment interface test (CEIT) for each mission. Photos from other opportunities are included as well.

Each set of orbiter books contains photos for the areas reflected in the following book titles:

Flight Deck Center and Forward	Middeck Aft/WCS/Airlock
Flight Deck Left	Middeck Overhead
Flight Deck Right	Middeck Deck and Right
Flight Deck Aft	Lower Equipment Bay
Flight Deck Overhead	Av Bay 1
Middeck Forward	Av Bay 2
Middeck Left and Galley	Av Bays 3A and 3B
Middeck Right	

TITLE

ORBITER ELECTRONIC PHOTOS

PURPOSE

Numerous electronic photos are taken at Crew Equipment Interface Test (CEIT) and Orbiter Maintenance Down Period (OMDP) to document orbiter cabin configuration for each mission or to document modifications to configuration or equipment. Other photos are taken of crew equipment, stowage, etc., for the same purpose. These electronic photos are stored on pc disc and displayed for various IFM procedure clarification, as well as verification. They are utilized for determining accessibility during troubleshooting and repair, and for documenting procedures during missions. Many of the electronic photos will contain views of areas not normally seen after cabin final closeout for flight. Therefore, these electronic photos allow planning and documentation of accessibility to areas and equipment for IFM purposes, prior to the execution of an IFM procedure by the crew. Also, in some rare instances, these electronic photos may document hardware misconfiguration. Electronic photo pc disc are maintained on the IFM console for simulation and real-time mission support.

PARTICIPATION

All IFM personnel are required to photo document CEIT and OMDP activities and download/store electronic photos to a dedicated Orbiter vehicle pc disc for future reference.

PROCEDURES

Electronic photos for upcoming mission are maintained on a separate pc disc until that particular mission ends. Upon completion of a shuttle mission, electronic photos pertaining to the orbiter for that mission should be incorporated onto its dedicated pc disc. They should be scrutinized for the following when being considered for placement onto the pc disc.

1. New equipment
2. New angle of view
3. Hardware modifications not previously documented
4. Better detail than previous photo view

Photos displaying outdated hardware configurations should be deleted from the pc disc

TITLE

CEIT COORDINATION

PURPOSE

To document the required coordination needed to prepare for Crew Equipment Interface Testing (CEIT). The CEIT is considered a class that the IFM group teaches the crew at approximately L-6 weeks. Although considered a class the CEIT is not conducted in a classroom, it is instead conducted in the actual space shuttle orbiter that the crew will be flying in. The IFM portion of the CEIT is similar to the IFM Procedures class that is held in the trainers in Building 9, except that only certain generic and mission specific IFM procedures will be reviewed. These procedures have all been identified before hand at the Pre-CEIT requirements meeting. The personnel at KSC will then review the IFM sequences to get an idea of what equipment will be required to conduct the CEIT and if that equipment will be available at the time. The Prime and one other IFM person will go to KSC to participate in the CEIT. The CEIT is coordinated through the JSC Vehicle Integration Test Team (VITT) office in conjunction with the KSC Flight Crew Engineering office.

DESCRIPTION

The prime IFM person has the responsibility of generating the briefing for the VITT CEIT coordination meeting. This meeting is usually held approximately L-8 or 9 weeks before the scheduled CEIT. The briefing is composed of all the sequences the IFM person is intending to review with the crew during CEIT.

Travel Coordination

The IFM personnel supporting the CEIT should plan to arrive two days prior to the planned CEIT. Travel plans for the CEIT should be made about 4 weeks prior. The travel coordinator for the IFM department is located in the division office, and is to be contacted with the arrival/departure dates as required. Other information the travel coordinator will require are the choice of accommodations or Hotel preferences, and rental car information. Keep all receipts.

Pre-CEIT Meeting at KSC

The day before the CEIT there is a pre-brief held with the VITT and KSC personnel. Within this meeting a status of the orbiter is given relative to each of the individual systems as related to the sequences that are to be reviewed with the crew the following day. For example; if there is a sequence for the Payload Isol valve, which is located in the tunnel adapter, but the tunnel adapter has not been installed in the orbiter. This would be discussed to determine a solution or workaround to completing this procedure. In addition an overall report on the condition of the orbiter is given as well as a status of any uncompleted work.

Bunny Suits

The day before the CEIT is a good time to go to equipment checkout in the Orbiter Processing Facility (OPF) and check out a "Bunny Suit". This suit consists of clean room overalls, boots, and hood. Without these you will not be granted access to the orbiter. The Bunny suits are to be put on in the clean room just prior to going into the orbiter and worn over your cloths. All loose items such as money, necklaces, etc should be removed and placed in a bag and kept with the person monitoring access to the clean room. Watches and rings, if left on, require Kapton tape be wrapped around them to avoid coming apart and getting lost in the orbiter.

Vehicle Integration Test Team (VITT) Contact

The VITT contact is the person that goes about coordinating the CEIT meetings, and the actual date of when the CEIT is to be conducted. This person will usually send out email letting you know in advance when the meetings are scheduled. There should be plenty of time to prepare. Any questions concerning the CEIT should be directed to the VITT contact for that particular flight.

TITLE

CEIT SEQUENCE REQUIREMENTS DOCUMENTATION

PURPOSE

Sequences to be executed at a CEIT are documented in the Operations Maintenance Instruction (OMI) manual, V5050. Not all of these sequences are performed at each CEIT. Those that are intended to be performed are identified in a CEIT requirements letter which is forwarded to KSC/Flight Crew Systems prior to the CEIT. However, any new vehicle, or any vehicle that has undergone a major modification since its last flight, will have all OMI V5050 sequences performed during CEIT.

Many sequences will not be documented in the OMI V5050, because of a one-time execution requirement (mission-specific, payload-specific, one-time new procedure verification, new equipment, etc.). To provide these sequences prior to the CEIT, they must be listed in the CEIT requirement letter composed and submitted by the VITT office. IFM is responsible for writing these sequences and providing them to the VITT office when requested.

PROCEDURE

The CEIT sequences may be accessed on the JSCDF server through utilization of Windows and Microsoft Word software. Each sequence is a file under S:/Divisions/DF/Private/DF54/IFM/CEITSEQ/IFMSEQ/. A new sequence file may be loaded, or written, or an existing file updated. The format in the example (see Figure 3.2-1) should be followed when writing sequences.

Once sequences are updated, at the appropriate deadline, the VITT office will download them to be listed in the CEIT requirement letter, and forwarded to KSC/Flight Crew Systems.

Seq. ** Flight Deck Stowage Container Removal Verification

Tools Required: #10 Torque Tip Screwdriver

** - 001 Open AFD stowage container to access interior fasteners. Remove two #10 torque-tip screws and bushings (two) one forward, one aft from interior of stowage container

Record location of stowage container(s) _____

** - 002 Remove eight #10 torque-tip screws and washers from top of each stowage container worked on in previous step

** - 003 Remove stowage container from AFD console and verify access to AFD console interior

** - 004 Replace stowage container in console and replace all fasteners, washers, and bushings hand-tight

** - 005 Flight deck stowage container removal verification complete

Figure 3.2-1. Format for writing CEIT sequences (example)

TITLE

CEIT SUPPORT DOCUMENTATION AND EQUIPMENT

PURPOSE

To list the appropriate technical documentation and equipment that IFM personnel who support the Crew Equipment Interface Test (CEIT) at KSC should have available.

PARTICIPATION

IFM personnel responsible for conducting the IFM portion of the CEIT are usually the Prime IFM person for the mission and one other IFM person. The second person is usually someone else assigned to work the mission.

DESCRIPTION

Personnel attending the CEIT and conducting the IFM portion should consider the following documentation and equipment to assist in performing those duties

1. Phone numbers for the following:
 - VITT personnel at KSC
 - VITT personnel from Houston supporting CEIT
 - Flightcrew Systems personnel at KSC
 - Houston personnel with other CEIT requirements
2. Flight-Specific Payload Systems Data and Malfunction Procedures, IFM procedures section.
3. Copy of all notes from the IFM Office Flight Status Board
4. Flight-specific CEIT requirements letter
5. Copy of all special sequences documented in the CEIT requirement letter
6. Copy of all OMI V5050 sequences required to be performed.
7. Flight-specific modular locker layout (latest revision)
8. Flight-specific CCCD
9. IFM Checklist
10. Digital Camera
11. One set of extra batteries (10 AA)

12. An additional set of extra batteries and the 110 V power adapter
13. Notebook to hold all loose paper and tetherable pen

If necessary the camcorder can also be taken, with spare batteries and tapes.

TITLE

MILITARY STANDARD SPECIFICATION DATABASE

PURPOSE

To identify the process of acquiring specifications for military standard (MS) hardware to support the documentation and execution of an IFM procedure.

PROCEDURE

The Scientific and Technical Information (STI) Center has a CD-ROM based information retrieval system that documents MS specifications. It is called Department of Defense Index of Specifications and Standards (DODISS). This database is accessed by loading the DODISS CD and conducting a search by input of the part number. The user is notified as to which CD (by number) has the specification image, which must then be loaded in the second drive. The specification may then be viewed or printed to hard copy. The librarians are available to help the user learn how to use the system. The DODISS system is also available via the Internet at:

<http://stic.jsc.nasa.gov>

Once at this web page select DODISS and instructions will be given on how to install the Standards Client. Those instructions are also listed here as follows:

Note: Please make sure that all programs on the computer are closed before running this client installation, because you will need to reboot your computer at the end of the installation.

1. Remove the LANCD Client before installing the new software. DODISS will not run with the LANCD Client software installed. Instructions are available here.
2. Map the M: drive using the following steps:
 - (a) Right click on the My Computer Icon
 - (b) Go to Map Network Drive
 - (c) Change the drive letter to M
 - (d) For the path, enter: \\jsc-isd-lib08\cdapps\
 - (e) Make sure that Reconnect at Log-on is checked and then press OK
3. Map P: drive using the following steps:
 - (a) Right click on the My Computer Icon
 - (b) Go to Map Network Drive

- (c) Change the drive letter to p
 - (d) For the path, enter: \\jsc-isd-lib08\dodstds\
 - (e) Make sure that Reconnect at Log-on is checked and then press OK
4. Double-click on the My Computer Icon
 5. Double-click on the M Drive
 6. Go to the HIS Folder, then to the DODWIN Folder, then to the Client Folder
 7. Double click on setup.exe
 8. Click the Next button at the Welcome Screen
 9. Change the Product Destination Path to: C:\PROGRAM FILES\HIS\DODWIN\ and then click Next. Choose YES if you receive a message saying that the directory doesn't exist.
 10. Choose the option that lets setup modify the AUTOEXEC.BAT file, click Next
 11. The files will begin copying to the hard drive
 12. Keep the Default Program Group, click Next
 13. Choose no when asked if you wish to view Product Information
 14. Choose yes to reboot the computer now, click Finish
 15. Run the DOD Client software (available through the Start Menu, then Programs, then HIS Products)
 16. After the software is done loading, go to the Options Menu and then to configure
 17. Under Network (in the lower right corner) make sure that LANCE Index ROM and LAN CD Image ROM are not checked
 18. Also under Network, check the Index path and enter the following for the path:
 - \\jsc-isd-lib08\dodstds\
 19. Also check Image Path and enter the following for the path:
 - \\jsc-isd-lib08\cdshare\
 20. Click OK
 21. The DODISS software is now configured and ready to use.

TITLE

PRE- AND POSTFLIGHT RESPONSIBILITIES

PURPOSE

This procedure defines the pre- and postflight console responsibilities of the IFM console operators. The list is designed to be a checklist that the operators can reference prior to and during the mission.

DESCRIPTION

A. Set up mission specific flight directory on the Personnel Computer (PC)

It is the responsibility of the prime IFM team member on a mission to set up the flight directory prior to the mission. This directory should be set up before hand so that all mission specific information can be stored here, as it becomes available. This directory is shared by all IFM team members, and prior to the flight it should be determined that all IFM team members have access. This directory is kept on the PC: d/lfm/lfm d/IFM/###/, where ### is the flight designation.

B. Mission Log

The mission log file is initiated at the beginning of the flight and is kept up by each shift. This mission log file is kept in the mission flight directory. It is important to keep as much information in the log as possible. This will help subsequent shifts in the event that an IFM has to be performed. A hard copy of the mission log is copied out at the end of each shift and signed by the out-going IFM shift. The mission log copy is kept in a binder along with other pertinent mission information.

C. Obtain BARS from MER, Food Installation

The BARS report is usually emailed to an IFM person sometime before launch where it is then put in the mission directory and left there for the duration of the mission.

D. Obtain 2001, 2002 documents from Photo/TV office (CEIT, bench review, etc.)

These documents are also e-mailed to the IFM group where these files are then put into the mission's flight directory. A photo/TV binder is kept on console and is kept up by the photo/TV people. This binder is referred to for any photo/TV type questions. Should problems arise that the IFM console person is not sure, the photo/TV people are given a call to come in and support the mission and coordinate with the IFM person if required.

E. Photo documentation for mission to console

Any photos that were taken while at CEIT are kept on console for aid in writing real time IFM procedures. These photos are placed in the appropriate binder, if useful, post flight.

F. L-1 MMACS meeting

This is a meeting held by the MMACS group one week before flight. IFM puts together a set of charts to support this tag up.

G. FDF update

The IFM FDF book manager takes care of all of the updates to the IFM checklist. Generic updates are made once a year, and flight specific updates are made for every flight, as required.

H. CIR drawings to console

These drawings are the drawings that have anything to do with payloads or station assembly and are usually to the IFM office through the company mail. IFM personnel review them and then take them to the MPSR for use during the mission, if required.

I. Payload System Data and Malfunction Procedures IFM section review

Any new payload related IFMs generated by the payload owner are sent to the IFM office for review. IFM reviews these procedures keeping in mind crew safety and hardware interface.

J. Postflight Report

At the conclusion of each flight the mission console log is reviewed by the prime IFM console operator. From this information a postflight report is put together giving a general rundown of all the IFM activity while on console. This report is in the form of any activity report that is used by the group lead.

K. Console log filing

Copies of all the mission logs are kept in the file cabinet located near console or in the locker behind the console.

L. Route written procedures to IFM Office for review

Any IFM procedures that are generated real time are reviewed by subsequent console shifts, and also by IFM persons in the office, time permitting.

M. Return all borrowed tools, parts, etc., to origin

At times it is necessary to borrow tools and equipment to aid in the generation of an IFM procedure real time. This equipment is usually left on console for the duration of the flight. It is the prime console operator's responsibility to ensure that all equipment is returned to the appropriate source.

N. Update IFM Intro 2101 briefing Flight History section

The original IFM introductory class handout had a listing of each flight and the IFM that was performed during that mission. A designated person in the IFM office usually keeps up this section.

O. Mission specific procedure generation

If a procedure that is written during mission is executed, record execution in the References section of the individual procedure – Maintain/document as much information about the procedure as necessary.

P. Sims

New Sim Stuff Manager transfers new procedures to IFM Supplemental checklist as appropriate.

Q. Postflight Reviews

After the mission conclusion, there are usually several post flight meetings, some of which IFM supports. During these meetings the crew discusses highlights of the mission as they relate to the different departments. If any IFMs were performed the crew will discuss how well the procedure was written, as far as being able to follow it, and if the pre-mission training was sufficient enough to prepare them for the task they had to perform. At this meeting any input that the crew can give, or any questions that they can answer may be of useful information in writing the next real time procedure.

TITLE

FLIGHT CONTROL TEAM 4

DESCRIPTION

Flight Control Team 4 is a group of flight controllers assigned to troubleshoot problems that need priority attention. Team 4 will be activated by Team 4 FD when the shift FD or mission management team deems it necessary. Although a specific person will be assigned, any non-prime-console personnel can be called upon to fulfill Team 4 activities during a mission.

The IFM Team 4 personnel may be called independently to support off-console activities related to IFM efforts during a mission. Procedure verification requires the attendance of non-console assigned personnel. Tools, drawings, or equipment may be retrieved by non-console assigned personnel.

REFERENCE DOCUMENTATION

FCOH

TITLE

MMACS L-1 WEEK MEETING

INTRODUCTION

The MMACS L-1 week meeting is a tag up conducted by the lead MMACS and is between MMACS, IFM, Crew Systems, Photo TV, and sometimes INCO. All flight controllers scheduled to work the mission should be present at this meeting, at the very least one representative from each group should be present. At this meeting each discipline will give a status of any last minute issues or activities in progress.

DESCRIPTION

The IFM team lead and alternate team members support this meeting and provide a briefing that contains any and all pertinent IFM information related to the mission, in addition to last minute issues that may be in work. The type of items found in this briefing include

- A list of the IFM crewmembers
- Orbiter Designation; OV number/name
- Crew Module Configuration; Sleeping Bags/stations, Number Standard Switch Panels, Ltwt lockers/MAR, Ergometer, Galley, EMUs, etc.
- Spacehab Configuration, if applicable
- CEIT Results; A list of the sequences that were reviewed by the crew while at CEIT, also listed are any squawks that were noted at CEIT and the status of each. A brief synopsis of the bench review is also presented.
- A list of spares is given; ex: PDI, MCIU, OSVU, SSOR, etc.
- IFM locker locations are listed
- Number of LiOH canister stowed, configuration
- A list of the IFM personnel and the shift each is assigned to
- A schedule of the filter cleaning is also provided, in addition to who is assigned to do it
- Any information regarding payload procedures or possible payload IFMs

Information that is contained in the MMACS L-1 briefing is not restricted to the above examples shown and can contain any pertinent information that the IFM lead determines necessary or of value to the other members of the team. The MMACS L-1 briefing is kept electronically at

S:\divisions\DF\Private\DF54\IFM\MISC\MSNDATA\StsXXX, where XXX is the flight designation.

The following is an example of the MMACS L-1 briefing that was assembled for STS-96.

STS-96 MMACS L-1 *IFM* BRIEFING 5/14/99

CMILP Console: x30033

IFM CREWPERSONS:

CDR	PLT	
K. Rominger	R. Husband	



ORBITER: OV-103 / DISCOVERY

CREW MODULE CONFIGURATION:

- ◆ Sleeping Bags (No sleep stations installed)
- ◆ 3 SSPs
- ◆ Ltwt MAR (stowage only)
- ◆ SRMS
- ◆ 3rd EMU
- ◆ Ergometer
- ◆ SORG – Shuttle Orbiter Repackaged Galley

SPACEHAB CONFIGURATION:

- ◆ Double Module (DM)

CEIT RESULTS:

- 1) Middeck Filter Cleaning
- 2) WCS Kickplate Removal Verification
- 3) Flight Deck Filter Cleaning
- 4) CDR/PLT Manual Seat Adjustment
- 5) Ku-Band Antenna Contingency Deploy/Stow
- 6) Middeck Modular Locker Removal/Installation Door Cycling
- 7) Middeck Modular Locker Turnbuckle Install
- 8) PSDP and MSDP Access Verification
- 9) Airlock ECLSS Booster Fan Removal Verification
- 10) Middeck ARS Orifice/Screen Verification
- 11) Payloads Isolation Valve Verification
- 12) ODS APDS Direct Drive Verification
- 13) ODS Fuse R & R
- 14) Spare PDI/MCIU Access Verification

- 15) OIU Access Verification
- 16) Supply Water Dump Purge Assembly Verification
- 17) Airlock pallet removal/install (New Ltwt pallet)
- 18) All IFM tools/equipment were checked out by crew
- 19) LEB familiarization

◆ CEIT Squawks:

- 1) DC Vacuum Cleaner missing Cabin Fan Fltr Cln Tool – Apparently in the past the DC Vacuum cleaner has not been flying with the Cabin Fan Filter Cleaning Tool. This has been an oversight. The tool has subsequently been manifested for STS-96 and all future flights utilizing the DC Vacuum. This tool is not flying in the Vacuum cleaner locker on this mission. It is located in MF71M.
- 2) In addition to the missing Cabin Fan Filter Cleaning Tool, the DC Vacuum cleaner was missing the 10 ft DC power cable that is flown as part of the assembly.
- 3) IFM locker contents decal was missing off of the inside of the locker door. Three were present, the fourth was missing.
- 4) The Crescent Wrench, from the IFM tool locker, had a dead spot in the adjustment and may not hold tightly. The tool is to be replaced.
- 5) During the airlock pallet removal, it was noticed that the 3 retaining bolts were not captive. Being worked, results unknown

◆ Bench Review (April 9, 1999)

No IFM issues

SPARES ONBOARD: (GPC, PDI, MCIU, HUD, RECORDERS, RCRS, ETC.)

COMPONENT	PDI	MCIU			
LOCATION	AV BAY 2	AV BAY 1			

IFM LOCKER LOCATIONS:

AIR BOTTLES/BOB	IFM TOOLS	VACUUM CLEANER (DC)
MF28G	MF28O	LTWT MAR

STOWAGE:

ORBITER		
43LiOH, 29 + 1 ATCO in LIOH Box, 2 Instld		
12 LiOH Cans Stowed in SH		
2 Charcoal Cans Stowed in SH		
3.5 Lockers of Crew Clothing Stowed in SH		

IFM CHECKLIST CONFIGURATION: GENERIC, REV. D, PCN-11

IFM Console Personnel:

	PRELAUNCH	ORBIT 1-A/E	ORBIT 2-LEAD	ORBIT 3	ORBIT 4	TEAM5-B/U
NAME		J. Shimp	S. A. Kieffer	V. Badillo		L. Russel
OFFICE #		3-2581	3-2578	3-3763		3-2539
HOME #		992-6849	326-0921	992-2937		481-6036

**FILTER CLEANING SCHEDULE: STS-96 FLIGHT PLAN, DATED: 4/06/99
REV: FINAL, PCN 1**

TIME	CREWPERSONS	TIME	CREWPERSONS
00/16:20	CDR		
04/13:30	CDR		
08/22:25	CDR		

FDf: (PAYLOAD, SPACEHAB IFM PROCEDURES)

- ◆ PCN 11 procedures added: ORBIT STATION ACCESS, OSVU REPLACEMENT
- ◆ ISS MIRTHS Replacement IFM (003/1540)
- ◆ ISS Early Comm IFMs:
 - 1) EARLY COMMUNICATIONS R/F POWER DISTRIBUTION R&R
 - 2) EARLY COMMUNICATIONS COMMAND TELEMETRY PROCESSOR R&R
 - 3) EARLY COMMUNICATIONS TRANSCEIVER R&R

MISC:

- ◆ Addition of two cable cutter assemblies – Drag through cables; BPSMU and two 40-ft floodlight extension cables, have no QDs at hatch interface. Cable cutters were manifested, and are to be located at critical hatches, should an emergency condition occur that would require quick hatch closure. Cable cutters are to be stowed in the Port Floor Bag for Ascent.

TITLE

FILING TECHNICAL DATA

PARTICIPATION

All IFM personnel

DESCRIPTION

For each IFM procedure there is a considerable amount of information from the research that goes into them that is compiled during the process of creating each specific procedure. All of this information is retained and filed in the IFM office for further referencing in the future, if required. This information may consist of technical drawing numbers, photos, how the procedure was verified and who was involved in the verification, connector information, wire gauge size, etc.

TITLE

DELIVERING DOCUMENTS TO CONSOLE

PURPOSE

To ensure that all technical documentation required for mission support is delivered to the IFM console to be accessible for support.

PARTICIPATION

All IFM assigned personnel.

PROCEDURE

The IFM office has a basket marked "IFM Console" which is to be utilized to collect all technical documentation that is required at the IFM MPSR console. When documentation is received and office review is completed (if necessary), such documentation should be placed in this basket for delivery to the console. All personnel are responsible for delivering this documentation to the console as they support training simulations, missions, or other work at the console. The basket should be checked, and any contents should be delivered to the console and incorporated into the console library or files as appropriate.

TITLE

PROCEDURE VERIFICATION

PURPOSE

To document the various means that an IFM procedure can be verified or considered verified.

PROCEDURE

Document in the PV records, and in the *Verification Steps Taken* section of the procedure. All data concerning the verification of the procedure is retained and filed.

DESCRIPTION

Procedures may be considered verified when the following has occurred:

1. Executed during a mission
2. Executed at CEIT
3. Desktop review
4. Executed at a verification facility (trainer, vendor facility, SAIL, orbiter, etc.)

TITLE

PREFLIGHT IFM PROCEDURE DEVELOPMENT

PURPOSE

The following information describes the process of developing an IFM procedure preflight. In an ideal situation, all IFM procedures that actually occur during missions would be only those preconceived IFM procedures that reside in the FDF IFM checklist. The advantages of developing IFM procedures preflight are obvious: more resources and a longer timeframe. This includes allowing more people to participate, thus allowing a greater knowledge base and amount of data to be utilized over a period of days or weeks versus hours or days for a real time procedure development.

The original idea for an IFM procedure may come from a variety of sources. The IFM engineer must take that idea and develop a procedure that is accurate and safe. A thorough search for all pertinent data is made and may include consulting other flight controller personnel, orbiter schematics and drawings, JSC engineering and subsystem managers, Boeing North America engineering, KSC technicians, and vehicle or hardware photographs. When gathering information for writing a procedure, the following guidelines should be considered:

1. Feasibility
 - (a) Accessibility
 - (b) Tools and equipment availability
 - (c) Crew training versus difficulty of task
2. Data required
 - (a) Is the most current/correct data available?
 - (b) Take steps to obtain the data.
 - (c) Verify that data is correct (use more than one source for data).
3. Coordination of proposed IFM with the appropriate experts
 - (a) Structural interface
 - (b) Electrical
 - (c) Fluids/gases
 - (d) Debris/contamination

- (e) Temperature extremes
- (f) Exposure to sharp edges

Most often the initial coordination anticipates all potential problems. At this point, if the proposed IFM is feasible, the appropriate experts then make a draft of the procedure available for review. When a mutually agreeable draft has been developed, the procedure may then either be filed for future use or, if circumstances merit, the procedure may be submitted for the FDF via a 482 FDF Change Request form.

The decision to submit a new procedure to the FDF is based on a variety of factors. If a division office directive or a FD office action initiated the procedure development, the procedure will be submitted.

In many cases, the failure scenario is not considered very credible. In the latter case, the procedure is filed away for future reference or use. Although the procedure has not been validated or verified in any official capacity, it can still be used to save valuable time when developing IFM procedures real time during missions or simulations.

Submitting a 482 pending acceptance will make a new procedure part of the FDF IFM Checklist. The 482 acceptance proceedings are designed to ensure that appropriate personnel for both accuracy and safety review all proposed IFM procedures.

Representatives from the following must accept the procedure:

1. The Astronaut Office (CB)
2. The Flight Director Office (DA8)
3. Systems Division (DF)
4. Branch Office (DF5)
5. Section (DF52)
6. The IFM Checklist book manager

In addition, all FDF IFM procedures are reviewed by engineers at Boeing - Huntington Beach for appropriate concurrence or inputs.

Validation/verification testing is highly desirable in most cases. Testing should be requested as part of the 482 submittal. This testing takes place in a suitable facility such as the SAIL or an engineering test bed, utilizing orbiter-quality hardware. Although the 482 contain a request for testing, the actual test procedure must be initiated through appropriate channels by Mechanical and Crew Systems Section (DF52). To initiate SAIL testing, a SAIL test request must be submitted. Other JSC testing facilities can usually be requested via an SF90 Test Request form submitted to the appropriate division.

Following the 482 approval and successful validation/verification testing, the IFM procedure is now certified for use both real-time missions and missions simulations. Publication also gives the procedure recognition and visibility, thus subjecting it to further scrutiny. The procedure is now part of normal preflight crew training and is included in the appropriate IFM class or classes.

During mission operations, procedures must still gain approval for use by the MCC flight team. This acts as a final safety check prior to initializing any AFM procedure. At this time the procedure is reviewed to ensure that it is being utilized in the proper or intended failure scenario. Finally, the shuttle commander and crew must also accept the procedure as the correct action.

TITLE

REVIEWING PAYLOAD IFM PROCEDURES

GENERAL

The payload customers provide a list of potential IFM procedures and malfunction procedures to JSC before the mission. JSC determines which of these procedures are IFM procedures and, of these procedures, which require real-time MCC approval only before implementation (though they have already received tentative preflight approval) and which of these require full real-time MCC coordination and validation before implementation. For the IFM procedures received too close to flight to be published, a Crew Procedure Change Request form (JSC Form 482) should be submitted by the respective payload customer representative(s). This action provides preflight approval for uplink and eliminates the need for extensive real-time MCC coordination, since HOUSTON FLIGHT, crew, and payload customer representatives will have previously approved the 482.

PROCEDURE

- A. If an anomaly occurs that requires an IFM procedure, the PAYLOAD REP contacts HOUSTON PAYLOADS on the PRIME OPS loop and requests that an IFM procedure be implemented. The PAYLOAD REP and HOUSTON PAYLOADS concur on the specific procedure to be used or decide if a real-time procedure must be developed. Any real-time-generated IFM procedure must be in the proper format for uplink, regardless of who develops the IFM procedure.
- B. HOUSTON PAYLOADS coordinates the implementation or development of the IFM procedure with the POCC and the MCC FCT, including safety and engineering personnel, if required.
- C. IFM personnel should request access to the following items, in order of preference, to allow for a timely and sound decision regarding the feasibility/safety of performing an IFM procedure and to properly validate the IFM procedure:
 1. Flight hardware
 2. Training hardware (engineering/backup unit)
 3. High-fidelity mockup
 4. Photos of flight hardware
 5. Schematics/drawings of electrical/mechanical interfaces

In addition, any videotape of the hardware being used (or of a preflight IFM procedure being performed) is also desired. IFM should also request any data that would enhance the possibility of providing an alternate power source, providing switch control/bypass capability, or enhance ground/onboard validation/verification.

- D. The process of real-time MCC approval and, in some case coordination extends to any previously published IFM procedure. IFM procedures in the FDF are not standalone procedures but are reviewed in real time upon occurrence of the defined anomaly. However, some payload IFM procedures do not require real-time MCC approval before implementation, as detailed in the Flight Rules. An IFM personnel determines the amount of MCC coordination and validation necessary for each IFM procedure, including whether formal support is required. Procedure validation can be as simple as desktop review or as complex as utilizing backup flight hardware to test the proposed procedure.

REAL-TIME IFM PROCEDURE DEVELOPMENT

- A. If the need arises, IFM procedures are developed during the mission as a result of an unexpected anomaly. When it is determined that a payload IFM procedure is required, the respective payload customer representative(s) notifies HOUSTON PAYLOADS and provides a brief summary of the complexity of the IFM required. Immediately following the identification of an IFM, the respective payload customer representative(s), IFM, HOUSTON FAO, and HOUSTON PAYLOAD SYSTEMS meet on the OPS ACTION loop to assess the impact of the IFM on orbiter and experiment operations. Questions that need to be answered at this time include the following:
1. What resources need to be allocated to the performance of the IFM procedure, including number of crewmembers (and if a specific one is required), special tools or equipment needed, and any special electrical/mechanical resources required from the orbiter?
 2. What is the priority/timeframe of the IFM procedure, including approximate time required, when it can be done, and when it cannot be done (constraints)?
 3. Who will develop the IFM procedure (IFM or the respective payload customer representative(s))?
 4. What level of procedure validation is required for the IFM procedure (ranging from desktop to flight hardware testing)?
 5. Has the crew been trained on hardware or a similar procedure?

If an orbiter interface or safety issue exists, the procedure is developed by the MCC and coordinated with the payload customers. If no orbiter interface or safety issue exists, the payload customers may both develop and implement the IFM procedure or request that IFM develop the IFM procedure.

- B. If the payload customer elects to develop the IFM procedure, MCC review and concurrence is still required. Once a preliminary IFM procedure has been developed, a copy of it is provided to HOUSTON PAYLOADS and IFM personnel for review and comment. HOUSTON PAYLOAD SYSTEMS and IFM personnel discuss any comments to the IFM procedure with the respective payload customer representative(s) on the OPS ACTION loop. Once the payload customer has completed the development of the IFM procedure, including preliminary MCC comments, a copy of the completed procedure is forwarded to HOUSTON MATS for preparation as an uplink message in standard FDF format. HOUSTON MATS forwards the proposed procedure to HOUSTON PAYLOADS and IFM personnel. IFM then initiates IFM procedure validation as required. HOUSTON PAYLOADS then coordinates MCC review of the IFM procedure in a timely manner.
- C. If the payload customers desire MCC development of the IFM procedure, IFM coordinates the development of the procedure. During the development of the IFM, working level coordination shall exist between IFM and the respective payload customer representative(s) to ensure that the IFM procedure is accurate. Once a draft copy is completed, the respective payload customer representative(s) and PAYLOAD SYSTEMS review the procedure and provide comments to IFM on the OPS ACTION loop. Once these comments have been incorporated, the IFM procedure is passed along to HOUSTON PAYLOADS and the respective payload customer representative(s), and IFM initiates procedure validation as required. Any comments by the respective payload customer representative(s) are resolved through HOUSTON PAYLOADS. HOUSTON PAYLOADS then obtains MCC approval for the IFM procedure in a timely manner.

TITLE

COMMONLY USED DRAWINGS

DESCRIPTION

Equipment: Av bays 1, 2, 3A fans 1 and 2; filter; and heat exchanger

Assembly Drawings/Part Numbers:

MC621-0008-0005	Av bay 1, 2, 3A cooling assembly and heat exchanger
VS70-613102	Av bay 1, 2, 3A cooling assembly
SV755502 (Hamilton Standard)	Av bay 1, 2, 3A cooling assembly
SV755524 (Hamilton Standard)	Av bay 1, 2, 3A air fan A and B
SV755525 (Hamilton Standard)	Av bay 1, 2, 3A air fan check valves (two)
SV755522 (Hamilton Standard)	Av bay 1, 2, 3A heat exchanger

Installation Drawings:

VO70-613890	(H ₂ O)
VO70-613999	(ARS) Av bay heat exchangers

Equipment:

Microbial filter (galley/tank A)

Assembly Drawing/Part Number:

VO70-623508	Pot H ₂ O tank A/galley microbial filter
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Installation Drawing:

VO70-623509	Pot H ₂ O tank A/galley microbial filter
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Equipment:

Humidity separator

Assembly Drawing/Part Number:

SV755513 (Hamilton Standard)	Water separator assy
SV767246 (Hamilton Standard)	Tubing, water outlet
SV755540 (Hamilton Standard)	Signal conditioner
SV767342 (Hamilton Standard)	Plug and lanyard assembly
SV755653 (Hamilton Standard)	Pitot, water separator
SV729703 (Hamilton Standard)	Valve, check liquid

Installation Drawings:

VO70-623002 (waste)
VO70-613438 (ARS)
VO70-613550 (ARS)

Equipment:

Cabin Air Fans A & B

Assembly Drawing/Part Number:

MC621-0008-0301	Cabin air fan and debris trap assembly
SV755508 (Hamilton Standard)	Cabin air fan and debris trap assembly
SV755527 (Hamilton Standard)	Cabin air fan A and B
SV755546 (Hamilton Standard)	Cabin air fan check valve (two)
SV755545 (Hamilton Standard)	Cabin air fan filter and debris trap (three)

Installation Drawing:

VO70-613438 (ARS)
VO70-613550 (ARS)

Equipment:

Cabin heat exchanger

Assembly Drawing/Part Number:

MC621-0008-0002	Cabin heat exchanger
SV755504-4 (Hamilton Standard)	Cabin heat exchanger

Installation Drawing:

VO70-613890 (H₂O)

VO70-613438 (ARS)

VO70-613550 (ARS)

Equipment:

H₂O tanks A, B, C, D, and waste tank

Assembly Drawing/Part Number:

MC282-0067-0001 H₂O tanks

Wire Installation Drawing:

VO70-793611 (zones 35, 166)

Installation Drawing:

VO70-623002 (waste)

VO70- 623201 (potable)

VO70-623200 (waste and potable)

Equipment:

WCS interfaces (in front of WCS)

Assembly Drawings/Part Numbers:

#47C265889 (G.E.) Urine dump line

VO70-623002 Urine dump, urine dump line, EMU drain, EMU drain line QDs

#47C265887 (G.E.) Extravehicular mobility unit (EMU) drain line

Installation Drawing:

VO70-623002

Equipment:

H₂O cooler (galley) and LCVG cooler

Assembly Drawings/Part Numbers:

MC621-0008-0020 Liquid-cooled garment (LCG) and galley heat exchangers

SV729791-1 (Hamilton Standard) LCG and galley heat exchangers

Installation Drawing:

VO70-613890 (H₂O)

Equipment:

Water pump package (beneath vol. C; see SSSH dwg 7.4)

Assembly Drawings/Part Numbers:

SV755509 (Hamilton Standard)	Primary water pump package
SV755507 (Hamilton Standard)	Secondary pump and accumulator assembly
SV729708 (Hamilton Standard)	Water pump (three - two primary and one secondary)
SV755547 (Hamilton Standard)	Water pump check valve (three - two primary and one secondary)
SV755538 (Hamilton Standard)	Accumulator
SV755534 (Hamilton Standard)	Filter
SV729725/26 (Hamilton Standard)	Water bypass valve

Installation Drawing:

VO70-613941

Equipment:

ARS ducting

Assembly Drawing/Part Number:

Installation Drawings:

MPA no. 3-7500-A-46D-13 (CM ECLSS air supply return duct and component instrumentation for OV-103)

VO70-613650 (WCS air inlet to cabin fan inlet)

613438 (Cabin fan inlet to cabin heat exchanger)

613724 (Cabin heat exchanger to ECLSS bay supply duct, payload supply duct, and flight deck supply duct)

Equipment:

H₂O lines and valve assemblies

Assembly Drawing/Part Number:

TBD

Wire Installation Drawing:

VO70-793611

Installation Drawing:

VO70-623002 (waste valves - LV7, 8, 15, 16, 17, urine dump filter)

VO70-623200 (waste and potable valves - LV1 through LV9, LV11 through LV13, LV17)

Equipment

Correct LiOH stowage box installation

Assembly Drawing/Part Number:

Installation Drawing:

Equipment:

Regenerable CO₂ removal system (RCRS)

Assembly Drawing:

VO70-623630

Installation Drawing:

VO70-623600

REFERENCE DOCUMENTATION

IFM APPLICATIONS

TITLE

REFERENCE AXES DEFINITION

PURPOSE

This information identifies and defines commonly used orbiter reference frames and terminology.

DESCRIPTION

Structural Axes

The Space Shuttle structural axes are normally utilized to describe structural locations (identify structural parts, equipment, etc.).

- A. Origin is 240 in. forward of the nose with the positive X-axis extending toward the tail of the vehicle, parallel to the longitudinal axis of the vehicle.
- B. The Z-axis is parallel to the orbiter plane of symmetry and is perpendicular to the X-axis. The positive direction extends vertically out of the payload bay.
- C. The Y-axis completes the right-hand orthogonal system.

BODY AXIS SYSTEM

The Space Shuttle body axes are used for defining attitudes.

- A. Origin is at the orbiter's center of mass.
- B. The positive X-axis extends from the center of gravity (c.g.) through the vehicle nose parallel to the structural X-axis.
- C. The Z-axis is parallel to the orbiter plane of symmetry and is perpendicular to the X-axis. It is positive through the belly of the orbiter.
- D. The Y-axis completes the right-hand orthogonal system.

REFERENCE DOCUMENTATION

“Shuttle Operational Data Book” (SODB), Vol. 1, Section 2.0, “Configuration”

TITLE

CREW MODULE FASTENER SUMMARY

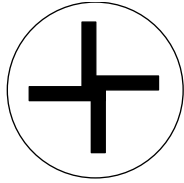
PURPOSE

The orbiter crew module utilizes a variety of fasteners for attaching hardware. These fasteners vary in type, size, and size of tool utilized. The crew module fastener summary table provides a summary of fasteners by part number, head type, thread size, fastener size, driver/tool size, and torque range. Table 4.3-1 is provided as a reference to be utilized in writing procedures that require accessing fasteners.

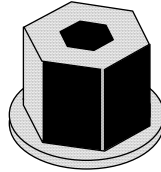
Table 4.3-1. Crew module fastener summary

Part Number	Head type	Thread size	Fastener size	Driver/tool size	Torque range (in-lb)
MD112-1002-03XX	Pan	0.1900	No. 10	No. 10 TT	20-30
MD112-1003-01XX	Pan	0.1120	No. 4	No. 4 TT	3.6-8.8
MD112-1003-02XX	Pan	0.1380	No. 6	No. 6 TT	4.4-10
MD112-1003-03XX	Pan	0.1640	No. 8	No. 8 TT	7-15
MD112-1003-04XX	Pan	0.1900	No. 10	No. 10 TT	20-30
MD112-3003-04XX	Flush	0.1900	No. 10	No. 8 TT	35-40
ME112-0010-XXXX	Hex head	0.2500	1/4-in.	3/16-in. hex or 7/16-in. socket	60-80*
ME112-0012-01XX	Flush	0.1380	No. 6	No. 5 TT	4.4-10
ME114-0044-0300	Nut	0.1900		1/4-in. socket	25-35
ME128-0026-4XXX	Pan	0.1640	1/4-in.	5/32-in. hex	20-30
ME128-0027-4XXX	Flush	0.1640	1/4-in.	5/32-in. hex	20-30
ME128-0039-01XX	Pan	0.1120	0.186	No. 6 TT	2.3-5.5
NAS 1004-XXX	Bolt	0.2500	1/4-in.	7/16-in. socket	85-105
NAS 1581-03T3	Flush	0.1900	No. 10	No. 8 TT	20-30
RD111-1012-6310	Bolt	0.1900	No. 10	3/8-in. socket	35-40
RD111-1012-6410	Bolt	0.2500	1/4-in.	7/16-in. socket	85-105
RD111-1012-6512	Bolt	0.3120	5/16-in.	1/2-in. socket	40-45

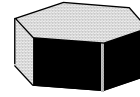
*Units not mounted on coldplates shall be torqued to 100-105 in-lb.



TT = Torque tip
viewed from
inside the screw



Hex-head
with internal hex
(or allen)



Hex-head

j_22673_051

Figure 4.3-1. Various crew module fastener head types

TITLE

QUICK DISCONNECTS

PURPOSE

Information on quick disconnect (QD) specifications, locations, mates, IFM procedures, and diagrams is provided. This information is provided on all QDs in the orbiter cabin which can be accessed for IFM purposes.

INFORMATION

Quick Disconnect Specifications

A. TYPE I - Male coupling (flight half) (MC276-0020-1xxx)

1. Group 1 (1/4-inch), push-pull

-1023:	Class 2B - Key 1, flange, 35 psig, N ₂ , w/press cap (tank pressurization)
-1141:	Class 14A - Key 2, flange, 55 psig, water, w/press cap (airlock - ECLSS service)
-1201:	Class 20 - No key, flange, 55 psig, water, w/dust cap (galley - potable water)
-1301:	Class 30A - No key, MS33656-4 end, 55 psig, water, w/dust cap (microbial check valve)

2. Group 1 (3/8-inch), push-pull:

-1101:	Class 10A - No key, flange, 55 psig, water, w/press cap
-1103:	Class 10B - Key 1, flange, 55 psig, water, w/press cap
-1191:	Class 19 - No key, MS33656-6, 90 psig, water, w/press cap (HPB water coolant loop)

B. TYPE III - Female coupling (flight half) (MC276-0020-3xxx)

1. Group 1 (1/4-inch), push-pull

-3142:	Class 14A - MP273-0002-1004 end, 55 psig, water, w/press plug
-3202:	Class 20 - MP273-0002-1004 end, 55 psig, water, w/dust plug (galley - potable water)
-3302:	Class 30A - MS33656-4 end, 55 psig, water, w/dust plug (microbial check valve)

2. Group 1 (3/8-inch), push-pull

-3102	Class 10A - MP273-0002-1006 end, 55 psig, water, w/press plug
-3104	Class 10B - MP273-0002-1006 end, 55 psig, water, w/press plug

3. Quick disconnect mates

Size	Male	Female
1/4 inch	-1201, -1301	-3142, -3202, -3302
3/8 inch	-1101, -1191	-3102
3/8 inch	-1103 (keyed)	-3104

4. Male quick disconnects

a. 1/4-inch

-1023 (keyed):	GSE water Tk N ₂ supply (behind WCS wall)
-1141:	Galley auxiliary port potable water (on galley)
	Galley water flush test port no. 4 (TP4) (on galley)
-1201:	Ambient water (just above middeck floor at ML90N)
	Chilled water (just above middeck floor at ML90N)
	Operational water dispenser assembly (OWDA) outlet (on OWDA)
-1301:	-1301 blue / -1301 blue contingency hose (in IFM contingency hose and cable kit in the window shade bag)
-1191:	Free fluid disposal nozzle (in IFM contingency hose and cable kit)
	Contingency water dispenser (in IFM contingency hose and cable kit)
	Potable tank A and galley/OWDA microbial check valve inlet (below middeck floor at MD25K accessed through LEB access panel (MD24I))

b. 3/8 inch

-1101:	Cont water X-tie potable (at WCS outboard wall (MD12H))
	Cont water X-tie waste (at WCS outboard wall (MD12H))
	WCS vacuum vent (on front panel of WCS)
	Payload supply (on middeck floor at MD24K)
	EMU drain (at front of WCS on middeck floor)
	Condensate collection QD (on middeck floor)
-1103 (keyed):	Payload return (on middeck floor at MD24K)
	Urine dump (at front of WCS on middeck floor)
-1191:	Contingency water container (CWC) (in vol. G at MD80R)
	Urine QD adapter (in WMC hygiene kit at MA82H)
	Waste water dump filter (WWDF) (in IFM BOB locker)
	Urine solids filter (beneath WCS and middeck floor)
	Free fluid disposal nozzle (in IFM contingency hose and cable kit)

5. Female quick disconnects

a. 1/4-inch

-3142:	-3142 red/-3142 red contingency hose (in IFM contingency hose and cable kit)
	-3142 red/-3102 yellow QD adapter (in IFM contingency hose and cable kit)
-3202:	Galley ambient water (below galley)
	Galley chilled water (below galley)
-3302:	Personal hygiene station hose (in IFM contingency hose and cable kit)

b. 3/8-inch

-3102:	-3102 yellow/-3102 yellow contingency hose (in IFM contingency hose and cable kit)
	-3102 yellow/-3142 red QD adapter (in IFM contingency hose and cable kit)
	EMU drain line (behind the WCS kickplate on middeck floor)
-3104:	Urine dump line (behind the WCS kickplate on middeck floor)
	Waste water dump filter (WWDF) (in IFM BOB locker)
	Urine solids filter (beneath WCS and middeck floor)

POTABLE WATER QUICK DISCONNECTS

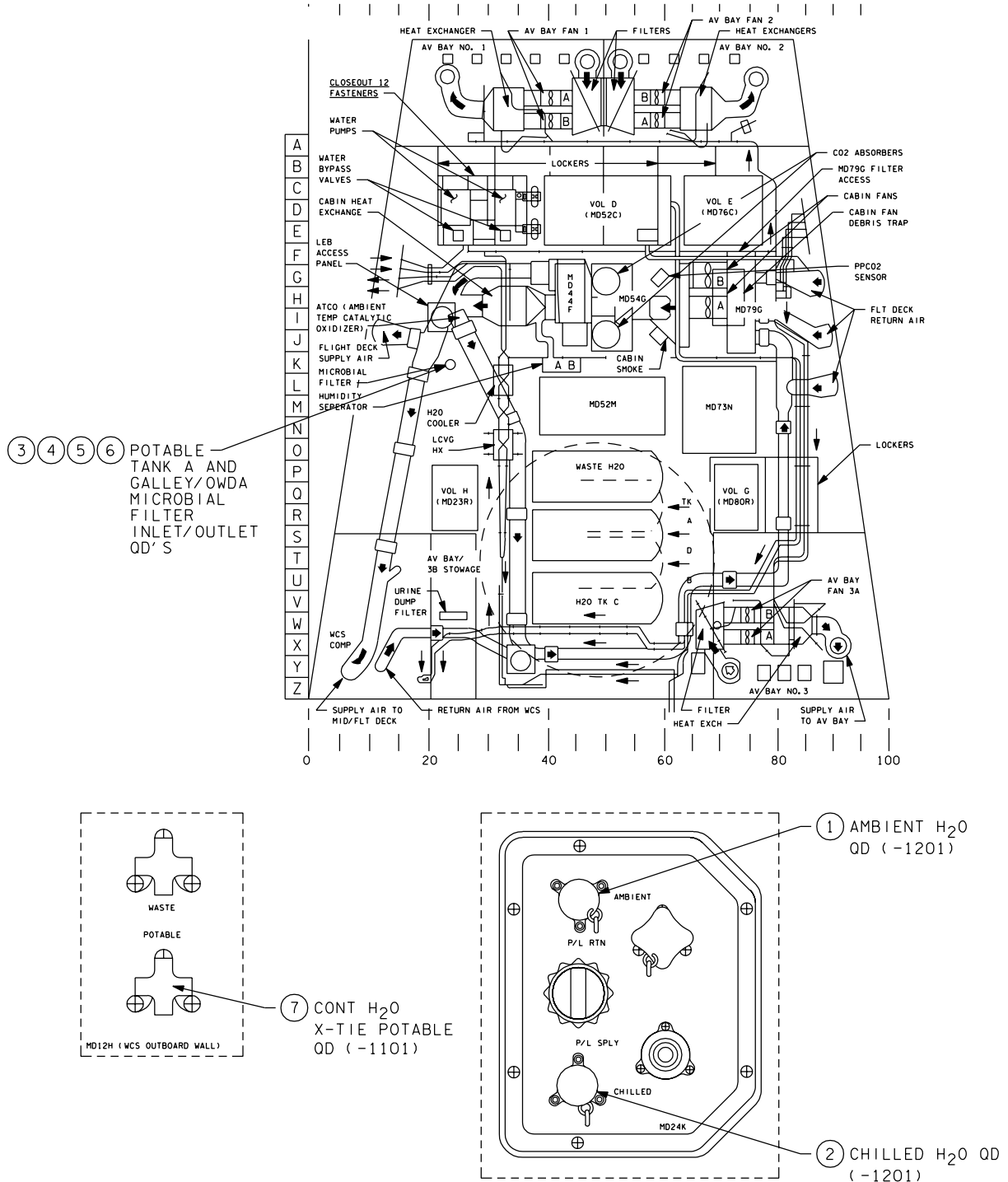
Supply Water

1. Ambient water (for the galley or OWDA)
2. Chilled water (for the galley or OWDA)
3. Potable tank A and galley/OWDA microbial filter inlet line
4. Potable tank A and galley/OWDA microbial filter inlet (lower blue)
5. Potable tank A and galley/OWDA microbial filter outlet
6. Potable tank A and galley/OWDA microbial filter outlet line
7. Contingency water cross-tie potable

Procedures	Function/QD	Contingency hose(s)	Function/QD
① FC H ₂ O supply line flush ② Water dispenser line flush ③ Galley H ₂ O line flush	Ambient H ₂ O QD -1201 OR Chilled H ₂ O QD -1201		
	OWDA outlet QD -1201		
	Galley H ₂ O flush TP4 -1141* OR galley aux port potable H ₂ O QD -1141* *MODIFIED		
④ Waste H ₂ O system backup dump ⑤ Water tank contingency X-tie ⑥ CWC operation	Cont H ₂ O X-tie waste QD -1101		-1101 Cont H ₂ O X-tie potable QD -1191 Contingency water container (CWC)
⑦ Supply H ₂ O system backup dump - tank A, B ⑧ Supply H ₂ O system backup dump - tank C, D	Cont H ₂ O X-tie pot QD -1101		
⑨ WCS - Failed urinal (fan sep failure)	7/8-in. to 5/8-in. Urine QD adapter Urinal funnel 7/8 in. 5/8 in. -1191		-1101 Cont H ₂ O X-tie waste QD
⑩ Free fluid disposal	Free fluid nozzle -1301		
⑪ Water dispenser/supply tank A connection	H ₂ O tank A Tk A inlet Potable tank A and galley/OWDA microbial filter -1201-3302 -1301		-1201 Ambient H ₂ O QD OR -1201 Chilled H ₂ O QD

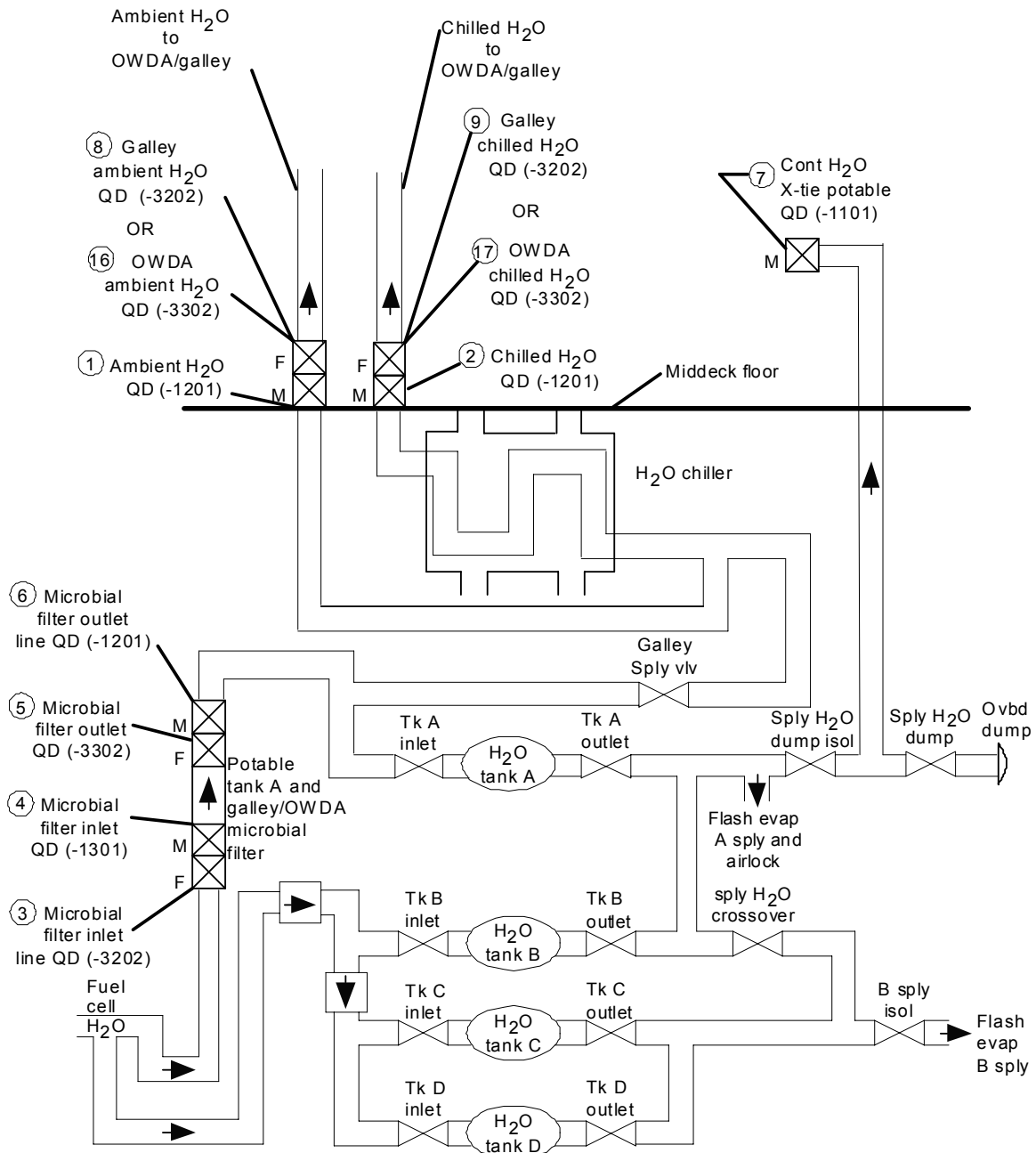
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Figure 4.4-1. IFM water procedures summary



22673010. ART# 1

Figure 4.4-2. Supply water QDs



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Figure 4.4-2. Supply water QDs (continued)

Item 1. Galley ambient water QD (-1201)

Quick disconnect: Galley ambient water

Location: Below the galley at ML90N

Part number: MC276-0020-1201 (Symetrics, P/N 502040-1201)

Description: Male coupling, 1/4-inch, push-pull

References:

1. SSSH dwg. 6.4 (Supply Water Storage) zones W3, V3.
2. Dwg. VO70-623200, zones 95, 125.

Comments: The ambient water QD (-1201):

- Has the galley ambient water QD (-3202) connected to it during galley flights and has the OWDA ambient water QD (-3302) connected to it during non-galley flights.
- Is used with the red/red hose (-3142 QDs) or the PHS hose (-3302 QD) attached to it in the "Fuel Cell Water Supply Line Flush" IFM procedure.

Item 2. Galley chilled water QD (-1201)

Location: Below the galley at ML90N

Part number: MC276-0020-1201 (Symetrics, P/N 502040-1201)

Description: Male coupling, 1/4-inch, push-pull

References:

1. SSSH dwg. 6.4 (Supply Water Storage) zones W2, U3.
2. Dwg. VO70-623200, zones 95, 125.

Comments: The chilled water QD (-1201):

- Has the galley chilled water QD (-3202) connected to it during galley flights.
- Is used with the red/red hose (-3142 QDs) or the PHS hose (-3302 QD) attached to it in the "Fuel Cell Water Supply Line Flush" IFM procedure.

Item 3. Microbial filter inlet line QD (-3202)

Location: Below the middeck floor at MD25K; accessed through MD24I panel on the inlet line at bottom end of the microbial filter

Part number: MC276-0020-3202 (Symetrics, P/N 502040-3202)

Reference design: 90V62TP106

Description: Female coupling, 1/4-inch, push-pull

- References:
1. SSSH dwg. 6.4 (Supply Water Storage), zone P8.
 2. VO70-623509 (Installation - Microbial Check Valve and Coupling Assy, Water Management System).

Comments: The potable tank A and galley/OWDA microbial filter inlet line is disconnected from the microbial filter inlet QD (-1301) in the "Water Dispenser/Supply Tank A Connection" IFM procedure.

Item 4. Microbial filter inlet QD (-1301)

Location: Below the middeck floor at MD25K; accessed through MD24I panel at the bottom end of the microbial filter

Part number: MC276-0020-1301 (Symetrics, P/N 502040-1301)

Description: Male coupling, 1/4-inch, push-pull

- References:
1. SSSH dwg. 6.4 (Supply Water Storage), zone P8.
 2. Dwg. VO70-623508 (Check Valve and Coupling Assy - Microbial, Water Management System).
 3. VO70-623509 (Installation - Microbial Check Valve and Coupling Assy, Water Management System).

- Comments:
- The microbial filter inlet (lower blue) QD is used in the "Water Dispenser/Supply Tank A Connection" IFM procedure.
 - The water line coming from the H₂ separators (fuel cell water) is disconnected from the -1301 QD on the bottom of the microbial filter and the red/red hose is connected to the bottom of the microbial filter (to the -1301 QD).
 - The procedure provides drinking water from tank A through the microbial filter (flowing backward) to the galley water dispenser in the event of a failed galley supply line.

Item 5. Microbial filter outlet QD (-3302)

Location: Below the middeck floor at MD25K; accessed through MD24I panel at the top side of the microbial filter

Part number: MC276-0020-3302 (Symetrics, P/N 502040-3302)

Description: Female coupling, 1/4-inch, push-pull

- References:
1. SSSH dwg. 6.4 (Supply Water Storage), zone P8.
 2. Dwg. VO70-623508 (Check Valve and Coupling Assy - Microbial, Water Management System).
 3. VO70-623509 (Installation - Microbial Check Valve and Coupling Assy, Water Management System).

- Comments:
- No published IFM procedures call for disconnecting this microbial filter outlet QD.
 - This microbial filter's mounting bracket (2 - no. 10 torque tip screws) must be removed to disconnect the microbial filter outlet QD.

Item 6. Microbial filter outlet line QD (-1201)

Location: Below the middeck floor at MD25K; accessed through MD24I panel on the end of the outlet line at the top side of the microbial filter

Part number: MC276-0020-1201 (Symetrics, P/N 502040-1201)

Reference design: 90V62TP105

Description: Male coupling, 1/4-inch, push-pull

- References:
1. SSSH dwg. 6.4 (Supply Water Storage), zone P8.
 2. Dwg. VO70-623508 (Check Valve and Coupling Assy - Microbial, Water Management System).
 3. VO70-623509 (Installation - Microbial Check Valve and Coupling Assy, Water Management System).

- Comments:
- No published IFM procedures call for disconnecting this microbial filter outlet line QD.
 - This microbial filter's mounting bracket (2 - no. 10 torque tip screws) must be removed to disconnect the microbial filter outlet line QD.

Item 7. Contingency water cross-tie potable QD (-1101)

Location: On the WCS outboard wall at MA16J

Part number: MC276-0020-1101 (Symetrics, P/N 502060-1101)

Description: Male coupling, 3/8-inch, push-pull

- References:
1. SSSH dwg. 6.4 (Supply Water Storage), zone H1.
 2. SSSH dwg. 6.5 (Waste Management), zone J5.
 3. Dwg. VO70-623300, zones 61, 69, and 94.

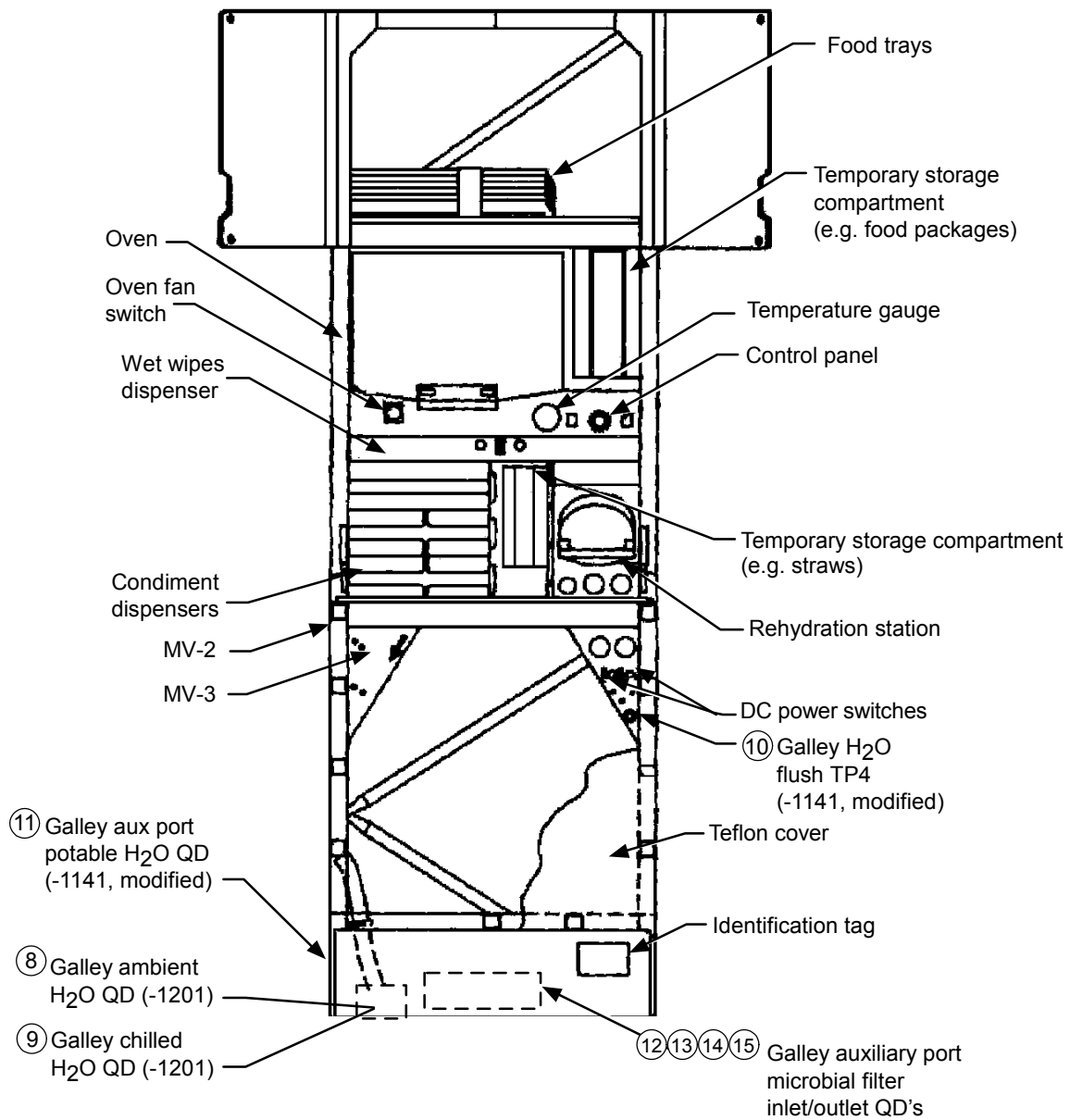
Comments:

The contingency water cross-tie potable QD

- Mates with the yellow/yellow hose (-3102 QDs) or the yellow/red QD adapter (yellow side).
- Is used in following IFM Procedures:
 - FES Supply, Waste Water
 - Supply H₂O Sys Backup Dump - Tk A, B
 - Supply H₂O Sys Backup Dump - Tk C, D
 - Waste Water Sys Backup Dump
 - Supply H₂O Purge from Dumpline

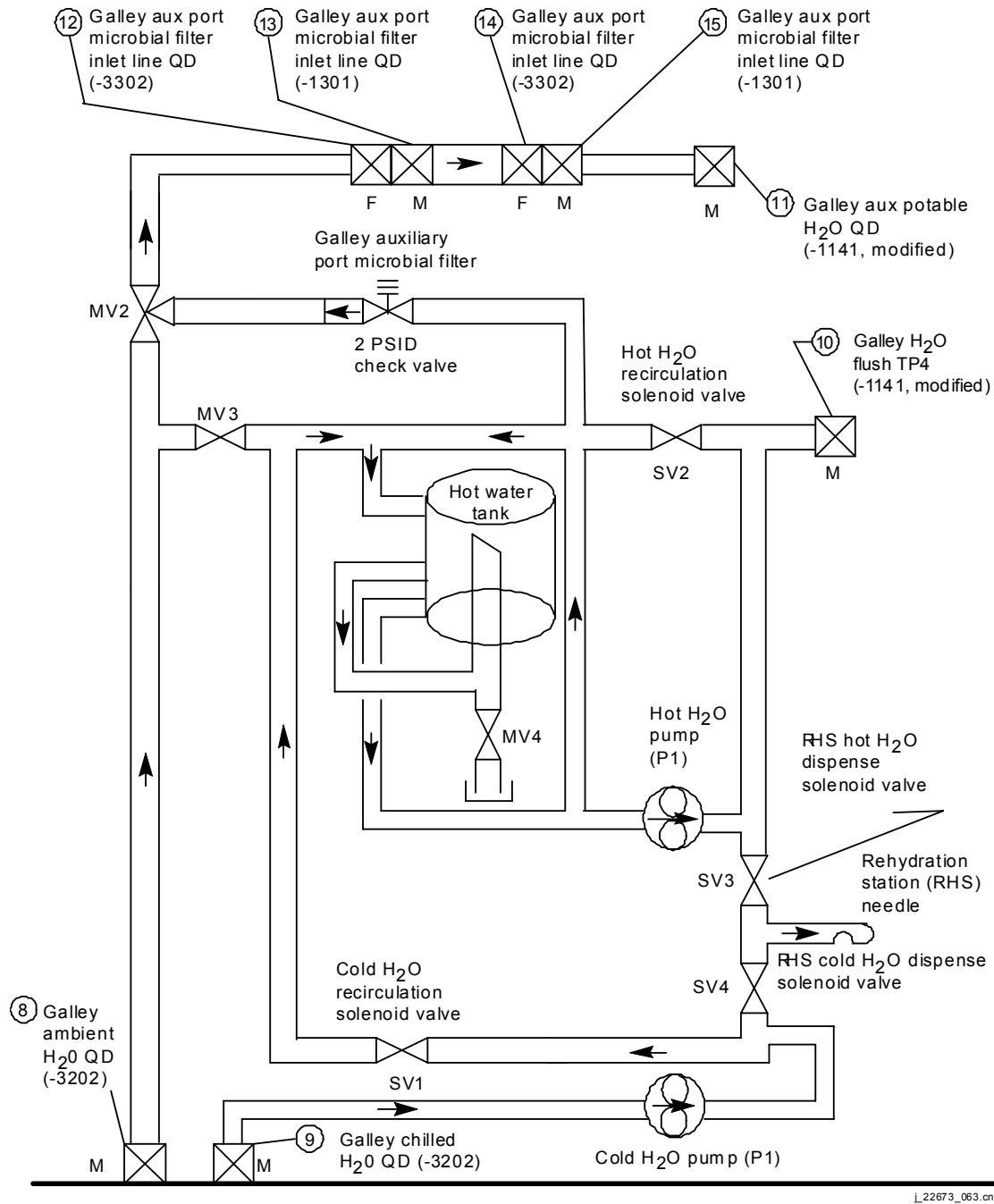
GALLEY

8. Galley ambient water
9. Galley chilled water
10. Galley water flush test port no. 4 (TP4)
11. Galley auxiliary port potable water
12. Galley auxiliary port microbial filter inlet line
13. Galley auxiliary port microbial filter inlet
14. Galley auxiliary port microbial filter outlet
15. Galley auxiliary port microbial filter outlet line



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Figure 4.4-3. Galley QDs



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Figure 4.4-3. Galley QDs (continued)

Item 8. Galley ambient water inlet line QD (-3202)

- Location: On the galley ambient inlet line, connected to the ambient water QD (-1201) beneath the galley at ML90N
- Part number: MC276-0020-3202 (Symetrics, P/N 502040-3202)
- Description: Female coupling, 1/4-inch, push-pull
- References:
1. SSSH Dwg. 6.6 (Galley), zone H6.
 2. Dwg. SGD 39119053 (Plumbing Installation Shuttle Orbiter Galley Upgrade Modifications), item 38, zone F8.
- Comments: The galley ambient water QD (-3202) is
- Normally connected to the ambient water QD (-1201) beneath the galley during galley flights.
 - Disconnected from the ambient water QD (-1201) and reconnected to the blue/blue hose (-1201 QDs) in the "Water Dispenser/Sply Tk A Connection" IFM procedure (this supplies ambient water to the galley from supply tank A backflowing through the galley/supply tank A microbial filter in the event of a failed galley water supply line).
 - Disconnected from the ambient water QD (-1201) and replaced with the red/red hose (-3142 QDs) or the PHS hose while performing the "Fuel Cell Water Supply Line Flush" IFM procedure.

Item 9. Galley chilled water inlet line QD (-3202)

- Location: Connects to the chilled water QD (-1201) beneath the galley at ML90N
- Part number: MC276-0020-3202 (Symetrics, P/N 502040-3202)
- Description: Female coupling, 1/4-inch, push-pull
- References:
1. SSSH Dwg. 6.6 (Galley), zone H5.
 2. Dwg. SGD 39119053 (Plumbing Installation Shuttle Orbiter Galley Upgrade Modifications), item 38, zone C8.
- Comments: The galley chilled water QD (-3202) is
- Normally connected to the chilled water QD (-1201) beneath the galley during galley flights.
 - Disconnected from the chilled water QD (-1201) and replaced with the red/red hose (-3142 QDs) or the PHS hose while performing the "Fuel Cell Water Supply Line Flush" IFM Procedure.

Item 10. Galley water flush test port no. 4 (TP4) QD (-1141)

- Location: On the galley, below the rehydration station (RHS)
- Part number: MC276-0020-1141, **modified*** (Symetrics, P/N 502040-1141)
- Description: Male coupling, 1/4-inch, push-pull
- References:
1. SSSH dwg. 6.6 (Galley), zones N2, C6.
 2. Dwg. SGD39119053 (Plumbing Installation Shuttle Orbiter Galley Upgrade Modifications), item 24, zone G8.
- Comments:
- Water can be flushed through the galley water lines and out the galley water flush test port no. 4, if necessary.
 - The galley auxiliary port potable water and galley water flush test port no. 4 (TP4) are -1141 QDs which have been modified (by removing their key ring) making them equivalent to a -1201 type QD (**see item 11, part number below**)*.
 - Consequently, these two -1141 modified QDs are able to mate with -3302, -3202, and -3142 1/4-in. female QDs.

Item 11. Galley auxiliary port (aux port) QD (-1141)

- Location: On the galley
- Part number: MC276-0020-1141, **modified*** (Symetrics, P/N 502040-1141)
- Description: Male coupling, 1/4-inch, push-pull
- References:
1. SSSH dwg. 6.6 (Galley), zones O1, H8.
 2. Dwg. SGD39119053 (Plumbing Installation Shuttle Orbiter Galley Upgrade Modifications) item 24, zone G8.
- Comments:
- On galley flights the PHS (personal hygiene hose) connects to the galley aux port.
 - Water can be flushed through the galley water lines and out the galley aux port, if necessary.
 - The galley auxiliary port potable water and galley water flush test port no. 4 (TP4) are -1141 QDs which have been modified (by removing their key ring) making them equivalent to a **-1201 type QD***.
 - Consequently, these two -1141 modified QDs are able to mate with -3302, -3202, and -3142 1/4-in. female QDs.

Item 12. Galley auxiliary port microbial filter inlet line QD (-3302)

Location: In the galley

Part number: MC276-0020-3302 (Symetrics, P/N 502040-3302)

Description: Female coupling, 1/4-inch, push-pull

References:

1. SSSH dwg. 6.6 (Galley), zone G8.
2. Dwg. SGD 39119053 (Plumbing Installation Shuttle Orbiter Galley Upgrade Modifications), item 41, zone F7.

Item 13. Galley auxiliary port microbial filter inlet QD (-1301)

Location: In the galley

Part number: MC276-0020-1301 (Symetrics, P/N 502040-1301)

Description: Male coupling, 1/4-inch, push-pull

References:

1. SSSH dwg. 6.6 (Galley), zone G8.
2. Dwg. SGD 39119053 (Plumbing Installation Shuttle Orbiter Galley Upgrade Modifications), item 40, zone F7.

Item 14. Galley auxiliary port microbial filter outlet QD (-3302)

Location: In the galley

Part number: MC276-0020-3302 (Symetrics, P/N 502040-3302)

Description: Female coupling, 1/4-inch, push-pull

References:

1. SSSH dwg. 6.6 (Galley) zone H8.
2. Dwg. SGD 39119053 (Plumbing Installation Shuttle Orbiter Galley Upgrade Modifications), item 41, zone F7.

Item 15. Galley auxiliary port microbial filter outlet line QD (-1301)

Location: In the galley

Part number: MC276-0020-1301 (Symetrics, P/N 502040-1301)

Description: Male coupling, 1/4-inch, push-pull

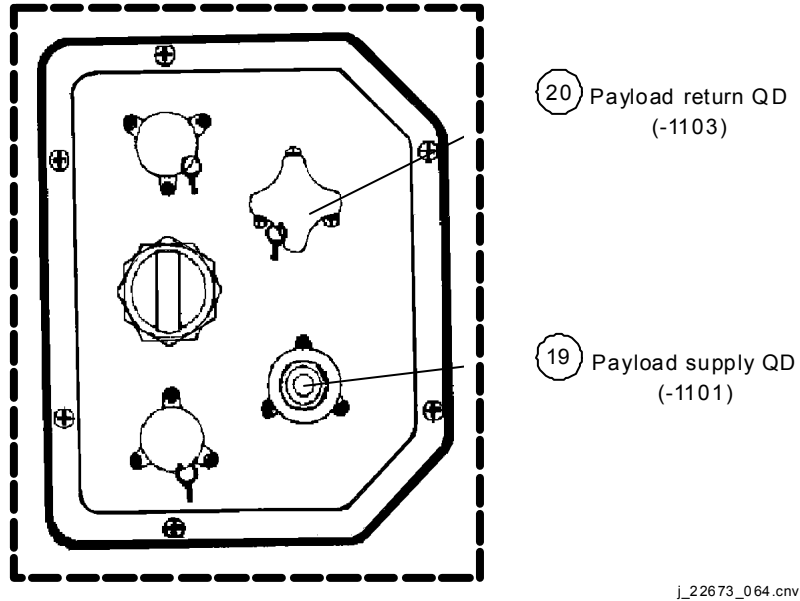
References:

1. SSSH dwg. 6.6 (Galley), zone H8.
2. Dwg. SGD 39119053 (Plumbing Installation Shuttle Orbiter Galley Upgrade Modifications), item 40, zone F7.

PAYLOAD

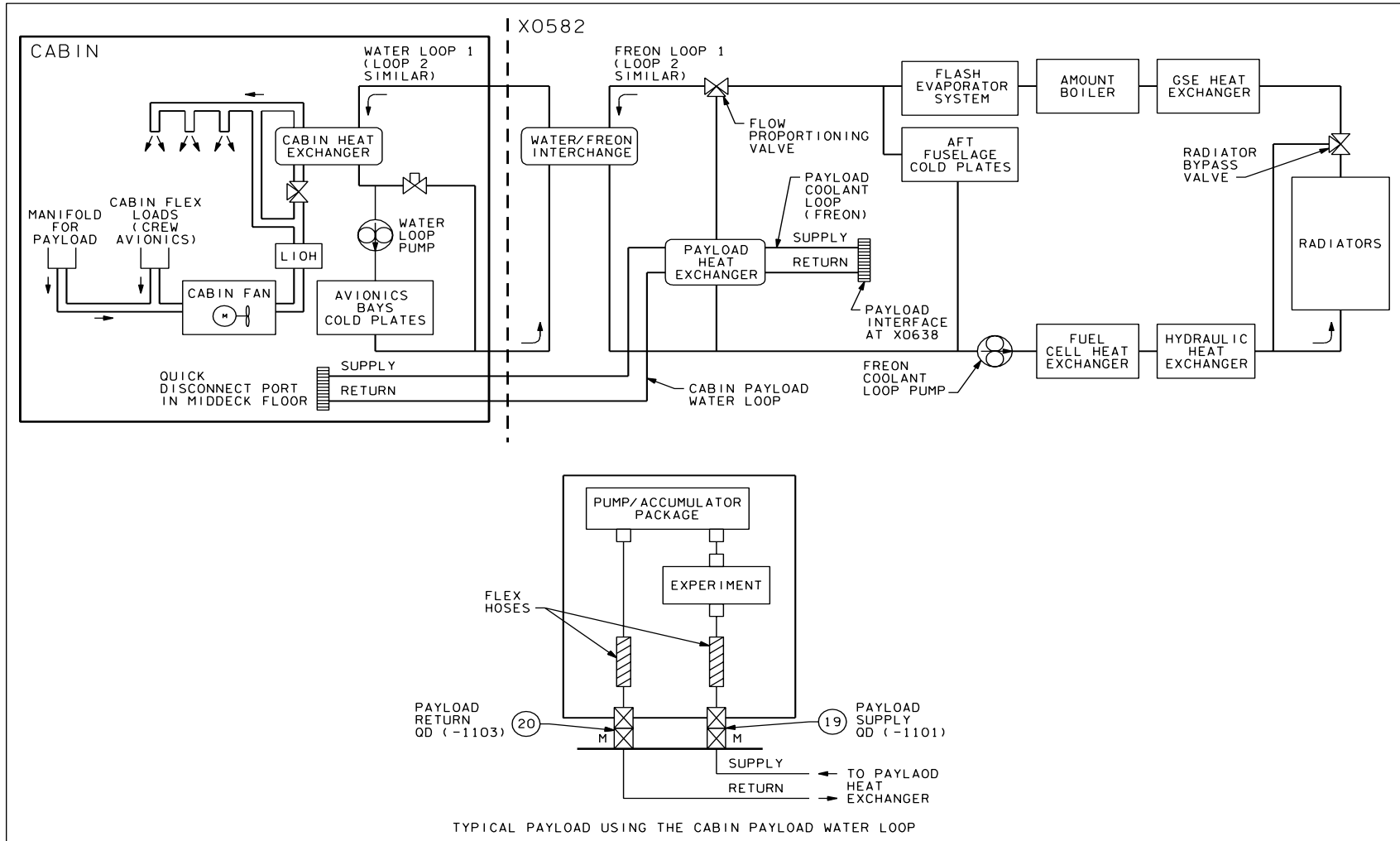
16. Payload Supply

17. Payload Return



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Figure 4.4-4. Payload QDs



226730010, ART. 1

Figure 4.4-4. Payload QDs (continued)

4.4-17

Verify that this is the correct version before use

Item 16. Payload supply QD (-1101)

Location: On the middeck floor below the MAR at MD24K

Part number: MC276-0020-1101 (Symetrics, P/N 502060-1101)

Description: Male coupling, 3/8-inch, push-pull

References:

1. SSSH dwg. 6.4 (Supply Water Storage), zone W2.
2. Dwg. VO70-613503 (Installation, Payload Coolant Lines, ECLSS Equipment Bay), zone 47.

Comments:

- The payload supply QD (-1101) mates with the yellow/yellow hose (-3102 QDs) but is not normally used.
- It is used when a water-cooled payload flies in place of the MAR.

Item 17. Payload return QD (-1103)

Location: On the middeck floor below the MAR at MD24K

Part number: MC276-0020-1103 (Symetrics, P/N 502060-1103)

Description: Male coupling, 3/8-inch, push-pull (KEYED)

References:

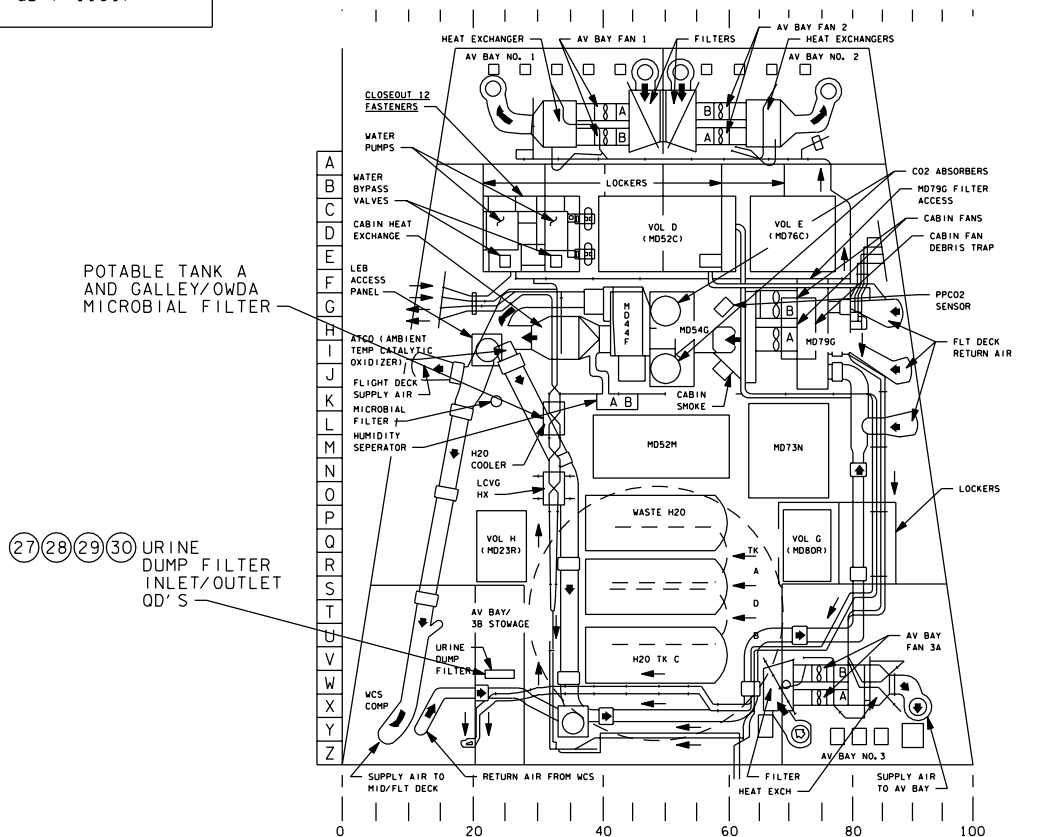
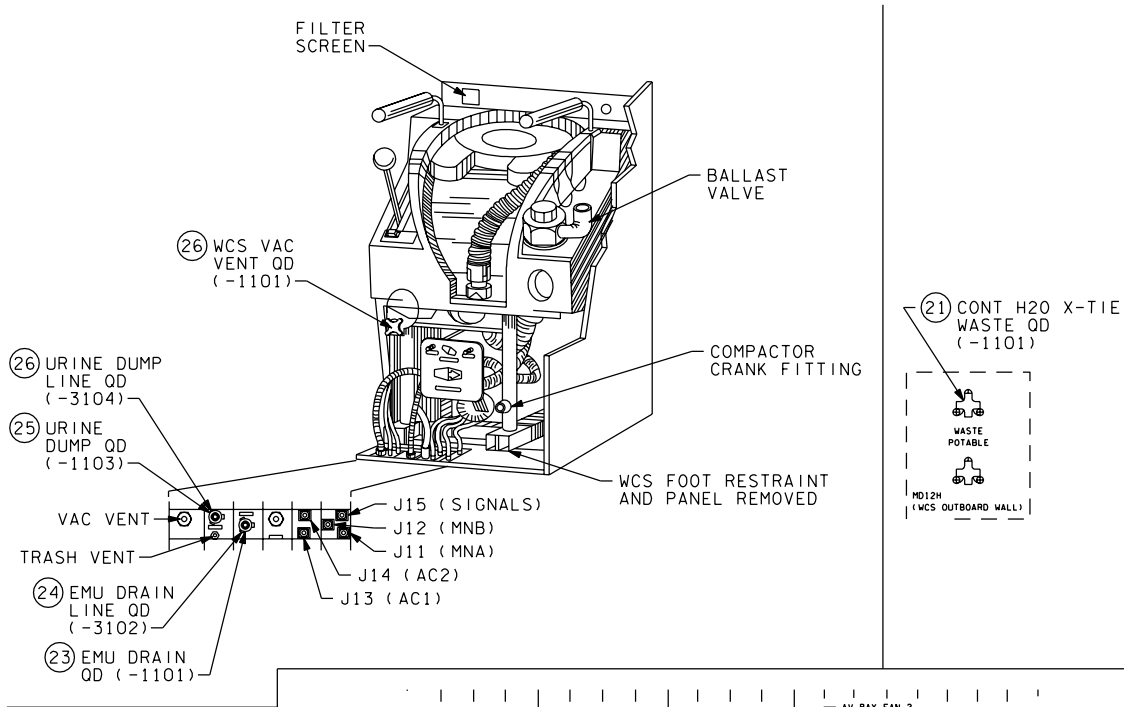
1. SSSH dwg. 6.4 (Supply Water Storage), zone W3.
2. Dwg. VO70-613503 (Installation, Payload Coolant Lines, ECLSS Equipment Bay), zone 47.

Comments: The payload return QD (-1103, KEYED) is used when a water-cooled payload flies in place of the MAR.

WASTE WATER QUICK DISCONNECTS

18. Contingency water cross-tie waste
19. WCS vacuum vent
20. EMU drain
21. EMU drain line
22. Urine dump
23. Urine dump line
24. Urine dump filter inlet line

- 25. Urine dump filter inlet
- 26. Urine dump filter outlet
- 27. Urine dump filter outlet line



22673007. ART 1

Figure 4.4-5. Waste water QDs

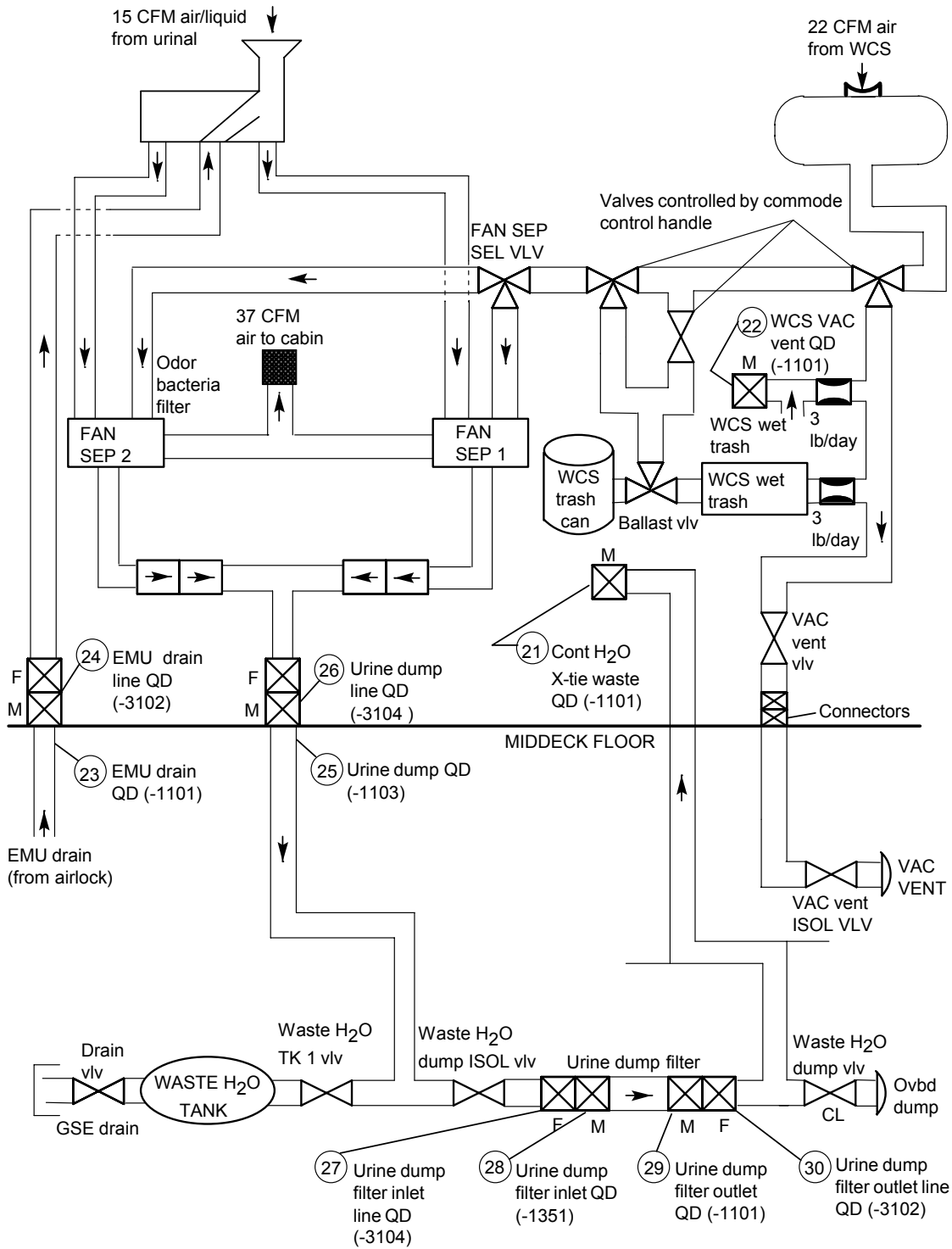


Figure 4.4-5. Waste water QDs (continued)

Item 18. Contingency water cross-tie waste QD (-1101)

Location: On the WCS outboard wall at ML16J

Part number: MC276-0020-1101 (Symetrics, P/N 502060-1101)

Description: Male coupling, 3/8-inch, push-pull

References: 1. SSSH dwg. 6.4 (Supply Water Storage), zone H2.
2. SSSH dwg. 6.5 (Waste Management), zone J4.
3. Dwg. VO70-623300, zones 61, 68, and 93.

Comments: The contingency water cross-tie waste QD

- Mates with the yellow/yellow hose (-3102 QDs) or the yellow/red QD adapter (yellow side).
- Is used in the following IFM Procedures:
 - CWC Operation
 - FES Supply, Waste Water
 - Free Fluid Disposal
 - Supply H₂O Sys Backup Dump - Tk A,B
 - Supply H₂O Sys Backup Dump - Tk C,D
 - Waste Water Sys Backup Dump
 - Water Dispenser Line Flush
 - Vacuum Vent Contingency Operation
 - WCS Fan Sep Failure
 - Waste H₂O Purge From Dumpline

Item 19. WCS vacuum vent QD (-1101)

Location: On the front panel of the WCS (upper starboard)

Part number: MC276-0020-1101 (Symetrics, P/N 502060-1101)

Reference desig: 80V62TP126

Description: Male coupling, 3/8-inch, push-pull

References: 1. SSSH dwg. 6.5 (Waste Management), zone P6.

Comments: 1. The WCS vacuum vent mates with the yellow/yellow hose.
2. This QD is used in the CWC Operation IFM procedure to vent the contingency water container (CWC) overboard if gas is present in the CWC.
3. The WCS vacuum vent is also used in vacuum vent contingency operations.

Item 20. EMU drain QD (-1101)

Location: Under the front of the WCS on the middeck floor with the EMU Drain Line QD (-3102) connected to it.

Part number: MC276-0020-1101 (Symetrics, P/N 502060-1101)

Reference desig: 90V62TP127

Description: Male coupling, 3/8-inch, push-pull

References:

1. SSSH dwg. 6.5 (Waste Management), zone R5.
2. Dwg. VO70-623002 (Sys Installation - Waste Management, ECLSS Equipment Bay), zone 10.

Comments:

- The EMU drain is used only when servicing the EMU's pre- or post-EVA.
- The EMU drain QD (-1101) can be connected to the yellow/yellow hose (-3102 QDs) or the yellow/red QD adapter (yellow side).

Item 21. EMU drain line QD (-3102)

Location: Under the front of the WCS on the middeck floor connected to the EMU drain QD (-1101)

QD part number: MC276-0020-3102 (Symetrics, P/N 502060-3102)

Drain line part no.: R28517-22 (Resistoflex)

Reference desig: 80V62TP127

Description: Female coupling, 3/8-inch, push-pull

References:

1. SSSH dwg. 6.5 (Waste Management), zone R6.
2. Dwg. VO70-623002 (Sys Installation - Waste Management, ECLSS Equipment Bay), zone 53.
3. G.E. dwg. no. 47C265887 (Hose Assembly EMU).

Comments: The EMU drain line is used only when servicing the EMU's pre- or post-EVA.

Item 22. Urine dump QD (-1103)

Location: Under the front of the WCS on the middeck floor with urine dump line QD (-3104) attached to it

Part number: MC276-0020-1103 (Symetrics, P/N 502060-1103)

Reference desig: 90V62TP121

Description: Male coupling, 3/8-inch, push-pull (KEYED)

- References:
1. SSSH dwg. 6.5 (Waste Management), zone M4.
 2. Dwg. VO70-623002 (Sys Installation - Waste Management, ECLSS Equipment Bay), zone 60.

- Comments:
- The urine dump QD can be disconnected from the urine dump line QD and reconnected to the contingency water container (via the yellow/yellow hose with one yellow QD (-3102) replaced with the urine dump line QD (-3104)).
 - This procedure allows the waste tank to be dumped to the CWC.

Item 23. Urine dump line QD (-3104)

Location: Under the front of the WCS on the middeck floor connected to the urine dump QD (-1103, KEYED)

QD part number: MC276-0020-3104 (Symetrics, P/N 502060-3104)

Drain line part no.: R29517-24 (Resistoflex)

Reference desig: 80V62TP121

Description: Female coupling, 3/8-inch, push-pull

- References:
1. SSSH dwg. 6.5 (Waste Management), zone M4.
 2. Dwg. VO70-623002 (Sys Installation - Waste Management, ECLSS Equipment Bay), zone 53.
 3. G.E. dwg. no. 47C265889 (Hose Assembly, Check Valves to Interface).

- Comments:
- The urine dump line normally connects to the urine dump QD (-1103, KEYED).
 - The urine dump -3104 QD can be removed and can replace one of the yellow QDs on the yellow/yellow hose when desiring to dump waste from the waste water tank to the CWC via the urine dump QD (see item 25).
 - An 11/16-in. combination wrench (for the dynatube hex nut which attaches the hose to the QD) and a 10-in. adjustable wrench (for the -3104 QD) are used to disconnect the urine line hose from the -3104 QD.

Item 24. Urine dump filter inlet line QD (-3104)

Location: Slightly forward of the middeck return air duct in the lower equipment bay beneath Av bay 3B on the port side of the urine dump filter

Part number: MC276-0020-3104 (Symetrics, P/N 502060-3104)

Description: Female coupling, 3/8-inch, push-pull

- References:
1. SSSH dwg. 6.5 (Waste Management), zone J4.
 2. Dwg. VO70-623002 (Sys Installation - Waste Management, ECLSS Equipment Bay), zone 77.
 3. Systems Data Book, p. 3-2.

Comments: The urine dump filter inlet line QD (-3104) is connected to the urine dump filter inlet QD (-1351) on the port side of the urine dump filter.

Item 25. Urine dump filter inlet QD (-1351)

Location: Slightly forward of the middeck return air duct in the lower equipment bay beneath Av bay 3B on the port side of the urine dump filter

Part number: MC276-0020-1351 (Symetrics, P/N 502060-1351)

Description: Male coupling, 3/8-inch, push-pull

- References:
1. SSSH dwg. 6.5 (Waste Management), zone J4.
 2. Dwg. VO70-623002 (Sys Installation - Waste Management, ECLSS Equipment Bay), zone 77.
 3. Systems Data Book, p. 3-2.

Comments: The urine dump filter inlet QD (-1351) is on the port side of the urine dump filter and is connected to the urine dump filter inlet line QD (-3104).

Item 26. Urine dump filter outlet QD (-1191)

Location: Slightly forward of the middeck return air duct in the lower equipment bay beneath Av bay 3B on the starboard side of the urine dump filter

Part number: MC276-0020-1191 (Symetrics, P/N 502060-1191)

Description: Male coupling, 3/8-inch, push-pull

- References:
1. SSSH dwg. 6.5 (Waste Management), zone J4.
 2. Dwg. VO70-623002 (Sys Installation - Waste Management, ECLSS Equipment Bay), zone 76.
 3. Systems Data Book, p. 3-2.

Comments: The urine dump filter outlet QD (-1191) is on the starboard side of the urine dump filter and is connected to the urine dump filter outlet line QD (-3102)

Item 27. Urine dump filter outlet line QD (-3102)

Location: Slightly forward of the middeck return air duct in the lower equipment bay beneath Av bay 3B on the starboard side of the urine dump filter

Part number: MC276-0020-3102 (Symetrics, P/N 502060-3102)

Description: Female coupling, 3/8-inch, push-pull

References:

1. SSSH dwg. 6.5 (Waste Management), zone J4.
2. Dwg. VO70-623002 (Sys Installation - Waste Management, ECLSS Equipment Bay), zone 76.
3. Systems Data Book, p. 3-2.

Comments: The urine dump filter outlet line QD (-3102) is connected to the urine dump filter outlet QD (-1191) on the starboard side of the urine dump filter.

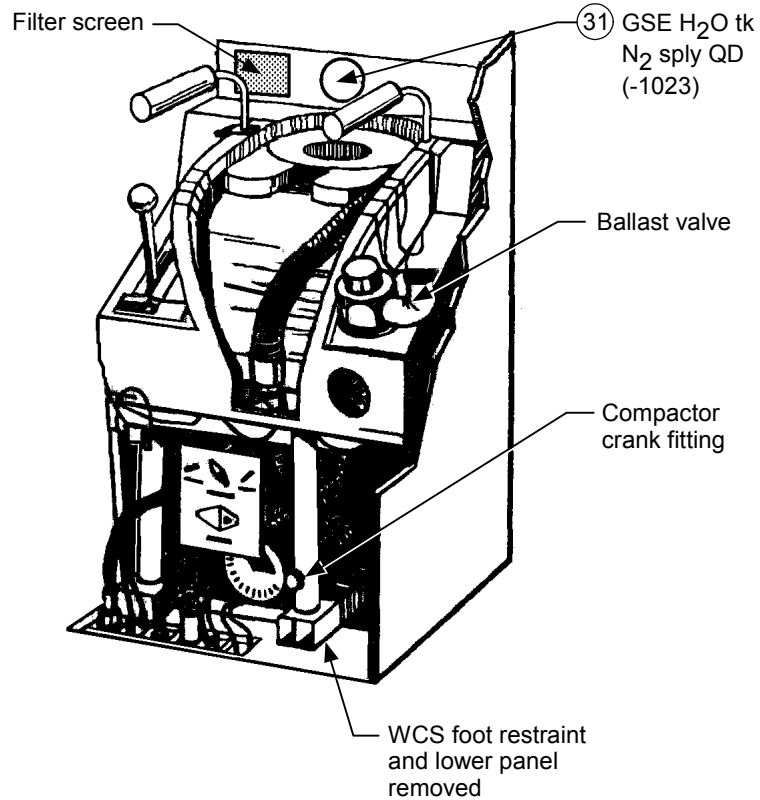
MISCELLANEOUS

Supply Water Nitrogen

28. GSE water tank N₂ supply

Condensate Collection

29. Condensate Collection (waste)



j_22673_068.cnv

Figure 4.4-6. Supply water nitrogen system QDs

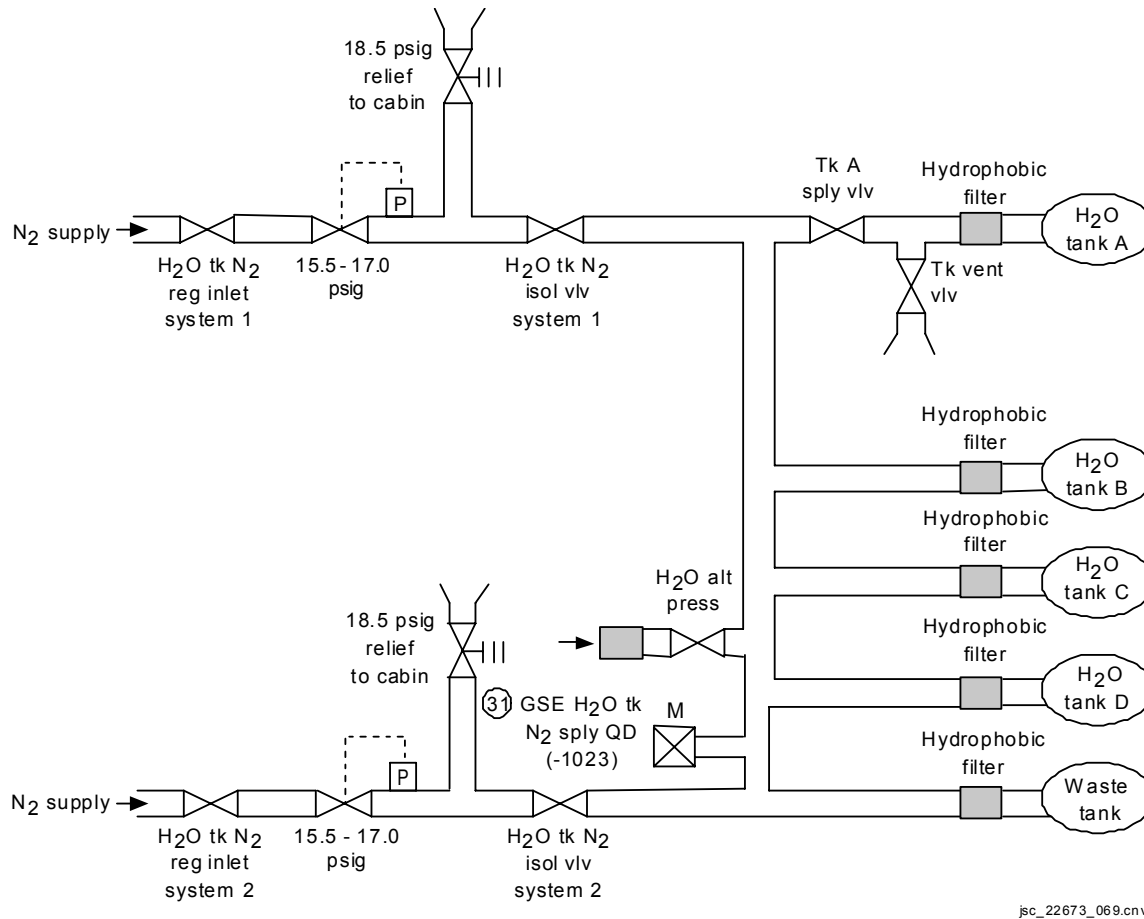
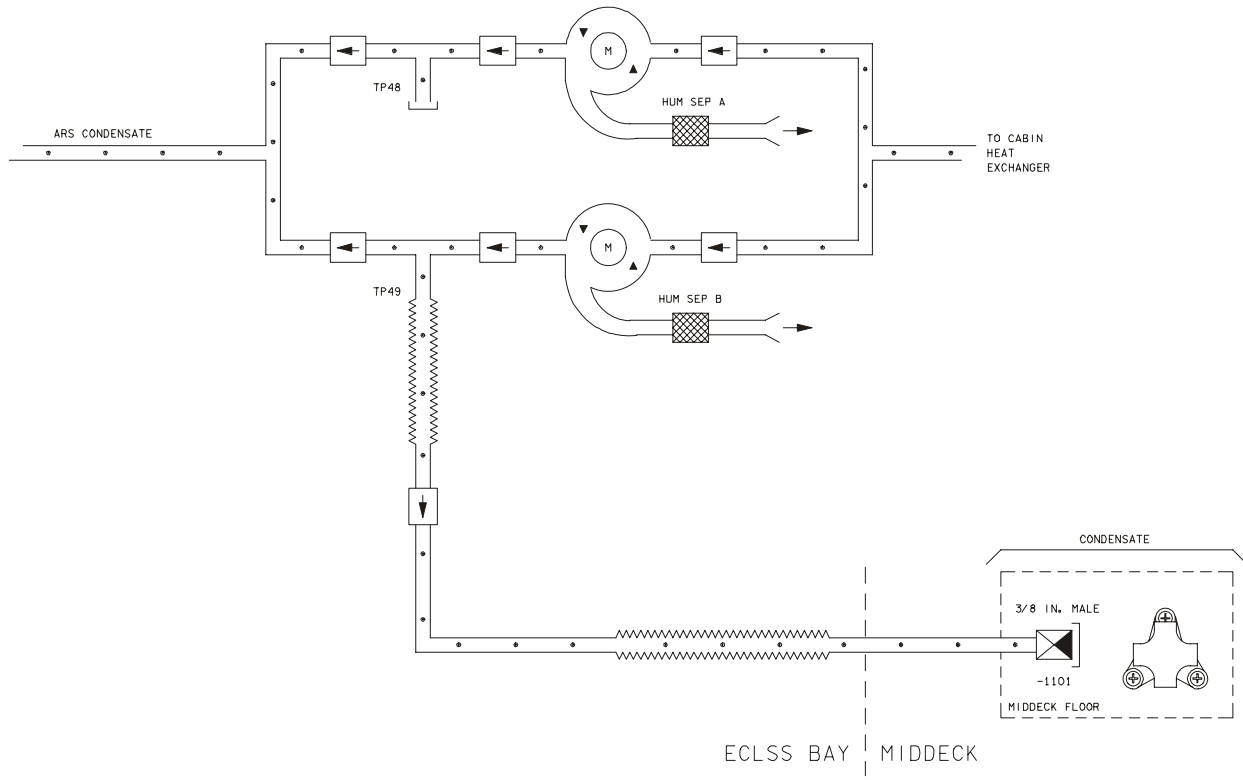


Figure 4.4-6. Supply water nitrogen system QDs (continued)



22673B005. SCH# 1

Figure 4.4-7. Condensate collection QD

Item 28. GSE water tank N₂ supply QD (-1023)

Location: Behind the WCS aft bulkhead

Part number: MC276-0020-1023 (Symetrics, P/N 502040-1023)

Description: Male coupling, 1/4-inch, push-pull (KEYED)

References: 1. SSSH dwg. 6.4 (Supply Water Storage), zone S4
2. Dwg. VO70-613130.

Comments: This QD is used when servicing the water tanks.

Item 29. Condensate collection QD (-1101)

Location: Middeck floor

Part number: MC276-0020-1101 (Symetrics, P/N 502060-1101)

Description: Male coupling, 3/8-inch, push-pull

References: 1. SSSH dwg. 6.5 (Sheet 3 of 3) Waste Management System, Zone F1
2. Dwg. V070-623002
3. Orbit Ops Checklist (Shuttle Condensate Collection)

Comments: The condensate collection QD (-1101) is used to attach a CWC via yellow/yellow hose (-3102 QDs) to collect condensation from the Orbiter cabin Humidity Separators.

TITLE

MO10W TEST PORT REFERENCE DATA

PURPOSE

To document IFM-related test port (TP) data for panel MO10W.

DESCRIPTION

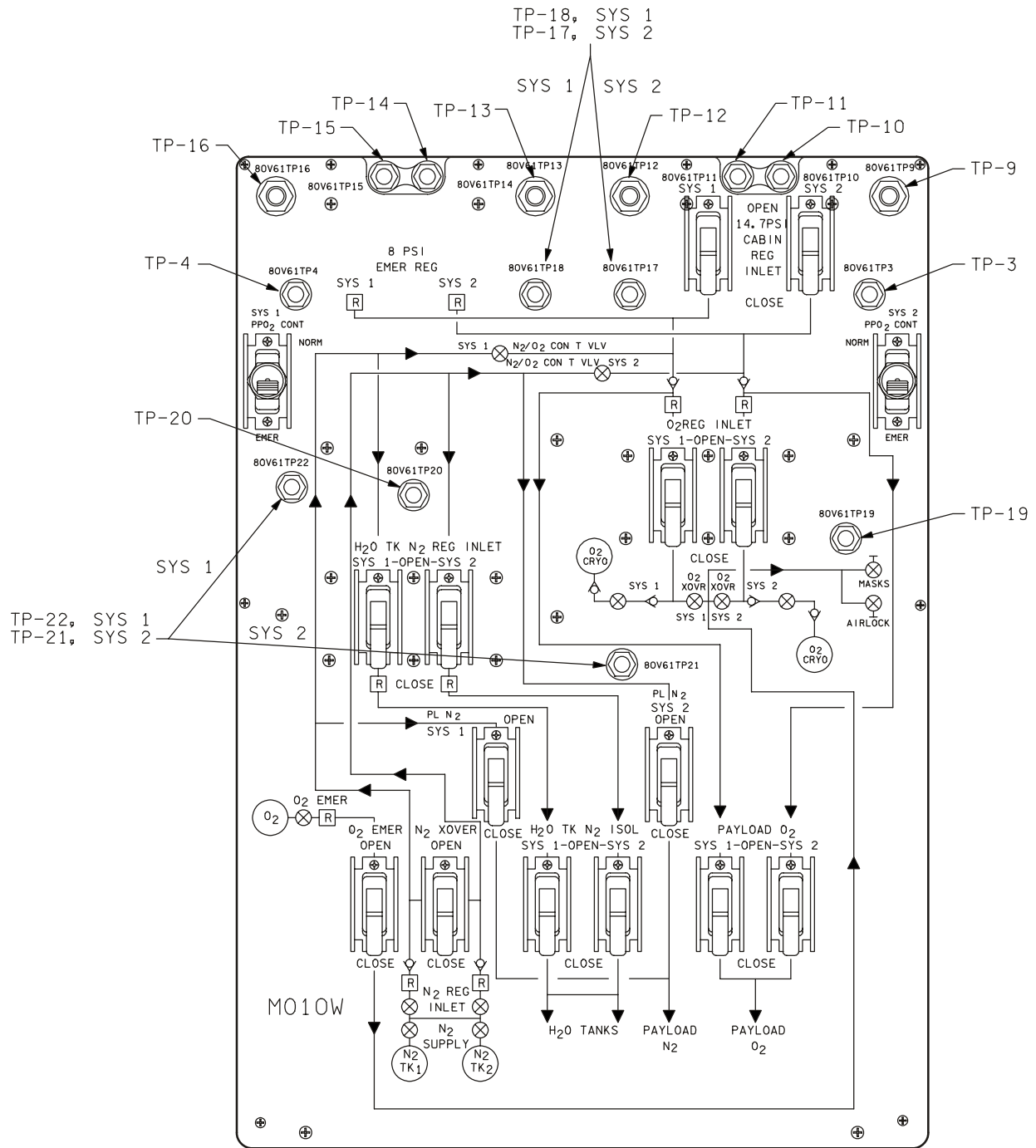
Test port	Gas	Pressure (psi)	System	Reference designator	Comment	Wrench size
TP-3	O ₂	100.0	2	80V61TP3	**	9/16-in.combination
TP-4	O ₂	100.0	1	80V61TP3	**	
TP-9	N ₂ O ₂	14.7	2		**	
TP-10	N ₂ O ₂	14.7	2		*	
TP-11	N ₂ O ₂	14.7	1		*	
TP-12	N ₂ O ₂	14.7	1		*	
TP-13	N ₂ O ₂	8.0	2		*	
TP-14	N ₂ O ₂	8.0	2		*	
TP-15	N ₂ O ₂	8.0	1		*	
TP-16	N ₂ O ₂	8.0	1		*	
TP-17	N ₂ O ₂	200(N ₂)/100(O ₂)		80V61TP17	**	
TP-18	N ₂ O ₂	200(N ₂)/100(O ₂)		80V61TP18	**	
TP-19						
TP-20						
TP-21	N ₂	16.0	2	80V61TP21	H ₂ O tanks**	9/16-in. combination
TP-22	N ₂	16.0	1	80V61TP22	H ₂ O tanks**	

* Use "large threaded" "B-nut" from Y/Y hose (dynatube fitting).

**Use "standard B-nuts" from any water hose (dynatube fitting).

IFM APPLICATIONS

Many procedures require connecting hoses and fittings to the test ports on panel MO10W to reroute N₂ or O₂ flow. The above information will help document those procedures.



22673006, ART 1

Figure 4.5-1. Pnl MO10W

TITLE

O₂ BLEED ORIFICE REFERENCE DATA

PURPOSE

To document wrench fit and part number data for the O₂ bleed orifice.

DESCRIPTION

Refer to Figure 4.6-1.

IFM APPLICATIONS

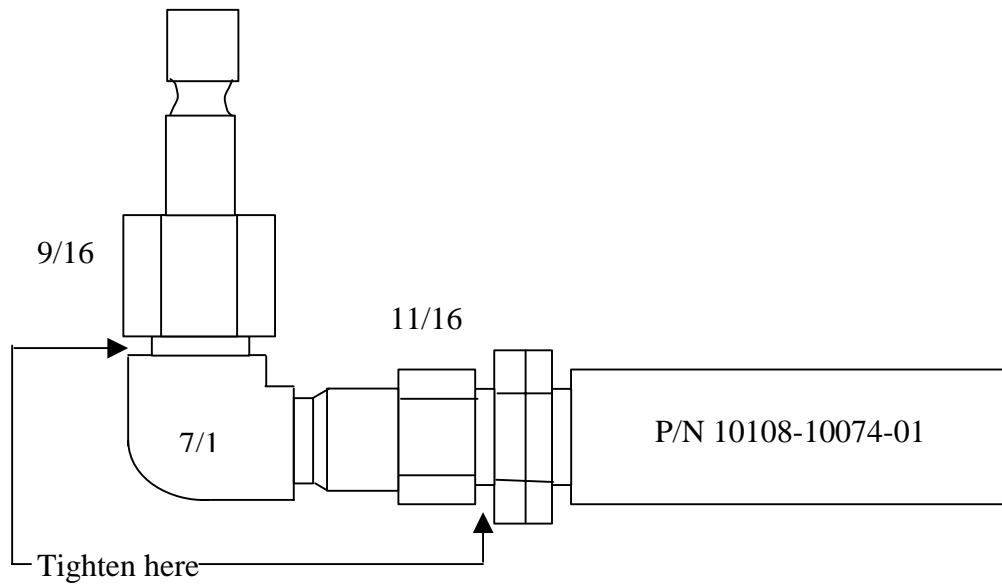


Figure 4.6-1. O₂ bleed orifice (not drawn to scale)

TITLE

ORBITER FUSE AND CIRCUIT BREAKER CHARACTERISTICS

PURPOSE

To provide information on the physical and technical characteristics of fuses and circuit breakers on the orbiter and possible IFM applicability.

REFERENCE DOCUMENTATION

Fuse and circuit breaker data is documented in the EGIL Console Handbook, JSC-12830, Section 4.5.

IFM APPLICATIONS

Spare fuses are carried in the IFM tool kit and may be utilized to replace failed fuses in orbiter, payload, and crew equipment.

A circuit breaker retention device is part of the complement of IFM tools. It is utilized for retaining the circuit breaker (cb) in a closed position in case a mechanical failure of the cb causes it to open. It is not used to override an electrical failure which causes the cb to open. See the IFM Tool Catalog for a description of this device.

TITLE

POTENTIAL ATMOSPHERIC DEBRIS COLLECTION SITES

PURPOSE

Information is provided about sites at which debris commonly collects within the orbiter cabin due to air recirculation. Many of these sites are required to be checked and/or cleaned in the IFM checklist procedure, FILTER CLEANING.

DESCRIPTION

- A. Most air-cooled avionics have "enhanced" filters to allow full design flow to boxes after accumulating significant debris (designated with).
- B. Easily accessible filters are cleaned during scheduled filter cleaning (designated with).
- C. Some LRUs, particularly in the flight deck instrument panel, do not have enough area around them for "filters" of any kind.

Cleaning Locations

- A. Flight deck
 - 1. Color monitors
 - 2. Oxygen partial pressure (PPO₂) sensor inlets
 - 3. Manipulator controller interface unit (MCIU)
 - 4. Video switching unit (VSU), remote control unit (RCU)
 - 5. Integrated Display Processors (IDP)s
 - 6. Display driver units (DDUs)
- B. Middeck
 - 1. Airlock Booster Fan
 - 2. ARS Hose Screen
 - 3. Cabin fans (only if there is a ΔP within that air loop)
 - 4. Inertial measurement unit (IMU) inlets
 - 5. Orbiter Cabin Air Cleaner (OCAC)
 - 6. WCS Cabin ARS Inlet

- C. Lower Equipment Bay (LEB) (requires stowage volume removal)
 - 1. Av Bay 1, 2, & 3 Fan Filters (only if there is a ΔP within that air loop)

TITLE

ORBITER WIRE IDENTIFICATION NUMBERS AND COLOR CODES

PURPOSE

To provide a method of identifying orbiter wire and wire characteristics.

DESCRIPTION

The wire or cable size number is used to identify the American wire gauge (AWG) size of the wire, or approximate AWG size if another gauge is used. A single digit number in the wire size column of the wire Identification, preceded by a dash, shall be used to indicate the number of naught gauge wire. For coaxial cables, the cable size number is not included.

All conductors within a multiconductor cable are given a single wire identification number. The wire identification number is suffixed with a color code to differentiate between conductors. The insulation sleeve of each conductor is color coded to wire gauge as follows:

Wire gauge	Color of insulation
26	Yellow
24	Blue
22	Green
20	Red
18	Yellow
16	Blue
14	Green
12	Yellow
10	Brown
8	Red
6	Blue
4	Yellow
2	Green
1/0	Brown

The above listed wire color code identification can be found in the Rockwell International, Space Systems Division, Electrical, Electromechanical, and Electronics publication 543-G-24, Volume 2, dated 1992, page 5711-5 through 7.

TITLE

ORBITER FLIGHT DECK CONNECTORS

PURPOSE

To provide a quick reference for flight deck connectors.

DESCRIPTION

Payload Station (panels L9, 10, 11, 12, 13, 14, 15, 16, 17; A3, 15)

LRU	Location	Ref designator	Part number	Drawings
Payload station distribution panel	Behind L16, L17	30V70A1		VO70-793115
Orbiter timing buffer, payload timing buffer	Behind L16	30V75A79	MC456-0060-0002	VO70-93115
MCIU (manipulator controller interface unit)	Behind L17	30V73A26		VO70-793115
ATU 1 (audio terminal unit)	Behind L9	30V74A101	MC409-0005-0001	VO70-793115, VO70-703935 (zn 10)
ATU 2	Behind L9	30V74A104	MC409-0005-0001	VO70-793115, VO70-703935 (zn 10)
IU 1 (interface unit)		30V74A45	MC409-0005-0030	VO70-703915 (zn 16)
TV monitor no. 1	A3	36V73A3A1		VO70-793115
TV monitor no. 2	A3	36V73A3A2		VO70-793115
Bulkhead feed through panel	576 blkhd (port side)	30V70A1		VO70-793115, VO70-793253
Bulkhead feed through panel	576 blkhd (port side)	30V70A3		VO70-793115, VO70-793255
Bulkhead feed through Panel	576 blkhd (port side)	30V70A5		VO70-793115, VO70-793257
Bulkhead feed through panel	576 blkhd (port side)	30V70A7		VO70-793115, VO70-793259

On-Orbit Station (panels A2, 4, 6A1, 6A2, 7A1, 7A2, 8A1, 8A2, 12, 13, 14, 16, 17; THC, RHC)

LRU	Location	Ref designator	Part number	Drawings
Aft station RHC (rotational hand controller)	A7A1	30V73A7		VO70-793149
Aft station THC (translational hand controller)	Above A6	30V73A8		VO70-793149
Event timer	A4	36V73A2		VO70-793149
RMS THC	Above A7A1			VO70-793149
RMS RHC	A10			VO70-793149

Mission Station (panels R10, 11, 12, 13, 14, 15, 16, 17, 18; A1, 11)

LRU	Location	Ref designator	Part number	Drawings
Mission station distribution panel	Behind R17, R18	32V70A2		VO70-793125
DDU 3 (display driver unit)	Behind R18	30V73A3	MC409-0023-0002	
VSU (video switching unit)	Behind R17	30V74A48	2294823-501	VO70-793125, VO70-703920 (zn 13)
RCU (remote control unit)	Behind R17	30V74A44	2294824-501	VO70-793125, VO70-703920 (zn 12)
CRT 4 (cathode ray tube)	R12A1	V73A12A1A1		VO70-793125
Keyboard no. 3	R12A2	30V73A12A2A1		VO70-793125
ATU 3 (audio terminal unit)	Behind R10	30V74A102	MC409-0005-0001	VO70-793125, VO70-703935 (zn 10)
ATU 4	Behind R10	30V74A103	MC409-0005-0001	VO70-793125, VO70-703935 (zn 10)
ACA 4 (annunciator control assembly)	Behind R13	30V73A19	MC434-0283-0001	VO70-793125, VO70-703920 (zn 23)
ACA 5	Behind R13	30V73A20	MC434-0283-0001	VO70-793125, VO70-703920 (zn 23)
PPO ₂ sensor A	Behind R17	30V61MT4		VO70-793125
PPO ₂ sensor B	Behind R17	30V61MT5		VO70-793125
PPO ₂ sensor C	Behind R18	30V61MT10		VO70-793125
Temperature sensor	Behind R17	30V61MT6		VO70-793125
Temperature sensor	Behind R17	30V61MT7		VO70-793125
Temperature sensor	Behind R17	30V61MT8		VO70-793125
Humidity sensor	Behind R18	30V61MT9		VO70-793125
Bulkhead feed through panel	576 blkhd (stbd side)	30V70A2		VO70-793125
Bulkhead feed through panel	576 blkhd (stbd side)	30V70A4		VO70-793125
Bulkhead feed through panel	576 blkhd (stbd side)	30V70A6		VO70-793125
Bulkhead feed through panel	576 blkhd (stbd side)	30V70A8		VO70-793125

Right Side Console (panels R1, 2, 3, 4, 5, 6, 7, 8, 9; O8, 9, 15, 16, 17, 19)

LRU	Location	Ref designator	Part number	Drawings
DEU 2 (display electronics unit)	Behind R9	30V73A41	MC615-0008-0105	VO70-793225, VO70-703905 (zn 9)
DEU 4	Behind R9	30V73A43	MC615-0008-0105	VO70-793225, VO70-703905 (zn 9)
IU 2		30V74A46	MC409-0005-0030	VO70-703905 (zn 15)

Forward Cross Ship and Main Display Console (panels F2, 3, 4, 5, 6, 7, 8, 9)

LRU	Location	Ref designator	Part number	Drawings
CRT 1 (cathode ray tube)	F7A1	34V73A7A1		VO70-793165
CRT 2	F7A4	34V73A7A4		VO70-793165
CRT 3	F7A6	34V73A7A5		VO70-793165
Fwd THC (translational hand controller)	F5A2	34V73A5A2		VO70-793165
DDU 1 (display driver unit)	Aft of MO42F/58F on FD	30V73A1	MC409-0023-0002	VO70-793165, VO70-703910 (zn 8)
DDU 2	Aft of MO42F/58F on FD	30V73A2	MC409-0023-0002	VO70-793165, VO70-703910 (zn 8)

Forward Flight Deck (panels O1, 2, 3, 7, 15 and access from MO42F/58F)

LRU	Location	Ref designator	Part number	Drawings
IMU 1 (inertial measurement unit)	Fwd of MO42F/58F on FD	30V71A13		VO70-793159
IMU 2	Fwd of MO42F/58F on FD	30V71A14		VO70-793159
IMU 3	Fwd of MO42F/58F on FD	30V71A15		VO70-793159
MDM OF4 (multiplexer/demultiplexer)	Stbd of MO42F/58F on FD	30V75A9		VO70-793159
ACA 1 (annunciator control assembly)	Fwd of DEU 3 on FD	30V73A16	MC434-0283-0001	VO70-793159, VO70-703915 (zn 12)
ACA 2	Fwd of DEU 2 on FD	30V73A17	MC434-0283-0001	VO70-793159, VO70-703905 (zn)
ACA 3	Port of MO42F/58F on FD	30V73A18	MC434-0283-0001	VO70-793159, VO70-703915 (zn 12)
AVVEU 1 (altitude/vertical velocity electronics unit)	Fwd of DEU 3 on FD	30V73A137	MC432-0226-0022	VO70-793159, VO70-703915 (zn 13)
AMEU 1 (alpha/Mach electronics unit)	Fwd of on FD	30V73A135	MC432-0224-0022	VO70-793159, VO70-703915 (zn 13)
AVVEU 2	Fwd of DEU 2 on FD	30V73A138	MC432-0226-0022	VO70-793159, VO70-703905 (zn 13)
AMEU 2	Fwd of DEU 4 on FD	30V73A136	MC432-0224-0022	VO70-793159, VO70-703905 (zn 13)
FD smoke detector	Stbd of MO42F/58F on FD	30V62A1		VO70-793159
FD smoke detector	Port of MO42F/58F on FD	30V62A12		VO70-793159

Center Pedestal (panel C2)

LRU	Location	Ref designator	Part number	Drawings
Keyboard unit (CDRs)	C2A1	35V73A2A1		VO70-793175
Keyboard unit (PLTs)	C2A3	35V73A2A3		VO70-793175

CDR and PLT Seats and RHCs

LRU	Location	Ref designator	Part number	Drawings
CDRs RHC (rotational hand controller)	Fwd of CDRs seat	30V73A5		VO70-793235
PLT's RHC	Fwd of PLTs seat	30V73A6		VO70-793235

Left-Hand Console and Jettison Panels (panels L1, 8)

LRU	Location	Ref designator	Part number	Drawings
DEU 1 (display electronics unit)	Behind L8	30V73A40	MC615-0008-0105	VO70-793215, VO70-703915 (zn 10)
DEU 3	Behind L8	30V73A42	MC615-0008-0105	VO70-793215, VO70-703915 (zn 10)

TITLE

SPARE FUSES AND BATTERIES

SPARE FUSES

Size (amps)	Item
2.0	AVIU (same as CCPI)
3.0	CC PWR/Video Cable (15 ft) (two spares, only for Mode 1)
3.0	CC Batt Charger
2.0 (2), 4.0, 8.0	CCPI (Spare CCPI fuse kit) (same as AVIU)
15.0	CPL
1.0 (disc)	Fiberscope Light (-301)
15.0	Fiberscope Light (-302)
5.0	HISL
0.10	Intervalometer
1.7	Photoflood Light
2.0	Sequential Still Video Encoder

BATTERIES

Size (volts)	Item
AA 1.5 (6)	Binocs – 14x40, 10x40 GYRO
18.0	BPSMU (two 9.0 V)
Li-ION	Camcorder – PD100 (same as Recorder – V10)
6.0 NiCd	CPL (same as Fiberscope Light –302)
Re-charge	DCS 660/760
AA 1.5 (2)	Discman
Lithium	EOS Adapter
AA 1.5 (4)	Intervalometer
76 (1)	Lavalier Mic
AA 1.5 (6)	LCD Monitor
9.0 (2)	Microphone – IMAX
AA 1.5 (8)	Nikon F5 Body
CR2025 3.0 (2)	Nikon F5 Data Back
AA 1.5 (4)	Nikon F5 Flash
AA 1.5 (4)	Recorder – ICOM
D (2)	Recorder – IMAX
AAA 1.5 (2)	Recorder – Microcassette (same as Slave Flash)
Li-ION	Recorder – V10
AAA 1.5	Slave Flash (w/spare) (same as Microcassette Recorder)
AA 1.5	Spotmeter - 303
AA 1.5	Walkman
AA 1.5 (2)	Kneeboard
AA 1.5 (2)	Crewmember Flashlight
AA 1.5 (4)	Treadmill

TITLE

AUDIO CENTRAL CONTROL UNIT BYPASS CONNECTOR INSTALLATION

PROCEDURES

The procedure recovers audio communication in the event of a total audio central control unit (ACCU) failure. A single ACCU avionics box located in Av bay 1 (zone MF28E) contains both ACCU 1 and ACCU 2. Should both ACCU 1 and ACCU 2 fail, a full bypass is performed. If a single ACCU fails, then a half bypass is performed and remains in place pending a failure of the second ACCU.

An ACCU bypass connector stowed in the IFM tool locker is used to route signals around the failed ACCUs. The bypass connector is a small, rectangular box containing two electrical connectors. Each connector essentially hot wires a commander (CDR) or pilot (PLT) ATU directly to a network signal processor (NSP).

1. Power down audio.
2. Access ACCU in Av bay 1, zone MF28E.
3. Remove harness(es) from ACCU J4 (and J3).
4. Connect harness(es) to bypass module J4 (and J3).
5. Reconfigure and repower audio.
6. Close out Av bay.

FAILURES

Loss of ACCU 1, ACCU 2, or both ACCU 1 and ACCU 2

BACKGROUND

1. Loss of two ACCUs

Two connectors (J3 and J4) are removed from the ACCU and attached to the two connectors on the ACCU bypass connector.

The resulting configuration leads to a hot-mike situation on S-BD air-to-ground (A/G) 1, using either NSP 1 or 2. Specifically, the CDR ATU will be hot mike to A/G 1 of NSP 1, and the PLT ATU will be hot mike to A/G 1 of NSP 2.

- (a) If NSP 1 is selected
 - (1) 05 left audio control - Norm
 - (2) 09 right audio control - Left

- (b) If NSP 2 is selected
 - (1) 05 left audio control - Right
 - (2) 09 right audio control - Norm

It should be noted that all communication with the spacecraft is not lost when both ACCUs fail. Still available via SSR-1 are the abilities to uplink text messages to the CRTs and to read the scratch pad line of the CRT as downlink in the MCC. However, both uplink voice communication and downlink voice communication are lost. Therefore, it is likely that the crew would initiate this procedure without consultation with the MCC. It is perhaps the only IFM procedure which has this characteristic.

Class 1 alarms are still available through flight deck and middeck speakers even if unpowered. Class 2 and class 3 alarms are still available through the middeck speaker in ACCU/BYPASS mode, if powered, and the sleep station headset.

2. Loss of one ACCU (either ACCU 1 or ACCU 2)

The one-half bypass IFM procedure is performed as published; only the connector mated to J4 on the ACCU is removed, then installed to J4 on the ACCU bypass connector. (The J3 harness is left connected to the ACCU.)

J3 remains connected to the ACCU because the CDR's ATU is routed through that connector and will be selectively switched to the good ACCU. The PLT's ATU is routed through J4; this ATU will be selected to the failed ACCU and the bypass performed to connect the PLT ATU to NSP 2 (A/G 1).

The functions associated with J3 and J4 on the ACCUs are noted below

<u>J3</u>	<u>J4</u>
---CDR ATU (Sta 1)	---PLT ATU (Sta 2)
MS ATU (Sta 3)	PS ATU (Sta 4)
Bypass MD SMU (Sta 6)	Bypass OS ATU (Sta 5)
MD CCU (Sta 7)	AL ATU (Sta 8)
NSP 2 A/G 2	NSP 1 A/G 2
---NSP 1 A/G 1	---NSP 2 A/G 1
UHF	TACAN 3 tones
TACAN 1 tones	NSP 1 RCD CH 2
TACAN 2 tones	NSP 2 RCD CH 1
NSP 1 RCD CH 1	C&W Tones - B
NSP 2 RCD CH 2	ICOM B - PLB (CCTV)
C&W tones - A	ICOM B - Launch UMB
ICOM A - PLB (CCTV)	IR FM audio (not used)
ICOM A - T/O UMB	EXP RCDR audio (not used)
IR AM audio (not used)	

See Figure 5.1-1 and Figure 5.1-2.

Both ACCUs must be powered down to do the procedure. After J4 is mated on the bypass connector, power up the good ACCU again.

The resulting configuration is as follows:

A/G 1 is used with NSP 1 (A/G 2 is lost).

A/G 2 is used with NSP 2 (A/G 1 is hot to PLT ATU).

- a. 09 R AUD CNTL - Left
- b. 05 L AUD CNTL - Norm
- c. A1 AUD CNTR VOICE RCD SEL CH 1 - ICOM A
- d. A1 AUD CNTR VOICE RCD SEL CH 2 - ICOM A

The following functions have been lost:

- a. PS ATU
- b. OS ATU
- c. AL ATU
- d. NSP 1 A/G 2
- e. TACAN 3 tones
- f. NSP 1 RCD CH 2
- g. NSP 2 RCD CH 1
- h. C&W (B) (via ACCU, MD SMU in ACCU bypass is OK)
- i. ICOM B - PLB (CCTV)
- j. ICOM B - T/O UMB

Only ICOM A is being recorded by the OPS recorders (on channel 2, if we are using NSP 2 or channel 1 if we are on NSP 1).

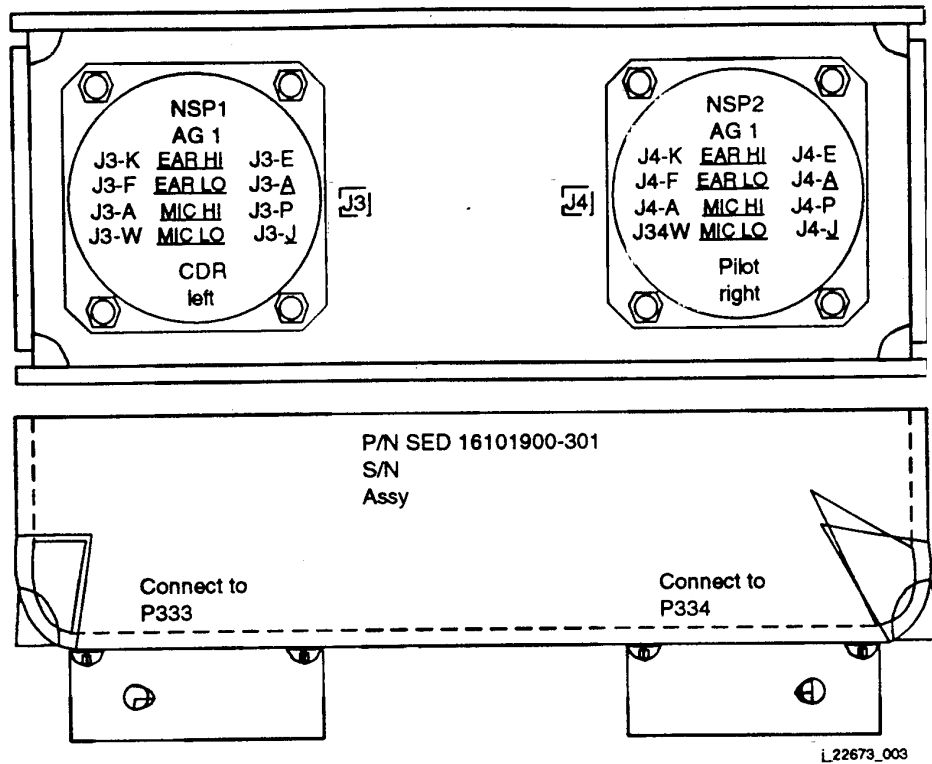


Figure 5.1-1. ACCU bypass connector

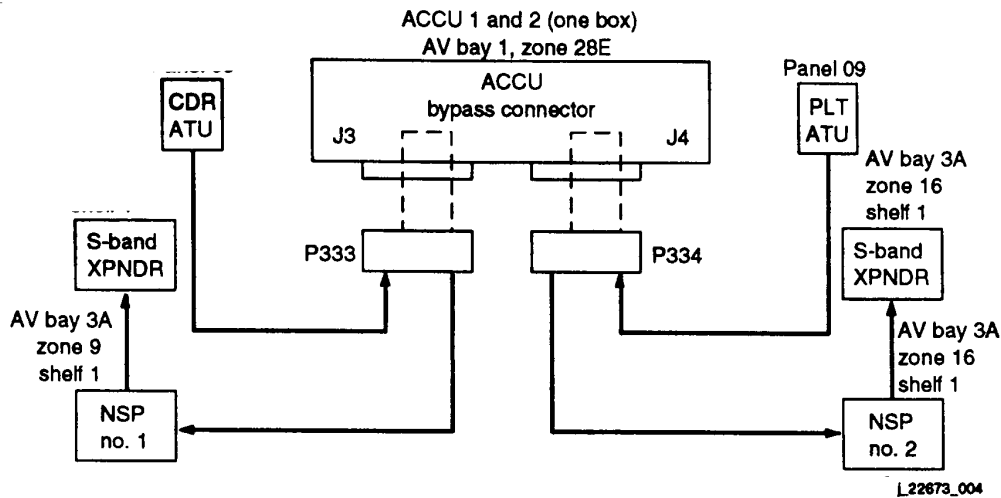


Figure 5.1-2. ACCU bypass

1. Subsequent failure of a second ACCU
 - (a) If on orbit, complete the ACCU bypass procedure (connect J3 harness to ACCU bypass connector).
 - (b) If during entry
 - (1) 09 R AUD CNTL - Norm
 - (2) 05 L AUD CNTL - Right

(This places both CDR and PLT hot mike to NSP 2 A/G 1. A/G 2 on NSP 2 and both A/G 1 and A/G 2 on NSP 1 will be dead. Also, there will be no ultrahigh frequency (UHF).)

2. Subsequent failure of an NSP

INCO switches NSPs (or crew does PNL/CMD) and uses alternate A/G (A/G 1 on NSP 1 and A/G 2 on NSP 2). There will be no loss of voice capability.
3. Subsequent failure of CDR ATU
 - (a) If on orbit, remove J4 bypass, time permitting.
 - (b) If during entry
 - (1) 09 R AUD CNTL - Norm

(2) 05 L AUD CNTL - Right

This places both CDR and PLT hot mike to NSP 2 A/G 1. A/G 2 on NSP 2 and both A/G 1 and A/G 2 on NSP 1 will be dead. Also, there will be no UHF.

REFERENCES

Drawings

1. VS72-956102 (integrated schematic)
2. V070-778218 (harness assembly)
3. MC409-0005 (Rockwell specifications)
4. SDD 43102697 (ACCU in the CCT)
5. Part number - SED 160101900-301

TITLE

AC POWER TRANSFER CABLE INSTALLATION

PROCEDURES

Repower an orbiter alternating current (AC) bus after losing one or more phases due to inverter loss. This procedure ties the failed bus to one of the remaining good AC buses via the IFM ac power transfer cable. The cable mates with orbiter AC utility outlets for AC1 and AC3 buses, and it mates with the J37 connector on the payload station distribution panel (behind panel L17) for the AC2 bus. The procedure enables the restarting of a fuel cell that was lost because fuel cell power failed. It also regains redundancy to other ac equipment.

1. Drop affected bus from inverters
2. Unpower outlets to be tied
3. Install cable
4. Repower bus via outlets and cable

FAILURES

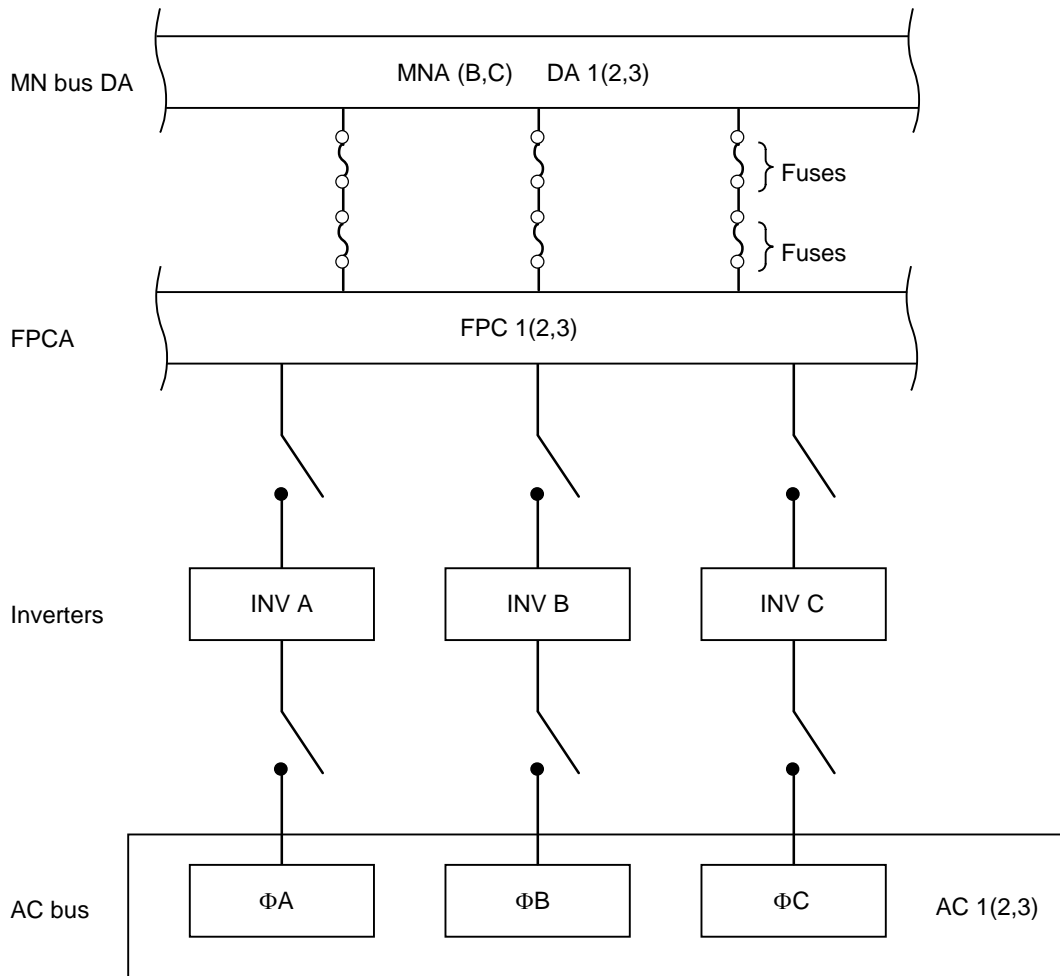
Loss of one or more phases of a three-phase AC bus due to inverter failure; loss of a forward power control assembly (FPCA), or loss of main (MN) DA1 (2,3).

BACKGROUND

Orbiter AC system is composed of nine inverters that power three independent three-phase buses. Each inverter set draws direct current (dc) power from an FPCA. See Figure 5.2-1.

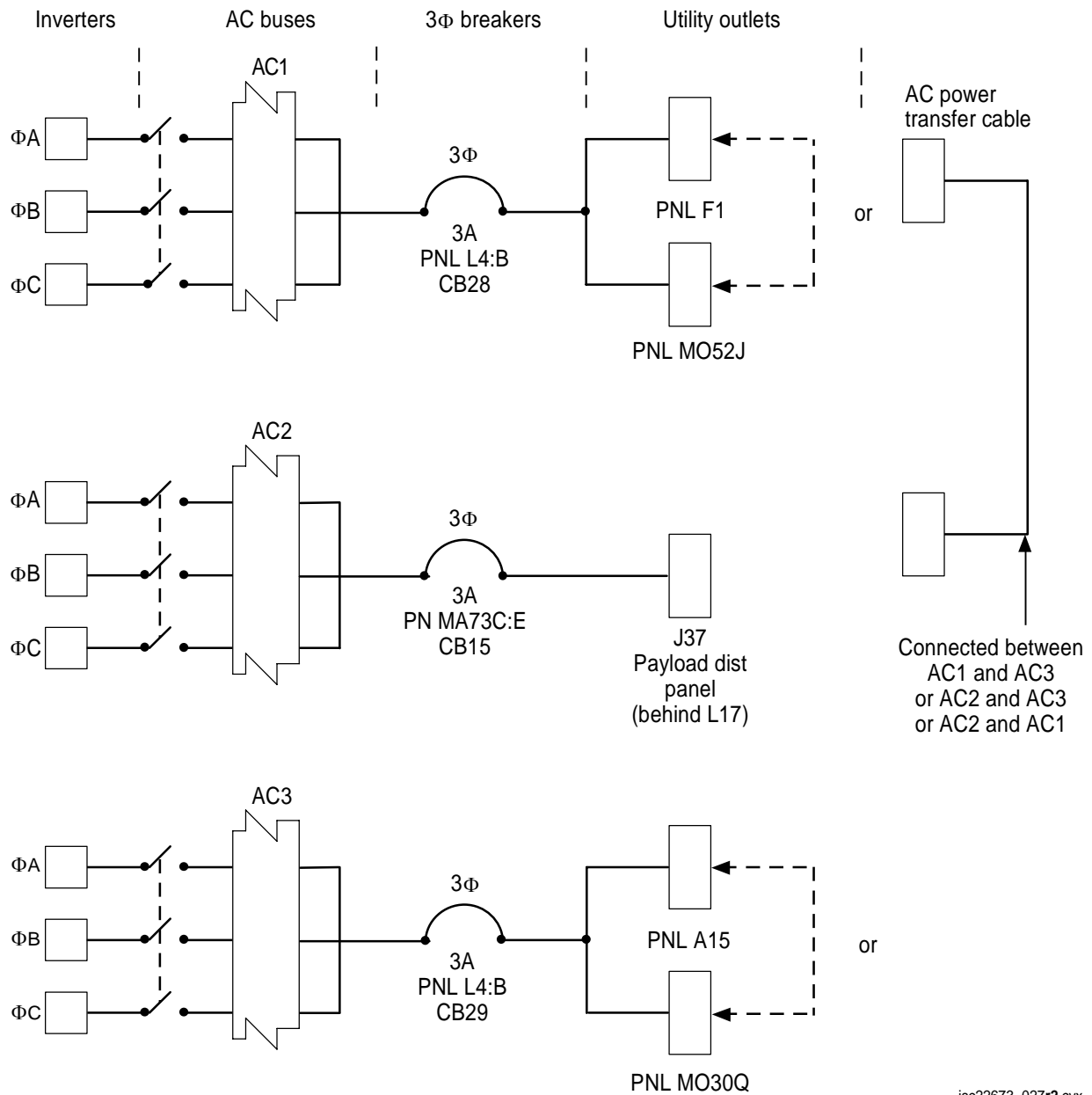
The AC power transfer cable is installed to tie any two ac buses together. Tying ac1 to AC3 is the easiest procedure, as the ac utility outlets are easily accessible; AC2 is available on the payload station distribution panel, connector J37. Accessing this connector requires removing panel L17 on the flight deck. After it is mated with the J37 connector, the cable may be threaded through the MCIU filter access door in panel L17, and the panel may be reinstalled. Figure 5.2-2 illustrates the ac power transfer configuration.

The AC2 bus can also be accessed on the power distribution panel behind R18, connector J36.



jsc_22673_023r1.cvx

Figure 5.2-1. The ac power configuration



jsc22673_027r2.cvx

Figure 5.2-2. The ac power transfer

The repowered bus is restricted to 3 amps per phase by a three-phase circuit breaker.

NOTES

The cable is 15 ft long and is stowed in the IFM contingency hose and cable kit.

Cable contains four conductors in twisted pairs.

Pair	Pin	Wire
1	A	Phase A
1	B	Phase B
2	C	Phase C
2	J	Neutral

All ac motors will run on two phases; cabin fans, water coolant loop pumps and Freon coolant loop pumps preferably are run on three phases due to improved performance.

REFERENCES

1. Drawings
 - (a) VS70-760402, ac power distribution and control
 - (b) VS70-760409, ac power distribution and control
2. ac PWR XFER cable P/N SED33101301-301
3. Flight rule A9-157

TITLE

APDS DIRECT DRIVE USING BOB

PROCEDURES

This procedure provides general guidelines for bypassing pallet avionics boxes and directly driving APDS Capture Latches, Ring Motors, Hooks, and/or Slip Clutch Motors utilizing the Breakout Box. 28 volts DC Power is supplied by way of the Breakout Box to a particular connector pin(s), depending on what is to be repowered, all of which are represented in the IFM Checklist (see Figure 5.3-1).

1. Power down the APDS and DC Utility outlet that is to be used.
2. Connect the Breakout Box to the DC utility outlet using the DC utility cable.
3. Determine which floor interface panel is to be used for access, and remove (Figure 5.3-2 and Figure 5.3-3). It should be noted that even numbered connectors are on the stbd side, odd on port side.
4. Disconnect the appropriate connector (see Figure 5.3-4 and Figure 5.3-5).
5. Configure the Breakout Box using Test Jumper Leads from the Pin Kit.
6. Initiate the Drive Function using the Breakout Box.

FAILURE

A failure of any one of the avionics boxes that control any of the functions mentioned above

BACKGROUND

This procedure was developed for the docking mechanism to ensure that there was an alternate method of driving the APDS Capture Latches, Ring Motors, Hooks, and/or Slip Clutch Motors in the event that any one of the avionics boxes that operate them were to become disabled/fail. A failure in the ability to contingency operate any of the necessary mechanisms for docking could possibly result in a failed mission.

**OV-103 (STS-91), 104 (STS-96), 105 (STS-89 (88))
Port Floor I/F**

Function	Connector	Pin # (to BOB + Jack)	Pin # (to BOB + Jack)
Capture Latch M1 OPEN	P9453 (J9413)	d	F
Capture Latch M2 OPEN	P9453 (J9413)	j	D
Capture Latch M3 OPEN	P9449 (J9409)	f	B
Capture Latch M1 CLOSE	P9453 (J9413)	d	E
Capture Latch M2 CLOSE	P9453 (J9413)	j	C
Capture Latch M3 CLOSE	P9449 (J9409)	f	A

**OV-103 (STS-91), 104 (STS-96), 105 (STS-89 (88))
Stbd Floor I/F**

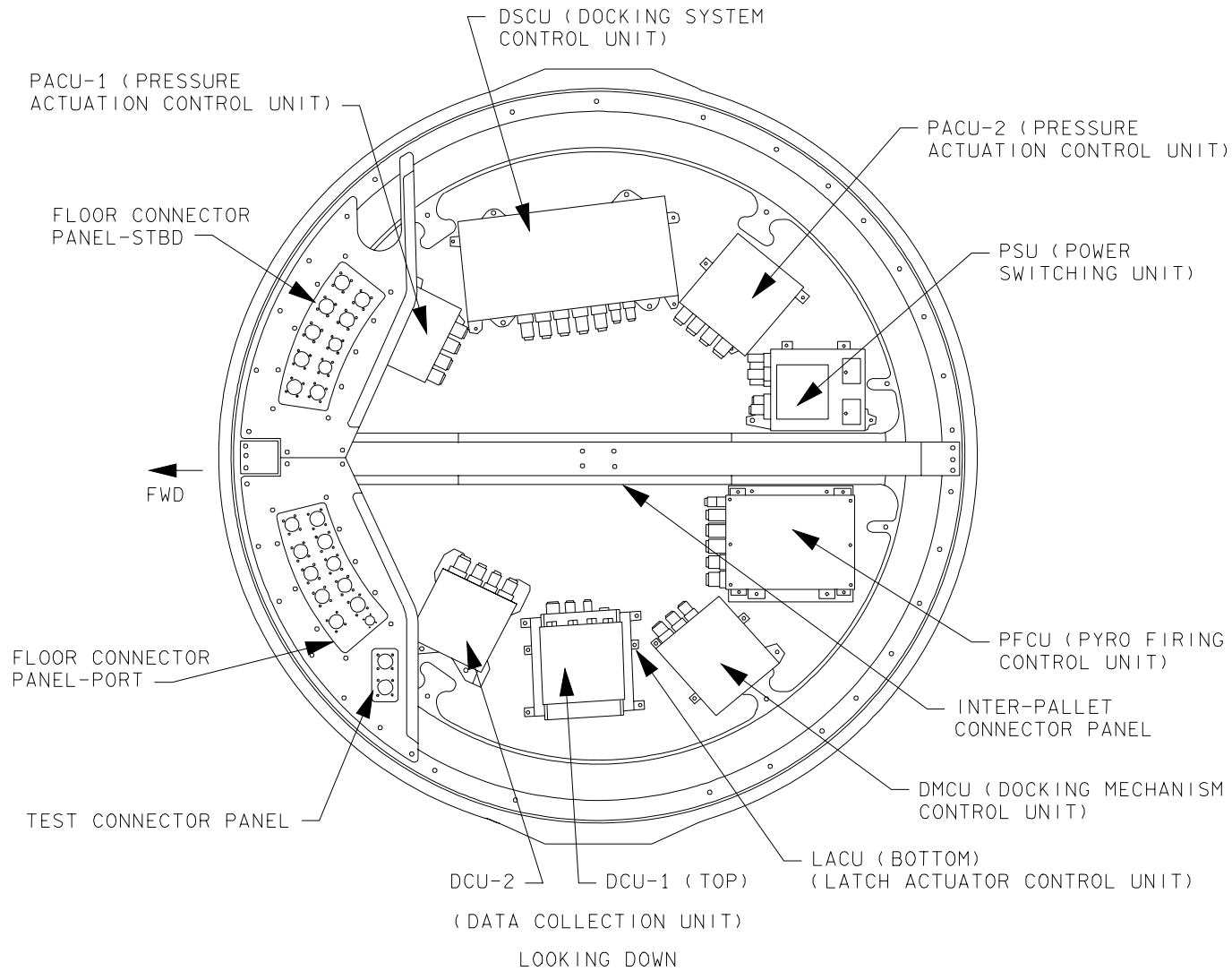
Function	Connector	Pin # (to BOB + Jack)	Pin # (to BOB + Jack)
Hooks 1 M6 OPEN	P9442(J9402)	b	F
Hooks 1 M7 OPEN	P9454(J9414)	B	d
Hooks 2 M8 OPEN	P9442(J9402)	D	A
Hooks 2 M9 OPEN	P9454(J9414)	H	D
Hooks 1 M6 CLOSE	P9442(J9402)	F	b
Hooks 1 M7 CLOSE	P9454(J9414)	d	B
Hooks 2 M8 CLOSE	P9442(J9402)	A	D
Hooks 2 M9 CLOSE	P9454(J9414)	D	H
Ring Motor M4 IN	P9446(J9406)	x	v
Ring Motor M5 IN	P9454(J9414)	r	t
Ring Motor M4 OUT	P9446(J9406)	v	x
Ring Motor M5 OUT	P9454(J9414)	t	r

**OV103 (STS-91), 104 (STS-96), 105 (STS-92)
Stbd Floor I/F**

Function	Connector	Pin # (to BOB + Jack)	Pin # (to BOB + Jack)
Slip Clutch Motor M10 SLIP	P9448(J9408)	69,71*	70,72
Slip Clutch Motor M11 SLIP	P9452(J9412)	69,71	70,72
Slip Clutch Motor M10 LOCK	P9448(J9408)	70,72	69,71
Slip Clutch Motor M11 LOCK	P9452(J9412)	70,72	69,71

*either contactor acceptable

Figure 5.3-1. Connector/Pin Identification Table

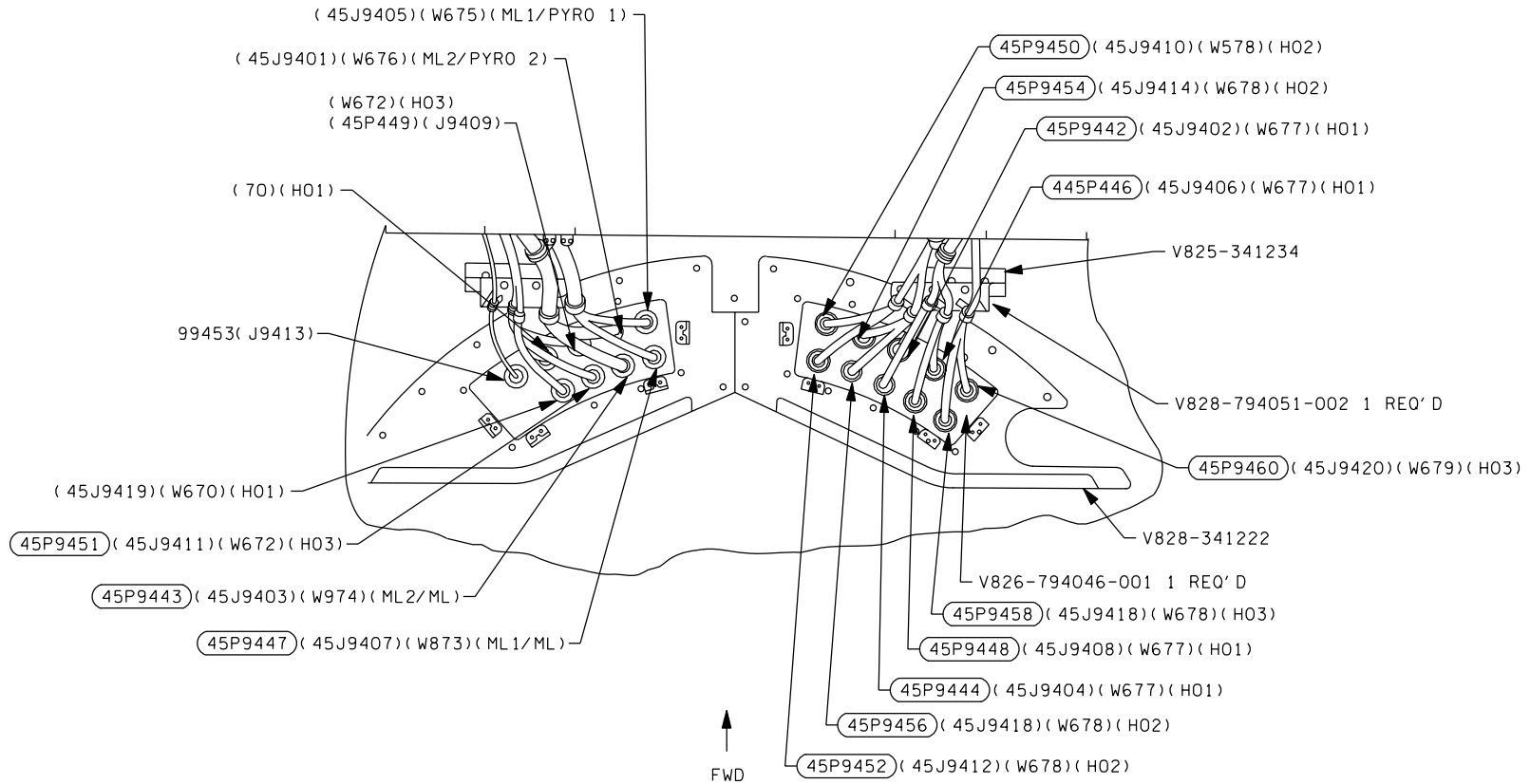


22673008. ART: 2

Figure 5.3-2. APDS electronics pallets

5.3-3

Verify that this is the correct version before use

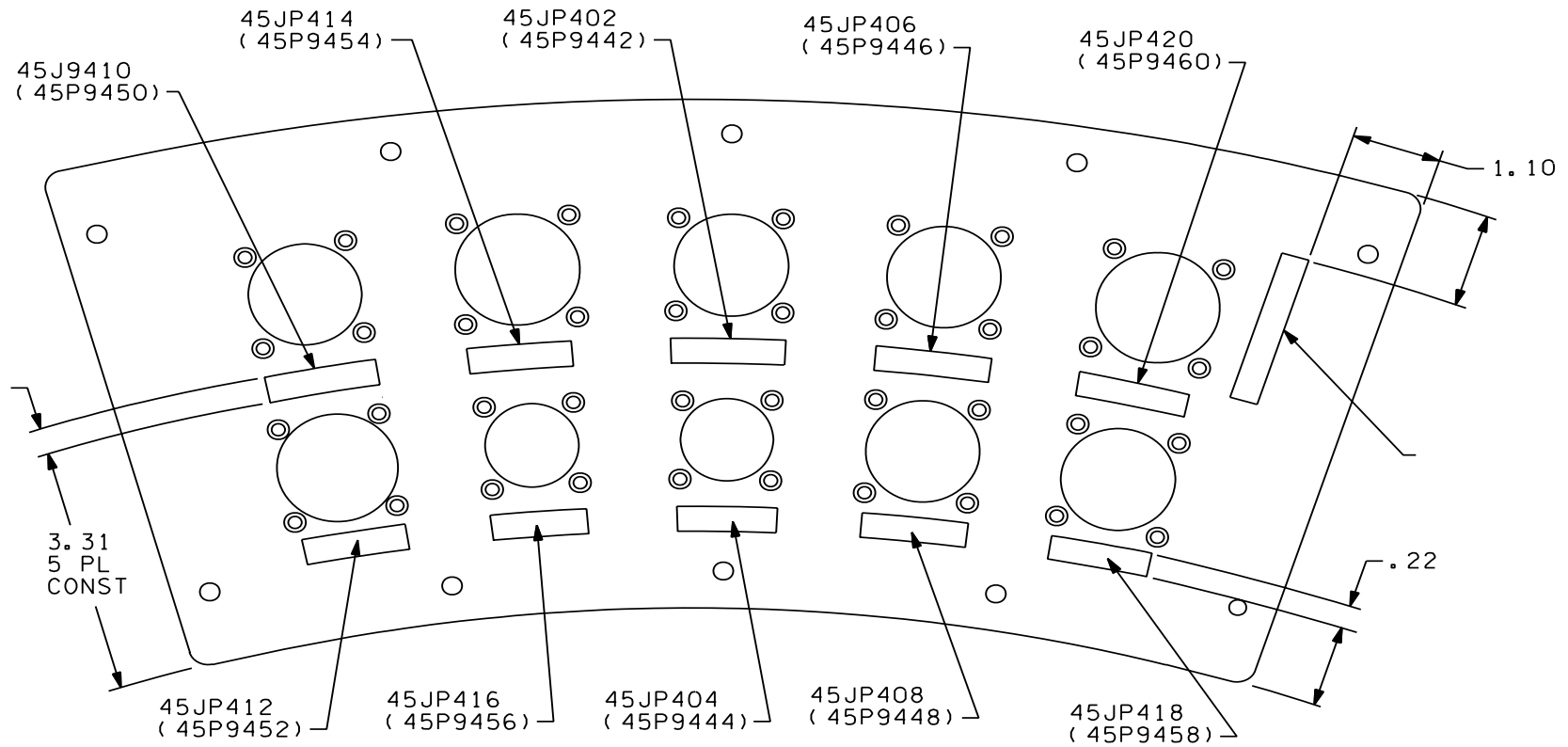


22673009. ART 1

Figure 5.3-3. Port/Stbd floor connector panels

5.3-4

Verify that this is the correct version before use

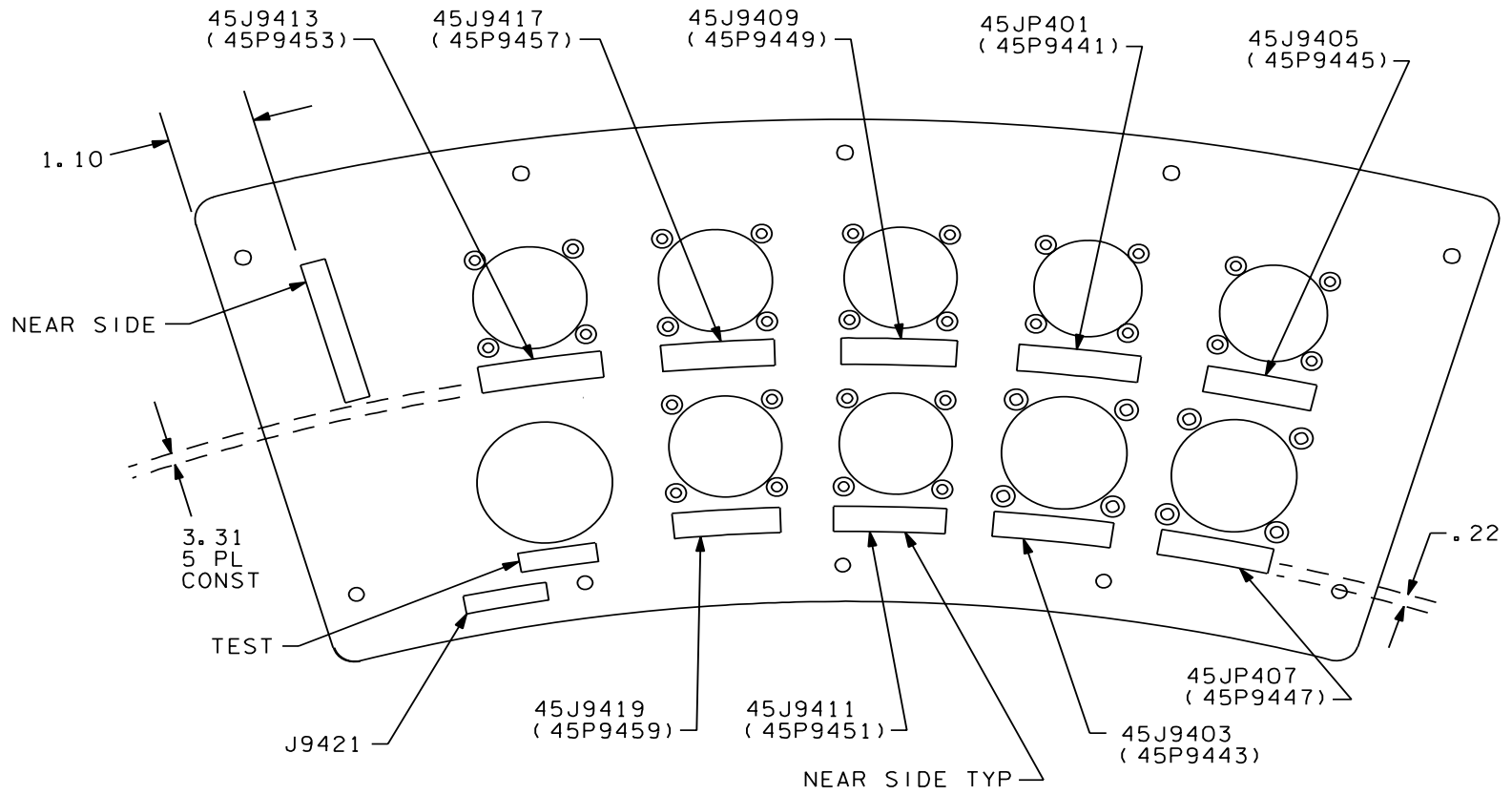


22673012. ART 1

Figure 5.3-4. View looking down, STBD side

5.3-5

Verify that this is the correct version before use



22673011. ART# 1

Figure 5.3-5. View looking down, PORT side

NOTES

This procedure was verified at Downey, Ca. 5/98 by S. A. Kieffer.

REFERENCES

Drawings:

VS70-953115	Sheet 50	Capture Latch Motors
	Sheet 31	Hooks 1 M6
	Sheet 33	Hooks 1 M7
	Sheet 35	Hooks 2 M8
	Sheet 37	Hooks 2 M9
	Sheets 22, 22.1	Ring Motor M4, M5

VS70-953103

TITLE

APDS SLIP CLUTCH POSITION INDICATION

PROCEDURES

This procedure provides the necessary steps to determine the position of the Androgynous Peripheral Docking System (APDS) Slip Clutch Locking device via sensor continuity test due to lack of positioning telemetry. The IFM Multimeter is used to determine APDS Slip Clutch position.

1. Power down the APDS
2. Configure the IFM Multimeter
3. Remove STBD Air Lock Bubble Cover
4. Access/Demate required wire harness connector for Logic Sensor 1(2)
5. Perform continuity test and log results
6. Report results to MCC

FAILURE

An APDS telemetry hardware failure will not allow required indication of the APDS Slip Clutch Locking device.

BACKGROUND

This procedure was developed for the docking mechanism to ensure that there is an alternate method for determining the APDS Slip Clutch position in support of successful SSP/ISS docking operations. The inability to determine correct APDS Slip Clutch position may potentially cause hardware damage. The Slip Clutch docking mechanism is designed to be in the Slip position during docking operations. There are Flight Rules in place that requires this information prior to docking to protect from potentially damaging docking mechanism hardware.

NOTES

This procedure was verified utilizing the APDS Brassboard located at the Boeing Annex near the Neutral Buoyancy Laboratory (NBL). This APDS Brassboard is an engineering test article that has a flight like (class II) docking mechanism attached to an airlock mockup.

REFERENCES

1. In-Flight Maintenance (IFM) Checklist, APDS Direct Drive Using Breakout Box (BOB) and ADI/DDU Voltage Test procedure.
2. Boeing Wire List / OV-105 for 45P9448(J9408) & 45P9452(J9412)

TITLE

AV BAY FAN CHANGEOUT

PROCEDURES

Regain Av bay air cooling in the event of the loss of two fans within a single Av bay. Power must still be available in at least one of the failed fan locations. This procedure will take a good fan from an alternate location; i.e., one of the other Av bays, and install it in place of one of the failed fans. The procedure also provides instructions for checking power voltages at the fan.

1. Power down affected fans.
2. Access LEB (may remove vols. E, G, or H, depending on the circumstances).
3. Access failed fan.
4. If required, check power to failed fan.
5. Remove failed fan and mark with tape.
6. Access spare fan and remove.
7. Install failed fan in spare location.
8. Install spare fan.
9. Power up fan.
10. Stow failed fan.
11. Close out LEB.

FAILURE

Loss of two fans, A and B, in a single Av bay; power must still be available to one of the two failed fan locations.

BACKGROUND

The location/choice of the fan to be used as a spare is dependent on the exact failure case and is subject to real-time judgment. For example, if Av bay 1 loses one fan due to the loss of an ac bus, and a second fan is hard failed, the two fans will be swapped to regain Av bay cooling. If both fans are hard failed, then the spare will come from another Av bay.

The voltage check procedure is used to determine whether power is available at the fan/wire harness connector. This can determine whether a short is in a fan or in the wire harness.

The fan locations within a single Av bay are immediately adjacent to one another. However, cable routing (per the installation drawings) will not permit the cables to be swapped. The orbiters have the cables routed around the outsides of each fan-pair; thus, the cables would not reach to the opposite unit. Pin kit jumper leads could be used to jump power from one fan's cable to the opposite fan in the pair if such a procedure became desirable.

REFERENCES

1. Schematic drawings
 - (a) VS70-610109
 - (b) VS70-610102
2. Installation drawings
 - (a) V070-613400
 - (b) V070-613999

TITLE

BRAKE ANTISKID CONTROL COMMAND INHIBIT

PROCEDURES

Inhibit brake coil command current output from Brake Antiskid Control Box associated w/failed Antiskid Control channel by cutting output signal wires from connector P301 (P302) on J1 (J2). Antiskid Fail Light annunciation signal will also be inhibited for channel that is cut/failed.

1. Power down Brakes, MNA,B,C
2. Verify that Antiskid system is off
3. Remove Locker MF28H (MF71H) and Thermal/Debris Trap to access skid control box.
4. Access wires attached to connector P301 (P302) attached to J1 (J2) on brake/skid control box.
5. Separate wires ~3-5 in back from the connector, remove ID tags as required.
6. Determine from the chart the appropriate wire for LCA, Fail Light to be cut, as directed by MCC.
7. Determine from the chart the appropriate wire to be located for the Brake Coil, as directed by MCC.

Brake Antiskid Control Box 1

Wheel	Signal	Connector	Wire ID*	Conductor
LOB	LCA, Fail Light	P301/J1	V23A26 (24)	
LOB	Brake Coil	P301/J1	1V124A26 (22)	One Stripe
LIB	LCA, Fail Light	P302/J2	V25A26 (24)	
LIB	Brake Coil	P302/J2	1V120A26 (22)	One Stripe
RIB	LCA, Fail Light	P302/J2	V24A26 (24)	
RIB	Brake Coil	P302/J2	1V118A26 (22)	One Stripe
ROB	LCA, Fail Light	P301/J1	V22A26 (24)	
ROB	Brake Coil	P301/J1	1V114A26 (22)	One Stripe

Brake Antiskid Control Box 2

LOB	LCA, Fail Light	P301/J1	V67A26 (24)	
LOB	Brake Coil	P301/J1	2V124A26 (22)	One Stripe
LIB	LCA, Fail Light	P302/J2	V69A26 (24)	
LIB	Brake Coil	P302/J2	2V120A26 (22)	One Stripe
RIB	LCA, Fail Light	P302/J2	V68A26 (24)	
RIB	Brake Coil	P302/J2	2B118A26 (22)	One Stripe
ROB	LCA, Fail Light	P301/J1	V66A26 (24)	
ROB	Brake Coil	P301/J1	2V114A26 (22)	One Stripe

- Wire ID number listed refers to orbiters 103, 4, and 5. Number in parenthesis refers to orbiter 102.

8. Strip ~2 in of insulation from the twisted shielded pair, ~3-5 in from the connector back shell without damaging inner wires.
9. Separate and cut number 1 conductor from twisted, shielded pair. Number 1 is identified by a single black band. The number 2 conductor has the double band.
10. Tape over the wire ends (4) and tape/secure wires to harness with gray tape, Inform MCC of status.
11. On MCC go ahead, configure for brake application.
12. Select MNA, B, C to on, verify that the ANTISKID is off.
13. Select the Hydraulic Circ pump 3 to on and wait 10 sec.
14. Select Hydraulic Isol Valve 3 to open and verify talk back indicates open.
15. Depress and hold brake pedals, check with MCC
16. Release brake pedals.
17. Reconfigure System by selecting the hydraulic brake isol valve 3 to close, and holding for 5 sec. Verify the talkback reads closed.
18. Select hydraulic circ pump 3 to GPC, to enable software control of the cycling of the pump.
19. Select ANTISKID to on and verify that the Antiskid Fail light is not illuminated, report status to MCC.
20. Select ANTISKID and BRAKES MNA, B, C to off.
21. With MCC go ahead replace the ID tags and reinstall the clamps on the wiring hand tight.
22. Reinstall the Thermal/Debris Trap and locker MF28H (MF71H), Torque to 30 in-lbs.
23. Stow the clamps and tools when finished.

FAILURE

Failure of the brake antiskid channel functions could result in wheel lock-up and subsequent tire failure.

BACKGROUND

On the STS-59 Terminal Countdown Demonstration Test, two discretes in the Brake/Skid control Box "B" began toggling between good and failed indications. The discretes were both part of the left outboard antiskid and brake built-in test equipment circuits. The output to the anti-skid coil measured 4.5 mA, instead of the expected 40 mA. (4.5 mA is the expected quiescent current during a nominal rollout, where conditions are such that wheel speed has not caused the ant-skid coil to energize). The circuitry and coil current readings were indicative of either half brakes on the left outboard wheel, or loss of anti-skid protection for half of the brake pistons on the left outboard wheel. The Brake and Anti-skid functions were powered on in order to ensure that none of the remaining Anti-skid channels were failed. The generic IFM procedure to disconnect any of the Brake coil channels in the event of a subsequent Anti-skid channel failure was pursued prior to launch, and refined during the flight.

NOTES

For further information, see MMACS, D. Paternostro STS-59 post flight data OV-105 flight #6 mission #62.

REFERENCES

1. ZKO7/S. Heath, Rockwell International, KSC
2. PR No. PV6-263766, dated 3/29/94
3. Rev. A incorporated Brake/Antiskid Verification flight note from MMACS into IFM procedure (R. Rogers)
4. STS-59 flight data and post flight report (MMACS)

TITLE

CABIN LEAK SEALING

PROCEDURES

This procedure provides general guidelines for sealing a cabin leak. An assumption is made that the most likely location of the leak would be areas around windows, hatches, vent valves, and penetrations of the 576 bulkhead.

1. Determine leak location.
2. Stop leaks using Duxseal (a putty-like sealant) and tape and/or the leak repair kit which is a room temperature vulcanize (RTV) foam.

FAILURE

Crew module leaks including

1. Damaged O-rings around cabin penetrations
2. Over torque bolt resulting in fracture of bolt or plate
3. Damaged pin or socket on an electrical connector
4. Micrometeorite penetrations

BACKGROUND

Duxseal and tape are considered the prime medium of repair for cabin leaks. Vacuum chamber testing of the leak repair kit worked best on electrical connector leaks. The low viscosity of the RTV can penetrate the wire bundle.

NOTES

Method of application of Duxseal and tape is in layers of Duxseal, tape, Duxseal, etc.

The leak repair kit is a two-part RTV closed-cell silicone foam with a plunger-type applicator. The applicator must be in close proximity to the area being sealed to prevent dispersion of the sealant into the cabin area. If the mixture is not sufficiently viscous, wait 10 seconds and begin application again. Mixing procedures for the RTV are in the IFM Checklist, page C-1.

REFERENCES

Drawing V070-331002, primary structure assembly - crew module

TITLE

CAUTION AND WARNING ELECTRONICS UNIT CONTINGENCY POWER (CIL)

PROCEDURES

Regain fail-safe operation of the C&W electronics unit (EU) by either bypassing a failed essential bus, or redundantly powering a C&W EU power supply. This procedure is used to eliminate a time-critical un-enunciated fuel cell failure due to the loss of an essential bus following a previous loss of one-half of the C&W EU (system A or B). This procedure requires the use of premanufactured caution and warning system (CWS) contingency power cables of which there are two, cable A and cable B. Cable A mates with the connector for the C&W EU A power supply, and cable B mates with the connector for the B power supply.

1. Access C&W EU in Av bay 3A
2. Power down EU
3. Install C&W system contingency power cable (A or B)
4. Repower EU
5. Perform C&W system checkout
6. Close out Av bay 3A

FAILURES

A single loss of any one of the following:

1. C&W power supply A
2. C&W power supply B
3. Essential bus 1BC DA1
4. Essential bus 1BC 013/R15
5. Essential bus 2CA DA2
6. Essential bus 2CA 013/R15

BACKGROUND

Essential bus 1BC and 2CA supply power to the C&W's A and B power supplies, respectively. See Figure 5.8-1.

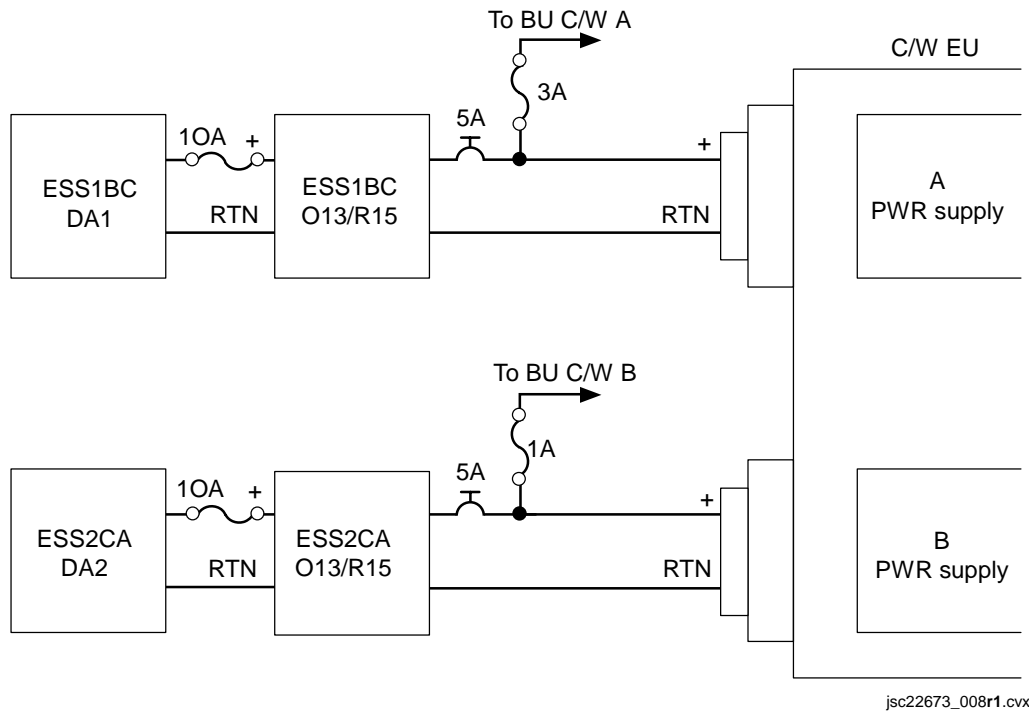


Figure 5.8-1. Orbiter C&W connections

Loss of an essential bus will cause the loss of a fuel cell coolant pump. The fuel cell must be shut down within 9 minutes to avoid a possible loss of crew/vehicle due to fuel cell overheating and crossover. An essential bus loss following a previous loss of redundant C&W capability (loss of system A or B) will result in the time-critical coolant pump loss situation with no aural warning to the crew.

Possible solutions following the loss of one-half of C&W:

1. Shut down the fuel cell associated with the essential bus powering the remaining C&W system.
2. Have the crew continuously monitor CRTs and talkbacks for failure indications of the bus in question.
3. Implement the IFM.

There are two failure modes that cause loss of one-half of C&W.

1. Essential bus loss 1BC DA1, 1BC 013/R15, 2CA DA2, or 2CA 0131R15.
2. C&W EU power supply A (or B) failure.

The CWS contingency power cables can be used to alleviate both of these failure modes. The cables are installed in line with the existing C&W EU power harnesses. By inserting a fuse into the contingency power cable, the cable can be used to send power

both into the EU and back to the O13 panel to power the backup C&W enunciators. With the fuse removed, the cable can be used to diode two power sources together and thus redundantly power the EU power supply. The malfunctions procedures book directs the crew to perform this IFM following a loss of one-half of C&W. The cable is designed to remain installed for the remainder of the mission, and for entry.

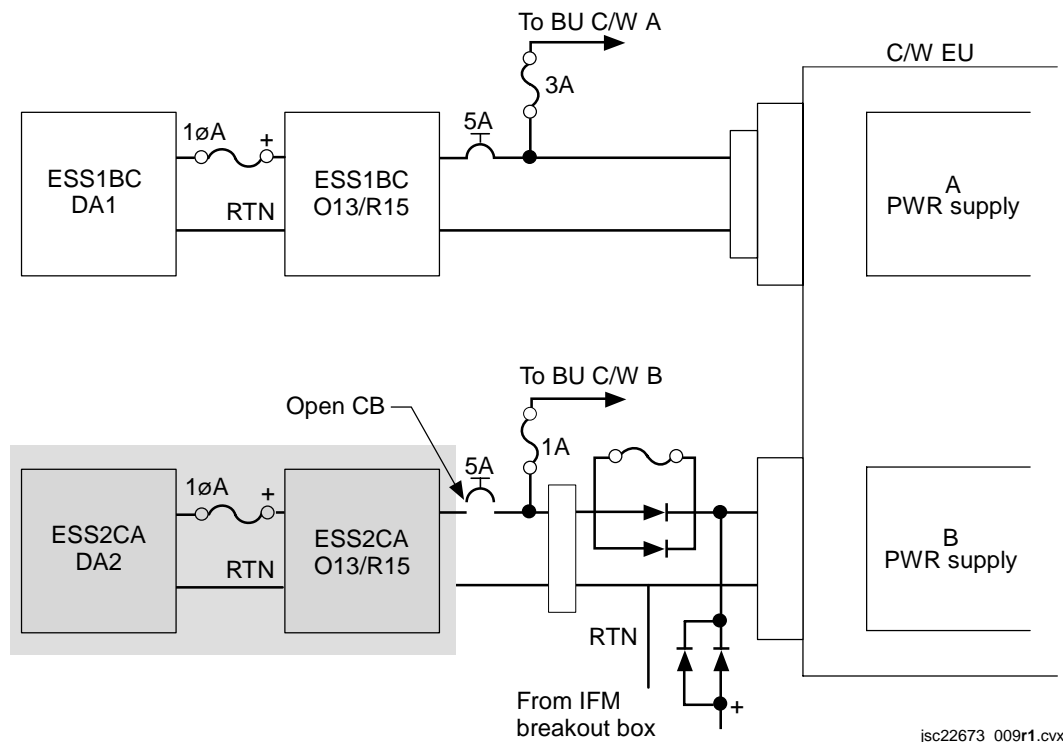
REFERENCES

CWS contingency power cables

1. Flight Support Equipment Configuration Control Board (FSE CCB) change request (CR) #G1981
2. Boeing drawing number 528-20216

C&W EU

1. Rockwell Integrated Schematic VS70-730129
2. FMEA/CIL 05-3 -12309-09



**Figure 5.8-2. C&W contingency power cables/orbiter
C&W connection failure scenario**

NOTES

1. Regains full C&W.
2. Contingency power cable is used to bypass the failed bus. Cable B is shown in Figure 5.8-2; cable A installation is identical.
3. In this configuration, the diodes serve no electrical purpose and are unnecessary.
4. A 5-A fuse is inserted to act as a “copper penny,” which bypasses the diodes and powers the backup C&W enunciators.

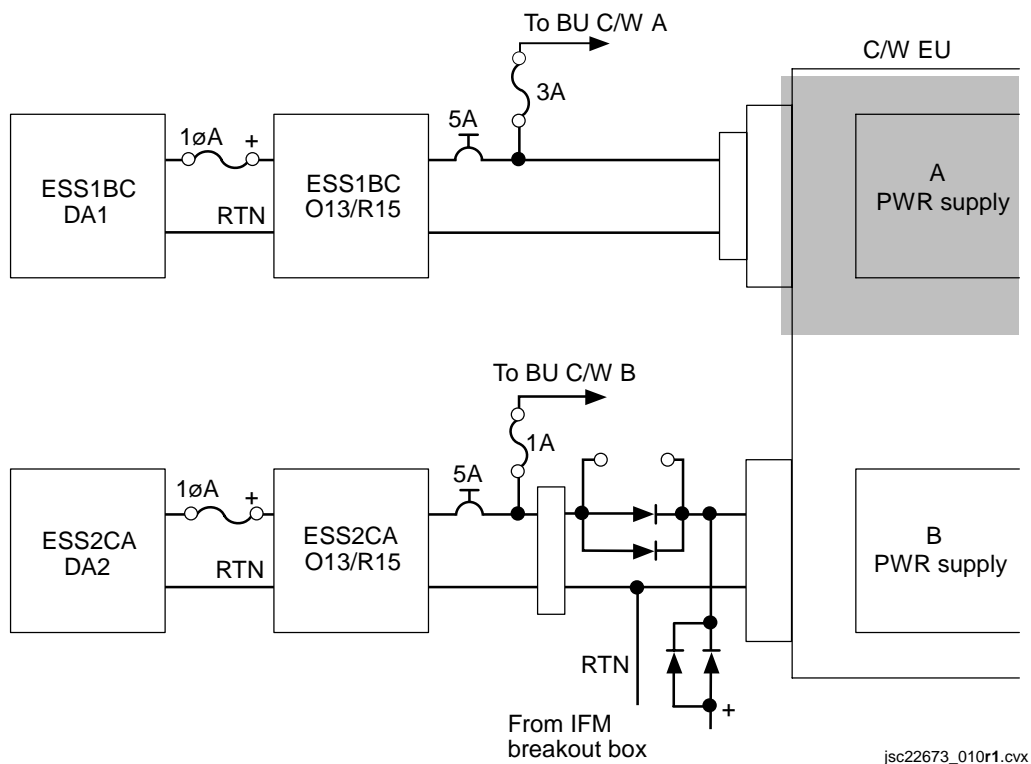


Figure 5.8-3. C&W contingency power cables/orbiter C&W connection failure scenario 2

NOTES

1. The C&W system remains single string but the remaining power supply is now redundantly powered. In the event of an essential bus loss, the C&W unit remains powered and the crew will get an alarm signal.

2. The diodes in the cable are used to isolate the essential bus power source from the dc utility power supply. This redundantly powers the remaining C&W power supply. Cable B installation is shown in Figure 5.8-3; cable A installation is identical.
3. Pairs of diodes installed in parallel are used for circuit isolation because the most common failure mode for a diode is for it to fail to conduct in the forward direction. Thus, a single diode can fail and the cable still performs its function.
4. Cable is to remain unfused.
5. Circuit protection is from the circuit breaker in panel O13, and from the 5-A fuse in the IFM breakout box.

TITLE

CONDENSATE COLLECTION RECONFIGURATION

PROCEDURES

To reconfigure humidity separators (Hum Sep) condensate collection plumbing to use Hum Sep A vs. Hum Sep B to process condensation.

1. Powerdown Hum Sep
2. Remove cap from Hum Sep A test port
3. Remove condensate collection line from Hum Sep B test port
4. Install condensate collection line to Hum Sep A test port
5. Install cap from Hum Sep A test port onto Hum Sep B test
6. Pwr-up Hum Hum Sep A

FAILURES

A clogged Hum Sep condensation manifold line.

BACKGROUND

Condensate collection via Contingency Water Container (CWC) was developed in support of docking operations with the International Space Station (ISS). During docked operations with the ISS, the Orbiter is prohibited to perform either waste or potable H₂O dumps. The primary concern was potential ISS element contamination. In attempt to provide more waste tank ullage, the Space Shuttle Program (SSP) decided to modify the Hum Seps to dump condensation to CWC's. This action will allow more waste H₂O storage capacity and reduce the quantity of dumps. Potable H₂O dumps are not an issue because we transfer most of it to ISS.

NOTES

This procedure was developed via a sim case anomaly. Hum Sep B condensate collection manifold was blocked with foreign debris. The procedure was required to process condensate via Hum Sep A.

REFERENCES

1. IFM personnel / Steve Contella created this procedure.
2. Drawings: VS70-610209
VS70-610109
VS70-610102

TITLE

CONTROL BUS POWERDOWN

PROCEDURES

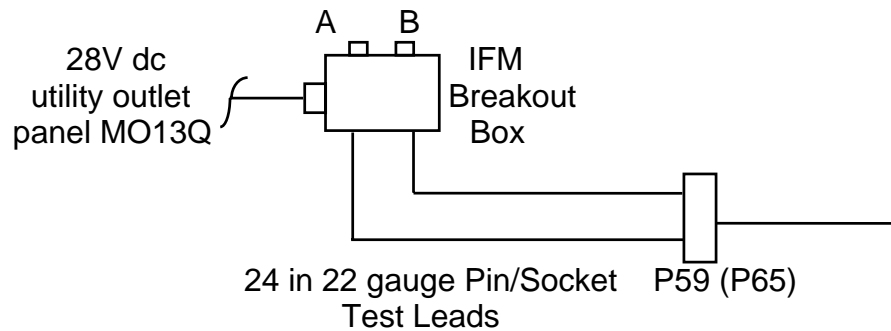
The objective is to remove power from shorted control bus section by removing power from appropriate control bus RPC(s) on MCC call. If control bus short trips off RPC, middle power source circuit breaker will be opened and this procedure is used to power down remaining RPC. If control bus short does not trip off either RPC, this procedure will be used to power down both RPCs.

1. Gain access to MDM LF1 by removing Volume A (Procedure found in General Information section).
2. Using the Control Bus Source Table verify, with MCC, the appropriate actions to be taken.

CNTL BUS TO BE UN-POWERED	PANEL R14 cb	LF1 MDM RPC COMMAND	ALSO LOST IS ONE SOURCE OF
AB1	cb MNC CNTL BUS AB1/2/3	AB1/BC1 - P59 PIN 22 AB1/CA1 - P59 PIN 14	AB2*, AB3*, BC1, CA1
AB2	cb MNC CNTL BUS AB1/2/3	AB2/BC2 - P59 PIN 80 AB2/CA2 - P59 PIN 70	AB1*, AB3*, BC3, CA3
AB3	cb MNC CNTL BUS AB1/2/3	AB3/BC3 - P65 PIN 58 AB3/CA3 - P65 PIN 47	AB1*, AB2*,

3. Remove connector P59 (P65) from J2 (J8) as required. Place gray tape over J2 (J8) to protect connector.
4. Verify that the DC utility power outlet to be used in conjunction with the breakout box is switched off.
5. Configure the breakout box as follows:
 - (a) Auxiliary power switch turned off
 - (b) The 28V/Variable Volt selector set to 28V
 - (c) Power to sides A and B turned off
 - (d) Remove the fuse caps from both A and B sides
 - (e) Rotate the GA selector for both A and B to 22
 - (f) Install two 5-Amp fuses (from the Pin Kit), one on each side, replace the fuse caps.

- (g) Connect two 24 in, 22 gauge Pin/Socket test jumper leads between the breakout box and connector P59 (P65), as illustrated;



6. Switch DC utility power to on.
7. Select breakout box power to sides A and B to on, verify that the 22 ga. indicator lights for each side are on.
8. On panel R1 select control bus power for MNA, B, C to off (power down).
9. Verified that the shorted control bus is still de-energized, check with MCC.
10. If required for entry, tape or secure the wiring harness, cables and Test Jumper Leads to a nearby structure.
11. Secure the Break Out Box to the Av Bay Shelf and re-install Volume A.
12. Secure the DC utility power cable and stow tools.
13. If the procedure is no longer required, select Breakout Box power to sides A and B to off.
14. Take the DC utility power outlet being used to OFF, and remove cables and Test Jumper Leads.
15. Re-install connector P59 (P65) to J2 (J8) on MDM LF1.
16. Reinstall Volume A and stow tools.

FAILURE

Failure is due to a control bus related short.

BACKGROUND

The crew would be referred to this IFM after completing the OPCL, CNTL BUS SHORT (TIME CRITICAL) procedure which would safe the system by either taking the CNTL BUS PWR switch to RESET (if no RPC has tripped), or by taking the CNTL BUS PWR

switch to RESET and pulling the appropriate Control Bus cb on panel R14 (if an RPC has tripped). With the CNTL BUS PWR switch in RESET, all associated RPCs are unpowered. The intent of this procedure is to use the breakout box to generate a 28 volt signal to the GSE port of a driver in one of the Forward Load Controllers in order to inhibit output to its RPC, thereby permanently unpowering that RPC. Once inhibited, power can be restored to the remaining RPCs by taking the CNTL BUS PWR switch out of RESET. This allows the associated control buses to be repowered without risk of repowering the shorted control bus.

TITLE

CRYO TANK HEATER FUSE REMOVAL (CIL)

SUMMARY

Disable a failed-on CRYO tank heater by removing two fuses from the back of panel R1A2, A11, or A15.

PROCEDURE

1. Determine the appropriate pair of fuses and their location by using the matrix cited in References.
2. Access back of the appropriate panel.
3. Clip safety wire and remove fuses.
4. Replace caps.
5. Close panel and stow tools.

FAILURE

Failed-on CRYO tank heater due to switch failure or other failure leading to excessive pressure and flow of cryogenic O₂ or H₂.

BACKGROUND

FMEA/CIL identified a potential scenario of an uncontrolled CRYO tank heater due to a switch failure. If the affected tank is at a residual cryo level, then tank rupture could occur in about 35 hours. The only options to correct this situation are to unpower the affected heater by dropping a main bus or performing the IFM. Development of this procedure satisfies the operational retention rationale prescribed by the CIL.

REFERENCES

FMEA Number - 05-6MB-2027-2

Heater	Panel	Fuses
02 TK1 HTR A	R1A2	F1 & F2
02 TK1 HTR B	R1A2	F3 & F4
H2 TK1 HTR A	R1A2	F5 & F6
H2 TK1 HTR B	R1A2	F7 & F8
02 TK2 HTR A	R1A2	F9 & F10
02 TK2 HTR B	R1A2	F11 & F12
H2 TK2 HTR A	R1A2	F13 & F14
H2 TK2 HTR B	R1A2	F15 & F16
02 TK3 HTR A	R1A2	F17 & F18
02 TK3 HTR B	R1A2	F19 & F20
H2 TK3 HTR A	R1A2	F21 & F22
H2 TK3 HTR B	R1A2	F23 & F24
02 TK4 HTR A	A11	F1 & F2
02 TK4 HTR B	A11	F3 & F4
H2 TK4 HTR A	A11	F5 & F6
H2 TK4 HTR B	A11	F7 & F8
02 TK5 HTR A	A15	F1 & F2
02 TK5 HTR B	A15	F3 & F4
H2 TK5 HTR A	A15	F5 & F6
H2 TK5 HTR B	A15	F7 & F8
02 TK6 HTR A	A15	F17 & F26
02 TK6 HTR B	A15	F35 & F44
H2 TK6 HTR A	A15	F11 & F20
H2 TK6 HTB B	A15	F29 & F38
02 TK7 HTB A	A15	F13 & F22
02 TK7 HTR B	A15	F31 & F40
H2 TK7 HTR A	A15	F15 & F24
H2 TK7 HTR B	A15	F33 & F42
02 TK8 HTR A	A15	F18 & F27
02 TK8 HTR B	A15	F36 & F45
H2 TK8 HTR A	A15	F16 & F25
H2 TK8 HTR B	A15	F34 & F43
02 TK9 HTR A	A15	F14 & F23
02 TK9 HTR B	A15	F32 & F41
H2 TK9 HTR A	A15	F12 & F21
H2 TK9 HTR B	A15	F30 & F39

TITLE

DDU CHANGEOUT

PROCEDURES

Replace a failed forward DDU (left or right) using the aft DDU as a spare. This ensures working flight station displays for entry.

1. Power down DDUs to be swapped.
2. Access and remove DDUs and mark failed unit.
3. Install aft DDU in the forward position.
4. Stow failed DDU in aft station.
5. Power up forward DDU and perform checkout.

FAILURES

Hard failed DDU 1 or DDU 2

BACKGROUND

The DDU's process GPC data to drive all orbiter guidance and navigation computer (GNC) displays (ADIs, HSIs, AMIs, and AVVIs). Aft DDU is identical to forward DDUs. The aft DDU drives only the aft ADI and other outputs are unused.

REFERENCES

Drawings

1. VS70-730109 (OV-103 and subs)
2. VS70-730172 (OV-102)

Flight Rule

1. A2-105

TITLE

DTV/MUX REPLACEMENT w/SPARE

PROCEDURES

To replace a hard-failed Digital Television/Multiplexer (DTV/MUX) with a stowed spare to recover DTV operations.

1. Powerdown MUX
2. Un-stow spare MUX
3. Access failed MUX by removing pnls L16, L17
4. De-mate wire harness connectors from failed MUX
5. Remove Failed unit
6. Install spare MUX
7. Mate wire harness connectors
8. Install pnls L16, L17

FAILURES

A hard failed MUX

BACKGROUND

Post STS-107 tragedy, Mission Management decided to perform an Orbiter vehicle survey after ascent phase of flight on all subsequent Space Shuttle missions. This action is an attempt to identify any potential Orbiter structural damage and/or breach. Therefore, on-board DTV hardware has become critical to accomplish a successful mission.

If there is any Orbiter structural damage and/or breach identified, then an attempt to repair it will be addressed prior to entry phase of flight. If the Orbiter vehicle experienced massive structural damage during the entry phase of flight and repairs cannot be accomplished, the crew will seek safe haven on the International Space Station (ISS). The severely damaged Orbiter will be discarded and a rescue mission will be deployed.

REFERENCES

1. In-Flight Maintenance (IFM) Checklist, RMS MCIU Changeout
2. P-TV personnel (Dave Williams)
3. Drawings: ICD-A-21429
MO72-710571
VS72-270151

TITLE

FILTER CLEANING

PROCEDURES

Use the vacuum cleaner to remove lint and debris from cabin air-loop filters and/or Av bay air-loop filters. This reduces free air contamination, prevents avionics air-cooled component damage, which could result from overheating, and maintains cabin (or Av bay) air-loop efficiency. Cleaning Av bay filters is not a part of scheduled maintenance. This will be accomplished only if a problem is detected with Av bay cooling.

1. Unstow vacuum cleaner and attachments
2. Configure for filter cleaning
3. Access filter and vacuum up debris

FAILURES

No failures for cabin air loop; regularly scheduled maintenance

High delta pressure in an Av bay air loop indicating a clogged filter

BACKGROUND

Cabin fan filter cleaning has been a scheduled activity since STS-1. Post-flight crew reports indicated that only a small amount of debris was found on the cabin fan filters on orbit. The reason for this became apparent on STS-5. During this mission, IDP 2 had failed and the crew was directed to do an IDP cable swap. When accessing the IDPs, the crew reported that a large amount of lint and debris had collected on the inlet filters of the IDPs. An examination of a cabin air-loop diagram revealed the reason. See Figure 5.14-1.

The majority of inlets to the cabin air loop are on air-cooled flight deck avionics boxes. Each of these inlets is filtered. As a result, the cabin air is being pre-filtered by the flight deck avionics equipment, and little debris reaches the cabin fan filters. The STS-5 crew cleaned the IDP filters with the vacuum cleaner prior to accomplishing the cable swap. Post-flight inspection revealed that lint and debris had accumulated on all the flight deck avionics filters despite having been cleaned prior to flight. The debris that has accumulated in the crew module between flights floats up out of the nooks and crannies in the micro-gravity and is deposited on the avionics filter screens. Subsequent to STS-5, filter cleaning has been a scheduled part of the FP.

The following avionics filters are located behind flight deck panels: IDPs, DDU, VSU, RCU, and MCIU. Prior to STS-26, accessing these filters required the removal of six flight deck panels (L17, L16, L8, R9, R17, and R18) with an excess of 100 fasteners. This was a very time consuming task. To speed this effort, the power screwdriver was added to the tool kit. With STS-26 and subs, five flight deck panels were modified to include filter access doors. (L16 has no filters behind it but its removal was necessary to remove L8.) These doors greatly reduce the time required for filter cleaning.

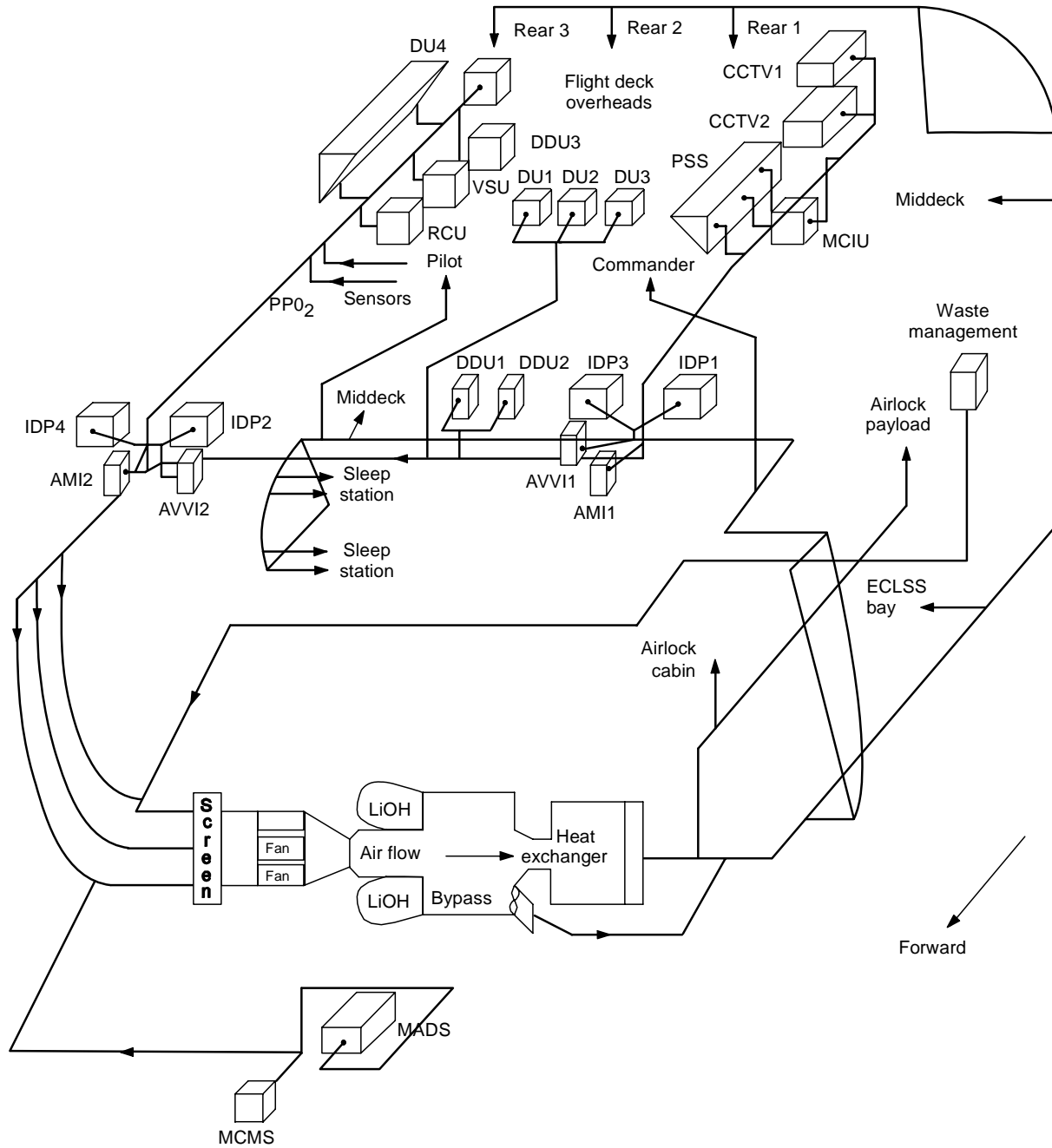


Figure 5.14-1. ARS air coolant loop

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Item	Flow rate (lb/hr)
Airlock cabin	0.0
Airlock payload	206.78
AMI1	12.03
AMI2	13.06
AVVI1	12.03
AVVI2	13.06
Commander	123.38
CCTV1	14.67
CCTV2	14.67
DDU1	50.56
DDU2	50.56
DDU4	49.85
IDP1	83.27
IDP2	92.71
IDP3	83.27
IDP4	92.71
DU1	57.89
DU2	57.89
DU3	57.89
DU4	57.06
ECLSS bay	94.16
Fan	1481.0
MADS	108.52
MCIU	77.73
MCM	19.07
Middeck	209.37
MSS	90.64
Pilot	104.71
PSS	254.29
RCU	18.17
Rear 1	111.95
Rear 2	109.59
Rear 3	106.88
PPO ₂ -sensor	10.19
Sleep station	353.68
Slurper	40.54
VSU	9.06
Waste mgmt	60.2

Filter cleaning is scheduled for flight day 2 and is repeated every third day thereafter (day 5, 8, 11, etc.) except landing day. Filter cleaning will be called out in the flight-specific FP. The filters normally cleaned: WCS inlet filter, cabin fan filter, IMU filters, partial pressure O₂ (PPO₂) sensor inlet filters, IDP filters, VSU filters, RCU filters, and (when manifested) the MCIU filters. Note that the IMU filters are part of a separate air loop exclusively for IMU cooling. The IFM Checklist also contains instructions for cleaning the Av bay fan filters in the LEB. Each Av bay also has its own air loop. This is not a part of scheduled filter cleaning and would only be required if telemetry showed a high delta pressure across the fans, indicating a possible clogged filter.

TITLE

HATCH, INNER - JAMMED ACTUATOR/LATCH

PROCEDURES

Use a delta pressure between the middeck and the airlock (A/L) to hold the A/L inner hatch closed when the hatch cannot be secured normally due to a jammed actuator or latch. The procedure assumes that the cabin is at 10.2 psi.

1. Position hatch in closed position.
2. Close equalization valves.
3. Repress cabin.
4. Secure hatch with treadmill force cords.

FAILURES

Failed-open (jammed A/L inner hatch actuator or latches)

BACKGROUND

The latches are easily observed on the A/L side of the hatch. The crew should be able to detect any problem with jammed latches.

REFERENCES

Rockwell Drawings

1. V070-332603
2. V070-593301

TITLE

GALLEY PURGE

PROCEDURES

This procedure purges the Galley supply lines of gas or contaminated H₂O into Waste Collection System (WCS) urinal and drink containers.

1. Configure Galley H₂O heaters
2. Configure WCS urinal hose
3. Reconfigure PHS hose to Galley TP-4
4. Flow Galley H₂O into WCS urinal hose for 5 min
5. Reconfigure PHS hose to Galley AUX
6. Flow Galley H₂O into WCS urinal hose for 2 min
7. Configure Galley MV2 vlv to Full AMB
8. Flow Galley H₂O into WCS urinal hose for 2 min
9. Fill two 8 oz drink containers w/cold H₂O at Galley rehydration station
10. Fill two 8 oz drink containers w/hot H₂O at Galley rehydration station
11. Reconfigure WCS urinal hose
12. Report results to MCC

FAILURE

Galley H₂O contamination

BACKGROUND

Procedure restores normal galley function by dumping contaminated H₂O.

REFERENCES

1. In-Flight Maintenance (IFM) Checklist, FC H₂O pH Test

TITLE

HATCH, SIDE - JAMMED ACTUATOR

PROCEDURES

Open the side hatch, which will not open normally due to a jammed actuator, from inside the crew module post-wheel stop.

1. Cut off actuator handle
2. Remove hatch cover
3. Disconnect actuator from linkage
4. Unlatch hatch with adjustable wrench

FAILURES

Jammed side hatch actuator

BACKGROUND

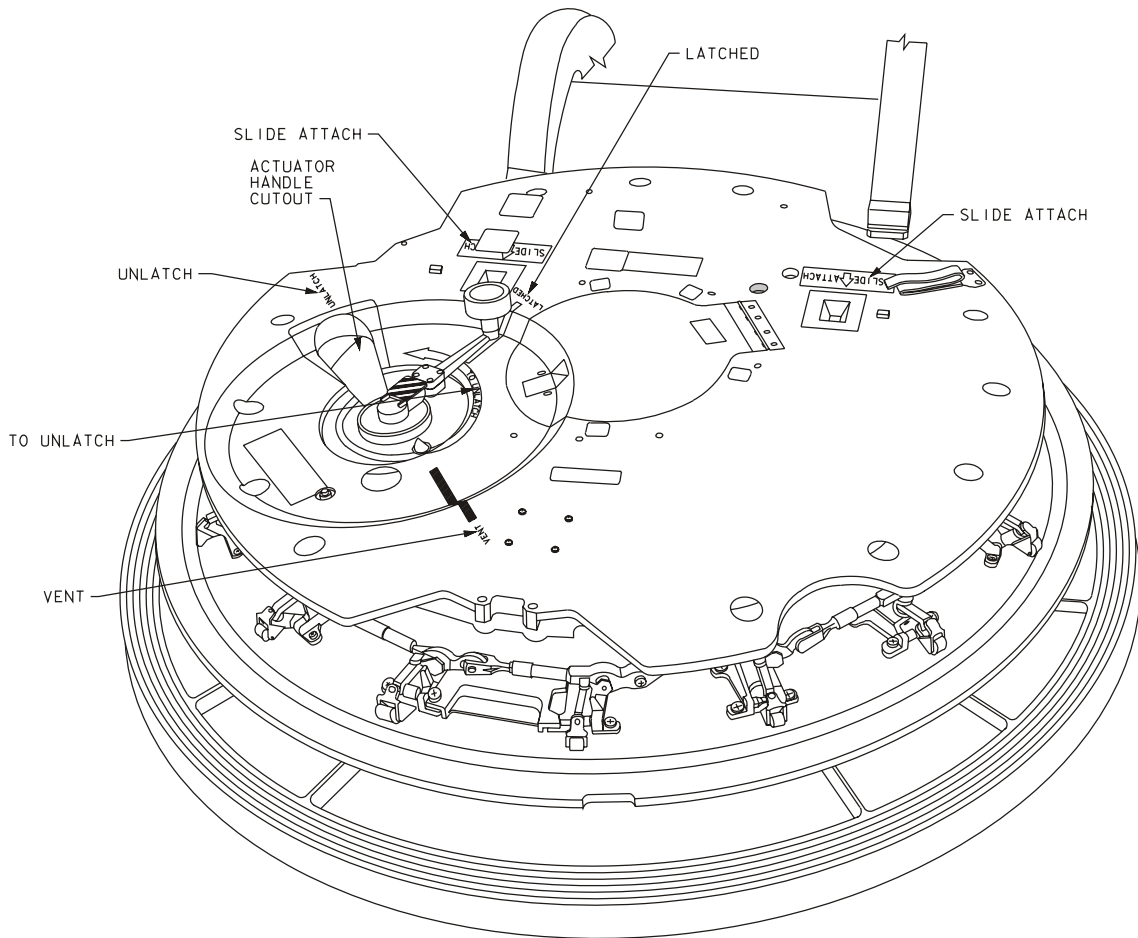
To access the side hatch latches and linkages, the actuator close-out cover must be removed. The cover has a cutout that allows the actuator handle to pass through when the cover is being removed. However, the actuator handle must be in the unlatched position for this to occur (or approximately 45° counterclockwise of the latched position). To allow cover removal when the actuator is jammed in the latched position, the actuator handle must be cut off using either the bonesaw or the hacksaw. See illustration in Figure 5.17-1.

Following cover removal, latches and latch linkages can be examined to locate and rectify the cause of the jam. This procedure can be used to prevent using a side hatch jettison.

REFERENCES

Rockwell Drawings

1. V070-332502
2. V070-593201



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Figure 5.17-1. Side hatch

5.17-2

Verify that this is the correct version before use

TITLE

HUD: HEADS UP DISPLAY ELECTRONIC (HUDE) UNIT CHANGEOUT

PROCEDURES

Provide instructions for changing out failed HUDE 1 (2) with operational unit or spare HUDE, if flown.

1. Select Left (right) Heads Up Display power to off, panel F3
2. Open Avionics Bay 3B, hinged access panels, top and bottom (five fasteners/door, 5/32 - in Allen Head Driver). It is noted that the center door be opened before the lower panel.
3. Remove connectors J1, J2, and J3 from the HUDE, as required.
4. Loosen HUDE mounting fasteners (twelve, 3/8 in socket)
5. Slide the Cold-plate Protective Cover between cold-plate and HUDE. Next remove HUDE with cold-plate protective cover as one unit. Mark the failed unit with gray tape.

To Install HUDE

6. Place HUDE 1(2) or spare with cold-plate protective cover into the desired location then remove the cover and tighten fasteners. Torque fasteners to 70 in-lb.
7. Install failed HUDE into vacated spot and torque fasteners to 70 in-lb.
8. Re-install connectors:
For HUDE 1 (Bottom Shelf) connect:
Cable 85V77W1P41 to J1
P43 to J2
P45 to J3
For HUDE 2 (Top Shelf) connect:
Cable 85V77W1P40 to J1
P42 to J2
P44 to J3
9. Close Avionics Bay 3B access panels and torque fasteners to 30 in-lbs.
10. Stow tools

FAILURE

If a spare HUDE is flown it will be used to replace either the Commanders or the Pilots HUDE. The Commanders HUDE has priority over the Pilots. Therefore if no Spare HUDE is flown and the Commanders HUDE fails, the Pilots HUDE will be used as a spare for the Commanders.

BACKGROUND

TBD

NOTES

TBD

REFERENCES

TBD

TITLE

HUD: PILOT DISPLAY UNIT (PDU) CHANGEOUT

PROCEDURES

Provide instructions for changing out failed Commander (Pilot) PDU with operational unit, or spare if one is flown.

To Remove PDUs

1. Select Left (Right) HUD power to OFF.
2. Fold the W2 and W5 handholds to the stow position
3. Cover windows W3 and W4 with shades.
4. Lift EMI cover to access mounting fasteners, ground strap and connectors.
5. Disconnect ground straps (two) from glare-shield. Note that the ground straps acts as a spring. Do not allow attachment screw, which is not captive, to fly loose when removing.

For OV 102:

One screw, washer per side, #6 Torque Tip

For OV 103 and subs:

One screw and washer per side, 7/64-in Allen Head Driver

6. Remove mounting fasteners, one per side (7/16-in socket). Due to limited space, it will be necessary to alternate sides while removing 7/16-in fasteners. (Two turns port, two turns starboard)
7. Slide the HUD unit out approximately 5 in and remove the connector.
8. Remove PDU, mark failed unit with gray tape.

To Install PDUs

9. Place the HUD unit in the approximate position and install the connector. Slide the unit forward making certain that the alignment pin at the forward end mates with the alignment hole in the mounting structure. Verification can be made with the inspection mirror.
10. Install the mounting fasteners and torque to 45 in-lbs.

11. Install the ground straps using one screw and washer per side, tighten the screws snug.
12. Re-install the EMI cover making sure that the cover does not obstruct light sensor. PDU will not work properly if light the sensor blocked. Ensure the Velcro is secure around the light sensor.
13. Install failed PDU into vacated position
14. When finished stow the tools.

FAILURE

TBD

BACKGROUND

TBD

NOTES

TBD

REFERENCES

TBD

TITLE

IMU CONTINGENCY COOLING

PROCEDURES

Provide forced-air cooling to all three IMUs by manifolding IMU exhaust hoses together and connecting them to the vacuum cleaner. The manifold is constructed from FDF covers and gray tape.

1. Access IMUs
2. Remove IMU exhaust flex hose clamps (three total) at the IMU fan inlet manifold
3. Remove hose ends and route flex hoses together
4. Build a manifold from FDF covers and gray tape and secure to the exhaust hoses
5. Secure manifold to the vacuum cleaner
6. Power up vacuum cleaner
7. Secure assembly with gray tape

FAILURES

Loss of IMU cooling due to:

1. Loss of three IMU fans
2. Failed check valve in the IMU fan housing
3. A blocked IMU air loop in the fan housing

BACKGROUND

The airflow provided by the vacuum cleaner is considered marginal for IMU cooling. This is a rather remote failure scenario.

Nominal IMU airflow

1. IMU muffler through the inlet filters
2. IMU intake hoses (white pipes)
3. IMUs
4. IMU exhaust flex hoses (red hoses)
5. IMU fan inlet manifold

6. IMU fan/check valve/heat exchanger assembly
7. IMU fan return hose
8. IMU muffler and air outlet

Contingency cooling follows the same airflow through to the IMU exhaust flex hoses. From there the air is manifolded together and pulled through the vacuum cleaner. This process does not reject heat through the IMU heat exchanger. Instead, the waste heat is dissipated into the cabin atmosphere.

REFERENCES

Rockwell Drawings

1. VS-710102, IMU schematic 109
2. VS70-613525, IMU muffler installation

TITLE

KEYBOARD CHANGEOUT

PROCEDURES

Replace a failed forward keyboard with the aft keyboard.

1. Power down the affected forward keyboard and the aft keyboard.
2. Access and remove the failed keyboard.
3. Access and remove the aft keyboard.
4. Install the aft keyboard in the forward station.
5. Stow the failed forward keyboard in the aft station.
6. Check out the keyboard by performing MAL, DPS, SSR-13, keyboard checkout.

FAILURES

CDR's keyboard unit, or PLT's keyboard unit

BACKGROUND

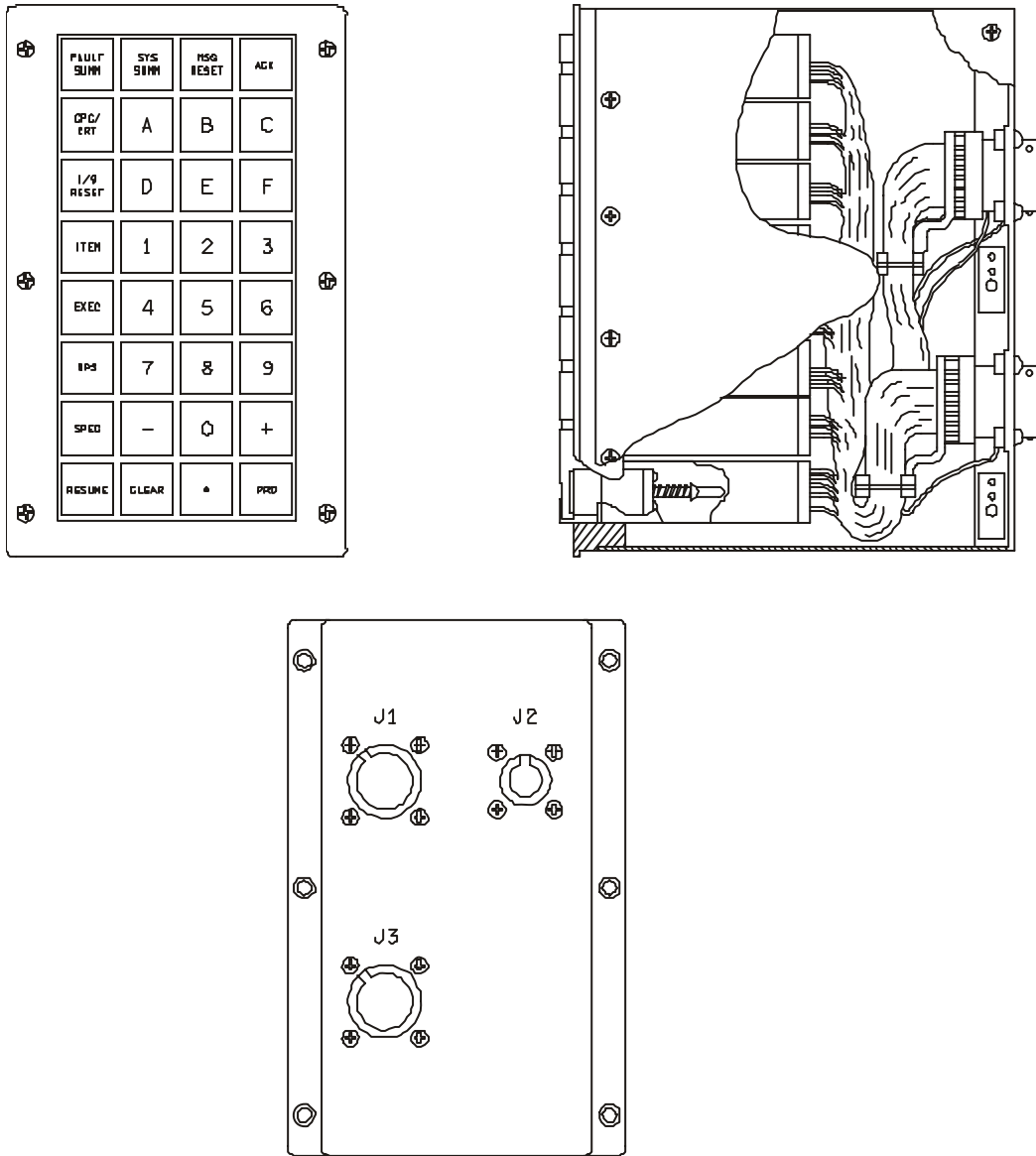
There are three keyboards. The forward keyboards (CDRs and PLTs) are on panel C2 and the aft keyboard is on panel R12L.

Keyboard	Panel	DEUs/CRTs (which it interfaces)
CDRs	C2	1 or 3
PLTs	C2	2 or 3
AFT	R12L	4

Replacing a failed forward keyboard assures two good keyboards for entry. See Figure 5.21-1.

REFERENCES

1. OMI V5L11: Orbiter keyboard unit removal/installation
2. IBM drawing no. 6239700, keyboard unit
3. Flight rules A2-105 and A7-109
4. MC615-0007: keyboard unit, orbiter
5. DPS Systems Briefs, Section 4.



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Figure 5.21-1. Keyboard unit and keys

5.21-2

Verify that this is the correct version before use

TITLE

KEYBOARD KEY CHANGEOUT

SUMMARY

Replace a failed key (both the PBI and the switch) in a forward keyboard using the ACK key from the aft keyboard as a spare.

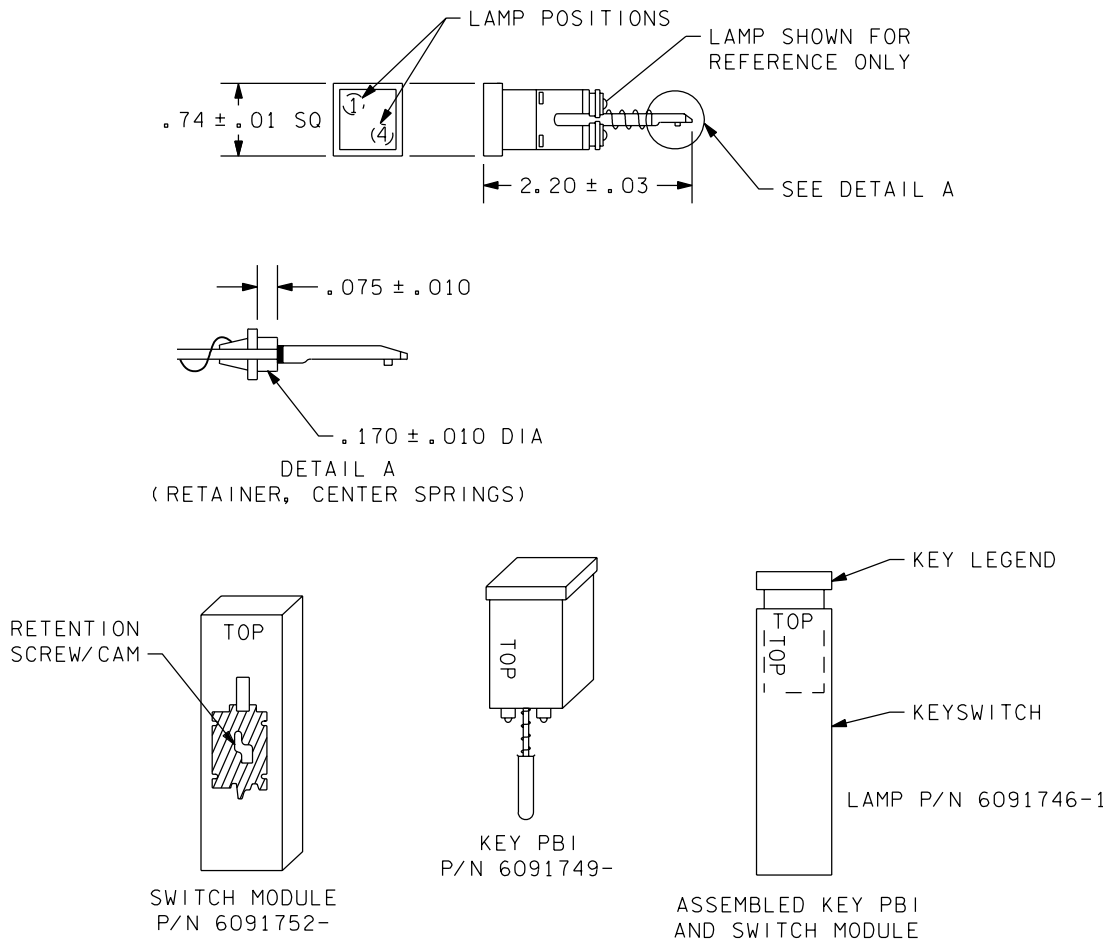
1. Power down the affected forward keyboard and the aft keyboard.
2. Remove the failed key (both the PBI and the switch) from the forward keyboard.
3. Remove the ACK key from the AFT keyboard.
4. Install the ACK key in the FWD keyboard.
5. Power up the forward and aft keyboards and check to see whether the spare key works.

BACKGROUND

The keyboard keys are made by Jay-El Products, Inc., Gardena, CA. The standard "spare" key is the ACK key; however, all 96 keys (32 keys on each of the 3 CRT keyboards) are interchangeable. Both the PBI and switch are removable from the panel front (vice digital autopilot (DAP) keys where only the push-button indicator (PBI) is removable). The switch is contained in the base of the key assembly. Removal requires 13-1/2 turns with a jeweler's screwdriver. The SPEC key on the CDR's keyboard failed on STS-3. The ACK key from the aft station was used as a spare. See Figure 5.22-1 through Figure 5.22-3.

REFERENCES

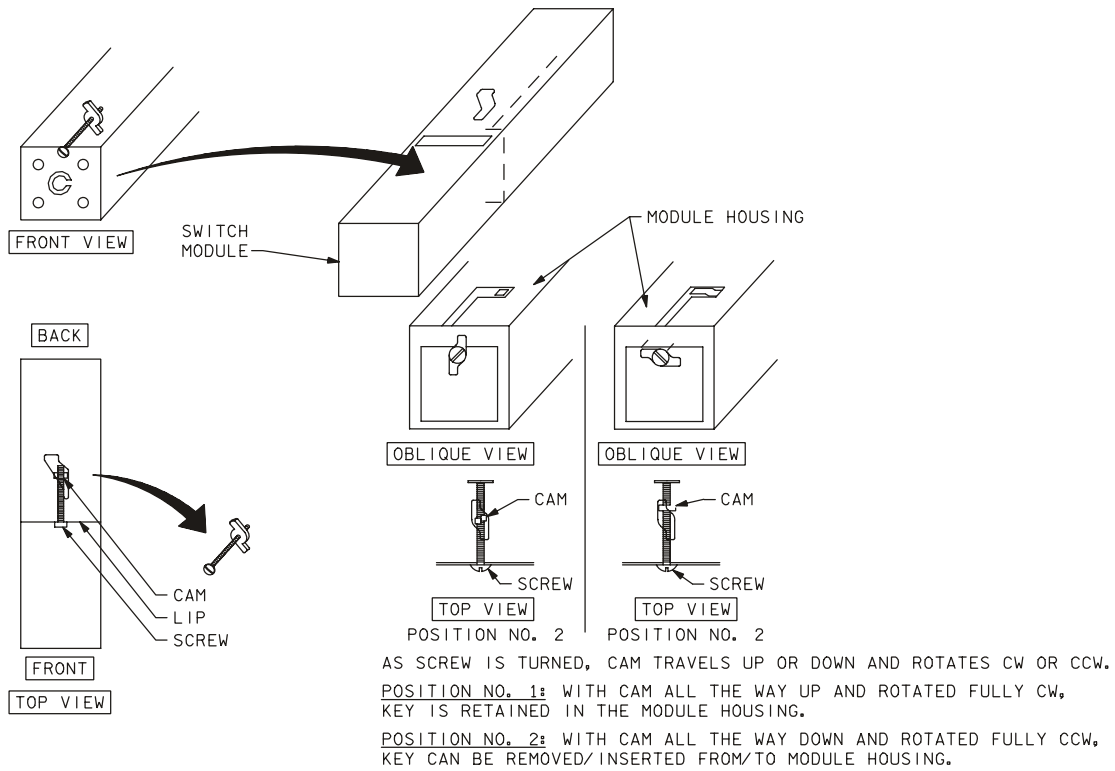
1. IBM Drawing 6091749: Lens-Switch, Push-button, Illuminated - 2 Lamp.
2. IBM Drawing 6239700: Keyboard Unit.
3. Jay-El Products Mark 11 P/N 10648 pamphlet.
4. OMI V5L11: Orbiter Keyboard Unit Removal/Installation.
5. Flight rules A2-105 and A7-109.
6. DPS Systems Brief, Section 4.



NOTE: THESE P/N'S ARE IBM P/N'S. PARTS MAY ALSO HAVE P/N'S FROM MANUFACTURER

22673KEYK. ART; 3

Figure 5.22-1. Keyboard key configuration



226730020. ART; 5

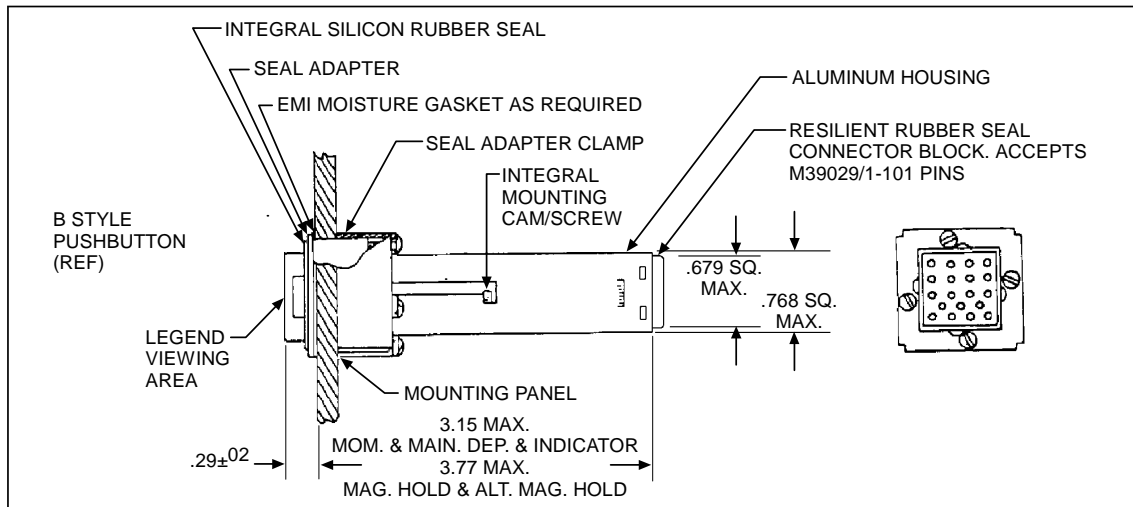
Figure 5.22-2. Keyboard key changeout



JAY-EL PRODUCTS

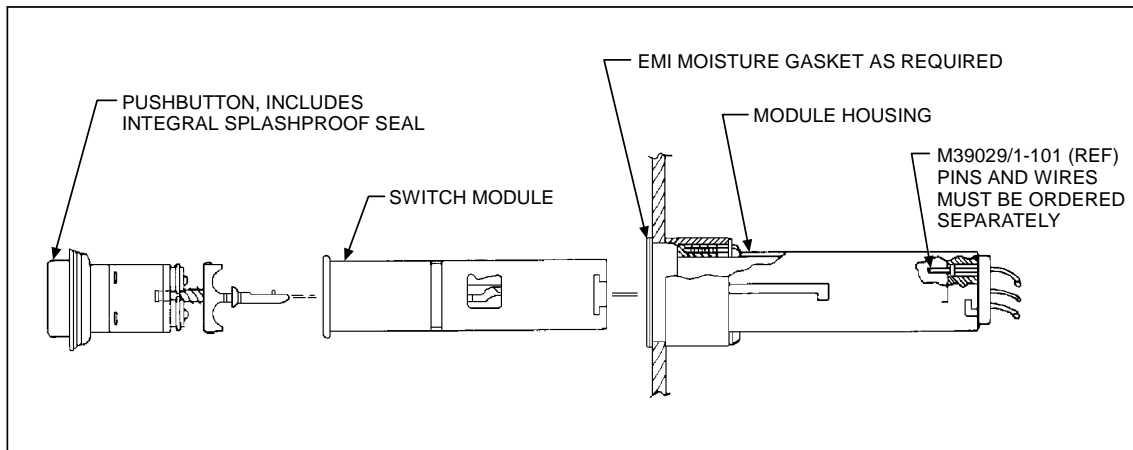
MARK 11 P/N 10648

MAJOR OUTLINE DIMENSIONS INTEGRAL
SEALED TYPE III
Single station mounting
SEALED TYPE III ASSEMBLED



VIEW SHOWING FRONT PANEL REMOVABILITY

Switch body may be replaced from front of panel without un-wiring



Tolerance: Unless otherwise specified-Fraction $\pm 1/32$ ",
XX $\pm .01$, XXX $\pm .005$

jsc_22673_050.cnv

Figure 5.22-3. JAY-EL products data sheet

5.22-4

Verify that this is the correct version before use

TITLE

KEY PBI CHANGEOUT (ORBITAL DAP TYPE)

SUMMARY

Replace a failed PBI with an operational spare (normally the ABORT key).

1. Remove failed key and spare key.
2. Install spare in failed location.

BACKGROUND

Three types of push-button switches are found in the orbiter fleet. All are described in the Rockwell procurement specification ME452-0061-XXXX. They are as follows:

- Type IV - Part numbers ME452-0061-4135 through -4139 are 2-pole switches. These are found only on the OV-102 O6 panel. The PBIs in these switches are larger than the other two types and can only be swapped with another type IV switch PBI.
- Type V - Part numbers ME452-0061-4XXX (excluding -4135 through -4139) and part numbers ME452-0061-7XXX are 4-pole switches. The -4XXX switches have solder pot terminals; the -7XXX switches use the integrated wire termination system (IWTS). This difference affects the installation of the switch body only and has no bearing on performing a PBI swap. (The -4XXX switches are found primarily on OV-102, but some have been replaced with -7XXX switches. The other three vehicles will primarily have -7XXX switches, but some of these may have been replaced with -4XXX switches.) The PBI can be swapped with any other Type V switch PBI or with a Type VIII switch PBI.
- Type VIII - Part numbers ME452-0061-9XXX are enunciators (contain no switches). They, too, are either solder pot terminals (-90XX) or IWTS (-91XX). (Again, the solder pot terminals are found primarily on OV-102.) The annunciation PBIs can be swapped with any other Type VIII PBI or with a Type V switch PBI.

The bases of these switches are installed and wired from behind the panel faces and are thus not removable in flight (unlike keyboard push-button switches). Therefore, the differences between solder pot terminal installations and the IWTS installations are transparent to the crew and do not in any way affect performing this IFM.

The illumination of the PBI switch legend is a result of panel wiring and PBI lamp installation.

The PBIs can be of three different classes and several different styles. The -XXXX will determine the class and style of an individual part.

Type IV switches are all class 2 - lighted legend.

Type V and VIII switches can be either class 3 - lighted indicator grid, or class 4 - lighted legend. See Figure 5.23-1.

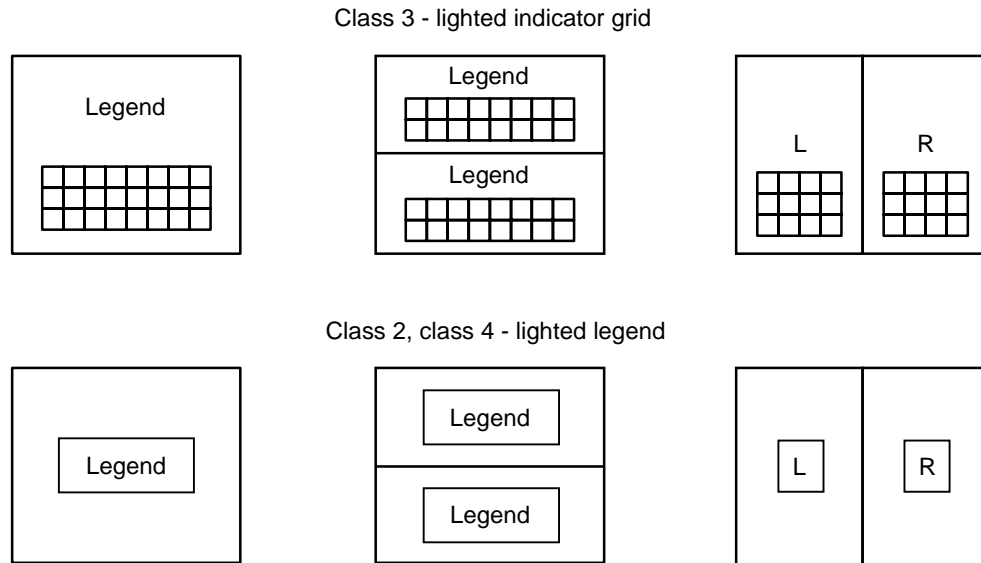
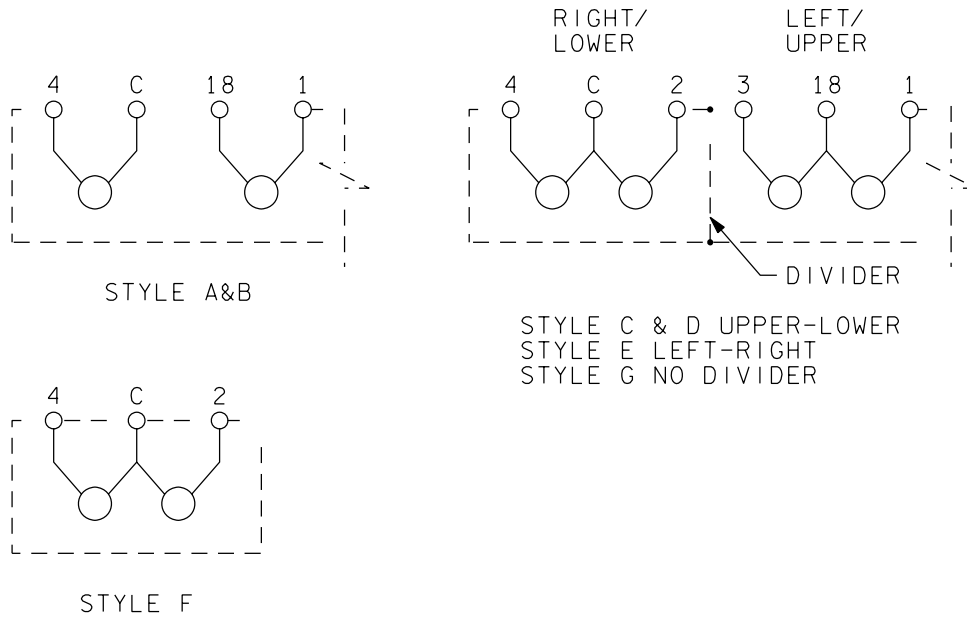


Figure 5.23-1. PBI classes

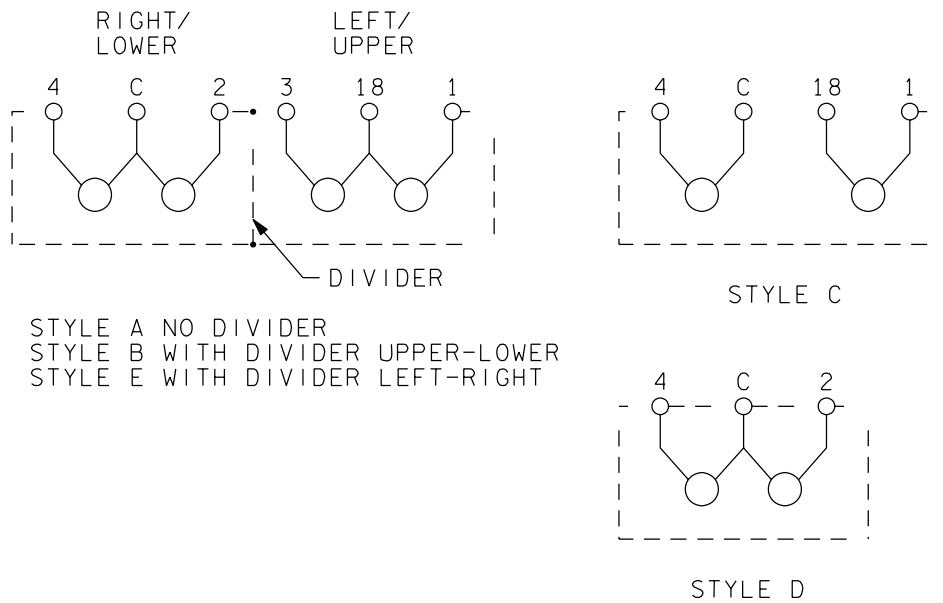
The style determines whether the PBI is standard, upper/lower, or right/left. Style also determines how the light bulbs are wired. See Figure 5.23-2.

Because the switch functions are determined by the internal panel wiring, and the PBIs can be interchanged regardless of class or style, the swapping of PBIs can cause confusing indications. It may, therefore, be desirable to use a “spare” PBI with an identical class and style, and even an identical legend.

TYPE IV OR V PUSHBUTTONS



TYPE VII ANNUNCIATOR ONLY



22673KEYP. ART 4

Figure 5.23-2. PBI styles

The following panels contain push-button switches:

Panel	DAP type keys	Annunciators
F2	6	1
F4	6	1
F6	4	1
F7	-	4
F8	3	-
C3	29	-
L1	3	-
A6U	25	-
A7U	27	-
O6	5	7
Total	108	14

REFERENCES

1. Procurement Spec. - ME452-0061
2. Drawings
 - VO70-730400 panel F2
 - VO70-730402 panel F4
 - VO70-730255 panel F6
 - VO70-730256 panel F6A1
 - VO70-730257 panel F6A5
 - VO70-730259 panel F6A8
 - VO70-730263 panel F8
 - VO70-730265 panel F8A5
 - VO70-730267 panel F8A
 - VO70-730281 panel C3A1
 - VO70-730284 panel C3A6
 - VO70-730285 panel C3A7
 - VO70-730353 panel A6A1
 - VO70-730356 panel A7A1
3. Manufacturer: Jay-El Products, Gardena, CA

TITLE

KU-BAND ANTENNA IFM PROCEDURES

1. Ku-band antenna contingency deploy/stow - failed deploy/stow switch.
2. Ku-band antenna contingency stow - EA1 alternate power.
3. Ku-band antenna contingency stow - gimbal lock.

INTRODUCTION

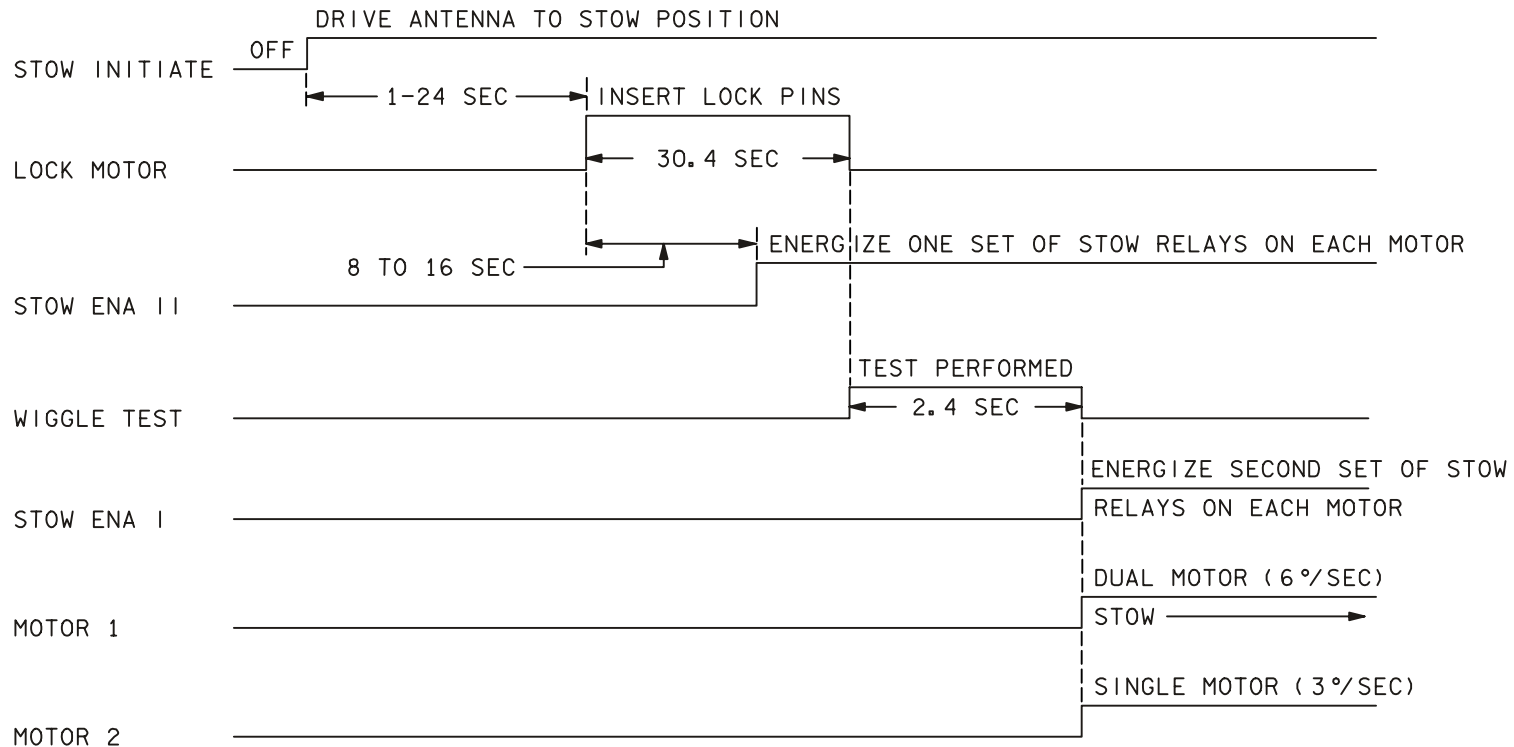
Ku-Band Antenna Stow Sequence

The following is a summary of the nominal stow sequence. When the deploy/stow switch on panel R13 is taken to the stow position, a stow initiate signal is generated, and the following events take place:

1. The servo-system drives the antenna to the stowed position:

Azimuth +125.0
Elevation - 29.0
2. The alpha and beta gimbal locking pins are inserted (each gimbal lock has one lock pin, one motor, and one micro-switch).
3. With both gimbals locked, a boom stow enable II signal (hardware driven) is sent to MMC2 and MMC4 which energizes one stow relay on each motor.
4. A 2.4-second wiggle test is performed (this drives the antenna in the positive alpha and beta directions for 1 second, and then in the negative directions for 1 second). This assures that the gimbals are locked.
5. If the wiggle test passes, the gimbal motors are turned off and a boom stow enable I signal (software driven) is initiated.
6. The boom stow enable I signal applies a direct current to the relay drivers; this procedure energizes the second set of deploy relays in MMC2 and MMC4 and stows the Ku-band antenna.

See Figure 5.24-1.



226732KUB. ART# 2

Figure 5.24-1. Stow sequence timeline

5.24-2

Verify that this is the correct version before use

TITLE

KU-BAND ANTENNA, CONTINGENCY DEPLOY/STOW - FAILED DEPLOY/STOW SWITCH

SUMMARY

This procedure bypasses a failed deploy/stow switch on panel R13L and deploys or stows the Ku-band antenna (single motor drive) using the IFM breakout box and pin kit (Figure 5.25-1).

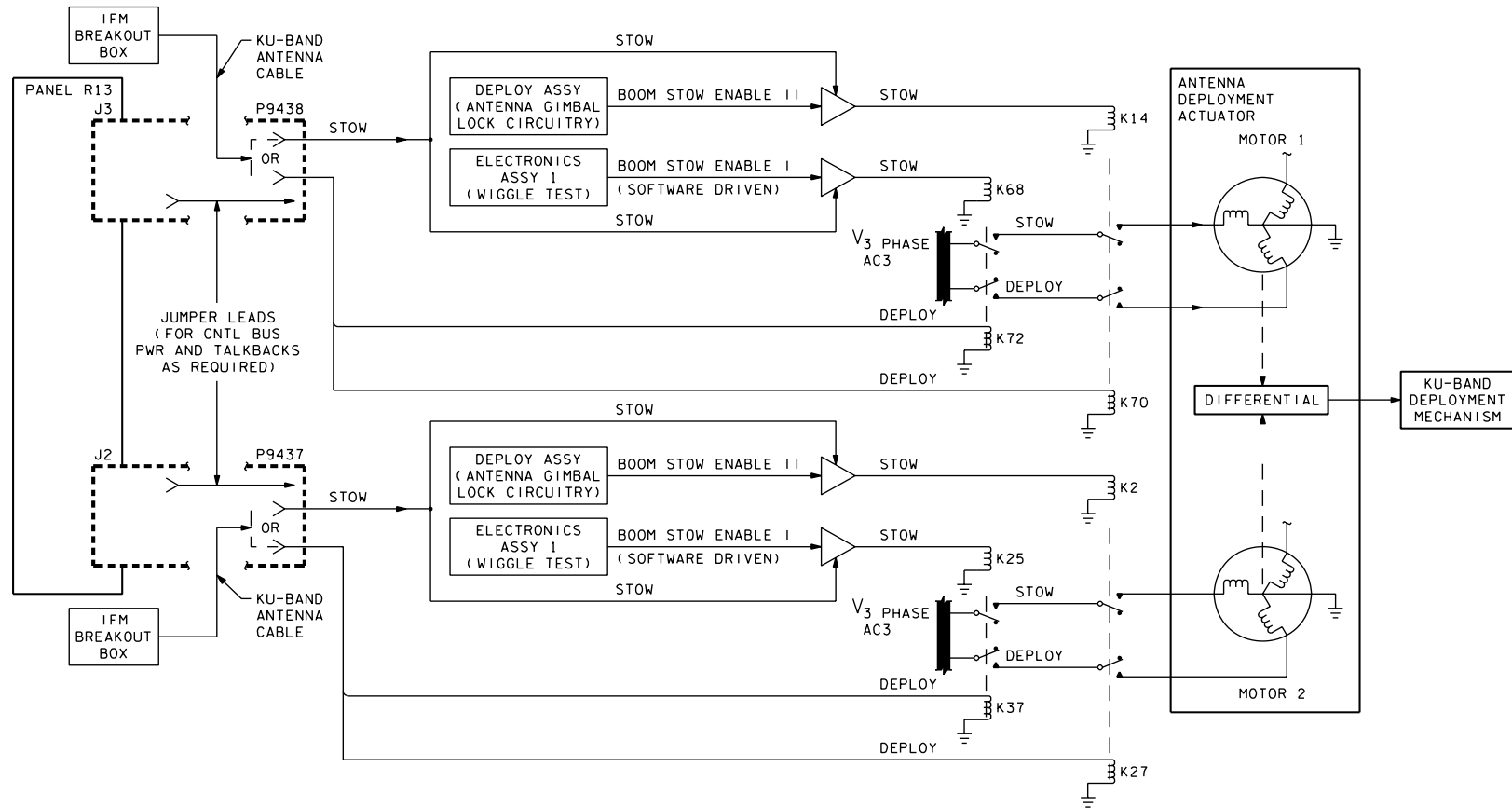
1. Power down and open panel R13L.
2. For motor 1 operation, disconnect cable from J3 (for motor 2 operation, disconnect cable from J2) on the back of panel R13L.
3. Configure the IFM breakout box, dc harness cable, Ku-band antenna cable, and test jumper leads to deploy or stow the Ku-band antenna (per the IFM checklist).
4. Using the switches on panel R13L and the dc utility outlet, stow or deploy the Ku-band antenna (single motor drive time, 46 seconds).
5. Power down and remove jumper leads, breakout box, etc.
6. Reconnect cable behind R13L and close panel.

FAILURE

Panel R13L DPY/GND/STO switch failure.

BACKGROUND

This procedure makes use of the Ku-band antenna cable that is stowed as part of the IFM pin kit. The cable was originally intended to move the antenna using dual motors. The IFM procedure was changed for single motor ops to minimize the risk of damaging a deploy/stow system. As a result, two of the IFM Ku-band antenna cable leads will not be used. The cable is pre-manufactured to save time on orbit should this procedure be required. The crew has the capability to manufacture a similar cable on orbit, but a Ku-band antenna stowage problem prevents payload bay door closure, and any time saved in performing the IFM procedure may prevent a delay in entry. This procedure is largely obsolete since the addition of the Ku-band antenna direct stow switch panel R13 (two separate switch failures would be required before the antenna could not be stowed). Using this procedure to deploy the antenna would normally not be considered unless the use of the antenna was deemed critical.



22673KUBA. SCH. 3

Figure 5.25-1. Ku-band antenna contingency deploy/stow

5.25-2

Verify that this is the correct version before use

NOTES

1. MECH MAL 9.3a Non-DEPLOY OR MECH MALF 9.3b Non-STOW.
2. Assumes failed deploy/stow switch.
3. Provides option to deploy or stow using either motor 1 or motor 2.
 - (a) MOTOR 1 operations are performed by using JACK/PLUG. J3/P9438
 - (b) MOTOR 2 operations are performed by using JACK/PLUG. J2/P9437
4. STOW Mode used different relays than DEPLOY Mode to change the phase relationship of the 3-phase ac power to the motor. (Allows the motor to drive in the opposite direction.)
5. The test jumper leads and Ku-band antenna cables connect to different pins sockets depending on whether the Ku-band antenna is being deployed or stowed.
6. In all cases:
 - (a) Test jumpers between the panel JACK and PLUG provide control signals to operate the motors or regain deploy/stow talk-backs.
 - (b) Auxiliary 28 V dc power from panel 019 via the IFM breakout box and Ku-band antenna cable closes the appropriate relays providing ac 3-phase power to operate the drive motors
 - (c) Only single motor operation will be performed.
7. On panel R13L:
 - (a) If PLUG P9348 is removed, you can still direct stow (switch 12) using motor 2 (through JACK J2).
 - (b) If PLUG P9347 is removed, you can still direct stow (switch 12) using motor 1 (through JACK J3).

REFERENCES

1. Flight rule A10-303
2. MECH MALF 9.3a Non-DEPLOY or MECH MALF 9.3b Non-STOW
3. Mechanical Systems Console Handbook, Volume II, Section 2.15, Ku-Band Antenna Deployment Subsystem
4. Orbit Operations Checklist

TITLE

KU-BAND ANTENNA, CONTINGENCY STOW - EA1 ALTERNATE POWER

SUMMARY

Bypasses a failed deploy/stow switch on panel R13L and deploys or stows the Ku-band antenna (single motor drive) using the IFM breakout box and pin kit. Refer to Figure 5.26-1.

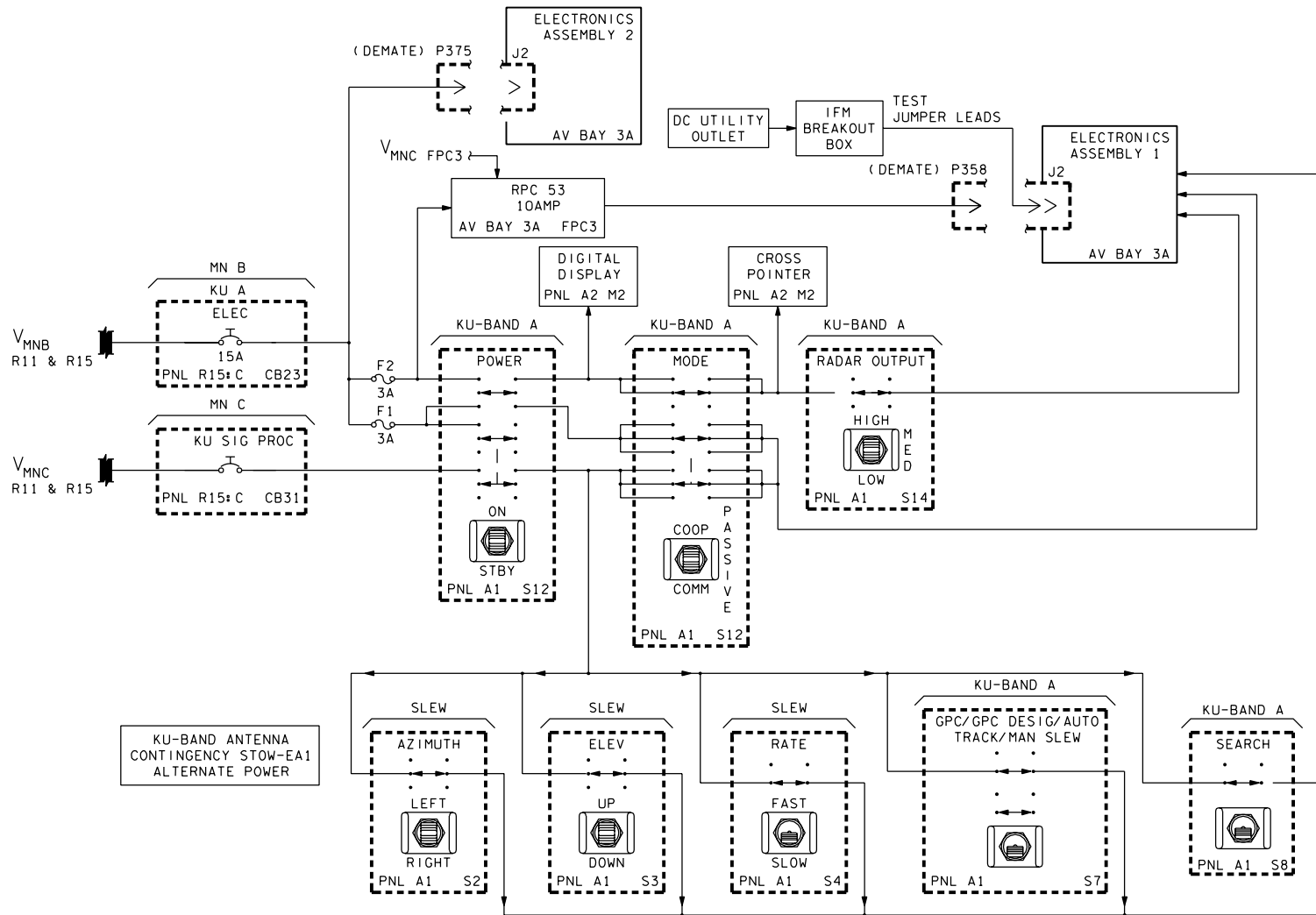
1. Power down and open panel R13L.
2. For motor 1 operation, disconnect cable from J3 (for motor 2 operation, disconnect cable from J2) on the back of panel R13L.
3. Configure the IFM breakout box, dc harness cable, Ku-band antenna cable, and test jumper leads to deploy or stow the Ku-band antenna (per the IFM checklist).
4. Using the switches on panel R13L and the dc utility outlet, stow or deploy the Ku-band antenna (single motor drive time, 46 seconds).
5. Power down and remove jumper leads, breakout box, etc.
6. Reconnect cable behind R13L and close panel.

FAILURE

Panel R13L DPY/GND/STO switch failure.

BACKGROUND

This procedure makes use of the Ku-band antenna cable that is stowed as part of the IFM pin kit. The cable was originally intended to move the antenna using dual motors. The IFM procedure was changed for single motor ops to minimize the risk of damaging a deploy/stow system. As a result, two of the IFM Ku-band antenna cable leads will not be used. The cable is pre-manufactured to save time on orbit should this procedure be required. The crew has the capability to manufacture a similar cable on orbit, but a Ku-band antenna stowage problem prevents payload bay door closure, and any time saved in performing the IFM procedure may prevent a delay in entry. This procedure is largely obsolete since the addition of the Ku-band antenna direct stow switch panel R13 (two separate switch failures would be required before the antenna could not be stowed). Using this procedure to deploy the antenna would normally not be considered unless the use of the antenna was deemed critical.



22673KUBB. SCH. 4

Figure 5.26-1. EA1 contingency power schematic

5.26-2

Verify that this is the correct version before use

REFERENCES

1. Flight rule A10-303
2. MECH MALF 9.3a Non-DEPLOY or MECH MALF 9.3b Non-STOW
3. Mechanical Systems Console Handbook, Volume II, Section 2.15, Ku-Band Antenna Deployment Subsystem
4. Orbit Operations Checklist

TITLE

KU-BAND ANTENNA, CONTINGENCY STOW - GIMBAL LOCK

SUMMARY

Lock the Ku-band antenna gimbal pins using the jumper wires and the IFM breakout box as a source of 14 V dc, bypassing EA1, and sending the lock command directly to the antenna gimbal pins.

PROCEDURE

1. Access Ku-band EA1 in Av bay 3A by removing volume B and Av bay 3A upper close-out.
2. Power down Ku-band EA1.
3. Disconnect cable from J3 on EA1.
4. Set up the IFM breakout box, multimeter, and pin kit test jumper leads to power the antenna gimbal lock drive circuit (14 V dc).
5. Stow the Ku-band antenna.
6. Power down the IFM breakout box; disconnect the test jumper leads; and reconnect the cable to J3 on EA1.
7. Reinstall the debris traps, lockers, close-outs, and volume B.

See Figure 5.27-1.

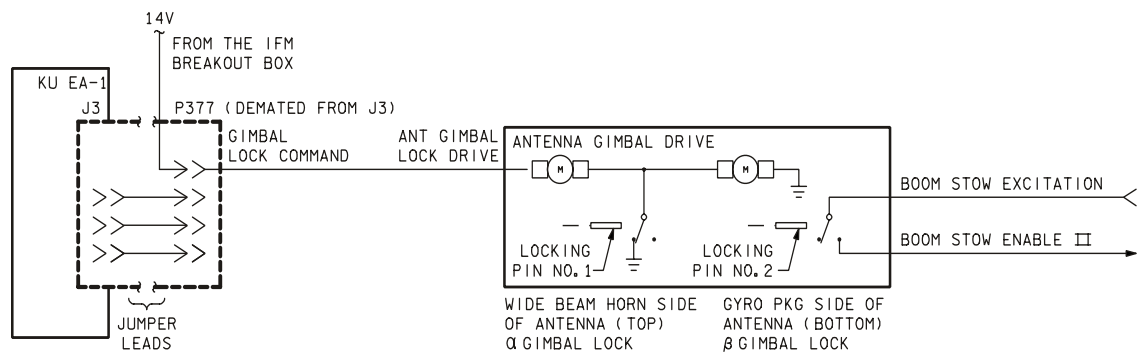


Figure 5.27-1. Ku-band contingency gimbal lock

FAILURE

KU-BAND ANTENNA GIMBAL LOCK EA1 COMMAND PATH FAILURE.

BACKGROUND

This procedure was accomplished on STS-41-G. The EA1 antenna drive unit was randomly driving the antenna. The antenna drive unit was disabled by pulling a cable. This left the antenna in a stationary position, and the antenna was pointed by maneuvering the vehicle. However, this left the crew unable to position the dish, or lock the gimbal pins prior to antenna stow. During a planned EVA, two crewmembers (Leestma and Sullivan) manually positioned the dish, while a third crewmember (Ride) used jumper leads to send the lock command to the dish. At the time, there was no IFM breakout box, and consequently no source of 14 V dc; 28 V dc power was used to drive the pins. To prevent the 28 volts from damaging the drive circuitry, power was only applied for 1-second duration's.

There was some difficulty in removing volume B. Once the retaining pip-pin was removed, the crew had to strike volume B with the deadblow hammer to free its mounting pins from their bearings.

REFERENCES

1. Flight rule A10-303
2. MECH MALF 9.3a Non-DEPLOY or MECH MALF 9.3b Non-STOW
3. Mechanical Systems Console Handbook, Volume II, Section 2.15, Ku-Band Antenna Deployment Subsystem
4. Orbit Operations Checklist

TITLE

LEAK SEALING – VACUUM

PROCEDURES

This procedure provides general guidelines for sealing a Orbiter cabin leak. An assumption is made that the most likely location of a leak would be areas around windows, hatches, vent valves, and penetrations of the fwd/aft crew module bulkheads.

1. Determine leak location.
2. Stop leak using Duxseal (a putty like sealant) and tape, and/or Foam Applicator which is a Room Temperature Vulcanizing (RTV) foam.

FAILURES

Crew module leaks including the following:

1. Damaged O-rings around cabin penetrations
2. Over torque bolt resulting in fracture of bolt or plate
3. Damaged pin or socket on an electrical connector
4. Micrometeorite penetrations

BACKGROUND

Duxseal and tape are considered the prime medium of repair for potential Orbiter cabin leaks on-orbit. Duxseal has been vacuum tested to seal a leak source up to $\frac{1}{8}$ -in. diameter. Vacuum chamber testing of the Foam Applicator RTV foam worked best on electrical connector leaks. The initial low viscosity of the RTV foam can penetrate the connector wire bundle.

NOTES

Duxseal is a Talc Chlorinated Paraffin and Mineral Wool Diatomite putty material. The method of application of Duxseal and tape is in laminate layers beginning with Duxseal, tape, Duxseal, tape, etc. ... for several redundant layers.

The Foam Applicator is a black two part RTV closed-cell silicone foam with a plunger type applicator. The applicator must be in close proximity to the area being sealed to prevent dispersion of the sealant into the cabin area. If the mixture is not sufficiently viscous, wait approx. 10 seconds and begin application again. However, the RTV closed-cell silicone foam will completely set up in approx. 68 seconds and cures in approx. 20 minutes. Mixing procedure for the RTV foam applicator is located in the IFM Checklist.

REFERENCES

1. Drawing V070-331002, Primary Structure Assembly – Crew Module

TITLE

LEAK DETECTOR ULTRASONIC

PROCEDURES

This procedure uses Ultrasonic Leak Detector (ULD) to locate gas leaks. The ULD is an ultrasound diagnostic tool that detects ultrasound in a narrow frequency band centered at 40,000 Hz. The ULD kit consists of:

- Receiver with attachments
- Headphones
- Transmitter

The receiver detects ultrasound and converts it so that humans can hear the corresponding sound through the headphones. The user is able to pinpoint the source of the ultrasound because the receiver has directional reception. The headset also serves to reduce or mask out ambient sound. The user can then better concentrate on the converted ultrasound - indicating pressure or vacuum leaks, electrical discharge, and the condition of working components. The ULD identifies defects while equipment is operating. It is non-destructive and non-invasive.

1. Install batteries in Transmitter and Receiver
2. Turn Transmitter and Receiver -ON
3. Set volume of Receiver
4. Turn Transmitter - OFF
5. Gain Access to area being leak checked
6. Connect appropriate attachment
7. Point ULD Receiver 90 to 180 degrees away from area being leak checked
8. Adjust gain knob until background noise is barely audible
9. Sweep ULD as close as possible past area being leak checked. Check for leak from several orientations to determine potential leak location
10. If any leaks located, mark with Gray Tape.

FAILURES

Applications include:

1. Pressure leaks in fluid and gas lines
2. Hatch or window seal integrity
3. Pinpoint pressure hall leaks to vacuum
4. Locate leaks in cooling system ducting
5. Identify arcing in motors
6. Checking for bad bearings

BACKGROUND

Ultrasound is sound with a frequency above the human hearing range. Humans can hear sound with frequencies between 20 Hz (Hertz) and 20,000 Hz. Ultrasound is all sound above 20,000 Hz and cannot be heard by humans.

All sound is the movement of pressure variations through a medium (solid, liquid or gas). Sound is created when there is

- Vibration
- Impact
- Turbulence
- Friction
- Electrical arcing or corona discharge

The primary properties of ultrasound that make it useful for diagnostic tools are the following:

- Higher frequency and accordingly shorter wavelength (The ULD detects ultrasound centered at 40,000 Hz with a wavelength in air of approximately 0.33 inch.)
- Ultrasound waves attenuate more quickly than sound waves (do not travel as far).
- Ultrasound waves in air can be easily shielded and do not travel around corners well.
- Narrow angle directional reception of airborne ultra-sound can be obtained with relatively small dimensions of the receiver's sensor.

These properties allow the user to distinguish and isolate the ultrasound of individual components and leaks. Operating equipment usually produces ultrasound all the time, but the intensity, frequency and shape of the resulting ultrasonic waves are in correlation to equipment operating conditions. Sources of ultrasound include bearings, valves, cylinders, pumps, actuators, gears, pressure and vacuum leaks, and electrical arcing or discharge.

NOTES

If gain control knob is turned too far (cw), ultrasonic background noise may be very loud. To avoid injury to hearing, do not don headphones until the transmitter is turned on. Do not point receiver directly at transmitter at distances closer than 10 feet. The Transmitter is very powerful and close proximity between the two could damage the ULD. When extension probes used, plastic probe end must always be at end of extension length to mitigate chances of electrical shock should an electrical source be contacted by probe extension. When used, entire length of aluminum probes must be visible at all times.

HISTORY

The Ultrasonic Leak Detector (ULD) arrived on the ISS in July of 2001 (ISS-7A). Immediately after its arrival, the Expedition 2 crew used the tool to detect a leaking valve in the newly installed airlock. Flight Engineering-CB/James Voss, was able to quickly find the leak with little instruction by MCC-H and no formal training to use the device. Astronauts aboard the ISS have expressed their satisfaction and enthusiasm for the tool.

REFERENCES

- ISS IFM/7A – All/FIN 1: D.5 Ultrasonic Leak Detection - Generic

TITLE

LIGHT BULB CHANGEOUT

PROCEDURES

Place a failed annunciator light bulb with a light bulb from an unused position (includes C&W F7 matrix lights).

1. Power down the affected light bulb (both failed unit and spare location).
2. Using the jewelers screwdriver, carefully pry the annunciators from the panel. (Note: Some annunciators have ground straps.)
3. Carefully pry the light bulbs from the units and swap.
4. Replace annunciators and power up.

FAILURE

Annunciator light bulb failure

BACKGROUND

The light bulbs in both the keyboard unit keys and the DAP type keys are interchangeable with the light bulbs in the annunciators. The abort annunciator is a good candidate for the source of the spare since this annunciator is not used after post-insertion.

Jay-El Products. Inc., Microlite part number 30268:

Type	Volts	Amps (± 10 percent)	Avg life (hr)
13	28.0	0.024	16,000

TITLE

LOCKERS - MISALIGNED (MOUNTING SCREWS WILL NOT START)

PROCEDURES

Procedure uses pinch bar/screwdriver to position locker for ease of installation or to close and latch locker doors.

FAILURES

Locker doors will not close, or lockers will not mount to Av bay.

BACKGROUND

On orbit, the delta pressure across the orbiter structure results in deformation of the locker-mounting surface. This results in the doors misaligning, preventing normal closing and latching or, following locker removal, it prevents reinstallation.

Structural recommendation for locker removal:

1. No more than three in a row should be removed in a single Av bay.
2. No more than four in a square should be removed in a single Av bay.

Structural requirements for locker replacement:

1. Three of four locker-mounting fasteners must be made.
2. Only one fastener may be omitted in any horizontal row of locker fasteners for each Av bay.
3. The lower starboard fastener of locker MF430 and the lower port fastener of locker MF570 must be made (i.e., if these lockers are removed, begin installation with these fasteners).

Note: These two lockers must be removed for accessing payload (PL) multiplexers/demultiplexers (MDMs.)

If lockers cannot be installed:

1. A maximum of one locker may remain un-installed in each Av bay.
2. Certain other combinations will support landing load requirements but not crash load requirements. For real-time cases where lockers cannot be reinstalled, an analysis of the impact should be requested from the MER.
3. Turnbuckles may be used if a locker cannot be installed.

The worst case would have four lockers in a square removed and be unable to install any of them. Three turnbuckles are manifested for this worst case. The turnbuckles are installed in the places of three of the four removed lockers, leaving one location with no structural support. The turnbuckles have adjustable spars to compensate for the deformation of the locker-mounting surface.

Beginning with STS-30, all middeck lockers have had a redesigned door. The new door has a floating hinge and ball bearing type locking latches. With this new design, there have been no problems with closing/latching doors. Therefore, this procedure is now primarily concerned with reattaching lockers to the Av bays.

REFERENCES

1. CCCD SGD32100938
2. M072-661612

TITLE

MA73 WIRE CUT

PROCEDURES

Isolates a single phase AC bus short between the inverter and panel MA73C from three phase motors so other two good phases can be used.

1. Check that the affected AC bus phase has been powered down, and all cbs for affected phase as well as all applicable 3 Φ ganged cbs on MA73C are open.
2. Open the Av Bay 3B upper access panel and locate the appropriate connector and wire bundle for the affected bus using the following table:

	Connect or	Wire ID	Φ A	Φ B	Φ C	Neutral
AC1	P9711 (J1)	1A7B1 2	One Stripe	Two Stripes	Three Stripes	Four Stripes
AC2	P9713 (J3)	2A7B1 2	One Stripe	Two Stripes	Three Stripes	Four Stripes
AC3	P9715 (J5)	3A7B1 2	One Stripe	Two Stripes	Three Stripes	Four Stripes

3. Cut the applicable wire approximately 5 inches from the connector backshell.
4. Using multimeter, check for continuity between connector backshell and wire (see Figure 5.32-1 below):

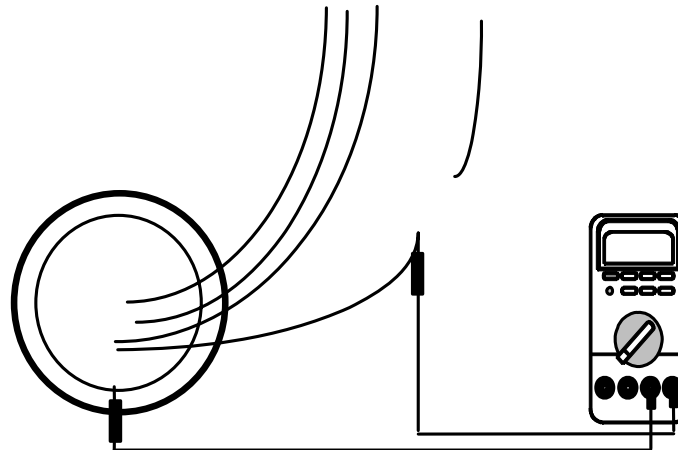


Figure 5.32-1. Multimeter continuity check between backshell and wire

5. If multimeter indicates continuity between connector backshell and wire, a panel short exists in MA73C and the MCC should be consulted before performing any further actions; however, if no continuity is indicated, proceed.
6. After taping over the exposed wire ends, close the Av Bay 3B upper access panel.
7. Close all three Φ ganged cbs on MA73C for affected as bus:

<u>AC 1 (5 cb's)</u>	
MA73C:C	cb MCA PWR AC1 3 Φ FWD 1 - cl MID 1 - cl
MA73C:D	cb MCA PWR AC1 3 Φ AFT 1 - cl MID 3 - cl
MA73C:F	cb AC1 MAR 3 Φ - cl

<u>AC 2 (9 cb's)</u>	
MA73C:C	cb MCA PWR AC2 3 Φ FWD 2 - cl MID 1 - cl MID 2 - cl
MA73C:D	cb MCA PWR AC2 3 Φ AFT 2 - cl MID 3 - cl MID 4 - cl
MA73C:E	cb AC2 PL 3 Φ - cl
MA73C:F	cb AC2 L SEAT 3 Φ - cl
MA73C:G	cb AC2 R SEAT 3 Φ - cl

<u>AC 3 (7 cb's)</u>	
MA73C:C	cb MCA PWR AC3 3 Φ FWD 3 - cl MID 2 - cl
MA73C:D	cb MCA PWR AC3 3 Φ AFT 3 - cl MID 4 - cl
MA73C:E	cb AC3 PL 3 Φ - cl
MA73C:F	cb AC3 L SEAT 3 Φ - cl
MA73C:G	cb AC3 R SEAT 3 Φ - cl

FAILURE

Single phase AC bus short located between the inverter and panel MA73C.

BACKGROUND

Because no circuit protection (or means of isolation) is located between the inverter and panel MA73C, the entire AC bus is affected due to the fact that the output side of panel MA73C routes all three phases of an AC bus through a single or ganged circuit breaker. Hence, the single, shorted AC phase would also effectively render the two good AC phases (or that entire AC bus output from MA73C) as useless unless the shorted phase can be isolated prior to entering MA73C. Cutting the suspect AC wire as it enters MA73C isolates the shorted bus from the other two good phases, and allows those two remaining phases to be used. The success of this procedure is dependent on the short being located between the inverter and panel MA73C - if the short is located in the panel itself (as evidenced by continuity between the connector backshell and the cut wire), the procedure will not be successful. For that case, every effort will be made to identify and isolate the suspect wire (or wires) on the output side of panel MA73C.

NOTES

Flight rules define the loss of an AC bus as a PLS call because the next electrical failure will result in the inability to perform PLBD opening/closing (zero fault tolerant). As mentioned previously, the loss of a single phase of AC power between the inverter and panel MA73C results in the loss of the entire affected AC bus due to the ganged nature of the AC phases on the output side of the panel. However, for this particular failure scenario, the IFM procedure can be considered as a second level of redundancy, and negates the PLS call for loss of an AC bus as the procedure should be able to restore 2 of the 3 phases of the affected AC bus.

REFERENCES

1. Rockwell Drawing VS70-733892, sheets 3, 5, and 7
2. BNA Electronic Notebook for the following connectors: 85P9711, 85P9713, and 85P9715

TITLE

MDM CHANGEOUT

PROCEDURES

Replace a failed MDM with an operational spare to regain critical MDM functions. This procedure either replaces a failed MDM flight forward (FF) 1(2, 3) with FF4 or swaps PL MDM's (PL1 with PL2).

1. Power down affected components
2. Access failed MDM and spare MDM
3. Remove connectors and tape out of the way
4. Loosen MDM mounting fasteners
5. Remove failed MDM using coldplate protective covers
6. Remove spare MDM and install in new location using cold plate protective covers
7. Stow failed MDM in spare location
8. Reinstall mounting fasteners
9. Reinstall connectors
10. Reinstall thermal debris traps, lockers, and volumes

FAILURES

- | | |
|----------|--|
| FF MDM's | Loss of an MDM (FF1, FF2, or FF3) that results in the loss of a second IMU, second (AA) (AA4 must be failed), or a second NSP |
| PL MDM's | Loss of a PL MDM (PL1 or PL2) accompanied by the loss of any payload bay door (PLBD) motor control assembly (MCA), which is controlled by the remaining PL MDM |

BACKGROUND

MDM's will be considered lost only after power cycling and port moding fail to clear a non-GPC caused "I/O Error FF1 (2, 3)" or "I/O Error PL1 (2)."

NOTES

PL MDM's will not be changed out for mission success. Because of the risk of damaging pin connectors, they will be swapped only if necessary to close the PLBD's. This presupposes that pin kit procedures would not be necessary to close the PLBD's once the swap is completed. If pin kit procedures would be necessary after the changeout, PLBD IFM procedures would be used instead of the swap.

FF MDM's are changed out if the failure has resulted in a potential loss of fail safe redundancy in an entry-critical system.

REFERENCES

1. Flight rule A2-105
2. Drawings for OV-102.
 - a. V070-703000, avionics equipment installation.
 - b. V070-703002, Av bay 1.
 - c. V070-703011, Av bay 2.
 - d. V070-703013, Av bay 3A.
3. Drawings for OV-103.
 - a. V070-703004, avionics equipment installation.
 - b. V070-703003, Av bay 1.
 - c. V070-703006, Av bay 2.
 - d. V070-703013, Av bay 3A.
4. Specification drawing MC615-0023 MDM's.

TITLE

MEDS IDP CHANGEOUT AND CABLE SWAP

PROCEDURES

Replace failed IDP 1, 3 (2) w/IDP 4. IDP 1 (3) will be changed out w/IDP 4, while only cables from IDP 2 will be connected to IDP 4.

Failure of either IDP 1 or IDP 3 requires physically swapping the box with IDP 4.

1. Power down affected IDP's
2. Access failed IDP and IDP 4
3. Change out IDP's/or swap cables
4. Perform checkout

FAILURE

- IDP 1 or 3 hard failed (IDP changeout)
- IDP 2 hard failed (cable swap)

BACKGROUND

This procedure was visually verified at Palmdale (OV-104) by VPB and LJR.

NOTES

IDPs and DEUs basically perform the same tasks and are installed in the same orbiter locations. IDPs interface the MDUs (refer to table below) and DEUs interface with the CRTs.

	CDR1	CDR2	CRT1	CRT2	CRT3	MFD1	MFD2	PLT1	PLT2	CRT4	AFD1
IDP1	X	X	X				X	X			
IDP2		X		X		X		X	X		X
IPD3	X				X	X	X		X		
IPD4										X	X

REFERENCES

V070-703905	IDPs 2 & 4
V070-703915	IDPs 1 & 3
V070-793225	IDPs 2 & 4 electrical connections
V070-793215	IDPs 1 & 3 electrical connections
V070-703260	Debris Filters

- Flight rule A7-109

TITLE

MEDS KEYBOARD CHANGEOUT

PROCEDURES

Replace failed fwd MEDS Keyboard w/aft Keyboard

1. Power down affected forward keyboard and the aft keyboard
2. Access and remove the failed keyboard
3. Install the aft keyboard in the forward station
4. Stow failed forward keyboard in the aft station
5. Perform keyboard checkout

FAILURE

CDR's or PLT's keyboard unit

BACKGROUND

There are three keyboards. The forward (CDR's and PLT's) are on panel C2 and the aft keyboard is on panel R12.

NOTES

Replacing a failed forward keyboard assures two good keyboards for entry. The following are the keyboard interfaces.

	CDR 1	CDR2	CRT1	CRT2	CRT3	MFD1	MFD2	PLT1	PLT2	CRT4	AFD1
LT K/B	X	X	X		X	X	X	X	X		
RT K/B	X	X		X	X	X	X	X	X		X
AFT K/B										X	X

REFERENCES

VT70-730023	Kybd Installation
VT70-730026	Kybd Installation
VS70-730222	R.H. Keyboard
VS70-730229	L.H. Keyboard
VS70-730229	MS Keyboard

- Flight rule A7-109

Keyboard lighting - The keyboards are power by the following panels

L.H (CDR)	O6 INST LEFT/CTR (ROTARY SWITCH R5)	VS70-73022/1 ZONE 18C
R.H. (PLT)	O8 RIGHT INST (ROTARY SWITCH R4)	VS70-730222/2 ZONE 32C
MSS	R10A2 MS LTG PNL (ROTARY SWITCH R4)	" ZONE 43A

VS70-730229 SCHEMATIC DIAGRAM-INSTRUMENT/NUMERIC LIGHTING
SUBSYSTEM is for OV104, 103, 105. √ EO or NOTES in first sheet.
VS70-730222 SCHEMATIC DIAGRAM-INSTRUMENT/NUMERIC LIGHTING
SUBSYSTEM is for OV-102. √ EO or NOTES in first sheet.

TITLE

MEDS MDU CHANGEOUT

PROCEDURES

Replace failed MDU w/operational MDU

1. √ MCC FOR MDUS TO BE SWAPPED
2. Power down appropriate MDUs
3. Remove appropriate MDUs
4. Installed MDUs in their appropriate location (determined in step 1)
5. Perform MDU checkout

FAILURE

Any MDU can be replaced with any other MDU (FR # A2-105)

BACKGROUND

All the MDUs are installed in the same manner. Therefore, the removal of any of the forward or the aft MDUs will be the same. The MDUs are removed by pulling the unit out until cables are taut, reaching behind the box and demating the connectors (the cables behind the MDUs have enough slack to allow this technique).

The MDUs in the CRT 1, 2, and 3 positions have a shorting plug on the J2 receptacle that will have to be reinstalled to regain normal ops on that MDU.

REFERENCES

VS70-730182	Diagram Display & Controls
VS70-733065	Panel F8
VS70-733005	Panel F6
V070-339105	Bracket Installation AFT MDU
V070-732726	Panel Bracket AFT MDU
V070-732780, 81, 82, 83, 86	ADF MDU Bracket

- Flight rule A7-109

TITLE

MMU CONTINGENCY POWERUP

PROCEDURES

Repower an MMU with orbiter dc utility power via the IFM breakout box to bypass a failed bus.

1. Power down affected MMU
2. Power down appropriate dc utility outlet
3. Configure breakout box with two 18-inch 16-gauge pin/socket jumper leads
4. Attach jumper leads to J1 on MMU
5. Repower MMU
6. Reinstall thermal debris traps and lockers taking care not to pinch jumper wires

FAILURE

Loss of orbiter dc power at the MMU

BACKGROUND

MMU's are solid state storage devices for the orbiter DPS. Each MMU contains all PASS and BFS software. MMU's are required to load orbit Ops and entry software into the DPS. See Figure 5.37-1.

NOTES

Procedure is performed only if both MMU's are lost.

REFERENCES

1. Drawings for OV-102.
 - a. V070-703000, avionics equipment installation.
 - b. V070-703002, Av bay 1.
 - c. V070-703011, Av bay 2.
2. Drawings for OV-103.
 - a. V070-703004, avionics equipment installation.
 - b. V070-703003, Av bay 1.
 - c. V070-703006, Av bay 2.
3. Specification drawing MC615-0005.
4. Flight rule A7-109.

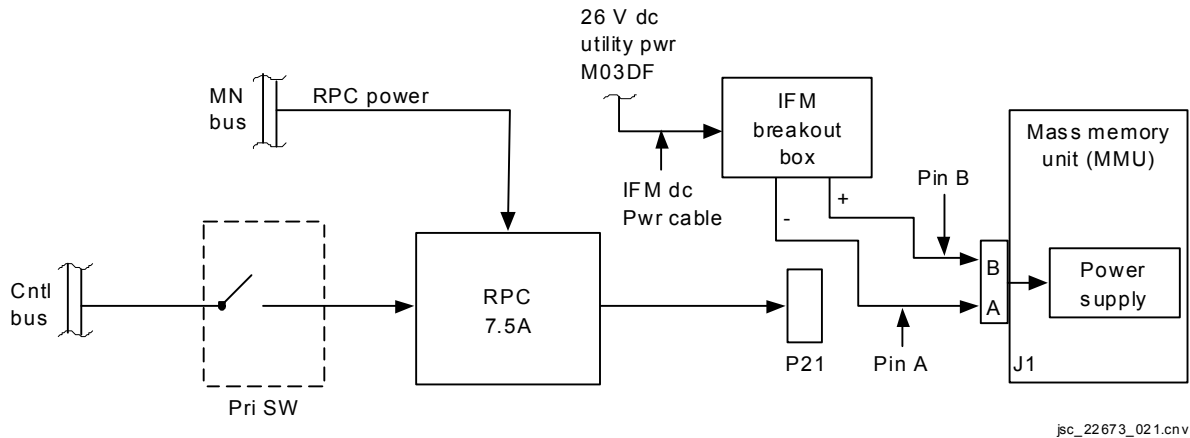


Figure 5.37-1. MMU contingency power

TITLE

MMU CHANGEOUT

PROCEDURES

Procedure swaps a failed MMU with the operational unit.

1. Power down MMU 1, 2
2. Remove lockers and thermal debris traps to access components
3. Remove connectors
4. Remove mounting fasteners
5. Swap location of components and reinstall using coldplate protective covers
6. Reinstall mounting fasteners
7. Reinstall connectors
8. Perform powerup and checkout

FAILURES

Loss of both MMU's where one MMU has hard failed internally and the other has failed externally (bad data path).

BACKGROUND

MMU's are solid state storage devices for the orbiter DPS. They contain all primary avionics software system (PASS) and backup flight system (BFS) software. MMU's are used to load orbit operations (Ops) and entry software.

REFERENCES

1. Drawings for OV-102.
 - a. V070-703000, avionics equipment installation.
 - b. V070-703002, Av bay 1.
 - c. V070-703011, Av bay 2.
2. Drawings for OV-103.
 - a. V070-703004, avionics equipment installation.
 - b. V070-703003, Av bay 1.
 - c. V070-703006, Av bay 2.
3. Specification drawing MC615-0005.
4. Flight rule A2-105.

TITLE

ODS CENTERLINE CAMERA ANGULAR ALIGNMENT

PROCEDURES

Verify and or adjust ODs centerline camera alignment.

1. Verify angular alignment using the CCTV
2. Report results of both translation and angular verifications to MCC
3. Adjust for angular misalignment
4. Loosen screws, align monitor, tighten screws
5. Adjust for vertical misalignment
6. Loosen screws, insert shims, tighten screws
7. Adjust horizontal misalignment
8. Loosen screws, insert shims, tighten screws
9. Stow tools

FAILURE

Mis-aligned ODs centerline camera

BACKGROUND

All alignments are done pre flight as part of the orbiter processing. Prior to docking the camera alignment is verified. Although to date there has not been a need to perform this IFM it is possible that the camera could become mis-aligned during ascent or by a crew member in the airlock. This camera is used for docking purposes and it's alignment is critical to a successful docking.

TITLE

OIU CABLE SWAP

PROCEDURES

To recover payloads commands and/or data by swapping connectors at the Orbiter Interface Unit (OIU) 1, 2.

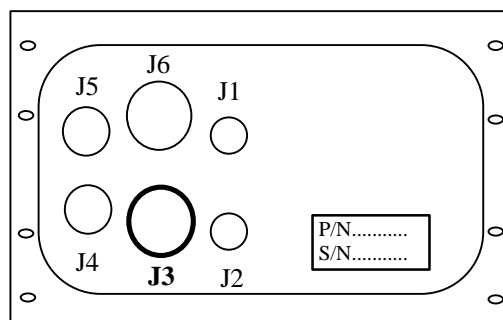
1. Reconfigure Payload Signal Processor (PSP) into a safe mode
2. Power down OIU 1, 2
3. Remove panel to access rear of OIU 1, 2
4. Demate appropriate cable from OIU 1, 2
5. Swap appropriate OIU 1, 2 cable as required
6. Perform PSP/OIU 1, 2 check-out
7. Reinstall OIU access panel

FAILURES

Loss of PSP commands and/or data due to failure of OIU 1, 2

BACKGROUND

Nominal Orbiter configuration has commands routed from PSP 1 to OIU 1 and PSP 2 to OIU 2. The OIU cable swap procedure reroutes commands and/or data from PSP 1 to OIU 2 and PSP 2 to OIU 1 at connector interface J3 located on rear of OIU 1, 2. An effect from this procedure changes the Payload Data Interleaver (PDI) Input. It changes OIU 1 to PDI Input 2 and OIU 2 to PDI Input 1. Due to the OIU system configuration, the Payload (PL) Timing Buffer low level timing signals will remain active on OIU 1, 2 connector de-mate/re-mate activity.



REAR VIEW OF OIU

REFERENCES

1. In-Flight Maintenance (IFM) Checklist, OIU Cable Swap procedure
2. Rockwell Drawing VS72-270087

TITLE

OS SPEAKER DISCONNECT

PROCEDURES

To disable the C&W tones (siren and Klaxon) at the aft flight deck speaker by removing the speaker connector behind panel A7U.

1. Power off speaker
2. Remove panel A7C to access cable clamp
3. Remove cable clamp
4. Reposition panel A7U to access speaker box connector
5. Remove orbit station (OS) speaker box connector
6. Tape over connector interfaces
7. Reinstall panel A7U
8. Reinstall cable clamp
9. Reinstall panel A7C

FAILURES

C&W system A tone generator, for siren and Klaxon, and smoke/fire or cabin dP/dT discrete failed on.

BACKGROUND

A failure mode has been identified wherein the C&W system A tone generator drivers can fail in the ON position, causing siren and Klaxon alarms to the aft speaker that cannot be reset using the master alarm pbi. The tone generator bypasses the audio controls on the aft speaker so that the volume cannot be controlled. Also, the C&W system is redundantly powered for safety, making it impossible to power off the speaker without powering down C&W. It is therefore necessary to remove the input to the aft speaker.

REFERENCES

- A. Drawings.
 1. VS70-973099, C&W overview.
 2. VS70-730622, C&W overview.
 3. VS70-740242, orbiter audio system.

TITLE

O₂ SYS 1(2), FAILED XOVR VLV BYPASS

SUMMARY

Provide dual O₂ system supply, bypass failed closed O₂ system crossover valve using O₂ Contingency hose between MO10W and C7.

PROCEDURE

1. Obtain O₂ Contingency from CHCK, tools and powder-free gloves
2. Close LEH O₂ SPLY 1, 2 valve
3. Close LEH O₂ 8 vlv (to close the O₂ bleed orifice)
4. Close REG INLET SYS 1 (2) vlv
5. Don powder-free gloves
6. Loosen TP 4(3) on panel MO10W
7. Depress TP cap to relieve pressure
8. Remove cap from TP 4(3)
9. Remove protective bag from one end of O₂ Contingency Hose; install onto TP4(3)
10. Loosen TP1 on panel C7
11. Depress cap to relieve pressure
12. Remove cap from TP 1
13. Remove protective bag from other end of O₂ Contingency Hose; install on TP1
14. Secure O₂ Contingency Hose with grey tape
15. Open REG INLET SYS 1 (2) vlv
16. Test LEH5 mask on panel MO69M

FAILURE

With an O₂ crossover valve failure (closed), the O₂ flow to the LEH manifold is limited to approximately 25 lbs/hr. per system. This IFM will restore to full, two system O₂ flow capability.

BACKGROUND

Each crew under normal conditions breaths 2 to 3 lbs/hr of O₂. In an emergency situation it could be as high as 5.5 lbs/hr. Therefore, full (SYS 1 and 2) O₂ capability is required to provide enough O₂ for a crew of five. System 1 is restricted by a single 23.9 lbs/hr orifice and SYS 2 is restricted by a dual 12.5 lbs/hr orifice providing a total of 48.9 lbs/hr of O₂.

REFERENCES

SSSH 6.1

TP4, zone 8G

TP3, zone 1G

TP1, zone 5I

TITLE

OBSS SW CONTINGENCY POWERUP

PROCEDURE

This procedure bypasses the Orbiter Boom Sensor System (OBSS) switch to regain Cabin Payload 3 Bus capability.

1. Remove OBSS switch power
2. Configure Breakout Box
3. Gain Access to P2 Connector behind Pnl R15
4. Connect test jumper leads
5. Turn on BOB to power OBSS
6. Breakdown and IFM tools when finished with OBSS ops

FAILURE

Failure of OBSS Power switch or Cabin Payload Bus 3.

BACKGROUND

Failure of the OBSS Power switch or Cabin Payload Bus 3 will preclude operation of the OBSS. The procedure recovers Cabin Payload 3 power by bypassing the switch behind panel R15.

REFERENCES

1. In-Flight Maintenance (IFM) Checklist, OBSS SW Contingency Powerup
2. SSSH VS72-270195

TITLE

OSVU CONTINGENCY POWERUP

PROCEDURE

The objective of this procedure is to re-power the Orbiter Space Vision Unit (OSVU) using the Break Out Box.

1. Power down the LCDM.
2. Power down the Orbiter Space Vision System (OSVS), Panel R12. Check that the light is off.
3. Check that the OSVS circuit breaker is open.
4. Remove Panel R15 to access connectors on the OSVS. Eighteen, 5/32 –in Allen Head fasteners.
5. On the bottom of the OSVS (Panel R15) de-mate connector P1(J1/Pwr) and put gray tape over the face of the wire bundle connector and tape it aside. See Figure 5.44-1.
6. Verify DC utility power is off
7. Check that the Breakout Box AUX switch is off, 28V/Variable Volts is set to 28 V, power A, B is off. Remove fuse cap from side B and rotate GA selector to 16. Install a 10 Amp fuse from the pin kit and replace cap. Connect two 24 in, 16 ga. Pin/Socket Test jumper leads and 24 ft DC power cable as shown in Figure 5.44-2. Use gray tape to secure the DC power cable and BOB as required.
8. Select DC utility power switch to on.
9. Select BOB power side B switch to On and check that the 16 ga. light is on.

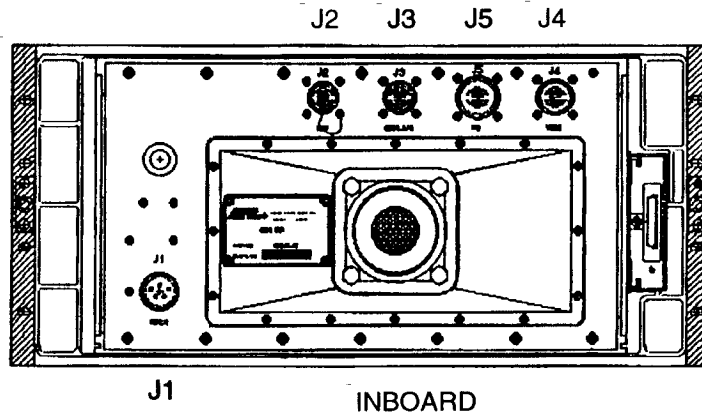


Figure 5.44-1. Bottom view of OSVS

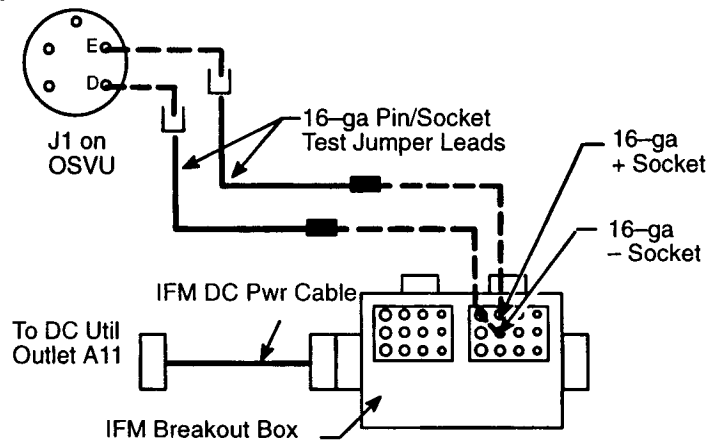


Figure 5.44-2. IFM BOB setup

UPON COMPLETION OF OSVU OPERATIONS:

10. Select Power to side B of the BOB to OFF.
11. Select DC Utility Power to OFF.
12. Stow BOB and cables.
13. Do not reconnect P1(J1) on the bottom of OSVS. Leave secured to bulkhead.
14. Place Gray Tape over J1 to protect sockets.
15. Replace Panel R15 and torque fasteners to 30 in-lb.
16. Stow tools.

FAILURES

This procedure was written specifically for the OSVU in the event of a failed power switch or circuit breaker.

REFERENCES

Drawings:

M072-710551 sheets 6 and 7

VS72-200159/4

M072-613107

V072-200168

TITLE

ORBITER SPACE VISION UNIT (OSVU) CHANGEOUT

PROCEDURE

1. Un-stow the spare OSVU, usually kept in the external air lock bag.
2. Power off the LCDM.
3. Power off the OSVS and check that the Light is off.
4. Open the OSVS circuit breaker.
5. Open panel R15 by removing the eighteen Allen head fasteners using a 5/32 in Allen head driver.
6. Attach the Anti-static wrist tether.
7. De-mate the connectors on the bottom of the OSVU by going through R15. P1(J1/pwr), P4(J4/video), P5(J5/HMI), and P3(J3/serial I/O). See Figure 5.45-1.
8. De-mate the orbiter air cooling hose from the bottom of OSVU using a 3/8 in deep-well socket and temp stow.
9. Remove the eight OSVU mounting screws using a #10 Torque Tip, temp stow.
10. Remove the failed OSVU from the panel and mark failed with gray tape.
11. Remove the OSVU hard drive (HDD1) from the failed unit.
12. Remove the dummy hard drive from the spare OSVU and install into the failed unit.
13. Install the original hard drive into the spare OSVU and tighten thumb screws.
14. Install the spare OSVU into the panel and hand tighten the eight mounting screws.
15. Mate the orbiter air cooling hose to the bottom of the OSVU and tighten using a 3/8 in deep-well socket.
16. Re-install the four connectors; P2(J3), P5(J5), P4(J4), and P1(J1).
17. Torque the eight OSVU mounting screws to 30 in-lbs.
18. Install panel R15 using the eighteen fasteners and torque to 30 in-lbs.
19. Perform the OSVS power up procedure (PDRS OPS, OSVS OPS)
20. Stow the failed OSVU in the same location that the spare was found.
21. Stow tools.

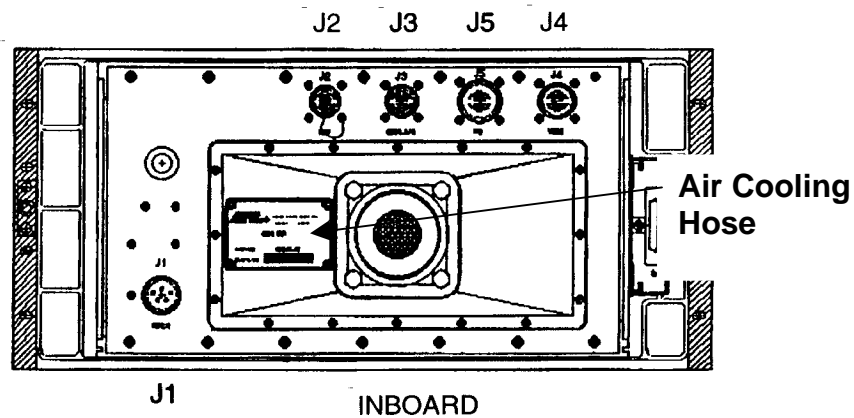


Figure 5.45-1. SVU bottom view

REFERENCES

TBD

TITLE

PAYLOAD BAY DOOR MOTOR OPERATIONS

PROCEDURES

Close and/or latch a PLBD by sending logic signals to the motor control assemblies through the connectors at the PL MDM's (bypasses the MDM's). Any portion of PLBD closing can be accomplished (door drives, bulkhead latches, and centerline latches).

1. Power down appropriate PL MDM and open circuit breakers (cb's) for MCA.
2. Configure breakout box with appropriate PLBD motor cable from pin kit.
3. Access PL MDM 1(2).
4. Remove appropriate connectors from the PL MDM and attach PLBD motor cables to designated pins/sockets (IFM Checklist - PLBD motor Ops).
5. Close cb for proper MCA.
6. Breakout box - on.
7. Check motor/latch operation.
8. When function complete, breakout box - off.
9. Open MCA cb's (all).
10. Disconnect jumper cables and reinstall connectors on MDM.
11. Reinstall lockers.
12. Re-power MDM.
13. Close MCA cb's (all).

FAILURES

Loss of PLBD operations due to multiple failures.

1. Loss of a single PL MDM (internal failure), and the loss of a motor function (motor or MCA) commanded by the remaining PL MDM
2. Loss of both PL MDM's

BACKGROUND

The procedure provides the capability to close/latch PLBD's using single motor drive by bypassing the MDM. The dc utility power is used to close appropriate relays in the MCA. Closing the three-phase cb allows ac power to drive the motor.

The IFM to swap payload MDM's would be used in preference to this procedure unless pin kit jumping would still be necessary after the swap. Reference Flight rule A7-109. See Figure 5.46-1.

NOTES

The door closure procedure also latches the bulkheads. For door closure, both an enable and close command are required. The A side of the breakout box (BOB) provides the PLBD enable and close commands. The B side of BOB provides enable and latch commands for the bulkhead latches.

For centerline latch groups, only one side of the BOB is used to provide both enable and latch commands.

REFERENCES

1. Flight rules A2-105 and A10-209
2. Drawings for OV-102.
 - a. V070-703000, avionics equipment installation.
 - b. V070-703002, Av bay 1.
 - c. V070-703011, Av bay 2.
3. Drawings for OV-103.
 - a. V070-703004, avionics equipment installation.
 - b. V070-703003, Av bay 1.
 - c. V070-703006, Av bay 2.
4. Specification drawing MC615-0023 MDM's.

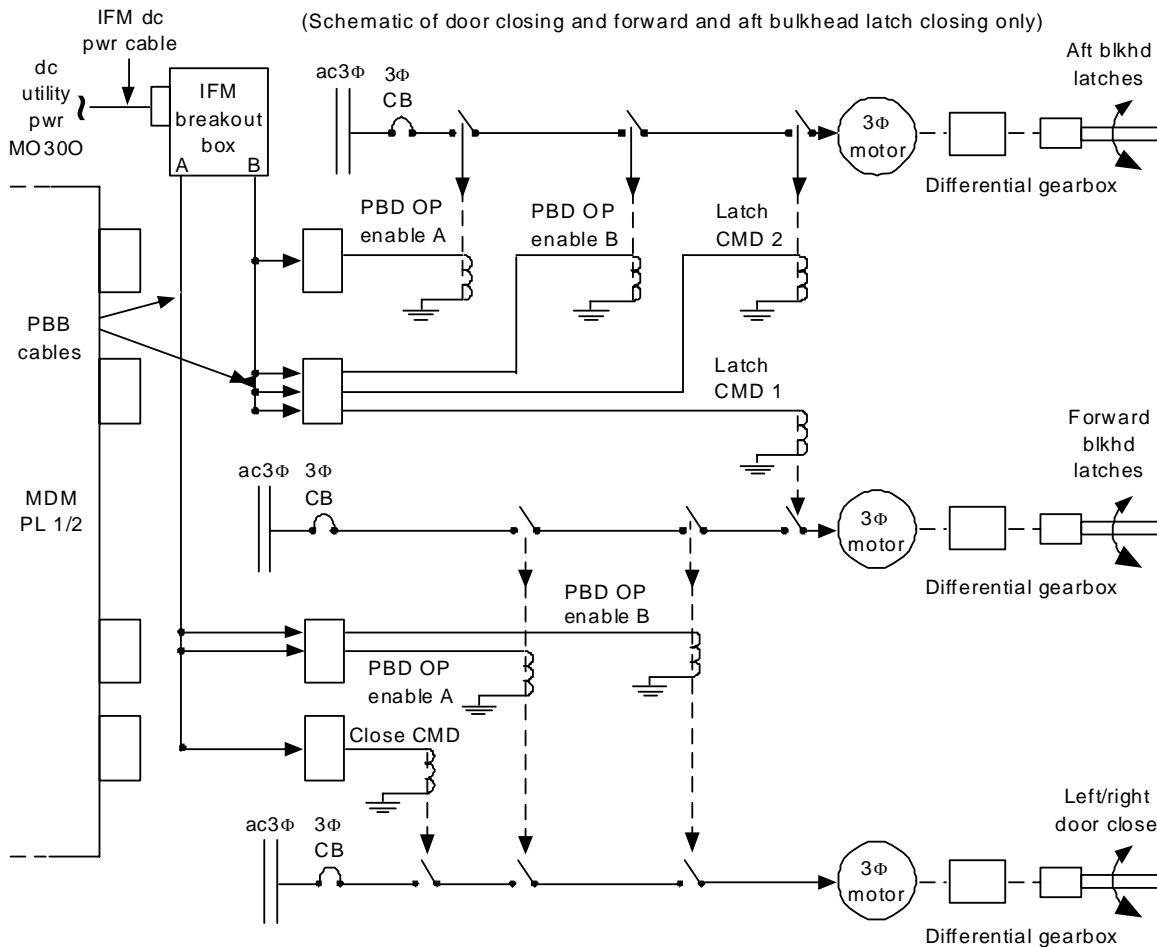


Figure 5.46-1. Payload bay door/latch motor operation

Note:

1. For door closure:
Both PLBD operation enable A and B signals are required in addition to a close command.
2. For latch closure:
Both PLBD operation enable A and B signals are required in addition to a latch command.
3. No single MALF procedure directs this procedure to be done. A combination of MALFS is required (i.e., loss of one PL MDM due to card failure and loss of motor driven by other MDM fails).
4. Procedure provides the capability to close PLBD's/latches using single motor drive by bypassing the PL MDM.

5. To close doors and latch the forward and aft bulkhead latches (as indicated on schematic).
 - a. The dc utility power is used to provide the signals needed from MO30F via the IFM breakout box.
 - b. The A side of the breakout box is turned on to provide the PLBD OP ENABLE A AND B and close commands. Closing the three-phase cb allows three-phase ac power to flow to the motor to close the doors.
 - c. The B side is then turned on to provide the additional enable A and B commands and latch commands. The three-phase cb's are closed, in turn allowing three-phase ac power to drive the latch motors.
6. Centerline latch groups are closed the same way using only one side of the breakout box and three connectors versus four. In this case, an enable command is input into two connectors and a latch command is input into the third connector.

TITLE

PDI REPLACEMENT

PROCEDURES

Replace an internally failed payload data interleaver (PDI) with a stowed spare (if one is flown).

1. Power down PDI
2. Remove lockers, etc., to access failed unit
3. Remove connectors
4. Loosen mounting fasteners
5. Using coldplate protective cover, changeout failed unit with spare
6. Reinstall mounting fasteners
7. Reinstall connectors
8. Reinstall lockers, etc

FAILURE

Internally failed PDI

BACKGROUND

Spare PDI's are flown on selected flights based on the criticality of communicating with the payload. For some payloads, the PDI is the sole source of communication; other payloads (inertial upper stage (IUS)) have a radio frequency (RF) capability as a backup. When a spare PDI is manifested, it will normally be stowed in a middeck locker.

REFERENCES

1. Drawings for OV-102.
 - a. V070-703000, avionics equipment installation.
 - b. V070-703002, Av bay 1.
2. Drawings for OV-103.
 - a. V070-703004, avionics equipment installation.
 - b. V070-703003, Av bay 1.
3. Specification drawing MC476-0136.

TITLE

PGSC CARD CHANGEOUT (OCA CARD)

PROCEDURES

1. Select PGSC power to OFF.
2. Select AC Utility power to OFF.
3. Demate the expansion unit power cable.
4. Demate the PGSC expansion card data interface cable, if required.
5. Attach the Anti-static wrist tether.
6. Loosen, do not remove (1.5 turns), two (2) countersunk Phillips Screws between connectors on aft face of chassis.
7. Remove five (5) non-captive screws from the bottom of the PGSC expansion chassis (four corners, center aft; #2 Phillips driver, Fastener Retainer)
8. Remove chassis cover, Temp stow.
9. Remove one screw securing PGSC card to chassis (#2 Phillips Driver, Fastener Retainer). It should be noted that the PGSC care has a label on the card end plate.
10. If required to help ease the card removal, loosen, but do not remove the two screws securing the card end guide positioning bracket to the chassis (#1 Phillips Screwdriver)
11. Grasping card by the edges only, remove the card from the edge connector. Gentle rocking may be required to release the card from the connector.
12. Once removed, mark the card failed using gray tape on the end plate only.
13. Retrieve the new card from it's stowage location.
14. Grasping the new card by the edges only, slide the card into place ensuring that the edge connector is engaged.
15. Install the single screw that holds the expansion card into place.
16. If step 10 **above** was performed, check proper engagement of end guide bracket; tighten two screws securing bracket to chassis, hand tight.
17. Tighten two (2) screws that were loosened in step 6 **above**.
18. Replace the chassis cover, install and tighten the five (5) screws.
19. Stow tools.

FAILURE

Swap malfunctioning PGSC card with a stowed spare.

BACKGROUND

TBD

REFERENCES

TBD

TITLE

PGSC EXPANSION CARD CHANGEOUT

FAILURE

Malfunctioning PGSC expansion card located in the expansion unit attached to the PGSC.

PROCEDURES

1. Select AC utility power to OFF.
2. Select PGSC power to OFF.
3. Demate the expansion unit power cable.
4. Demate the PGSC expansion card data cable, if required.
5. Attach the Anti-static wrist tether.
6. Insert the security key and rotate to the unlock position. Remove the PGSC from the expansion unit.
7. Remove the single captive screw attaching the metal chassis cover using the #2 Phillips Driver. Remove the cover and temp stow.
8. Remove the single screw securing the PGSC expansion card using a #2 Phillips Driver. Temp stow.
9. Grasping the card by the edges only, remove the card from the connector. Gentle rocking back and forth may be required to release the card from the connector.
10. Once removed, mark the card failed using gray tape on the end plate only.
11. Retrieve the new card from it's stowage location.
12. Grasping the new card by the edges only, slide the card into place ensuring that the edge connector is engaged.
13. Install the single screw that holds the expansion card into place.
14. Replace the chassis cover. Make sure that the guide clips on the top right seat properly. Tighten screws.
15. Mate the PGSC to the expansion unit and rotate security key to the lock position.
16. Stow tools.

BACKGROUND

TBD

REFERENCES

TBD

TITLE

PREFLIGHT TEST BUS SETUP

PROCEDURES

Restart a failed FC by regaining ac power to the FC pump package. Power is recovered by utilizing preflight test circuitry. See Figure 5.50-1. The FC must be failed due to an electronic control unit (ECU) power failure.

1. Access MDM LF1 and PCA 1(3) (PCA 1 for FC 1 and PCA 3 for FC 2 or 3).
2. Remove MDM LF1 power connector.
3. Set up the IFM breakout box, dc harness cable, fuse cap test lead (at F10 of PCA 1 or 3), and test jumper leads (to LF1: plug 59 (connected to J2) for FC1 or 2, and plug 63 (connected to J6) for FC3).
4. Open affected FC reactant valves (on panel R1).
5. Start up the FC, using the switches on panel R1 and the IFM breakout box.
6. If the FC stack TEMP or exit TEMP are abnormal; perform FC shutdown and back out of procedure.
7. If the FC is operating properly:
 - a. Secure the fuse cap test lead to PCA 1 (or 3) and the test jumper leads to MDM LF1 with gray tape.
 - b. Reinstall all thermal debris traps, lockers, and volume A, ensuring to not crimp wires going to PCA 1 (or 3) or MDM LF1.

FAILURES

Loss of FC pump package due to a failure in the FC ECU as follows: Short-to-ground in the ECU on the circuit noted in heavy lines in, or in the FC control power load driver circuit causing the 3A fuse to blow; FC control power switch failure; and loss of the ESS bus in the MPC or in the FD.

BACKGROUND

For the loss of an essential bus DA the procedure will not work because the preflight bus attempts to power the ESS APC bus through a 15-amp RPC. See Figure 5.50-3.

There is a definite risk associated with powering up a preflight test bus. Other preflight test circuits are powered by these buses. A failure in a driver in one of these circuits could result in an “un-commanded on” condition in the driver and cause that test circuit to function. These test circuits include FC valves and landing gear deploy functions. Because of these circuits, powering up the preflight test bus puts the vehicle in a single-point-failure condition. Therefore, the use of the IFM procedure should be considered carefully. The procedure would probably only be used in extreme cases such as avoiding a single FC entry.

The FC contingency powerup procedure can be modified to operate some of the other test circuitry previously mentioned. The commands are sent to the appropriate drivers by changing the plug and pin assignments from the LF1 MDM as required. The LF1 pin/plug assignments are documented in the EGIL Console Handbook. Once again, using this procedure is risky, and the amount of time that a preflight test bus is energized should be minimized.

REFERENCES

1. EGIL Console Handbook, SCP 2.9, Fuel Cell Contingency Powerup.
2. Flight rule A9-110.
3. Drawing VS70-760322, Schematic Diagram - Main DC Power Distribution Subsystem.

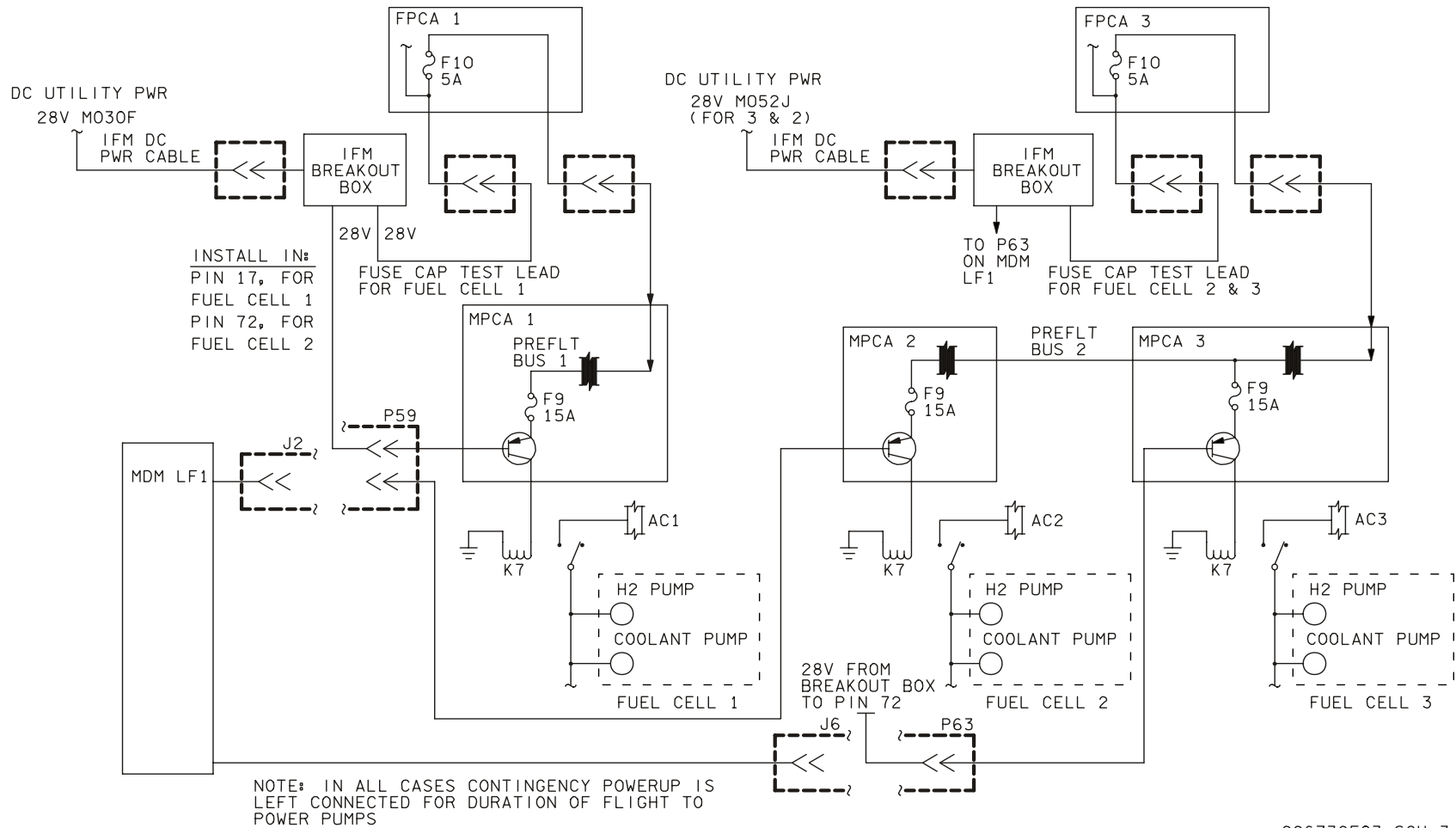


Figure 5.50-1. Fuel cell contingency power schematic

4. For fuel cell 1 powerup:
 - a. Fuse cap test lead is routed from breakout box to FPCA 1, fuse 10.
 - b. Another jumper is routed from IFM breakout box to pin 17 on P59 (disconnected from J2) at MDM LF1.

NOTE

1. 28 V through F10 of FPCA 1 powers preflight bus 1 in MPCA 1.
2. 28 V through P59 of MDM LF1 activates transistor in MPCA 1, closing relay K7; allows 3f ac to turn on fuel cell 1 H2 and coolant pumps.
3. EPS MALF SSR 70, 72, 73 directs crew to this procedure.
4. For fuel cell 2 powerup:
 - a. Fuse cap test lead is routed from IFM breakout box to FPCA 3, fuse 10.
 - b. Another jumper is routed from IFM breakout box to pin 72 on P59 (disconnected from J2) at MDM LF1.

NOTE

1. 28 V through F10 of FPCA 3 powers preflight bus 2 in MPCA 3.
2. 28 V through P63 of MDM LF1 activates transistor in MPCA 3, closing relay K7; allows 3f ac to turn on fuel cell 3 H2 and coolant pumps.
3. EPS MALF SSR 90, 92, 93 directs crew to this procedure.

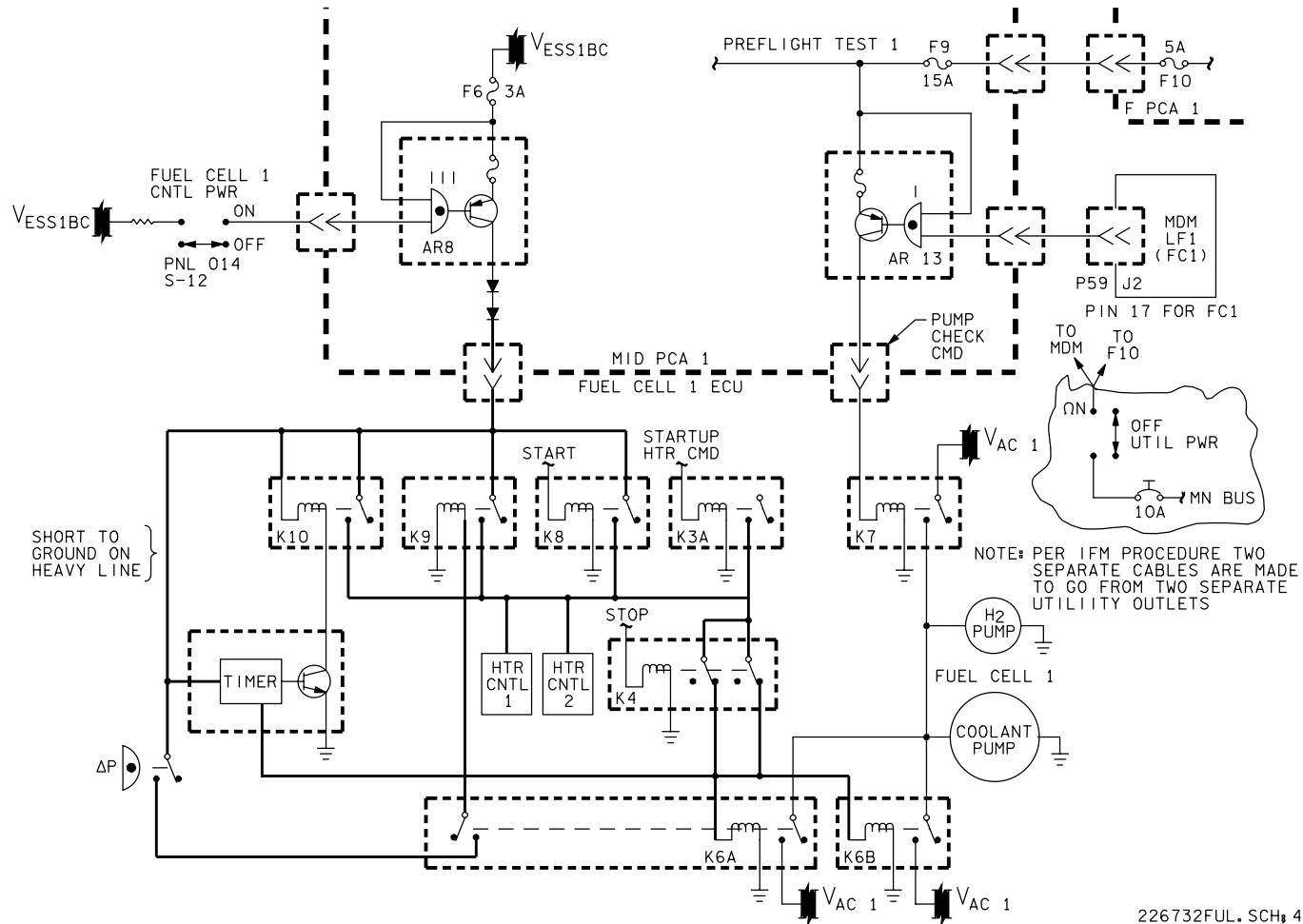
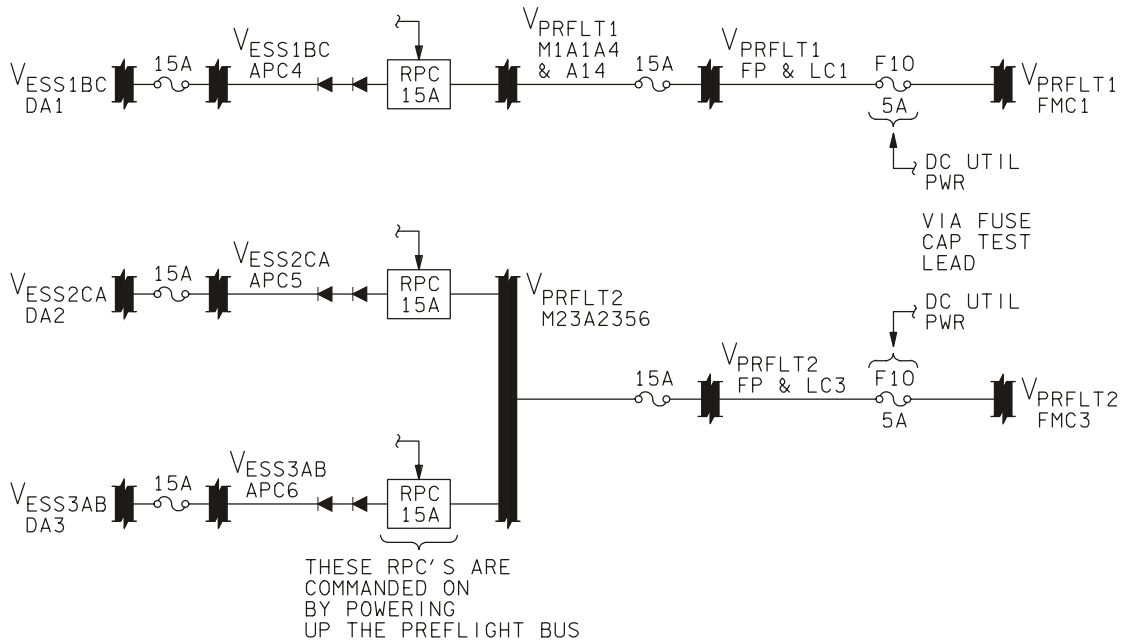


Figure 5.50-2. Fuel cell contingency power circuit (FC 1 not shown)



22673002F. SCH 3

Figure 5.50-3. FC contingency powerup to ESS DA current path

TITLE

PSP CHANGEOUT

PROCEDURES

Replace a failed payload signal processor (PSP)1 with PSP2

1. Power down payload signal processor PSP 1, 2
2. Remove lockers and thermal debris traps to access PSP's
3. Remove connectors
4. Loosen mounting fasteners
5. Using coldplate protective cover, change out PSP's
6. Reinstall mounting fastener
7. Reinstall connector
8. Reinstall thermal debris traps and lockers

FAILURE

Internal failure of PSP1.

BACKGROUND

Although PSP2 is the redundant set, some payloads are wired through PSP1 only. If restringing fails to restore communication with the payload, a PSP changeout will be considered.

REFERENCES

1. Drawings for OV-102.
 - a. V070-703000, avionics equipment installation.
 - b. V070-703011, Av bay 2.
2. Drawings for OV-103.
 - a. V070-703004, avionics equipment installation.
 - b. V070-703006, Av bay 2.
3. Specification drawing MC476-0138.

TITLE

RECORDER CHANGEOUT

SUMMARY

This procedure replaces a failed Ops 1(2) or payload recorder with an operational spare (Ops 1(2) or payload).

1. Power down recorders to be swapped
2. Access recorders
3. Remove connectors
4. Loosen mounting fasteners
5. Using coldplate protective covers, swap designated recorders
6. Reinstall connectors
7. Reinstall lockers, etc.
8. Re-power and perform checkout

FAILURE

Loss of two Ops recorders, both units internally failed; use payload recorder as a spare. One unit failed internally and second unit lost due to a bad data path; use the Ops recorder with the bad data path as a spare.

Loss of payload recorder affects mission success; only Ops recorder 1 or 2 can be used as a spare, if desired.

BACKGROUND

Recorders are used to back up or supplement telemetry data. As real-time data is not continuous, it is possible that Ops recorders could provide the sole source of orbiter data and recorded voice at the time of a system anomaly. Ops recorder 1 is the sole source of the space shuttle main engine (SSME) engine interface unit (EIU) during ascent. After main engine cutoff the two Ops recorders are a redundant pair, as only one is required for nominal mission operations. The payload recorder is not used for orbiter systems data and its loss would only impact mission success. Therefore, it is not likely that an Ops recorder would be used as a spare for a payload recorder.

REFERENCES

1. Drawings for OV-102.
 - a. V070-703000, avionics equipment installation.

- b. V070-703002, Av bay 1.
- c. V070-703011, Av bay 2.
- 2. Drawings for OV-103.
 - a. V070-703004, avionics equipment installation.
 - b. V070-703003, Av bay 1.
 - c. V070-703006, Av bay 2.
- 3. Part no. is 4411700-3 GFE.
- 4. Flight rule A11-71

TITLE

RHC CHANGEOUT

PROCEDURES

Replace a failed forward rotational hand controller (RHC) with the RHC from the aft station.

1. Power down and remove the failed RHC.
2. Power down and remove the aft RHC.
3. Install the aft RHC in the forward RHC station.
4. Stow the failed RHC in the aft station.
5. Power up and test the replaced RHC in the forward station.

FAILURES

Loss of a forward RHC (an RHC is considered lost if any two channels are failed for a single axis of rotation).

BACKGROUND

There are three RHC's onboard the orbiter.

RHC	Location	Power supplies	Main power bus
Left	Forward of the CDR's seat	DDU no. 1 A, B, and C	MNA and MNB
Right	Forward of the PLT's seat	DDU no. 2 A, B, and C	MNB and MNC
Aft	Panel A7U	DDU no. 3 A, B, and C	MNA and MNC

The CDR and PLT RHC's are usable during all mission phases (ascent, entry, and on orbit). The aft station RHC is usable only during the on-orbit flight phase.

Flight phase	Commands sent to
Ascent	Solid rocket boosters (SRB's) Main engine thrust vector control (TVC) Orbital maneuvering system (OMS) Reaction control system (RCS)
On orbit	Orbital maneuvering system (OMS)
Entry	Aerodynamic control surfaces

Each RHC has three channels (A, B, and C) for each of its three axes (roll, pitch, and yaw) for a total of nine channels. These channels are powered by three separate supplies located in the associated DDU. (Power supply A feeds the A channels for all three axes of the RHC, etc.)

The loss of yaw channels is not considered critical for landing, because during atmospheric flight, yaw commands are input by the rudder pedals.

The remote manipulator system (RMS) RHC is not compatible with the CDR, PLT, or aft station RHC's.

REFERENCES

1. OMI V5B05 rotational hand controller CDR, PLT, MSS removal/installation.
2. Drawing V070-730035, controller inst rotational hand, seat mounted.
3. Drawing V070-732063, shroud - vertical and angular adjust lower RHC, assembly.
4. Specification MC621-0043 space shuttle flight control subsystem-(P/N: MC621-0043-3042).
5. GNC Systems Brief, Section 13.
6. Flight rules A2-105, A8-9, and A8-1001

TITLE

RMS CONTINGENCY OPERATION (INSTALLATION AND REMOVAL OF THE RMS IFM D&C KIT)

PROCEDURES

The RMS IFM display and control (D&C) kit allows for contingency operation of the RMS following certain D&C failures on the orbiter A8 panel. The D&C kit utilizes orbiter dc utility power and crew optical alignment sight (COAS) single-phase ac power. The single-phase ac power is used to activate the RMS shoulder brace release. The dc utility power is passed through a simple voltage regulator to supply 12.4-V and 6.2-V signals to provide direct drive and end effector capture/release and rigidize/de-rigidize capabilities. There is also a safing inhibit switch which provides 28 V to inhibit RMS safing. The D&C kit has four connectors, two of which connect to the dc utility outlet and the COAS power outlet on panel 019. The other two connectors mate in line with the P3/J9583 connection behind orbiter panel A8L.

1. Un-stow RMS IFM D&C kit.
2. RMS to temperature monitor mode.
3. Access back of A8L by removing panel A7C.
4. De-mate orbiter P3 from J9583 on connector bracket behind A8L.
5. Mate orbiter P3 to P1 on RMS IFM D&C kit.
6. Mate D&C kit P2 to J9583 on orbiter connector bracket.
7. Mate DC1 and AC1 to 019 panel.
8. Power up D&C kit and operate the RMS.

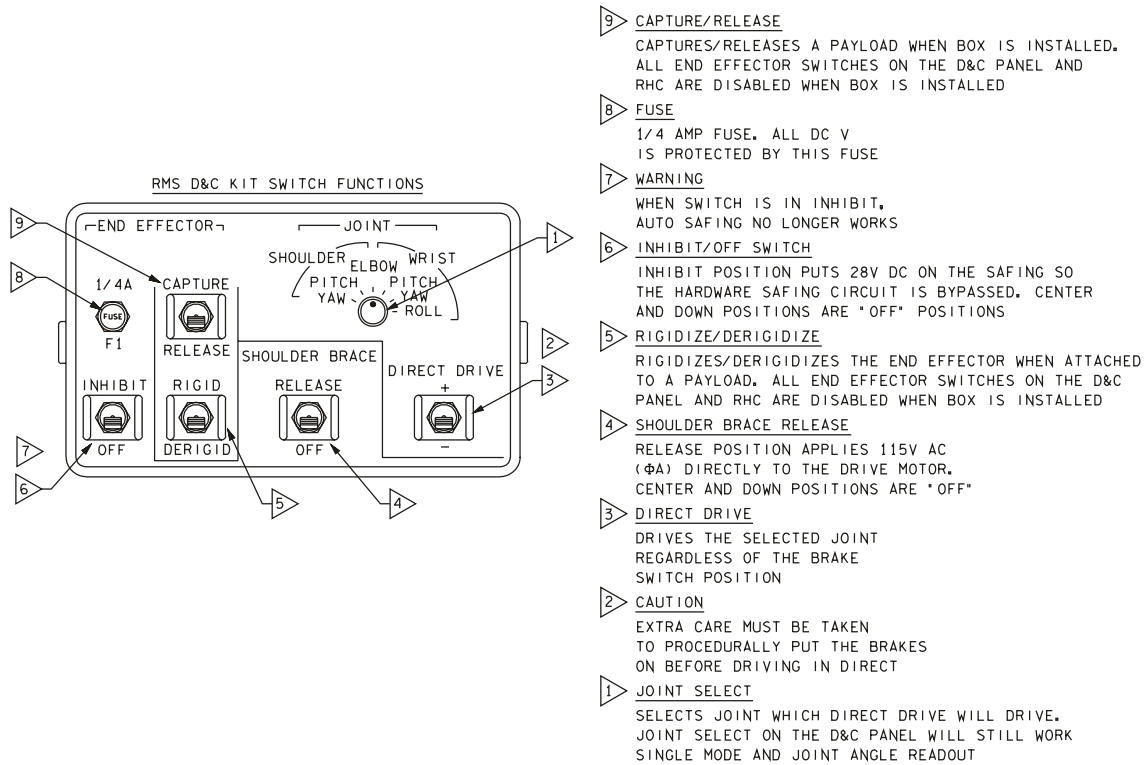
FAILURES

Shoulder brace release switch, end effector capture/release switch, end effector rigidize/de-rigidize switch, end effector auto/manual switch, or D&C circuitry K1 or K2 relays (inside MPCA1).

BACKGROUND

The D&C kit provides only rudimentary control of the RMS. When the kit is installed, computer supported modes are still available. See Figure 5.54-1, Figure 5.54-2, and Figure 5.54-3.

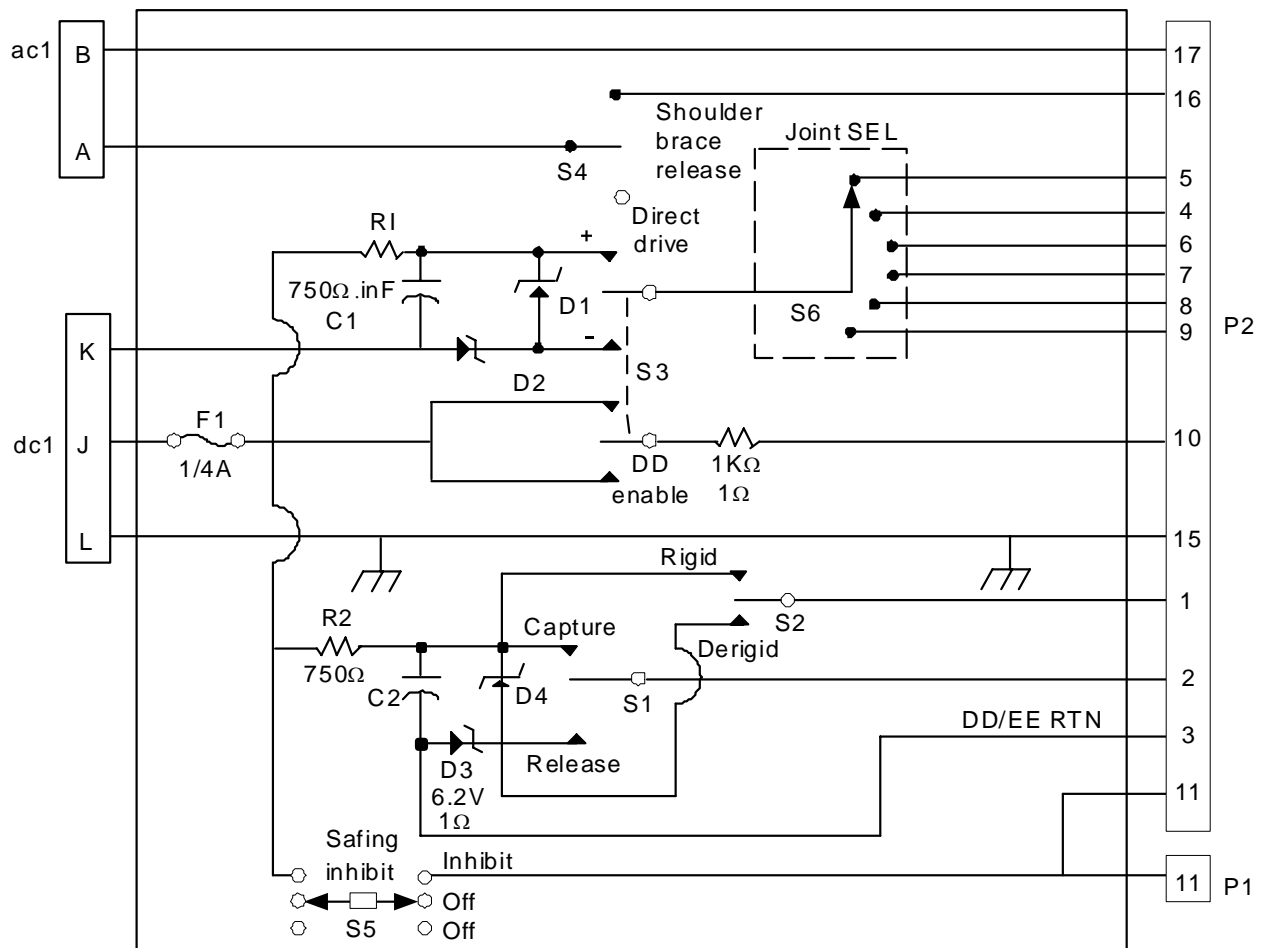
D&C kit connector P1 provides safing inhibit signal from the A8 panel.



- 9 **CAPTURE/RELEASE**
CAPTURES/RELEASES A PAYLOAD WHEN BOX IS INSTALLED. ALL END EFFECTOR SWITCHES ON THE D&C PANEL AND RHC ARE DISABLED WHEN BOX IS INSTALLED
- 8 **FUSE**
1/4 AMP FUSE. ALL DC V IS PROTECTED BY THIS FUSE
- 7 **WARNING**
WHEN SWITCH IS IN INHIBIT, AUTO SAFING NO LONGER WORKS
- 6 **INHIBIT/OFF SWITCH**
INHIBIT POSITION PUTS 28V DC ON THE SAFING SO THE HARDWARE SAFING CIRCUIT IS BYPASSED. CENTER AND DOWN POSITIONS ARE "OFF" POSITIONS
- 5 **RIGIDIZE/DERIGIDIZE**
RIGIDIZES/DERIGIDIZES THE END EFFECTOR WHEN ATTACHED TO A PAYLOAD. ALL END EFFECTOR SWITCHES ON THE D&C PANEL AND RHC ARE DISABLED WHEN BOX IS INSTALLED
- 4 **SHOULDER BRACE RELEASE**
RELEASE POSITION APPLIES 115V AC (ΦA) DIRECTLY TO THE DRIVE MOTOR. CENTER AND DOWN POSITIONS ARE "OFF"
- 3 **DIRECT DRIVE**
DRIVES THE SELECTED JOINT REGARDLESS OF THE BRAKE SWITCH POSITION
- 2 **CAUTION**
EXTRA CARE MUST BE TAKEN TO PROCEDURALLY PUT THE BRAKES ON BEFORE DRIVING IN DIRECT
- 1 **JOINT SELECT**
SELECTS JOINT WHICH DIRECT DRIVE WILL DRIVE. JOINT SELECT ON THE D&C PANEL WILL STILL WORK SINGLE MODE AND JOINT ANGLE READOUT

226730245, PNL 2

Figure 5.54-1. RMS IFM D&C kit

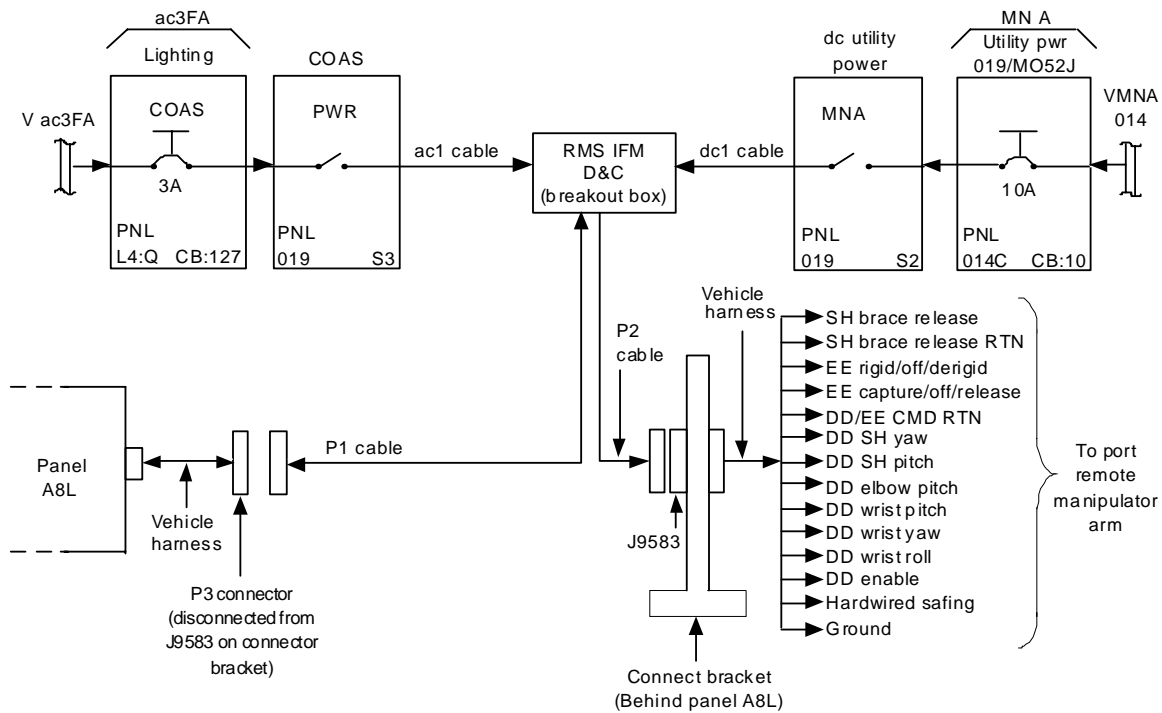


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Figure 5.54-2. RMS D&C kit schematic

5.54-3

Verify that this is the correct version before use



1. The RMS IFM D&C kit design to work around the following failure:
 - a. Shoulder brace release sw
 - b. End effector capture/release and rigidize/derigidize sw
 - c. End effector auto/manual sw
 - d. D&C circuitry failure (K1 and K2 relays, MPCA 1)
2. Ac1 and dc1 provide power through RMS breakout box to the P2 cable to transmit the signals listed on the right to the RMS arm. The P1 cable is a hardwired safing signal to the ABL panel and the arm.

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Figure 5.54-3. D&C kit installation schematic

NOTES

The D&C kit will be used with the following operating rules:

1. The DC UTIL PWR MNA on panel O19 will be turned ON just prior to using the kit, and OFF during idle periods to minimize exposure times for un-commanded motion of the RMS.
2. The DC UTIL PWR MNA switch on O19 will be used as a disable switch for un-commanded motion during kit operation.
3. Before engaging backup power, the kit will be turned OFF.
4. If safing needs to be inhibited from the D&C kit, disconnect D&C kit connector P1 from P3 on the vehicle harness to isolate the D&C kit from possible shorts in the A8L panel circuitry.

The kit is usually stowed in the Bob locker.

REFERENCE

1. Drawing SIE33103307 (wiring diagram).
2. Flight rule A12-7

TITLE

RMS, CONTINGENCY POWERUP

PROCEDURES

These three similar procedures utilize dc utility power via the IFM breakout box to provide power or signals to the RMS system at connector interfaces behind panel A8L. The procedures differ in the specific connector that they interface and in the pin/sockets that receive power in each procedure. All three procedures involve accessing connectors behind A8L. These procedures are intended to be used for safely stowing the RMS following certain failures and, thus, avoiding an EVA or an RMS jettison.

1. Power down the RMS.
2. Remove panel A7C.
3. Loosen panel A8L.
4. Locate and de-mate P1, P2, P3, and P4 from J9587, J9588, J9589, and J9590, respectively.
5. Reposition panel A8L to allow access to P1/J9587 for the powerup procedure, P2/J9588 for the manipulator positioning mechanism (MPM) procedure, or P3/J9589 for the manipulator retention latch (MRL) procedure.
6. Configure IFM breakout box and jumper leads with the appropriate connector, as specified in the IFM Checklist.
7. Reinstall panel A8L and re-mate the three connectors that were not interfaced in the above step: P2, P3, and P4 or P1, P3, and P4, or P1, P2, and P4.
8. Power up the IFM breakout box and the RMS and perform RMS operations.
9. Power down RMS and the IFM breakout box.
10. Remove breakout box and cables.
11. Re-mate connector P1 to J9587 or P2 to J9588 or P3 to J9589 as appropriate.
12. Install panel A7C.

FAILURES

1. RMS power switch
2. RMS MPM deploy/stow switch
3. RMS MRL release/latch switch

BACKGROUND

In order to read the pin/socket assignments on the connector faces in question, it is necessary to loosen and reposition panel A8L. This is due to the limited length of the wire harnesses. To accomplish this, panel A7C is removed to access connectors behind A8L. Four connectors are de-mated and A8L is repositioned to allow access to the connector interface in question. The breakout box is then interfaced with the appropriate pin/sockets. A8L is then reinstalled and the remaining three connectors are re-mated. Contingency operation of the RMS may then take place by powering up the IFM breakout box. Following RMS operation, the installation is removed.

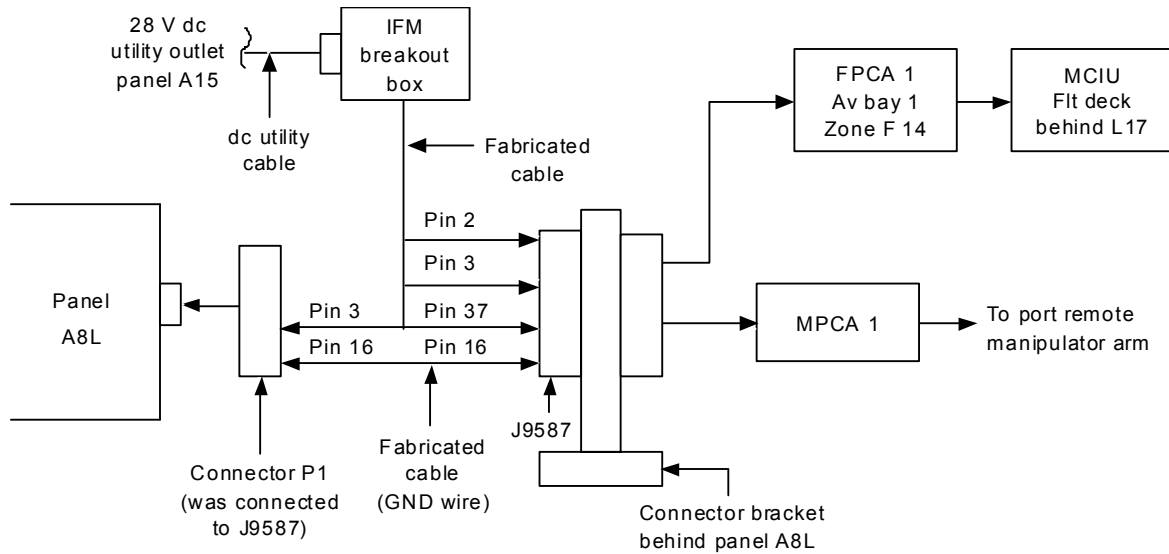
There are two sets of connectors behind panel A8L that are referenced J1, J2, and J3. However, only one of the sets is mated with J9587, J9588, and J9589 on the connector bracket. These connectors are clearly illustrated in the IFM Checklist.

See Figure 5.55-1, Figure 5.55-2, and Figure 5.55-3.

REFERENCES

Drawings

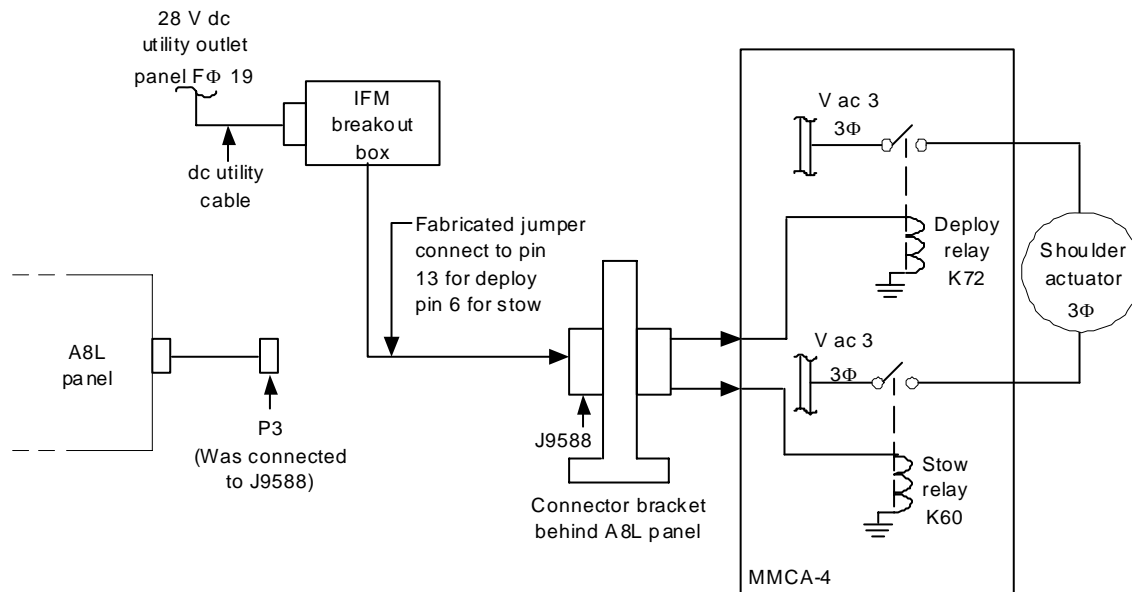
1. VS70-540512, 519, 552, 559, 702, and 709.
2. VS70-956099, and 102.
3. V070-764419, 429, 439, and 449.
4. V070-764522, 532, and 542.



1. 28V dc utility power is provided from A15 panel via breakout box and fabricated cable to power RMS system.
2. Connection to pin 3 of connector P1 provides power to A8L panel.
3. Jumper wire between pin 16 and pin 1 and pin 16 of J9587 must be installed for ground.
4. Connection to pin 2 of J9587 provides power to the MCIU via FPCA1.
5. Connection to pin 3 and pin 37 of J9587 provides power to port manipulator arm MN bus A and heater bus MN A respectively.
6. Procedure assumes failure of RMS power switch.

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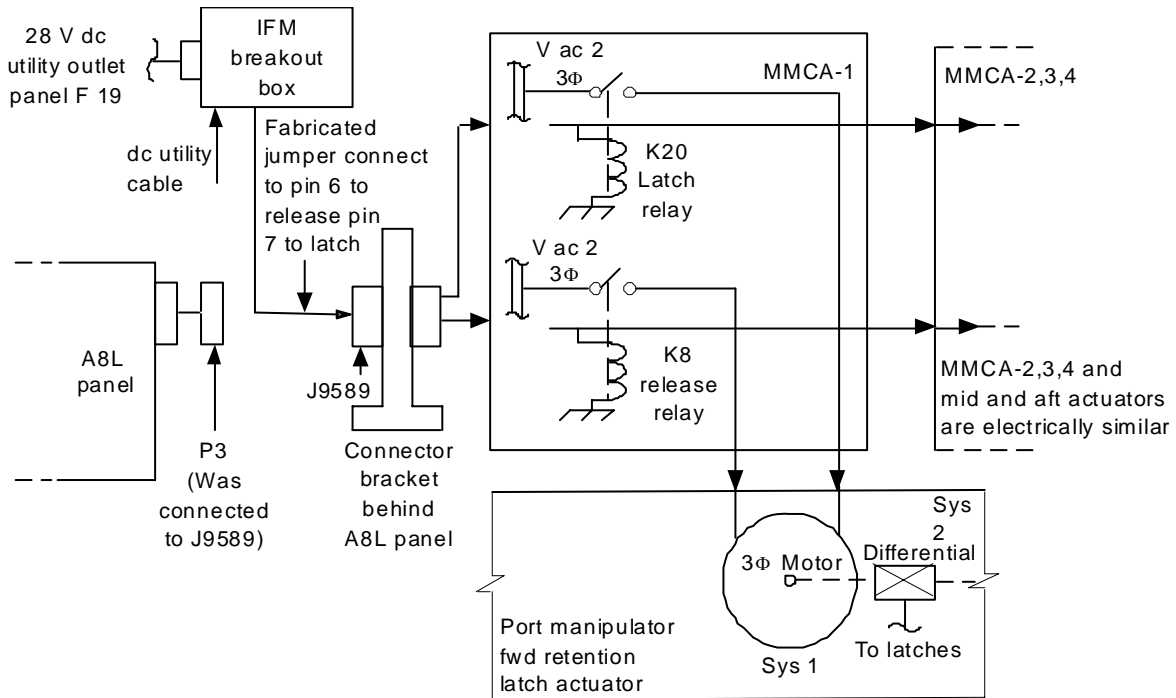
Figure 5.55-1. RMS contingency powerup



1. Procedure assumes failure of the RMS DEPLOY/STOW switch.
2. Procedure is directed by PDRS MALF 13.4 a/b.
3. 28 V dc utility power is supplied via the IFM breakout box and a fabricated jumper through J9588 on the connector bracket to MMCA-4.
4. The fabricated jumper is installed in pin 13 or pin 6 for DEPLOY or STOW operation respectively. This in turn provides power to the appropriate relay in MMCA-4 to allow 3Φ power to operate the shoulder actuator.
5. Talkbacks are still operable.

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Figure 5.55-2. RMS MPM contingency deploy/stow



1. Procedure assumes failure of RMS Retention latches switch.
2. Procedure is directed by PDRS MALF 13.4 c/d.
3. 28 V dc utility power is supplied from panel 019 via IFM breakout box and a fabricated jumper through J9589 on the connector bracket to the MMCA's.
4. The fabricated jumper is installed in pin 6 or pin 7 for release/latch operation respectively. This in turn provides power to the appropriate relays in the MMCA's to allow 3 ϕ power to operate the actuators.
5. Talkbacks are still operable.
6. Diagram illustrates only the fwd retention latch (sys 1) and MMCA 1. MMCA 2, 3, 4, mid and aft latches, and sys 2 are electrically similar.

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Figure 5.55-3. RMS MRL contingency release/latch

TITLE

RMS, JETT REDUNDANCY

SUMMARY

Restore RMS jettison system redundancy by re-powering a sub-bus in the A14 panel.

1. Power down the RMS jettison pyro system for the affected bus.
2. Power off the affected OMS/RCS jet heaters.
3. Loosen fasteners and reposition panel A14.
4. Remove connector on back of panel A14 for affected system.
5. Connect breakout box and test jumper leads to re-power redundant (lost) side.
6. Reposition panel A14 and continue until RMS Ops are complete.
7. Remove and stow equipment, and replace connector and panel A14.

FAILURE

Loss of either of two sub-buses at panel ML86B (MNB ML86B, or MNC ML86B), which power the redundant RMS pyro jettison system in panel A14.

BACKGROUND

The RMS jettison system is redundantly powered by two of the main sub-buses (MNB and MNC) in panel ML86B through connectors J4 and J5 on the back of panel A14. These two sub-buses also power the OMS/RCS jet heaters for jets 2, 3, MNB and jets 4, 5, MNC through the same connectors. If either MNB or MNC sub-bus from ML86B is lost, Flight rule A12-181, Jettison System Constraint, states that RMS Ops must stop and the arm must be cradled and stowed. This is required because redundancy has been lost to one side of the jettison system and there is no telemetry into the other side of the jettison system. Performing the IFM will re-power the RMS jettison system directly. Breaking the connector will isolate the system from the ML86B panel.

NOTES

During the time that this IFM is installed, either jets 2, 3 or jets 4, 5 will be without power.

REFERENCES

1. Flight rule A12-181.
2. EPS SSR-4 BUS LOSS: MNB ML86B.
3. EPS SSR-66 BUS LOSS: MNC ML86B.
4. Electrical Schematics: VS72-956099 pages 56MA, MB, MC, & MD; PORT MANIP ARM SHLDR JTSN & RETIN LCH JTSN.

TITLE

**RMS MANIPULATOR POSITIONING MECHANISM (MPM) CONTINGENCY
DEPLOY/STOW**

PROCEDURES

These procedures utilize dc utility power via the IFM breakout box to provide power or signals to the RMS system at connector interfaces behind panel A8L. The procedures differ in the specific connector that they interface and in the pin/sockets that receive power in each procedure. All procedures involve accessing connectors behind A8L. These procedures are intended to be used for safely stowing the RMS following certain failures and, thus, avoiding an EVA or an RMS jettison. This procedure is the same as the RMS, Contingency Powerup procedure, which includes three procedures in one section.

1. Power down the RMS.
2. Remove panel A7C.
3. Loosen panel A8L.
4. Locate and de-mate P1, P2, P3, and P4 from J9587, J9588, J9589, and J9590, respectively.
5. Reposition panel A8L to allow access to P1/J9587 for the powerup procedure, P2/J9588 for the manipulator positioning mechanism (MPM) procedure, or P3/J9589 for the manipulator retention latch (MRL) procedure.
6. Configure IFM breakout box and jumper leads with the appropriate connector, as specified in the IFM Checklist.
7. Reinstall panel A8L and re-mate the three connectors that were not interfaced in the above step: P2, P3, and P4 or P1, P3, and P4, or P1, P2, and P4.
8. Power up the IFM breakout box and the RMS and perform RMS operations.
9. Power down RMS and the IFM breakout box.
10. Remove breakout box and cables.
11. Re-mate connector P1 to J9587 or P2 to J9588 or P3 to J9589 as appropriate.
12. Install panel A7C.

FAILURES

1. RMS power switch
2. RMS MPM deploy/stow switch
3. RMS MRL release/latch switch

BACKGROUND

In order to read the pin/socket assignments on the connector faces in question, it is necessary to loosen and reposition panel A8L. This is due to the limited length of the wire harnesses. To accomplish this, panel A7C is removed to access connectors behind A8L. Four connectors are de-mated and A8L is repositioned to allow access to the connector interface in question. The breakout box is then interfaced with the appropriate pin/sockets. A8L is then reinstalled and the remaining three connectors are re-mated. Contingency operation of the RMS may then take place by powering up the IFM breakout box. Following RMS operation, the installation is removed.

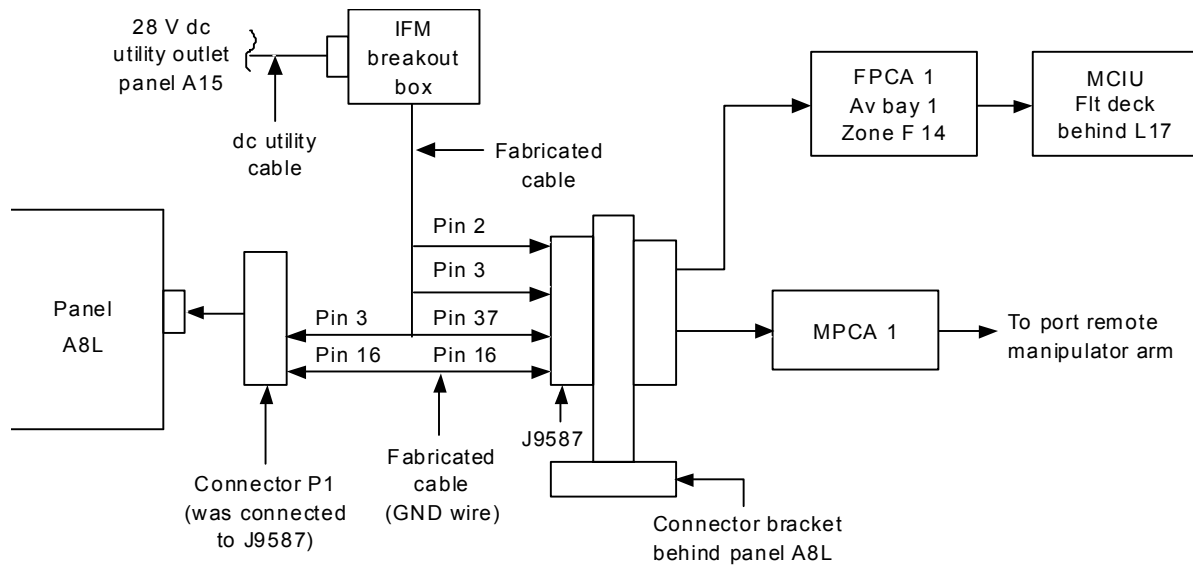
There are two sets of connectors behind panel A8L that are referenced J1, J2, and J3. However, only one of the sets is mated with J9587, J9588, and J9589 on the connector bracket. These connectors are clearly illustrated in the IFM Checklist.

See Figure 5.57-1, Figure 5.57-2, and Figure 5.57-3.

REFERENCES

Drawings

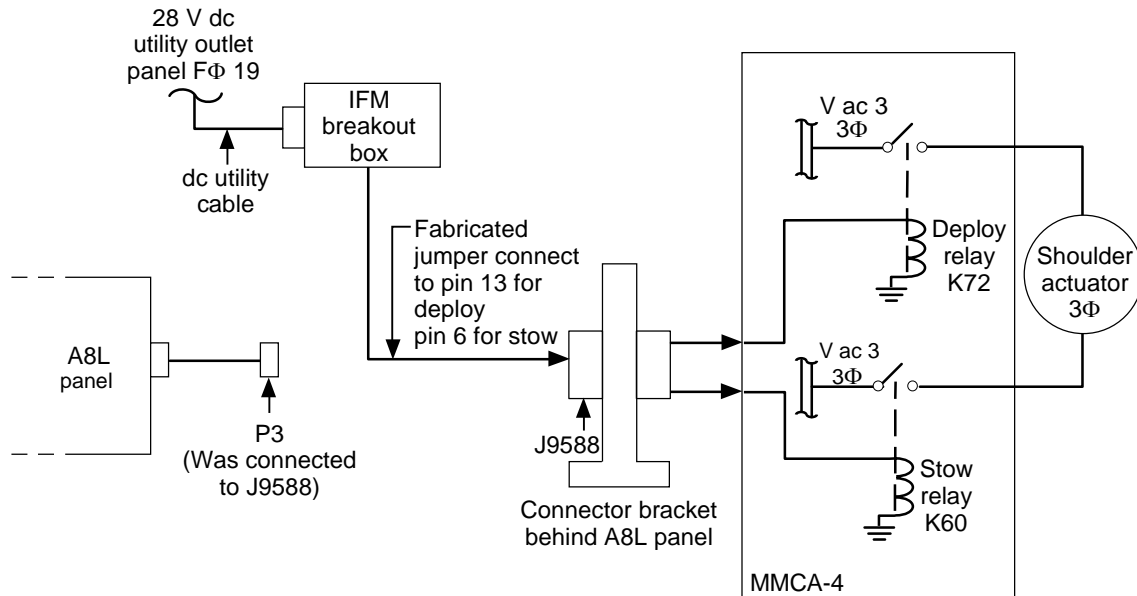
1. VS70-540512, 519, 552, 559, 702, and 709.
2. VS70-956099, and 102.
3. V070-764419, 429, 439, and 449.
4. V070-764522, 532, and 542.



1. 28V dc utility power is provided from A15 panel via breakout box and fabricated cable to power RMS system.
2. Connection to pin 3 of connector P1 provides power to A8L panel.
3. Jumper wire between pin 16 and pin 1 and pin 16 of J9587 must be installed for ground.
4. Connection to pin 2 of J9587 provides power to the MCIU via FPCA1.
5. Connection to pin 3 and pin 37 of J9587 provides power to port manipulator arm MN bus A and heater bus MN A respectively.
6. Procedure assumes failure of RMS power switch.

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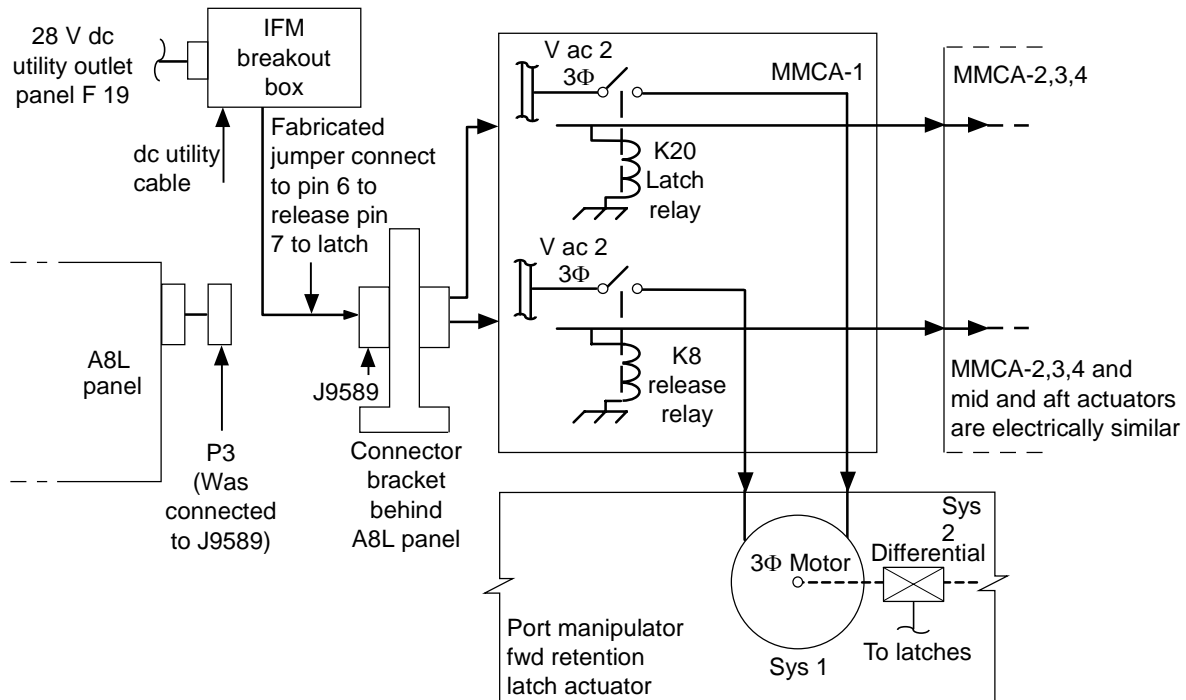
Figure 5.57-1. RMS contingency powerup



1. Procedure assumes failure of the Port RMS DEPLOY/STOW switch.
2. Procedure is directed by PDRS MALF 12.5 A/B.
3. 28 V dc utility power is supplied via the IFM breakout box and a fabricated jumper through J9588 on the connector bracket to MMCA-4.
4. The fabricated jumper is installed in pin 13 or pin 6 for DEPLOY or STOW operation, respectively. This in turn provides power to the appropriate relay in MMCA-4 to allow 3F power to operate the shoulder actuator.
5. Talkbacks are still operable.
6. STBD RMS switches are electrically similar.

jsc22673_016r1.cvx

Figure 5.57-2. RMS MPM contingency deploy/stow



1. Procedure assumes failure of RMS Retention latches switch.
2. Procedure is directed by PDRS MALF 12.5 A/B.
3. 28 V dc utility power is supplied from panel O19 via IFM breakout box and a fabricated jumper through J9589 on the connector bracket.
4. The fabricated jumper is installed in pin 6 or pin 7 for release/latch operation, respectively. This in turn provides power to the appropriate relays in the MMCAs to allow 3Φ power to operate the actuators.
5. Talkbacks are still operable.
6. Diagram illustrates only the fwd retention latch (sys 1) and MMCA 1. MMCAs 2,3,4, mid and aft latches, sys 2, and STBD switches are electrically similar.

jsc22673_015r2.cvx

Figure 5.57-3. RMS MRL contingency release/latch

TITLE

MANIPULATOR RETENTION LATCHES (MRL) CONTINGENCY RELEASE/LATCH

PROCEDURES

Provide an alternate method of releasing or latching MRLs due to Retention Latch sw failure using the Break Out Box to power FWD MRL mtr 1, MID MRL mtr 1, and AFT MRL mtr 2.

1. Power off procedures for RMS
2. Open circuit breakers to power down appropriate connector
3. Configure BOB
4. Access connectors through panel A7C and A8L
5. Demate P1, P2, P3, and P4 to reposition panel A8L and gain better access to connectors
6. Connect BOB to DC Util Outlet O19 and install 22-ga Test Jumper Leads for required operation
7. Move panel back in to place, and reconnect P1, P2, and P4 from A8L
8. Close AC 1, 2, and 3 circuit breakers
9. Power on RMS
10. Power on BOB, single motor drive times
11. Check talk backs for desired position of MRLs
12. Power off BOB
13. Power off RMS

FAILURE

MRLs failed to open or close due to hardware failure on Switch #6, panel A8L "PORT RMS RETENTION LATCHES".

BACKGROUND

In the event of switch #6 malfunctioning the RMS would be either latched in place and unable to be used for the mission, or unlatched and free, denying entry.

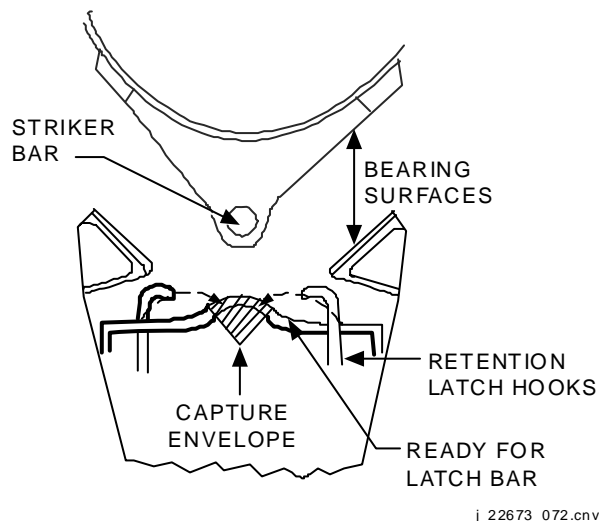
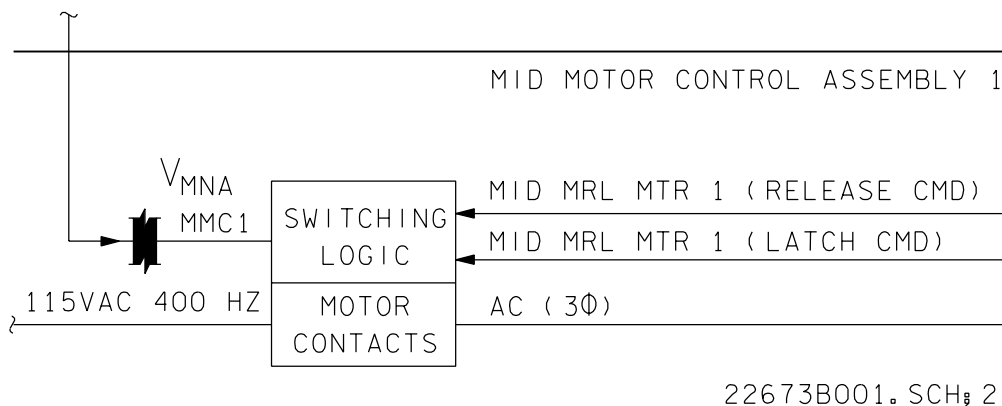


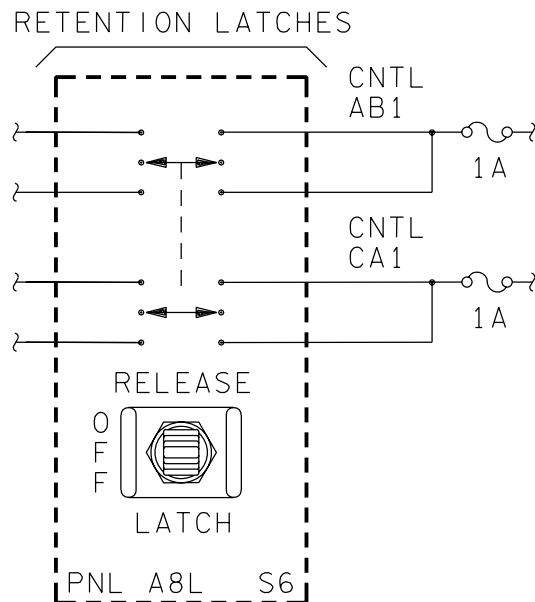
Figure 5.58-1. SSH 14.6-2

The RMS FWD, MID and AFT MRL actuators are Manipulator Retention Latches (MRL) that secure the RMS to the PLB on ascent and entry (Figure 5.58-1). Each is mechanically driven by 2 115 VAC 3 ϕ motors. These motors are powered by the AC power busses 1 and 2 and are operated by power relays (that operate on MECH PWR) (Figure 5.58-2), which are commanded by the three position switch #6 on panel A8L labeled "PORT RMS RETENTION LATCHES" (Figure 5.58-3).



22673B001. SCH; 2

Figure 5.58-2. SSH 14.4-8



22673B002. SCH 2

Figure 5.58-3. SSSH 14.6-3

Power is provided for the S6 switch on A8L by CNTL CA1 through socket # 14 on J-9589(P-3) and CNTL AB1 through socket # 26 on J-9588(P-2) (Figure 5.58-4, and Figure 5.58-5). Therefore, when the connector J-9589(P-3) is powered by the BOB only MID MRL mtr 2, FWD MRL mtr 2, and AFT MRL mtr 1, powered by CNTL CA1 power is supplied, no CNTL AB1 power is provided to MID MRL mtr 1, FWD MRL mtr 1, and AFT MRL mtr 2, and thus producing only single motor times.

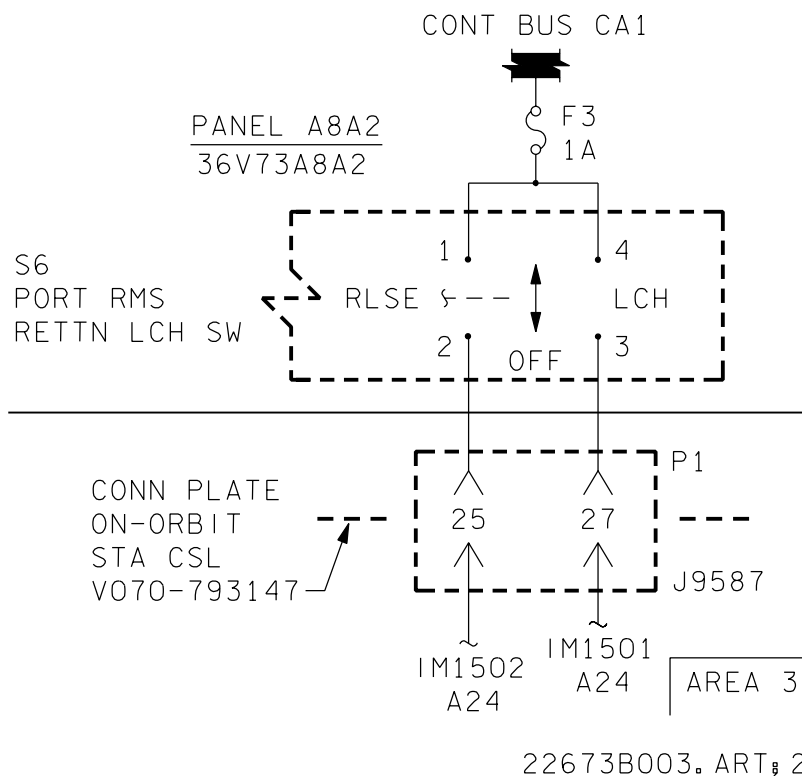
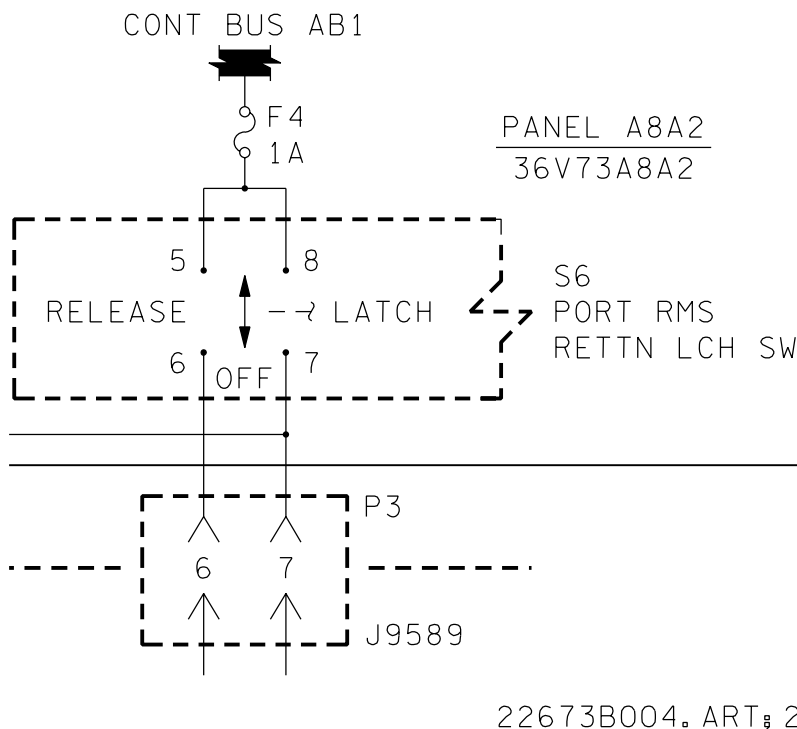


Figure 5.58-4. VS70-540702-3



22673B004. ART. 2

Figure 5.58-5. VS70-540702-4

NOTES

The fact that the power goes through the same connector opens the possibility of doing the procedure without the BOB by using a pin/pin jumper and connecting either socket # 6 for RELEASE or # 7 for LATCH to any of: socket # 14 (CA1), socket # 3 (AB2), socket # 4 (CA2), socket # 12 (BC1), socket # 13 (CA3).

When power is provided to socket # 6 or socket # 7 for either LATCH or RELEASE, using the BOB or the pin/pin jumper method described above, the appropriate MID MOTOR CONTROL ASSEMBLY is sent a discrete command that orders the logic to close a relay to the proper motor contacts which rotate the latch in the desired direction. This closes the AC circuit and the motors are driven in the direction necessary.

This discussion is specific to the operation of the Port RMS MRL's. STBD MRL's are electronically similar.

REFERENCES

1. RSS Boeing Engineering web page (<http://p51.ksc.nasa.gov/>)
2. SSSH DWG NO. 14.4-8; DWG NO. 14.6-1, -2
3. VS70-540702 sheets 3 and 4

TITLE

RMS, MCIU CHANGEOUT

PROCEDURES

Replace a hard-failed MCIU with a stowed spare to recover RMS computer supported modes and data display to the CRT and A8 D&C panel.

1. Power down RMS
2. Un-stow spare MCIU
3. Access failed MCIU (behind panel L17)
4. De-mate connectors from failed MCIU
5. Remove failed unit
6. Install spare MCIU
7. Mate connectors
8. Install panel L17

FAILURES

Hard-failed MCIU.

BACKGROUND

For RMS-intensive missions, computer-supported RMS capability is considered critical for mission success. In these situations, a spare MCIU is manifested and will normally be stowed inside a middeck locker. The MCIU is air cooled and is a normal part of in-flight filter cleaning.

REFERENCES

Drawings

1. V070-773301, V070-773303, and V070-773305 (OV-103).
2. V070-773271, V070-773203, and V070-773285 (OV-102).

TITLE

S-BAND DOWNLINK RECOVERY (SOLID STATE MMU)

PROCEDURES

Recover real-time downlink telemetry due to S-band transponder failure by bypassing MMU1 (2) using alternate data path from NSP1 (2) to S-band Fm System.

1. Perform Powerdown: S-BD PM CNTL - PNL
NSP POWER - OFF
MMU1 (2) OFF
2. Remove lockers and debris traps to access MMU1 (2)
3. For MMU1 demate P511 from J1 and P513 from J3
4. For MMU2 demate P511 from J1 and P513 from J3
5. Install required test jumper leads
6. Tape/secure cables and jumper leads in place
7. Re-power NSP's and S-band PM CNTL - CMD
8. MCC checkout
9. Reinstall debris traps and lockers

FAILURES

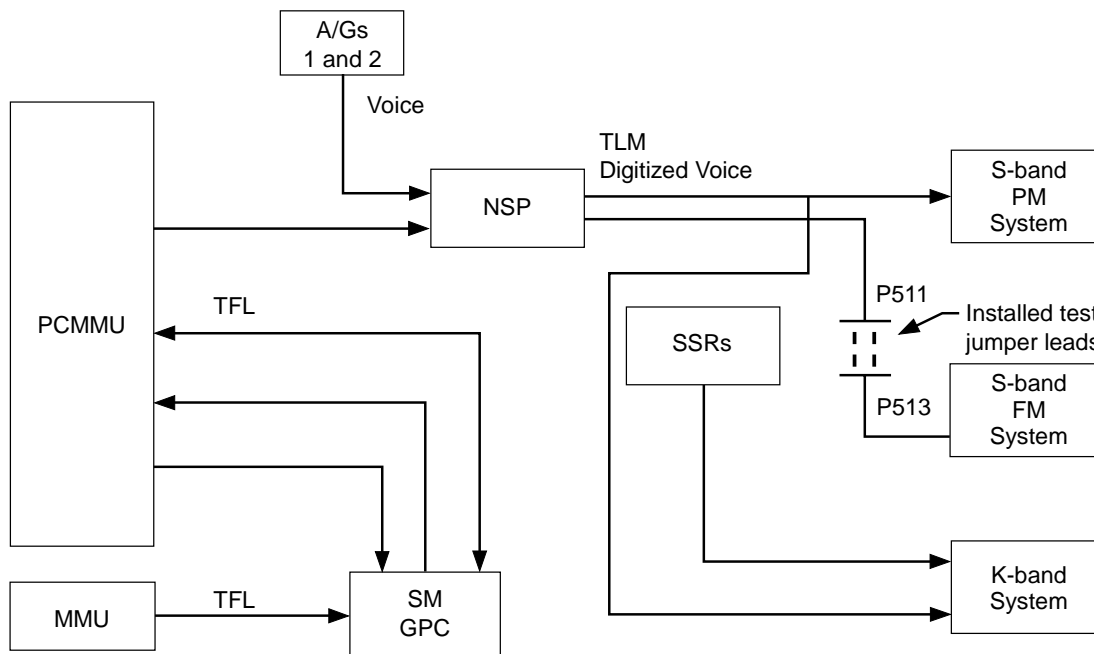
Loss of nominal S-band downlink data path.

BACKGROUND

Real-time data is processed by the NSP's and S-band transponder for normal downlink via the TDRS and ground stations. The NSP data is also fed to the Solid State MMU's where it is stored during LOS to be dumped via the S-band FM system during acquisition of signal (AOS). Therefore, if the normal S-band downlink data path is lost, downlink data can be recovered by using the alternate data path of NSP 1(2) to the S-band FM system. However, this path is for storing and later for dumping data. Real-time data can be recovered by cutting the MMU SSR out of this data path. When this is done the MMU SSR is lost and each NSP will be dedicated to S-band downlink only. See Figure 5.60-1.

REFERENCES

1. OMI's.
 - a. V5Q16.01 and 02
 - b. V5A32 and 33
 - c. V5A05
2. Drawings.
 - a. V070-703005
 - b. V070-703006
 - c. V070-793811
 - d. V070-783881



1. Under normal operation, signals are downlinked from NSP 1/2 through S-band transponder 1/2 to TDRS or ground sites during launch or entry.
2. This procedure bypasses the failed transponder to provide downlink telemetry via the S-band FM signal processor.
3. Connectors P511 and P513 are removed from J1 and J3 respectively on the solid state MMU. Test Jumper Leads are connected to jumper the input signal and the return signal.
4. This procedure results in loss of the SSR function in the bypassed MMU.
5. The FM system is not compatible with TDRS.
6. This procedure would be installed for reentry.
7. On-orbit downlink would still be via Ku-band system.

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Figure 5.60-1. S-band real-time downlink recovery

5.60-2

Verify that this is the correct version before use

TITLE

STANDARD SWITCH PANEL CABLE CHANGEOUT

PROCEDURES

Swap cables on the back of a single standard switch panel (SSP) to regain a failed switch or talkback (tb) function. This is possible because each SSP is made up of identical redundant halves.

PROCEDURE

1. Power down affected switch harnesses.
2. Remove SSP fasteners.
3. Remove/open panels, as required, to access the harness wire ties.
4. Cut wire ties, as required, to allow panel removal.
5. Remove/reposition panel, as required, to access connectors on back.
6. Swap required connectors.
7. Re-power switches.

FAILURE

Switch or tb failure on the SSP. (This procedure covers only mechanically failed switches and tb's. It does not cover loss of input power or other power-related failures.)

BACKGROUND

Each SSP consists of 24 switches and their 24 tb's, 4 cb's, and 1 input/output (I/O) connector on the face of each panel. There are normally two SSP's flown, SSP no. 1 and SSP no. 2, located on the flight deck in either the L11 or L12 position. The output functions of switches 1-12 and 13-24, their tb's, and cb's 1 and 3 are wired through identical but separate connectors.

Specifically,

- | | |
|-----------------|--|
| Switches | 1, 2, 8, 11, 12, and (9) are wired through J6. |
| | 13, 14, 20, 23, 24, and (21) are wired through J2. |
| | 3, 4, 5, 6, 7, 10, and (9) are wired through J12. |
| | 15, 16, 17, 18, 19, 22, and (21) are wired through J8. |
| Talkbacks | 1-12 are wired through J5. |
| | 13-24 are wired through J1. |
| Circuit breaker | 3 is wired through J7. |
| | 1 is wired through J11. |

The connector size, key phasing, and the pin/socket arrangement on J6 and J2 are identical, also J12 and J8, J5 and J1, and J7 and J11. Therefore, if switch 8 jammed, the harness connected to J2 could be removed, and the harness connected to J6 could be moved to J2, thereby allowing switch S20 to function for switch S8. Similarly if switch J19 jammed, the harness connected to J12 could be removed, and the harness connected to J8 could be moved to J12, allowing switch S7 to function for switch S19. The only exceptions to this are switches 9 and 21. In these cases, two harnesses may need to be swapped to regain complete function of the switch. Logically the swap of harnesses for the tb's and cb's would follow the same pattern.

One exception to this: the output of cb 3 on SSP no. 1 is dedicated to the payloads timing buffer and probably would not be swapped.

Failure	Remove cable on	Swap cable from -	Use function
S1	J2	J6 to J2	S13
S2	J2	J6 to J2	S14
S3	J8	J12 to J8	S15
S4	J8	J12 to J8	S16
S5	J8	J12 to J8	S17
S6	J8	J12 to J8	S18
S7	J8	J12 to J8	S19
S8	J2	J6 to J2	S20
S9	J2 & J8	J6 to J2 & J12 to J8	S21
S10	J8	J12 to J8	S22
S11	J2	J6 to J2	S23
S12	J2	J6 to J2	S24
S13	J6	J2 to J6	S1
S14	J6	J2 to J6	S2
S15	J12	J8 to J12	S3
S16	J12	J8 to J12	S4
S17	J12	J8 to J12	S5
S18	J12	J8 to J12	S6
S19	J12	J8 to J12	S7
S21	J6 & J12	J2 to J6 & J8 to J12	S8
S20	J6	J2 to J6	S9
S22	J12	J8 to J12	S10
S23	J6	J2 to J6	S11
S24	J6	J2 to J6	S12
tb 1-12	J1	J5 to J1	tb 13-24, respectively
tb 13-24	J5	J1 to J5	tb 1-12, respectively
cb 1	J7	J11 to J7	cb 3
cb 3	J11	J7 to J11	cb 1

REFERENCES

1. Drawing V072-200007, crew module.
2. Drawing VS70-760809, schematic diagram payload subsystem interface.

TITLE

THC CHANGEOUT

PROCEDURES

Replace a failed forward translation hand controller (THC) with the aft THC (if the THC is required for entry).

1. Power down and remove the failed forward THC.
2. Power down and remove the aft replacement THC.
3. Install the aft replacement THC in the forward THC location.
4. Power up and test the replaced THC in the forward station.
5. Install the failed forward THC (with the connector interfaces taped over) in the aft THC station.

FAILURE

Loss of the forward THC if it is required for entry (aft THC is considered failed when two channels are lost).

BACKGROUND

There are two THC's onboard the orbiter.

THC	Location	Power supplies	Main bus
Fwd	Panel F5A2	DDU no. 1 A, B, and C	MNA and MNB
Aft	Above panel A6U	DDU no. 3 A, B, and C	MNA and MNC

Each THC manually inputs commands to the flight control system in the $\pm X$, Y, or Z direction. The forward THC can be used for the orbit insertion, on-orbit, and de-orbit flight phases (after de-orbit burn, the THC is not used). The aft THC can be used only during the on-orbit flight phase. Each THC has three channels (A, B, and C) for each axis of translation (X, Y, and Z or longitudinal, lateral, and vertical) for a total of nine. These channels are powered by three separate supplies inside the associated DDU. (Power supply A feeds the A channels for all three axes of the THC, etc.) The THC changeout would only be considered if the RCS was required to perform the de-orbit burn and the fwd THC had failed.

REFERENCES

1. Specification MC621-0043 space shuttle flight control subsystem (P/N: MC621-0043-3140).
2. Drawing V070-730032, panel installation orbit station areas THC, A2, A4, A6, and A7.
3. Flight rules A2-105 and A8-1001.
4. GNC Systems Briefs Section 13, Controllers.

TITLE

UTIL CABLE/OUTLET PWR CHECK (AC)

SUMMARY

Determine location of ac power failure for a middeck experiment

PROCEDURE

1. Power down AC UTIL outlet.
2. Remove test probes from multimeter leads and configure with 20-ga. test adapters from pin kit.
3. Install a 5-in., 20-ga. pin/socket test jumper lead onto red test adapter and a pin/pin test jumper lead onto black test adapter.
4. Configure multimeter to read volts ac.
5. Install test jumper leads into sockets of cable or outlet to be tested.

Socket A - ϕA

Socket B - ϕB

Socket C - ϕC

Socket J - Ground

Socket F - Neutral

6. Turn utility power on and record voltages, and then turn utility power off. Repeat steps 5 and 6 for other phases as required

FAILURE

Shorted or open power cable or failed bus to ac utility outlet.

BACKGROUND

Procedure is intended to provide preliminary troubleshooting to isolate ac power problems. It determines if power is reaching outlets and the consumer but does not measure voltages under load conditions.

REFERENCES

VS70-760402 - AC PWR DIST and Control - Subsystem.

VS70-760409 - AC PWR DIST and Control - Subsystem.

TITLE

UTIL CABLE/OUTLET PWR CHECK (DC)

SUMMARY

Determine location of dc power failure for a middeck experiment.

PROCEDURE

1. Power down DC UTIL or MUP Outlet.
2. Remove test probes from multimeter leads and configure with 16-ga. test adapters from Pin Kit (MUP outlets J5, J11, and J21 are 12 ga.).
3. Install a 5-in., 16-ga. pin/socket test jumper lead onto red test adapter and a pin/pin test jumper lead onto black test adapter.
4. Configure multimeter to read volts dc.
5. Install test jumper leads into sockets of cable or outlet to be tested.

Socket J - +28 V

Socket K - Return

Socket L - Ground
6. Turn utility power on and record voltages then, turn utility power off.

FAILURE

Shorted or open power cable or failed bus to dc utility outlet.

BACKGROUND

Procedure is intended to provide preliminary troubleshooting to isolate dc power problems. It determines if power is reaching outlets and the consumer but does not measure voltages under load conditions.

REFERENCES

SID39119180 - Middeck Utility Panel.

TITLE

VTR CHANGEOUT

PROCEDURE

To replace a hard-failed Video Tape Recorder (VTR) with a stowed spare to recover VTR operations.

1. Powerdown VTR
2. Un-stow spare VTR
3. Access failed VTR
4. De-mate wire harness connectors from failed VTR
5. Remove failed unit
6. Mate wire harness connectors to spare
7. Install spare VTR

FAILURES

A hard failed VTR

BACKGROUND

Post STS-107 tragedy, Mission Management decided to perform an Orbiter vehicle survey after ascent phase of flight on all subsequent Space Shuttle missions. This action is an attempt to identify any potential Orbiter structural damage and/or breach. Therefore, on-board Photo-TV (P-TV) hardware has become critical to accomplish a successful mission.

If there is any Orbiter structural damage and/or breach identified, then an attempt to repair it will be addressed prior to entry phase of flight. If the Orbiter vehicle experienced massive structural damage during the entry phase of flight and repairs cannot be accomplished, the crew will seek safe haven on the International Space Station (ISS). The severely damaged Orbiter will be discarded and a rescue mission will be deployed.

NOTES

The VTR Changeout IFM procedure was performed on STS-114. At MET 001/01:45, the crew called down mentioning problems with the VTR. Immediately, IFM console operators began reviewing the IFM Checklist published VTR Changeout procedure in preparation for potential hardware changeout post initial troubleshooting activity. Then

at MET 001/02:42, the crew called down to inform MCC that they have accomplished VTR changeout and recovered VTR operations.

The crew actually took it upon themselves to changeout the hardware before we (MCC) instructed them to do so. The only difficulty experienced during VTR changeout was that #6 Torque Tip Driver called out in the procedure was too big for the Strain Relief connector bracket fastner. Therefore, a Phillips head screwdriver was used vs. the #6 Torque Tip Driver.

REFERENCES

1. In-Flight Maintenance (IFM) Checklist, RMS, MCIU Changeout & MUX Changeout w/Spare
2. P-TV personnel (Dave Williams)
3. Drawings: VS72-270151
ICD-8-214298

TITLE

WATER PROCEDURES, GENERAL INFORMATION

PURPOSE

This section identifies the water related hardware stowed on the orbiter that can be used to support IFM procedures. In addition a legend is included to aid in the use of the schematics that are also provided. The following chart identifies all water related equipment carried on board the orbiter to support IFM procedures:

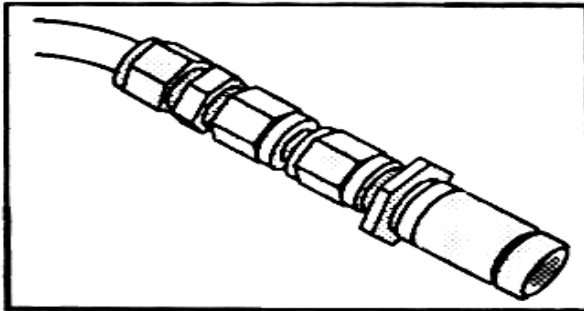
COMPONENT	COLOR BAND	LENGTH	CONNECTOR
B/B Hose	Blue - Blue	10 ft	Male ^{4,1}
R/R Hose	Red - Red	10 ft	Female ¹
Y/Y Hose	Yellow - Yellow	8 ft	Female ³
Y/R QD Adapter	Yellow - Red	5 in	Female ⁴
Free fluid Nozzle	None	8 in	Male ⁸
Personal Hygiene Hose	None	12 ft	Female ²
CWC Hose (1)	Yellow - Yellow	20 ft	Female ³
CWC (2)	None		Male ^{3,5}
Contingency Water Dispenser	None	6 in	Male ⁶
Waste Water Dump Filter	None	8 in	Male, Female ⁷

NOTES

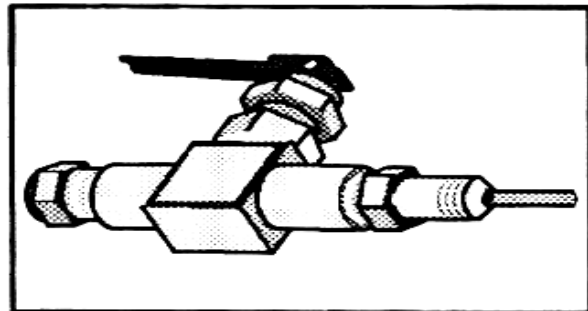
1. Red hose mates to blue hose, both are ¼ in.
2. Personal hygiene hose mates with auxiliary ports and deck quick disconnects. Connector is the same size as the Red/Red hose connectors.
3. Yellow hose mates with potable and waste CONTINGENCY CROSS TIE quick disconnects located on the forward outboard wall in the WCS compartment, the Free Fluid Nozzle, and the CWC and payload quick disconnects.
4. Yellow/Red quick disconnect adapter allows blue hose to mate with the potable and waste CONTINGENCY CROSS TIE quick disconnects in the WCS compartment.
5. Contingency Water Container (CWC) – Maximum allowable capacity is 95 lb.

6. Contingency water dispenser attaches to the Red/Red hose.
7. The Waste Water Dump Filter connects to the CONTINGENCY CROSS TIE quick disconnects in the WCS and is used for Free Fluid Disposal and CWC dumps.
8. The Free Fluid Nozzle attaches to the Yellow/Yellow and CWC hoses.

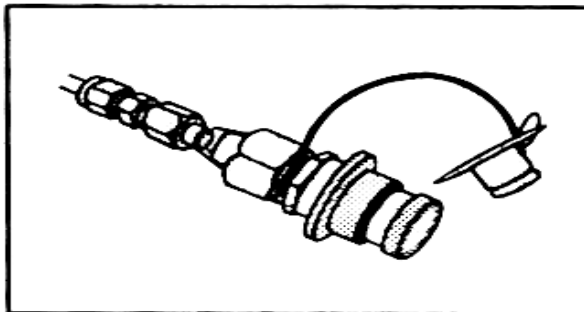
Diagrams on the following pages depict water related equipment.



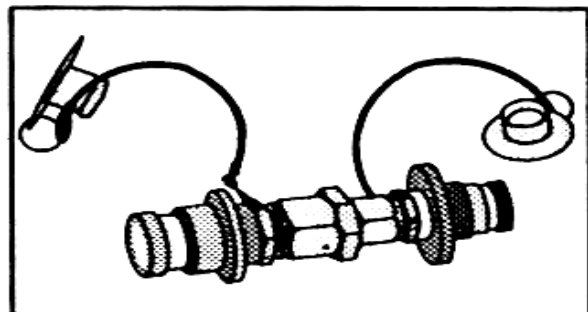
B/B Hose (male QD)



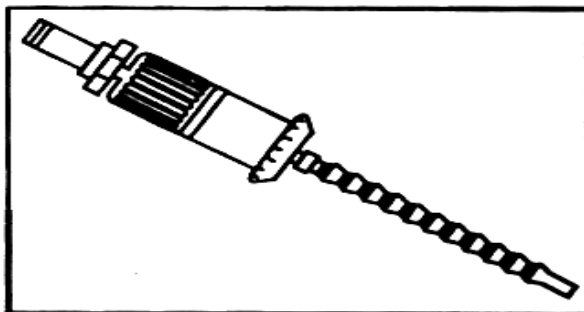
Contingency Water Dispenser
(male QD)



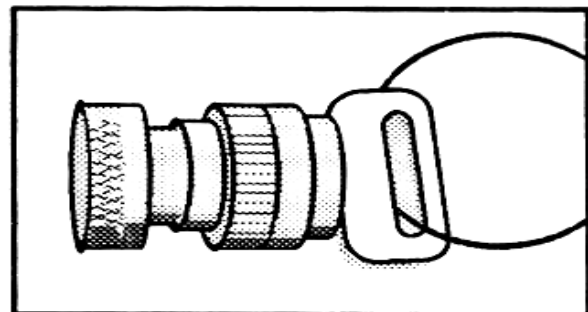
R/R Hose (female QD)



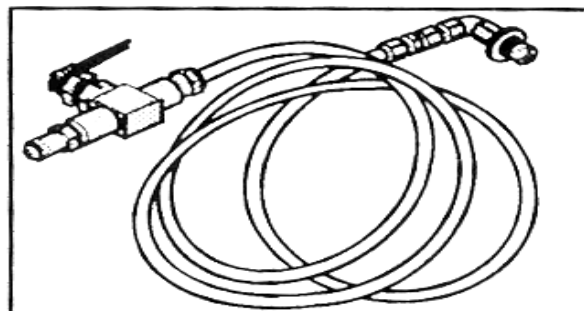
Y/R QD Adapter
(female/female QDs)



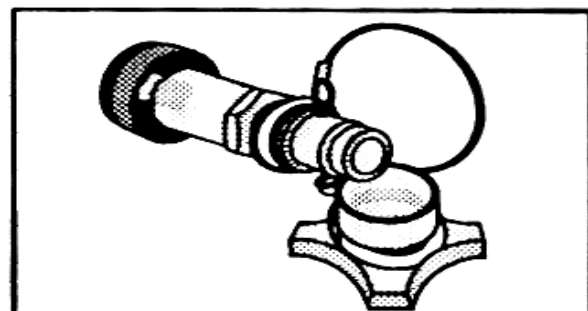
Free Fluid Nozzle (male QD)



5/8-in to 7/8-in Adapter

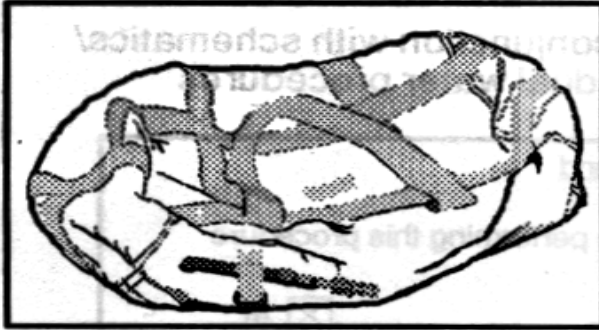


Personal Hygiene Hose
(female QD)

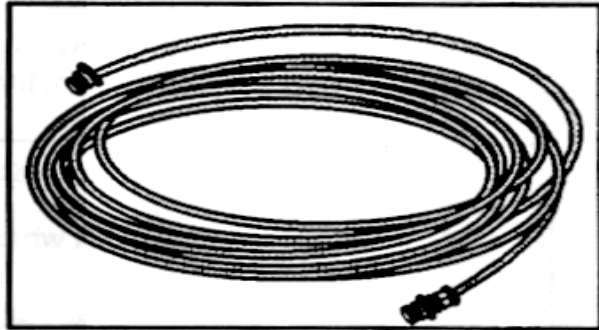


Urine QD Adapter
(male QD)

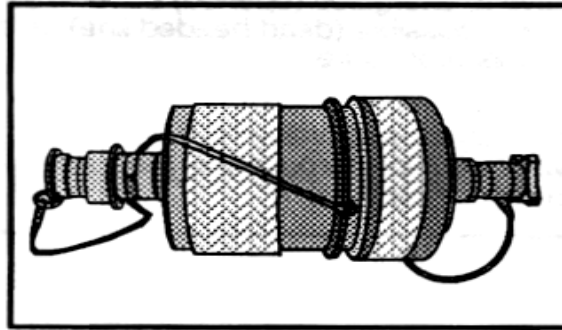
ifm_sw_



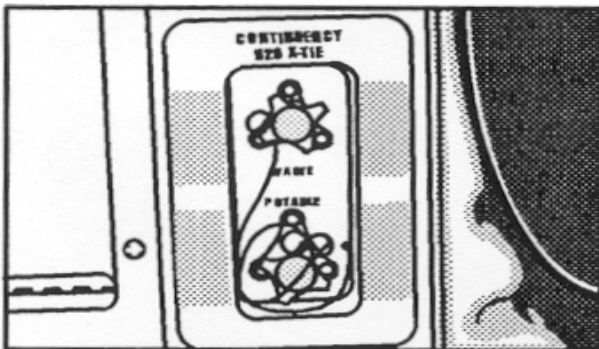
Contingency Water
Container (CWC) (male)



CWC Hose (20 ft)



Waste Water Dump Filter
(male, female QDs)



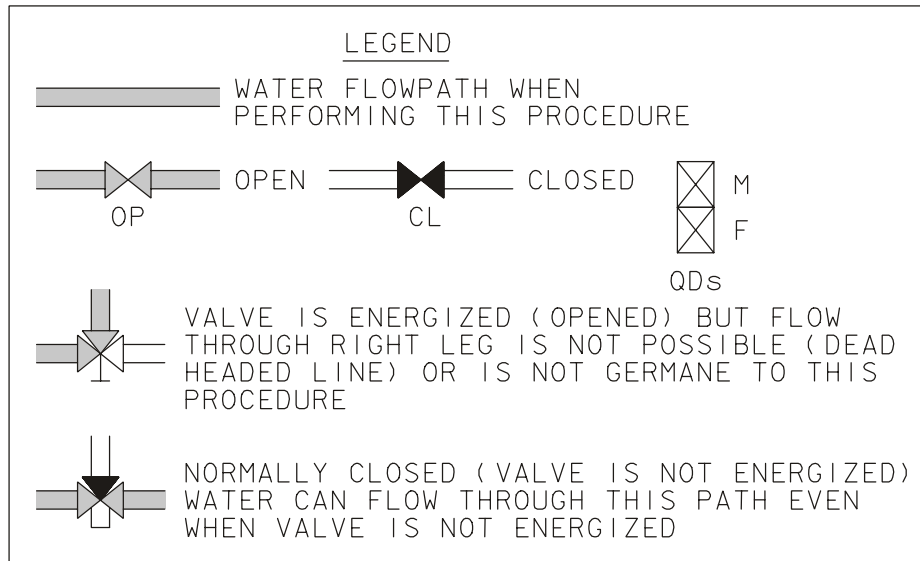
Contingency H2O X-TIE
(male QDs)



WCS Vacuum Vent
(male QDs)

LEGEND

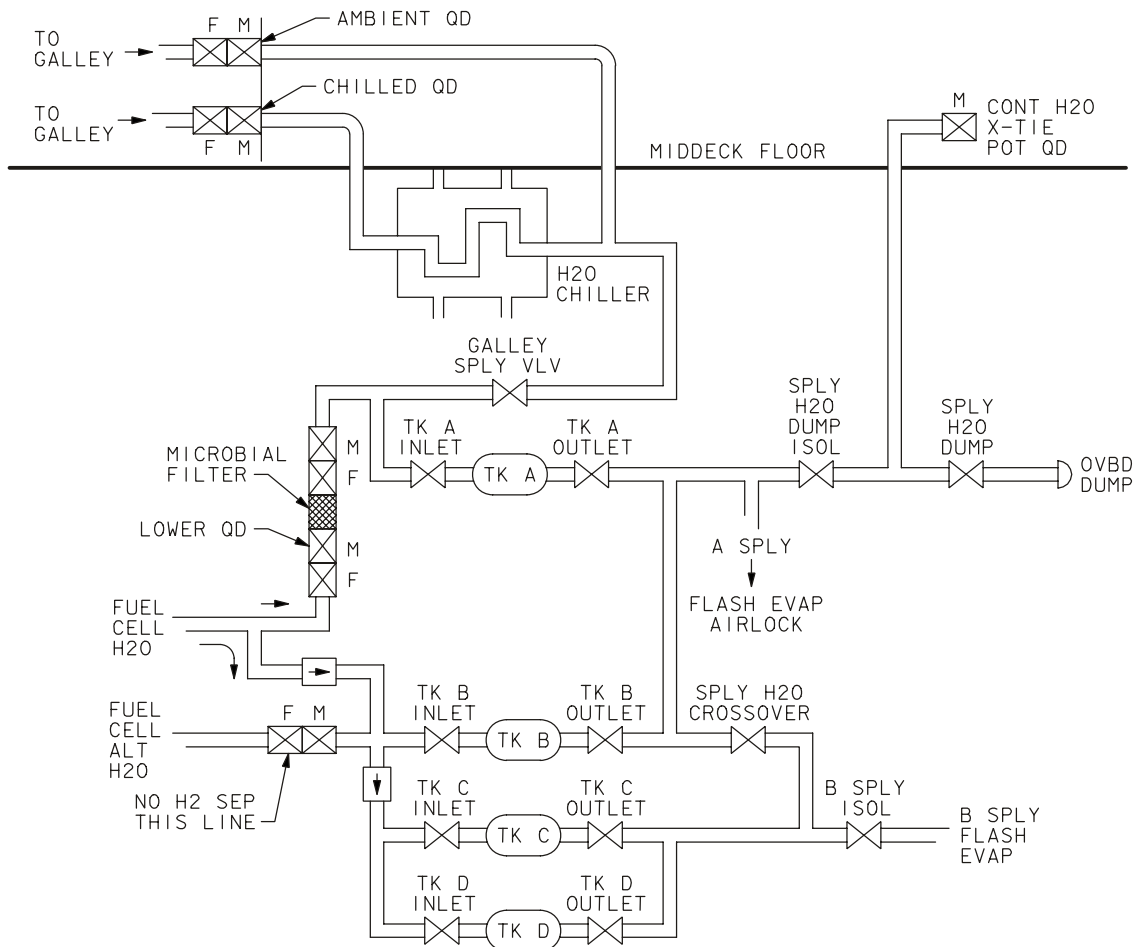
The following legend is included and may be used in conjunction with the schematics and drawings provided as part of individual water procedures.



22673005. ART# 1

SCHEMATICS

The following schematics cover galley, supply, and waste water systems. The Middeck floor reference line shown to distinguish between water lines in the cabin and water lines in the lower equipment bay. The schematics included here are the Supply Water System (SWS). (Figure 5.66-1), Waste Water System (WWS) (Figure 5.66-2), and the Galley Water System (GWS) (Figure 5.66-3).



22673004. ART; 1

Figure 5.66-1. Supply water system schematic

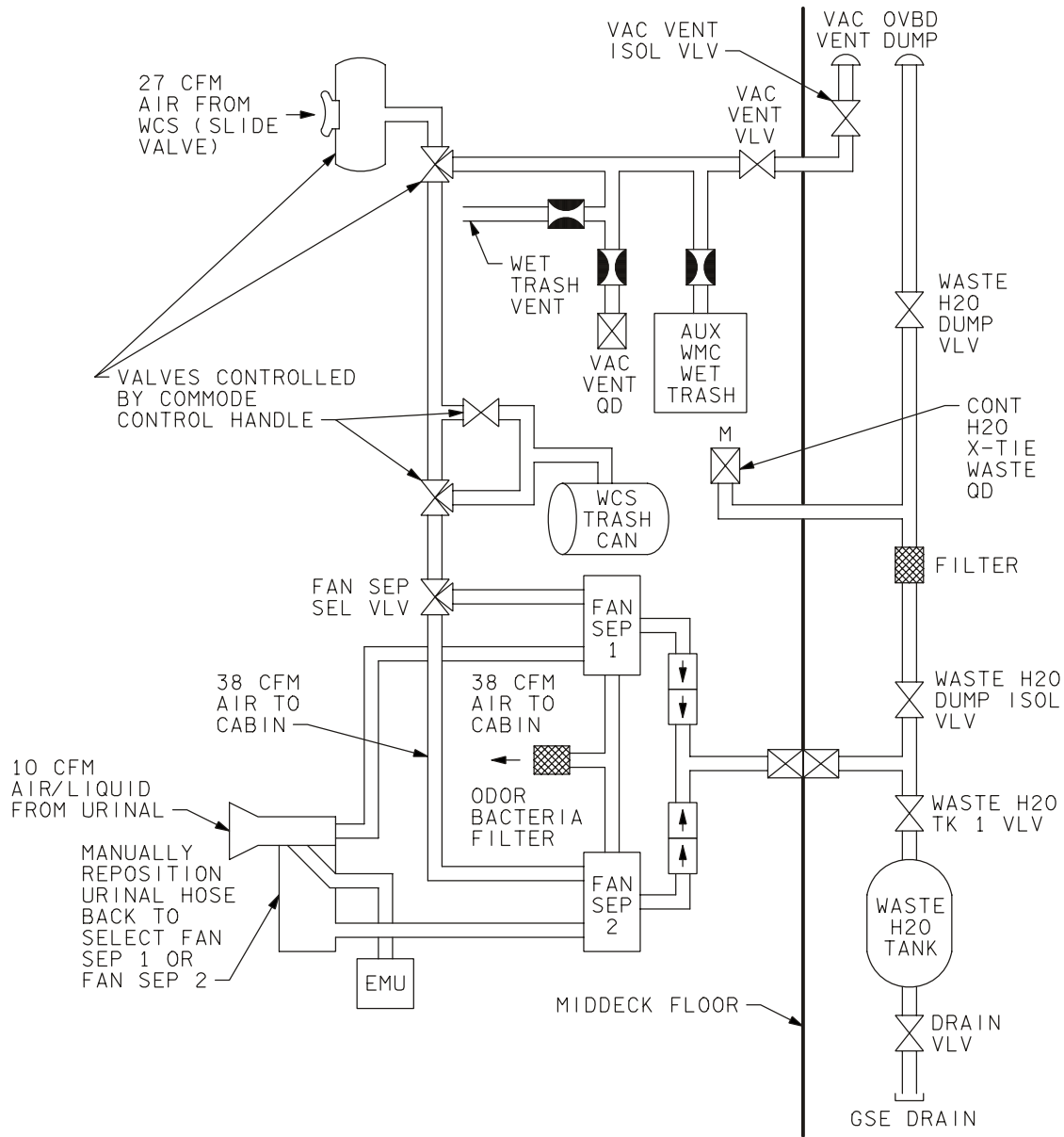
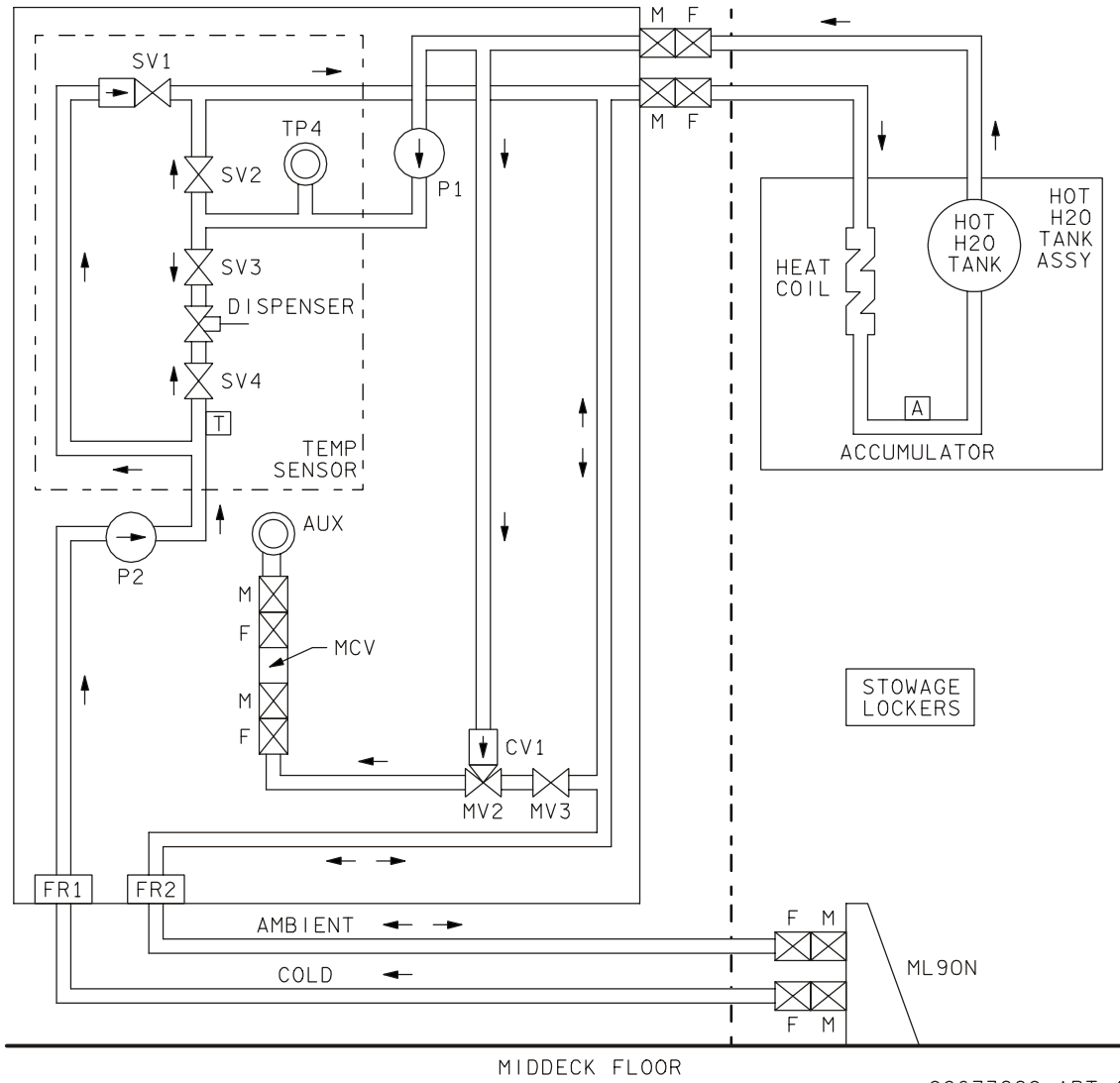


Figure 5.66-2. Waste water system schematic

5.66-7

Verify that this is the correct version before use



22673002. ART 1

Figure 5.66-3. Galley water system schematic

TITLE

CONTINGENCY WATER CONTAINER OPERATION (SUPPLY)

PROCEDURES

Stow supply water in the contingency water container (CWC) in the event that the water can't be dumped due to payload constraints or system failure. FDF procedure references water dumps from tank B, but can be reconfigured for other supply water tanks.

1. Clear stowage volume H(G) (Vol. G access can be found in the General Information section of the IFM FDF). Temp stow contents of volume H(G), as directed by MCC.
2. Line the bottom of volume H(G) with soft material, such as clothing or towels.
3. Check that there is no trapped gas in the CWC, if there is connect hose to CWC QD and WCS vacuum Vent QD, and vent CWC. Disconnect hose from vacuum vent.
4. Install CWC in Vol H(G).
5. Select the Supply water dump isol valve to close and check that the Tank B outlet talk back is to open.
6. Connect the CWC contingency hose to contingency water cross-tie potable QD, secure the hose with gray tape.
7. Maintain a log of the present supply water tank B quantity: _____%.
8. Subtract 56% (95 LBM).
9. FDA limit for supply tank B to CWC transfer is the difference between line 7 and 8 above.
10. ITEM 1+0620420 EXEC.
11. ITEM 2+TKB limit form above EXEC.
12. Select the supply water dump isol valv to open.
13. Monitor the CWC fill rate continuously.
14. When 'S66 H₂O' for supply tank quantity, continue.
15. Select supply water dump isol valve to close.
16. Check that the total quantity dumped from tank B is 56% (95 LBM).
17. If the total dumped is less than 56% continue the dump.

18. When the total dump is 56%, disconnect the CWC contingency hose from the contingency water cross tie potable QD.
19. Disconnect the CWC contingency hose from the CWC QD.
20. Cover the CWC with towels or clothing and close volume H(G), stow tools.
21. Select supply water dump isol valve to open.

FAILURE

TBD

BACKGROUND

TBD

REFERENCES

TBD

TITLE

CONTINGENCY WATER CONTAINER OPERATION (WASTE)

PROCEDURES

Stow waste water in the contingency water container (CWC) in the event that the waste tank is full and cannot be dumped overboard.

1. Clear stowage volume H (or G) for CWC operations.
2. Configure contingency water equipment (CWC, Y/Y hose, and contingency water X-tie waste WD).
3. Dump waste tank to CWC.
4. Disconnect CWC and leave in volume for entry.
5. Reconfigure waste water system and equipment.

FAILURE

Blocked waste water dump nozzle or line, or a failed closed waste water dump valve.

BACKGROUND

The CWC was developed as a result of the STS-41-D mission. During this mission, an iceball formed on the waste water dump nozzle during nominal dump operations. As a result, the crew was unable to provide/create ullage in the waste tank and was unable to use the WCS.

The CWC was created to serve as a "spare" waste tank. It can be used in either volume H or volume G. Use in volume G requires a longer hose (20 ft) than the Y/Y hose (8 ft) to reach from the contingency water x-tie waste quick disconnect (QD) across the middeck to volume G. For this possible configuration, a 20-ft hose is flown. To use the 20-ft hose, the QD's must be removed from the Y/Y hose (adjustable wrench, combination wrench) and attached to each end of the 20-ft hose.

The CWC and the 20-ft hose are normally stowed in volume G along with the contingency waste equipment.

The procedure dumps up to 90 lbm (53 percent of a full waste tank) to the CWC. CWC capacity is 120 lbm of water. It will not be filled greater than 90 lbm so as not to place excessive loads in either volume H or G.

REFERENCES

Drawings

1. VS70-620202, waste management subsystem diagram.
2. VS70-420209, waste management subsystem diagram.
3. VS70-623200, system installation, ECLSS equipment bay.

TITLE

FC H₂O pH TEST

PROCEDURES

1. Redirect Fuel Cell H₂O to galley
2. Disconnect ambient and chilled H₂O QD's from Galley
3. Remove one QD from R/R hose
4. Power up WCS
5. Tape R/R hose (non QD end) to spare urinal funnel
6. Connect R/R hose to ambient QD on Galley
7. pH test H₂O
8. If pH > 9
Disconnect R/R from ambient QD and return to MAL, EPS, 7.3a, step 10
9. If pH < 9
Flow water into urinal for 10 minutes
check pH
10. If pH > 9
Disconnect R/R from ambient QD and return to MAL, EPS, 7.3a, step 10
11. If pH < 9
Disconnect R/R from ambient QD, remove second R/R QD and evacuate residual H₂O in the hose
12. Reconnect Galley ambient line to QD
13. Shut down WCS
14. Reattach QD's to R/R hose
15. Stow tools
16. Return to MAL, EPS, 7.3a, step 10

FAILURE

SM alert from ORB PKT FC pH HIGH or H₂O LINE pH HIGH. A pH detector in the fuel cell or in the H₂O line has detected high pH in the H₂O. This is due to high either concentrations of KOH or a pH XDCR failure. The pH XDCR failure has to be ruled out by pH testing using a litmus paper test strip.

BACKGROUND

The malfunction matrix takes into account the possible failure of a XDCR and requires that the litmus test be performed on the FC H₂O. By closing the SPLY H₂O TKA INLET, and opening the GALLEY SPLY VLV, H₂O from the FC is routed directly to the GALLEY. Disconnecting both GALLEY QDs ensures that minimal contaminated H₂O enters the GALLEY.

Once the R/R hose has been connected to the GALLEY, there is a direct line from the FC to the R/R. If the problem has been identified to be the XDCR, the system is returned to its original configuration and the failure is noted. If the pH is due to a concentration of KOH, return to MAL, EPS, 7.3a.

NOTES

TBD

REFERENCES

1. SSSH DWG NO. 3.1-1 (E5-C3); DWG NO. 6.4 (T2-T1, Q3); DWG NO. 6.6-1
2. VS70-623103, sheet 2

TITLE

FC H₂O SPLY LINE FLUSH

PROCEDURES

1. Redirect Fuel Cell H₂O to galley
2. Disconnect ambient and chilled H₂O QDs from Galley
3. Remove one QD from R/R hose
4. Power up WCS
5. Tape R/R hose (non QD end) to spare urinal funnel
6. Connect R/R hose to ambient QD on Galley
7. pH test H₂O
8. Flow H₂O into urinal for 10 min. to clear high pH from Fuel Cell to ambient QD
9. pH test H₂O
10. If pH > 9
11. Continue to flow until pH < 9
12. Open TK A inlet
13. Flow water into urinal for 10 minutes
14. pH test H₂O
 - if pH > 9
 - TK A is unusable (contaminated)
 - Close SPLY H₂O TK A INLET
 - continue to flow until pH < 9
 - if pH < 9
 - TK A is usable
15. Disconnect R/R hose from ambient QD
16. Evacuate residual water from R/R hose
17. Connect R/R hose to chilled QD on Galley

18. pH test H₂O
19. Flow water into urinal for 10 minutes to clear high pH from Fuel Cell to chilled QD
20. pH test H₂O
21. If pH > 9
 continue to flow until pH < 9
22. Disconnect R/R hose from chilled QD
23. Evacuate residual water from R/R hose
24. Reconnect ambient and chilled lines
25. Shut down WCS
26. If pH > 9 when H₂O started to flow (steps X and X) execute GALLEY H₂O LINE FLUSH procedure
27. If GALLEY H₂O LINE FLUSH not required, remove R/R from urinal and clean
28. Reattach QDs to R/R hose
29. Stow tools

FAILURE

SM alert from ORB PKT FC pH HIGH or H₂O LINE pH HIGH. After FC H₂O pH TEST is accomplished and FC is safed, the contaminated H₂O must be purged from the H₂O lines and TK A.

BACKGROUND

See FC H₂O pH TEST.

NOTES

TBD

REFERENCES

1. SSSH DWG NO. 3.1-1 (E5-C3); DWG NO. 6.4 (T2-T1, Q3); DWG NO. 6.6-1
2. VS70-623103, sheet 2

TITLE

FES SUPPLY, WASTE WATER

SUMMARY

Interconnect the waste and supply (sply) water systems via the contingency cross-tie ports and the Y/Y hose to allow waste water to be used for flash evaporator system (FES) operation.

PROCEDURE

1. Close sply H₂O dump isolation valve and sply dump valve.
2. Close waste H₂O dump isolation valve, waste dump valve, and open waste water tank valve.
3. For FES A water supply (Figure 5.71-1).
 - a. Close sply H₂O tk A,B outlet valves and sply crossover valve.
 - b. Interconnect the sply and waste water systems by connecting one end of the Y/Y hose to the contingency H₂O cross-tie potable quick disconnect (CONT H₂O X-TIE POT QD) and the other to the contingency H₂O cross-tie waste quick disconnect (CONT H₂O X-TIE WASTE QD).
 - c. Open the sply H₂O dump isolation valve and waste H₂O dump isolation valve.
4. For FES B water supply (Figure 5.71-2).
 - a. Close sply H₂O tk A, B outlet valves and sply crossover valve.
 - b. Interconnect the sply and waste water systems by connecting one end of the Y/Y hose to the contingency H₂O cross-tie potable quick disconnect (CONT H₂O X-TIE POT QD) and the other to the contingency H₂O cross-tie waste quick disconnect (CONT H₂O X-TIE WASTE QD).
 - c. Open the sply H₂O dump isolation valve and waste H₂O dump isolation valve.

FAILURES

The H₂O tk contingency cross-tie procedure would be used in the event of a revolution 7 (REV 7) primary landing site (PLS) of a high inclination orbit flight. It would also be used for any combination of hardware failures (sply H₂O tks, valves, H₂O lines, and or bus failures) where sply H₂O would not support de-orbit FES requirements.

BACKGROUND

Since this procedure interconnects the supply and waste systems, it is highly undesirable to utilize it unless essential.

REFERENCES

1. Environmental Systems Console Handbook.
2. Vendor Drawings.
 - a. VS70-623103 schematic - ECLSS water management system.
 - b. VS70-620309 schematic diagram - water management subsystem.
 - c. VS70-620302 schematic diagram - water management subsystem.
 - d. VS70-454025 fuel cell water relief alternate path.
 - e. VS70-620202 schematic diagram - waste management subsystem.
 - f. VS70-623200 system installation waste management, ECLSS equipment bay.
 - g. VS70-634460 mid-fuse subsystem ECLSS instl-frame Xo-582 through Xo-693.
3. Flight rules.
 - a. A18-1 Supply Water Tank.
 - b. A18-52 Supply/Waste Water Cross connect.

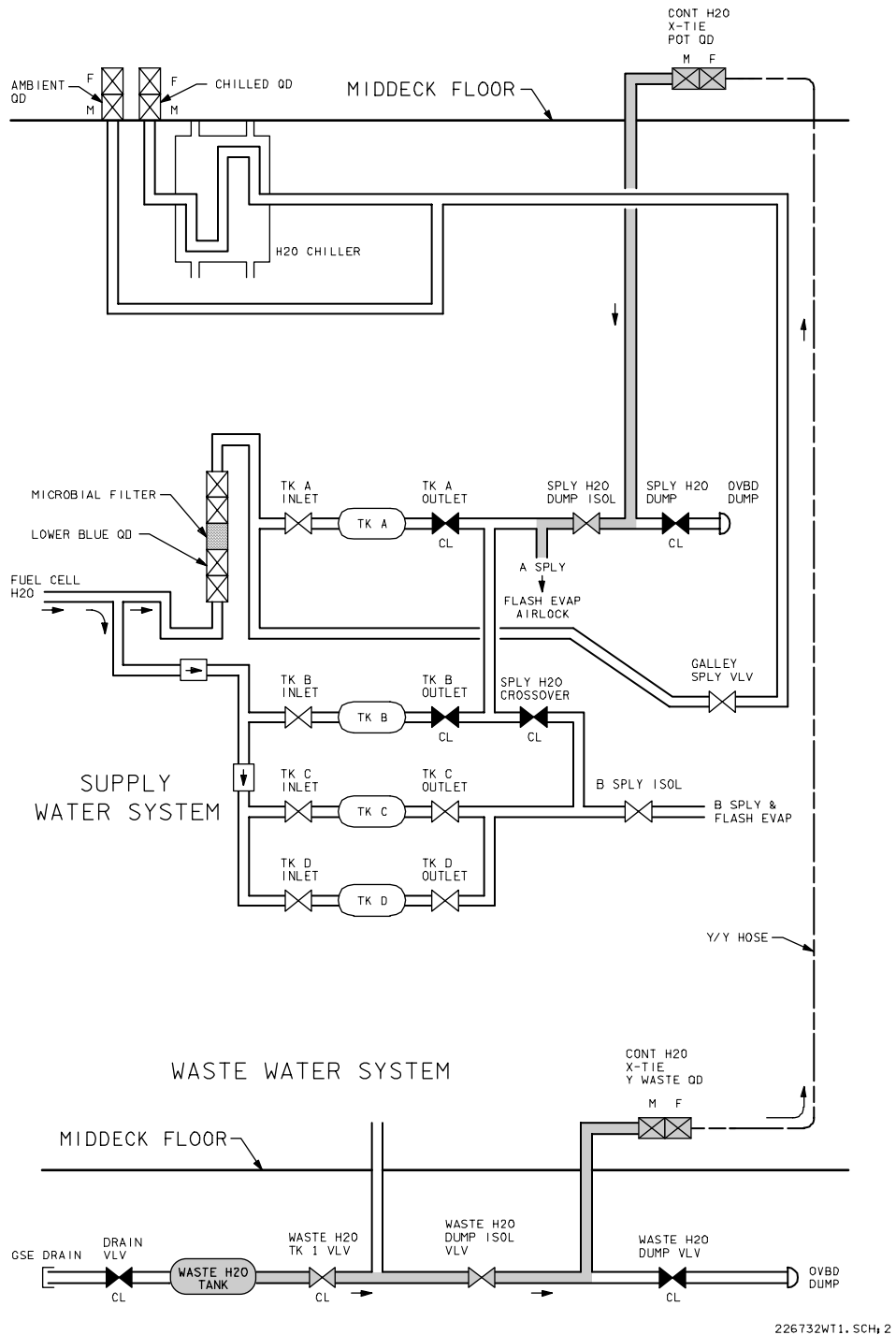
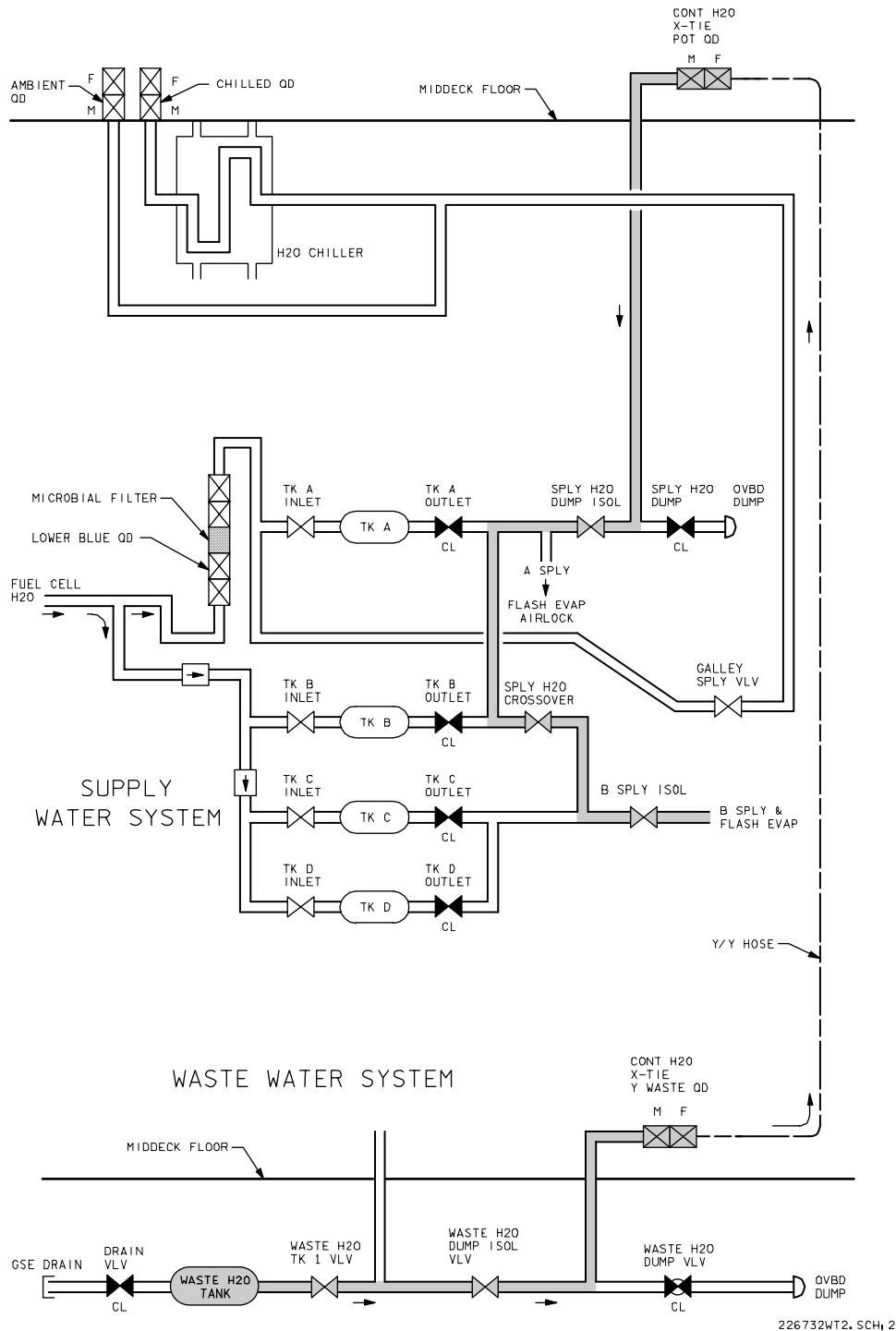


Figure 5.71-1. Contingency X-TIE FES A supply

5.71-3

Verify that this is the correct version before use



226732WT2. SCH, 2

Figure 5.71-2. Contingency X-TIE FES B supply

5.71-4

Verify that this is the correct version before use

TITLE

FREE FLUID DISPOSAL

PROCEDURES

Remove free fluid from the crew module by venting it overboard through the contingency water x-tie QD and the waste dump nozzle.

1. Close waste H₂O dump ISOL valve.
2. Configure hoses and contingency water equipment to contingency water x-tie waste QD.
3. Vent/dump free fluid overboard.

FAILURES

Water leaks, etc., in the crew module.

BACKGROUND

This procedure will be used to dispose of large fluid spills in the crew module including contaminants. Free fluid disposal was used successfully in STS-27. The humidity separator had failed and leaked approximately 2 to 3 gallons of condensate into the lower equipment bay (LEB). The free fluid disposal procedure was used to remove the condensate in approximately 1 hour.

REFERENCES

Drawings

1. VS70-620202, waste management subsystem diagram.
2. VS70-420209, waste management subsystem diagram.
3. VS70-623200, system installation, ECLSS equipment bay.

TITLE

GALLEY, FAILED SUPPLY LINE, BYPASS

SUMMARY

Bypass a failed galley supply line by routing water from the inlet side of tank A, through the microbial check valve (MCV) and the IFM contingency hoses directly to the galley (or operational water dispenser assembly (OWDA)) ambient inlet lines.

PROCEDURE

1. Access the MCV through the LEB access panel at MD25K and disconnect the sply H₂O inlet line (fuel cell hose) from the lower QD on the MCV (see p. W-42, IFM C/L).
2. Access the galley/OWDA ambient H₂O QD connection and disconnect from middeck QD.
3. Connect one end of the R/R hose to the MCV QD and the other end to the B/B hose.
4. Route hoses through the LEB access panel and connect the other end of the B/B hose the galley/OWDA ambient inlet line QD.
 - a. Open tk A inlet valve (Figure 5.73-1).
 - b. Operate galley normally (chilled water not available).

FAILURES

Galley supply valve failed closed, blocked galley supply line.

BACKGROUND

Access to the MCV is fairly complicated because of its location. The lower QD on the MCV is visible through the LEB access door; i.e., it is not a blind access. The crew is shown how to access this QD during training and during the CEIT/IFM walk down.

REFERENCES

VS70-623200, system installation, ECLSS equipment bay.

NOTES

In this mode of operation, no chilled water is available at the galley/OWDA.

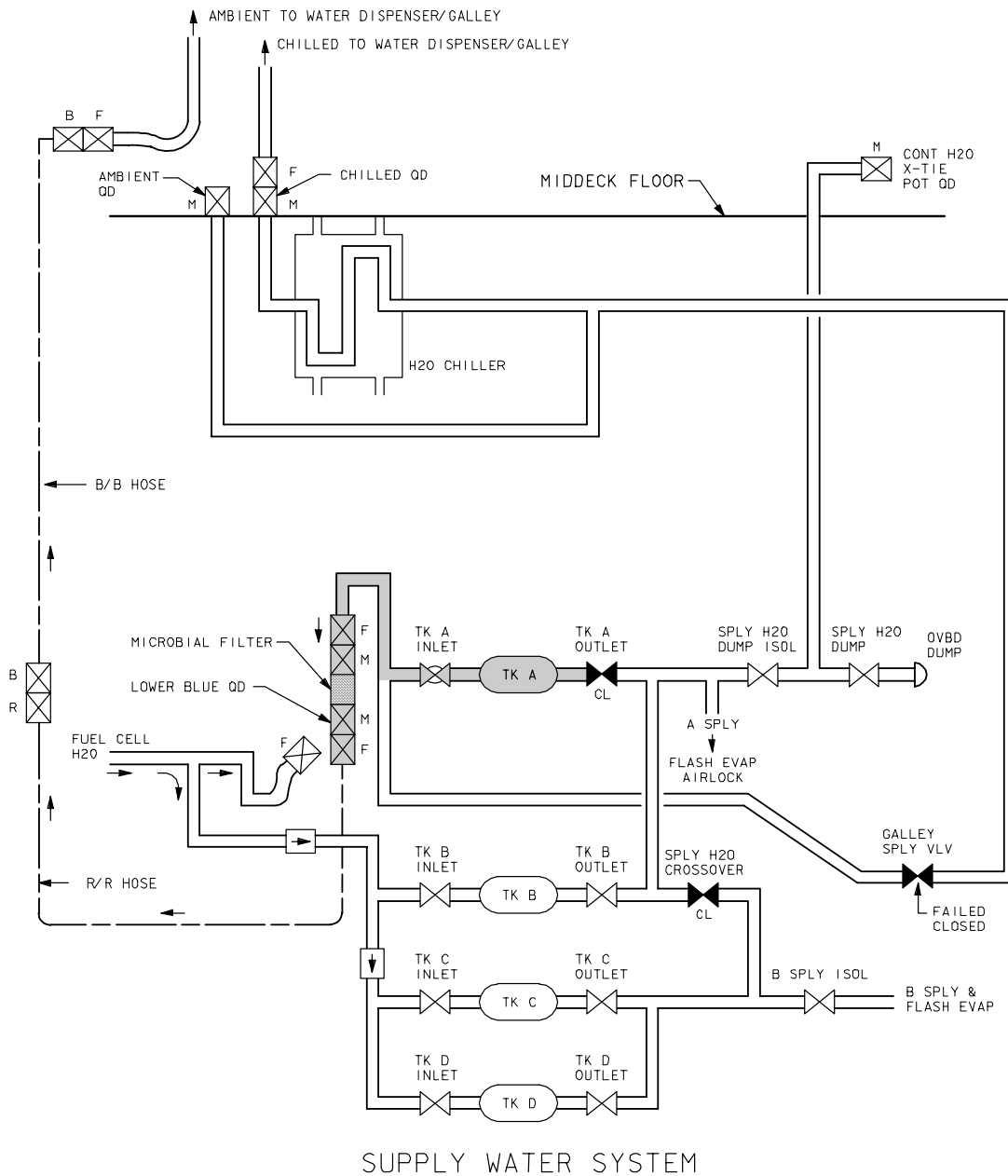


Figure 5.73-1. Water dispenser/Tk A connection

5.73-2

Verify that this is the correct version before use

TITLE

GALLEY WATER LINE FLUSH

PROCEDURE

The objective of this procedure is to clear the galley of water which is high in pH. A pH level of < 9 is normal, but can get out of range (higher), due to a malfunctioning fuel cell. The high pH is caused by high levels of potassium hydroxide (KOH). This high pH water will be flushed into the waste management system (WMS) via the urinal hose.

This procedure will normally be done as a follow up to the fuel cell water pH test & fuel cell water supply line flush procedures.

1. Don goggles and gloves from the contamination cleanup kit (CCK). KOH is caustic, so skin and eye protection is required.
2. On panel R11, check the supply water tank A inlet is closed & the supply water galley supply valve is open. This forces water from the fuel cell to flow directly to the galley. The galley is normally supplied by tank A.
3. Remove a quick disconnect (QD) from one end of the red/red (R/R) hose. This open end of the R/R hose will be taped to the WMS urinal.
4. Check the fan separator is the same as the hose block. Check the mode is in auto. Check the cradle is in auto. And unstow the hose and install the spare urinal funnel. This configures the WMS for urinal operation.
5. Tape the end of the R/R Hose, from which the QD was removed, into the spare urinal funnel attached to the WMS urinal hose. Allow for adequate airflow through urinal funnel.
6. Check air flow at urinal funnel and check that the waste collection system (WCS) on light is on. The WCS is now functioning and ready to receive water from the galley.
7. Turn the MV2 valve to the full ambient position. This allows for flushing of the ambient supply line and ambient lines within the galley through the auxiliary (AUX) port, or personal hygiene hose (PHS).
8. Remove the PHS hose from the AUX port and install the end of the R/R hose with the remaining QD to the AUX port. Water will now begin flowing through the galley and into the WCS.
9. Flow water for 10 min. or until the pH is < 9. Check the pH by obtaining a pH test strip from the CCK and a length of 22 gauge insulation tubing from the pin kit. Using the tubing get a single drop of water and dab onto the test strip. Do not immerse the test strip into the water stream. This clears the ambient water line from the fuel cell through the galley ambient lines of high pH water.

10. Remove the R/R hose from the AUX port and fill an 8 oz. drink container with cold water from the galley re-hydration station. This clears the galley internal chilled water lines of high pH water.
11. Remove the cap from test port (TP) 4 and connect the R/R hose. Water will begin flowing from the hot water side of the galley.
12. Flow water for 10 min. or until the pH is < 9. Check the pH as described above. This clears the hot water lines and hot water tank of the galley of high pH water.
13. Remove the R/R hose from TP-4 and replace the cap. Then fill an 8 oz. drink container with hot water at the galley re-hydration station. This clears the hot water line internal to the galley through the hot water solenoid valve (SV-3) of high pH. All galley lines are now clear of high pH water.
14. Remove the remaining QD from the R/R hose to allow evacuation of residual water from the hose.
15. Remove R/R hose from urinal funnel and reconnect the PHS hose to the AUX port. Flush this line into urinal funnel.
16. Stow urinal hose onto the cradle. And check that the WCS on light is off. The WCS fan separators will run for approximately 30 sec. after hose stowage.
17. Reattach both QD's onto the R/R hose.
18. Stow tools.

FAILURES

This procedure is one of three procedures written to test then clear the Orbiter supply water lines of high pH water caused by a malfunctioning fuel cell

REFERENCES

Drawings:

VS70-623103	VO70-623200	SED39121045	SED39121035
VS70-620309	VS70-620202	SED39120917	SED39121038
VS70-620302	VS70-620209	SED39121032	
VO70-454936	SED39121058	SED39120899	

TITLE

HUM SEP AIR OUTLET H₂O ABSORPTION

PROCEDURE

The objective of this procedure is to prevent water from a clogged or partially clogged humidity separator from leaking into the lower equipment bay (LEB). The humidity separator pulls water and air from the cabin heat exchanger and separates them. Sending the water to the waste management system (WMS) and blowing the air into the LEB.

1. Remove the LiOH stowage volume from the floor of the middeck. The LiOH stowage volume has become the primary method for accessing equipment in the LEB.
2. Obtain a trash bag liner and reinforce the bottom and sides with strips of gray tape.
3. Using a pocketknife, cut holes through the gray tape and liner to allow airflow out of the bag. The gray tape will reinforce the cut area and help prevent tearing of the plastic bag.
4. Loosely pack one or two towels into the trash bag liner. These towels will absorb the water blowing out of the air vent of the malfunctioning humidity separator.
5. Secure the towel and trash bag liner to the outlet of the leaking humidity separator. The towel should be placed so that one tip touches the humidity separator outlet screen, to wick the water into the towel, but does not restrict the airflow from the humidity separator. The bag should be sealed around the air outlet. Leave room to reinstall the LiOH container.
6. If required periodically check the towel/s for water. If saturated replace with a dry towel. Place the wet towel into the wet trash container
7. Stow tools.

FAILURES

This procedure requires that both humidity separators be clogged or that one is clogged and the other is hard failed.

REFERENCES

Drawings:

VS70-610209, VS70-610109, VS70-610102

TITLE

SUPPLY H₂O SYS BACKUP DUMP - TK A, B

SUMMARY

Allows supply water to be dumped through the waste water dump nozzle by interconnecting the waste and sply H₂O systems at the contingency cross-ties (x-ties) using the Yellow/Yellow (Y/Y) hose.

PROCEDURE

1. Supply H₂O Backup Dump - tk A, B
 - a. Check H₂O valves for proper configuration.
 - (1) Sply H₂O tk A and B inlet open
 - (2) Sply H₂O A tk outlet closed
 - (3) Sply H₂O B tk outlet open
 - (4) Sply H₂O crossover valve closed
 - (5) Waste and sply H₂O dump isolation valves closed
 - b. Interconnect the supply and waste water systems by connecting one end of the Y/Y hose to the contingency H₂O cross-tie potable quick disconnect (CONT H₂O X-TIE POT QD) and the other to the contingency H₂O cross-tie waste quick disconnect (CONT H₂O X-TIE WASTE QD).
 - c. Check for the waste dump line temperature >50° F and switch line heaters from A to B if line temperature is <50° F.
 - d. Turn on the waste H₂O dump valve enable/nozzle heater.
 - e. Condition waste H₂O nozzle temperatures to >250° F <350° F.
 - f. Open the waste H₂O dump valve, and sply H₂O dump isolation valves (Figure 5.76-1).
 - g. When the dump is complete, close the waste H₂O dump valve and sply H₂O dump isolation valves.

- h. Turn the dump valve enable/nozzle heater off and check for sply H₂O quantity C (D) not decreasing; waste H₂O nozzle temperature (A/B) not increasing.
 - i. Disconnect the Y/Y hose and open the waste dump isolation valve.
2. Supply H₂O Backup Dump - tk C, D
- a. Check H₂O valves for proper configuration.
 - (1) Sply H₂O tk A closed
 - (2) Waste and sply H₂O dump isolation valves closed
 - b. Interconnect the sply and waste water systems by connecting one end of the Y/Y hose to the CONT H₂O X-TIE POT QD and the other to the CONT H₂O X-TIE WASTE QD.
 - c. Close sply H₂O tk B outlet and open the sply H₂O crossover valve.
 - d. To dump sply H₂O tk C only (Figure 5.76-2).
 - (1) Sply H₂O tk D inlet closed
 - (2) Sply H₂O tk D outlet closed
 - e. To dump sply H₂O tk D only (Figure 5.76-3).
 - (1) Sply H₂O tk C inlet closed
 - (2) Sply H₂O tk C outlet closed
 - f. To dump sply H₂O tk C and D (Figure 5.76-4).
 - (1) Sply H₂O tk C inlet closed
 - (2) Sply H₂O tk C outlet closed
 - (3) Sply H₂O tk D inlet closed
 - (4) Sply H₂O tk D outlet closed
 - g. Check for the waste dump line temperature >50° F and switch line heaters from A to B if line temperature is <50° F.
 - h. Turn on the H₂O dump valve enable/nozzle heater.
 - i. Condition waste H₂O nozzle temperatures to >250° F <350° F.
 - j. Open the waste H₂O dump and sply H₂O dump isolation valves.

- k. When the dump is complete, close the waste H₂O dump valve and sply H₂O dump isolation valves.
- l. Turn the dump valve enable/nozzle heater off and check for waste H₂O nozzle temperature (A/B) not increasing and quantity C (D) not increasing.
- m. Disconnect the Y/Y hose and open the waste dump isolation valve.
- n. Open the waste H₂O dump isolation valve; close the sply H₂O crossover valve; and open the tank B outlet valve.
- o. Reconfigure tanks C and D as follows:
 - (1) If tank C was dumped, open the tank D inlet and outlet valves.
 - (2) If tank D was dumped, open the tank C inlet and outlet valves.
 - (3) If tanks C and D were dumped, no reconfiguration is required.

FAILURES

The supply water dump capabilities are considered lost if

- 1. The supply system dump valve fails
- 2. The supply water dump nozzle temperatures cannot be maintained to 90° F
- 3. The dumpline is blocked
- 4. The dumpline is ruptured
- 5. Both supply water nozzle temperature measurements are failed
- 6. Supply dump nozzle ice formation
- 7. The supply water dumpline is below 32° F (37° F)

BACKGROUND

The supply H₂O dump valve is a 30 V dc solenoid latching valve with two microswitches that indicate whether the valve is full open or full closed. The latching feature latches the valve in either the OPEN or CLOSED position and will remain in the position last selected in the event of power failure. The two H₂O heaters are 11.7- watt resistance heaters powered by 28 V dc power. The supply H₂O nozzle heater is a 22.5-watt, 28 V dc heater. The supply nozzle heater is controlled via the supply water dump valve/enable switch. Diameter of the supply water dumpline is 0.25 in. o.d. with a 0.16 in. wall thickness. The diameters of the supply water dump nozzles are 0.0565 in. (OV-102), 0.052 in. (OV-103), and 0.550 in. (OV-104). The diameters of the waste water dump nozzles are 0.565 in. (OV-102), 0.056 in. (OV-103), and 0.555 in. (OV-104)

so the water dump rate (130-160 lb/hr) will be approximately the same rate as the supply water dump nozzles.

The contingency cross-tie panel is located aft of the main hatch on the aft port middeck wall. The Y/Y hose is 8 ft long and has female QD's that connect to the male QD's on the contingency cross the panel.

REFERENCES

1. Environmental Systems Console Handbook.
2. Vendor drawings.
 - a. VS70-623103 schematic - ECLSS water management system.
 - b. VS70-620309 schematic diagram - water management subsystem.
 - c. VS70-620302 schematic diagram - water management subsystem.
 - d. VS70-640102 schematic - active thermal control subsystem.
 - e. VS70-634460 mid-fus subsystem ECLSS instl-frame Xo-582 through Xo-693.
 - f. VS70-620202 schematic diagram - waste management subsystem.
 - g. VS70-623200 system installation waste management, ECLSS equipment bay.
3. Flight rules.
 - a. 9-191 - Supply Water Dump.
 - b. 9-194 - Supply Water Dump Nozzle Temperature Constraint.
 - c. 9-201 - Waste Dump Nozzle Ice Formation.
 - d. 9-202 - Supply/Waste Water Cross-connect.
 - e. 9-205 - Waste Dump Nozzle Temperature Constraint.

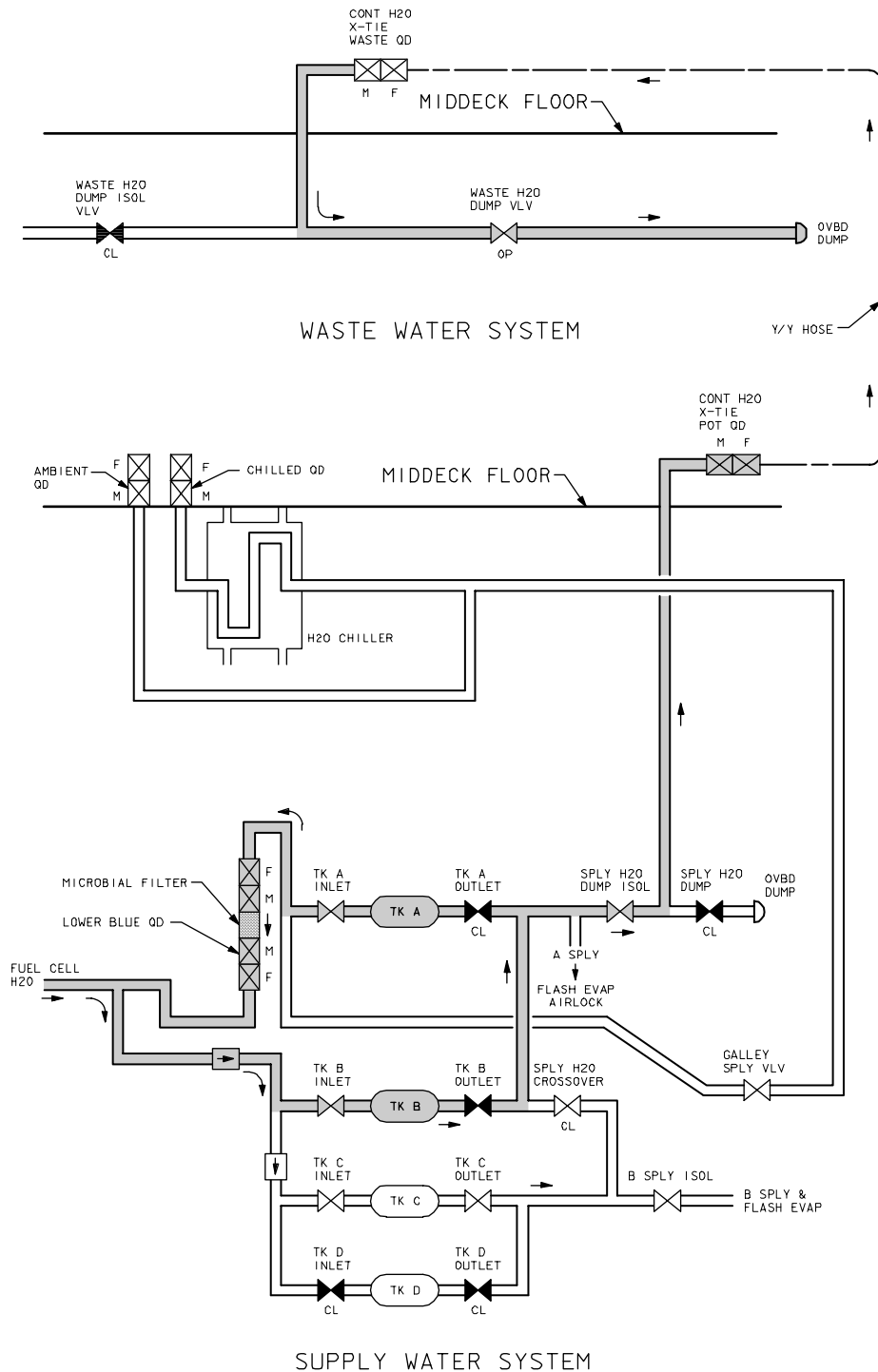
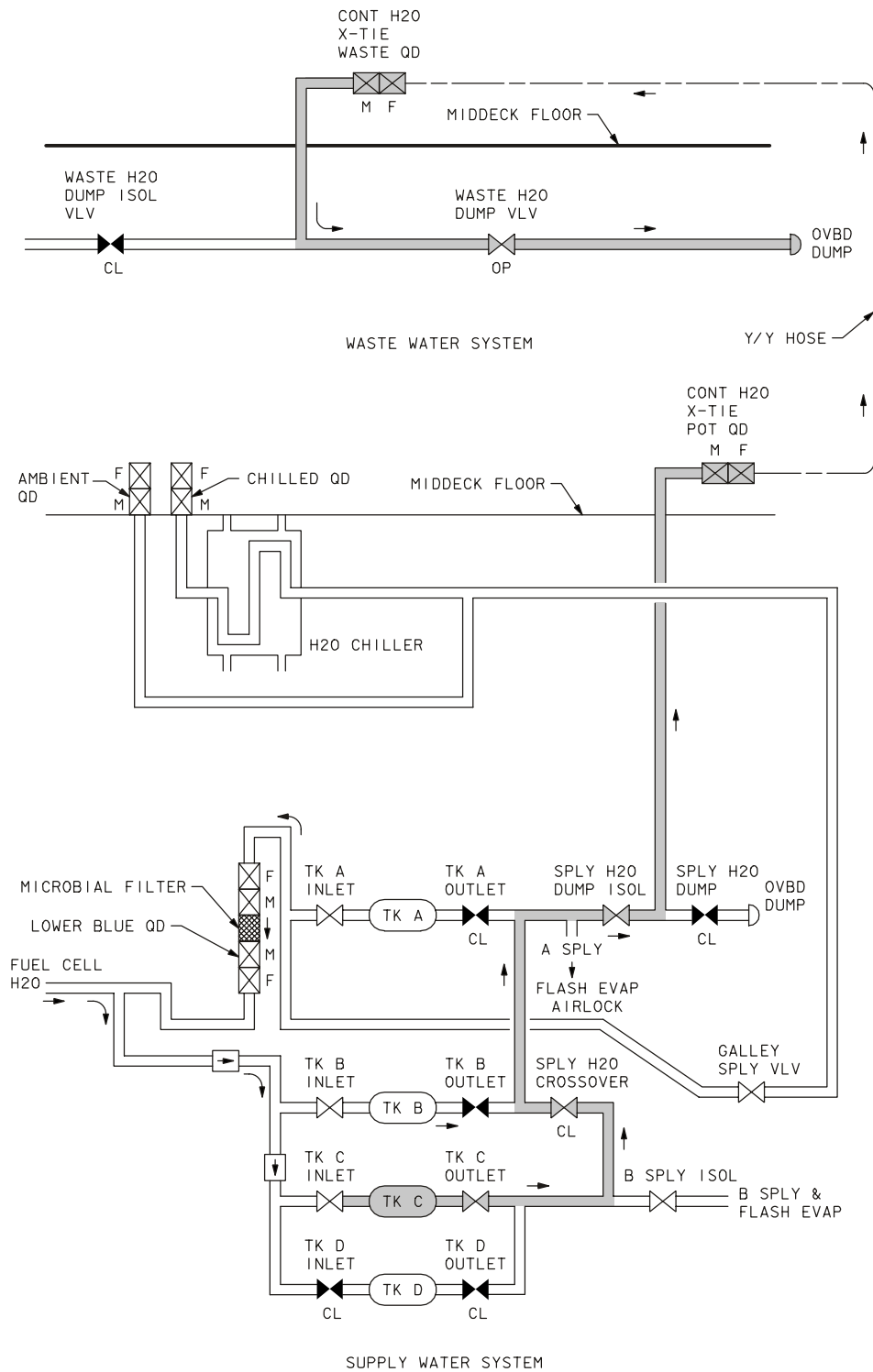


Figure 5.76-1. Tank A, B backup dump

5.76-5

Verify that this is the correct version before use

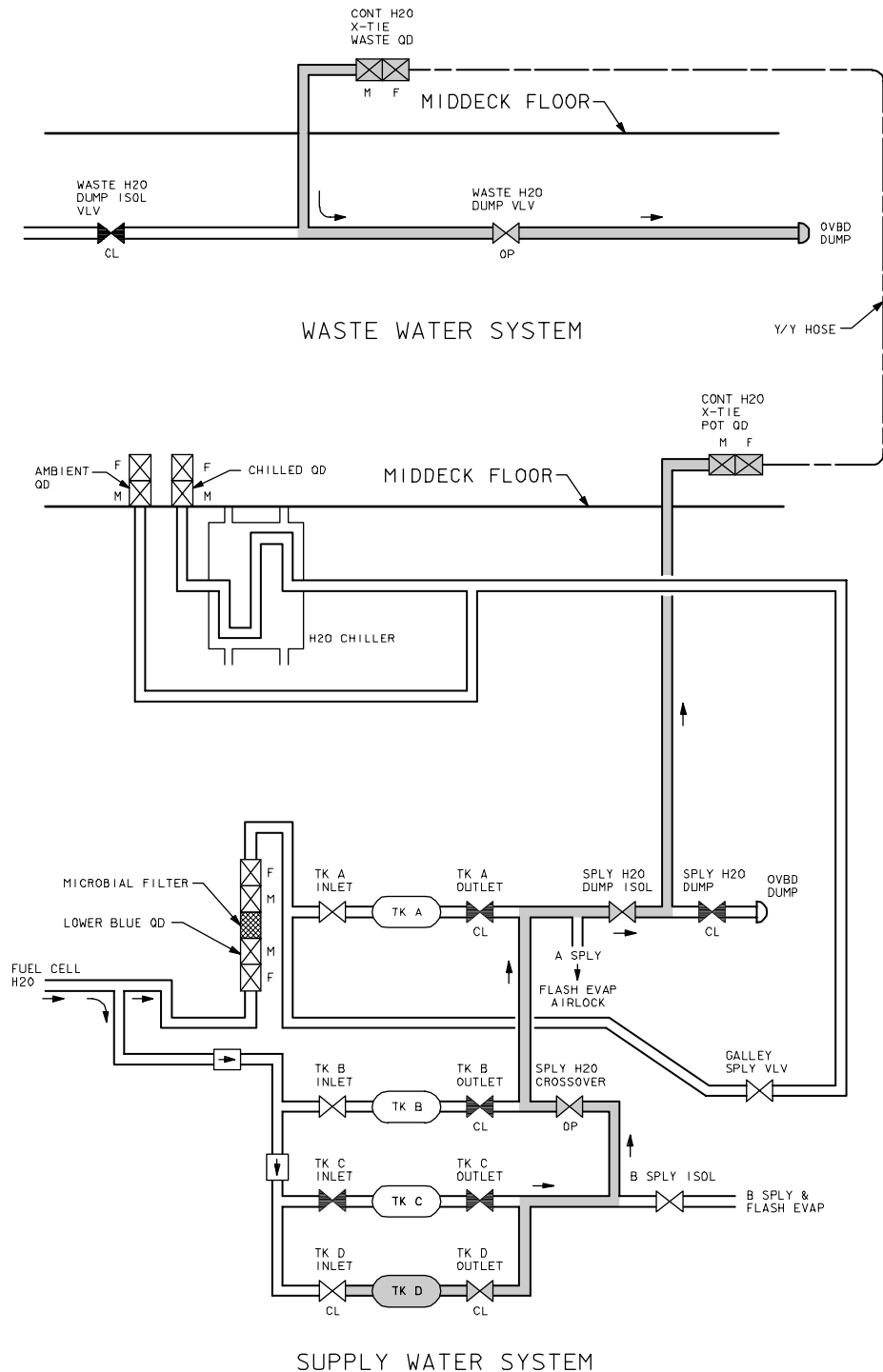


226732WB1. SCH 4

Figure 5.76-2. Tank C dump schematic

5.76-6

Verify that this is the correct version before use



226732WB3. SCH 1

Figure 5.76-3. Tank D dump schematic

5.76-7

Verify that this is the correct version before use

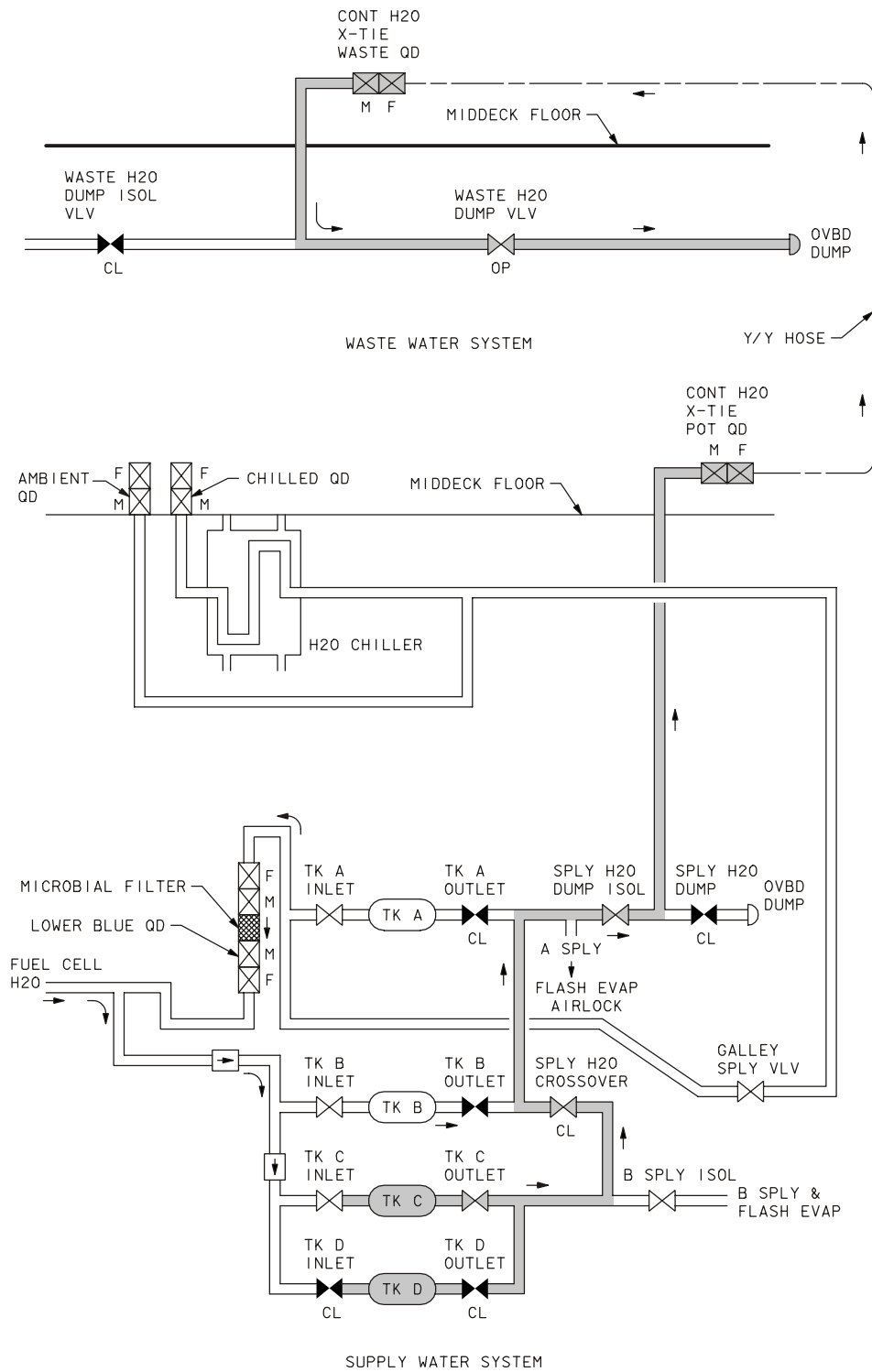


Figure 5.76-4. Tank C and D dump schematic

5.76-8

Verify that this is the correct version before use

TITLE

SUPPLY WATER SYSTEM BACKUP DUMP – TANK C OR D

PROCEDURE

The objective of this procedure is to dump supply water from tank's C or D through the waste water dump line, by interconnecting the waste and supply water dump lines at the contingency cross ties.

This procedure may be done if the supply system dump valve fails.

1. On panel ML31C take the waste water dump isolation valve to close.
2. On panel R11L take the supply water dump isolation valve to close and the supply water tank A outlet valve to close.
3. On the wall next to the Waste Collection System (WCS), connect one end of the yellow/yellow (Y/Y) hose to the contingency water cross tie potable quick disconnect (QD) and the other end to the contingency water cross tie waste QD.
4. On panel R11L take the supply water tank B outlet valve to close, the supply water tank C inlet valve to open, the supply water tank C outlet valve to open, and the supply water crossover valve to open.
5. On panel ML31C take the supply water tank D inlet valve to open and the supply water tank D outlet valve to open.
6. Tanks C&D may be dumped individually or simultaneously.
7. If only tank C is to be dumped, on panel ML31C, take the supply water tank D inlet and outlet valves to close.
8. If only tank D is to be dumped, on panel R11L, take the supply water tank C inlet and outlet valves to close.
9. If tank C&D are to be dumped simultaneously no further valve action is necessary.
10. On the Systems Management (SM) 60 TABLE MAINT display, reset the low and high SM ALERT, waste water nozzle temperature A&B parameters (PARA) to 60 (low) and 250 (high). PARA ID's A (0620520) and B (0620519).
11. Caution, the waste water nozzle temperature A/B should not exceed 350.
12. On the SM 66 ENVIRONMENT display, check the waste dump line temperature is greater than 50. If the line temperature is less than 50, enable the 2nd line heater. On panel ML86B: Take the circuit breaker (cb) for MNB (MNA) water line heater B (A) to close.
13. On panel ML31C take the waste water dump valve enable/nozzle heater to on. When the waste water nozzle temperature A, B is greater than 250 continue.

14. If the PASS SM displays are not available, dump the tanks using times supplied by MCC. On panel R11L take the supply water dump isolation valve to open.
15. On panel R11L take the supply water dump isolation valve to open.
16. On panel ML31C take the waste water dump valve to open.
17. On the CRT check the supply water quantity tanks C (D) are decreasing.
18. When the supply water quantity in tanks C (D) are at the specified level or the specified time has elapsed: On panel ML31C take the waste water dump valve to closed.
19. On panel R11L take the supply water dump isolation valve to close.
20. On panel ML31C take the waste water dump valve enable/nozzle heater to off.
21. On the CRT check the supply water quantity tanks C (D) are not decreasing.
22. If the nozzle temperatures are increasing: On panel ML86B: A take the cb for MNA waste water dump valve/nozzle heaters to open.
23. On the SM 60 TABLE MAINT display, reset the low SM ALERT, waste water nozzle temperature A&B PARA to -82 (low). PARA ID's A (0620520) and B (0620519).
24. On the wall next to the WCS, disconnect the Y/Y hose from the contingency water cross tie potable and waste QD's.
25. Stow tools and tape.
26. On panel ML31C take the waste water dump isolation valve to open.
27. On panel R11L take the supply water dump isolation valve to open, take the supply water crossover valve to closed and take the supply water tank B outlet valve to open.
28. Reconfigure tanks C & D as follows: if tank C was dumped; on panel ML31C, take the supply water tank D inlet and outlet to open. If tank D was dumped; on panel R11L, take the supply water tank C inlet and outlet to open. If tanks C & D were dumped simultaneously, no reconfiguration is required.

FAILURES

This procedure assumes that the supply water system dump valve has failed and is not recoverable. This could be due to either an electrical or mechanical failure.

REFERENCES

Drawings:

VS70-623103, VS70-620309, VS70-620302, and VO70-623200.

TITLE

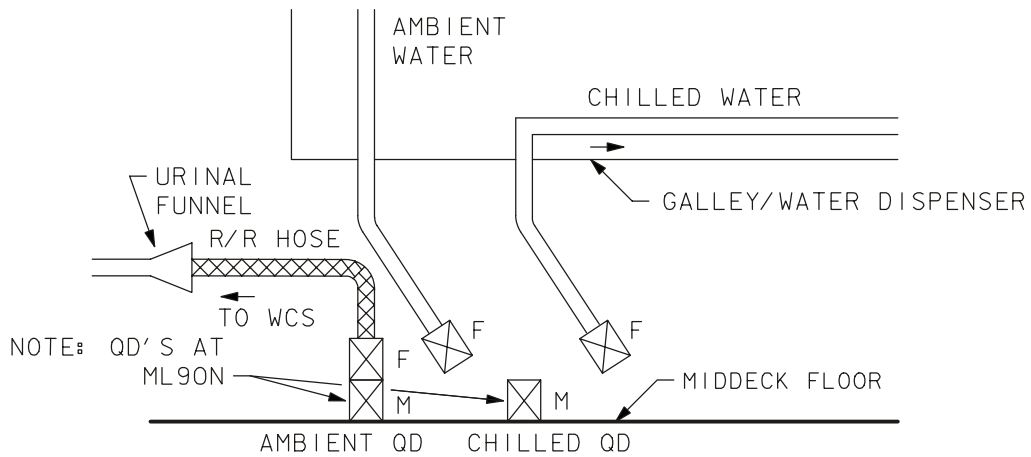
SUPPLY WASTE H₂O PURGE FROM DUMP LINE(S)

1. Fuel Cell (FC) H₂O Sply Line Flush
2. Water Dispenser Line Flush
3. Galley Water Dispenser Line Flush

PROCEDURE

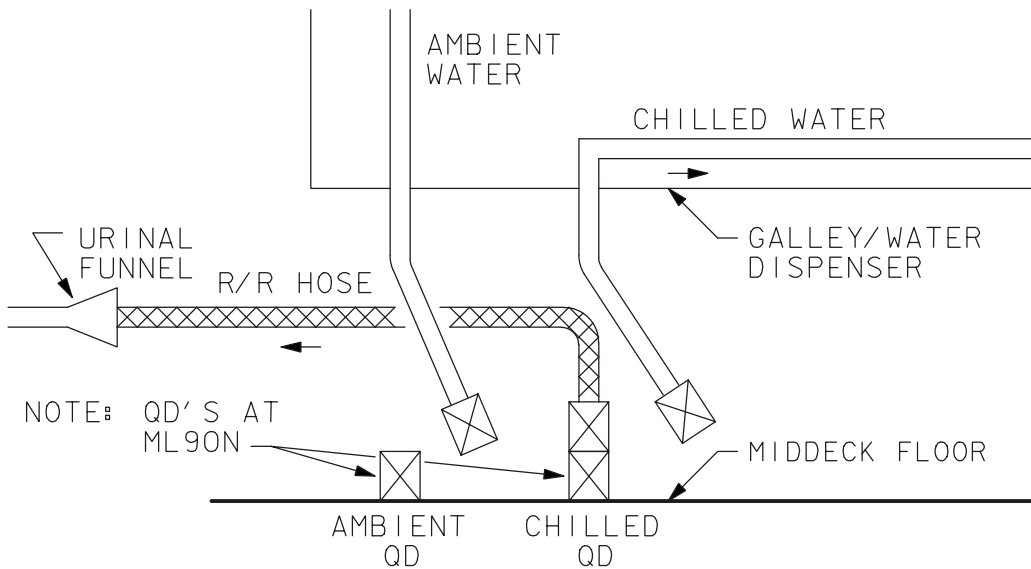
The sply H₂O procedures flush supply water lines of contamination caused by high potassium hydroxide (KOH) concentration that has migrated from the FC matrix. This condition is due to FC flooding. KOH is a base and when in solution with H₂O causes a proportional rise in PH. In the procedures, sply H₂O lines are flushed of high KOH concentrations and therefore lower the PH to a range suitable for drinking. The FC H₂O sply line flush would be performed after the FC flooding was resolved. The galley water line flush or the water dispenser line flush procedures will be required if the water at the middeck ambient or chilled quick disconnects (QD's) has a PH >9.

1. FC H₂O sply line flush
 - a. Close tank A inlet and open galley sply H₂O.
 - b. Disconnect ambient and chilled H₂O line QD's from middeck QD fittings.
 - c. Remove a QD from one end R/R hose and tape into a waste collection system (WCS) urinal funnel on the WCS (Figure 5.78-1).
 - d. Turn on WCS/extravehicular mobility unit (EMU) airflow and connect the other R/R hose QD to the middeck ambient fitting QD (Figure 5.78-1).
 - e. Check PH when water begins to flow with chemical strips from the emergency medical kit (EMK); if the PH >9 the galley water or water dispenser line flush procedure will be performed.
 - f. Flow water for 10 minutes and check water for a PH of less than 9 by using a chemical strip.
 - g. Disconnect R/R hose QD from middeck ambient QD fitting and connect free fluid disposal nozzle QD to R/R hose QD in order to evacuate the hose.
 - h. Repeat the process on the middeck chilled line QD (Figure 5.78-2) and reconnect the ambient and chilled middeck QD's.
 - i. Turn off WCS; remove R/R hose from urinal; and stow equipment.



226732WS1. SCH; 4

Figure 5.78-1. Galley ambient supply flush



226732WS2. ART; 4

Figure 5.78-2. Galley chilled supply flush

5.78-2

Verify that this is the correct version before use

2. Water dispenser line flush
 - a. Close tank A inlet; open galley supply H₂O; and install spare urinal funnel to WCS.
 - b. Install the personal hygiene station (PHS) hose QD to the personal hygiene H₂O QD on the water dispenser and the PHS H₂O valve in the WCS urinal (Figure 5.78-3).
 - c. Turn on WCS/EMU airflow and open the personal hygiene H₂O valve.
 - d. Flow water for 10 minutes (Figure 5.78-4); disconnect PHS hose QD from the personal hygiene H₂O QD; and connect free fluid disposal nozzle QD PHS hose QD to evacuate the hose.
 - e. Turn on the water dispenser with chilled selected and fill an 8-oz drink container from the auto fill selector (Figure 5.78-5).
 - f. Select ambient on the water dispenser and fill an 8-oz drink container, using the bypass valve to flush the bypass of high PH water (Figure 5.78-6).
 - g. Fill another 8-oz drink container from the fill selector and check for a PH <9, using a chemical strip from the EMK.
 - h. Remove PHS hose valve from the urinal funnel and stow equipment.

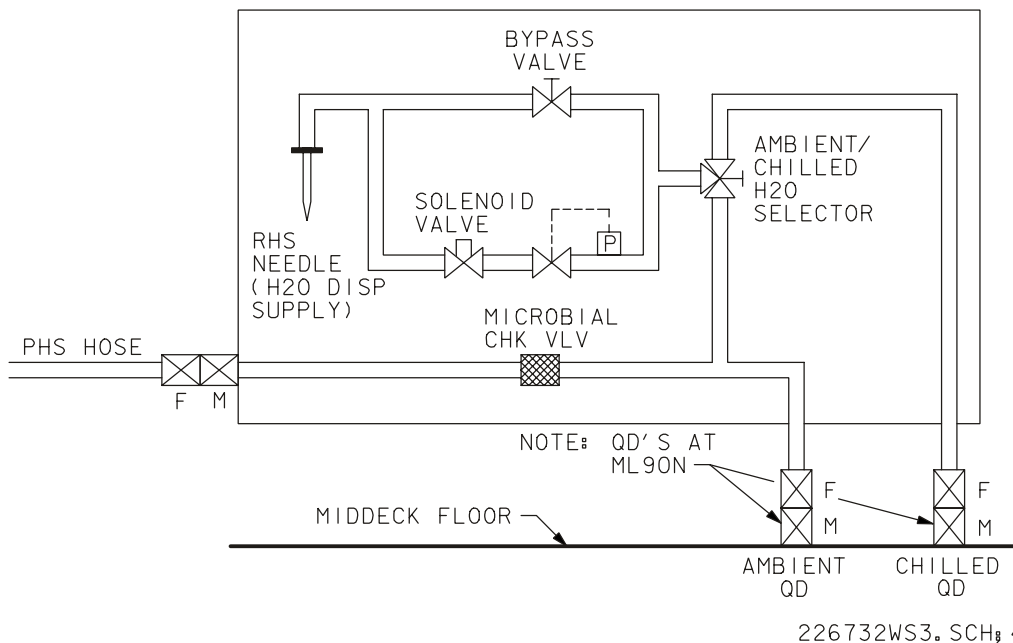


Figure 5.78-3. Water dispenser

5.78-3

Verify that this is the correct version before use

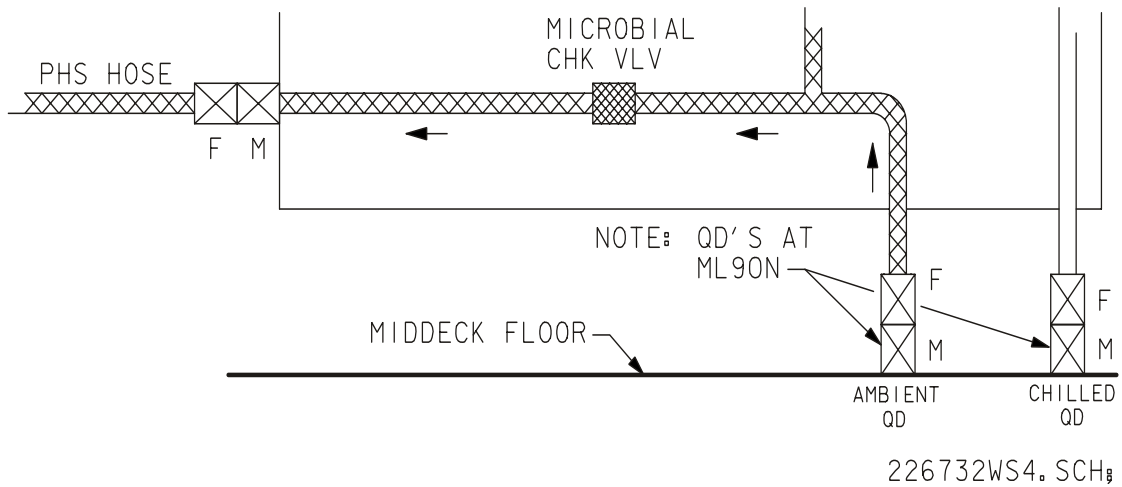


Figure 5.78-4. Water dispenser PHS flush

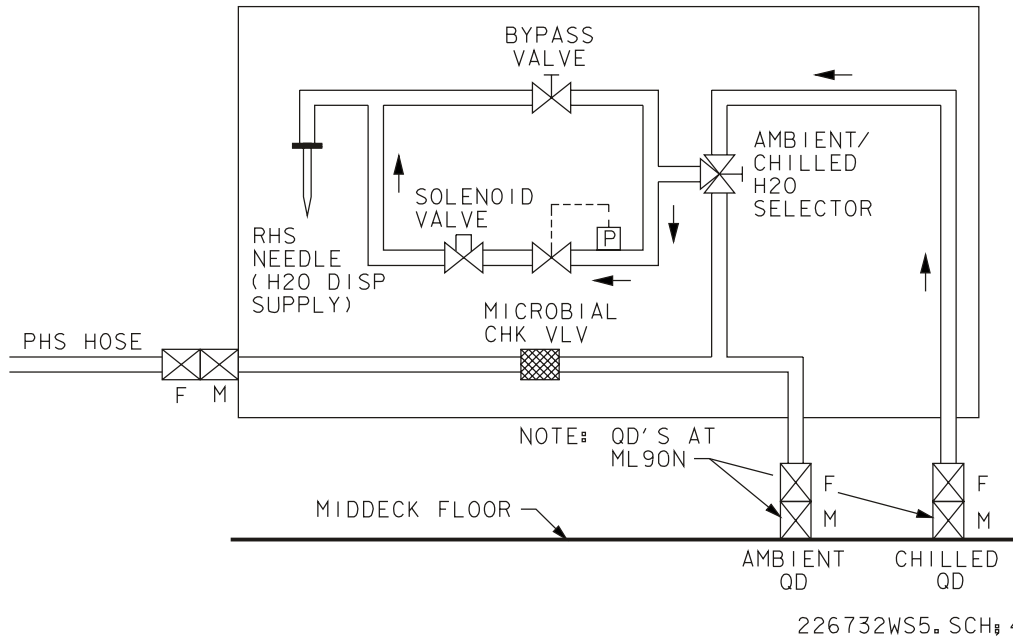
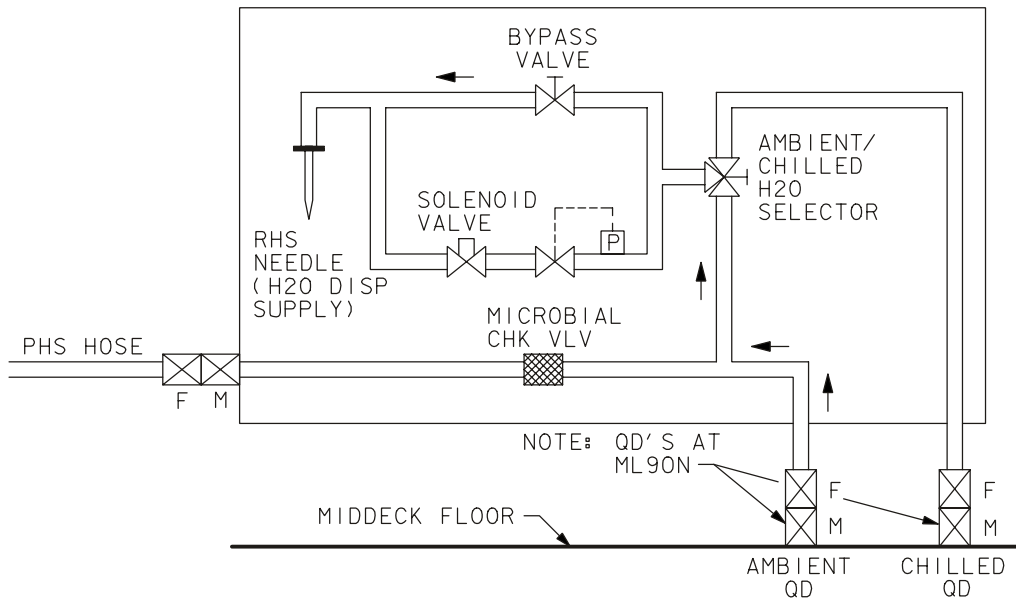


Figure 5.78-5. Water dispenser chilled flush

5.78-4

Verify that this is the correct version before use



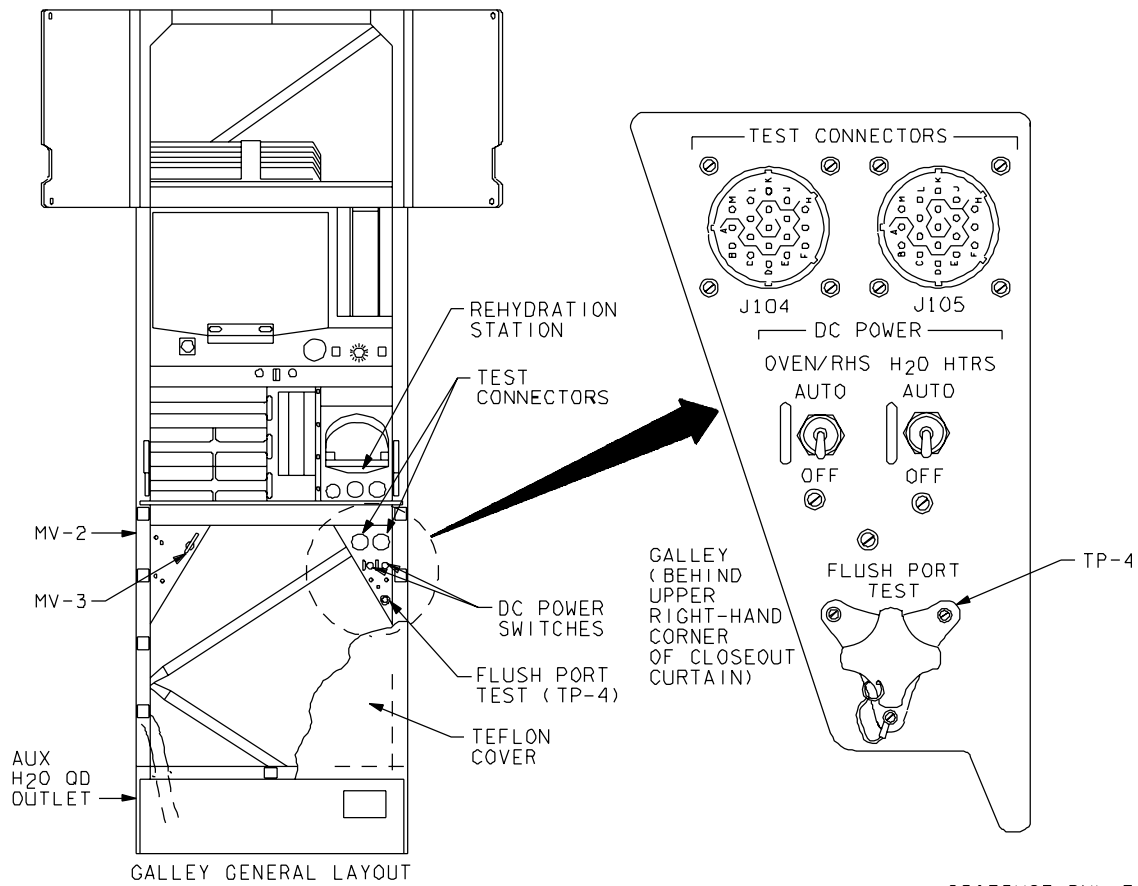
226732WS6. SCH; 4

Figure 5.78-6. Water dispenser ambient flush

5.78-5

Verify that this is the correct version before use

3. Galley water dispenser line flush
 - a. Close tank A inlet and open galley supply H₂O.
 - b. Install the spare urinal funnel to the WCS and tape the personal hygiene H₂O valve into the WCS urinal funnel.
 - c. Remove the cap from test port-4 (TP-4) on the galley and connect the PHS hose QD to the TP-4 (Figure 5.78-7 and Figure 5.78-8).
 - d. Turn on WCS/EMU airflow and open the PHS H₂O valve.
 - e. Flow water for 10 minutes or until the water has a PH >9 checking with the chemical strips from the EMK.
 - f. Turn off the PHS valve.
 - g. Disconnect PHS hose from TP-4; connect to the auxiliary port on the galley (Figure 5.78-9).
 - h. Fill an 8-oz drink container with chilled water at the re-hydration station (Figure 5.78-10).
 - i. Fill an 8-oz drink container with hot water at the re-hydration station (Figure 5.78-11).
 - j. Turn on WCS airflow and open the PHS H₂O valve and flow for 5 minutes.
 - k. Close the PHS hose valve and turn off the WCS airflow.
 - l. Release PHS hose from the urinal funnel; disconnect PHS hose from the auxiliary port; reinstall galley closeout; and stow equipment.

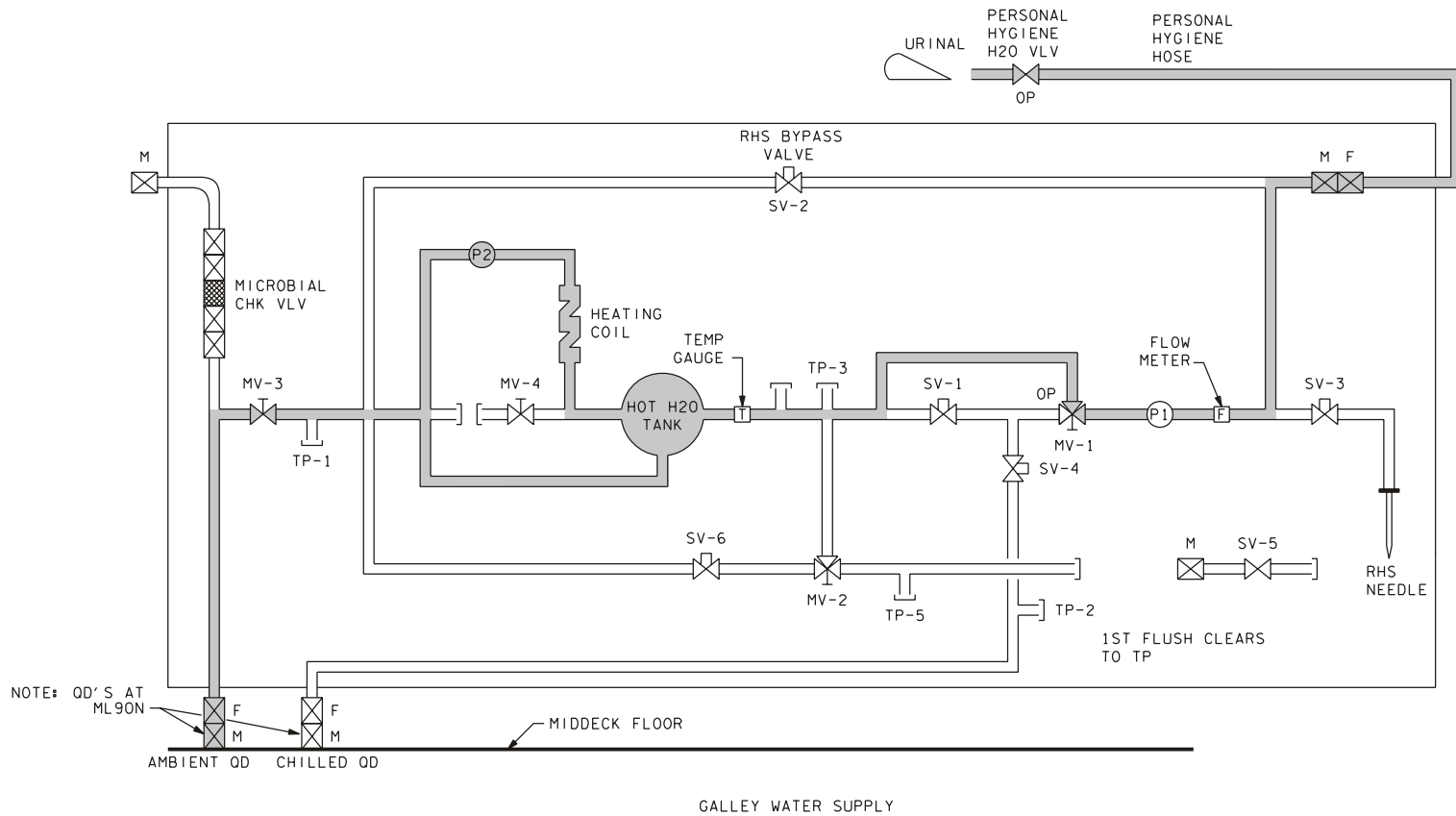


22673WS7. PNL 3

Figure 5.78-7. Galley test port 4

5.78-7

Verify that this is the correct version before use

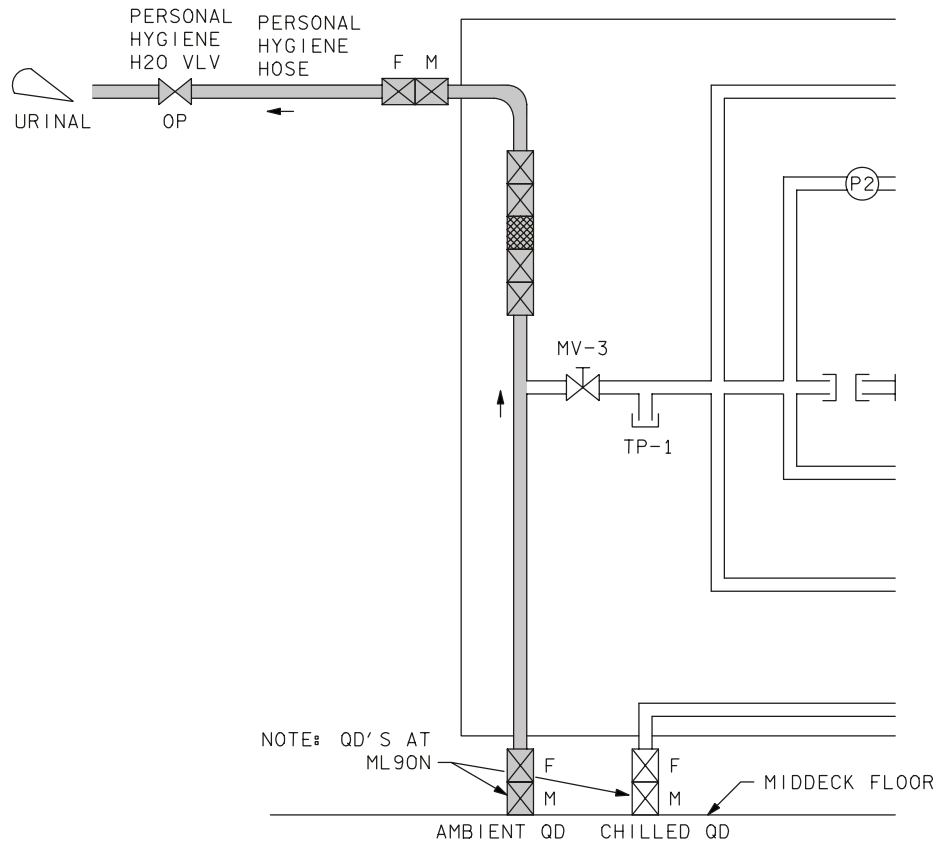


226732WS8, SCH# 5

Figure 5.78-8. Test port flush

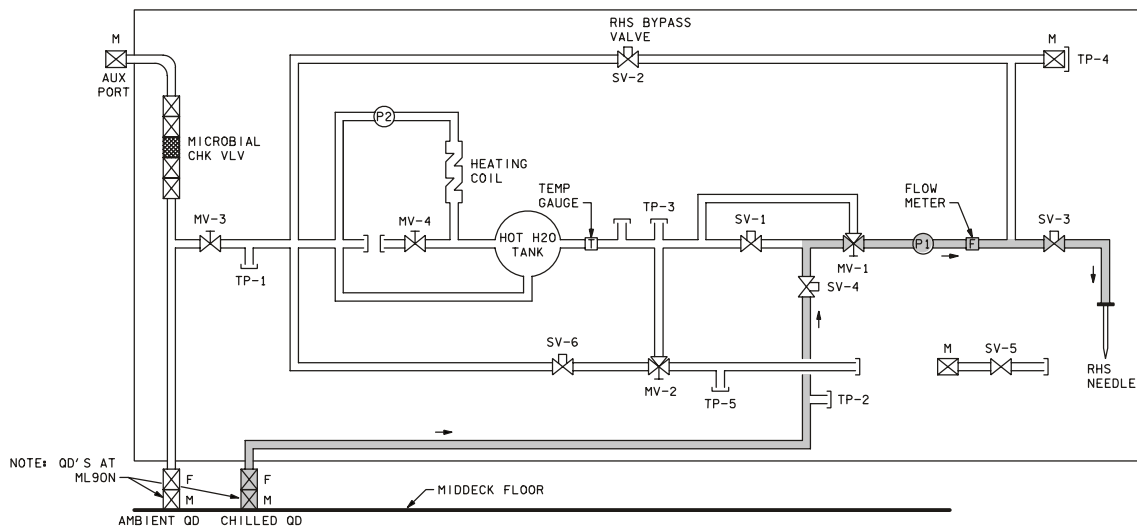
5.78-8

Verify that this is the correct version before use



226732W11. SCH 4

Figure 5.78-9. Galley PHS flush



226732W59. SCH 4

Figure 5.78-10. Galley chilled flush

5.78-9

Verify that this is the correct version before use

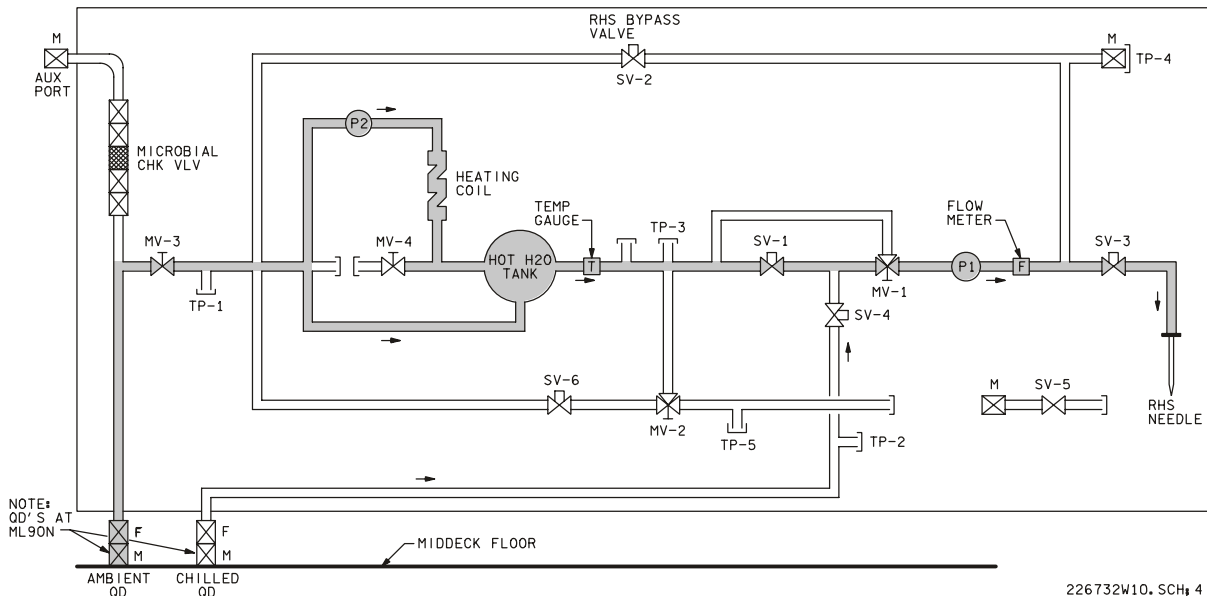


Figure 5.78-11. Galley ambient flush

FAILURES

Contaminated potable water (high PH due to FC flooding): When the FC floods, high concentrations of KOH leave the matrix and form a high PH solution that contaminates the supply water lines. The supply water will be “slick” in taste when the PH is high.

BACKGROUND

Supply water is produced from a combination $H_2 + 2O_2 \rightarrow 2H_2O$. A catalyst (KOH) is used to facilitate the reaction. FC flooding causes KOH to leave the matrix and to go into solution with the FC water (product of the FC reaction) that flows into the supply water system. The high KOH solution causes the PH to rise. The primary cause of FC flooding is a failed H_2 pump. Other causes may include stack temperature drop, regulator shift, or water line blockage. High KOH is sensed by either individual FC PH transducers, a common PH transducer entering the supply water tanks, or the crew’s reporting that supply water tastes “slick.” After the FC flooding problem is solved, the FC H₂O supply line flush procedure is used to flush the line of high PH H₂O.

NOTES

The R/R hose is 10 ft long and has female QD's (-3142). The PHS hose is 12.5 ft long and has a female QD.

(-3142) on one end and an open/close water valve on the other end. The middeck ambient and chilled fittings are male QD's (-1201).

REFERENCES

1. SGD39119053 plumbing installation shuttle orbiter galley upgrade modifications.
2. P/N 1010B-20044 3142 Red/Red (R/R) hose assy.
3. P/N 1010B-10047 PHS hose assy.

TITLE

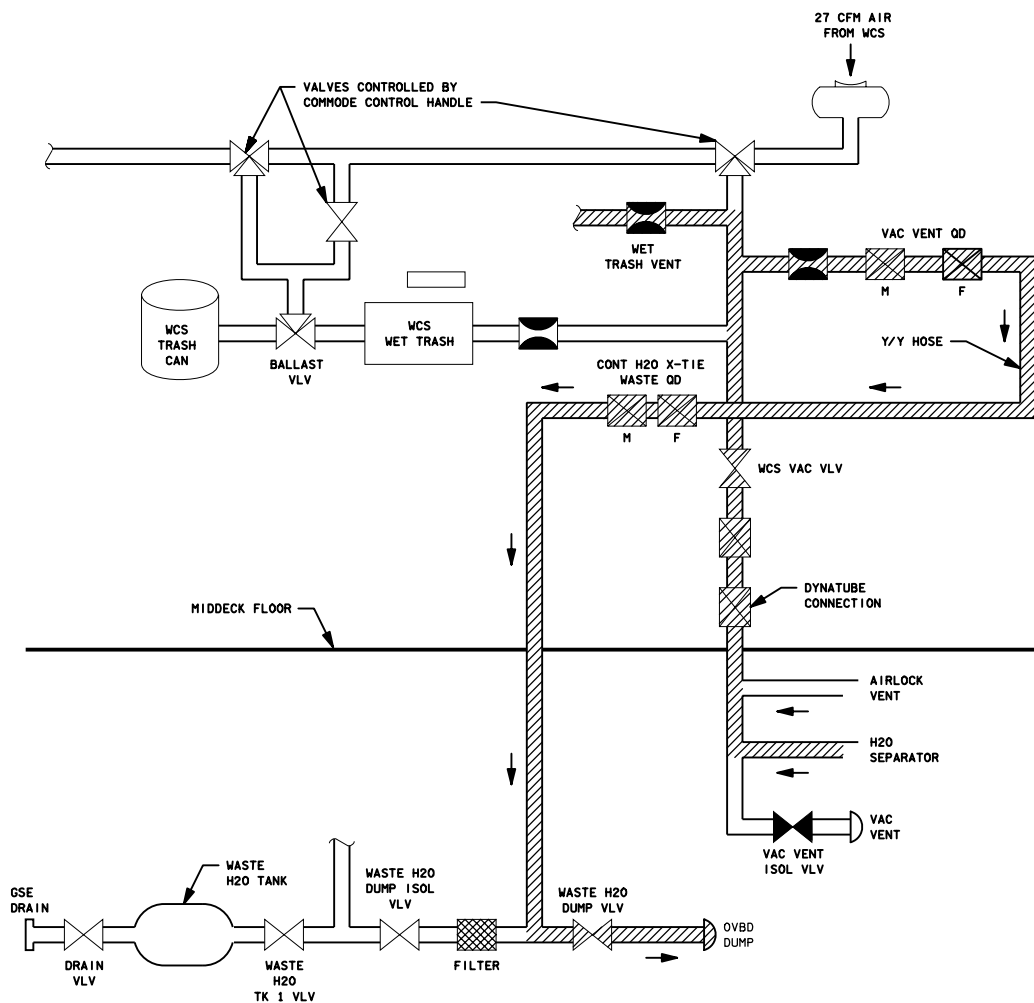
VACUUM VENT CONTINGENCY OPERATION (CIL)

PROCEDURES

After Vacuum Vent Isolation Valve fails closed and valve body orifice becomes clogged, interconnects Vacuum Vent System to Waste Water Dump System to allow H₂ gas from the Hydrogen Separator and wet trash odors to be vented overboard. Refer to Figure 5.79-1.

1. Purge water from Waste Water Dump Line using Free Fluid Nozzle
 - a. Turn the Waste H₂O Dump Valve Enable/Nozzle Heater on, and check that the Waste H₂O Dump Isolation Valve is open.
 - b. Initiate WCS Fan Sep flow.
 - c. When Waste H₂O Dump Nozzle Temperatures have been conditioned to > 250° F < 350° F, close the Waste H₂O Tank 1 Valve, and open the Waste H₂O Dump Valve.
 - d. After 5 minutes, connect one end of the Y/Y Hose to the Free Fluid Nozzle, and the free end of the Y/Y Hose to the Contingency H₂O X-Tie Waste QD.
 - e. Terminate WCS Fan Sep flow.
 - f. Take the Waste H₂O Dump Isolation Valve to close, and the Waste H₂O Tank 1 Valve to open.
 - g. After 5 minutes, disconnect the Y/Y Hose from the Free Fluid Nozzle.
2. Interconnect Vacuum Vent and Waste Water Dump Systems
 - a. Connect the free end of the Y/Y Hose to the Vacuum Vent QD (TP 126) located on the front of the WCS.
 - b. Check that the Waste H₂O Dump Valve is open, then take the Waste H₂O Dump Valve Enable/Nozzle Heater to off.
 - c. Check MCC for Waste Collector Pressure
 - d. Route the Y/Y hose to avoid interference w/egress path and emergency egress slide, secure hose with Gray Tape.
3. Configure for Waste Water Dumped
 - a. Disconnect the Y/Y hose QD from the Contingency H₂O X-Tie Waste QD.
 - b. After turning the Waste H₂O Dump Valve Enable/Nozzle Heater to on, close the Waste H₂O Dump Valve.

- c. Open the Waste H₂O Dump Isolation Valve, and return the Waste H₂O Dump Valve Enable/Nozzle Heater to off.
 - d. Proceed with the Waste Water Dump procedure as written.
4. Reconfigure for Contingency Vacuum Vent operation
- a. Repeat steps to purge water from Waste Water Dump Line using Free Fluid Nozzle.
 - b. Reconnect Y/Y Hose QD to Contingency X-Tie Waste QD.
 - c. Check that the Waste H₂O Dump Valve is open, then take the Waste H₂O Dump Valve Enable/Nozzle Heater to off.
 - d. Check MCC for Waste Collector Pressure



22673013. ART 1

Figure 5.79-1. Vacuum vent contingency operation

5.79-2

Verify that this is the correct version before use

FAILURE

Vacuum Vent Isolation Valve fails closed and orifice in the valve plate becomes plugged allowing no overboard venting of gaseous waste. Result is the rapid formation of a flammable/detonable gas mixture within the WCS/vacuum vent ducting from mixing of H₂ from the Hydrogen Separators and cabin air from wet trash/WCS.

BACKGROUND

FMEA/CIL identified a potential scenario in which the Vacuum Vent Isolation Valve fails in the closed position followed by blockage of the bleed orifice in the valve plate by ice/contamination from the wet trash/WCS. Without the capability to vent gaseous waste overboard through the vacuum vent, the potential exists for the mixing of hydrogen (from the hydrogen separators) and oxygen (from cabin air), and the formation of a flammable/detonable gas mixture within the WCS/vacuum vent ducting. The best option to alleviate this situation was to develop a procedure using available, onboard IFM hardware to provide an alternate means to vent this mixture overboard. Development of this procedure satisfied the operational retention rationale prescribed by the CIL.

REFERENCES

1. FMEA Number - 06-1A-1631-2
2. Flight rule A17-405

TITLE

WASTE WATER SYS BACKUP DUMP

SUMMARY

Allows waste water to be dumped through the supply (sply) water dump nozzle by interconnecting the waste and sply H₂O systems at the contingency cross ties using the yellow/yellow (Y/Y) hose.

PROCEDURES

1. Close sply H₂O dump isolation valve and open waste water tank valve.
2. Interconnect the sply and waste water systems by connecting one end of the Y/Y hose to the contingency H₂O cross-tie potable quick disconnect (CONT H₂O X-TIE POT QD) and the other to the contingency H₂O cross-tie waste quick disconnect (CONT H₂O X-TIE WASTE QD).
3. Open the waste H₂O dump isolation valve.
4. Check for the waste dump line temperature > 50° F and switch line heaters with from A to B if line temperature is < 50° F.
5. Turn on the sply H₂O dump valve enable/nozzle heater.
6. Condition waste H₂O nozzle temperatures to > 250° F < 350° F.
7. Open sply H₂O dump valve (Figure 5.80-1).
8. When the dump is complete, close the sply H₂O dump valve and waste H₂O dump isolation valves.
9. Turn the dump valve enable/nozzle heater off and check for waste H₂O quantity not decreasing; sply H₂O nozzle temperature (A/B) not increasing.
10. Disconnect the Y/Y hose and open the waste dump isolation valve.

See Figure 5.80-1.

FAILURES

The waste water dump capabilities are considered lost if.

1. The waste system dump valve fails closed.
2. The waste dumpline is blocked.
3. The waste dump line is ruptured.
4. Both waste dump nozzle temperature measurements are failed.
5. Waste dump nozzle ice formation.
6. The waste water dump line is below 32° F (37° F).

BACKGROUND

The waste H₂O dump valve is a 30 V dc solenoid latching valve with two microswitches that indicate whether the valve is full open or full closed. The latching feature latches the valve in either the open or closed position and will remain in the position last selected in the event of power failure. The two H₂O heaters are 15.6-watt resistance heaters powered by 28 V dc power. The supply H₂O nozzle heater is a 22.5-watt, 28 V dc heater. The waste nozzle heater is controlled via the waste water dump valve/enable nozzle. Diameter of the supply water dump line is 0.375 in. outside diameter with a 0.16 in. wall thickness. The diameter of the supply water dump nozzles are 0.0565 in. (OV-102), 0.052 in. (OV-103), and 0.0550 in. (OV-104). The diameters of the waste water dump nozzles are 0.0565 in. (OV-102), 0.056 in. (OV-103), and 0.0555 in. (OV-104) so the water dump rate (130-160 lb/hr) will be approximately the same rate as the supply water dump nozzles.

The contingency cross-tie panel is located aft of the main hatch on the aft port middeck wall. The Y/Y hose is 8 ft long and has female QD's that connect to the male QD's on the contingency cross-tie panel.

REFERENCES

1. Environmental Systems Console Handbook.
2. Vendor drawings.
 - a. VS70-623103 schematic - ECLSS water management system.
 - b. VS70-620309 schematic diagram - water management subsystem.
 - c. VS70-620302 schematic diagram - water management subsystem.
 - d. VS70-640102 schematic - active thermal control subsystem.
 - e. VS70-634460 mid-fus subsystem ECLSS instl-frame Xo-582 through Xo-693.

- f. VS70-620202 schematic diagram - waste management subsystem.
 - g. VS70-623200 system installation waste management, ECLSS equipment bay.
3. Flight rules
- a. A17-452 - Waste Water Dump Capability.
 - b. A17-502 - Waste Dump Nozzle Ice Formation.
 - c. A18-52 - Supply/Waste Water Cross-connect.
 - d. A17-503 - Waste Water Storage.
 - e. A17-505 - Waste Water Dump Nozzle Temperature Constraint.

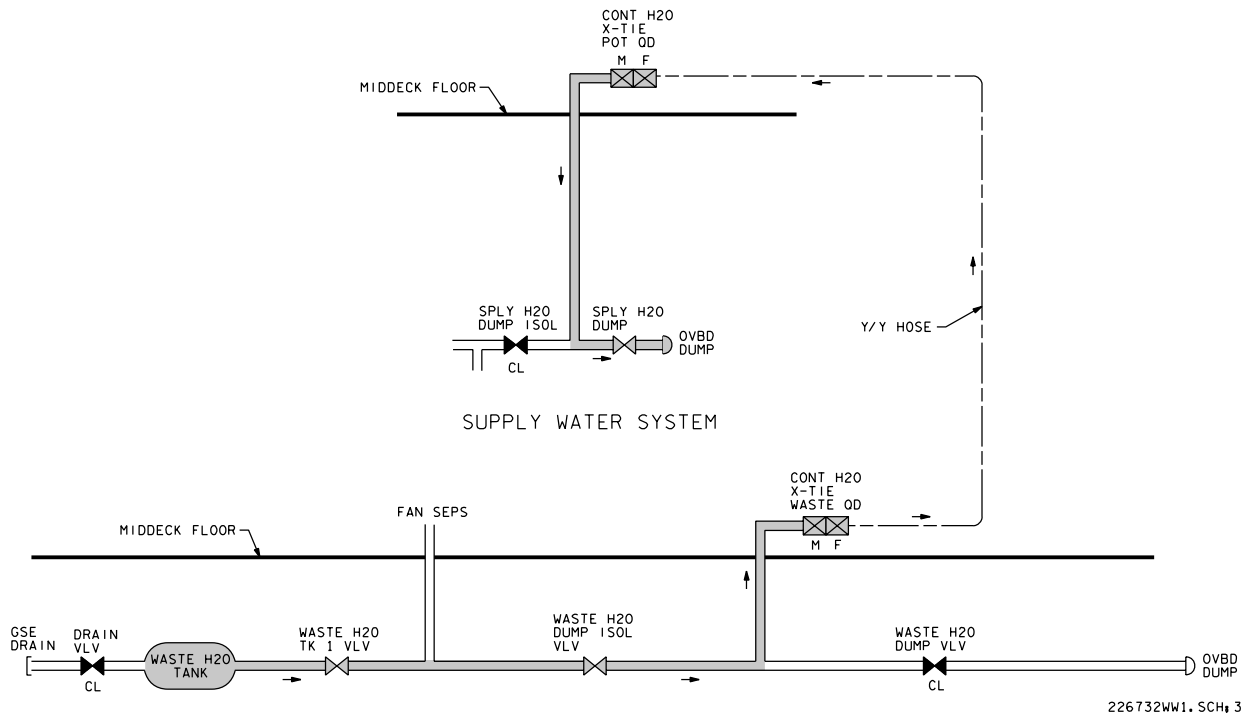


Figure 5.80-1. Waste water backup dump

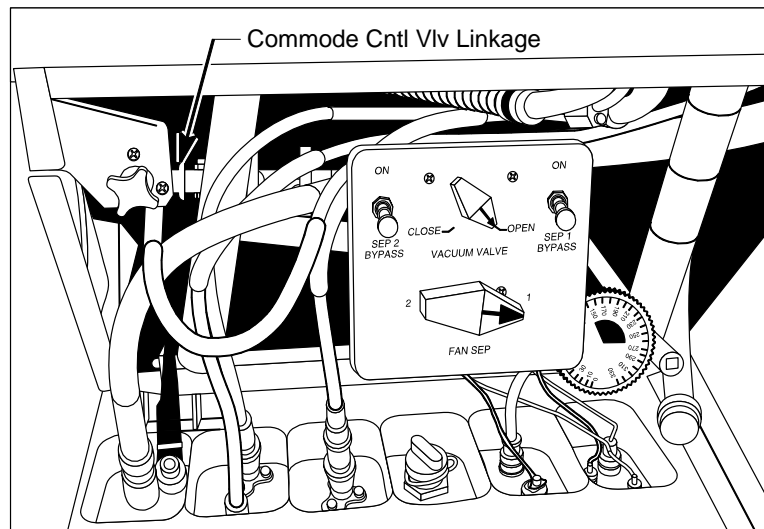
TITLE

WCS FAILED COMMODE CNTL VLV

PROCEDURES

Provides access to the WCS Commode Control Valve linkage, tests function of the linkage, and if required, restores function of the WCS linkage using the WCS Linkage Tool

1. Remove power to the WCS Controllers and Fan Separators by opening the appropriate circuit breakers (cb's).
2. Close the Vacuum Vent Valve located on the WCS.
3. After removal of the WCS kickplate, locate the WCS Commode Control Linkage:
 - a. Start from the WCS Vacuum Valve switch.
 - b. Locate the valve housing immediately aft of this switch.
 - c. WCS Commode Control Valve linkage extends horizontally inboard from valve assembly.
 - d. Commode Control Valve linkage is forward-most, larger, of two double-U-joint linkages. See Figure 5.81-1 below.



toilet_002

Figure 5.81-1. WCS with kickplate removed

4. Rotate WCS MODE switch to COMMODE/MANUAL/EMU.
5. While taking WCS COMMODE CONTROL to the UP position, observe Commode Control valve linkage - report observations to MCC (linkage normally rotates clockwise (cw) during this action with cw oriented looking outboard along the axis of Commode Control Valve linkage).
6. If Commode Control Valve linkage does not rotate, on MCC call, continue.
7. Locate Allen Bolt and nut fastening inboard U-joint to Commode Control valve (approximately 3.5 inches inboard of valve and 4 inches aft of the SEP 2 Bypass Switch). See Figure 5.81-2 below.

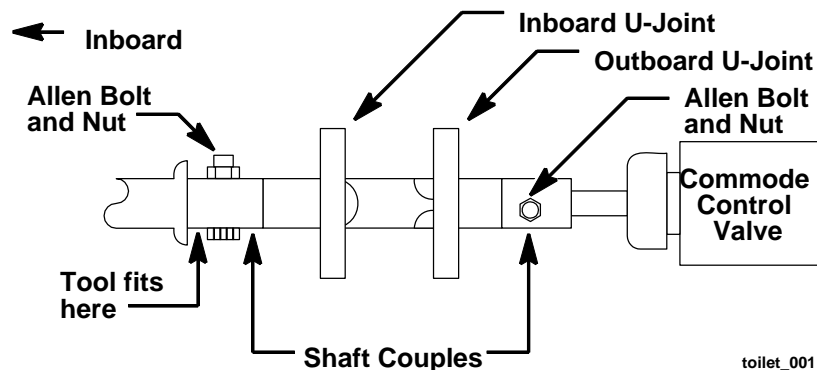


Figure 5.81-2. WCS commode control linkage

8. Slide WCS Linkage Tool upwards onto shaft to immediate left of Allen Bolt.
9. Rotate WCS Commode Control valve linkage cw 1/4 turn (90 deg) against stop; do not over torque.
10. Open the WCS Vacuum Vent Valve, then wait 20 seconds.
11. Push the WCS COMMODE CONTROL forward.
12. If cabin dP/dT alarm occurs (indicating overboard leak):
 - a. Close the WCS Vacuum Vent Valve
 - b. Take the WCS COMMODE CONTROL back
 - c. Check with MCC for further actions
13. If no cabin dP/dT alarm occurs, continue.
14. Take the WCS COMMODE CONTROL back.

15. Rotate the WCS Commode Control valve linkage ccw 1/4 turn (90 deg) against stop, being careful not to over torque.
16. Rotate WCS MODE switch to AUTO (if Mode Control vlv will not rotate, ensure Commode Control Valve linkage fully ccw against stop).
17. Re-power the WCS Controllers and Fan Separators by closing the appropriate circuit breakers (cb's).
18. Rotate WCS MODE switch to COMMODOE/MANUAL/EMU.
19. Rotate WCS Commode Control valve linkage cw 1/4 turn (90 deg) against stop, do not over torque; then wait 20 seconds.
20. Push the WCS COMMODOE CONTROL forward.
21. Check WCS airflow at both commode and urinal, and report results to MCC.
22. Take the WCS COMMODOE CONTROL back, then down.
23. Rotate Commode Control Valve linkage ccw against stop.
24. Rotate WCS MODE switch to AUTO.
25. Stow tools, however, leave WCS Linkage Tool mounted on shaft.

REVISED WCS OPERATING PROCEDURES

TO USE WCS:

1. Rotate WCS MODE switch to COMMODOE/MANUAL/EMU.
2. Rotate WCS Commode Control valve linkage cw 1/4 turn (90 deg) against stop, do not over torque; then wait 20 seconds.
3. Take WCS COMMODOE CONTROL to the up position, then forward.

TO SECURE WCS:

1. Take WCS COMMODOE CONTROL back, then down.
2. Rotate WCS Commode Control Valve linkage ccw 1/4 turn (90 deg) against stop; do not over torque.
3. Rotate WCS MODE switch to AUTO.

FAILURE

The Commode Control Handle has been disconnected from the Commode Control Valve linkage, resulting in the inability to depress and repress the commode bowl.

BACKGROUND

During normal operation of the WCS, movement of the Commode Control Handle up/down rotates the Commode Control Valve linkage, and places the Commode Control Valve in the proper position to repress/depress the WCS bowl for use. On two occasions (STS-33 and STS-42), the crew broke pins on the Commode Control Valve linkage, effectively separating the Commode Control Handle from the Commode Control Valve Assembly. Development of an IFM procedure during those flights had the crew remove the WCS kickplate, and attach a set of vise grips to the Commode Control Valve linkage. Rotation of that linkage with the vice grips for each commode repress/depress returned the WCS to full operation. Post flight, the linkage was redesigned and pin materials were improved. In addition, a tool was developed to take the place of the vice grips should the failure ever reoccur.

REFERENCES

1. Environmental Systems Console Handbook, Volume 8 - Waste Collection System (WCS)

TITLE

WCS FAN SEP FAILURE (FAILED URINAL) OPERATION

SUMMARY

Provide a contingency method of urine disposal by adapting the urinal hose and funnel to the Y/Y hose with the 7/8-in. to 5/8-in. QD adapter, and venting the assembly overboard, using the waste water contingency cross-tie QD and the waste water dump system.

1. Close the waste water dump isolation valve and connect one end of the Y/Y hose to the contingency H₂O cross-tie waste quick disconnect (CONT H₂O X-TIE WASTE QD).
2. Configure the urinal and IFM equipment to the CONT H₂O X-TIE WASTE QD (Figure 5.82-1).
3. Thermal condition the waste dump line and nozzle to avoid freezing.
4. To urinate, open to dump valve and vent overboard via the waste H₂O dump system.
5. Urination complete, close the waste H₂O dump valve and remove the 7/8 in. to 5/8 in. QD adapter.
6. Urination operations complete, remove the Y/Y hose from the CONT X-TIE WASTE QD and open the waste H₂O dump isolation valve.

FAILURES

Loss of both WCS sep fans.

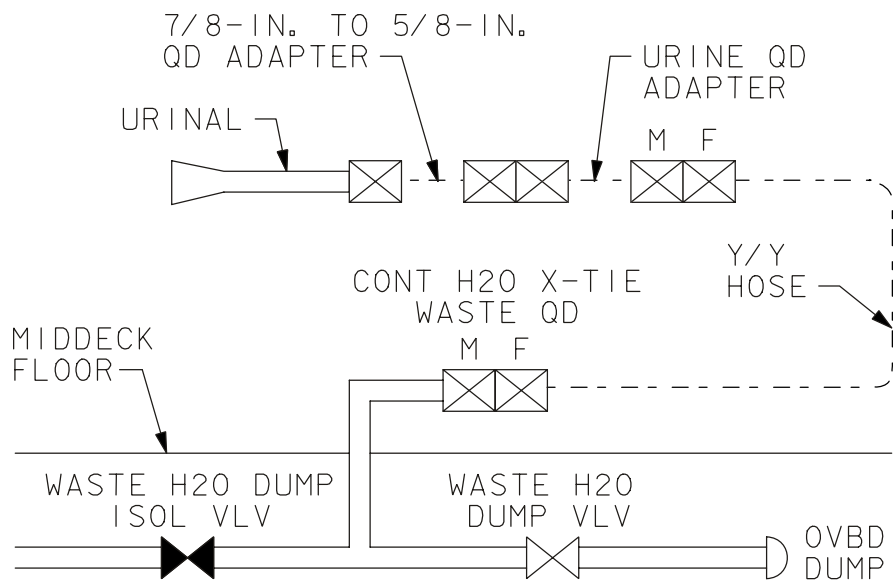
BACKGROUND

The use of this contingency urinal is preferred to the urine collection bags since it eliminates the problem of stowing the urine. The crew must exercise extreme caution when using this procedure as the hose is vented overboard to vacuum. If this procedure is required during flight, the crew should be cautioned to use "prox ops" only; i.e., no "hard docking."

REFERENCES

1. Drawings.
 - a. VS70-623103 schematic - ECLSS water management system.
 - b. VS70-620309 schematic diagram - water management subsystem.
 - c. VS70-620302 schematic diagram - water management subsystem.

- d. VS70-620202 schematic diagram - waste management subsystem.
 - e. VS70-623200 system installation waste management, ECLSS equipment bay.
 - f. VS70-634460 mid-fus subsystem ECLSS instl-frame Xo-582 through Xo-693.
 - g. VS70-620202 schematic diagram - waste management subsystem.
2. Flight rules.
- a. A17-351 - WCS Separator.
 - b. A17-352 - WCS Urine Collection.



22673001. ART# 1

Figure 5.82-1. Contingency urinal

TITLE

WCS FAN SEP 1 (2) CLEARING

SUMMARY

Attempt to clear a flooded WCS fan sep by reducing waste water tank pressure.

1. Dump waste tank if required.
2. Flash evaporator system (FES) off - Equalize tank A and tank B quantities.
3. Open H₂O GN₂ tank vent valve (depress waste tank).
4. Remove odor/bacteria filter and replace with towels.
5. Run fan sep to clear flooding.
6. When flooding clear, replace odor/bacteria filter.
7. Repress waste tank.

BACKGROUND

Fan seps are centrifugal-type gas-liquid separators. Liquid is transported from the fan housing via a Pitot tube and check-valve and into the waste water system. A flooded fan will have a degraded performance due to increased mass being moved. A degraded fan may not be able to supply the needed pressure to open the check valve and clear itself of the excess liquid. Normally the waste water system is pressurized by GN₂ to about 30 psia. Depressing the water system tanks takes them to ambient pressure, 14.7 psia. This reduced pressure may allow a flooded fan sep to clear itself.

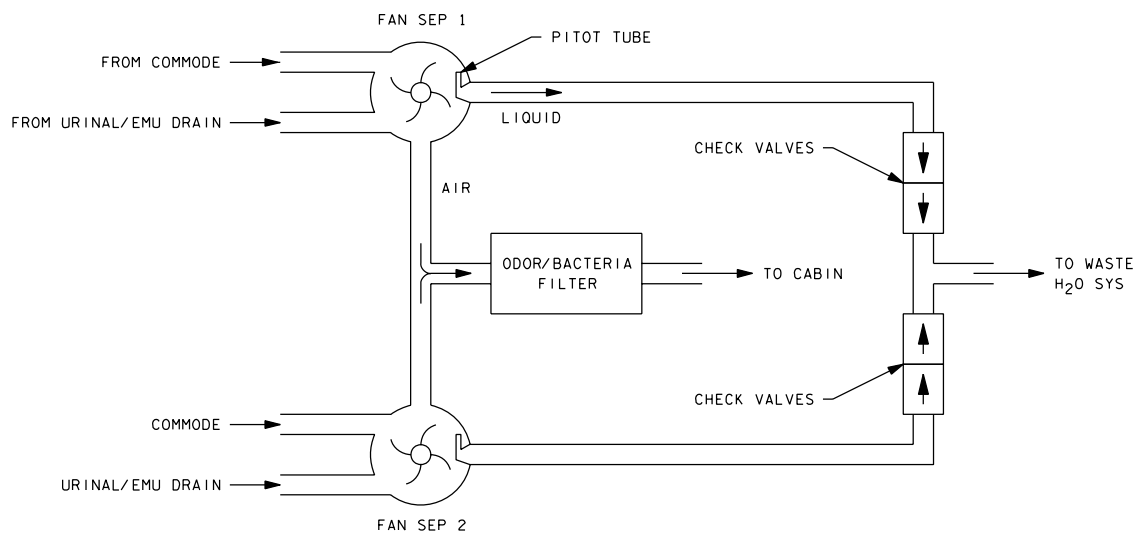
The towels are used to absorb excess liquid from the flooded fan. A flooded fan will push excess liquid into the air-outlet stream, through the odor/bacteria filter cavity and into the cabin.

See Figure 5.83-1 and Figure 5.83-2.

REFERENCES

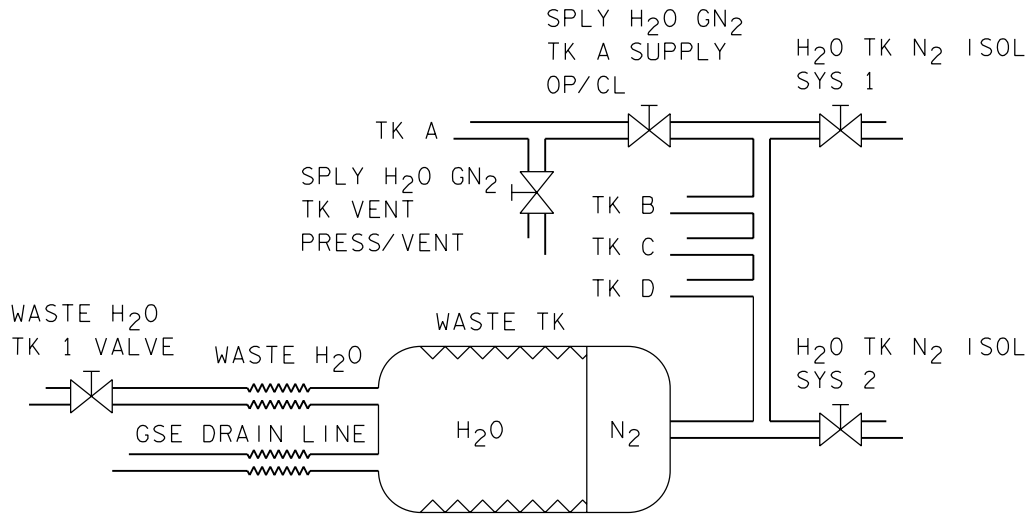
1. Environmental Systems Console Handbook.
2. Vendor drawings.
 - a. VS70-623103 schematic - ECLSS water management system.
 - b. VS70-620309 schematic diagram - water management subsystem.
 - c. VS70-620302 schematic diagram - water management subsystem.

- d. VS70-620202 schematic diagram - waste management subsystem.
 - e. VS70-623200 system installation waste management, ECLSS equipment bay.
 - f. VS70-634460 mid-fus subsystem ECLSS instl-frame Xo-582 through Xo-693.
3. Flight rules.
- a. 9-210 - WCS Separator.
 - b. 9-211 - WCS Urine Collection.
 - c. 9-212 - WCS Commode.



22673WFAN, SCH: 2

Figure 5.83-1. WCS fan seps



22673WFA2. SCH# 3

Figure 5.83-2. Waste tank and GN2 supply

**APPENDIX A
ACRONYMS AND ABBREVIATIONS**

A/G	air-to-ground
A/L	airlock
AC	alternating current
ACA	annunciator control assembly
ACCU	audio central control unit
ADI	attitude direction indicator
ADTA	air data transducer assembly
AFD	aft flight deck
AMEU	alpha/Mach electronics unit
AMI	airspeed/Mach indicator
AOS	acquisition of signal
APDS	Androgynous Peripheral Docking System
ARS	air recirculation system
ATU	audio terminal unit
Av	avionics
AVVI	altitude/vertical velocity indicator
AWG	American wire gauge
BARS	baseline account reporting system
BFS	backup flight system
BITE	built-in test equipment
BOB	breakout box
C&D	control and display
c.g.	center of gravity
C/L	checklist
cb	circuit breaker
CCB	Configuration Control Board
CCCD	crew compartment configuration drawing
CCT	
CCTV	closed-circuit television
CCW	counterclockwise
CDMS	command and data management subsystem
CDR	commander
CE	crew escape
CEIT	crew equipment interface test
CIL	
CIR	Cargo Integration Review
CIR SEG	circuit segment
CM	crew module
COAS	crew optical alignment sight
CPCG	Commercial Protein Crystal Growth
CPU	central processing unit

CR	change request
CRT	cathode-ray tube
CS	crew systems
CSM	cargo systems manual
CSR	customer support room
CSRM	Crew Systems Reference Manual
CW	clockwise
CWC	contingency water container
CWS	caution and warning system
DAP	digital autopilot
dc	direct current
DDU	display driver unit
DEU	display electronics unit
DMM	digital multimeter
DODSSI	Department of Defense Standardization Service Index
DPS	data processing system
DSO	detailed science objective
DTO	detailed test objective
DVIS	Digital Voice Intercommunications system
DWG-ZN	drawing and zone number
E&D	engineering and development
ECLSS	environmental control and life support system
ECU	electronic control unit
EECOM	electrical, environmental, and consumables manager
EEE	electronic, electrical, and electromechanical
EGIL	electrical, generation, instrumentation, and lighting
EIU	engine interface unit
EMK	emergency medical kit
EMU	extravehicular mobility unit
EPS	electrical power system
EU	electronics unit
EVA	extravehicular activity
FAO	Flight Activities Officer
FCOH	Flight Control Operations Handbook
FCR	flight control room
FD	flight director
FDF	Flight Data File
FES	flash evaporator system
FF	flight forward
FFT	full fuselage trainer
FM	frequency modulation
FMEA	failure mode and effects analysis
FP	flight plan

FPCA	forward power control assembly
FRD	Flight Requirements document
FSE	flight support equipment
FSS	fire suppression system
GMT	Greenwich mean time
GNC	guidance and navigation computer
GPC	general purpose computer
GSE	ground support equipment
GSFC	Goddard Space Flight Center
HM	HIGH MONITOR
HMU	hardware mockup
HOSC	Huntsville Operations Support Center
HPB	
HSI	horizontal situation indicator
HUD	head up display
HUDE	head up display electronics
Hum Sep	humidity separators
I/O	input/output
ICD	Interface Control Document
ID	identification inside diameter
IDP	Integrated Display Processor
IFM	in-flight maintenance
IMU	inertial measurement unit
INCO	Integrated Communications Officer
IOP	input/output processor
IPS	instrument pointing system
IU	interface unit
IUS	inertial upper stage
IWTS	integration wire termination system
JSC	Lyndon B. Johnson Space Center
KSC	Kennedy Space Center
LCG	liquid-cooled garment
LCVG	liquid cooling and ventilation garment
LEB	lower equipment bay
LED	light emitting diode
LOS	loss of signal
LRU	line/replaceable unit
M	MONITOR
MADS	modular auxiliary data system

MAL	malfunction
MCA	motor control assembly
MCC	Mission Control Center
MCIU	manipulator controller interface unit
MCV	microbial check valve
MDF	manipulator development facility
MDM	multiplexer/demultiplexer
MER	mission evaluation room
MMACS	Mechanical, Maintenance, Arm and Crew Systems
MMU	mass memory unit
MN	main
MOMS	Maintenance Operations Management System
MPM	manipulator positioning mechanism
MPSR	multipurpose support room
MRL	manipulator retention latch
MS	military standard
MSBLS	microwave scan-beam landing system
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NBL	Neutral Buoyancy Laboratory
NSP	network signal processor
OBSS	Orbiter Boom Sensor System
O.T.	overtravel
OCAA	orbiter cabin air cleaner
OMI	operations maintenance instruction
OMRSD	operations maintenance requirements and specifications documents
OMS	orbital maneuvering system
Ops	operations
OS	orbit station
OSVS	Orbiter Space Vision System
OSVU	Orbiter Space Vision Unit
OWDA	operational water dispenser assembly
PABX	mode that provide on- and offsite phone dialing capability
PADM	portable audio data modem
PADS	problem action data system
PASS	primary avionics software system
pbi	pushbutton indicator
PCP	power control panel
PDI	payload data interleaver
PDRS	payload deployment and retrieval system
PDU	pilot display unit
PEV	pressure equalization valve

PFR	postflight report
PHS	personal hygiene station
PL	payload
PLBD	payload bay door
PLS	primary landing site
PLT	Pilot
POCC	Payload Operations Control Center
PPO ₂	partial pressure O ₂
PSP	payload signal processor
QC	quality control
QD	quick disconnect
RCRS	regenerable CO ₂ removal system
RCS	reaction control system
RCU	remote control unit
RF	radio frequency
RHC	rotational hand controller
RHS	rehydration station
RMS	remote manipulator system
RPC	remote power controller
RTV	room temperature vulcanize
SAIL	Shuttle Avionics Integration Laboratory
SCAN	Shuttle Connector Analysis Network
SF	standard form
SFOM	Shuttle Flight Operations Manual
SPAN	spacecraft analysis
SRB	solid rocket booster
SSME	space shuttle main engine
SSP	standard switch panel
SSR	special sub-routine
SSSH	Space Shuttle Systems Handbook
STS	Space Transportation System
SW	software, switch
tb	talkback
TDRS	tracking and data relay satellite
THC	translation hand controller
TIPS	thermal impulse printer system
TL	TALK/LISTEN
TLM	TALK/LISTEN/MONITOR
TP	test port
TPS	Technical Publishing Software
TT	torque tip

TVC	thrust vector control
UHF	ultra high frequency
VCV	vacuum cycle valve
VITT	vehicle integration test team
VPI	valve position indicator
VSU	video switching unit
VTR	video tape recorder
W/T	walkthrough
WCS	waste collection system
WMC	waste management compartment
WWDF	waste water dump filter
Y/Y	yellow/yellow

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