

Group Standard

TL 217

Issue 2009-08

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Zinc Coatings

Surface Protection Requirements

Previous issues

TL 217: 1976-07, 1979-05, 1980-01, 1983-02, 1986-01, 1987-06, 1988-06, 1989-11, 1991-11, 2001-07, 2002-07

Changes

The following changes have been made as compared to TL 217: 2002-07:

- Section 1 "Scope" expanded
- Section 3.2 "General requirements" modified
- Table 1 supplemented by the note concerning the requirements for brake calipers made of cast iron
- Table of Cr(VI)-containing surface protection types (formerly Table 2) removed
- Special rules for welded parts introduced (see Tables 3 and 5)
- Referenced documents updated and supplemented
- Appendix A "Traditional surface protection types" removed

1 Scope

This standard specifies requirements for Cr(VI)-free, electrolytically deposited zinc coatings on steel parts as well as for parts made from hot-dip galvanized semifinished products according to code letter c of Volkswagen standard [VW 13750](#). The coatings are not suitable for use at long-term elevated temperatures > 100 °C.

Surface protection type OfI-c340 must be used preferentially for weld studs, weld screws, welded pins, and weld nuts.

Check standard for current issue prior to usage.

This electronically generated standard is authentic and valid without signature.

The English translation is believed to be accurate. In case of discrepancies the German version shall govern.

Numerical notation acc. to ISO practice.

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Technical responsibility			Standards Department	
GQL-LM/2	Hans-Joachim Koeppen	Tel.: +49-5361-9-25803		
GQL-LM/2	Günther Laudien	Tel.: +49-5361-9-25846	EKDV/4 Jürgen Wiesner	EKDV
GQL-L	Dr. Stephan Eisenberg	Tel.: +49-5361-9-21151	Tel.: +49-5361-9-29064	Manfred Terlinden

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NOTE 1 The standard has been expanded to include special rules for welded parts with surface protection OfI-c340 in order to improve weldability (for details, see Table 3 and Table 5).

2 Description

See VW 13750, Section 2.

3 Requirements

3.1 Surface protection types

The surface protection types listed in Table 1 apply.

For requirements for hot-dip galvanized semifinished products, see DIN EN ISO 1461.

Table 1

Surface protection type	Characteristics and appearance
OfI-c310, OfI-c610	Unalloyed zinc coating (any galvanic method), without post-treatment, silver-colored
OfI-c330, OfI-c630	Zinc coating (hot-dip galvanized), without post-treatment, silver-colored
OfI-c340, OfI-c640	Unalloyed zinc coating (any galvanic method), thin-film passivation treatment, silver-colored
OfI-c341, OfI-c641	As for c340 and c640, additionally with organic or inorganic sealing, silver-colored to pale bluish iridescence
OfI-c342, OfI-c642	Unalloyed zinc coating (any galvanic method), thick-film passivation treatment, bluish, greenish, reddish, yellowish iridescence
OfI-c343 ^{a)} , OfI-c643	As for c342 and c642, additionally with organic or inorganic sealing, silver colored, pale bluish, reddish, yellowish iridescence
OfI-c347, OfI-c647	As for c342 and c642, additionally treated with sliding agent according to Technical Supply Specification TL 52132

a) For brake calipers made of cast iron with surface protection OfI-c343, further requirements of the VDA 237-299, type 05 apply with regard to coating thickness, appearance, adhesion and corrosion resistance.

3.2 General requirements

Approval of first supply and changes according to VW 01155.

Avoidance of hazardous substances according to VW 91101.

A total of 10 finished parts are required for complete testing.

Unless certain sections of a part that are marked in the drawing are excluded from the surface coating, the entire surface of the parts must comply with the required surface protection type and display the specified properties.

Contrary to this, the minimum layer thickness for joining elements must be determined acc. to DIN EN ISO 4042. For components with process-related weak spots such as bending radii or shank

and threaded areas of joining elements, the corrosion protection requirements in these areas are reduced to 2/3. This exception does not apply to wheel bolts.

Furthermore, the specifications in DIN EN ISO 4042 concerning the maximum possible thickness of the electroplated coating in the thread profile must be taken into consideration.

For parts made from hot-dip galvanized and additionally oiled semifinished products, the test requirements only apply to the zinc coating thickness and to resistance in the SO₂ test according to DIN 50018 – KWF 2,0 S.

The protective coatings must not exhibit any pores, cracks, damage, or other flaws impairing the corrosion protection and/or specified appearance.

Moreover, the layers must securely adhere to the base material and must not flake off during slight deformation.

The production process must be designed and controlled such that functional characteristics of the finished part are not impaired. In particular, the pretreatment and heat treatment methods must be suitably selected and combined to ensure that no hydrogen embrittlement occurs.

All heat treatments to avoid hydrogen embrittlement must be performed as soon as possible after depositing, within 4 hours at most, and before any further treatment of the coatings (see DIN EN ISO 4042).

If, in special cases, deviating from the specifications stated in VW 13750, Section 3.6, Paragraph 1, electrolytically deposited zinc coatings are used for high-strength steel parts with $R_m > 1000$ MPa, these must be galvanized in a cyanide bath or alkaline cyanide-free bath. The special case must be agreed upon with the QA laboratories of the individual brands.

3.3 Zinc coatings for the following paint finishes

Electroplated zinc coatings on semifinished products, whose surface treatment is not completed immediately after the galvanizing process (e.g., product is shipped from the galvanizing plant to the painting plant) must not exhibit any passivation or phosphating in order to avoid possible paint adhesion problems (OfI-c310/c610).

Any required transport and storage protection of zinc-coated parts, e.g. in oils, shall be agreed upon with the painting plant.

If painting is carried out at a plant in the Volkswagen Group, the transport or storage protection must correspond to Quality Specification QP A001.

In addition, the zinc coatings must display impeccable adhesive strength even at greater layer thicknesses, e.g., in the edge area.

3.4 Cr(VI)-free passivation treatment layers

In order to improve the corrosion resistance of electrolytically deposited zinc coatings to salt water and condensed water, a post-treatment in passivation treatment solutions is the usual practice.

If the passivation treatment solution used contains no Cr(VI) compounds, the resulting conversion layers will also be Cr(VI)-free.

Colorless and blue passivation treatments, so called thin film passivation treatments, with a layer thickness of approx. 0,1 µm are preferred for parts in the passenger compartment and/or trunk area. If required, they may also be additionally sealed.

The corrosion protection is further improved using so-called thick layer passivation treatments (with a layer thickness of approx. 0,5 µm). Due to their optical appearance (iridescence), they must also be sealed to ensure they are suitable for areas visible to the customer.

When a passivation treatment is used, it must not adversely affect further usability of the components. In case of doubt, consultation with the responsible engineering department (GQL-LM/2, I/GQ-322, N/GQ-551, or I/EG-72) is required.

3.5 Coatings with sealing

In the sealing process, organic and/or inorganic materials are applied to the previously formed conversion layers and partially deposited.

The additional sealing can increase the thickness of the layer structure by 0,5 µm to 2,0 µm.

Compared to unsealed coatings, sealed coatings provide the following advantages:

- Increased corrosion resistance (delays zinc corrosion and base metal corrosion with no change in the zinc coating thickness)
- Change in the sliding properties (reduces the coefficients of friction and related spread for joining elements)
- Coloring (distinctly diminishes the iridescence produced by thick-layer passivation treatments, thereby improving the appearance)

3.6 Structure

3.6.1 Base material

Material according to drawing and/or master data list.

3.6.2 Protection types/appearance

See Table 1.

3.7 Layer thickness

For coatings without post-treatment (surface protection types OfI-c310 and OfI-c610) the determination of the corrosion resistance according to DIN 50018 - KFW2.0S can be used as an indirect measure for the layer thickness of the zinc coating (see Table 2).

Table 2

Surface protection type	Test cycles	Requirement
OfI-c310, OfI-c330	2	No base metal corrosion after the prescribed test duration
OfI-c610, OfI-c630	5	

Alternatively, the layer thickness must be determined by a test according to DIN EN ISO 1463, DIN EN ISO 2177, DIN EN ISO 2178, DIN EN ISO 2360, or DIN EN ISO 3497.

For requirements, see Table 3.

Table 3

Resistance class	Components of a general nature	Metric threaded parts and welded parts of a general nature	Weld studs, weld screws, welded pins, weld nuts
3	8 µm to 35 µm	8 µm to 14 µm	6 µm to 12 µm
6	15 µm to 35 µm	15 µm to 23 µm	-

3.8 Adhesive strength

Thermal shock test based on DIN EN ISO 2819.

The specimen part is aged for 30 minutes at $(220 \pm 10) ^\circ\text{C}$ and then dipped in water with a temperature of $15 ^\circ\text{C}$ to $25 ^\circ\text{C}$.

3.9 Corrosion behavior

The corrosion resistance of the systems must be ensured in the as-received condition and also after a 24-hour period of aging at an elevated temperature of $120 ^\circ\text{C}$. These are minimum requirements and must always be adhered to.

3.9.1 Passivation treatment layers and sealing

Test method NSS according to DIN EN ISO 9227, evaluation according to DIN 50961; for test durations and requirements, see Table 4. The test is not performed for weld studs, weld screws, welded pins and weld nuts.

Table 4

Surface protection type	Test duration in h		Requirement
	Barrel-plated goods	Rack-plated goods	
Ofl-c340, Ofl-c640	6	12	No zinc corrosion after the prescribed test duration
Ofl-c341, Ofl-c641	48	72	
Ofl-c342, Ofl-c642, Ofl-c345, Ofl-c647	72	96	
Ofl-c343, Ofl-c643	96	168	

3.9.2 Zinc coatings including passivation treatment layers and sealing

Test method NSS according to DIN EN ISO 9227, evaluation according to DIN 50961; for test durations and requirements, see Table 5.

Table 5

Surface protection type	Test duration in h	Requirement
OfI-c310, OfI-c330	48 (24 for weld studs, weld screws, welded pins and weld nuts)	No base metal corrosion after the prescribed test duration and no zinc corrosion after the test durations according to Table 4
OfI-c340, OfI-c610, OfI-c630	96 (48 for weld studs, weld screws, welded pins, and weld nuts)	
OfI-c341	144	
OfI-c342, OfI-c347, OfI-c640	168	
OfI-c343, OfI-c641, OfI-c642, OfI-c647	240	
OfI-c643	360	

Weld studs, e.g. according to DIN EN ISO 13918 with surface protection OfI-c340 may be treated with a lubricant according to TL 52132 in order to improve its lead-in properties. The lubricant must not impair the welding suitability.

4 Referenced documents

The following documents cited in this standard are necessary for application.

In this Section terminological inconsistencies may occur as the original titles are used.

Standards with the titles given in German are either only available in German or may be procured in other languages from the institution issuing the standard.

QP A001	Prelube, Hot Melt, Blank Washing Oil, Drawing Oil, Slushing Oil (General); Quality Requirements
TL 52132	Lubricant for Threaded Fastening Elements with Electrolytically Applied Coatings or those of Stainless Steel; Requirements
VW 01155	Vehicle Supply Parts; Approval of First Supply and Changes
VW 13750	Surface Protection of Metal Parts; Surface Protection Types, Codes
VW 91101	Environmental Standard for Vehicles; Vehicle Parts, Materials, Operating Fluids; Avoidance of Hazardous Substances
DIN 50018	Testing in a saturated atmosphere in the presence of sulfur dioxide
DIN 50961	Electroplated coatings - Zinc coatings on iron and steel - Terms, testing and corrosion resistance
DIN EN ISO 13918	Welding - Studs and ceramic ferrules for arc stud welding
DIN EN ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
DIN EN ISO 1463	Metallic and oxide coatings - Measurement of coating thickness - Microscopical method

DIN EN ISO 2177	Metallic coatings - Measurement of coating thickness - Coulometric method by anodic dissolution
DIN EN ISO 2178	Non-magnetic coatings on magnetic substrates - Measurement of coating thickness - Magnetic method
DIN EN ISO 2360	Non-conductive coatings on non-magnetic electrically conductive basis materials - Measurement of coating thickness - Amplitude-sensitive eddy current method
DIN EN ISO 2819	Metallic coatings on metallic substrates - Electrodeposited and chemically deposited coatings - Review of methods available for testing adhesion
DIN EN ISO 3497	Metallic coatings - Measurement of coating thickness - X-ray spectrometric methods
DIN EN ISO 4042	Fasteners - Electroplated coatings
DIN EN ISO 9227	Corrosion tests in artificial atmospheres - Salt spray tests
VDA 237-299	Oberflächenschutz für Bremssättel; aus Gusseisen