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WE LOOK AFTER THE EARTH BEAT

EURO-CARES: A Plan for European Curation of Returned Extra-terrestrial Samples

WP 6 Update Sample Transport Vienna WP3 Workshop

27/04/2016

Ref.:

13/04/2016

THALES ALENIA SPACE CONFIDENTIAL



Scope

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- ✈ to propose methods for recovery and transport of Mars Moon or asteroid samples from the landing site to the curatorial facility



WP6 Team and Deliverables

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Report	Title	Responsible
D6.1	Preparation for Recovery	UoLeicester
D6.2	Recovery and Initial Inspection	Thales Alenia Space
D6.3	Transport to Curation Facility	INAF
D6.4	Impact of Planetary Protection	Public Health England
D6.5	Identification of Innovations Necessary	All

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1. Mars caching and biocontainment update
2. Landing site considerations
3. Sample return capsule size and mass range
4. Restricted mission recovery procedure
5. Argument for a temporary cleanroom
6. Transport container
7. Interface with WP3

NASA Sample Cache concept

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Returned Sample Material Types

- Core samples
- Atmospheric
- Regolith
- Adhering
- Blanks
- Witness plates
- (Head) Gas

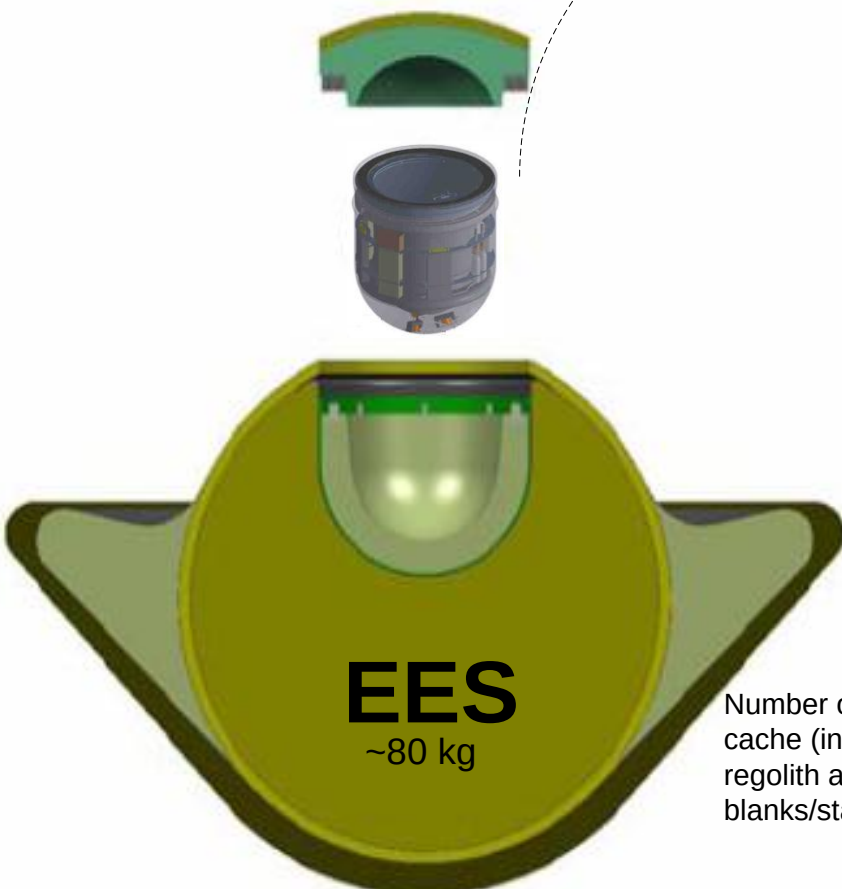
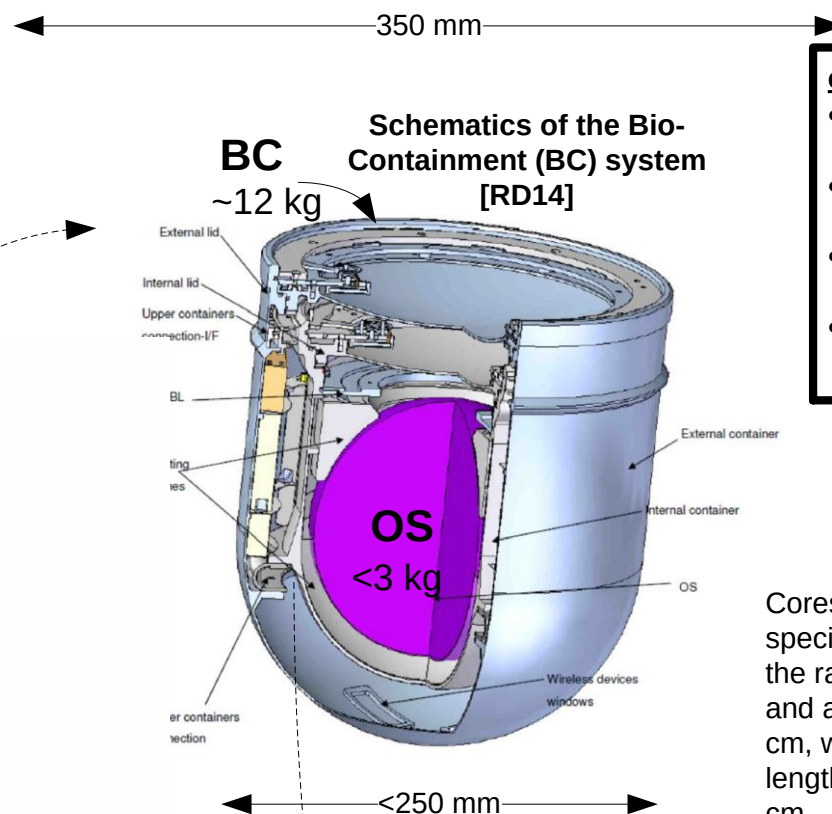
containing hardware consisting of:

- Earth Entry System (EES) (Earth surface pressure 1000mbar)
- Orbiting Sample (OS) (pressure: 50 mbar to 500 mbar TBD)
- Sample Container (SC) (Mars surface pressure 5mbar)
- Sample Vessel (SV) (Mars surface pressure 5mbar)

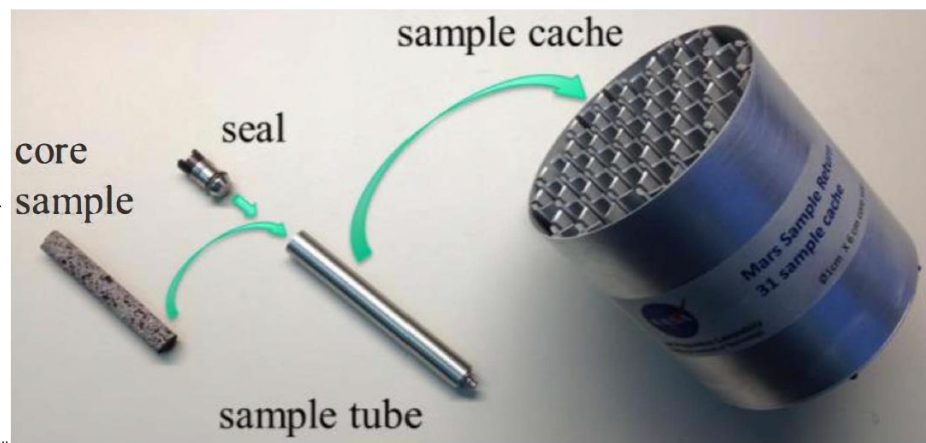
Mass of sample material in each Sample Vessel (SV)
~ 20g for core sample, regolith

Cores will be of a single, specific diameter within the range 0.5 to 1.5 cm, and a length of up to 10 cm, with a minimum core length not greater than 2 cm

Minimum Sample Volume per Sample Vessel (SV) (Rock or Regolith) = 8 ml for core sample, regolith

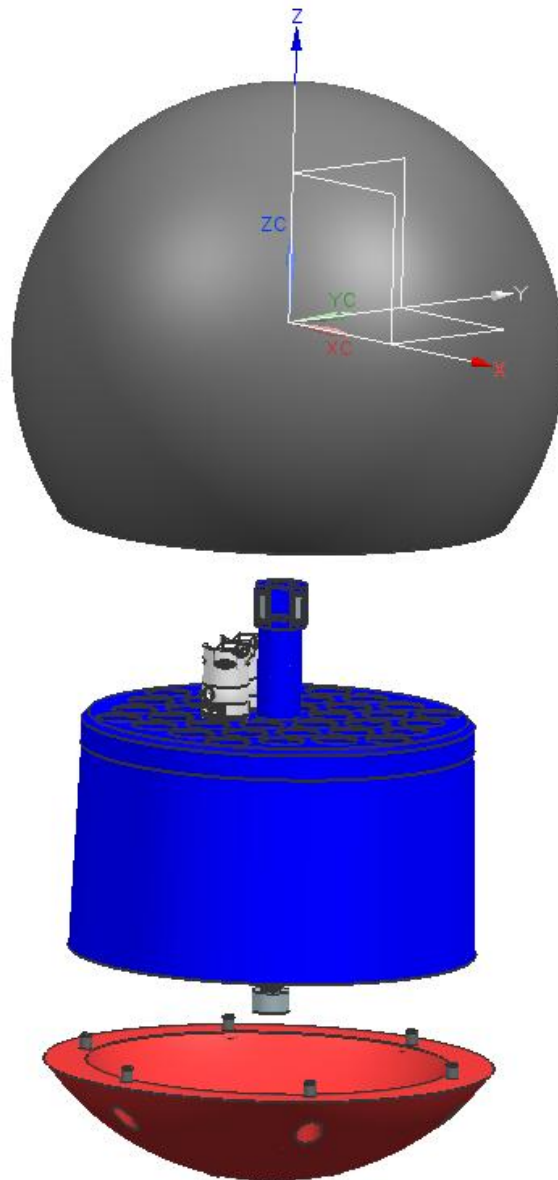


Number of samples in the cache (includes: rock, regolith and/or dust, blanks/standards) = 38



Sample cache concept used for NASA Mars2020 Technology Demonstration of Sample Tube sealing [RD12]

Current ADT Design of OS

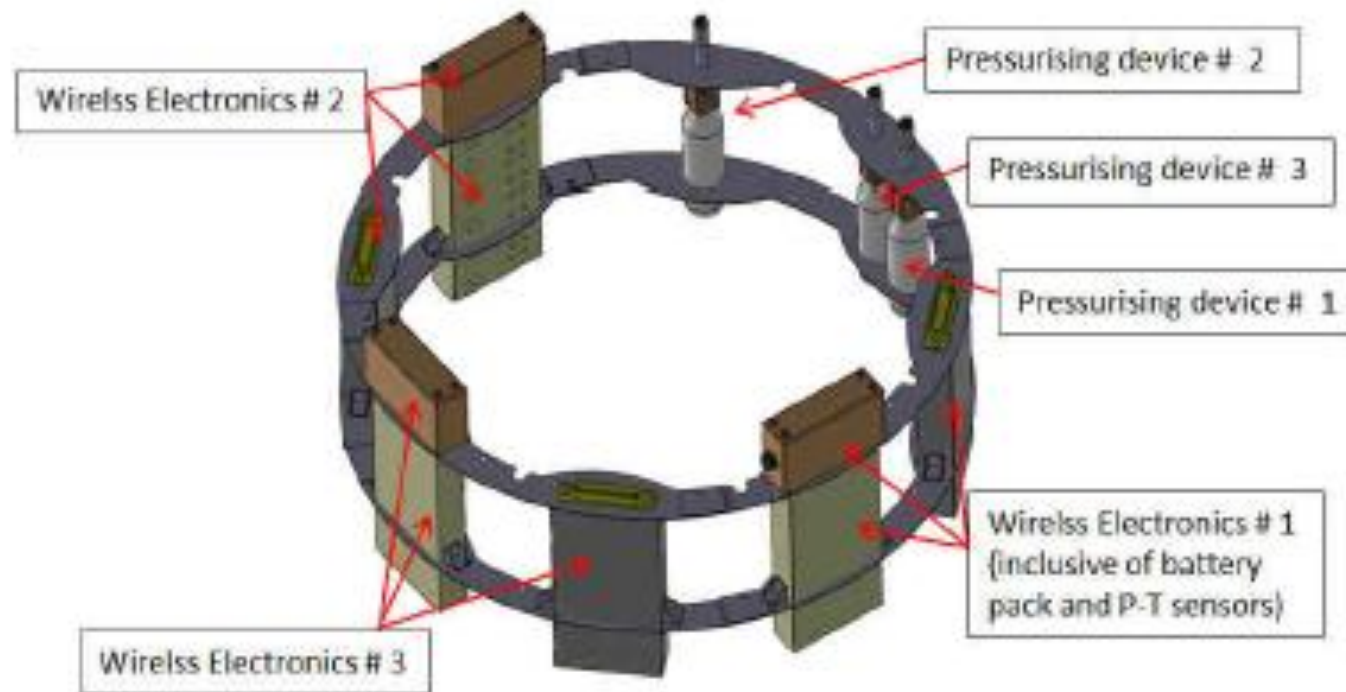


Three piece design for OS allows the samples to be individually secured in a canister and then loaded onto the OS (already within the MAV) as a single piece.

Monitoring system for biocontainment

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- The monitoring system is a pressure/temperature based system that will monitor a defined pressure within a well-known volume.



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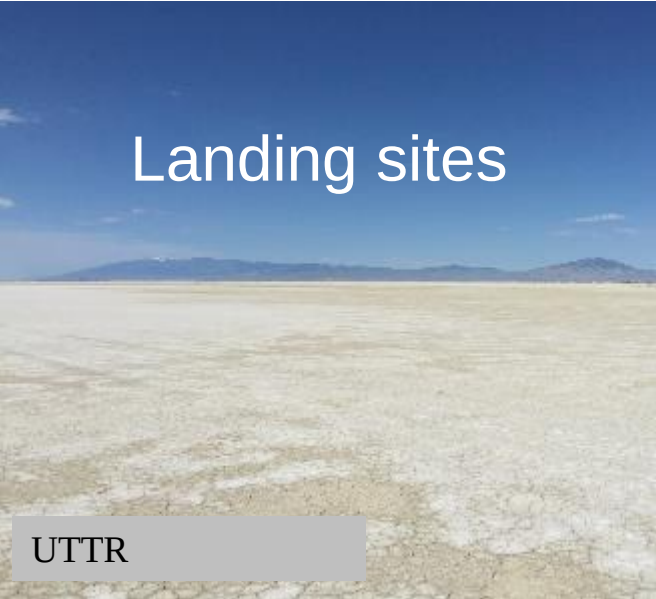
Return Capsules

Mission	Sample mass (g)	Capsule size (m dia)	Capsule mass (kg)
Genesis	2×10^{-5}	1.5	191
Stardust	10^{-3}	0.8	46
Hayabusa-1	10^{-5}	0.04	18
Osiris Rex	60	0.8	50
Marco Polo*	2000	0.9	33
Luna 16, 20, 24	101,55,170	N/A	40
Chang'e	2000	2.5	600
Fobos Grunt (F)	160	?	11
Phobos SR	100	0.8	31
Mars Sample Return	500	1.5	100

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Landing sites



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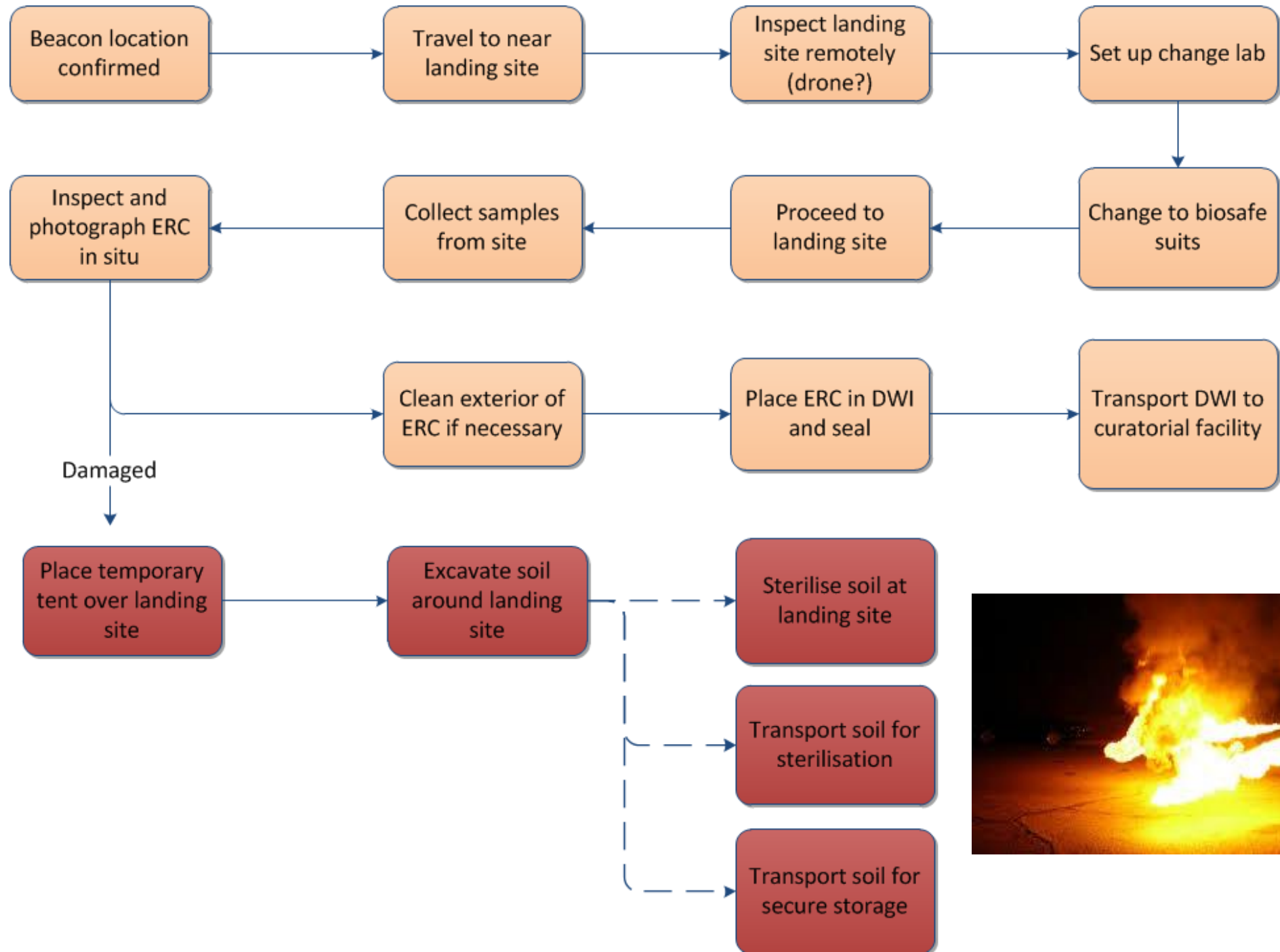
Unrestricted return

Eg: Stardust timeline from press kit

- | | |
|-------------|--|
| G + 30 min | Capsule field processing complete <ul style="list-style-type: none">- Photos taken to document capsule's condition- Gas samples collected from vicinity of capsule- Three persons lift capsule, one person removes debris, material bagged- Capsule double-bagged with sulfur dioxide monitor- Capsule secured in handling fixture- Soil samples collected from impact and recovery sites |
| G + 45 min | Overhead helicopter lands <ul style="list-style-type: none">- Capsule handling fixture secured in helicopter for transport |
| G + 75 min | Helicopter returns to air field with capsule |
| G + 90 min | Capsule manually transferred from helicopter to ground vehicle |
| G + 110 min | Ground transport vehicle arrives outside entrance to Building 1012 <ul style="list-style-type: none">- Capsule transferred from vehicle to a point just outside entrance to building- Wearing half mask respirator, safety expert removes double bags from capsule- Any additional external debris removed and bagged- Building door opened; capsule transferred inside and placed on cleanroom holding fixture |
| G + 120 min | Capsule transferred into cleanroom <ul style="list-style-type: none">- Photos taken |
| G + 130 min | Capsule processing begins <ul style="list-style-type: none">- 6 bolts and parachute canister removed- 2 cables disconnected |



Restricted mission recovery procedure



Why use an Intermediate Cleanroom at Landing site?

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- For Category V unrestricted missions
 - Safing pyrotechnics and batteries (but Hayabusa did this at site)
 - Cleaning outside of spacecraft
 - Collect parts of spacecraft if damaged (eg: Genesis)
 - Optional: remove canister from return capsule



Genesis Capsule Being Moved into Intermediate Cleanroom at UTTR

Image credit: NASA

- For Category V restricted missions
 - A biocontainer is necessary.





Transport Container

➤ Weight:

- I. <20 kg (small)
- II. 20-50 Kg (medium)
- III. 50-100 Kg (large)

➤ Materials: absorbant material in case of spillage

➤ Sample to transport: 50-500 g

➤ Configuration: double transparent bag in order to examine its content.

Hayabusa transport container





Conclusions and Interfaces with WP3 Facility Design

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- Sample mass
 - μg to 500g
- Sample temperature and form
 - Core, Atmospheric gas, regolith, adhering, witness plates, head gas.
- Capsule size
 - 0.04-1.5m dia, 10-200kg (Chang'e aside), transport boxes scalable.
- Preparing for a non-nominal scenario
 - Capsule may be in many pieces
 - Containers, labelling, database may need to start at landing site
 - Interim cleanroom at site may be necessary for sorting and cleaning
 - Site decontamination may be necessary
- Rehearsals and timeline
 - 15months rehearsal time was not enough (Stardust)

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