Orbiter Crew Compartment Integration-Stowage

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Orbiter Crew Compartment Integration-Stowage

- Orbiter Crew Compartment Integration (CCI)
  - Analytical Integration - Planning the Orbiter CC configuration for ascent, on-orbit ops, and return
    - Stowage
    - Payload/GFE/FCE/CFE Hardware installations
  - Crew Compartment Configuration Drawing
  - MIP, Interface Control Annex-Manifest (NSTS 21000-IDD-MDK interfaces)
  - Plug-in-Plan and Cable routing (Photo/TV-Laptops-Power)
    - Crew Compartment Avionics Interface Tool (CCAIT)

Orbiter Crew Compartment Integration-Stowage

- Orbiter Crew Compartment Integration (CCI)-Stowage
  - Implementation of SSP and ISSP manifest requirements within Orbiter SSP constraints/capabilities.
  - Configuration drivers:
    - Changes in Space Shuttle Mission-Deployable Satellites, Spacelab science, SpaceHab, MIR/ISS (transfers and crew rotation), and HST repairs
    - Differences in Orbiters
    - Technology evolution of Orbiters and hardware-Laptops, Photo/TV, ACES
    - Satisfy engineering requirements for SSP/ISSP hardware installations/stowage
    - On-orbit Shuttle/Crew operations-Habitability
    - Transfer operations between Orbiter and MIR/ISS
    - Ferry Flight configurations for landings at alternate sites
  - What works
    - The Crew Compartment Integration process including pre-pack physical integration in Houston to installation in Orbiter at KSC.
      - Excellent communication and team work.
      - CCI team has responsibility and control per NSTS 07700 vol. IV, Bk1 and CoFR NSTS 08117.
    - Orbiter mass property envelopes allow analytical integration without unique analysis- “stay in the box” go fly.

Orbiter Crew Compartment Integration-Stowage

- Orbiter Crew Compartment Integration (CCI)-Stowage
  - Available Orbiter volume:
    - 127.5 Middeck Locker Equivalents (MLE) (OV-104/OV-105, OV-103 125.5)
    - Orbiter volumes, Middeck lockers, stowage bags.
    - Actual stowage volume available dependent on mission requirements-Shuttle forward CG or Ascent Performance Margins
  - Requirements:
    - Core set of hardware for 5 CM/ 7Days- food, clothing, Hygiene, LiOH, IFM tools, Laptop computers, Photo/TV, navigation aids, EMUs, EVA tools
    - Above Core mission requirements
      - Rendezvous and docking- Range finders, Binoculars, Centerline Camera
    - Addition GFE hardware requirements/evolution of technology
    - Payload requirements (ISS MKD/HST)

MLE: Middeck Locker Equivelent/2.0 cu ft.

Orbiter Crew Compartment Integration-Stowage

- Orbiter Crew Compartment Integration (CCI)-Stowage
  - Orbiter Stowage (typical mass constraint= 30#/ft^3):
    - Under floor: LiOH Box, Vol. H (EVA hardware), Vol. F (wet trash), Vol. G (contingency Hygiene hardware), Vol. D (mission specific)
    - Volume 3 B (ET tank photography)
    - Light Weight Middeck Accommodation Rack (MAR)- 6 MLE
    - Waste Management Compartment- Hygiene
    - Middeck Lockers: Single, Double
    - Trays: single, double
      - Orbiter CTB's: single, Half CTB's
    - Middeck Aft (Ditch)/Ext. A/L Bags (5 MLE/10 MLE)
      - (ISS Double, Triple CTB's, MO2, MO3)
    - Aft Flight stowage containers, volumes (A16 and A17)
  - External Airlock installation of two EMU's

MLE: Middeck Locker Equivelent/2.0 cu ft.

Orbiter Crew Compartment Integration-Stowage

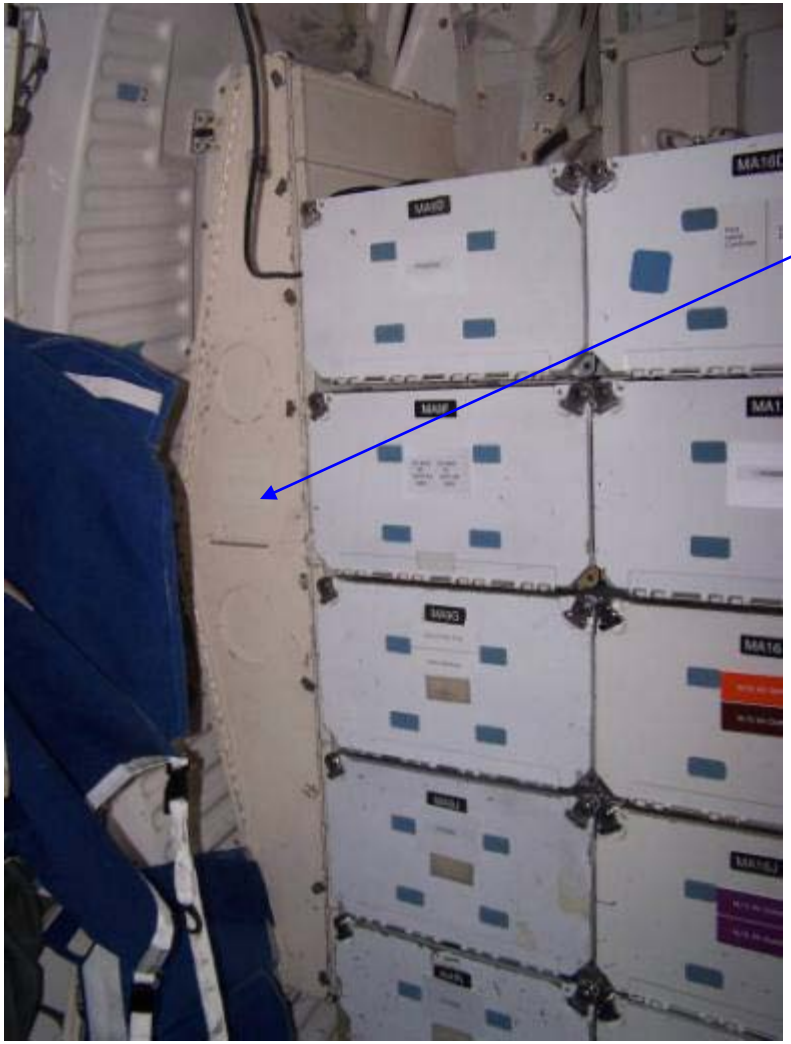
Evolution of Orbiter Crew Compartment Stowage volume

Volume Name	First Flight	Stowage volume
MA9N Stwg. Bags (3)	STS-44 (11/91)	1.50 MLE
Middeck Accommodations Rack (MAR)	STS-49 (5/92)	6.00 MLE
Lockers MA9D / MA16D	STS-49 (5/92)	2.00 MLE
Extended Volume B (N/A on OV-103) approx.	STS-49 (5/92)	4.00 MLE
Volume D (N/A on OV-103 or with RCRS)	STS-49 (5/92)	4.00 MLE
EDO LiOH Box (available only with RCRS)	STS-50 (6/92)	3.50 MLE
Aft Flight Deck Stwg. Cont.s (**CCCD concept**)	STS-50 (6/92)	0.75 MLE
Volume 3B	STS-58 (10/93)	2.00 MLE
Internal A/L Ceiling Bag	STS-62 (2/94)	4.00 MLE
Seat 6/7 Stwg. Bag	STS-74 (11/95)	3.00 MLE
ODS Stwg. Bag	STS-76 (3/96)	5.00 MLE
Airlock out MDK Stwg. Bags (OV-103,104,105)	**STS-82 (2/97)**	**40.00 MLE**
Lt. Wt. MAR	STS-96 (5/99)	N/A
Lt. WT. Lockers	STS-103 (12/99)	N/A
Total volume increase	**(151.5 cu. ft.)**	**75.75 MLE**

1 MLE equals approximately 2 ft^3

Crew Compartment Photos

Orbiter Crew Compartment Integration-Stowage



Volume B and EDO version Vol B
Fits curvature of Orbiter wall for
addition ascent on-orbit stowage volume only

Orbiter Crew Compartment Integration-Stowage

Under Floor Volumes

Volume D (4 MLE) restricted access

Volume F (4 MLE) Wet Trash

Volume G Contingency Hygiene

Orbiter Crew Compartment Integration-Stowage

Middeck Lockers and Trays

Middeck Aft Lockers

Double MDK Locker Tray
Approx. net 0.8 ft3

MA9N bags- 3-stowage bags to fit curvature of Orbiter STBD wall
1/2 MLE ea.

Middeck Forward Lockers
Lt. Wt. MAR, Galley, Lockers, Payloads, seats

Orbiter Crew Compartment Integration-Stowage

Post Landing View- Aft Middeck Stowage Bags
Crew re-packed on-orbit

2- 5 MLE Bags STBD FL and 2- 5 MLE Bags Port FL

(4) Ceiling 5 MLE Bags

8 Total 5 MLE bags available in the Middeck Aft

Orbiter Crew Compartment Integration-Stowage

Miscellaneous Middeck Stowage

Middeck Retention Net
On-Orbit stowage and limited return stowage
Looking Forward STBD

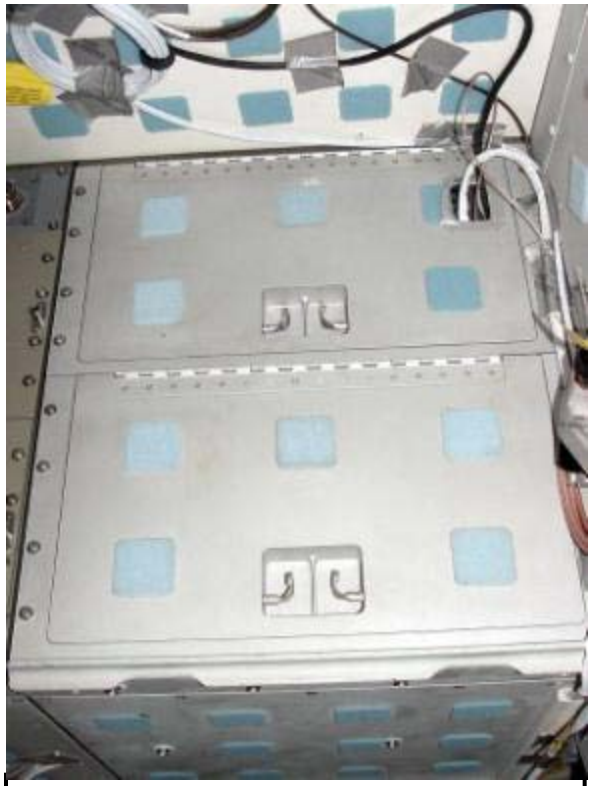
Dry Trash Bags
For on-orbit use only

EMU stowage in the Middeck

Sleep restraints, Ergometer
Shoe Bag
Middeck air ducts
Looking STBD

Orbiter Crew Compartment Integration-Stowage

Miscellaneous Stowage



Aft Flight Deck L10 Stowage Containers
3/4 MLE each

WMC
Aft wall and Port wall stowage

Volume 3 B
Approx. 4 MLE

Orbiter Crew Compartment Integration-Stowage

On-Orbit Stowage/Habitability

Orbiter Middeck looking STBD/FWD

Orbiter Middeck looking Aft at 576 bulkhead hatch

Orbiter Middeck looking FWD/STBD

Orbiter Crew Compartment Integration-Stowage

On-Orbit cable routing-Crew situational awareness

Orbiter AFD looking STBD STS-116 left STS-112 right

Orbiter Crew Compartment Integration-Stowage

On-Orbit Single Logistics Module
STS-116/13A.1

ISS MO3 Bag- approx 10 MLE

Orbiter Crew Compartment Integration-Stowage

Launch/Return Middeck Configuration

Advanced Crew Escape Suits (ACES)
Provides O2/COMM and Individual Cooling (water)

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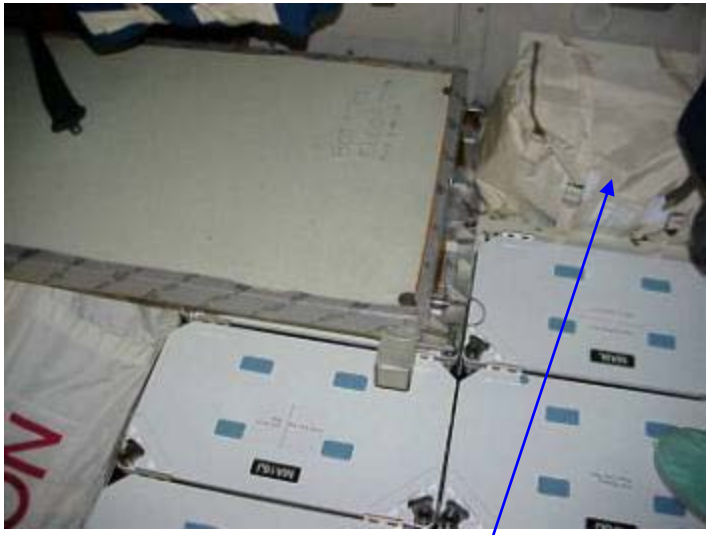
Orbiter Vertical Installations at the Pad

Stowage considerations for Vertical launch vs. Horizontal for landing

Emergency Egress Net/Closeout, Av. Bay 3A MDK Lockers, Escape Pole



MA9N bags, Av. Bay 3A MDK Lockers, GSE platform

Orbiter Crew Compartment Integration-Stowage

Misc. hardware stowage

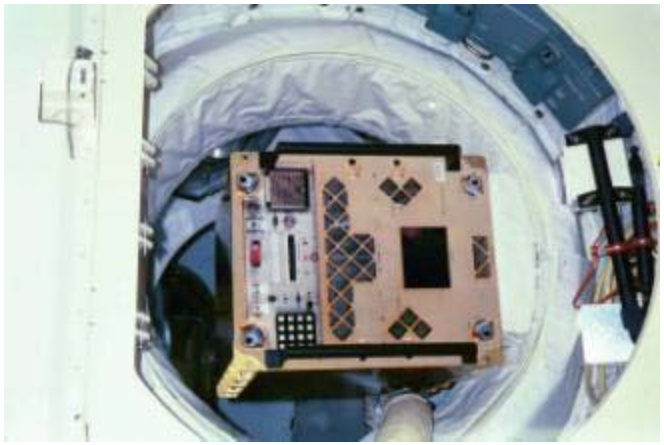
Typical CTB packing
designed by the
Crew Compartment Integration Team
for transfer to ISS
Mini Cell, Pyrell with NOMEX cover

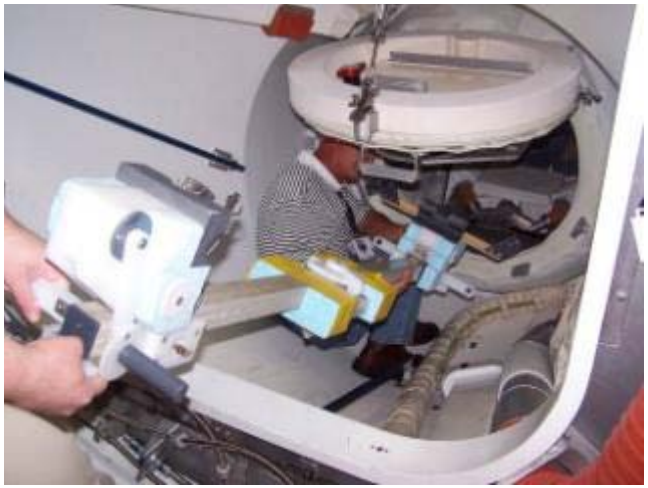
5 MLE Bag with EMU
LTA's

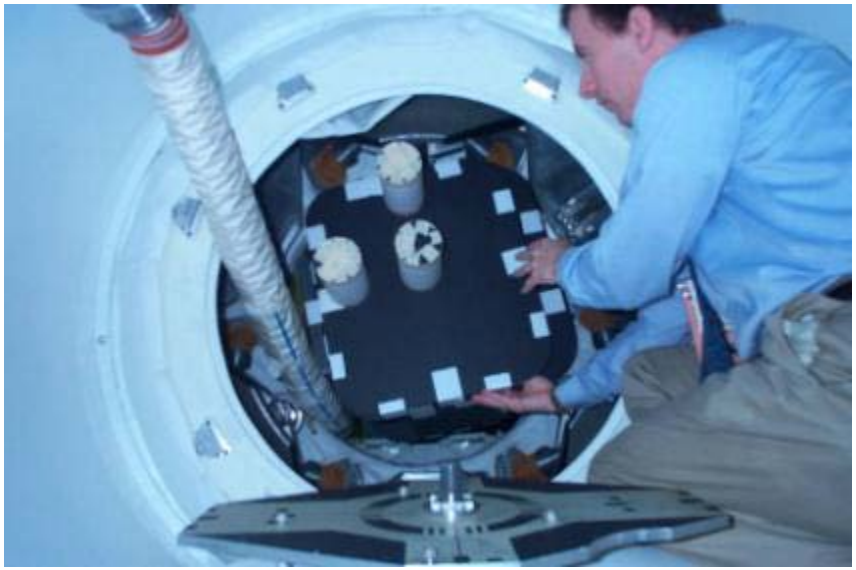
IELK (Soyuz Seat Liners)
Crew Rotation
5 MLE bag each

Orbiter Crew Compartment Integration-Stowage

Translation fit-checks between Orbiter middeck-Ext. A/L- ISS PMA







Orbiter Crew Compartment Integration-Stowage

Middeck looking forward at MF43C/E PGBA Dbl. Size Middeck payload on STS-113/11A
Transferred from ISS to Orbiter

Considerations for avionics bay Middeck Locker interface structure movement.
Pressure Vessel “oil canning”
Ground vs On-Orbit vs 10.2 for EVA’s

Questions/Answers