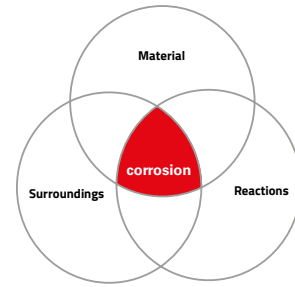


GALVANIZATION PROCESS

INTRODUCTION

Corrosion means the breaking down of essential properties in a material due to reactions with its surroundings.

This can compromise the function of a metal component or the function of a whole system DIN 50900.



WEEE

Waste Electrical and Electronic Equipment

Requires that equipment must be built to certain standards to ensure that disassembly for recycling is optimized and that suppliers must have programs to take back and recycle the equipment they sell.

Suppliers will have to register an report sales and recycling data.

In order to further minimize the hazardous substance and to improve recyclability, RoHS was written.

RoHS

Restriction of Hazardous Substances

Under RoHS, each European State must ensure that, from July 2006, new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).

It is accepted (based on EU commission guidelines and put into the law of some member states) that „does not contain“ means, for purpose of the RoHS Regulations, a maximum concentration value of:

- up to 0,1% by weight in homogeneous materials for lead, mercury, hexavalent chromium, PBB and PBDE
- up to 0,001% by weight in homogenous materials for cadmium.

ZINC-PLATING SYSTEM

Introduced in 2006, the zinc-plating system guarantees high corrosion resistance of all the products we supply, in compliance with regulations: RoHS 2002/95/CEEL V 2000/53/CE guarantees protection of the environment thanks to the exclusion of hexavalent chromium, maintaining and increasing the corrosion resistance of its products.

The new zinc-plating system, besides ensuring a better rust resistance, improves lubrication and threads coupling.

The new system guarantees a 10 - 15 micron thickness, and a protection of at least 240 hours in salty mist (ISO 9227) before any appearance of white corrosion.

COMPARATIVE DIAGRAMS

Red rust resistance changes from 216 hours of the old system to 384 hours* on the new one.

White rust resistance changes from 72 to 240 hours*.

*The data of resistance refer to products before the swaging operations (SAE J516).

GALVANIZATION PROCESS

- Pre-treatment
- Electrolytic Zinc-plating
- Passivation

The electrolytic zinc-plating is an anodic protection system against steel corrosion; it is carried out through proper electrolytic solutions with the help of direct current.

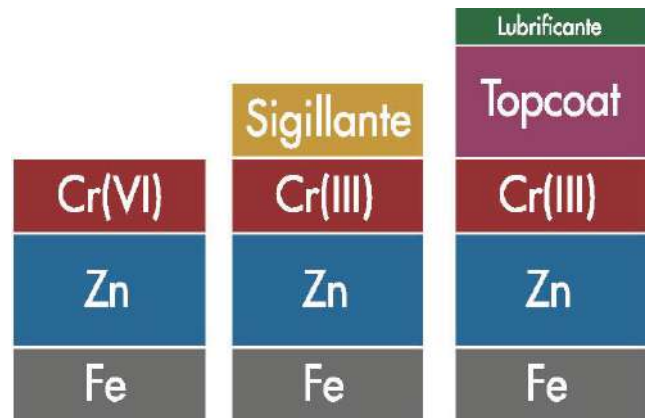
The industrialization process has occurred during the years till today getting performances in compliance with various regulations (CE 2000/53 elv; WEEE and RoHS regulation 2002/95/CE).

The zinc-plating satisfies the demands of various specifications in motor field both in functional terms (corrosion resistance, coefficient of friction) and in aesthetic terms.

With the introduction of trivalent chromium, the colour is silver, or better colourless with some yellow-green iridescences in order to respect the environment.

CORROLUX 510 and CORROLUX 550L systems, that are ATOTHEC products, represent the most advanced technology to protect the electrolytic zinc-plating, satisfying the various regulations (uni_iso)-car, among which:

- RENAULT 01-71-002-P**
- GM 3044**
- FIAT 9.57045**
- DENSO PF60814**
- BOSCH 5J0105**



Old zinc-plating system Cr(VI)
white rust resistance 72 hours
red rust resistance 216 hours.

Old Zinc-plating system Cr(III)
white rust resistance 144 hours
red rust resistance 288 hours.

Zinc-plating system Cr(III) in use
white rust resistance 240 hours
red rust resistance 384 hours.

Transparent Cr(VI)-free

Atotech Cr(VI)-free Post Treatment Systems

System Name	Type	Cr(III) Passivate	Seal	Lubricant
Corrolux 150	Transparent Cr(VI)-free	EcoTri	Rogard Supreme Seal 500	n/a
Corroulx 400	Transparent Cr(VI)-free	CorroTriBlue	Corrosil Plus 401	n/a
Corroulx 450	Transparent Cr(VI)-free	EcoTri	Corrosil Plus 401	n/a
Corrolux 500	Transparent Cr(VI)-free	CorroTriBlue	Corrosil CFS-R Plus 501	n/a
Corrolux 510	Transparent Cr(VI)-free	CorroTriBlue Extreme	Corrosil CFS-R Plus 501	n/a
Corrolux 520	Transparent Cr(VI)-free	CorroTriBlue Ultra	Corrosil CFS-R Plus 501	n/a
Corrolux 550	Transparent Cr(VI)-free	EcoTri or EcoTri HC	Corrosil CFS-R Plus 501	n/a
Corrolux 550L	Transparent Cr(VI)-free	EcoTri or EcoTri HC	Corrosil CFS-R Plus 501	Rogard Lube 100

Corrolux®

The perfect process combination of a Cr(VI)-free passivate and a final sealer offers excellent corrosion protection performance while fully complying with the ELV directive and the automotive industry demands.

(Brands highlighted in red are approved by automotive OEMs)

	Brand	Passivate	Sealer	Lubricant	Comments
Black Cr(VI)-free Post Treatment	Corrolux® Black 110	CorroTriBlack Zn	Corrosil® Plus 501 BG or Corrosil® Plus Black 600 BG		
	Corrolux® Black 500	CorroTriBlack ZnFe	Corrosil® Plus 501 BG		
	Corrolux® Black 660	CorroTriBlack ZnNi	Corrosil® Plus Black 600 BG		
	Corrolux® Black 900	Rodip® ZNX	PPG ElectroPolySeal III		
	Corrolux® Black 800	Rodip® ZNX	Magni W11		
Transparent Cr(VI)-free Post Treatment	Corrolux® 150	EcoTri®	Rogard Supreme Seal 500		
	Corrolux® 330	Tridur® Zn B	Corrosil® Plus 301		
	Corrolux® 400	CorroTriBlue	Corrosil® Plus 401		
	Corrolux® 450	EcoTri® or EcoTri® HC	Corrosil® Plus 401		Ideal for brake calipers
	Corrolux® 500	CorroTriBlue	Corrosil® Plus 501 BG		
	Corrolux® 510	Corrolux® 510	Corrosil® Plus 501 BG		
	Corrolux® 520	CorroTriBlue Ultra	Corrosil® Plus 501 BG		
	Corrolux® 530	Tridur® ZN B	Corrosil® Plus 501 BG		
	Corrolux® 530L	Tridur® ZN B, Tridur Enhancer	Corrosil® Plus 501L		
	Corrolux® 540	Tridur® ZN I	Corrosil® Plus 501 BG		
	Corrolux® 550	EcoTri® or EcoTri® HC	Corrosil® Plus 501 BG		
	Corrolux® 550L	EcoTri® or EcoTri® HC	Corrosil® Plus 501 BG	Rogard Lube 100	Ideal for fasteners
	Corrolux® 570	Rodip® ZNX	Corrosil® Plus 501 BG		
	Corrolux® 590	Tridur® ZnNi Clear	Corrosil® Plus 501 BG		

ZINC ELECTROPLATED FINISHES

FINISH	SALT SPRAY		SPECIFICATIONS
	WHITE CORROSION	RED CORROSION	
<i>Yellow Chromate</i> CONTAINS Cr6+	48 – 72 hrs.	96 – 120 hrs.	S309 / GME 00252 B3 / RES 21.ZS.01 PtC
Clear Trivalent*	4	72	GMW 3044 / 9K96/24
Clear Blue Trivalent	48	120	GMW 3044 MGRES 21 ZS 01
Iridescent Trivalent	96	240	BMW GS 90010 ZNT TRW TS 2-21-71A (& 79A)
Clear Trivalent + Seal*	24	96	GMW 3044 / MGRES 21 ZS 01 TRW TS 2-21-71B (& 79B)
Iridescent Trivalent + Seal *	120	384	GMW 3044 / FORD S437 TRW TS 2-21-71B (&79B)

Coefficients of friction can be supplied in the range 0.12 - 0.18 and 0.09 to 0.14 to suit most requirements

* Preferred finishes

CORROSION TEST

There is rarely a connection between the salty mist action resistance and the corrosion resistance in other surroundings, because a lot of elements that affect the corrosion process, such as protection layers formation, change considerably depending on the conditions. For this reason, the test results should not be considered a direct guide for the corrosion resistance of the metal materials in all surroundings in which these materials can be used.

In the same way, the different materials behaviour during the tests should not be considered as a direct indication of the corrosion resistance of these materials.

Nevertheless, the described method gives the possibility to check that the quality of a metal material, with or without a corrosion coating, is preserved.

Zinc is less noble than iron; the first protection is given by the zinc coating, that is corrosion resistance.

If the coat is damaged, the electrons which are set free move to the base material.

This process will continue to guarantee the corrosion resistance during the time.

MAIN ACTIVITIES

- Feeding Passivation Control
- Determination of polluting limits
- Operating Management of chemical-physical Passivation parameters
- Feeding Sealer Control
- Operating Management of chemical-physical Sealer parameters (corrosil 501)
- Polymerization temperature control of the item
- Cycle control from the washing before neutralization to the final washing after passivation
- Adjustment of barrel speed
- Rack control (hooks, contacts, frame)
- Thickness Control of high and low current intensity sections on similar products
- Measurement at least on two points of the product
- Thread functional Control
- Pre treatment control and improvement

EQUIPMENT

D.C.T.C. 600 P Angelantoni

In our Quality Management System Manual the following procedures are scheduled:

- ALL05_07_D Zinc plating values Control
- ALL05_07_O Data valuation of rack zinc plating line
- ALL05_07_P Data valuation of barrel zinc plating line
- ALL05_07_N Salt spray corrosion tests
- ALL05_07_M Tests registration

EXPERIENCES AND CONSIDERATIONS

Usually, the studies are carried out in test samples that differ from the mass-production. For products such as fittings, it is important to study the components and the coatings produced in the same conditions as the mass-production.

Therefore our results are based on researches carried out on items produced in conditions similar to the ones used for the mass production.

Fittings are produced in big amounts. For this reason it is certain that, during the production and assembly process, mixing and impacts occur. It is therefore necessary to consider the resulting damages.

In coatings without hexavalent chromium, the „auto-repairing effect“ is absent; this effect is particularly important for sealings and coatings sensible to impacts and abrasion.

RESULT EVALUATION

Several principles for the test results evaluation in relation to particular requirements may be applied, for example:

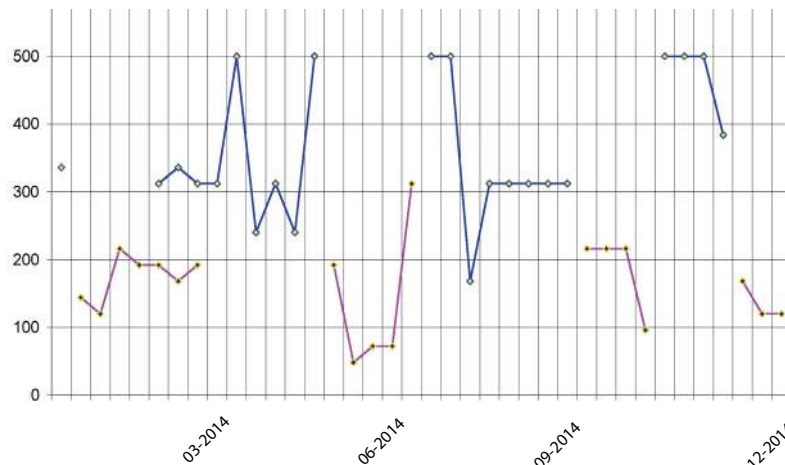
- aspect after the test
- aspect after the removal of the superficial corrosion products
- number and distribution of the defects arising from corrosion, such as pittings, cracks, scabs, etc.
- time for the first corrosion manifestation
- mass change
- changes visible under the microscope
- mechanical features changes.

The criterions we adopt are related in the test report. In particular, it is considered the superficial aspect as well as the distribution of defects caused by the corrosion compared to the time for the first corrosion manifestation.

SALTY MIST TREND

Year 2014

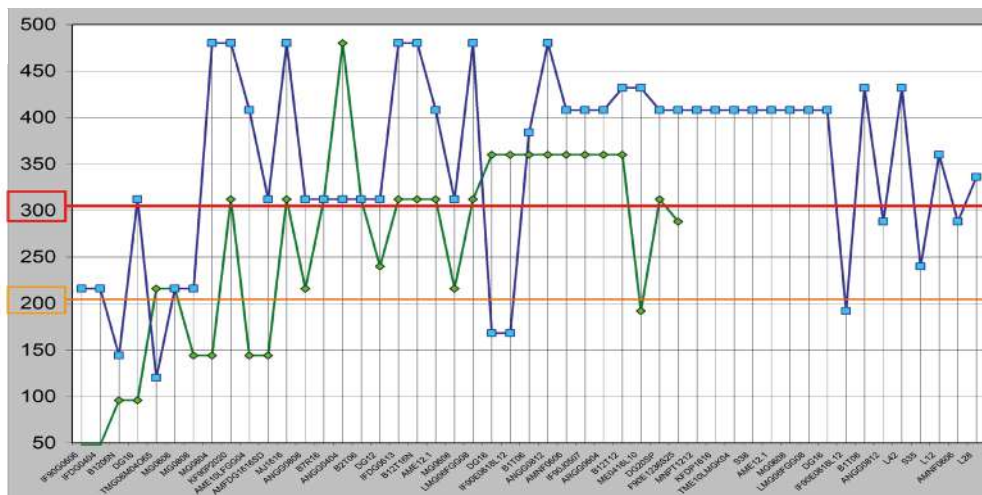
- ◆ Roto
- ◆ Static



SALTY MIST TREND

Year 2015 up to April

—●— Roto
—■— Static



EXAMPLE OF SALT SPRAY TEST

480hrs Test - Before and After



AFGJ04MG04R



AFGJ08MG06R



LMJ08FGJ08



PROVA DI CORROSIONE IN NEBBIA SALINA

All. 05.07.N Rev.0 del 25.10.07

N° 23

Prova :	Nebbia salina neutra // UNI ISO 9227		
Tipo di trattamento:	Zincatura cromo trivalente		
Descrizione pezzo / codice:	campionatura raccordi		
Data inizio prova:		<i>Durata della prova: VEDI TABELLA</i>	
Frequenza del controllo:	24h		
Apparecchiatura	D.C.T.C. 600 P Angelantoni	Tipo di atmosfera	Salt Spray Test
PH della soluzione (serbatoio)	6 - 7	Tipo di nebbia	Neutra
Temperatura in camera	35°C±2°C	Soluzione salina	NaCl 50 +/-5 g/l
PH della soluzione raccolta	6,5 - 7,2	K pluviometrica	1 - 2 ml/h - imbuto Ø 100mm
Pulitura finale	Asciugatura 30' - 60' - Risciacquo con acqua corrente		

LEGENDA	
B + n%	= indicazione % di superficie con focolai di corrosione bianca
G + n%	= indicazione % di superficie con corrosione grigia (decomposizione zinco)
R + n%	= indicazione % di focolai di corrosione rossa (corrosione metallo base)
F	= Festività
PF	=PROVA FINITA la ruggine rossa è evidente e supera il 5%

Campioni della prova:

CODICE	24h	48h	72h	96h	120h	144h	168h	192h	216h	240h	264h	288h	312h	336h	360h	384h	408h	432h	456h	480h	504h
AFGJ04MG04R	-	-	F	-	-	-	-	-	-	F	-	-	-	-	-	-	F	B	B 5%	PF	
AFGJ08MG06R	-	-	F	-	-	-	-	-	-	F	-	B	B	B 5%	PF						
AMJ08MG06R	-	-	F	-	-	-	-	-	-	F	-	-	-	-	-		F	B 5%	B 5%	PF	
AMJ12MG12R	-	-	F	-	-	-	-	-	-	F	-	-	-	B	B	B 5%	F	PF			
AMJ16MG16R	-	-	F	-	-	-	-	-	-	F	-	-	-	-	-		F	B 5%	B 5%	PF	
LMJ04FGJ04	-	-	F	-	-	-	-	-	-	F	-	-	-	-	-		F	B 5%	B 5%	PF	
LMJ08FGJ08	-	-	F	-	-	-	-	-	-	F	-	-	-	-	-		F	B 5%	B 5%	PF	
LMJ08MOG06	-	-	F	-	-	-	-	-	-	F	-	-	-	-	-		F	B 5%	B 5%	PF	
LMJ10FJ10	-	-	F	-	-	-	-	-	-	F	-	-	-	-	-		F	B 5%	B 5%	PF	
LMJ16FGJ16	-	-	F	-	-	-	-	-	-	F	-	-	-	-	-		F	B	B 5%	PF	
TMJ08FGJ08B	-	-	F	-	-	-	-	-	-	F	-	-	-	-	-		F	B	B 5%	PF	
TMJ08FGJ08P	-	-	F	-	-	-	-	-	-	F	-	-	-	-	-		F	B 5%	PF		