

**Part 2: ELECTROPLATED BRIGHT ZINC COATINGS  
ON CAST IRON AND STEEL**

04	MAY 2015	R.PERSEVAL	Section 5 updated with a process added for appearance parts
03	06 JUNE 2012	E.LAJOYE	<ul style="list-style-type: none"> <li>- Section 1 becomes Introduction, update of European directives, reference documents added; Section 2: definition of non-significant surfaces modified; Section 10 added.</li> <li>- Modification of requirements in entire document according to recommendations of ISO 2081, ISO 4042, ISO 9588 and ISO 10289 with cancellation of corresponding appendixes.</li> </ul>
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**PART 2 - ELECTROPLATED BRIGHT ZINC COATINGS**  
**ON CAST IRON AND STEEL**

## **1 Introduction**

### **1.1 Object**

This standard applies to electroplated bright zinc, with subsequent passivation, on cast iron and steel for protection against corrosion.

A mechanically deposited coating of zinc according to CMS M1047 part 5 can be substituted to the electroplated coating.

Furthermore, due to consolidated 2000/53/EC and 2011/65/CE European Directives coming into force that limits the use of Hexavalent Chromium in some industries:

When part drawing is asking for an Electroplated Bright Zinc Coating to CMS M1047 part 2, a **Zn coating with Cr(III) conversion coating without finishing layer** according to **CMS M1047 part 12** can be used as an alternative.

### **1.2 Reference Documents**

#### AGCO-GIMA documents

- **CMS M1047 part 5 (Revision 1):** Mechanical Zinc plating on cast iron and steel
- **CMS M1047 part 12 (Revision 3):** ZnCr3 coating with Cr(III) conversion coating passivation without finishing layer

#### ISO standards

- **ISO 2081 (2008):** Electroplated coatings of zinc with supplementary treatments on iron or steel
- **ISO 4042 (1999):** Fasteners - Electroplated coatings
- **ISO 9227 (2006):** Corrosion tests in artificial atmospheres – Salt spray tests
- **ISO 9588 (2008):** Metallic and other inorganic coatings - Post-coating treatments of iron or steel to reduce the risk of hydrogen embrittlement
- **ISO 10289 (1999):** Methods for corrosion testing of metallic and other inorganic coatings on metallic substrates - Rating of test specimens and manufactured articles subjected to corrosion tests
- **ISO 16047 (2005):** Fasteners - Torque/Clamp force testing

#### European Directives

- **2000/53/CE consolidated with 2011/37/CE:** Directive of the European parliament and of the council of 18 September 2000 on end-of life vehicles
- **2011/65/CE :** Directive of the European parliament and of the council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)

## 2 Definitions

### 2.1 Significant surfaces

This shall mean all surfaces unless those defined below and otherwise specified. The significant surface might be subject of agreement and is to be indicated on drawings or by the provision of suitably marked samples.

### 2.2 Other surfaces

Sharp edges and nibs are not deemed significant surfaces.

- Case of threaded parts

Thread ridges are not deemed significant surfaces during the performance test.

- Case of parts with strong curves

Areas of parts with a strong curve (i.e. an angle of curvature superior or equal to 60°, or for tubes/hollow parts a bending radius superior or equal to the external diameter) are not deemed significant surfaces during the performance test.

- Case of parts with setting or flaring after zinc plating

Areas of parts that are subject to a mechanical distortion of the coating due to crimping or flaring made after zinc plating are not deemed significant surfaces during the performance test.

## 3 Designation

Metallic coatings covered by this specification shall be designated, according to application, as follows:

"Zinc coating according to CMS M1047 Part 2"

or

"Zinc coating and Hydrogen-embrittlement-relief heat treatment according to  
CMS M1047 Part 2"

## 4 Purity

Coatings shall not contain Mercury.

## 5 Appearance

Appearance of the coating shall comply with appearance requirements of ISO 2081.

In case of hollow parts, it is admitted that the area corresponding to the interior of them remains uncovered.

In case where parts are specified like “appearance part” on drawing, it shall be mandatory to use the rack plating process (immersion process).

The part shall have a slight iridescent appearance from bright yellow to golden yellow without colourless areas.

## 6 Adhesion

### 6.1 Zinc Adhesion

Adhesion of coating shall be verified according to the test method for zinc adhesion defined in ISO 2081. As an alternative, method of test described in Appendix A can be used.

A coating which does not continue to adhere to the basis metal when subjected to the test does not comply with this specification.

### 6.2 Chromate Adhesion

Adhesion of chromate coating shall be verified according to the test method for chromate adhesion defined in ISO 2081. As an alternative, method of test described in Appendix C can be used.

A chromate coating which does not continue to adhere when subjected to the test does not comply with this specification.

## 7 Hydrogen-embrittlement-relief heat treatment

When this treatment is specified on drawings, it must be realized within 4 hours after coating:

- For non-threaded parts in conformity with instructions of ISO 2081 and its recommendation of procedures (ISO 9588).
- For threaded parts in conformity with instructions of ISO 4042.

In any case chosen procedure shall never be inferior (in time or in temperature) to required conditions of Annex B, unless specifically agreed otherwise.

Hydrogen-embrittlement-relief heat treatment shall be carried out before Chromium conversion coating.

## 8 Zinc Coating thickness

### 8.1 Non-threaded Parts

The thickness of the coating is specified by its local thickness and measured in conformity with ISO 2081. It shall be at least 8µm without exceeding 25µm.

Coating of non-threaded parts is consequently defined as following:

ISO2081 - Fe/Zn8/C  
or  
ISO2081 - Fe/Zn8/ER(xxx)x/C

((xxx)/x representing the procedure of chosen heat treatment)

### 8.2 Threaded Components

Nominal thicknesses are defined according to the following criteria:

Nominal diameter of thread	Nominal thickness (µm)	Coating classification code (ISO 4042)
$d \leq 8 \text{ mm}$	5	Fe//Zn5c2C
$d > 8 \text{ mm}$	8	Fe//Zn8c2C

Corresponding local and average thicknesses shall be in conformity with recommendations of ISO 4042.

### 8.3 Thickness measurements

- Thickness coating: definition

Thickness applies either before or after passivation, since passivation has little effect on total coating thickness.

- Local thickness

Local thickness coating is tested by one of the methods described in ISO 2081.

In case of dispute between AGCO/GIMA and the supplier, only microscopical method shall be used.

If measured thickness is inferior to the local value defined in above table, in three separate tests, at points not less than twelve millimeters apart, the part does not comply with the specification.

- Average thickness

In cases where it is not possible to measure local thickness, average thickness is measured using methods described in ISO 2081 (case of non-threaded parts) or in ISO 4042 (case of threaded components). If the average thickness is found to be less than the local thickness defined above, the coating does not comply with the specification.

## 9 Performance test: Corrosion resistance

The final coating, after an ageing period of 24h minimum, shall withstand a Neutral Salt Spray test according to ISO 9227.

An assessment of the deterioration of the coating and the base metal due to corrosion shall be done according to ISO 10289 with the following requirements.

Corrosion assessment				
	Test Duration	Rating	Test Duration	Rating
Thread nominal diameter $d \leq 8\text{mm}$	N/A	<i>No criteria</i>	72h	Rp = 10 Ra = /
Thread nominal diameter $d > 8\text{mm}$ and non-threaded part	72h	<u>Significant surfaces:</u> Rp = 10 and Ra = 10	96h	<u>Significant surfaces &amp; Other surfaces:</u> Rp = 10 Ra = /
		<u>Other surfaces:</u> Rp = 10 and Ra $\geq 4$		

Note: correspondences of ratings defined in ISO 10289:

Rp: base metal corrosion defect

Ra: appearance defect including white corrosion

Rp = 10 or Ra = 10: no defects

Ra  $\geq 4$ : appearance defects present on an area inferior or equal to 5% of considered surface.

Ra = /: no assessment of appearance defects

## 10 Coefficient of friction

*This requirement is requested for threaded parts only.*

Coefficient of friction measured according to ISO 16047 ( $\mu_{\text{tot}}$ ) shall be superior or equal to 0.20. A variation of 10% can be tolerated owing the fact that there is no finishing layer that guarantees this coefficient of friction.

## **APPENDIX A**

### **METHOD FOR THE DETERMINATION OF COATING ADHESION**

Rub an area of 625mm<sup>2</sup> minimum of the plated surface, selected at the discretion of the inspector, rapidly and firmly with a smooth metal implement for 15 seconds.

A suitable burnishing implement is a copper disc (e.g. a copper coin) used edgewise and broadside. The pressure shall be sufficient to burnish the film at every stroke, but not so great as to cut the deposit. A poor adhesion will be shown by the appearance of a loose blister which grows as rubbing is continued. If the quality of the deposit is also poor, the blister may crack and the plating will peel away from the base metal.

More than one area may be tested if desired.

## **APPENDIX B**

### **HYDROGEN-EMBRITTEMENT-RELIEF HEAT TREATMENT**

1) Parts quenched or cold worked with a tensile strength over 1000MPa shall be heated to 150-200°C for 2 hours minimum.

2) Parts with a surface hardening for hardness equal or over 55HRC shall be heated to 150-175°C for 2 hours minimum.

3) Steel springs shall be heated for 2 hours minimum at a temperature remaining inferior to the temperature used for tempering of them so that yield characteristics of spring are not reduced.

## **APPENDIX C**

### **TEST FOR ADHESION OF CHROMATE FILM**

The adhesion of a chromate film is tested by rubbing the surface with a fragment of white paper on the tip of the finger and then examining the paper and the rubbed surfaces.

Failure is constituted by the appearance of anything more than the faintest stain on the paper, or by indications that the treated surface has been rubbed through.