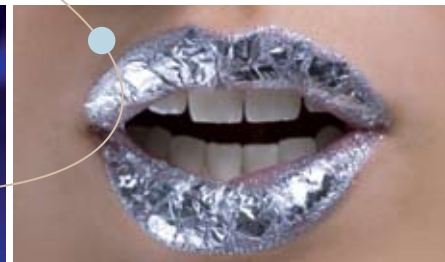


TECHNOLOGY IN MOTION



MACO SURFACE FINISH



Expertise in surface treatment technology



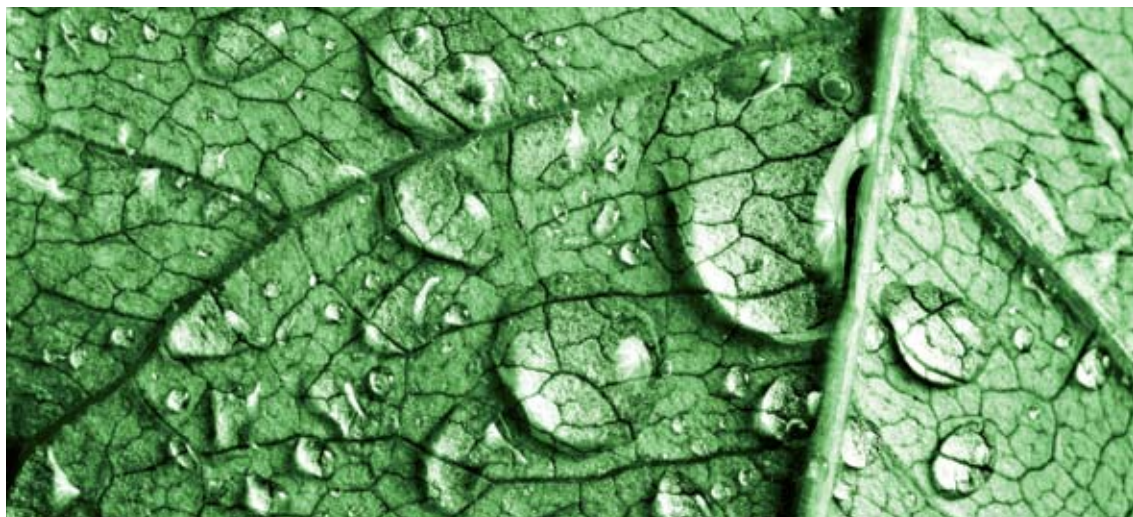
MACO applies a total of eight different in-house surface treatment processes. Apart from having the largest in-house production facilities in the hardware industry (95 percent), MACO also has the widest range of surface treatment processes to be applied to the fittings during the in-house course of production.



The right surface finish for every application



Table of contents



	Page
What is surface protection needed for?	4
What is corrosion?	5
Materials that MACO uses	6
MACO surface treatment technology	7
• MACO Silver-look	8 – 9
• MACO TRICOAT	10 – 11
• Powder-coated	12
MACO RUSTICO- <i>premium</i>	13 – 14
• Anodising	15
• Wet painting	16
• KTL painting (cathodic dip painting)	17
• Vacuum coating	18
• Plastic coating	19
Tested in accordance with EN 13126	20
Tested in accordance with EN 1670	21
Surface-finish quality tests	22
Preservation of fittings component's surface protection	23 – 24



What is surface protection needed for ?



- Protection of the basic material against environmental influences/corrosion
- Aesthetics – decorative design options
- Improvement of technical characteristics (sliding and wear properties etc. . .)



What is corrosion ?



Corrosion is the attack and destruction of metallic materials by means of chemical or electrochemical reactions with agents from the surrounding area.

What are corrosive agents?

Corrosive agents are materials that surround the component, act upon the material and cause the corrosion; e.g. indoor and outdoor air with or without industrial pollution, marine atmosphere, water, condensation, soil or chemicals.

Types of corrosion

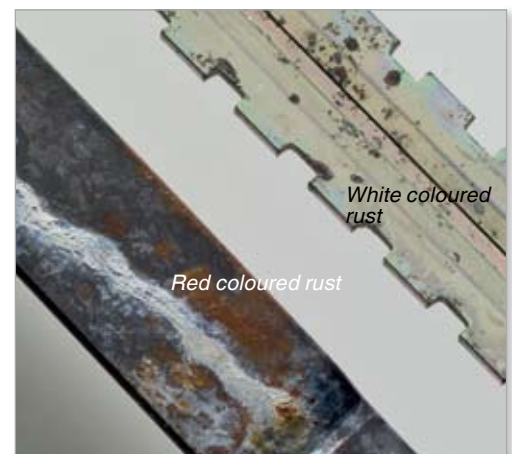
Different types of corrosion develop, depending on the type of material and the corrosive properties of the material. One differentiates between uniform corrosion, shallow pit and pitting corrosion, contact and crevice corrosion, selective corrosion, as well as stress corrosion cracking and corrosion fatigue cracking.

Ferrous material rusting = base metal corrosion (red coloured rust)

As a result of the effect of corrosive agents on ferrous materials, a loose brown-red layer of hydrous iron oxides forms.

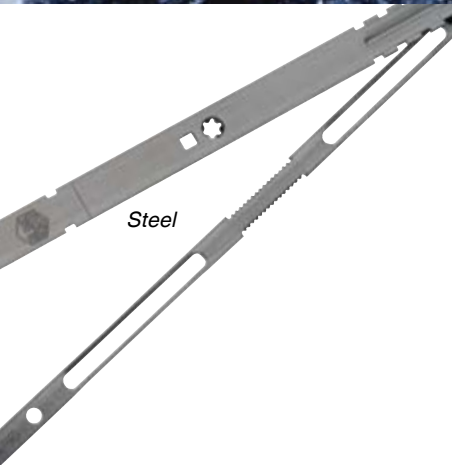
What is metal corrosion coating?

White coloured rust (metal corrosion coating) will form first on zinc-protected steel components. This occurs because zinc is a more base metal than steel and therefore acts as a sacrificial anode. That is to say, as long as zinc is applied in the immediate vicinity of the corrosion area, steel cannot rust.





Materials that MACO uses



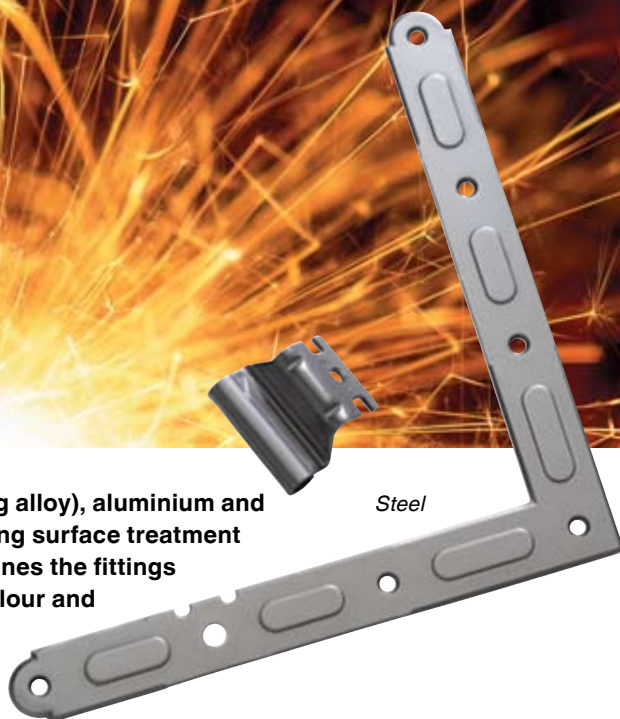
MACO uses steel, Zamak (zinc die casting alloy), aluminium and PVC for hardware production. The finishing surface treatment guarantees corrosion protection and defines the fittings components aesthetics with regard to colour and surface structure.

Steel

Faceplates, deadbolts, the RUSTICO wall subframe and masonry installation product range as well as various small components are manufactured from high-quality cold-rolled coiled and sectional steel.

ZAMAK (zinc diecasting alloy)

Diecast strikers, hinges and various small components are produced from high-quality zinc diecasting alloy.



Aluminium

Window and door handles are produced from anodisable aluminium alloy.

PVC

Handles, cover caps, bushes and miscellaneous small components are produced from various engineered plastics.





MACO surface treatment technology



Widest range in the industry

- Eight different surface treatment processes
- Applied to the fittings during the course of in-house production

Application process	MACO fittings solution
MACO Silver-look	MULTI Turn-Only and Tilt&Turn fittings, PROTECT doorlocks, RAIL sliding fittings, ESPAGS espagnolettes
MACO TRICOAT	MULTI Tilt&Turn and Turn-Only fittings, PROTECT doorlocks, RAIL sliding fittings, ESPAGS espagnolettes
Powder-coated	Shutter fittings, pivot post and scissor stay hinges and individual EMOTION window handles
Anodising	EMOTION window handles
Wet painting	Components from the EMOTION window handle product range
KTL painting (cathodic dip painting)	Primer for RUSTICO- <i>premium</i> surface-finish, additional corrosion protection
Vacuum coating	Cover caps (gold and chrome colour)
Plastic coating	EMOTION <i>resist</i> window handles

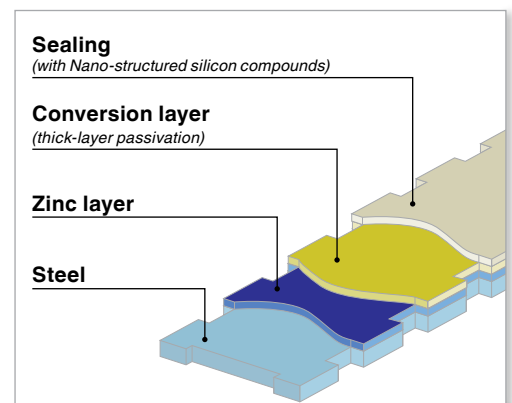


MACO Silver-look



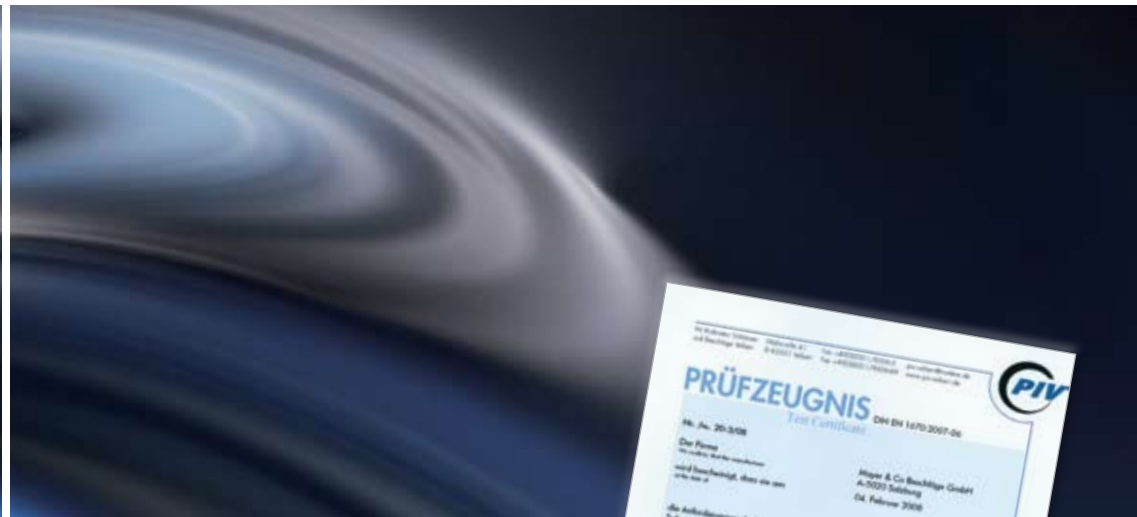
Back in the year 2000 MACO was the first architectural fittings manufacturer to introduce chromium VI free silver passivation with subsequent silicate-based sealing in their electrogalvanising process. This process yielded excellent surface-finish characteristic results and represented the first alternative to chromating with chromium VI. Fittings components made of steel and/or zinc diecast are zinc-plated, passivated and sealed.

The thick-layer passivation and sealing serves improving both corrosion resistance and the zinc coating's aesthetics on metal.





MACO Silver-look



The highest corrosion resistance with an environmentally friendly process

Within the framework of state-of-the-art systems and ongoing development particularly in electroplating (sealing with Nano-structured silicon compounds), MACO has been successful in fulfilling the requirements of the highest 'Grade 5' in accordance with EN 1670:2007.

The coating process in question is exceptionally environmentally friendly; and it does it without the use of chromium VI.

Application areas

As has been well proven, electrogalvanised fittings are well suited for normal stresses. Despite achieving grade 5, these are however only applicable to a limited extent for higher stresses such as e.g. damp rooms, food processing companies, coastal areas, certain types of timber etc. This is due to the chemical reaction of the zinc coating in conjunction with aggressive substances.

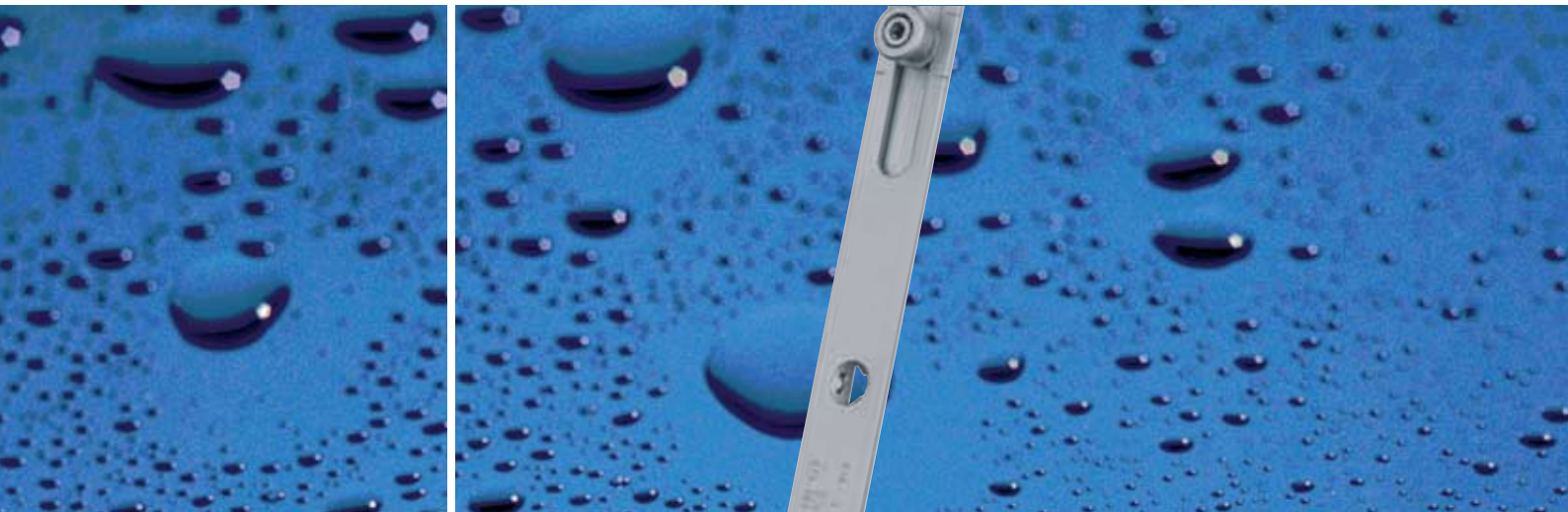
In application areas for which a high chemical resistance is required, MACO TRICOAT fittings should be used.

Fabricator benefits

- High-quality Silver-look surface-finish
- The highest corrosion resistance with grade 5 in accordance with EN 1670:2007
- Well suited for normal environmental influences/application areas
- Quality leadership on the strength of our decades of experience in electrogalvanising
- Our window and door fittings are enhanced in 10 state-of-the-art in-house electroplating facilities.



MACO TRICOAT



MACO TRICOAT fittings were designed especially for application areas with increased corrosion protection requirements.

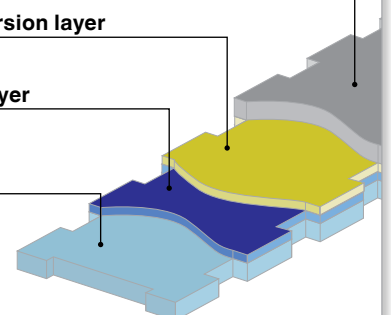
The special thing about MACO TRICOAT fittings is that an organic Top-Coat ('MKS' micro corrosion protection system) is applied on top of the electrogalvanised surface of the installed Silver-look fittings. With this coating system MACO TRICOAT fittings achieve a very high level of chemical resistance and are as a result far superior than electrogalvanised fittings with regard to corrosion.

MKS micro corrosion protection system
(zinc-aluminium flake coating)

Conversion layer

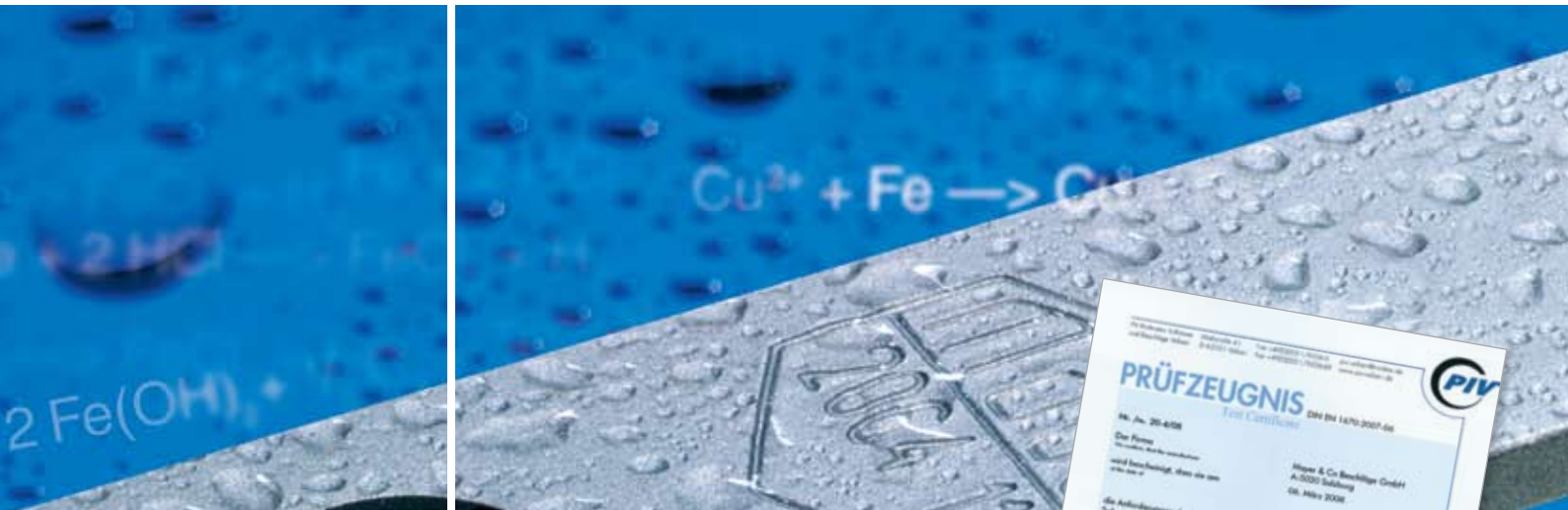
Zinc layer

Steel





MACO TRICOAT



The highest corrosion resistance with an environmentally friendly process

The quality of the MACO TRICOAT fittings is well above the requirements specified in grade 5 of EN 1670:2007.

Corrosion tests with over 1000 h red coloured rust in accordance with EN ISO 9227 have been carried out by accredited testing institutes. As with the MACO Silver-look surface-finish, this is an exceptionally environmentally friendly coating process without the use of chromium VI.

Application areas

Generally speaking anywhere where corrosion resistance of the electrogalvanised surface-finishes is not sufficient; for example in coastal areas, industrially congested areas, damp rooms, industrial premises with high corrosion impact, timber containing acids (e.g. oak, accoya . . .), indoor swimming pools, food processing companies such as butcher's shops, cheese dairies, etc.



Fabricator benefits

- Differentiating characteristics
- Unrivalled attractive aesthetics
- Durability under extreme conditions
- Ultimate corrosion resistance
- No corrosion during the construction phase
- Less complaints
- Solutions for problematic application areas
- 10 year surface-finish guarantee for use in Accoya timber



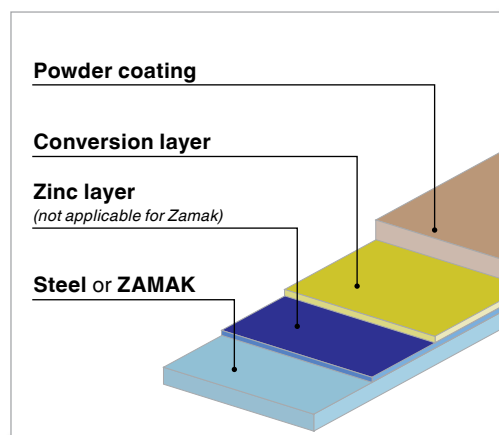
Powder-coated



MACO has been using the powder coating process successfully since the year 2000 on pivot posts and scissor stay hinges, handles and on RUSTICO shutter fittings. The advantage of powder coating lies in the environmental friendliness of the production process. Powder coating also provides a high level of corrosion protection, is scratch-resistant, water and dirt-repellent and as a result, protects the fittings against aggressive environmental influences.

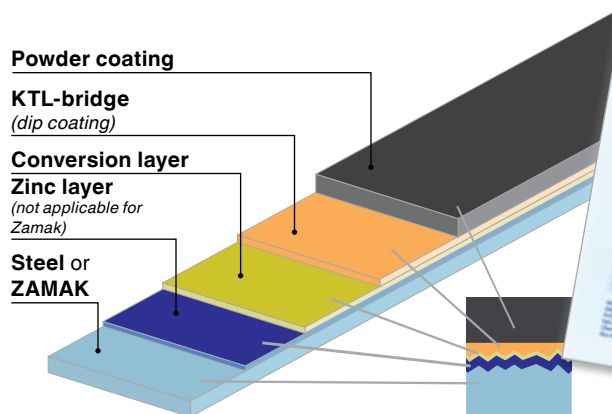
MACO colours

Pivot posts and scissor stay hinges are available in traffic white (RAL 9016), cream-white (RAL 9001), grey-brown (RAL 8019) and titanium. Additional RAL colours are available upon request. Window and door handles are available in RAL colours upon request at an extra charge.





MACO RUSTICO-premium



MACO RUSTICO shutter fittings are exposed to the elements. For this very reason, an additional KTL-coating is applied to the fittings for even better corrosion protection.

MACO colours **Surface-finish MACO-premium**

MACO RUSTICO shutter fittings are available in grey, white and black. MACO offers its customers additional RAL colours upon request at an extra charge.

With our MACO RUSTICO-premium surface-finish, we provide the best corrosion protection for shutter fittings. The structured surface-finish has premium aesthetics and is scratch-resistant, as well as being water and dirt-repellent.





MACO RUSTICO-*premium*



Application areas

MACO RUSTICO shutter fittings are well suited for conventional application areas. Furthermore they display a very high level of durability in problematic application locations such as in coastal areas. Experience has shown us however that the corrosion impact in such application locations is very varying. For this reason, no binding statement concerning the time period of corrosion resistance can be given for such locations. The durability/lifespan is further increased with regular maintenance (cleaning and lubricating).

Fabricator benefits

- Premium aesthetics
- High level of colour fastness
- Hard-wearing, scratch-resistant surface-finish
- Ultimate corrosion resistance
- Solutions for problematic application areas
- Grade 5 test report in accordance with EN 1670:2007 from accredited test laboratories



Anodising



With the help of direct current and/or alternating current in suitable electrolytes with anodic process, the

- hard
 - wear-resistant
 - weather resistant and
 - decorative oxide layers
- are applied to the surface of the handles.

In doing so it is possible to produce aluminium surface-finishes in a wide range of different colours

MACO-colours

MACO anodises in the following colours:
champagne, bronze, brown, titanium and silver.





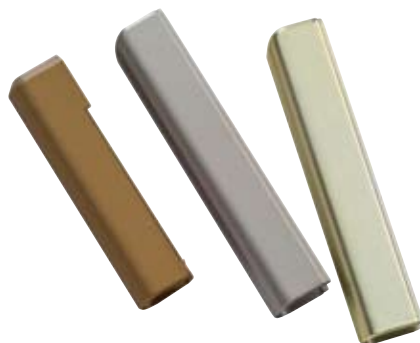
Wet painting



Depending on the requirements, spray painting with liquid paint is used with the following procedures on MACO EMOTION handle components (recessed grips, door backplates, rosettes, cover caps).

1. Manual spray painting
2. Automatic surface spray painting
3. Automatic barrel spray painting

With the use of hydro coatings (water-based paint), many different colours are applied in a very environmentally friendly process.





KTL-painting (Cathodic dip painting)



An alternative to electrogalvanising is KTL-dip coating of steel and ZAMAK (zinc diecasting alloy) fittings.

MACO uses this process in particular as a primer for the surface-finish of MACO-premium on RUSTICO shutter fittings.

The process

Cathodic dip painting (KTL) is a special electro dip-coating process.

Electro dip-coating is a water-based paint deposit process on metallic work pieces in an immersion process under electrical current.

Advantages

- Uniform, controllable layer formation also on complex shaped objects
- Good covering characteristics on the corners and edges
- Good coating characteristics in cavities or inaccessible areas thanks to the 'wrap-around' effect
- No paint runs or paint sags
- High level of corrosion protection





Vacuum coating



In this process an aluminum wire is evaporated at a high temperature in a vacuum chamber. This vapour is then applied to the work pieces by the vacuum.

Subsequently a protective coating is applied to the components using a special clear paint. This paint can also be dyed. The protective layer becomes hard and wear-resistant during drying at a high temperature. The vacuum coating process is mainly used for gold and chrome coloured MACO PVC cover caps.

Advantage

- This process creates particularly high-gloss (metal-look) surface finishes.





Plastic coating



With the MACO EMOTION window handles *resist*, a diecast core is coated with a plastic layer by means of injection moulding technology.

Advantages

- Robust metal core with a 3 mm plastic protective layer
- Very durable plastic surface
- Perfect aesthetical characteristics (colour, shine)
- Very high resistance to mechanical loads
- Good resistance to chemicals
- Good long-term behaviour
- Aesthetical unity between handle, cover plate and rosette





Tested in accordance with EN 13126



The EN 13126 is the standard for architectural hardware and window and door hardware. The test procedure requirements for durability, strength, security and operation are defined in this standard. It is divided into 19 parts, covering all versions of windows and balcony doors.

What does this standard imply with regard to corrosion resistance?

The fittings must at least comply with the stated grades in EN 1670, whereby at least grade 3 must be reached.



Excluded from the assessment are

- Riveted areas
- Subsequent processed areas, such as cropping of the fittings
- Components whose surface finish has not been processed, provided they are not located in a visible area of the fittings
- Welded joints and their immediate surroundings



Tested in accordance with EN 1670



The EN 1670 is the standard for corrosion resistance on locks and architectural hardware.

Corrosion resistance is divided into 5 grades

Grade 1	24 hours	Low resistance for indoor areas in dry environments
Grade 2	48 hours	Moderate resistance for indoor areas, in which condensation can develop
Grade 3	96 hours	High resistance for outdoor areas, where occasional or frequent humidity, rain or dew can develop
Grade 4	240 hours	Outdoor areas with very severe conditions
Grade 5	480 hours	Outdoor areas with extraordinarily severe conditions where long-term product protection is required

The most important points

The required corrosion tests must be carried out on assembled components in the same normal condition as they are despatched from the factory.

Only the corrosion of the base material is assessed in the appraisal, white rust is excluded from the appraisal. Screws and fixing elements that are sold together with the hardware products must also comply with this standard.

MACO has achieved the best possible classification three times

- **Grade 5** for **MACO Silver-look**
- **Grade 5** for **MACO RUSTICO-premium**
- **Grade 5** for **MACO TRICOAT**

The quality of MACO TRICOAT fittings lies far above the grade 5 requirements. Corrosion tests of over 1000 hours in accordance with EN ISO 9227 have been carried out by accredited testing institutes.

Test certificates and test reports can be found on our homepage: www.macouk.net



Surface-finish quality tests



MACO is an EN ISO 9001:2008 certified company. All processes and procedures are defined. The entire manufacturing process is ensured with Factory Production Control ('FPC').

A continuous process-control and policy takes place based on the values obtained.

The individual procedures are described in detail with work instructions. This as a result guarantees consistent surface-finish quality and corrosion resistance.

Monitoring is carried out by external certified testing institutes.



Test methods

- Salt spray test in accordance with EN ISO 9227
- Climate change test
- UV test
- Cross-cut test
- Layer thickness measuring
- Durability test
- Free movement test
- Microsection test
- Outdoor exposure test



Preservation of fittings component's surface protection



In order to guarantee a perfect operation of the window fittings, a number of guidelines are to be adhered. The following points should be taken into account so that end users can enjoy perfect operation and aesthetics of the windows and fittings for a long time.

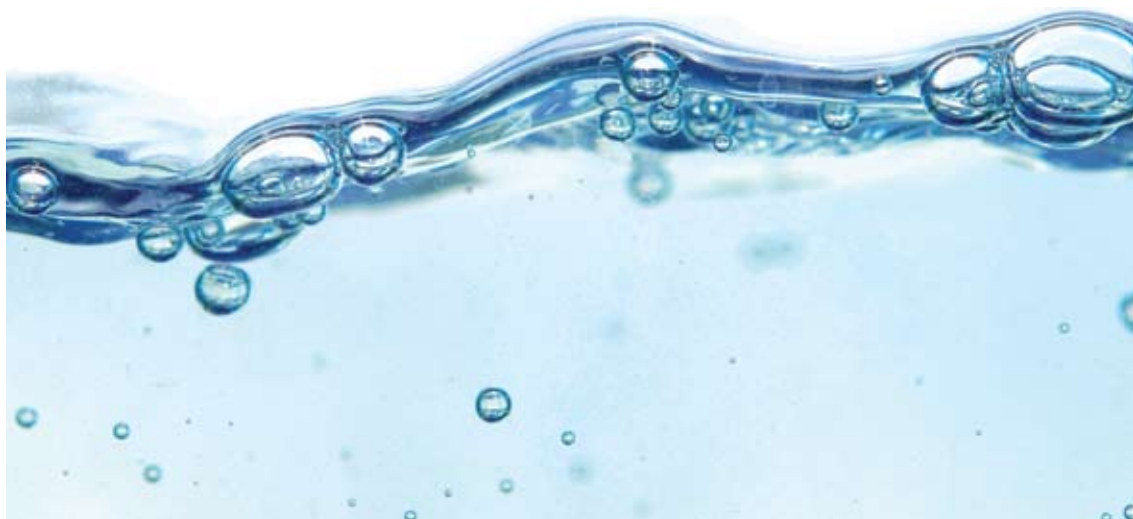
Causes of corrosion on fittings components

Should in individual cases - despite the surface protection - signs of corrosion on fittings components develop after a short period of time, the following listed points are as a general rule the cause of the corrosion:

- a) The actual cause of corrosion is the atmospheric oxygen. In practice however, corrosion only appears when the relative humidity reaches a critical value of approx. 60 to 70 %.
- b) An additional cause of corrosion can be the formation of condensation on the metal components; due to passing below the dew point during severe fluctuation of temperatures.
- c) Corrosion attacks have increased due to gaseous air pollution (industrial atmosphere, car exhaust emissions) e.g. sulphur dioxide (SO_2) and nitrogen oxide gases (NO_2) and resulting compounds in the presence of humidity – sulphurous acid (H_2SO_3), sulphuric acid (H_2SO_4), nitric acid (HNO_3).
This air pollution also has a corrosive effect in a dry condition.
- d) The issue of location of the affected project in conjunction with point c) is to be taken into account; e.g. busy roads, industrial areas, waste water treatment plants, sea air, air containing chlorine, intensive livestock breeding etc.
- e) Also harmless materials e.g. paper/cardboard
- f) as well as different types of timber used in the fenestration industry contain aggressive constituents to some extent (acids, alkali, chlorides) that can destroy the passivation upon contact and with this cause corrosion.
- f) Plaster, cement and other building materials e.g. acetic acid cross-linked silicone as is used frequently in the fenestration industry, are additional causes for corrosion.
- g) A common and not sufficiently recognised source of damage is cleaning agents, that e.g. destroy the passivation either by chemical attack (acetic cleaning agents, acidic cleaning agents with citric acid, cement residue remover with phosphoric acid, severe alkaline cleaning agents etc.) or by means of mechanical abrasion (abrasive cleaners, steel wool) and as a result, speed up the corrosion attack.



Preservation of fittings component's surface protection



Measures to preserve the surface-finish

- The fittings and/or the rebate areas are to be ventilated sufficiently – in particular during the building phase – so that they are not exposed to direct wetness impact or to condensation.
- The fittings are to be kept free from deposits and soiling from building materials (building dust, plaster, cement etc.), that is to say; the windows are to be covered accordingly.
- Aggressive vapours in conjunction with small formations of condensation can lead to fast corrosion on the fittings components.
- Timber frames and sashes with a high concentration of (tannic-) acid are to be appropriately surface-treated in order to ensure that these content substances do not evaporate out of the timber.
- No acetic-acid or cross-linked acidic sealing compounds or those with the above mentioned contents may be used.
- The fittings may only be cleaned or polished with mild, pH-neutral cleaning agent in diluted form.
- The fittings must not be damaged with sharp edged tools.