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No. of enclosures  
**1**

Title

## CR(VI)-free corrosion protection of fasteners

### Summary

The legal requirement of Directive 2011/65/EU (formerly 2002/95/EC) has necessitated Cr(VI)-free finished products and corresponding surface protection systems since 2006. In this company standard, the requirements are specified throughout the Group

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## 1. Purpose

According to EU Directive 2011/65, no finished products containing compounds containing Cr (VI) may be placed on the market after July 1, 2006. This means that all new surface protection systems must be Cr (VI)-free. The previous abbreviations for Cr (VI)-containing surface protection types (e.g. A3G) will become invalid and be replaced or supplemented by new abbreviations (e.g. ZNTDIV SI) for Cr (VI)-free coating systems. The surface protection abbreviation specifies a particular corrosion protection and coating color. The surface protection systems are supplier/coater dependent and must meet the corrosion protection requirements. The requirements for Cr (VI) freedom and the new abbreviations are specified in this works standard.

## 2. Scope

The factory standard applies to Miele, Imperial and suppliers throughout the Group and to the electrical and electronic equipment specified in EU Directive 2011/65.

Special surfaces which are Cr (VI) free, such as nickel-plated surfaces, and hot-dip coated sheets are not affected by this works standard.

## 3. Supplied documents

### 3.1. Normative

DIN 50969	Resistance of high-strength steel components to hydrogen-induced brittle fracture
DIN EN ISO 1463	Metal and oxide coatings - Coating thickness measurement - Microscopic method
ISO 1463	Metallic and oxide coatings - Measurement of coating thickness - Microscopical method

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DIN EN ISO 4042	Fasteners Galvanic coatings
ISO 4042	Fasteners - Electroplated coatings
DIN EN ISO 10683	Fasteners Non-electrolytically applied zinc flake coatings
ISO 10683	Fasteners - Non - electrolytically applied zinc flake coatings
DIN EN ISO 15330	Fastening elements Stress test for the detection of hydrogen embrittlement - Method with parallel bearing surfaces
ISO 15330	Fasteners - Preloading test for the detection of hydrogen embrittlement - parallel bearing surface method
VDA 235-101	Lubrication of threaded mechanical fasteners
VE 0210	Testing instructions: Qualitative detection of chromium VI in coatings

### 3.2. Informative

DIN EN ISO 9227	Corrosion tests in artificial atmospheres - Salt spray testsNeutral salt spray test (NSS test)
DIN 50960-1	Galvanic coatings Designation in technical documents
DIN 50961	Galvanic coatings Zinc coatings on ferrous materials Terms, corrosion test and corrosion resistance
DIN 50965	Galvanic coatings Tin coatings on ferrous and copper materials
DIN EN ISO 1461	Zinc coatings applied to steel by hot-dip galvanizing (batch galvanizing) Requirements and tests
ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods specifications and test methods
VDA 235-104	Cr (VI)-free surface protection types for fasteners with metric thread
DIN EN ISO 10684	Fasteners - Hot dip galvanizing

## 4. General

### 4.1. Fasteners (standard and drawing parts)

Fasteners in the sense of this standard are e.g.: Bolts, nuts, hinges, shims and similar components, even if these fasteners are supplied in assemblies.

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#### 4.2. Term „surface protection“

Surface protection is achieved by chemical/electrochemical or physical application of coatings or by transforming the workpiece surface into a more corrosion and/or wear resistant state.

The main objective of surface treatment, in addition to possible decorative effects, is corrosion protection adapted to the stress and requirements.

#### 4.3. Hydrogen-induced brittle fracture

Hydrogen-induced brittle fracture can occur in steel parts of higher strength, e.g. as a result of acid pickling processes or galvanic treatment. For this reason, highly stressed parts with a tensile strength  $R_m \geq 1000 \text{ N/mm}^2$  should not be electroplated as a matter of principle.

Exceptions must be coordinated between the KEW, QM and CM specialist functions. To avoid hydrogen-induced brittle fractures, measures in accordance with DIN EN ISO 4042 and DIN 50969 must be taken. These must be documented in the initial sample test report.

#### 4.4. Layer thicknesses

The coating thickness on screws is determined at the screw head (compare DIN EN ISO 4042 and DIN EN ISO 10683). Measuring points deviating from the standard (e.g. hinge) must be agreed between the supplier and the specialist functions (KEW, QM, CM). The measuring method is optional and must be specified in the initial sample test report. In case of doubt, the metallographic determination on longitudinal section according to DIN EN ISO 1463 applies.

The values given in the appendix are minimum coating thicknesses.

Layer thicknesses must be adapted to the respective tolerance position of the threaded parts. A significant increase of the coating thicknesses in the thread compared to the specified minimum coating thicknesses requires corresponding dimensions of the bare threaded parts (DIN EN ISO 4042 and DIN EN ISO 10683).

In the case of zinc flake coatings and electroplated coatings with an organic top layer, it must also be ensured that the function of the threaded parts is not impaired by high and/or fluctuating coating thicknesses under the head/support surface.

#### 4.5. Friction behavior of fasteners with metric and thread-forming screws and nuts.

For defined fasteners (only metric and thread-forming screws and metric nuts) for which Miele has specified a friction coefficient window, the requirements of VDA 235-101 apply. The fasteners are generally to be set to a friction coefficient window of  $\mu_{ges} = 0.09$  to  $0.15$ .

For the mean value of a series of measurements, a value of  $\mu_{ges} = 0.12$  should be aimed for.

**The influence of lubricants on adhesive, clamping and sealing threadlockers (e.g. microencapsulation) must be taken into account.**

The breakaway torques must be tested and complied with in accordance with DIN 267-27.

#### 4.6. Bonding agent

In the case of adhesion promoters (e.g. phosphatings, passivations), system compatibility with subsequent sealers or top coats must be ensured and Cr (VI) freedom must be maintained.

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#### **4.7. Electrically conductive connections**

For electrically conductive connections (e.g. grounding screws), only the surface protection systems identified in Annex A (VDE approval) are permitted. Other coatings must be agreed with the specialist departments.

### **5. Surface protection types, brief description**

#### **5.1. Galvanic zinc coatings**

The electroplated coatings are described in Annex A. For black passivations, treatment solutions containing silver are not permitted.

#### **5.2. Zinc flake coatings according to DIN EN ISO 10683**

The ductility (deformability) of the zinc flake coatings is low; these coatings are therefore only conditionally suitable for parts which are deformed or pressed in after coating.  
In the case of mechanical fasteners with captive washers, bonding may occur depending on the geometry. The baking temperature must be  $\geq 180^\circ\text{C}$ .

#### **5.3. Galvanic tin-zinc alloy coatings**

High alloy tin coating with 30% zinc and 70% tin.

### **6. Surface protection types; properties, requirements**

#### **6.1. Requirements for high-strength parts**

For parts with tensile strengths  $R_m \geq 1000 \text{ N/mm}^2$ , the surface and heat treatment processes must be state of the art to avoid hydrogen-induced brittle fractures. This applies in particular to electrodeposited coatings. Even in the case of zinc flake coatings, the parts must not be pickled in acids without inhibitors (inhibitors that restrict or prevent chemical processes) during pretreatment. The time between pretreatment and coating must be kept as short as possible.  
Proof of process reliability can be provided by stress testing according to DIN EN ISO 15330 or DIN 50969. This must be documented in the initial sample test report.

#### **6.2. Released Cr(VI) - free surface protection systems**

see. Attachment 1

For the surface protection systems approved in Annex A, the most cost-effective system shall always be used. In the event of cost equality, the surface protection system offering the higher corrosion protection shall always be used.

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## 7. Designation/Drawing entry

The entry for surface protection on drawings, material master data and other technical documentation shall be made in accordance with MWN 188. The standard coating color is silver/matt silver. Deviations from this must be noted on the drawing.

Designation example: Hexagon head bolt M6 x 20 -ISO 4014-8.8-MWN 188

In the purchase order text (purchasing info record), all data required for the purchase order (such as: layer thickness, surface protection abbreviation) are transferred by the Purchasing function after the materials have been released.

## 8. Test method

### 8.1. Acceptance and test specification

The test shall cover: Appearance and general requirements, layer thicknesses and dimensional tolerances as well as climate and corrosion resistance.

### 8.2. Initial sampling

A prerequisite for the initial delivery is the release of initial samples, which the manufacturer/supplier must submit in sufficient quantity in good time.

Sampling is always carried out in accordance with VDA Volume 2.

For example, initial sampling for DIN and catalog parts can be carried out in consultation with the respective plant on the basis of a supplier confirmation or according to VDA submission level 0.

In connection with surface changes, a family release is also possible in consultation with the respective plant(s).

### 8.3. Appearance and general requirements

The coatings must not have any defects that impair the appearance or function. Parts from series deliveries must correspond to the initial sample with regard to gloss, decorative appearance and corrosion resistance.

### 8.4. Corrosion protection tests

Parts shall be considered defective if base metal or zinc corrosion occurs prior to the expiration of the prescribed test time in accordance with Appendix A. Other test procedures and cycles shall be agreed with the specialist functions (KEW, QM, CM) and noted on drawings and initial sample test reports.

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## **8.5. Testing for chromium VI - freedom**

The test for chromium VI freedom is carried out purely qualitatively according to test instruction VE 0210 without detection limit

## **8.6. Series continuity**

The sampled design of the surface protection is binding for the subsequent series and may only be changed with the consent of the customer. This also applies to the change of the coater and its coating process.

Changes that deviate from the initial sample test report must be presented again and approved by Miele.

## **9. Change history**

### **Version 03:**

Item 3 Applicable documents Informative DIN 50021 replaced by DIN EN ISO 9227 03.03.2009

### **Version 04:**

Applicable documents informative  
DIN EN ISO 10684 - Fasteners - Hot dip galvanizing added.

4.5 Friction behavior of fasteners with metric and thread-forming screws and nuts. -  
Specification on screws for which a friction value is specified by Miele. - The breakaway torques are to be tested and complied with according to DIN 267-27.

### **8.2 Initial sampling**

Sampling is always carried out in accordance with VDA Volume 2.

Various changes due to name change GTG/WVE to GTG/CM

## **Attachments**

Released Cr(VI)-free surface protection systems

Center of Materials