

Group standard

VW 13750

Issue 2018-07

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Surface Protection for Metal Parts

Surface Protection Types, Codes

Previous issues

VW 13750: 1953-06, 1954-07, 1956-10, 1958-04, 1959-03, 1959-06, 1963-03, 1963-05, 1966-06, 1966-06, 1966-10, 1967-05, 1967-11, 1969-10, 1970-11, 1971-12, 1972-02, 1974-08, 1975-06, 1976-07, 1980-09, 1983-10, 1986-10, 1989-12, 1991-11, 1994-10, 1999-04, 2005-02, 2008-01, 2008-06, 2014-05, 2016-12

Changes

The following changes have been made to VW 13750: 2016-12:

- Technical responsibility changed
- Section 1 "Scope": Supplement 1 superseded by VW 13750-1
- Section 3.6 "Zinc and zinc alloy coatings": Reference to DIN EN ISO 4042 deleted and section rephrased
- Table 2: Assignment to TL 240 for Ofl-b111 and Ofl-b113 deleted (because the planned incorporation into TL 240 was rejected)
- Table 2 expanded by Ofl-w626, Ofl-w645, Ofl-w646 (all as per TL 182)
- Table 2 expanded by Ofl-w699 as per TL 212
- Section "Applicable documents" updated

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

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1
Scope

This standard applies to the identification of general surface protection types for vehicle parts and units in drawings and technical documentation.

Volkswagen standard VW 13750-1 (previously VW 13750 supplement 1) lists all invalid surface protection types that were contained in earlier issues of VW 13750.

2
Designation

2.1
Structure of the codes

See figure 1: The abbreviation for surface protection ('OfI-', from the German word for 'surface'), is followed by a 4-character code from table 2.

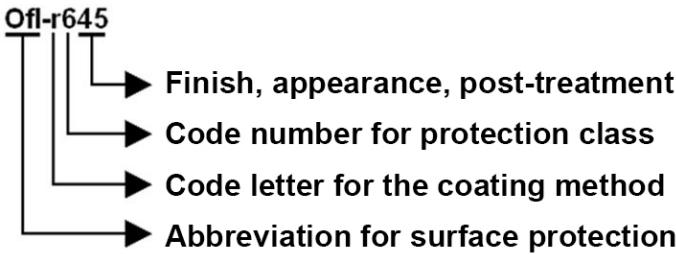


Figure 1 – Structure of the code for surface protection types

2.2 Designation example

For surface protection: Electrolytically zinc-alloy-plated, heavy protection, silver-colored to slightly iridescent blue, passivated, transparently sealed and treated with lubricant, as per Technical Supply Specification TL 244:

VW 13750 – OfI-r645

3 Requirements

3.1 Basic requirements

Together with Volkswagen Materials Engineering for Metals (GQL-M) and/or the Audi AG Laboratory (I/GQ-L), the appropriate Development department will classify the vehicle parts and units according to their corrosion load and assign them to a protection class with a code number (as per table 1).

If the parts and units are handled according to their intended applications, there must be no damage that leads to a functional impairment and/or a decrease in the prescribed corrosion protection.

The restrictions as per VW 60361 must be observed for mechanical fasteners.

The following standards apply to thread dimensions before a surface treatment: VW 11610, VW 11614, VW 11624, VW 11625, and VW 11627.

The following standards apply to thread dimensions after surface treatment: VW 11611, VW 11615, and VW 11628.

Avoidance of hazardous substances as per VW 91101.

Table 1 – Classification of vehicle parts

Part groups	Corrosion load	Protection class
– Parts that are not visible in their installed condition and that have corrosion protection that is intended exclusively as a transit coating and is not required for the parts' proper function.	Low load	Light protection Code number 1
– Components in the vehicle interior and in the exterior in a protected installation position; not for fasteners (for exceptions, see VW 01110-1)	Medium load	Medium protection Code number 3
<ul style="list-style-type: none"> – Parts exposed to direct open-air weathering (e.g., chassis, engine, motor, transmission) – Parts that can be seen in their installed condition (including from the bottom of the vehicle) – Parts for which corrosion protection is required in order to safeguard proper function of the parts – Parts, e.g., fasteners, that can be used in the vehicle interior or in the exterior for reasons of minimizing part proliferation 	Heavy load	Heavy protection Code number 6

3.2 Specifications in drawings

If a specific surface protection is required for the entire part or for several parts in the assembly (ASSY), the code must be entered in the title block under "Surface protection"; e.g., OfI-t650 (see also VW 01058). If several surface protection types are approved for use at the user's discretion, the codes of all approved treatments are indicated,

e.g., OfI-r673/x630.

If only partial protection is applied to a workpiece, "See drawing" must be entered in the title block under "Surface protection", the affected area on the part must be marked with a wide dash-dot line (figure 2), and the code must be indicated with a datum line.

If only a small area on the part has no surface protection, then the unprotected area must be marked (figure 3). In this case, "See drawing" is indicated under "Surface protection."

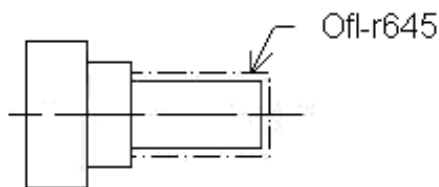


Figure 2

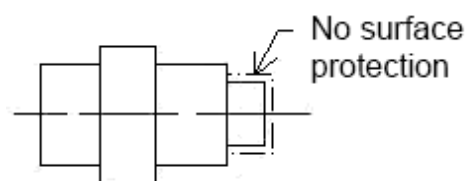


Figure 3

If different surface treatments are specified for a single part, "See drawing" must be entered under "Surface protection." The affected areas on the part must be clearly delineated.

If parts from one ASSY are coated individually (one or several different surface treatments), then "See drawing" must be entered under "Surface protection" in the assembly drawing. The surface treatments must then be listed individually on a part-specific basis in the respective drawing itself.

3.3 Weldability

If parts with surface protection are to be welded together with one another or with other metal parts, then the parts must be tested for weldability.

OfI-c340 must be reserved as the standard surface protection type for welding parts in body manufacture (e.g., for weld nuts).

3.4 Agents impairing wetting ability

Lubricants and slushing oils must be free of silicone oils and other agents that significantly impair wetting ability.

3.5 Friction behavior

Threaded parts with a metric ISO thread must stay within the coefficient-of-friction range in VW 01129 with integrated or additional lubricant treatment.

The lubricant must be neither hazardous to the user's health nor emit an unpleasant odor during the screw-on process. It must also be suitable for automated bolting.

All-metal prevailing torque type nuts must always be treated with an additional or integrated lubricant. Nuts with non-metallic clamping may be lubricated in order to achieve the specified functional characteristics. The functional characteristics of nuts treated with a protective coating and/or with a

lubricant must not deteriorate within a storage period of 6 months in weather-sheltered rooms. The storage temperature must be between -5 °C and 40 °C.

Fasteners made of stainless or heat-resistant materials may require an additional lubricant treatment in order to meet the requirements in [VW 01129](#).

The influence of the surface protection on the friction behavior, particularly for parts with a metric ISO thread, must be determined by testing and matched to the performance characteristics (see [VW 01131](#)).

For coatings without lubrication, there is no guarantee that the coefficient-of-friction range as per [VW 01129](#) is adhered to.

NOTE 1: Fasteners without lubrication usually meet the criteria of friction class D or E in Association of German Engineers (VDI) technical rule [VDI 2230](#), sheet 1, table "Assignment of coefficient-of-friction classes with reference values for various materials/surfaces and lubrication conditions in threaded connections." For parts without lubricant treatment and a locking or adhesive coating with a set thread coefficient of friction, a coefficient-of-friction range of $\mu_{\text{tot}} = 0.18$ to 0.25 must be adhered to.

3.6 Zinc and zinc alloy coatings

Electroplated/galvanized coatings are not permissible for high-strength steel or standard parts with a tensile strength of $R_m > 1\,000$ MPa and threaded parts with a property class ≥ 10.9 . The use of zinc flake coatings as per code letter t is preferred.

Exceptions are possible for Zn/Ni coatings as per [TL 244](#) and [TL 196](#) for steel parts with a tensile strength of 1 000 to 1 200 MPa (max. Vickers hardness of 370 HV), as well as for components that are only subjected to compression loads, e.g., nuts with a property class ≤ 12 . The same applies to PT screws as per [VW 60358](#) and self-tapping screws as per [DIN EN ISO 1478](#). In all the aforementioned use cases, a heat treatment is required. Reference values for tempering processes are described in [DIN EN ISO 19598](#), table "Standard values for a heat treatment for hydrogen effusion after galvanizing." The heat treatment must take place within four hours, preferably within one hour, after the coating. The temperature and hold times must be specified in the initial sample inspection report (ISIR). The supplier must take into account the notices of [DIN 50969-1](#) and [DIN 50969-2](#) when designing the processes. The supplier must ensure the effectiveness of the measures for preventing hydrogen-induced brittle fractures.

Electro-galvanized and zinc alloy electroplated parts may be post-treated in passivation solutions in order to improve their corrosion resistance. Yellow passivation treatments with the appearance of yellow chromate conversion coatings containing Cr(VI) are not permissible.

Galvanized zinc systems without additional coatings (e.g., paint finishes or sealants) are only permissible for the vehicle interior area.

Zinc/nickel alloy coatings for electrically conductive connections are permissible only with transparent passivation.

3.7 Screws, bolts, nuts, threaded parts, and molded parts

For screws, bolts, nuts, and similar threaded parts and molded parts, more stringent test requirements apply to the thread-free areas than to the thread profile and shank. Details concerning the test requirements are described in the relevant standards.

The application of the protective coatings must not result in the h tolerance zone position being exceeded in the case of external threads or the H tolerance zone position not being reached in the case of internal threads.

3.8 Commercial surface protection types

Commercial surface protection types may be used for less important applications (e.g., steel wire). However, they are not subject to corrosion resistance testing. If such protection is sufficient for a given part, only the code letter for the respective procedure and the numbers 010 must be provided. The designation will then read, e.g., for commercial paint: Ofl-x010.

The commercial surface protection types, e.g., Ofl-c010, "commercial zinc coating," and Ofl-r010, "commercial electroplated zinc alloy coating," must not contain any Cr(VI) compounds.

The avoidance of hazardous substances as per [VW 91101](#) also applies to commercial surface protection types.

3.9 Parts without surface protection

3.9.1 Metal parts except for the parts in section 3.9.2

The components must be delivered in a clean and corrosion-free condition all the way to their installation. It must be possible to further process the components (e.g., welding) without any trouble, and they must be able to be stored temporarily for 12 weeks at the hall. Appropriate packaging measures must be additionally incorporated.

For drawing note Ofl-a103, oiling as per Quality Specification [QP A001](#), appendix "Product lists" is required. If alternative products must be used, this must be discussed and agreed upon with the Process Engineering departments at the plants using the parts. Alternative products must also meet the requirements in [QP A001](#).

If, in exceptional cases, parts without their own temporary surface protection are to be delivered, this must be explicitly indicated in the drawing with drawing note Ofl-a100. These parts will require packaging that is adequate for the relevant transport route.

Drawing notes such as "plain", "none", "no designation", and "-" are no longer permissible. These notes must usually be replaced with Ofl-a103.

3.9.2 Fasteners with a metric ISO thread

The following codes must be used for surface protection types:

Ofl-a100:	Corresponds to "not oiled"
Ofl-a101:	Corresponds to "lightly oiled" as per DIN ISO 8992
Ofl-a102:	Oil film dependent on manufacturing and/or material conditions permissible

3.10 Assignment of surface protection types and codes

The specifications in [table 2](#) apply.

The use of surface protection types with codes in italics and bold is preferred.

Surface protection types with codes highlighted in gray are standard surface protection types for components without threads.

[Table A.1](#) lists the surface protection types as per VW 13750 that correspond to the surface protection types as per [VDA 235-104](#).

Table 2 – Codes for surface protection types

Surface protection type				Code		
Code letter	Coating method	Finish or system; Requirements	Post-treatment and appearance	Code number for protection class		
				1 Light	3 Medium	6 Heavy
a	Untreated	None	Not oiled	a100	-	-
		See footnote a)	Lightly oiled	a101	-	-
		Oil film dependent on manufacturing and/or material conditions permissible		a102	-	-
		Oiling as per QP A001		a103	-	-
b	Phosphated	Phosphated using any method See footnote b)	Not oiled, gray	b100 c)	-	-
			Passivated, gray	b101	-	-
			Oiled, greased, gray	b110 d)	-	-
			Layer containing zinc, silver gray (for interior area)	b111 b)	-	-
			Zinc flake coating with top coat containing lubricant, dark gray	b113 b)	-	-
		Thin-layer zinc phosphated; TL 240 b)	Oiled, gray	b140	-	-
			Not oiled, gray	b149 c)	-	-
c	Hot-dip galvanized	TL 217	Without post-treatment, silver color	-	c330	c630
	Electro-galvanized e)	Any method; for high-strength parts, but restricted as per section 3.6 ; TL 217	Without post-treatment f) , silver color	-	c310	c610
			Passivated g) , silver color	-	c340 c)	c640 c)
			Passivated and sealed g) , silver to slightly iridescent blue color	-	c341	c641
			Thick-layer passivated g) , silver color, iridescent color	-	c342	c642
			Thick-layer passivated and sealed g) , silver color, iridescent color	-	c343	c643

Surface protection type				Code		
Code letter	Coating method	Finish or system; Requirements	Post-treatment and appearance	Code number for protection class		
				1 Light	3 Medium	6 Heavy
c	Electro-galvanized ^{e)}	Any method; for high-strength parts, but restricted as per section 3.6; TL 217	Thick-layer passivated, treated with lubricant ^{g)}	-	c347 ^{h)}	c647 ^{h)}
		For contact with Mg; for high-strength parts, but restricted as per section 3.6; TL 194	Passivated and sealed ^{g), i)} , silver color	-	-	c696
			Passivated and sealed, treated with lubricant ^{g), i)} , silver color	-	-	c697 ^{h)}
e	Electrolytically nickel-plated ^{e)}	Semi-bright nickel-plated	Without post-treatment, silver color	-	e310 ^{j)}	e610 ^{j)}
		Bright nickel-plated	Without post-treatment, silver color	-	e320 ^{j)}	e620 ^{j)}
f	Chrome electroplated	Bright chrome-plated; TL 203	High-gloss, with micro-cracks, silver color	-	-	f620
			High-gloss, silver color	-	f350	f650
g	Electrolytically tin-plated ^{k)}	Bright tin-plated	Without post-treatment ^{l)} , silver color	g100	g300	g600
			Without post-treatment ^{l)} , treated with lubricant, silver color	-	-	g605 ^{h)}
	Hot-dip tin-plated ^{k)}		Without post-treatment, silver color	g120	g320	g620
k	Copper electroplated		Without post-treatment	k110 ^{m)}	-	-
r	Electrolytically zinc-alloy-plated ^{e)}	Alloyed with Fe; TL 153	Transparent passivation ^{g)} , silver color	-	r301	-
			Passivated, sealed, black	-	r302	-
		Alloyed with Ni, alkaline; TL 244	Transparent passivation (silver to slightly iridescent blue color) ^{g)}	-	-	r642 ^{c)}
			Sealing and transparent passivation ^{g)} (silver color)	-	-	r643 ⁿ⁾
			Sealing and transparent passivation, treated with lubricant ^{g)} (silver color)	-	-	r645 ^{h)}
		Alloyed with Ni, weakly acidic; TL 244	Transparent passivation, silver color, only for castings ^{g)}	-	-	r649
		Alloyed with Ni, alkaline; TL 244	Passivated, black	-	-	r672 ^{c)}
			Passivated, sealed, black	-	-	r673 ⁿ⁾

Surface protection type				Code		
Code letter	Coating method	Finish or system; Requirements	Post-treatment and appearance	Code number for protection class		
				1 Light	3 Medium	6 Heavy
r	Electrolytically zinc-alloy-plated ^{e)}	Alloyed with Ni, alkaline; TL 244	Passivated, sealed, treated with lubricant, black	-	-	r677 ^{h)}
s	Duplex coating (zinc or zinc/nickel plus cathodic electrocoating)	TL 196	Zinc coating as per TL 217 , phosphated plus cathodic electrocoating, jet black	-	-	s611
			Zn/Ni alloy coating as per TL 244 , phosphated plus cathodic electrocoating, jet black	-	-	s621
			Zn/Ni alloy coating as per TL 244 , phosphated plus cathodic electrocoating, treated with lubricant, jet black	-	-	s627 ^{h)}
t	Zinc flake coating	TL 245	Without post-treatment, silver gray	-	-	t601
			With top coat, silver gray	-	-	t602
			Without post-treatment, silver gray	-	-	t610 ^{e)}
			With top coat, silver gray	-	-	t611
			Treated with lubricant as per TL 52165 , silver gray	-	-	t615 ^{e)}
		TL 233	With top coat containing lubricant ^{p)} ; preferably black	-	t330	t630
		TL 245	With top coat containing lubricant, silver gray	-	-	t647
		TL 233	With top coat, preferably black ^{p)}	-	t350	t650
		TL 180	With top coat, black	-	-	t660
			With top coat containing lubricant, black	-	-	t667
		TL 134	With top coat, anthracite gray	-	-	t670
			With top coat, bright gray	-	-	t680
u	Self-oxidation	DIN 50938	Oiled	u110	-	-
	Zn-ThD coating	TL 184	Passivated, silver gray	-	-	u610
			Passivated, treated with lubricant, silver gray	-	-	u615 ^{h)}

Surface protection type				Code		
Code letter	Coating method	Finish or system; Requirements	Post-treatment and appearance	Code number for protection class		
				1 Light	3 Medium	6 Heavy
u	Zn-ThD coating	TL 184	Passivated, organic coating (cathodic electrocoating), jet black	-	-	u620
v	Passivation	Passivated, gray		v111 q)	-	-
		Passivated plus post-dip solution, gray		v112 r)	-	-
w	Anodizing	TL 212, decorative use	Anodized, matte, silver color or s)	-	-	w610
			Anodized, glossy, silver color	-	-	w620
		TL 182, decorative use	Anodized, glossy; inorganic coating, silver color	-	-	w625
			Anodized, glossy; organic coating, silver color	-	-	w626
		TL 212, decorative use	Anodized, dyed, matte s)	-	-	w630
			Anodized, dyed, glossy	-	-	w640
		TL 182, decorative use	Anodized, glossy; inorganic coating, black colored	-	-	w645
			Anodized, glossy; organic coating, black colored	-	-	w646
		TL 212, decorative use	Anodized, matte s), silver color	-	-	w660
			Anodized, glossy, silver color	-	-	w670
		TL 212, technically functional use	Anodized; color dependent on material	w180	-	w680
			Hard-anodized; color dependent on material	-	-	w690
			Hard-anodized and impregnated; color dependent on material	-	-	w695
			Cast surface blasted or pickled, and hard-anodized	-	-	w699
x	Finish	Pretreatment and cathodic electrocoating, TL 178		-	-	x590
		Pretreatment not required, single-layer liquid paint or cathodic electrocoating t); TL 260		x100	x300	x600
		Passivated with top coat containing lubricant as per VW 60469		-	-	x607
		Tri-cationic phosphate coating; TL 218	Multi-coat system	-	-	x610
			Piano lacquer structure	-	-	x611

Surface protection type				Code		
Code letter	Coating method	Finish or system; Requirements	Post-treatment and appearance	Code number for protection class		
				1 Light	3 Medium	6 Heavy
x	Finish	Galvanized, tri-cationic phosphate coating; TL 218	Multi-coat system	-	-	x612
			Piano lacquer structure	-	-	x613
		Zirconium-dioxide-based pretreatment; Fe, Zn, or Mn phosphated; TL 260	Single-layer liquid paint or cathodic electrocoating ^{t)}	-	x330	-
		Zinc or tri-cationic phosphate coating; TL 260	Cathodic electrocoating ^{t)}	-	-	x630 ^{u)}
		Zinc or tri-cationic phosphate coating; TL 260	Double-layer paint (dip painting + spray painting) ^{t)}	-	-	x631
		Zinc or tri-cationic phosphate coating; electro-galvanized (batch galvanized); TL 227	Cathodic electrocoating ^{t)}	-	-	x632
		Zinc or tri-cationic phosphate coating (passivation in exceptional cases); galvanized semi-finished product; TL 227	Cathodic electrocoating ^{t)}	-	-	x633
		Zinc or tri-cationic phosphate coating; TL 260	Thick-layer cathodic electrocoating ^{t)}	-	-	x634
		Tri-cationic phosphate coating; TL 262	Thick-layer cathodic electrocoating ^{t)}	-	-	x635
		Zinc or tri-cationic phosphate coating, electro-galvanized (batch galvanized); TL 227	Thick-layer cathodic electrocoating ^{t)}	-	-	x638
		Zinc or tri-cationic phosphate coating (passivation in exceptional cases), galvanized semi-finished product; TL 227	Thick-layer cathodic electrocoating ^{t)}	-	-	x639
		Tri-cationic phosphate coating; TL 227	Cathodic electrocoating	-	-	x640
	Powder coating ^{t)}	Any pretreatment; TL 256	For vehicle interior parts in non-visible areas	-	x340	-

Surface protection type				Code		
Code letter	Coating method	Finish or system; Requirements	Post-treatment and appearance	Code number for protection class		
				1 Light	3 Medium	6 Heavy
x	Powder coating ⁱ⁾	Film-forming pretreatment; TL 256	For use in the exterior, in non-visible areas	-	-	x650
		Film-forming pretreatment, primed; TL 256	For use in the exterior, in visible areas as well	-	-	x651
y	Finish with zinc dust paint	TL 214	Base coating, e.g. for leaf springs	-	-	y600
			Heat-resistant zinc dust paint	-	-	y650
z	Electroplated tin/zinc coating	Transparent passivation, silver color		-	z300 ^{v)}	-
		Transparent passivation, treated with lubricant, silver color		-	z305 ^{h)}	-

- a) No base metal corrosion after four hours in the condensation standard atmosphere with constant humidity as per **DIN EN ISO 6270-2**.
- b) If necessary, after being phosphated, steel parts with tensile strength values greater than 1 200 MPa must be subjected to an appropriate heat treatment with a temperature of up to 200 °C in order to prevent brittle fractures induced by hydrogen (**DIN EN ISO 9717**).
In addition to the specifications in **table 2**, the following periods of time must be observed for the individual protection classes when performing the neutral salt spray test as per **DIN EN ISO 9227**:
- | | |
|--------------------|--|
| OfI-b100, OfI-b101 | 2 hours, without base metal corrosion |
| OfI-b110 | 6 hours, without base metal corrosion |
| OfI-b111, OfI-b113 | 48 hours, without base metal corrosion |
- NOTE 2: OfI-b111 = OfI-b100 + (2-µm to 4-µm) zinc flake coating; light abrasion, high susceptibility to soiling of other parts in the event of contact.
- NOTE 3: OfI-b113 = OfI-b149 + (2-µm to 4-µm) zinc flake coating + (2-µm to 3-µm) top coat (lubricant additive); less abrasion than for OfI-b111.
- c) Suitable for fasteners used in the body-in-white and for fasteners with adhesive coatings as per **DIN 267-27**, locking coatings as per **DIN 267-28**, and sealing coatings as per **TL 195**.
- d) For threaded parts, only oil or oil emulsions are permissible.
- e) Immediately after surface treatment, steel parts that are subject to tensile loads and have tensile strength values greater than 1 000 MPa must be subjected to an appropriate heat treatment in order to prevent brittle fractures induced by hydrogen. This must be verified by means of stress testing as per **DIN 50969-1** and **DIN 50969-2**.
- f) For parts to be painted in-house.
- g) Electro-galvanized components with Cr(VI)-free passivation must not appear yellowish in order to be able to distinguish these components from the yellow chromate conversion coatings containing Cr(VI) that were often used in the past.
- h) Metric ISO threaded parts must be treated with lubricant as per **TL 52132**.
- i) Preferably for steel parts in ASSYs with magnesium in order to prevent bimetallic corrosion.
- j) OfI-e310, OfI-e320 = Coating thickness > 10 µm
OfI-e610, OfI-e620 = Coating thickness > 20 µm
- k) Requirements for:
Protection class 1: Steel substrate – coating thickness > 4 µm; copper substrate – coating thickness > 4 µm
Protection class 3: Steel substrate – coating thickness > 12 µm; copper substrate – coating thickness > 8 µm
Protection class 6: Steel substrate – coating thickness > 20 µm; copper substrate – coating thickness > 15 µm
- l) For steel parts in ASSYs with magnesium in order to prevent bimetallic corrosion, but only when electrical conductivity is required.
- m) OfI-k110 = Coating thickness of (3 +3) µm.
- n) Preferred surface protection type for self-tapping screws and PT screws.
- o) Metric ISO threaded parts must be treated with lubricant as per **TL 52165**.
- p) Contains PTFE, not suitable for adhesive bonds.
- q) No change to the surface after 120 h of the neutral salt spray test as per **DIN EN ISO 9227** (e.g., no zinc corrosion of zinc die-castings).
- r) No change to the surface after 240 h of the neutral salt spray test as per **DIN EN ISO 9227** (e.g., no zinc corrosion on zinc die-castings; this surface protection consists of a passivation coating plus a post-dip solution containing phosphate).

- s) In order to create a special surface structure, a special pickling stage, e.g., EO/E6, is required.
- t) Color as per drawing; otherwise, black.
- u) Requirements also apply to dip-primed body components.
- v) Sn: (70 ±12)%, balance: Zn. Coating thickness ≥ 5 µm. No base metal corrosion after 360 h of the neutral salt spray test as per DIN EN ISO 9227.

4 Applicable documents

The following documents cited are necessary to the application of this document:

Some of the cited documents are translations from the German original. The translations of German terms in such documents may differ from those used in this standard, resulting in terminological inconsistency.

Standards whose titles are given in German may be available only in German. Editions in other languages may be available from the institution issuing the standard.

QP A001	Prelubricant, Hot-Melt Adhesive, Blank Washing Oil, Drawing Compound, Slushing Oil (General-Type)
TL 134	Non-Electrolytically Applied Zinc Flake Coatings with Organic Coating for Increased Corrosion Protection Requirements; Requirements and Testing
TL 153	Zinc/Iron Coatings; Surface Protection Requirements
TL 178	Cathodic Electrocoating of Body Skin Parts Made from Aluminum Semi-Finished Products; Surface Protection Requirements
TL 180	Non-Electrolytically Applied Zinc Flake Coatings with Black Top Coat; Surface Protection Requirements
TL 182	Duplex Coating on Aluminum Parts; Surface Protection Requirements
TL 184	Zinc Thermal Diffusion Layers (Zn-ThD Layers); Surface Protection Requirements
TL 194	Coating for Fasteners in Contact with Magnesium; Surface Protection Requirements
TL 195	Mechanical Fasteners; Steel Metric Bolts with Sealing All-Around Coating; Materials Requirements
TL 196	Duplex Coating Systems for Small Parts and Bulk Parts; Surface Protection Requirements
TL 203	Decorative Chrome Plating (Ni-Cr Coatings) on Metal Components; Surface Protection Requirements
TL 212	Oxide Coatings on Aluminum Parts; Surface Protection Requirements
TL 214	Zinc Dust Paint Coating; Surface Protection Requirements
TL 217	Zinc Coatings for Batch-Galvanized Components; Surface Protection Requirements
TL 218	Body Color Multi-Layer Paint on Metallic Body Skin Parts; Requirements
TL 227	Single-Layer Paint Coating of Zinc-Coated Metal Surfaces; Surface Protection Requirements

TL 233	Non-Electrolytically Applied Zinc Flake Coatings with an Organic Top Coat; Surface Protection Requirements
TL 235	Manganese Phosphated Surfaces; Requirements
TL 240	Thin-Layer Zinc Phosphating; Surface Protection Requirements
TL 244	Zinc/Nickel Alloy Coatings; Surface Protection Requirements
TL 245	Non-Electrolytically Applied Zinc Flake Coatings; Surface Protection Requirements
TL 256	Powder Coating on Metal Surfaces; Surface Protection Requirements
TL 260	Paintwork of Metal Surfaces; Surface Protection Requirements
TL 262	Paint Finish of Chassis Parts; Corrosion Protection
TL 52132	Lubricant for Threaded Fasteners with Electrolytically Applied Coatings or Made of Stainless Steel; Requirements
TL 52165	Lubricant (greenish) for Threaded Fasteners; Material Requirements
VW 01058	Drawings; Lettering
VW 01110-1	Threaded Connections; Part 1: Design and Assembly Specifications
VW 01129	Limit Values for Coefficients of Friction; Steel Mechanical Fasteners with Metric ISO Threads
VW 01131	Determination of Coefficients of Friction; Steel Mechanical Fasteners with Metric ISO Threads
VW 11610	Metric ISO Thread; Limit Dimensions for Medium Tolerance Class; External Threads 6g / Internal Threads 6H
VW 11611	Metric ISO Thread; Limit Dimensions with Protective Coating for Medium Tolerance Class; External Threads 6gh / Internal Threads 6H
VW 11614	Metric ISO Thread; Limit Dimensions for Coarse Tolerance Class, External 8g, Internal 7H
VW 11615	Metric ISO Thread; Limit Dimensions with Protective Coating for Coarse Tolerance Class (8g/7H)
VW 11624	Metric ISO Thread; Limit Dimensions for Tolerance Class 6f/6G
VW 11625	Metric ISO Threads; Limit Dimensions for Tolerance Class 8f/7G; External Thread 8f, Internal Thread 7G
VW 11627	Metric ISO Thread; Limit Dimensions for Medium Tolerance Class; External thread 6e
VW 11628	Metric ISO Thread; Limit Dimensions for External Threads, Tolerance Class 6g with Galvanic Protective Coating
VW 13750-1	Surface Protection for Metal Parts; Part 1: Invalid Surface Protection (OfI) Designations
VW 60358	Self-Tapping Screws for Thermoplastics; Dimensions, Requirements, Tests
VW 60361	Mechanical Fasteners; Parts Reduction; General Guidelines

VW 60469	Bolts Made of Aluminum Alloy AL9; Technical Supply Specifications and Testing
VW 91101	Environmental Standard for Vehicles; Vehicle Parts, Materials, Operating Fluids; Avoidance of Hazardous Substances
DIN 267-27	Fasteners - Part 27: Steel screws, bolts and studs with adhesive coating, Technical specifications
DIN 267-28	Fasteners - Part 28: Steel screws, bolts and studs with locking coating, Technical specifications
DIN 50938	Black oxide coatings on ferrous metal components - Requirements and test methods
DIN 50969-1	Prevention of hydrogen-induced brittle fracture of high-strength steel building elements - Part 1: Advice on the prevention
DIN 50969-2	Prevention of hydrogen-induced brittle fracture of high-strength steel building elements - Part 2: Test methods
DIN EN ISO 1478	Tapping screw thread
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 ISO 6270-2	Paints and varnishes - Determination of resistance to humidity - Part 2: Condensation (in-cabinet exposure with heated water reservoir)
DIN EN ISO 9227	Corrosion tests in artificial atmospheres - Salt spray tests
DIN EN ISO 9717	Metallic and other inorganic coatings - Phosphate conversion coating of metals
DIN ISO 8992	Fasteners - General requirements for bolts, screws, studs and nuts
VDA 235-104	Cr(VI)-free surface protection for mechanical fasteners with metric thread
VDI 2230, sheet 1	Systematic calculation of highly stressed bolted joints - Joints with one cylindrical bolt

Appendix A (informative) Surface protection types as per VDA 235-104

A.1 Surface protection types as per VDA 235-104 and VW 13750

Table A.1 lists the Cr(VI)-free surface protection types for fasteners with a metric ISO thread described in VDA 235-104 together with comparable surface protection types from VW 13750.

Table A.1

Type of surface protection coating	Designation	
	As per VDA 235-104	As per VW 13750
Thin-layer phosphating	VDA 235-104.10	Ofl-b140
Galvanized zinc coating, transparent passivation	VDA 235-104.20	Ofl-c347
Electroplated zinc alloy coating, transparent passivation	VDA 235-104.25	Ofl-r645
Electroplated zinc alloy coating, black passivation	VDA 235-104.30	Ofl-r302 or Ofl-r677, no direct equivalence possible
Zinc flake coating, silver gray	VDA 235-104.40	Ofl-t610
Zinc flake coating with top coat containing lubricant, silver color	VDA 235-104.42	Ofl-t647
Zinc flake coating with top coat containing lubricant, black	VDA 235-104.50	Ofl-t667, Ofl-t630