



DECORATIVE CHROME ELECTROPLATED PART PERFORMANCE REQUIREMENTS, ABS OR PC/ABS SUBSTRATES, GENERAL EXTERIOR USE

WSS-M1P83-E2

1. SCOPE

This specification defines the performance requirements for copper, nickel, and chromium electroplated acrylonitrile butadiene styrene (ABS) and polycarbonate/acrylonitrile butadiene styrene blend (PC/ABS) parts for exterior applications.

2. APPLICATION

This specification was released originally where a decorative chrome finish is required for exterior applications, including, but not limited to, grilles, door handles, badges, belt moldings, and mirror caps.

2.1 LIMITATIONS

No coating (paint, ink, etc.) may be applied over chrome plating per Ford Design Rule OR-010812-0001.

2.2 REFERENCES

Appendix A: Applicable Design Rules
Appendix B: PPAP Report Template
Appendix C: Reference Images
Appendix D: Example SCCAF

3. REQUIREMENTS

This specification is performance based and does not have approved sources.

All requirements identified for this specification must be met to achieve acceptable field durability. No one requirement, exclusive of others, is capable of insuring satisfactory performance. Any deviations to the requirements of this specification may be subject to additional performance requirements.

Testing at Design Verification (DV), Material Color Durability/Compliance Certification (MCDCC), and Process Validation (PV) must be conducted per Table 7. For MCDCC approval, parts from DV and/or PV testing may be submitted in lieu of separate test parts, as long as the quantity of parts per Table 7 is met.

Routine testing for process control shall be conducted per Table 7, or as directed on the Special Characteristics Communication and Agreement Form (SCCAF). An example SCCAF can be found in Appendix D. The required number and frequency of samples may be changed due to part geometry or production concerns and at the discretion of Ford Design and Release Engineering (D&R) and Supplier Technical Assistance (STA).

3.1 APPEARANCE

The plated parts shall be free from surface imperfections and must conform to the color requirements defined by Ford Design Quality, the Ford Color Harmony Team Styling Master and the Approved Boundary Sample.

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2016 12 20	Released		



Documents

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Document Sharing Hub



3.2 MOLDED SUBSTRATES

Material substrates used for exterior plated applications and tested to this specification must be approved to the Approved Source List (ASL) for one of the following Ford Material Specifications:

WSS-M4D836-B1/latest for ABS
WSS-M4D813-B1/latest for PC/ABS

The decision to use either ABS or PC/ABS shall be directed by the part specific Global Material Strategy located at <https://www.edms.ford.com/webtop/drl/objectId/0b00cad9803f607d> and all applicable Ford Design Rules, including those listed in Appendix A.

Part geometry must be conducive to plating, in accordance with all applicable Ford Design Rules, including those listed in Appendix A.

The use of regrind or recycled material for substrates in plated applications is prohibited.

Material must be processed per Global Manufacturing Standard W-IMMS - Control of Plastic Injection Molding Processes, located on the Ford Supplier Portal, STA Global Technical Services, Plastic Molding, https://web.qpr.ford.com/sta/Ford_GTS.html.

The parts shall be smooth and without flow lines, knit lines, visible porosity, cracks, sink marks, or other molding defects which may detract from the part appearance or performance. Molded substrates must also be free of any residual stresses which would impact electroplate adhesion, dimensional stability, or appearance. Mold flow analysis should be conducted to minimize residual stress in molded substrates.

Parting lines, flash and other characteristics of molding may impact part durability and must be minimized. Any rework of parting lines prior to plating must be reviewed and approved by STA before use in the production process. Testing to this standard must be completed on parts with the rework process and submitted to STA for approval.

3.3 FINISHED PARTS

Design Verification testing must be completed on geometrically representative parts plated with the production process. Production Validation testing must be done on actual production parts. Where part dimensions limit testing, or other exceptions exist, substitution of surrogate parts or plaques requires approval of D&R, STA, and Ford Materials Engineering and documentation on the SCCAF.

All visible surfaces of the component, including terminating exterior edges visible after assembly shall conform to the full requirements of this specification, unless otherwise specified in the SCCAF or on the engineering drawing.

Plated test specimens prepared for investigations according to this specification must be aged a minimum of 2 hours at 23 +/- 2 °C prior to testing.

3.4 PROCESS OPTIMIZATION

Process development is to be completed prior to any qualification testing to this specification (DV, PV, etc.). Repetition of these tests may be necessary in order to optimize molding and plating parameters for successful part performance. Once optimization of all parameters is complete, all testing, including tests in Section 3.4, must be conducted at the production parameter levels. Only results of the final tests, with production levels of all parameters, are required to be submitted as part of the PPAP package.



3.4.1 Residual Stress Test

No cracking

Residual stresses in molded plastic parts are areas of potential weak electroplate adhesion.

Testing for residual stress must be conducted for new parts, when any molding parameter changes, or when adhesion issues may be due to molding stress. Repetition of this test may be necessary in order to optimize molding parameters for reduction of molded-in stresses before all additional testing is completed.

Areas with high contrast between light and dark indicate locations of high molded-in stress (Appendix C, Figures 1 and 2). High stress areas should be documented as "adhesion points" or "A-points" in the SCCAF at the direction of the D&R. A minimum of two "A-points" per part must be indicated. All subsequent adhesion testing per Section 3.5 must be conducted at these locations.

Completely immerse the unplated part in glacial acetic acid, 99% purity, at 23o C +/- 3 °C for 30 seconds. Remove and immediately rinse the part with water to remove acid from the surface and allow to dry at room temperature. Review and photograph the part, noting any areas of uneven whitening.

Return the part to the glacial acetic acid bath for up to the duration indicated by Table 1 below.

Table 1: Glacial Acetic Acid Test Time

Substrate	Time
ABS	120 seconds
PC/ABS	180 seconds

After the specified time has elapsed, immediately rinse the part with water to remove acid from the part surface and allow to dry at room temperature. Review and photograph the part again, noting any areas of uneven whitening.

Report must include photos of the part before testing, after 30 seconds, and after 120-180 second durations. These photos must be retained for process control validation of the optimized molding process.

3.4.2 Scanning Electron Microscopy (SEM)

Report Only

In order to document the level of etch obtained on the surface of successfully tested parts, PV testing submissions must include SEM images at 500X magnification of the etched, unplated plastic surface. Images should be taken in high and low stress areas (whitened and dark areas), as determined by the Residual Stress Test in Section 3.4.1.

Examples of under-etched, over-etched and properly etched surfaces can be seen in Appendix C, Figures 3, 4 and 5, respectively.

Improper molding of the part may cause elongated etch sites, which reduce adhesion of the electroplate to the substrate. An example of this condition can be found in Figure 6.



3.4.3 Simultaneous Thickness and Electrochemical Potential Test (STEP) (ASTM B764)

The graph of the STEP test, along with the calculated difference of potentials shall be provided with the submission package. An example STEP curve can be found in Appendix C, Figure 7.

3.4.3.1 Semi-bright nickel to decorative nickel 100 mV min

3.4.3.2 Discontinuous nickel to decorative nickel 20 – 90 mV

3.4.4 Minimum Discontinuities (ASTM B604, X4)

Exterior applications require a discontinuous chromium layer (microporous or microcracked) on a multiple layer nickel system. Microporous systems are the preferred method for corrosion resistance of plastic parts. Microcracked system usage should be limited and pre-approved by the D&R and Materials Engineering.

The active sites method shall be the preferred method used to determine microporosity. Images at proper magnification taken before and after CASS exposure must be recorded.

For Satin finishes, the active sites method and a SEM must be used to determine microporosity.

Evaluation of microcracks may be done directly by counting the cracks that intersect a straight line with length of at least 1 mm with a microscope at 100X and calculating to the appropriate units.

Plating sources are required to maintain minimum discontinuities as defined in Table 2.

Table 2: Minimum Discontinuity Quantities

Type	Minimum Discontinuity
Micropores	10,000 pores/cm ²
Microcracks	250 cracks/cm

Micrographs used for determination of discontinuities and the calculated values must be included in submissions. Example images of discontinuities are available in Appendix C, Figures 8, 9, 10, and 11.

3.4.5 Minimum Plating Thickness (ASTM B487, ASTM B504, ASTM B568)

Minimum plating thicknesses are defined in Table 3. For typical plating construction, refer to Appendix C, Figure 12.

Plating thickness should be optimized prior to PV testing to ensure all requirements of the specification are met. To achieve this, electroplated part suppliers must identify the plating thickness distribution for each unique part and rack design by mapping the system per Ford Design Rule CPG10801-0032. An example of a single layer analysis of chromium can be found in Appendix C, Figure 13. The plating thickness distribution must be examined for both the production rack and the production part geometry for each plating layer. This process is used to demonstrate that the minimum metal plating thicknesses can be obtained for the entire part or to alert Ford to any potential metal thickness concerns. The use of auxiliary anodes is recommended, where applicable.



Areas of low and high thickness must be documented in the SCCAF on a part and rack level as "pick points", and submitted to the D&R as part of DV. The lowest thickness part shall also be documented on the SCCAF.

Areas with exceptions to the minimum metal thickness requirements must be approved in writing by the D&R and shown in detail on the SCCAF. Formal deviation is not required. Details must include the area or areas below the minimum and the allowed thickness exception for each. An example of a documented exception can be found in the example SCCAF, Appendix D, item number 2. Parts with these exceptions must meet all other applicable specification and SDS/CDS requirements.

Copper and nickel layer thickness to be determined by Microscopic Examination (ASTM B487). Chromium layer thickness to be determined by Coulometric Method (ASTM B504), or X-Ray Spectrometry (ASTM B568).

Table 3: Plating Layer Minimum Thickness Requirements

Plating Layer	Minimum thickness (µm)
Copper	18
Semi Bright Nickel	15
Decorative Nickel	6
Microporous Chromium	0.18
Microcrack Chromium	0.8

The percent of the total nickel thickness which is composed of semi-bright nickel and decorative nickel shall be as indicated in Table 4.

Table 4: Percent of Semi-Bright to Decorative Nickel

Nickel Type	Percent of Total Nickel
Semi Bright Nickel	At least 60%
Decorative Nickel	No more than 40%

3.5 PLATING ADHESION

All adhesion testing must be completed on the part at the "A-points" in areas of high stress as indicated by Section 3.4.1, Residual Stress Test, unless otherwise noted. Where a single part is produced by multiple cavities, testing at PV must be completed on parts molded from the tool cavity that produces the highest stress conditions, as determined by Section 3.4.1.

3.5.1 Grind-Saw Test (ASTM B571, with modifications below)

Testing will be performed using a handheld hacksaw with 6-8 teeth/cm, cutting from the substrate toward the plating. The cut will be made with the plane of the saw 90 degrees to the test area and the blade angled at 45 degrees towards the part (visual representation in Appendix C, Figure 14). A minimum 5 cm cut shall be made at a rate of approximately 1 stroke per second. If part geometry doesn't allow the minimum cut length, the part shall be cut at the maximum length possible. Bandsaws shall not be used for this test.

Testing shall be completed in both "A-points" per Section 3.4.1, and in high thickness "pick points" per Section 3.4.5.



All tested samples must indicate no evidence of peeling, flaking, or lifting of the electroplate from the substrate or between the plating layers. The approving Ford engineer should attempt to peel the plating away from the cut edge with a sharp blade to further evaluate the propagation of adhesion loss.

3.5.2 Peel Strength of Metal Electroplated Plastics
(ASTM B533, Procedure A, except production plating layers on parts)

ABS	9.0 N/cm curve ave min 7.0 N/cm curve low min
PC/ABS	4.5 N/cm curve ave min 3.5 N/cm curve low min

Testing shall be completed on a flat section of the part. If no large flat area exists, or if part size prohibits full peel size, a strip of minimum 1 cm X 5 cm can be substituted. The resulting values must then be calculated to match the units of the requirement. Testing must be conducted on as large of an area as possible.

For each Peel Strength graph, discard the beginning and breaking point of the curve. The average of this center section must meet the curve average minimum requirement. No data point in the center section of the peel curve shall be below the curve low minimum requirement. Average and low values must be reported for each curve. Test curves must be provided with results. An example curve can be found in Appendix C, Figure 15.

Where part geometry or size prohibits suitable Peel Strength testing, results will be substituted with additional test samples of 3.7 Extreme Thermal Cycle, as directed by Table 7.

3.6 CHIP RESISTANCE

Tested specimens should be taken from low plating thickness areas as identified in Section 3.4.5.

- | | | |
|-------|---|---------------|
| 3.6.1 | Test for Chip Resistance of Surface Coatings
(SAE J400, 1.4 L, -20 C +/- 2 °C and 23 +/- 2 °C) | Rating 5B min |
| 3.6.2 | High Performance Stone Chip Resistance
(FLTM BI 157-06) | Rating 6 min |

All tested samples must indicate no evidence of peeling, flaking, chipping, or lifting of the electroplate from the substrate or between the plating layers.

3.7 EXTREME THERMAL CYCLE

Thermal cycling must be completed on individual, unassembled, chromed parts, such as single grille bars. Temperatures to be used for Extreme Thermal Cycles are described in Table 5. Temperature changes must be completed within one minute. Testing will consist of 10 cycles of the following:

- 1 hour at Extreme Low Temperature
- 1 hour at Extreme High Temperature

After completing the indicated cycles, the part shall show no degradation of part appearance. There shall be no evidence of plating failure, warpage, sink marks, deformation, cracks, blistering, or delamination.