



## **Zinc Plating**

### **1 Scope**

**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. 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, do not need a 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 Symbols.** Not applicable.

**1.3 Applicability.** Zinc plating is typically applied on small-sized 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).

**1.4 Remarks.** This specification covers the basic requirements for electroplated zinc applied to fasteners, clips, and small and medium-sized ferrous parts, such as castings and stampings. This specification also provides for plating thickness, use or non-use of supplementary treatments and corrosion and for mechanical plating. GM Materials Engineering approvals for this finish are specific to the post-supplementary treatment (suffix) evaluated for initial chemical/applicator approval (reference Section 6).

The use of this specification to plate other parts, including, but not limited to, stampings or roll-formed parts for body or chassis applications must be reviewed and approved by the responsible materials engineering organization.

### **2 References**

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

#### **2.1 External Standards/Specifications.**

|            |          |             |              |
|------------|----------|-------------|--------------|
| ASTM E140  | ISO 1463 | ISO 16047   | SAE/USCAR-7  |
| ASTM F1470 | ISO 9227 | SAE/USCAR-5 | SAE/USCAR-11 |
| DIN 946    |          |             |              |

#### **2.2 GM Standards/Specifications.**

|         |          |          |
|---------|----------|----------|
| 9984094 | GMW3221  | GMW14657 |
| GMW3059 | GMW14573 | GMW17000 |

#### **2.3 Additional References.**

None

### **3 Requirements**

**3.1 Requirements on Test Specimens.** Reference GMW3221.

**3.2 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.

**3.3 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.

**3.3.1** 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 ISO 1463.

**3.3.2** 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 gauge with appropriate basic size Go thread gauge. Threads may be produced undersize or 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 or oversizing is subject to approval by the pertinent engineer, and all undersizing or oversizing shall be within permissible limits as agreed upon.

**3.3.3** The allowable variation of maximum plating thickness in the case of non-fasteners could be more than twice the minimum specified plating thickness, as long as it shall not affect 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.

**3.4 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  $220 \pm 5$  °C for  $30 \pm 5$  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.

**3.5 Corrosion Resistance.** Parts plated to these specifications shall be capable of withstanding Neutral Salt Spray (NSS) testing for the minimum number of hours shown in Table 1 or as designated for the suffix specified by the purchaser.

**3.5.1** 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 Production Part Approval Process (PPAP) submissions.

**3.5.2** 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.

**3.5.3** The applicator shall run a periodic NSS test of the parts in process on each line running this coating, with sample size of three (3) 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.

**3.5.4** 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.

**3.5.5** 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.

**3.5.6** 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  $+150 \text{ }^{\circ}\text{C} \pm 5 \text{ }^{\circ}\text{C}$  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 Section 8 of this specification. In this case, the finish shall meet the corrosion resistance requirements before and after heat treatment.

**3.5.7** 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.

**3.5.8** 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 <sup>Note 1</sup> | Minimum Plating Thickness ( $\mu\text{m}$ ) <sup>Note 2</sup> | Supplementary Treatment <sup>Note 3</sup> | Typical Appearance <sup>Note 4</sup> | Neutral Salt Spray, h <sup>Note 5</sup> |                                          |
|------------------------------------------------|---------------------------------------------------------------|-------------------------------------------|--------------------------------------|-----------------------------------------|------------------------------------------|
|                                                |                                                               |                                           |                                      | Base Metal Corrosion                    | Zinc Corrosion Product <sup>Note 6</sup> |
| 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/<br>Conversion<br>Coating     | Clear (Bright)                       | 96                                      | 48                                       |
| 8K240/120                                      | 8                                                             |                                           |                                      | 240                                     | 120                                      |
| 15K360/120                                     | 15                                                            |                                           |                                      | 360                                     | 120                                      |
| 8B240/120                                      | 8                                                             | Passivation/<br>Conversion<br>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 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 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 a drawing. Unless other color is specified, the 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  $1 \text{ h} \pm 5 \text{ minutes}$  at  $+150 \pm 5 \text{ }^{\circ}\text{C}$ .

**Note 6:** Codes that specify more than 48 h before 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.

**3.6 Hydrogen Embrittlement.** Fasteners heat-treated or highly cold-worked to the specified core hardness greater than HRC 32 (HV320) or surface hardness HV 353, 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.