

ArcelorMittal Europe – Flat Products

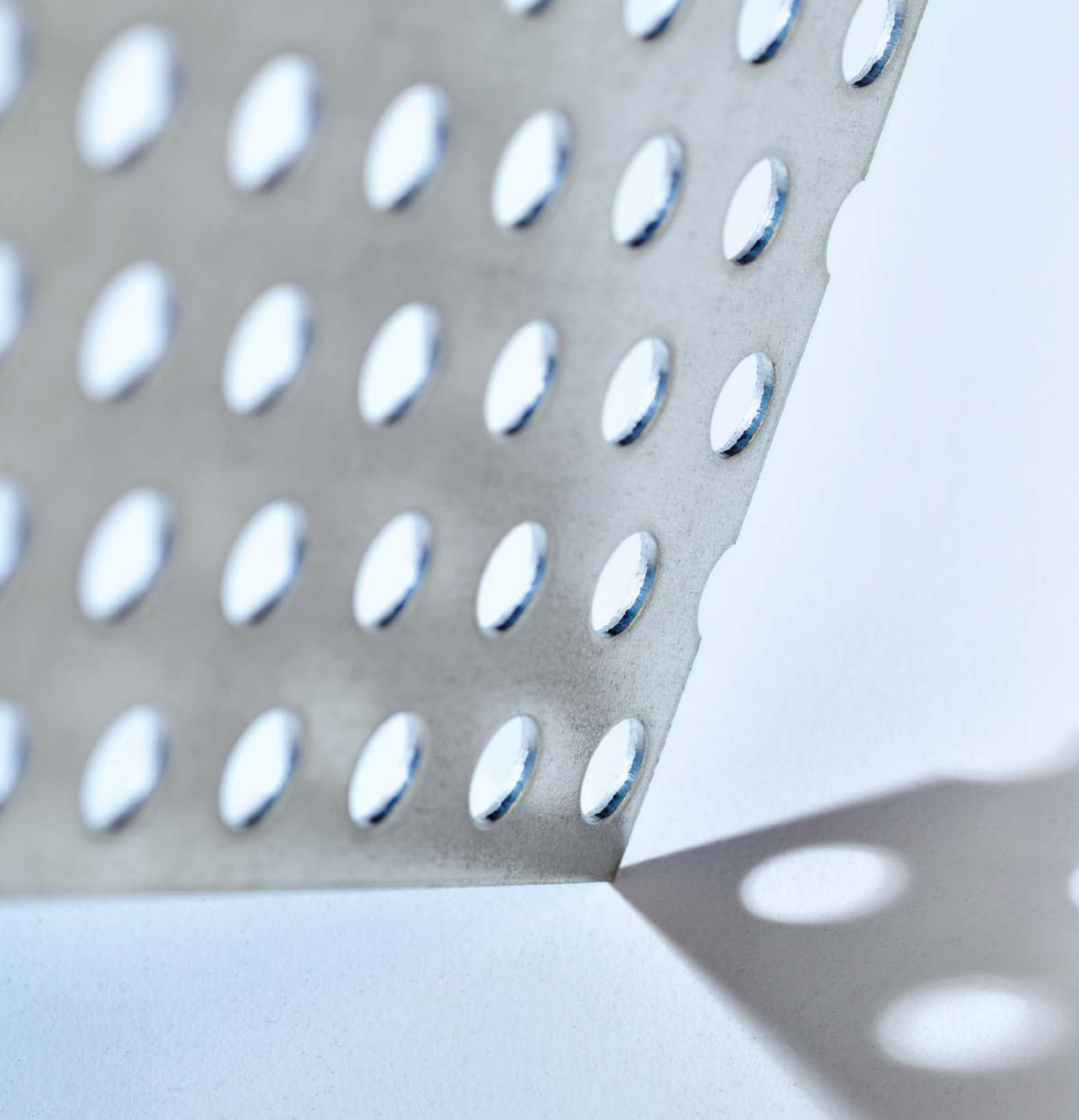


ArcelorMittal

Protected by

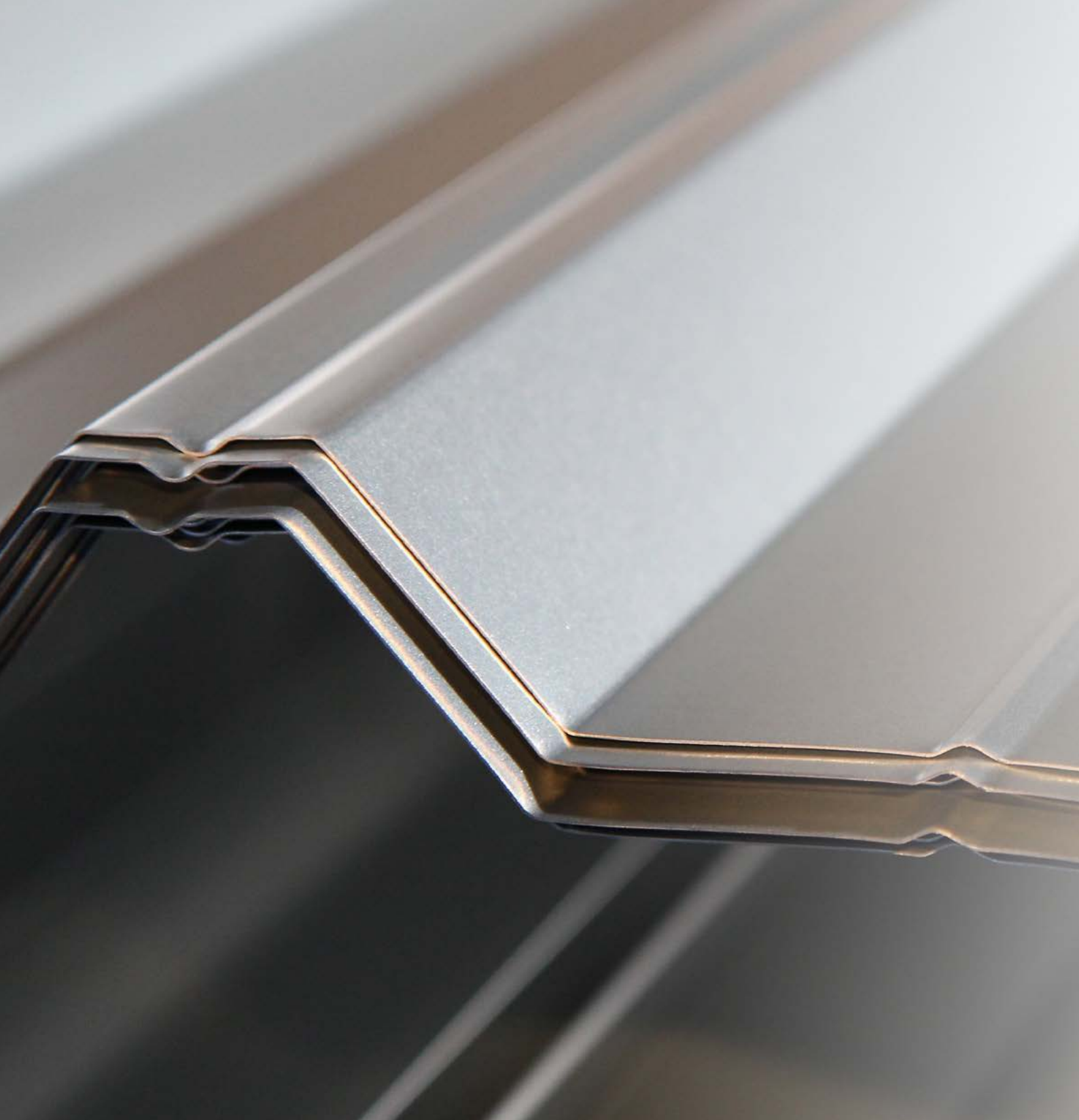
Magnelis®





Protected by

Magnelis[®]



Protected by

Magnelis®

5

7	What is Magnelis®?
9	Outstanding corrosion performance
11	Corrosion protection mechanism
13	Edge protection with self-healing effect
15	Corrosion resistance, accelerated corrosion tests
17	Corrosion resistance, proven across the world
19	Coating design life of 50+ years
21	Cost advantages over competing solutions
23	Technical specifications
25	Easy to process
27	Standards
29	Certifications & technical approvals
31	The environmentally responsible coating
33	Co-engineering Magnelis® solutions
	Magnelis®, the best metallic coating through a large panel of markets
37	Magnelis® outperforms pre-coated welded tubes
39	The durable coating for solar structures
41	Optimum abrasion resistance for steel solar structures in deserts
43	Magnelis®, superior behaviour in soils
45	Optimal protection for agricultural applications
49	Durability guaranteed
51	Diverse range of applications
53	Durable safety barriers, lighting poles, acoustic walls...
55	Appliances and electrical equipment
57	Benefits of Magnelis® in a nutshell



Main advantages

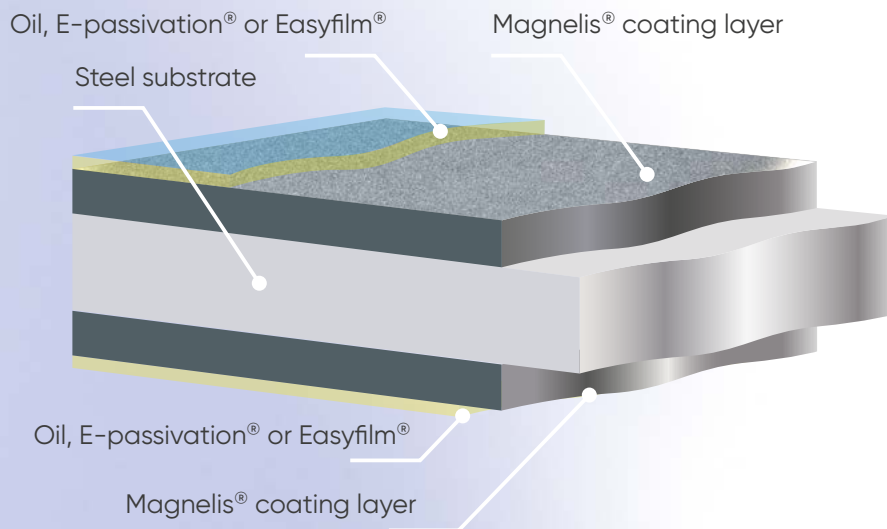
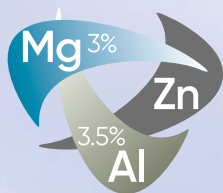
- Excellent corrosion resistance:
three times better than galvanised steel
(based on outdoor tests)
- Self-healing effect
ensures excellent edge protection
- Best and most cost-effective alternative
to post-galvanised steels
- Wide feasibility range
- Excellent processing properties
- Environmentally friendly

What is Magnelis® ?

Magnelis® is an exceptional metallic coating which provides a breakthrough in corrosion protection. Magnelis® is also the best choice for a wide variety of applications.

Thanks to its unique composition, Magnelis® provides an unprecedented level of surface and cut-edge protection, even in the most hostile environments.

Magnelis® is produced on a classic hot dip galvanising line, but the molten bath has a unique chemical composition including zinc, 3.5% aluminium, and 3% magnesium.



Magnelis® has a naturally dark grey aspect. It is available with environmentally-friendly surface treatments: E-passivation® and Easyfilm®. It can be oiled on request.

Magnelis® provides
outstanding corrosion resistance,
even in harsh environments

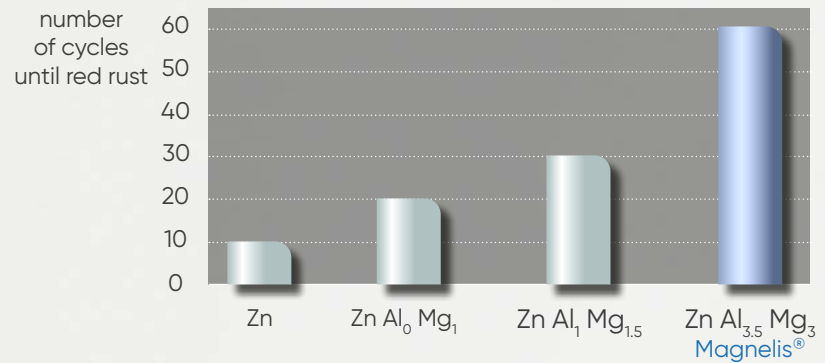


Outstanding corrosion performance

Magnelis® resists corrosion for longer than standard galvanised products and it outperforms coatings containing less aluminium and magnesium.

The specific composition of Magnelis® (3% Mg and 3.5% Al) is crucial as it leads to a stable and durable layer across the entire surface and edges of the steel. This provides more effective corrosion protection than coatings with a lower aluminium and magnesium content.

Corrosion resistance in cyclic test for different Zn, Al, Mg compositions



10 µm of coating submitted for an alternated cycling of 8 hours fog cycle (5% NaCl) / dry cycle / humidity cycle
Source: ArcelorMittal Global R&D



Magnelis® offers
deformed surfaces
extra protection

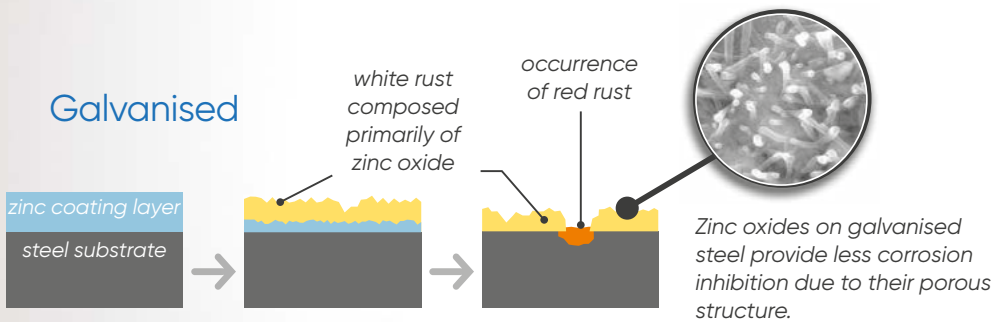
Corrosion protection mechanism

The specific composition of Magnelis® (3% Mg and 3.5% Al) is crucial as it leads to the formation of a very dense, stable, and durable layer of protection. The compact layer of Magnelis® acts as a barrier to corrosion, preventing the underlying steel from coming into contact with the ambient environment. The result is highly effective corrosion protection, even in the harshest environments.

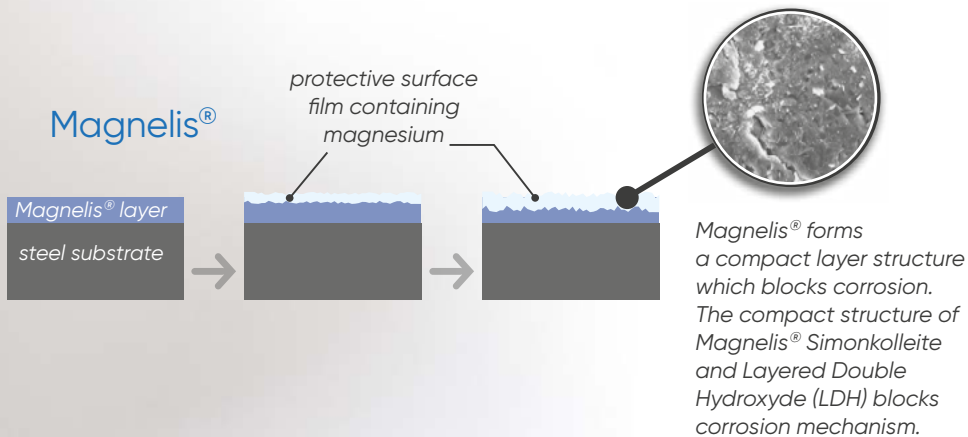
Best protection for deformed areas

Magnelis® will even form a dense layer on highly deformed zones. This gives deformed steel shapes the same protection as flat surfaces. This is a key advantage of Magnelis® compared to other metallic coatings.

Galvanised

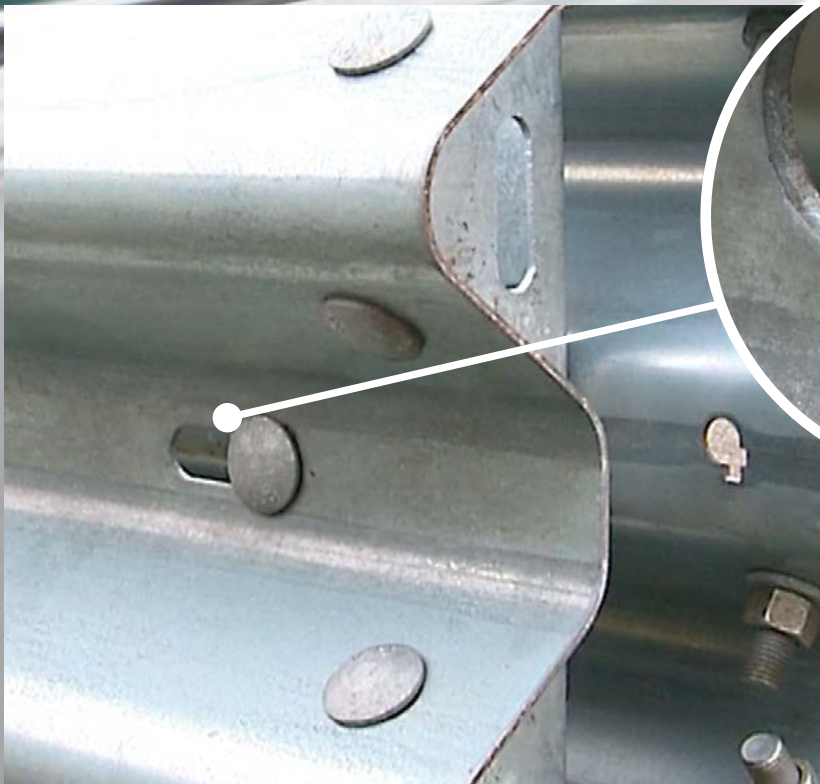


Magnelis®



No red rust observed after 1440 hours of salt spray testing on Magnelis® cup, where the galvanised cup is completely corroded.

The self-healing effect of Magnelis® ensures the protection of uncoated edges, scratches and perforations



The perforated zone on a safety barrier is protected by the self-healing effect of Magnelis®.

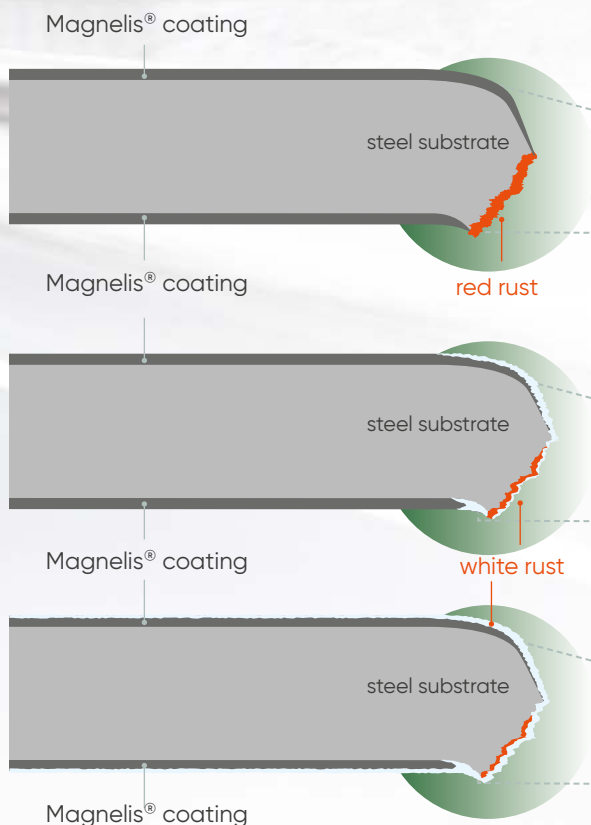
Edge protection with self-healing effect

When exposed to the environment, Magnelis® forms a very dense zinc-based protective film, unlike galvanised where the film is very porous.

This unique dense film is also formed on edges, welds, perforations and scratches. In case some red rust was present on these uncoated zones, the red rust will be gradually covered by the Magnelis® film.

It is almost impossible for the environment to penetrate this film. The result is that Magnelis® provides perfect protection of the whole structure, even on the uncoated edges, scratches and perforations.

Increasing the coating weight will improve edge protection, especially for thick material.



Initial exposure period (up to several weeks)*

The exposed cut end of the substrate is oxidised and forms red rust.



Subjected to rain and condensation (beyond several weeks)*

The zinc-based film containing magnesium on the coating layer migrates over the cut end.




Long exposure period (after more than a year)*

Disappearance of red rust and increase in white rust.



* The speed of the self-healing depends on the environment.

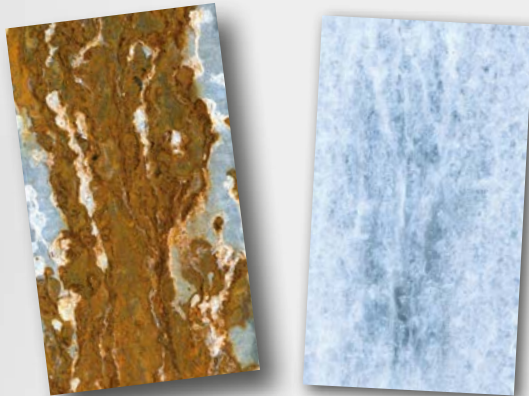
A woman with dark hair tied back, wearing a white lab coat and safety glasses, is seen from the back and side. She is standing in a laboratory, looking into a fume hood. The fume hood is a large, white, rectangular structure with a glass front and a metal top. Inside the hood, there are several glass beakers and test tubes. The background is a brick wall with various pipes and conduits. The lighting is bright, and the overall atmosphere is professional and scientific.

The superior corrosion resistance of Magnelis[®] has been demonstrated in accelerated laboratory testing and proven through outdoor tests

Magnelis[®] samples are tested in the laboratory.

Corrosion resistance, accelerated corrosion tests

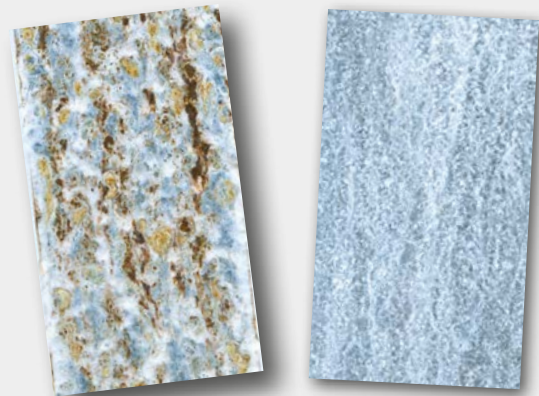
Magnelis® versus pre-galvanised
(salt spray test)



Hot dip galvanised 20 µm
after 6 weeks

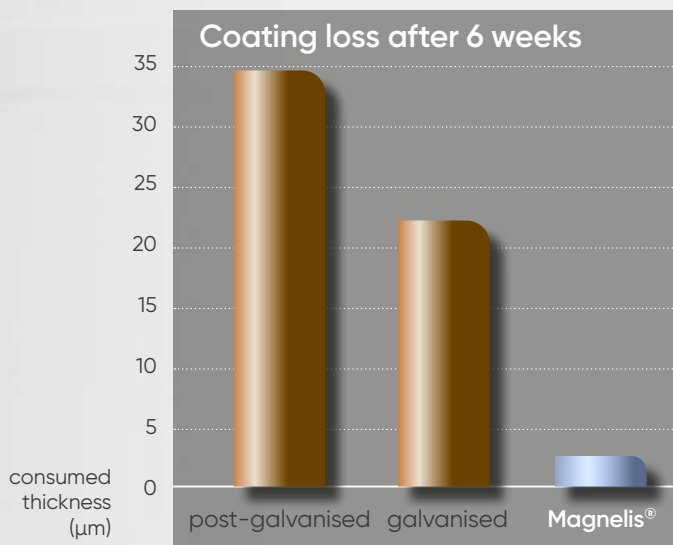
Magnelis® 20 µm
after 34 weeks

Magnelis® versus post-galvanised
(salt spray test)



Post-galvanised 85 µm
after 12 weeks

Magnelis® 20 µm
after 12 weeks

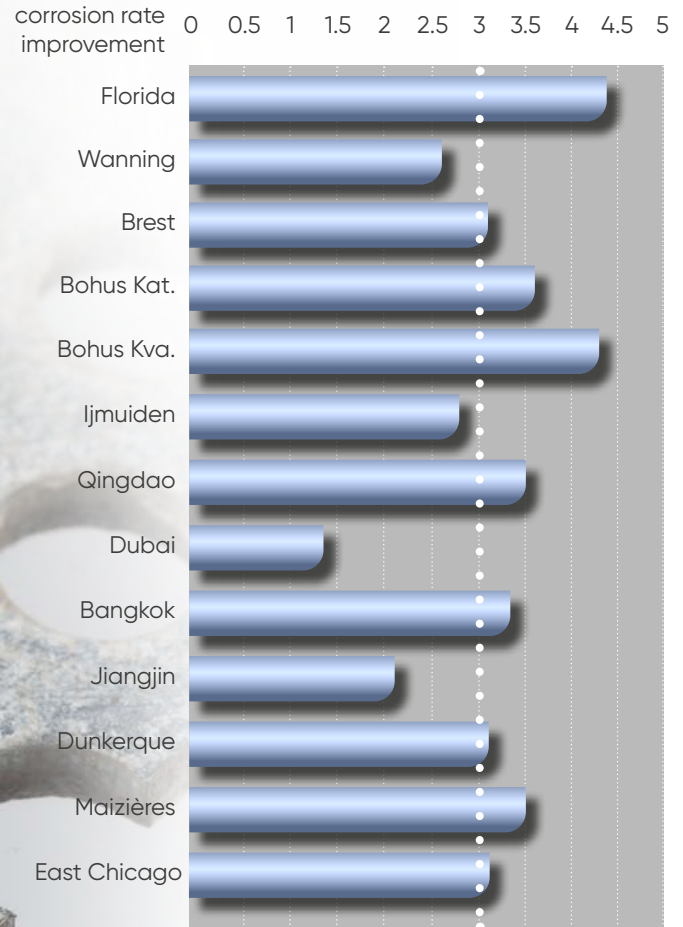


Salt spray and cyclic corrosion test results highlighted the superior performance of Magnelis® compared to other metallic coatings. No red rust was observed on steel with a 20 µm coating of Magnelis® after 34 weeks of salt spray testing. Magnelis® offers a real advantage over post-galvanised steel.

These are results from a 3CT (VDA 621-415) cyclic corrosion test. Source: ArcelorMittal Global R&D

Magnelis® outperforms galvanised steel in all types of environments

After 6 years of testing, Magnelis® behaves on average 3 times better than regular galvanised steel



Highly perforated Magnelis® ZM250 sample after 10 years outside exposure at the French Corrosion Institute in Brest.

Corrosion resistance, proven across the world

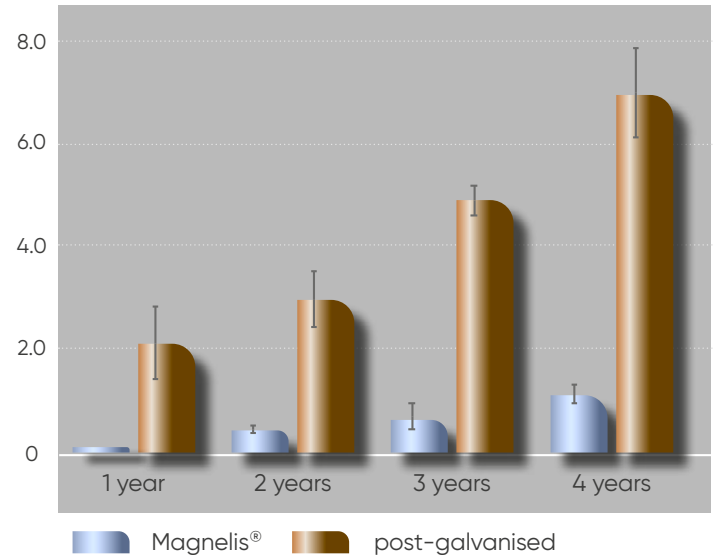
More than a thousand Magnelis® samples have been exposed to a variety of different environments around the world in outdoor tests. These tests covered the full range of outdoor environment categories (rural, industrial, marine, tropical, ...).

The samples included shapes such as flat sheets, tubes and profiles, and a range of different dimensions.

These tests have proven the improved durability of Magnelis® compared with regular galvanised steel.

In addition, updated Brest testing field results confirm the outstanding performance of Magnelis® compared with post-galvanised steel.

Average total coating consumption (μm)
with standard deviation
measured in Brest testing field



Magnelis® is the only metallic coating product certified for use in a C5 environment



*Magnelis® samples
at the French Corrosion
Institute in Brest.*

Coating design life of 50+ years

Based on all outdoor field tests, ArcelorMittal has calculated the coating design life¹ expectations for Magnelis® ZM310, ZM430 and ZM620 (respectively 25, 35 and 50 microns per side).

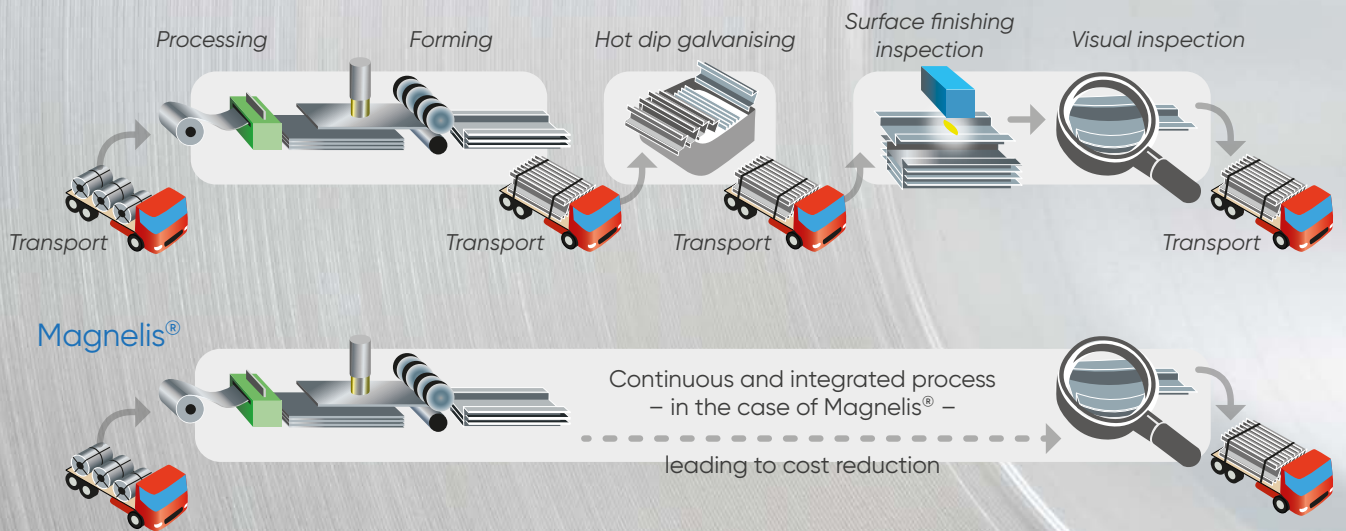
Corrosion category for Zn (ISO 12994-2:2017)	Coating design life (years ¹)		
	Magnelis® ZM310	Magnelis® ZM430	Magnelis® ZM620 ²
C2	> 50	> 50	> 50
C3	30 to > 50	40 to > 50	> 50
C4	15 to 30	20 to 40	30 to > 50
C5	8 to 15	10 to 20	15 to 30

¹ The expected coating design life is the average time until 100% of the undamaged coating, exposed only to atmospheric conditions, is consumed on the surface. At that point, the structural integrity of the coated part is no longer assured and major repair is necessary. These estimates are valid for both outdoor and indoor applications, excluding situations where the coating is in permanent contact with a moisture source, such as soil or concrete. These durations are indicative and non binding.

² feasibility on request

Please note that in June 2023, Magnelis® ZM620 was not included in the EN10346:2015 norm.

Post-galvanised versus Magnelis®



Cost advantages over competing solutions

Advantages over post-galvanised steels

- Freedom to optimise designs thanks to the ability of Magnelis® to protect deformed shapes
- Lower weight of Magnelis® coating (depending on environment) to obtain the same level of corrosion resistance
- Protects flat and deformed surfaces as well as cut edges
- Shortens the logistics chain thanks to simpler fabrication processes.

Cost effective compared to stainless steel and aluminium

- Magnelis® provides the high level corrosion resistance of stainless and aluminium at a significantly lower cost.

Reduces maintenance costs compared to post-painting:

- The use of Magnelis® can avoid the need for post-painting. This leads to cost savings and productivity improvement
- The extended durability of Magnelis® results in reduced maintenance.

Magnelis®

Think strategy



Technical specifications

Magnelis® is applied to the steel on a continuous hot dip galvanising line.

The steel strip is dipped into a molten bath of Magnelis® which includes zinc, 3.5% aluminium, and 3% magnesium.

By closely controlling the process conditions, ArcelorMittal is able to ensure the optimal properties of the final product.

Magnelis® can be applied to a very wide range of steel grades. These include steels for cold forming and deep drawing applications, as well as structural and high strength, low alloy steels.

Steel thickness can range from 0.4 to 6 mm, while the coating can be from 5 to 50 µm/per side (ZM620).

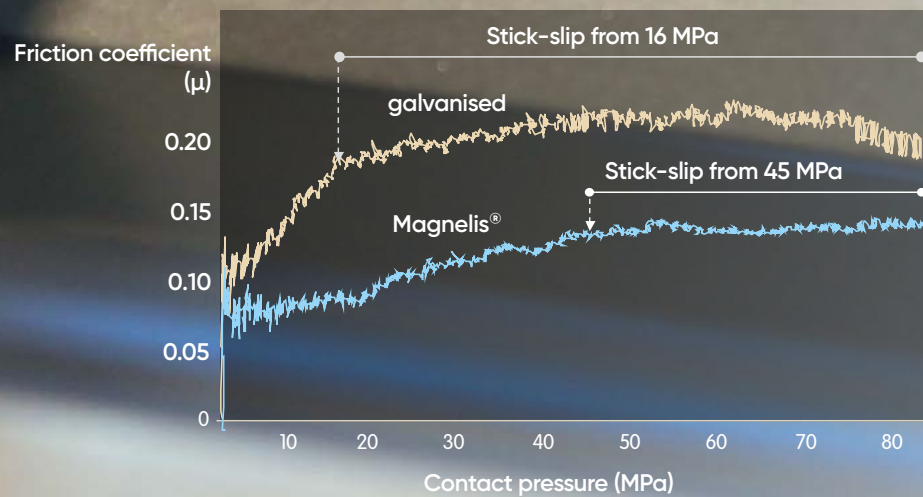
Coating designation		ZM70	ZM90	ZM120	ZM175	ZM200	ZM250	ZM310	ZM430	ZM620 ^{1/2}
Coating mass (total both sides)	g/m ²	70	90	120	175	200	250	310	430	620
Coating thickness	µm/per side	5	7	10	14	16	20	25	35	50
Aspect	MA and MB aspect*									
Surface treatment	C (E-Passivation® CrVI-free), O (oiled), S (Easyfilm®) ²									
Thickness	0.4 to 6.0 mm (0.016 to 0.236 inches)									
Width	Up to 1680 mm (66 inches)									
Steel grades ²	DX51D to DX57D+ZM S220GD to S450GD+ZM (according to EN 10346:2015) S420GD-HyPer® to S700GD-HyPer®+ZM (Eurocode compliant) HX260LAD up to HX500LAD+ZM (according to EN 10346:2015) HX600LAD and HX700LAD+ZM									

¹ Please note that in June 2023, Magnelis® ZM620 was not included in the EN10346:2015 norm.

² feasibility on request

Friction test

Magnelis[®] offers improved friction behaviour.



Lubrication Oil Fuchs 41075 in excess
Source: ArcelorMittal Global R&D

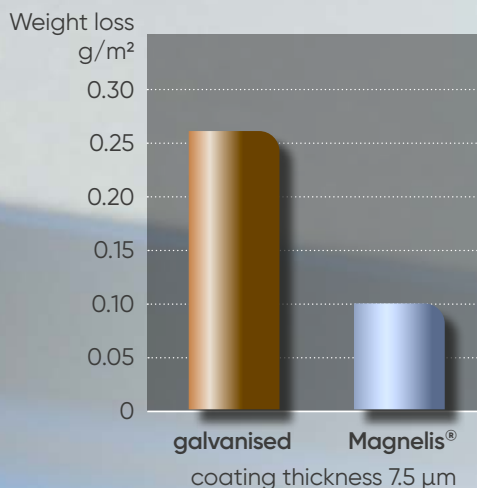
Easy to process

Thanks to its highly resistant, adherent metallic layer, Magnelis® can be processed using a variety of methods. These include bending, drawing, and profiling. Magnelis® maintains a high level of corrosion protection, even in the deformed zones.

Outdoor exposure tests have confirmed the exceptional corrosion resistance of Magnelis® on deformed parts compared to galvanised steel. The Magnelis® barrier protects the entire surface including cut edges and perforations.

Powder behaviour comparison

Magnelis® reduces powdering behaviour.



Lubrication Oil Fuchs 41075 in excess
Source: ArcelorMittal Global R&D

Formability

Magnelis® provides better results for workability of the product and protection of the processing tools.

Friction tests show that Magnelis® performs better than hot dip galvanised steel.

Steels coated with Magnelis® are easy to process and do not harm processing tools. Magnelis® also enables manufacturers to deform the steel without the need for a lubricant, something that is not possible with galvanised steels.

Weldability

Arc, spot, and high frequency induction (HFI) welding techniques are compatible with Magnelis®.

Magnelis® offers improved weldability due to its thinner coating. Magnelis® can be welded with similar processes to zinc-coated products with adjusted parameters case by case. For arc welding, the same welding consumables, procedures, and guidelines can be used.

In cases where welded areas need to be re-protected, Magnelis® demonstrates even better corrosion resistance than a post-galvanised coating.

Paintability

Magnelis® can be post-painted and offers superior corrosion resistance compared to other metallic coated steels.



Standards

Magnelis® is included in the EN 10346:2015 standard, extended in July 2015 to include zinc-aluminium-magnesium coatings. Whenever norm compliance is a prerequisite, architects, engineers and construction companies can now propose Magnelis®. Magnelis® is the preferred material for an increasing number of applications, including solar support structures, light steel framing in construction, agricultural applications and road infrastructure.

Magnelis® is included in the new version of ASTM A1046-17. Magnelis® is classified as a Type 2 coating.

Magnelis® is suitable for food contact applications in accordance with European regulation EC 1935/2004.

Magnelis® complies with the European directives covering:

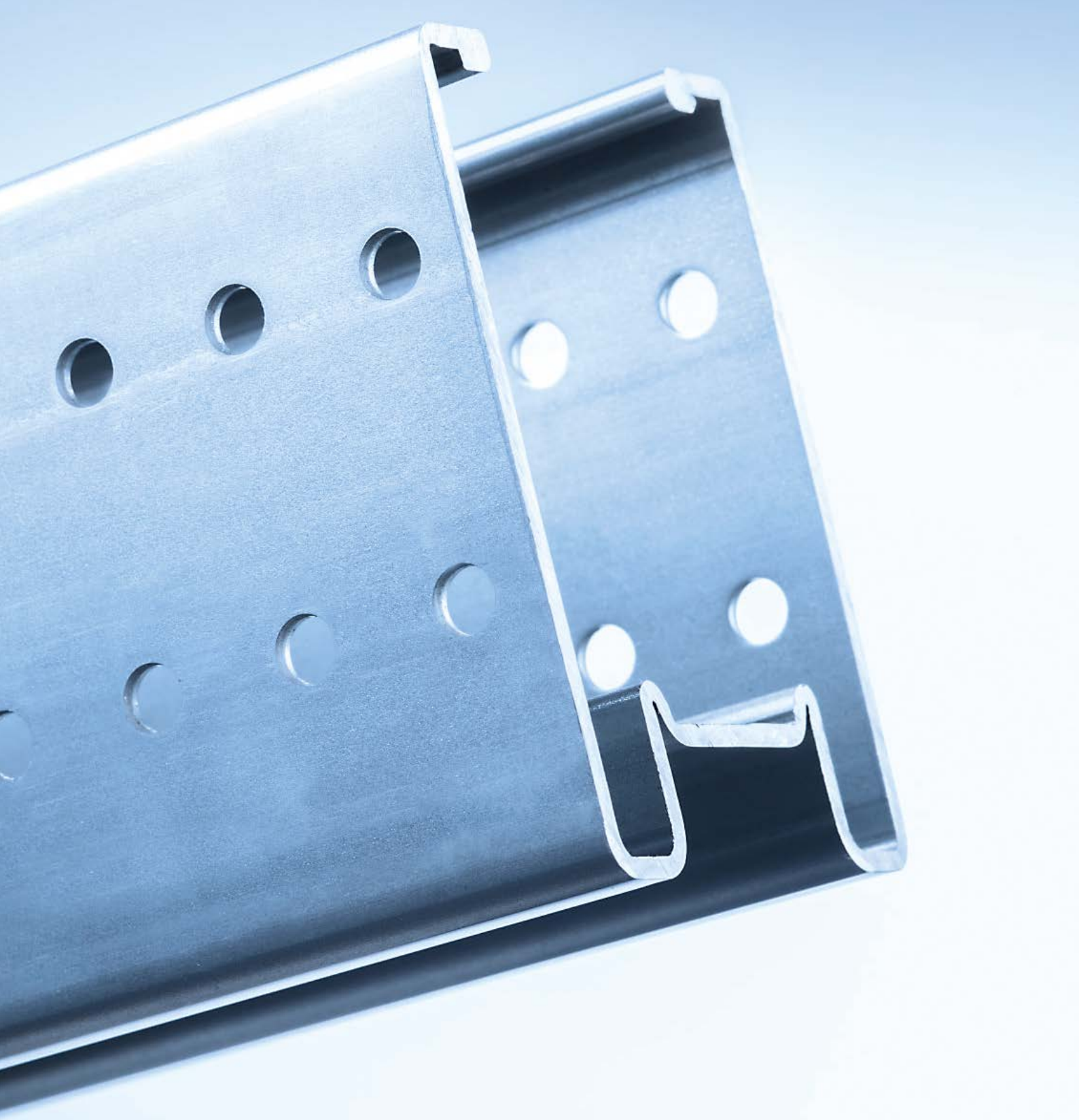
- Restriction of Hazardous Substances (RoHS)
- Registration, evaluation, authorisation and restriction of chemicals (REACH)
- Waste Electrical and Electronic Equipment (WEEE)

Coating weights

According to EN 10346:2015*

Coating Designation	Minimal total coating mass both surfaces (g/m ²)		Theoretical guidance values for coating thickness per surface in the single spot test (µm)	
	Triple spot test	Single spot test	Typical value	Range
	Zinc-Magnesium alloy coating masses (ZM)			
ZM70	70	60	5.5	4 to 8
ZM90	90	75	7	5 to 10
ZM120	120	100	9	6 to 14
ZM175	175	145	13	9 to 18
ZM200	200	170	15	10 to 20
ZM250	250	215	19	13 to 25
ZM310	310	265	24	18 to 31
ZM430	430	365	35	26 to 46
ZM620*	620	525	50	34 to 66

* Please note that in June 2023, Magnelis® ZM620 was not included in the EN10346:2015 norm.



Certifications & technical approvals

Germany: DIBt certification

Magnelis® is positioned as best-in-class for durability versus other ZM coatings according to DIN 55634-1- 2017.

Sweden: RISE certification

Technical approval no. SC0559-13: Magnelis® is the first metallic coated product that is certified for use in a C5 environment.

France: CSTB certification

Magnelis® has been recognised by CSTB as a superior coating after two technical studies (Evaluation Technique de Produits et Matériaux). The most recent conclusions include thickness up to 6.0 mm and coating up to ZM620.

UK: SCI performance review

The Steel Construction Institute in UK concluded that Magnelis® ZM120 provides corrosion protection which is not less than the corrosion protection provided by Z275 coating and is well suited for the same applications as the Z275 coating when specified in UK and Irish construction.

Russia: Gost assessment

Low carbon steels with Magnelis® coating have high protective properties.

Technical approvals for crash barriers

Magnelis® solutions have been certified by bodies which oversee the crash barrier product regulations in Austria, Belgium, the Czech Republic, Norway and Spain. Certification is ongoing in other countries.

CSTB
ETPM N° 22/0081

EVALUATION TECHNIQUE DE PRODUITS ET MATERIAUX
N° 22/0081 du 08 Novembre 2022

concernant le produit de revêtement métallique sur tôle d'acier
« **MAGNELIS®** »

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DIBt
Deutsches Institut für Bautechnik

Zulassungsstelle für Bautechnische und Bauwesen Bautechnisches Prüfamt
Eine vom Bund und den Ländern gemeinsamer geprüfter Anstalt des öffentlichen Rechts Mitglied der DIN EN ISO 9001 und der ISO 14001

National technical approval / General construction technique permit

Z-28.15-51

Application: ARCELOMITTAL FLAT CARBON EUROPE
24-26, Boulevard d'Anvaert
1160 LUXEMBOURG
LUXEMBOURG

Subject of decision: Steel strips protected against corrosion by "Magnelis®", a metallic coating, to be used for the production of thin-walled, cold formed members

Validity: from 17 September 2019 to 17 September 2024

The subject named above is herewith granted a national technical approval (allgemeine bauaufsichtliche Zulassung) / general construction technique permit (allgemeine Baugenehmigung). This decision contains eight pages. The subject concerned was granted the first national technical approval on 23 July 2013.

Translation authorised by DIBt

DIBt
DIN | Köln | www.dib.de

RISE
Type Approval and decision on production control
SC0559-13

Magnelis ZM310, Corrosion protection

Manufacturer: ArcelorMittal Europe - Flat Products
24-26 Boulevard d'Anvaert, L-1160 Luxembourg
Organisation number/VAT number: LU93917034
Web: www.arcelormittal.com

Information supplied to: RISE Certification Europe - Flat Products, Rue Verte-vole, 40, BE-4400 Schiemen, Belgium
Tel: +22 4 222 21 99, E-mail: sc@rise.be

Product description: Corrosion protection coating, Magnelis ZM310, is a special coating composed by a matrix of zinc, aluminium and magnesium.

Intended use: Intended as corrosion protection of steel sheet for indoor and outdoor applications. The corrosion protection is suitable for corrosivity class C5, according to EN ISO 12944-2 described class, based on a designed expected lifetime of 20 years.

Trade name: Magnelis ZM310.

Approval: The product satisfy the requirements of fourth in chapter 8.4.5 I REL, in respect to and under conditions stated in this certificate, and are therefore approved in accordance with the provisions of the following sections of standard mandatory provisions on application of the European construction standards (Eurocodes) EN 51.

ENX: Durability: Section A, 151
Durability: Section G, 4.5

Associated documents: -

Control: The factory production control (FPC) is monitored by an independent inspection body. Control agreement: Approval date: 2014-02-28, inspection body: Kurtarup Institut for Technologi Control agreement: 2014-04-01, inspection body: RISE Research Institute of Sweden AB.

In production and during its service life, Magnelis® has a significant lower environmental impact compared to its competitors

ENVIRONMENTAL PRODUCT DECLARATION
as per ISO 14025 and EN 15804+A2

Owner of the Declaration	Arceormittal Europe – Flat Products
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-ARC-20220236-CBA1-EN
Issue date	16/11/2022
Valid to	15/11/2027

XCarb® Recycled and Renewably produced hot dip galvanized steel with Magnelis® Coating
Arceormittal

www.ibu-epd.com | https://epd-online.com



Green steel certificate

Arceormittal

Presented to:

Customer name

Customer address

This certificate attests that Arceormittal Europe - Flat Products has saved 2712 metric tonnes of CO₂e and that *Customer* has purchased 1000 metric tonnes of XCarb® green steel certificates from *Sales Organisation*. This will enable *Customer* to report an equivalent reduction in their Scope 3 emissions in accordance with the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard. DNV GL Business Assurance Services UK Limited has verified the CO₂e savings and corresponding purchase of XCarb® green steel certificates.

Certificate number	CO ₂ e savings	Certificate quantity	Issue date
12345-67	2712 tonnes	1000 tonnes	01 January 2022

Independent Assurance

We commissioned DNV to provide assurance over the CO₂e savings used by Arceormittal as the basis for issuing XCarb® green steel certificates. For DNV's assurance statement, scan QR code or visit: <https://www.dnv.com/assuranceservices/arc>

For the issuing office:
Arceormittal Flat Carbon Europe
S.A. 26 Boulevard of Arranches
1700 Luxembourg

[Signature]
CEO
Arceormittal Europe

XCarb®
Green steel certificate

XCarb® green steel certificates can be purchased alongside your Magnelis® order.

Magnelis® is available as XCarb® recycled and renewably produced coated steel exhibiting a CO₂e footprint reduced by 70% compared with the conventional blast furnace route.

The environmentally responsible coating

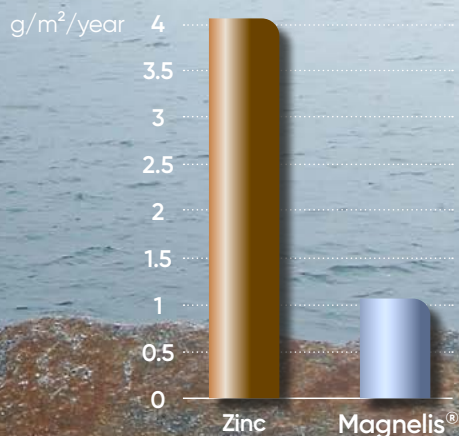
The application of a Magnelis® coating ensures the preservation of natural resources as it uses significantly less zinc than pure zinc coatings. Magnelis® also reduces zinc runoff* to soils.

Magnelis® is 100% recyclable and does not contain any harmful elements. It is REACH compliant and an environmental product declaration (EPD) is available.

The production of Magnelis® also has a lower environmental impact compared to other highly durable materials such as stainless steel or aluminium.

Zinc runoff rate*

Magnelis® considerably reduces zinc runoff into soil.

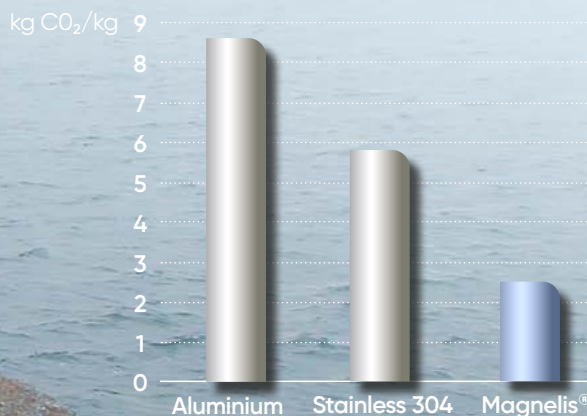


* the rate of dissolution of a material from its surface into the soil

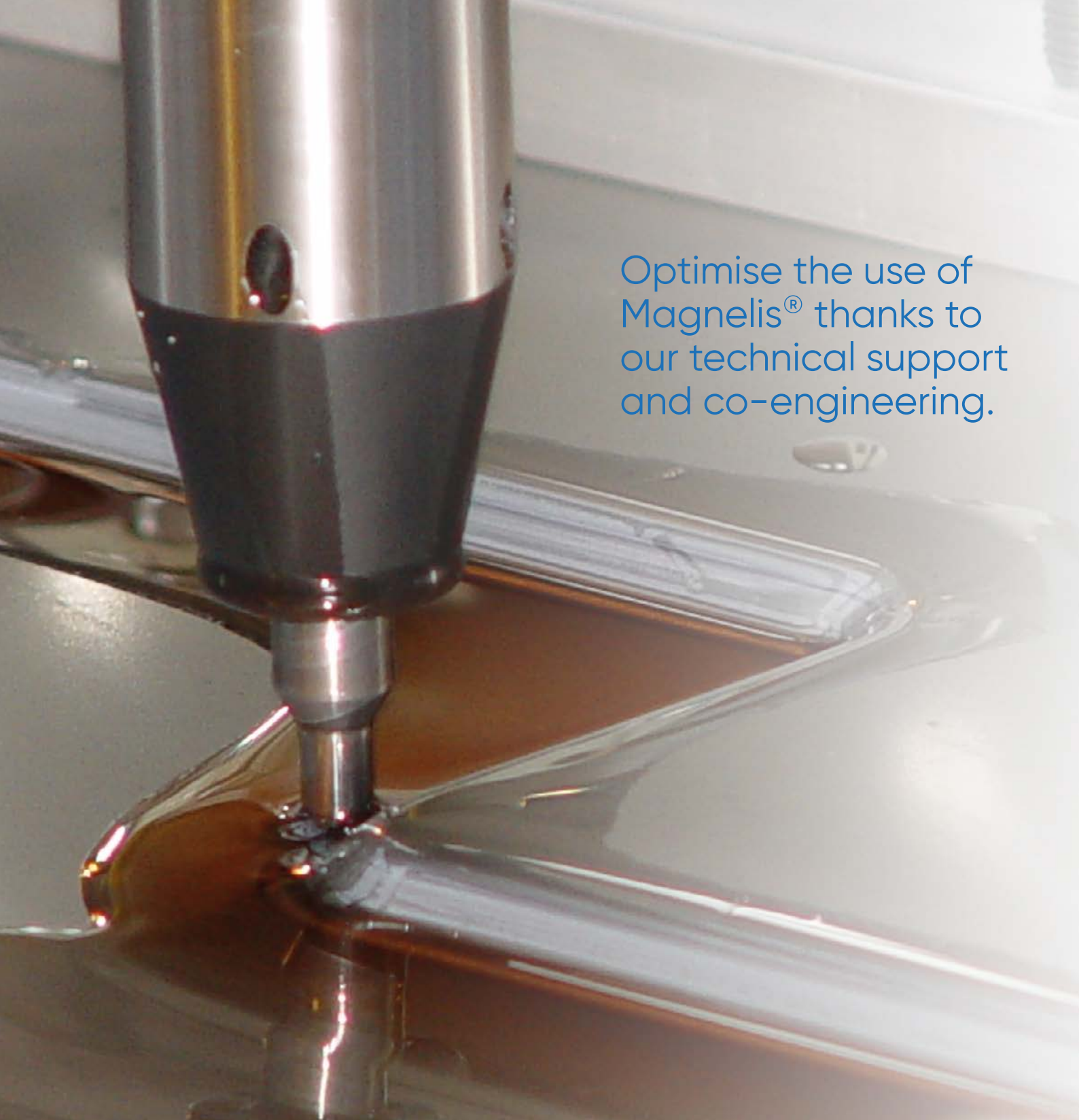
Source: French Corrosion Institute

Production impact on CO₂ emissions

CO₂ emissions for the production of Magnelis® are much lower than for aluminium, a difference that is not compensated by aluminium during the use phase, even when aluminium parts are lighter than steel parts.



Sources: ArcelorMittal Global R&D, European Aluminium Association, World Steel Association, Eurofer



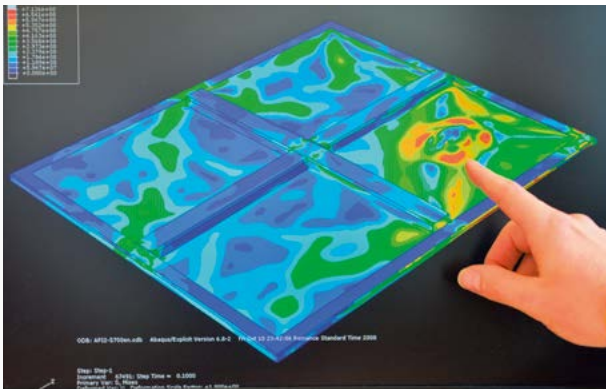
Optimise the use of
Magnelis[®] thanks to
our technical support
and co-engineering.

Co-engineering Magnelis[®] solutions

33

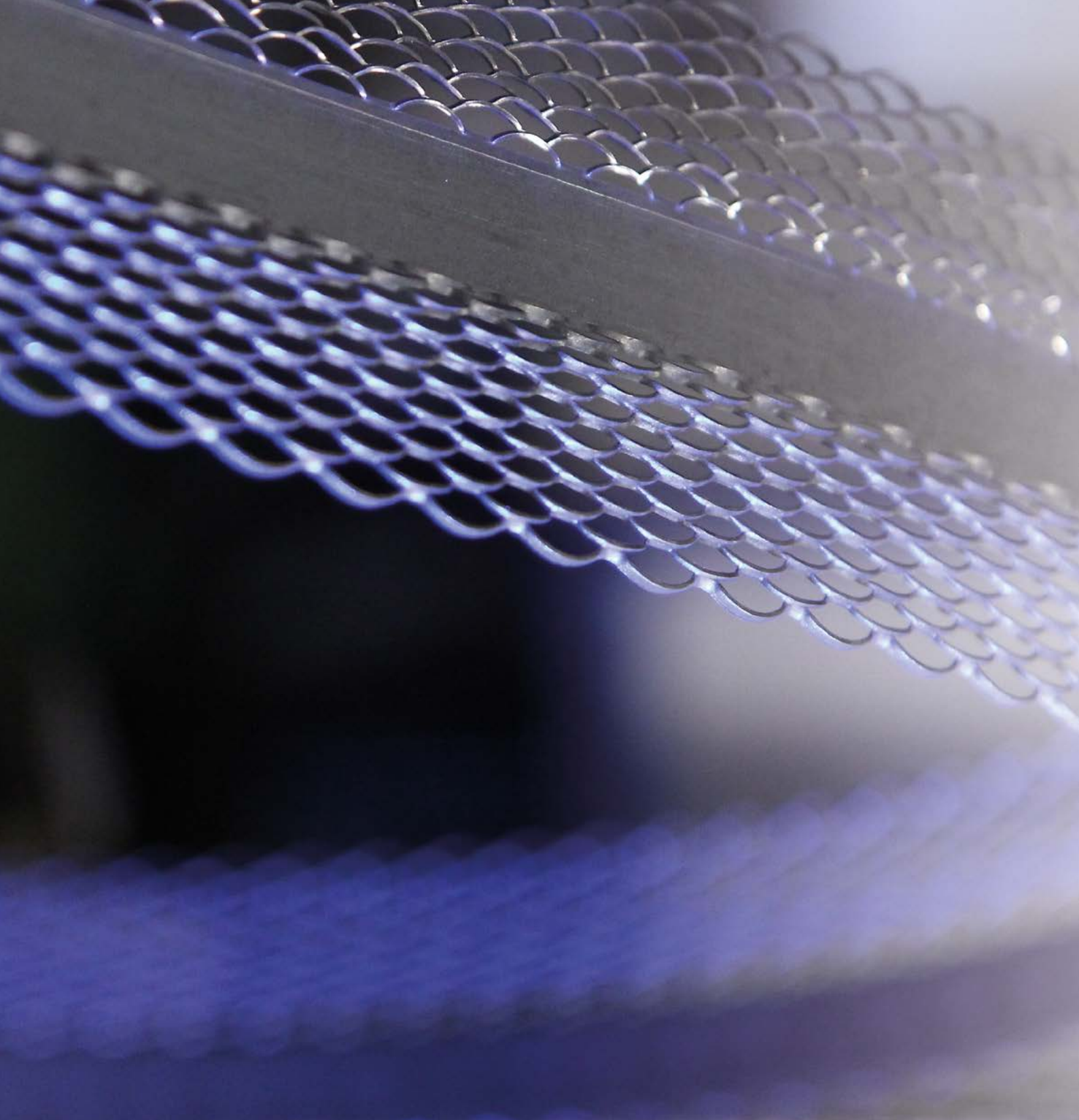
ArcelorMittal is offering an innovative co-engineering approach to its customers in order to optimise the use of Magnelis[®] and to achieve the best possible results and cost reduction.

Our co-engineering team includes researchers and technicians with a strong background in mechanical design.



ArcelorMittal's assistance to customers can be applied at all stages of product development, from initial design through to serial production. We can help you to take every advantage of the benefits Magnelis[®] can offer:

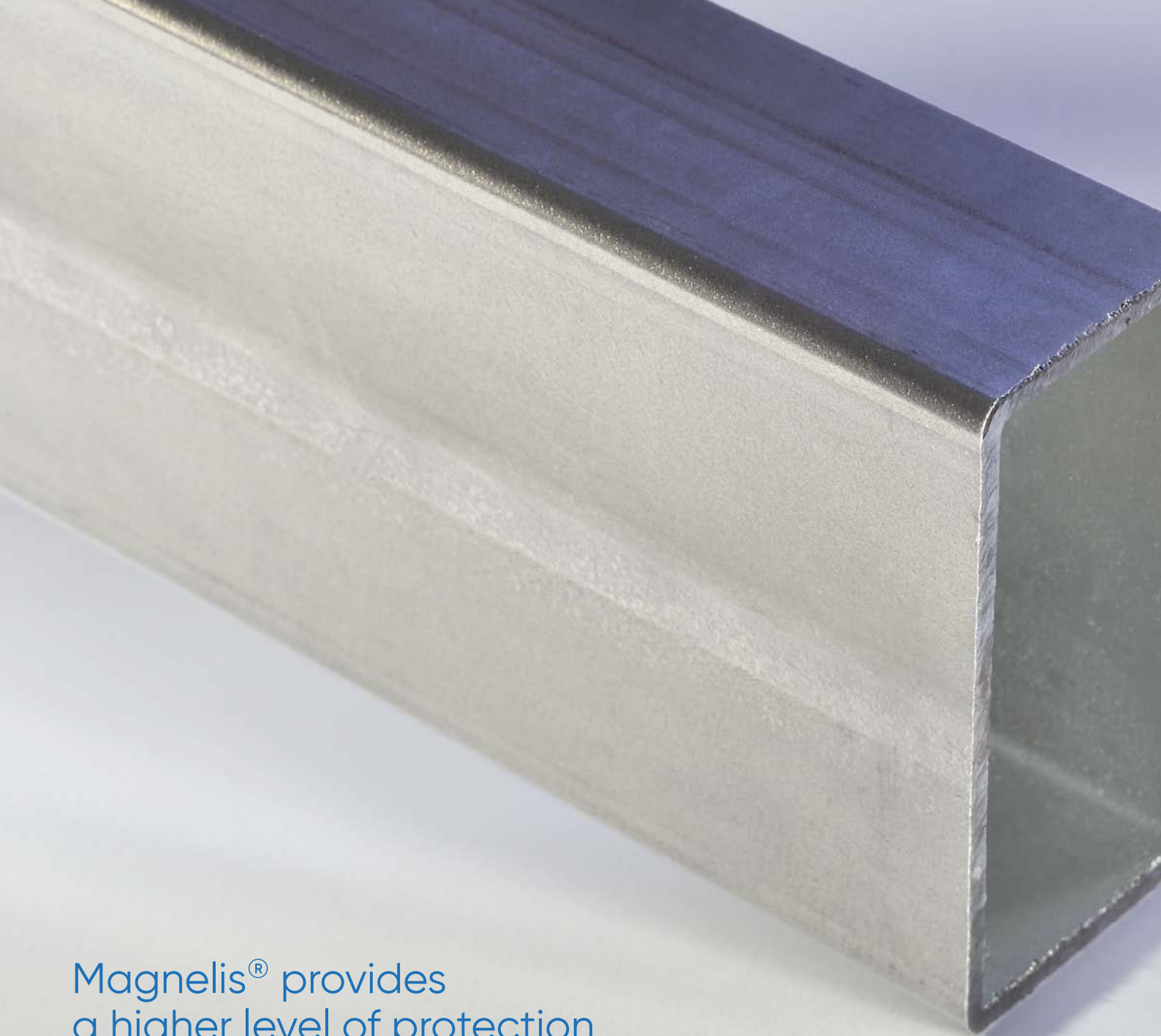
- The most suitable steel grade and coating for your application
- Cost optimisation through thickness reduction and process improvements (using finite element simulations)
- Improving the quality and durability of your product
- Definition of minimal mechanical properties and thicknesses for successful production
- Deformation analysis of stamped parts to validate the theoretical analysis
- Technical support during production.



Magnelis®

the best metallic coating in a wide range of markets

- 37 [tubes](#) – Magnelis® outperforms pre-coated welded tubes
- 39 [solar](#) – The durable coating for solar structures
- 45 [agriculture](#) – Optimal protection for agricultural applications
- 49 [construction](#) – Durability guaranteed
- 53 [infrastructure](#) – Durable safety barriers, lighting poles, acoustic walls...
- 55 [industry](#) – Appliances and electrical equipment



Magnelis® provides
a higher level of protection
on welded areas compared to other coatings

Magnelis® outperforms pre-coated welded tubes

Magnelis® has very clear advantages when it comes to tubes. On a standard galvanised tube, the welded area is the weak point for corrosion. Magnelis® increases the protection and lifetime of the welded zone to unprecedented levels.

Processing

Arc, spot, and high frequency induction (HFI) welding techniques are compatible with Magnelis®. Magnelis® offers improved weldability due to its thinner coating. Magnelis® can be welded with similar processes to zinc-coated products with adjusted parameters case by case. For arc welding, the same welding consumables, procedures, and guidelines can be used.

Self-healing effect

Magnelis® self-heals on cut edges and thin welded zones. The zone is progressively covered with protective Magnelis® compounds which act as a barrier to corrosion. The result is outstanding corrosion resistance, even on welded zones.

The life of a welded tube can be extended significantly beyond that of a post-galvanised tube if the welded area is re-protected with Magnelis®.

Magnelis® versus pre-galvanised



Magnelis® ZM120 welded, not re-protected Galvanised Z275 welded, not re-protected

Magnelis® versus post-galvanised



Magnelis® ZM310 welded and re-protected Post-galvanised welded

cyclic test 3CT (VDA 621-415) after 33 weeks of tests



The durable coating for solar structures

Magnelis® supports moves to generate clean and renewable energy by offering advanced corrosion protection for solar installations.

Magnelis® is the preferred coating solution for both concentrating solar power (CSP) plants and structural solutions for photovoltaic (PV) solar farms (ground-mounted or floating structures). It offers increased durability, the best possible protection against corrosion and abrasion.

In moderate soil conditions or areas that are subject to high levels of abrasion, we recommend Magnelis® ZM430 (35 µm coating per side). If the soil is more aggressive, Magnelis® ZM620 (50 µm/side) is recommended.

Magnelis® can be supplied in a wide range of steel grades and thicknesses up to 6 mm. This flexibility allows operators to optimise the design and total cost of their solar structures.

Magnelis® extends the life of solar structures so operators can maximise the return on their investment. Its key advantages in these applications are:

- Guaranteed* durability up to 25 years
- Improved resistance against abrasion
- Effective against corrosion even when placed in soil
- Large feasibility range both in thickness and steel grade
- Cost effective
- Rapid installation
- Reduces environmental impact.

* The Magnelis® guarantee is subject to project-specific conditions. Contact us for more information.

Magnelis[®] is the preferred material
for the structural components of solar fields



Optimum abrasion resistance for steel solar structures in deserts

Magnelis® has much higher hardness compared to standard zinc coatings. This has a direct and positive impact on the abrasive wear resistance of the coating.

The hardness of Magnelis® is much higher than that of hot dip galvanised coatings, increasing its resistance to abrasion

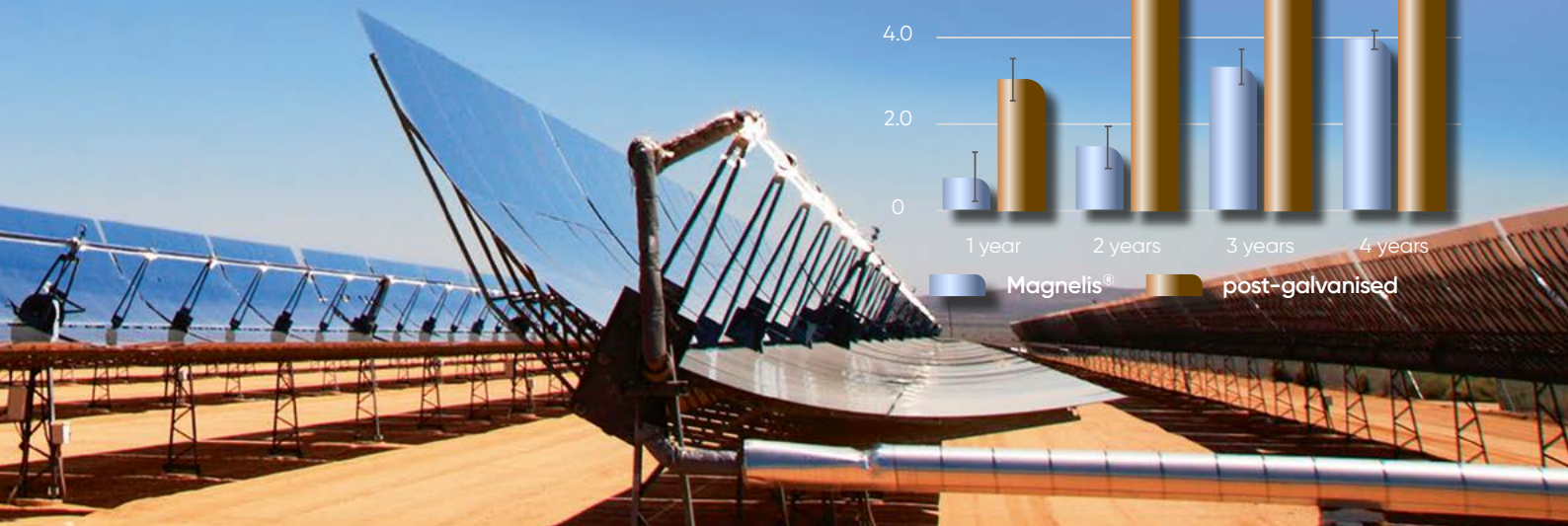
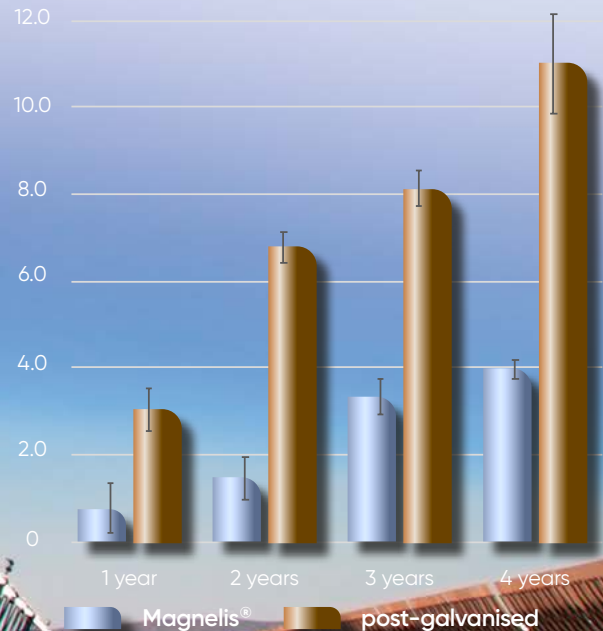
Galvanised		64
Magnelis®		141

Hardness Vickers (HV)

The excellent abrasion resistance of Magnelis® has been proven through outdoor exposure tests in desert environments.

Dubai testing field updated results and confirms the outstanding performance of Magnelis® compared with post-galvanised steel.

Average total coating consumption (μm) with standard deviation





Drest, France, December 17th 2021

Global statement of the relative corrosion performance of Magnelis® in soils

Since 2006, the Institut de la Corrosion has performed comparative corrosion studies in soils on coatings for ArcelorMittal. The materials studied were mainly continuous hot dip zinc coating and zinc aluminum magnesium coating (Magneis®), both produced according to EN 10346. Studies have been carried out under collaborative joint industrial programs including material end users.

The exposures consisted in field exposure, laboratory exposure using natural soils and various ranges of parameters investigated, and exposure time are detailed in Table 1.

Table 1. Soil parameter ranges in the corrosion studies including Magnelis® based on DIN

Parameter	Range
Exposure time	6 months to 5 years
Texture	clay, silt and sand mixtures
pH	4 to 9
Resistivity	5 to 900 Ω.m
Chlorides	<10 to 2200 ppm
Sulfides	0 to 507 ppm
Sulfides	0 to 82 ppm

The obtained results show that the average corrosion resistances of the Magnelis® in soils are by an average factor of 3.8, compared to continuous hot dip zinc coating. This factor has been based on mass loss according to the ISO 8407 standard.

solar

Magnelis[®], superior behaviour in soils

When it comes into contact with soils, Magnelis[®] also produces its protective film to cover the steel surface. This very dense film reduces the contact between the steel and the soil, dramatically slowing the progression of corrosion.

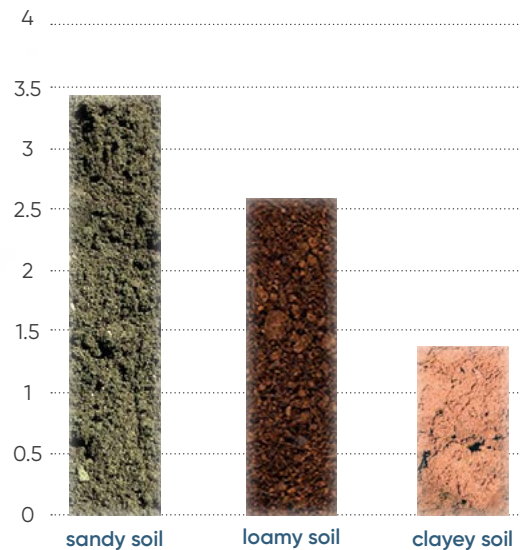
Magnelis[®] ZM430 and ZM620 provide excellent corrosion protection for steel structures which are placed in soil. The exact coating should be chosen based on the local soil conditions in consultation with ArcelorMittal.

In December 2021, The French Corrosion Institute assessed the performance in soil of Magnelis[®], based on mass loss according to the ISO 8407 standard.

“Corrosion resistance of Magnelis[®] in soils was improved by an average factor of 3.8 compared to continuous hot dip zinc coating”

In real soil field testing, Magnelis[®] behaves better than post-galvanised steel.

Corrosion rate improvement with Magnelis[®] versus post-galvanised steel



Source: ArcelorMittal Global R&D



Optimal protection for agricultural applications

Magnelis® is used in a variety of agricultural applications due to its excellent corrosion resistance in highly alkaline atmospheres (pH between 10 and 13) and those rich in ammonia.

Vineyards

Magnelis® ensures ultimate corrosion protection for vineyard poles. Poles coated with Magnelis® have a life span in line with that of the vines they support.

Poles account for more than 60% of the cost of vineyard fences. Magnelis® poles are at least 20% more cost-effective than wood and galvanised poles and can perform over the total lifetime of the vines.

Outdoor tests have proven that Magnelis® has superior corrosion resistance in soils compared to zinc-heavy coatings. Magnelis® is more stable than conventional coatings when it is placed in contact with soil.

Magnelis® is eco-friendly and reduces zinc runoff to soil considerably compared to post-galvanised products.

Greenhouses

Greenhouse structures must sustain extremely warm and humid atmospheres. Magnelis® offers excellent corrosion resistance in this application due to its very dense protective layer.

In addition to its excellent formability, Magnelis® also provides a high level of corrosion resistance on deformed parts.



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Optimal protection for agricultural applications

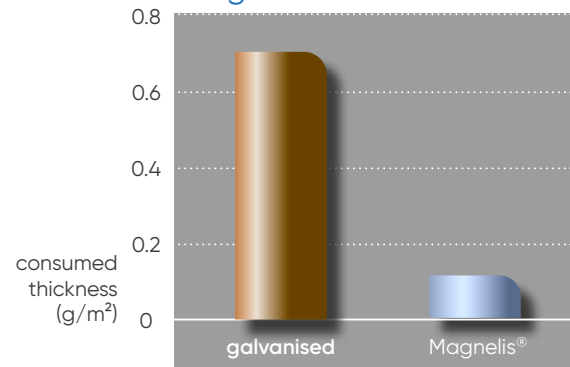
Animal housing and equipment

Farm buildings housing cattle, pigs, and poultry face severe challenges from atmospheric corrosion. Magnelis[®] coated profiles and tubes are the ideal answer to guarantee the durability of these structures. Multiple tests (including accelerated tests and long exposure on real farms) have demonstrated the outstanding corrosion performance of Magnelis[®] in animal housing. Magnelis[®] reduces the risk of corrosion and disease as bacteria have no corrosive areas in which to hide.

Thanks to its high surface hardness Magnelis[®] is also better at resisting animal scratches. Magnelis[®] also eliminates the need for post-painting, and can replace stainless steel or aluminium.

Magnelis[®] is available in all dimensions required for animal housing, and offers a very cost-effective solution.

Weight loss in g/m² in agricultural environments



Measurement of mass loss:
pH: 11.7 – Solution with 5% NH₃ –
T: 20°C – Test duration 24 h

Source: ArcelorMittal Global R&D

Silos

Magnelis[®] offers excellent outdoor corrosion protection for silos, wherever they are located. The hard surface of Magnelis[®] also reduces the abrasive effect of grain on the coating.

Magnelis[®] is suitable for food contact applications such as the interiors of fermentation silos and meets the requirements of European regulation EC 1935/2004.

Magnelis[®] is available in thicknesses ranging from 0.4 to 6.0 mm, and in various steel grades, coating weights, and levels of protection.



Magnelis® guarantees a cost effective
and long life solution

Durability guaranteed

The remarkable corrosion resistance of Magnelis® allows it to be used for a wide range of structural applications. These include the sub-structures of ventilated facades, composite floors, purlins for roofs, side rails for walls, rainwater systems, and light steel framing. But it can also be used for roof and wall profiles in some corrosive environments such as coastal areas, agricultural structures, and water transport systems.

Longer lifetime

Magnelis® increases the lifetime of structures by a factor of three compared to hot dip galvanised solutions. In more severe environments, the benefits of Magnelis® can be even greater.

Self-healing effect

When cut, perforated, or scratched, Magnelis® slows down corrosion by forming a very dense zinc-based protective film. This ensures perfect protection of the whole structure.

Excellent workability

Profiling processes are facilitated by the excellent forming behaviour of Magnelis® as it has a lower friction coefficient than galvanised steel. The Magnelis® coating also adheres firmly to the steel to prevent powdering during processing.

Reduced coating thickness

The superior corrosion protection of Magnelis® offers our customers two possibilities. They can increase the level of corrosion protection with the same metallic coating thickness; or they can achieve the same protection while significantly reducing coating thickness.

Low total cost of ownership

Magnelis® offers significant cost reductions as it reduces the need for ongoing maintenance and avoids the need for additional painting. This makes Magnelis® the most cost-effective solution compared to galvanised and post-galvanised corrosion protection.

Contact with concrete

As concrete hardens, a very alkaline environment is created. This can be extremely aggressive against coated steel. Magnelis® resists corrosion in these applications much better, and is the preferred metallic coating for applications which come into contact with concrete.

Wide feasibility range

Magnelis® is available in a wide range of high strength steels, allowing design optimisation.



Diverse range of applications

Building structures

Magnelis® is the perfect corrosion protection solution for roof structures and purlins, wall side rails, facade sub-structures, and light steel-framed structures. It can be utilised in outdoor, exposed, semi-exposed, or unexposed environments to ensure a longer lifetime than hot dip galvanised steel and other traditional coatings. The performance of Magnelis® has been proven in outdoor tests.

Rainwater and roofing systems

Magnelis® can be utilised for roofs and corrugated profiles in aggressive environments such as marine or agricultural areas. When used in rainwater systems, a 10-year guarantee is available.

Flooring

Composite floor systems made with steel and concrete are flexible and adaptable to any kind of structure or renovation. They allow large spans and reduce floor thickness while maximising interior space.

Metallic coated steel with Magnelis® is the ideal solution for durable, long lasting composite floors. It offers excellent corrosion performance when in contact with concrete or in high alkaline atmospheres.



Durable safety barriers, lighting poles, acoustic walls...

Magnelis® is widely used to protect safety barriers, lighting poles, road signs, acoustic walls, bridge parapets, and many other infrastructure applications.

Outstanding corrosion protection

The excellent corrosion behaviour of Magnelis® has been extensively proven in outdoor tests. Magnelis® outperforms galvanised steel by a factor of three, and higher in more severe environments.

ArcelorMittal offers a guarantee for Magnelis® used in road safety applications.

Magnelis® is now included in the EN 1317 standard for road safety systems. Magnelis® solutions have also been certified by bodies which oversee the Construction Product Regulation. Certifications have been granted in Austria, Belgium, the Czech Republic, Norway, and Spain. Certification is ongoing in other countries.

Self-healing effect

Magnelis® offers protection for cut edges and perforations thanks to its inbuilt self-healing properties.

Reduced corrosion in soil

Outdoor tests have proven that Magnelis® has superior corrosion resistance in soils compared to zinc-heavy coatings. Magnelis® is more stable than conventional coatings when it is buried in the soil and results in less zinc runoff.

Magnelis® ZM430 and ZM620 offer the best possible corrosion protection depending on the type of soil.

Wide feasibility range

Magnelis® can be provided in a range of thicknesses and grades suitable for road safety and other infrastructure applications.

Cost competitive compared to post-galvanisation

Using Magnelis® for infrastructure applications offers clear cost advantages. Total cost of ownership is optimised as production, logistic, installation, and maintenance costs are reduced significantly.



Appliances and electrical equipment

Manufacturers of appliances and electrical equipment are requesting significantly improved corrosion protection, while maintaining processing and cost effectiveness. Magnelis® is the answer to these demands. Magnelis® is already widely used for the casings, structures, and hinges of appliance units, cable trays, and cooling towers.

Outstanding corrosion protection

The excellent corrosion behaviour of Magnelis® has been proven through extensive outdoor tests. Magnelis® outperforms galvanised steel by a factor three.

Self-healing effect

Magnelis® also protects edges and perforations thanks to its inbuilt self-healing properties.

Significantly improved protection against white rust

Conventionally galvanised steel shows substantial signs of white rust after a salt spray test. Magnelis® offers a huge improvement in white rust resistance. Salt spray tests have shown it lasts much longer.

Reduced coating thickness

The superior corrosion protection of Magnelis® offers our customers two possibilities. They can increase corrosion protection by applying the same coating thickness, or target the same level of protection with a significantly thinner metallic coating layer.

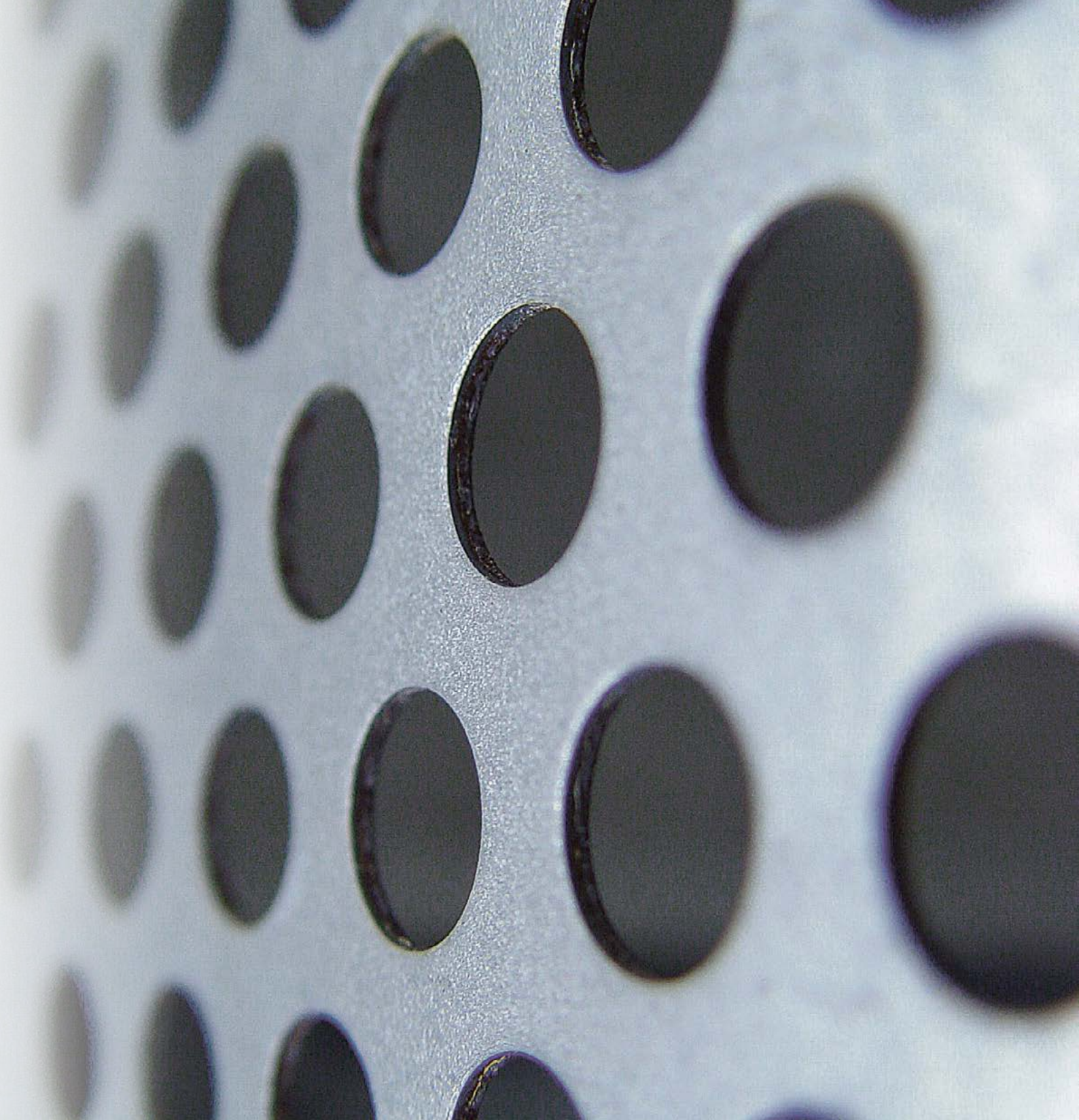
Scratch resistance

Thanks to its very high hardness, Magnelis® offers excellent wear and abrasion resistance.

Improved productivity and paintability

The lower friction coefficient and improved adhesion of Magnelis® increases its processing properties. Magnelis® is easy to post-paint, bringing a further improvement of corrosion resistance versus galvanised steel.

Magnelis® ensures corrosion resistance while maintaining the electrical conductivity of cable trays.



Benefits of Magnelis® in a nutshell

Features		Magnelis® versus hot dip galvanised (Zn)
Anti-corrosion properties	Outdoor corrosion	+++
	Agricultural buildings (animal housing, barns, greenhouses, silos...)	+++
	Marine environments (construction, swimming pools...)	+++
	Industrial environments (acid- or alkaline-rich environments)	+
	High humidity	+++
	Contact with concrete	+++
	Abrasion	+++
	Soil corrosion	+++
	Edge protection thanks to self-healing effect	+++
	Perforations or scratches on exposed applications	+++
	Corrosion of formed parts (bent or stamped)	+++
	Temporary protection (transport, storage)	+++
Processing properties	Bending and profiling	+
	Forming and shaping	+
	Welding (equivalent coating thickness)	=
	Painting	++

Credits

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