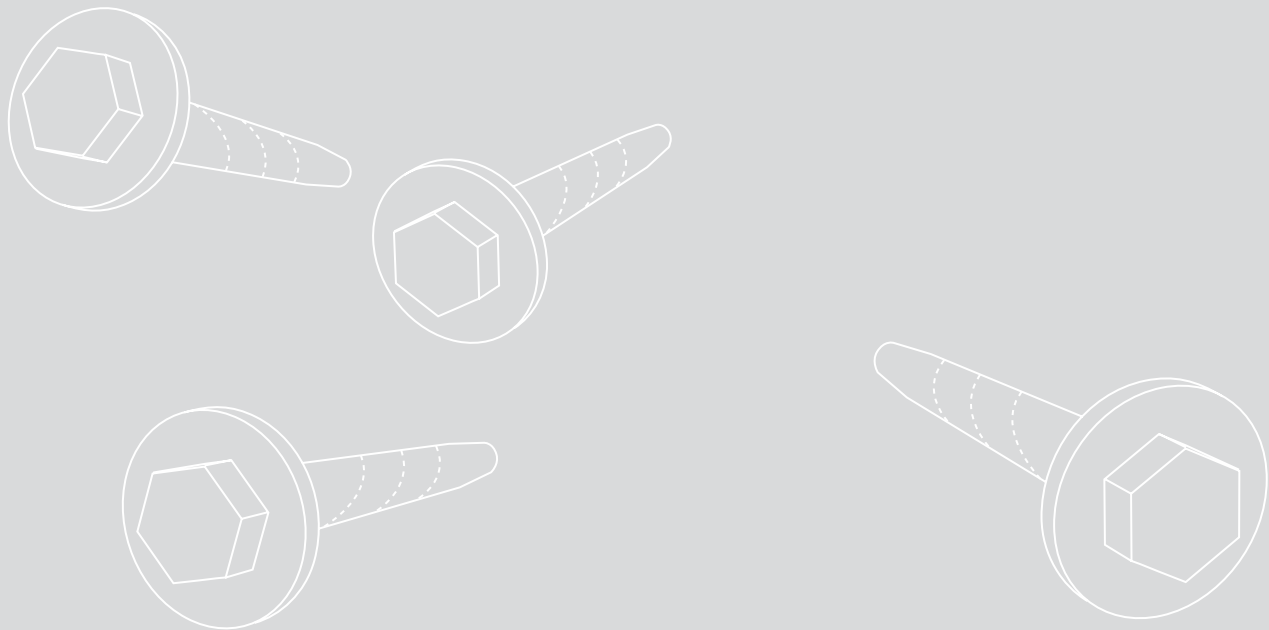
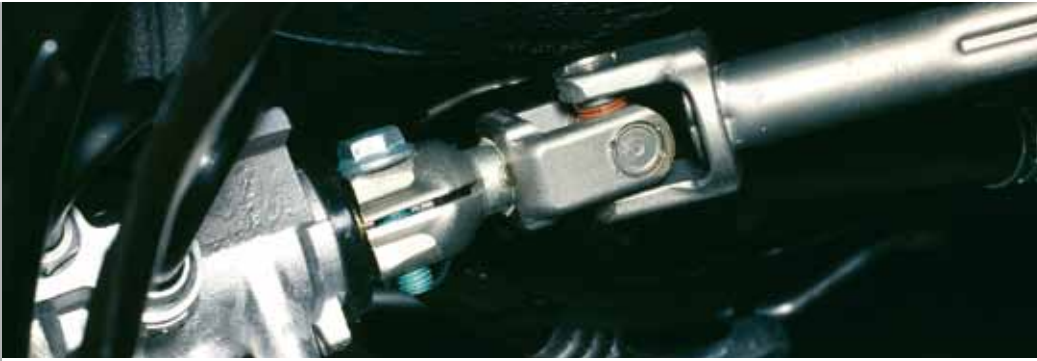


Corrosion Protection Automotive Fastener Coatings





Automotive Fastener Coatings

Automotive fasteners are the most sophisticated application for corrosion protection coatings. In order to fulfill the wide range of global automotive OEM requirements, Atotech offers a diverse array of coating technologies. These technologies include a full range of products for electrolytic deposition as well as for dip spin applications.

Robots which are programmed to a specific torque are used on the assembly lines at the automotive plants. The robots drive the bolts that create the joint. Therefore the coefficient of friction of the coatings applied to the bolts has to meet the specific OEM requirements to ensure that at the prescribed torque the joint is tight and conversely the bolts are not broken. As fasteners are safety parts these values are constantly controlled during plating and coating production. Lubricants, either integrated within a sealer or as a separate step are used to make sure that the CoF values are met.

More and more light metals are used in the automotive industry to reduce weight of components. For this reason the compatibility of coating material to aluminum as well as magnesium has to be taken into account. Contact corrosion of light metals in presence of humidity is an obstacle to overcome by using the best coating. Perfect coating combinations have been developed to provide the best solutions.

Because of the European End Of Life Vehicle directive, which came into effect in the year 2007 for corrosion protection coatings, all deposited materials are required to be Cr(VI)-free.





Electrolytic Zinc Coatings

Acid zinc electroplating is the most commonly used process for plating fasteners in barrel application due to its high current efficiency and therefore high plating speed. The coatings have a very appealing bright appearance at comparatively low plating cost. The best plating performance is achieved with hot acid zinc electrolytes, that are specially formulated for stable operation at 45 °C. **Zylite® HT** is a potassium chloride-based hot acid zinc electrolyte with high plating performance, that also fulfills the environmental demands.

Some OEMs require the plating with a cyanide-free alkaline zinc electrolyte because corrosion protection is superior to zinc coatings deposited by an acid zinc electrolyte. In this case **Protolux® 3000** is the preferred process to use.

Zinc coatings are frequently used with high performance blue or iridescent passivates that are sealed with a lubricated post-treatment to give high corrosion protection as well as the right coefficient of friction range. This coating is chosen for fasteners which are assembled to steel or magnesium in cars. The most frequently used blue passivates are **Unifix® Zn 3-15 L** and **Tridur® Zn B**. Also iridescent thick film passivates are used all over the world for zinc coatings. The latest generation of our **EcoTri®** family is called **EcoTri® HC2 Nano** which ensures improved corrosion protection even without a sealer applied. **EcoTri® HC2 Nano** is already approved for GMW 3044 N.

A diverse range of sealers is available to meet all global OEM requirements, some examples are **Sealer 300 WL**, **Sealer 300 WL7** and **Corrosil® Plus 501 (BG)**. To specifically fulfill the demand of Ford S449 a process combination was developed consisting of **Zylite® HT / Tridur® Zn B** with **Tridur® Enhancer / Corrosil® 501L**.

The relatively low difference in electrochemical potential between zinc and magnesium makes zinc coatings the best choice for magnesium contact. A sealer is used to insulate the zinc coating and therefore reduces the contact corrosion of the less noble magnesium, which is quite active and will corrode rapidly when a galvanic cell is created. The best process combination for this application is **Unizinc ACZ / Unifix® Zn 3-15 L / Sealer 300 WL**, which is approved for Audi TL 194.

Approved silver zinc fastener coatings

OEM	Performance		Approved Systems
	Coefficient of friction	White rust / Red rust	
Audi TL 194 (Mg)	0.12 ± 0.04	192 h / 600 h	Unizinc ACZ / Unifix® Zn 3-15 L / Sealer 300 WL
VDA VDA 235-104	0.12 ± 0.03	96 h / 240 h	Unizinc ACZ / Unifix® Zn 3-15 L / Sealer 300 WL7 Zylite® HT / EcoTri® / Corrosil® Plus 501 (BG) + Corrosil® Plus 415
General Motors GMW 3044 G	0.13 ± 0.03	120 h / 240 h	Zylite® HT / EcoTri® / Corrosil® Plus 501 (BG) + Rogard Lube 100 Unizinc ACZ / Unifix® Zn 3-15 L / Sealer 300 WL7
GMW 3044 N	not applicable	120 h / 240 h (as plated) 120 h / 240 h (1h 150 °C)	Unizinc ACZ / EcoTri® HC2 Nano Zylite® HT / EcoTri® HC2 Nano
Ford S449 WSS-M21P50-A1	0.14 ± 0.03	96 h / 384 h (as plated) 72 h / 360 h (4 h 120 °C)	Zylite® HT / Tridur® Zn B + Tridur® Enhancer / Corrosil® 501L

Black zinc coatings are not yet required except from the Japanese automotive industry. The best suited process combination is **Zylite® HT / Tridur® Zn H2 / Tridur® Finish 300**. Very high coefficient of friction values are achieved with this coating meeting the requirement for this non-sealed process combination.

Electrolytic Zinc Nickel Coatings

Zinc nickel coatings provide superior corrosion protection to red rust compared to pure zinc coatings due to the deposition of γ -phase ZnNi alloy. Also the formation of white rust is much less voluminous which makes it easy to disassemble the fasteners after a certain service time. The electrochemical potential difference between ZnNi (12 - 16% Ni incorporation) and aluminum is very low, this allows the use in assembling with aluminum materials. The corrosion protection is stable even when heat is applied. For this reason it is highly demanded in the engine compartment area. Due to the high wear resistance of the coating it can also be used on the underbody of cars. All these named coating properties are the reason for the increasing demand for ZnNi coatings by the automotive industry. **Reflectalloy® ZNA**, **Zinni AL 450**, **Zinni AL 15** and **Protedur® Ni 75** are the approved processes for alkaline ZnNi.

The most frequently used passivate coatings over ZnNi are **Unifix® Ni/Fe 3-10 L** and **EcoTri®**. For the sealer coating **Sealer 300 WL7** and **Corrosil® Plus 501 (BG)** are used.

The French automotive industry requires the bolt to have the same coefficient of friction when measured against steel as when measured against aluminum. **Protedur® Ni 75 / EcoTri® / Corrosil® AL 2007** process combination has been developed to meet this request.

Approved silver zinc nickel fastener coatings

OEM	Performance		Approved Systems
	Coefficient of friction	White rust / Red rust	
VDA VDA 235-104	0.12 ± 0.03	120 h / 720 h	Zinni AL 450 / Unifix® Ni/Fe 3-10 L / Sealer 300 WL7 Protedur® Ni 75 / EcoTri® / Corrosil® Plus 501 (BG) + Corrosil® Plus 415 Reflectalloy® ZNA / EcoTri® / Corrosil® Plus 501 (BG) + Corrosil® Plus 415
General Motors GMW 4700 G Type B	0.13 ± 0.03	240 h / 1000 h	Reflectalloy® ZNA / EcoTri® / Corrosil® Plus 501 (BG) / Rogard Lube 200 Zinni AL 450 / EcoTri® HC2 / Sealer 350 WL3
Ford WSS-M21P44-(A2)	0.14 ± 0.03	360 h / 960 h	Reflectalloy® ZNA / EcoTri® / Corrosil® Plus 501 (BG) + Rogard Lube 100
Renault 01-71-002/--R	0.15 ± 0.03	200 h / 600 h (1 h 120 °C)	Reflectalloy® ZNA / EcoTri® / Corrosil® Plus 501 (BG) / Alutech Protedur® Ni 75 / EcoTri® / Corrosil® Plus 501 (BG) / Alutech
PSA B15 4102	0.15 ± 0.03	200 h / 720 h (1 h 120 °C)	Reflectalloy® ZNA / EcoTri® or Zinnifix 3 / Corrosil® AL 2007 Protedur® Ni 75 / EcoTri® or Zinnifix 3 / Corrosil® AL 2007 Zinni AL 15 / EcoTri® or Zinnifix 3 / Corrosil® AL 2007

Acid ZnNi electroplating processes provide a lot higher current efficiency. This means the productivity can be increased compared to alkaline ZnNi electroplating processes and as a result the plating cost can be reduced. At the same time the finish has a much more appealing bright finish.

Zinni AC AF 210 is an ammonium-free acid ZnNi process, which is easy to wastewater treat as it avoids the use of high amounts of strong complexing agents, necessary with alkaline ZnNi processes. The process produces γ -phase ZnNi alloy which gives excellent corrosion protection. Automotive OEMs are testing this newly developed coating.

Black ZnNi coatings are also highly requested by all the global automotive OEMs and a diversity of process combinations have been developed. The most suited black passivate process is called **Unifix® Ni 3-30 L**. The black sealer is pigmented to deepen the black color of the coating. The product choice depends on the coefficient of friction requirement. **Rodip® ZNX** is the preferred product for use as an adhesion promotor for lacquers.

Approved black zinc nickel fastener coatings

OEM	Performance		Approved Systems
	Coefficient of friction	White rust / Red rust	
VDA VDA 235-104	0.12 ± 0.03	120 h / 720 h	Zinni AL 450 / Unifix® Ni 3-30 L / Sealer 3500 WL3
Ford WSS-M21P44-A3	0.14 ± 0.03	480 h / 960 h	Reflectalloy® ZNA / Rodip® ZNX / PPG Electro Polyseal III
Hyundai-Kia MS 611-15	K = 0.18 - 0.21 (bolt & screw) K = 0.13 - 0.16 (nut)	200 h / 1000 h (5 µm)	Zinni® AL 450 / Unifix® Ni 3-30 L / Corrosil® Plus 600 (BG) + Corrosil® Plus 415
PSA B15 4102	0.15 ± 0.03	200 h / 720 h (1h 120 °C)	Reflectalloy® ZNA / CorroTriBlack® ZnNi / Corrosil® Black AL 2007 Protedur® Ni 75 / CorroTriBlack® ZnNi / Corrosil® Black AL 2007 Zinni AL 15 / CorroTriBlack® ZnNi / Corrosil® Black AL 2007
Renault 01-71-002/--R (for interior parts)	0.15 ± 0.03	48 h / 96 h	Zinni AL 15 / Unifix® Ni 3-31 L / Sealer 700 W Black Protedur® Ni 75 / CorroTriBlack® ZnNi / Corrosil® Plus Black 600 (BG) Reflectalloy® ZNA / CorroTriBlack® ZnNi / Corrosil® Plus Black 600 (BG)



Zink Flake Coatings

With a comprehensive zinc flake product range, Atotech provides a perfect complement to its product portfolio of electroplated corrosion resistant coatings. The zinc flake technology is largely embraced by the automotive fastener industry due to its excellent corrosion protection and competitive costs. The coatings are completely chromium-free.

Zintek® base coats contain zinc and aluminum flakes. The metal particles and the reactive mineral resins react with the steel substrate to form an adhesive bonding. During baking a conductive, non-toxic zinc aluminum coating with cathodic corrosion protection is formed. As the base coat is applied in a non-electrolytic dip spin technique, hydrogen embrittlement is irrelevant. This is one of the main advantages over electrolytic coatings. The base coat can be either silver or black.

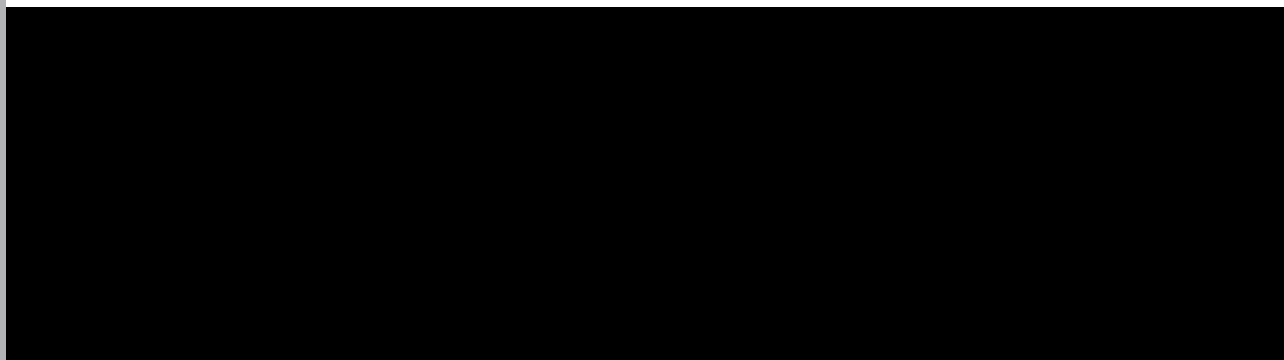
The **Zintek® 200** silver base coat is applied to achieve a coating thickness of 6 - 10 microns. **Zintek® Top (L)** is a water-based mineral reactive sealer. It improves greatly the corrosion protection and the mechanical properties of the base coat by only applying a sealer coat of 0.5 - 1 micron. For the adjustment of the coefficient of friction the sealer contains an internal lubricant. It is perfectly suited for the automotive fastener application due to high temperature resistance. Atotech provides also products for special requirements, e.g. Zintek® Top LV has excellent heat loosening properties.

Zintek® 200 can also be coated with an organic water-based top coat **Techseal® Silver W(L)**. For the adjustment of the coefficient of friction the top coat contains also an internal lubricant. The combination Zintek® 200 + Techseal® Silver WL has the specific advantage of no stick slip effect and therefore meets Renault standards.

For black zinc flake coatings **Zintek® 300 B** is the best choice. This unique black base coat avoids issues with silver scratch marks after handling. **Techseal® Black S(L)** is a new generation of solvent-based black top coats which also contains a lubricant for coefficient of friction requirements. It gives a deep black color and excellent corrosion behaviors.

Extract of approved silver zinc flake fastener coatings

OEM	Performance			Approved Systems
	Coefficient of friction	White rust	Red rust	
GM GMW 3359	0.13 ± 0.03	144 h	480 h	Zintek® 200 / Techseal® Silver WL
PSA B15 3320	0.15 ± 0.03	Not applicable	600 h	Zintek® 200 / Zintek® Top LF
Renault 01-71-002/--R	0.15 ± 0.03	200 h	600 h	Zintek® 200 / Techseal® Silver WL
VW TL245 (Of-t647)	0.12 ± 0.03	Not applicable	Components of a general nature: 720 h With thermal conditioning: 480 h Threaded barrel goods: 600 h With thermal conditioning: 480 h	Zintek® 200 / Zintek® Top LV
VDA VDA 235-104	0.12 ± 0.03	Not applicable	With thermal conditioning 96 h at 180 °C: Silver min. 6 µm: 480 h Silver min. 8 µm: 720 h Black min. 10 µm: 480 h	Zintek® 200 / Zintek® Top LV Zintek® 200 / Techseal® Silver WL Zintek® 300 B / Techseal® Black SL 28 V





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Atotech's extensive knowledge and vast product offering give you highly productive systems and single-source responsibility. Solid research and development combined with decades of field-proven processing is your assurance of the best electroplating systems in the world.

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Environmental Know-how

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Atotech regional Headquarters are situated in Rock Hill (USA), Berlin (Germany) and Yokohama (Japan)