RUNNUR

Salt Spray Study

White Paper

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Introduction

This white paper presents a comprehensive exposition highlighting the inherent advantages and benefits of RUNNUR MAC (magnesium alloy coating) coated cable trays.

It focuses on the distinctive qualities and diverse applications of RUNNUR MAC cable trays in the electrical and industrial sectors. The unique RUNNUR MAC finish is distinguished by a blend of zinc-aluminium-magnesium, offering outstanding corrosion resistance, durability, and simplified installation. This distinctive characteristic surpasses traditional coating like hot-dipped galvanisation (HDG) and pre-galvanisation. The document thoroughly explores the unique properties of RUNNUR MAC and provides an in-depth comparison with conventional coating methods.

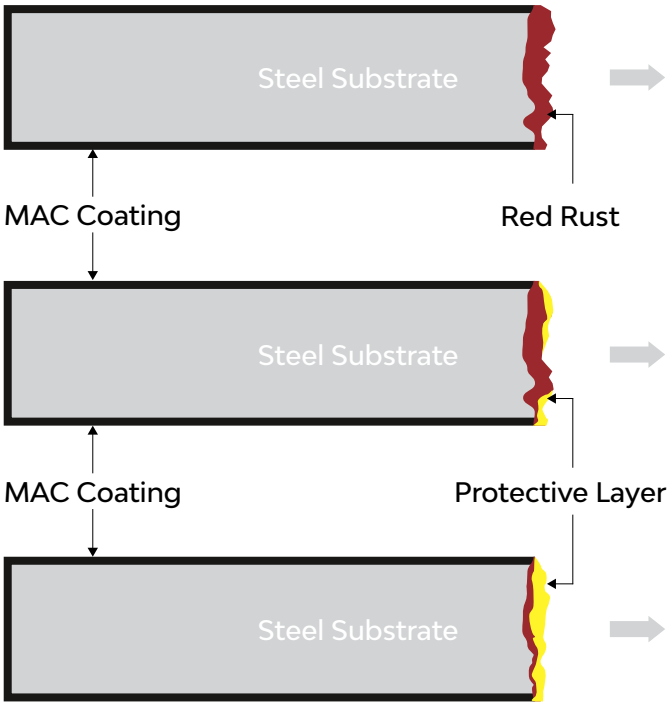
Corrosion Resistant and Self-Healing Properties

During the corrosion process, the strategic inclusion of magnesium within the RUNNUR MAC coating layer takes on a self-sacrificing role. It catalyses the formation of Simonkoelleite, a remarkably robust and dense corrosion-resistant substance. Once formed, Simonkoelleite acts as an exceptional corrosion inhibitor, providing shielding that safeguards the underlying base material.

The aluminium component persists and protects the base metal from the harsh environment, whereas the zinc in the coating layer undergoes corrosion and is gradually consumed. The combined reactions of zinc and aluminium provide protection to the base metal, even under the most severe conditions.

ⓘ Simonkolleite is a mineral compound with the chemical formula $Zn_5(OH)_8Cl_2 \cdot H_2O$. It is typically recognised by its blue-green hue and found as thin, platy crystals. Simonkolleite emerges as a product of corrosion, commonly forming on zinc-rich materials when exposed to moisture and chloride-containing substances.

RUNNUR MAC Self-Healing Mechanism



The exposed base material undergoes oxidation, resulting in red rust.

The magnesium present in the RUNNUR MAC layer gradually moves towards the exposed end, resulting in a transformation of the affected area into a shade of dark grey.

This transformation effectively inhibits any subsequent corrosion on the exposed section.

The Salt Spray Test

RUNNUR MAC-coated steel cable trays and other conventional products, such as hot-dipped galvanised, underwent an accelerated salt spray test (SST) at a local independent NATA-accredited facility. The test follows the guidelines of ASTM B117-19 and AS 2331.3.1, with an exposure of 3000 hours. While the traditional components exhibit significant corrosion and severe signs of red rust, RUNNUR MAC cable trays exhibit minimal to no corrosion.

Red rust is a form of corrosion that occurs on steel surfaces when they come into contact with oxygen and moisture. The formation of red rust indicates that the initial protective coating layer, intended to shield the base metal, has been damaged and compromised. Beyond its negative impact on the visual appeal of metal components, red rust also poses risks to the structural integrity of the metal, potentially leading to catastrophic damage in severe instances.

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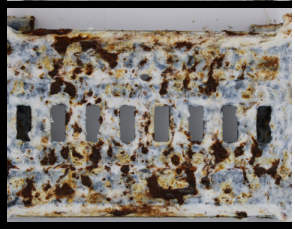
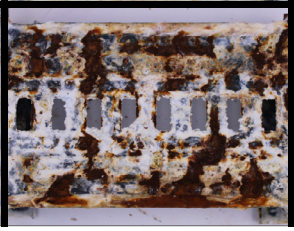
SST	RUNNUR MAC	Alternative A	Alternative B	Alternative C
1000 hours				
2000 hours				
3000 hours				

Finish	Comments
RUNNUR MAC	No corrosion was observed on the substrate. The RUNNUR MAC coating has undergone complete oxidation.
Alternative A	The majority of substrate corrosion observed on the surface facing the salt fog generator appears as varying-sized spots resulting from blister rupture. In most areas, the zinc coating has oxidised, while smaller patches exhibit only a dulling effect.
Alternative B	The presence of steel corrosion spots with different diameters can be attributed to the blistering of the zinc coating. The zinc coating, where still intact, has experienced oxidation throughout its surface.
Alternative C	The presence of steel corrosion spots, exhibiting varying diameters, can be attributed to the blistering of the zinc coating. Moreover, a consistent oxidation of the zinc coating has been observed throughout its entire surface, including areas where it remains intact.

Dissimilar Metal and Galvanic Corrosion

Dissimilar metals refer to two or more different types of metals that are in contact with each other. These metals have distinct chemical compositions, physical properties, and electrochemical behaviours. When dissimilar metals come into contact, there is a potential for galvanic corrosion or other adverse reactions due to the difference in their electrochemical potentials. It is important to consider the compatibility and potential risks associated with dissimilar metals when designing or implementing systems to prevent corrosion and maintain structural integrity.

Galvanic corrosion, also known as bimetallic corrosion, is an electrochemical process that occurs when two different metals or alloys with different electrochemical potentials are in contact with each other in the presence of an electrolyte, such as moisture.

The process of galvanic corrosion involves the flow of electric current between the dissimilar metals, leading to the accelerated corrosion of the more reactive metal, anode. The less reactive metal, on the other hand, acts as a cathode.

Several factors contribute to the occurrence of galvanic corrosion:
1) Presence of electrolyte – to create a conductive path between the dissimilar metals
2) Difference in electrochemical potentials

*The electrolyte facilitates the flow of ions, enabling the electrochemical reactions to take place.

The severity of galvanic corrosion depends on various factors:
1) Nature of the metals involved
2) The surface area ratio between anode and cathode
3) The conductivity of electrolyte
4) The environmental conditions

To prevent galvanic corrosion, measures such as electrical insulation, the use of protective coatings, and **the application of sacrificial anodes or cathodic protection systems can be employed** – like the use of zinc, aluminium and magnesium in RUNNUR MAC coating.

Material	Electrochemical Potential
RUNNUR MAC Steel	-1.10V
Aluminium (6005-T5)	-0.90V
Stainless Steel (SUS304)	-0.53V

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According to UL 2703, dissimilar metal combinations are deemed acceptable if the electrochemical potential difference is below 0.6V. Consequently, RUNNUR MAC is a suitable choice for use in conjunction with aluminium (6005-T5) as per the standard's specifications.

Magnesium, magnesium alloys	Zinc, zinc alloys	80 tin/20 Zn on steel, Zn on iron or steel	Aluminium	Cd on steel	Al/Mg alloy	Mild steel	Duralumin	Lead	Cr on steel, soft solder	Cr on Ni on steel, tin on steel, 12% Cr stainless steel	High Cr stainless steel	Copper, copper alloys	Silver solder, austenitic stainless steel	Ni on steel	Silver	Rh on Ag on Cu, silver/gold alloy	Carbon	Gold, platinum	
0	0.05	0.55	0.7	0.8	0.85	0.9	1.0	1.05	1.1	1.15	1.25	1.35	1.4	1.45	1.6	1.65	1.7	1.75	Magnesium, magnesium alloys
	0	0.05	0.2	0.3	0.35	0.4	0.5	0.55	0.6	0.65	0.75	0.85	0.9	0.95	1.1	1.15	1.2	1.25	Zinc, zinc alloys
		0	0.15	0.25	0.3	0.35	0.45	0.5	0.55	0.6	0.7	0.8	0.85	0.9	1.05	1.1	1.15	1.2	80 tin/20 Zn on steel, Zn on iron or steel
			0	0.1	0.15	0.2	0.3	0.35	0.4	0.45	0.55	0.65	0.7	0.75	0.9	0.95	1.0	1.05	Aluminium
				0	0.05	0.1	0.2	0.25	0.3	0.35	0.45	0.55	0.6	0.65	0.8	0.85	0.9	0.95	Cd on steel
					0	0.05	0.15	0.2	0.25	0.3	0.4	0.5	0.55	0.6	0.75	0.8	0.85	0.9	Al/Mg alloy
						0	0.1	0.15	0.2	0.25	0.35	0.45	0.5	0.55	0.7	0.75	0.8	0.85	Mild steel
							0	0.05	0.1	0.15	0.25	0.35	0.4	0.45	0.6	0.65	0.7	0.75	Duralumin
								0	0.05	0.1	0.2	0.3	0.35	0.4	0.55	0.6	0.66	0.7	Lead
									0	0.05	0.15	0.25	0.3	0.35	0.5	0.55	0.6	0.65	Cr on steel, soft solder
										0	0.1	0.2	0.25	0.3	0.45	0.5	0.55	0.6	Cr on Ni on steel, tin on steel, 12% Cr stainless steel
											0	0.1	0.15	0.2	0.35	0.4	0.45	0.5	High Cr stainless steel
												0	0.05	0.1	0.25	0.3	0.35	0.4	Copper, copper alloys
													0	0.05	0.2	0.25	0.3	0.35	Silver solder, austenitic stainless steel
														0	0.15	0.2	0.25	0.3	Ni on steel
															0	0.05	0.1	0.15	Silver
																0	0.05	0.1	Rh on Ag on Cu, silver/gold alloy
																	0	0.05	Carbon
																		0	Gold, platinum

Ag = Silver
Al = Aluminium
Cr = Chromium
Cd = Cadmium
Cu = Copper
Mg = Magnesium
Ni = Nickel
Rh = Rhodium
Zn = Zinc

NOTE. – Corrosion due to electrochemical action between dissimilar metals which are in contact is minimized if the combined electro-chemical potential is below about 0.6V. In the following table the combined electrochemical potentials are listed for a number of pairs of metals in common use; combinations above the dividing line should be avoided.

S3426E

Source: UL 2703-2015

Notes

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