X-723-66-12

DECONTAMINATION, CLEANING, COATING AND ENCAPSULATION OF ELECTRONIC CIRCUIT BOARDS

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NOVEMBER 1964
REVISED DECEMBER 1965

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DECONTAMINATION, CLEANING, COATING AND ENCAPSULATION AIMPS "D" AND "E" ELECTRONIC CIRCUIT BOARDS

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DECONTAMINATION, CLEANING, COATING AND ENCAPSULATION AIMPS "D" AND "E" ELECTRONIC CIRCUIT BOARDS

1.0 SCOPE

1.1 Purpose of Document. – The purpose of this document is to outline the procedure that will be used by the Mechanical Systems Branch personnel in the cleaning, decontamination, conformal coating and encapsulation of electronic circuit boards and electrical connectors for use on the IMP's D&E spacecraft.

1.2 Purpose of Procedure. – The purpose of this procedure is to obtain decontaminated and/or microbial free components for assembly and integration into the prototype and flight units, IMP's D&E spacecraft.

1.3 Definitions. – Definitions as apply to this procedure are as follows:

1.3.1 Asepsis. – The prevention of access of micro-organisms to materials, component and/or spacecraft.

1.3.2 Bacteriostatic. – Is the technical term meaning capable of hindering bacterial reproduction so that the micro-organisms die only after hours, days, or years, without a significant increase in number.

1.3.3 Clean. – A general term implying that an area and/or equipment involved has been treated so as to reduce the microbial load.

1.3.4 Control strip. – A sample or samples of materials affixed to components so that they will be subjected to the same handling and/or contamination environments as the components themselves. In some cases a spore strip will be used in addition to control strips.

1.3.5 Decontamination. – The killing and removal of the greatest number possible of micro-organisms, flora or fauna, which are capable of independent existence.

1.3.6 Disinfectants. – Alcohols, formaldehyde, phenol and its derivatives which will destroy bacteria by one or more of the following:

1.3.6.1 Rapid oxidation. –

1.3.6.2 Coagulation of bacterial protoplasm.

1.3.6.3 Diffusion through cell membrane and chemical combination with bacterial protoplasm.

1.3.6.4 Dehydration owing to difference in tonicity between the cell protoplasm and the disinfectant such as in the case of alcohol.

1.3.7 Germicide. – Is any substance that will kill bacteria.

1.3.8 Nonsterile, components or materials presumed to be contaminated with micro-organisms.

1.3.9 Plate count. – Properly diluted and measured samples of culture mixed with nutrient agar in sterile petri dish incubated to required temperatures and counted. This number multiplied by the dilution factor is the "bacterial count."

1.3.10 Spore. – Certain rod-shaped bacterial cells capable of forming destruction resistant resting cells. Spores which have been dried and kept cool for more than twenty years have developed into vegetative life when placed in a favorable environment as to temperature, moisture, and nutrition.

1.3.11 Spore strip. – A cloth strip inoculated with a known number (10^6) of bacillus subtiles var niger bacterial spores that will first be subjected to some decontaminating treatment of component, then be immersed into a nutrient broth for a "yes" – "no" measurement of sterility.

1.3.12 Sterilant. – An agent which sterilizes such as ethylene oxide, peracetic acid, dry heat, flame, steam, moist heat, and certain chemicals.

1.3.13 Sterilization. – A process or treatment which will destroy all viable flora and fauna, including spores.

1.3.14 Ultraviolet radiation. – Refers to radiation in the 2537 Å band.

1.4 Documentation. – The following section records are to be kept current by the lead technician, IMP D&E project.

1.4.1 Assembly and Quality Control Record, Structural and Mechanical Applications Section, Mechanical Systems Branch and photographic log.

1.4.2 Decontamination Record, Components and Spacecrafts.

1.4.3 Conformal coating and Encapsulation Record.

1.4.4 Viable microbial count record sheets.

1.4.5 Monitoring and Control Equipment Record.

1.5 Pre-Encapsulation Inspection and Certification. –

1.5.1 All electronic cards and/or electrical connectors are to be inspected according to the dictates of Head, Spacecraft Integration Branch and the AIMP D&E Project Manager.

1.5.2 Any electronics card and/or electrical connector that is to be cleaned, bacterial decontaminated, conformal coated and/or encapsulated by personnel in the Mechanical Systems Branch must be accompanied by an electronic inspection certificate and be signed off by an individual authorized by the Head, Systems Integration Branch. It is to be understood that any waiver to the preceding must come from the AIMP D&E project.

management office. Spacecraft Integration and Sounding Rocket Division Procedures Q-II and Q-III apply.

2.0 PROCEDURE

2.1 Documentation and Inspection. –

2.1.1 Polaroid photographs are to be made of all incoming electronics cards prior to any cleaning coating or encapsulation. Photographs are to be serialized.

2.1.1.1 Log picture number in Assembly and Quality Control Record Book, and/or the decontamination and encapsulation Record Book.

2.1.1.2 File picture in the photographic section of the Decontamination and Encapsulation Record Book.

2.1.2 Visually inspect electronics card and connector using a 15 power stereo macroscope and look for the following:

2.1.2.1 Solder spatter. –

2.1.2.2 Metallic whiskers. –

2.1.2.3 Damaged leads. –

2.1.2.4 Flux. –

2.1.2.5 Scratches on printed circuits. –

2.1.2.6 Cold solder connections. –

2.1.2.7 Evidence of excessive heat. –

2.1.2.8 Foreign material. –

2.1.2.9 Need for stand-offs. –

2.1.2.10 Damaged sleeving. –

2.1.2.11 Bent pins. -

2.1.2.12 Other, as pertinent. -

2.1.3 Log any discrepancy found in the appropriate record book, red tag item, and note discrepancy on same.

2.1.4 Employee is to report finding of a discrepancy to his section head, and deliver the tagged item to him.

2.2 Preparation for Coating. -

2.2.1 Remove one section of control strip and place in a sterile petri dish. Mark "#1" on the outside top cover of the petri dish with a red grease pencil also, the date, name of component and its serial number.

2.2.2 Place petri dish in the control storage cabinet.

2.2.3 Place electronics card and/or connector in its container.

2.2.4 Carry container into room "B" through room "A" and place on table room "B" then proceed as follows.

2.2.4.1 Wash hands, wipe outside of plastic container with cloth that was saturated with germacide.

2.2.4.2 Place container in a sterile plastic bag and place upon table.

2.2.4.3 Wash hands, then dress into clean-room clothing.

2.2.4.4 Place hands into germacide.

2.2.4.5 Air dry hands and put on sterile gloves.

2.2.4.6 Pick up plastic bag with container and electronic card and carry on through air lock to room "C" and deposite same under hood.

2.2.5 Alternate method of carry-in of electronics to be coated and/or encapsulated shall be thru the clean room pass thru window.

2.2.5.1 Inspection and preliminary documentation as per 2.1.1, 2.1.2, 2.1.3, and 2.1.4, shall have been completed.

2.2.6 Remove electronics card from its frame prior to cleaning and/or the decontamination.

2.3 Cleaning and Decontamination. -

2.3.1 Item to be cleaned and decontaminated and its control strip must both be handled, and cleaned, in the same manner and at the same time.

2.3.2 All cleaning and/or decontaminating to be performed under fume hood.

2.3.3 Wash the electronic circuit boards in the areas where soldered connection's have been made. For this operation use xylene and a clean natural bristle brush and brush wash the soldered connections from 10 to 15 seconds.

2.3.3.1 Rinse electronic circuit board in a fresh 85 to 95% isopropanol bath and brush wash with a clean natural bristle brush for approximately 3 minutes.

2.3.3.2 Hang on hanger under hood and allow to drain for five minutes.

2.3.3.3 Place electronic circuit board in any oven that has been preheated to approximately +55° +0° - 5°C and allow board to remain in this environment for five minutes. Upon removing circuit board from oven, if white spots appear on board around the soldered connections, repeat the cleaning procedure as stated; 2.3.3 thru 2.3.3.2.

2.3.4 Place the electronics card and/or connector in a fresh isopropyl alcohol bath. Allow to remain in bath for at least 15 minutes. With rubber gloved hand, grasp edge of card and agitate, with a twisting motion of the wrist at least 3 times during this time period. Remove from bath and proceed as follows.

2.3.5 Hang on hanger under hood and allow to drain for five minutes.

2.3.6 Place electronics card and/or connector into the thermo vacuum chamber and raise temperature to $+55^{\circ} + 0^{\circ}, -5^{\circ}C$.

2.3.6.1 Reduce pressure to 1×10^{-1} mm Hg.

2.3.6.2 Maintain temperature and pressure for a minimum of one hour.

2.3.6.3 Back fill vacuum chamber with dry nitrogen gas.

2.3.6.4 Remove items from chamber with sterile gloved hand and place in sterilized container.

2.3.6.5 Place container under fume hood and immediately prepare for/and conformal coat

2.4 Conformal Coating and Preparation. –

2.4.1 Item to be conformal coated and its control strip must both be handled, cleaned and coated in the same manner and at the same time.

2.4.2 Mask edge of electronic circuit board with Teflon pressure sensitive tape. A lip of 1/16 of an inch from edge on both sides of the card and around its perimeter would suffice.

2.4.3 Handling items with sterile gloves, place in position on turning stand under the fume hood. The turning stand must have been heat sterilized previous to being placed under hood.

Note: Do not conformal coat mother board on the side where the submodule lead wires pass into the mother board. This is to allow for removing submodules in case of failure.

2.4.4 Apply mold release and/or protective covering where called for by the experimenter or cognizant engineer.

Note: Connectors shall not be dipped, poured or spray-coated. They must have mating connector attached and taped so that absolutely no conformal coating enters connector body or, is deposited on its exterior.

2.4.5 Thoroughly saturate electronics card and control strip with conformal coating.

2.4.5.1 Conformal coating must be non-rigid epoxy type such as Biggs #823.

2.4.5.2 The method of saturation shall be by immersion if at all possible. However, repeated pourings, spray gun, or brushing is acceptable if immersion is not possible. Card layouts will determine the correct method.

2.4.5.3 If coating method employed was immersion or pouring the electronics card must first be removed from the turning stand.

2.4.5.4 If coating method employed was spraying the electronics card should remain on the turning stand and be rotated during the spray coating process, see note 2.4.4.

2.4.5.5 Place coated item on turning stand and direct rays from infrared heat lamps on to the coated item.

2.4.5.6 Rotate coated item mechanically until epoxy polymerizes.

Notes: The card temperature is not to exceed 45°C during polymerization time, including exothermic of epoxy. For the - AIMP spacecrafts "D" and "E" the following propotion' of epoxy mix is to be used:

a. Resin (Biggs 823)	50 grams
b. (Versamid 125)	10 grams
c. Allyl Glycidal Ether	15 grams
d. Curing Agent Z (Shell)	3.5 grams

2.5 Cure and Decontamination. – Make entries pertinent to conformal coating on the Conformal Coating and Encapsulation Record Form, 670-24(8/64).

2.5.1 Remove coated electronics card and/or connector from under the fume hood and place in the "Hot Pack" oven that has been preheated to 50°C -0°C +5°C.

2.5.1.1 Allow coated item to remain at this temperature for minimum of 4 hours and then assemble into its frame.

2.5.3 Prior to Assembly into Frame. – Remove one section of coated control strip and place in a sterile petri dish.

2.5.4 Mark "#2" on the outside top cover of petri dish with a green grease pencil, also, date, name of component and the component's serial number.

2.5.5 Place petri dish in the control storage cabinet.

2.5.6 Immediately place the coated item into its container.

2.5.7 Place container with coated and decontaminated item in the storage cabinet set aside for same.

Note: Containers with the coated item enclosed may be moved through clean room area pass through window.

2.6 Encapsulation. –

2.6.1 Electronics card and/or electrical connectors that are to be encased in an encapsulant will be handled as described in this procedure 2.2.4 through 2.2.5.

2.6.2 Item is to be placed directly under fume hood.

2.6.3 Remove one section of control strip and place in sterile petri dish. Mark "#3" on the outside top cover of petri dish with a red grease pencil, also, the date, name of component and its serial number.

2.6.4 Place petri dish in the control storage cabinet.

2.6.5 Cleaning and Decontaminating.

2.6.6 Proceed as outlined in this procedure items 2.3.4 through 2.3.6.3 for electronic cards which have been conformal coated.

2.6.6.1 For electronic cards which have not been coated proceed as outlined 2.3.1 thru 2.3.6.4.

2.6.7 Remove remaining section of control strip.

2.6.8 Encapsulate electronics cards with Eccofoam FPH mix 5 to 8 pounds per cubic foot density.

2.6.8.1 Make entries pertinent to encapsulation on the Conformal Coating and Encapsulation Record Form, 670-24 (8/64).

2.6.9 Place encapsulated electronics card in its container and store in instrument storage cabinet.

Notes: Documentation as outlined, this procedure item 1.4 is to be kept current on a daily basis, and reviewed weekly by section head or his appointee. Copies of Documentation Record Sheets are affixed to this procedure for purpose of information only.

New control strips will be affixed to designated instrument packages after encapsulation with Eccofoam. Sections of these control strips will be removed at various stages of assembly as specified by Project Management and/or the cognizant Project Engineer, Mechanical Systems Branch.

After electronics cards are encapsulated with Eccofoam they will be mechanically integrated into the spacecraft, prior to test phases, under asepsis conditions.

MONITORING AND CONTROL EQUIPMENT RECORD
SPACECRAFT DECONTAMINATION & ASSEMBLY FACILITY

ROOM NO.	TEMP		PRESSURE		HUMIDITY		PARTICLE COUNT		RECORDED BY	DATE
	AM	PM	AM	PM	AM	PM	AM	PM		
B										
C										
D										
E										
B										
C										
D										
E										
B										
C										
D										
E										
B										
C										
D										
E										
B										
C										
D										
E										

MECHANICAL SYSTEMS BRANCH
STRUCTURAL AND MECHANICAL APPLICATIONS SECTION

DECONTAMINATION RECORD

UNIT NAME _____ SERIAL NO. _____

LINE ITEM _____ SPACECRAFT UNIT _____

AT TIME OF CONFORMAL COATING

Condition	Exposure		Bacteria Count						Performed By	Date
			Sample No.							
	Method	Time	1	2	3	4	5	6		
Contaminated										
Decontaminated										

AT TIME OF ENCAPSULATION

Contaminated										
Decontaminated										

IN THE FIELD

Contaminated										
Decontaminated										

CERTIFICATION

SPORE STRIP — Positive Growth ☐

670-27 (8/64) — Negative Growth ☐

Name _____

Title _____

Date _____

MECHANICAL SYSTEMS BRANCH
STRUCTURAL AND MECHANICAL APPLICATIONS SECTION
CONFORMAL COATING AND ENCAPSULATION RECORD

COMPONENT NOMENCLATURE _____

LINE ITEM _____ SERIAL NUMBER _____

ASSEMBLY AND Q.C. RECORD BOOK NUMBER _____ PHOTO. NUMBERS _____

CONFORMAL COATING

Material		Mix in Grams	Method of Coating	Cure		Coated By	Date
				Temp.	Time		
Base							
Diluents							
Hardner							

WEIGHT OF COMPONENT IN GRAMS _____ PERTINENT REMARKS _____

BEFORE COATING _____

AFTER COATING AND CURE _____ _____

POT ☐ REPOT ☐

ENCAPSULATION

Material		Mix in Grams	Cure		Encapsulated By	Date	Weight in Grams	
			Temp.	Time			Before	After
Base								
Catalyst								
Diluent								

POT ☐ REPOT ☐

Base								
Catalyst								
Diluent								

PERTINENT REMARKS _____

_____

_____

670-24(8/64)