REYHER®

CHROME(VI)-FREE SURFACE COATINGS

Regulating Cr(VI) and chromium trioxide

For many years the surfaces of steel fastening elements have been electrogalvanized to increase corrosion resistance and/or to enhance the appearance.

After completing the electro-galvanizing a conversion layer is applied, also called chromate coating or passivation. Today we talk about protective surfaces including Cr(VI) using the term "chromate coating" and for Cr(VI)-free protection layers the term "passivation".

Chromate coatings are inorganic, non-metal protective layers. During chromate coating the base material is etched using chrome acid. The dissolved metallic ions from the base material are integrated into the chromate layer. The thickness of the layer is approx. 0.1 µm. Higher corrosion protection and the familiar yellow, black and olive colouring distinguishes these chromate layers.

As hexavalent chromium, Cr(VI) can be hazardous to health and the environment its use is already regulated in some sectors. For example, in line with ELV- End of Life Vehicle Directive in car manufacture and the RoHS guidelines in various electric products the threshold values of 0.1% weight Cr(VI) in homogeneous materials can no longer be exceeded.

During passivation in an electroless process the metal surfaces are made more corrosion resistant with a non-metal protective layer. The thickness of the layer produced is in the range of <0.5 µm. The various processes - transparent passivation thick layer passivation, blue passivation - differ from each other in corrosion protection, appearance and colouring.

Passivation often has an additional top coat. This ensures not only higher corrosion protection but also serves to set friction coefficient windows.

The REACH regulation takes a different course than ELV and RoHS. Fundamentally, the regulation differentiates materials and preparation as well as production and defines special substances of high concern in a ten-candidate list (Appendix XIV of the REACH regulation). This list includes, chromium trioxide essential to produce chromate coatings, but banned as from 21.09.2017. The consequences of banning this material: From the "sunset date", all yellow, black and olive chrome coatings may no longer be produced in the European Union.

Thanks to regulations like ELV and RoHS, which have been in place for many years, alternative solutions have been established for fixing elements. These are found in many standards and norm drafts.

Overview of the legal regulation/ EU Guideline valid for:

- ELV – End of Vehicle Life Directive 2000/53/EG, valid from 1.7.2003
- RoHS I – 2002/95/EG, valid from 1.7.2006
- RoHS II – 2011/65/EU, valid from 3.1.2013
- REACH- Regulation 1907/2006, valid from 1.6.2007

FDS The technical committee of the FDS recommends as alternatives to the yellow chromate coating a thick layer passivation with the following minimum requirements:

Product sector	Layer thickness (min)	Resistance to white rust formation	Resistance to red rust in NSS
Mechanical fastening elements	5 µm	72 h	120 h

Status: October 2016

Which fasteners are affected by the regulations?

Fasteners containing Cr(VI) corrosion protection, among them are galvanised coatings with
▸ yellow chromate coating ▸ black chromate coating ▸ olive chromate coating include Cr(VI)e zinc laminated coating such as DACROMET®.

Cr(VI)-free corrosion protection

Corrosion protection coatings are often defined by two criteria as regards their performance:

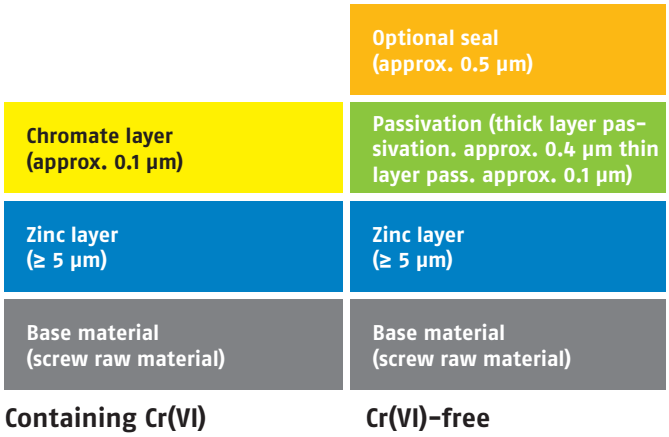
- **coating thickness and**
- **resistance in salt spray tests in line with ISO 9227**

The deciding criteria is from a normative perspective the result of the salt spray test. A direct or linear connection between layer thickness and resistance is not present. Therefore an additional coating that often includes the setting of the friction coefficient window achieves a considerable increase in corrosion resistance. The graph shows a sample layer structure.

The parameters determined in the salt spray tests are labelled as white or red rust. White rust indicates the beginning of zinc corrosion and red rust the beginning of base metal corrosion.

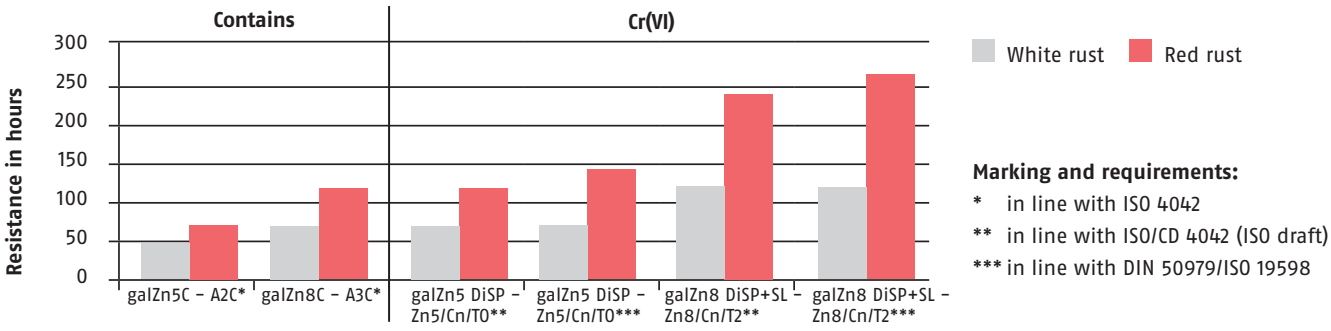
The following comparison shows the resistance of ten different corrosion protection coatings on the basis of their standard requirements. From this we deduce, that

Layer structure of a corrosion protective coating



the alternative Cr(VI)-free protective layers are comparable in their standard requirements to the previous chromate coating.

Various corrosion protection coatings in salt spray tests



Marking and requirements:
* in line with ISO 4042
** in line with ISO/CD 4042 (ISO draft)
*** in line with DIN 50979/ISO 19598

Standards for Cr(VI)-free coatings

The requirements for galvanized fastener coatings are laid down in ISO 4042. This standard dated January 2001 does not include Cr(VI)-free coatings. The current Committee draft dated 2016 is the first to include the preliminaries of a draft standard to take such coatings into account.

Parallel to this standard, which covers especially requirements for fasteners, all common standards such as DIN 50979 were worked on and replaced in April 2017 by ISO 19598 in order to standardize Cr(VI)-free coatings. These standards will also be used for fastening elements as there are no alternatives.

Standards overview

- ISO 4042:2001-01 Fasteners – Galvanized coatings
- ISO/CD 4042:2016 Fasteners – Electroplated coating systems (CD = Committee Draft)
- DIN 50979:2008-07 Metal coatings – Galvanized zinc – and zinc alloy coating on ferrous metal with additional Cr(VI)-free treatment (status: withdrawn)
- ISO 19598:2017-04 Metal coatings – Galvanized zinc – and zinc alloy coating on ferrous metal with additional Cr(VI)-free treatment (subsequent to standard DIN 50979)
- ISO 10683:2014-10 Fasteners – zinc laminated coatings applied non- electrolyte

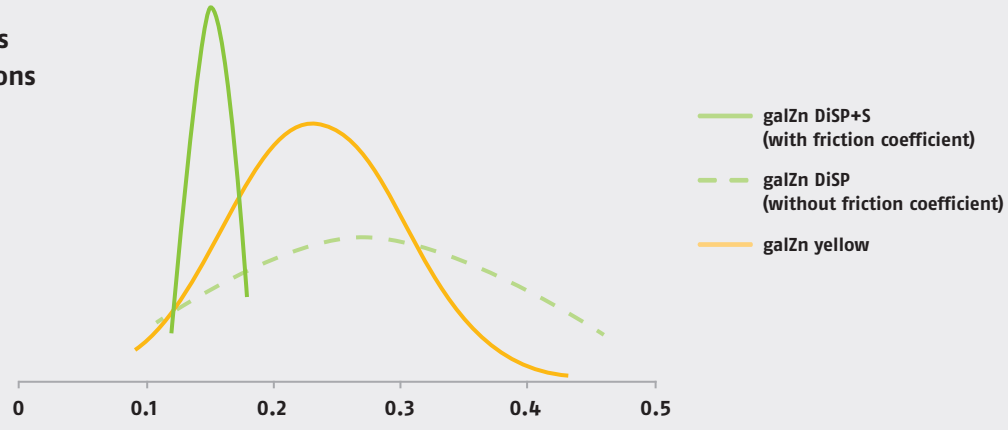
Increased assembly quality

With the publication of the VDI regulation 2862, sheet 2 in February 2015, for the first time outside the automotive industry, a standard was set as a benchmark for the classification of screw connections and a guideline for selection and use of such screw assembly tools/screw systems. The coating of fasteners makes a significant contribution to the highest possible pre-load force in a screw connection.

With a set friction coefficient window the efficiency of a screw connection can be increased considerably, leading to a much safer connection, but seen as a whole can also lead to a reduction in cost and effort. The highest possible efficiency is achieved by the friction coefficient window with a tolerance range in the region of 0.05. Up to now the commonly stocked galvanized zinc coating products with yellow or another colour chromate coating have no defined friction coefficient window.

The following diagram illustrates the friction coefficients of various coatings. While the friction coefficient of common yellow chromate coatings is very wide (μ_{ges} ~ 0.10-0.45), the range of a defined thickness passivation with μ_{ges} = 0.12-0.18 is considerably less. This facilitates targeted setting of the assembly parameters, leading to more accurate pre-load forces.

Friction coefficients for screw connections without lubricant



REYHER supports users in the preparation of high quality screw connections with a stock of fasteners ready for despatch with friction coefficient windows set.

REYHER product range with Cr(VI)-free coatings

REYHER has built up its range of Cr(VI)-free coatings with the future in mind and is ready to provide customers who need to align to Cr(VI)-free fasteners, with all the support they need.

Product	Hardness class	Ø	Surface name REYHER	Standard name/ number	Corrosion resistance in salt spray tests [h] white rust/ red rust	Friction coefficient
Screws/ nuts	**<8.8/8**	<M 6	galZn DiSP	–	72/120	–
Screws/ nuts	**<8.8/8**	≥M 6	galZn8 DiSP	–	72/120	–
Screws/ nuts	**8.8/8**	<M 6	galZn DiSP + SL	ISO 19589 – Fe//Zn//Cn//T2yL	120/264	0.12 – 0.18**
Screws/ nuts*	**8.8/8**	≥M 6	galZn8 DiSP + SL	ISO 19589 – Fe//Zn8//Cn//T2yL	120/264	0.12 – 0.18**
Screws/ nuts	**10.9/10**	≥M 6	flZnnc 480h-L	ISO 10683 – flZn/nc/TL/x/480h/C	-/480	0.09 – 0.14**
Screws/ nuts*	**10.9/10**	≥M 6	flZnncL-480h	ISO 10683 – flZnL/nc/x/x/480h/C	-/480	0.12 – 0.18**
Hexagon socket – screws	**12.9**	≥M 6	flZnnc 480h-L	ISO 10683 – flZn/nc/TL/x/480h/C	-/480	0.09 – 0.14**
Washers*	**200 HV**	<M 6	galZn DiSP + S	ISO 19589 – Fe//Zn//Cn//T2	120/264	–
Washers*	**200 HV**	≥M 6	galZn8 DiSP + S	ISO 19589 – Fe//Zn8//Cn//T2	120/264	–
Washers	**200 HV**	≥M 6	flZnnc 480h-L	ISO 10683 – flZn/nc/TL/x/480h/C	-/480	0.09 – 0.14***
Washers*	**300 HV**	≥M 6	flZnnc 480h-L	ISO 10683 – flZn/nc/TL/x/480h/C	-/480	0.09 – 0.14***
Washers*	**300 HV**	≥M 6	flZnncL-480h	ISO 10683 – flZnL/nc/x/x/480h/C	-/480	0.12 – 0.18***

* building up stock.
** test conditions in line with ISO 16047.
*** friction for washers is only for information. Standards do not define test conditions for washers.

+49 40 85363-0

mail@reyher.de

www.reyher.de

F. REYHER Nchfg. GmbH & Co. KG

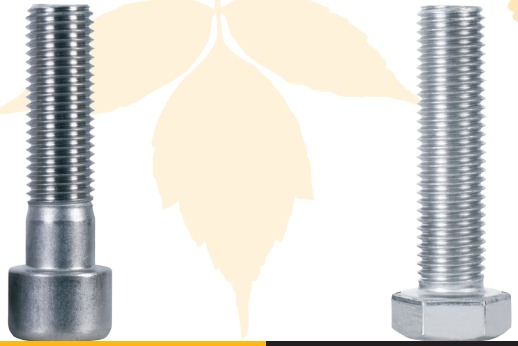
Haferweg 1

22769 Hamburg

Germany

Your reliable partner for Cr(VI)-free fasteners and fixing elements

- ✔ Comprehensive Cr(VI)-free product range
- ✔ Choice of surface coatings:
  thick layer passivation, and zinc laminated coating
- ✔ Fasteners with adjustable friction coefficient
  windows
- ✔ Technical consulting



49406.090.2017.000
P7/DE1/5/0817