DECORATIVE CHROMIUM PLATING - COPPER, NICKEL, CHROMIUM TYPE

GM4372M GM4373M GM4374M

1 SCOPE. These specifications cover basic requirements for electroplated parts of the copper-nickel-chromium type as used on steel, zinc die cast, copper based alloys, and plastic components, and wrought, die-cast or forged aluminum and aluminum alloys, excluding wheels.

1.1 GM4372M and GM4374M are intended for exterior parts and provide 2 levels of corrosion protection. GM4374M provides corrosion protection for severe service conditions that include likely damage from denting, scratching and abrasive wear in addition to corrosive environments such as encountered by automotive bumpers and related components. This specification differs from GM4372M in that it requires a longer corrosion (CASS) exposure. GM4372M provides corrosion protection for corrosive environments which receive little additional mechanical abuse. Both specifications require the use of discontinuous chromium plate in addition to a multiple layer nickel system.

1.2 GM4373M is intended for interior applications. It does not require the use of discontinuous chromium or multiple layer nickel systems.

1.3 When specifying chromium plating on aluminum, a coating must be applied to all of the non-significant surfaces which do not receive a full complement of plate and are exposed to severe corrosive environments. Aluminized wax or other corrosion protective coatings are recommended.

2 REFERENCED STANDARDS.

GM4260P	ASTM B456	ASTM B764
GM9071P	ASTM B487	
ASTM B368	ASTM B571	

3 REQUIREMENTS.

3.1 PLATING THICKNESS. Shall be determined by the microscopic method (ASTM B487) or the electrochemical method of GM4260P. In case of disagreements between purchaser and supplier, the microscopic method shall be the preferred method.

3.1.1 Minimum plate thickness as specified in Table 1 is intended to apply to all low current density and high current density areas of significant surfaces as specified on appropriate part drawings or as otherwise agreed upon between purchaser and supplier. Such surfaces are those normally visible - directly or by reflection - on the finished part when assembled in car position, or which can be the source of corrosion deposits that deface visible surfaces on the assembled vehicles.

3.1.2 The multiple layer nickel thickness consisting of at least 2 layers of electro-deposited nickel shall be a minimum of 60% semibright nickel, except when high activity nickel strike is used between the semibright and bright nickel layers, then the semibright thickness shall be a minimum of 40%.

3.1.3 Minimum thickness and corrosion resistance performance requirements for textured finishes (matte, vapor blast, brush, etc.) apply after texturing.

3.1.4 Exceptions to the minimum plating thickness are generally shown as a detail on the part drawing by either designating plating checkpoint(s) or by indicating in an appropriate view the area(s) with deviated thickness(es) allowed. These exceptions must still meet the specified number of corrosion test hours.

3.2 NICKEL ELECTROCHEMICAL POTENTIAL (GM4372M AND GM4374M ONLY). Determine potential difference following ASTM B764.

3.2.1 The bright nickel layer shall exhibit an anodic electrochemical potential difference of 100 mV minimum to semibright nickel on all significant surfaces. Conformance to this requirement shall be determined with 99% confidence (3 sigma) using appropriate statistical charting techniques on a routine quality control basis.

3.2.2 The maximum electrochemical potential difference between the microparticulate nickel layer and the bright nickel on all significant surfaces of all substrates is 20 mV.

3.3 DISCONTINUOUS CHROMIUM. Shall be performed by either the copper deposition (Dubpernell) method or by the determination of active corrosion sites after corrosion testing. Both are described in the appendix of ASTM B456. In the case of an active sites determination, compare the viewed sample at 100X to the pore density charts shown in Appendix A of this specification to determine pore count.

3.3.1 The microdiscontinuous chromium surface shall exhibit a minimum of 10 000 pores/cm^2 as determined by copper deposition or 2000 pores/cm^2 as determined by active sites.

3.4 CORROSION RESISTANCE. Shall be determined by the CASS test, ASTM B368, according to the number of hours specified in Table 1.

3.4.1 Plated components shall be free of corrosion on all significant surfaces when examined at normal reading distance with the unaided eye and uniform diffused light.

3.5 ADHESION. Plated metallic components shall be subjected to the Saw-Grind Test, ASTM B571, with no evidence of lifting or peeling either between plated layers or the plate and the substrate.

3.5.1 Plated plastic parts shall be subject to the thermal cycling test described below. At the conclusion of the test sequence the plated part shall show no deformation, crazing, blistering, splitting, or loss of adhesion to the substrate or loss of adhesion between individual layers of the plated metal.

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3.5.2 The thermal cycling test shall be performed as follows:

(a) When corrosion test is specified, expose part for 22 h minimum CASS prior to Step (b). When corrosion test is not required, completely immerse part in water maintained at 38 ± 1.5°C for 22 h prior to Step (b).
(b) Mount part in a restrained position simulating in service usage. One hour maximum is allowed between end of Step (a) and start of Step (c).
(c) Expose part for 1 h min at –30 ± 1.5°C.
(d) Expose part for 15 minutes minimum at 25 ± 5°C.
(e) Expose part for 1 h min in an air circulating oven at 85 ± 1.5°C.
(f) Expose part for 15 minutes minimum at 25 ± 5°C.
(g) Steps (c) thru (f) constitute 1 thermal cycle. Repeat Steps (c) thru (f) 3 additional times for a total of 4 cycles. Examine part per the requirements in 3.5.2 after each cycle.
(h) For parts not completely enveloped with electroplate, following the fourth cycle, scribe an X through the plating at the stop off demarcation into the basic material; place pressure sensitive adhesion tape, as described in GM9071P, approximately 20 mm wide over the X (leaving sufficient length of tape to grasp between fingers for quick removal); quickly pull tape at approximately 90 degrees to the surface of part to remove entire strip. Examine for evidence of lifting of electroplate.

4 SAMPLING. Methods of sampling and resampling, and the basis of rejection, shall be subject to mutual agreement of supplier and purchaser. The number of samples to be selected and the frequency of selection will, in general, depend upon the number of pieces plated.

5 INITIAL SOURCE APPROVAL. No shipment shall be made by any supplier until representative initial production samples have been approved by engineering as meeting the requirements of this specification.

5.1 Completed copies of the GM Material Safety Data Sheet and Critical Material Register (available from the engineering department or laboratory), or equivalent, must be submitted with any new submissions or where a composition change has occurred.

6 INSPECTION AND REJECTION. All shipments of material or parts under contract or purchase order manufactured to this specification shall be equivalent in every respect to the initial samples approved by engineering. There shall be no changes in either formulation or manufacturing processes permitted without prior notification and approval by engineering. Lack of notification by the supplier constitutes grounds for rejection of any shipment. While samples may be taken from incoming shipments and checked for conformance to this specification, the supplier shall accept the responsibility for incoming shipments meeting this specification without dependence upon purchaser's inspection.

7 APPROVED SOURCES. Engineering qualification of an approved source is required for this specification. Only sources listed in the GM Corporate Materials File under this specification number have been qualified by engineering as meeting the requirements of this specification. Sources are available through the on-line MATSPC System.

8 GENERAL INFORMATION. This standard was first issued in September 1962. The latest revisions include:

Rev.	Date	Description
E	7/89	Complete revision
F	4/92	Revision to add Aluminum Substrates

DECORATIVE CHROMIUM PLATING - COPPER, NICKEL, CHROMIUM TYPE
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TABLE 1

GM Number	Basic Material (Part)	Minimum Thickness Significant Surface				Minimum Corrosion Resistance
		Total	Copper	Nickel	Chromium (NOTE 3)	
		µm	µm	µm	µm	h
GM4374M	Steel	40	Optional (NOTE 2)	30	0.25	44 (CASS)
	Zinc	40	10	30	0.25	
	Copper	40	10 (NOTE 5)	30	0.25	
	Aluminum (NOTE 6 & 7)	50	10	40	0.25	
GM4372M	Steel	38	Optional (NOTE 2)	20	0.25	22 (CASS)
	Zinc	38	10	20	0.25	
	Copper	38	10 (NOTE 5)	20	0.25	
	Plastic	38	10	20	0.25	
	Aluminum (NOTE 6 & 7)	50	10	40	0.25	
GM4373M (NOTE 1 & 4)	Steel	13	Optional (NOTE 2)	8	0.25	
	Zinc	13	5	8	0.25	
	Copper	13	5 (NOTE 5)	8	0.25	
	Plastic	20	10	8	0.25	
	Aluminum (NOTE 6)	13	5	8	0.25	

NOTE 1: For nonwear interior parts, minimum chromium thickness may be 0.13 µm, if authorized by purchaser. Approval is indicated by addition of symbol (B) to the specification number; e.g. "GM4373M(B)."

NOTE 2: Copper may be used but not required. If not used at supplier option, then nickel must be used to meet the total plate thickness requirement. When copper is not used when plating steel substrates to GM4372M or GM4374M requirements, the total minimum thickness is reduced to 30 µm.

NOTE 3: Chromium thickness should be limited to 0.4 µm to preclude overlaying the microparticulate nickel pores if used. The use of chromium deposits from trivalent chromium baths is not permitted unless otherwise specified on the detail drawing.

NOTE 4: Tin Cobalt alloy may be used in lieu of chromium when symbol (K) is added to the specification number, e.g. "GM4373M(K)".

NOTE 5: For cloisonné type substrates, copper is optional.

NOTE 6: Suitable pretreatment processes must be developed for each type of alloy and processes of manufacture of the alloy. All pretreatment of aluminum processes must pass all visual adhesion and corrosion resistance properties as specified prior to production on each type of alloy and each type of manufacturing process of aluminum.

NOTE 7: All plated components must receive an aluminized wax or other corrosion-resistant coating on nonsignificant surfaces unless otherwise specified on the drawing.

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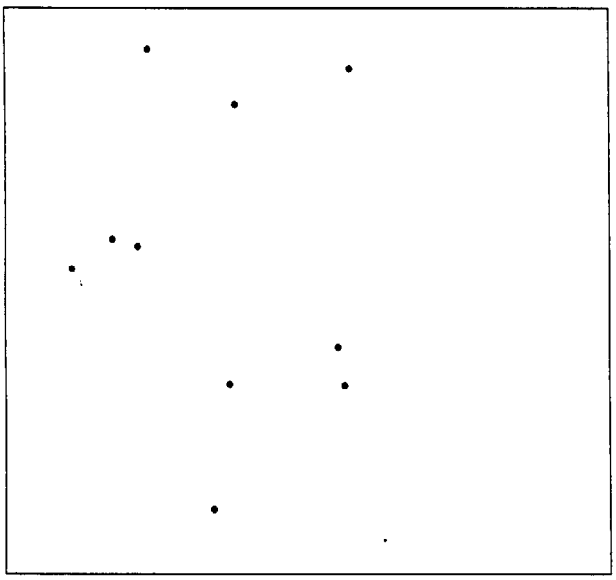
GM4372M GM4373M GM4374M

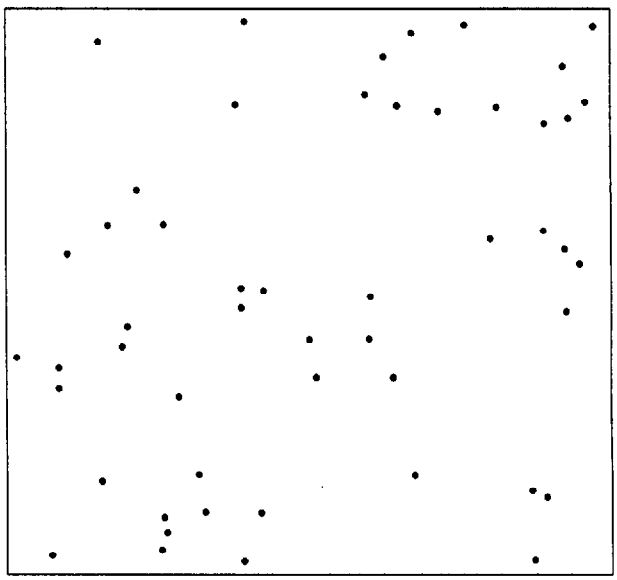
APPENDIX A

APPENDIX – PORE DENSITY CHARTS (1mm BY 1mm)

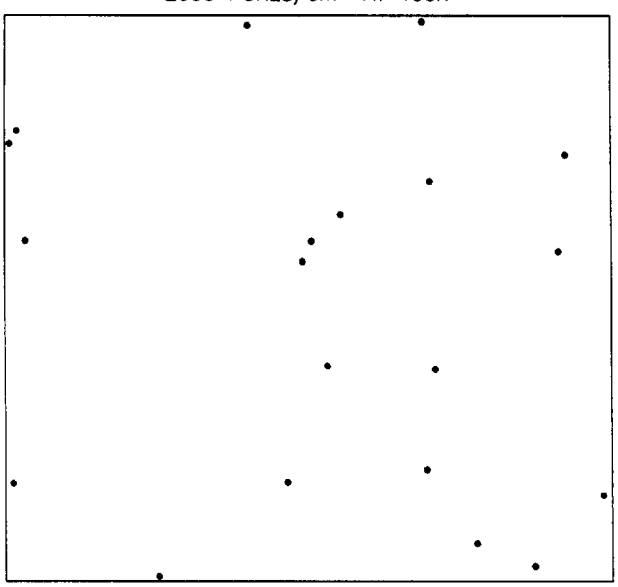
1000 PORES/cm² AT 100X



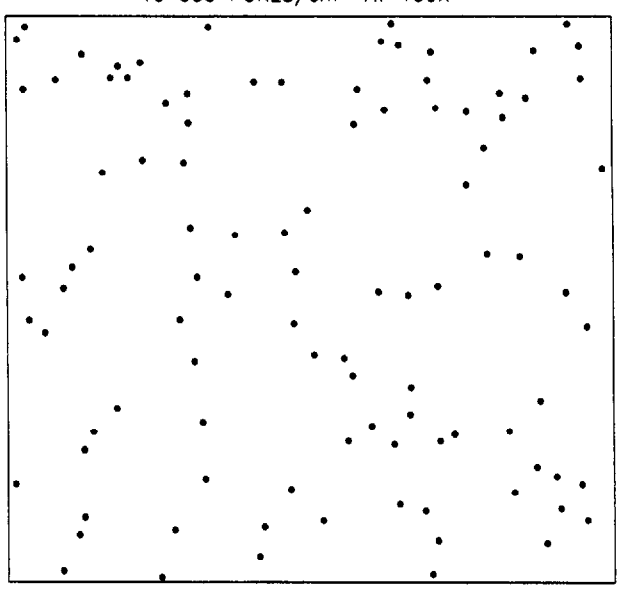
5000 PORES/cm² AT 100X



2000 PORES/cm² AT 100X



10 000 PORES/cm² AT 100X



4372–A01(4/92)

4372–A02(4/92)

Procedure For Evaluating Parting Lines

1 Scope

This specification covers the evaluation method for determining the acceptability of parting lines on interior trim, visible or customer contact plastic parts.

Note: Nothing in this test method supersedes applicable laws and regulations unless a specific exemption has been obtained.

Note: In the event of a conflict between the English and domestic language, the English language shall take precedence.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None.

2.2 GM Standards/Specifications.

None.

2.3 Additional References.

Boundary Sample Process,
www.supplypower.com

NAO 4425, Styling Verification Form, Interior Department

3 Test Equipment

Digital Calipers / Feeler Gages

Silver paint

4 Test Material

Production tooled finished molded parts shall be evaluated.

Approvals to grain cavities evaluations are based on injection-molded parts from production tooling not based on reviews of tooling nor cold pour impressions from tooling.

5 Test Method

5.1 Summary of Test Method. Visually inspect interior trim, visible or customer contactable parts for parting line condition.

5.2 Test Sample Preparation. Production molded parts are painted silver by GM Interiors Dept.

5.3 Test Procedure. Parts should be viewed installed in a vehicle or buck. If a property is not available the part may be evaluated by holding it to approximate installed position.

6 Evaluation and Rating

6.1 Evaluate tool half mismatch, flash and texture location. See Figure 1.

6.2 On tactile parts no tool half mismatch is acceptable. Tactile surfaces examples are inside remote handles, knobs, switches and buttons.

6.3 Tool half mismatch less than or equal to 0.05mm or .002 in. is acceptable. Tool half mismatch greater than 0.05 mm or .002 in. is not acceptable.

6.4 Flash is not acceptable.

6.5 All parts must be texture free on both sides of the parting lines for a distance of 0.010 in.

6.6 The part submission and evaluation procedure is repeated until all issues are in agreement.

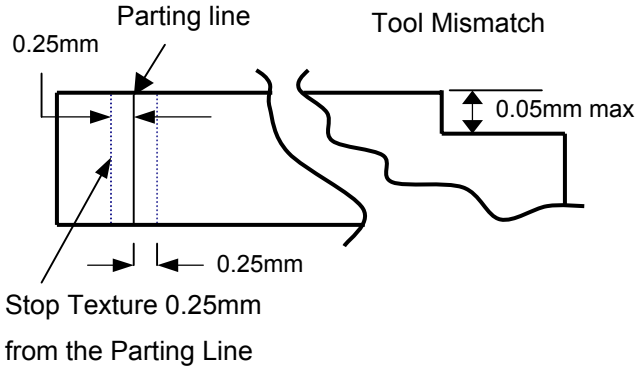


Figure 1: Parting Line and Tool Mismatch Requirements

7 Report

Approval of textured tool cavities and inserts based on reviews of production injection molded parts will be authorized on the Styling Verification Form (NAO 4425) issued by the Interior department. Boundary samples will be maintained as specified by the Supplier Quality departments Boundary Sample Process (www.supplypower.com).

8 Safety

This method may involve hazardous materials, operations and equipment. This method does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

9 Coding system

This material specification shall be given in other documents, drawings, VTS, SSTS, CTS etc. as follows:

Test to: GM9684P

Where

GMN = Validation Area (North American)

GMN# = Base Test Method Specification

10 Release and Revisions

10.1 Release. This test method originated in October 1993 and was approved by IPP Committee and Midsize Car Division in June 1994. It was first published in July 1994.

10.2 Revisions.

Rev	Approval Date	Description (Organization)
A	June 2003	Revised acceptance criteria for interior trim, customer interface parts to allow no parting line mismatch, offset or flash based on request by Interior Center to support Perceived Quality Initiatives. (IPP)

GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification Finish	GMW14668

Minimum Performance Requirements for Decorative Chromium Plated Plastic Parts

1 Scope

This specification covers basic requirements for copper-nickel-chromium electroplated plastic parts, including assemblies.

1.1 Material Description. Platings to this specification are intended for interior (code A) and exterior (code B) application with two levels of corrosion protection. For exterior applications discontinuous chromium plate (microporous (mp) or microcracking (mc)) in addition to a multiple layer nickel system shall be used. Interior applications do not require the use of discontinuous chromium or multiple layer nickel systems. For interior application non discontinuous chrome (r) is permissible. Exterior plastics plated to this specification are further subdivided into application types: Type 1 which receives little or no stone chipping exposure on a vehicle, and Type 2 which is exposed to significant chipping. Type 2 includes significant surfaces of plated plastic parts attached to forward-facing vehicle areas or to vehicle areas subject to self-generated stone chipping (as defined by ≥ 15 degree impingement of straight line projection from tire). If no type is listed on detail drawing, Type 2 is assumed.

1.2 Symbols. Not applicable.

1.3 Typical Applications. This type of finish shall be principally used for decorative purpose. Bright and other (e.g., satin, brushed, grained) appearances for interior and exterior plastic applications, as defined by styling and specific appearance standards.

1.4 Remarks. Not applicable.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ASTM B368	DIN 50021
ASTM B456	ISO 1463
ASTM B571	ISO 2177
ASTM D764	ISO 3497

2.2 GM Standards/Specifications.

GMW3001	GMW14458
GMW3059	GMW14700
GMW3286	GMW14829

3 Requirements

3.1 Requirements on Delivery

3.1.1 Chemical Requirements. Not applicable.

3.1.2 Physical Requirements. Not applicable.

3.1.3 Mechanical Requirements.

3.1.3.1 Plating Thickness. Shall be determined by the microscopic method (ISO 1463) or the electrochemical method (ISO 2177), or by X-Ray method (ISO 3497). In case of disagreements between purchaser and supplier, the microscopic method shall be the preferred method.

3.1.3.1.1 Minimum plate thickness as specified in Summary Table, Table B1 is intended to apply to all low current density and high current density areas of significant surfaces as specified on appropriate part drawings or as otherwise agreed upon between purchaser and supplier (written statement). Such surfaces are those normally visible - directly or by reflection - on the finished part when assembled in car position, or which can be the source of corrosion deposits that deface visible surfaces on the assembled vehicles. If corrosion products are visible anywhere on a finished & dressed component in vehicle position, this specification is not met.

3.1.3.1.2 For systems with a total nickel layer thickness ≥ 20 microns, multiple layer nickel thickness consisting of at least 2 layers of electro-deposited nickel shall be as indicated in Table 1.

3.1.3.1.3 Exceptions to the minimum plating thickness are generally shown as a detail on the part drawing by either designating plating checkpoint(s) or by indicating in an appropriate view the area(s) with deviated thickness(es) allowed. These exceptions must still meet the specified number of corrosion test hours.

Table 1: Nickel Thickness

	Thickness Relative to Total Nickel Thickness	
Type of Nickel Layer	Double Layer	Triple Layer
Bottom (semi bright)	60 to 80% Note 1	50 to 70%
Middle (high-S)	Not applicable	≤ 10%
Top (bright)	20 to 40%	≥ 30%

Note1: If the total nickel layer thickness is < 20 microns, the semi bright thickness shall be 50% minimum.

3.1.3.1.4 Minimum thickness and corrosion resistance performance requirements for textured finishes (matte, vapor blast, brush, etc.) apply after texturing.

3.1.4 Additional Requirements.

3.1.4.1 Substrate / Molded Part.

3.1.4.1.1 Substrate type. Only for plating approved and designed substrates shall be used. Main types see Table 2.

Table 2: Substrate Types

Substrate Type	Max Temp.
ABS	+90 ± 3°C
ABS / PC	+110 ± 3°C
PC, PA6, PA66 - MF (10 to 40)	+120 ± 3°C
PA6, PA66 - GF (10 to 30)	+130 ± 3°C

3.1.4.1.2 Substrate Structure. Parts shall demonstrate no defects like cracks or shrink holes. Parts shall be free of internal tension, which may influence adhesion or appearance of the galvanic coating.

3.1.4.1.3 Surface properties. The surface shall be smooth, free of flow lines, cracks, sink marks, craters or substrate separations, which may influence the appearance. Surface shall also contain no oil/fat or any human sweat from handling. In the tool no separation agents may be used, also parts may not be mechanically polished or sanded before plating.

3.2 Processing Requirements.

3.2.1 Chemical Requirements. Not applicable.

3.2.2 Physical Requirements. Not applicable.

3.2.3 Mechanical Requirements.

3.2.3.1 Nickel Electrochemical Potential (only exterior parts). Determination of potential difference following ASTM B764.

3.2.3.1.1 The bright (or satin) nickel layer shall exhibit an anodic electrochemical potential difference of 100 to 200 mV to semi bright nickel on all significant surfaces. The supplier must demonstrate the conformance to this requirement by using appropriate statistical charting techniques on a routine quality control basis.

3.2.3.1.2 The micro particulate nickel layer shall exhibit a cathodic electrochemical potential difference of 10 to 40 mV to the bright or satin nickel on all significant surfaces of all substrates.

3.2.3.1.3 If a micro cracking system is used, usually no microparticulate electrochemical potential difference is measurable.

3.2.3.1.4 The optional “high activity nickel strike” layer shall exhibit an anodic electrochemical potential difference of 15 to 40 mV to the bright nickel layer.

3.2.3.2 Discontinuous Chromium, shall be performed by either the copper deposition (Dubpernell) method or by the determination of active corrosion sites after corrosion testing. Both are described in the appendix of ASTM B456. In the case of an active sites determination, compare the viewed sample at 100X to the pore density charts shown in Appendix A of this specification to determine pore count.

3.2.3.2.1 Microporous System (mp). The microdiscontinuous chromium surface shall exhibit a minimum of 10 000 pores/cm^2 as determined by copper deposition or 2000 pores/cm^2 as determined by active sites per ASTM B456 Appendix X4 or X5.

3.2.3.2.2 Microcracking System (mc). The cracked chromium surface shall exhibit 250 to 800 cracks/cm and provide a closed homogenous network in all directions.

3.2.4 Additional Requirements. Not applicable.

3.3 Performance Requirements.

3.3.1 Chemical Requirements. Not applicable.

3.3.2 Physical Requirements.

3.3.2.1 Adhesion.

3.3.2.1.1 Saw Grind Test. Plated plastic components shall be subjected to the Saw-Grind Test, ASTM B571, with no evidence of lifting or peeling between plated layers. Place pressure sensitive adhesion tape, as described in GMW14829. approximately 10 to 20 mm wide over the cut edge (leaving sufficient length of tape to grasp between fingers for quick removal); quickly pull tape at approximately 90 degrees to the surface of part to remove entire strip. Examine for evidence of lifting of electroplate.

3.3.2.2 Temperature Storage. All parts shall be temperature tested for 6 ± 0.5 h. Temperatures see below. Test pieces shall show no surface changes, adhesion loss or other changes which reduce the performance and shall comply with specified drawing requirements after test.

3.3.2.2.1 If not defined separately all parts will be tested to the following temperature: +90 ± 3°C

3.3.2.2.2 For high temperature application areas e.g., engine compartment the substrate has to be selected to suit requirements. Test temperature: +110 ± 3°C. This must be indicated on the drawing.

3.3.2.3 Temperature Cycle. All plated plastic parts interior and exterior shall be subject to the thermal cycling test described below. At the conclusion of the test sequence the plated part shall show no deformation, crazing, blistering, splitting, or loss of adhesion to the substrate or loss of adhesion between individual layers of the metal plating layers.

3.3.2.3.1 Cycle A.

The thermal cycling test shall be performed as follows:

a. When corrosion test is specified, expose part for 24 ± 1 h CASS prior to Step (b). Note for LAAM non export vehicles only, it is optional to replace 24 ± 1 h CASS with 72 ± 1 h NSS. When corrosion test is not required, completely immerse part in water maintained at 38 ± 1.5°C for 22 h prior to Step (b).

b. Mount part in a restrained position simulating in service usage. One (1) h maximum is allowed between end of Step (a) and start of Step (c).

c. Expose part for 1 h min at -30 ± 1.5°C.

d. Expose part for 15 minutes minimum at 25 ± 5°C.

e. Expose part for 1 h minimum in an air circulating oven at 85 ± 1.5°C.

f. Expose part for 15 minutes minimum at 25 ± 5°C.

g. Steps (c) thru (f) constitute 1 thermal cycle. Repeat Steps (c) thru (f) 3 additional times for a total of 4 cycles. Examine part per the requirements in 3.3.2.3 for evidence of electroplate adhesion loss after each cycle.

h. After completion of thermal cycle step (g), expose part for 24 ±1 h CASS. Note for LAAM non export vehicles only, it is optional to replace 24 ± 1 h CASS with 72 ± 1 h NSS.

i. For parts not completely enveloped with electroplate, following the fourth cycle, scribe an X through the plating at the stop off demarcation into the basic material. Place pressure sensitive adhesion tape, as described in GMW14829 approximately 20 mm wide over the X (leaving sufficient length of tape to grasp between fingers for quick removal). Quickly pull tape at approximately 90 degrees to the surface of part to remove entire tape strip. Examine for evidence of lifting of electroplate.

3.3.2.3.2 Cycle B. The test piece shall be subjected 3 temperature cycles before the corrosion test one cycle consists of temperatures listed below.

a. 22 ± 1 h at +80 ± 3°C followed by

b. 2 h ± 10 minutes at -20 ± 3°C.

Immediately upon removal from the refrigerator test piece shall be subjected to one of the following impact tests:

Test pieces having a weight of ≤ 440 g shall be dropped in the cold condition from a height of ≈ 1 m onto a hard (stone-)floor.

Test pieces weighing > 440 g:

A ball of diameter 50 ± 1 mm and a mass of 550 ± 50 g shall be dropped from a height of ≈ 80 cm onto the center of the cold test piece, placed on a hard (stone-)floor. In case of curved test pieces care shall be taken that the test piece is supported on the intended attachment areas.

Immediately following to above the first 3 cycles, the test piece shall be further subjected to the test cycle listed below.

a. 1 h ± 5 min at +60 ± 3°C followed by

b. 1 h ± 5 min at -40 ± 3°C.

This test cycle shall be repeated two further times, 3 cycles total.

3.3.2.4 Stone Chipping. Exterior parts (B) & Type 2 for component validation only. Significant surfaces of the plated component shall be sectioned. For EU platings the chip resistance tests per GMW14700 is performed followed by a thermal cycle (as described under 3.3.2.3) plus 48 hours CASS after chip test with no adhesion loss (plating separation from substrate) and no blistering (visible as distorted reflection) larger than 5 mm diameter at chip site is allowed. For US platings CASS and Thermal cycle are performed after chip testing. This additional test only applies to adhesion assessment, not to corrosion. Other performance criteria in paragraph 3.3.2.3 apply away from chip sites.

3.3.3 Mechanical Requirements.

3.3.3.1 Corrosion Resistance. Shall be determined by the CASS test, GMW14458 ASTM B368/DIN 50021(CASS), according to the number

of hours specified in the Summary Table, Table B1. Note for LAAM non export vehicles only, it is optional to replace the CASS test with the NSS test, GMW3286, according to the number of hours specified in the Summary Table, Table B1. Plated components shall be free of any surface defects an free of corrosion on all significant surfaces when examined at normal reading distance 0.5 ± 0.1 m with the unaided eye and uniform diffused light.

3.3.4 Additional Requirements. Not applicable.

4 Manufacturing Process

Not applicable.

5 Rules and Regulations

5.1 All materials supplied to this standard must comply with the requirements of GMW3001, **Rules and Regulations for Material Specifications.**

5.2 All materials supplied to this standard must comply with the requirements of GMW3059, **Restricted and Reportable Substances for Parts.**

6 Approved Sources

Engineering qualifications of an approved source is required for this specification. Only sources listed in the GM Materials File (i.e., GM Supply Power) under this specification number have been qualified by engineering as meeting the requirements of this specification.

For other GM locations, the responsible engineering group should be contacted to obtain the approved source in that individual country.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

ABS	Acrylonitrile Butadiene Styrene
CASS	Copper-Accelerated Acetic Acid Salt Spray
GF	Glass filled
mc	microcracking
MF	Mineral filled
mp	microporous
NSS	Neutral Salt Spray
PA	Polyamide (Nylon)
PC	Polycarbonate

8 Coding System

This standard shall be referenced in other documents, drawings, VTS, CTS, etc. as follows:

Material per GMW14668

9 Release and Revisions

9.1 Release. This standard originated in October 2005, replacing GME 00006. It was first approved by the Global Finish Team in June 2006. It was first published in February 2007.

Appendix A

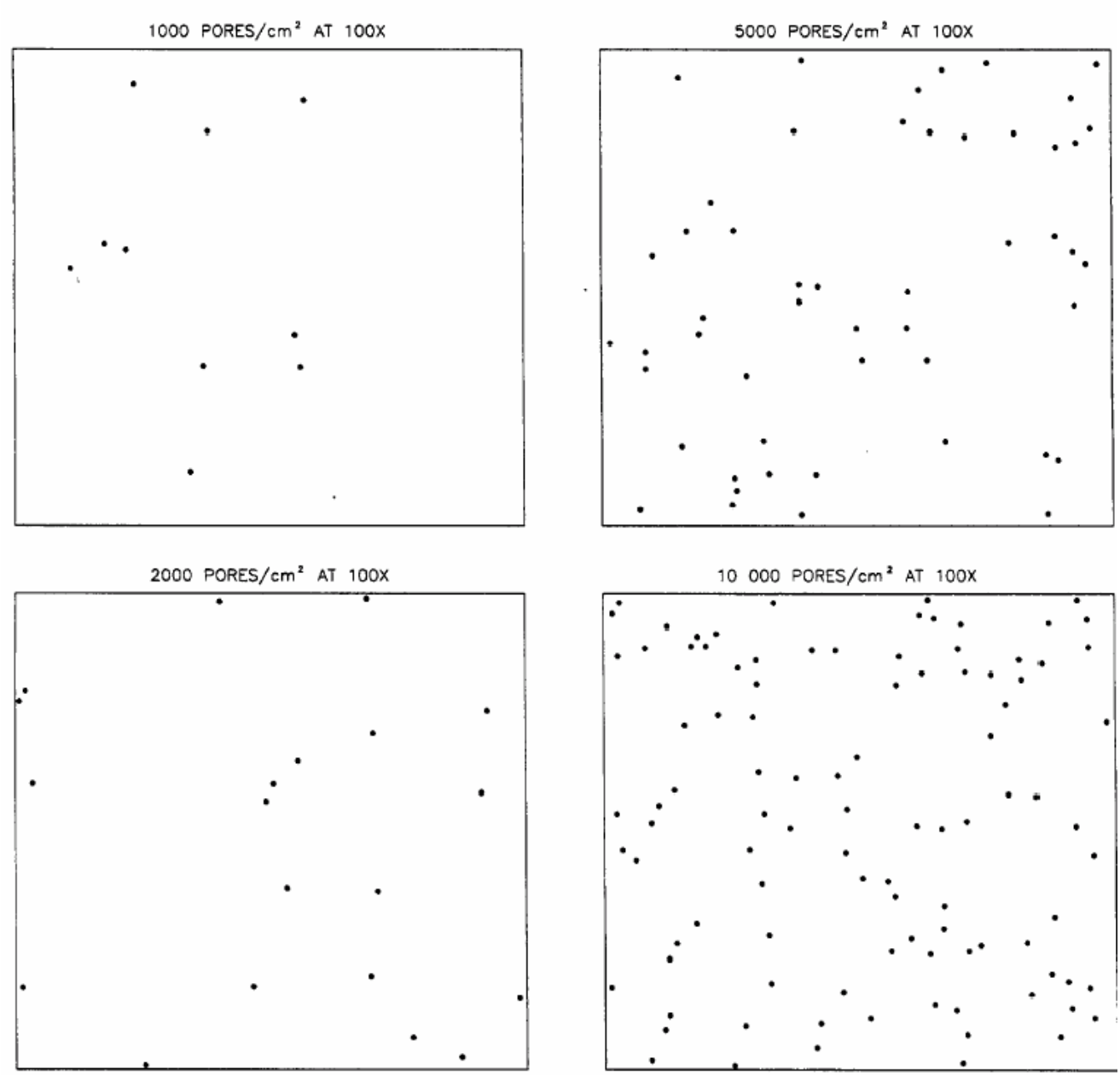


Figure A1: Pore Density Charts (1 mm by 1 mm)
Applicable to both "Active Sites" and "Copper Deposition" evaluation methods

Appendix B

Table B1: Summary Table

Code		CASS	NSS	Plating Thickness			
		Minimum Corrosion Resistance (h)	Minimum Corrosion Resistance (h)	Total (µm) minimum	Copper (µm) minimum	Nickel (µm) minimum	Chromium (µm)
(A) Interior	Note 1, 2, 3	**8**	**24**	**18**	**10**	**8**	**(r) 0.25 minimum (mp) 0.25 minimum (mc) 0.25 minimum**
(B) Exterior - Type 1 w/o Stone Chip Note 6	Var 1 "Low Copper" (GMNA)	**48**	**144**	**35**	**15**	**20**	**(mp) 0.25 to 0.5**
	Var 2 "High Copper" (GME)	**48**	**144**	**35**	**25**	**15**	**(r) not allowed (mp) 0.25 to 0.5 (mc) 0.8 minimum**
-Type 2 with Stone Chip Note 6	Var 1 "Low Copper" (GMNA)	**48**	**144**	**35**	**15**	**20**	**(mp) 0.25 to 0.5**
	Var 2 "High Copper" (GME)	**48**	**144**	**35**	**25**	**15**	**(r) not allowed (mp) 0.25 to 0.5 (mc) 0.8 minimum**

Note 1: For nonwear interior parts, minimum chromium thickness may be > 0,15 µm if authorized by purchaser and engineering. Approval is indicated by addition of symbol (R) to specification number on drawing.
Note 2: Tin Cobalt alloy may be used in lieu of chromium when symbol (K) is added to the specification number on the drawing.
Note 3: (r) = continuous chrome, (mp)= microporous chrome, (mc)= microcracked chrome.
Note 4: Run water immersion per 3.3.2.3.1(a) (instead of first CASS) with thermal followed by CASS.
Note 5: No impact test during thermal cycle required.
Note 6: Depending on manufacturing and approval location Supplier must choose one variant.
Note 7: For LAAM Non Export Vehicles only, optional to replace CASS with NSS.

Table B2: Summary Table - Testing

Code		Testing					
		Adhesion Saw Grid	Temperature Storage	CASS & Thermal Cycle (A) & CASS Note 7	Thermal Cycle (B) & CASS Note 7	Stone Chip & CASS & Thermal Cycle (A) Note 7	Stone Chip & Thermal Cycle (B) & CASS Note 7
(A) Interior	Note 1, 2, 3	**Yes**	**Yes**	**Yes (US)** Note 4	**Yes (EU)**	No	No
(B) Exterior - **Type 1** w/o Stone Chip Note 6	Var 1 "Low Copper" (GMNA)	**Yes**	**Yes**	**Yes**	No	No	No
	Var 2 "High Copper" (GME)	**Yes**	**Yes**	No	**Yes**	No	No
-Type 2 with Stone Chip Note 6	Var 1 "Low Copper" (GMNA)	**Yes**	**Yes**	**Yes**	No	**Yes**	No
	Var 2 "High Copper" (GME)	**Yes**	**Yes**	No	**Yes**	No	**Yes** Note 5

Note 1: For nonwear interior parts, minimum chromium thickness may be > 0,15 µm if authorized by purchaser and engineering. Approval is indicated by addition of symbol (R) to specification number on drawing.
Note 2: Tin Cobalt alloy may be used in lieu of chromium when symbol (K) is added to the specification number on the drawing.
Note 3: (r) = continuous chrome, (mp)= microporous chrome, (mc)= microcracked chrome.
Note 4: Run water immersion per 3.3.2.3.1(a) (instead of first CASS) with thermal followed by CASS.
Note 5: No impact test during thermal cycle required.
Note 6: Depending on manufacturing and approval location Supplier must choose one variant.
Note 7: For LAAM Non Export Vehicles only, optional to replace CASS with NSS.

GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification Finish	GMW14672

Minimum Plating Structure and Performance Requirements for Decorative Chromium Plated Metallic Parts

1 Scope

This specification covers basic requirements for copper-nickel-chromium electroplated metallic parts, including assemblies.

1.1 Material Description. Platings to this specification are subdivided into three performance classes. Class A is intended for exterior components with severe service conditions likely to include damage from denting, scratching, and abrasive wear, such as those encountered by automotive bumpers. This class requires longer corrosion exposure resistance than Class B, for which components are expected to receive little additional mechanical abuse. For exterior applications, discontinuous chromium plate {(microporous (mp) or microcracked (mc)} in addition to a multiple layer nickel system shall be used. Class C is intended for interior applications and does not require the use of discontinuous chromium or multiple-layer nickel systems. For interior application a continuous chrome layer (r) is permissible. Plating per this specification is intended for use over metallic substrates; plating on plastics is specified in GMW 14668**.**

1.2 Symbols. Not applicable.

1.3 Typical Applications. This type of finish shall be principally used for decorative purpose, including bright and other (e.g., satin, brushed, grained) appearances for interior and exterior applications, as defined by styling and specific appearance standards.

1.4 Remarks. Not applicable.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ASTM B368	ISO 1463
ASTM B456	ISO 2177
ASTM B571	ISO 3497
ASTM B764	SAE/USCAR-5
DIN 50021	SAE/USCAR-7

2.2 GM Standards/Specifications.

GMW3001	GMW14458
GMW3059	GMW14668
GMW3286	GMW14829

3 Requirements

3.1. Plating Thickness. Shall be determined by the microscopic method (ISO 1463) or the electrochemical method (ISO 2177), or by X-Ray method (ISO 3497). In case of disagreements between purchaser and supplier, the microscopic method shall be the preferred method.

3.1.1. Minimum plate thickness as specified in Table 1 is intended to apply to all low current density and high current density areas of significant surfaces as specified on appropriate part drawings or as otherwise agreed upon between purchaser and supplier (written statement). Such surfaces are those normally visible - directly or by reflection - on the finished part when assembled in vehicle position, or which can be the source of corrosion deposits that deface visible surfaces on the assembled vehicles. If corrosion products are visible anywhere on a finished & dressed component in vehicle position, this specification is not met.

3.1.2 For systems with a total nickel layer thickness ≥ 20 microns, multiple layer nickel thickness consisting of at least two layers of electro-deposited nickel shall be as follows:

Table 1: Summary of Requirements for Double and Triple Layer Nickel Systems

	Thickness Relative to Total Nickel Thickness	
Type of Nickel Layer	Double Layer	Triple Layer
Bottom (semi bright)	60 to 80% Note 1	50 to 70%
Middle (high-S)	Not applicable	≤ 10%
Top (bright)	20 to 40%	≥ 30%

Note 1: If the total nickel layer thickness is < 20 microns, the semi bright thickness shall be 50% minimum.

3.1.3 Exceptions to the minimum plating thickness are generally shown as a detail on the part drawing by either designating plating checkpoint(s) or by indicating in an appropriate view the area(s) where deviated thickness(es) are allowed. These exceptions must still meet the specified number of corrosion test hours.

3.1.4 Minimum thickness and corrosion resistance performance requirements for textured finishes (e.g., brushed) apply after texturing.

3.2. Substrate/Molded Part.

3.2.1 Substrate Structure. Parts shall demonstrate no defects such as cracks, shrink holes, or surface porosity. Parts shall be free of internal tension, which may influence adhesion or appearance of the plating.

3.3 Relief from Hydrogen Embrittlement. All steel parts heat treated or cold worked to a specified core hardness of Hardness, Rockwell "C" Scale (HRC) 32 or greater or a surface hardness of HRC 35 or greater, that are finished in accordance with this specification, must be processed by the applicator per SAE/USCAR-5 and tested for de-embrittlement per SAE/USCAR-7

3.4 Nickel Electrochemical Potential (Only Exterior Parts). Determination of electrochemical potential difference between plating layers shall follow ASTM B764 (STEP test). A schematic view of a typical STEP chart is shown in Appendix B.

3.4.1 The bright (or satin) nickel layer shall exhibit an anodic electrochemical potential difference of 100 to 200 mV to semi bright nickel on all significant surfaces. The supplier must demonstrate the conformance to this requirement by using appropriate statistical charting techniques on a routine quality control basis.

3.4.2 The micro particulate nickel layer shall exhibit a cathodic electrochemical potential difference of 10 to 40 mV to the bright or satin nickel on all significant surfaces of all substrates.

3.4.3 If a micro crack chrome plating system is used, no microparticulate electrochemical potential difference will be measurable.

3.4.4 The optional "high activity nickel strike" layer shall exhibit an anodic electrochemical potential difference of 15 to 40 mV to the bright nickel layer.

3.5 Discontinuous Chromium, shall be performed by either the copper deposition (Dubpernell) method or by the determination of active corrosion sites after corrosion testing. Both are described in the appendix of ASTM B456. In the case of an active sites determination, compare the viewed sample at 100X to the pore density charts shown in Appendix A of this specification to determine pore count.

3.5.1 Microporous System (mp). The micro discontinuous chromium surface shall exhibit a minimum of 10 000 pores/cm^2 as determined by copper deposition or 2000 pores/cm^2 as determined by active sites per ASTM B456 Appendix X4 or X5.

3.5.2 Microcracking System (mc). The cracked chromium surface shall exhibit 300 to 800 cracks/cm in all directions and provide a closed homogenous network in all directions.

3.5.3 The surface pores or cracks shall be invisible to the unaided eye.

3.6 Adhesion.

3.6.1 Saw Grind Test. Plated components shall be subjected to the Saw-Grind Test, ASTM B571, with no evidence of lifting or peeling between plated layers or between plating and substrate. Place pressure sensitive adhesion tape, as described in GMW14829 approximately 10 to 20 mm wide over the cut edge (leaving sufficient length of tape to grasp between fingers for quick removal); quickly pull tape at approximately 90 degrees to the surface of part to remove entire strip. Examine for evidence of lifting of electroplate.

3.6.2 Thermal Shock Test. A temperature shock test to determine the adhesion must be performed. The temperature depends on the type of substrate. Parts shall be heated to the temperature listed below for 1 h ± 15 minutes and then direct immersed to water at room temperature (23°C ± 3K). The requirement is no blistering or flaking of the coating after immersion.

- Steel 300°C ± 10 K
- Copper 250°C ± 10 K
- Zinc 150°C ± 10 K
- Aluminum 150°C ± 10 K

Parts which are exceptionally large may be cut/sectioned to fit in the oven.

3.7 Mechanical Requirements.

3.7.1 Corrosion resistance shall be determined by the CASS test, GMW14458, ASTM B368, or DIN 50021(CASS), according to the number of hours specified in the Table 1. (As noted in Table 1, some limited applications may allow the use of Salt Spray testing.) Plated components shall be free of any surface defects and free of corrosion on all significant surfaces when examined at normal reading distance (0.5 ± 0.1 m) with the unaided eye and uniform diffused light.

4 Manufacturing Process

Not applicable.

5 Rules and Regulations

5.1 All materials supplied to this standard must comply with the requirements of GMW3001, **Rules and Regulations for Material Specifications.**

5.2 All materials supplied to this standard must comply with the requirements of GMW3059, **Restricted and Reportable Substances for Parts.**

6 Approved Sources

Engineering qualification of an approved source is required for this standard. Only sources listed in the GM Materials File (i.e., Supply Power) under this standard number have been qualified by engineering as meeting the requirements of this standard.

For other GM locations, the responsible engineering group should be contacted to obtain the approved source in that individual country.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

HRC	Hardness, Rockwell “C” Scale
mc	Microcracked
mp	Microporous

8 Coding System

This standard shall be referenced in other documents, drawings, etc. as follows:

Plating per GMW14672 Class A

9 Release and Revisions

9.1 Release. This standard originated in October 2005, replacing GM4372M, GM4373M, GM4374M, and GME00251. It was first approved by Global Materials Engineering in July 2006. It was first published in June 2007.

Table 2: Plating Construction and Performance Requirements

Plating Class	Minimum Corrosion Resistance CASS hrs Note 8	Basic Material (Part)	Minimum Thickness Significant Surface			
			Total	Copper	Nickel	Chromium (Note 3)
			µm	µm	µm	µm
A	66	Steel	40	Optional Note 2	30	0.25 to 0.5 (mp) 0.8 minimum (mc)
			45	20	25	
		Zinc	40	10	30	0.25 to 0.5 (mp) 0.8 minimum (mc)
		Copper	40	10 Note 5	30	0.25 to 0.5 (mp) 0.8 minimum (mc)
		Aluminum Note 6, 7	50	10	40	0.25 to 0.5 (mp) 0.8 minimum (mc)
B	44	Steel	35	Optional Note 2	20	0.25 to 0.5 (mp) 0.8 minimum (mc)
			45	20	25	
		Zinc	35	10	20	0.25 to 0.5 (mp) 0.8 minimum (mc)
		Copper	35	10 Note 5	20	0.25 to 0.5 (mp) 0.8 minimum (mc)
		Aluminum Note 6, 7	50	10	40	0.25 to 0.5 (mp) 0.8 minimum (mc)
C Note 1 &4	8	Steel	13	Optional Note 2	8	0.25 to 0.5 (mp) 0.8 minimum (mc) 0.3 (r)
		Zinc	13	5	8	0.25 to 0.5 (mp) 0.8 minimum (mc) 0.3 (r)
		Copper	13	5 Note 5	8	0.25 to 0.5 (mp) 0.8 minimum (mc) 0.3 (r)
		Aluminum Note 6	13	5	8	0.25 to 0.5 (mp) 0.8 minimum (mc) 0.3 (r)

Note 1: For nonwear interior parts, minimum chromium thickness may be 0.13 µm, if authorized by purchaser. Approval is indicated by note on part drawing.

Note 2: Copper may be used but not required. If not used at supplier option, then nickel must be used to meet the total plate thickness requirement. When copper is not used for plating steel substrates to GMW 14672 Class A or B requirements, the total minimum nickel thickness is reduced to 30 µm for both Class A, and Class B.

Note 3: Chromium thickness is limited to 0.5 µm to prevent overlaying the microparticulate nickel pores if used. Exceeding this limitation may be acceptable provided that pore count is proper. Microcracked chromium deposits shall have a minimum thickness of 0.8 µm.

Note 4: Tin Cobalt alloy may be used in lieu of chromium when symbol (K) is added to the specification number, e.g. “GMW 14672 Class C (K).”

Note 5: For cloisonnė type substrates, copper is optional.

Note 6: Suitable pretreatment processes must be developed for each type of alloy and processes of manufacture of the alloy. All pretreatment of aluminum processes must pass all visual adhesion and corrosion resistance properties as specified prior to production on each type of alloy and each type of manufacturing process of aluminum.

Note 7: All plated components must receive an aluminized wax or other corrosion-resistant coating on nonsignificant surfaces unless otherwise specified on the drawing.

Note 8: If authorized by purchaser and for use only in markets where vehicle operating corrosion environments are negligible, Salt Spray testing per GMW3286 may be substituted in place of CASS testing as follows: 66 hours CASS or 216 hours Salt Spray, 44 hours CASS or 144 hours Salt Spray, 8 hours CASS or 24 hours Salt Spray. This test substitution will not be allowed for use in North America or Europe.

Appendix A

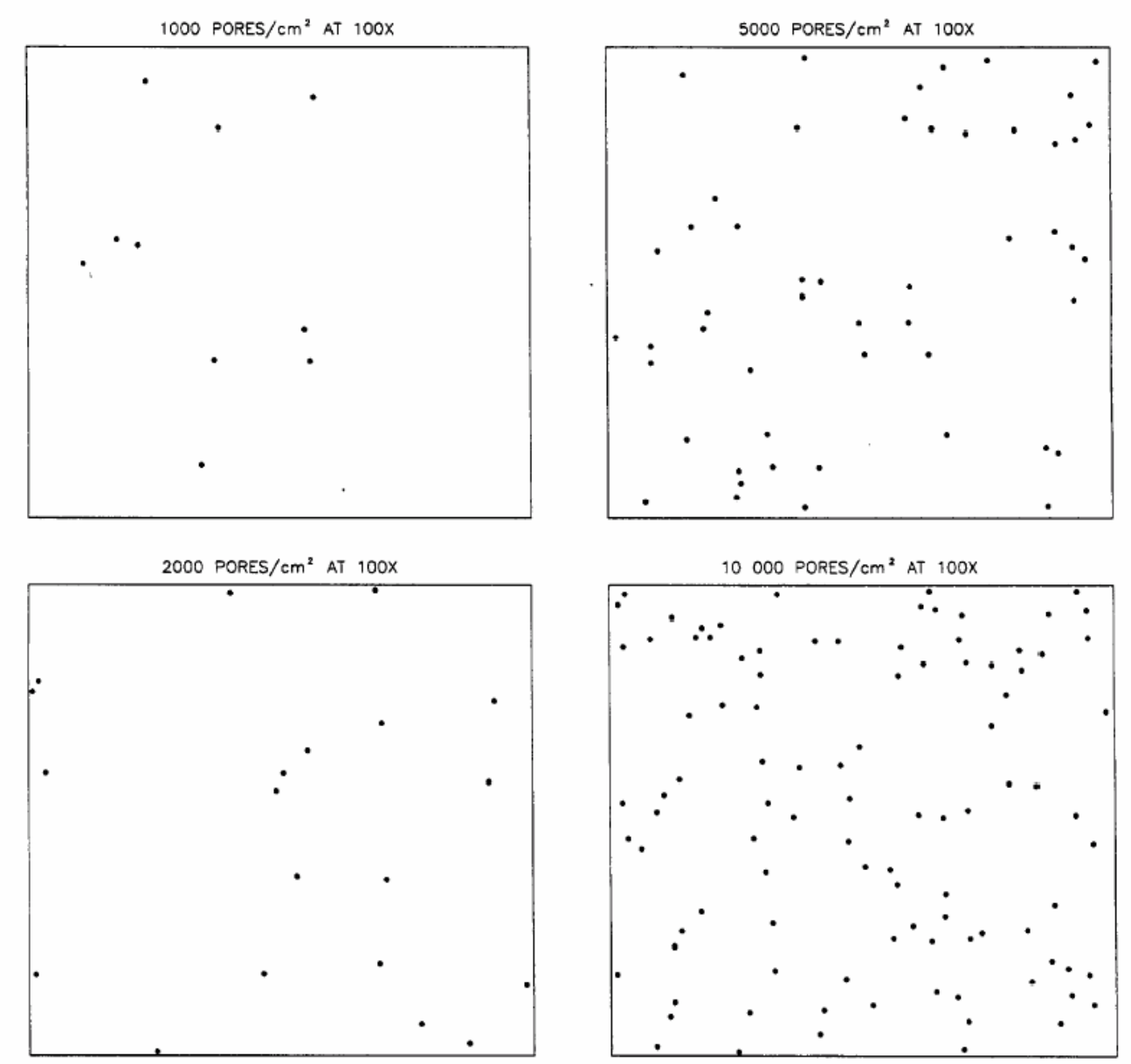


Figure A1: Pore Density Charts (1 mm by 1 mm)
Applicable to Both "Active Sites" and "Copper Deposition" Evaluation Methods

Appendix B: Example STEP Chart

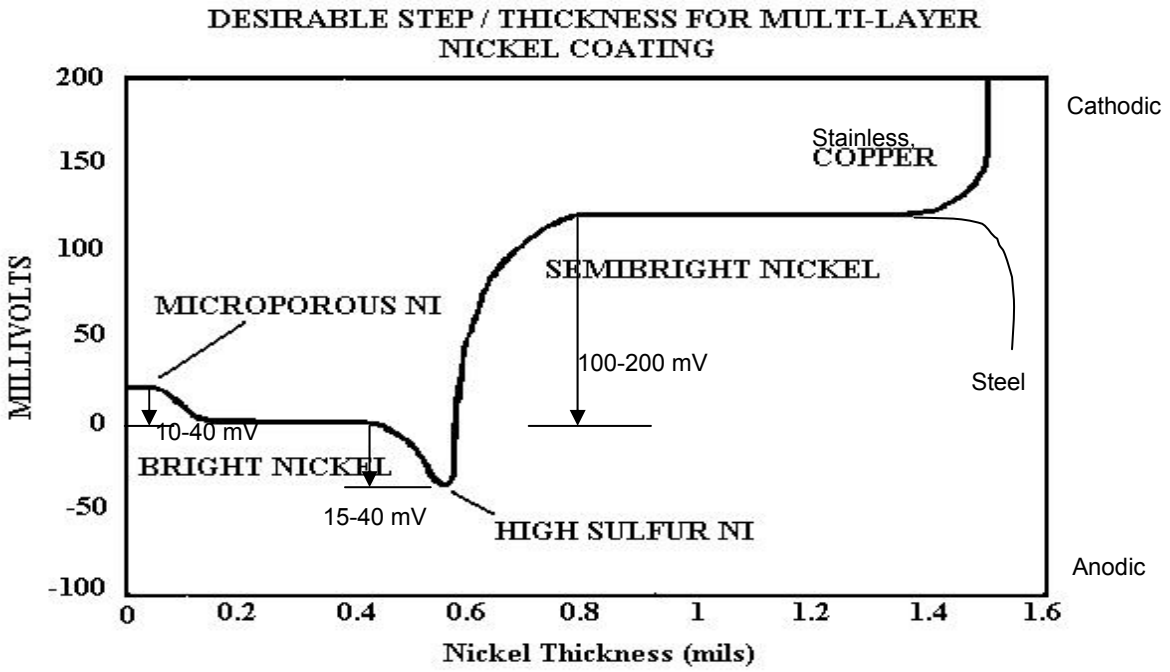


Figure B1: Desirable Step/Thickness for Multi-Layer Nickel Coating

GM	WORLDWIDE ENGINEERING STANDARDS	Test Procedure Materials	GMW15424

Procedure For Evaluating Parting Lines

1 Scope

Note: Nothing in this standard supersedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

This standard covers the evaluation method for determining the acceptability of parting lines on visible or customer contact plastic parts.

1.1 Purpose. Part approval process.

1.2 Forward. Not applicable.

1.3 Applicability. All visible or customer contact plastic parts.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

3 Resources

3.1 Facilities. Not applicable.

3.2 Equipment. Molded parts from production tooling (not the tool or cold pour impressions from tooling).

3.3 Test Vehicle/Test Piece. Minimum of two samples.

3.4 Test Time. Not applicable.

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Not applicable.

4 Procedure

4.1 Preparation. Parts should be installed in vehicle or buck; if property is not available, the part is held in approximate installed position.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 Evaluate parting line; visual and tactile (perceptible to the touch).

4.3.2 Visually and tactilely inspect parts for parting line execution.

4.3.3 Test Sample Preparation. Tool Mismatch – Parting Line core to cavity; Parting Line at edge of part. (See Figure 1 and Figure 2.)

4.3.4 Maximum 0.05 mm mismatch, unless otherwise specified, or designed as an offset.

4.3.5 Texture execution stops at 0.25 mm minimum to 0.50 mm maximum to protect parting line appearance.

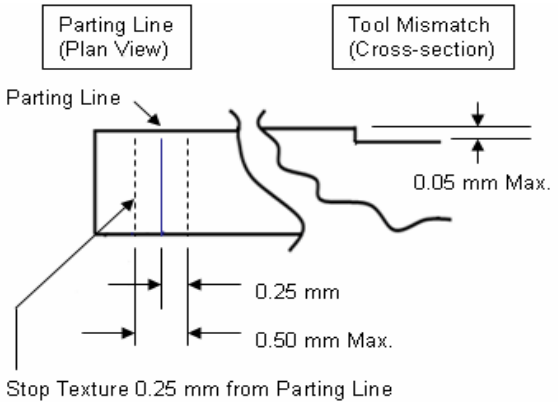


Figure 1: Tool Mismatch and Parting Line Texture Execution

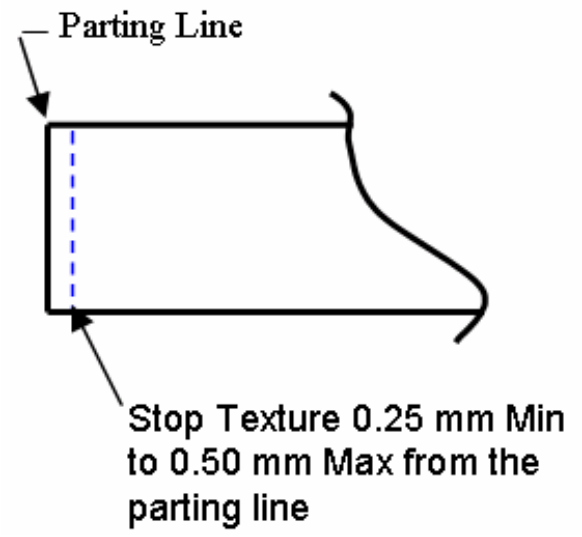


Figure 2: Edge of Part Texture Execution

4.3.6 Seamless Execution Parting Line. See Figure 3.

4.3.7 No Tool Mismatch Allowed. Applies to:

4.3.7.1 Parting Line on A-Surface (Lifter/Slide to cavity).

4.3.7.2 Core to cavity on Tactile parts (handles, knobs, switches, etc.).

4.3.8 Texture execution stops at 0.10 mm minimum to 0.20 mm maximum to protect parting line appearance.

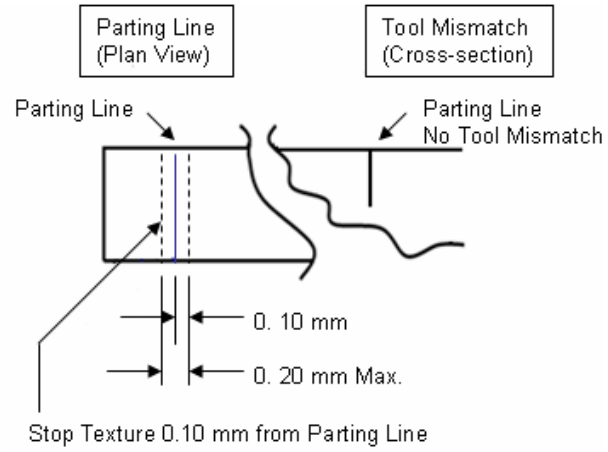


Figure 3: Seamless Execution Requirements Lifter/Slide Parting Line and Tactile Surface Parting Line

4.3.9 The part submission and evaluation procedure is repeated until all issues are in agreement.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Not applicable.

5.3 Test Documentation. Global Pre-texture Instruction Form (GIF), Appearance Approval Report (AAR).

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

7 Notes

7.1 Glossary.

Appearance Approval Report (AAR) Form: Used to document parting line non-compliance at the time of Production Part Approval Process (PPAP) apearance submission.

Global Pre-Texture Instruction Form (GIF): Used to document parting line non-compliance at the time of Surface Quality Evaluation.

7.2 Acronyms, Abbreviations, and Symbols.

AAR	Appearance Approval Report
GIF	Global Pre-Texture Instruction Form
PPAP	Production Part Approval Process

7.3 Figures are not to scale.

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW15424

9 Release and Revisions

9.1 Release. This standard originated in August 2006, replacing GM9684P. It was first approved by Global Appearance Quality in October 2007. It was first published in November 2007.

Handläggare/Handled by	Fastställd/Approved	Datum/Date	Utgåva/Issue	Sida/Page
TVLME/Lars B Alexandersson	TQAG/P-O Hedkvist	2005-01	5	1 (6)

Krombeläggningar på metaller

Innehåll

Orientering

Denna standard omfattar elektrolytiska beläggningar av nickel plus krom alternativt koppar plus nickel plus krom, på gjutjärn, stål, zinklegeringar, koppar och kopparlegeringar med undantag av:

- beläggningar på gängor (med tolerans)

- beläggningar på plåt, band eller tråd i obearbetad form, eller på skruvfjädrar

- beläggningar pålagda av andra skäl än skydd eller dekoration.

Standarden överensstämmer i tekniskt avseende med SS-ISO 1456 och ISO 1457. Beläggningarna utgör ett begränsat urval av de som anges i SS-ISO 1456 respektive ISO 1457.

1. Kontrollbestämmelser

STD 340.

2. Definition

Kravyta: del av artikelns yta som är väsentlig för utseende eller användning och som skall täckas eller täcks av ytbeläggningen.

Vid behov skall kravytan anges på ritning eller vara markerad på likare.

Chromium coatings on metals

Contents

Introduction

This standard covers electrolytic coatings of nickel plus chromium or alternatively copper plus nickel plus chromium on cast iron, steel, zinc alloys, copper and copper alloys with the exception of.

- coatings on threads (With tolerances)

- coatings on sheet metal, strip or wire in unworked form, or on helical springs

- coatings applied for reasons other than for protection of decoration.

In technical respects this standard conforms with SS-ISO 1456 and ISO 1457. The coatings are a limited selection of those appearing in SS-ISO 1456 and ISO 1457 respectively.

1. Inspection regulations

STD 340.

2. Definition

Significant surface: that part of the part´s surface that is crucial for appearance or utilization and which is to be covered or is covered by the surface coating.

Where necessary the significant surface is to be marked on the drawing or on a sample.

3. Beteckningar och beläggningar

Följande beläggningar används för artiklar som utsätts för svåra korrosionsförhållanden, t ex utvändiga artiklar:

3. Designations and coatings

The following coatings are used for parts subjected to severe corrosion, e g exterior parts:

Basmetall Base metal	Beteckning SAAB (anges på ritning) Designation SAAB (appears on drawing) 1)	ISO
Stål och gjutjärn Steel and cast iron	123 (A-1) 104 (B-1) 102 (B-2)	Fe/Cu 20 Ni 30 Cr Fe/Ni 40 Cr 2) Fe/Ni 25 Cr 2)
Rostfritt stål Stainless steel	200	-
Zinklegeringar Zinc alloys	313 (D-1) 312 (E-1)	Zn/Cu Ni 35 Cr Zn/Cu Ni 25 Cr 2)
Koppar och kopparlegeringar Copper and copper alloys	402 (C-1)	Cu/Ni 20 Cr

Tabell 1
Table 1

Följande beläggningar används för artiklar som utsätts för mindre svåra korrosionsförhållanden, t ex invändiga artiklar:

The following coatings are used for parts that are subjected to less severe corrosion, e g interior parts:

Basmetall Base metal	Beteckning SAAB (anges på ritning) Designation SAAB (appears on drawing) 1)	ISO
Stål och gjutjärn Steel and cast iron	121 (A-2)	Fe/Cu 20 Ni 10 Cr
Zinklegeringar Zink alloys	311 (D-2)	Zn/Cu Ni 15 Cr

Tabell 2
Table 2

1) Inom parentes angivna beteckningar är äldre och skall ej användas.

2) Nickelskikten skall vara dubbla, se avsnitt 4.2.1.

1) The designations in brackets are older and should not be used.

2) The layer of nickel is to be double, see section 4.2.1.

4. Fordringar

4.1 Allmänna fordringar

4.1.1 Utseende

Den ytbelagda artikelns kravyta skall vara fri från tydligt synliga ytbehandlingsfel, såsom blåsor, gropar, sprickor eller ofullständigt belagda partier och får ej vara fläckig eller missfärgad.

Om ej annat anges på ritning skall den förkromade ytan vara blank. Ytutseende jämförs om så erfordras med likare som godkänts av Saab.

4.1.2 Tjocklek

Siffrorna efter de kemiska tecknen Cu och Ni anger kopparskiktets resp nickelskiktets mintjocklek i µm. Tjockleken skall mätas enligt ISO 1463, antingen på överenskomna mätpunkter (på kravytan) eller var som helst på kravytan där beröring kan ske med en kula med diametern 20 mm.

På zinklegeringar skall ett kopparskikt med mintjock-lek 10 µm läggas på före nickelbeläggningen.

Krombeläggningens tjocklek skall mätas enligt ISO 2177 med elektrolyt B4 som provningslösning, antingen på överenskomna mätpunkter (på kravtyan) eller var som helst på kravytan där beröring kan ske med en kula med diametern 20 mm.

4.1.3 Vidhäftning

Beläggningens vidhäftning skall bedömas enligt någon av de metoder som anges i avsnitt 5.1 och 5.2. Beläggningen skall fortfarande häfta vid basmetallen efter att ha utsatts för den valda provningen.

4. Requirements

4.1 General requiremetnts

4.1.1 Appearance

The significient surface of the coated part is to be free from clearly visible surface treatment faults, i.e. bubbles, pits, cracks or sections not completely coated, and is not to be mottled or miscoloured.

Unless otherwise stated on the drawings the chromium-plated surfaces are to be bright. If required the surface appearance is to be compared with a sample approved by Saab.

4.1.2 Thickness

The numbers following the chemical symbols Cu and Ni indicated the minimum thickness of the copper and nickel layers in µm. The thickness is to be measured in accordance with ISO 1463, either at the agreed measurement poit (on the significant sufrace) or anywhere else on the surface that can be touched by a ball 20 mm in diameter.

A layer of copper of a minimum thickness of 10 µm is to be applied on zink alloys before coating with nickel.

The thickness of the chromium coating is to be measured in accordance with ISO 2177 using B4 electrolyte as the test solution either at the agreed measurement points (on the significant surface) or anywhere else on the surface that can be touched by a ball 20 mm in diameter.

4.1.3 Adhesion

The adhesion of the coating is to be assessed using one of the methods described in sections 5.1 and 5.2. The coating shall continue to adhere to the basis metal when subjected to the test selected.

4.1.4 Korrosiosnhärdighet

Förkromade artiklar ska utsättas för korrosionsprov enligt tabell 3. Detta prov är till för att kontrollera beläggningarnas kontinuitet och kvalitet och provningstidens längd behöver inte ha något direkt samband med den ytbehandlade artikelns livslängd.

Efter korrosionsprovning ska bedömning ske enligt STD 202. För godkännande ska lägst betyg 9 innehållas.

4.1.4 Corrosion resistance

Chroumium-plated articles are to be tested for resistance to corrosion as show in Table 3. This test is intended to test the continuity and quality of the coating and the length of the testing period is not necessarily directly related to the life of the coated part.

Once the corrosion resistance test has been performed an assessment is to be made in accordance with STD 202. The lowest acceptable grade for approval is 9.

Tabell 3
Table 3

Basmetall Base metal	Beläggning Coating		Korrosionsprovets exponeringstid (i timmar) Corrosion test´s exposure time (in hours)	
	SAAB	ISO	ASS	STD 1249
Stål och gjutjärn Steel and cast iron	104 102 123 121	Fe/Ni 40 Cr Fe/Ni 25 Cr Fe/Cu 20 Ni 30 Cr Fe/Cu 20 Ni 10 Cr		144 96 96 24
Rostfritt stål Stainless steel	200	-		-
Zinklegeringar Zinc alloys	313 312 311	Zn/Cu Ni 35 Cr Zn/Cu Ni 25 Cr Zn/Cu Ni 15 Cr		144 96 24
Koppar eller kopparlegeringar Copper or Copper alloys	402	Cu/Ni 20 Cr		24

Anm

Provningstiderna är kortare när basmetallen är koppar eller kopparlegering än när den är järn, stål eller zinklegering. Detta är nödvändigt, eftersom för samma miljöklass nickelbeläggningarna på koppar och kopparlegeringar är tunnare än på järn, stål eller zinklegering. Användningen av dessa tunnare och mindre korrosionshärdiga beläggningar berättigas av de långsammare korrosionsangreppen på koppar och kopparlegeringar när beläggningarna har genomträngts. Provningstiderna ska därför inte uppfattas som ett direkt mått på allmän prestationsförmåga i användning.

Note

The testing times are shorter when the base metal is copper or copper alloys than for iron, stell or zinc alloys. This is necessary because in the same enviromental class nickel coatings on copper and copper alloys are thinner than on iron, steel or zinc alloys. The use of these thinner and less corrosion resistant coatings is justified by the slower attack of corrosion on copper and copper alloys once the coatings have been penetrated. The testing times should therefore not be regarded as a direct measurement of the general performance capacity in use.

4.2 Särskilda fordringar för olika typer av beläggningar

Anm - Leverantören kan välja det alternativ som han bedömer lämpligast med hänsyn till produktionsutrustningen. Leverantören skall dock meddela Saab enligt vilket alternativ han önskar leverera. Övergång till annat utförande får ej ske utan Saabs vetskap och godkännande. Beläggningarna 102, 104 och 312 skall alltid utföras som dubbelskiktsbeläggning enligt punkt 4.2.1.2.

4.2.1 Nickelbeläggning

4.2.1.1Matt eller halvblank beläggning

Svavelhalt: max 0,005 %

Förlängning: min 8 % vid provning enligt avsnitt 5.3

4.2.1.2 Dubbelskiktsbeläggning

a) Understa skiktet

Svavelhalt: max 0,005 %

Förlängning: min 8 % vid provning enligt avsnitt 5.3

Mintjocklek: 60 % av den totala nickeltjockleken

b) Yttersta skiktet

Svavelhalt: mer än 0,04 %

Mintjocklek: 20 % av den totala nickeltjockleken

4.2.2 Krombeläggning

4.2.2.1 Mikrosprucken krom

Sprickmönster med mer än 250 sprickor/cm i godtycklig riktning och som bildar ett slutet nätverk över hela kravytan.

Mintjocklek: 0,3 μm (vid beläggning på rostfritt stål skall mintjockleken vara 0,25 μm).

4.2.2.2 Mikroporös krom

Antal porer: min 10 000/cm^2 Porerna skall vara osynliga för blotta ögat.

Mintjocklek: 0,3 μm (vid beläggning på rostfritt stål skall mintjockleken vara 0,25 μm).

4.2 Special requirements for different types of coatings

Note - The supplier is to select the alternative that he considers the most suitable with regard to the production equipment. However, the supplier is to in-form Saab of which alternative he wishes to supply. Change to another design may not occur without Saab`s knowledge and approval. Coatings 102, 104 and 312 are always to be a two-layer coating as described in point 4.2.1.2.

4.2.1 Nickel coating

4.2.1.1Dull or semi-bright coatings

Sulphur content: 0,005 % max

Elongation: 8 % min When testing as per section 5.3

4.2.1.2 Double layer coatings

a) Bottom layer

Sulphur content: 0,005 % max

Elongation: 8 % min When testing as per section 5.3

Minimum thickness: 60 % of the total nickel thickness

b) Top layer

Sulphur content: in excess of 0,04 %.

Minimum thickness: 20 % of the total nickel thickness

4.2.2 Chromium coatings

4.2.2.1 Micro-cracked chromium

Crack pattern showing more than 250 cracks/cm in any direction forming a closed network over the whole of the significant surface.

Minimum thickness: 0,3 μm (the minimum thickness is to be 0,25 μm for coatings on stainless steel).

4.2.2.2 Micro-porous chromium

Number of pores: at least 10 000/cm^2 The pores shall be invisible to the unaided eye.

Minimum thickness: 0,3 μm (the minimum thickness is to be 0,25 μm for coatings on stainless steel).

5. Provningsmetoder

5.1 Vidhäftningsprovning genom filning

Såga av ett stycke av en ytbelagd artikel och fäst det i ett skruvstycke och försök fila den avsågade kanten med en grov fil på sådant sätt att beläggningen lossnar från underlaget. Fila i riktningen från basmetallen mot beläggningen och i ca 45° vinkel mot den belagda ytan.

5. Testing methods

5.1 File test for adhesion

Saw off a piece of a plated article, hold it in a vice and apply a coarse file to the cut edge in such a manner as to try to raise the deposit. File in the direction from the basis metal to the coating at an angle of approximately 45° to the coated surface.

5.2 Vidhäftningsprovning genom hastig avkylning

Värm en belagd artikel under 1 h i en ugn vid den temperatur som nedan anges för ifrågavarande basmetall, med en tolerans av ± 10°C:

- stål - 300°C

- zinklegering - 150°C

- koppar eller kopparlegering - 250°C

Artikeln kyls sedan hastigt genom doppning i vatten av rumstemperatur. Provningen kan försämra artikelns mekaniska egenskaper.

5.2 Quenching test for adhesion

Heat a plated article for 1 hour in an oven at a temperature appropriate to the basis metal as given below, with a tolerance of ± 10°C:

- steel - 300°C

- zinc alloy - 150°C

- copper or copper alloy - 250°C

Then quench the article in water at room temperature. This may have an adverse effect on the mechanical properties of the article tested.

5.3 Duktilitetsprovning

5.3.1 Provberedning

Tillverka en ytbelagd provstrimla 150 x 10 x 1 mm på följande sätt:

Polera en plåt av ifrågavarande basmetall liknande den som i de ytbelagda artiklarna. I de fall basmetallen är en zinklegering kan plåten vara av mjuk mässing. Använd en plåt med storlek som medger att provstrimlan skärs ut från den efter att en minst 25 mm bred kant skurits bort runt om. Belägg plåtens ena sida med nickel till en tjocklek av 25 µm under samma betingelser och i samma bad som motsvarande artiklar.

Klipp ut provstrimlan ur den ytbelagda plåten med plåtsax. Avrunda eller fasa provstrimlans långa kanter, åtminstone på den belagda sidan, genom omsorgsfull filning eller slipning.

5.3.2 Provning

Böj provstrimlan med den belagda sidan under sträckning med kontinuerligt pålagt tryck, 180° över en dorn med diametern 11,5 mm till strimalns två ändar är parallella. Se till att kontakt råder mellan strimal och dorn under böjningen.

5.3.3 Bedömning

Beläggningen anses uppfylla kravet på minst 8 % förlängning om det efter provningen inte finns några sprickor som sträcker sig över hela den konvexa ytan. Små sprickor vid kanterna medför inte underkännande.

5.3 Ductility test

5.3.1 Preparation

Prepare a plated test strip 150 mm long, 10 mm wide and 1 mm thick by the following method.

Polish a sheet of the appropriate basis metal, similar to that of the articles being plated except that the sheet may be of soft brass if the basis metal is zinc alloy. Use a sheet that is sufficiently large to allow the test strip to be cut from it after trimming off a border at least 25 mm wide all round. Plate the sheet on one side with nickel to a thickness of 25µm under the same conditions and in the same bath as the corresponding articles.

Cut the test strip from the plated sheet with a guillotine. Round or chamfer the longer edges of the test strip, a least on the plated side, by careful filing or grinding.

5.3.2 Procedure

Bend the test strip with the plated side in tension, by steadily applied pressure, through 180° over a mandrel of diameter 11,5 mm until the two ends of the test strip are parallel. Ensure that contact between the test strip and the mandrel is maintained during bending.

5.3.3 Assessment

The coating is deemed to comply with the minimum requirement of an elongation of 8 % provided that after testing there are no cracks passing completely across the convex surface. Small cracks at the edges do not signify failure.

Ändringar från föregående utgåva

Standarden är, för nykonstruktion, ersatt av GME00251.

Changes from previous issue

This standard is, for new design, replaced by GME00251.