

**TECHNICAL EVALUATION OF PRODUCTS AND  
MATERIALS No. 20/0067 of 03 February 2020**

regarding the  
**‘MAGNELIS®’**  
metal coating product for steel sheets

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*In case of doubt or dispute, the French version only is valid.*

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### **CAUTIONARY STATEMENT**

The aim of this Technical Evaluation of Products and Materials is to determine the intrinsic characteristics of a product or material. As such, it does not have the value of a Technical Appraisal within the meaning of the amended decree of 21 March 2012. It does not eliminate the need to check the suitability of the product or material to be incorporated into a given structure, by consulting the reference documents of the application in question (NF-DTU, CPT [Technical Specifications], Technical Appraisal, etc.).

## TECHNICAL EVALUATION

### Brief definition

The Magnelis<sup>®</sup> metal coating is intended to protect steel sheets used for cladding and coverings against corrosion. The usage of steel rolls with the Magnelis<sup>®</sup> coating as a sandwich panel facing is excluded.

The Magnelis<sup>®</sup> metal coating is made up of an alloy of aluminium, zinc, and magnesium.

The spread of the Magnelis<sup>®</sup> coating is 70, 90, 120, 175, 200, 250, 310, or 430 g/m<sup>2</sup> double-sided for the unfinished version.

### Technical Evaluation

All of the tests performed are indicated in part B of the Technical File.

In regards to corrosion resistance, the analysis of tests performed concludes that MAGNELIS<sup>®</sup> performs the same as or better than a galvanised zinc coating based on NF P34-310 for identical fields of application.

The improved performance justifies the proposed spreads that are less than those required for hot-dip galvanisation Z275, according to Standard NF EN 10346.

DX51D steel is used only to manufacture accessories and is a product that complies with Standard NF EN 10346.

Tables 1 and 2 at the end of the report present, given a comparable lifespan to that of reference works, the exposures for which the Magnelis<sup>®</sup> sheet metal coating is appropriate.

### Inspections

Manufacturing is subject to inspections on regularity of manufacturing. The inspections are described in paragraph 3.2 of the Technical File.

The composition was submitted to CSTB at the time of the first ETPM request in 2011, and any change to the Magnelis<sup>®</sup> coating must be reported to CSTB throughout the entire duration of this evaluation. This composition is consistent with note 1 of paragraph 3.4 of Standard NF EN 10346: 2015.

### Conclusions

The elements of the Technical File did not show any incompatibility that might rule out the usage of this coating for cladding, facades, and coverings, as per this evaluation.

Keep in mind that this Prior Technical Evaluation of the Material is not intended to cover all the criteria for the suitability for use for each of the proposed applications. It is generally subject to unified technical documents (DTUs), professional rules, and RAGE/PACTE professional recommendations, for the traditional scope, and subject to Technical Appraisals or Technical Application Documents, which may be evaluated based on this Prior Technical Evaluation of the Material and any additional justifications needed, for the non-traditional scope.

**Valid until : 30 September 2024**

The Head of the  
Facade, Covering, and Roofing Division

**Stéphane Gilliot**

**TECHNICAL FILE ESTABLISHED BY THE APPLICANT****A. Description****1. General**

The Magnelis® metal coating is intended to protect steel rolls against corrosion. These steel rolls coated with Magnelis® can be used to manufacture ribbed plates, ribbed steel sheets, and plates. The usage of steel rolls with the Magnelis® coating as a sandwich panel facing is excluded.

The Magnelis® metal coating is made up of an alloy of zinc, magnesium, and aluminium.

The composition was submitted to CSTB at the time of the first ETPM request in 2011, and any change to the Magnelis® coating must be reported to CSTB throughout the entire duration of this assessment. This composition is consistent with note 1 of paragraph 3.4 of Standard NF EN 10346: 2015.

The production of bent items made from sheet metal coated with Magnelis® must be compatible with the specifications of § 4.2 of the Technical File.

The spread of the Magnelis® coating is 70, 90, 120, 175, 200, 250, 310, or 430 g/m<sup>2</sup> double-sided for the unfinished version.

**2. Materials****2.1 Technical characteristics****2.1.1 Characteristics of the steel substrate**

The steel used to produce ribbed sheet metal intended for covering or cladding is of the following grades: S220 GD, S250 GD, S280 GD, S320 GD, S350 GD, S390 GD, S420 GD, S450 GD, S550 GD, produced in compliance with Standard NF EN 10346.

The steel used only to manufacture accessories is of the following grade: DX51D, produced in compliance with Standard NF EN 10346.

**2.1.2 Characteristics of the Magnelis® coating**

The double-sided nominal surface density of the coating is 70 g/m<sup>2</sup>, 90 g/m<sup>2</sup>, 120 g/m<sup>2</sup>, 175 g/m<sup>2</sup>, 200 g/m<sup>2</sup>, 250 g/m<sup>2</sup>, 310 g/m<sup>2</sup>, or 430 g/m<sup>2</sup>.

The densities of the Magnelis® coating for cladding and covering are given in table 3 at the end of the file.

**2.2 Surface appearance of the Magnelis® coating**

After the normal solidification process for the coating, the surface has a metallic appearance and may appear between slightly matt to shiny. The surface may also have variations in appearance and may tend towards blackening.

A non-skin-passed appearance is available upon request.

**3. Manufacture, inspections, and packaging of strips coated with Magnelis®****3.1 Manufacture**

The manufacture is similar to that of continuous hot-dipped galvanised steel sheets. The rolls of steel sheets coated with Magnelis® are manufactured continuously in the Ramet plant in Belgium.

Hexavalent chromium-free passivation is applied. Oiling is possible upon request.

**3.2 Inspections**

The inspections performed by the manufacturer seem to be of a nature that ensures satisfactory consistency of quality.

**3.2.1 Inspections on the coating application line**

See table 4 at the end of the Technical File.

**3.2.2 Inspections conducted on finished products**

See table 5 at the end of the Technical File.

### **3.3 Packaging and storage**

#### **3.31 Packaging**

The Magnelis®-coated rolls and sheets must be protected against moisture (rain, condensation) and against all external sources of harm. For this, they will be covered with packaging appropriate for the risks that may arise during transport and storage, based on the duration thereof.

#### **3.32 Transport and storage**

The rolls must be transported, stored, and handled under conditions that protect the material from permanent deformation or damage that may jeopardise the appearance and durability of the coating. These precautions for transport and storage are the same as those employed for all types of steel rolls with typical metal coatings.

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## **4. Installation (forming) of Magnelis® strips**

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### **4.1 Profiling**

Steel sheets coated with Magnelis® are just as capable of being formed and profiled as classic galvanised steel sheets. Profiling must be done on a slip roll machine. To avoid leaving marks on the surface, it is best to use a vanishing oil.

### **4.2 Bending/profiling radii and thickness**

The minimum bending and profiling radius to maintain for steel is in line with the NF P 34-310 standards.

This radius is compatible with the creation of ribbed sheeting to be used for cladding and covering.

The maximum steel sheet thickness to be used is 2 mm.

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## **5. Durability and guide for choosing materials and coatings according to the atmosphere**

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Definitions of internal and external atmospheres are given in Standard NF P 34-310 of April 2017, Appendix B.

Tables 1 and 2 at the end of the report present, given a comparable lifespan to that of reference works for each type of exposure previously defined, the exposures for which the Magnelis® sheet metal coating is appropriate.

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## **6. Installation and maintenance**

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### **6.1 Installation**

The procedures for installing covering or cladding elements made with Magnelis®-coated sheet metal are those used in the traditional domain for the same elements made with galvanised steel sheets or those provided in the Technical Appraisals or Technical Application Documents, if applicable.

### **6.2 Maintenance**

The maintenance conditions for steel sheets coated with Magnelis® do not differ from those for galvanised steel sheets.

## B. Experimental results

- Salt spray and Kesternich test combining Magnelis<sup>®</sup> with stainless steel and aluminium – Origin: ArcelorMittal R&D.
- Galvanic corrosion test with stainless steel, aluminium, lead, copper – Origin: ArcelorMittal R&D.
- Salt spray tests - 1,000 hours – Origin: ArcelorMittal R&D.
- Natural ageing report for 18 months at class C4 site (Brest) – Institut Français de la Corrosion – Report No. IC 89770-2.
- Natural ageing report for 24 months at class C5M steel site (Brest) – Institut Français de la Corrosion – Report No. IC 89713-6 – 25/05/2011.
- Natural ageing report for 60 months at class C5M steel site (Brest) – Institut Français de la Corrosion – Report No. IC 89713-9 – 20/06/2014.
- Exterior exposure report for Magnelis<sup>®</sup> coating in a marine atmosphere for 6 years - Institut Français de la Corrosion – Report No. IC 820003 – 03/07/2019.

## C. References

Production of Magnelis<sup>®</sup> began in 2008. From 2008 to the end of 2018, its total cumulative production was 1,000,000 metric tonnes.

## TECHNICAL FILE TABLES

**Table 1 – Internal finishes (categorised according to NF P34-301)**

Normal atmosphere					Aggressive atmosphere
Metal	Brand	Low hygrometry	Average hygrometry	High hygrometry	
Magnelis® ZM 70 to 90	Magnelis®	■	—	—	—
Magnelis® ZM 120	Magnelis®	■	■	O	O
Magnelis® ZM175	Magnelis®	■	■	■	O
Magnelis® ZM 200	Magnelis®	■	■	■	O
Magnelis® ZM 250	Magnelis®	■	■	■	O
Magnelis® ZM 310	Magnelis®	■	■	■	O
Magnelis® ZM 430	Magnelis®	■	■	■	O

■ Coatings appropriate for the exposure.  
O Coatings for which the definitive choice and particular characteristics must be determined after consultation with and approval from the manufacturer.  
— Unsuitable coatings.

**Table 2 – External finishes (categorised according to NF P34-301)**

Metal	Brand	EXTERNAL ATMOSPHERES								
		Rural, non-polluted	Urban and industrial		Marine				Special	
			Normal	Harsh	20 to 10 km	10 to 3 km	Seaside (< 3 km) <sup>1</sup>	Mixed	Strong UV	Specific
Magnelis® ZM120	Magnelis®	O	O	—	—	—	—	—	ND	—
Magnelis® ZM175	Magnelis®	■	O	—	O	—	—	—	ND	—
Magnelis® ZM200	Magnelis®	■	■	O	■	O	O	O	ND	O
Magnelis® ZM250	Magnelis®	■	■	O	■	O	O	O	ND	O
Magnelis® ZM310	Magnelis®	■	■	O	■	■	■	O	ND	O
Magnelis® ZM430	Magnelis®	■	■	O	■	■	■	O	ND	O

■ Coatings appropriate for the exposure.  
O Coatings for which the definitive choice and particular characteristics must be determined after consultation with and approval from the manufacturer.  
— Unsuitable coatings.  
ND: Not a decisive factor for choosing sheets and strips coated with Magnelis®. Refer to the other columns.  
(1) With the exception of seaside environments, for which definitive assessment or the establishment of specific measures must be determined after consultation with and approval from the producer.

**Table 3 – Deliverable coating weights for cladding and covering**

Designation of the coating	Minimum coating weight, in g/m <sup>2</sup> , total for both sides		Theoretical indicative values for the coating thickness per surface in the test at one point, in µm	
	Test at three points	Test at one point	Characteristic value	Spread
<b>Magnelis® 70 g/m<sup>2</sup></b>	70	60	5.5	4 - 8
<b>Magnelis® 90 g/m<sup>2</sup></b>	90	75	7	5 - 10
<b>Magnelis® 120 g/m<sup>2</sup></b>	120	100	9	6 - 14
<b>Magnelis® 175 g/m<sup>2</sup></b>	175	145	13	9 - 18
<b>Magnelis® 200 g/m<sup>2</sup></b>	200	170	15	10 - 20
<b>Magnelis® 250 g/m<sup>2</sup></b>	250	215	19	13 - 25
<b>Magnelis® 310 g/m<sup>2</sup></b>	310	265	24	18 - 31
<b>Magnelis® 430 g/m<sup>2</sup></b>	430	365	35	26 - 46

**Table 4 – Inspections of the unfinished coating on the application line**

Frequency	Inspection operation	Reference system
<b>Input thickness</b>	RX gauge – Continuous Micrometer – Manual – all rolls – when gauge is out of order	Internal method
<b>Input width</b>	Metres – Manual – 1x per roll	Internal method
<b>Input weight</b>	Scale – 1x per roll	Internal method
<b>Annealing temperature</b>	IR pyrometer – Continuous	Internal method
<b>Erichsen test</b>	Erichsen machine – 1x per 5 rolls	Internal method
<b>Bonding strength</b>	90° bending machine - 1x per 5 rolls	Internal method
<b>Air-tightness of annealing oven</b>	Distalarm gas detector - 1x per session	Internal method
<b>Magnelis bath temperature</b>	Thermocouple – Continuous	Internal method
<b>Line speed</b>	Tachymeter – Continuous	Internal method
<b>Surface appearance</b>	Air-drying pressure – Continuous	Internal method
<b>Zinc load</b>	RX gauge in line – Continuous – Sweeping on each side RX gauge out of line – 1x per 5 rolls or with each load change	EN10346: 2015
<b>Tightening force on skin-pass mill/leveller</b>	Manometer – Continuous	Internal method
<b>Standard deviation for skin-pass mill</b>	Manometer – Continuous	Internal method
<b>Surface appearance</b>	High-resolution cameras – Continuous	Internal method
<b>Roughness</b>	Roughness meter – 1x per 5 rolls	Internal method
<b>Flatness</b>	Manometer – 1x per 2 rolls	EN10143 - 2006
<b>Oiling</b>	Precision scale – 1x per day IR measuring device – 1x per session Flow meter – Continuous	Internal method
<b>Hexavalent chromium-free passivation</b>	Visual detection test – 1x per roll	Internal method
<b>Marking</b>	Visual – 1x per roll	Internal method
<b>Final thickness</b>	RX gauge – Continuous	Internal method
<b>Weight</b>	Scale – 1x per roll	Internal method



**Table 5 – Inspections of finished products after application of unfinished coating**

<b>Frequency</b>	<b>Inspection operation</b>	<b>Standard</b>
<b>1x per roll</b>	Mechanical properties – Tensile strength	Internal reference documents
<b>1x per roll</b>	Roughness – Roughness meter – By sample	Internal reference documents
<b>1x per 5 rolls or with each load change</b>	Coating – RX gauge off-line – By sample – 1x per 5 rolls or with each load change	EN10346: 2015
<b>1x per roll</b>	Final thickness – Micrometer – By sample	EN10143 - 2006