



ArcelorMittal

Do you want  
more performant safety barriers?



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committed to safety, sustainability and  
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# ArcelorMittal Europe – Flat Products : committed to safety, sustainability and competitiveness



Providing safe, sustainable steels are key values for ArcelorMittal. So it's only natural that the world's leading provider of flat carbon steels is active in the development of safer steel solutions for road safety equipment. Over the past ten years, ArcelorMittal has developed a full range of products and specific services to help our customers become more competitive and constantly improve the performance of their steel solutions.

## An opportunity for more competitive safety barriers

Reducing the number of people killed or injured on the roads is one of the European Union's strategic objectives. New standards have been implemented to better define the levels of safety required on road networks. Introduced in July 2013, the new EN 1317-5 standard for road safety barriers is entirely performance-based, unlike older norms.

EN 1317-5 allows ArcelorMittal's customers to consider new steel designs and solutions for safety barriers. ArcelorMittal is working with manufacturers to develop new, more competitive barriers using High Strength Low Alloy (HSLA) steels. When combined with new coatings such as Magnelis®, ArcelorMittal's HSLA steels offer long-term, cost-effective solutions.

For steel, the new EN 1317-5 standard typically sets minimum yield stress for barriers at 235 MPa – the same level as in the previous standard. However, manufacturers are now free to replace structural steels such as S235JR with High Strength Low Alloy steels that are lighter per metre, better able to absorb energy in the event of a crash, and more cost-competitive. As they are lighter than structural steel solutions, HSLA barriers have less impact on the environment during manufacturing and installation. Like all steel products, the barriers can be 100% recycled if they become damaged or are no longer required.

Given their excellent mechanical properties, high strength steels are the best choice to improve the performance of safety barriers while improving competitiveness.

ArcelorMittal offers a wide range of steels and advises on the best choices to meet requirements between energy absorption, vehicle containment and maintaining the optimum working width.



# ArcelorMittal's High Strength Low Alloy (HSLA) steels increase competitiveness by up to 20%

Using ArcelorMittal's High Strength Low Alloy steels enables safety barrier manufacturers to increase competitiveness by between 15 and 20% thanks to:

## Controlled properties

HSLA steels have much tighter tolerances than structural steel grades. Their mechanical properties are more controlled than those of structural steels, providing better test result reliability and optimal safety.

## Tailor-made solutions

The combination of different steel qualities enables barrier makers to design tailor-made solutions which exactly fulfil the different requirements of the standard. HSLA steels can also enable manufacturers to limit the range of profiles they have to produce by mixing the steel qualities.

## 25% weight reduction

The significant reduction in the overall weight of the post and beam (up to 25% compared to the S235JR structural grade) reduces greenhouse gas emissions as less material is required and more finished products can be transported in one load – for example, to the installation site. The low weight of a safety barrier made from high strength steels also makes the job easier for the workers who install or renew them.

## Reduced maintenance

Using high strength steels for barriers with high containment levels reduces maintenance as less damage occurs in the event of an impact.

## Benefits of using high strength steels

Compared to structural grades, HSLA steels such as S420MC offer a choice between:

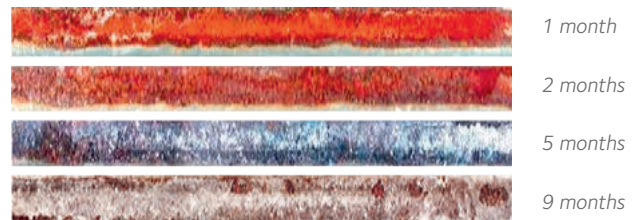
- Same performance at reduced thickness
- Same thickness with increased performance.



## Magnelis® ensures durability for the entire lifecycle of steel barriers

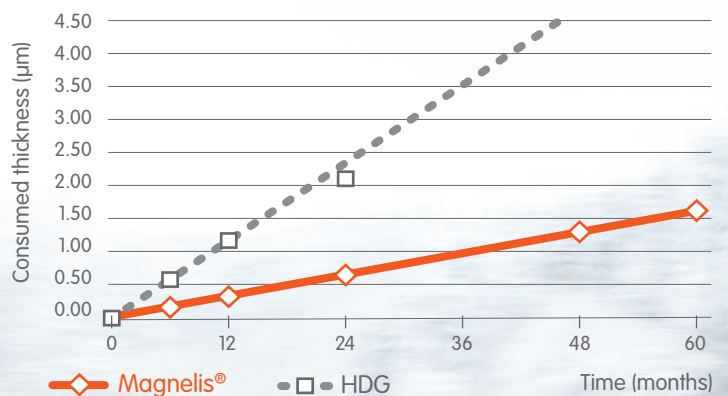
ArcelorMittal offers a full range of coating solutions to protect steel safety barriers against corrosion. These include heavy gauge hot dip galvanising, as well as new high performance metallic coatings such as Magnelis®.

Comprising a distinctive metallic chemical composition of zinc with 3.5% aluminium and 3% magnesium, Magnelis® lasts much longer than traditional coatings such as hot dip galvanization. The excellent corrosion behaviour of Magnelis® has been proven in outdoor tests. Magnelis® also offers protection for edges and perforations thanks to its inbuilt self-healing properties.



Self-healing protection of Magnelis® ZM310 after exposure to atmosphere (steel thickness 5.5 mm)

Magnelis® loses three times less coating thickness per year compared to hot dip galvanised coatings.



Magnelis® thickness evolution compared to standard hot dip galvanised (HDG).

Results of a four-year outdoor exposure test of Magnelis® in Brest (France).



Safety barrier by Mieres Tubos/Grupo Condesa coated in Magnelis® ZM310 (steel thickness 3 mm). Exposure was started outdoors in September 2011 (left). Note the self-healing effect on the perforations in October 2013 (right).

## Benefits of using Magnelis®

- Outstanding corrosion resistance, even on cut edges, in harsh environments
- Warranty of up to 20 years.



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 run-off to the soil. Magnelis® is the best coating material to resist corrosion in various soil types.

ArcelorMittal offers a warranty of up to 20 years on Magnelis® in road safety applications.

Magnelis® can be used on steels up to 6 mm thick and is compatible with ArcelorMittal's range of High Strength Low Alloy grades.

The combination of high strength steels and Magnelis® offers the best-performing and most cost-effective solutions for the safety barrier market.

Changes to allow the use of zinc-aluminium-magnesium coatings such as Magnelis® on safety barriers will be introduced in a forthcoming revision to the EN1317-5 standard.

### Processed steels and services

ArcelorMittal is able to deliver high strength steel combined with Magnelis® to safety barrier makers. Through our own steel service centres network and our partnerships with other suppliers, ArcelorMittal can provide coated, processed steels such as slit coils in the required dimensions. Our services help manufacturers meet their need for just-in-time delivery and minimise the level of stock they need to hold at their factories.



# ArcelorMittal's co-engineering helps clients win in the marketplace

ArcelorMittal's Global R&D teams support our customers at all stages in the development of new solutions. Our assistance starts with the design of the first components and extends to the launch of the product on the market.

To help our customers achieve their goals, ArcelorMittal has developed extensive knowledge of numerical analysis and experimental tests. We also have a deep understanding of safety standards and lightweighting thanks to our many years of experience in the automotive market. ArcelorMittal's expertise is continuously upgraded and improved through our involvement in EU projects and large testing campaigns.

For our customers, ArcelorMittal's co-engineering services increase the chances of success during the crash test certification of new barriers. ArcelorMittal solutions have already achieved a success rate of 85% in European full-crash tests. As a global player, ArcelorMittal is able to integrate the specific requirements of local authorities to ensure safe and compliant barrier solutions.

Our expertise includes design, numerical modelling, physical tests on components and whole systems. The exact suite of solutions that can be provided depends on the needs of individual customers.



## Safety barrier design

To save lives, roadside restraint systems are designed to:

- Stop vehicles rolling over
- Redirect errant vehicles back to the road after a crash with an exit trajectory which avoids collisions with other vehicles on the road
- Gently decelerate the vehicle to minimise the severity of an impact on people and vehicles.

All of the following elements interact during an impact and have an effect on barrier performance:

- Barrier (beams, posts, spacers, junctions)
- Vehicle and its occupants (structural elements, steering system, suspension system)
- Road and its environment (soil, pavement).



# What can ArcelorMittal provide to barrier makers?

ArcelorMittal Global R&D can provide barrier makers with numerical and experimental tests including:

- Steel characterisation
- Investigation of beams and beam connections
- Pull-out tests and optimisation of the beam/spacer connection
- Soil characterisation
- Post length and geometry optimisation
- Transmission of energy to bridge decks.

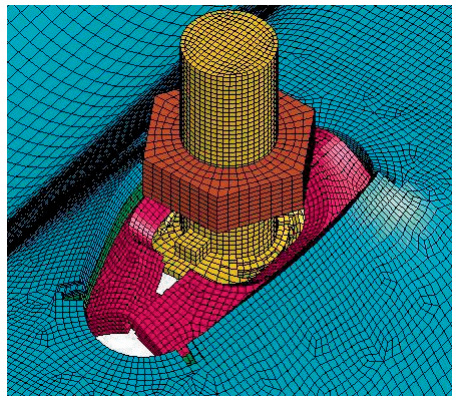
We offer assistance on safety barriers, motorcyclist protection systems, transition parts and terminals.

## A comprehensive approach to barrier testing

The behaviour of a barrier and its elements can be tested in several ways at ArcelorMittal's facilities. Experimental results are used to check the accuracy of advanced modelling and numerical tests.



Bending test on W-beam

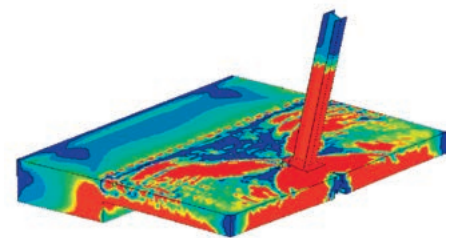


Test of bolted joints

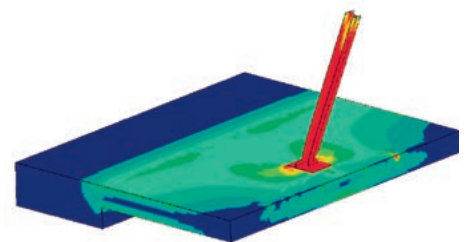
## Bridge-deck barrier testing

ArcelorMittal can also help barrier makers to test their designs in order to analyse how crash loads will be transmitted to a bridge deck.

The images below show a simulation of barrier performance on a bridge deck, without and with adapted reinforcement.



Deck and barrier damage



Barrier damage



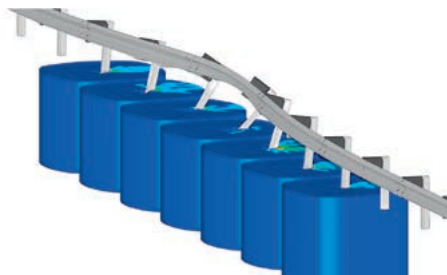
Beam-to-beam connection test



Equipment to test soils and anchor plates

### Anticipating the influence of soils

Different soil types affect the working width of safety barriers and can influence their containment level. ArcelorMittal Global R&D is developing highly detailed soil models so we can predict this behaviour. Experimental tests form the basis of our advanced and reliable numerical models.



Crash test simulation including soil behaviour

### Extensive library of vehicles model

ArcelorMittal uses a comprehensive library of tailorable vehicle types and dummies in our numerical simulations. Our data corresponds to the EN1317 standard and the US Manual for Assessing Safety Hardware (MASH).

### Recommending the best steel

ArcelorMittal recommends the steel with the most suitable mechanical properties for the client's application. Our expertise includes static and dynamic tests, steel characterisation for structural and multi phase steels, and triaxial characterisation which is essential for rupture modelling.

## Case studies

### Your barrier in six months

In less than half a year, ArcelorMittal has helped a customer to design a more competitive safety barrier using the appropriate combination of high performance steels. The following savings were achieved with the new H1 barrier design:

- Cost savings of more than 15%
- Weight savings up to 30% with the same level of performance
- Reduction of installation time.

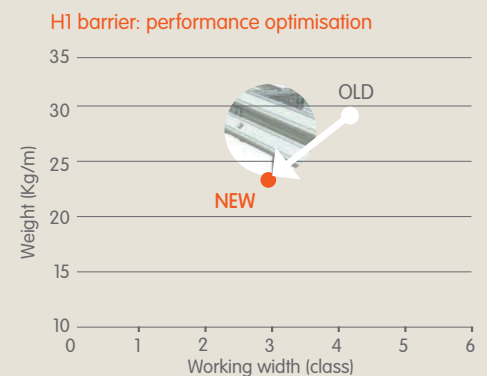
By using a High Strength Low Alloy steel (S460MC in place of the structural grade S235JR), the thickness of the barrier could be reduced and the distance between posts increased.

The project demonstrated that a weight saving of up to 30% is possible. Together with a significant reduction in installation time, the change to a HSLA steel led to a 15% cost saving. That's without calculating the reduced stock levels required, lower transport costs as there are fewer (and lighter) parts, and the ease of working with the new barrier.

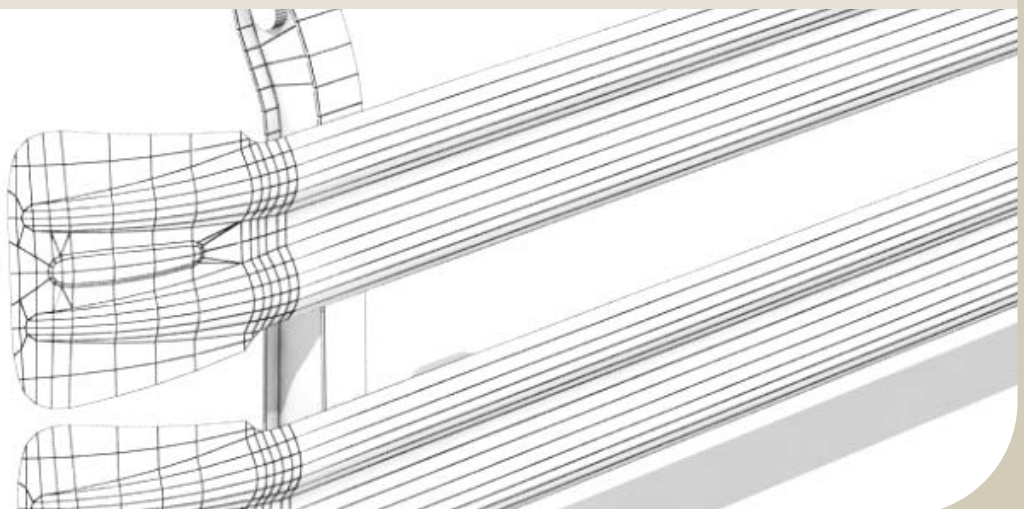
### Material selection increases performance

ArcelorMittal helps barrier makers increase the performance of their products by selecting a more suitable steel.

By selecting a HSLA steel (S460MC) instead of a structural grade S235JR, the thickness of a generic H1 barrier can be reduced while improving its deformation properties (from W4 to W3). Without changing a design, a more competitive steel selection can result in a weight saving of around 20%.



Performance optimisation of a generic H1 barrier



## Sustainability is part of our values

Steel is fully and permanently recyclable and is the most recycled material globally. All recovered steels are recycled. Steel can be recycled indefinitely without loss of properties and can be up-cycled to produce steel with superior performances.

ArcelorMittal develops and manufactures environmentally friendly steels which offer:

- Lead-free metallic coatings
- Reduced material consumption thanks to the use of advanced High Strength Low Alloy steels
- Zinc-aluminium-magnesium metallic coatings such as Magnelis® which reduce zinc run-off into soils and preserve natural resources as they use less zinc.

ArcelorMittal has also developed its own expertise in lifecycle analysis for construction products which is in line with the new European Product Declaration (EPD) standard EN 15804.

As a member of the European Union Road Federation (ERF), ArcelorMittal supports the organisation's efforts to make policymakers aware that roads, safety and sustainable development go hand-in-hand.

Public health concerns over emissions from road vehicles and their impact on air quality have risen over the past decades. Recognising the need for greener road transport, the road infrastructure sector has taken significant steps to ensure its practices are more environmentally friendly.

ArcelorMittal is strongly committed to developing safer and sustainable steels for road restraint applications.

*ArcelorMittal is an active member of the following road safety organisations:*



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