Application of coatings on space hardware

Field of application:
This internal process describes the operation done on space hardware at MAP company Application department.

Diffusion PDF
* MAP Internal network
* MAP web site

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Summary

This process is under ECSS-ST-Q-70-31C (*) with, below, the connections in blue.
(*) refer to applicable conformity matrix with ECSS for difference or exemption.

0. Applicable documentation, Areas conditions and general rules

* All cycling or aging tests have to be carried out:
  - after 4 weeks (Room temperature conditions)
  - after Fast curing FAST CURING until the hardware/samples reach the room temperature .
* Applicable documentation: Customer specifications and drawings, MAP documentation.
* All available and critical information must be forwarded to MAP by the customer before any RFQ.
* Areas conditions are described in the annex.
* All the following process shall be done by MAP certified operator* All operations must be done with Nitrile gloves.
* All material and test equipment must be qualified before use and ordered under specifications.

1. Quotation

Adequacy of coating/substrate couple shall be verified during when setting the quotation, through the last issue of MAP internal standard 100/NI. For checking, use the matrix of compatibility
"Ref.Matrice_Compatibilité_Peinture_Substrat_Client"
Verify the existence of customer specification.

ECSS-ST-Q-70-31C: § 4.1.2.

2. Receipt of hardware

The hardware are received in the "airlock" (B10) then brought out of their primary package.
They will be stored in the "unpacking room" (B11).

A visual inspection will be done maximum 48 hours after Receipt of hardware.
In case of large hardware, the un-packaging and visual inspection will be done hardware after hardware (in several times).
MAP is not qualified to carry out mechanical control, and cannot be responsible for the aspect and dimension of the hardware. The delivered hardware is considered corresponding to the drawings and ready to the application process.
Refer to MAP Receipt of hardware process: P/RCM/001.

Primary packages are stored in "storage area" or outside with a plastic protection if they are too voluminous.
The original packaging will be used for packaging and expedition of coated hardware.
The customer agrees to provide MAP with a suitable packaging in order to ship back the coated hardware without damage. In case of a defect on treated hardware during the delivery in customer packaging, MAP cannot be responsible of any non-conformance due to transport conditions.

ECSS-ST-Q-70-31C: § 4.2.2.1.

3. Receipt of coatings

The coatings and their thinner are internally delivered in their final packaging and already controlled as other products for external customers. The batches are registered in order to manage the expiry dates. Those materials are stocked in specified areas.

4. Verification/Receipt of hardware documentation

The hardware must be delivered with the following documents:

-Delivery note
-Order
-Drawings of masking areas

ECSS-ST-Q-70-31C: § 4.2.2.1, 4.2.2.3

5. Control of samples:

The samples follow the same process as the space hardware from the receipt of hardware to the expedition. The hardware has to be delivered with witness samples. These witness samples shall be made of the same materials and be surface treated the same way as the hardware. Acceptable criteria is defined on samples (see § 13). Regarding the level of hardware complexity (Hardware's shape), the results of thickness and linked parameters should be, on hardware, different from the thickness on samples. In case of no witness sample provided by the customer, the conformity will be verified with the tests carried out on MAP samples.

MAP provides samples as described below:

-Bare aluminium sample 2017T4 (2 minimum) size: 30 x 100 mm.
-Aluminium Alodine sample (1 minimum) size: 80 x 80 mm if the hardware are made of Aluminium Alodine.
-GFRP sample (1 minimum) size 100 x 150 mm if the hardware are made of composite.
-1 Glass sample size 100 x 100 mm or 100 x 150 mm.

MAP samples will be stored during a minimum duration of 10 years.
Customer samples will be sent back with the hardware. One of them will be used for control testing.

ECSS-ST-Q-70-31C: § 4.2.2.1, 4.2.2.3

6. Identification

Pictures of hardware will be taken (room B11).

The hardware will be recorded in planning files.
A reference number called application number (Numéro d'application) will be given for each batch of hardwares, i.e. 1 Receipt of hardware>> several hardwares and samples >> 1 application number.
An application report will be created. "Special requirement of customer sheet" will be edited if applicable (see: Liste_des_documents_externes_APPLICATIONS.xls).

ECSS-ST-Q-70-31C: § 4.2.2.2 and 4.5.5.

7. Cleaning

These operations will be done in cleaning room (B11).
If there is no customer specification, the hardware will be cleaned according to MAP internal cleaning process.
These internal processes are based on the nature of the substrate (substrate + chemical treatment, for example aluminium + Alodine treatment) described on the drawings.
In case of doubt, (see § 1 quotation) a confirmation email will be sent to the customer.
Application report will be filled before proceeding to the following stage.

ECSS-ST-Q-70-31C: § 4.3.1.1, 4.3.1.2 and 4.5.5.

8. Masking

These operations will be done in masking room (B12).
If there is no customer specification, the hardware will be masked according to MAP masking internal process.
These internal processes are based on the nature of the substrate (substrate + chemical treatment, for example aluminium + Alodine treatment) described on the drawings.
The masking will be done with a precision of +/-1 mm.

In case of chamfered surface: When the chamfered surface is smaller than 1 mm, this surface will not be coated (the chamfered area will be applied and the coating removed after drying [see § 12 unmasking]), except otherwise indicated on drawing.
After masking, a self-checking will be done by highlighting on the drawing the masked areas.
Application report will be filled before proceeding to the following stage.

ECSS-ST-Q-70-31C: § 4.3.2 (except f) and 4.5.5.

9. Cleaning after masking

These operations will be done in cleaning room (B11).
A final manual cleaning will be done, after masking and before application.
If unpolishing step is required in MAP cleaning internal process, this operation will be done after masking with a particular attention on the borders of masking. If needed, replace the damaged masking tapes during this operation.
Wait for minimum 1 hour before starting application process.
The application of coatings shall be done maximum 8 hours after this stage.
Application report will be filled before proceeding to the following stage.

ECSS-ST-Q-70-31C: § 4.3.1.1, 4.3.2 and 4.5.5.

10. Storage and Mixing of products

The storage and mixing will be done:

- in "mixing silicone area" (B15) for silicone products..
- in "mixing polyurethane area" (B15) for the other products.

The preparation of the mixture will be done according to the technical data sheet of each product in new containers.
The expiry date of the coating will be verified before use.
The application report with name and batch number of coating and corresponding thinner will be filled.

ECSS-ST-Q-70-31C: § 4.2.5.g, 4.3.3, 4.3.4 and 4.5.5.

11. Application

Application will be done in spraying room (B14). Any water condensation must be avoided during application (dew point).
If there is no customer specification and neither MAP application internal process, the hardware will be applied according to MAP technical data sheet. The application of coatings will be done only after any mechanical operation and adhesive bonding.
The spraying will be done with a spray gun (silicone spray gun for silicone products and polyurethane spray gun for other products). The compressed air must be clean, without traces of water or oil. Cleaning of spray gun must be done before/after each application with relevant solvent.
The aspect of each coat during the application must be wet and homogeneous. No traces of drop, agglomerates…
The goal is to obtain a final dry smooth coat of product.
One coat of product could be made of several mist coats and crossed coats until obtaining the required thickness.
The application process will be adapted to the geometry of the surface to be coated. However, in order to get a general homogeneous thickness, the areas of difficult access could be applied with a lower thickness or sometimes not applied at all.

Notice: when the surfaces applied are lower wide than 1 mm, the adhesion of coating could be decreased. MAP cannot guarantee a good adhesion on such small areas.
Application with paintbrush could be done in this case according to MAP internal repairing process.
Application report will be filled before proceeding to the following stage.
After the end of spraying step, any remaining mixture will be thrown away in the appropriated trash.

ECSS-ST-Q-70-31C: § 4.2.4.2.c/d, 4.2.5.b.c.d.e.f, 4.3.3, 4.3.4 and 4.5.5.

12. Drying, curing and accelerated polymerization

After application, the hardware will remain in the application room during the evaporation of solvent (around 1 hour).The hardware will be transferred to the drying room (B16).
If necessary, repeat the mixing and application step, up to the final coat.
Final curing is according to the technical data sheet.
Usually, the drying takes 7 days at room temperature, after application of the last coat.
The unmasking will be done during the curing (see § 12 unmasking).

Some coatings can be polymerized at higher temperatures. See technical data sheet of each product.
For FAST CURING process, please see CNES report DCT-TV-TH-2014-10593-Ed1-Rev0_10-07-2014.
* SCK5 cannot be cured at high temperature. Control could be done after 7 days of drying at room temperature.
* PN, PNC, PNAS can be cured 5 days at room temperature + 48 hours at 70°C.
* PU1, PUC, PUK, MAP AQ PU1, MAP AQ PUK can be cured according to several processes:
  - 1 week at room temperature
  - 48 hours at room temperature + 4 hours at 70°C
  - 24 hours at room temperature + 16 hours at 50°C
* FAST CURING process can apply only for SG121FD, SG122FD, PCBE, PNC, PUK, PU1, PSB et PSBN
  - Evaporation of solvent 1 hour to 10 hours
  - Curing minimum 15 hours at 70°C.

Accelerated polymerization (including FAST CURING) will be done in oven room (B19).
Control and expedition could be done after accelerated polymerization and until the hardware reach the room temperature.
Application report will be filled before proceeding to the following stage.

ECSS-ST-Q-70-31C: § 4.3.3.2, 4.3.4.3 and 4.5.5

13. Unmasking

The unmasking will be done in preparation room (B12).
Depending on the coating, the unmasking will be done after several days of drying at room temperature:
- Wait 4 hours minimum of drying before unmasking MAP® AQPU1 and MAP®AQ PUK.
- Wait 24 hours minimum of drying before unmasking SCK5.
- Wait 48 hours minimum of drying before unmasking SG121FD, SG122FD, PCBE, PN, PNAS and PNC
- In case of not accelerated polymerization wait 48 hours minimum of drying before unmasking PU1 and PUC and wait 72 hours minimum of drying before unmasking PUK.
- Wait 72 hours minimum of drying before unmasking PSB and PSBN

In case of accelerated polymerization (including FAST CURING): wait the end of accelerated polymerization and until the hardware reach the room temperature before unmasking.
Unmasking shall be performed carefully to avoid the starting of pulling stresses in the coating: in general, from the edges to the centre of masking.
All adhesive tape and tool of masking will be removed. The edges of the coating will be cut with a scalpel.
Verify if there is no trace of glues from adhesive tape of masking. Clean it with "SWAB" soaked with acetone and/or alcohol.

Application report will be filled before proceeding to the following stage.

ECSS-ST-Q-70-31C: § 4.3.4.2 and 4.5.5.

14. Acceptance criteria
(MAP Internal standard 101/NI last issue "Internal matrix for acceptance criteria")

The controls are done on hardware in room (B12) and on samples in room (B18).
They are done after complete drying (see § 11 Drying, curing and accelerated polymerization).
If there is no customer specification (see § 5 Identification), the control will be done on hardware and samples as follows:

On following sample (see § 4.)

❶ Measurement of thickness of each coat according to MAP internal standard 2B
⇨For the value to be obtained, see data sheet and internal matrix #

❷ Measurement of specular brightness according to MAP internal standard 2F
⇨For the value to be obtained, see data sheet and internal matrix #

❸ Visual aspect and under binocular according to MAP internal standard 2B.
⇨Verify that there is no crack, run-out, agglomerate, lack of coating.
⇨No speck of dust or coating (inclusion) i.e. maximum 3 dimension < 0.2 mm/1dm². See internal matrix #

❹ Visual control of colour, see internal matrix #

❺ Control of adhesion by squaring + adhesive tape according to MAP internal standard 2E1 or 2E2.
Use adhesive tape 92 from 3M for silicone coating and adhesive 8705-b from SCAPA for the other coatings.
⇨For the value to be obtained, class 0-1 (See internal matrix #)
⇨Case of SG122FD: white aspect on adhesive tape (mist) is acceptable.
⇨Case of PSB/PSBN: class 0-2 (See internal matrix #)

❻ Measurement of surface resistance for conductive coatings (PCBE, SCK5, PNC, PNAS, PUC and PUK) according to MAP internal standard 2G1, 2G2 or 2G4.
⇨For the value to be obtained, see data sheet and internal matrix #

❼ Measurement of solar absorbance αs according to MAP internal standard 2V1.
⇨For the value to be obtained, see data sheet and internal matrix #

On hardware

❽ Visual aspect according to MAP internal standard 2B.
⇨Verify that there is no crack, run-out, agglomerate, lack of coating.
❾ Verification of unmasking: a self-checking will be done on masked areas.

Application report will be filled before proceeding to the following stage.

ECSS-ST-Q-70-31C: § 4.4 and 4.5.5

15. Final checking

This checking will be done in room (B12). Before packing the hardware, a final control will be done on the hardware.
The acceptance criteria are the following:

-Conformance of masking with drawing.
-All adhesive tape and tool of masking will be removed.
-No trace of glues from adhesive tape of masking.
-All the coated edges will be cleanly cut. No flakes of coating.
-No infiltration of primer or coating on the untreated areas.
-Visual aspect of the coating must be homogeneous. Verify that there is no crack, run-out, agglomerate…
-No lack of coating on the treated surfaces.
-No scratches on the coating.

Application report will be filled before proceeding to the following stage. A picture of hardware will be taken in room (B11).
ECSS-ST-Q-70-31C: § 4.4 and 4.5.5.

16. Packaging of finished hardware

These operations will be done in room (B11).
If there is no customer specification, the hardware will be packed according to MAP packaging internal process P/C/003.
The packed hardware is transferred in the "airlock" (B10). They are then packed in their original packaging (see § 2 Receipt of hardware) with the document defined in MAP packaging internal process P/C/003.
Application report will be filled before proceeding to the following stage.

ECSS-ST-Q-70-31C: § 4.3.5, 4.2.2.1.d.e and 4.5.5.

17. Expedition

After packing a document called "assurance transport/transport insurance" will be sent to the customer in order to organize the back shipment of coatd hardware.

18. Non-conformance

During all the process, if any deviation is observed, the application department provides information to MAP quality department maximum 24 hours after deviation observed. A discrepancy report will be filed and sent to the customer by the quality department maximum 48 hours after deviation observed.
Application process will be stopped.
Customer approval is required to continue the process.

ECSS-ST-Q-70-31C: § 4.5.3.

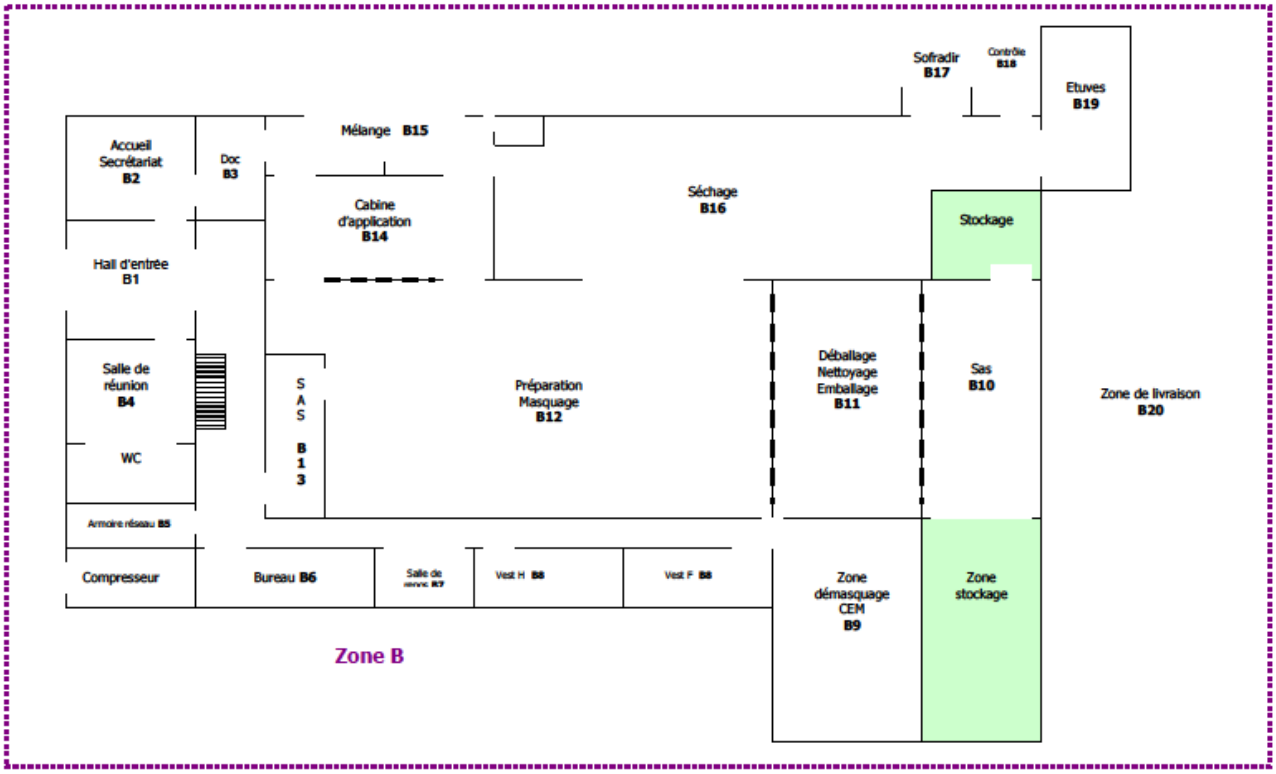
19. Repairing process

During step 12 to 14, if MAP detects a defect, lower than 10% of total surface, MAP can repair within the frame defined in MAP internal repairing process AQ/P/R/001.
For higher repair, see § 17. Customer approval is required to continue the process under discrepancy report.
Application report will be filled.

ECSS-ST-Q-70-31C: § 4.3.6 and 4.5.5.

Annex 1

MAP application department facilities



Conditions	Cleanliness (*)	Temperature (°C) (**)	Relative hygrometry (%) (**)
B14	--	monitored	monitored
B12	ISO 8 (*)	22+/-3	55+/-10
B16	ISO 7 (*)	22+/-3	55+/-10
B11	ISO 7 (*)	22+/-3	--
B13, B17	--	22+/-3	55+/-10
B15, B18	--	22+/-3	--
Others	--	22+/-3	--

(*) for information only and based on MAP measurements.
(*) MAP measurements can be done upon customer's request.
(*) Each year, MAP measurements are performed according to MAP internal standard 102/NI.

(**) monitored, according to MAP technical data sheets

History of changes

Description	Identification of impacts on QMS system	Rev.
Creation	No identified impact because of creation of this procedure by checking Application process with ECSS-ST-Q-70-31C. MAP residual actions have been listed on conformity matrix v3. MAP application process has been issued.	1
Modification of grammar and syntax	No impact.	2
*Inspection during the reception removed from chapter 5 and included in chapter 2 (with changes). *Details on the responsibility of packaging in chapter 2. *Addition of "fast curing" process (chapter 11 & 12). *Logo Fast curing added FAST CURING. *Tp/HR ranges of ECCS ST-Q-70-31C (annexe 1). *(Part replaced by hardware). *Times before cycling/aging tests added.	Modifications of "MAP General terms and conditions of services" and "MAP hardware particular procedure P/CM/001".	3
Adding chapter on receipt / acceptance of batches of paints. Addition of monitoring for Tp/HR	Update of ECSS conformity matrix and ASF documentation	4
Addition of the word "wide" for small surface (see 11). Paint replaced by coating (general substitution without mark or identification). Addition of MAP®AQ PUK	Update of ECSS conformity matrix and ASF documentation	5

The end