

NAVISTAR, INC.		
Material, Parts, and Process Specifications (MPAPS)		NUMBER: MPAPS G-19 Part I
		<i>Former Designation: CEMS G-19 Part I</i>
TITLE: Decorative Copper/Nickel/Chromium and Nickel/Chromium Plating		CURRENT REV No.: 1608
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<i>This specification may involve hazardous materials, equipment, and procedures. This specification does not purport to address all of the safety issues associated with its use. The user is responsible to consult appropriate safety and health practices and to determine the applicability of regulatory limits prior to use.</i>		

1.0 APPLICATION

This specification applies to the construction of all multi-layer Cu/Ni/Cr or Ni/Cr decorative coatings that may be applied to steel, stainless steel, aluminum, and die-cast zinc-alloy truck and engine components. Since appearance is a primary requisite, plated articles must have adequate corrosion resistance to the environment in which they are exposed.

2.0 SCOPE

This specification covers base metal requirements, plating appearance, thickness and electrochemical potential requirements, corrosion resistance, adhesion, qualification, source approval and quality control, and shipping and handling requirements for parts in which the drawings call out this specification.

2.1 Chrome plating representing five service condition classes for corrosion resistance, related to the severity of the intended application, are included in this specification. One or more plating systems are provided for commonly plated base materials in Table I for each service condition. All options shown for a given service condition class are considered to have equivalent corrosion resistance. If a specific system option (indicated by a letter following the class designation) is not shown on a part drawing, the supplier may select the plating system option to be used. The five classes are as follows:

2.1.1 SC5 Exterior- Extended Severe: Exposure where long term protection of the substrate is required and where plating is exposed to damage from denting, scratching and abrasive wear in addition to corrosive environments such as salt. Many bumpers and grille surrounds are examples of subject parts.

2.1.2 SC4 Exterior- Severe: Exposure that is likely to include occasional or frequent wetting by rain or dew and less exposure to road salts and other corrosive materials. Subject parts may include mirrors, grab handles, exhaust pipes, and similar components.

2.1.3 SC3 Exterior-Moderate: Exposure to some moisture and dew but which are generally protected from exposure to salt. Subject parts may include wiper arms and blades, window trim, ornaments, antennas, underhood components and similar parts.

2.1.4 SC2 Interior- Moderate: Exposure in-cab in places that are normally warm and dry but where condensation of moisture may occur and parts that are handled including control knobs, door and window handles, mirror frames, mounting brackets, and other similar parts.

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2.1.5 SC1 Interior- Mild: Exposure inside cab in places that are generally warm and dry and rarely handled, including most interior trim pieces, dome light bezels, emblems, inside windshield moldings, and other similar parts.

2.2 Restricted Chemical Substances

Effective January 1, 2007, all product supplied to the requirements of this specification must comply with the requirements of the MPAPS B-50 specification.

3.0 REFERENCE DOCUMENTS

Unless otherwise specified, the latest issue of all referenced standards shall apply. The following standards, specifications and regulations are referenced in this specification.

Quality System Standard ISO-9001 or TS-16949	ASTM B 456
NAVISTAR Engineering Design Std. A-16	ASTM B 487
NAVISTAR Supplier Packing and Shipping Std. D-13	ASTM B 530
CFR Title 29, Part 1910	ASTM B 183
NAVISTAR MPAPS B-50	ASTM B 252
NAVISTAR EPS-158	ASTM B 253
NAVISTAR EPS-159	ASTM B 254
ASTM G-85	ASTM B 764
ASTM B 287	ASTM B 490
ASTM B 368	ASTM B 537

4.0 REQUIREMENTS

4.1 Base Metal Requirements

The principal supplier is responsible for procuring base metal of the specified composition with surface quality suitable to provide the required surface finish, luster and corrosion resistance on the plated part. The base metal and applicable Navistar specification should be specified in the material block on the part drawing.

4.2 Base Metal Processing

Finishing of the base metal may be performed before or after forming. Surfaces on the formed part shall be free of stretch marks, die marks, nicks, scratches or other defects affecting the appearance of the plated parts. ***Buffing of the final chromium plating is not permitted.*** Surfaces to be plated shall be suitably cleaned and activated prior to plating. Suitable preparation methods are described for low carbon steels in ASTM B183, zinc alloy die castings in ASTM B252, aluminum alloys in ASTM B253, and stainless steel in ASTM B254. The cleaning operation for steels will be controlled to prevent hydrogen embrittlement, especially in those parts which are hardened, cold worked or subject to high service stresses. See "Appendix – General Information" at the end of this specification.

4.3 Plating Requirements

4.3.1 Appearance

Plated parts shall exhibit a bright and uniformly reflective finish, be smooth and free of stains, pin holes, buffing and polishing lines or other defects affecting the plated appearance or the ability of the

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plating to pass required corrosion tests on class A surfaces. The appearance of surfaces of production parts shall match color and finish of the master samples agreed upon by Navistar Industrial Design, Supplier Quality and the supplier per Navistar's Visual Component Approval Process (EPS-158) and Material Styling Evaluation Process (EPS-159).

The surface classifications are described below:

4.3.1.1 Class A surfaces are those surfaces which are directly visible, or visible by reflection, when the finished part is assembled on the truck, and/or those surfaces which can be a source of corrosion products which are visible either directly or by reflection.

4.3.1.2 Class B surfaces are those surfaces that may be partly, but not directly, visible or mating surfaces that may be partly covered or hidden when the part is assembled on the truck.

4.3.1.3 Class C surfaces are the non-visible surfaces or on the backside of the part.

4.3.1.4 The appearance of all surfaces shall be consistent with appearance requirements listed for class A, B and C surfaces in the Appendix or as agreed during visual component approval process. The construction, anodic potential differences, Nickel Sulphur, Chrome micro-discontinuity, and performance requirements apply to class A surfaces. Class B surfaces must meet performance requirements.

4.3.1.5 Trivalent Chrome Plating. Some trivalent chrome plating systems produce chrome that is noted to tarnish in service. It will be the supplier's responsibility to warranty against tarnishing if trivalent chrome is used.

4.3.2 Coating Thickness and Construction

4.3.2.1 Plating thickness may be determined by the microscopic method, ASTM B 487, or the electro chemical method of ASTM B 764. In the event of conflict, the microscopic method shall be the referee method.

4.3.2.2 Engineering may specify on the drawing check points ('C' points) for specific evaluation of the plating thickness on class A surfaces.

4.3.2.3 The minimum thicknesses shown in Table 1 apply to specified check points (C-points) or, in the absence of indicated check points, apply to the entire significant surfaces. Engineering exceptions to the minimum plating thickness requirements of Table 1 shall be shown on the engineering drawing.

4.3.2.4 SC5, SC4 and SC3 class coatings, when applied to low carbon steel, zinc or aluminum, require double or triple layer nickel coatings (coating type "D") (refer to Table 1 for coating types). Double layer coatings consist of a semi-bright nickel layer, and a bright nickel layer and may contain a special particle nickel layer for microporous (mp) or microcracked (mc) chrome layers. Triple layer coatings contain an additional high-sulfur, highly active nickel layer between the semi-bright and bright nickel layers. SC2 and SC1 coatings and coatings applied to stainless steel substrates do not require a semi bright nickel layer. They only require a bright nickel layer or a bright nickel layer and a special particle nickel layer (coating type "B").

4.3.2.5 When double layer nickel is used on carbon steel, zinc or aluminum substrates, at minimum acceptable total thickness, the semi-bright nickel thickness shall be no less than 60% or greater than 80% of total nickel thickness, and the combined thickness of the bright nickel and special nickel layer added to provide discontinuities in chrome shall be no less than 20% of total nickel thickness. When triple layer nickel is used on carbon steel, zinc or aluminum substrates, at minimum acceptable total thickness, the semi-bright nickel thickness shall be no less than 50% or no greater than 70% of the total thickness and the high-sulfur intermediate layer shall be no more than 10% of the total thickness,

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and the combined thickness of the bright and special particle nickel layer added to provide discontinuities in chrome shall be no less than 30% of the total nickel thickness. When total nickel thickness exceeds the minimum required, the overall ratios of the layer thickness may vary from those implied above so long as the minimum thickness of each layer as determined at minimum required total thickness is exceeded.

4.3.2.6 Due to the complex geometry of some parts, such as exhaust pipes, there may be a vast difference in the plated thickness between low and high current density locations. It may not be practical and/or cost effective to meet the minimum thickness in low current density locations on these parts. In such cases, the supplier shall request a plating thickness deviation from Materials Engineering. With the approval of Materials Engineering, an average of plating thickness at selected locations may be used to meet the minimum plating thickness. However, at no location on A or B class surfaces will the plating thickness be below 60% of the minimum thickness specified.

4.3.3 Step Test – Interlayer Anodic Potential Difference

4.3.3.1 Test per ASTM B-764

4.3.3.2 The bright nickel layer shall exhibit a minimum of 100 mV anodic potential difference to the semi bright nickel layer on all significant surfaces.

4.3.3.3 The microdiscontinuous top nickel layer shall be more noble than the bright nickel layer and shall exhibit a potential difference between 10 and 60 mV greater than the bright nickel layer.

4.3.4 Nickel Sulfur Content and ductility

4.3.4.1 The semi- bright nickel layer for a double or triple layer nickel coating shall contain less than 0.005 mass % sulfur and have a ductility of greater than 67% (ASTM B490)

4.3.4.2 The bright nickel layer for any double or triple layer nickel coating shall contain no less than 0.04 mass % sulfur and have ductility of no less than 3% (ASTM B490) for exhaust components and no less than 8% for all other parts.

4.3.4.3 The intermediate layer in a triple layer nickel coating shall contain no less than 0.15 mass % sulfur.

4.3.5 Chrome Microdiscontinuity

4.3.5.1 The chrome layer may be microporous (mp) or microcracked (mc). Microporous chrome is more common and preferred type of chrome. Non-microdiscontinuous chrome (r) should not be specified on new designs or allowed on resourced parts.

4.3.5.2 Microporous chrome layers shall exhibit a minimum of 10,000 pores/cm² as determined by the copper deposition (Dubpernell) method as described in ASTM B 456 or a minimum of 2000 pores/cm² as determined by active corrosion sites after testing as described in ASTM B 456.

4.3.5.3 If microcracked chrome is used, it shall exhibit a crack density of 300-850 cracks per linear centimeter (750-2200 cracks/in.)

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