VOLKSWAGEN AG	**Zinc Thermal Diffusion Layers (Zn-ThD Layers)** Surface Protection Requirements	**TL 184**
Konzernnorm		

Descriptors: corrosion protection, zinc, thermal diffusion, diffusion layer, Zn-ThD layer, surface

DISTEK NOTE: Can add that the coating is very uniform overall.

Changes

The following changes have been made as compared to Technical Supply Specification TL 184: 2004-04:

- the status of the standard has been changed (previously withdrawn)
- scope restricted
- responsibility extended
- temperature resistance decreased from 350 °C to 300 °C
- requirements adapted to current surface protection systems

Changes in requirements as compared to the previous issue are indicated by a vertical bar on the side of the modified text block.

Previous issues

2004-04

1 Scope

This standard defines requirements for Cr(VI)-free zinc alloy coatings applied to ferrous materials by means of thermal diffusion. This procedure is described in Appendix A.1.

The silver gray coatings are used as heavy-duty corrosion protection (protection class 6) for components for which operation temperatures of up to 300 °C (e.g., in the engine compartment or in the area of the brake and exhaust systems) as well as an increased corrosion load are to be expected. Since hydrogen embrittlement cannot be caused by this coating process, this corrosion protection can also be used for hardened and high-strength steel parts with tensile strength values R_m> 1000 MPa or surface hardness values > 320 HV.

The absence of a transition between the diffusion zone and the actual coating makes this surface treatment particularly suitable for so-called bulk goods, since mechanical damage to the surface will not significantly impair corrosion protection.

The coating is not suitable for applications where it comes into contact with magnesium.

Threaded parts with metric ISO threads may only be used as multi-purpose parts if the above mentioned coating was applied. Application of this coating to standard parts is not permissible.

Zinc thermal diffusion layers should not be used in the visual range of the customer. In case of a damaged passivation treatment, localized red corrosion will occur within a relatively short period of time. Although such corrosion has no critical impact on the component's function, it impairs the component's appearance in the visual range of the customer.

DISTEK NOTE: The issue of "false" rusting has been overcome by a change in the TopCoat in the ArmorGalv system of TDZ.

2 Description

See VW 13750, Section 2.

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3 Requirements

3.1 Surface protection types

The surface protection types listed in Table 1 apply.

Table 1

Surface protection type	Characteristics/appearance
Ofl-u610	Zinc alloy coating, silver gray, with colorless, Cr(VI)-free passivation treatment
Ofl-u615	Zinc alloy coating, silver gray, with colorless, Cr(VI)-free passivation treatment and additional lubrication treatment

3.2 General requirements

Approval of first supplies and changes according to Volkswagen standard VW 01155.

Avoidance of hazardous substances according to VW 91101.

10 finished parts are required for complete testing. For first-sample release of small parts, e.g., threaded fastening elements, a test production of > 50 kg shall be performed.

The coating must not exhibit any flaking or cracks during expansion or contraction (e.g., of springs) according to specifications.

The coating must be free of flaws and excess material impairing the component's function.

Manufacturer, coating method and location of use schall be agreed upon for each component with the Volkswagen Central Laboratory (K-GQL-2/2) and/or with the Audi Design Engineering Ingolstadt (I/EG-72).

The protective layers must be free of large pores, large cracks, damages and other flaws impairing the corrosion protection and/or the specified appearance.

The layout of the production process shall not impair the functional characteristics of the part.

3.3 Threaded parts with metric ISO threads

The coating process must not impair the mechanical and physical properties specified for joining elements. Therefore, the manufacturer shall verify whether the treatment temperatures specified by the coating company are suitable for the parts to be coated.

In the case of screws, the test specifications listed below only apply to the head and/or the wrench bearing surfaces; in the case of nuts they apply only to the face surfaces and/or wrench bearing surfaces. For threaded and thread-like shaped parts, such as tap end studs, the test requirements only apply to the face surfaces.

Prior to coating, threaded parts shall exhibit tolerances corresponding to the coating thickness; tolerances for metric threaded parts with external threads preferably according to VW 11627, for parts with internal threads according to VW 11624.

After the coating process, the actual thread profile must not exceed the maximum material limit for the tolerance zone positions H and h at any point.

For further information see VW 01110, Section 2.

3.4 Structure

3.4.1 Base material

For component base material see drawing.

3.4.2 Layer structure

a) Zinc-iron diffusion layer (approx. 2 to 90% Zn, Zn content increasing towards the edge, max. 10 to 20% Fe permissible at the surface).
b) Passivation treatment layer (see Appendix A.2)

3.4.3 Passivation treatment layer

In order to improve corrosion resistance to salt water and condensed water, a post-treatment in passivation treatment solutions is required.

The passivation treatment solution used in this process must not contain any Cr(VI) compounds in order to ensure that the resulting passivation layers are likewise Cr(VI)-free.

DISTEK NOTE: Passivation is REACH compliant.

3.4.4 Top coats/lubricants

The use of additional immersion lubricants is specified in order to ensure defined friction parameters on joining elements with metric thread. In this case, the coefficients of friction acc. to VW 01129 shall be adhered to.

If further functional surface characteristics such as repaintability, compatibility with other agents, specific friction properties, specific threadening behavior, vulcanizability or specific temperature behavior are required besides corrosion protection, part-specific tests or functional tests must be performed.

3.4.5 Layer thicknesses

The thickness of the zinc-iron diffusion layer is determined using a microsection according to DIN EN ISO 1463 (see Table 2 for requirements). Layer thickness measurements during standard production may also be performed with the help of the x-ray fluorescence method according to DIN EN ISO 3497 using the Zn/Fe measuring task (Fischerscope measuring device from Helmut Fischer or Röntgenanalytik, for example). This requires the use of a suitable standard as well as the comparison with a microsection (determination of the correlation dependent on the layer thickness).

Table 2 – Layer thicknesses

	Zinc alloy layer (µm)	Passivation treatment (µm)
Threaded parts [1)]	10 to 20	1 to 2
Other components	15 to 25	

1) Increased layer thicknesses appropriate to the tolerance zone position are permissible for threaded parts > M10

3.5 Liability

Test for sheet metal parts: Bending test using 1-mm-thick sheet metal, 90° bend with a radius of approx. 2 mm. Requirement: No chipping must occur in the deformed area.

The following applies to joining elements: Chipping must neither occur as a result of transportation as bulk goods nor during the subsequent assembly according to specifications.

3.6 Corrosion behavior

In the case of threaded fasteners, the test requirements apply only to head and/or wrench bearing surfaces. The following applies to the evaluation of the shank and thread areas of threaded and quick fastening elements: no base metal corrosion permissible after a test duration of 480 h using the NSS (neutral salt spray) test method acc. to DIN EN ISO 9227.

The corrosion protection must not be impaired by 24-hour aging at elevated temperature (120 ± 5 °C).

NSS test method acc. to DIN EN ISO 9277. According to Table 3, the following applies to the evaluation of zinc thermal diffusion layers including the passivation treatment layer:

Table 3

System	Test duration in h	Requirement
u610, u615	240	Zinc corrosion is not permissible, gray cast is permissible.
	720	Base metal corrosion is not permissible.

DISTEK NOTE: CORROSION RESISTANCE IS > 1500 HOURS.

3.7 Resistance to chemicals (only for first-sample test)

Test according to VDA 621-412, A; evaluation according to DIN EN ISO 4628-1, Table 3; test media and requirements see Table 4.

Table 4

No.	Test medium	Requirement
1	For parts to be installed in the engine compartment	
1.1	Premium unleaded gasoline acc. to DIN EN 228	No change in surface and no impairment of corrosion protection, characteristic value: max. 1.
1.2	Diesel fuel acc. to DIN EN 590	
1.3	Factory-fill engine oil acc. to TL 52107	
1.4	Automatic transmission fluid acc. to TL 52162	
1.5	Central hydraulic system fluid acc. to TL 52146	
2	For parts to be installed outside the engine compartment	
2.1	Brake fluid acc. to TL 766	Minor change permitted, but characteristic value max. 1 after 5 h resting period
2.2	Coolant acc. to TL 774	

4 Referenced standards*

TL 766	Brake Fluid; Material Requirements
TL 774	Ethylene Glycol-Based Coolant Additive; Material Requirements
TL 52107	SAE 15W-40 Factory Fill Engine Oil; Lubricant Requirements
TL 52146	Central Hydraulic System Fluid; Lubricant Requirements
TL 52162	Factory-Fill-for-Life Automatic Transmission Fluid; Lubricant Requirements
VW 01110	Threaded Joints; Design, Assembly and Process Assurance
VW 01129	Limit Values for Coefficients of Friction; Mechanical Joining Elements with Metric ISO Thread
VW 01155	Vehicle Supply Parts; Approval of First Supply and Changes
VW 11611	Metric ISO Threads; Limit Dimensions with Surface Protection Layer for Medium Tolerance Class 6g/6H
VW 11624	Metric ISO Thread; Limit Dimensions for 6G/6f Tolerance Zone, Male 6f, Female 6G
VW 11627	Thread Limit Dimensions for External Threads – of Tolerance Class 6e; Metric ISO Threads
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
VDA 621-412	Anstrichtechnische Prüfungen; Chemikalienbeständigkeit von Kraftfahrzeuglackierungen (Tests for Coating Methods; Resistance to Chemicals of Motor Vehicle Paints - only available in German)
DIN EN 228	Automotive Fuels – Unleaded Petrol – Requirements and Test Methods
DIN EN 590	Automotive Fuels – Diesel – Requirements and Test Methods
DIN EN ISO 1463	Metallic and Oxide Coatings – Measurement of Coating Thickness – Microscopical Method
DIN EN ISO 3497	Metallic Coatings – Measurement of Coating Thickness – X-Ray Spectrometric Methods
DIN EN ISO 4628-1	Paints and Varnishes - Evaluation of Degradation of Coatings; Designation of Quantity and Size of Defects, and of Intensity of Uniform Changes in Appearance – Part 1: General Introduction and Designation System
DIN EN ISO 9227	Corrosion Tests in Artificial Atmospheres - Salt Spray Tests

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

Appendix A (informative)

A.1 System description

A.1.1 Pretreatment

Parts to be coated are mechanically cleaned by means of abrasive blasting (30 to 70 µm grain size). The blast material must be matched to the material to be coated. Oiled parts shall be degreased prior to blasting.

A.1.2 Coating process

The components are placed in drums with a capacity of up to 1,000 kg for coating. A powder consisting of up to 90 % zinc dust is then added to the drum in a fixed ratio to the component size (approx. 1 to 3 %, depending on the required layer thickness).

In addition to the zinc (particle size < 5 µm), the powder can also contain metallic and non-metallic additives as well as additives facilitating and controling the actual coating process.

The drum is closed after filling and placed in a chamber oven.

The diffusion treatment takes 1,5 to 3 hours under air atmosphere once the treatment temperature is reached.

With a material-dependent temperature of 330 to 400 °C, turning the drum will result in a diffusion layer of constant thickness as well as a slightly cracked top layer across the entire component surface.

After the diffusion treatment, the container is removed from the chamber oven, cooled to room temperature and then emptied. The coated parts are freed from powder residues, cleaned using ultrasonics, passivated and dried.

A.2 Released surface protection systems

A.2.1 u610/u615

DIFFCO; Fa. ITW Automotive Products GmbH & Co. KG, 58642 Iserlohn-Letmathe

A.3 Released coating suppliers

Fa. ITW Automotive Products GmbH & Co. KG, Coating Division, 58642 Iserlohn-Letmathe