Electroplated coatings of zinc / zinc-alloy

Technical information

Electrolytic zinc plating is a surface treatment process in which steel components are coated with metallic zinc to protect against corrosion. The zinc coating is deposited from an aqueous solution consisting of zinc salts (electrolyte), as zinc ions. These zinc ions are reduced to metallic zinc on the component surface by means of an external power source. At Midtjydsk Fornikling electrolytic zinc plating is carried out both for large objects suspended from a rack (rack plating) and for small components, which are treated in barrel installations (barrel plating).

The zinc coating surface is then chromated / passivated to improve the corrosion resistance and maintains the appearance of the zinc surface for an extended period of time. This extension will depend on the type of chromating / passivating. In the following referred to as passivating.

Zinc-alloy

There are also zinc-alloy plating processes available in the market. At Midtjydsk Fornikling we offer a zinc-iron coating with subsequent passivating and – if the customer wishes – an additional final sealing coat. Compared to ordinary electrolytic zinc plating the zinc-iron deposit results in a significant improvement in corrosion protection.

The EU Directives

The EU legislation prohibits the application of chrome-VI in certain products. The particular directives including later changes are:

1. The European Parliament and the Council directive 2002/95/EF dated 27.01.2003 (The ROHS directive) concerning the occurrence of chrome-VI used in electric and electronic products become effective 01.07.2006.
2. The European Parliament and the Council directive 2000/53/EF dated 18.09.2000 (The ELV directive) concerning the occurrence of chrome-VI used in automobiles become effective 01.07.2007 / 01.07.2008.

Midtjydsk Fornikling offers alternatives to treatments containing chrome-VI which comply with the requirements in the above mentioned directives. See figure 1 for an overview of our alternatives.

Application data on zinc (Zn) and zinc coatings

Melting point: 419º C
Molar weight: 65,4 g/molar
Volume weight: 7,1 g/cm^3 at 20ºC

Maximum application temperature for zinc coatings on steel is 200º C

Specification of electro zinc plating

Ordering and specification of electro zinc plating is carried out according to the standards DS/EN ISO 2081 or DIN 50961 which consist of four types of zinc coating thickness on 5, 8, 12 and 25 µm respectively.

DS/EN ISO 2081 states as a requirement that the above mentioned coating thickness must be adhered to.

DIN 50931 states that the zinc coating thicknesses are guidelines and make demands on the corrosion protection of the zinc coating and the ability to offer protection against red rust attack. This is tested by use of salt fog testing according to DIN 50012 or by Kesternich-testing according to DIN 50018-SFW 2,0 S. The length of the testing depends on the zinc coating thickness and passivation type.

The requirements on zinc coating thickness and on protection against red rust, as tested by use of accelerated corrosion testing, must be applied only to the significant surfaces of the components. That is, unless agreed otherwise, the part of the component that can come into contact with a ball which has a diameter of 20 mm. The requirements only encompass the outer surfaces of the components and not the inner surfaces of pipes and not inner voids that are electrically shielded during electroplating and, therefore, do not receive a zinc coat.

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At Midtjydsk Fornikling the electro zinc plating process is always finished with a passivate film. If desired a subsequent topcoat / sealer can be applied to further improve the protection and durability. Figure 2 indicates the minimum requirements of the standards covering passivate protection against white rust formation (white rust = zinc corrosion products) by use of salt fog testing. We refer to the standards concerned for a more detailed description of the passivate requirement and the testing procedure. Figure 3 refers to the results retrieved at Midtjydsk Fornikling.

As an example the specification of an electro zinc plating with minimum 12 µm and with a yellow chromating on an iron (steel) component: DIN 50961 – Fe/Zn 12 C or DS/EN ISO 2081 – Fe/Zn 12/C.

When ordering it should, furthermore, be stated if the electroplating subsequently is to be powder coated or painted.

Corrosion of zinc coatings
Zinc coatings are well-known for their good corrosion protection characteristics. Zinc is a base metal compared to steel (a sacrificial coating) and in normal use is capable of protecting small areas of exposed steel (up to approx. 5 mm in diameter). This is important for e.g. bolts, screws and fittings, where small areas of damages to the zinc coatings easily occur. The principle is known as cathodic protection.

In for instance seawater uncoated surfaces can by the use of attached zinc be cathodically protected, with the protected area being significantly larger than the zinc. This is exploited in e.g. shipping, where anti-corrosion blocks of zinc are mounted under the water line on the outside of steel ship hulls.
Repeated influences from water and dampness will over time corrode the passivate films, after which the zinc surface will corrode at a steady rate depending on the corrosion environment, which is specified in figure 4.

The zinc coating will start to change appearance when the passivate surface begins to corrode and the zinc surface is exposed to corrosion. The surface gets a grey and possibly a somewhat white stained appearance caused by zinc corrosion products. In figure 5 estimations of the durability of the most common chromate types tested in normal environmental circumstances are presented.

The stated durability assumes that the chromate layers are not subjected to mechanical influence, which can lead to faster corrosion.

We offer
Midtjydsk Fornikling offers all passivate types and a wide range of topcoat / sealers.

Rack plating:
3 rack plating lines, max length of components:
3100 x 1500 x 750 mm
3750 x 1300 x 300 mm

Barrel plating: 3 barrel plating lines

Receive a no-obligation consultant visit or call for more information.

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Chromating/ passivating	Chrome type[3)]	Alternatives to Cr^{6+}
Zinc		
Blue passivating	Cr^{3+}	-
Yellow chromating	Cr^{6+}	Blue, however, not the same durability Silver passivate , the same or longer durability Yellow passivate , the same durability
Yellow passivating	Cr^{3+}	-
Black passivating	Cr^{3+}	-
Silver passivating	Cr^{3+}	-
Zinc-iron		
Yellow chromating	Cr^{6+}	Zinc-iron black passivate Silver passivate
Black chromating	Cr^{6+}	Zinc-iron black passivate
Black passivating	Cr^{3+}	-
Silver passivating	Cr^{3+}	-

Figure 1: *MFF's alternatives to chrome-VI pursuant to the RoHS and ELV directives*

[3)] Cr^{6+}: Hexavalent chrome, also called chrome-VI
Cr^{3+}: Trivalent chrome, also called chrome-III
The chrome type indicates which valency the chrome has in a specific chromate / passivation. Chrome in oxidation state VI is the form of chrome that is forbidden in certain products.

Requirements from standards

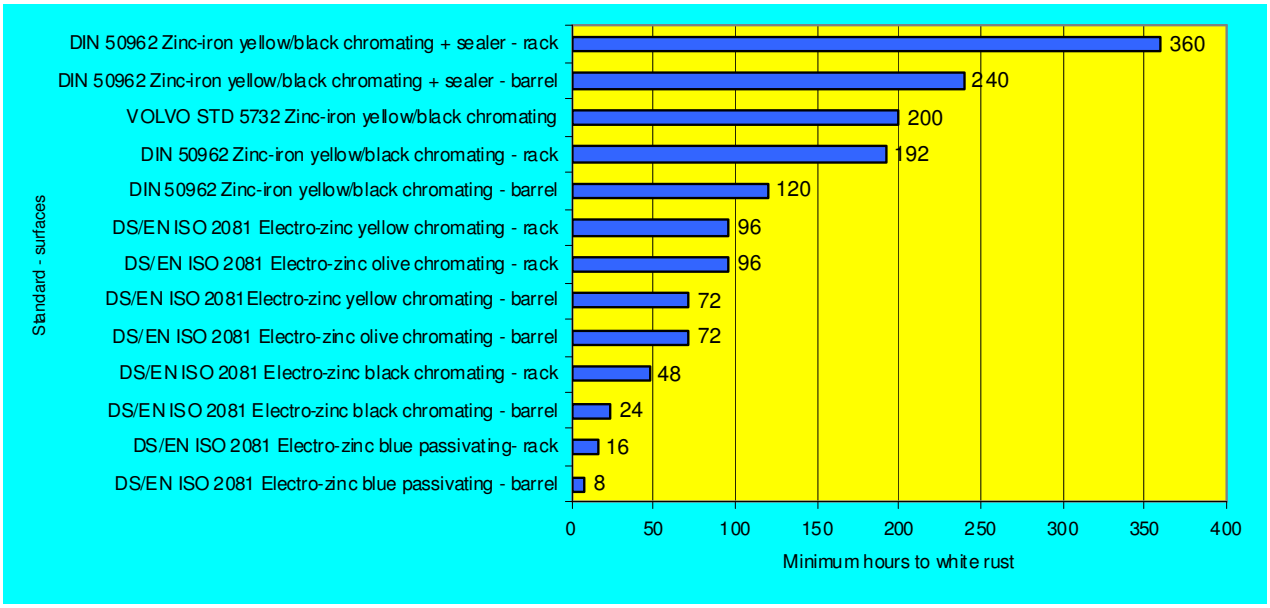

Figure 2: *Minimum testing time before occurrence of white rust formation during salt fog exposure according to standards.*

Midtjydsk Forniklings surface treatments fully match the requirements stated in the standards (apparent in figure 2). By comparison figure 3 states what actual testing times Midtjydsk Fornikling surfaces as a minimum satisfy.

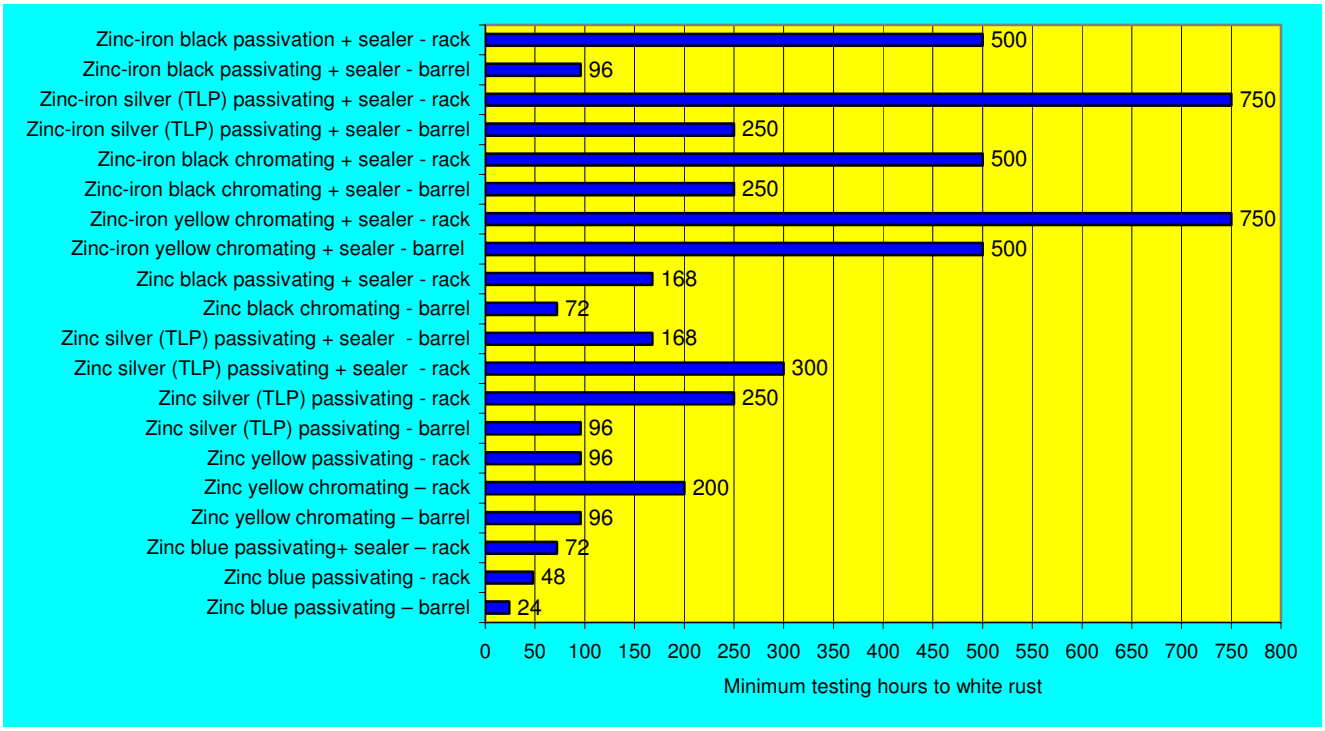

Figure 3: *Actual testing time before occurrence of white rust formation during salt fog exposure of MFF's surfaces. Passivating is chrome-VI free while chromating contains chrome-VI.*

Corr.-Class	Aggressiveness of the environment	Examples of environments	Corrosion rate of zinc		Guiding durability of chromating	
			Average	(min - max)	A/B	C
0	None	Indoor, dry (<60% RF)	0	(0-0)um/year	>10 years	>10 years
1	Insignificant	Indoor, unheated, well-ventilated	0,5	(0-1)um/year	1/2 – 1 year	3 – 5 years
2	Medium	Outdoor in land atmosphere	1,5	(1-2)um/year	3 - 6 months	2 – 3 years
3	High	In city- and industry atmosphere	3	(2-5)um/year	1 - 3 months	1 - 2 years

Figure 4: *Corrosion rates for zinc coatings and durability of the chromating layer on zinc in corrosion class 0-3 (DS/R 454) according to Danish circumstances.*