

Zinc flake technology from Dörken MKS: Explanation and areas of use





Seatbelt buckles:
 System: DELTA®-TONE + DELTA®-SEAL
 Supplier: TRW
 OEM: Automotive

Rear-axle brackets:
 System:
 DELTA-PROTEKT® KL 100 +
 DELTA-PROTEKT® VH 301 GZ
 Supplier: Kirchhoff
 OEM: Porsche



Seatbelt D-rings:
 System:
 DELTA-PROTEKT® KL 100 +
 DELTA-PROTEKT® VT 600
 Supplier: AST in initial sample
 production
 System:
 DELTA®-TONE 9000 + DELTA®-SEAL
 + plastic sheathing
 Supplier: TRW



Brake disks:
 System: e.g. DELTA-PROTEKT® KL 100
 Supplier: Caparo
 OEM: McLaren

In real-world use: DELTA-MKS® systems in the automotive market

Get an overview here of the multitude of parts and applications for which our micro-layer corrosion protection systems can be used. From little screws, to a variety of different springs, to large parts like engine brackets - the breadth is enormous. The suitability of our systems for precisely these areas of use and this portfolio of parts is regularly confirmed by their incorporation into new specifications. Our systems now feature in all major automotive specifications of German and international OEMs.



Pressure springs:
System: DELTA®-TONE + DELTA®-SEAL
Supplier: Baumann Federn



Bolts:
System: DELTA-PROTEKT® KL100 or DELTA®-TONE 9000 + DELTA®-SEAL GZ top coat [colour optional] or top coats from the DELTA-PROTEKT® VH range
OEM: Automotive, wind energy etc.

Nuts:
System: DELTA-PROTEKT® KL 100 + DELTA-PROTEKT® VH 301 GZ or DELTA-PROTEKT® VH 301.1 GZ
Supplier: Winker



Hose clamps:
System: DELTA-PROTEKT® KL 101 + DELTA®-SEAL HC
Supplier: Togo/Scherdel, Norma



Visit our website

www.doerken-mks.de/de/produkte-systeme
and learn more about our products and licences from the product fact sheets.



GE imagination at work



Threaded bolts:

System: DELTA®-TONE 9000 + DELTA®-SEAL

OEM: Vestas, General Electrics, Enercon,

Acciona Windpower



Hexagon-head screw (M12 - M76):

System: DELTA®-TONE 9000 + DELTA®-SEAL

OEM: Vestas, General Electrics, Enercon,

Acciona Windpower



In real-world use: DELTA-MKS® systems in the wind power market

The green energy of the wind power market and our environmentally friendly, chrome(VI)-free coating systems supplement each other superbly. Bolts coated with DELTA-MKS® systems get used in particular on nacelle housing and rotor blades.

After over 15 years of experience in the field and with our systems approved for use by many leading wind turbine manufacturers, in 2012 Germanischer Lloyd too awarded to the DELTA®-TONE and DELTA®-SEAL GZ composition (typical in the wind power sector) its certificate for use on standard bolts for onshore and offshore turbines. You will find examples of the standard system here.



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Germanischer Lloyd



Stud bolt set:

System: DELTA®-TONE 9000 + DELTA®-SEAL

OEM: Vestas, General Electric, Enercon, Acciona Windpower



LIEBHERR



IVECO



CAT



VOLVO
VOLVO TRUCKS



M14 nuts

System: DELTA-PROTEKT® KH 200 + DELTA-LUBE® 10 green
OEM: Daimler Trucks



Truck bolts

System: DELTA PROTEKT® KL 105
OEM: Caterpillar, Liebherr, JCB



M14 bolts

System: DELTA-PROTEKT® KL 100 + DELTA-LUBE® 10 green
OEM: MAN



In real-world use: DELTA-MKS® systems in the truck and construction machines market

Awareness of our systems and their existence for over 30 years have led other sectors too to put their faith in the quality of DELTA-MKS® systems.

Our zinc flake systems are, for instance, being increasingly used in thread fastening situations on trucks, construction machines and agricultural machinery - be it on threaded wheel joints, for the chassis or the engine compartment. For large parts too, such as semi-trailers and machines, we offer the appropriate system solution, tailored to the different requirements of the respective OEMs. You will find a few selected systems here.



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In real-world use: DELTA-MKS® systems in other markets

Away from our core markets, Dörken MKS products and systems are also in use in niche markets. We, for instance, supply selected products to the aviation industry and are also to be found in the mechanical engineering sector (e.g. in use on diverse fasteners, etc.). Parts that come into contact with drinking water or are used in toys are also coated with DELTA-MKS® systems.



Nuts

System:
DELTA PROTEKT® KL 105
OEM: Caterpillar



Screws/bolts

System:
DELTA-PROTEKT® KL 100 + DELTA-PROTEKT® VH 301 GZ or
DELTA-PROTEKT® VH 301.1 GZ
OEM: Iveco

Zinc flake technology from Dörken MKS: explanation and areas of use

A coating of zinc flakes is a 'paint' made up of lots of little flakes, which primarily protects components of various types from corrosion. Through the sacrificial effect of the less noble zinc it provides active protection from environmental influences: this form of corrosion protection is called cathodic protection. Zinc flake coatings generally contain a combination of zinc flakes and aluminium flakes (as per DIN EN ISO 10683 or DIN EN 13858), which are fused together by an inorganic matrix. Illustration 1 shows a microscopic cross-section (REM).

Even with extremely thin coats – typically a system consists of a base coat and topcoat of 8-12 μm – it is possible to achieve protective effects against base metal corrosion (red rust) - as per DIN EN ISO 9227 - of up to 1,000 hours.

By contrast, other conventional technologies require a greater coating thickness in order to offer similar corrosion protection or due to the way they are applied cannot work in the thinnest micro-layer range (see illustration 2).

In addition to the necessity for extremely thin layers due in part to the components' design, e.g. the need for threads to fit precisely, it is also worth mentioning from an ecological and economic perspective the low use of resources.

During the coating process no hydrogen is produced and thus no danger exists of any hydrogen-induced embrittlement. For this reason zinc flake coating is also particularly well suited to high-strength steels of classes 10.9 and 12.9 / of 1,000 MPa and above.



Illustration 1: REM of a zinc flake coat (20 μm)

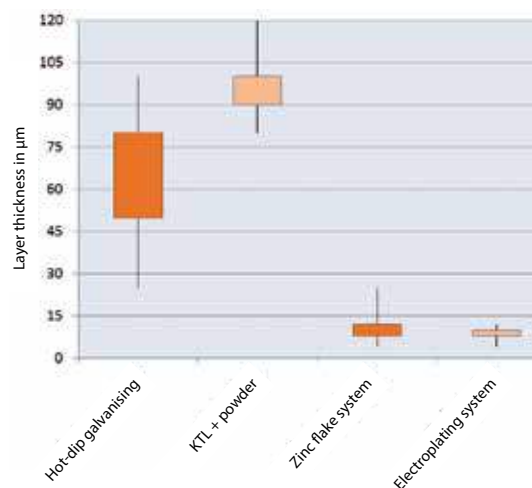


Illustration 2: Typical thickness levels of other systems' coatings (in μm)



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Corrosion

Corrosion is the physiochemical interaction between a metal and its surroundings, which leads to an alternation of the metal's properties and can lead to significant impairment of the function of the metal, the surrounding object or the technical system of which these form a part. (to ISO 8044-1986)

The characteristics of our zinc flake systems at a glance:

- Offer high levels of cathodic corrosion protection
- Consist of a base coat and usually a topcoat (referred to as a system)
- Have extremely thin coats of typically 8-12 µm
- Are annealed at low temperatures (up to max. 240°C)
- Cause no application-induced hydrogen embrittlement
- Have an attractive appearance and colouring possible via the topcoat
- Can be adjusted regarding their coefficients of friction for threaded parts according to customer specifications and fulfil other assembly characteristics
- Completely forgo any use of heavy metals that are harmful to health, such as chrome(VI), and are thus environmentally friendly
- Sparing on natural resources
- Conduct electricity
- Are highly resistant to chemicals
- Permit the coating of threaded parts without any reworking or re-cutting
- Comply with EU, 'End-of-Life Vehicle Directive' 2000/53/EC and 'Electrical and Electronic Equipment Waste Directive' 2002/95/EC

Due to its ability to perform well with coatings of minimal thickness the zinc flake concept has become most widely used for screws and fasteners in the automotive industry: every second screw used by the leading manufacturers is coated with zinc flake systems.

In this brochure you are provided with an overview of all DELTA-MKS® products – divided up by base coats and topcoats – and their features, plus possible application techniques and areas of use / markets.

The history of our base coats' development

- Solvent-based
- Protection against base metal corrosion
- Cathodic protection
- Suitable for all parts

- Improved protection against base metal corrosion
- Assists resistance to stone chipping
- Thermal ageing
- Ideal for fasteners

- Water-based
- Limited availability
- Suitable for all parts



- Integrated coefficient of friction through lubricant additive (GZ)
- Efficient use of resources
- High level of cathodic corrosion protection
- Ideal for fasteners

- Not VOCs
- Air-drying
- High level of protection against corrosion
- Suitable for large and solid parts

- Matt grey, ideal for black topcoats (avoids silvery gleam)
- Very good corrosion protection (against base metal corrosion and coating corrosion)
- Very good adhesion
- Suitable for all parts



DELTA-MKS® base coats

The base coat determines the system's corrosion protection properties and is responsible for the cathodic protection; the more noble metal gets protected from corrosion by the sacrificial effect of the zinc.

Listed here you see the split of our base coats into the

- DELTA®-TONE
- DELTA-PROTEKT® KH and
- DELTA-PROTEKT® KL ranges

A special feature is offered here by DELTA-PROTEKT® KL 105. It is a base coat that contains an integrated lubricant and can thus be set to specific coefficient of friction (0.12-0.18 μ ges as per ISO 16047).



The make-up of the DELTA-PROTEKT® base coat names:

K: cathodic protection

- L: solvent-based
- H: water-based



Illustration: Base coat as a layer applied directly to the base metal (roughly to DIN EN ISO 10683)

- Dark grey, ideal for black topcoats (avoids silvery gleam)
- Good corrosion protection

The history of our topcoats' development

- Solvent-based topcoats
- Can be universally used, customised for DELTA®-TONE 9000 base coat
- Can be combined for DELTA-PROTEKT® base coats or galvanic substrates
- Available in different colours
- Coefficient of friction can optionally be set from 0.09-0.14µges
- High resistance to chemicals



- Solvent-based Topcoats
- Can be ideally combined with DELTA-PROTEKT® base coats
- Colours: silver, black or white
- Optional coefficient of friction can be set from 0.09-0.14µges
- Developed for special applications such as UV and chemical resistance



DELTA-MKS® topcoats

Topcoats supplement the properties of the base coat, increase the corrosion protection and have an influence on the whole system's chemical or mechanical resistance. They can also be used for colouring, with the standard colours being silver and black. Thanks to multifunctional properties they facilitate a broad basis of applications.

Depending on the intended purpose you have a choice of organic or inorganic topcoats, which can be used on zinc flake base coats or electroplated surfaces.

DELTA-PROTEKT® VH 301.1 GZ sets new standards in the marketplace. This topcoat enables repeat assembly as specified by VW against various different materials using just one top surface. That makes it a tribological premium product.

The toughest of demands in terms of the combination of appearance, screw fastening qualities and corrosion protection are fulfilled by the new black DELTA-PROTEKT® VH 321 GZ topcoat, which has been developed for the requirements of German and American OEMs.

Here is an overview of our standard seals.

Further topcoats and the different colours of the DELTA®-SEAL range are presented on the following pages.

- DELTA®-SEAL
- DELTA-PROTEKT® VH range
- DELTA-PROTEKT® VL range



Illustration: Applied to the base coat, the topcoat produces a complete system (roughly to DIN EN ISO 10683)

- Water-based seal
- Can be used for DELTA-PROTEKT® and DELTA®-TONE base coats or in part for galvanic substrates
- Transparent, can sometimes be coloured
- Lubricant additive optional, coefficient of friction as per VW/VDA, Ford/GM or Renault/PSA
- Extremely thin layers of 1-2 µm possible
- The system for screws

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The make-up of the DELTA-PROTEKT® topcoat names:

V: Seal

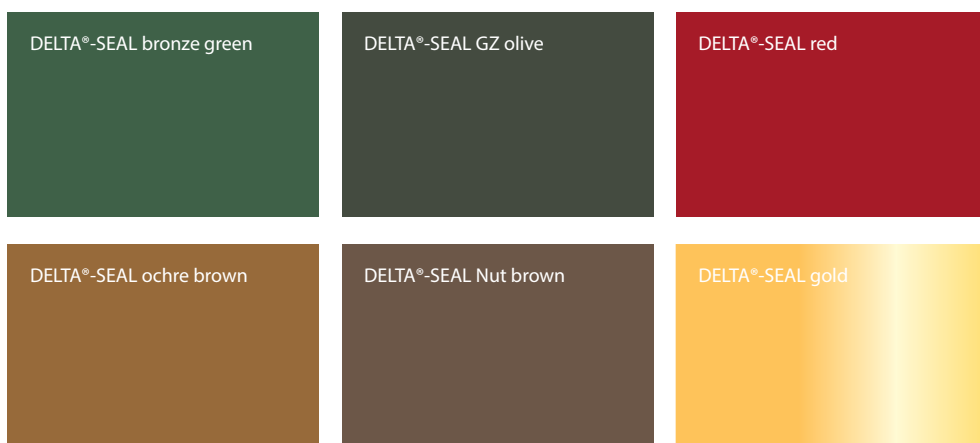
- L: solvent-based
- H: water-based

GZ: Lubricant additive

DELTA® SEAL range standard colours



DELTA® SEAL range special colours



DELTA-MKS® special products

Besides the standard topcoats for our base coats, there are for example some special products like sealers and lubricants

- DELTACOLL® 80
- DELTA-LUBE® 10
- DELTA-PROTEKT® VT 600

DELTACOLL® 80 is suitable for use as a topcoat, especially for galvanic substrates. It is available in black or as a transparent product and can be set to the VDA coefficient of friction range of 0.09-0.14µges.

DELTA-LUBE® 10 is a lubricant with multifunctional properties that is appropriate for the DELTA-MKS® base coats.

The product is used in particular in the truck sector; the slightly greenish or blueish colouring makes it easier to keep different fasteners apart during installation.

New to the portfolio is **DELTA-PROTEKT® VT 600**. It is an anti-friction coating that is ideal for parts such as seatbelt D-rings and seat tracks, which involve constant friction.



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