Internal Cargo Integration

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Overview

- Typical Cargo for Launch/Disposal
  - Cargo Accommodations
    • CTB, M1/M2, M3
  - Standard Non-Packed Cargo for Launch/Disposal
    • Food Containers
    • Waste Containers
    • Large ORUs – Hardmounted

- Cargo Delivery Requirements
- Cargo Return Requirements
  - Typical Cargo for Return
- Vehicle On-Orbit Stay Time
Typical Cargo for Launch/Disposal

- Cargo Accommodations
  - Cargo Transfer Bags (CTB)
  - M1/M2/M3 Bags

- Standard Non-Packed Cargo for Launch/Disposal
  - Large ORUs –
    - Hardmounted for Launch
    - Strapped/other mounted for Disposal
  - Food Containers
  - Waste Containers
Cargo Transfer Bag (CTB)

- Cargo Transfer Bags (CTBs) are Nomex stowage bags that contain removable, reconfigurable dividers used for packaging cargo for launch, disposal or return.
- CTBs are available in half, single, double, and triple sizes.
- Each configuration has a zipper closure and a removable mesh netting restraint system located inside of the CTB.

<table>
<thead>
<tr>
<th>CTB</th>
<th>Approximate Size (external dimensions)</th>
<th>Maximum Load Strapped kg (lbs)</th>
<th>Maximum Load Locker kg (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEG33111836 Half (1/2x)</td>
<td>24.8 cm x 42.5 cm x 23.5 cm (9.75” x 16.75” x 9.25”)</td>
<td>13.61 (30)</td>
<td>27.22 (60)</td>
</tr>
<tr>
<td>SEG33111837/838 Single (1x)</td>
<td>50.2 cm x 42.5 cm x 24.8 cm (19.75” x 16.75” x 9.75”)</td>
<td>27.22 (60)</td>
<td>45.36 (100)</td>
</tr>
<tr>
<td>SEG33111839 Double (2x)</td>
<td>50.2 cm x 42.5 cm x 50.2 cm (19.75” x 16.75” x 19.75”)</td>
<td>54.43 (120)</td>
<td>81.65 (180)</td>
</tr>
<tr>
<td>SEG33111840 Triple (3x)</td>
<td>74.9 cm x 42.5 cm x 50.2 cm (29.5” x 16.75” x 19.75”)</td>
<td>81.65 (180)</td>
<td>81.65 (180)</td>
</tr>
</tbody>
</table>
Cargo Transfer Bags
P/N 33111836-40

- Reference JSC 39207, Cargo Transfer Bag (CTB) Certification and Acceptance Requirements Document and JSC-39233 Rev. D, Cargo Transfer Bag (CTB) Interface Design Document (IDD) for actual CTB design, installation, volume, and interface requirements, ground handling, packaging and stowage requirements
- CTBs are certified for launch/return stowage configurations inside hard side lockers (RSR/Middeck) and TBD ATV/HTV strapping configurations.
# Historical CTB Weights

<table>
<thead>
<tr>
<th>CTB</th>
<th>Total Bags Used</th>
<th>Bag Tare Kg (lbs)</th>
<th>Cargo Avg. Kg (lbs)</th>
<th>Crew Provision Kg (lbs)</th>
<th>N/A</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half</td>
<td>239</td>
<td>1.0 (2.2)</td>
<td>5.13 (11.3)</td>
<td>5.07 (11.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>223</td>
<td>1.81 (4.0)</td>
<td>10.26 (22.6)</td>
<td>9.42 (20.8)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Double</td>
<td>21</td>
<td>2.04 (4.5)</td>
<td>20.51 (45.2)</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triple</td>
<td>15</td>
<td>2.81 (6.2)</td>
<td>30.76 (67.8)</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sample Oversized Items for Launch

- **Hardmounted Items**
  - Items requiring specific FSE for hardmount to carrier structure
    - TESS, ARED, and Heat Exchanger
- **M01/M02/M03 Packed Bag Items**
  - Items that can fit weight, cg and dimensionally in oversized bag accommodations.
  - Allows for later modeling and less cost in the development of FSE
  - CDRA, Elektron, TVIS Chassis
Example Oversized Item
TESS (Hardmount)

Dimensions: 78” x 40” x 6.7”
Mass: 89 lbs
Example Oversized Item
ARED (Hardmount)
Example Oversized Item
HX and FSE

Dimensions: 38.5" x 24.5" x 17.5"
Mass: 116 lbs
M01 Bags  
P/N SEG32105875-301

- JSC 28169, Interface Control Document (ICD) for International Space Station (ISS) Resupply Stowage Platform 1 Stowage System.
- M01 bag is certified to carry 300 lbs of cargo (includes cargo and associated installation hardware) for RSP MPLM strapping configuration and TBD lbs for ATV/HTV strapping configuration.
- Weight 10.64 lbs (empty bag).
- Volume of M01 bag is 13 ft³.
- A total of 6 Cargo Transfer Bag Equivalents (CTBEs) can be stowed inside an M01 bag.
- The external dimensions are: 35.3” (W) x 21.0” (D) x 32.2” (H).
M02 Bags
P/N SEG32105876-301

- JSC 28169, Interface Control Document (ICD) for International Space Station (ISS) Resupply Stowage Platform 1 Stowage System.
- M02 bag is certified to carry 90.8 kg (200 lbs) of cargo (includes cargo and associated installation hardware) for RSP MPLM strapping configuration and TBD lbs for ATV/HTV strapping configuration.
- Weight 6.83 lbs (empty bag).
- Volume of M02 bags is 8 ft³.
- A total of 4 CTBEs can be stowed inside an M02 Bag.
- The external dimensions are:
  35.3” (W) x 21.0” (D) x 20.0” (H).
M03 Bags
P/N 33117683

- JSC 28169, Interface Control Document (ICD) for International Space Station (ISS) Resupply Stowage Platform 1 Stowage System.
- M03 bag is certified to carry 226.8 kg (500 lbs) of cargo (includes cargo and associated installation hardware) for RSP MPLM strapping configuration and TBD lbs for ATV/HTV strapping configuration.
- Weight 16.5 lbs (empty bag).
- Volume of M03 bags is 22.0 ft³.
- A total of 10 CTBEs can be stowed inside an M03 Bag.
- The external dimensions are: 35.3“ (W) x 21“ (D) x 52.5“ (L)
Example Oversized Item
BMRRM (Special BMRRM Bag)

Dimensions: 24.5" x 30" x 30"
Mass: 165 lbs
Example Oversized Item
IELK (M1 Bag)

Dimensions: 43.7” x 20.5” x 16.3”
Mass: 79.4 lbs
Example Oversized Item
CDRA (M1 Bag)

Dimensions: 42.5” x 12.0” x 10.0”
Mass: 100 lbs
Example Oversized Item
Elektron (M03 Bag)

Dimensions: 49.8” x 13.4” (diameter)
Mass: 350 lbs
Example Oversized Item
SpaceDrums (M03 Bag)

Dimensions: 5.22 CU FT
Mass: 200 lbs
M03 Bag Installation

- Some oversized hardware/bags may require special FSE.
Standard Unpacked Cargo Items

- Food Containers
- Common Waste Containers
Food Containers

- Food Containers –
  - US Non-Collapsible, SEG48101834-301
    15” x 12.0” x 4.85”
  - Collapsible, 17KC.260IO 3200-0
    14.875” x 12” x 4.875” (Collapsed)
    14.875” X 12” X .59” (Uncollapsed)
- Mass (Full) – 14.3 lbs
- Mass (Empty) –
  - Non-Collapsible – 3.75 lbs
  - Collapsible – 2.2 lbs
Standard Waste Containers

• Bags (compressible)
  – KBO-M generally use for dry trash
  – Table Food Bag (TFB) and/or Rubber-Lined Bag (RLB) used for wet trash
• Human waste containers (hard)
  – EDV and KTO
• Hardware (ORUs, filters, fans, etc.)
  – Odd sizes and shapes
KBO-M

- Soft Trash Bag, OpNOM: KBO-M
- PN: 11φ 615.8715-OA15-01
- Heavy duty rubberized cloth bag. Metal band around the top and rubber flaps to keep the trash inside.
- Acceptable for undamaged alkaline batteries, some bio waste directly into container – i.e. kleenex; hazardous waste must be properly contained prior to insertion
- Dimensions (Stowed) - 11.75” x 11.75” x 2”
- Dimensions (Full) - 17” long x 11.5” diameter ring x 8” diameter
- Mass (Full) - 17.5 to 20 lbs
Food Waste Bag

Food Waste Bag, OpNOM:
PN: 11 φ 615.8716-0-A15

Soft, rubberized cloth bag used to place table scraps, and other small waste items. This bag can be used for wet or dry trash.

Dimensions (Stowed) – 10" x 5" x 0.2"
Dimensions (Full) – 8" x 5" diameter
Mass (Full) – 2 lbs
Rubber Lined Bag

- Rubber Lined Bag, OpNOM: Rubber Lined Bag PN: 11f615.8716-20A15,
- Rubberized cloth lined bag can contain up to 3 full KBO-M bags or approximately 8 table bags. It has a draw string closure and is nominally closed tighter with the rubber ties known as “szkoo’tee”. Can be wiped down and reused. Preferred by crew for wet trash. Not as heavy duty as the KBO-M, but larger.
- Dimensions (Stowed) - 11.75” x 11.75” x 2.2” (folded around KBO-M)
- Dimensions (Full) – 25” x 15”
- Mass (Full) – 23.7 lbs
EDV

- EDV, OpNOM: EDV
  PN: 11φ 615.8711-0A15-1
- Primarily used for urine and wastewater collection. Limited Life: 90-days of on-orbit operations (defined as any operations where the hydro-connector is connected/disconnected).
- Dimensions (Stowed) - EDVs usually launched in set of 6 buckets and separately 6 lids. With rack attachment spike and lid
  - Top - 13.1” (Diameter) x 21.57” (H)
  - Bottom 9” (diameter)
  - EDV Bucket - 17.3” (H) x 13” (Diameter)
  - EDV lid - 4.1” (H) x 13” (Diameter)
- Dimensions (Full) - Without rack attachment spike and lid
  - Top - 13” (Diameter) x 15.7” (H)
  - Bottom - 9” (Diameter)
- Mass (Full) – 58.4 lbs
Solid Waste Container, OpNOM: KTO PN: 11 φ 615.8720A55-0,
The KTO is used for solid waste and can contain biological waste.
Dimensions (Stowed) –
  - Body - 13” (H) x 13 “ (diameter)
  - Lid - 2” (H) x 13” diameter
Dimensions (Full) – 15” (H) x 13”
Mass (Full) – 25.4 lbs
Example Stowage in Progress for Disposal

Rubber lined bags

Strapped ORUs
Example Stowage in MPLM for Launch
## Historical Delivery Dates for Launch Integration

<table>
<thead>
<tr>
<th>% Cargo</th>
<th>Delivery Template</th>
<th>Type Cargo</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>Launch minus (L-) 4 to 3 months</td>
<td>All cargo types, Hard mounted items</td>
</tr>
<tr>
<td>10</td>
<td>L - 2 months</td>
<td>All size CTBs/Mbags</td>
</tr>
<tr>
<td>35</td>
<td>L - 1 month</td>
<td>All size CTBs/5 and 10 MLE bag, some hardmount, Middeck lockers</td>
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<td>10</td>
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</tr>
<tr>
<td>5</td>
<td>L-24 to 6 hours</td>
<td>All size CTBs, Middeck lockers</td>
</tr>
<tr>
<td>% Cargo by Item</td>
<td>% Cargo by Volume</td>
<td>Type Cargo</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>&lt; 5</td>
<td>&lt; 5</td>
<td>Hardmounted Items</td>
</tr>
<tr>
<td>15</td>
<td>35</td>
<td>Oversized Items (larger than triple CTB)</td>
</tr>
<tr>
<td>75</td>
<td>50</td>
<td>Cargo Transfer Bags (1/2, single, double, triple)</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>Non-bag items (food containers, waste containers, etc)</td>
</tr>
</tbody>
</table>
Historical Cargo Return Data

<table>
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<tr>
<th>% Cargo</th>
<th>Return Template</th>
<th>Type Cargo</th>
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<tbody>
<tr>
<td>MAX</td>
<td>MIN</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>40</td>
<td>Return plus (R+) 2 weeks</td>
</tr>
<tr>
<td>15</td>
<td>30</td>
<td>R + 24 hours</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td>R + 4</td>
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- Typical Return Cargo Types
  - Payload experiments
  - Samples (water, air, blood)
  - Logistics items – inoperable hardware for analysis
  - Crew Health Care Systems (CHeCS)
  - Crew Preference Items
- R + 4 Percentages will significantly increase with payload refrigerator/freezer returns
On-Orbit Estimates for Cargo Transfer

- Cargo operations minimum stay time is based on the time required to unload (Internal and External)
  - Internal Estimates:
    - Typical MPLM flight transfer estimated between 80 and 120 hours transfer (Approximately 200 CTBe) depending on the amount of cargo, that includes transferring the resupply items to ISS and stowing the return items in MPLM.
    - Cannot necessarily increase crew participation to increase hours. Inefficiencies in the operations due to limited working space.
    - Typically no more than 3 - 4 crew members dedicated to transfer
    - Typically no more than 6 hours per day/ 5 days per week.
    - Rack Transfer Estimates – Approximately 2 crew - 1 hour (2 crew hours) together to transfer 1 rack to ISS. Not including connecting up to the ISS utilities

- Maximum stay time is the time to fill the vehicle with waste based on waste generation rates.
  - Increased capability improves operational flexibility
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<tbody>
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<td>MIN</td>
<td></td>
</tr>
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<td>40</td>
<td>Return plus (R+) 2 weeks</td>
</tr>
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<td>15</td>
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</tr>
<tr>
<td>10</td>
<td>30</td>
<td>R+ 4</td>
</tr>
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- **Typical Return Cargo Types**
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  - Samples (water, air, blood)
  - Logistics items – inoperable hardware for analysis
  - Crew Health Care Systems (CHeCS)
  - Crew Preference Items
- **R + 4 Percentages will significantly increase with payload refrigerator/freezer returns**
# Example Soyuz Return Items

<table>
<thead>
<tr>
<th>Part Name</th>
<th>Part Number</th>
<th>Qty</th>
<th>Planned Disposition</th>
<th>Haz/Tox</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>RETURN ZIPLOCK BAG ASSY</td>
<td>SEG46118278-702</td>
<td>1</td>
<td>TURNOVER TO HW PROVIDER NLT R + 4 HOURS</td>
<td>N</td>
<td>ZIPLOCK CONTAINS ITCS SAMPLES. DO NOT CRUSH. PROTECT FROM PUNCTURE. DO NOT ALLOW ITEMS TO FREEZE OR EXPOSED TO 49 DEG C OR ABOVE. PACK IN RUBBER LINED BAG (KBO-M) TO AVOID LEAKS.</td>
</tr>
<tr>
<td>BAG ASSY., TOC WATER SAMPLE (300 ML)</td>
<td>KLSK270288-308</td>
<td>1</td>
<td>TURNOVER TO HW PROVIDER NLT R + 4 HOURS</td>
<td>Y</td>
<td>CONTAINS SVO-ZV SAMPLE. KEEP TEMP BTWN 41-104 DEG F (5-40 DEG C). DO NOT FREEZE/BEND/Crush/PUNCTURE/RIp. PACK IN RUBBER LINED BAG (KBO-M) TO AVOID LEAKS. COVER SEAL OF ZIPLOCK IN GREY TAPE. REFRIGERATE SAMPLES UNTIL PICKUP.</td>
</tr>
<tr>
<td>BAG ASSY., TOC WATER SAMPLE (300 ML)</td>
<td>KLSK270288-308</td>
<td>1</td>
<td>TURNOVER TO HW PROVIDER NLT R + 4 HOURS</td>
<td>Y</td>
<td>CONTAINS SRV-K SAMPLE. KEEP TEMP BTWN 41-104 DEG F (5-40 DEG C). DO NOT FREEZE/BEND/Crush/PUNCTURE/RIp. PACK IN RUBBER LINED BAG (KBO-M) TO AVOID LEAKS. COVER SEAL OF ZIPLOCK IN GREY TAPE. REFRIGERATE SAMPLES UNTIL PICKUP.</td>
</tr>
<tr>
<td>BEARING, GYROSCOPE, GYROSCOPE ASSY - TVIS SYSTEM</td>
<td>SDG46115139-001</td>
<td>2</td>
<td>TURNOVER TO HW PROVIDER NLT R +14 DAYS</td>
<td>N</td>
<td>NO SPECIAL HANDLING REQUIREMENTS</td>
</tr>
<tr>
<td>DUAL SORBENT TUBE ASSEMBLY</td>
<td>SEG46120272-304</td>
<td>12</td>
<td>TURNOVER TO HW PROVIDER NLT R +12 HOURS</td>
<td>0</td>
<td>DO NOT OPEN TUBES. DO NOT PUNCTURE/Crush/Bend BAG. RETURN DUAL SORBENT TUBE ASSYS &amp; DUAL SORBENT TUBE CONTROL ASSYS TOGETHER. PACK WITH AT LEAST 0.5 INCH SOFT PADDING. KEEP TEMP BTWN 0-46 °C (32-114.8°F). TEMP MONITORING REQUIRED.</td>
</tr>
<tr>
<td>FORMALDEHYDE MONITOR KIT ASSY</td>
<td>SDD46108168-301</td>
<td>1</td>
<td>TURNOVER TO HW PROVIDER NLT R + 12 HOURS</td>
<td>1</td>
<td>DO NOT BEND/Crush/PUNCTURE. PACK WITH AT LEAST 0.5 INCH OF SOFT PADDING TO AVOID CRUSHING. KEEP TEMPERATURE WITHIN -18°C AND 46°C. NOT HAZARDOUS NOR TOXIC.</td>
</tr>
<tr>
<td>VALVE ASSEMBLY, GRAB SAMPLER</td>
<td>SDD46108778-301</td>
<td>1</td>
<td>TURNOVER TO HW PROVIDER NLT R + 4 HOURS</td>
<td>0</td>
<td>KEEP TEMP BETWEEN 13 - 46 DEGREES C. PACK ITEM IN AT LEAST 0.5 INCH OF SOFT MATERIAL. PREVENT METAL-TO-METAL CONTACT &amp; SHARP EDGES. AVOID SCRATCHING/PUNCTURE/Crush/BENDING. DO NOT REMOVE KAPTON TAPE OR OPEN VALVE. TEMP MONITORING REQD.</td>
</tr>
<tr>
<td>ZIP-LOC BAG, 6X6</td>
<td>S28-21039-3</td>
<td>1</td>
<td>TURNOVER TO HW PROVIDER NLT R + 14 DAYS</td>
<td>N</td>
<td>CONTAINS TVIS DEBRIS. KEEP TEMPERATURE BETWEEN -50 AND 50 DEGREES C (-58 TO 122 DEGREES F).</td>
</tr>
</tbody>
</table>