GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification	GMW8

Hot Dip Zinc Coatings for Sheet Steel

1 Scope

This standard covers the requirements for hot dip coatings, both galvanized and galvannealed, applied to a sheet steel substrate utilizing a continuous hot dip process. The substrate may be cold or hot rolled sheet steel specified per GMW2, GMW3032, GMW3399, or GMW17627. Additional requirements or agreements shall be specified by regional GM business units. Coated substrates per GMW14400 are **not** within the scope of this specification.

1.1 Material Description. The type of coating and its mass and finish are specified by suffixes added to the basic specification number. The first two (2) letters will designate a continuous hot dip (HD) coating. The coating mass for each side is designated by a minimum value in gram per square meter (g/m^2). Only coating masses shown in Table 1 shall be used unless Materials Engineering is consulted. Other coating masses shall follow the same designation method. The letter G designates a pure zinc coating (galvanized) and the letter A designates a zinc/iron alloy (galvannealed) coating. The first set of digits along with the letter designation specifies the coating parameters of the unexposed side. The remaining designation specifies E (exposed), Z (semi-exposed), U (unexposed), or T (temper-rolled).

1.2 Symbols. Not applicable.

1.3 Applicability. Sheet metal parts consisting of steel grades as described in GMW2, GMW3032, GMW3399, or GMW17627.

1.4 Finish Suffixes.

1.4.1 Exposed (E). A finish produced by eliminating all visual spangle pattern and surface defects per 3.1.3.3, to be used for critical appearance applications.

1.4.2 Semi-Exposed (Z). A spangle free finish produced by minimizing surface defects per 3.1.3.3 is used for secondary visible surfaces that do not require an exposed quality finish.

1.4.3 Unexposed (U). A minimum spangle finish used for non-critical appearance applications. See 3.1.3.3.

1.4.4 Temper Rolled (T). This surface shall have sufficient temper rolling such that Luders Lines or stretcher strain will not show when formed and painted. All other requirements are the same as U surface described in 1.4.3.

2 References

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

2.1 External Standards/Specifications.

ISO 1460	ISO 7438

2.2 GM Standards/Specifications.

GMW2	GMW14019	GMW14829	GMW16549
GMW3032	GMW14699	GMW15056	GMW16823
GMW3059	GMW14700	GMW15282	GMW17627
GMW3399	GMW14704	GMW15425	
GMW4795	GMW14729	GMW16170	

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2.3 Additional References.

- GWS-5A (ID)
- weld.council@gm.com

(ID) = This reference is limited to internal use within General Motors and shall not be accessed outside this company. Contact the GM Lead Engineer for further instructions.

3 Requirements

3.1 Requirements on Delivery. Section 3 defines specific requirements for material on delivery, processing, performance, and other stages during life cycle performance. Deviations required for individual GM business units are listed in the Deviations Section and shall be agreed upon between GM Purchasing and the supplier.

3.1.1 Chemical Requirements.

3.1.1.1 Free Zinc Coatings. The coating produced shall consist of pure zinc and only minimum alloy layer. Pure zinc coatings may contain 75 ppm maximum cadmium and 100 ppm maximum lead, and must meet the requirements of GMW3059. The coatings shall not contain trace elements that are detrimental to adhesive bondability, phosphateability or paintability.

3.1.1.2 Zinc-Iron Alloy Coatings. The coating is produced on a continuous hot dipped galvanizing line followed by a thermal treatment. The zinc-iron alloy shall be a completely alloyed coating. This product is not spangled and has the tendency to powder when severely formed. For this reason, the bulk iron content of the coating shall be 8% to 12% by mass, when tested per GMW4795 or other regionally accepted specification, in order to eliminate flaking problems. Zinc-iron coatings may contain 75 ppm maximum cadmium and 100 ppm maximum lead, and must meet the requirements of GMW3059.

3.1.1.3 Base Metal. The sheet steel base metal chemical composition shall conform to the requirements specified in GMW2, GMW3032, GMW3399, or GMW17627.

3.1.1.4 Surface Treatment. Products coated with a designated lubricant (e.g., mill oil or prelube) shall comply with GMW14019 and/or be approved by the local business unit. Material shall be supplied unpassivated/unchromated and any supplemental coatings shall be approved by the local GM Materials Engineering Department.

3.1.2 Mechanical Requirements.

3.1.2.1 Coating Bend Test. All bend tests shall be performed in accordance with ISO 7438. For all steels supplied according to GMW2 and GMW3032 (with 0.2% offset yield strength < 500 MPa), a Zero T (0T) bend test shall be performed. Test specimens of coated metal shall be capable of being bent through 180 degrees in any direction without evidence of flaking of the coating when viewed at 10x magnification on the outside of the bend only. For steels supplied to GMW3032 with 0.2% offset yield strength > 500 MPa and all GMW3399 and GMW17627 grades, the steel must be capable of a 90 degree test in any direction with a maximum former radius (r) related to the steel thickness (t) without evidence of flaking when viewed at 10x magnification on the outside of the bend. Refer to Appendix A, Table A1 for maximum bend test former radii for each grade and a diagram of the test setup (Appendix A, Figure A1). For testing of all steels, flaking of the coating within 6 mm of the edge of the bend test shall not be cause for rejection. The specimens shall not be cut < 25 mm from the coil edges of the test sheet.

3.1.2.2 Coated Base Metal. The mechanical properties of the coated material in the as delivered condition shall conform to the requirements specified in the applicable GMW or industry substrate standards.

3.1.3 Physical Requirements. Coating mass and finish quality shall conform to the requirements prescribed in Table 1.

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Table 1: Preferred Coatings and Coating Mass Requirements Note 1, Note 2

	40G40G	50G50G	60G60G	70G70G	90G90G	45A45A	52A52A
Minimum Average Coating Mass Each Side by Triple Spot Test (g/m^2)	40	50	60	70	90	45	52
Maximum Average Coating Mass Each Side by Triple Spot Test (g/m^2)	60	70	90	100	120	60	74
Minimum Coating Mass for any Individual Spot (g/m^2)	34	43	50	60	75	40	45
Coating Thickness Each Side Note 1 Minimum/maximum (microns) by triple spot test:	5.6/8.5	7.0/9.9	8.5/12.7	9.9/14.1	12.7/16.9	6.3/8.5	7.3/10.4

Note 1: Coating thicknesses are shown for reference only, not for conformance to specification requirements.
Note 2: Other coating masses may be used by exception. Refer to Deviations Section.

3.1.3.1 Coating Mass. ISO 1460 shall be used for determination of coating mass of hot dip zinc coatings. Test sample size shall be 2000 mm^2 minimum with a preferred sample size of 3330 mm^2 (57.7 mm ± 0.1 mm square or 65.1 mm ± 0.1 mm in diameter). Coating mass shall be measured by triple spot test and must conform to the values in Table 1. The mass shall be the average of three (3) measurements taken across the width of the strip at least 25 mm from each edge. In no case shall the lowest value of any of the three (3) test samples fall below the minimum individual spot requirement in Table 1. Each side should be measured separately to ensure that the requirements of Table 1 are met. See Deviations Section at the end of this standard.

3.1.3.2 Coating Thickness. Coating thickness measurements may be used for routine quality control evaluations. Coating thickness shall be measured using a suitable layer thickness gauge, on-line x-ray gauge or from a specimen cut perpendicular to the panel surface. Suitable instruments for evaluation of coating thickness (e.g., Eddy current, ferromagnetic, or metallurgical microscope) shall have a capability of ± 1.0 µm accuracy. When using a metallurgical microscope, standard mounting practices shall be used and thickness shall be measured at 1000x magnification. The referee method for determining coating thickness shall be coating mass, as specified in 3.1.3.1. For conversion between coating thickness and coating mass, the density factor of 7.1 g/cm^3 shall be used for pure zinc and zinc-iron alloy (galvannealed) coatings.

3.1.3.3 Coating Surface Quality. The steel shall be free from surface defects as negotiated between purchaser and supplier. For unexposed (U) surfaces defects such as, slight indentations, small marks, minor scratches, and slight coloring, which do not affect corrosion resistance, formability or the application of surface coatings are allowed. Exposed (E) surface shall be free of defects which might affect the uniform appearance of quality paint or an electrolytic coating, electrodeposited primer, cathodic e-coat (ELPO). Semi-exposed (Z) surfaces are spangle free and skin passed (temper rolled) to impart a higher degree of smoothness than is normal for as coated products. Certain applications require that both surfaces of the steel be of exposed (E) or semi-exposed (Z) surface quality. Temper rolling may be required and shall be specified with a (T) designation. The other surfaces shall conform at least to surface quality (U). Regulations in detail will be issued by the local business unit.

3.1.3.4 Surface Texture. Specific requirements for the texture for each region are detailed in GMW16823.

3.1.4 Additional Requirements.

3.1.4.1 Marking. Unless otherwise agreed at the time of ordering, marking shall be carried out on the unexposed surface of full finish coils for the outer panels and on the outer side of the coils for inner panels. The marking ink shall not interfere with welding, phosphating/thin film pretreatments, transfer to opposite side or print through during fabrication. The marking shall be agreed upon between the supplier and purchaser. The ink used for marking shall be released by the purchaser.

3.1.4.2 Other Requirements. Requirements such as tolerances on product shape and dimensions, inspections units, number of tests, sampling, test conditions, retests, inspection documents, packing, and handling of disputes shall be agreed upon between supplier and the local business unit.

3.2 Processing Requirements.

3.2.1 Additional Requirements.

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