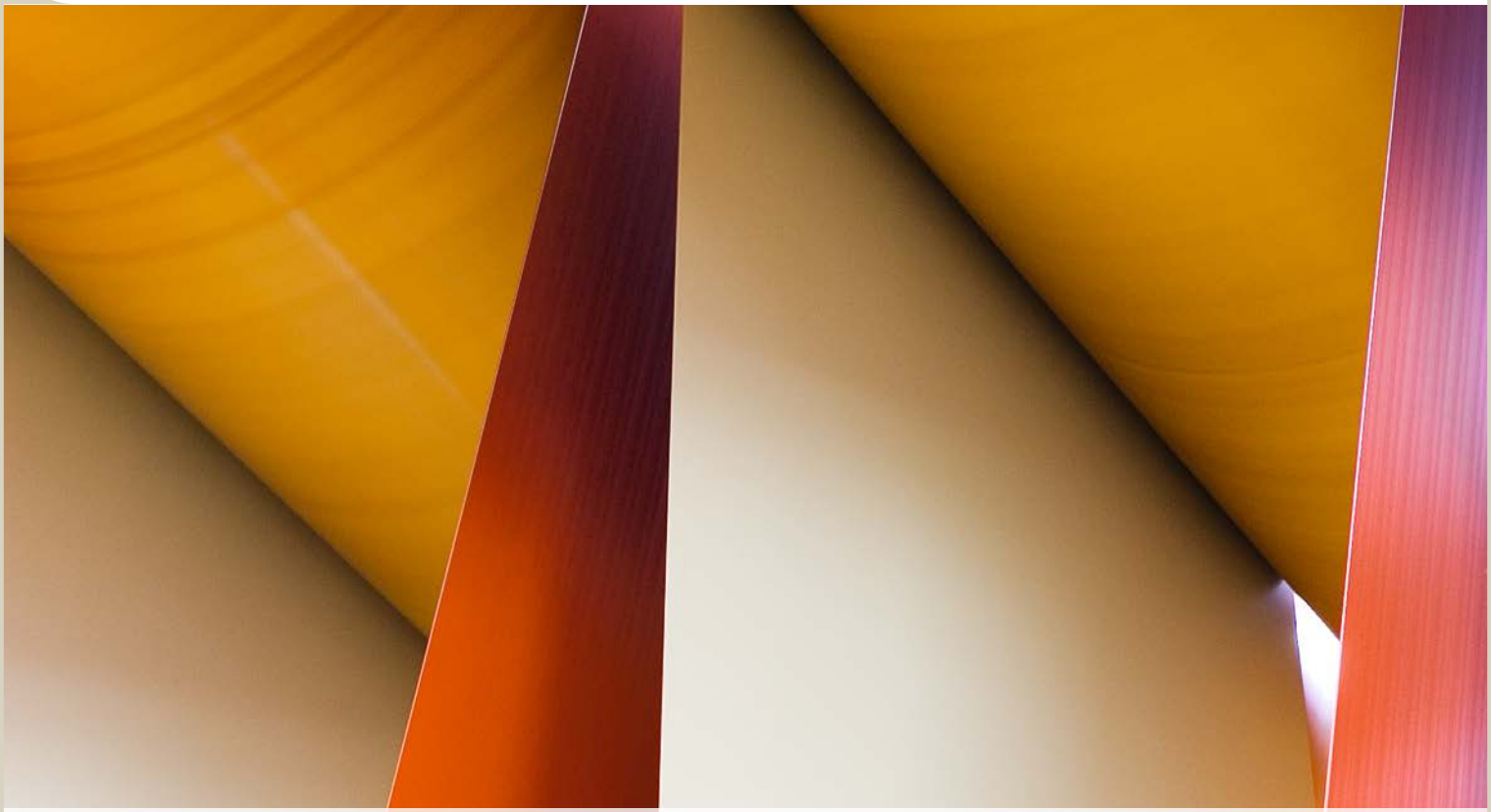
ArcelorMittal

# Organic coated steel coils
# Granite® - Estetic®



# ENVIRONMENTAL PRODUCT DECLARATION

## in accordance with EN 15804

| | |
|---|---|
| Declaration Holder | ArcelorMittal Europe – Flat Products |
| LCA Practitioner | ArcelorMittal Global R&D – Sustainability |
| Date of issue | October 2014 |

# 1. General information

## ArcelorMittal Europe – Flat Products – Organic coated steel coils

**Programme operator**

N/A

**Declaration Holder**

ArcelorMittal Europe – Flat Products
24-26, boulevard d'Avranches. L-1160 Luxembourg

**Declaration number**

N/A

**Declared Product / Declared Unit**

The EPD applies to 1 m² of organic coated steel coil in the Granite® and Estetic® product range.

**This Declaration is based on the Product Category Rules (PCR) document**

EN 15804 - Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.

**Date of issue**

2014-10-09

**Validity date**

2018-01-31

CEN standard EN 15804 serves as core PCR.
The Life Cycle Assessment which supports this declaration has been peer reviewed by an independent external party and was declared compliant with ISO 14040, ISO 14044 and EN 15804 standards.
Verifier: PE International
Date: 25 September 2014

### Abbreviations

| | |
|---|---|
| **OCS** | Organic coated steel coils |
| **LCA** | Life Cycle Assessment |
| **BF** | Blast Furnace |
| **BOF** | Basic Oxygen Furnace |

# 2. Product

## 2.1. Product description and application

ArcelorMittal's coloured organic coated steel coils (OCS) comprise hot dip galvanised coils as a substrate over which organic coatings are applied. The coils are then delivered to transformers for shaping into end products to be included in building works, generally to precise dimensions, thereby avoiding losses on the construction site.

The thickness of coatings (i.e. zinc layer plus organic coating) varies according to the intended end use of the products. Indoor as well as outdoor use is targeted.

This EPD relates to products supplied by ArcelorMittal Europe – Flat Products under the Granite® and Estetic® tradenames.

The following table presents the range of organic coated products covered by this EPD*. The zinc layer is expressed in grams per m² of the coated coil.

| | Metallic coating | Topside organic coating | | Backside organic coating | |
|---|---|---|---|---|---|
| | Zinc layer (g/m²) | Chemical nature | Thickness (µm) | Chemical nature | Thickness (µm) |
| Granite® | 200-350, typical 275 | Polyester-Polyurethane-PVDF | 25-55 | Polyester-Polyurethane | 5-55 |
| Estetic® | 100-225 | Polyester | 15-55 | Polyester | 5 |

*NB: Galfan or Optigal™ range are also covered by this declaration. For example, Optigal™ metallic coating uses half the coating weight while maintaining the same performance and lifetime; the results of this EPD are therefore conservative.*

OCS are delivered to customers in the form of coils with the following typical dimensions:

- Thickness (used for calculations): 0.56 mm
- Width from 750 mm to 1850 mm.

Organic coated steel is used in all sectors of industry. In building and construction, it is used as profiles for cladding, roofing, tiles, gutters etc. The OCS range of applications is as follows:

| | | |
|---|---|---|
| Granite® | Roofing & cladding profiles & sandwich panels, flashing, rainwater systems | Outdoor use |
| Estetic® | Ceiling tiles, partitions, liner | Indoor use |

## 2.2. Control tests and product performance

Control tests and functional product performance comply with current standards and are described in *(1,2,3,4)*.

## 2.3. Technical data

Typical average composition of the products in terms of main functional components for coating used for the calculations:

| Material | | Average (kg/m²) | Average content (wt %) |
|---|---|---|---|
| Uncoated steel substrate | 0.56 mm | 4.396 | 93.33% |
| Metallic coating (zinc or equivalent) | 275 g/m² | 0.275 | 5.84% |
| Organic coating (outer + inner sides) | 25 + 5 µm | 0.039 | 0.83% |
| Total | | 4.710 | 100% |

Zinc is the typical coating used; other, equivalent, metallic coatings may be used and equivalences for coating weights are available in the brochures *(5)*.

The detailed data sheets for each specific product in the range are published in *(6)*.

** Data for Granite® is used in this EPD and can also be used for products having lower metallic and organic thicknesses; results will be conservative.*

## 2.4. Base materials / Ancillary materials

### 2.4.1. Base materials

Steel (from hot rolling mills): chemical composition in accordance with EN 10130 and grades according to *(4)*.
The metallic layer has a Zn content of at least 93%, and may include Al and Mg for the remaining part; the product specification complies with the EN 10346 standard.

The organic coatings are made from polyester, polyurethane or polyvinylidene fluoride (PVDF) resins.

### 2.4.2. Ancillary materials - Packaging

Packaging used to protect the coils for transport and delivery to customers consists essentially of steel straps and paper/cardboard, plastic and wood. Details of delivery packaging components can be obtained from *(7)*.

### 2.4.3. Substances of Very High Concern

ArcelorMittal's organic coated steel is produced in full compliance with the European REACH Regulation (Registration, Evaluation, Authorisation and Restriction of Chemicals). In line with its proactive policy, ArcelorMittal R&D continuously investigates alternatives to any substance of concern while maintaining product performance and durability. In particular, all coatings and surface treatments used for the Nature product line *(8)* (which includes Granite® and Estetic®) are free of hexavalent chromium compounds, which are substances of very high concern included in REACH Annexe XIV, and hazardous heavy metals (Pb, Hg and Cd).

## 2.5. Instructions at delivery point and safety recommendations

The OCS User Manual *(9)* contains all the information required by coated coil transformers to enable them to understand and optimise the following steps:

- handling, packaging and storage
- decoiling, slitting, cutting to length, shearing, punching and mechanical cutting out.

## 2.6. Reference service life

Reference service life depends on the actual composition of the coating used (thickness and organic coating type).

# 3. LCA: calculation rules, scenarios and additional technical information

## 3.1. Declared unit

The declared unit is: **1 m² of organic coated steel** in the Granite® and Estetic® product range.

## 3.2. System limits

Type of declaration: cradle to gate - with options.

The LCA study underlying this EPD complies with ISO 14040/44 *(10,11)* and EN 15804, and takes into account production of the raw materials and inputs to the process chain up to the OCS plant gate.

## 3.3. Comparability

Comparison of the environmental performance of construction products using the EPD information shall be based on the product's use in and its impact on the building, and shall consider the complete life cycle by accounting for all information modules described in EN 15804.

## 3.4. Data collection

Production inventory data used to generate the environmental indicators stems from several plants, and is representative of OCS production within ArcelorMittal Europe – Flat Products. The production (tonnage) breakdown of the plants is used to calculate the results as average values.

Data was collected on an annual basis for the period 2006-2008 from a selection of ArcelorMittal Europe – Flat Products plants producing organic coated steels for which production data is available. Data collection for these sites is part of a wider data collection exercise managed by the World Steel Association, with the participation of worldsteel's members, in order to assess the environmental profile of all steel products on the market. The data collection methodology as well as the methodological LCA options have been peer-reviewed (by an independent panel) and certified compliant with the ISO 14040/44 series. The worldsteel methodology report *(12)* is available at www.worldsteel.org. Data is computerised and obtained from the GABI 6 software, which uses the worldsteel's life cycle inventory data.

## 3.5. Modules considered in the declaration

A1: raw material supply
A2: transportation to the production site
A3: manufacturing
D: recycling, loads and credits.

The results are presented with modules A1, A2 and A3 aggregated. Module D details the environmental credit or burden relating to the recycling of steel as a secondary raw material to produce new steel. The worldsteel methodology is applied; the principle of credit/burden is based on the saving of high-burden raw materials when steel is recycled to the electric arc furnace (avoided impact principle).

A1-A3: From raw materials supply to manufacturing

The European dataset developed by the World Steel Association is used for the production of organic coated steel coil.
Other processes regarding modules A1-A3 originate from the GABI 6 database *(13)*.

D: Benefits and loads of Reuse-Recovery-Recycling-potential recycling

In this study, module D concerns the recycling of steel products. There are two sources of steel scrap for recycling: the production losses occurring during production, and the end-of-life panels after deconstruction. To strictly comply with the definition of secondary materials stated in EN 15804, only scrap arising from end-use products (post-consumer scrap) is accounted for. According to *(14)*, organic coated steel products are assumed to be recovered with 98% efficiency to produce new steel by recycling, or to be reused. The avoided impact methodology used is described in the methodology report from worldsteel.

# 4. LCA results

Numbers are rounded off to two decimal places and relate to 1 m² of organic coated coil.

### Description of the system boundary

*(X = included in LCA; MND = module not declared)*

| | | | |
|---|---|---|---|
| Product stage | Raw material | A1 | X |
| | Transport | A2 | X |
| | Manufacturing | A3 | X |
| Construction process stage | Transport | A4 | MND |
| | Construction-installation process | A5 | MND |
| Use stage | Use | B1 | MND |
| | Maintenance | B2 | MND |
| | Repair | B3 | MND |
| | Replacement | B4 | MND |
| | Refurbishment | B5 | MND |
| | Operational energy use | B6 | MND |
| | Operational water use | B7 | MND |
| End-of-life stage | De-construction demolition | C1 | MND |
| | Transport | C2 | MND |
| | Waste processing | C3 | MND |
| | Disposal | C4 | MND |
| Benefits and loads beyond the system boundaries | Reuse-Recovery-Recycling-potential | D | X |

*For greater clarity, the modules not declared have been masked in the tables below.*

## Results of the LCA

### Environmental impact

| | | Manufacturing | Credits |
|---|---|---|---|
| Parameter | Unit | A1-3 | D |
| Abiotic Depletion Potential (ADP elements) | kg Sb-eq | 5.71E-04 | -6.61E-05 |
| Abiotic Depletion Potential (ADP fossil) | MJ | 1.46E+02 | -6.12E+01 |
| Acidification Potential (AP) | kg $SO_2$-eq | 1.81E-02 | -9.87E-03 |
| Eutrophication Potential (EP) | kg Phosphate-eq | 2.61E-03 | -4.28E-04 |
| Global Warming Potential (GWP 100 years) | kg $CO_2$-eq | 1.31E+01 | -6.48E+00 |
| Ozone Layer Depletion Potential (ODP, steady state) | kg R11-eq | 1.42E-09 | 2.07E-07 |
| Photochem. Ozone Creation Potential (POCP) | kg Ethene-eq | 6.68E-03 | -3.23E-03 |

### Resource use

| | | Manufacturing | Credits |
|---|---|---|---|
| Parameter | Unit | A1-3 | D |
| Use of renewable primary energy, excluding renewable primary energy resources used as raw materials | MJ | 2.73E+00 | 3.49E+00 |
| Use of renewable primary energy resources used as raw materials | MJ | 1.84E-05 | 3.89E-02 |
| Total use of renewable primary energy resources | MJ | 2.73E+00 | 3.53E+00 |
| Use of non-renewable primary energy, excluding non-renewable primary energy resources used as raw materials | MJ | 1.46E+02 | -6.10E+01 |
| Use of non-renewable primary energy resources used as raw materials | MJ | 0.00E+00 | 0.00E+00 |
| Total use of non-renewable primary energy resources | MJ | 1.46E+02 | -6.10E+01 |
| Use of secondary materials | kg | 2.58E-01 | 4.20E+00 |
| Use of renewable secondary fuels | MJ | 7.32E-05 | 0.00E+00 |
| Use of non-renewable secondary fuels | MJ | 6.93E-04 | 0.00E+00 |
| Use of net fresh water | $m^3$ | 3.68E-01 | 6.72E-03 |

### Output flows and waste categories

| | | Manufacturing | Credits |
|---|---|---|---|
| Parameter | Unit | A1-3 | D |
| Hazardous waste disposed of | kg | 2.01E-01 | -6.67E-02 |
| Non-hazardous waste disposed of | kg | 3.63E-01 | -1.42E-01 |
| Radioactive waste disposed of | kg | 2.17E-03 | 2.22E-03 |
| Components for reuse | kg | 0.00E+00 | 0.00E+00 |
| Materials for recycling | kg | 3.23E-01 | -7.12E-02 |
| Materials for energy recovery | kg | 0.00E+00 | 0.00E+00 |
| Exported energy per energy carrier | MJ | 0.00E+00 | 0.00E+00 |

# 5. LCA interpretation

## 5.1. Environmental indicators (modules A1, A2, A3)

**ADP elements**. The indicator of abiotic depletion of elements is nearly 100% dominated by zinc as a non-renewable resource. This could be reduced by half using the new Optigal™ product.

**ADP fossil**. This indicator is dominated by the use of hard coal at the BF (~70%) and natural gas at the hot dip galvanising line (12%); the balance is due to fossil fuels used for the upstream production of electricity (national grid) required by the steel plants, and to fossil fuels used in the upstream zinc production process.

**AP**. Sulphur dioxide and nitrogen oxides together contribute most to the acidification potential indicator (90%). They arise from electricity production and transportation (sea shipping as major contributor), respectively.

**EP**. The EP for steel products is dominated by emissions to air, which contribute 94% to this impact. The main contributor is nitrogen oxides (90%). Emissions to water that contribute to this impact are from nitrogen-containing substances, e.g. nitrates and ammonia.

**GWP**. The global warming potential indicator is dominated by emissions of $CO_2$ (~93%) at the BF and by energy production and use throughout production. Methane also contributes to a lesser extent (6%) to GWP at the coking plant. The balance (~1%) is due to nitrous oxide and non-methane organic compound emissions.

**ODP**. The ozone layer depletion indicator value is mainly accounted for by electricity production for high-grade zinc refining. This could be reduced by half using the new Optigal™ product.

**POCP**. The photochemical ozone creation potential for steel products is dominated by carbon monoxide arising from the iron ore preparation process (sintering plant), which accounts for over 60% of the contribution to this impact. The other major substances contributing to the POCP are sulphur dioxide and nitrogen oxides.

**Total primary energy demand** (use of renewable and non-renewable primary energy resources). The majority of the primary energy demand comes from hard coal consumption (80%) and natural gas (9.5%), and the balance comes from consumption of uranium, crude oil, renewable fuels and lignite.

## 5.2. Module D considerations

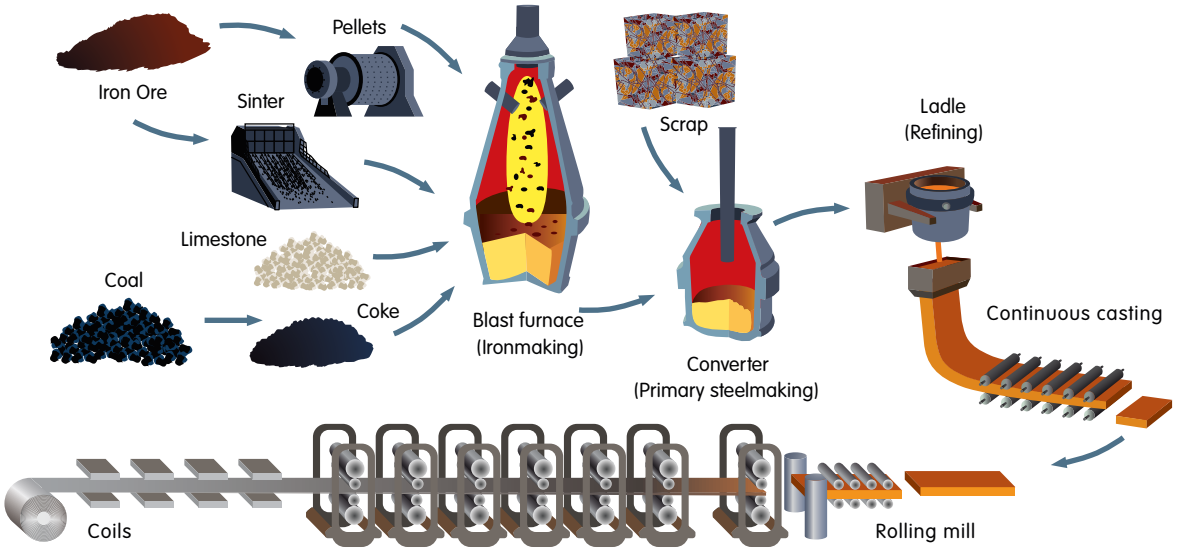
Module D calculates the credits or burdens associated with end-of-life recycling of the OCS. When steel is recycled in the electric arc furnace (EAF), energy consumption decreases considerably. Recycling avoids the first stages of production of new steel by the BF/BOF route; for example, a credit of 53.5 MJ can be subtracted from the 161 MJ of total primary energy used for the production of 1 m² of OCS, in order to assess the energy footprint of the product from a whole life cycle perspective. However, in this case, whereas the total primary energy demand decreases, the primary energy from renewables increases because the power mix used by the EAF requires more renewable energy resources. Credits are also important for GWP.

# 6. Additional information

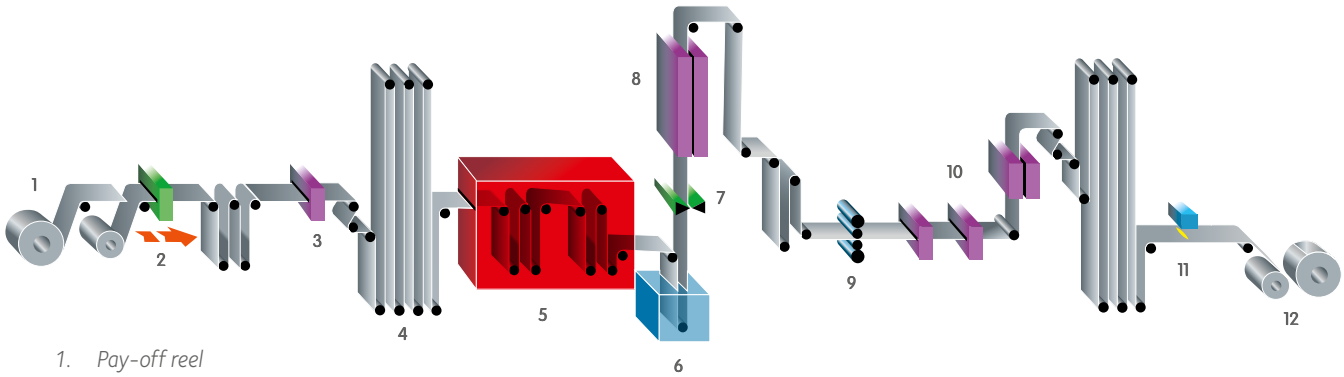
## 6.1. General process description from raw materials to OCS production

OCS are semi-finished products produced using the blast furnace (BF) route. The process begins with the extraction of raw materials (mainly iron ore, hard coal and limestone). These are prepared in the coking, sintering and pelletising plants in order to supply feedstock to the BF; the "pig" iron produced is then fed to the BOF (basic oxygen furnace) along with steel scrap (typically 10 to 25% of the load weight). The molten iron from the BOF is poured into a ladle into which are added trace elements to refine the steel to the target chemical composition.

Continuous casting technology is used to produce slabs, which are rolled in several passes in rolling mills until the desired thickness is achieved. At this stage, we have coils.




The coils enter the galvanisation process in which a zinc coating is applied to both coil surfaces by passing the coil through a molten zinc bath (400 °C). The zinc-coated coils are then fed into a coating line and paint is applied (see figure next page).




1. *Pay-off reel*
2. *Stitching machine*
3. *Cleaning and surface quality optimisation*
4. *Entry looper*
5. *Controlled temperature and atmosphere annealing*
6. *Lead-free zinc bath*
7. *Coating thickness adjustment*
8. *Alliation*
9. *Skin-pass to obtain the required surface texture*
10. *Post-treatment*
11. *Inspection point*
12. *Coiler*

A continuous coil coating line consists of the steps described below.

### The entry section

Coils are placed on a pay-off reel. To allow the process to proceed continuously, the head of the incoming coil is "stitched" to the tail of the coil being processed.

### The process section

The surface of the strip is prepared for coating. This pre-treatment is performed in various steps. First, the strip is degreased and then a surface treatment coating is applied to increase the adherence of the paint.

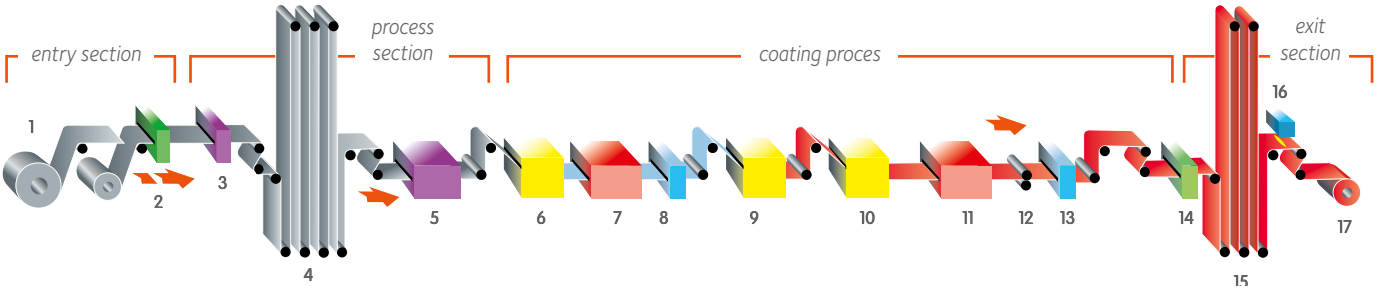
### The coating process

The first coating head applies liquid paint to both sides of the strip, usually primer on the topside and backing coat on the underside. The strip is then passed through an oven, where the solvents are extracted and the coating is cured. After leaving the oven, the strip is cooled and a top coat is applied to the upper surface in the second coating head, followed by another curing and cooling cycle.

### The exit section

The strip passes through an inspection section and finally reaches the coiler.

Note: Optionally, OCS can be produced on "combilines", where the painting steps have been coupled with the hot dip galvanising process. Results presented in this document are conservative for such a case.




1. *Pay-off reel*
2. *Stitching machine*
3. *Degreasing*
4. *Entry looper*
5. *Pretreatment*
6. *Coater: primer coater, top & backing coats*
7. *Oven**
8. *Cooler*
9. *Coater: top*
10. *Coater: underside*
11. *Oven**
12. *Embossing roll*
13. *Cooler*
14. *Leveller*
15. *Exit looper*
16. *Inspection section*
17. *Coiler*

** Each oven is equipped with a solvent incinerator*

## 6.2. QA & HSE issues during the manufacturing process

All ArcelorMittal Europe – Flat Products plants producing Granite® or Estetic® are ISO 9001 and ISO 14001 certified.

## 6.3. On-site works

Storage on the construction site is minimised because the coated sheets can be cut to the right dimensions in the forming plant and only the exact quantities required are delivered, thus reducing the need for transportation.

Assembling steel parts is quick and is done "dry"; no dust is emitted and no water is used on site.

## 6.4. End of life

OCS can easily be removed at the end-of-life stage of a building or for the purpose of repair. At that point they are recovered and recycled* to the electric arc furnace with a European average efficiency rate of 98%. The module D is calculated using this recycling rate. Steel is re-melted with a primary energy demand of only 36% compared to that of the BF/BOF route and with a reduction of 80% of $CO_2$-equivalent emissions. Zinc ends up in the EAF dust, which is filtered. This zinc is then sent back to the zinc recycling industry. As for the organic coatings, their components dissociate at high temperature in the EAF at around 1700°C, and are accounted for in the air emission inventories. Moreover, there is no loss of properties after steel is recycled to make new steel. Recycled steel is used in the EAF as well as in the BOF process.

**Note: it may happen that steel panels are collected and reused directly. The reuse rate is estimated at around 5 to 10% of the collected panels. The result of reuse is not accounted for here, so that the values shown are conservative as regards the overall environmental profile.*

## 6.5. Water consumption

Net fresh water consumption is calculated on the basis of the following sources: rivers, lakes, rainwater and groundwater. It is equivalent to the difference between fresh water input and output, which is mainly due to evaporation in upstream processes. Wherever possible, closed-loop circuits or purification circuits are used to circulate water. For example, the water recycling concept of ArcelorMittal Ghent is based on the use of fresh canal water in counterflow to the production processes. Fresh water is used first in the cold rolling mills. After purification, the same water is used again in the hot rolling mill, and so on.

All ArcelorMittal's European plants comply with local laws and regulations concerning pollution thresholds.

# 7. References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2 Tolerance tables,
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3 Description of mechanical properties,
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4 Index of steel grades and standards as listed in the brand correspondance tables in our Industry product catalogue,
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5 In press

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**Credits**

Photography & graphics:
Jeroen Op de Beeck, Philippe Vandenameele

ArcelorMittal Europe – Flat Products

24-26, boulevard d'Avranches
L-1160 Luxembourg
industry.arcelormittal.com

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