WORLDWIDE ENGINEERING STANDARDS	Material Specification	GMW15774

Chromium Plated Aluminum Wheels and Aluminum Wheel Metal Trim

1 Scope

This standard covers the materials and processing required to chromium plate aluminum wheels and trim. Plating durability requirements are also included.

While not all surfaces of a three dimensional part can be exposed at the prescribed test angles, all exposed surfaces must be evaluated for compliance to the requirements. In order to evaluate a wheel to this specification, a part drawing is required so that the analyst can select the appropriate tests for the various plated, partially plated, and painted surfaces.

1.1 Material Description. Chromium Plated Aluminum Wheels and Aluminum Wheel Metal Trim.

1.2 Symbols. Not applicable.

1.3 Typical Applications. This specification applies for all cast and forged wheels and could also be used for some metallic trim on wheels.

2 References

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

2.1 External Standards/Specifications.

ASTM B456	ISO 2177
ASTM B764	ISO 3497
ISO 1463	

2.2 GM Standards/Specifications.

GMW3059	GMW14700	GMW15891
GMW3286	GMW14829	GMW15919
GMW14458	GMW15282	

2.3 Additional References.

TMC003 Material Safety Data Sheet guidance documents (available at www.gmsupplypower.com).

3 Requirements

Note: Online systems using more than one chemical supplier are not recommended for purposes of problem resolution and continuous improvement.

3.1 Chemical Requirements.

3.1.1 Pretreatment for Chromium Plating. Adequate pre-plating surface preparation requires cleaning and metrology related procedures. The choice of these procedures should be based upon knowledge of the incoming surface to be prepared, including the soils, surface topography and alloy chemistry. It is recommended that only one chemical supplier be used throughout the preparation stages, for purposes of problem resolution and continuous improvement.

3.1.2 Physical Requirements.

3.1.2.1 Plating Thickness. Plating thickness measurements shall include a mapping of the areas of the wheel as identified on the part drawing.

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3.1.2.1.1 Plating Thickness Requirements.

- Chrome (0.25 to 0.4) µm
- Micro porous nickel (No minimum but must meet STEP requirements)
- Bright nickel 16 µm minimum
- High sulfur nickel (No minimum but must meet STEP requirements)
- Semi-bright nickel 24 µm minimum
- Semi-bright/(semi-bright + bright) 60 % minimum
- Copper thickness 10 µm minimum
- Total nickel thickness 40 µm minimum
- Total plate thickness 50 µm minimum

3.1.2.1.2 Plating thickness requirements apply on all surfaces designated on the Engineering Part Drawing.

3.1.2.1.3 Plating thickness shall be determined by the microscopic method, ISO 1463, the electrochemical method, ISO 2177 or the x-ray method, ISO 3497. The x-ray method is applicable to measuring only the chrome thickness.

3.1.2.1.4 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 Plated Part Performance for Primary Surfaces. The engineering part drawing shall designate all of the surfaces that must meet these requirements. These surfaces should all be plated with near optimum current densities as recommended in the control plans and technical data sheets for the process and chemicals, respectively, either by system anodes or auxiliary anodes. In addition, these surfaces shall be protected from creepback, peeling or other forms of degradation that could initiate from other areas of the part. The table in Appendix B could be used to organize the plating data for PPAP submissions.

The test parts shall be positioned in the environment such that at least one of the primary surfaces is exposed at the specified Copper Accelerated Acetic Acid Salt Spray (CASS) test (GMW14458) angle, but all exposed surfaces must be evaluated for compliance to the requirements. Since all other surfaces would therefore be exposed to a less severe environment than the chosen primary surface, they should be evaluated and held to the full requirements of the specification.

3.2.1 Plated parts must pass 120 h of CASS testing per GMW14458, with no significant corrosion on the exposed surfaces. Parts should be evaluated at 66 h to determine if the finish is in conformance at that stage of the test. The only visual change that could be considered acceptable is the expected opening of the micro pores because this is designed into the system as a mode of degradation. The micro pore change must be uniform, and must be considered acceptable to the buyer of the parts. Analysts are encouraged to develop visual standards and review them with GM for a conformance/non-conformance agreement.

3.2.2 All surfaces with some plating must pass the Reverse Saw Cut Test, Appendix A. In the Reverse Saw Cut Test, position the part in a vise or fixture so that the exterior plated surface is perpendicular to the saw blade and the cutting motion of the blade is in a direction which tends to pull the plating away from the base metal with no loss of adhesion at any interface. Without exception, all surfaces with any plating must pass this test with no loss of adhesion.

3.2.3 Plated parts shall be evaluated using the following Thermal Shock Test after CASS exposure:

Parts or wheel sections shall be heated to (+150 ± 10) °C for 1 h ± 15 minutes and then direct immersed to water at room temperature ((+23 ± 3) °C). The requirement is no blistering or flaking of the coating after immersion.

3.2.4 Nickel Electrode Potential. Determine potential difference following ASTM B764.

3.2.4.1 The bright nickel layer shall exhibit an anodic electrode potential difference of 100 mV minimum and 170 mV maximum to semi-bright nickel.

3.2.4.2 The bright nickel layer shall exhibit an anodic electrode potential difference of 10 mV minimum and a 40 mV maximum to the micro porous nickel layer.

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3.2.4.3 The bright nickel layer shall exhibit a cathodic electrode potential difference of -40 mV minimum and a -5 mV maximum to the high sulfur nickel.

3.2.5 Discontinuous Chromium. This shall be evaluated 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.

3.2.5.1 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. Stripping of chrome after 120 h CASS testing and prior to active site determination is acceptable.

3.3 Secondary Surfaces. The brake side and tire side of the rim are secondary surfaces that could require cosmetic protection beyond that which is provided by the less than optimum current densities plated within these areas. The cosmetic performance of these surfaces must meet the consumer's expectations and is the responsibility of the wheel manufacturer.

The engineering part drawing must document the specific areas for which the minimum requirements of the primary and secondary surfaces apply. In addition, the wheel supplier is responsible for implementing adequate cosmetic protection to avoid peeling of the plating layers and thus, avoid cosmetic or handling issues for all wheel surfaces.

Production parts must meet the requirements of this section when tested 72 h minimum after the coating process is completed. A shorter aging time may be used provided it is recognized that it represents a more severe condition of test.

Rim sections of the test parts shall be positioned in the environment such that each type of secondary surfaces of interest is tested at the prescribed test angle. The part drawing is required so the analyst can determine how many surfaces should be evaluated, e.g., brake side rim, tire side rim, back of the spokes, etc.

3.3.1 All rim areas where a coating is applied over the plating must meet the following requirements:

3.3.1.1 There shall be no creepback, peeling, or flaking more than 1 mm from a straight scribe, and no blisters after being exposed to 66 h in CASS per GMW14458, and followed by air blow-off of the scribe per GMW15282.

3.3.1.2 After exposure to 500 h according to GMW3286, the un-scribed surface shall not exhibit any evidence of blistering or other appearance changes. The exposure will be continued to 1000 h, the surface will be examined for changes, and any changes will be addressed in the supplier's continuous improvement plans.

3.3.1.3 Coatings shall exhibit 99 % adhesion along a scribe as shown in GMW14829, after exposure to the Thermal Shock Test according to GMW15919.

3.3.1.4 Chip resistance according to GMW14700 with a Rating ≥ 6 between the plating and the coating. No chipping is allowed between plating layers.

3.3.1.5 Paint cure test according to GMW15891.

3.3.2 Coating thickness shall be identified on the drawing with minimum film builds at designated T points for each surface of the wheel. Since the quality of each low current density surface is unique and depends on the wheel design, and the process pretreatment and plating, the amount of added protection that is required of a coating must be determined by the wheel manufacturer. The wheel manufacturer shall document the coating and coating thickness for each surface on the part drawing.

4 Manufacturing Process

Not applicable.

5 Rules and Regulations

5.1 Legal Regulations. All materials must satisfy applicable laws, rules, regulations and recommendations valid in the country of usage.

5.2 Language. In the event of conflict between the English and domestic language, the English language shall take precedence.

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