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EURO-CARES
A PLAN FOR EUROPEAN CURATION OF RETURNED EXTRATERRESTRIAL SAMPLES

PLANETARY PROTECTION

SAMPLE TRANSFER

WP 2 D2.4

Issue 1 Rev. 1

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1. Introduction

Once recovered from the sample collecting mechanism, returned samples should be moved from the canister to the working area where they have to be analyzed, stored and delivered to external laboratories. In general, there are three possible transfer paths:

- Inside the ESCF;
- From the ESCF to external locations (i.e., external laboratories, other curation facilities, etc.);
- From external locations to the ESCF.

Some specific technological solutions should be defined for each path, able to satisfy both requirements:

- Keep the samples as pristine as possible;
- Avoid any forward contamination, in case of a mission to Mars or other objects where there is the possibility of extant or extinct life.

One more point to be considered is the presence, or the suspect of presence, of infectious and potentially infectious materials. In this case, the samples are subject to strict national and international regulations. These regulations describe the proper use of packaging materials, as well as other shipping requirements.
Compliance with the rules will:

- Reduce the likelihood that packages will be damaged and leak;
- Reduce the exposures resulting in possible infections;
- Improve the efficiency of package delivery.

2. Sample holder

To minimize manipulation that might result in increasing the sample contamination, within the rooms of ESCF samples should be transferred inside the canister (the sample holder where they were originally collected by space mission). Alternatively, a special sample holder should be designed. The design of sample holders should satisfy the requirement of easy manipulation both by humans and robotic arms. Different archetypes of sample holders should be available according to the environments where they are used, specifically:

- Internal sample holder (inside ESCF, restricted/unrestricted);
- Transportation container (from ESCF to external laboratories and vice-versa, restricted/unrestricted);
- Special container (from ESCF to external laboratories and vice-versa, restricted/unrestricted, for "special" samples).

The aim is to keep the samples always in a controlled and inert atmosphere in order to minimize the degree of manipulation and contamination. This should be extended to the

delivery to external laboratories, where the architecture and the technical devices should be ready to continue the procedures.

2.1. Materials, contamination and bio-containment

Considering the contamination issues, the materials suitable to make sample holder will be: aluminium, compact gold sheets, Teflon, stainless steel, and quartz. The controlled atmosphere inside storage boxes and cabinets must be composed of inert gas such as Argon or nitrogen (GN2). Using vacuum is an alternative solution, but it requires careful evaluation. Considering the environmental outgassing and technical complexity required to handle samples in vacuum, the use of vacuum should be only a working condition for specific purposes, and not for curatorial aims. Hereafter GN2 is considered as environmental gas present inside the sample storage boxes, cabinets, transfer chains and sample holders. Steady conditions require the use of gas flowing.

However, all types of material can interact with samples to a certain extent. Indeed, both the organic and inorganic portion of regolith can desorb or adsorb atoms or molecular fragments from the interface of containers. However, since pure solid Au and fluorocarbons are not expected to be part of extraterrestrial materials, they can be easily identified as exogenous components, whereas Al, Si, silicate ions and C may be more ambiguous. From a physical point of view, the stickiness of materials is an important issue. Teflon, stainless steel and quartz boxes are suitable for regolith larger than 1-2 mm, whereas powder-like specimens should be stored on a softer material, such as gold or aluminium sheets. Table 1 reports the main features of the materials analyzed for sample container fabrication.

Table 1. Sample container materials pros & contr.

Materials	**Materials that regolith can adsorb**	**Stickiness**	**Interaction time scale**
Aluminum	Al	Yes	months
Compact gold sheets	Au	Yes	months-years
Teflon	fluorocarbon fragments	No	months-years
Stainless steel	C	No	months-years
Quartz	Si and silicate ions	No	years

Considering all the issues discussed above and costs, Teflon boxes are suggested for regolith. However, in case of powder-like specimen, a compact gold sheets is proposed as sample support, since it has two important advantages:

- The surface of the boxes become sticky, so that powder samples are safety fixed to the boxes
- The sample is not removed from the box for experiments and mineralogical analysis requiring electric conductivity.

Furthermore, all materials with which samples come into contact have to be sterilized, cleaned and packaged according to approved procedures, and introduced to the work area only through sterilized transfer locks.

Sample holders will be cleaned and sterilized through a procedure optimized by researchers working in the field of surface analysis, when highly uncontaminated holder surfaces are required (see D2.3). A possible protocol consists of soaking the sample holder in sterile HPLC grade solvents with increasing polarity, from water to acetone, and has a double purpose:

- Removes water contaminants having high polarity (typically salts), intermediate polarity (inorganic oxides, small organic molecules with heteroatoms) and low polarity (e.g. hydrocarbons);
- Facilitates drying by using solvents that are increasingly volatile and mutually miscible.

These cleaning/sterilization steps are schematically shown in Figure 1.

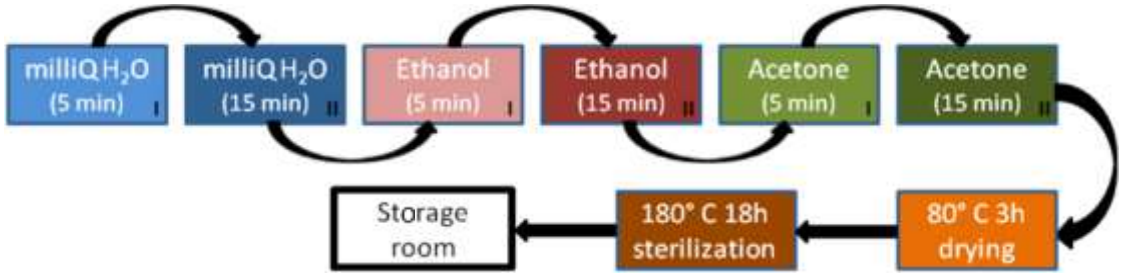

Figure 1. Scheme of the cleaning procedure for sample holders. All passages are made in sonicating baths with 1 lt solvent each. This volume is suitable for 10 open sample holders. Each second run can be done by using the solvent of bath II to fill bath I, while using fresh solvent for the new bath II. All operations are made in glove box.

All the previous statements apply for unrestricted missions, where contamination prevention must maintain the samples in their pristine status and no bio-containment of the samples is required.
In case of restricted mission, the bio-containment is discussed in the following paragraphs.

2.2. Internal Sample Holder

The internal sample holder will be used to move the samples inside the ESCF or, by means of an additional transportation container, between the ESCF and the external locations (e.g. external laboratories, other curation facilities, etc.). The internal sample holder should be designed as a small box (e.g. 3 x 3 x 3 cm^3 volume) that can contain small (≤100 μm) and large samples (up to few cm diameter). They should be fabricated using materials reported in Table 1. They should be composed of two parts: a base and a cover. Once closed, the internal sample containers are sealed and able to protect samples from the external environment. The internal sample holder is composed of two parts: a base and a cover. A

possible design is shown in Figure 2. Four different sizes of the base should be available, one for each sample size range, as shown in Table 2.

Table 2. *Types of sample containers.*

Function	Samples Sizes	Notes
Storage Containers	- Up to 100 µm - From 100 µm 1 mm - From 1 mm to 1 cm - More than 1 cm	Samples retrieved from SRC or from external laboratories
Transportation Container	- Up to 100 µm - From 100 µm 1 mm - From 1 mm to 1 cm - More than 1 cm	To deliver sample to external laboratories
Special Container	- Up to 100 µm - From 100 µm 1 mm - From 1 mm to 1 cm - More than 1 cm	Samples holder embedded with an active control, to store and deliver special samples to external laboratories

The cover is interchangeable, and can be mounted on any of the four base sizes. The four sizes should have the same external interface with the handling system, with the external transportation container and with the special container. The four Storage Container sizes have different internal interfaces so to better house the sample of the relevant size range. The internal sample holder is sealed and performs one level of containment so to avoid that contaminants enter the internal volume and so to keep constant the atmosphere composition from the assembly moment till the disassembly. The cover should be composed of a cover frame, a gasket and a window. The cover mates with the base by means of a threaded interface, to allow a fast assembly. The correct gasket compression is assured by a mechanical stop between base and cover, so the assembly can be performed by hand without any special tools (e.g. no torque screwdriver needed). The window located on the cover allows the sample observation without the needs to open the container.

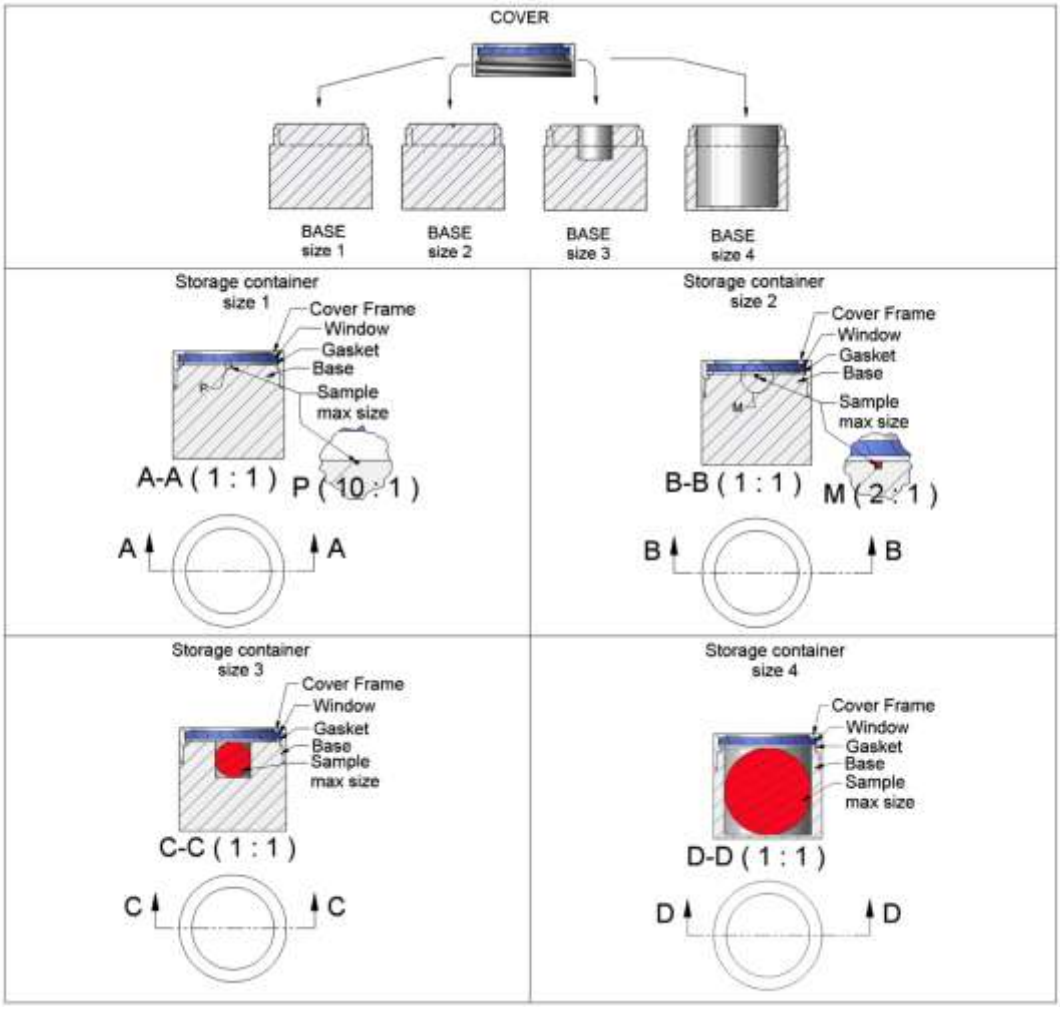

Figure 2. Possible design of the internal sample holder (courtesy Kayser Italia).

A removable thin Au foil can cover the internal area of the base to stick small samples and to allow easier sample handling for measurements.
The Storage Container will be used for the following procedures:

- To keep the samples inside the pristine samples cabinets of the Storage Room in the Curation work area;
- To send the samples to external laboratories (to do this procedure, the Storage Container will be mounted inside the Transportation Container or in the Special Containers);
- To store the samples in the delivered samples cabinets of the Storage Room of the Curation work area.

However, once the final design of the internal sample holder is defined in an advanced or final version, it will be qualified. A number of internal sample holders will be tested as described below:

- Measure of physical properties (mass and dimension);

- Execution of sterilization process;
- Leak test: The leak test will be performed partially filling the internal sample holder with distilled water and applying an external de-pressurization up to 1 bar. The internal sample holder will be weighted before and after de-pressurization and the test will be considered successful if the calculated leak rate will be less than $5 \cdot 10^{-5}$ standard cubic centimetre per second (sccs).

The internal sample holders will be cleaned with standard cleaning technique. They will be cleaned to the required cleanliness level and sterilized in the ESCF laboratory.
In case of restricted missions, the bio-containment is done by the curation infrastructure (i.e., units, glove boxes, storage cabinets, etc.). Since the internal sample holder never leave the bio-containment area, there are no technological needs for the internal sample holder.
To move the sample to and from the SRC to external facilities (e.g. external laboratories) the internal sample holder should be located into an additional container. We assumed a couple of possible transportation container described in the following paragraphs

- External transportation container, for "normal" deliveries;
- Special container, embedded with an active control, to store and deliver special samples to external laboratories.

2.3. Transportation container

The transportation container will be used to move the samples between the ESCF and the external locations (e.g. external laboratories, other Curation facilities, etc.). It can be considered as an external box where the internal sample holder should be located. We can assume that, for handling and safety reason, the transportation container should house up to 8 internal sample holders. There should be no direct contact between the samples and the transportation container: the transportation container is a container, possibly but not mandatorily sealed, capable to protect the internal sample holders and the samples from dirt and mechanical damages.
In case of restricted missions, when a bio-containment is needed, a double sealed layout is needed: both the internal sample holder and the transportation container must be sealed. Furthermore, it has to be remarked that, in case of infectious and potentially infectious samples, the transportation is subject to strict national and international regulations. These regulations describe the proper use of packaging materials, as well as other shipping requirements.

2.4. Special container

Special containers are sample holders embedded with an active control, to store and deliver special samples to external laboratories. The special container will be used to move special samples in their internal sample holders between the ESCF and the external locations (e.g.

external laboratories, other curation facilities, etc), when an additional level of containment is required and the atmosphere composition outside the Storage Container should be kept constant. The special container will be a sealed box, to maintain a GN2 atmosphere inside the internal sample holder, till the end of the delivery operations from curation to external locations. The special container will also host the internal sample holders after the retrieval from external laboratories. The main reason to use it is to create a further external defence in order to avoid possible contamination due to shipping procedures and travel, manipulation operations performed before to be stored inside the sample cabinets.

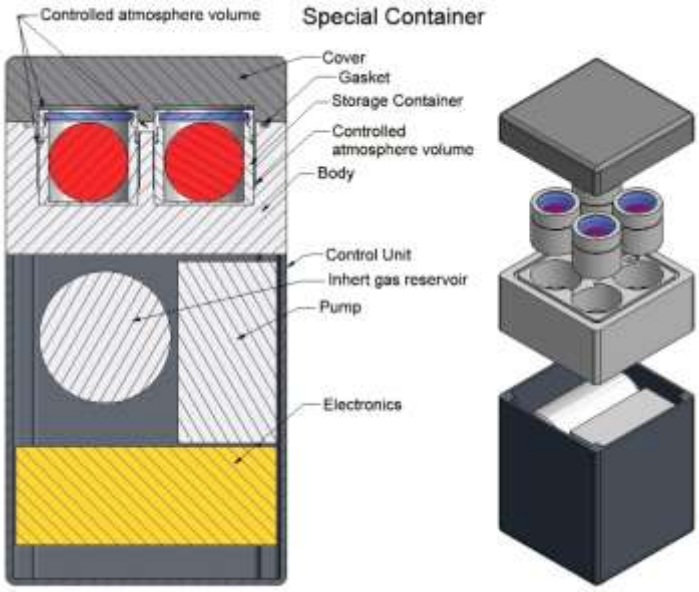

Figure 3. Special Container (courtesy Kayser Italia).

We can assume that the special container should house up to 4 Storage Containers. Figure 3 shows a possible layout of the special container. The special container will include a control unit to monitor the pressure inside the internal volume of the special container and a gas reservoir to supply the internal volume with additional amounts of GN2 so to keep it constantly at a pressure greater than the external pressure.
In case of unrestricted mission, when a bio-containment is needed, a double sealed layout is needed: both the internal sample holder and the special container must be sealed.
Furthermore, it has to be remarked that, in case of infectious and potentially infectious samples, the transportation is subject to strict national and international regulations. These regulations describe the proper use of packaging materials, as well as other shipping requirements.

3. Transfer operations

The operational protocols are strictly related to their "boundary condition": the curation infrastructure, the technological plants, the scientific devices, the type of mission, the samples etc. For this reason, at this stage of the study, some protocols may be designed with

some assumptions. Here, the main assumption is that a Sample Manipulation Cabinet (SMC) exists, to extract the sample canister from the ERC and the samples from the canister, provide sample cataloguing and finally prepare the samples for their storage. The SMC should be designed as a modular structure composed by a number of single modules, arranged in a row, with each module adjacent to the following and airtight doors separating them. This architecture allows the sample to always stay inside a safe environment, minimizing the transfer phases and the risk of forward and backward contamination.

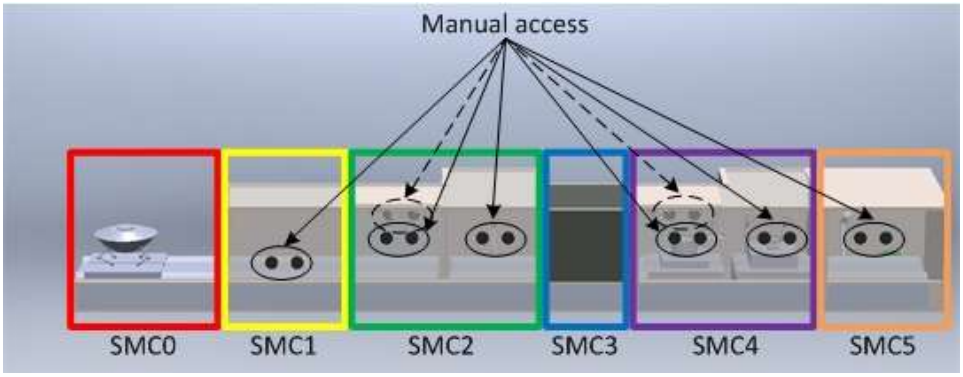

Figure 4. The SMC design highlighting and the six modules in which it is subdivided.

As the external containers are removed, samples are moved through the different modules, each one of those designed to perform specific operations, to keep them separated from potentially contaminant surfaces. In Figure 4 a possible SMC layout is shown, with 6 cabinets. The flow chart of the operations is showed in Figure 5.

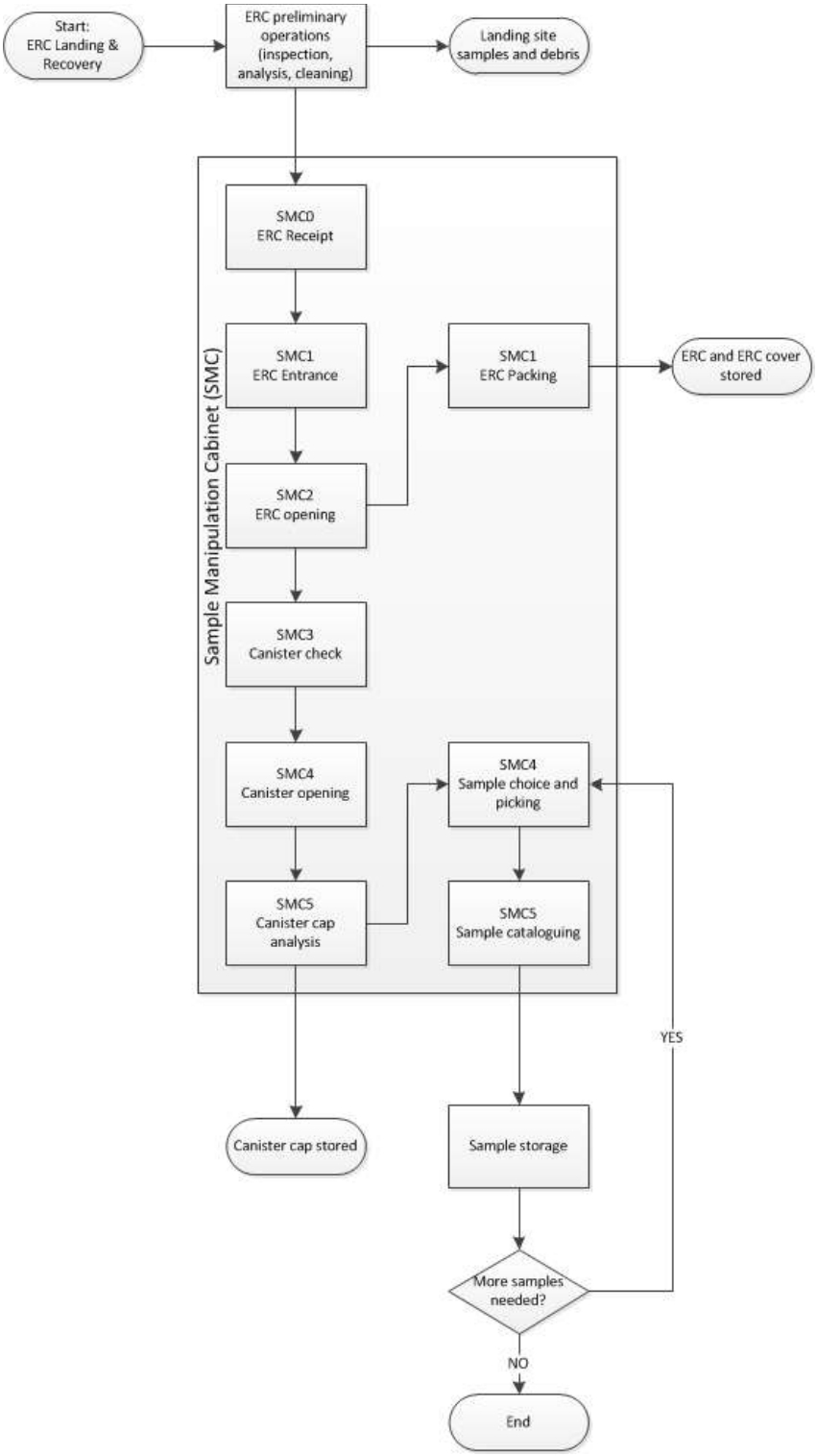

Figure 5. Flowchart of operations.

Upon its arrival at the curation facility the ERC is subjected to X-ray examination to check its integrity, which is the conditions for a decision making whether automatic operations for canister removal are feasible or not. Then, the ERC external surface is washed and cleaned to remove as much terrestrial debris and deposit as possible.

Step 1-0
The ERC is placed on its adjustable support system in SMC0 module in such a way that its upper surface is almost horizontal. The ERC support system features a guideway that allows the ERC to be moved from SMC0 to SMC1 and SMC2. The ERC is then moved in SMC1 module.

Step 1-1
The SMC1 module is a compensation chamber that allows the ERC to enter the inert atmosphere (GN2) which fills all the SMC modules except SMC0. The rationale of replacing the normal atmosphere with an inert one is to avoid possible reactions of the elements contained in the samples with the Oxygen that is present in the air. While the ERC is in the SMC1, with both of the module doors sealed, the initial "normal" atmosphere is replaced by the inert one. The atmosphere monitoring system embedded in SMC1 constantly checks the atmosphere composition in the module and only when the latter is compliant with anti-contamination requirements the ERC is allowed to leave SMC1 and enter SMC2.

Step 1-2
SMC2 is the ERC opening module. When the ERC arrives in this module, its lid is removed and stored. According to the ERC conditions after the atmosphere re-entry and landing, investigated through X-ray analysis descripted above, the lid removal may occur through robotic means or manually. The removed ERC lid is placed on a dedicated holder for further analysis before being sent to the Storage room. Once the ERC lid is removed, the canister is picked from the ERC and placed in a dedicated support system, featuring a sled. The canister support sled slides on linear guideway that is similar but separated to that used for ERC transportation. The canister is therefore moved to SMC3 while the ERC remains in SMC2 to be analysed and further inserted in its storage container and sent to Storage room.

Step 1-3
In SMC3 further controls are performed on the canister, comprising both a visual and an X-Ray exam. Even if the canister has already been subjected to an X-Ray examination while still placed in the ERC before entering the SMC, the presence of several material layers could have affected the analysis of the status of the more internal sample containers. This further inspection provides important information on the most appropriate canister opening procedure, particularly delicate being the canister the most internal sample container, which is performed in SMC4.

Step 1-4a
As the canister gets in SMC4, its lid is removed. The removal process may be automatic/robotic or manual, according to the outcomes of the canister analyses performed in SMC3. During this phase, a recognition of the canister content is also performed: high

resolution and tri-dimensional pictures of the interior of the canister are acquired and a "map of the samples" is created reporting the position and the apparent size of each recognizable sample. When the original lid is removed and the recognition is performed, the canister is re-covered with a new dedicated "laboratory" cover. The inner surface of the original lid is then checked for the presence of eventual scientific matter (samples) stuck on it and the lid is after moved to SMC5 to be further analysed and stored.

Step 1-4b
Once the canister lid has left the SMC4 module, an internal sample holder, whose support system features a high precision scale, enters SMC4 from SMC5. When the sample container is in its position and the door between SMC4 and SMC5 is sealed again, the canister is opened once more and the chosen sample is picked to be placed in its internal sample holder. The canister cover is placed again to protect the canister content before moving the sample to SMC5 module. The sample picking sequence is repeated as long as new samples are needed; when instead the sample picking phase is over, a new and more definitive cover is placed on the canister and the canister itself is moved to its storage cabinet.

The SMC5 module should be dedicated to life detection and bio-hazard assessment, or for the cataloguing and analysis process. Samples are subjected to all prescribed cataloguing exams before sealing the internal sample holder and sending it to the Storage room.
As far as tools are concerned, three support and transportation systems, robotic and manual tools are present in the SMC as well as video surveillance systems. The transportation systems are the sleds that allow the ERC, the canister and the samples to be moved through the SMC modules to be subjected to the various curation phases. The robotic tools are instead present in some of the SMC modules to perform physical operations on the samples and their containers, including ERC cover and canister cap removal, as well as canister placing on its dedicate support and the picking of samples from the canister. Since the condition of the ERC and of the canister after several years of space mission and atmosphere re-entry and landing cannot be granted for being suitable for robotic operations, manual tools are present in SMC. Operators can pick those tools through dedicated glove boxes to use them without posing a contamination threat.
Concerning environmental control, all SMC modules excepted SMC0 are sealed with respect to the external environment and equipped with a GN2 venting system that ensures the absence of oxygen and any other potentially contaminant agent from the SMC atmosphere. To keep the SMC atmosphere safe also from potential minor leaks, the SMC modules are kept at a pressure that is slightly higher than that of the surrounding rooms. Any undetected leak will therefore generate a gas flux from the SMC to the outside but will block any flux entering the SMC. The composition of the SMC atmosphere is also checked both with proper witness plates that are periodically analysed during the SMC operation and through a continuous mass spectrography of the ambient gas.

4. Pathogens and infective substances transfer

This section applies to following transfer path:

- From the ESCF to external locations (i.e., external laboratories, other curation facilities, etc.)
- From external locations to the ESCF

Transfer of infectious and potentially infectious materials is subject to strict national and international regulations. These regulations describe the proper use of packaging materials, as well as other shipping requirements.
Laboratory personnel must ship infectious substances according to applicable transport regulations. Compliance with the rules will:

1. Reduce the likelihood that packages will be damaged and leak;
2. Reduce the exposures resulting in possible infections;
3. Improve the efficiency of package delivery.

4.1. Regulations

All the worldwide regulations are based on the World Health Organization (WHO) directives about the transport of hazardous/infectious samples. The regulations for the transport of infectious materials are based upon the United Nations Model Regulations on the Transport of Dangerous Goods, a dynamic set of recommendations subject to biennial amendments. These recommendations are developed by the United Nations Committee of Experts on the Transport of Dangerous Goods (UNCETDG). The Regulations have to be introduced into national regulations and international modal regulations by the competent authorities (i.e., the Technical Instructions for the Safe Transport of Dangerous Goods by Air of the International Civil Aviation Organization (ICAO) for air transport and the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)). The International Air Transport Association (IATA) also issues Infectious Substances Shipping Guidelines. IATA guidelines must follow ICAO's Technical Instructions as a minimal standard, but may impose additional restrictions. IATA guidelines must be followed if a shipment is carried by members of IATA. WHO serves in an advisory capacity to UNCETDG and ICAO.
International modal regulations are not intended to supersede any local or national requirements. However, in situations where national requirements do not exist, international modal regulations should be followed.
Furthermore, it is important to note that international transport of infectious substances is also dependent on and subject to national import/export regulations.

4.2. Infectious substances

According to the WHO directives, infectious substances are divided into the following categories:

- **Category A** - An infectious substance which is transported in a form that, when exposure to it occurs, is capable of causing permanent disability, life-threatening or fatal disease in otherwise healthy humans or animals.
- **Category B** - An infectious substance which does not meet the criteria for inclusion in Category A.

As mentioned in D6.3, according to these definitions, the samples recovered from the ERC, once returned to Earth, can be classified as follows:

- Mars and Europa samples should be treated as "Category A" samples, since it is not known if they could contain simple forms of life which could cause disease in humans.
- Asteroid and lunar samples should be treated as "not hazardous".

These classifications also work after the samples are transferred to the ESRF, where, according to the operation performed on samples, they can be modified as follows:

- Unsterilized or not LD/BH assessed samples from Mars and Europa should be treated as "Category A" samples, since it is not known if they could contain simple forms of life which could cause disease in humans.
- Asteroid and lunar samples should be treated as "not hazardous".
- Sterilized Mars and Europa samples should be treated as "not hazardous".
- Mars and Europa samples which received a negative LD/BH assessment should be treated as "not hazardous".

The flowchart for the classification of infectious substances and patient specimens, according to the WHO regulations, is showed in Figure 6:

- The case of asteroid, lunar, sterilized and LD/BH negative assessment for Mars and Europa samples is highlighted in green: these samples are classified as not hazardous.
- The case of unsterilized Mars and Europa samples is highlighted in red. According to WHO rules, these samples should be treated as Category A. This is due to the fact that the answer to the question "*Does it meet the definition of a Category A substance?*" is "*Unknown*".

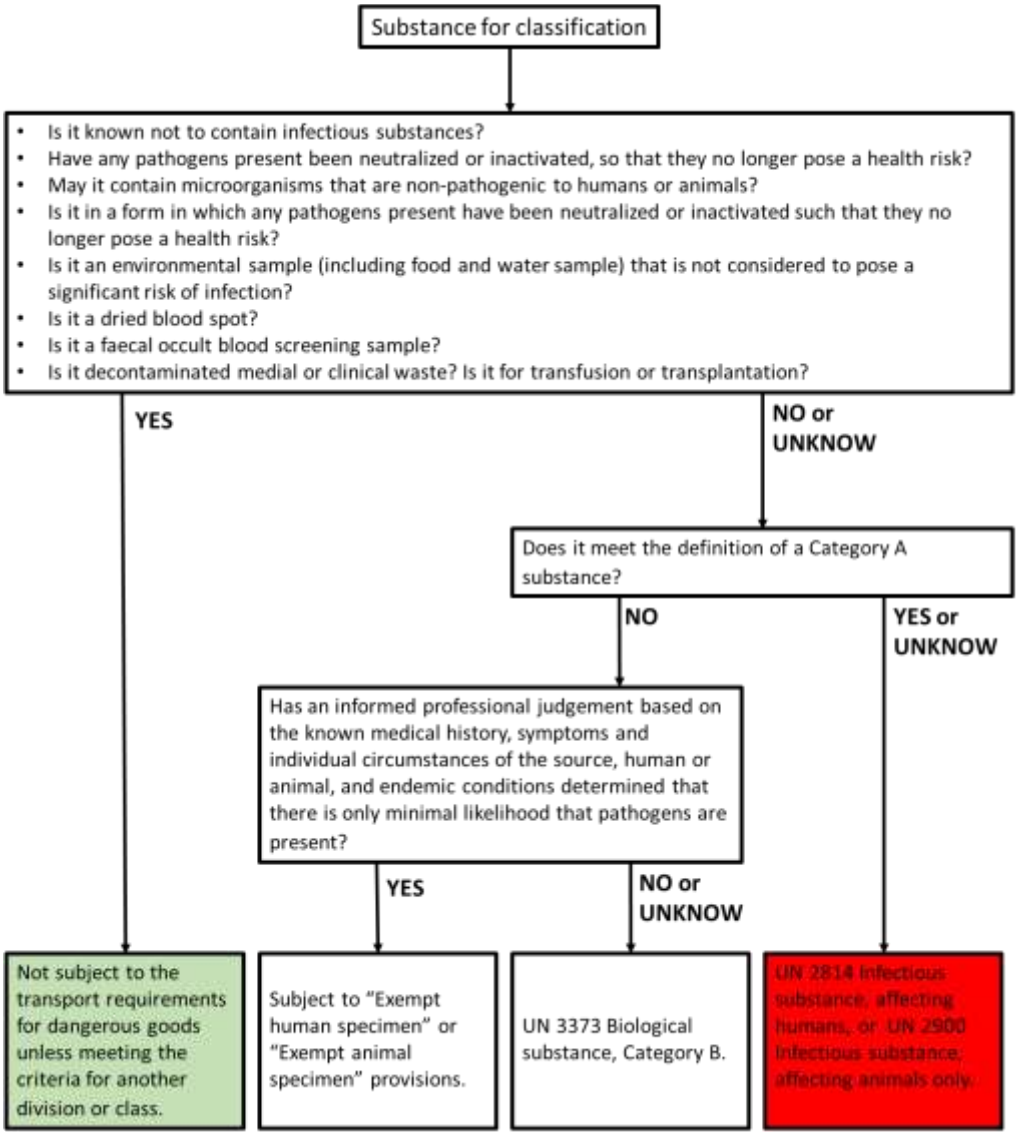

Figure 6. WHO flowchart for the classification of infectious substances.

4.3. Packaging

Because of the differences in the hazards posed by Category A infectious substances (UN 2814 and UN 2900) and Category B infectious substances (UN 3373), there are variations in the packaging, labelling and documentation requirements for the two categories. Some general main rules are provided from WHO:

- Hand carriage of Category A and Category B infectious substances and transport of these materials in diplomatic pouches are strictly prohibited by international air carriers.
- Inner packaging containing infectious substances shall not be consolidated with inner packaging containing unrelated types of goods.

- Shippers of infectious substances shall ensure that packages are prepared in such a manner that they arrive at their destination.

According to WHO [1], the choice for the transport of infectious and potentially infectious substances is the triple packaging system. This packaging system consists of three layers:

- **Primary receptacle** - The primary receptacle containing the specimen must be watertight, leak-proof and appropriately labelled as to content. The primary receptacle is wrapped in enough absorbent material to absorb all fluid in case of breakage or leakage.
- **Secondary packaging** - A second watertight, leak-proof packaging is used to enclose and protect the primary receptacle(s). Several wrapped primary receptacles may be placed in a single secondary packaging. Volume and/or weight limits for packaged infectious substances are included in certain regulatory texts.
- **Outer packaging** - The third layer protects the secondary packaging from physical damage while in transit. The smallest overall external dimension shall be 10 x 10 cm.

Specimen data forms, letters and other types of information that identify or describe the specimen and identify the shipper and receiver, and any other documentation required, must also be provided according to latest regulations.
The United Nations Model Regulations prescribe the use of two different triple packaging systems. The basic triple packaging system applies for the transport of a variety of infectious substances; however, high-risk organisms must be shipped according to more stringent requirements. For further details about the use of the different packaging according to the materials to be transported, it is advisable to consult national and/or international modal regulations for applicable regulatory texts.
According to the rules, this means that the transportation container and the special container must be part of, or be, the primary receptacle. Packaging and labelling of Category A and Category B infectious substances are shown in Figure 7 and 8.

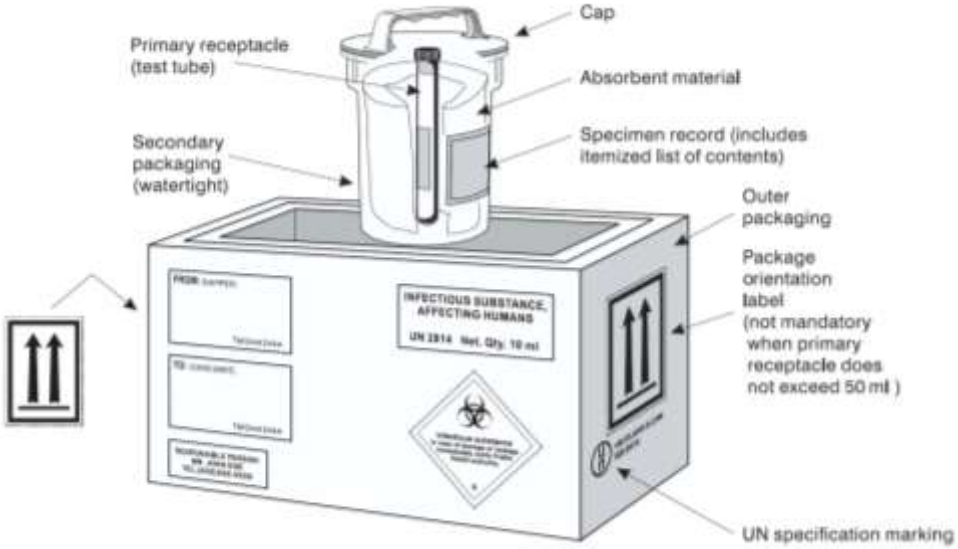

Figure 7. Packaging and labeling of Category A infectious substances (figure provided by IATA, Montreal, Canada [3]).

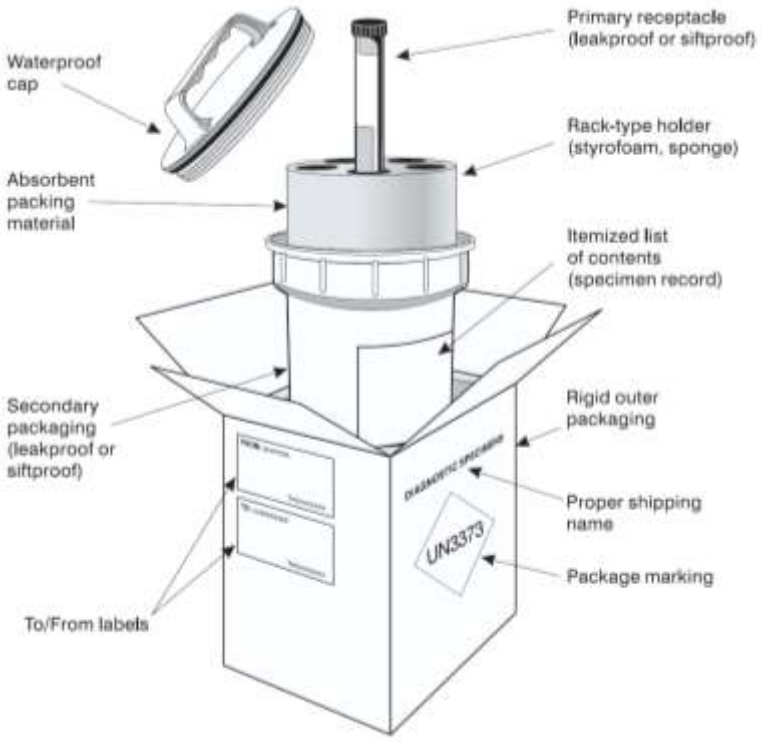

Figure 8. Packaging and labeling of Category B infectious substances (figure provided by IATA, Montreal, Canada [3]).

Both primary and secondary packages are required to survive to a differential pressure of 95 kPa and to the temperature range from -55°C to 40°C.

Additional requirements apply if the transported substance has to be kept at low temperature, i.e. should be consigned refrigerated or frozen.

- Ice, dry ice, ice pads or other refrigerants can be applied around the secondary package. Alternatively, a fourth external layer, i.e. the over pack, can be used, and the refrigerant applied around the outer package. The latter may consist of an insulated vessel or a flask.
- If ice is used, the over pack the outer package shall be leak-proof.
- If dry ice is used, it must not be placed inside the primary or secondary receptacle because of the risk of explosions. Moreover, the over pack shall permit the release of carbon dioxide gas.
- Other refrigerants (except liquid nitrogen) can be placed in the primary/secondary package, provided that their amount is not larger than 30 ml.
- Interior supports shall be provided to secure secondary packaging in position after the ice or dry ice has dissipated.
- The primary receptacle and the secondary packaging shall maintain their integrity at the temperature of the refrigerant used, especially in the case of liquid nitrogen.

4.4. Packaging, labelling and documentation requirements

According to [4], infectious substances in Category A may only be transported in packaging that meets the United Nations class 6.2 specifications and complies with Packing Instruction. This ensures that strict performance criteria are met; tests for compliance with these criteria include a 9-metre drop test, a puncture test, a pressure test and a stacking test. The outer packaging shall bear the United Nations packaging specification marking, which indicates that the packaging has passed the performance tests to the satisfaction of the competent authority.
The primary receptacle or the secondary packaging shall be capable of withstanding a pressure differential of not less than 95 kPa. The United Nations packaging specification marking alone does not indicate that a test for this has been undertaken, and packaging users should ask their suppliers whether the completed package meets this requirement.
For surface transport, there is no maximum quantity per package. For air transport, the limits per package are as follows:

- 50 ml or 50 g for passenger aircraft;
- 4 liters or 4 kg for cargo aircraft.

Any primary receptacle with a capacity of more than 50 ml shall be oriented in the outer packaging so that the closures are upwards. Orientation labels ("UP" arrows) shall be affixed to two opposite sides of the outer packaging.

For infectious substances in Category B, the triple packaging system continues to apply, including for local surface transport. Testing documents are not required, however. It may be possible to source packaging locally rather than finding an authorized supplier, provided that

the packaging manufacturer and the shipper can comply fully with the requirements. To ensure correct preparation for transport, packaging manufacturers and subsequent distributors shall provide clear instructions to the consignor or persons preparing packages (e.g. patients) on how the packaging should be filled and closed.
For surface transport there is no maximum quantity per package. For air transport:

- No primary receptacle shall exceed 1 liter and the outer packaging must not contain more than 4 liters (for liquids);
- The outer packaging must not contain more than 4 kg (for solids).

4.5. Spill clean-up procedure

According to [1], in the event of a spill of infectious or potentially infectious material, the following spill clean-up procedure should be used.

1. Wear gloves and protective clothing, including face and eye protection if indicated.
2. Cover the spill with cloth or paper towels to contain it.
3. Pour an appropriate disinfectant over the paper towels and the immediately surrounding area (generally, 5% bleach solutions are appropriate; but for spills on aircraft, quaternary ammonium disinfectants should be used).
4. Apply disinfectant concentrically beginning at the outer margin of the spill area, working toward the center.
5. After the appropriate amount of time (e.g. 30 min), clear away the materials. If there is broken glass or other sharps involved, use a dustpan or a piece of stiff cardboard to collect the material and deposit it into a puncture-resistant container for disposal.
6. Clean and disinfect the area of the spillage (if necessary, repeat steps 2–5).
7. Dispose of contaminated materials into a leak-proof, puncture-resistant waste disposal container.
8. After successful disinfection, inform the competent authority that the site has now been decontaminated.

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