**Mercedes-Benz**
Company Standard

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Person in charge: Dr. Clemens Franz
E-mail: clemens.franz@daimler.com
Plant: 010; Dept.: PT/TWL
Phone: +49 (0) 711-17-23506
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# Electrodeposited Zinc and Zinc Alloy Coatings for Components Manufactured from Ferrous Materials

## Foreword

This supply specification describes the special requirements, properties, and characteristics of parts with electrodeposited and aftertreated zinc and zinc alloy coatings.

This edition replaces the previous edition of this standard.

## Changes

In comparison with the 2015-06 edition, the following changes have been made:

Primarily:

- Adjustment of DBL to international standards
- Specification of corrosion protection requirements for threaded holes/blind holes
- Exclusion of aftertreatment of the coatings with easy to remove oils/greases/waxes to improve the corrosion protection effect
- Omission of component degreasing prior to the laboratory corrosion test
- New instructions on number of components to be checked and length of test period
- Explanation of the background of the Kesternich test added

## Contents

# 1 Scope of application

This DBL applies to parts with electrodeposited zinc and zinc-alloy coatings and subsequent aftertreatment.

This DBL does **not** apply to parts with electrodeposited single part coatings used on body shells and are, together with the body, subjected to the pretreatment and painting process and not parts with electrodeposited precoating that subsequently receive a topcoat with the body. The requirements for these applications are described in DBL 8466.

For surface protection for screws and nuts, see DBL 9440, DBL 9441 and DBL 9460.

In order to select suitable product versions of this DBL for vehicle components and to decide whether the surface treatment complies with the current corrosion protection guidelines, the department responsible for the component (component manager) must involve the specialist colleagues of the "Complete Vehicle Corrosion Protection" department.
Approval for usage, following testing, shall be decided by each responsible component manager, taking all the aspects that affect the component's function and durability into account.

**Table 1: Product versions (PV), overview**

<table>
<tr><th>Coat</th><th colspan="2">Zinc</th><th colspan="2">Zinc/Iron</th><th colspan="2">Zinc/Nickel</th></tr>
<tr><th>Part type / Surface</th><th>without thread</th><th>with thread</th><th>without thread</th><th>with thread</th><th>without thread</th><th>with thread</th></tr>
<tr><td>transparent, sealing allowed when function not impaired</td><td>.15</td><td>.16</td><td></td><td>.96</td><td>.66</td><td>.76</td></tr>
<tr><td>transparent, not sealed</td><td></td><td></td><td></td><td></td><td>.62</td><td>.72</td></tr>
<tr><td>transparent, sealed</td><td></td><td></td><td>.86</td><td></td><td>.65</td><td></td></tr>
<tr><td>silver-colored</td><td>.12</td><td>.22</td><td></td><td></td><td></td><td></td></tr>
<tr><td>black, sealed</td><td colspan="4">.13</td><td></td><td></td></tr>
<tr><td>black, additionally coated with organic surface film</td><td>.19</td><td>.29</td><td></td><td></td><td>.69</td><td>.79</td></tr>
</table>

For requirements of above product versions and corresponding test, see Section 7 and Table 3.

**Blocking note:**
When using PV.13, significantly lower corrosion resistance is given for the black color scheme than for the versions additionally covered with black organic surface films. PV .13 shall therefore only be used for interior vehicle parts and only when a surface film must not be applied for technical or functional reasons and a black surface must be used. Electrodeposited zinc or zinc-iron coatings serve as a base coat. This DBL product version also applies to older parts for which surface protection according to DBL 8451.13 was specified on the drawing.

## 2 References

The following referenced documents are indispensable for the application of this supply specification. For dated references, only the referenced edition applies. For undated references, the latest edition of the cited document (including any changes) applies.

| | |
|---|---|
| DBL 8585 | General Requirements - Environmental protection, hazardous substances, hazardous materials - Negative substance list for the selection of materials |
| DBL 8440 | Parts Manufactured from Ferrous Materials with Inorganic Coating (Zinc Flake Coating) |
| DIN 50969-1 | Prevention of Hydrogen-Induced Brittle Fracture of High-Strength Steel Building Elements – Part 1: Preventative Measures |
| DIN 50969-2 | Prevention of Hydrogen-Induced Brittle Fracture of High-Strength Steel Building Elements – Part 2: Tests |
| DIN 50969-3 | Prevention of Hydrogen-Induced Brittle Fracture of High-Strength Steel Building Elements – Part 3: Subsequent operational influences and extended tests |
| DIN EN ISO 19598 | Metallic coatings - Electroplated coatings of zinc and zinc alloys on iron or steel with supplementary Cr(VI)-free treatment |
| DIN EN 15205:2007-02 | Determination of hexavalent chromium in corrosion protection layers - Qualitative analysis |
| DIN EN ISO 2081 | Metallic and other inorganic coatings - Electroplated coatings of zinc with supplementary treatments on iron or steel |
| DIN EN ISO 6270-2 | Coating materials - Determination of resistance to moisture - Part 2: Condensation (loading in a climatic chamber with a heated water tank) |
| DIN EN ISO 9227 | Corrosion Tests in Artificial Atmospheres - Salt Spray Tests |
| DIN 50018 | Testing in Condensed Water in the Presence of Sulfur Dioxide |
| VDA 235-204:2013-11 | High-Strength Fasteners for the Automotive Industry |
| MBN 10513 | Parts Manufactured from Ferrous Materials with Inorganic Coating and Black Surface Finish - Assessment of Corrosion Onset |

## 3 Terms and definitions

**PV:** Product version according to this DBL, e.g. DBL 8451.76

**Zinc coatings (Zn):**

Zinc coatings in accordance with this DBL are electrodeposited on ferrous materials from aqueous electroplating baths.

**Zinc-iron coatings (ZnFe):**

Zinc-iron coatings are deposited galvanically from an alkaline electrolyte with an iron installation rate of 0.3% to 1% on metallic workpieces.

**Zinc-nickel coatings (ZnNi):**

The most common electrodeposited zinc-nickel coatings have a nickel content in the 12 to 16% range. The significantly higher corrosion resistance of the metallic coating in combination with less prominent/voluminous corrosion products, compared to pure zinc coatings and low-alloyed zinc-iron coatings, is characteristic of zinc-nickel coatings. This is also the reason for the comparably higher temperature resistance of the passivated zinc-nickel coatings.

**Passivation:**

Passivation is the manafacturing of conversion coatings on newly plated zinc or zinc-alloy coatings by treatment with suitable Cr(VI)-free solutions. In this case, the newly electrodeposited coating reacts with the passivation solution to form a thin film (approx. 0,05 µm to approx. 0,5 µm) composed of complex reaction products, which protects the metallic coating. The formation of the passive film may also result in iridescent effects on the component surface.

**Sealers:**

Sealing as defined by this DBL is the creation of a thin organic or inorganic protective coating with a thickness of approx. 0,5-2 µm on zinc or zinc-alloy coatings. The sealing is normally applied on passivated surfaces, whereby the sealing penetrates into the passivation layer, forming a composite coating. Depending on the sealing agent, the sealing shall be completed wet on wet or following intermediate drying. The sealing agent may be coated with pigments for the colour scheme (black).

**Surface films:**

A surface film as defined by this DBL is a black organic or inorganic protective layer for zinc or zinc-alloy coatings with a layer thickness >2 µm. Surface films: may contain suitable additives for the adjustment of defined coefficients of friction.

**Classification of corrosion resistance (Kb):**

| | |
|---|---|
| Kb I | Transportation and storage protection, installation in oil chamber |
| Kb II | Very low corrosion resistance, installation in non-corrosive areas, e.g. in the vehicle interior |
| Kb III | Low corrosion resistance, for parts that can change in appearance due to corrosion |
| Kb IV | Moderate corrosion resistance, for parts in areas subject to low corrosion stresses |
| Kb V | High corrosion resistance, for parts in visible area or where corrosion must be excluded for functional reasons |
| Kb VI | Extremely high corrosion resistance |

# 4 General requirements

To guarantee product safety and product quality, and to meet certification requirements, all relevant statutory regulations and laws shall be complied with. In addition, the relevant requirements of the Daimler Group shall apply.

In terms of ingredients and recyclability, the materials, process engineering, component parts and systems shall comply with all applicable legal requirements.

DBL 8585 shall be observed.

The manufacturer must consider that, depending on the shape and dimensions of the components, corrosion resistance can be reduced due to handling, packaging, transport and feeding devices.

# 5 Technological specifications

## 5.1 Chromium(VI)-containing corrosion protection systems

According to EU Directive 2000/53/EC on end-of-life vehicles or the German End-of-Life Vehicles Act, it must be ensured that corrosion protection coatings on components of vehicles of the M1 classes (passenger cars with a maximum of 8 seats) or N1 (commercial vehicles with a maximum permissible mass of up to 3.5 t - in accordance with Appendix II Section A of Directive 70/156/EEC) which were placed on the market after 1 July 2007 do not contain hexavalent chromium (Cr(VI)). Accordingly, this DBL exclusively contains product versions with Cr(VI)-free coatings for corrosion control. On the other hand, coating systems containing Cr(VI) may still be used in the case of commercial vehicles, buses, and vans (all vehicle classes except M1 and N1).

Owing to the requirements of the current EU Chemicals Regulation (REACH), it must be expected that the application of chromic acid will lead to the discontinuation of the production of anti-corrosion coatings with Cr(VI)-containing conversion layers on electroplated zinc and zinc-alloy coatings in European electroplating plants. As a result, the coating systems produced in the EU zone and specified on a high number of commercial vehicle component drawings will no longer be available for commercial vehicles, buses, or vans.

In order to avoid changes to individual design drawings as much as possible because of the large number of components, an implementation table was given for the first time in the 2015-06 edition of Appendix A and the procedure was described which should make it possible to substitu te Cr(VI)-containing layer systems with Cr(VI)-free layer systems for commercial vehicle BUS-VAN components (all vehicle classes, except M1 and N1) .

The supplier shall supply evidence of freedom from Cr(VI) based on recognized analytical methods as per DIN EN 15205:2007-02.

## 5.2 Parts with thread

Before applying this DBL for threaded parts, threading examinations and approvals by the responsible fastener representative are recommended.

For a new supply of samples of threaded parts, it must be continuously ensured that the friction coeffcients of the supplied threaded parts permit proper screwing (technologically required screwing properties generally similar to DBL 9440). The hereby required friction coefficient window must be determined, if necessary, and compliance must be ensured in the case of a new supply of samples and series deliveries. Deviations from the friction coefficient window as defined in DBL 9440 shall be indicated by the supplier. In the unlubricated surface condition, total friction coefficients ($\mu_{tot}$) ≥0,13 are expected for surfaces according to this DBL..

## 5.3 Base materials

The parts to be electroplated shall not exhibit any material, machining or surface defects which could impair the corrosion protection and/or the appearance of the coatings. This includes, for example, cracks, pore clusters, foreign matter inclusions and laminations, sunk spots and cold welds, shrinkage and toe-cracks, as well as swirls and shrink holes. If necessary, an agreement concerning surface finish may have to be made.

Any contamination on the surface of the parts to be treated (corrosion products or scale, oil, grease, dirt etc.) shall be completely removable in the normally used automatic cleaning and pre-treatment facilities without leaving any residue.

## 5.4 Material strength

The production, joining and surface treatment procedures must be executed such that degradation due to delayed hydrogen induced brittle fractures can be excluded with higher reliability.

### 5.4.1 Materials in the ≥1000MPa strength range

When coating components with tensile strengths ≥1000MPa (possibly limited locally as well, e.g. case-hardened or cold-worked structures or in weld seam areas), particular emphasis should be placed on safety against delayed brittle fracture (hydrogen embrittlement). If material strengths are ≥1000MPa, then inform the coater. This also applies if the component strength exceeds this value in some areas only.

The measures and tests required to eliminate the risk of hydrogen embrittlement, such as minimization of component stresses, selection, composition and checking of chemicals, physical and chemical process limits, types of tests, test frequency, number of test pieces etc., shall be documented in process and inspection plans according to the state of the art. The treatment of incorrect coatings (removal of coatings and new coatings) shall be investigated and the resulting consequences specified. Investigations shall be documented.

For parts with threads and tensile strengths Rm≥1200MPa or core and surface hardnesses > 385HV, coatings according to this DBL are not permissible (similar to VDA 235-204:2013-11). In general, the same applies to parts without threads.

Note:
Parts without threads with strengths ≥1200MPa that were already coated according to DBL 8451 before publication of DBL issue 2014-12 may continue to be used. The measures defined below for the reduction of hydrogen absorption shall be observed in addition to the requirements for heat treatments for hydrogen effusion. For new designs and particularly critical parts, a switch shall be made to DBL 8440 with acid-free pre-treatment.

#### 5.4.1.1 Reduction of hydrogen absorption

The instructions given in DIN 50969-1, DIN 50969-2 and DIN 50969-3 must be observed. In addition to this, the coater is expected to assess the process in detail (FMEA) with regard to all sub-steps in which hydrogen can infiltrate the material structure. If necessary, the processes shall be optimized.

Process assessment shall be validated by component tests. This results in the derivation of measures that reliably minimize the amount of hydrogen penetrating into the material during treatment (e.g. suitable inhibitors and a maximum justifiable reduction of the pickling time) and permit regular inspection regarding their effectiveness over time.

#### 5.4.1.2 Heat treatment

Heat treatments are required to avoid brittle fractures; they shall be performed for hydrogen effusion after electrodeposition and, if necessary to remove component residual stress, also before electrodeposition. Also see DIN 50969-1.

The ideal heat treatment to be used for a part (temperature, duration, process sequence) shall be ascertained and stated in the ISIR (initial sample inspection report). For reference values, see e.g. DIN EN ISO 19598 and DIN EN ISO 2081. It must thereby be ensured that the properties of the parts are not adversely affected and the effectiveness of the heat treatment must be demonstrated.

When coating components that are potentially subject to hydrogen embrittlement, it is also expected that, in addition to the measures described above, additional distortion tests are performed to document the reliable non-critical process cycle (e.g. on finished electrodeposited components in a deformed fixture in which the component is subjected to loads near the yield strength).

# 6 Abbreviated material designation for documentation

Example: Surface protection DBL 8451.62 (in the drawing block for surface protection)

# 7 Technical requirements and process descriptions

## 7.1 Corrosion protection coatings

Following electroplating, parts shall be within the specified tolerances stated on the standard sheets or drawings, taking any thread sizes into special consideration.

Parts shall exhibit a dense, uniform, homogeneous, (dull) glossy coating which bonds well with the base material even under changing service temperatures and which does not chip off as a result of the customary application and mounting torsion in use. A uniform appearance of the surface shall also be provided in the passivated and, where applicable, sealed condition.

Damage to the coating through improper handling of the parts after electroplating, e.g. throwing or unsuitable transportation conditions, shall be avoided.

The parts supplier or component manufacturer shall select the coater. Before initial sample coating, a coordination process between the component manufacturer and coater should be carried out in which the optimal coating production process for the product is jointly defined.

Before commencement of production deliveries, the coating company shall determine and record the complete pretreatment and coating process, the physical data (treatment periods, temperatures) and the composition of all process chemicals, and, if required, optimize them. Individual process action limits as well as the frequency of monitoring and analysis procedures shall be defined. The resulting measures shall be specified by the coater.

The documentation for this process description shall be submitted to Daimler AG when requested during audits. The data shall be treated as confidential and not disclosed to third parties.

Any changes to the production coating process which according to the state of the art can influence the properties of the base material or the coating shall be reported to Daimler AG promptly and without prior request. A renewed sampling of the parts shall be performed.

In contrast to national and international standards, these Supply Specifications do not differentiate between the manufacturing process for barrel or rack coating, because often when determining the surface protection required, the process technology to be used is not yet known. Normally, the size of the component and its design, along with the technology available at the coater's, will determine whether the coating process should be performed using the less expensive barrel plating method or by rack plating.

Should it be necessary to apply limitations to the coating process from the point of view of the developer responsible for the component (component manager), e.g. for parts with thread that have to be produced on the rack, this shall be noted on the drawing accordingly.

For coating in accordance with this DBL, a coat thickness less than 8 µm is not recommended.

The thickness of surface films is typically between 4 µm and 8 µm. This information serves orientation purposes. The coat thickness may deviate, however, due to the geometry, for example.

Compliance with the corrosion requirements and required component tolerances is of primary importance. The applied maximum coat thicknesses shall not cause impairments to the component or system function.

### 7.1.1 Metallic base coats

No specification of the electrolyte type acidic/alkaline for the deposition of the galvanic layers according to this DBL is made. Selection is left to the component supplier.

#### 7.1.1.1 Zinc coatings (Zn)

Zn coatings offer the lowest corrosion protection quality within the systems of this DBL. With good cathodic protection, relatively voluminous corrosion products occur on corrosive attack.

#### 7.1.1.2 Zinc-nickel coatings (ZnNi)

Zinc-nickel coatings demonstrate the best behavior of the metallic coatings within this DBL with regard to corrosion protection quality. The method used (electrolyte type) and the nickel content (specified and actual values) in the layer shall be indicated in the initial sample inspection report (ISIR).

#### 7.1.1.3 Zinc-iron coatings (ZnFe)

The method used and the content of the alloy element(s) (specified and actual values) in the layer shall be stated in the initial sample inspection report (ISIR).

### 7.1.2 Aftertreatment for protection of metallic coating

Aftertreatment shall completely cover the electroplating, bond well and, apart from interference colors, be uniform and free of spots.

Aftertreatment of the electroplated coatings with easy to remove oils/greases/waxes to improve the corrosion protection effect is not permissible since these substances are removed in the vehicle by the use of cold cleaners and the corrosion protection quality can be impaired as a result.

#### 7.1.2.1 Passivation

As a rule, passivations (conversion layers) are applied to the galvanically deposited metal layers, which, in the event of a corrosion attack, provide a certain degree of corrosion protection for the metallic coating and prevent premature changes in the surface appearance. Due to the low passivation film thickness, it is less probable that the component function will be influenced by passivation than by sealers, but it must be possible to rule this out.

#### 7.1.2.2 Sealers

For all PVs that require or permit sealers, the following applies, provided the function is not impaired:

Sealers increase corrosion resistance and are generally permissible if the layer thickness is not increased by more than 0.5 to 2 µm and the functional properties of the component, such as contact resistance, weldability, compatibility with service products or adhesive bonds, are not impaired. Additional checks may be necessary here.

For components which are glued and/or pressed in (e.g. core hole covers), particular attention shall be given to the influence of the coat structure and/or sealant on the assembly and functional properties. The use of specially prescribed products may be necessary in this respect.

The use of sealants with integrated lubricants which may have an effect on the sliding properties of the finish is not permitted in principle with regard to these components. Any deviations shall be agreed and documented separately.

Parts that subsequently undergo electrophoretic dip coating shall not be sealed thereafter. The coater shall be notified of this.

If an improvement of the coating corrosion resistance of passivated surfaces is also required for thermal loads, this can be achieved by means of sealing. Suitable sealing means shall be defined after testing and the exclusive application of these products shall be ensured.

#### 7.1.2.3 Organic surface films

PVs .19, .29, .69, and .79 apply to electrodeposited zinc and zinc alloy coatings on ferrous materials that also have a thin organic surface film. The coatings serve as corrosion protection under maximum demands and give the material a black color scheme.

The applicability of these types of coating systems shall be tested and evidence provided in each case by means of suitable investigations.

The processes and products used shall be recorded in the initial sample inspection report at the time of initial sampling of surfaces.

Organic surface films are generally not suitable for parts with a metric thread <M6 for dimensional reasons.

## 7.2 Coatability with tubes (pipes) and sleeves (exception)

This section does not apply to all components with internal surface areas, such as rivets, but exclusively to pipe/tubess and sleeves (short tube sections). Here , galvanic deposition is made difficult or prevented by the shielding effect. That is why, for example, the inner surfaces of the tubing generally remain coating-free and the layer "scatters" - depending on the inner diameter of the tube - only a short distance into the tube interior at the tube ends. The greater the diameter/length ratio of the tubing, the better the coatability of the inside.

All requirements as per Section 8 and Table 3 are imposed on the external surface areas and also the end edges (as for all other parts according to this DBL). The diameter/length ratio as of which the internal surface areas shall **also** meet the requirements of this DBL is defined for tubes and sleeves in Table 2 in the following.

**Table 2: Requirements for internal surfaces of tubes and sleeves**

| | **Ratio =** $\frac{\text{Inside diameter}}{\text{Length or depth}}$ |
|---|---|
| | Tubes, sleeves |
| All requirements also apply to the internal surface areas. | ≥1 |
| No demands whatsoever are placed on the internal surface areas with regard to their behavior in the Kesternich test. The requirements in the salt spray test DIN EN ISO 9227 must be fulfilled. | ≥0.5 and <1 |
| No corrosion protection requirements as per Table 3 are imposed on the internal surface areas whatsoever. Corrosion protection arising in these areas due to the process shall be accepted. | < 0.5 |

If requirements for internal surface areas of tubes and sleeves must be stipulated that exceed the requirements in Table 2, then additional measures such as internal anodes for coating must be agreed upon.

For tubes with a reduced corrosion resistance of their "inner surfaces" and highly active inner surfaces due to the galvanic treatment process, the component supplier must ensure that these areas receive sufficient transport and storage protection so that delivery to the Mercedes-Benz plants is corrosion-free. In the case of sealers and also any temporary corrosion protection substances, and particularly in the case of internal tube surfaces, attention shall be paid to possible residue formation, meeting of residual contamination requirements, and compatibility with service products.

## 7.3 Coatability with threaded holes/blind holes

As a rule, the requirements for the surfaces of threaded holes/ blind holes are not reduced. However, if it is not possible to meet the DBL requirements at these points or if it is only possible with a disproportionately high effort in terms of coating technology, then a reduction of the corrosion protection requirements must be examined in consultation with the supplier/coater and Daimler AG and, if necessary, the specific surface areas must be defined with the changed requirements on the drawing.

### 7.4 Coatability with special component configurations (possible exceptions)

Should, in addition to the exceptions described in Section 7.2, it not be possible due to geometric reasons to apply a sufficient all over coating by using standard galvanic processes in drum or frame coating due to special component configurations, then a decision on the application of special measures such as internal anodes must be made in consultation with Daimler AG. The agreed special measures shall be documented.

The contact points (suspension points) required for the electroplated coating are no exception and must meet the required specifications as well.

## 8 Tests

### 8.1 Corrosion resistance test

The required corrosion resistance must be achieved upon delivery in the respective Mercedes-Benz plants. This also means that the outgoing tests do not have to be carried out by the supplier prior to any still necessary processing steps.

After the required test periods are completed, the components are then removed from the test cells, rinsed with de-ionized water and then dried with compressed air, e.g. by soft blowing, prior to evaluation.

The corrosion resistance test is deemed to have been passed when the following requirements, as well as those in Table 3 of this DBL, have been complied with.

The anti-corrosion coatings shall not demonstrate any blisters or peeling during the specified corrosion tests after the specified test period.

During the corrosion test of small parts, at least 10 parts per individual type of test must be tested in each case in order to record fluctuations from component manufacture as well as from the test proecdure. For larger parts, the number of test parts (not less than 3 parts) can be reduced. It is essential that it can be derived from the test result that all parts from the series coating process meet the requirements of this DBL.

It is recommended to conduct corrosion tests beyond the times required by the DBL in order to discover how far the actual coating quality is from the required limit and how the coating quality varies.

#### 8.1.1 Corrosion test in accordance with DIN EN ISO 9227 NSS (salt spray test)

The requirements labeled with "A)" in Table 3 shall be met <u>with and without</u> heat treatment before corrosion exposure in accordance with DIN EN ISO 9227 NSS.

Assessment of black parts regarding freedom from zinc corrosion:
Test instruction MBN 10513 with the corrosion degree KG 1 shown there gives an indication of how incipient zinc corrosion appears on drum parts.

Note: The specified corrosion test according to DIN EN ISO 9227 NSS is only a "short-term test method" used to prove that the supplied coating quality conforms to the defined target specification. The test results of the salt spray test, however, cannot be used to derive any conclusions concerning the suitability of the coated component under corrosion conditions in practice.

#### 8.1.2 Corrosion test in accordance with DIN EN ISO 6270-2 CH (constant condensation water test)

During initial sampling of surfaces, as well as during requalification tests for PVs .19, .29, .69, and .79, evidence shall be provided that neither base material or coating corrosion, nor blistering or peeling occur (system test/validation) under constant condensation water exposure for 240 h in accordance with DIN EN ISO 6270-2 CH. If this is the case, further series condensation water tests need not be performed.

#### 8.1.3 Corrosion test in accordance with DIN 50018 AHT 2,0S (Kesternich test)

The tests in the condensation water alternating climate with sulphur dioxide-containing atmosphere are primarily used to quickly detect flaws, virtually as an integral layer thickness test, but also to briefly determine the corrosion protection quality of alloyed Zn coatings.

Time-based correlation of the behavior in these tests with the atmospheric corrosion behavior of vehicle components is not feasible.

The designation of the test atmospheres has changed with the issuing of DIN 50018:2013-05. The former designation DIN 50018 KFW 2,0S was renamed to DIN 50018 AHT 2,0S.

#### 8.1.4 Corrosion protection requirements for parts with reshaping after coating

Reshaping after surface treatment may impair corrosion resistance. Coating corrosion (zinc corrosion) is not generally assessed in the area of the component surface reshaped after coating. The requirements for the base material (Fe) corrosion protection also apply to these areas, however. Deviations from this rule shall be stated on the component drawing. The initial sample inspection report shall point out the presence of components which have been reshaped after coating.

For surface areas unaffected by deformation as well as for the complete components prior to deformation, the standard requirements of the respective PV according to Table 3 shall then apply.

Example:

Corrosion protection requirements for and assessment of reshaped tubing according to DBL 8451.62

1. The following are required for **the entire straight, coated tubing before reshaping** and **for straight tubing sections after reshaping**:

    a. 240 h without Zn corrosion in the test according to DIN EN ISO 9227 NSS
    b. 720 h without Fe corrosion in the test according to DIN EN ISO 9227 NSS
    c. two cycles without Fe corrosion in the Kesternich test according to DIN 50018 AHT 2,0S

2. The following requirements are placed on tubing **after reshaping** in the **reshaped** tubing sections:

    720 h without Fe corrosion in the test according to DIN EN ISO 9227 NSS

    two cycles without Fe-corrosion in the Kesternich test according to DIN 50018 AHT 2,0S

The requirements shall apply for this example with and without previous heat treatment.

Definition of the straight tubing sections for tubing reshaped after coating:

Tubing sections shall be considered to be straight if they are longer than 10 cm on the reshaped tubing. During assessment based on the criteria above, the starting lengths of the straight section shall not be assessed. The unassessed length shall measure 3 cm in each case. Example: The straight length of the reshaped area of subsequently bent tubing is 12 cm. Of this, 3 cm on each end is not assessed. This results in an average straight tubing length for assessment of 6 cm.

### 8.2 Coating adhesion test (thermal shock resistance, blistering)

Store test parts for 30 minutes at 220 ± 10 °C and quench them immediately afterwards in water at a temperature of 15 °C to 25 °C. No chipping or blistering of the coat shall occur. Bending of the components is recommended as an additional adhesion test, as far as it is practical.

### 8.3 Test for susceptibility to brittle fracture

Proof of a successfully completed overall process for parts with strengths ≥1000MPa must be provided by a crack-free bracing test in accordance with DIN 50969-2.

## 9 Sample/test report

The following information regarding this DBL shall be indicated in the initial sample inspection report:

- Specified DBL PV
- Any agreed deviations from the DBL requirements
- Coater applying surface protection, or subcontractor if applicable
- Coating methods employed and materials applied, including product names
- If the component was reshaped after coating, additional information as per Section 8.1.4
- Information concerning any measures performed to prevent hydrogen embrittlement
- Test results: the appearance of the test specimens after the test, along with the position of the test parts in the tester, shall be documented. The pictures shall be enclosed with the initial sample inspection report.
- Name of the testing body (supplier and/or subcontractor and/or testing institute)

In the case of several coaters/locations, each electroplating shop shall submit initial samples with the ISIR, and particular attention shall be paid to identical functional and/or assembly characteristics of the parts that are finish-plated in different systems. As a rule, this also requires the use of identical products (base chemicals) for the creation of the coating.

The data shall be treated as confidential and not disclosed to third parties.

## 10 Deliveries

Ongoing deliveries shall correspond to the approved samples.

In the event of any changes regarding the coater, location, process, significant parts of the process, or the layer-forming products, renewed initial sampling of the surface quality shall be performed.

For production deliveries, the supplier shall conduct an in-process quality check and make the data available on request.

All parts shall be delivered free from corrosion products. When storing parts until they are required for subsequent processing or assembly, preservation or special storage conditions may be required.

**Table 3: Technical data and requirements**

| PV | Coating metal | Parts category with or without Threads | Surface | Sealer | DIN EN ISO 9227 NSS (h) until Zn Corrosion | DIN EN ISO 9227 NSS (h) until Fe Corrosion | DIN 50018 AHT 2,0 S cycles until Fe corrosion | Corrosion resistance (Kb) |
|---|---|---|---|---|---|---|---|---|
| .15 | Zn | without | transparent passivated | permissible | 168 [A] | 360 [A] | 5 | IV |
| .16 | | with | | | 96 [A] | 240 [A] | 3 | III |
| .12 | | without | silver-colored passivated | permissible | 48 | 120 | 5 | only for interior parts |
| .22 | | with | | | 24 | 72 | 3 | only for interior parts |
| .13 | Zn or ZnFe | all | black passivated | yes | 168 | 360 | 5 | only for interior parts |
| .86 | ZnFe | without | transparent passivated | yes | 360 [A] | 600 [A] | 5 | V |
| .96 | | with | | permissible | 120 [A] | 480 [A] | 3 | III to IV |
| .66 | ZnNi | without | transparent passivated | permissible | 240 [A] | 720 [A] | 2 | V to VI |
| .62 | | without | | no | 240 [A] | 720 [A] | 2 | V to VI |
| .65 | | without | | yes | 360 [A] | 720 [A] | 2 | V to VI |
| .76 | | with | | permissible | 120 [A] | 720 [A] | 1 | IV to V |
| .72 | | with | | no | 120 [A] | 720 [A] | 1 | IV to V |
| .19 | Zn | without | Duplex layer (metallic base coat, passivated + organic surface films) | | 240 | 480 | | V to VI |
| .29 | | with | | | 168 | 240 | | IV to V |
| .69 | ZnNi | without | | | 480 | 720 | | VI |
| .79 | | with | | | 360 | 720 | | VI |

A) Requirements must **also** be met following a heat treatment of **24h at 120°C**.

# Annex A (normative)
# Comparison table for substitution of Cr(VI) coatings with Cr(VI)-free coatings

Owing to the requirements of the current EU Chemicals Regulation (REACH), it must be expected that the application of chromic acid will lead to a discontinuation of the production of anti-corrosion coatings with Cr(VI)-containing conversion layers on electroplated zinc and zinc alloy coatings in European electroplating plants. As a result, the coating systems produced in the EU zone and specified on a high number of commercial vehicle component drawings will no longer be available for commercial vehicles, buses, or vans.

In order to avoid changes to individual design drawings for a majority of the affected components, the comparative substitution list for the Cr(VI)-containing product versions still used in commercial vehicles indicates possible alternative, Cr(VI)-free surfaces with similar technological properties.

The technology used for manafacturing Cr(VI)-free surfaces is similar in the majority of cases, i.e. the base coat specifications are identical, with differences only arising in the final conversion treatments. Thus, Cr(VI)-based chromate conversion coating is transformed into Cr(VI)-free passivation. However, this also changes the surface color and anti-corrosion properties.

The basic system is also changed in some substitution specifications. Thus, for example, a galvanic base layer is turned into a zinc flake base layer there according to the standard coating on our metric screws (DBL 9440.40). Due to the specific requirements for friction behavior, the drawing entry shall also be modified via the component manager in this case.

**For components in which surface protection product versions (PV) according to DBL8451 can result in the application of Cr(VI)-containing chromate conversion coatings, these product versions are substituted by product versions with Cr(VI)-free passivations according to the following scheme in Table 4.**

**Table 4: Substitution list for the transition from Cr(VI)-containing chromate conversion coatings to Cr(VI)-free coating systems**

| Group | Requirement | | Corrosion protection of the Cr(VI)-free coating | Color scheme |
|---|---|---|---|---|
| | Initial PV (containing Cr(VI)) according to DBL 8451:2008-09 | Substitution PV (Cr(VI)-free) according to DBL 8451:2015-04 | | |
| A | 8451.11 | 8451.15 | slightly better | yellow becomes silver |
| | 8451.21 | 8451.16 | slightly better | yellow becomes silver |
| | 8451.18 | 8451.15 | very similar | yellow becomes silver |
| | 8451.28 | 8451.16 | very similar | yellow becomes silver |
| | 8451.68 | 8451.65 | requirement identical | yellow becomes silver |
| | 8451.78 | 8451.76 | requirement up to Zn corrosion lower | yellow becomes silver |
| | 8451.61 | 8451.66 | requirement identical | yellow becomes silver |
| | 8451.71 | 8451.76 | requirement up to Zn corrosion lower | yellow becomes silver |
| | 8451.83 | 8451.69 | better due to org. surface film | black is retained |
| | 8451.93 | 8451.79 | better due to org. surface film | black is retained |
| | | | | |
| B | 8451.25 | 9440.40 shall be checked by component manager; a new drawing entry is required | | |
| | 8451.75 | 9440.40 shall be checked by component manager; a new drawing entry is required | | |
| | 8451.97 | 9440.xx shall be checked by component manager; a new drawing entry is required, e.g. 9440.50 | | |
| | | | | |
| C | 8451.14 | No direct substitution; seek a new solution with component manager if necessary | | olive |
| | 8451.24 | No direct substitution; seek a new solution with component manager if necessary | | olive |

**Method based on an example for group A:**

- Supplier announces its plans to stop chromate conversion coating to the responsible supply management of Daimler AG. The period until chromate conversion coating is discontinued must not be shorter than six months.
- Supplier informs Daimler (the responsible supply manager of the affected component or component group) of the specific date on which the chromate conversion coating was stopped and of his initial sampling result for the components in accordance with Section 9 of this DBL, which he has coated and tested in accordance with Substitution PV 8451.xx from Table 4. This information must be available at least three months before the conversion date.
- Daimler approves the initial/new samples.

**Procedure based on an example for group B:**

- Supplier announces its plans to stop chromate conversion coating to the responsible supply management of Daimler AG. The period until chromate conversion coating is discontinued must not be shorter than twelve months.
- Supply management of Daimler AG informs the development department responsible for components (component manager) and asks for the specification of a design type of the DBL 9440 with screw-driving properties that can replace those of the previously used DBL 8451. Component manager changes drawing (at least six months prior to transition) and supplier is informed.
- The supplier performs sampling and delivers according to the new specifications after sample approval by Daimler AG.

**Procedure based on an example for group C**:

- Supplier announces its plans to stop chromate conversion coating to the responsible supplier management of Daimler AG. The period until chromate conversion coating is discontinued must not be shorter than twelve months.
- Supplier management of Daimler AG informs the development department responsible for components (component manager) and asks for the specification DBL or maybe another standard with which surface protection methods suitable for the application are determined.
- Component manager changes drawing (at least six months prior to changeover) and supplier is informed.
- The supplier performs sampling and delivers according to the new specifications after sample approval by Daimler AG.

Daimler department responsible for this topic:
Trucks, Complete Vehicle Corrosion Protection