Thermal finishing of space hardware

Field of application:
This internal process describes the operation done on space hardware Thermal finishing department at MAP SPACE COATINGS.

Diffusion PDF
* MAP SPACE COATINGS Internal network
* * MAP SPACE COATINGS 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 SPACE COATINGS documentation.
* All available and critical information must be forwarded to MAP SPACE COATINGS by the customer before any RFQ.
* Areas conditions are described in the annex.
* All the following process shall be done by MAP SPACE COATINGS certified operator.
* All operations must be done with powder-free 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 SPACE COATINGS 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 hardwares are received in the "airlock" (EN2) then take out of their primary package (AP2 ou EN2).
They will be brought to the "unpacking" room (AP2).

In case of large hardware, the un-packaging and visual inspection will be done one after the other (in several times).
MAP SPACE COATINGS 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 Thermal Finishing process.
Refer to MAP SPACE COATINGS 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 SPACE COATINGS 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 (paper, PDF, CATPART, STEP/STP files, ...)

ECSS-ST-Q-70-31C: § 4.2.2.1, 4.2.2.3

5. Control samples

The hardware should be delivered with witness samples. These witness samples must be made of the same materials and treated on the surface in the same manner as the hardware.

MAP SPACE COATINGS use samples for Thermal finishing process's monitoring 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 is made of Aluminium Alodine.
-1 Glass sample size 100 x 100 mm or 100 x 150 mm.

MAP SPACE COATINGS 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.

The samples follow the same process as the space hardware from the receipt of hardware to the expedition.

ECSS-ST-Q-70-31C: § 4.2.2.1, 4.2.2.3

6. Identification

Pictures of hardware will be taken ("Picture" room AP3).

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

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

7. Cleaning

These operations will be done in cleaning area into Preparation room (AP6).
If there is no customer specification, the hardware will be cleaned according to MAP SPACE COATINGS 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.
The Thermal Finishing 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 on masking tables into preparation room (AP6).
If there is no customer specification, the hardware will be masked according to MAP SPACE COATINGS 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 accuracy 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.
The Thermal Finishing 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 on cleaning tables into preparation room (AP6).
A final manual cleaning will be done, after masking and before deposit, projection or treatment.
If unpolishing step is required in MAP SPACE COATINGS 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 deposit, projection or treatment process.
The deposit, projection or treatment of coatings shall be done maximum 8 hours after this stage.
The Thermal Finishing 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 will be done in "EN3/EN4" areas.
The preparation of the mixture will be done into "AP10" areas according to the technical data sheet of each product in new containers.
The expiry date of the coating will be verified before use.
The Thermal Finishing 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. Deposit, projection or treatment

The deposit, projection or treatment will be done in spraying room (AP8/AP9). Any water condensation must be avoided during this process (dew point).
If there is no customer specification and neither thermal finishing internal process, the hardware will be applied according to MAP technical data sheet. The deposit, projection or treatment 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 deposit, projection or treatment with relevant solvent.
The aspect of each coat during the projection 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 Thermal Finishing 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.
A deposit with a brush could be done in this case according to MAP internal repairing process.
The Thermal Finishing 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 deposit, projection or treatment the hardware will remain in the Thermal finisging room during the evaporation of solvent (around 1 hour). The hardware will be transferred to the drying room (AP7).
If necessary, repeat the mixing and deposit, projection or treatment 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 deposit, projection or treatment of the last coat (for packaging, see sectiono, p2). The unmasking will be done during the curing time (see § 13 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-Revo_10-07-2014.

* MAP®PN, PNC, PNAS can be cured 5 days at room temperature + 48 hours at 70°C.
* MAP®PU1, PUC, 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 MAP® SCK5-N
  - Evaporation of solvent 4 hours minimum
  - Curing minimum 15 hours at 70°C.
* FAST CURING process can apply only for MAP®SG121FD, SG122FD, PCBE, PNC, PUK, PU1, PSB et PSBN
  - Evaporation of solvent 1 hour minimum
  - Curing minimum 15 hours at 70°C.
* FAST CURING process can apply only for MAP®AQ PUK and MAP®AQ PU1
  - Evaporation of solvent 3 hours minimum
  - Curing minimum 15 hours at 70°C.

Accelerated polymerization (including FAST CURING) will be done in oven room (AP5) or in AP8/AP9 (Thermal finishing cabins). Control and expedition could be done after accelerated polymerization and until the hardware reach the room temperature. The Thermal Finishing report will be filled before proceeding to the following stage.
In any cases, the accelerated polymerisation FAST CURING will be done after unmasking.

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 (AP6).

Definitions of unmasking

-Easy. Acces easy of masking tape and no risk of touch the coated surface.
-Difficult. Other cases.

Coating	Difficult unmasking	Easy unmasking
MAP® AQ PU1	≥4 hours	≥4 hours
MAP® AQ PUK	≥4 hours	≥4 hours
MAP®SCK5-N	≥24 hours	≥24 hours
MAP®SG121FD	≥24 hours	≥16 hours
MAP®SG122FD	≥24 hours	≥16 hours
MAP®PCBE	≥48 hours	≥24 hours
MAP®PN	≥24 hours	≥16 hours
MAP®PNC	≥24 hours	≥16 hours
MAP®PNAS	≥24 hours	≥16 hours
MAP®PU1	≥48 hours	≥36 hours
MAP®PUK	≥72 hours	≥48 hours
MAP®	≥72 hours	≥48 hours
MAP®PSB	≥72 hours	≥72 hours
MAP®PSBN	≥72 hours	≥72 hours

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.

The Thermal Finishing report will be filled before proceeding to the following stage.

In any cases, the accelerated polymerisation FAST CURING will be done after unmasking.

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 (AP6) and on samples in control room (CO1).
They are done after complete drying (see § 12 Drying, curing and accelerated polymerization).
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.
If there is no customer specification (see § 5 Identification), the control will be done on hardware and samples as follows:

On following sample (see § 5.)

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

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

❸ Visual aspect and under binocular according to MAP SPACE COATINGS 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 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 SPACE COATINGS internal standard 2B.
⇨Verify that there is no crack, run-out, agglomerate, lack of coating (According internal criteria).

❾ Verification of masking areas according drawing plan.

The Thermal Finishing 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 (AP6). 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.
-No FOD larger than 1mm

(*) larger than 1mm

The Thermal Finishing report will be validated before proceeding to the following stage. Pictures of hardware will be taken in picture room (AP3).

ECSS-ST-Q-70-31C: § 4.4 and 4.5.5.

16. Packaging of finished hardware

These operations will be done in packaging room (AP4).
If there is no customer specification, the hardware will be packed according to MAP SPACE COATINGS packaging internal process P/C/003. The packed hardware is transferred in the "airlock" (EN2). They are then packed in their original packaging (see § 2 Receipt of hardware) with the document defined in MAP SPACE COATINGS packaging internal process P/C/003.
The Thermal Finishing 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. Shipping/delivery

After packing, an e-mail of information of "Ready to pick up" with packaging size is sent to the customer in order to organize the back shipment of coated hardware.

18. Non-conformance

During all the process, if any deviation is observed, the Thermal Finishing department provides information to MAP SPACE COATINGS 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.
The Thermal Finishing process will be stopped. Customer approval is required to continue the process.

ECSS-ST-Q-70-31C: § 4.5.3.

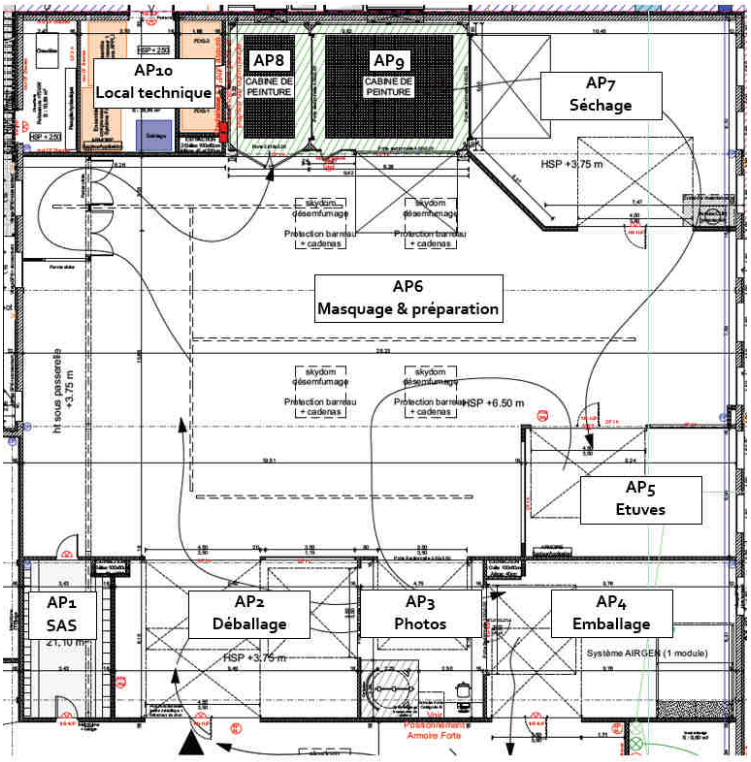
19. Repairing process

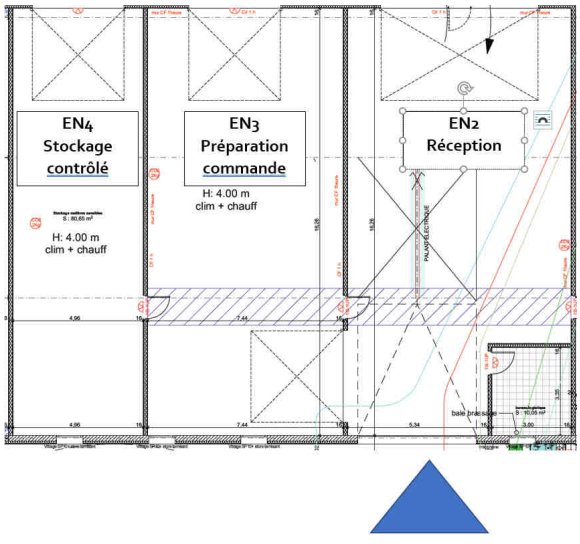
During step 13 to 15, if MAP SPACE COATINGS detects a defect, lower than 10% of total surface, MAP SPACE COATINGS can repair within the frame defined in MAP SPACE COATINGS internal repairing process AQ/P/R/001.
For higher repair, see § 18. Customer approval is required to continue the process under discrepancy report.
The Thermal Finishing report will be filled.

ECSS-ST-Q-70-31C: § 4.3.6 and 4.5.5.

Annex 1

The Thermal Finishing**department facilities**





Conditions	Cleanliness (*)	Temperature (°C)	Relative hygrometry (%)
AP8/AP9	--	regulated according to MAP technical data sheets	
AP2	--	22+/-3 (**)	--
AP3	--	22+/-3 (**)	--
AP4	ISO 5 (*)	22+/-3 (**)	55+/-10 (**)
AP5	--	22+/-3 (**)	--
AP6	--	22+/-3 (**)	--
AP7	--	22+/-3 (regulated)	55+/-10 (regulated)

(*) Installation in progress. For information only and based on MAP measurements.
(*) MAP measurements can be done upon customer's request.
(**) monitored.

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
Update with new areas of the new facility and his rooms (all section) and new name "MAP SPACE COATINGS" "Unmasking" table created with updated data instead of less visible section. Thermal finishing replace Application process and Deposit/projection/treatment replace application step. 1mm size added for FOD and visual defect.	Update of ECSS conformity matrix and ASF documentation (see qualification special process dossier)	6

The end