



Zinc Plating

1 Scope

This specification covers the basic requirements for electroplated zinc applied to iron and steel substrates with provision for plating thickness, use or non-use of supplementary treatments and corrosion resistance. Provision is also made to specify mechanical plating. GMNA MATSPC approvals for this finish are specific to the post-supplementary treatment (Suffix) evaluated for initial chemical/applicator approval (reference section 6 Approved Sources).

1.1 Material Description. This coating system must be free of hexavalent chromium, per GMW3059 requirements. The plating shall be shown on the part drawing as per the example shown in Section 7. Table 1 lists the common plating thickness codes covered by this specification.

It is recommended to use these common codes to avoid product complexity.

This plating is at present approved in clear (bright) color only. Black color (passivation product) as shown in Table 1 is not approved yet. Any other colors (where color is developed by adding pigment), if required don't need specially approved source for the color. Establish availability at one of the sources approved to the required post-supplementary code (suffix) before putting any color other than clear (Bright) on the drawing.

1.2 Cross-Reference of Replaced Specifications.

GMW	GMW3044
Delta Motors	
GM do Brasil	
GM Holdens	HN1264
GMNA	GM4345M
ISUZU	
ITDC	GME 00252
SAAB	

1.3 Typical Applications. Zinc plating is typically applied on small to medium-sized ferrous parts such as castings, fasteners, stampings, and clips.

1.3.1 Zinc plated parts or their corrosion products must not come in contact with stressed Polyamides 6 or 66.

1.3.2 Zinc plating types without supplementary treatment are also used as a basecoat for an additional paint. This coating must be so applied that no negative influence in appearance and adhesion appears (e.g. blistering by effusion of hydrogen).

2 References

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

2.1 External Standards/Specifications.

ASTM F1470	SAE/USCAR-5
DIN 946	SAE/USCAR-7
ISO 9227	SAE/USCAR-11

2.2 GM Standards/Specifications.

9984094	GM6175M
9985490	GM6189P
GM4260P	GMW3001
GM6121M	GMW3059
GM6121M	

3 Requirements

3.1 Appearance. The *as-received* appearance and color hue shall be as agreed upon between the purchaser and supplier using approved color and hue engineering standards when available. In the case of zinc plus passivation coating listed herein, a clean, commercial finish is required; range of color, iridescence, opaqueness, and sheen are normally not critical unless otherwise specified by the purchaser. In the case of bright zinc plus clear finishes listed herein, a clear bright appearance (also referred to as colorless, blue-bright and clear silver-white) is required. Specified colors shall be uniform, tightly adherent, hard and dry.

3.2 Plate Thickness. Thickness of plate shall be no less than the values shown in Table 1 or as designated for the suffix specified by Product

Engineering. Such values are intended to apply to significant surfaces as specified on engineering drawings. In the case of finishes with supplementary treatment, color, etc., the values shown apply to the thickness of plate after treatment. Supplementary treatments such as oils, waxes or other specified coatings are not applicable to thickness measurements. The plating thickness on bolts and screws shall be measured on the head and the thread tip, on nuts it shall be measured on the spanner flats.

3.2.1 The thickness of the plated finish shall be determined by microscopic examination of cross sections taken perpendicular to significant surfaces, or by other methods agreed upon by the supplier and purchaser. For recommended practice for measuring thickness of electrodeposits see GM4260P.

3.2.2 The maximum allowable thickness of the plating on threaded fasteners shall be twice the minimum specified plating thickness. The maximum thickness of plating, which may be applied to threads on threaded products, is limited by the basic thread size (tolerance h or H). After coating, parts must gage with appropriate basic size GO thread gage. Threads may be produced undersize/oversize (before coating) to accommodate the coating thickness, providing the finished product (after coating) meets all specified mechanical properties. Where mechanical properties are not specified, undersizing/oversizing is subject to approval by pertinent engineer, and all undersize/oversize shall be within permissible limits as agreed upon.

3.2.3 The allowable variation of maximum plating thickness in case of non fasteners could be more than twice the minimum specified plating thickness, as long as it shall not effect the function of the part.

Note: In special cases, such as welding applications, limiting the maximum plating thickness to a specific requirement shall be noted on the engineering drawing.

3.3 Adhesion. The coating shall have good adhesion to the base material. There shall be no blistering or flaking of the finish, including after any heat treatment as follows:

The adhesion in the as-received conditions shall be checked as follows:

Expose coated parts to $220 \pm 5^\circ\text{C}$ for 30 ± 5 minutes and quench in water at room temperature. After quenching in water blistering and/or chipping is not allowed.

Electrolytically coated components produced from aqueous solutions must satisfy the mechanical property requirements of the uncoated parts.

3.4 Corrosion Resistance. Parts plated to these specifications shall be capable of withstanding NSS testing for the minimum number of hours shown in Table 1 or as designated for the suffix specified by the purchaser.

3.4.1 Parts must be tested to ISO 9227 to meet the corrosion resistance requirements on significant surfaces per 3.4.4 and 3.4.5 for initial approval of the finish, applicator and PPAP submissions.

3.4.2 For the normal production process, the NSS test shall be part of the applicator's statistical process control to ensure that parts meet the corrosion resistance requirements.

3.4.3 The applicator shall run a periodic NSS test of the parts in process on each line running this coating, with sample size of three pieces minimum per shift per line. Based upon the chemical manufacturer's instructions the actual processing control checks shall be made and recorded. The supplier shall maintain the test results in a file to be submitted when required by GM, unless otherwise agreed between the purchaser and supplier.

3.4.4 Significant surfaces for test evaluation of fasteners shall be all exposed surfaces of the fastener when installed, including but not limited to fastener heads, socket recess, sems washers and external surface of nuts. Fastener threads and point are excluded unless otherwise specified on the drawing.

3.4.5 Significant surfaces on parts other than threaded fasteners shall be all surfaces. Deep recesses, such as blind holes and the interior of tubes are excluded unless otherwise specified on the drawing.

3.4.6 In the case of finishes involving supplementary treatment, parts shall be aged at the ambient laboratory temperatures for at least 24 h before the test. In some cases, a heat treatment $1 \text{ h} \pm 5 \text{ minutes}$ at $+150 \pm 5^\circ\text{C}$ may be required prior to NSS testing. When such treatment is necessary, it shall be specified on the part drawing by using an H in the plating suffix as shown in the section 7 of this specification. In this case the finish shall meet the corrosion resistance requirements before and after heat treatment.

3.4.7 When evaluation of zinc corrosion products is specified, acceptable resistance is defined as no white corrosion products on significant surfaces after exposure to NSS for the number of hours shown.

3.4.8 Except for black, color dyed, bright, light iridescent blue and clear coatings, the degree of color change after salt spray test is not a significant

parameter unless otherwise agreed upon by the purchaser and supplier.

Table 1: Zinc Plating and Related Finishes

Code to Specification Number	Minimum Plating Thickness (μm) (Note 2)	Supplementary Treatment (Note 3)	Typical Appearance (Note 4)	Neutral Salt Spray, h (Note 5)	
				Base Metal Corrosion	Zinc Corrosion Product (Note 6)
3U24/0	3	None	No Requirement	24	–
6U48/0	6			48	–
9U72/0	9			72	–
12U96/0	12			96	–
15U120/0	15			120	–
6K96/48	6	Passivation /Conversion Coating	Clear (Bright)	96	48
8K240/120	8			240	120
15K360/120	15			360	120
8B240/120	8	Passivation /Conversion Coating	Black	240	120

Note: Other codes are possible in special cases e.g. 11K360/120 and may be devised as per the guidelines in paragraph 1.1. Establish availability before creating special codes.

Note 1: Where a mechanical (peen) plating is required in lieu of electroplating, the letter M is added to the code in the position immediately following the thickness number, e.g.: GMW3044 6MU48/0.

Note 2: See paragraphs 3.2.2 and 3.2.3 for maximum thickness requirements. Any deviation for the plating thickness requirements can be shown on the drawing of the part.

Note 3: Further supplementary treatments such as oil, wax or other coatings, if required, are specified on the drawing as suffix Y. Any changes that affect corrosion properties shall be negotiated between the purchaser and supplier.

Note 4: Clear (Bright) and Black colors are available. Establish availability before putting any color other than Clear (Bright) and Black on drawing. Unless other color is specified supplier will process the parts in Clear (Bright) color.

Note 5: When the finish is to be heat treated prior to salt spray testing, the letter H shall be shown as the last character of the plating code, e.g. GMW3044 8K240/120XH. Samples shall be heat treated for 1 h ± 5 minutes at (+150 ± 5)°C.

Note 6: Codes that specify more than 48 h to zinc corrosion products may require special handling. The suffixes T, X, Y, G, or N when added to the plating code, indicate the application of post-treatment materials as described in 3.6. Example: 8K240/120X.

3.5 Hydrogen Embrittlement. All parts heat treated or highly cold worked to the specified core hardness greater than HRC 32 or surface hardness HRC 35, which are processed through the hydrogen generating processes shall be processed per SAE/USCAR-5 and tested for de-embrittlement per SAE/USCAR-7. The sample size for the SAE/USCAR-7 test shall be per ASTM F1470.

3.5.1 When supplementary treatment is specified for a part that requires baking after plating, the

supplementary treatment shall be applied after the baking operation.

3.6 Processing Requirements. For certain applications a post-treatment of the electrolytically coated components — with or without passivation — may be necessary, using lubricants, waxes, dipping solutions or other materials. In this case the following suffixes apply:

T: with or without dipping solution, coefficient of friction 0.13 ± 0.03 (6-sigma). This suffix is to be used on fasteners of special applications to meet 3.7, 3.8 and 3.9 requirements.

X: with dipping solution only.

G: with or without dipping solution, coefficient of friction 0.13 ± 0.03 (6-sigma). This suffix is to be used on general fasteners to meet the basic torque- tension/coefficient of friction requirements per 3.7 and 3.8.

Y: other material, as specified on drawing. Y suffix could be used along with other suffix in a code if required (example: GMW3044 8K 240/120NY, then describe 'Y' on the drawing)

N: without any dipping solution, lubricant, or any chemicals applied.

Note: If no suffix to the code is used the provision of suffix N shall apply.

3.6.1 All these treatments shall not reduce the corrosion protection of the finish.

3.7 Torque-Tension Test. For bolts and nuts which are post-treated to suffixes G and T, M10 x 1.5 surrogate bolts shall be processed with the production parts. A minimum of ten bolts per finish line per shift shall be tested per SAE/USCAR-11, except tightening speed shall be 30 ± 3 RPM and test parts as shown in Table 2. The six sigma torque value must be within the listed range (Table 2). The test results shall be maintained in the file to be submitted when required by GM.

Table 2: Test Parts

Thread Size	Surrogate Bolt Part Number	Test Nut Part Number	Test Washer Part Number	Torque (N·m)	Tension (kN)	Suffixes
M10 x 1.5	11516105	11516090	11502644	48 ± 8	28.3	T and G

Note: Engineering drawings for surrogate fasteners for Torque-Tension test are available from Global Engineering Document/IHS.

3.8 Coefficient of Friction. For fasteners, which are post-treated to suffixes G and T, the coefficient of friction of the threaded fasteners tested per DIN 946 shall be 0.13 ± 0.03 (6-sigma).

Note: Both tests shall be run for the initial approval of the finish materials. Suppliers are required to run either the Torque-Tension Test or the Coefficient of Friction Test for routine test.

3.8.1 Coefficient of Friction Test. The coefficient of friction of threaded fasteners shall be tested per DIN 946 with the following exceptions:

- Tightening speed shall be 30 ± 3 RPM
- Test samples (excluding driven fasteners shall be thoroughly cleaned with an appropriate fluid/chemical to remove any grease/oil/wax/other contaminants.
- Test clamping force shall be calculated at 75% of proof load.

3.9 Bearing Surface Characteristics. For bolts and nuts which are post treated to suffix T, M10 heavy flange bolts (part number 11900193 or equivalent) shall be monitored per SAE/USCAR-11 with the following requirements: Tightening speed shall be 30 ± 3 RPM. Test nut shall be 11516090. Tension load shall be 24 kN. Tests shall be conducted with ELPO coated test washers (11515490 except unhardened and coated with 9984094, medium build ELPO) and aluminium test washers (3.0 mm min thick, (10.25...10.50) hole size, AA6063T52 aluminium). The 6-sigma torque

range must lie within (35...52) N·m for ten samples tested for both the ELPO and aluminum bearing surfaces.

Note: This test is required for the initial approval of the finish chemicals only. This testing does not supersede PPAP requirements of the individual part.

3.10 Thread Locking/Sealing Compatibility. The finish shall be compatible with thread adhesives, non-metallic elements/sealers in thread locking/sealing abilities when tested per GM6124M (paragraphs 3.4 & 4.1), GM6175M (paragraph 6.1), GM6189P (paragraph 4.1), and 9985490 (paragraph 4.3) specifications.

Note: This test is required for the initial approval of the finish chemicals only. This testing does not supersede PPAP requirements of the individual part.

3.11 Label Adhesion Compatibility. This finish shall be compatible with labels (Part Number 12565635 or label of equivalent construction) in adhesion when tested per GM6121M (paragraph 4.2). Test plaques (Steel, 75 x 125 mm) containing the plating post treatment and affixed label shall be tested per GM6121M.

Note: This test is required for the initial approval of the finish chemicals only. This testing does not supersede PPAP requirements of the individual part.

4 Manufacturing Process

Not applicable.

5 Rules and Regulations

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

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

6 Approved Sources

Suppliers to this specification must be approved by the respective GM Specialist Teams/TDGs. GMNA approved supplier names are available in the on-line MATSPC system. GMNA approvals are specific to the post supplementary treatment suffix (T, G, X, or N) tested for initial approval of the supplier. Approval to suffix G & X will be automatic with a suffix T approval, and a suffix X approval will be automatic with a suffix G approval due to subset test requirements. Any approved applicator can provide zinc plated parts without passivation conversion (code U). The GM MATSPC system supplier approval listings include the specific suffix approvals. For other GM locations, the appropriate engineering group should be contacted to obtain the approved sources in the individual countries.

7 Coding System

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

Material per GMW3044

Example:

Zinc Plating per GMW3044 15K360/120XH (clear) indicates the following:

3044 – Specification Number

15 – 15 micrometer min thickness

K – Clear conversion coating

360 – 360 h NSS without evidence of base metal corrosion

120 – 120 h NSS requirement for white corrosion

X – with dipping solution only.

H – Heat Treatment required prior to NSS testing

Clear – Clear appearance

8 Release and Revisions

8.1 Release. This specification was first approved in February 2000 and published in June 2000.

8.2 Revisions.

Rev	Approval Date	Description (Organization)
E	SEP 2004	Revised Table 1 and Note 2 and 6, old paragraphs 3.1.3.2.2, 3.1.4.1.4, 3.2, 3.2.2.2.1 and Appendix A and rewrote in new GMW template. (GMNA)
F	APR 2005	Revised sections 1, 6 and Table 1, added tightening speed to 3.1.4.10, deleted Appendix A with some editorial changes.