ENGINEERING MATERIAL SPECIFICATION

ELECTROPLATING, BRIGHT OR LOW GLOSS DECORATIVE OVER ABS OR PPO PLASTIC - EXTERIOR **ESB-M1P47-C1**

ELECTROPLATING, BRIGHT OR LOW GLOSS DECORATIVE OVER ABS OR PPO PLASTIC - SPECIAL EXTERIOR **ESB-M1P47-C2**

NOT TO BE USED FOR NEW DESIGN

1. SCOPE

These specifications define the performance requirements for finished coatings of mechanically or chemically deposited electrical conductor coat and electrodeposited copper, nickel, and chromium for the decoration and protection of ABS or polyphenylene oxide (PPO) parts.

2. APPLICATION

These specifications were released originally where a bright or low gloss decorative and/or protective finish is required for exterior parts. Unless otherwise specified on the engineering drawing, all parts shall be finished with a final coating of chromium. Two levels of performance are defined as follows:

ESB-M1P47-C1 General exterior - grilles, parking lamp doors, other lighting components.

ESB-M1P47-C2 Special exterior - script, lettering, and intricately designed small parts.

Note: ESB-M1P47-C1 and ESB-M1P47-C2 suffix designations replace ESB-M1P47-A and ESB-M1P47-B respectively.

3. REQUIREMENTS

Material specification requirements are to be used for initial qualification of materials.

3.1 STANDARD REQUIREMENTS FOR PRODUCTION MATERIALS

Material suppliers and part producers must conform to the Company's Standard Requirements For Production Materials (WSS-M99P1111-A).

3.2 APPEARANCE

All parts shall have the finish (bright, low gloss or paint overlay) specified on the engineering drawing. The plated parts shall be free from surface imperfections such as rough or orange peel conditions, crazing, cold shuts, sink marks, weld lines, delamination, splays, pits, slivers, dullness, stains, discoloration, breaks in the plate, and wheel marks or buff lines to the extent required by specifications for the visual inspection of appearance items established by the product engineering office having design responsibility. Low gloss parts shall match the approved Styling master sample for appearance.

Date	Action	Revisions
2006 04 26	Revised	Updated format
2002 08 23	Revised	Updated and Renumbered
1980 12 06	Released	CTK1-DR587040-1

3.2.1 Buffing of Plating

Because of the potential adverse effect on corrosion resistance, buffing of final chromium plating on exterior parts is not permitted. Brushing or other approved mechanical treatment on nickel coatings are permitted provided that minimum plating thickness requirements are met after treatment.

3.3 ADHESION

The plate shall have satisfactory adhesion to the base plastic and show no more separation between the layers of plate than is defined in para 3.6.2.5. Plate adhesion should be tested as follows:

3.3.1 Sawing

Position the part in a vise or holding fixture so that the plated surface is perpendicular to the saw blade and the cutting motion of the blade is in a direction which tends to pull the plating away from the base plastic.

3.3.2 Bending

Any section of the part containing a significant plated surface (para 3.3.1) shall be positioned in a vise or holding fixture and subjected to repeated bending until fracture of the section and the plate occurs.

3.4 PLATING THICKNESS

Minimum plating thickness requirements are shown in para 3.4.3.

3.4.1 Significant Surfaces

All unpainted surfaces visible on a part as assembled in a vehicle or surfaces which can be the source of corrosion products visible on a vehicle are significant surfaces. Except as noted on the engineering drawing, all significant surfaces shall meet the corrosion and plate thickness requirements, as detailed in para 3.3, 3.4, 3.5 and 3.6. (Paint surface requirements are specified in ESB-M2P69).

3.4.2 Plating Thickness Measurement

The optical measurement of copper and nickel deposits on significant surfaces shall be considered the Standard thickness test method (ASTM B 487).

The chromium plate thickness on significant surfaces shall be checked by the spot test as described in ASTM B 556 or by the electronic deplating test, Ford Laboratory Test Method BQ 003-01, Determination of Thickness of Chromium Plate. In case of dispute, Ford Laboratory Test Method BQ 003-01 shall be the umpire method.

3.4.3 Minimum Plating Thickness in (μm) Requirements:

When the supplier cannot meet the C1 minimum plate thicknesses, he may plate to the C2 plating requirements. SQA and the PEO will agree on definition of the leading edge of the specified part. Leading edges are defined as those surfaces which contact a surface plate when the significant surface is placed face down.

ESB-M:	**1P47-C1**	**1P47-C2(a)**
Application:	Exterior	Exterior script, letters and intricately designed small parts.
Copper:	0.0007 (17.8)	0.0007 (17.8)
Nickel: Semi-bright	0.00050 (12.7)	0.00080 (20.3)
(b) Bright or low gloss	--	--
(c) Special nickel (1)	--	--
Special nickel (2)	--	--
Semi-bright, bright or low gloss, and special nickel		
Total	0.00080 (20.3)	0.00160 (40.6)
Chromium:	0.00001 (0.25)	0.00001 (0.25)

(a) Minimum requirements on leading edges of script, lettering and intricately designed small parts. These are considered to be high current density areas. All significant surfaces must be completely covered with copper, nickel and chromium, with no evidence of plating discontinuities in low density areas. Discontinuities can be determined by careful visual examination and will be depicted by a full or matte finish.

(b) Low gloss nickel containing inorganic particles, insoluble in the plating bath, which are co-deposited with the nickel: soluble addition agents which are co-deposited with the nickel; or mechanically applied low gloss treatment of the bright nickel (i.e., brushed or glass bead blasted). When low gloss nickel is specified, the special nickels need not be applied.

(c) Special nickels promote microporosity in the chromium layer.

(1) Bright nickel which contains sub-microscopic non-metallic particles.

(2) Bright nickel which plates around sub-microscopic non-metallic particles on the nickel surface.

Note: Since bright nickel is more highly stressed, its thickness should be kept minimal, sufficient to provide luster. 0.0002 - 0.0003 in (5 - 8 μm) is adequate for this purpose.

3.5 MICROPOROSITY, min 64000 pores/in^2 (10 000 pores/cm^2)
(FLTM BQ 103-06)

3.6 THERMAL CYCLE - CORROSION TEST (UNRESTRAINED)

There shall be no evidence of plating failure on significant surfaces or failure of the plastic due to corrosion in excess of that detailed in 3.6.2.1, 3.6.2.2, 3.6.2.3, 3.6.2.4 and 3.6.2.5 for engineering approval and/or initial sample approval when components are subjected to three complete cycles consisting of the following:

3.6.1 Requirements for Engineering Approval and/or Initial Samples

(1) 82 +/- 2 °C for 2 h
(2) 23 +/- 2 °C for 1 h
(3) -34 +/- 1 °C for 2 h
(4) 23 +/- 2 °C for 1 h
(5) 16 h CASS Test (BQ 105-01)

Note: Parts shall be rinsed with tap water only, after each CASS test cycle. Scrubbing, abrasive cleaning, or polishing is not permitted. Parts are then examined for corrosion defects.

To avoid redundant testing, CASS exposure associated with ESB-M1P47-C1/C2 may be applied to the requirements for CASS exposure as specified in ESB-M2P69.

3.6.2 Plating and Corrosion Defects

3.6.2.1 Cracks and Crazing

Cracks and crazing of the plate are caused by expansion and/or contraction due to temperature change.

The total length of a crack shall be counted in the grid method of determining green corrosion whenever the crack penetrates through the semi-bright nickel layer as evidenced by green corrosion bleed out after one 16 h CASS Test. See para 3.6.2.2 "Grid Method for Evaluation of Defects". Cracks which do not exhibit green corrosion shall not be included in the evaluation.

3.6.2.2 Blistering and Corrosion

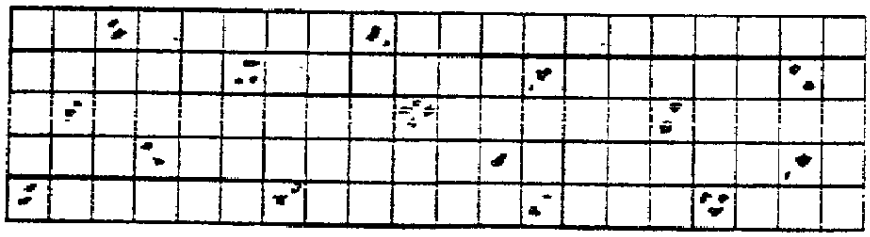
Blisters, defined as "pop-ups", can be caused by improper molding or plating, or result from corrosion.

Failure is to be noted as follows:

- Any blister larger than 1/4 in (6.4 mm) in diameter visible on any significant surface shall be considered failure of the part.
- More than 2.0% blisters (grid method) of the entire significant surface area, including blisters and green corrosion, shall be considered failure of the part.
- 15% or more blisters and corrosion in a grid section containing 100 1/4 x 1/4 in (6.4 x 6.4 mm) spaces placed anywhere on the significant surface (local corrosion) shall be considered failure of the part.

Grid Method for Evaluation of Defects

- A grid is defined as having a surface area of 6.25 in^2 (40.3 cm^2) and is divided into 100 1/4 x 1/4 in (6.4 x 6.4 mm) squares. The dimensions of the grid may vary from 1/4 x 25 in (6.4 x 635 mm) to 2-1/2 x 2-1/2 in (64 x 64 mm).
- For evaluation, the entire significant surface of the part is divided into 1/4 in (6.4 mm) squares.
- If any specific 1/4 in (6.4 mm) square contains one or more defects, that entire 1/4 in (6.4 mm) square is considered to have failed.
- If more than 2% of the 1/4 in (6.4 mm) squares are rated as failures, the part is considered to have failed.
- If more than 15% of the 1/4 in (6.4 mm) squares in single grid sections are rated as failures, the part is considered to have failed.



EXAMPLE OF 15% CORROSION

3.6.2.3 Green Corrosion

Green corrosion results when penetration through the nickel to the copper occurs in a corrosive environment. Copper corrosion products are green in color when CASS tested.

Failure is Noted When:

Any site (hole) larger than 1/16 in (1.6 mm) on any significant surface (not including rundown stain) shall be considered failure of the part.

More than 2.0% corrosion of the entire significant surface area (including rundown stain) shall be considered failure of the part.

15% or more corrosion in any single grid section containing 100 1/4 x 1/4 in (6.4 x 6.4 mm) spaces placed anywhere on the significant surface shall be considered failure of the part.

Note: Green corrosion may be added to blisters for local and overall corrosion ratings.

3.6.2.4 Surface Pitting - Nickel Corrosion

Surface pitting can result when the bright nickel is too reactive with the semi-bright nickel or in the absence of micro discontinuous chromium (micro discontinuous chromium is normally not the cause of nickel pitting).

Any grid area (100 1/4 in (6.4 mm) squares) that contains more than 10 spots 0.048 in (1.22 mm) in diameter or larger shall be considered failed for surface pitting corrosion. Pits less than 0.048 in (1.22 mm) shall be disregarded.

Surface pitting is not rated with blisters or green corrosion as corrosion defects since surface pitting is less objectionable than blisters or green corrosion.

3.6.2.5 Peeling - Plate to Substrate and Plate to Plate

Plate peeling from the substrates is caused by molded-in stresses in the plastic (substrate) resulting from improper molding and/or plating processes. Plate to plate separation is due to plating machine breakdowns, malfunction of rectifiers, improper rinsing, bi-polar effects, etc. Separations sometimes occur between electroless copper or nickel and copper or nickel strikes, strike and copper plate, copper plate and semi-bright nickel, semi-bright and bright nickel, bright nickel and special bright nickel, or within the individual deposits.

Parts shall be examined after Thermal Cycle CASS Test for peeling and blistering (i.e., para 3.6.2.2).

Failure is also to be noted during sawing when the plate peels back from the plastic substrate 1/4 in (6.4 mm) or more or if there is any separation of more than 1/16 in (1.6 mm) between plates. The part shall be bent, twisted, or deformed in any manner (i.e., para 3.3.2).

If there is evidence of lifting between plates or layers of plate, a knife should be used to determine if the bond is poor. Any lifting between plates or within the plate greater than 1/16 in (1.6 mm) shall constitute failure.

3.7 THERMAL CYCLE - CORROSION TEST (RESTRAINED)

At the option of the responsible PEO, the supplier shall provide six approved components which have satisfied the requirements of section 3.6 THERMAL CYCLE - CORROSION TEST (UNRESTRAINED) for testing in the restrained vehicle position using the released production fasteners. Parts will be evaluated by the BEPE Materials Engineering Department and must meet the requirements of para 3.5.1 when tested per the schedule shown below. The initial sample submission is to be considered incomplete for a period up to 60 days or until such time as all requirements of this specification are satisfied.

(1) Mount component in fixture
(2) 3 Thermal cycles, each cycle consisting of:

- 82 +/- 2 °C, 2 h
- 23 +/- 2 °C, 1 h
- -34 +/- 1 °C, 2 h
- 23 +/- 2 °C, 1 h

(3) Dismount component from fixture
(4) CASS test, for 32 h (unrestrained)
(5) Tap water rinse

Parts shall be rinsed with tap water only, after each CASS test cycle. Scrubbing, abrasive cleaning, or polishing is not permitted. Parts are then examined for corrosion defects.

Note: At the option of the responsible PEO, an additional 16 h CASS test cycle may be conducted before the initial mounting of the component for thermal cycle exposure.

3.8 SURFACE FINISH

When the low gloss finish is specified for glare reduction surfaces, the specular gloss of the surface shall not exceed the requirement of specification ESB-M25P2-A. Special nickels are not required in the case of low gloss finishes.

4. GENERAL INFORMATION

The information given below is provided for clarification and assistance in meeting the requirements of these specifications.

4.1 MATERIAL REFERENCE

- Plating Grade ABS Plastic ESB-M4D241
- Plating Grade Polyphenylene Oxide (Modified) ESB-M4D351

4.2 MOLDED PARTS

Plastic parts intended for plating by this specification must be molded in keeping with the best commercial practice to achieve stress free parts and insure good plateability. Molded-in stresses can result in part failure by loss of plating adhesion (blistering) and/or cracking of the plastic and/or plating when subjected to service temperature extremes.

4.3 SAMPLING AND INSPECTION

As specified in Quality Control Specification Q-101 and consistent with the appropriate engineering specification (ES) as released by the responsible design engineering activity.