

Date of translation: 11/2019

Organic coating for metallic parts on the outer side and underside of the vehicle and in the engine compartment

Foreword

This Daimler-Benz Supply Specification (DBL) specifies the requirements with regard to the coating quality of coated metal parts, which are used on the vehicle exterior, on the underbody and in the engine compartment. Apart from that, the scopes on testing the binding requirements for the coatings are also described. These coatings are final coatings: No further additional coating will be carried out in the receiving plant.

This edition replaces the previous edition of this standard.

Changes

In comparison with edition 2015-05, the following changes have been made:

- New PV23 added: all cathodically coated component parts in the underbody with cavities, or component parts that are subject to particularly high corrosive stress and are additionally cavity-preserved.
- New PV24 added: Like PV23 with additional stone impact resistant coating
- Aluminum wheels removed from PV30
- Neue PV50 added: aluminum wheels
- Technical Data (tests) adapted
- Requirements for the thermal analysis for aluminum wheels incorporated

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Note: This translation is for information purpose only.
The German version shall prevail above all others.

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1 Scope of application

This standard applies to passenger cars and vans. It applies to all metallic base materials on the exterior and underside of the vehicle and in the engine compartment that receive an organic coating or paint, as well as for the OEM body painting carried out by the supplier.

Depending on the purpose, the organic coatings or paint coats can be divided into exposure groups that represent the respective product versions in this standard.

The standard specifies the requirements for the organic coating or painting and thus their properties depending on the product version. An overview of the permissible product versions can be found in table 1 below.

This DBL does not apply to metallic component parts installed in the vehicle interior. DBL 7382 shall be applied for these.

This DBL does not apply to body replacement and follow-up-drawn parts. DBL 7383 shall be applied for these.

Table 1: Product versions, overview

Product version	Moderate corrosive stress	Medium corrosive stress	Heavy corrosive stress	Cavity preservation	Stone-chip primer	Thermal load	Decorative effect	Type of coating	Application examples
00	X							Single or multicoat finish, cathaphoretic dip coating, powder, etc.	Only for special cases, agreement required
01	X					X		Thermally stable single or multicoat finish	
10		X						Single or multicoat finish, cathaphoretic dip coating, powder, etc.	Component parts in the engine compartment and on the underbody not falling in the category body component or PV 20/21/40.
11		X				X		Thermally stable single or multicoat finish	
12		X			X			Multicoat finish or powder coating	
20			X					Cathaphoretic dip coating black	All component parts in the underbody with cavities, or components subject to particularly high corrosive stress
21			X		X			Cathaphoretic dip coating black + Stone impact resistant coating	
22			X					Cathaphoretic dip coating gray	Body parts e.g. underbody, engine compartment wall, etc.
23			X	X				Cathaphoretic dip coating black + cavity preservation	All component parts in the underbody with cavities, or component parts that are subject to particularly high corrosive stress and are additionally cavity-preserved
24			X	X	X			Cathaphoretic dip coating black + cavity preservation + stone impact resistant coating	
30			X				X	Decorative and weather-resistant baked multicoat finish or powder coating, co-extrudate, and other coatings	Decorative or functional parts, e.g. Parktronic sensors, bezels, roof trim strips, wipers, emblems, etc.
31			X				X	OEM body painting at the supplier decorative and weather resistant	Body and/or detachable body parts such as trunk lids, engine hood, doors, flaps, front module, etc.
40			X					Single or multicoat paint, powder, etc. Non-decorative	For component parts that are subject to very extreme corrosive stress due to where they are installed, such as hinges, various holders, etc. and are not cathaphoretically dip coated.
50			X				X	Decorative and weather-resistant baked multicoat finish or powder coating, and other coatings on aluminum wheels	aluminum wheels

For product versions 20/21/22, the responsible specialist department for coating shall be contacted in the event of a constant thermal load > 130 °C.

Single or multicoat finish: all common coating systems, provided that they comply with the requirements of this DBL.

2 Normative references

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

A1690034299	Implementation regulation for surface treatment A1690034299
DBL 5416	Parts Manufactured from Thermoplastics for Paneling, Housings and Functional Parts for External Applications
DBL 6714	Negative List – Constituents of Process Materials
DBL 6905	Supply specification; Protective Agent for underbody, Cavities and Engine Compartment
DBL 7292	Supply specification; Electrophoretic Primer for Bodies and Add-On Parts
DBL 7382	Supply specification; Coating/Painting of Metallic Parts in the Vehicle Interior
DBL 7383	Supply specification for Coating/Painting of Body Replacement and Follow-Up-Drawn Parts
DBL 8585	General Requirements – Environmental Protection, Hazardous Substances, Dangerous Goods – Negative Substance List for the Selection of Materials
DIN 55635	Paints and Varnishes – Cyclic Corrosion Testing of Coating Systems on Materials and Component parts in Automotive Construction
DIN EN ISO 2813	Paints and Varnishes - Determination of Gloss Value at 20°, 60° and 85°
EN ISO 9001	Quality Management Systems - Requirements
ISO/IEC 17025	General Requirements for the Competence of Testing and Calibration Laboratories
MBN 10300	Standard Designation of Materials for Technical Documentation
MBN 10473-1	Measurement of Colors
MBN 10473-2	Technical Data for Color Measurement
MBN 10476	Visual Color Assessment of Painted Bodies, Add-On Parts and Metal Sheets in the Exterior
MBN 10494-1	Paint Test Methods – Part 1: General Requirements
MBN 10494-4	Paint Test Methods – Part 4: Optical Tests
MBN 10494-5	Paint Test Methods – Part 5: Technical-Mechanical Tests
MBN 10494-6	Paint Test Methods – Part 6: Climatic Tests
MBN 10494-7	Paint Test Methods – Part 7: Resistance to Chemicals, Test Mixtures and Test Concentrates
VDA 250	Material laboratory assessment (for making deeper assessment according to ISO/TS 16949)
VDA Volume 2	Quality Management in the Automotive Industry – Quality Assurance of Supplies – Production Process and Product Approval (PPA)

3 Terms and definitions

PV	Product version
AAW	Work instruction
Conditionally OK	Conditionally OK
BQF	Approval of procurement source
DBL	Daimler-Benz Supply Specification
CH	Test of constant condensed water climate
ISIR	Initial sample inspection report
SP	Spare parts

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GE	Gloss unit
OK	Correct, corresponding to required quality
N.r.	No requirement
KTL	Electrodeposited (cataphoretic dip) coat
MAG	Metal active gas welding
MIG	Metal Inert Gas welding
PLP	Process control plan
Rep.	Repair paintwork
RT	Room temperature
SQMS	Supplier Quality Management System
Tg	Glass transition temperature
CASS test	copper-accelerated acetic acid salt spray
ZGS	Drawing status

4 General requirements

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

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

DBL 8585 and DBL 6714 shall be observed.

5 Abbreviated material designation for documentation

The material designation is shown, for example, for the PV10, in Table 2.

Table 2: Structure of abbreviated material designation (see MBN 10300)

Material data					Description of final condition	
a. Material group	b. Material standard	c. Material number	d. Material designation	e. DBL material	f. Processing condition	g. Binding Daimler-Benz Supply Specification
Steel	DIN EN 10130	1.0338				DBL 7381.10

String, for example, according to MBN 10300:

e.g.: Steel DIN EN 10130-1.0338 + DBL 7381.10

Alternatively, the specification can be mentioned in the drawing.

6 General properties of materials, raw materials and delivery condition

6.1 All product versions

6.1.1 General requirements

The materials (cleaning and phosphating agents) used for pretreatment before coating, the binder types and pigments used for the paintwork structure as well as the coating methods and drying types shall be disclosed to the receiving Daimler AG plant for initial samples and in the event of changes. This stipulation is intended to facilitate, in particular within the framework of development processes, the general material assessment and compliance with any necessary technical and/or personal protective measures for the processing of painted component parts (e.g. grinding, welding). The pretreatments and coatings shall be free of heavy metals such as arsenic, cadmium, compounds containing chromium-VI, lead or their compounds. Pretreatment, coating material and coating processes as well as coat thickness shall be selected by the part supplier so as to fulfill the requirements of this DBL. Residues which could promote corrosion and/or impair adhesion of the coatings, in particular on weld seams or laser cut edges (flux, scale or similar), shall be removed chemically or mechanically.

Edges, corners, overlaps and points accessible only with difficulty which are subject to the risk of corrosion shall be treated with particular care.

The surface of the coating shall be free of any visible pretreatment markings, roughness, craters, dust inclusions, etc.

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6.1.2 PV 30: Decorative and weather-resistant baked multicoat finish or powder coating, co-extrudate, and other coatings

This product version requires an approval of the painting system.
For coated co-extrudate, only the CASS test is carried out as part of this DBL; all other tests are checked in accordance with the DBL 5416.

6.1.3 PV 22/31: Cataphoretic dip coating gray or OEM body painting at the supplier

All materials used for this PV must have a material policy approval according to the applicable material DBL and, if necessary, a BQF. For example cataphoretic dip coating in accordance with DBL 7292.

6.1.4 PV 20/21, 23/24: Cataphoretic dip coating black or with stone protection painting or with cavity preservation

The color of the cataphoretic dip coat must be black.
When it comes to cavity preservation, only those materials that comply with the DBL 6905 must be used.

6.1.5 PV 50: Baked multicoat finish or coating for aluminum wheels

This product version requires a material policy approval as well as an approval of the painting system. Both approvals are issued by the Paint Development team. Epoxy-polyester hybrid powder coatings must be used as a primer. The required gloss level for the primer must be > 80 gloss units, measured under 60° measuring angle geometry, as per DIN EN ISO 2813 (layer thickness $90 \pm 5 \mu\text{m}$, baking conditions 10 min / 200°C object dwell time, Q-Panel Al-brushed substrate).
For the generation of coatings on test panels for the chemical resistance and artificially accelerated weathering tests, the lower baking limit (UEG) and the minimum layer thickness of the varnish layer must be applied (total layer thickness 200 μm). Paint compatibility with the competitor must be ensured.
The minimum layer thicknesses and paint systems for wheels are stored in the "Implementation regulation for surface treatment A1690034299" under the document number A1690034299 in the DocMaster and must be complied with in accordance with the ZGS.

6.2 Changes (material, process)

All the modifications regarding the material and process must be shown to Daimler AG's receiving plant as pre VDA volume 2 on time and their initial sampling must be performed and approved before the application in series.

6.3 Assemblies

Note that the DBL 7381 can apply to the testing of individual parts and assemblies. The determined tests must also be carried out on the individual part or on the assembly, depending on this. This shall be coordinated with the specialist department.

6.4 Mechanical pre-treatment method

The determination of the mechanical pre-treatment method must be selected such that a sufficient cleaning of the surfaces must be guaranteed, but without other component part properties being negatively affected by this.
Entry of more precious particles in the surface of component parts must be excluded (e.g. no shot peening of aluminum with steel or stainless steel). Classic sandblasting is impermissible.

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6.5 MAG- + MIG weld seams / heat-affected zone

MAG weld seams shall be pretreated so that silicate and slag residues are removed to an extent that allows proper pretreatment (e.g. phosphating). The heat-affected zone shall be treated in the same way, if it is accessible. Reliable processes for removing residues resulting during welding shall be requested from the responsible specialist department. Currently approved methods are: ceramic blasting, "trowalization" (barrel finishing), dry ice blasting, pickling (only on steel). In individual cases, an additional coating on the weld seams is also possible. Which of these aforementioned possibilities makes sense depends on the component part and must be decided together with the specialist department.

Weld spatter must be avoided as much as possible in the process since it can lead to surface corrosion. Slag and silicate residues on the weld seam, which do not lead to any reduction of the determined component part properties, do not constitute a defect, see Figure 1.

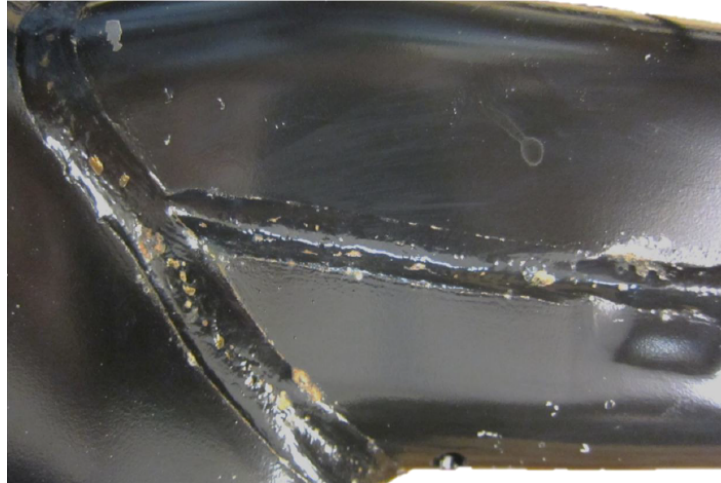


Figure1: Faults in coatings occur due to process-related silicate residues through MAG welding

6.6 Punched and cut edges

Punched and cut edges shall be designed such that compliance with the edge protection required in the relevant PV is ensured. The following rework possibilities are available to improve edge protection: grinding, brushing, barrel finishing ("trowalization"), shot peening etc. If freedom from burrs is specified on the drawing, embossing of the edges, where possible, must be recommended. If the parts are laser cut, then an oxygen-free cut without active gas shall be chosen. Where this is not possible, the edges shall be reworked as described above.

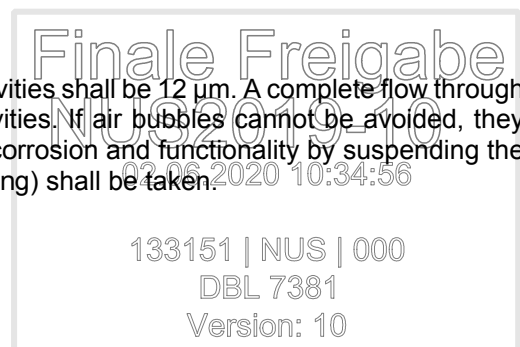
6.7 Cataphoretic dip coating material and pretreatment

The supplier shall ensure that the phosphate content in the cataphoretic dip coating bath does not exceed 100 ppm, as anti-corrosion protection deteriorates significantly with increasing phosphate content. The responsible specialist department of the receiving plant shall be notified in writing if the cataphoretic dip coating materials are changed following sampling with regard to binder/solids ratio, or if measures are taken which might affect the flow.

A nickel content of 0.8 – 1.2 g/l shall be maintained during phosphating when zinc-coated sheets are used. When using aluminum during a coat-forming phosphating process, care shall be taken to ensure that the free fluoride content is closer to the lower tolerance limit (coat formation is just still occurring) than the upper tolerance limit.

6.8 Cavity coating

The minimum layer thickness of cataphoretic dip coatings in cavities shall be 12 µm. A complete flow through the parts shall be ensured for cataphoretic dip coating of cavities. If air bubbles cannot be avoided, they shall be shifted to areas which are non-critical with regard to corrosion and functionality by suspending the parts appropriately. If required, additional measures (e.g. waxing) shall be taken.



6.9 Repair of faults in cathaphoretic dip coating on SP body parts and component parts

6.9.1 General requirements

In case of faults in cathaphoretic dip coating, they must be repaired by suppliers (contract coaters) with repair primer (2K epoxy, black). The repair primer must have MB approval. If these faults in cathaphoretic dip coating are repaired, then the repaired areas of these component parts must reach a surface corrosion value of Ri 0. This applies to all product versions except for PV31.

6.9.2 PV 30: Decorative and weather-resistant baked multicoat finish or powder coating, co-extrudate, and other coatings

Spot repair is not permissible, only complete repair.

6.9.3 PV 31: OEM body painting at the supplier

The guidelines for repair of grinding and sanded-through spots, repair of the paintwork structure on car bodies in the production plants must be inquired about at the Paint Development department.

6.9.4 Rewelded, cathaphoretically coated component parts

The following process is required for re-welded, cathaphoretically coated component parts:

- Completely remove any weld residues from the weld
- Use angle grinder to remove weld flash.
- Re-sand using 80 grit sanding paper
- Clean using commercially available silicone remover
- Apply MB-approved repair primer
- Ensure mixing ratio, layer thickness and drying according to the manufacturer's specifications
- Repaint with 2K epoxy primer, black with spray can or 1kg container with spray gun
- Two spray passes, air drying

6.9.5 PV 50: Baked multicoat finish or coating for aluminum wheels

Spot repair is not permissible, only complete repair.

6.10 Coat thicknesses

The coat thicknesses specified by the paint supplier which fulfill the requirements of this material-specific DBL shall be maintained for the paints used. If specifications are indicated on the drawing, they shall be observed; see Table 3: Coat thicknesses.

For PV50: The minimum layer thicknesses and paint systems for wheels are stored in the "Implementation regulation for surface treatment A1690034299" under the document number A1690034299 in the DocMaster and must be complied with in accordance with the ZGS. Applicable document is the material approval list for alloy wheel surfaces.

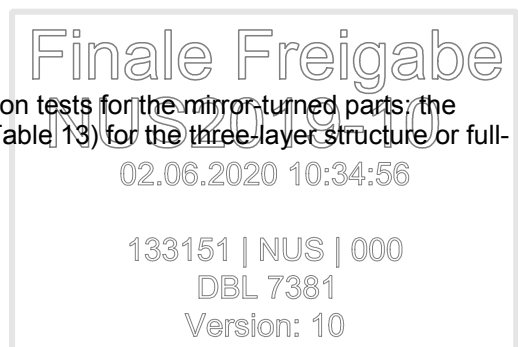
6.11 Special considerations for product versions with light alloys as base material

6.11.1 Extruded aluminum parts/ rolled aluminum/ cast aluminum (pressure, sand, ingot molds)

The CASS test (see Table 13) shall be performed as an approval-relevant corrosion test. In addition, filiform corrosion (see Table 14) can be required.

6.11.2 Mirror-turned / polished aluminum wheels

The following tests are performed as approval-relevant corrosion tests for the mirror-turned parts: the filiform corrosion test (see Table 14) and the CASS test (see Table 13) for the three-layer structure or full-painted area.



6.11.3 Magnesium die casting / zinc die casting

The corrosion cycle test (see Table 12) shall be performed as the approval-relevant corrosion test. To check the closure of the surface, the CASS test (see table 13) can be used as an accelerated test. Do not scribe the surface for this test.

7 Dimensions and tolerances/ form of supply

According to drawing and approved sample

8 Technical Data

For requirements of the approval-relevant tests with set values or target values, refer to Annex A.

Preliminary remark:

Since the material, the pre-treatment and the shape of the parts to be coated - in addition to the quality of the coating material itself - may also be crucial to compliance with the following requirements, the tests shall be conducted on finished parts, if necessary, in agreement with the "Global material sampling" team.

If, due to their size, component parts are sawn into pieces, the cut surfaces shall be protected, e.g. with a green polyester adhesive tape or with wax. The selected method must guarantee the protection of the edges from the moisture of corrosive media getting drained and must not affect the surrounding areas to be tested. For component parts intended for the underbody, at least two parts shall be tested, whereby the underside of the component parts in the installation position in the vehicle shall form the upper side in the test chamber and vice versa. This is required in order to be able to assess any effects resulting from the reverse situation. A test angle of 70° is desirable for the main surface.

9 Duties of the supplier

9.1 General requirements

As part of the initial sampling, the supplier shall verify that all guidelines of the "Global material sampling" team are observed. The necessary forms and documents such as test matrix and process data can be accessed in DocMaster: Document number: WEB V*. Questions shall be addressed to the Global material sampling department.

This DBL as well as all other required Daimler standards shall be available to all sub-suppliers in order to ensure DBL-compliant products.

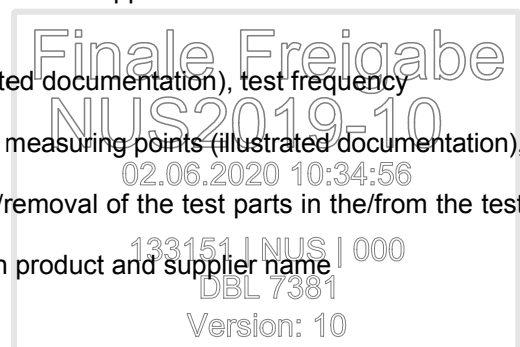
The supplier shall ensure that all relevant documents are available to all those involved in the product creation process.

9.2 Initial sampling

9.2.1 General requirements

The corrosion-relevant documents of the initial sample inspection report (ISIR) shall be attached in the SQMS system and contain the following information:

- Indication of the production and coating location. If the component part is produced or coated at several locations, then these locations shall be listed separately and include the following data for each location. In addition, component parts shall be submitted for sampling for each production/coating location.
- Pretreatment materials, product name with product code, supplier
- Coating materials, product name with product code (for e-coat, binder and pigment paste as well), supplier. The IR correlation coefficient shall be at least 0.97 to the approved reference.
- Process description (flow chart)
- Process parameters, test frequency
- Layer thickness, layer thickness measuring points (illustrated documentation), test frequency
- Object stoving temperature (ideal, minimum, maximum)
- Object temperature curves (at full load), object temperature measuring points (illustrated documentation), test frequency
- Illustrated corrosion test report, e.g. test position, storage/removal of the test parts in the/from the test chamber
- Repair paintwork: Work instructions, coating materials with product and supplier name
- Corrosion test report for the repair concept (illustrated)



9.2.2 PV 50 aluminum wheels

In addition to the documents required in 9.2, the following documents are required:

- Material policy approval
- Paint system approval, see Section 6.1.5 of this DBL
- Proof Resistance to chemicals, gradient oven test method: Table 18.
- Proof Resistance to test fuels: Table 19
- Proof Resistance to process and service products: table 20
- Tests for material policy approval: In agreement with the Paint Development department
- Tests for paint system approval: In agreement with the Paint Development department

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Annex A (normative)

Tests with set / target values

A.1 Definition of the test method classes

A Method accredited under ISO/IEC 17025 and approved by Daimler AG – WEB certificate (assessment scale compared with the Daimler AG; questions answered according to VDA 250).

B Method accredited under ISO/IEC 17025.

C Company certified under ISO/TS 16949 or EN ISO 9001.

The **laboratories approved** regarding **A methods** are filed in DocMaster under the document number WEB V100. **No laboratories are specified for B and C methods**

Preload describes a test that precedes the subsequent evaluations. For example, a component part is first exposed to a constant condensation water climate in order to then carry out the corresponding **evaluations** on the component part, such as a cross-cut, etc.

A.2 General requirements

Table 3: Coat thicknesses

Preload	Evaluation	Test	Affected PVs and their requirements	Test method
			All PVs	
	X	Coat thickness	According to the PLP and AAW drawing or approved sample with the tolerances typical of the material, as documented in the ISIR.	MBN 10494-1 Non-destructive coating thickness PLP- OF
	X	Cross grain in the key procedure	Cross-section polish as per DIN 2808: Method 6a cross grain	MBN 10494-1

A.3 Testing of paints in wet condition

Not relevant for this DBL.

A.4 Processing tests

Not relevant for this DBL.

A.5 Visual inspections

The requirements for the optical properties of coated or painted surfaces are specified in Table 4.

Table 4: Visual inspection

Preload	Evaluation	Test	Affected PVs and their requirements				Test method
			00/01/10/11/12	20/21/22/23/24	30/31	50	
	X	Gloss assessment	In accordance with drawing or approved sample. Deviation with respect to reference sample not greater than characteristic value 2-3. N.r. for cataphoretically dip coated materials	N.r.	High gloss: Measuring angle 20°: Gloss ≥ 80 GE Satin-finish: Measuring angle 60°: Gloss 23±7 GE	High gloss: Measuring angle 20°: Gloss ≥ 80 GE Matt: Measuring angle:60° Gloss level as per color sample	MBN 10494-4 Gloss measurement using a reflectometer
	X	Color assessment	Deviation with respect to reference sample not greater than characteristic value 3-4. N.r. for cataphoretically dip coated materials	N.r.	measuring technology: MBN 10473-2 visual: MBN 10476	Visual inspection: MBN 10476 Deviation compared to color sample/reference sample	MBN 10494-4 Visual color assessment MBN 10473-1 MBN 10473
	X	Appearance	N.r.	N.r.	MBN 10514-3 MBN 10514-4	In accordance with approved sample.	MBN 10494-4 MBN 10514-2

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A.6 Technical-mechanical tests

The tests of Table 5 are only necessary for **development patterns** and must be carried out on test plates. PV31 must be tested even when a system approval is not mandatory.

Table 5: Technical-mechanical tests 1

Preload	Evaluation	Test	Affected PVs and their requirements				Test method
			00/01/10/11/12	20/21/22/23/24	30/31	50	
	X	Mandrel bending test cylindrical mandrel	N.r.	N.r.	≤20 mm	≤20 mm	MBN 10494-5
	X	Cupping	N.r.	N.r.	OK: ≥ 6 mm Rep.:≥ 3.5 mm Conditionally OK: ≥ 5 mm Rep.:≥ 2.5 mm	6 mm	MBN 10494-5
	X	Scratch resistance	N.r.	N.r.	Amtec-Kistler: Residual luster ≥ 70% before reflow Crockmeter: Residual luster ≥ 70 % before reflow	N.r.	MBN 10494-5

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Table 6: Technical-mechanical tests 2

Preload	Evaluation	Test	Affected PVs and their requirements					Test method
			00/01/10/11/12/ 22/40	20/21/23/24	30/31		50	
	X	Cross-cut	Gt 1	Gt 1	OK: Gt 1 Rep.:Gt 1.5	Condition ally OK: Gt 1.5 Rep.:Gt 2	Gt 1	MBN 10494-5
	X	Scratch test	K 2	K 2	OK: K 2 Rep.: K 2.5	Condition ally OK: K 2.5 Rep.: K 3	K 2	MBN 10494-5
	X	Scratch test Cavity	N.r.	K 2	N.r.		N.r.	MBN 10494-5
	X	Adhesion test by means of tape pull-off on cataphoretically dip coated cavity weld seam	N.r.	No loss of adhesion on e-coat	N.r.		N.r.	MBN 10494-5
	X	Multi-impact stone chipping test Method B	PV 12: Overall damage: grade 2 Degree of corrosion: grade 1	PV 21/24: Overall damage: grade 2 Degree of corrosion: grade 1	OK: Overall damage: grade 2 Degree of corrosion: grade 0.5 Rep.: Overall damage: grade 2.5 Degree of corrosion: grade 0.5	Condition ally OK: Overall damage: grade 2.5 Degree of corrosion: grade 1 Rep.: Overall damage: grade 2.5 Degree of corrosion:	Overall damage: grade 2 Degree of corrosion: grade 0.5	MBN 10494-5

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Table 7: Technical-mechanical tests 2

Preload	Evaluation	Test	Affected PVs and their requirements			Test method	
			00/01/10/11/12/ 20/21/22/23/24	30/31			50
	X	High-pressure water jet test on St. Andrews cross	N.r.	OK D1 Rep.: D1	Conditionally OK D1.5 Rep.: D1.5	No loss of adhesion on St. Andrew's cross	MBN 10494-5
	X	High-pressure water jet test for damage due to multi-impact stone chipping Method B	N.r.	D 1, minor wash-out of existing damage		D 1, minor wash-out of existing damage	MBN 10494-5
	X	High-pressure water jet test on the cutter knife scribe	N.r.	Only Parktronic sensors No loss of adhesion on the scratch		N.r.	MBN 10494-5 Analog to St. Andrews cross
X		Balancing weight adhesion on aluminum wheel surfaces					MBN 10494-8
	X	Not aged	N.r.	N.r.		Average ≥ 50 N/cm²	
	X	tempered	N.r.	N.r.		Average ≥ 45 N/cm² No individual value ≥ 20 N/cm²	

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A.7 Climatic tests

The requirements for the temperature resistance of coated or painted surfaces are specified in Table 8.

Preload	Evaluation	Test	Affected PVs and their requirements	Test method
			01/11	
X		Temperature resistance		24 h 130 °C
	X	Cross-cut	Gt 1	MBN 10494-5
	X	Scratch test	K 2	MBN 10494-5
	X	Corrosion cycle test on steel	Refer to Table 10	MBN 10494-6
	X	Corrosion cycle test on galvanized steel	Refer to Table 11	MBN 10494-6

The requirements for the constant condensed water climate test are specified in Table 9.

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Table 9: Condensation atmosphere with constant humidity (CH)

Preload	Evaluation	Test	Affected PVs and their requirements					Test method
			00/01	10/11/12	20/21/22/23/24/40	30/31	50	
X		Constant condensed water climate (CH)						MBN 10494-6
		Exposure time in h	120	240	240	240	240	
	X	Blistering/ Degree of blistering (S)	< 2 (S 2)			0 (S 0)		MBN 10494-6
	X	Scratch test after 24 h	K 2			OK K 2 Rep.: K 2.5	Condition ally OK K 2.5 Rep.: K 3	MBN 10494-5/-6
	X	Cross-cut after 24 h	Gt 1			OK Gt 1 Rep.: Gt 1.5	Condition ally OK Gt 1.5 Rep.: Gt 2	MBN 10494-5/-6
	X	Multiple stone chipping test method B (component part)	PV 12/21 Overall damage: grade 2 Degree of corrosion: grade 1			N.r.		Overall damage: grade 2 Degree of rust: Rating 0.5 MBN 10494-5
	X	High-pressure water jet test: On multi-impact stone chipping Method B	N.r.			N.r.		D1, minor wash-out of existing damage MBN 10494-5

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Table 10: Corrosion cycle test 1 for steel

Preload	Evaluation	Test	Affected PVs and their requirements				Test method
			00/01	10/11/12	20/21/22/23/24/40	30/31	
X		Corrosion cycle test 1	Steel substrates				MBN 10494-6
		Exposure time in cycles	3	6	10	10	
	X	Surface corrosion	Ri 1	Ri 1	Ri 1	Ri 0	MBN 10494-6
	X	Edge corrosion	KR 2 (30 %)	KR 2 (30 %)	KR 2 (30 %)	KR 1 (5 %)	MBN 10494-6
	X	Weld seam corrosion	SR 1.5 (20 %)	SR 1.5 (20 %)	SR 1.5 (20 %)	SR 1.5 (20 %)	MBN 10494-6
	X	Sub-surface corrosion U/2	1.5 mm	2.0 mm	1.5 mm	1.5 mm	MBN 10494-6
	X	Blistering/ Degree of blistering (S)	< 2 (S 2)			0 (S 0)	MBN 10494-6
	X	Scratch test after 24 h	K 2			K 2 Rep.: K 2.5	MBN 10494-5/-6
	X	Cross-cut after 24 h	Gt 1			Gt 1 Rep.: Gt 1.5	MBN 10494-5/-6
	X	Flange corrosion Unopened: Assessment after 3 cycles	No leakage of red rust from the flange				
	X	Flange corrosion Opened: Assessment after end of test	PV23/24: free of corrosion				
	X	Cavities Assessment after end of test	PV 20/21/22: Surface corrosion Ri 1, scratch test K 2 (even in the area of the heat-affected zone) Adhesion test by means of tape pull-off on cathodically dip coated cavity weld seam: no loss of adhesion PV 23/24: Surface corrosion Ri 0, scratch adhesion K 2				MBN 10494-6

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Table 11: Corrosion cycle test 1 Galvanized steel

Preload	Evaluation	Test	Affected PVs and their requirements				Test method
			00/01	10/11/12	20/21/22/23/24/40	30/31	
X		Corrosion cycle test 1	Galvanized/ galvanized + organic coating / hot-dip aluminized substrates The values indicated refer to white rust. No red rust shall occur in any case (does not apply to SR).				MBN 10494-6
		Exposure time in cycles	3	6	10	10	
	X	Surface corrosion	Ri 1	Ri 1	Ri 1	Ri 0	MBN 10494-6
	X	Edge corrosion	KR 3 (50 %)	KR 3 (50 %)	KR 3 (50 %)	KR 2 (30 %)	MBN 10494-6
	X	Weld seam corrosion	SR 1.5 (20 %)	SR 1.5 (20 %)	SR 1.5 (20 %)	SR 1.5 (20 %)	MBN 10494-6
	X	Sub-surface corrosion U/2	4.0 mm			4.0 mm Rep.: 4.0 mm	MBN 10494-6
	X	Blistering/degree of blistering (S)	< 2 (S 2)			0 (S 0)	MBN 10494-6
	X	Scratch test after 24 h	K 2			K 2 Rep.: K 2.5	MBN 10494-5/-6
	X	Cross-cut after 24 h	Gt 1			Gt 1 Rep.:Gt 1.5	MBN 10494-5/-6
	X	Flange corrosion Unopened: Assessment after 3 cycles	No flange corrosion (no white rust) visible to customer				MBN 10494-6
	X	Flange corrosion Opened: Assessment after end of test	Ri 4 white rust (no red rust) PV23/24: free of corrosion				
	X	Cavities Assessment after end of test	PV20/21/22: Surface corrosion Ri 1 Adhesion test by means of tape pull-off on cataphoretically dip coated cavity weld seam: no loss of adhesion PV 23/24: Surface corrosion Ri 0, scratch test K 2				MBN 10494-6

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Advance notice:
In the subsequent version, the corrosion cycle test 2 (VDA 233-102/ DIN 55635) is incorporated, including requirements in the DBL 7381.
This corrosion test will replace the ISO 11997-1 Cycle B for the long term and become the basis for all new designs.

Table 12: Corrosion cycle test 1 Magnesium/ zinc die casting

Preload	Evaluation	Test	Affected PVs and their requirements				Test method
			00/01	10/11/12	20/21/22/23/24/40	30/31	
X		Corrosion cycle test 1	Magnesium /zinc die casting				MBN 10494-6
		Exposure time in cycles	10				
	X	Surface corrosion	Ri 0				MBN 10494-6
	X	Edge corrosion	KR 2				MBN 10494-6
	X	Blistering/ Degree of blistering (S)	0 (S 0)				MBN 10494-6
	X	Sub-surface corrosion U/2	1.5 mm				MBN 10494-6
	X	Scratch test after 24 h	K 2			K 2 Rep.: K2.5	MBN 10494-5/-6
	X	Cross-cut after 24 h	Gt 1			Gt 1 Rep.:Gt 1.5	MBN 10494-5/-6

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Table 13: CASS test

Preload	Evaluation	Test	Affected PVs and their requirements					Test method
			00/01	10/11/12/ 20/22/23	21/24/40	30/31	50	
X		CASS test <i>Aluminum</i>	This test will be applied to all aluminum substrates (even cast).					MBN 10494-6
X		Exposure time in h	96	168 For CDC: 96 h	240 For CDC: 168 h	240		
	X	Visual assessment				No change in surface of the original		MBN 10494-4
	X	Surface corrosion	Ri 1			Ri 0		MBN 10494-6
	X	Edge corrosion	KR 2 (30 %)			KR 1 (5 %)	3-layer or full-painted areas: KR ≤1 mirror-turned edges: KR 0	MBN 10494-6
	X	Blistering/ Degree of blistering (S)	< 2 (S 2)			0 (S 0)	0 (S 0) after 24 h	MBN 10494-6
	X	Sub-surface corrosion U/2	2.0 mm			1.0 mm ground:2.0mm	1.0 mm	MBN 10494-6
	X	Sub-surface corrosion on the cutter knife scribe in case of Parktronic sensors	N.r.			1.0 mm	N.r.	MBN 10494-6
	X	Scratch test after 24 h	K 2			K 2 Rep.: K 2.5	K 2	MBN 10494-5/-6
	X	Cross-cut after 24 h	Gt 1			Gt 1 Rep.:Gt 1.5	Gt 1	MBN 10494-5/-6

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The requirements for the filiform test are specified in Table 14.

Table 14: Filiform corrosion

Preload	Evaluation	Test	Affected PVs and their requirements		Test method
			30 / 31	50	
X		Filiform corrosion <i>Aluminum</i>	Aluminum	Mirror-turned/polished aluminum wheels	MBN 10494-6
		Exposure time	Cass test 24 hours + 28 days at 60°C ± 1°C / 82 % ± 2 % rel. humidity		
	X	Visual assessment	No gloss decrease, no color change in the original		MBN 10494-4
	X	Surface corrosion	Ri 0		MBN 10494-6
	X	Edge corrosion	KR 1 (5 %)	KR 0	MBN 10494-6
	X	Blistering/degree of blistering (S)	0 (S 0)	0 (S 0)	MBN 10494-6
	X	Sub-surface corrosion U/2	2.0 mm	2.0 mm	MBN 10494-6
	X	Maximum filament length	4 mm ground: 6 mm	4 mm	MBN 10494-6
	X	Scratch test after 24 h	K 2	N.r.	MBN 10494-5/-6
	X	Cross-cut after 24 h	Gt 1	Gt 1	MBN 10494-5/-6

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The requirements for the resistance to low temperatures and natural weathering with salt are specified in Table 15 and Table 16.

Table 15: Cold resistance

Preload	Evaluation	Test	Affected PVs and their requirements		Test method
			30/31/50		
	X	Low-temperature test	No cracks		MBN 10494-6

Table 16: Natural weathering with salt

Preload	Evaluation	Test	Affected PVs and their requirements		Test method
			22	31	
X		Natural weathering with salt	This test is not relevant for purchased parts.		MBN 10494-6
		Exposure time	12 months with light protection	12 months	
	X	Surface corrosion	Ri 0	Ri 0	MBN 10494-6
	X	Edge corrosion	KR 2.5	KR 2	MBN 10494-6
	X	Blistering/ Degree of blistering (S)	< 2 (S 2)	0 (S 0)	MBN 10494-6
	X	Sub-surface corrosion U/2 Steel	2 mm	3 mm	MBN 10494-6
	X	Sub-surface corrosion U/2 Zinc	2 mm	2 mm	MBN 10494-6
	X	Sub-surface corrosion U/2 Aluminum	1 mm ground: 2 mm	1 mm ground: 2 mm	MBN 10494-6

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Table 17: Weathering

Preload	Evaluation	Test	Affected PVs and their requirements			Test method
			30	31	50	
		Weathering	Proof of compliance with this requirement by the paint supplier is sufficient (reference sample is part of the ISIR).	The coating materials used require a separate DBL-approval system approval as regards compliance with this item.		
X		Florida test				MBN 10494-6 Test plates
		Exposure time	Min. 3 years		Min. 2 years	
	X	Visual color assessment	Color deviation with respect to unexposed reference sample not greater than characteristic value 3-4			MBN 10494-4
	X	Gloss measurement using a reflectometer	Gloss decrease ≥ 20 GE			MBN 10494-4/-6
	X	Visual assessment	No cracks, no chalking			MBN 10494-6
X		Artificial weathering SAE J 2527 (CAM 180)				MBN 10494-6
		Exposure time	4000 h		3000 h	
	X	Visual color assessment	Color deviation with respect to unexposed reference sample not greater than characteristic value 3-4			MBN 10494-4
	X	Gloss measurement using a reflectometer	Gloss decrease ≤15 GE			MBN 10494-4/-6
	X	Visual assessment	No cracks, no chalking			MBN 10494-6
X		Constant condensed water climate	This test must be carried out in accordance with the artificial and natural weathering.			MBN 10494-6
		Exposure time	N.r.	240 h		
	X	Scratch test after 24 h	N.r.	K 2-3	N.r.	MBN 10494-5/-6
	X	Cross-cut after 24 h	N.r.	Gt 1-2	Gt 2	MBN 10494-5/-6
	X	Degree of blistering	N.r.	0 (S0)	N.r.	MBN 10494-6

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A.8 Resistance to chemicals, test mixtures and test concentrates

Table 18: Resistance to chemicals

Preload	Evaluation	Test	Affected PVs and their requirements	Test method
			30/31/50	
		Resistance to chemicals Gradient oven test method	Proof of compliance with these requirements by the paint supplier is sufficient (test results are part of the ISIR).	MBN 10494-7
	X	Water	no damage to surfaces: $\geq 75^{\circ}\text{C}$, warning limit $\geq 65^{\circ}\text{C}$	MBN 10494-7
	X	Tree resin	no damage to surfaces: $\geq 45^{\circ}\text{C}$, warning limit $\geq 40^{\circ}\text{C}$	
	X	Pancreatin	no damage to surfaces: $\geq 50^{\circ}\text{C}$, warning limit $\geq 40^{\circ}\text{C}$	
	X	Caustic soda	no damage to surfaces: $\geq 55^{\circ}\text{C}$, warning limit $\geq 45^{\circ}\text{C}$	
	X	Sulfuric acid	no damage to surfaces: $\geq 45^{\circ}\text{C}$, warning limit $\geq 40^{\circ}\text{C}$	
	X	Destructive sulfuric acid	no destruction of the paint layer below 55°C	

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Table 19: Resistance to test fuels

Preload	Evaluation	Name of test	Affected PVs and their requirements	Test method
			00/01/10/11/12/20/21/22/23/24/40/30/31/50	
	X	Resistance to test fuels	Proof of compliance with these requirements by the paint supplier is sufficient (test results are part of the ISIR).	MBN 10494-7

Table 20: Resistance to process and service products

Preload	Evaluation	Name of test	Affected PVs and their requirements	Test method
			00 /01/10/11/12/20/21/22/23/24/40/30/31/50	
		Resistance to process materials and service products	Proof of compliance with these requirements by the paint supplier is sufficient (test results are part of the ISIR).	MBN 10494-7
	X	Hydraulic fluid/ servo-oil	16 h/23°C: no visible change in surface PV31: 4 h/50°C: no visible change in surface	MBN 10494-7
	X	Brake fluid	23°C/10 min and 100°C/10 min: no swelling or discoloration PV31: 23°C/10 min: no swelling or discoloration after regeneration time of 16 hours	MBN 10494-7
	X	Cold cleaning solvent	23°C/1 h: no swelling or discoloration PV31: 23°C/10 min: no swelling or discoloration after regeneration time of 16 hours	MBN 10494-7
	X	Preservative	23 ± 2°C/60 min: no swelling or discoloration, except PV31	MBN 10494-7
	X	Wheel cleaner	PV50: RT/16 h: no swelling or discoloration, no gloss change	MBN 10494-7

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A.9 Analytical tests

The requirements for Film-Tg and the degree of hardness of ΔFilm-Tg are specified in Table 21.

Table 21: Thermal analysis

Preload	Evaluation	Test	Affected PVs and their requirements	Test method
			50	
	X	Film-Tg	Glass transition temperature Film-Tg: Clear acrylic powder 69°C (20 min /175°C) Clear PES powder 67°C (15 min/170°C) EP/PES hybrid primer 60°C (15 min/170°C) Reactive EP/PES hybrid primer 60°C (17 min/150°C)	MBN 10494-1
	X	Degree of hardness ΔFilm-Tg	ΔFilm-Tg: Clear acrylic powder 1°C ±0.5°C Clear PES powder 1°C ±0.5°C Clear EP/PES hybrid primer 1°C ±0.5°C Reactive EP/PES hybrid primer 1°C ±0.5°C	MBN 10494-1

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