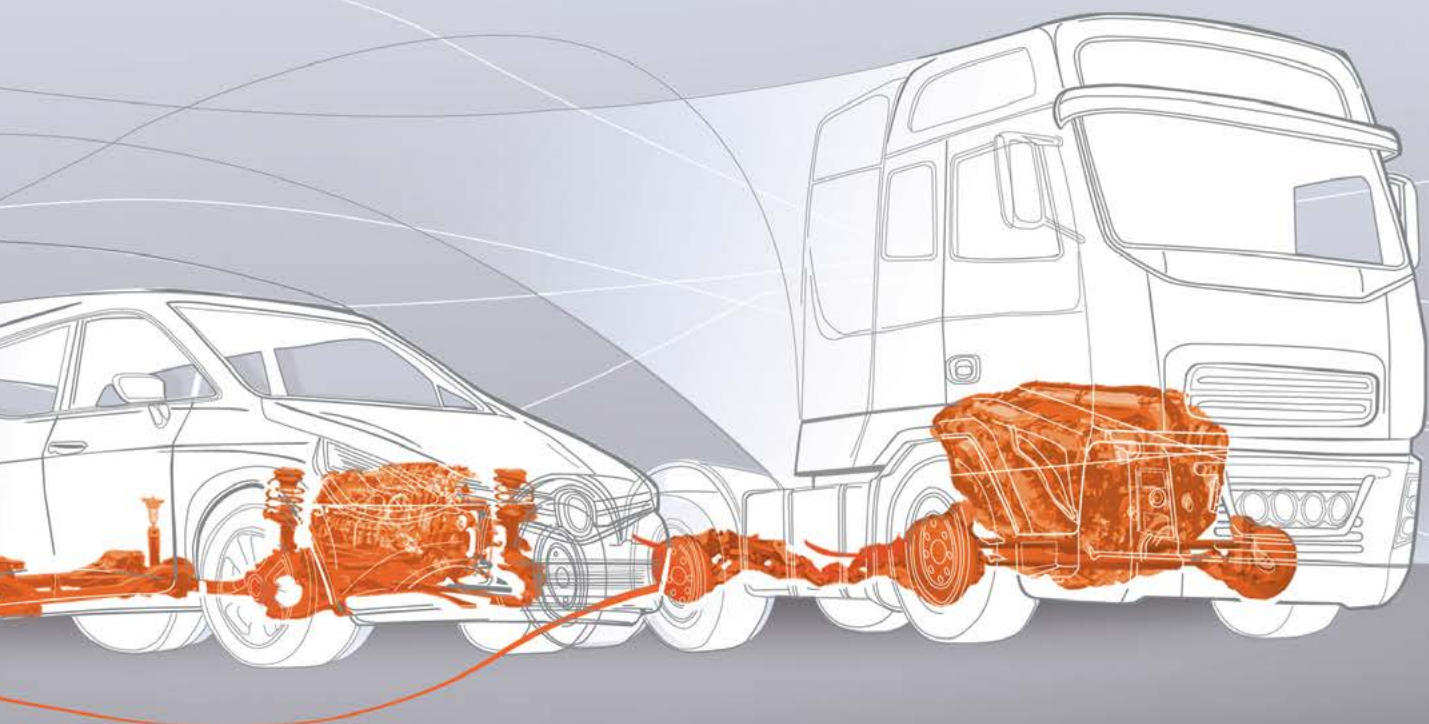




ArcelorMittal

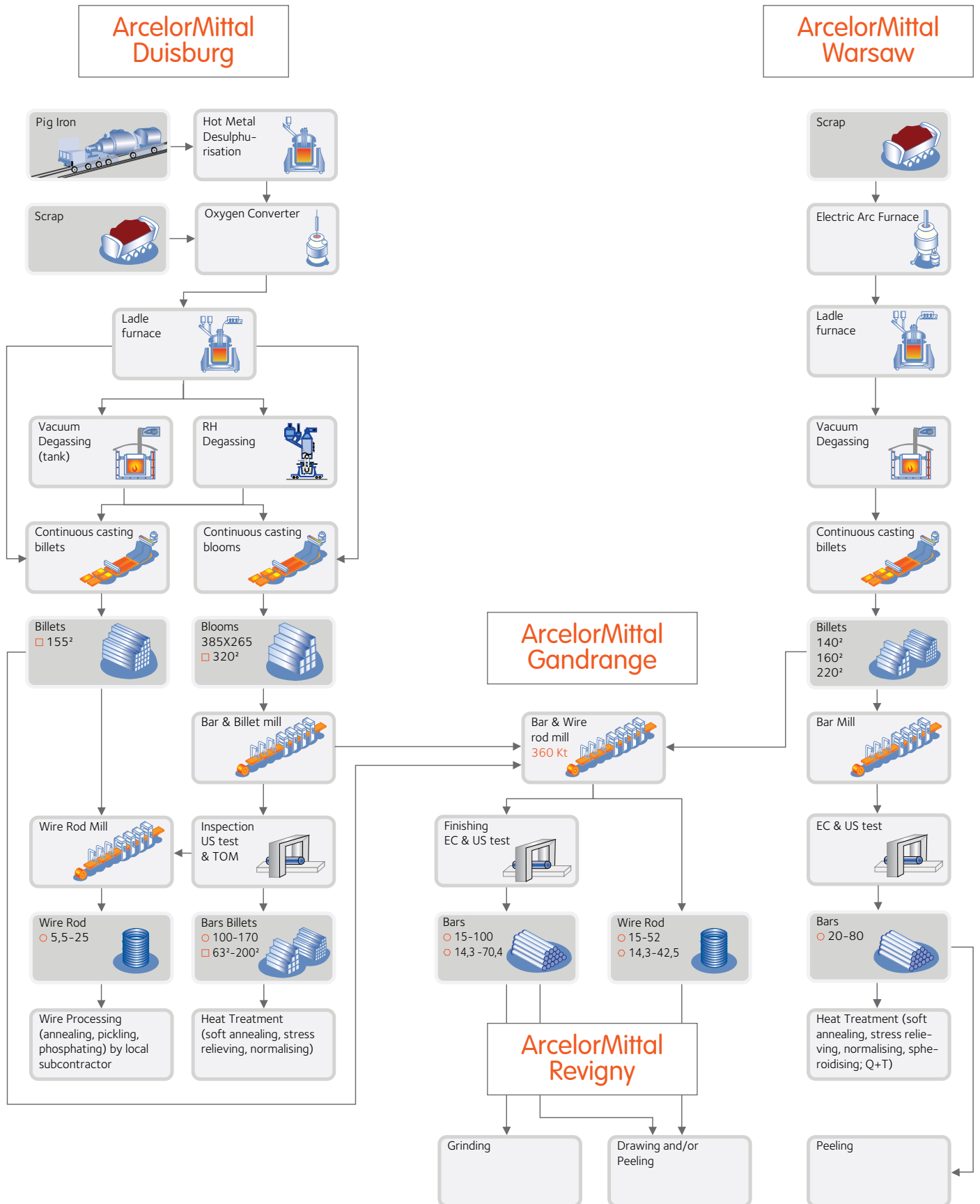
Automotive product catalogue



Bars and rods facilities



Automotive products process flow

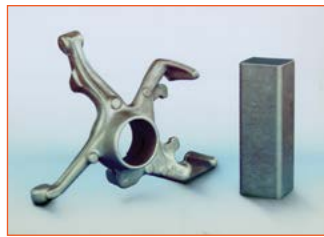
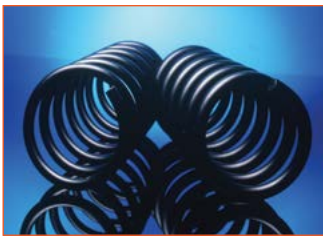




ArcelorMittal Duisburg

Today the wire rod mill offers products on a high-end quality spectrum, and the billet mill produces advanced bainitic steels for hot forging.

The new rod mill is set to become European benchmark for high value added wire-rod in mechanical properties, tolerances, surface quality.



Final applications

- ▶ Cold heading qualities:
 - steel for cold extrusion; fasteners
- ▶ Heat treatable steel grades:
 - components of common rail systems
- ▶ Carbon grade: offshore; pre-stressed steel
- ▶ Alloyed spring steel: Valve springs; clutch springs
 - tension/ compression and axle springs
- ▶ Free-cutting steel
 - special shape turned parts
 - shafts and hydraulic systems
- ▶ Bainitic steel
 - front axle beams, steering levers & knuckle parts

Strengths

- ▶ Production of crude steel with lowest C content (< 100 ppm) and a defined alloy concentration.
- ▶ Refining of metal charges in 150 t converters due to a specific model calculation incl. management of lance status, oxygen flow rate and alloys.
- ▶ Ladle metallurgical centre for precise alloying, reduction of solute gases, desulphurisation and adjustment of melting temperature.
- ▶ Bloom and billet casters with re-oxidation prevention and mould stirring.
- ▶ Square blooms
- ▶ Most modern layout and equipment on a new single-strand wire rod mill like thermo-mechanical rolling and special cooling devices for a fine-grained structure.
- ▶ Special customer requirements upon request.

Facilities

- ▶ Steel plant:
 - Two oxygen converters (TBM process)
 - Ladle furnace
 - Steel ladle vacuum treatment: circulation degasser (RH) and tank degasser (VD), as per metallurgical need
 - Steel conditioning (Argon & Nitrogen stirring)
 - 2 casters bloom & billet
- ▶ Bar & Billet mill:
 - Reversing breakdown and finishing stand
- ▶ Inspection and finishing line for bars & billets:
 - Conditioning with ultrasonic and surface testing (Therm O' Matic)
 - Annealing devices (up to 9 m length): soft annealing, normalising
 - Dimension control
 - Surface grinding (including robot)
- ▶ Wire rod rolling mill:
 - High speed single-strand 28 stands including pre-block
 - Thermo-mechanical rolling incl. loop
 - 104 m long stelmor line
- ▶ Wire rod processing (annealing, pickling, phosphating) upon request

Finished products

- ▶ Wire rod (mm): ● 5.5 to 25 (steps of 0.5 mm)



Coil length (mm) (max.): 2300

Coil weight (t) (max.): 3
1.5t; 2t; 2.5t on request

- ▶ Bars (mm): ■ 63² to 200² (round corner square)
● 100 to 170



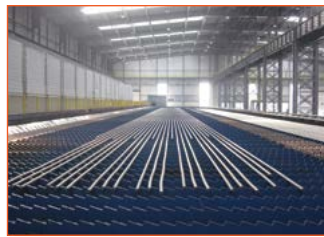
Length: 5-16 meters (3-5 m upon request)
Strapping: 6 steel bands
Labelling: content upon request

Bundle weight (t) (max.): 10

ArcelorMittal Warsaw



Mini-mill with a strong position in mechanical engineering and automotive markets.



Final applications

- ▶ Case hardening steels
Parts such as camshafts, gearbox shafts, engine parts
- ▶ Heat treatable steel grades
Components of steering system, braking system, axle hubs, front axles
- ▶ Cold heading qualities
Steel for cold extrusion, fasteners, screws, ball pins
- ▶ Carbon and micro-alloyed steel grades
Hot forging / stamping – flanges, conrods
Cold forming
- ▶ Carbon and alloyed spring steel
Tension/ compression and axle springs
- ▶ Bearing steel
Bearing rings

Facilities

- ▶ Steel plant:
Electric arc furnace with eccentric bottom tapping
Ladle furnace
Vacuum degassing
4 strand billet caster
- ▶ Bar & Billet mill:
18 stands in continuous system roll line
- ▶ Inspection and finishing line:
Straightening machines
Milling and chamfering devices
Surface control (Circograph, Circoflux)
Ultrasonic control device
Antimixing control - spectrotest devices, packaging, marking
- ▶ Bar processing:
Heat treatment: soft annealing, normalising, isothermal, spheroidising and stress relieving treatments, quenching and tempering (Q+T)
Peeling

Strengths

- ▶ Production of wide range of steel grades
- ▶ Flexibility of mini-mill
- ▶ Steel with controlled/ regulated sulphur content
- ▶ Micro alloys steel with Nb, V, B
- ▶ Steel with "restricted hardenability" (Jominy, 2/3 of band)
- ▶ Full downstream capability: heat treatment and peeling on bars

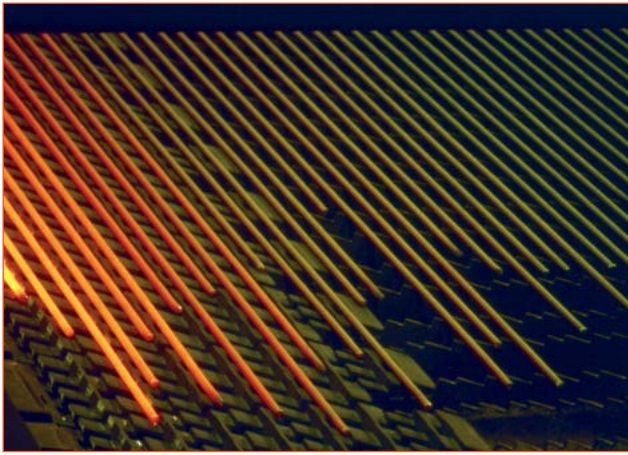
Finished products

- ▶ Bars (mm): ● 20 - 80



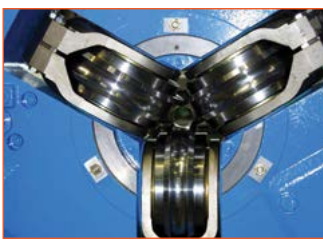
Length (m): 3.5 - 12
Strapping: min. 3 steel bands
Labelling: customer specifications (min. 2)

Bundle weight (t) (max.): 10



ArcelorMittal Gandrange

Products for Automotive and Mechanical Engineering markets with a large range of bars and wire rods.



Final applications

- ▶ Carbon and micro-alloyed steel grades
 - Hot forging / stamping
 - Cold forming
- ▶ Cold heading qualities
 - Steel for cold extrusion; fasteners
- ▶ Free-cutting steel grades
 - Special shape turned parts
 - Shafts and hydraulic systems
- ▶ Heat treatable steel grades
 - Components of Common Rail systems
- ▶ Carbon and alloyed spring steel
 - Tension/ compression and axle springs, torsion bars

Strengths

- ▶ Possibility to source steel from both BOF and EAF routes
- ▶ A wide range of grades and dimensions on Bars and Wire Rods
- ▶ State of the art Sizing Block and Bar Conditioning
- ▶ Mini-mill flexibility in order to meet customer needs
- ▶ Tolerances according EN10060 A to P, tighter tolerances upon request

Facilities

- ▶ Bar & Wire rod rolling mill:
 - Furnace with tight temperature control
 - Sizing block
 - On-line dimensional control
 - On-line surface control
 - Garrett coiling for wire rod
- ▶ Inspection and finishing line for bars:
 - Multi-roll straightener
 - Sawing and chamfering devices (45° or 60° from 0.2 up to 4mm)
 - Surface control (Circoflux)
 - Ultrasonic control device
- ▶ Bar processing upon request:
 - Peeling
- ▶ Wire rod processing (annealing, pickling, phosphating) upon request

Finished products

- ▶ Wire rod (mm): ● 15 - 52 (steps of 0.1 mm)
- 14.3 - 42.5 (hexagons)



Coil length (mm) (max.): 1500

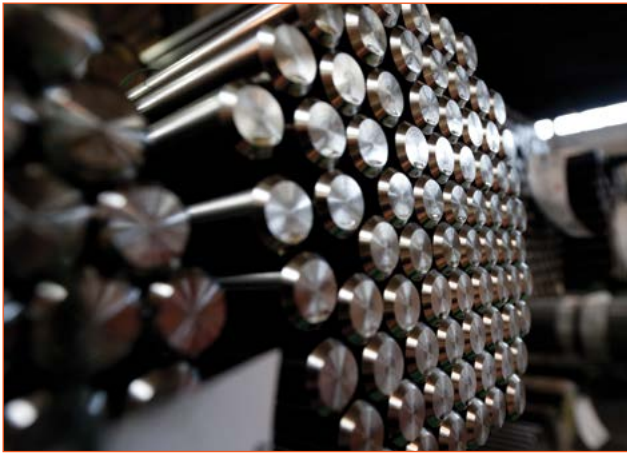
Standard coil weight (t) (max.): 2.5
other coil weights available upon request.

- ▶ Bars (mm): ● 15 - 100 (steps of 0.1 mm)
- 14.3 - 70.4 (hexagons)



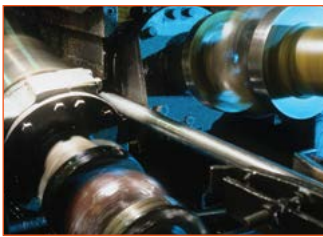
Length (m): 5 - 16
Strapping: 4 - 8 steel bands
Labelling: 2 per bundle

Bundle weight (t) (max.): 1.5 - 8



ArcelorMittal Revigny

Cold drawn and peeled bars for Automotive and Mechanical Engineering markets with a large range of grades and sections.



Final applications

- ▶ Steels for general engineering
 - head rest support – stabiliser bar – green good applications
- ▶ Free-cutting steels
 - components for camshaft – injector pieces – temperature sensors
 - ABS parts – hydraulic couplings –
- ▶ Case hardening steels
 - Air conditioning parts
- ▶ Steels for quenching and tempering
 - components for shock absorber
 - struts – gearbox fork

Strengths

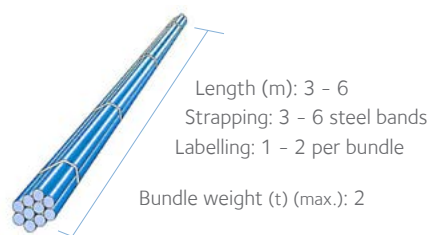
- ▶ Production of wide range of diameters
- ▶ Tight quality control
- ▶ Various upstream supply routes – wide range of product choice
- ▶ High supply flexibility due to tight relation with the rolling mills of ArcelorMittal Duisburg & Gandrange
- ▶ 3 Service Centres in Italy, France & Germany

Facilities

- ▶ Cold drawing
- ▶ Peeling
- ▶ Grinding
- ▶ Inspection
 - Eddy current control (Circograph – Defectomat)
 - Ultra-sonic testing

Finished products

- ▶ Bright bars (mm): ● 5 - 80 (special shape on request)
 - 5.5 - 75 (hexagons)
- ▶ Peeled bars (mm): ● 20 - 100
- ▶ Grinded bars (mm): ● 6 - 50



ArcelorMittal Europe - Long Product (non-exhaustive products offer)

Improved Machinability Steels

Improved Machinability Steel grades have small amounts of additional alloying elements to improve machinability. Alloying elements are added during secondary steelmaking specifically to modify the steel inclusion population. Some elements form controlled inclusions to promote chip formation and break-up during subsequent machining, while others melt locally at the tool / work piece interface acting as a lubricant and reducing tool wear. Possible additions include Sulphur, Lead, Tellurium, Bismuth and Selenium.

Specifications

Grade designation	Duisburg (as rolled)	Gandrange (as rolled or peeled)	Warsaw (as rolled, peeled or heat-treated)	Revigny (as drawn or peeled)	Comments
Usimax [®] D10				●	UTS 400-700 MPa drawn - High Speed Free Cutting Steel (without lead)
Usimax [®] D38				●	UTS 700-850 MPa drawn - Free Cutting Steel for Heat Treatment
Usimax [®] D950				●	UTS 950-1100 MPa drawn - High Resistance Free Cutting Steel
11SMn30	●	●	●	●	
11SMnPb30	●	●		●	
11SMn37	●	●	●	●	
11SMnPb37	●	●		●	
36SMnPb14	●	●		●	
38SMn28	●	●	●	●	
35S20	●	●	●	●	
46S20	●	●	●	●	
44SMn28	●	●	●	●	Camshaft Sleeve
C15Pb	●	●		●	
C35Pb	●	●		●	
C45Pb	●	●		●	Camshaft

Quenched and Tempered Steels

Quenched and Tempered Steel grades have greater hardenability than structural carbon steels. The grades contain specific amounts of alloying elements to favour transformation of austenite into martensite during the quenching process. After forging, the work piece is quenched in water, polymer or oil to increase the hardness even in thick sections (through-hardening). The tempering process allows to obtain the best compromise between strength, ductility and toughness.

Specifications

Grade designation*	Duisburg (as rolled)	Gandrange (as rolled or peeled)	Warsaw (as rolled, peeled or heat-treated)	Revigny (as drawn or peeled)	Comments
38Cr2	●	●	● (Q+T)		
37Cr4	●	●	● (Q+T)		
34Cr4	●	●	● (Q+T)	●	
41Cr4	●	●	● (Q+T)	●	
18CrMo4	●	●	● (Q+T)		Common Rail
25CrMo4	●	●	● (Q+T)		
30CrMo4	●	●	● (Q+T)		
34CrMo4	●	●	● (Q+T)		UTS > 1100 MPa - Rocker Arms, Pistons, Crankshaft
42CrMo4	●	●	● (Q+T)	●	
36MnCr5	●	●	● (Q+T)		
34CrNiMo4-6	●	●	● (Q+T)		Rocker Arms, Crankshaft
36CrNiMo4	●	●	● (Q+T)		
30CrNiMo8	●	●	● (Q+T)		
42CrMo4 NiV	●	●	● (Q+T)		UTS > 1200 MPa - Crankshaft
51CrV4	●	●	● (Q+T)		
15Mo3	●	●	● (Q+T)		
40NiCrMo4	●	●	● (Q+T)		Crankshaft

ArcelorMittal Europe - Long Product (non-exhaustive products offer)

Bainitic Steels

Bainitic Steels are designed for applications requiring a good compromise between Tensile Strength and Ductility, and offer the added benefit of eliminating the final Quench and Tempering process usually performed to achieve high properties. Controlled cooling after forging steers the Austenite transformation into the Bainitic region. The fine tuning of alloying elements will enable to reach the desired level of strength, taking into account the customer process and the size of the part.

Specifications

Grade designation*	Duisburg	Gandrange	Revigny	Comments
SOLAM® B1100	●	○	●	UTS > 1100 MPa Truck Front Axle Beam, Steering Knuckle, Steering Arm
SOLAM® B1150 IH	●		●	UTS > 1150 MPa - Crankshaft (Induction Hardened)
SOLAM® B1200	○		●	UTS > 1200 MPa Common rail, Axle Beam, Steering Lever (hot forged parts 30-100 mm)
20MnCrMo7	●	●	●	UTS > 1200 MPa - Injectors, Injection Nozzles

Cold Heading Steels

Cold heading steels are designed to fulfil the most demanding customer specifications. So, the formability, ductility and strength required for producing by cold deformation the most complex parts is offered by a wide range of low carbon, alloyed, micro-alloyed and boron grades produced according to international standards. Closely controlled rod manufacturing practices ensure their good internal soundness and their defect-free surface. For specific grades, a close control of the chemical composition and post-rolling cooling allow the achievement of requested mechanical properties of the parts even by cold heading without final heat treatment.

To produce cold headed fasteners, threaded rods, wheel bolts, rivets, studs, nuts, U-bolts & welded studs and other complex formed parts for automotive, engineering and construction industries.

Specifications

Grade designation*	Duisburg	Gandrange	Warsaw	Comments
C4	●	●		
C10	●	●		
C22	●	●		
17B2	●	●		
18B2	●	●	●	
17MnB4	●		●	
19MnB4	●			
20MnB5	●	●		UTS > 800 Mpa - Wheel Screw
23MnB4	●			
27MnB5	●	●		
35B4	●			
D-Phi 8.8	●	●		
FREEFORM® B 10.9 IT	○			UTS 1000-1200 Mpa - Wheel Spindle, Ball Joint, Fastener
FREEFORM® B 10.9	○			UTS > 1000 Mpa - Ball Joint, Fastener
FREEFORM® M 1500 H2	●			UTS > 1500 MPa Conrod Screw (High Characteristics) - Suspension Screw
28MnCrB7-2	●		●	Ball pin
27MnCrB5-2	●		●	Ball pin
32CrB4	●		●	Screw
36CrB4	●		●	Screw
36CrNiB4	●		●	Screw

- Industrial in all dimensions
- In development (part trial or produced)
- In-house development

* Sulphur levels on request

ArcelorMittal Europe - Long Product (non-exhaustive products offer)

Spring Steels

Spring Steels are Medium or High Carbon Steels with very high Yield Strength. This property allows the part formed with these grades to return to their original shape after significant bending or twisting. The principal alloying elements to achieve the high yield strength are Silicon and Manganese. For the very demanding applications, the grades are processed with high cleanliness level: hence, a very good fatigue behaviour.

Specifications

Grade designation	Duisburg	Gandrange	Warsaw	Revigny	Comments
45SiCrV6	●		●		
45MnSiCrV6	●		●		
46SiCrMo6	●		●		
55Cr3	●	●	●		
51CrV4	●		●	●	
58CrV4	●		●		
58CrMoV4	●		●		
55SiMo8	●		●		
52SiCrNi5	●		●		
51SiCr7	●		●		
54SiCr6	●		●	●	UTS > 1900 MPa - Suspension Spring
54SiCrV6	●		●		UTS > 2030 MPa - Suspension Spring
60SiCrV7	●		●		
SOLAM® M 2050 S-Cor	○				UTS > 2050 MPa - Suspension Spring (Corrosion Resistant)
SOLAM® M 2000 S	○				UTS 2200-2300 MPa - Suspension Spring (High Characteristics)
54SiCr6 super clean	●				UTS > 1980 MPa - Valve Spring (High Characteristics)
60SiCr8	●		●		
60SiCr ++	○				UTS > 2200 MPa - Clutch Spring (High Characteristics)

Case Hardening Steels

Case Hardening Steels are used for parts requiring high surface wear resistance but retaining a soft core that absorbs stresses without cracking. After forging, the outer layer is carburised (diffusion of carbon) and/or carbo-nitrided and then locally hardened by quenching. The grades are Low-Carbon steels with addition of suitable alloying elements. These additions typically include Chrome and Manganese, but also Nickel and Molybdenum can be involved to increase the through-hardening for larger cross-sections. A special characteristic of this kind of grade is the Jominy curve, which needs to be well controlled.

Specifications

Grade des.*	Duisburg	Gandrange	Warsaw	Revigny	Comments
20Mn5	●	●	● Annealed	●	Axles / Shafts Pinions Gears
16MnCr5	●	●	● Annealed	●	
16MnCrS5Pb	●	●		●	
20MnCr5	●	●	● Annealed	●	
25MoCr4	●	●	● Annealed	●	
12NiCr3	●	●	● Annealed	●	
14NiCr14	●	●	● Annealed	●	
18NiCrMo6	●	●	● Annealed	●	
15CrNi6	●	●	● Annealed	●	
16CrNi4	●	●	● Annealed	●	
17CrNi6	●	●	● Annealed	●	
18CrNi8	●	●	● Annealed	●	
17Cr3	●	●	● Annealed	●	
20NiCrMo2	●	●	● Annealed	●	
14NiCrMo13	●	●	● Annealed	●	
23MnCrMo4	●	●	● Annealed	●	
17CrNiMo6	●	●	● Annealed	●	

ArcelorMittal Europe - Long Product (non-exhaustive products offer)

Micro-Alloyed Steels

Micro-Alloyed Steel grades allow to produce parts with higher strength obtained as forged. Typical additions include Niobium, Vanadium and Titanium. These additions increase yield strength by precipitation hardening, and also offer finer grain structures. These 2 effects increase the strength of the forged parts compared to conventional Carbon steels.

Specifications

Grade designation*	Duisburg	Gandrange	Warsaw	Comments
10MnV6	●	●	●	
17MnV5	●	●	●	UTS > 550 MPa
22MnV6	●	●	●	UTS > 650 MPa
27MnSiV6	●	●	●	UTS > 750 MPa
30MnSiV6	●	●	●	UTS > 850 MPa
49MnV3	●	●	●	UTS > 850 MPa
38MnSiV5-6	●	●	●	UTS > 850 MPa - Crankshaft, Pistons
44MnSiV6	●	●	●	UTS > 900 MPa - Rocker Arms
C70S6	●	●	●	UTS > 900 MPa - Splittable Connecting Rod

Bearing Steels

Bearing Steels are High-Carbon grades with very high mechanical properties achieved by quench and tempering combined with a very high wear resistance. Depending on the type of applications, different levels of cleanliness will be required to avoid inclusions that initiate fatigue during rolling contact.

Specifications

Grade designation*	Duisburg	Gandrange	Warsaw	Revigny	Comments
100Cr6	●	●	●	●	Mechanical Application / Tooling
100Cr6			●		Bearing Ring
100CrMn6			●	●	Bearing Ring
100CrMo7			●	●	Bearing Ring
C55			○		Hub bearing
C70			○	●	Hub bearing

Carbon Steels

Carbon Steel grades are the combination of 3 families: Low, Medium and High Carbon. Low Carbon steels: Carbon range between 0.1 to 0.25%. One of the most common type of steels used for general purposes and are inherently easier to cold-form and handle (draw, bend, etc.) due to their soft and ductile nature.

Medium Carbon steels: approximately 0.30 to 0.59% Carbon content. Can be heat treated to have a good balance of ductility and strength. These steels are typically used in large parts, forgings, machined and automotive.

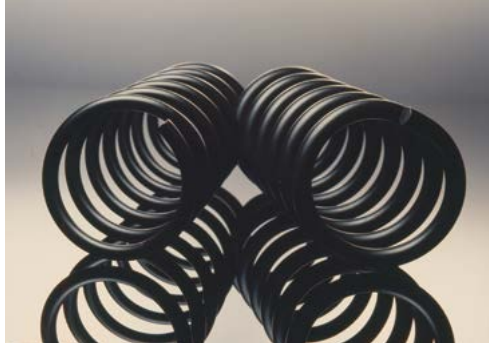
High Carbon steels: above 0.60% of Carbon content. High Tensile and Yield strengths. Used for applications in which high strength, hardness and wear resistance are necessary, such as wear parts, gear wheels, chains, brackets.

Specifications

Grade designation*	Duisburg	Gandrange	Warsaw	Revigny	Comments
C10 to C25	●	●	●	●	Camshaft, Injectors, Joint Casing
C30 to C60	●	●	●	●	Drive shafts, Tripod Tulip
C68 to C92	●	●	●		

- Industrial in all dimensions
- In development (part trial or produced)
- In-house development

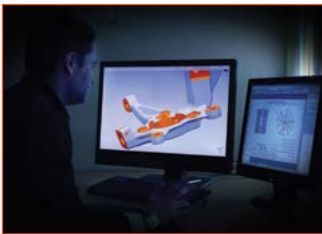
* Sulphur levels on request





ArcelorMittal Global R&D for Bars, Wire rod and Wires

Committed R&D network (Montataire & Maizières-lès-Metz Automotive Research Centres)



Main missions

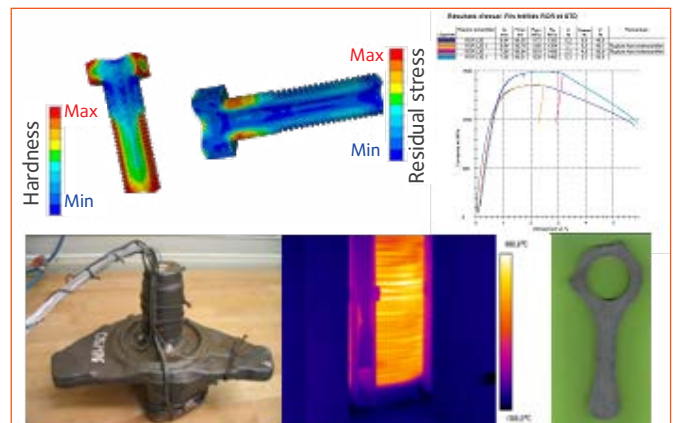
- ▶ Contribute with ArcelorMittal Europe - Long Products to strategic development of Automotive, Energy & Construction markets for Bars & Wires products
- ▶ Support plants in process improvement & new process developments
- ▶ Innovate to supply new steel solutions generating high value creation

Main activities

- ▶ Develop new solutions & new products: Conception of new steel grades (SOLAM®, FreeForm®, Maflex®...)
- ▶ Design of thermal treatments to achieve desired microstructure
- ▶ Surface treatment and coatings development (galvanising, galvanising, paints, lacquers, powder...)
- ▶ Qualify manufacturing & service properties of products
- ▶ Expertise process/ product, to provide technical support to the plants & customers
- ▶ Contribute to conception & optimisation of processes by using Finite Element and other specific models : liquid metallurgy, casting, hot rolling, hot and cold forming, heat treatment, ...
- ▶ Support for instrumentation of industrial processes (Thermal camera, pyrometers, force sensors...)

Strengths

- ▶ Numerical modelling from liquid metallurgy, casting to hot rolling & cold forming
- ▶ Product characterisation at micro & macro scale (Field Emission Gun SEM, macro-probe, torsion & fatigue machines, dilato-plastometry, corrosion chambers...)
- ▶ Process pilots for machinability, drawing and heat treatment
- ▶ Steel Design
- ▶ part of 1300 full-time researchers team



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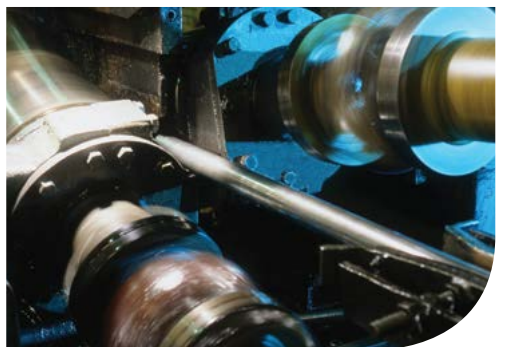
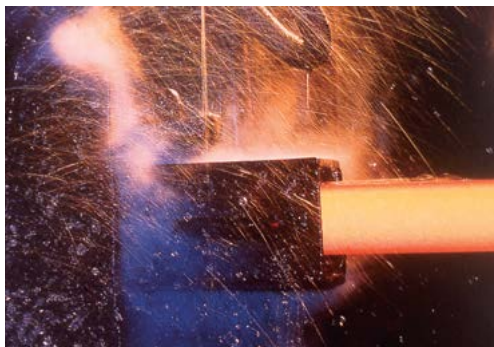
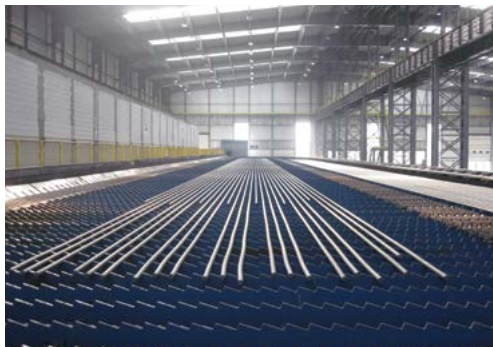
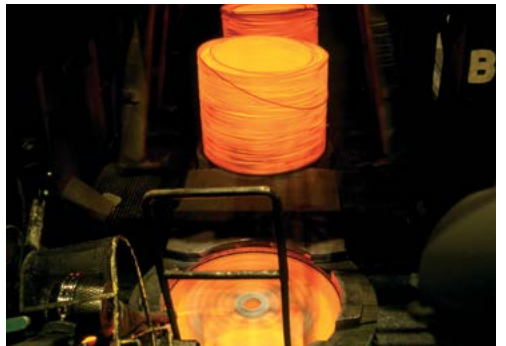
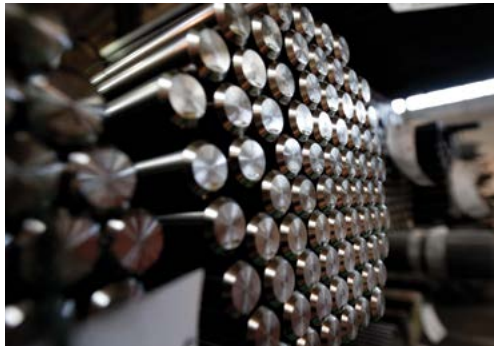
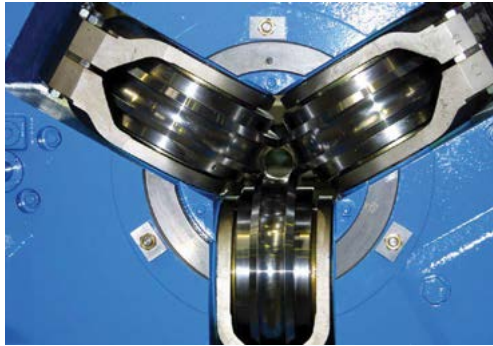
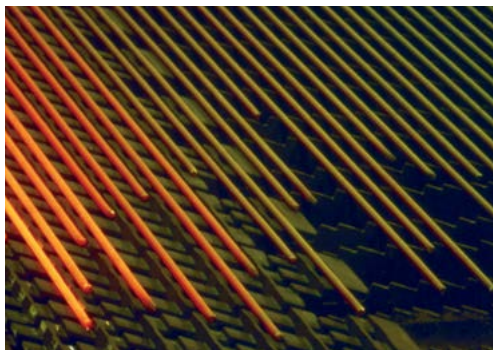
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