



Thin Organic Precoatings

1 Scope

1.1 Material Description. Thin organic precoatings are applied on zinc-plated coil material by no-rinse technique. To realize good adhesion, chromium-free adhesion promoters are used. For improved adhesion and creep back resistance a passivation can be applied before the application of the adhesion promoter itself. The thin organic precoating can be based on different polymer systems like epoxy, polyurethane, polyacryl, or polyester. The weldability is guaranteed by pigments.

1.2 Symbols. Not applicable.

1.3 Applicability. Thin organic precoatings serve to improve the corrosion protection of flanges and contact faces which cannot at all or only insufficiently be protected from corrosion by secondary measures such as E-coating, application of hem flange sealants or cavity waxing.

1.4 Remarks. This standard covers the requirements for thin organic precoatings applied to a hot dip coated or electro-galvanized sheet steel substrate. The substrate may be cold rolled (CR) or hot rolled (HR) sheet steel. First generation products are not suitable on Bake-Hardening (BH) substrates because of higher curing temperatures.

2 References

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

2.1 External Standards/Specifications.

ISO 20482

2.2 GM Standards/Specifications.

B 040 0180	GMW3221	GMW14085	GMW15200
GMW2	GMW3224	GMW14124	GMW15282
GMW8	GMW3286	GMW14700	GMW15416
GMW11	GMW3399	GMW14704	GMW15425
GMW3008	GMW14019	GMW14729	GMW16549
GMW3032	GMW14057	GMW14829	GMW16823
GMW3059	GMW14058	GMW14872	

2.3 Additional References.

- GWS-1M and GWS-5A (GM SupplyPower website
<http://supplier.body.gm.com/crw/production/main/globalStandards/weldingStandards.cfm>)
- SEP 1160 (Stahl-Eisen-Prüfblatt, available at <http://stahleisen.de> -> Go to Products -> Bookshop)

3 Requirements

3.1 Requirements on Test Specimens. Reference GMW3221, Code D.

3.2 All materials supplied to this standard must comply with GMW3059, **Restricted and Reportable Substances**, including the requirement to submit a full material composition disclosure to GM via the International Material Data System (IMDS) or via a completed GMW3059 report form.

3.3 Requirements on Delivery.

3.3.1 Chemical Requirements.

3.3.1.1 Base Metal. The base metal chemical composition shall conform to the requirements specified in the applicable material specification GMW2, GMW3032 or GMW3399.

3.3.1.2 Coatings. The thin organic precoating shall be tempered completely and shall not contain any volatile organic compounds. The grain size of the pigments has to be minimized by the supplier to receive a homogeneous, smooth surface quality. The pigments may not cause abrasion and wearout of dies and tools. For the zinc precoating below the thin organic precoating the requirements of GMW8 or GMW11 are valid.

Both coatings together may contain 75 ppm maximum Cadmium and 100 ppm maximum Lead and must meet the requirements according to GMW3059. Furthermore the coatings shall not contain trace elements which are detrimental to adhesive bondability or paintability.

3.3.1.3 Surface Treatment. Products coated with a designated lubricant (e.g., mill oil or prelube) shall comply with GMW14019.

3.3.2 Mechanical Requirements.

3.3.2.1 Coated Base Metal. The mechanical properties of the coated base material in as-delivered condition shall conform to the requirements specified in the applicable material specification GMW2, GMW3032, or GMW3399.

3.3.2.2 Cross Hatch Test.

3.3.2.2.1 Flat Panels. The adhesion of the thin organic precoating shall be tested on a flat test sample, degreased with cleaning benzene, by cross hatch test according to GMW14829 for each coated side. After stripping with adhesive tape the result shall be Rating 0. Sample size: 200 mm × 300 mm, 4 to 6 cross hatches on each side.

3.3.2.2.2 Deep Drawn Panels. Three (3) flat test samples 100 mm × 200 mm, degreased with cleaning benzene, shall be provided with three (3) cross hatches each according to GMW14829. The cut zones shall be deep drawn according to ISO 20482 (Erichsen Cupping Test, deformation depth: 6.3 mm). The cross hatches shall be appearing in the center of the deformations, laying on the outer side. After stripping with adhesive tape, the adhesion of the coating shall be checked. Results Rating 0 to 1 are permissible. For two (2) side coated material each side shall be tested.

3.3.2.3 Coating Adhesion Test. (Qualification testing) Coating adhesion of thin organic precoatings to the substrate is evaluated on degreased samples (3 minimum per test condition) that have been adhesively bonded and subsequently investigated by lap shear testing as described in GMW15200-HS-IR-FS with a GM-approved high strength impact resistant full spectrum adhesive.

The adhesive shall be cured in an air circulating oven for 20 minutes at $+170\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ (object temperature).

On one set of samples an "Initial Test" should be performed at ambient temperature, on the other set a "Cold Test" at $-40\text{ }^{\circ}\text{C}$, both as described per GMW15200.

Exhibiting "initial" lap shear strengths $> 16\text{ MPa}$, exhibiting "cold test" lap shear strengths $> 12\text{ MPa}$ are required for each of the tested samples. Cohesive separation within the adhesive (preferred) or delamination of thin organic precoating to the substrate that occurs above the specified minimum strength levels are considered acceptable separation modes. The bond strength and fracture mode shall be reported.

3.3.2.4 Methyl Ethyl Ketone (MEK) Test. By the MEK-Wipe-Test, the adhesion of the thin organic precoating shall be tested on a flat test sheet, size: 200 mm × 300 mm, degreased with cleaning benzene. Use an 80 cm × 100 cm, 100% cotton bleached (thread position 10/7) polishing cloth (e.g., B 040 0180), wetted with methyl ethyl ketone and fixed to the base of a weight for scales ($\approx 1\text{ kg}$ mass).

Note: The polishing cloth shall be wet during the complete test duration. The weight shall be moved on the test sample back and forth **without pressure**. One movement back and forth corresponds to one double stroke. The test length shall be $\approx 25\text{ cm}$. After the defined number of double strokes the appearance of the thin organic precoating shall be checked. Areas within 4 cm distance from the turning points are not be taken into account. Within the checked length the thin organic precoating shall be complete and not show loss of adhesion. Slight lightening is permissible.

Minimum Requirement for Products with Zinc Pigments: Ten (10) double strokes.

3.3.3 Physical Requirements.

3.3.3.1 Material Thickness and Tolerance. The detailed engineering part drawing or electronic math file will specify the material thickness and tolerance. The tolerance requirements and strength levels are listed in GMW3224.

3.3.3.2 Coated Base Metal. The physical properties of the coated base material in as-delivered condition shall correspond to the requirements specified in the applicable material specification GMW2, GMW3032, or GMW3399.

3.3.3.3 Coating Mass. The coating mass of the thin organic precoat shall be investigated by chemical stripping with concentrated sulfuric acid (water-free, 98% minimum) and gravimetric determination. Test sample size shall be 2000 mm² minimum with a preferred sample size of 2500 mm². The test sample shall be degreased with cleaning benzene, dried and weighed with 0.0001 g accuracy. Afterwards one (1) side is covered with an acid resistant adhesive tape that only the investigated sample side is in contact with the paint remover. The sample shall be dipped completely in the sulfuric acid. The dissolution time depends on the type of thin organic precoat. After removing the thin organic precoat, the sample shall be washed with deionized water until the sulfuric acid is completely removed. The adhesive tape has to be stripped off and if necessary loose sticking particles have to be removed. No residual thin organic precoat on the investigated side and adhesive tape shall be observable. After drying, the sample shall be weighed with the same accuracy. From mass difference and sample geometry the coating mass can be calculated. If the initial testing is outside the specified coating mass range as shown in Appendix A, Table A1, three (3) additional specimens shall be taken 25 mm minimum from the edges of the coil. The average of the three (3) replicate specimens must conform to the specified range. Each sample must meet the minimum requirement for the coating mass.

Note: Other coating masses may be used by exception.

3.3.3.4 Coating Thickness. For conversion between coating thickness and coating mass, the dry film density for the relevant thin organic precoat, according to Appendix A, Table A1, shall be used. Coating thickness measurements may be used for routine quality control evaluations. Coating thickness measurements using a suitable layer thickness gauge or from a specimen cut perpendicular to the panel surface. Suitable instruments for evaluation of coating thickness (e.g., Betascope or metallurgical microscope) shall have a capacity of $\pm 1.0 \mu\text{m}$ accuracy. When using a metallurgical microscope, standard mounting practices shall be used and thickness shall be measured at 1000x magnification. In case of disagreements between the supplier and purchaser, the weigh-strip-weigh method shall be the reference, as specified in paragraph 3.3.3.3.

Note: Coating thicknesses are shown for reference only, not for conformance to specification requirements.

3.3.3.5 Corrosion Resistance.

3.3.3.5.1 Cyclic Corrosion Test with Glass Flanges. (Qualification testing) For each side with thin organic precoat three (3) replicate test samples shall be evaluated. The samples shall be prepared according to Appendix B (see Figure B1) and tested to GMW14872, UB, All, four (4) salt spray per cycle, method 1/2, Exposure D and GMW14124, cycle U.

Requirements:

1st Generation Products:

GMW14872: 32 cycles ± 3 cycles, $217 \mu\text{m} \pm 13 \mu\text{m}$

GMW14124, cycle U: 10 cycles

2nd Generation Products:

GMW14872: 63 cycles ± 7 cycles, $430 \mu\text{m} \pm 17 \mu\text{m}$

GMW14124, cycle U: 20 cycles

After the minimum test duration the samples shall not show any corrosion at the base steel. Corrosion of the precoat is allowed.

3.3.3.5.2 Further Corrosion Tests. For further, regional required corrosion tests, see Deviation Section.

3.3.3.6 Coating Surface Quality. The steel shall be free from surface defects as negotiated between purchaser and supplier. Mechanical defects of the thin organic coating such as scratches, notches or defective coating, blisters, cracks, splits, etc. are inadmissible. Exposed (E) surfaces shall have a homogeneous surface quality without any stripes or orange peel. The grain size of the pigments shall meet the requirements for the appearance of a high quality paint coating. For unexposed (U) surfaces, slight discolors and stripe structures, which do not affect adhesion, corrosion resistance, formability or the application of paint are allowed. A special requirement for temper rolling may be required and shall be specified with a (T) designation.

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

3.3.4 Additional Requirements.

3.3.4.1 Marking. If required, marking shall be carried out on the unexposed surface of full finish coils for outer panels and on the outer side of the coils for inner panels. The marking must be agreed upon between the supplier and purchaser. The purchaser must release the marking ink.

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

3.4 Processing Requirements.

3.4.1 Chemical Requirements.

3.4.1.1 Compatibility with Process Agents (Qualification testing). The compatibility of thin organic precoatings with agents used in the phosphating process (cleaning, activation, phosphating, passivation in spray or immersion application) shall be tested on three (3) test specimens 100 mm × 50 mm for each agent. The process agents which shall be used for testing have to be agreed with the responsible department. After degreasing with cleaning benzene and drying, the samples shall be weighed (0.0001 g accuracy) and dipped in the process agent for 30 minutes. The test temperature shall be the same as the relevant process temperature. The test specimens shall be covered completely with the process agent. After exposure the samples shall be cleaned with de-ionized water and dried five (5) minutes at +120 °C. After the samples have been cooled down to ambient temperature of +23 °C ± 5 °C, they shall be weighed with the same accuracy again. Mass loss of the organic precoatting ≥ 10% by mass is permissible. The thin organic precoatting shall not show any visible changes or loss of adhesion.

3.4.1.2 Compatibility with Corrosion Prevention Wax. (Qualification testing) The wax compatibility requirements of GMW15416 "High Humidity Environments" shall be met for cavity and underbody wax. The test sample preparation shall be performed according to GMW15416. After the prescribed test duration the corrosion preventives shall not cause any visible changes or a quality loss of the organic coating. For evaluation the wax film shall be removed with cleaning benzene.

3.4.2 Mechanical Requirements.

3.4.2.1 Abrasion of Thin Organic Precoatting. In comparison to zinc-coated surfaces (electrolytical- or hot-dip-galvanized) with identical coating masses, the organic precoatting material shall not show any significant differences during processing (especially in view to tool workout, amount of precoatting abrasion and tool cleaning).

3.4.3 Physical Requirements. Not applicable.

3.4.4 Additional Requirements.

3.4.4.1 Pre-Treatment Compatibility/Paint Adhesion (Qualification Testing). On surfaces with thin organic precoatting the formation of a closed phosphate layer is not given. Nevertheless they shall meet the overall requirements with regard to paint adhesion.

After application of production representative pre-treatment and paint, the material shall meet the following requirements:

1. Adhesion of the E-coat shall fulfill test requirements of cross hatch test according to GMW14829: Rating 0 as received and after 240 h humidity exposure per GMW14729.
2. E-coated samples must meet delamination test requirements according to GMW14704: Rating 0 or 1 after 48 h test duration.

3. The paint adhesion on fully painted samples shall be checked by crosshatch test according to GMW14829 before and after 240 h of humidity according to GMW14729. Results Rating 0 to 1 are permissible.
4. For painted applications on exposed (E) surfaces, the material shall also meet the requirements of the stone chip resistance test according to GMW14700, method A (or B) and method C, with a minimum stone impact resistance Rating of 8.
5. For outer surfaces, the paint appearance on thin organic precoatings shall correspond to the appearance of standard qualities. Details have to be agreed with the responsible department.

3.4.4.2 Scribe Creep Back Resistance in Cyclic Corrosion Test (Qualification Testing). For each side with thin organic precoating, three (3) replicate E-coated test samples 100 mm × 200 mm shall be evaluated. The test samples shall run through the production steps of cleaning, activation, pre-treating, passivation, and E-coating. The samples shall be scribed per GMW15282 and tested according to GMW14872, EXT, All, 4 salt spray per cycle, method 1/2, exposure C, and GMW14124, cycle U. The creep back for both tests shall be evaluated per GMW15282.

Requirement: After the specified test exposures a maximum scribe creep back of 15 mm (total width) along the scribe line is permissible.

Note: Future products should be improved due to creep back resistance. Creep back should be comparable to zinc coatings. Details shall be agreed with the responsible department.

3.4.4.3 Throw Power of Electrodeposition Primers. (Qualification testing) The throw power of E-coat in combination with thin organic precoating shall be evaluated according to GMW3008, Appendix B. The requirements are described per section "Throw Power" in GMW3008.

3.4.4.4 Welding. Sheet steel supplied to this standard shall be weldable with standard GM Weld Practices and meet spot weld, arc weld, or laser fillet weld acceptance criteria per GMW14057, GMW14058, or GMW15425, respectively. When required for qualification, testing for spot weldability shall be performed per GWS-5A or modified in consultation with and approved by the ME-Weld Department of GM Manufacturing Engineering. Contact the GM Weld Council for specific information regarding weldability at weld.council@gm.com.

Note: Modifications to these methods may be required for high strength, retained austenite bearing steels. Due to unique properties of advanced high strength steels, selection of the weld process parameters should be determined in consultation with the steel supplier and GM Manufacturing Engineering.

3.4.4.5 Mechanical Clinch Joining. For mechanical clinch joining technique the material shall be evaluated according to GWS-1M or modified in consultation with and approved by the ME-Weld Department of GM Manufacturing Engineering (contact the GM Weld Council for specific information regarding weldability at weld.council@gm.com) and GMW14085 by the responsible department.

3.4.4.6 Adhesive Compatibility (Qualification testing). Thin organic precoatings as described in this specification shall be capable of being bonded with GM approved adhesives when tested according to GMW16549. Testing to this specification will evaluate bonding characteristics to the substrate surface.

3.5 Requirements on Other Stages during Life Cycle.

3.5.1 Chemical Requirements. Provisions shall be made to prevent the addition of such elements (see paragraphs 3.2 and 5.1) from scrap or other materials used in the manufacturing process which would impair the recyclability on the finished components.

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.