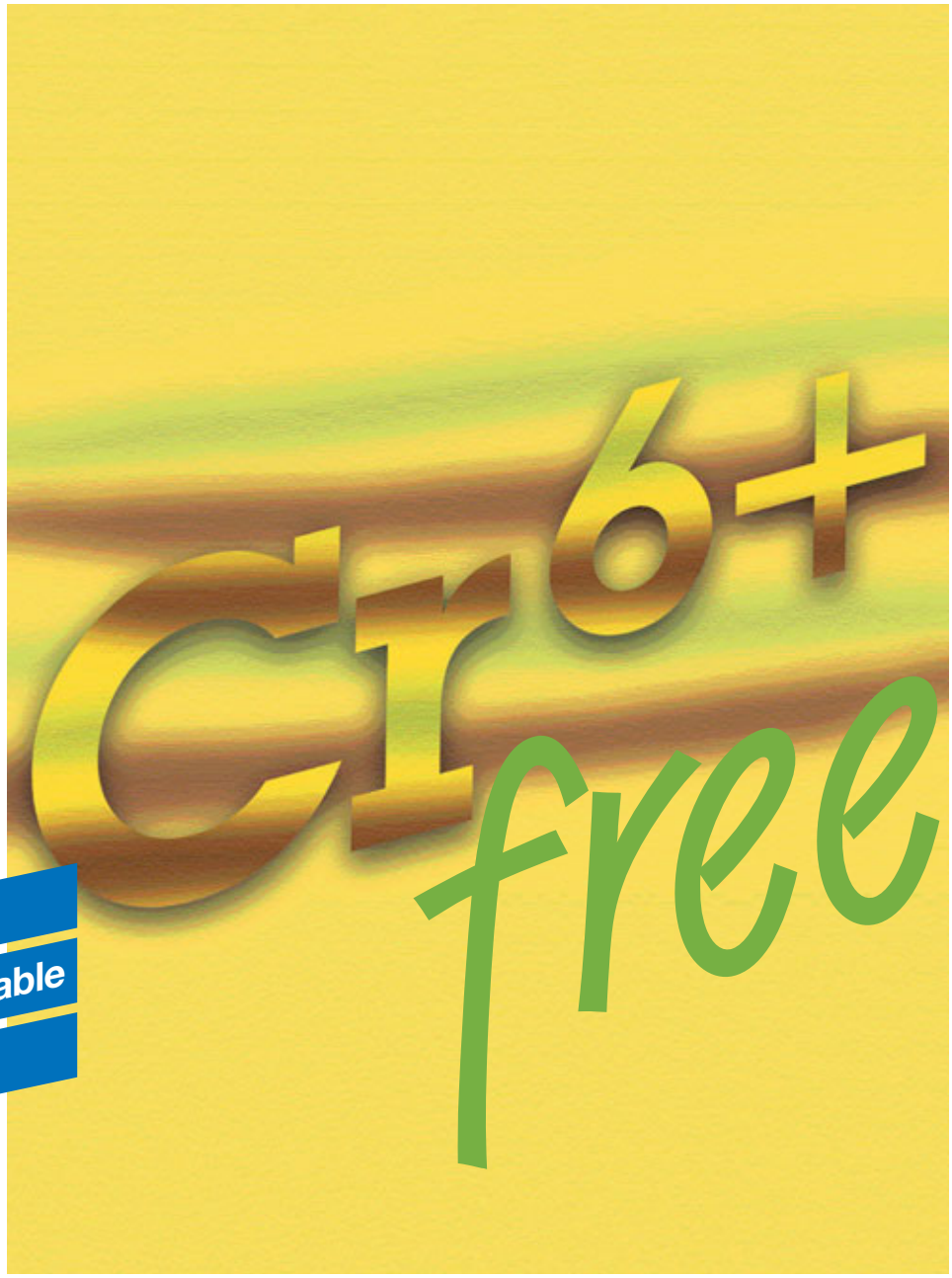
Information
for
customers

BÖLLHOFF

bulletin

Issue 22

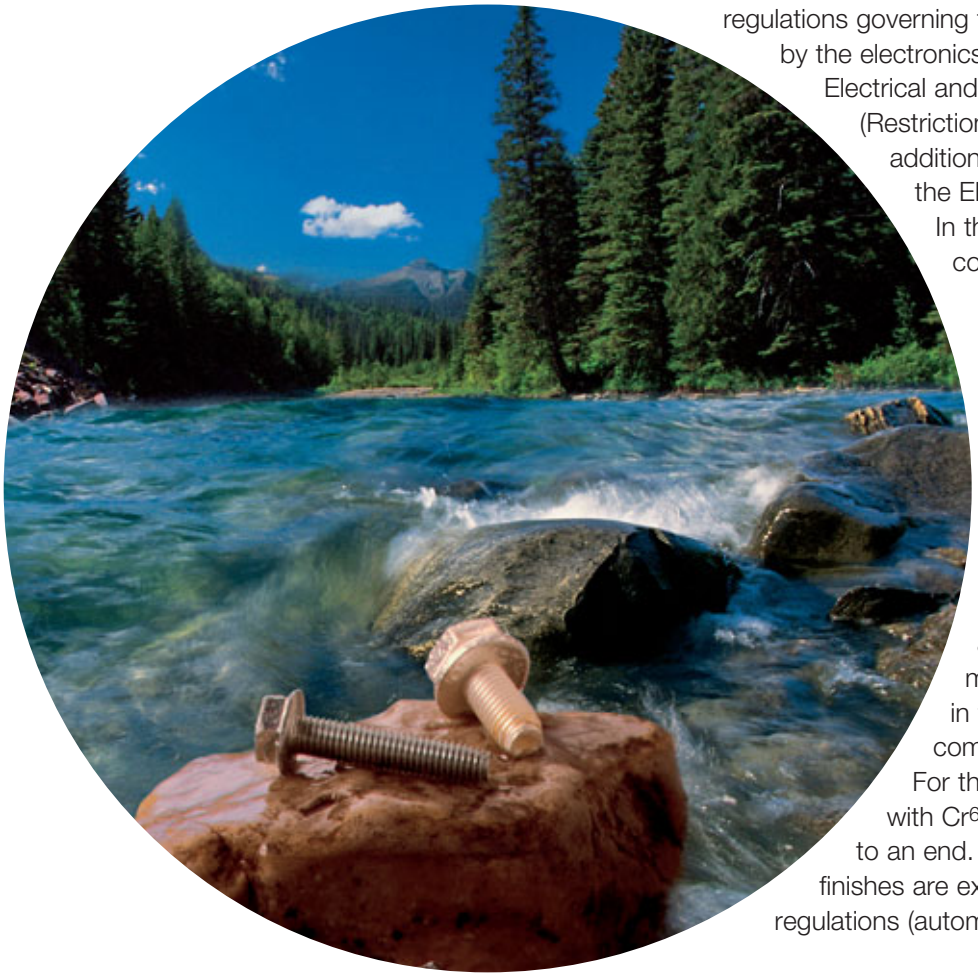


Cr6+-free alternatives available from stock

Changeover to Cr6+-free protective zinc layers for fasteners


Cr6+

The end of Cr^{6+}-containing finishes for fasteners



2006 and 2007 saw the introduction of sector-specific EU regulations governing the use of hazardous substances by the electronics industry such as WEEE (Waste of Electrical and Electronic Equipment) and ROHS (Restriction of Hazardous Substances), in addition to the automotive industry with the ELV (End of Life Vehicles Directive). In these market segments finishes containing Cr^{6+} are already prohibited.

In 2013 their inclusion in Annex XIV of the REACH Regulation was decided by the European Chemicals Agency in conjunction with the improved control of hazards resulting from the use of Cr^{6+} and its compounds.
Following a certain transition period such inclusion constitutes a prohibition on the use of Cr^{6+} as a material. This affects all users based in the European Union and is due to come into force in September 2017.
For this reason the availability of fasteners with Cr^{6+}-containing finishes will thus come to an end. Any derogation by virtue of existing finishes are excluded in relation to the above EU regulations (automotive and electronics industry).

This directly impacts on some surface treatment systems which are still commercially available and in particular concerns galvanised layers subject to post-treatment with chromate, e.g. yellow chromating or Dacromet coating.

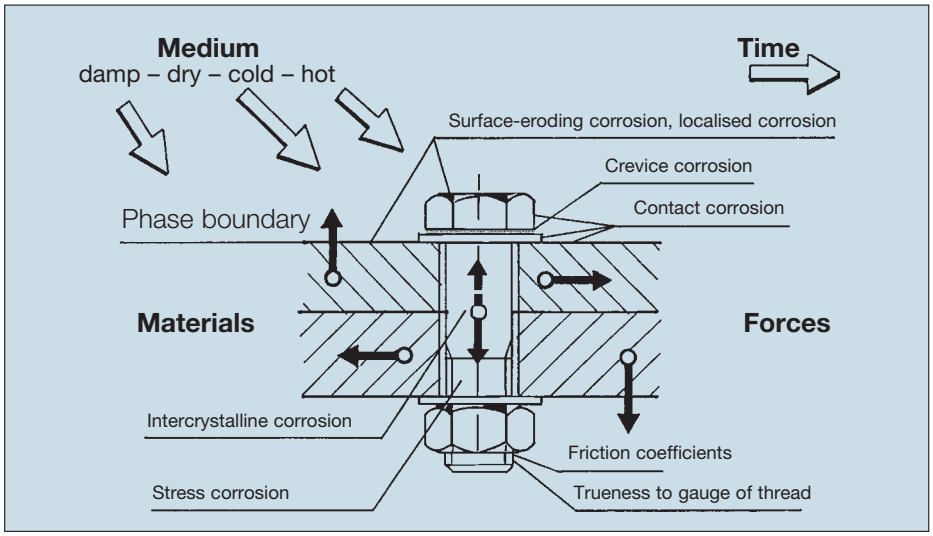
Responsibility and environmental protection

The Böllhoff Group would like to immediately implement the prohibitions laid down by the above regulations and so help to eliminate hazardous substances from the circulation of goods without delay. Böllhoff introduced an environmental management system certified to DIN EN ISO 14001 at the company in 1999. As an international service provider for fastening, assembly and systems technology, Böllhoff has for many years attached great importance to environmental protection in its corporate strategy, with this issue determining product innovations to a significant extent and so also opening up new areas of growth. This has prompted us to develop a product range of fasteners featuring Cr^{6+}-free coatings for our customers.

Zinc as surface protection for fasteners made of steel

The safety of many areas of technology greatly depends on the functionality and operational suitability of fasteners.
The surface treatment used for fasteners must likewise fulfil the demands of the finished products. Where metal layers are concerned, zinc is an ideal material and as a coating or finish ironware can no longer be imagined without it. Following damage to the finished surface zinc will protect the higher-grade iron underneath thanks to its electrochemical effect and safeguard steel fasteners from corrosive influences.
With electrolytically deposited zinc coatings passivation brings about the formation of a conversion coating on the zinc surface with the aim of improving corrosion protection while enhancing appearance.
This function can in particular be attributed to chromating. In future post-treatment solutions with trivalent chromium will be available for such conversion layers with electrolytic coatings.

With electroplating the entire process entails major potential for the release of hydrogen atoms in the baths. Zinc flake coating has become the established method for high-strength and spring-tempered fasteners as this method allows the risk of hydrogen charging to be reduced, so minimising the cause of brittle fracture. Fastener coating is generally performed using dip-spinning process in an inorganic system containing zinc.
The product Dacromet, which contains Cr^{6+}, is replaced by alternative systems.



Principle of “Threaded connection corrosion system” with its key functional variables and examples of possible types of corrosion

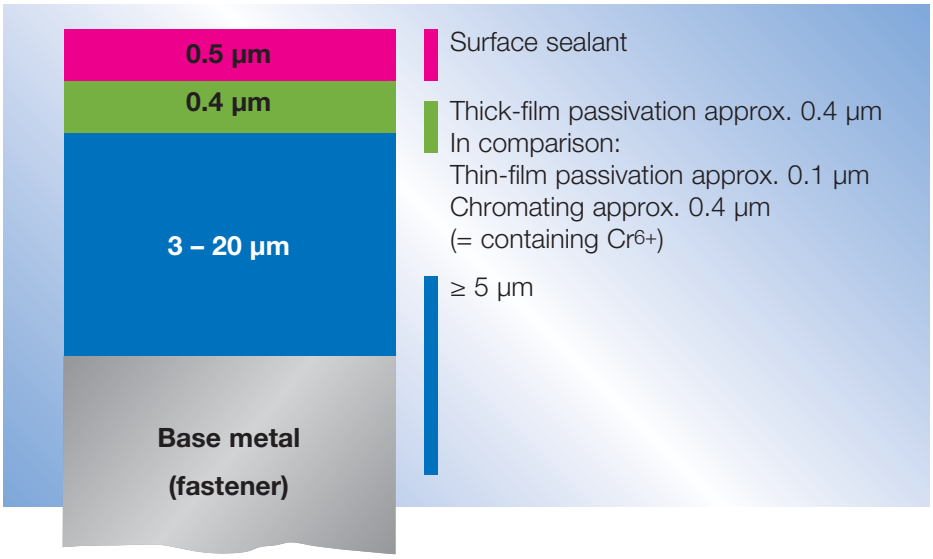
Secure threaded connection

The aim is to protect the threaded connection system with a surface coating.
The simplified diagram of a threaded connection illustrates how different reactions to corrosion can be initiated at the phase boundary. In addition, it clearly demonstrates that both the forces exerted and the required functions within the threaded connection also call for different functional characteristics from the surface coating.

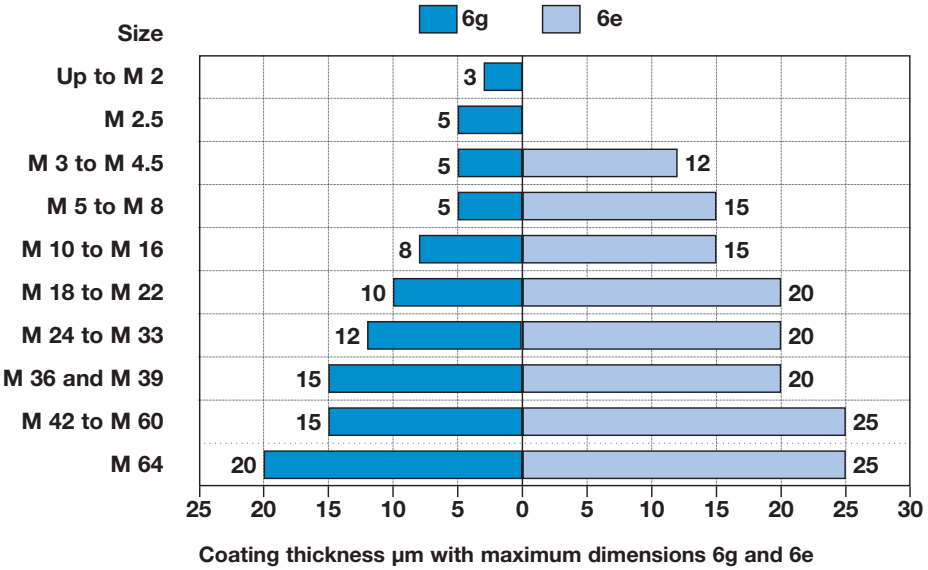
Changeover to Cr^{6+}-free protective layers of zinc

No surface treatment system is ever able to fulfil all requirements in the spectrum of applications in different sectors to optimum effect.

Where electroplated zinc finishes are concerned, we have opted for a product range that covers a wide variety of applications.



Allowable coating thicknesses DIN EN ISO 4042
Metric standard thread DIN 13 (ISO 965) tolerance positions 6g and 6e



Coating thickness µm with maximum dimensions 6g and 6e

The arguments in favour of the coating variant were as follows:

- Equivalent level of corrosion protection for a demanding surface application in line with DIN ISO 4042 = A3C (reference system)
- Standardisation of numerous variants results in greater economy in terms of application options
- Applicability for a wide range of fasteners in its different dimensions
- Safe action and secure assembly
- Excellent availability
- Attractive appearance

At the same time we note that none of the current DIN or ISO standards cover these characteristics in a definition as a technical code. This has given rise to a surface definition which can be described under the designation “B1” as follows:

- A zinc layer with a thickness of min. 5 µm is guaranteed
- The corrosion resistance in the salt spray test is higher than for the above reference system, i.e. greater than 72h for zinc-corrosion resistance and min. 144h until base metal corrosion
- Conservation of the zinc layer is generally permitted
- With screws of property class of 8.8 or higher an lubricant additive is applied to ensure secure assembly (total coefficient of friction 0.12 – 0.18 μ_{total} as per DIN ISO 10644)
- Heat-resistant (to 120°C), thick-layer-film passivation
- Self-locking nuts with a metal resistance device and thread-self-tapping screws for metals include an optimised lubricant additive to ensure reliable assembly
- Silvery, iridescent effect

Quality management – Product safety comes first

Quality management is a cornerstone of the Böllhoff Group's company profile. Product safety is our top priority; we can surely garantee quality. That is why Böllhoff always seeks certification to the latest standards in quality and environmental management.
Our customers benefit directly from these continuing improvements.

State-of-the-art measuring and test equipment forms the basis for reliable quality assurance and flawless product quality. We leave nothing to chance. The technical test laboratory of the Böllhoff Group is certified, the test procedures are accredited. In the case of particularly complex challenges, our customers benefit from our close cooperation with colleges, universities and the Fraunhofer Institutes.

We systematically plan top quality. In interdisciplinary teams working closely with our customers we manage the advance quality planning for all new processes and products. We set out measurable objectives for all areas of activity – and get our staff involved in the process. Every year we reformulate target agreements based on our customers' expectations. Because what was the benchmark for everything yesterday cannot suffice for today.

Systematic process control and constantly striving for continuous improvement form the basis of our ideal: we want to achieve zero defects and, thereby, have a prevention rather than cure approach to faults.

We need the best suppliers for raw materials, semi-finished products and fasteners.
Safety and reliability are the result of longstanding partnerships with these suppliers. Trust is good, but it is not enough: we also check compliance with all the agreed processes by way of clearly defined audits. New suppliers must undergo a multi-stage qualification procedure, followed by trial deliveries. It is only by taking these steps that we achieve our objective: we are able to exempt our customers from liability as per HGB [German Commercial Code] § 378. This reduces their quality control costs, and accelerates the internal flow of goods.

Böllhoff products must be just as reliable when used in a household appliance as in a car or for air or space travel. This requires maximum product and service quality, a fact which goes without saying for our staff. They are competent, motivated and have the best training. They undertake regular further training as part of their ongoing commitment to fulfilling the quality standards of our customers day in, day out.

The Optimised Böllhoff System (OBS) works on lean production, assembly, logistics and management. Month for month we implement up to 100 improvement measures, large and small. We hold workshops to find ways to further reduce assembly times, improve production and standardise test processes. Together with our customers, we aim to adapt packaging units, optimise internal transport, reduce packaging costs and thereby conserve the environment. We avoid waste and focus our efforts on adding value.

We expect quality to play an even more important role in the future. This is evidenced by the short production cycles of our customers as well as the increasing complexity of our customers' production. The currently rising international trend of product recalls can only be stemmed by consistently meeting quality standards. The whole market will reap the benefits.

Laboratory testing for the determination of Cr^{6+} in anti-corrosion coatings

Examples of Cr^{6+}-containing finishes

The following anti-corrosion coatings contain Cr^{6+} and should be replaced by alternative finishes without delay:

Before:	**New:**
Zinc-coated, yellow-chromated Zinc-coated, 5 µm, yellow-chromated, e.g. A2C Zinc-coated, 8 µm, yellow-chromated, e.g. A3C	Böllhoff “B1”
Dacromet 500 A coating	Zinc flake 50

Zinc-passivated surfaces

Zinc flake finishes

In addition, zinc-coated, black-chromated surfaces must be replaced.

Opportunities from change

The necessary changeover from the existing finishes to the alternative “B1” will initially entail effort in terms of evaluation, decision-making, amendment of the article master, etc. This process however also offers the opportunity to take stock of the functional requirements on fasteners and to compensate for any weak points. Furthermore it is also a chance to standardise products and product ranges if other systems were previously in existence. Where finishes with different coating thicknesses and passivation types are in use, it is frequently possible to reduce the extent of these variants and also make cost savings. In all cases a high-quality system will bring improvements in quality in relation to zinc-coated yellow-chromated finishes. Guaranteeing a friction-coefficient window allows assembly to be optimised, overdimensioning to be curbed and the risk of incorrectly fitted screws to be ruled out.

Friction – a disruptive factor for screw assembly?

When designing a threaded connection, it is necessary to determine the preload force required. This force should create a connection between the clamped components that lasts as long as possible to ensure they ideally behave like a single part. This means that the force must also prevent any movement between the clamped parts with changes in operational stresses. The preload force cannot be directly established with most assembly methods; assembly thus involves torque. There is now a direct link between the torque applied with the assembly tool and the preload force attained in the threaded connection. This is directly influenced by the friction resulting from the nature of the screw's surface and the components.

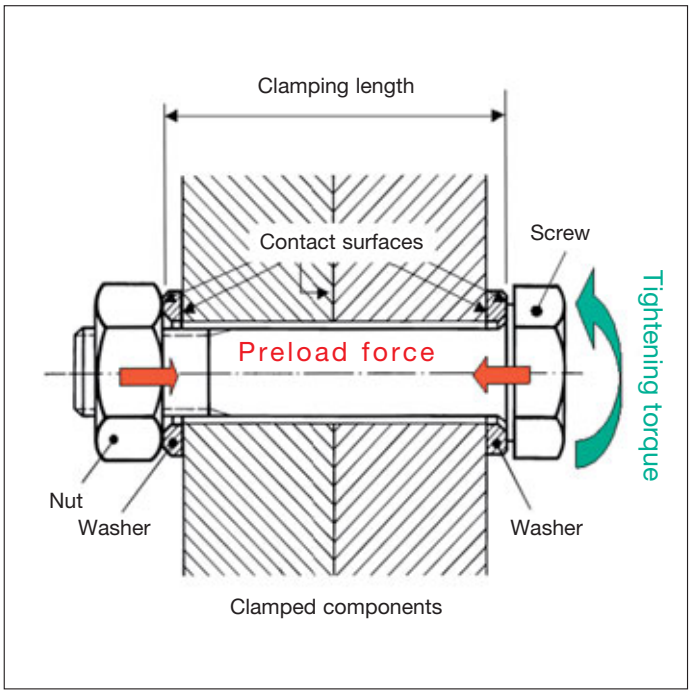
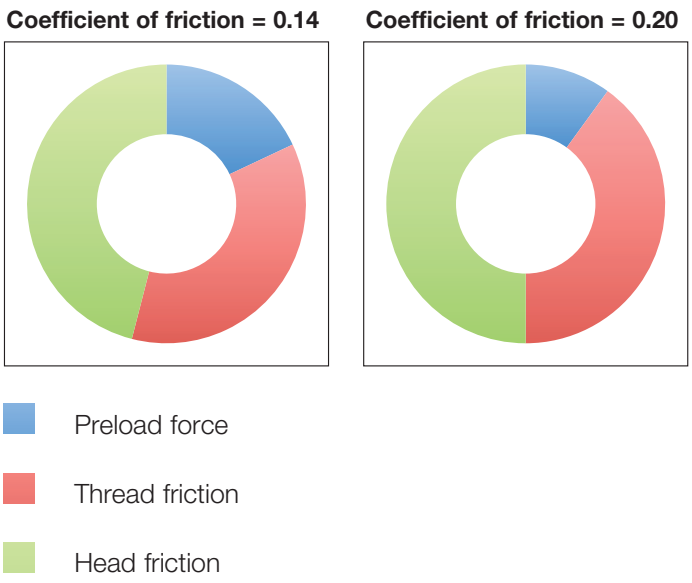


Diagram of torque distribution



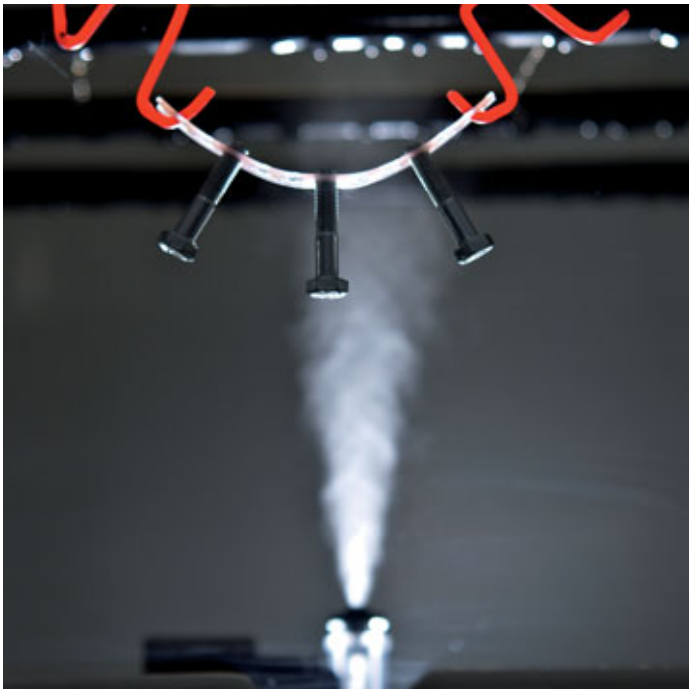
Galvanising companies have for years successfully coated and supplied fasteners in the quality “zinc yellow”. In the case of this finish, which is not specified any further, this means that the friction coefficient of a screw can vary between 0.10 μ_{total} and 0.26 μ_{total}, depending on the geometry, chemical composition of the baths, oils normally used for after-treatment, etc. In this context it becomes clear to what extent the result of assembly may vary due to this circumstance. Friction is thus only a disruptive factor where the coefficients of friction are subject to major variation or are too great.

The coefficients of friction provided for high-strength screws from Böllhoff's B1 range and the zinc flake 50 system therefore in the order of 0.12 – 0.18 μ_{total}. This ensures that, with appropriate assembly parameters, threaded connections can be preloaded in a controlled manner.

Corrosion resistance of Cr^{6+}-free surfaces in salt spray tests

Coating	Min. coating thickness [µm] **	DIN EN ISO 9227 SS white rust [h]	DIN EN ISO 9227 SS red rust [h]	Böllhoff finish
Zn (thin-film) passivated without surface sealant	5	12	36	C1
	8	24	72	C2
Zinc, thick-film passivated optional surface sealant	5	72	144	B1 standard finish*
Zn thick-film passivated with surface sealant	5	96	168	V4
	8	96	240	V5
ZnNi transparent with surface sealant	5	144	480	N3
	8	144	720	N4
ZnNi black with surface sealant	5	120	480	N8
	8	120	720	N9
Zinc flake coating DIN EN ISO 10683 - flZnnc-720 h-L	~ 10	–	720	Examples: G7 = Geomet 321 B + VL, L2 = Delta Protekt KL 100 + VH 301 GZ
Zinc flake 50 coating DIN EN ISO 10683 - flZnncL-480 h	~ 8	–	480	Examples: G9 = Geomet 500 A L8 = Delta Protekt KL 105 Standard finish
Zinc flake coating DIN EN ISO 10683 - flZnnc-480 h black	~ 8	120	480	Examples: L4 = Delta-Protekt + Delta Seal, L9 = Zintek 300 + Techseal SL

The values given are guideline values for barrel-plated products tested immediately after coating.
* With lubricant additive for high-strength screws (≥ 8.8), coefficient of friction B1 = 0.12 - 0.18 μ_{total}, also possible with coefficient of friction B2 = 0.09 - 0.14 μ_{total} (as per VDA)
** Recommended minimum coating thickness



Conclusions

The changeover to alternative systems is urgently recommended before any shortage is noticeable. New applications should be realised using the new Cr^{6+}-free finishes without fail.

Not only environmently friendly but also improving the quality of screw fastenings and finished products at the same time. This means: good standardised corrosion resistance, a uniform and attractive appearance with a silvery effect, safe assembly with high-strength screws, heat resistance and availability.

By way of comparison, Cr^{6+}-containing reference finishes

Coating	Min. coating thickness [µm]	DIN EN ISO 9227 SS white rust [h]	DIN EN ISO 9227 SS red rust [h]	Description
Zinc, yellow chromating	3	24	24	DIN ISO 4042 / A1C
Zinc, yellow chromating	8	72	120	DIN ISO 4042 / A3L
Zinc-iron, black chromating	8	72	360	DIN ISO 4042 / R3R

The figures in the above table are calculated guideline values for barrel-plated fasteners.
The degree of corrosion protection varies according to dimensions and geometry.

Böllhoff – Your Total-Cost Optimiser

ECOTECH is short for ECOnomical TECHnical Engineering and stands for cost savings thanks to optimised fastening technology. The future manufacturing costs of a product are largely determined at the design stage of a new development. The economic efficiency of a fastening technique does not greatly depend on the price of the fasteners. The processing costs for preparation and assembly of the components to be joined are of far greater importance here.

The main cost drivers in the process are:

- Design
- Purchasing
- Quality assurance
- Logistics
- Stock-keeping
- Preparation for assembly
- Final assembly
- Capital lock-up

Compared to this, the unit price of the fastener is relatively low: 20%. This means that the earlier experts in fastening technology are involved, the greater the impact on the overall value-added chain will be.

You can benefit from a comprehensive range of services:

- Design and engineering of fasteners
- Design and supply of customised special articles
- Application engineering tests in a certified laboratory
- In-house prototyping
- Standardisation of fasteners
- Optimisation of product lines
- Specialist publications about fastening technology
- Customer seminars

Our priority is always to improve customer products while cutting the costs of production.

Böllhoff International with companies in:

Argentina
Austria
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Canada
China
Czech Republic
France
Germany
Hungary
India
Italy
Japan
Korea
Mexico
Poland
Romania
Russia
Slovakia
Spain
Switzerland
Turkey
United Kingdom
USA

Apart from these 23 countries, Böllhoff supports its international customers in other important industrial markets in close partnership with agents and dealers.

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