STS-104/7A FRR

EVA Project Office
Johnson Space Center

Steve Broussard

June 28, 2001

EVA Mission Overview

- **EVA Capability (STS-104/7A)**
  - Three scheduled EVA's:
    - Consumables to support:
      - Two 10.2 psi scheduled EVA's from orbiter and one scheduled EVA from joint airlock or
      - Three 10.2 psi scheduled EVA's from orbiter
  - One unscheduled EVA: To achieve mission success or ISS contingencies
    - Can be performed from either airlock post EVA 2
  - Two contingency EVA's: For orbiter, RMS, and ODS contingencies
- **EVA Capability (7A Stage)**
  - No planned U.S. EVA's (three EVA contingency capability)
  - No planned Russian EVA's (two EVA contingency capability)
- **EVA Training (STS-104/7A)**
  - EVA training ratio is 10:1
  - All planned tasks can be accommodated within scheduled 6:30 timeline, less EVA 1 which is scheduled at 6:55

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EVA Mission Overview

- **EVA 1 (Flight Day 4) - 6:55**
  - 6:55 duration includes 3:25 Joint Airlock SSRMS/SVS and CBM dock operations
    - EV crew on Orbiter SCU's for 1:05 of 3:25 airlock installation time period
    - STS-104/7A JOP and EVA CCB have reviewed and approved EVA extension past 6:30
  - Tasks
    - Passive CBM Thermal Cover Remove
    - Installation of three High Pressure Gas Tank (HPGT) Towel Bars and one HPGT Guide Post
    - LTA Jumper Remove (four connectors)
    - PLB Cleanup
    - Inspect Node Stbd CBM for Early Comm FOD
    - Airlock to Node Jumper Mate (two connectors)
    - Setup APFR's for HPGT one worksite

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EVA Mission Overview

- **EVA 2 (Flight Day 7) – 5:35**
  - Tasks
    - Remove MLI from HPGT install locations (two) and install remaining HPGT Guide Posts (three)
    - Release tank from Spacelab pallet
    - Repeat tank release, install, and checkout for second tank
    - Install Airlock trunnion thermal covers (four) and Airlock Flight Releasable Grapple Fixture (FRGF) thermal cover (one)

- **Completion of EVA 2 allows STS-104/7A to meet minimum mission success criteria.**
- **ISS provided with capability to support EVA out of the joint airlock**

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EVA Mission Overview

- **EVA 3 (Flight Day 9) – 5:35**
  - EVA 3 conducted out of joint airlock
    - First planned use of Exercise Prebreathe Protocol
    - First planned use of METOX in EMU during EVA
    - Flight prepared to perform EVA from orbiter if required
  - Tasks
    - Orlan comm cable install (one connector)
    - Remove MLI and install third and fourth HPGT's repeating previous method
    - Install handrails (five)
    - Install HPGT FRGF thermal covers (four)
    - Stow Lab LTA cable disconnected in EVA 1
    - Open Node nadir CBM cover flap
- **EVA Get Ahead Tasks**
  - BMRRM inspection with WVS
  - PMA 3 Connector (P601) Mate (task left over from 5A.1)
  - SSRMS MLI closeout (task left over from 6A)

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EMU and SAFER Logistics

- **Three EMU's Manifested/Two EMU's On-orbit**
  - Two Large Orbital Replacement Unit (ORU) EMUs, and one medium ORU EMU launched on STS-104/7A
    - STS-104/7A to return from ISS with two large ORU EMUs from STS-98/5A and STS-100/6A.
- **Two SAFER's Left On-orbit by STS-100/6A**
  - STS-104/7A will use two ISS SAFER's for all EVA's.
    - Planned SAFER transfer to orbiter to accommodate EVA 1 and EVA 2
    - Both SAFER's to remain on ISS post STS-104/7A

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EMU and SAFER Logistics

- **EMU and SAFER First Flight Hardware**
  - EMU
    - Adjustable Waist Brief Assembly
    - ISS EMU Servicing Kit
    - EMU ORU Tools
    - Metox Regenerator
    - First use of EMU hardware delivered to ISS via STS-100/6A
      - Metox Canisters
      - ISS EMU Umbilical
  - SAFER
    - No new equipment

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EVA Tools and Crew Aids Manifest Summary

- **EVA Tools and Crew Aids First Flight Items**
  - HPGT Quick Disconnect Tool
  - EVA Tool Stowage Assembly (ETSD tool boxes)
    - 25 contingency tools stowed in ETSD
  - SAFER Stowage Bags
- **Non-GFE EVA Hardware First Flight Items**
  - None
- **Standard Contingency Tools in Port TSA**
- **Starboard (Lightweight) TSA**

Launch

4 A/L Trunnion thermal covers*
1 A/L FRGF thermal cover*
1 Ret. Equipment Tether
1 80” Adjustable Equipment Tether

Return

1 A/L CBM thermal cover*
1 STS to A/L LTA cable*
2 EVA fuse tethers
8 A/L PCBM contam. covers*
2 Ret. Equipment Tethers
2 Adj. Equipment Tethers
1 EVA Wire Tie

* Airlock element provided equipment

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EVA Tools and Crew Aids Manifest Summary

- **Sill-Mounted PFR Configuration**
  - Three full stacks (Bay 2 Port Location, Bay 13 Port and Bay 13 Starboard)
- **Standard complement of slidewires, safety tethers, crew hook locks, and winches in PLB**

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EVA Tools and Crew Aids Manifest Summary

- **EVA Tools and Crew Aids Left On-orbit**
  - 25 Tools launched in ETSD's to remain on ISS
  - 142 Tools launched in STS middeck and joint airlock to remain on ISS
  - Upon completion of STS-104/7A the basic complement of ISS EVA tools will reside on orbit
- **EVA Tools and Crew Aids Swapped On-orbit**
  - None Currently planned
- **EVA Tools and Crew Aids Returned**
  - None currently planned

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EVA Fit Checks and Sharp Edge Inspections

- **Tool-to-tool Fit Checks (578 total tasks)**
  - 90 percent Total Complete (523 of 578)
    - 107/107 airlock ETSD = 100 percent
    - 80/128 payload bay and TSA = 63 percent
      - 8 open fit checks in PLB (PFR stacks that have not been cross fit checked)
        - RISK- LOW. Planned use of PFR stacks is as assembled for launch.
      - 40 open fit checks in TSA. Open are bayonet fitting fit checks to Modular Mini Work Station (MMWS) due to unavailability of hardware from previous flights
        - RISK- LOW. All items are contingency equipment and have alternate method of transport to work station
    - 336/343 Middeck = 98 percent
      - 7 open fit checks in middeck. EVA trash bags and ratchet wrench not fit checked with MMWS sub assemblies
        - RISK- LOW. All items have an alternate method of transport to work station
  - All incomplete fit checks have been dispositioned as acceptable through the EVA CoFR Process

EVA Fit Checks and Sharp Edge Inspections

- **Tool-to-Interface and Interface-to-Interface Fit Checks (254 total tasks)**
  - 253/254 complete = 99 percent
    - Fit check of MPEV in Equipment Lock PPRV location (IVA on orbit swap)
  - All incomplete fit checks have been dispositioned by the ISSP
- **Sharp Edge Inspections**
  - 100 percent complete on airlock, Spacelab pallet, HPGT's
    - PLB will be completed by pad walk down on June 28, 2001

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Previous Flight Anomalies

- **EVA Crewmember Eye Irritation**
  - Background
    - During STS-100 a crewmember had a burning sensation in both eyes during EVA
    - Previous eye irritation scenarios had occurred during the repress phase of EVA, and were attributed to exposure of eyes to Anti-fog solution (soap)
  - Investigation Status and Rationale for Flight
    - Most likely cause determined to be irritant (most likely Anti-fog solution) being transported into crewmembers eyes by leaking Disposable In-suit Drink Bag (DIDB)
    - For STS-104/7A, DIDB is being replaced with a previous configuration In-suit Drink Bag (IDB) to eliminate potential leaking Bite Valve and thus control one known transport mechanism. IDB valve is much less susceptible to leakage
    - For ISS-2/Stage 7A, the risk of DIDB leakage as a transport has been accepted for any contingency EVA's which may occur during the 1 month Stage 7A.

Transport Mechanism is Controlled and Crew is Properly Trained

Previous Flight Anomalies

- **EMU Boot Pressure Point**
  - Background
    - Crewmembers have experienced pressure point on feet
    - Foot discomfort has potential to be mission impact
  - Investigation Status
    - Root cause is foot contact with a pressure bladder seam on the top side of the boot
    - Depending on foot size, the boot design and foot wear (multiple sock options, boot sizing insert, thermal slippers, toe caps) selected, a stack up combination can occur to provide the potential for boot fit concerns that might not be readily screened for on the ground
    - To accommodate potential physiological changes on-orbit, options to increase foot easement have been provisioned (boot sizing inserts, thermal slippers, thinner socks, smooth bladder wrinkles and leg length resizing)
  - Rationale for Flight
    - Modified the boot fit check process to more effectively simulate 0-g effects
    - 7A crewmen have been successfully fit checked (i.e., foot easement within boot dimensions)
    - Additional crew sizing options are manifested if required for on-orbit modifications

Fit Checks and On-orbit Options Ensure Proper Fit

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- **Special Topics**
  - **Exercise Prebreathe Protocol**
  - **Bends Treatment Adapter**
  - **SSRMS Workarounds**
  - **ISS Airlock UIA to EMU 0_2 Temperature**

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Exercise Prebreathe Protocol

- **Exercise Prebreathe Protocol**
  - Overview
    - Exercise Prebreathe protocol is a new method for more efficient denitrogenization of EV crew prior to EVA from ISS
    - Protocol is planned as prime for ISS crews beginning with ISS-3 and prime for STS crews using the joint airlock beginning with STS-104/7A EVA 3
    - Protocol eliminates need for 12-hour crew isolation (campout) or 4-hour in-suit prebreathe (14.7 psi)
    - Total Protocol duration is 2:20
      - 80-minute total mask prebreathe time using dedicated hose and mask system from airlock (140 ft. hose)
        - 10 minute exercise on mask while on CEVIS using exercise tubing for upper body exercise
        - Depress airlock to 10.2 psi for suit donning
        - Repress airlock to 14.7 psi following suit donning
      - 60-minute in-suit prebreathe immediately prior to depress to vacuum
- **Exercise Prebreathe Protocol**
  - Status
    - All necessary equipment currently on ISS or on STS-104/7A manifest
    - Protocol will be dry run on flight day six and flight day eight
    - Ability to switch to alternate protocol (Campout or Shuttle 10.2 psi) as late as flight day eight for EVA 3 without impact to mission objectives

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Bends Treatment Adapter

- **Revised Bends Treatment Procedure**
  - NASA Medical has implemented a revised on orbit Decompression Sickness (DCS) treatment procedure utilizing the existing Bends Treatment Adapter (BTA) 8.45 psid relief valve
    - DCS treatment is significantly improved over the current procedure by not initially depressurizing the suit and installing the BTA with the suit pressurized
  - Revised procedure installs BTA in series with the EMU in-suit relief valve and requires IV crew action to prevent suit over pressurization in the unlikely event of EMU regulator failure
  - After BTA installation, IV Crewmember will be prepared to perform the following
    - IV crew performs 8 “pump-up” cycles on the EMU primary O_2 system to raise suit pressure from ~4.3 to 8.0 psid to accomplish DCS treatment
    - IV crew monitors suit pressure during each 15 second “pump-up” cycle to ensure indications of EMU Primary Oxygen Regulator failure are not present
    - IV crew reacts and shuts off oxygen flow in less than a 5 second operation if failure indications are present. Time to reach maximum design pressure is 12 seconds.

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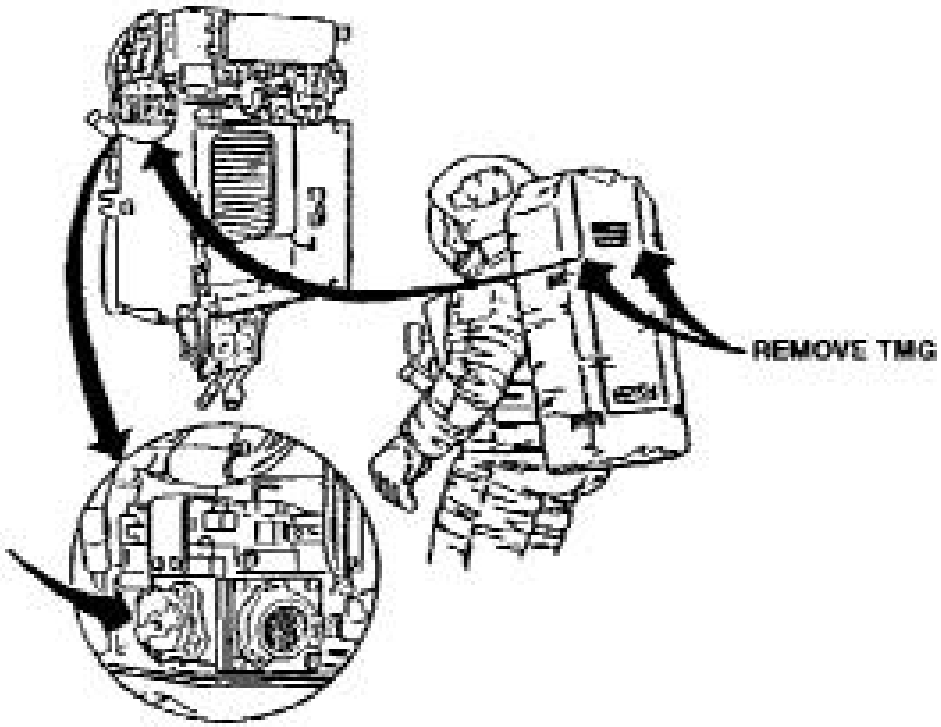
Bends Treatment Adapter

BTA Installation Location on EMU

Positive Pressure Relief Valve



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SSRMS Workarounds

- **SSRMS Failure EVA Workarounds**
  - STS-104/7A EVA crew prepared for SSRMS failures via EVA actions
    - Manual drive of SSRMS to occur via EVA crew use of Pistol Grip Tool (PGT)
    - SSRMS trajectory revised to allow access to joints by EVA crew using Shuttle RMS
  - EVA 1 failure overcome by manually positioning Airlock approximately 3 feet from ISS Node Starboard CBM and attaching jumper cables as in the baseline plan
    - Preserves potential Airlock installation on 7A via contingency EVA
  - EVA 2 or 3 failure overcome by EV crew manually driving SSRMS and releasing tank to EV crew at revised handoff positions
  - HPGT 2 and HPGT 3 can be installed using the Shuttle RMS if required
  - EV crew has received training and has conducted NBL evaluations for the above contingencies

ISS Airlock UIA to EMU O_2 Temperature

- **Potential for Airlock to EMU ICD Violation for O_2 temperature**
  - Initial analysis showed that EMU could receive O_2 below the current ICD limit of 40 degrees F from the Airlock O_2 system
  - Recent analysis shows good margin to maintain EMU interface temperatures for nominal cases, final analysis in work for off nominal cases
  - EVA Project considers issue to be no constraint to STS-104/7A and is working with ISS Vehicle office on final issue closure

STS-104/7A FRR
Planned Forward Work

Title	Plan to Close	Responsible Organization	ECD	Risk
V1103.02	V1103.02	EC/MOD	7/2/01	Low
Sharp Edge Inspection	Final Pad Walk Down	VITT	6/28/01	Low
EMU Middeck Batt Charger ISS Cert for Contingency Use	SMART panel ISS approval	USA	6/29/01	Low

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STS-104/7A FRR

- There are no EVA exceptions for STS-104/7A FRR
- The EVA Project Office is ready to proceed with STS-104/7A launch operations pending completion of the planned forward work
- All open work will be closed or dispositioned by L-2

Original signed by:

_____

G. Allen Flynt
Acting Manager, EVA Project Office

STS-104/7A
FRR

Backup Charts

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STS-104/7A EVA FRR Backup Charts

Eye Irritant

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FIGURE E.1 DISPOSABLE IN-SUIT DRINK BAG (DIDB) COMPONENTS

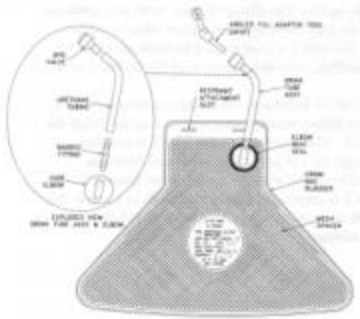

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FIGURE 3.9.3 IDB OUTLET VALVE

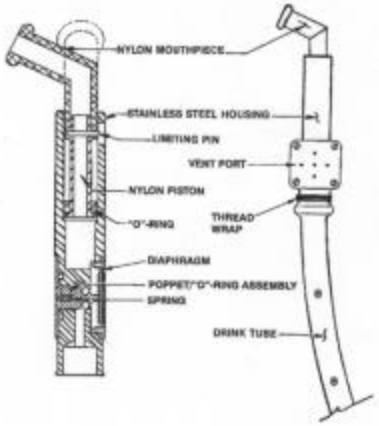

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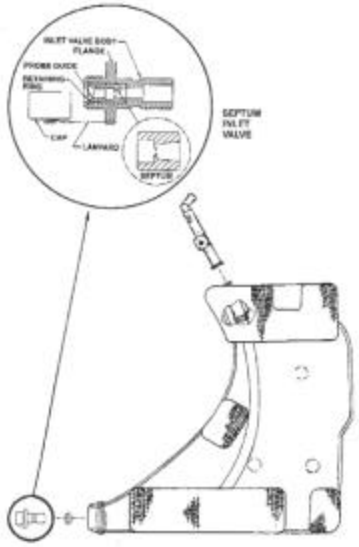
FIGURE 3.9.2 IDB INLET VALVE



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STS-104/7A EVA FRR Backup Charts
Boot Configuration

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FIGURE 3.4.4 BOOT

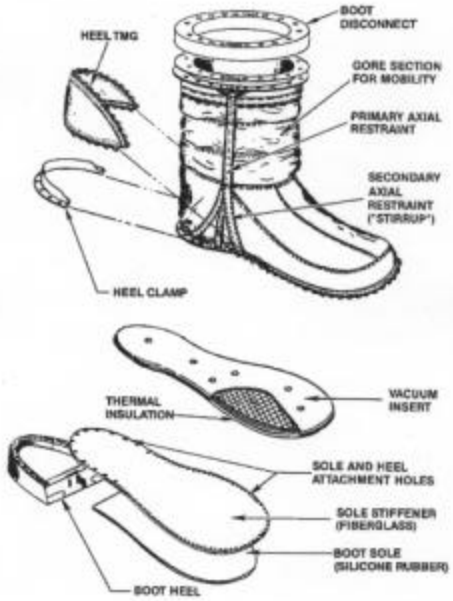

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FIGURE 3.4.5 BOOT SIZING INSERTS

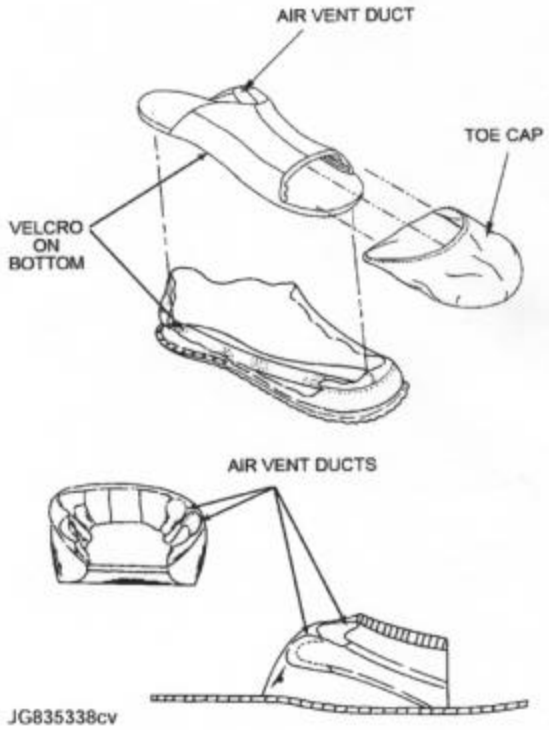

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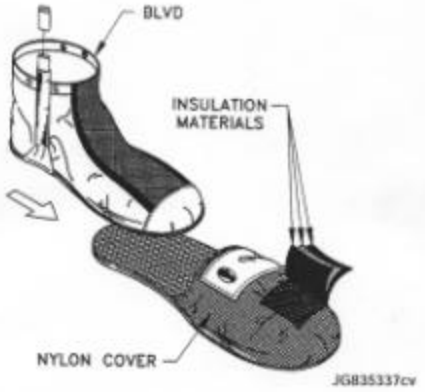
FIGURE 3.4.6 EMU THERMAL SLIPPER (ETS) ASSEMBLY



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STS-104/7A EVA FRR Backup Charts
High Pressure O_2 Test Rig Regulator Ignition

- **Background**
  - During SOP S/N 1015 Acceptance Testing at HSWL a test rig high pressure O_2 regulator developed a leak
  - Disassembly showed ignition internal to the Test Rig Regulator Vent Port
- **Rationale for Flight**
  - Root cause is a damaged regulator o-ring ignited by flow friction
  - O-ring damage due to dimensional outage on the Test Rig Regulator housing
  - Combustion occurred within two operating cycles of the regulator
  - SOP S/N 1015 cleanliness is under evaluation, unit is at HSWL
  - Flight SOPs were processed with a Test Rig Regulator that had been in service for over 2 years, disassembly of the regulator showed only normal wear

Incident Isolated To Unique Outages In Test Rig Regulator

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