

# Surface treatments

Table of contents  
Catalogue 7 chapter 6

	Page
• Corrosion	601
• Surface treatments	601
• Surface treatment layers and thread tolerances	602
• Surface treatment codes	603
• Zinc-iron	604
• Anodizing	605
• Geomet® (Dacromet®)	605
• Delta-P+S	605
• Delta-Seal	605
• Delta-Protect	605
• Ferroblack	606
• Phosphatising	606
• Copperplating, Silverplating, Tin-coating	606
• Copper, Nickel, Tin	607
• Chromating	607
• Mechanical zincplating	607
• MW 4-20	607
• Sandbond-Z	607
• Black-finishing	607
• Hot dip galvanizing	608
• Hydrogen embrittlement	608
• Electroplated coatings of zinc	608
• Zinc-Nickel	608
• Nycote®	609
• gleitmo®	609
• Approximate lifetime in different environments	610
• Environment-/Corrosivity classes	611
• Safety classes	611
• Corrosion protection	611

# Corrosion

Very large amounts are lost every year due to corrosion. Therefore, there is reason in taking a closer look at the causes and try to eliminate the risk of corrosion as effective as possible. To choose the right material and surface finishing for the screw/rivet is essential for the strength and safety in a corrosive environment.

## What is corrosion?

Steel corrodes, copper becomes coated with verdigris and other metals are broken down in similar ways. Exceptions are the most noble metals, for example gold. Corrosion takes place when the material reacts with the environment and creates corrosion products. Oxygen and moisture are necessary components for the creation of corrosion products. Salts, particles of dirt and dust are examples that increase the pace of the corrosion process. In practice all corrosion in normal environment is galvanic corrosion.

## Galvanic corrosion

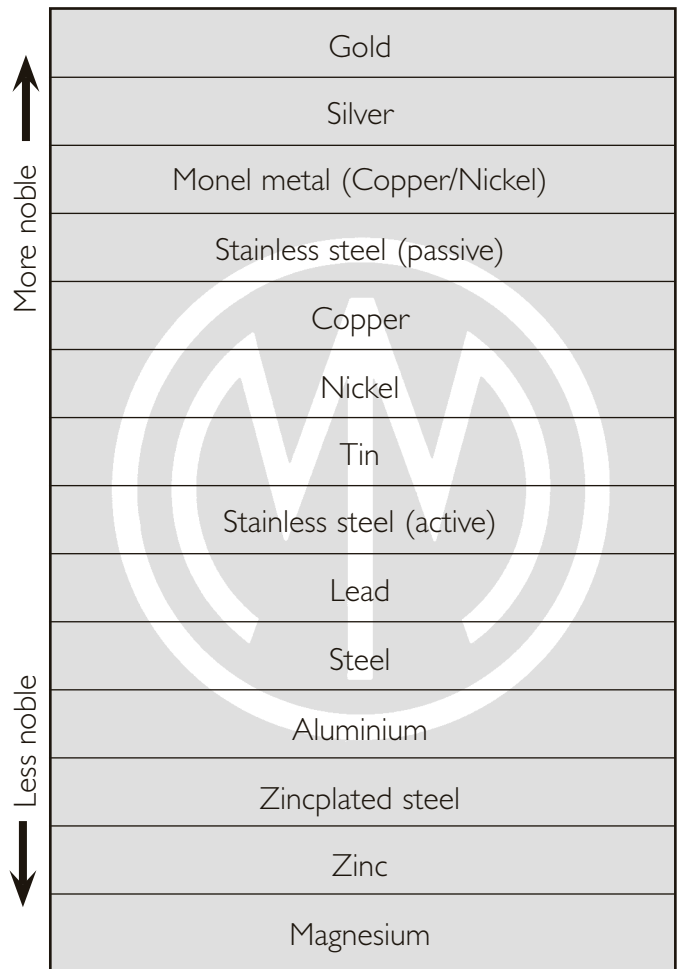
Of two jointed metals exposed to couple action, the one with the lowest potential is the one that corrodes and dissolves. It acts as anode - sacrificial anode. The other metal, the cathode, gets protected at the corresponding level, which prevents it from corroding.

Therefore, in a design you ought not to join materials with electrode potentials that differ too much. This is not very important in dry air, but if the air is humid and particularly if the materials are exposed to water it is preferable to use only one material in a design.

If the anode area is small in comparison to the cathode area, i.e. if the metal lower in the electrode potential chain has a small area compared to the metal higher up, in the chain the damages will be especially great. When creating joints of different metals attached to each other, it is preferable to arrange them so that the less noble metal has a larger free area than the nobler one. Consequently the fastener should be nobler than the plate.

If, for example, a small steel screw is assembled in a large copper sheet the corrosion pace is increased by the screw. A small copper screw in a large steel sheet lives longer.

## Galvanic series for different metals in seawater at a temperature of 20°C.



↑ More noble	Gold
	Silver
	Monel metal (Copper/Nickel)
	Stainless steel (passive)
	Copper
	Nickel
	Tin
	Stainless steel (active)
	Lead
	Steel
↓ Less noble	Aluminium
	Zincplated steel
	Zinc
	Magnesium

Always choose a screw/rivet of a nobler material than the material it should be jointed with. The screw/rivet then has the smaller area and the risk of damages due to corrosion is reduced. Try to use a screw/rivet that has as small electrode potential difference as possible compared to the surrounding material. If possible, use the same material for the screw/rivet as used in the surrounding material.

## Surface treatments

*Mattssons's has the possibility to offer the most existing surface treatments. Some examples are given below.*

Anodizing  
Anti-friction coating  
Antique appearance  
Blasting  
Brassplating  
Chemical tin  
Chromating  
Chromating blue, yellow, green and black  
Copperplating  
Delta  
Duplex nickelplating  
Electrolytical tin  
Ferlite coating  
Ferrolblack  
Galvaspin  
Geomet

Gold coating  
Hot dip galvanizing  
Lacquering  
Leading - Pollution load - not performed by Mattssons  
Mechanical zincplating  
MW 4-20  
Nedox coating  
Nickelplating chemical  
Nickelplating electrolytic  
Nickelplating FNB  
Nikrolite coating  
Nilite coating  
Oxidation  
Phosphatising  
Pickling  
Polishing

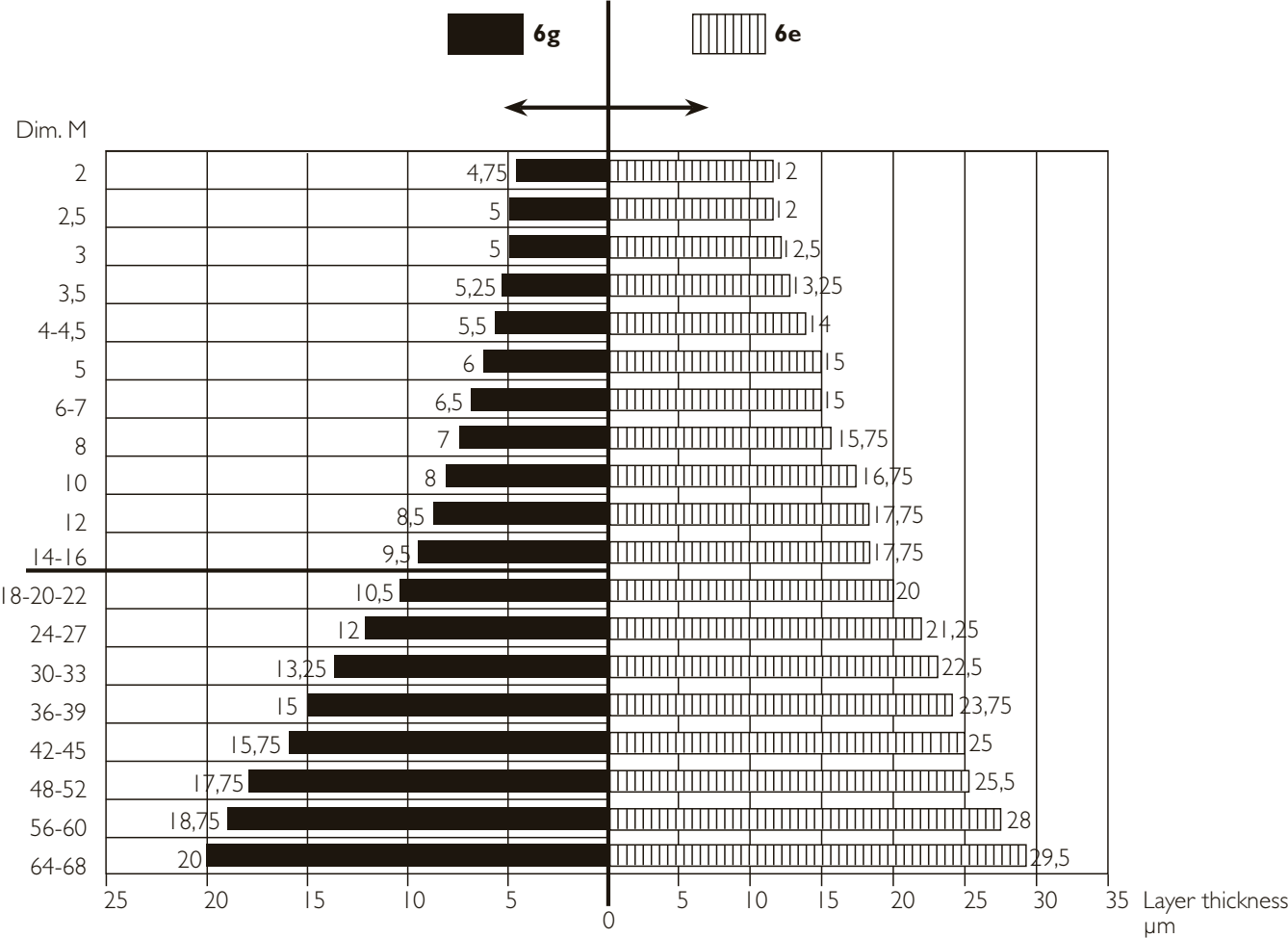
Post-sealing  
Ruspert  
Sandbond-z-coating  
Sherardizing  
Silverplating  
Teflite coating  
Teflon coating  
Termosil  
Thread locking  
Thread sealing  
Tufram coating  
Waxing  
Ytox coating  
Zinc-iron coating  
Zinc-nickel coating  
Zincplating FZB

# Surface treatment layers and thread tolerances

The automotive and electronic industry often demands a thicker surface treatment layer on small dimensions. That makes it important to choose the right thread tolerance at manufacturing to be able to add the desired surface treatment layer according to specification. Mattssons controls its purchases towards 6e thread to be able to surface with the right layer thickness. Below follow examples of possible layer thicknesses on a M10 screw.

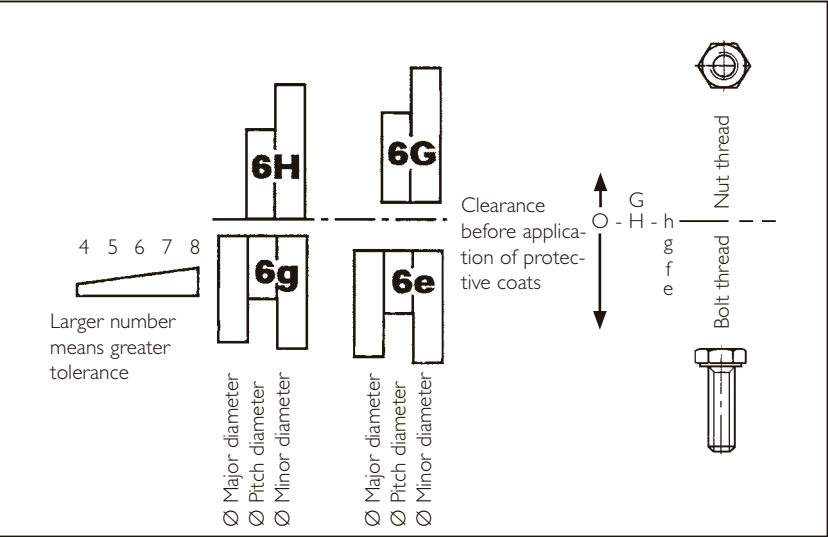
Tolerance 6e gives space for 16,75 $\mu\text{m}$
Tolerance 6g gives space for 8 $\mu\text{m}$
Tolerance 6h gives space for 0 $\mu\text{m}$

Table 166 Layer thickness for various dimensions



Source: Dörken. Metric standard threads according to DIN 13 thread tolerance 6g and 6e.

Table 226 Tolerance fields of screw and nut threads



# Surface treatment codes

Example of a hexagon screw M8x30 DIN 933 8.8 with galvanic zincplating surface treatment, layer thickness 5 µm and yellow chromated.

According to ISO 4042: M6S DIN 933 M8x30-8.8 - **A2 L**.

According to SS 3191: M6S DIN 933 M8x30-8.8 - **Fe/Zn 5 c2**.

M6S DIN 933 M8x30-8.8 - A 2 L

**Table 57**

Code	Coating metal
A	Zinc (Zn)
AM	Mechanical zincplating
AI	Sandbond-Z
B	Cadmium (Cd)
C	Copper (Cu)
D	Brass (CuZn)
E	Nickel (Ni)
ED	Duplex nickelplating
EN	Nedox
EI	Chemical nickelplating
E2	Teflote (PTFE/NiP)
E3	Nilite
E4	Ferlite
F	Nickel-Chrome (NiCr)
G	Copper-Nickel (CuNi)
H	Copper-Nickel-Chrome (CuNiCr)
J	Tin (Sn)
JE	Nickel-Tin (NiSn)
JI	Chemical tin
K	Copper-Tin (CuSn)
L	Silver (Ag)
N	Copper-Silver (CuAg)
P	Zinc-Nickel (ZnNi)
R	Zinc-Iron (ZnFe)
0	Untreated
IA	Delta-Seal
IB	Delta-Protect
IC	Delta P+S
	(Delta-Protect + Delta-Seal)
2A	Iron phosphatising
2B	Manganese phosphatising
2C	Zinc phosphatising
3	Oxidation
3A	Antique appearance
4	MW 4-20
4A	Geomet 32I
4B	Geomet 500
4C	Delta Zinc/Zincotech
5	Lacquering
6A	Hot dip galvanizing TZN 45
6B	Hot dip galvanizing TZN 65
6C	Hot dip galvanizing TZN 25
6E	Hot dip galvanizing TZN 55
7	Anodizing
8	Anodizing
8T	Tufram
8Y	Ytox
9	Gold coating
10	Ferrobblack
11	Chrome (Cr)
12	Hard chrome (Cr)
13	Nikrolite

Code	Layer thickness
1	3 µm
2	5 µm / 2+3 µm
3	8 µm / 3+5 µm
4	12 µm / 4+8 µm
5	15 µm / 5+10 µm
6	20 µm / 8+12 µm
7	25 µm / 10+15 µm
8	30 µm / 12+18 µm
9	10 µm / 4+6 µm
20	8 µm

Code	Brightness/Chromating/Colour
A	Bright, dull
B	Blue, dull
C	Yellow, dull
D	Green, dull
E	Bright, semi-bright
F	Blue, semi-bright
G	Yellow, semi-bright
H	Green, semi-bright
J	Bright, bright
K	Blue, bright
L	Yellow, bright
M	Green, bright
N	Bright, high-bright
P	Blue, yellow or green with optional brightness
R	Brown-black-black, dull
S	Brown-black-black, semi-bright
T	Brown-black-black, bright
0	Copper bright
1A	Silver (lacquer)
2A	White (lacquer)
3A	Red (lacquer)
4A	Grey (lacquer)
5A	Black (lacquer)
6A	Brown (lacquer)
7A	Blue (lacquer)
8A	Natural (lacquer)
9A	Yellow (lacquer)
MA	Green (lacquer)

Code	Treatments
A	Oiling
B	Pickling
BL	Blasting
GR	Thread cleaning
H	Hanging parts
PO	Polishing
V	Hydrogen embrittlement
VH	Hydrogen embrittlement + hanging parts

Code	Treatments
A	Aquares
AI	Post-sealing
B	Bota locking
C	Corrosil (black)
DC	Delta-Coll, transparent
DS	Delta-Coll, black
D1	Drilloc 201
D2	Driseal
D3	Drilloc 218 (green)
D5	Driseal 516
E	Eslok
G	Glide lacquer
G1	Gleitmo 603 (standard)
G2	Gleitmo 605
G3	Gleitmo 610
G4	Gleitmo 925
G5	Gleitmo 627
NI	Nyseal
N2	Nytemp
NP	Nycote P (painting)
NU	Nycote U (universal)
NW	Nycote W (welding)
PI	Precote 5
P2	Precote 30
P3	Precote 80
P4	Precote 85
PT	Teflon (PTFE)
T1	Tuflok 1 (soft)
T2	Tuflok 2 (standard)
T3	Tuflok 3 (hard)

Code	Treatments
I	Induction-hardening
K2	Carbonitriding DC=0,2
KS	Carbonitriding DC=0,5
N	Nitro carburettling
S	Sorting/Zero defect, 0-defect
SE	Tough-hardening
SÄ	Case-hardening

Dimension	Layer thickness
- M8	5
M10 - M16	8
M18 - M22	10
M24 - M33	12
M36 - M60	15
M64 -	20

= Standard ISO 4042.

# Zinc-iron

Electroplated zinc coat is one of our most common coatings. It has many advantages:

- It is anodic in relation to steel.
- It has a low price.
- The process is simple.

The corrosion protection is in many cases sufficient, but does not meet the demands set by the motor industry today, in particular when the coat is black chromated. Also, the chromate coats used on unalloyed zinc-coats are broken down when heated above 70 °C. This temperature is for instance exceeded in and around the engine of a car.

This has pushed the development of processes for precipitation of alloyed zinc-coatings forward. These processes were first developed for coating of strip steel, since it is easier to maintain unvarying precipitation conditions and get a uniform coat when coating strip steel. These processes have later on been developed to be used when coating hanging metals or coating in drum. Every process has its advantages and disadvantages, they all have the common disadvantage compared to regular electro-coating, that they require a more extensive control of the process.

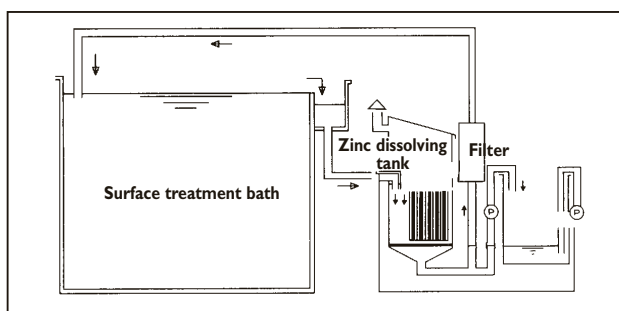
Considering the demands made by our customers for coating properties of alloyed zinc-coats, we have chosen zinc-iron coats. This greatly improves the corrosion protection, which is made clear by the table below.

CHROMATE TYPE	TEMPERATURE AFTER CHROMATING	IRON ZINC ALKALINE WHITE/RED RUST		ALK. ZINC CYANIDE FREE WHITE/RED RUST	
YELLOW	ROOM TEMP.	500	2000	200	900
BLACK	ROOM TEMP.	600	2000	48	800
YELLOW	100°C 3 HRS	500	2000	24	600
BLACK	100°C 3 HRS	600	2000	24	600

The corrosion protection in neutral salt spray test for 8 µm coats. Number of hours until the first corrosion is observed.

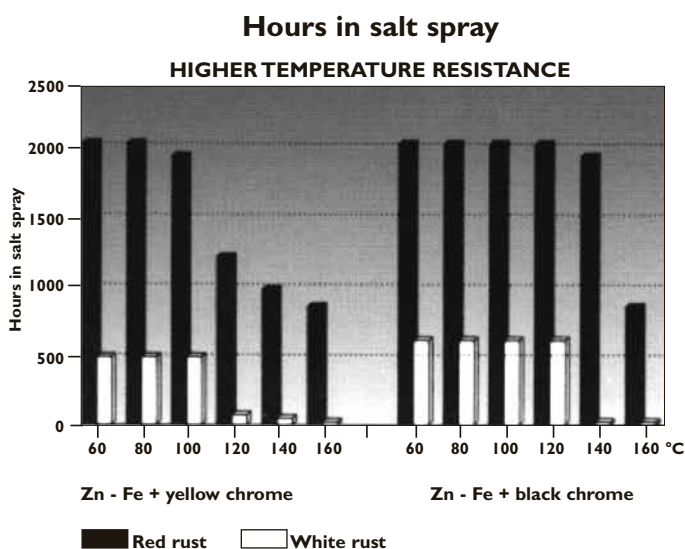
When the coating for yellow iridescent chromating is exposed to temperatures above 100 °C and 140 °C for black iridescent chromating, you get a break down of the chromate coat even with zinc-iron coats.

The coating process is a bit different from ordinary zincplating. Anode steel plates are used, but no iron is dissolved in the strongly alcalic solution, and the iron is added through a special chemical. Zinc is added to the solution through chemical dissolving in a tub apart from the coating tub. The solution is continuously pumped through the dissolver. The bath is continuously filtered. It is important to stay within the given temperature limits and percentage of iron as it affects the iron content, and consequently also the corrosion resistance of the layer.

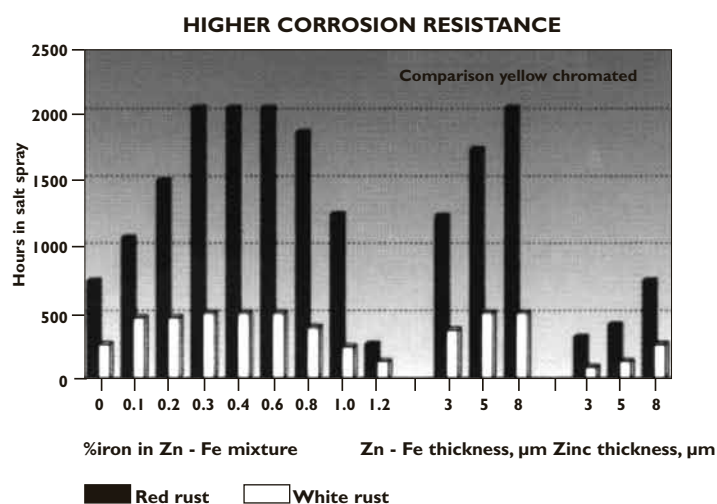


Environmental aspects: Please see page 608.

Environmental effects: Please see page 608.



These diagrams show that hydrogen embrittlement relief must take place before the chromating or it will break the chromate coat down.



The need for hydrogen embrittlement relief is the same for hydrogen-sensitive steel as for ordinary zincplating.

# Anodizing

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Anodizing is the most common surface treatment of aluminium. By anodizing the surface can become natural, black, yellow, blue, red or green.

## Geomet® (Dacromet®)

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Geomet is a coating consisting of zinc flakes and some other metals in a binding agent of chromate.

The binding agent is conductive, and the coating is anodic in relation to steel. By the embedding of the zinc in chromate, the corrosion attacks on the Geomet layer are very slow compared to pure zinc. The coating is evenly distributed without weak spots on shadowed parts. It is metallic grey with a satin-etched surface.

Geomet preserves its corrosion protection ability in temperatures up to 250°C. The chromate layer of the zinc plating is broken down at 70°C.

We store Geomet 500 which contains Teflon.

Geomet 500 has a friction value of 0,14.

Source: Ferro products.

Anodizing results in:

- A new look when exposed in atmosphere.
- Dirt resistance and an easy cleaned surface, decorative surface and a surface resistant to wear.
- A good base for lacquering, printing and gluing.

### Summary of the advantages:

- Improved corrosion protection!
- No hydrogen embrittlement!
- Withstands high temperatures!
- Is anodic in relation to steel!

Environmental aspects:

The adhesive that contains chromate partly consists of hexavalent chrome, which is to be listed on Volvo's black list.

Environmental effects:

Allergy arousing, bio accumulating. Hexavalent as well as trivalent chrome is poisonous. The hexavalent chrome is very acute poisonous.

Geomet, which is free from hexavalent chromium, replaces Dacromet.

## Delta-P+S

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Delta-Protect and Delta-Seal can be applied separately or in combination, which gives additional characteristics. The two layers are together called Delta-P+S. Delta-P+S gives an optimal corrosion protection safety in extreme conditions, and can be adjusted to suit the needs of particular coating for several different branches.

Environmental aspects:

Contains organic solvents that vaporise when hardened.

Environmental effects:

Contributes to the creation of photochemical oxide, for example ground level ozone and is free from 6-worth chrome.

## Delta-Seal

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*The organic topcoat*

Delta-Seal has been developed as a topcoat together with Delta-Protect. Its main qualities are:

- Exceptional adherence.
- No heavy metals.
- High hardness together with great flexibility.
- Very low friction values.
- Electric isolation effect.
- Excellent chemical resistance.

coat of stainless steel- and acid proof steel materials, as a protection against galvanic corrosion between, for example, stainless steel and aluminium. Thanks to the low hardening temperature - approximately 200°C, the characteristics of the metal parts are not affected.

Environmental aspects:

Contains organic solvents that vaporise when hardened.

Environmental effects:

Contributes to the creation of photochemical oxide, for example ground level ozone and is free from 6-worth chrome.

Delta-Seal is very suitable as a powerful friction reducing

## Delta-Protect (KL 100)

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*The inorganic basecoat*

Delta-Protect consists of zinc and aluminium particles that are kept together by an inorganic binder. This creates an effective corrosion barrier even for very thin layers. Already at 8-10 µm when performing a salt spray test according to DIN 50021 SS you achieve a resistance that exceeds 480 hours before the original metal starts to corrode.

Delta-Protect is added in liquid form and pierce into the smallest cracks. In this way weldings are protected just as effective as plane metal surfaces.

During the hardening at approx. 200°C, a chemical reaction is created during approx. 20 min. Then the Delta-Protect creates

a tight compound with the underlying metal. Hardened metal parts are not damaged at this low temperature and the treatment with Delta-Protect means that there is no risk for hydrogen embrittlement. Delta-Protect is generally added in 4-10 µm, in thick layers. The layer thickness can vary and the corrosion protection is adjusted to the demands put in each different case.

Environmental aspects:

Contains organic solvents that evaporate when hardening.

Environmental effects:

Contributes to creation of photochemical oxides, like ground ozone and is free from 6-worth chrome.

Source: YtbehandlingsGruppen.

# Ferroblack

Ferroblack is a black colouring method that can replace black-finishing.

## Phosphatising

Phosphatising is a chemical surface conditioning that is performed on a number of metals and alloys.

### Through phosphatising you get:

- An excellent ground for painting - adherence between the paint film and the metal surface increases considerably and when the paint layer is damaged it counteracts under-corrosion.
- Together with oil, it provides good protection against corrosion, especially suitable for mass articles like screws, bolts etc. Steel and cast iron however does not get a satisfying protection against corrosion through phosphatising. When phosphatising steel surfaces it is common to differ between three main types of coating - zinc, manganese and iron phosphate layers. These generally have different fields of application.

### Zinc phosphatising

Zinc phosphatising is the most common process. The layers become grey and are given a smooth surface that after lacquer gives an excellent protection against corrosion. The layer thickness can vary greatly - from 1 to 30 µm.

### Manganese phosphatising

Manganese phosphatising gives a black-grey layer, usually with rough crystalline. The layers are porous and brittle and also very thick, 20-30 µm. These features make them unsuitable as ground for lacquering but better suitable as lubricant carrier.

Details made from steel which are sensitive to hydrogen embrittlement should not be manganese phosphatised. In these cases zinc phosphatising are more suitable.

### Iron phosphatising

Iron phosphatising gives hard and thin layers, 0,2-0,5 µm. The paint can vary from yellow to grey-blue. The layers have good paint binding characteristics and withstand after covering, amongst other things, bending without cracking. It gives though a lower protection against under-corrosion than the zinc phosphate and is therefore mainly used on products for indoor use, for example, steel furniture.

### Some limitations for phosphatising

Phosphatised steel details can not be heated up to more than 200°C. At higher temperatures the phosphate layers' adherence and protection capacity deteriorate noticeable. Above 300°C they are transformed to pyrophosphate. High-alloy steel, foremost those that either contain more than approximately 12% chrome or two of the so-called carbide formers - chrome, molybdenum, vanadium, and wolfram -, are less suitable to phosphatise.

The corrosion protection for a phosphatised product rubbed with oil is very limited. In outdoor environments rust generally appears within a year. Our phosphatised stock-goods are zinc phosphatised and we can perform manganese phosphatising on request.

Environmental aspects:

The zinc bath does in some cases contain nickel, which is on the National Chemicals Inspectorate's list of substances to limit. Occurrence of phosphates in sewage.

Environmental effects:

Allergy arousing, bio-accumulating and poisonous for organisms living in water:

Contributes to over-manuring if emission is allowed.

## Copperplating, Silverplating, Tin-coating

Technical coatings with different qualities.

Coatings that give good soldering characteristics, conductivity and reflection capability for electricity as well as heat. It is carried out on steel, invar, aluminium, copper/brass and press casted zinc and aluminium.

Field of application: Components for telecommunication, electrical and technical functions.

Environmental aspects:

The copper bath contains cyanide as sequestering agent. Cyanide is on the N.BI-list. Nickel in the surface coating is on the National Chemicals Inspectorate's list of substances to limit.

Environmental effects:

Cyanide is acute poisonous for organisms (living in water).

Allergy arousing, bio accumulating and poisonous for organisms living in water:



## Copper, Nickel, Tin

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Shielding and corrosion protection for the electronic industry.  
8 µm copper + 8 µm nickel + 6-7 µm tin decrease the risk for nickel allergy.

Environmental aspect:

The copper bath contains cyanide as sequestering agent.

Cyanide is on the N.B!-list.

Nickel in the surface coating is on the National Chemicals Inspectorate's list of substances to limit.

Environmental effects:

Cyanide is acute poisonous for organisms (living in water).  
Allergy arousing, bio accumulating and poisonous for organisms living in water.

## Chromating

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Corrosion protection and a good base for lacquering.

Yellow and colourless chromating is a surface treatment that gives a layer with improved corrosion protection and at the same time a good base for lacquering. It is also used on components that demand electrical conductivity.

It is carried out on die-cast or drawn aluminium.

Fields of application: Products for the vehicle, airplane and electronic industry.

Source: YtbehandlingsGruppen.

Environmental aspects:

Chromating may, depending on colour and method, involve coating with sexivalent chrome, which is prohibited according to RoHs directives. The chromating bath may also contain cyanide that is on the N.B!-list.

Environmental effects:

Allergy arousing, bio accumulating. Sexivalent as well as tri-valent chrome is poisonous. The sexivalent chrome is most acute poisonous. Cyanide is acute poisonous for organisms (living in water).

## Mechanical zincplating

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In a bath with glass balls and zinc flakes the zinc is punched into the material. The surface becomes tough and receives a dull lustrous appearance. No risk of embrittlement.

Environmental aspects:

Chromating may, depending on colour and method, involve coating with sexivalent chrome, which is prohibited according to RoHs directives.

Environmental effects:

Allergy arousing, bio accumulating. Sexivalent as well as tri-valent chrome is poisonous. The sexivalent chrome is very acute poisonous.

## MW 4-20

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The surface treatment is a zinc-nickel based process.

MW 4-20 gives an excellent protection against corrosion, and is approved for corrosion class C4 in accordance with SS-EN ISO 12944-2. Other alternatives that are approved for this class are hot zinc coating and stainless steel.

MW 4-20 is very resistant against surface deterioration.

MW 4-20 counteracts galvanic corrosion related to stainless steel and aluminum.

Environmental aspect:

The surface treatment is free from hexavalent chromium and meets the directives of RoHS.

Environmental effects:

Bio-accumulating.

## Sandbond-Z

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Better protection against corrosion than a traditional zincification. There is no risk for hydrogen embrittlement.

Sandbond-Z is a coating that consists of nickel and zincification. It is carried out in three steps. Firstly, the article is provided with a nickel coating, then it is hardened and finally the zincification is carried out.

Environmental aspects:

Nickel in surface treatments are found in to the Swedish National Chemical Inspectorate's restricted list.

Environmental effects:

Allergy arousing, bio accumulating. Trivalent chrome is poisonous.

## Black-finishing

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Black-finishing or metal colouring gives a certain decorative effect along with low reflection. The oxide layer thickness can vary from 0,6 to 1,2 µm.

Environmental aspects:

The process bath is very strongly alkaline.



## Hot dip galvanizing

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Hot dip galvanized products are often used in outdoor environments or in demanding indoor environments. Hot dip galvanizing gives a long corrosion protection for a relatively low price. Hot dip galvanized screws in property class 8.8 are available from stock. Higher strengths should not be hot dip galvanized due to the annealing effect and risk for embrittlement. This means that the strength decreases and the steel loses its tenacity. Here follow some screws that should not be hot dip galvanized.

- Screws with inner key grips.
  - Cross-slotted screw.
  - Socket head cap screw.
  - Sixpoint socket grip.
- Case-hardened screws due to decreased surface hardness.

Environmental aspects:

Emissions of flux smoke, which amongst other things contains zinc chloride.

Environmental effects:

Zinc chloride is poisonous for humans.

## Hydrogen embrittlement

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The harder a detail is, the more sensitive it becomes for hydrogen absorption in connection with an electrolytic treatment. Details with hardness above HRC 31, HV 300, HB 300 or a tensile strength above 1000 N/mm<sup>2</sup> should be baked after electrolytic treatment. Baking is a heat treatment that is performed at a temperature of approximately 200°C.

The corrosion characteristics of the chrome layer is heavily decreased if exposed to temperatures above 70°C. That makes it necessary to perform the chromation after the baking.

When it comes to screws you get a concentration of hydrogen in the transition between stem and head. This shows as an indication of fracture which leads to the screw's head coming loose.

We do not recommend electrolytic treatments on property class 10.9 or above. This is due to that baking cannot completely guarantee embrittlement from arising.

## Zinc (coatings of zinc)

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Decorative appearance and corrosion protection in one.

Corrosion protective surface treatments that can be coated with glossy-, yellow-, green-, or black chromate. Satin-zinc has a decorative tarnish similar to aluminium. It is performed on steel and zinc.

Areas of application: Interior design- and consumer products which require a decorative appearance and protection against corrosion.

Environmental aspects:

Chromating may, depending on colour and method, involve coating with sexivalent chrome, which is prohibited according to RoHs directives.

Environmental effects:

Allergenic, bio accumulating. Sexivalent as well as trivalent chrome are poisonous. The sexivalent chrome is very acute poisonous. The alternative with trivalent chrome is available for all colours except green.

## Zinc-Nickel

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Galvanic bath with zinc-nickel.

Zinc-nickel gives a significantly better corrosion protection than zinc only.

Salt spray chamber tests show that zinc-nickel lasts twice the time of zinc-iron. The proportion of nickel makes the coating harder and therefore resistant against surface damage. The combination counteracts galvanic corrosion in connection with stainless steel and aluminium. Can be coated with transparent (=grey/blue) or black passivation.

Environmental aspects:

Chromating may, depending on colour and method, involve coating with sexivalent chrome, which is prohibited according to RoHs directives.

Environmental effects:

Bio accumulating. Sexivalent as well as trivalent chrome are poisonous. The sexivalent chrome is very acute poisonous, but is in this treatment in a fixed form.

# Nycote®-Type P masking

## Simplifies the lacquering process

NYCOTE®- type P is an optimised masking protection when lacquering. The different parts of the lacquering process can therefore be performed completely without any consideration to threads and other details that have to be

protected against paint, a very competitive alternative to tape, plugs, cover caps etc. Further advantages are that NYCOTE® treated details preserve their electrical conductivity, and NYCOTE® is also a good environmental choice.

# Nycote®-Type W welding sparks protection

A well-known and repeating problem when welding around bolts, nuts and other fasteners is the welding sparks. The welding particles often cause problems when they stick on threads etc.

Now NYCOTE®- type W is available, a method that in an easy way prevents the sparks from sticking onto, for example, threads.

# gleitmo® Protection wax

Protection waxes are designed to, guarantee that the demands on friction are accomplished when assembling joint reinforcements. To give the treated articles an aesthetically appealing look, to contribute to protecting the threaded articles against corrosion and contribute lower the free amount of hexavalent chrome in some coatings. Protection waxes are mainly suitable for application on bulk goods like screws and nuts. Avoid long term repeated contact with the skin.

For each particular protection wax there is a recommended application.

**See facts about different types of gleitmo® protection waxes below.**

### Product description:

**gleitmo 603** is an antifriction film for coating mass-produced parts. Dispersion of high molecular polymers in water. The antifriction film, which remains after application, adheres very well to the widest variety of surfaces and forms a colourless and absolutely non-slip film.

### Application areas:

Coating of mass-produced parts, e.g. nuts and bolts for the car industry with a friction coefficient between 0,12 and 0,16.

### Product description:

**gleitmo 605** is an antifriction film for coating screws. Forms a dry abrasion resistant, colourless, shiny, lubrication film with a coefficient of friction  $\mu$  of approx. 0,11. Contains an UV-additive for coating control. BAM approval for oxygen armatures and DVGW approval for use in drinking water appliances. The coefficient of friction may be adjusted by the rate of dilution.

### Application areas:

Coating of mass-produced parts, e.g. nuts and bolts. For chipboard screws and plastic screws.

### Product description:

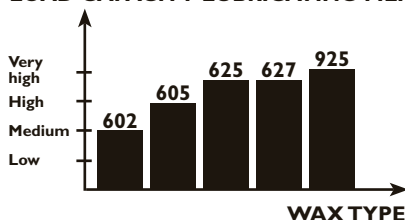
**gleitmo 627** is an antifriction film for coating mass-produced parts. Forms a dry, abrasion resistant, colourless lubricating film with maximum performance ( $\mu$  = approx. 0,08). Completed with a specially selected PTFE additive for the achievement of the best possible lubrication efficiency.

### Application areas:

Stainless steel nuts and bolts, thread-forming and self-tapping screws, rivets and sheet metal screws.

## Comparison between different dry lubrication films

LOAD CAPACITY LUBRICATING FILM

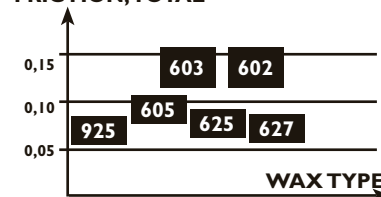


Low For example std chassi screw metric, 8.8, ZnFe.  
Medium For example metallic locking nut.  
High For example threadrolling screw.  
Very high Special demands mainly covered by glide lacquers.

Source: gleitmo Technik AB.

## Expected friction with different dry screw lubrication agent

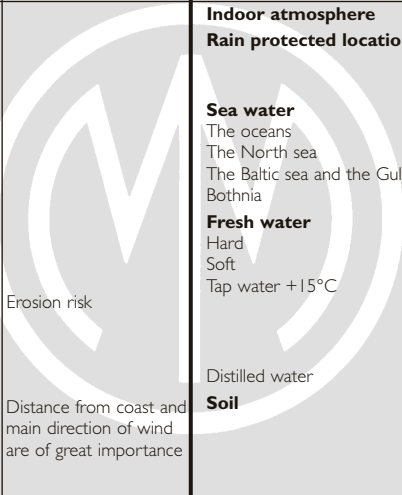
FRICITION, TOTAL



The values assume complete lubrication effect at "normal" materials/surface treatments (for example ZnFe or yellow/blue chromated zinc).

# Approximate lifetime in different environments

Table 59 Guideline values for corrosion of zinc coating

Environment	Approximate corrosion		Comment	Environment	Approximate corrosion		Comment
	Limit value g/m <sup>2</sup> year	µm/year			Limit value g/m <sup>2</sup> year	µm/year	
<b>Industrial atmosphere</b> Europe, US, Sweden (hard) Sweden (normal)	70– 175 15– 70	10 – 25 2 – 10	 Erosion risk Distance from coast and main direction of wind are of great importance	<b>Indoor atmosphere</b> <b>Rain protected location</b>		< 0,5	Approx. half the value of corrosion at free exposure  The water's velocity of flow and the temperature affects heavily  Ditto  Strongly dependent on the water's velocity of flow and the percentage of atmospheric oxygen.  Ditto Strongly dependent on type of soil
<b>City atmosphere</b> Larger cities (Europe, US) Larger cities (Sweden) Suburbs (Europe, US) Smaller cities (Sweden) "Örestad" - area	30– 50 5– 20 15– 30 5– 10 15– 35	4 – 7 1 – 3 2 – 4 0,75 – 1,5 2 – 5		<b>Sea water</b> The oceans The North sea The Baltic sea and the Gulf of Bothnia	70– 630 85– 320 approx. 70	10 – 90 12 – 46 approx. 10	
<b>Countryside atmosphere</b> In temperated climate (Europe) In temperated climate (Sweden) In tropical dry climate In desert climate In polar climate	10– 20 3– 10 < 15 < 7 < 7	1,5 – 3 0,5 – 1,5 < 2 < 1 < 1		<b>Fresh water</b> Hard Soft Tap water +15°C	15– 30 < 140 < 105	2 – 4 < 20 < 15	
<b>Sea atmosphere</b> The oceans West coast, communities West coast, countryside East coast, communities East coast, countryside Near the waterside	7– 50 7– 20 5– 15 7– 20 3– 15 15– 20	1 – 7 1 – 3 0,75 – 2 1 – 3 0,5 – 2 2 – 3		Distilled water <b>Soil</b>	350–1400 30–3500	50 – 200 4 – 500	

Source: SIS Handbook I 48.

## Comparing test Geomet/Hot dip galvanizing

For Geomet there are no present values comparable with table 59. To give you an idea about Geomet's performances, a test was made by Mattssons at three locations in Sweden. One location with sea atmosphere, one with industrial atmosphere and one with countryside atmosphere.

Testing has been made with Scabtest where the samples were sprayed 2 times per week with 5% NaCl-solution. Test material was screw M6S M12X30 and nut M12.

Surface treatment: Hot dip galvanizing (FZV) approx. 60 µm  
Geomet 3 layers (D3) approx. 8 µm  
Geomet 4 layers (D4) approx. 12 µm  
Geomet 5 layers (D5) approx. 15 µm

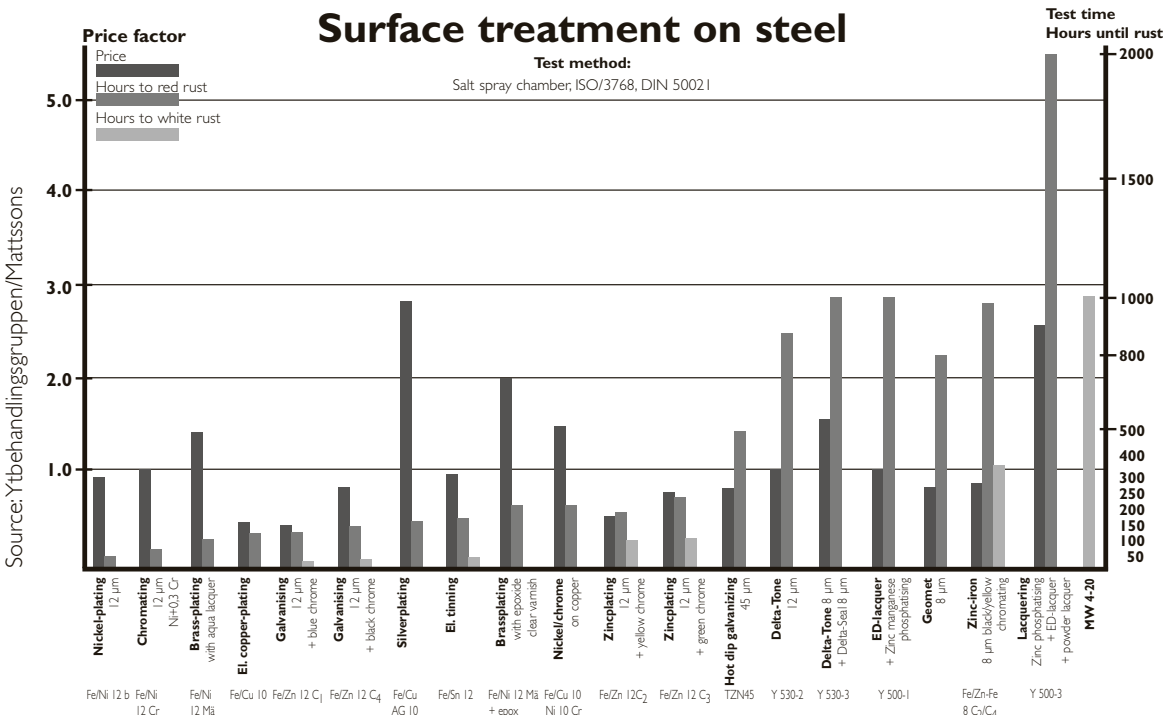
Mounting plates: Aluminium  
Cold-rolled, primed  
Plastics  
Aluminium-Zinc  
Stainless

Testing interval: 26 weeks

Results:  
A=industrial environment B=countryside environment C=sea environment  
0=no rust I=rust

Table 125

	FZV			D3			D4			D5		
	A	B	C	A	B	C	A	B	C	A	B	C
Plastic	I	0	0	0	I	I	0	0	0	0	0	0
Stainless	I	0	I	0	I	I	0	I	I	0	I	I
Aluminium	0	0	0	0	0	0	0	0	0	0	0	0
Aluminium-zinc	0	0	0	0	I	I	0	0	0	0	0	0
Cold-rolled	0	0	0	0	I	0	0	0	0	0	0	0



# Environmental-/Corrosivity categories

Environment class	Corrosivity category	Environmental corrosivity	Environmental aggressiveness	Examples of typical environments	
				Exterior	Interior
M0	C1	Very low	None	-	Heated buildings with clean atmospheres, e.g. offices, shops, schools, hotels.
M1 M2	C2 C2	Low Low	Insignificant/ Moderate	Atmospheres with low level of pollution. Mostly rural areas.	Unheated buildings where condensation may occur, e.g. depots, sports halls.
M3	C3	Medium	Large	Urban and industrial atmospheres, moderate sulfur dioxide pollution. Coastal areas with low salinity.	Production rooms with high humidity and some air pollution, e.g. food-processing plants, laundries, breweries, dairies.
M3	C4	High	Large	Industrial areas and coastal areas with moderate salinity.	Chemical plants, swimming pools, coastal ship- and boatyards.
M4-A	C5-M	Very high - marine	Very large	Industrial areas with high humidity and aggressive atmosphere.	Buildings or areas with almost permanent condensation and with high pollution.
M4-B	C5-I	Very high - industrial	Very large	Coastal and offshore areas with high salinity.	Buildings or areas with almost permanent condensation and with high pollution.

Source: Corrosivity categories acc. to SS-EN ISO 12944-2.

## Acceptable protections against corrosion for fasteners in concrete

Environment-/ Corrosivity classes according to BSK 1:23	Safety class		
	1	2	3
M0/C1	-	-	-
M1/C2	Fe/Zn 12	Fe/Zn 25	Fe/Zn 25
M2/C2	Fe/Zn 25	Fe/Zn 45 <sup>a)</sup> e)	Fe/Zn 45 <sup>a)</sup> e)
M3/C3, C4	Fe/Zn 45 <sup>a)</sup> b)e)	Stainless <sup>c)</sup>	Acid-proof <sup>d)</sup>
M4A+M4B/ C5-M+C5-I	Acid-proof <sup>d)</sup>	Acid-proof <sup>d)</sup>	Acid-proof <sup>d)</sup>

a) Alt. stainless.

b) Not suitable in heavy industrial atmosphere.

c) Stainless quality concern screws made of steel from group A2 according to standard SS-ISO 3506.

d) Acid-proof quality concern screws made of steel from group A4 according to standard SS-ISO 3506.

e) Concern fasteners with dimensions M10 or larger.

## Safety classes

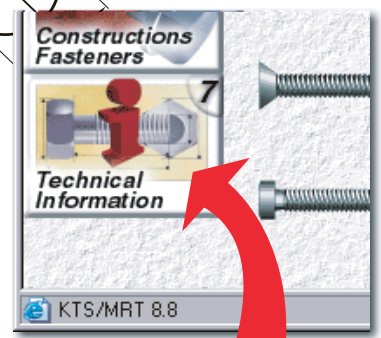
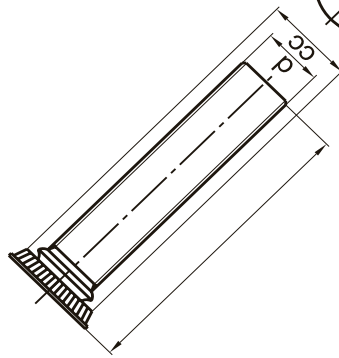
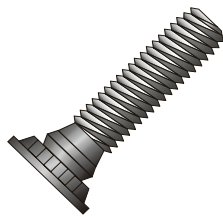
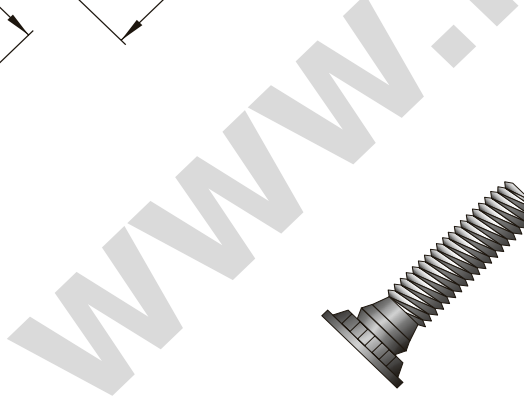
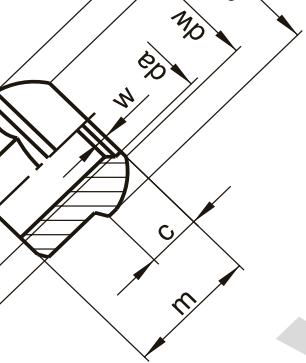
### Examples of safety classes

As an example of assemblage which is related to a certain safety class it could be mentioned:

Safety class 1 Attachments of installations (for example ventilation and cable ducts), external wall panels with small heights (for example cavity walls up to 3,5 m above ground), light-weight false ceilings (for example light-weight sound absorbing material). Joints that are used only to fix a position.

Safety class 2 Attachments of external wall constructions (for example concrete panels and cavity walls), roofs, false ceilings. Bedding of columns or other stabilising construction parts.

Safety class 3 A building's supporting framework, and also the construction parts that are necessary for the stability of the system. Stairs and other construction parts that are parts of the building's emergency exits. Railings on stands and similar constructions in combination with considerable heights, where a large number of persons are located. Beams for bays. Building hoists.



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