Mercedes-Benz
Company Standard

DBL 9440
Date published: 2015-05
Supersedes: DBL 9440:2012-10

Total no. of pages (including annexes): 14
Person in charge: Dr. Heinz-Dieter Hesse
E-mail: dieter.hesse@daimler.com
Plant: 10; Dept.: TF/VWO
Phone: +49 (0) 711 17 23506
Date of translation: 2015-11

Fasteners with Metric Thread

Surface Protection and Supplementary Technical Delivery Conditions

Foreword

This DBL describes the requirements for surface treatment for fasteners with metric (internal and external) thread. Deviating surface treatments are only permissible in justified exceptional cases.

Changes

In comparison with edition 2012-10, the following changes have been made:

- Product version DBL 9440.20 no longer permissible for new designs
- Product version DBL 9440.50 no longer permissible for new designs
- Product version DBL 9440.59 introduced.
- Section 1: New scope description
- Section 2: Normative references updated
- Section 3: Terms and definitions updated and extended
- Section 6: Relevant content of VDA test sheet 235-101:2009-11 (coefficients of friction) included

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

Contents

1 Scope

This DBL applies to fasteners with metric (internal and external) thread. Surface protection types other than those specified in this DBL for fasteners are permissible only in justified exceptional cases.

These include:

- Fasteners used in the internal engine compartment and transmission areas without corrosion exposure or in other oil-coated spaces. The surface protection types described in Table 1 are not required here, or are even problematic (residual contamination), and shall thus be avoided. Surface product versions according to DBL 9400 shall be planned for these application areas.

- Surfaces for mechanical fasteners which are fastened to the body shell and run through pre-treatment and the painting process together with the body. These are also not part of this DBL 9440. The requirements of DBL 8466, "Electrodeposited Coating of Individual Components for Body-in-White Applications", shall apply to these applications.

Table 1 Cr(VI)-free product versions, overview

Product version	Application	Coat appearance
9440.20 *)	Only in exceptional cases, only for parts for subsequent painting on commercial vehicles	Gray to black
9440.40	**Standard design of this DBL** **Zinc flake coating with lubrication integrated into sealing**	**Silver**
9440.43	For special cases only Zinc flake coating, without sealing and with subsequent lubrication by means of fast-to-handling lubricant, for special threaded connection requirements, e.g. threaded connection against painted surfaces	Silver, dyed bluish by subsequent lubrication
9440.47	Electrodeposited zinc-nickel coats, transparent passivated, sealed if required for special anti-corrosion requirements and e.g. for nuts with smaller dimensions. The coefficient of friction is set by subsequent lubrication.	Silver
9440.49	Electrodeposited zinc-nickel coats with additional top coat and subsequent lubrication for highest special anti-corrosion requirements.	Silver
9440.50 *)	For styling and special requirements	Black
9440.59	Electrodeposited zinc-nickel coats with sealing and/or additional top coat with demanding requirements for the corrosion protection quality of the black surface, lubrication integrated or separate, fast-to-handling lubricant	Black
9440.89	***Only for fasteners* ≥ M14 used in *vehicles with a permissible gross weight of* ≥ *3,5 t*** Zinc flake coating without sealing and with subsequent lubrication by means of fast-to-handling lubricant	Silver, dyed greenish by subsequent lubrication
*) Product version not for new designs		

With regard to its requirements, product version .89 corresponds to product version .43 with the difference of the different coloring, but in particular that only certain coating/finish treatment materials, which are approved in Annex A to this DBL, shall be used on screws/bolts according to product version DBL 9440.89.

This supply specification does not apply to parts with property class 120 or 12.9 /12 or to fasteners with micro-encapsulated adhesive or sealant (in this regard, see DBL 9460).

Otherwise, this supply specification shall apply to all screws, bolts, and nuts with metric thread with property classes ≤ 10.9 /10 and their washers, and to pipe connectors, spring clips, and similar parts unless otherwise specified in product standards.

2 Normative references

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

VDA 235-101:2009-11	Reibungszahleinstellung von mechanischen Verbindungselementen mit metrischem Gewinde (Setting of Coefficient of Friction for Mechanical Fasteners with Metric Threads)
VDA 235-203:2005-08	Verschraubungsverhalten/Reibungszahlen – Praxis- und montagegerechte Prüfung (Threading Behavior / Coefficients of Friction – Practical and Assembly-Oriented Testing)
VDA 235-104:2013-07	Cr(VI)-freie Oberflächenschutzarten für Verbindungselemente mit metrischem Gewinde (Cr(VI)-Free Surface Protection Types for Fasteners with Metric Threads)
VDA 235-204	Hochfeste Verbindungselemente für die Automobilindustrie (High-Strength Fasteners for the Automotive Industry)
DBL 8440	Parts Manufactured from Ferrous Materials with Inorganic Coating (Zinc Flake Coatings)
DBL 8451	Electrodeposited Zinc or Zinc Alloy Coatings for Components Manufactured from Ferrous Materials
DBL 8466	Electrodeposited Coating of Individual Components for Body-in-White Applications
DBL 8585	General Requirements - Environmental Protection, Hazardous Substances, Dangerous Goods - Negative Substance List for the Selection of Materials
DBL 6714	Negative List - Constituents of Process Materials
DBL 9400	Threaded Parts Manufactured from Ferrous Materials with Oil-Baked or Phosphated Surface
DBL 9460	Bolts with Micro-Encapsulated Liquid Adhesive
DIN EN 15205:2007-02	Determination of Hexavalent Chromium in Corrosion Protection Layers - Qualitative Analysis
DIN EN ISO 898-1	Mechanical Properties of Fasteners Made of Carbon Steel and Alloy Steel
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	Corrosion Tests in Artificial Atmospheres – Salt Spray Tests
DIN EN ISO 10683	Fasteners - Non-Electrolytically Applied Zinc Flake Coatings
MBN 10248	Threaded Connections - Joining Using Thread-Rolling Screws - Design Standard for Light Metal Casting Alloys
MBN 10436	Testing of Coated Inside Threads
MBN 10513	Parts Manufactured from Ferrous Materials with Inorganic Coatings and Black Surface Finish - Assessment of Corrosion Onset

Guidelines of the Deutscher Schraubenverband (German Fasteners Association) "Berücksichtigung der Schütt- und Transportprozesse bei der Umstellung auf Cr (VI) freie Oberflächen" (Consideration of Bulk Handling and Conveying Processes on Switching to Cr (VI)-Free Surfaces) – Edition 2006-04

3 Terms and definitions

PV: Product version according to this DBL, e.g. DBL 9440**.40**

Zinc flake coating:

Essentially inorganic, thin coating with cathodic corrosion protection capability, characterized by the fact that zinc, and to a lesser extent also aluminum, flakes are applied to the component from a dispersion. The coating constituents will evaporate and polymerize during the subsequent baking process. In order to achieve optimum corrosion protection, the coating shall normally be applied and baked at least twice.

Zinc-nickel coatings (ZnNi):

The most common electrodeposited zinc-nickel coatings have a nickel content of 12 to 16 %. Compared to pure zinc coatings and low-alloyed zinc-iron coatings, the significantly higher corrosion resistance of the metallic coating, in combination with less prominent/voluminous corrosion products and the comparatively higher temperature resistance of the passivated zinc-nickel coatings, is characteristic of zinc-nickel coatings .

Passivation:

Passivation is a standard treatment for electrodeposited zinc and zinc alloy coatings to prevent early coat corrosion. Passivation is the creation of conversion coatings on newly deposited zinc or zinc alloy layers by treatment with suitable Cr(VI)-free solutions. In this case, the newly electrodeposited coating reacts with the passivation solution to form a thin film (approx. 0,05 µm to approx. 0,5 µm) composed of complex reaction products, which protects the metallic coating. The formation of the passivated coating may also result in iridescent effects on the component surface.

Sealing:

Sealing as defined by this DBL is the creation of an organic or inorganic protective coating with a layer thickness of approx. 0,5 µm to 2 µm on zinc flake, zinc or zinc alloy coatings. The sealing on zinc or zinc alloy coatings is normally applied on passivated surfaces, whereby the sealing penetrates into the passivation layer forming a composite layer. Depending on the sealing agent, the sealing shall be executed wet on wet or following intermediate drying. The sealing agent can be provided with pigments for coloration (black). Top coats or subsequently provided paint applications with relatively thick layers are not permitted for sealing. Sealing can incorporate suitable additives to set the required defined coefficients of friction.

Top coats:

A top coat as defined by this DBL is an organic or inorganic protective layer for zinc flake, zinc or zinc alloy coatings with layer thicknesses >2 µm. The top coat may also contain zinc and/or aluminum and include pigments for coloration (silver or black). Top coats may contain suitable additives for the adjustment of defined coefficients of friction.

Separate fast-to-handling lubricant:

An additionally applied lubricant has the task of setting the overall coefficient of friction within the range specified in Section 6.2 and, according to VDA 235-101:2009-11 Section 2.2, shall not impair the component finish visually or chemically, shall adhere well, be dry to touch, and shall not lead to any malfunctions in conveying systems or assembly areas.

4 General requirements

For safety requirements, homologation (in particular, exhaust emissions) and quality, the existing statutory requirements and laws shall be complied with. In addition, the relevant requirements of the Daimler Group apply.

All materials, procedures, processes, components, and systems shall conform to the current statutory requirements regarding regulated substances and recyclability. In particular, the provisions of the EU Directive on End-of-Life Vehicles (2000/53/EC) concerning freedom from Cr(VI), including the applicable exceptions, shall be observed.

The supplier shall provide evidence of freedom from Cr(VI) based on recognized analytical methods. Such evidence shall be furnished as per DIN EN 15205:2007-02 or according to other recognized methods for determining Cr(VI) compounds in corrosion protective coatings.

DBL 8585 and DBL 6714 shall be observed.

Due to the detection problems associated with chromium (VI) in Cr(VI)-free zinc flake coatings, the application of chromium compounds for such coatings is not permitted.

The corrosion resistance values specified in this DBL shall be attained on delivery to the relevant Mercedes-Benz plants.

Depending on the coating system and the geometry and dimensions of the fasteners, there is a risk that the corrosion resistance significantly deteriorates as a result of handling, transportation and automatic sorting and feeding processes. The screw supplier shall ensure that any screw segregation processes after coating are investigated as regards endangerment of the surface protection coating and, if necessary, are modified so that reduction of the anticorrosive effect to values below the resistance limit required by the DBL is prevented.

For explanations and concrete notes relating to pertinent improvement measures on the process side, refer to the guidelines of the Deutscher Schraubenverband (German Fasteners Association) "Berücksichtigung der Schütt- und Transportprozesse bei der Umstellung auf Cr (VI) freie Oberflächen“, edition April 2006.

To minimize damage to the coating due to bulk handling and conveying processes, care shall be taken to ensure that coating companies and screw suppliers handle the parts as carefully as possible (e.g. by restricting the drop heights; use of non-slip materials during bulk handling and chute processes).

5 Abbreviated material designation for documentation

The designation shall be assigned in accordance with the relevant product standards instead of the previous surface protection specifications. e.g.:

Screw with external hexalobular driving feature and flange MBN 10142 - M8x60 - 8.8 DBL 9440.40
or for drawings in the block for surface protection e.g.: **DBL 9440.40**

6 Brief descriptions of the process technologies and technical requirements

The technical conditions of delivery specified in the product standards apply. For further information on this, see also VDA recommendation 235-104, DIN EN ISO 898-1, and VDA recommendation 235-204.

6.1 Coatings

The parts shall have a smooth and clean surface and shall be free of corrosion products.

To minimize mechanical damage to the thread during the coating of heavy screws and bolts, the thread of screws/bolts ≥ M14 is normally smoothed or re-rolled after coating. It shall be ensured in this case that the corrosion protection of the screws/bolts continues to meet the requirements of this DBL even after re-rolling. In order to reduce any risk of damage, rack coating or other suitable gentle methods are alternatively possible for pretreatment and coating.

6.1.1 Application of thin-layer phosphating

DBL 9400 and especially the specifications for product version DBL 9400.40 shall be observed on application of thin-layer phosphating.

6.1.2 Application of zinc flake coatings

When applying zinc flake coatings according to this DBL, DBL 8440 shall be observed, particularly the section "Materials with strengths ≥ 1000 N/mm^2".

In cooperation with the coating companies, the screw/bolt suppliers are expected to specify the required minimum coating system mass (e.g. > 30 g/m^2) specific to each component. Compliance with this specification shall be checked regularly.

The coating company shall monitor and control the coating process with zinc flake coatings as well as the drying and baking process of such layers, in as far as possible, by continuous measurement of the process parameters. In addition to many other parameters, this shall include e.g. temperature measurements at the different process locations, measurement of the humidity during the drying processes of water-borne zinc flake coatings, as well as monitoring of the viscosity of the coating liquids by means of appropriate measures.

The supplier of the source material of the coatings (manufacturer of the treatment chemicals/coating materials) is expected to introduce a system which, by means of regular audits of the users of the coating materials (coating companies), ensures the ability of the coating companies to produce a high-grade and uniform coating quality in line with the requirements of the relevant specified DBL PV. This shall be attested by the supplier of the source material of the coatings.

In addition, the coating material manufacturer shall enable the coating company to assess the stability of its substances in practical use.

A similar procedure is also expected of the coating company. Audits on the premises of the treatment chemicals/coating materials manufacturer are intended to verify the uniformity of the products used, improve communication between both parties, and assist in developing a problem solving management system.

In parts with cavities or recesses (e.g. banjo bolts, nuts) or sections of parts with cavities or recesses (e.g. driving recess of screws or bolts), accumulations of coating material detrimental to the operation of the part are not permissible.

The applicability of zinc flake coatings in the case of threaded parts, e.g. especially in the case of nuts with smaller dimensions, can be limited due to uneven coating thickness. Giving preference to the application of electroplating as per this DBL is recommended in this case.

If subsequent additional lubrication using a separate fast-to-handling lubricant is planned on zinc flake coatings, and if sealing systems on zinc flake coatings are used, no integrated lubricants shall be used in these systems as a rule. Such coating systems on thread forming (rolling) screws, for example, represent an exception. Integrated lubricants and additional lubrication are used in these cases.

6.1.3 Application of electroplating

On application of electroplated coatings according to this DBL, DBL 8451 shall be observed, especially the section "Material strength".

The statements from VDA 235-104:2013-07 Section 4.1 of relevance to electroplating shall additionally apply. This also results in the requirement that suitable heat treatment (tempering) shall be performed for hydrogen effusion in the case of material strengths ≥ 1000 N/mm^2.

6.1.4 Application of zinc-nickel coatings with additional top coat ("duplex layers" according to DBL 9440.49 and 9440.59)

For these coating systems, the type of the additional coating and subsequent lubrication on the zinc-nickel base layers is not restricted, provided that systems are in place that significantly increase corrosion protection even under mechanical loading of the fasteners compared to conventional passivation and sealers applied in electroplating systems.

Note: The effort required to manufacture the duplex anti-corrosion systems specified for this PV results in higher corrosion resistances until base material corrosion than the corrosion resistances required in this DBL with times of 720 h in accordance with DIN EN ISO 9227 NSS.

6.2 Coefficients of friction / threading behavior and finish treatment

Based on VDA 235-101:2009-11, a deviating overall coefficient of friction range of
μ tot. = 0,08 to 0,14
shall be set for all threaded parts.

The requirement defined in VDA 235-101:2009-11,
μ = 0,08 to 0,16, shall apply to the part coefficients of friction.

For similar parts with special configurations where a coefficient of friction cannot be determined, the finish treatment shall also be carried out in such a way that corresponding parts without the special configuration would achieve the relevant value range (e.g. for self-locking screws).

Exception DBL 9440.40:
If, in the case of parts ≤ M8 with driving recess, the sealer with integrated lubricant causes dimensional problems in the driving recess, the use of a lubricant is also permissible in place of the sealer.

For metric thread forming screws (e.g. according to MBN 10248) or all-metal prevailing torque nuts, additional lubrication treatment may be required to ensure that the permissible forming or clamping torques are adhered to. This may also apply to drawing parts in specific assembly situations.

When a coating system or finish treatment according to VDA 235-101:2009-11 is used for the first time, and during initial sampling, the supplier shall verify that the product it selects to set the coefficient of friction range exhibits the desired threading behavior (validation). To do this, systematic investigations according to VDA test sheet 235-203 shall be performed and the investigation results submitted.

The geometry-relevant data for the geometry specified for sampling (e.g. thread size, underhead geometry) shall be submitted with the initial samples.
Example: An M14x1,5x70 bolt according to MBN 10143 is sampled. The supplier is expected to enclose the validation results of a bolt with thread dimensions M14x1,5, in any length, with comparable/similar underhead geometry. This can also be a bolt according to MBN 10105, for example.

Records shall be retained and presented during a supplier audit.

Additional lubricant treatment on sealers / top coats with integrated lubricant shall be documented, resampled and approved.
In these cases, and for product versions marked with separate lubricant, a lubricant shall be used which creates a fast-to-handling film and complies with the range of properties specified in VDA 235-101 Section 2.2. The subsequently applied lubricant shall be dyed in blue and green for PV .43 and PV .89, respectively, and shall not contain any UV additives.

Blue or green color pigments added to verify the application of such lubricants shall lead to only a slight, barely visible change in the color of the component surfaces, such that the silver character of the base layer is still clearly recognizable. This significantly reduces the risk of discoloration on handling these fasteners until installation.

Example: In the adjacent figures, the nuts (Figure A) are dyed as required. Conversely, the bolt (Figure B) reveals excessively intensive green coloring.

Figure A

Figure B

6.3 Requirements for specific product groups

6.3.1 Nuts with plastic prevailing torque element

Generally, only methods with maximum baking temperatures of approx. 200 °C, and plastics suitable for the application, shall be used for nuts with plastic prevailing torque element; if the plastic prevailing torque element is inserted after surface coating, the required corrosion resistance values shall also be ensured after the crimping-in process. In this case and if temperature-sensitive plastic prevailing torque elements are used, consideration of the use of PV .47 is recommended, since experience shows that these coat structures are not impaired as much by the crimping process.

6.3.2 Pipe connectors

Zinc flake coatings on pipe connectors shall be applied only by companies for which the quality management unit of the customer plant has specifically granted approval.

For pipe connectors with zinc flake coatings conveying air, no loose particles or accumulations of the coating material are permitted which could impair the functioning of fine valves or bore holes within the system where the pipe connectors are used.

For pipe connectors conveying liquid with electrodeposited coatings, there are no internal corrosion protection requirements. The manufacturer shall ensure, however, that the internal areas are provided with adequate transportation and storage protection so that corrosion-free delivery to Mercedes-Benz plants is ensured.

7 Tests

For a description of acceptable coat structures, tests, and requirements, see Annex B.

7.1 Dimensional stability test

In the case of tests with a thread ring gauge, dimensional stability is deemed satisfactory if the thread ring gauge can still be screwed on without other aids/tools, even with resistance (tightening torque).

In arbitration cases, DIN EN ISO 10683 specifies tightening torque limits for the testing of the trueness to gauge. The gauge measurement applies to the as-supplied condition.

For parts with internal thread, the test shall be performed in accordance with MBN 10436.

For zinc flake coatings, particularly those with additional organic top coats, excessive material accumulations on the contact surfaces (e.g. underneath the bolt head) of threaded parts may lead to unacceptable setting behavior and are therefore only tolerated if no excessive negative influence on the setting behavior is observed. No reliable limit values exist yet, but experience so far shows

that a maximum value of 25 µm still appears to be acceptable for material accumulations under the contact surfaces of threaded parts.

Uneven accumulations of coating materials on the surfaces of the threaded parts disturbing the tightening and functional properties and the conveying and feeding of the threaded parts to the fastening locations are not permitted.

7.2 Corrosion resistance test

The corrosion resistance test is deemed to have been passed when each respective requirement in Annex B of this DBL is complied with.

Following the test duration required according to DIN EN ISO 9227 NSS, the components are removed from the test chamber, rinsed with demineralized water and then dried prior to assessment, e.g. by gently blowing off with compressed air. The anti-corrosion coatings shall not demonstrate any blisters or peeling during the specified corrosion tests after the specified test duration.

Assessment of black parts for freedom from zinc corrosion:
Test instruction MBN 10513, with corrosion level KG 1, indicates how the onset of zinc corrosion appears.

The fastener manufacturer should also perform corrosion tests beyond the time periods required in this DBL in order to generate knowledge regarding the gap between the actual coating quality and the required limit and regarding the scatter of the coating quality.

For each variant, at least 10 screws/bolts for each individual test type shall be tested. The requirement for the test duration without base material corrosion shall also apply if test substance accumulates in a part of the screws/bolts (i.e. driving recesses).

For cases where separate lubricants are used, the required anti-corrosion properties shall be achieved in both original and degreased condition (e.g. using petroleum ether).

Corrosion testing as per DIN EN ISO 6270-2 is waived. Nevertheless, the supplier shall provide evidence at the time of initial use of a coating system that the selected product or system does not show any weaknesses with regard to this corrosion stress (system test/validation). The requirement is that the coating systems used in constant condensation water atmosphere prevent any base material corrosion for at least 720 h.

Note: The specified corrosion test according to DIN EN ISO 9227 NSS is only a "short-term test method" used to prove that the supplied coating quality conforms to the defined target specification. However, the salt spray test results cannot be used to derive any conclusions concerning the suitability of the coated component under corrosion conditions in practice.

7.3 Adhesion test

7.3.1 Zinc flake coatings according to DBL 9440.40, DBL 9440.43, and DBL 9440.89

To test layer adhesion on the base material, an adhesive textile tape with an adhesive strength of (7 ± 1) N per 25 mm width shall be pressed on firmly by hand and then abruptly torn off perpendicular to the surface. The coating shall not peel off during this test. Small amounts of coating material are permitted to adhere to the adhesive tape.

7.3.2 Zinc-nickel coatings according to DBL 9440.47

To test the layer adhesion on the base material and between the layers, store test specimens for 30 minutes at 220 ± 10 °C and quench them immediately afterwards in water at a temperature of 15 °C to 25 °C. No chipping or blistering of the layer(s) shall occur.

7.3.3 Zinc-nickel coatings with additional top coat according to DBL 9440.49 and DBL 9440.59

Both tests according to 7.3.1 for the complete system and tests according to 7.3.2 to assess the adhesion of the top coat on the zinc-nickel coating are required here.

8 Initial sample inspection report (ISIR)

The following information regarding this DBL shall be indicated in the initial sample inspection report:

- Specified DBL PV
- Any agreed deviations from the DBL requirements
- Coating company applying surface protection, or subcontractor if applicable
- Employed methods and applied coating materials, including product names
- In the case of zinc flake coatings, minimum coating system mass to be maintained, in g/m^2
- If necessary, information on any measures performed to prevent hydrogen embrittlement, such as e.g. tempering
- Company performing lubrication treatment, if applicable
- Lubricant used, if applicable
- Corrosion test results; the appearance of the test parts after the test and the position of the specimens in the tester shall be documented and the pictures enclosed with the initial sample inspection report
- Coefficient of friction test result $\mu_{tot.}$ (VDA 235-101:2009-11), if feasible with the available part dimensions
- Test results regarding the behavior according to VDA test sheet 235-203:2005-08 "Verschraubungsverhalten/Reibungszahlen – Praxis- und montagegerechte Prüfung (Threading Behavior / Coefficients of Friction – Practical and Assembly-Oriented Testing)". Also refer to Section 6.2 in this respect.
- Name of the testing bodies (supplier and/or subcontractor and/or testing institute)

In the case of multiple coaters, each coater shall submit initial samples with the initial sample inspection report, in which case particular attention shall be given to identical functional and/or assembly properties of components which are finish-coated in different systems. This normally also requires the use of identical products (base chemicals) for the creation of the layer.

The data accessible to Daimler AG in this case shall be treated as confidential and not forwarded to third parties.

In the event of changes to the coating company, methods used, significant parts of the methods, or products applied, renewed initial sampling is required.

9 Packaging and transportation

The components shall be protected against the effects of corrosive media. During transportation, the parts shall not damage each other such that the requirements of this DBL are no longer met.

10 Shelf life

All parts shall be delivered free from corrosion products. On storage of the parts until further processing or assembly, preservation or special storage conditions may be required.
It shall be ensured in this case that the threading properties as per this DBL, such as the coefficient of friction requirements, are still maintained.

Annex A (normative)

Products for Cr(VI)-free product version DBL 9440.89

This product version shall apply exclusively to fasteners ≥ M14 installed in *vehicles with a permissible gross weight of over 3,5 t.*

Permissible coating materials for fasteners according to DBL 9440.89:

Base coat Zinc flake	Fast-to-handling lubricant	Coating material manufacturer
Geomet 321	Dacrolub 10 (green)	**NOF METAL COATINGS EUROPE SA** 120, rue Galilée F-60315 CREIL Cedex (For information: formerly Dacral SA)

Permissible coating materials for nuts according to DBL 9440.89:

Base coat Zinc flake	Fast-to-handling lubricant	Coating material manufacturer
Delta-Protekt KH® 200	**Delta-Lube® 10 (green)**	**Dörken MKS-Systeme GmbH & Co. KG** Wetterstraße 58 D-58313 Herdecke

Selection criteria for coat structures:
The requirements of VDA 235-203:2005-08 concerning the hot loosening behavior shall still be met at temperatures up to and including 180 °C.

Other objectives:
The friction and threading behavior of the coating materials shall be largely unimpaired by fluctuations of the relative humidity and by short-term exposure to water.
The relevant test requirements are still being created.

Approval of coat structures:
Technical approval of the coating systems shall be issued by the Lead Engineering Group X14 following positive development testing.

Annex B (normative) Technological data and tests

	PV	Appea-rance	Nominal thread size	Permitted coating systems	Lubricant	Recommended total coating thickness (µm) [1]	Testing in accordance with DIN EN ISO 9227 NSS	
							Until coating	Until base material
							corrosion (h)	
	.20[*]	Gray / black	**≥ M18**	Thin-film phosphated	Separate fast-to-handling lubricant	1-4	-	-
Standard design	**.40**	Silver	**d < M6**	ZnNi, transparent passivated, sealing permitted	Integrated into sealer, optionally separate lubricant	≥ 8, max. 15	120 [3], [A]	720 [4], [A]
				ZF with sealing			-	720 [2], [B]
			M6 ≤ d < M14	ZF with sealing	Integrated in sealing	≥ 8, max. 25	-	720 [2], [B]
			≥ M14	ZF optionally with or without sealer	Integrated into sealer, optionally separate lubricant			
Only in exceptional cases	**.43**	Silver	**all sizes**	Zinc flake (ZF)	Separate fast-to-handling lubricant	≥ 8, max. 25	-	720 [2], [B]
	.47	Silver	**all sizes**	ZnNi, transparent passivated, sealing permitted	Separate fast-to-handling lubricant	≥ 8, max. 15	-	720 [4], [A]
	.49	Silver	**M6 ≤ d**	Duplex: ZnNi base layer + top coat	Separate fast-to-handling lubricant	≥ 8, max. 25	-	720 [4], [A]
	.50[*]	Black	**d < M6**	ZnNi, black passivated sealing permitted	Integrated into sealer or top coat, optionally separate, fast-to-handling lubricant	≥ 8, max. 15	120 [3], [A]	480 [2], [A]
				ZF with top coat			240 [3], [B]	480 [2], [B]
			M6 ≤ d < M18	ZF with top coat	Integrated in top coat	≥ 8, max. 25	240 [3], [B]	480 [2], [B]
	.59	Black	**all sizes**	ZnNi, passivated, sealer or top coat permissible	Integrated into sealer or top coat, optionally separate, fast-to-handling lubricant	≥ 8, max. 25	480 [3], [A]	720 [2], [A]
	.89	Silver	**≥ M14**	Zinc flake (ZF) See Annex A	Separate fast-to-handling lubricant (see Annex A)	≥ 8, max. 25	-	720 [2], [B]

*) Not for new designs

[1] Since the coated thread must lie within the thread tolerance (6h or 6H) specified for the component, the tolerance position of the uncoated thread and the thickness of the surface protective layer shall be coordinated with each other.

[2] < M14: No base metal corrosion; the complete screw, bolt or nut is assessed.
≥ M14: No base metal corrosion in areas without thread.

[3] No coating corrosion or other visible changes in locations without thread. In this regard, also see MBN 10513.

[4] No base metal corrosion; the complete screw or nut shall be assessed; voluminous zinc corrosion products are not permissible.

[A] Requirements shall **also** be met following heat treatment for **24 h at 120 °C**

[B] Requirements shall **also** be met following heat treatment for **96 h at 180 °C**