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Surface Protection of 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, 1966-10, 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

Changes

The following changes have been made as compared to Volkswagen standard VW 13750: 2008-01:

- error in Table 2, surface protection type b140 corrected

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Check standard for current issue prior to usage. The English translation is believed to be accurate. In case of discrepancies the German version shall govern. Numerical notation acc. to ISO practice.

This electronically generated standard is authentic and valid without signature.

Technical Responsibility GQL-LM Dr. Stephan Eisenberg GQL-LM/2 Günther Laudien GQL-LM/2 Hans-Joachim Koeppen	Standards EKTC/4 Jürgen Wiesner EKTC Tel.: +49-5361-9-29064 Manfred Terlinden
Tel.: +49-5361-9-25803	

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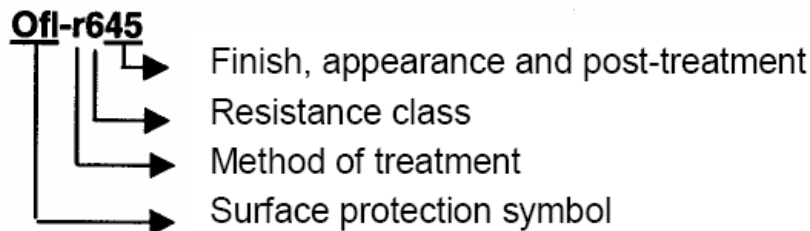
1 Scope

This standard applies to the identification of general surface protection types of vehicle parts and units in drawings and technical documentation. Separate Technical Supply Specifications (TL standards) apply to special surface protection types without identification by surface protection code (see Appendix A.2.).

2 Description

2.1 Code composition

The abbreviation for surface protection ('Ofi-' from the German word for 'surface') is followed by a 4-digit code taken from Table 2.



2.2 Description example

For surface protection: zinc alloy electroplated, heavy protection, transparent Cr(VI)-free passivated, sealed and with lubricant treatment, according to TL 244.

密封 润滑 VW 13750 - Ofi-r645

3 Requirements

3.1 General requirements

The vehicle parts and units are categorized according to their corrosion load and assigned to a resistance class with grade (according to Table 1) by the responsible Engineering Department upon agreement with the Volkswagen AG Laboratory (GQL-LM) and/or the AUDI AG Laboratory (I/GQ-32).

The restrictions stipulated in VW 60361 shall be observed for mechanical joining elements.

The following standards apply to thread dimensions prior to surface treatment: VW11610, VW11614, VW11624, VW11625 and VW11627. For thread dimensions after surface treatment, VW11611 and VW11615 apply.

Avoidance of hazardous substances according to VW 91101.

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All-metal clamping nuts shall always be treated with additional or integrated lubricants. Nuts with non-metallic insert may be treated with lubricant in order to ensure the defined functional characteristics. The lubricant must not be hazardous to the user nor exhibit an unpleasant odor when un-tightening, and shall be suited for automatic tightening. The functional characteristics of nuts treated with protective coating and/or lubricants must not deteriorate within a storage period of six months in weather-sheltered rooms. The storage temperature shall be between -5 °C and +40°C.

Joining elements made of stainless or high-temperature resistant materials may require additional lubricant treatment in order to comply with the requirements of VW01129.

Table 1 – Classification of vehicle parts

Vehicle part types	Corrosion load	Resistance class
Parts which are not visible in as-installed condition, corrosion protection only serves as transit coating and is not compulsory for proper functioning.	Low load level.	Light protection grade 1
Interior and exterior components in a protected installation position. Not for joining elements (for exceptions see VW 01110-1).	Medium load level.	Medium protection grade 3
Parts directly exposed to exterior environmental conditions (e.g. chassis, engine, transmission). Parts which are visible in as-installed condition (also from vehicle underside). Parts which require corrosion protection in order to ensure proper functioning. Parts such as joining elements which are used in interior as well as exterior areas due to diversity reduction constraints.	Heavy load level.	Heavy protection grade 6

3.2 Drawing specifications

If a certain surface protection is required for the entire part or for several parts in an ASSY, the code shall be entered in the "surface protection" title block; e.g. OfI-t650 (see also VW01058). If several surface protection types can be applied optionally, the codes of all permissible treatments shall be given,

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e.g. OfI-r673/x630.

If only partial protection is applied to a part, "see drawing" shall be entered in the "surface protection" title block; the respective area of the part shall be marked by a wide dash-dot line (see Figure 1) and the code shall be specified on a datum line.

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If there is only a small area on the part that is without surface protection, the unprotected area shall be marked (Figure 2). In this case "see drawing" shall be entered in the "surface protection" title block.

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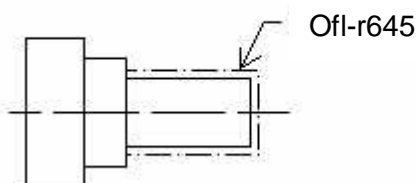


Figure 1

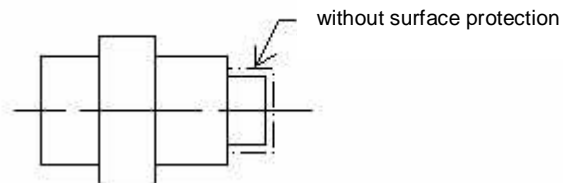


Figure 2

If different surface treatments are specified for a given part, "see drawing" shall be entered in the "surface protection" field. The respective areas on the part shall be clearly identified.

If parts from one ASSY are separately coated (one or more different surface treatments), "see drawing" shall be entered in the "surface protection" title block of the assembly drawing. The surface treatments shall be referred to separately in the part-related drawings.

3.3 Weldability 可焊性

If parts with surface protection are to be welded to each other or to other metal parts, the parts shall be tested for weldability. OfI-c340 shall be considered as the standard surface protection type in body assembly (e. g. for weld nuts).

3.4 Agents impairing wetting ability

Lubricants and slushing oils shall be free of silicone oils and other agents that significantly impair wetting ability. 抗湿性 硅树脂

3.5 Friction behavior 摩擦力

The influence of the surface protection on the friction behavior, particularly for parts with metric ISO threads, shall be determined by testing and matched to the performance characteristics (see VDA 235-203).

3.6 Zinc and zinc alloy coatings 可允许的

Electrodeposited / galvanized coatings are not permissible for high-strength steel and/or standard parts with a tensile strength of $R_m > 1000$ MPA and threaded parts with a property class of ≥ 10.9 . Zinc flake coatings according to code letter t shall preferably be used. 剥落

Exceptions are possible for parts which are only subject to pressure load, e. g. for bolts according to VW60277 and VW60358 and for nuts with a property class ≤ 10 (nuts with washer assembly only up to \leq property class 8). For these parts, heat treatment according to DIN EN ISO 4042 is compulsory. 被强制的

Only in exceptional cases, when electrodeposited zinc coating or zinc alloy coating is absolutely necessary for functional reasons can these coatings be applied with integrated heat treatment according to DIN 50969 (zinc alloy coatings are preferred). For bolts with metric ISO thread, the use of such coatings is limited to tensile strength values of up to 1200 MPa (see VW60250).

Zinc electroplated or zinc alloy electroplated parts may be post-treated in passivation solutions in order to improve corrosion resistance. Yellowish passivation treatment corresponding to the finish of yellow chromating treatment with Cr(VI) is not permissible. 淡黄色

Electroplated zinc systems without additional coatings (e. g. paint coatings or sealants) are only permissible for interior areas. 可允许的

The appearance of zinc/nickel alloy coatings shall be matched to their immediate environment. Only transparent passivation treatment is permissible for electrically conducting connections.

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

The test specifications according to Table 2 apply to the thread-free areas of screws, bolts, nuts and similar threaded or shaped parts; the next resistance class down is applied to the thread and shank.

The application of the protective layers must not result in the h-position being exceeded in the case of external threads or the H-position being fallen below in the case of internal threads.

3.8 Commercial protection types

Commercial surface protection types can be used for less important applications (e.g. steel wire). However, they are not tested for corrosion resistance. If such protection is sufficient for a given part, only the code of the respective procedure and the figures 010 shall be indicated. The designation for commercial paint coating for example appears as follows: OfI-x010. It is also possible to distinguish between procedure and finish; e.g. for commercial hot-dip tin coatings: OfI-g020.

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

Avoidance of hazardous substances according to VW 91101 also applies to commercial surface protection types.

3.9 Parts without surface protection treatment

3.9.1 Joining elements with metric ISO thread

Parts with the designation "plain", surface protection type "without", "-" or without any designation at all shall, as indicated in DIN ISO 8992, be supplied in lightly oiled condition. If, in exceptional cases, unoiled parts must be supplied, this must be indicated in the drawing. To this end, the following surface protection types shall be used:

OfI-a100: corresponds to "not oiled".

OfI-a101: corresponds to "plain", "without", "-" or without any description in the sense of "lightly oiled" according to DIN ISO 8992.

3.9.2 Other parts

For parts without surface protection and with surface protection specification "without" or "plain, oiled", QP A001 applies. If, in exceptional cases, unoiled parts must be supplied, this must be indicated in the drawing by means of the entry "not oiled". The use of surface protection types introduced for joining elements is permissible.

3.10 Assignment of surface protection types and codes

The specifications of Table 2 shall apply. Surface protection types with codes represented in bold italics shall preferably be used for joining elements; surface protection types with framed codes are standard surface protection types for components without threads. 框架

Surface protection types in brackets contain Cr(VI) and are not available for new designs.

Table A.1 specifies which protection types are not permissible for new designs and which protection types shall be used instead. Table A.3 presents the surface protection types according to VW 13750 that correspond to the protection types of VDA 235-104. VW13750, Supplement 1 lists all invalid protection types that were included in earlier issues of VW13750. 支架

Table 2 – Surface protection type codes

Code letter	Coating process	Surface protection type		Codes for resistance classes		
		Finish/system; requirements	Post-treatment and appearance	1 light	3 medium	6 heavy
a	untreated	None	not oiled	a100	-	-
		see footnote 1	lightly oiled	a101	-	-
b	phosphated	see footnote 4	not oiled	b100 ²⁾	-	-
			passivated	b101	-	-
			oiled, greased, waxed	b110 ³⁾	-	-
			silver gray (for internal applications)	b111	-	-
			manganese phosphated and oiled	b130 ^{5), 6)}	-	-
		thin layer zinc phosphated; TL 240	oiled	b140	-	-
		not oiled	b149 ²⁾	-	-	

For footnotes see page 11.

Table 2 (continued)

Code letter	Coating process	Surface protection type		Codes for resistance classes		
		Finish/system; □ requirements	Post-treatment and appearance	1 light	3 medium	6 heavy
c	hot-dip zinc coated	TL 217	without post-treatment	-	c330	c630
	zinc electroplated ¹⁰⁾	Method optional, for high-strength parts, however restricted acc. to Section 3.6; TL 217	without post-treatment ⁷⁾	-	c310	c610
			passivated ⁸⁾	-	c340 ²⁾	c640 ²⁾
			passivated and sealed ⁸⁾	-	c341	c641
			thick-layer passivated ⁸⁾	-	c342	c642
			thick-layer passivated and sealed ⁸⁾	-	c343	c643
			thick-layer passivated, with lubricant treatment ⁸⁾	-	c347 ⁹⁾	c647 ⁹⁾
			yellow chromated	-	(c350) ⁵⁾	(c650) ⁵⁾
			yellow chromated and sealed	-	(c351) ⁵⁾	(c651) ⁵⁾
			yellow chromated, with lubricant treatment	-	(c355) ^{5), 9)}	-
			olive chromated ¹¹⁾	-	(c360) ⁵⁾	(c660) ⁵⁾
		acid bright zinc-coated; TL 217	olive chromated ¹¹⁾	-	-	(c683) ⁵⁾
			olive chromated ¹¹⁾ , with lubricant treatment ¹²⁾	-	(c385) ^{5), 9)}	(c685) ^{5), 9)}
		weakly acidic, for contact with Mg; □ TL 194	pale yellow chromated, sealed ¹²⁾	-	-	(c686) ⁵⁾
			pale yellow chromated, sealed with lubricant treatment ¹²⁾	-	-	(c687) ^{5), 9)}
			passivated and sealed ^{8), 12)}	-	-	c696
			passivated and sealed, with lubricant treatment ^{8), 12)}	-	-	c697 ⁹⁾
e	nickel electroplated	semigloss nickel-plated	without post-treatment	-	e310 ¹³⁾	e610 ¹⁴⁾
		bright nickel-plated	without post-treatment	-	e320 ¹³⁾	e620 ¹⁴⁾
f	chromium electroplated	bright chrome-plated; TL 203	mirror-bright, with microcracks	-	-	f620
			mirror-bright	-	f350	f650
g	tin electroplated ¹⁵⁾	bright tin-coated	without post-treatment ¹⁶⁾	g100	g300	g600
			without post-treatment ¹⁶⁾ , with lubricant treatment	-	-	g605 ⁹⁾
	hot-dip tin coated ¹⁵⁾		without post-treatment	g120	g320	g620
k	copper electroplated		without post-treatment	k110 ¹⁷⁾	k310 ⁵⁾¹⁷⁾	-

For footnotes see page 11.

Table 2(continued)

Code letter	Coating process	Surface protection type		Codes for resistance classes		
		Finish/bath type; requirements	Post-treatment and appearance	1 light	3 medium	6 heavy
q	aluminum alloy electroplated	Al coating, TL 243	silvery matte without post-treatment	-	-	q600
			silvery matte with lubricant treatment	-	-	q605 ⁹⁾
r	zinc-alloy electroplated ¹⁰⁾	alloy and/or electrolyte type optional; TL 153	black chromated ¹¹⁾	-	-	(r600) ⁵⁾
			Fe-alloyed; TL 153	silver passivated ⁸⁾	-	r301
		Fe-alloyed; TL 153	black passivated, sealed	-	r302	-
			alloy and/or electrolyte type optional; TL 153	black chromated, with lubricant treatment	-	-
		low-alloy with Fe and Co; TL 153	black chromated ¹¹⁾	-	-	(r610) ⁵⁾
		low-alloy with Fe, alkaline cyanide-free; TL 153	black chromated ¹¹⁾	-	-	(r620) ⁵⁾
		low-alloy with Co, alkaline or acidic; TL 153	black chromated ¹¹⁾	-	-	(r630) ⁵⁾
		Ni alloy, alkaline; TL 244	transparent passivated, sealed ⁸⁾	-	-	r640 ⁵⁾
			transparent passivated ⁸⁾	-	-	r642 ²⁾
			transparent passivated, sealed ⁸⁾	-	-	r643 ¹⁸⁾
			transparent passivated, sealed, with lubricant treatment ⁸⁾	-	-	r645 ⁹⁾
		Ni alloy, weakly acidic; TL 244	transparent passivated, only for castings ⁸⁾	-	-	r649
			yellow chromated	-	-	(r650) ⁵⁾
		Ni alloy, alkaline; TL 244	yellow chromated	-	-	(r660) ⁵⁾
			yellow chromated, with lubricant treatment	-	-	(r665) ^{5), 9)}
			black chromated	-	-	(r670) ⁵⁾
		Ni alloy, alkaline; TL 244	black passivated	-	-	r672 ²⁾
			black passivated, sealed	-	-	r673 ¹⁸⁾
			black chromated, with lubricant treatment	-	-	(r675) ^{5), 9)}
			black passivated, sealed, with lubricant treatment	-	-	r677 ⁹⁾

For footnotes see page 11.

Table 2(continued)

Code letter	Coating process	Surface protection type		Codes for resistance classes		
		Finish/bath type; requirements	Post-treatment and appearance	1 light	3 medium	6 heavy
s	duplex coating (zinc or zinc/nickel plus cathodic electro-coating)	Zn/Ni; TL 196	passivated acc. to TL 217 plus cathodic electrocoating, black	-	-	s611
			passivated acc. to TL 244 plus cathodic electrocoating, black	-	-	s621
			passivated acc. to TL 244 plus cathodic electrocoating, black, with lubricant treatment	-	-	s627 ⁹⁾
t	zinc flake coating	TL 245		-	(t300) ⁵⁾	(t600) ⁵⁾
		silver gray; use in in exposed installation positions (engine); TL 245				t601
		silver gray; use in exposed installation positions (engine, chassis), however not for threaded parts with metric ISO thread; TL 245		-	-	t602
		silver gray; for components that are used in the body-in-white before painting or for which a special adhesive compatibility or a locking behavior of the coating is required (microencapsulation); TL 245		-	t310 ⁵⁾	t610 ²⁾
		silver gray; for components that must not be exposed to high temperatures (e.g. spring elements), not for threaded parts with metric ISO thread; TL245		-	-	t611
		silver gray; standard surface protection for nuts with non-metallic locking element; with lubricant treatment; TL 245		-	-	t615 ¹⁹⁾
		TL 245		-	(t320) ⁵⁾	(t620) ⁵⁾
		with top coat containing lubricant preferably black ²⁰⁾ ; TL 233		-	t330	t630
		TL 245		-	(t345) ^{5), 21)}	(t645) ^{5), 19)}
		silver gray, standard surface protection for threaded parts with metric ISO thread; TL 245		-	-	t647
with top coat containing lubricant preferably black ²⁰⁾ ; TL 233		-	t350	t650		
u	black finish	DIN 50938	oiled	u110	-	-
	Zn-ThD layer	silver gray passivated; TL 184		-	-	u610
silver gray passivated, with lubricant treatment; TL 184		-	-	u615 ⁹⁾		
v	chromated			(v110) ^{5), 22)}	-	-
	passivated			v111 ²³⁾	-	-

For footnotes see page 11.

Table 2(continued)

Code letter	Coating process	Surface protection type		Codes for resistance classes		
		Finish/electrolyte type; requirements	Post-treatment and appearance	1 light	3 medium	6 heavy
w	anodized	decorative application; TL 212	transparent, matte	-	-	w610
			transparent, bright	-	-	w620
			transparent, matte glosse; TL 182	-	-	w625
			dyed, matte	-	-	w630
			dyed, bright	-	-	w640
			transparent, matte	-	-	w660 ⁵⁾
			dyed, bright	-	-	w670 ⁵⁾
		transparent anodized; TL 212	w180	-	w680	
		hard anodized; TL 212	-	-	w690	
hard anodized and impregnated; TL 212	-	-	w695			
x	paint-coated	pretreatment not specified ²⁴⁾ , single-layer liquid paint or cathodic electro-coating; TL 260		x100	x300	x600
		zinc phosphated and paint-coated	multi-layer structure; TL 218	-	-	x610
			piano lacquer structure; TL 218	-	-	x611
		zinc electroplated and paint-coated	multi-layer structure; TL 218	-	-	x612
			piano lacquer structure; TL 218	-	-	x613
		Zn, Fe or Mn phosphated, single-layer liquid paint or cathodic electrocoating ²⁴⁾ ; TL 24		x130	x330	-
		zinc phosphated, single-layer liquid paint or cathodic electrocoating ²⁴⁾ ; TL 260		-	-	x630 ²⁵⁾
		zinc phosphated; dual layer paint ²⁴⁾ ; TL 260		-	-	x631
		zinc phosphated; zinc electroplated (individual parts) and paint-coated ^{24), 26)} ; TL 227		-	-	x632
		zinc phosphated (passivated in exceptional cases); hot dip zinc coated (semi-finished product) and painted ^{24), 26)} ; TL 227		-	-	x633
	zinc phosphated, thick layer cathodic electro-coating or cathodic electrocoating + dip paint; TL 260		-	-	x634	
powder paint-coated	layer-forming ²⁴⁾ ; TL 256		-	-	x650	
	layer-forming and primed ²⁶⁾ ; TL 256		-	-	x651	
y	paint-coated with zinc dust	base layer, e.g. for leaf springs; TL 214		-	-	y600
		heat-resistant zinc dust; TL 214		-	-	y650
z	electroplated tin/zinc coating	passivated		-	z300 ²⁷⁾	-

For footnotes see page 11.

Table 2(continued)

Code letter	Coating process	Surface protection type		Codes for resistance classes											
		Finish/electrolyte type; requirements	Post-treatment and appearance	1 light	3 medium	6 heavy									
		<p>1) No base metal corrosion after 4 cycles in CH test atmosphere according to DIN EN ISO 6270-2.</p> <p>2) Suitable for joining elements used in the body-in-white and for joining elements with adhesive coatings acc. to DIN 267-27, locking coatings acc. to DIN 267-28 and sealing coatings acc. to TL 195.</p> <p>3) For threaded parts only oil or oil emulsion permissible.</p> <p>4) After phosphating, steel parts with tensile strength values above 1200 MPa shall be subjected to appropriate heat treatment up to a max. temperature of 200 °C if required in order to avoid brittle fracture induced by hydrogen (DIN EN 12476). In addition to the specifications made in Table 2, the following periods of time shall be taken into account for the given resistance class when performing the salt spray test NSS according to DIN EN ISO 9227:</p> <table border="0"> <tr> <td>OfI-b100, OfI-b101, OfI-b130</td> <td>2 hours</td> <td>without base metal corrosion,</td> </tr> <tr> <td>OfI-b110</td> <td>6 hours</td> <td>without base metal corrosion,</td> </tr> <tr> <td>OfI-b111</td> <td>48 hours</td> <td>without base metal corrosion.</td> </tr> </table> <p>NOTE: OfI-b111 = OfI-b100 + (2 to 4) µm zinc flake coating.</p> <p>5) Not for new designs.</p> <p>6) For characterization of the layer see TL 235. No longer permitted for new joining element designs, replaced by OfI-b140.</p> <p>7) For parts to be painted in-house.</p> <p>8) <u>Zinc electroplated parts with Cr(VI)-free passivation must not appear yellowish in order to distinguish the parts from the yellow chromating containing Cr(VI) often used in the past.</u></p> <p>9) Metric ISO threaded parts shall be treated with lubricant according to TL 52132.</p> <p>10) Immediately after surface treatment, steel parts with tensile strength values above 1000 MPa that are subject to tensile stress shall be subjected to appropriate heat treatment to avoid brittle fracture induced by hydrogen. Verification by bracing test according to DIN 50969.</p> <p>11) Mainly for vehicles of the German Federal Armed Forces.</p> <p>12) Preferably for steel parts assembled with magnesium in order to avoid bimetallic corrosion.</p> <p>13) Layer thickness > 10 µm.</p> <p>14) Layer thickness > 20 µm.</p> <p>15) Requirements in resistance class 1 = DIN 50965-Fe//Sn4, coating thickness > 4 µm; resistance class 3 = DIN 50965-Fe//Sn12, coating thickness > 12 µm; in resistance class 6 = DIN 50965-Fe//Sn20, coating thickness > 20 µm.</p> <p>16) For steel parts assembled with magnesium in order to avoid bimetallic corrosion, but only when electrical conductivity is required.</p> <p>17) OfI-k110 layer thickness (3 + 3) µm, OfI-k310 layer thickness (12 + 4) µm.</p> <p>18) Preferred protection type for sheet metal screws and PT screws</p> <p>19) Metric ISO threaded parts shall be treated with lubricant according to TL 52165.</p> <p>20) Contains PTFE, not suitable for adhesive bonds.</p> <p>21) Treated with blue lubricant, only for joining elements of LT2.</p> <p>22) <u>No change of surface after 240 h of salt spray test NSS according to DIN EN ISO 9227 (e.g. no zinc corrosion of zinc die-castings).</u></p> <p>23) <u>No change of surface after 120 h of salt spray test NSS according to DIN EN ISO 9227 (e.g. no zinc corrosion of zinc die-castings).</u></p> <p>24) Color specification according to drawing, otherwise black.</p> <p>25) Requirements also apply to dip-primed body parts.</p> <p>26) Instead of single-layer liquid paint, cathodic electrocoating can be demanded; if this is the case, the addendum "KTL" (German abbreviation for cathodic electrocoating) must be added to the code.</p> <p>27) Sn: (70 ± 12) %, remainder: Zn. Layer thickness ≥ 5 µm. Without base metal corrosion after 360 hours of salt spray test NSS acc. to DIN EN ISO 9227.</p>					OfI-b100, OfI-b101, OfI-b130	2 hours	without base metal corrosion,	OfI-b110	6 hours	without base metal corrosion,	OfI-b111	48 hours	without base metal corrosion.
OfI-b100, OfI-b101, OfI-b130	2 hours	without base metal corrosion,													
OfI-b110	6 hours	without base metal corrosion,													
OfI-b111	48 hours	without base metal corrosion.													

4 Referenced standards

The following documents cited in this standard are necessary for application. In this Section, terminological inconsistencies may occur as the original titles are used.

QP A001	Prelubes, Slushing Oils (General), Blank Washing Oils, Drawing Oils and Drawing Agents; Quality Requirements
TL 153	Zinc-Iron Coatings; Requirements for Surface Protection
TL 182	Anorganische Schutzschicht auf Aluminiumteilen; Oberflächenschutzanforderungen (Non-Organic Coatings on Aluminum Parts; Surface Protection Requirements - only available in German)
TL 184	Zinc Thermal Diffusion Layers (Zn-ThD Layers); Requirements for Surface Protection
TL 194	Coating for Joining Elements in Contact with Magnesium; Requirements
TL 195	Mechanical Joining Elements; Metric Steel Screws/Bolts with Sealing Coating; Material Requirements
TL 196	Duplex Coating Systems for Small Parts and Bulk Parts; Requirements for Surface Protection
TL 203	Electroplated Nickel/Chromium Coatings; Requirements for Surface Protection
TL 212	Anodized Coatings on Aluminum Parts; Requirements for Surface Protection
TL 214	Zinc-Dust Paint Coating; Requirements for Surface Protection
TL 217	Zinc Coatings; Requirements for Surface Protection
TL 218	Multicoat Painting in Body Color on Metallic Exterior Body Components; Requirements
TL 227	Paint Coating of Zinc-Coated Metal Surfaces; Requirements for Surface Protection
TL 233	Non-Electrolytically Applied Zinc Flake Coatings with Surface Layer; Surface Protection Requirements
TL 235	Manganese Phosphated Surfaces; Requirements
TL 240	Thin-Layer Zinc Phosphating; Requirements for Surface Protection
TL 243	Electrolytically Deposited Al Coatings and Al/Mg Alloy Coatings; Requirements for Surface Protection
TL 244	Zinc/Nickel Alloy Coatings; Requirements for Surface Protection
TL 245	Non-Electrolytically Applied Zinc Flake Coatings; Surface Protection Requirements
TL 256	Powder Paint Coating on Metal Surfaces; Requirements for Surface Protection
TL 260	Paint Coating of Metal Surfaces; Requirements for Surface Protection
TL 52132	Lubricant for Electrolytically Zinc-Plated Threaded Parts
TL 52165	Lubricant (Greenish) for Threaded Fasteners; Material Requirements
VW 01129	Limit Values for Coefficients of Friction; Mechanical Joining Elements with Metric ISO Thread
VW 01058	Technical Drawings; Lettering
VW 01110-1	Threaded Joints; Design, Assembly and Process Assurance

VW 11610	Metric ISO Threads; Limit Dimensions for Medium Tolerance Class; External Thread 6g, Internal Thread 6H
VW 11611	Metric ISO Threads; Limit Dimensions with Surface Protection Layer for Medium Tolerance Class 6g/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 6G/6f Tolerance Zone, Male 6f, Female 6G
VW 11625	Metric ISO Threads; Limit Dimensions for Tolerance Class 8f/7G; External Thread 8f, Internal Thread 7G
VW 11627	Thread Limit Dimensions for External Threads of Tolerance Class 6e; Metric ISO Threads

VW 13750 Supplement 1 Surface Protection of Metal Parts; Invalid OfI Designations

VW 60250	High-Strength Screws and Similar Threaded Parts; Technical Supply Specifications
VW 60277	Hexagon head screw and washer assemblies for thermoplasts
VW 60358	Screws for Thermoplasts; Dimensions, Requirements, Testing
VW 60361	Mechanical Joining Elements; Parts Reduction; General Guidelines
VW 91101	Environmental Standard for Vehicles; Vehicle Parts, Materials, Operating Fluids; Avoidance of Hazardous Substances
VDA 235-104	Cr(VI)-Free Surface Protection Types for Joining Elements with Metric Thread
VDA 235-203	Verschraubungsverhalten; Reibungszahlen; Praxis- und montageorientierte Prüfung (Threading Behavior; Coefficients of Friction; Practice- and Mounting-Oriented Testing - only available in German)
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 Iron or Steel; Requirements and Test Methods
DIN 50965	Electroplated Coatings; Tin-Coatings on Iron Steel and on Copper and Copper Alloys
DIN 50969	Testing of High-Strength Steel Building Elements for Resistance to Hydrogen-Induced Brittle Fracture and Advice on the Prevention of Such Fracture
DIN ISO 8992	Fasteners – General Requirements for Bolts, Screws, Studs and Nuts
DIN EN 12476	Phosphate Conversion Coatings of Metals - Method of Specifying Requirements
DIN EN ISO 4042	Fasteners – Electroplated Coatings
DIN EN ISO 6270-2	Paints and Varnishes – Determination of Resistance to Humidity – Part 2: Procedure for Exposing Test Specimens in Condensation-Water Atmospheres
DIN EN ISO 9227	<u>Corrosion Tests in Artificial Atmospheres - Salt Spray Tests</u>

Appendix A (informative)

A.1 Comparison of "not for new design"/"for new design"

See Table A.1 Protection types containing Cr(VI) are parenthesized.

Table A.1

Surface protection type not permitted for new designs	Replacement surface protection type for new designs
OfI-b130	OfI-b140
(OfI-c350)	OfI-c342 (for joining elements intended for welding OfI-c340)
(OfI-c650)	OfI-c642 (for joining elements intended for welding OfI-c340)
(OfI-c351)	OfI-c343
(OfI-c651)	OfI-c643
(OfI-c355)	OfI-c347 (for weld nuts and weld screws OfI-c340)
(OfI-c360) and (OfI-c660)	OfI-t630, olive-green
(OfI-c683)	OfI-c696 (for components in contact with Mg)
(OfI-c385)	OfI-c697 (for joining elements in contact with Mg)
(OfI-c685)	OfI-c697 (for joining elements in contact with Mg)
OfI-k310	OfI-k110
(OfI-r600)	OfI-r672
(OfI-r605)	OfI-r677
(OfI-r610)	OfI-r301, (or OfI-r302, if the part must be black in appearance), for joining elements OfI-r673
(OfI-r620)	OfI-r301, (or OfI-r302, if the part must be black in appearance), for joining elements OfI-r673
(OfI-r630)	OfI-r301, (or OfI-r302, if the part must be black in appearance), for joining elements OfI-r672
OfI-r640	OfI-r643 (OfI-r642 for parts with adhesive or locking coating)
(OfI-r650)	OfI-r642
(OfI-r660)	OfI-r642
(OfI-r665)	OfI-r645
(OfI-r670)	OfI-r673 (OfI-r672 for parts with adhesive or locking coating)
(OfI-r675)	OfI-r677
(OfI-t300)	OfI-t610, for threaded parts with metric ISO thread OfI-t647 ¹⁾
OfI-t310	OfI-t610 (reduced temperature range), for threaded parts with metric ISO thread OfI-t647 ¹⁾
(OfI-t320)	OfI-t611 (reduced temperature range), for threaded parts with metric ISO thread OfI-t647 ¹⁾
(OfI-t345)	OfI-t647 ²⁾
(OfI-t600)	OfI-t602, for threaded parts with metric thread OfI-r643, for threaded parts with metric ISO thread OfI-t647 ¹⁾

For footnotes see Page 16.

Table A.1 (continued)

Surface protection type not permitted for new designs	Replacement surface protection type for new designs
(OfI-t620)	OfI-t611 (reduced temperature range), for threaded parts with metric ISO thread OfI-t647 ¹⁾ (reduced temperature range)
(OfI-t645)	OfI-t647 ²⁾
(OfI-v110)	OfI-v111
OfI-w660	OfI-w610
OfI-w670	OfI-w640
1) or OfI-t610 or OfI-t601, if threaded parts are used in the body-in-white before painting or for threaded parts with microencapsulation or with locking coating. 2) or OfI-t615 for nuts with non-metallic locking element.	

A.2 Surface protection types without code

Apart from the surface protection types specified in VW 13750, further surface protection types exist which are not assigned a code. The technical supply specifications listed in Table A.2 shall apply to these.

Table A.2 – Surface protection types without code

TL	Title
152	Powder Coating for Cylinder Block and Crankcase; Requirements for Surface Protection
155	Ternary Composite Layer for High-Strength Joining Elements
187	Ball Pins, Nitrocarburated
193	Flake Metal Coatings For Brake Disks
215	Electroplated Chromium and Nickel/Chromium Coatings for Piston Rods
216	Corrosion Protection for Drive Shafts
221	Electroplated Chromium and Nickel/Chromium Coatings for Brake Pistons
222	Corrosion Protection Coatings For Brake Lines
235	Manganese Phosphated Surfaces
236	Nickel/Phosphorus Coatings
238	Surface Protection, Steel Disk Wheels
239	Surface Protection of Alloy Wheels
241	Heavy-Coat Phosphating
242	Organic Coatings Containing Fluorine
243	Electrolytically Deposited Al-coatings
247	Paint Coating of Cylinder Head Covers
261	Painting on Coil Springs
262	Cavity-Forming Chassis Parts; Corrosion Protection
265	Duplex Coating For Pipes
52483	Al and Zn-Al Hot-Dip Coatings for Power Steering Tubes

A.3 Surface protection types according to VDA 235-104 and VW 13750

Table A.3 compares the Cr(VI)-free surface protection types for joining elements with metric ISO thread described in VDA 235-104 with counterpart protection types from VW 13750.

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Table A.3

Type of surface protection layer	Description	
	according to VDA 235-104	according to VW 13750
Thin-layer phosphating	VDA 235-104.10	OfI-b140
Electroplated zinc coating, transparent passivated	VDA 235-104.20	OfI-c347
Electroplated zinc alloy coating, transparent passivated	VDA 235-104.25	OfI-r645
Electroplated zinc alloy coating, black passivated	VDA 235-104.30	OfI-r302 or OfI-r677, no direct assignment possible
Zinc flake coating, silver	VDA 235-104.40	OfI-t610
Zinc flake coating with top coat, silver	VDA 235-104.42	OfI-t647
Zinc flake coating with top coat, black	VDA 235-104.50	OfI-t630