

ArcelorMittal Europe – Long Products

Long Products Europe is one of the key business units of ArcelorMittal. Employing 10,700 people, with about 12 million tonnes of steel shipped each year and a total of 23 plants in 10 countries, 4 of them serving the automotive industry, it is Europe's leading producer of wire rod, rebar, special and merchant bar, sheet piles and sections. ArcelorMittal Europe –. In the pages below, we take a closer look at some of its most successful products.

Bars & rods

ArcelorMittal Europe – Long Products has a long and rich tradition of producing bars and wire rod in its locations in Germany, France, Spain, Poland, the Czech Republic, Bosnia Herzegovina and Morocco. These mills are at the forefront of technical innovation and provide best-in-class customer service, offering a wide spectrum of qualities covering the full range of wire rod applications.

ArcelorMittal's bars and rods are sold to every major market – construction, infrastructure, automotive, mechanical engineering and energy. The group's commitment to reducing the company's carbon footprint is a key element of its development strategy, working alongside its customers to develop lighter and more cost-effective designs. In 2015, Long Products produced 6.3m tonnes of bars and rods in Europe, using 3.4m tonnes of recycled steel – representing 53.6% of total bars & rods production and 4.6m tonnes per annum of CO2 savings.

Key investments

Long Products Europe is continuously improving its product range to meet the evolving needs of the industry. In recent years, the group's European mills have made major investments in state-of-the-art equipment for the production of bars and rods, including:

- a €135 m investment in a 690,000 t/y **state-of-the-art wire rod mill in Duisburg** (Germany), commissioned in 2012, for the production of high quality wire rod for the auto industry and mechanical engineering, plus extensive upgrades to the site's continuous casting facility
- a recent investment of over €7m in a **new control and finishing line for bars at Gandrange** (France), inaugurated in 2013.
- an extensive revamp of **Ostrava's Continuous Caster No.1** (Czech Republic), commissioned end 2013. The €36m investment will enable Ostrava to cast round billets up to 400mm in diameter, up from 210mm previously. The modernisation included a new vacuum degasser.

These investments have significantly improved the quality and capabilities of the group's products in the most demanding market segments.

R&D

With an expanding network of over **1,300 full-time researchers in 12 research centres across the globe**, ArcelorMittal's experts are committed to improving steel processing and engineering, with the aim of developing new steel solutions to address future market needs. Some of the most recently developed solutions for bar & rod, already in use, include **bainitic grades for forging (Solam®)**, **high plasticity** and **high strength grades for cold heading (FreeForm®)** and **high machinability grades**.

The R&D missions of the group include:

- A proactive approach to the future needs of our customers
- Development of products, solutions and processes - from pre-design to implementation
- Assistance to plants for complex technical issues

ArcelorMittal has developed sophisticated methods of mapping the steel production process: from liquid metallurgy to hot rolling and cold forming, connecting microstructural behaviour and thermomechanical processes to steel performance. These methods enable the group's partners such as forgers or fastener makers to minutely control their processes and increase the robustness of their products.

In addition, drawability and machinability are specific areas of research for which the group has dedicated equipments. ArcelorMittal can provide specific surface expertise for wire, including surface morphology and aptitude to coating.

Innovating for different markets

Automotive: close partnerships for lighter, safer and fuel efficient vehicles

ArcelorMittal's customers are under significant pressure to reduce CO₂ emissions, primarily related to fuel consumption. ArcelorMittal supports them by providing reliable weight reduction solutions, taking into account the entire life cycle of the material.

ArcelorMittal continues to invest in delivering high-quality steel for the automotive industry. Today, new continuous casting equipment in ArcelorMittal's mills is providing higher quality products, such as rotating parts for trucks and cars made from products rolled in **Duisburg** (Germany) and **Gandrange** (France). Duisburg is today a leading supplier of premium quality alloyed spring and cold heading grades for automotive.

A new peeling line for the production of higher added-value steels and a new quality inspection facility have also been implemented at the bright drawing plant in **Revigny-sur-Ornain** (France). Worth a total of €3.5m, these two investments finalised in 2015, of which 75% of production goes to the automotive segment, will further strengthen its market position for high added value products.

Verina is implementing new equipment for improving diameter tolerances and surface defect detection to strengthen its position in the steel cord market.

ArcelorMittal's offer for the automotive industry includes specific brand products such as:

- **Freeform® M1500H2** for the production of ultra-high strength engine bolts with improved hydrogen resistance. For powertrain, possible applications include screws for con-rod caps, crankshaft bearing and engine flywheel, bolts for cylinder head, differential and pulleys (M6-M10 screws). The product can also be used for suspension and transmission bolts (M10-M14).
- **Advanced steel forging grade SOLAM® B 1100¹** with a yield strength of over 1100 MPa, providing weight reductions of 20%, obtaining a 30% performance increase while eliminating costly heat treatment steps. Its many applications include truck front axle beams, steering arms, steering knuckles, etc.
- **Advanced steel grade Solam® M2050 S – Cor**, developed for suspension spring to reduce weight by up to 20% by increasing mechanical properties and improving fatigue resistance after corrosion as compared to standard grade 54SiCrV6

Mechanical engineering: products for high precision applications

ArcelorMittal serves the mechanical engineering market from Gandrange, Duisburg and Warsaw. Our product range includes bars and wire rod in round and hexagons in a wide spectrum of grades and dimensions.. Our production equipments include state-of-the-art sizing block, integrated bar conditioning line with surface and ultrasonic testing..

As well as serving the automotive market, **Revigny-sur-Ornain** also produces for the mechanical engineering and construction markets. Located in the heart of Europe, between Strasbourg and Paris, Revigny is the leading French supplier of free cutting steel producing about 50kt per year of cold drawn, peeled and grinded bars. Revigny has a diversified portfolio of low, high carbon and alloyed steels, leaded and unleaded free-cutting mild steels with sulphur, free-cutting steels for heat treatment, case-hardening

¹ SOLAM = **S**teel **S**olution of **A**rcelor**M**ittal for hot forging. B= Bainitic microstructure. 1100 in MPa is the minimum UTS achieved after forging

steels, and leaded and unleaded carbon steels. The site produces the special grade **Usimax®**, a freecutting steel allowing high mechanical characteristics and high level of productivity in machining operations.

Construction and infrastructure ArcelorMittal Europe Hamburg, Verina and Sosnowiec are very well known suppliers in Europe and Export markets especially in steels for infrastructure (cables, pre stressed concrete, rail clips)

ArcelorMittal Hamburg will further improve its market position thanks to increased coil weight to 2t by 2017

Energy: innovative solutions for energy generation, transportation and storage

ArcelorMittal is Europe's leading supplier of high-performance steel products for the global energy industry. The group is also the leader in welding applications for this extremely demanding market, with steel supplied from Hamburg, Sosnowiec and Verina. Hamburg is specialised in alloyed alloyed welding grades. ArcelorMittal Europe supplies continuous cast round billets from Ostrava with enlarged diameter ranges (130, 200, 270, 350 and 400mm) and Hunedoara (Romania) (180, 200, 250, 270 and 310mm), recently equipped with a new vacuum degassing system for production of seamless pipes with application for the oil and gas industry.

Yellow goods: steels for extreme conditions

Strong, abrasion-resistant steel is required for the production of yellow goods (construction and earth moving equipment, quarrying equipment, fork lift trucks, and agricultural equipment) ArcelorMittal's high performance steel grades help to create durable construction equipment and the most challenging designs. ArcelorMittal Warsaw and Duisburg are approved by the main actors of the segment for use of their products in harsh conditions for excavation, quarrying, mining, etc

Rails

ArcelorMittal is one of the important suppliers of rails for railways, subways, tram, light tracks, crossings, crane rails and rail components.. Out of its sites in Gijón, Dąbrowa Górnicza and Huta Krowleska (Poland) and Rodange (Luxembourg), it supplies rails and track fittings of the highest quality to the European market and the rest of the world. ArcelorMittal supplies rails for the underground and intercity railway lines for some of the largest cities in the world.

ArcelorMittal is engaged in continuous upgradation of its product range, through the development of new types of rails and welding techniques.

Accordingly, the following investments have been made:

- a €37m investment in 2014 to install a new rail rolling mill at Dąbrowa Górnicza, making Dąbrowa one of only three sites in the world capable of producing rails 120m long
- a €25m investment a new CHHR (continuous head hardening of rail) production line at Gijón in 2011. Head-hardened rails can withstand increased wear from trains travelling faster, at greater frequencies and with heavier cargo. Gijón and Dąbrowa have also undergone improvements in their inspection lines, and ongoing works to increase length in Gijón rail mill

R&D

ArcelorMittal has a dedicated R&D rail unit based in *Asturias (Spain)* with different *prototyping* facilities for developing new rail mill processes and products and a welding pilot plant, recently installed in Asturias to develop and test new welding techniques, both for rail grades currently in use and for new grades under development. Rail welding is a critical process for ArcelorMittal's customers, and the group is capable of providing recommendations on the most suitable welding techniques in each case.

Other lines of research are:

- Process modeling and control (rolling, cooling & straightening)

- Improved inspection systems (profile, flatness, surface and stamp inspections)
- Industrialisation support in heat hardened products, development of advanced new grades and microstructures with superior in-use-properties
- Advanced characterisation of in-use properties and client solutions (wearing, rolling contact fatigue and welding pilot equipment).

Recent high speed rail projects

- **Casablanca–Tangier (Morocco):** ArcelorMittal's Veriña site in Spain is supplying 46,000 tonnes of rails for the Casablanca –Tangier high-speed rail line project in Morocco, Africa's first high-speed rail line. ArcelorMittal is the sole rail supplier for Phase 1 of the project, the 200 km section between Kenitra and Tangier.
- **ArcelorMittal has supplied more than 1,5 million tonnes of rails for high speed projects like Istanbul – Ankara (Turkey), Mediterranean Corridor (Spain) and for the first Middle East High Speed railway**

Project case studies: tram rail

ArcelorMittal has been the preferred supplier of grooved rails from its Dabrowa Gornicza site for the following leading new tramways:

Palermo (Italy)
Bonde de Santa Teresa (Brazil)
Oran tramway first line (Algeria)
First line LRT of Kaohsiung city(Taiwan)
People Mover System, Education City Doha (Qatar)
Antalya Tram Phase 1 and 2 - Istanbul Transportation (Turkey)
Samsun tram phase 1 and 2 (Turkey)

These projects represent over 20000 tonnes of grooved rails over the last four years

Sheet Piling

ArcelorMittal is the world's largest producer of hot-rolled steel sheet piles, cold formed sheet piles, bearing piles and foundation solutions. These are produced at Belval and Differdange in Luxembourg, Dąbrowa Górnicza in Poland (for U-shaped hot rolled sheet piles); 'Palfroid' in Messempré, France (for cold formed sheet piles) and Dintelmond in the Netherlands (steel tubes for foundations). **ArcelorMittal Belval** is the world's largest rolling mill of hot rolled steel sheet piles and has been playing a leading role in the development of piling technology for over 100 years.

Steel sheet piles are used worldwide for the construction of quays and harbours, locks and breakwaters, and for bank reinforcement on rivers and canals. Other applications are the protection of excavations on land and in water and excavation works for bridge abutments, retaining walls, foundation structures, etc.

ArcelorMittal's piling series are especially suitable for building reliable structures rapidly and cost-effectively. They are characterised by excellent section modulus to weight ratios and high moments of inertia.

The group offers worldwide comprehensive services and customised support to all the parties involved in the design, specification and installation of sheet and bearing piles, such as consulting engineers, architects, regional authorities, contractors, academics and their students.

R&D

In 2015, in response to a steady increase in demand for wider sheet piles, ArcelorMittal launched a new generation of wider, lighter sheet piles that can be installed with the same equipment, making them more cost efficient: the **AZ® XL range**, made possible through a €35m upgrade to the group's Belval rolling mill in Luxembourg. The new sheet piles come in widths of up to 800 mm. The increased width reduces the required number of elements, consequently leading to faster execution time. Today, four new sizes of sheet piles are available from ArcelorMittal: **AZ® 25-800**, **AZ® 30-750** and **AZ® 20-800 & AZ® 50-700**.

The new AZ® range is suitable for all types of soil conditions, has excellent driveability and uses standard pile driving equipment. All these new profiles are available in high strength steels that enable the design of lighter sheet pile sections, while reducing overall deformation under loads. All prefabricated elements are quality-checked at the plant before delivery. The introduction of the new range to the market will strengthen the competitive position of ArcelorMittal's sheet piling customers in the foundations solutions market.

Case study: Underground Tunnels using ArcelorMittal's sheet piles for Denmark's first high-speed railway line infrastructures.

ArcelorMittal is a key supplier of sheet pile foundation solutions for Denmark's new below ground tunnel elements serving the high-speed rail line between Copenhagen and Ringsted via Køge. To date, the group has supplied approximately 13,000 tonnes of Z and U sections for the line, due to open in December 2018. ArcelorMittal was involved right at the start of the project, crucial in order to be able to provide a solution of real value to its client, the state agency Banedanmark in terms of price, logistics, quality and guarantees. The timely delivery of steel for the various tender packages was also paramount, due to the high tonnages to be delivered in a short period of time. Orders often included various lengths of the same section, adding to the challenge for the supply chain and requiring unconventional solutions, such as a new hub in Køge from where a portion of the orders could be delivered by truck directly to the site. Additional lines are due to be commissioned over the next few years. ArcelorMittal is well positioned to remain the customers' first choice for these upcoming challenges.

Sections and Merchant Bars

ArcelorMittal Europe has a long tradition and renowned leadership in the production and commercialisation of structural shapes, commonly known as rolled sections or commercial sections. The business segment counts 10 mills in 5 European countries and relies on a large sales and marketing network spanning 60 countries worldwide. The group offers the widest spectrum of structural steel grades and shapes to cover every application for sections and merchant bars, and for every market segment: construction, civil engineering and energy.

ArcelorMittal works with its customers to evolve lighter, cost-effective designs that meet the criteria of safety, sustainability and design.

Examples of some unique ArcelorMittal products are:

- **Histar®**, a high-performance, high-strength steel for sections used in hundreds of iconic structures worldwide, including New York's Freedom Tower, achieves average weight reductions of 32% in steel columns and 19% in beams, equal to a CO2 reduction of 20-30%.
- Elegantly combining function with flexibility, the sinusoidal and circular web openings of ArcelorMittal's lightweight castellated beams **Angelina™** and **ACB®** allow the easy installation of mechanical, electrical and plumbing (MEP) pipes and ducts, maximizing ceiling height.
- **CoSFB** (Composite Slim-Floor Beam), a recent award-winning product development by ArcelorMittal, uses an innovative concrete dowel technology to ensure the composite action of the beam without increasing construction height.
- Used as columns in ultra-high-rise buildings and heavy industrial facilities, and ten times larger than average commercial sections, ArcelorMittal's **jumbo sections** are very heavy rolled sections weighing up to 1377 kg/m with flange thicknesses of up to 140mm.