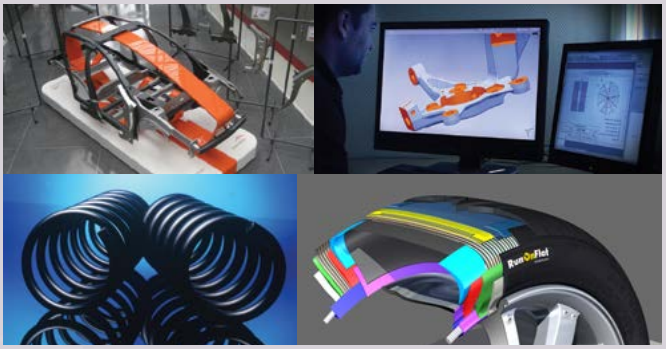
ArcelorMittal Europe
Long Products

ArcelorMittal

Bars and rods

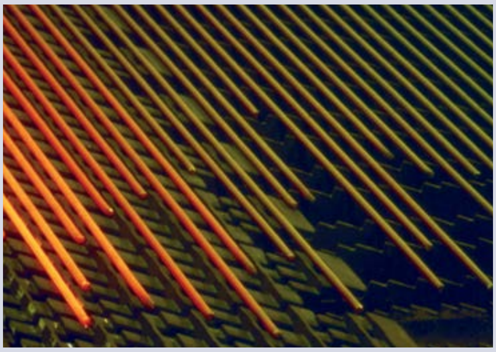
Mechanical engineering

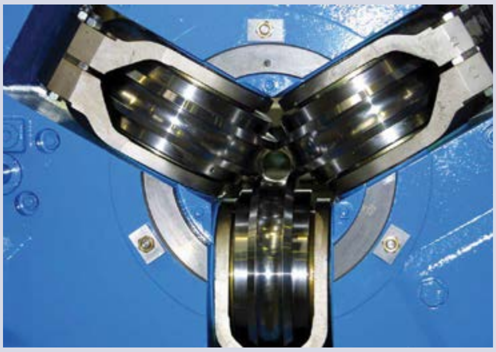
Automotive

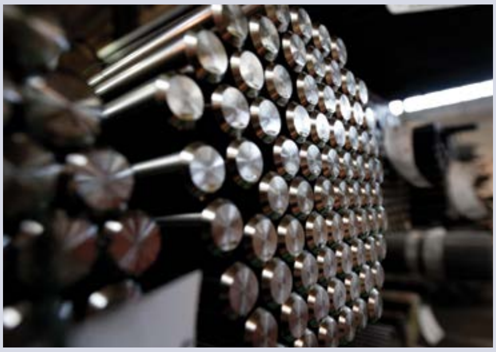


Energy

Construction & Infrastructure

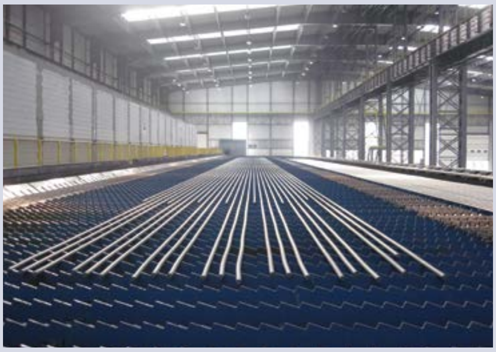



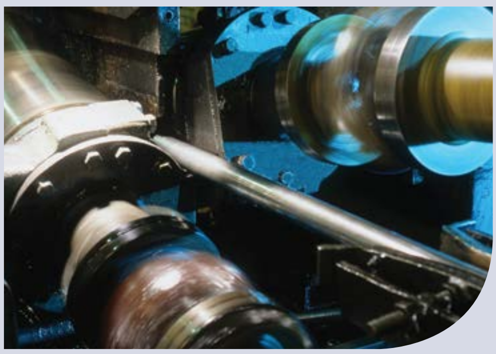










Dear Customer,

ArcelorMittal Europe 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. They offer a wide spectrum of wire rod qualities covering the full range of wire rod applications.

In recent years, our European plants have made major investments in state-of-the-art equipment: a new bar mill in Warsaw, a new wire rod mill in Duisburg, a new finishing line in Gandrange and a new vacuum degassing station and round CC caster in Ostrava. These investments significantly improve the capability and the quality of our products and support the development of our customers in the most demanding market segments.

Bars and rods find applications in every major market segment – construction, infrastructure, automotive, mechanical engineering and energy. ArcelorMittal Europe offers a unique combination of industrial, technical and sales resources fully committed to supporting you in your endeavour to offer the best products to your customers. Our commitment to reducing the company's carbon footprint is another key element in our development strategy, enabling our customers to develop lighter and more cost-effective designs.

Our product range is continuously evolving to meet the needs of the industry. The highly experienced technicians in our mills and in our research & development centres are looking forward to working with you to meet your specific needs – now and in the future.

Regards,

Amit Sengupta
Chief Marketing Officer ArcelorMittal Europe - Long Products

ArcelorMittal Europe
Long Products

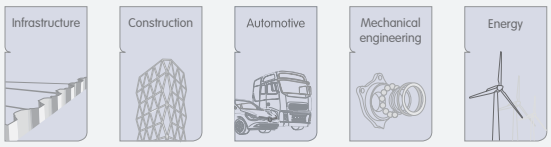
Bars and rods facilities

Table of content

Drawing and cold rolling

Key properties

- Grade analysis
- Microstructure homogeneity
- Surface quality and descaling ability



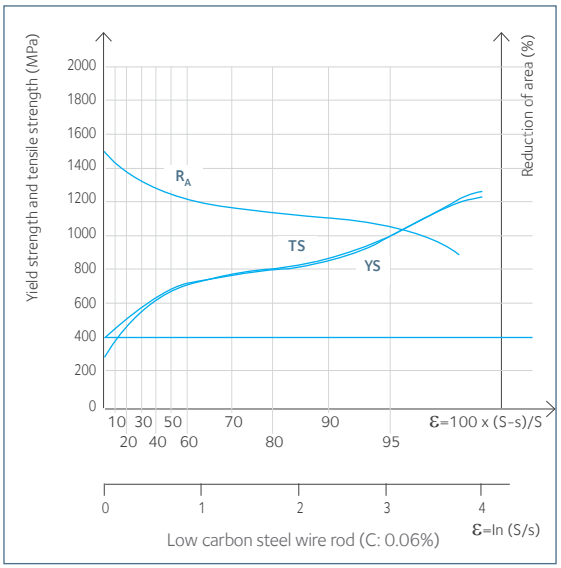
Carbon steel grades for wire rod are classified in three families: low, medium and high carbon. The European standard EN 16120 for carbon grades defines a large range of grades with a carbon content from 0.03% to 1%.

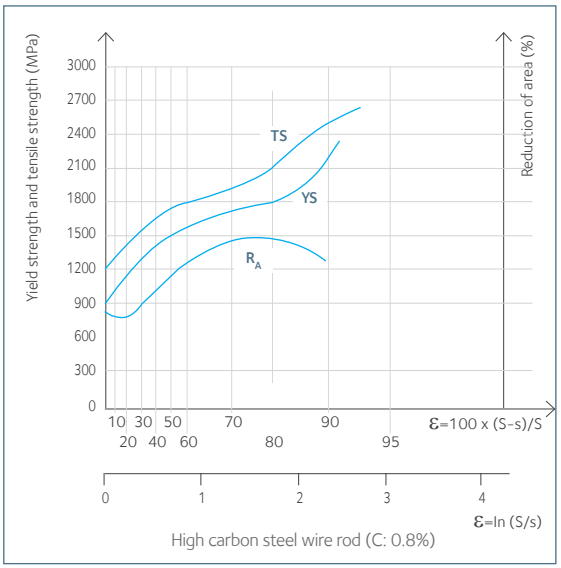
Carbon content is the first parameter for obtaining the final mechanical properties defined by international standards (EN, ASTM, JIS,...). For a wider range of properties, alloying elements such as boron, titanium, vanadium or chromium can be added.

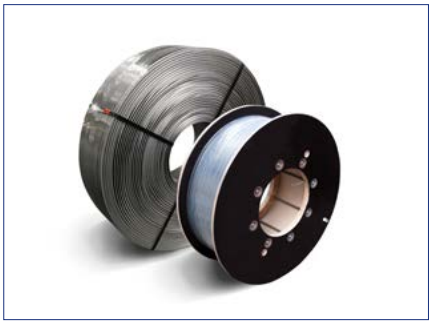
The second parameter is strain hardening, induced by the drawing or rolling process.

Specific customers' requirements influence steel production standards to meet expected surface quality and ability for descaling or ultimate coating.

Evolution of tensile properties (yield strength, tensile strength, reduction of area) with strain hardening for low and high carbon grades







Typical steel grades (according to EN 16120)

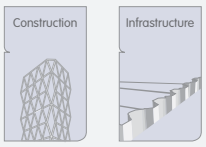
Name	Material No.	C	Si	Mn	P	S	Cr	Ni	Cu	Al	TS*
		%	%	%	%	%	%	%	%	%	MPa
		–	–	–	max.	max.	max.	max.	max.	max.	–
C2D1	1.1185	max. 0.03	max. 0.05	0.10-0.35	0.02	0.02	0.10	0.10	0.10	0.01	330
C3D1	1.1187	max. 0.05	max. 0.05	0.20-0.40	0.025	0.025	0.10	0.10	0.15	0.05	350
C4D1	1.1188	max. 0.06	max. 0.10	0.20-0.45	0.025	0.025	0.15	0.15	0.15	0.05	370
C4D	1.0300	max. 0.06	max. 0.30	0.30-0.60	0.035	0.035	0.20	0.25	0.30	0.01	370
C10D	1.0310	0.08-0.13	max. 0.30	0.30-0.60	0.035	0.035	0.20	0.25	0.30	0.01	420
C26D	1.0415	0.24-0.29	0.10-0.30	0.50-0.80	0.03	0.03	0.20	0.25	0.30	0.01	600
C15D2	1.1126	0.13-0.17	max. 0.30	0.30-0.50	0.02	0.025	0.10	0.10	0.15	0.01	490
C36D2	1.1145	0.34-0.38	0.10-0.30	0.50-0.70	0.02	0.025	0.10	0.10	0.15	0.01	700
C60D2	1.1228	0.58-0.62	0.10-0.30	0.50-0.70	0.02	0.025	0.10	0.10	0.15	0.01	930
C76D2	1.1253	0.74-0.78	0.10-0.30	0.50-0.70	0.02	0.025	0.10	0.10	0.15	0.01	1095
C86D2	1.1265	0.84-0.88	0.10-0.30	0.50-0.70	0.02	0.025	0.10	0.10	0.15	0.01	1200
C88D2	1.0628	0.86-0.90	0.10-0.30	0.50-0.70	0.02	0.025	0.10	0.10	0.15	0.01	1225
C92D2	1.1282	0.90-0.94	0.10-0.30	0.50-0.70	0.02	0.025	0.10	0.10	0.15	0.01	1250

* For 5.5 mm wire rod, typical value

Prestressed concrete

Key properties

- Tensile strength related to high carbon content and micro alloying
- Steel cleanliness
- Microstructure homogeneity
- Surface quality



Wire rod for prestressed concrete has high carbon grades (typically over 0.75% C) that can be alloyed with chromium (up to 0.5 % Cr) and vanadium (up to 0.16% V) and is delivered in diameters up to 16 mm.

Depending on the grades and diameters, tensile strength ranges from 1000 MPa to 1350 MPa.

Special know-how is required for prestressed concrete wire rod production and drawing because of the carbon content, alloying elements and the final mechanical properties required.

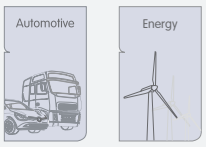
Typical steel grades

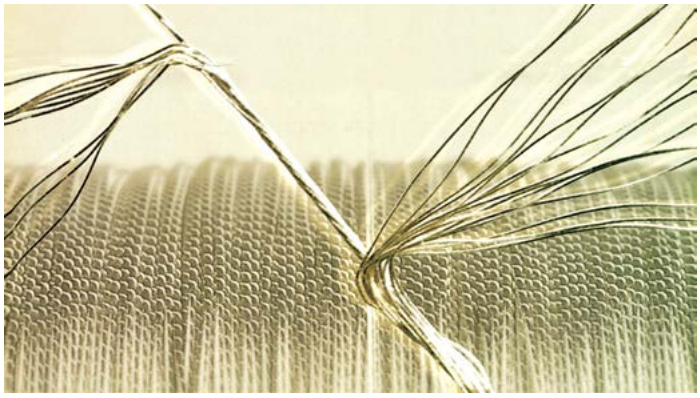
	C	Si	Mn	Cr	V	TS* (MPa)		
Name	%	%	%	%	%	Ø 6.5	Ø 10	Ø 15
C80	0.78-0.82	0.15-0.25	0.60-0.70	max. 0.10	max. 0.02	1200	1150	1020
C82+Cr	0.80-0.84	0.15-0.25	0.65-0.75	0.07-0.25	max. 0.02	1280	1200	1150
C82+Cr+V	0.80-0.84	0.15-0.30	0.70-0.80	0.07-0.25	0.03-0.06	–	1250	1200

* Typical value

Steel cord, hose wire, bead wire

Key properties
- Grade analysis
- Steel cleanliness
- Microstructure homogeneity
- Surface quality

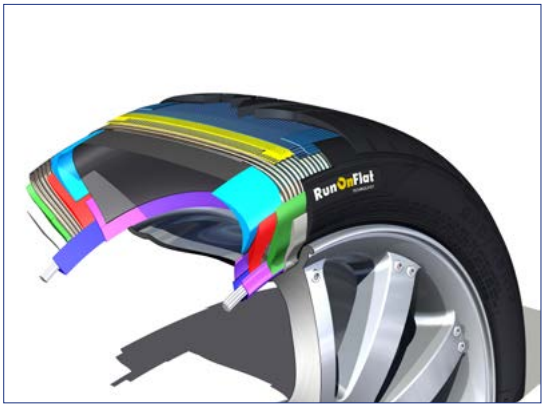




Steel for rubber reinforcement is a 5.5 mm hot rolled wire rod designed to be drawn down to 0.2 mm or less while reaching final mechanical properties over 4000 MPa.

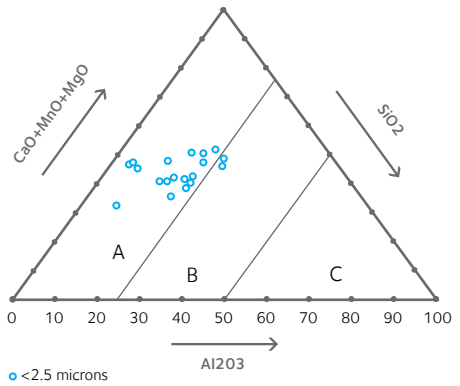
For the steel producer it is the most demanding high carbon product.

We have developed 0.9% carbon chromium alloyed grades to obtain high mechanical properties for thinner drawing to lighten tires and improve fuel efficiency.



Courtesy of Goodyear Dunlop Tires Operations EMEA

Typical inclusion distribution analysis by ternary diagram on steel cord



To achieve small drawn diameters and to avoid the risk of segregation and decarburisation, steel cleanliness is tightly controlled and inclusions are strictly monitored in terms of chemistry, density and size.

Surface quality is the final success factor for achieving very fine drawing quality, enabling surface treatments such as brass plating to be applied.

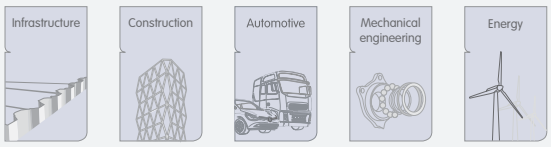
Typical steel grades

Name	C	Si	Mn	P	S	Cr
C60	0.55 - 0.65	0.15-0.30	0.40-0.80	max. 0.03	max. 0.03	–
C70	0.65 - 0.75	0.15-0.30	0.40-0.80	max. 0.03	max. 0.03	–
C80	0.75 - 0.88	0.15-0.30	0.40-0.80	max. 0.03	max. 0.03	–
C90+Cr	0.90 - 0.95	0.15-0.30	0.10-0.40	max. 0.03	max. 0.03	0.10 - 0.30

Welding

Key properties

- Grade analysis
- Mechanical properties prior to drawing by controlled cooling



Steel welding grades are developed to guarantee coherent chemical and mechanical properties between the welded joint and the base metal.

The grade analysis is a determining factor, especially

1. in obtaining the required mechanical properties: carbon, manganese and alloying elements such as vanadium or niobium;

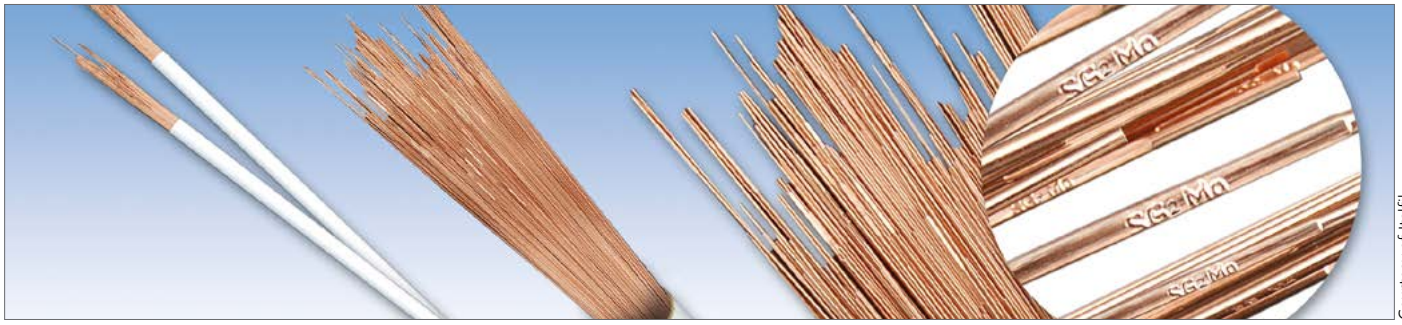
2. for toughness or corrosion resistance: nickel, chromium or molybdenum;

3. depending on the welding process and the protection used (shielding gas or flux): carbon, silicon, aluminium or titanium to limit the risk of welded joint oxidation;

4. residual content such as copper, chromium and tin, ... are tightly controlled to avoid cracks as are phosphorus, sulphur and hydrogen;

5. special processes have been developed to achieve
   a. ultra-low levels of residuals such as lead, bismuth
   b. alloyed grades with up to 9% chromium, nickel, molybdenum...

All these metallurgical considerations explain the diversity of grades available for welding and which can only be partially covered by international standards.



Courtesy of Italfil


Courtesy of Air liquide


Courtesy of Sidergas


Courtesy of Italfil

Standard steel grades

			C	Si	Mn	P	S	Cr	Ni	Mo	Cu
			%	%	%	%	%	%	%	%	%
Name	Standard	Applications	-	-	-	max.	max.	max.	max.	max.	max.
SG1	ISO 14341	Shielded arc welding	0.06-0.10	0.50-0.70	1.00-1.30	0.015	0.015	0.10	0.10	0.05	0.10
SG2	ISO 14341	Shielded arc welding	0.06-0.09	0.80-0.90	1.40-1.50	0.015	0.015	0.10	0.10	0.05	0.10
SG3	ISO 14341	Shielded arc welding	0.06-0.09	0.85-1.00	1.60-1.70	0.015	0.015	0.10	0.10	0.05	0.10
S1	ISO 14171	Stick electrode	0.05-0.15	max. 0.15	0.35-0.60	0.025	0.025	0.10	0.10	0.05	0.10
S2	ISO 14171	Submerged arc welding	0.07-0.15	max. 0.15	0.80-1.30	0.025	0.025	0.10	0.10	0.05	0.10
S3Si	ISO 14171	Submerged arc welding	0.07-0.15	0.15-0.40	1.30-1.85	0.025	0.025	0.10	0.10	0.05	0.10
S2Mo	ISO 14171	Submerged arc welding	0.07-0.15	0.05-0.25	0.95-1.20	0.025	0.025	0.10	0.10	0.45-0.65	0.10
S3Mo	ISO 14171	Submerged arc welding	0.07-0.15	0.05-0.25	1.30-1.75	0.025	0.025	0.10	0.10	0.45-0.65	0.10

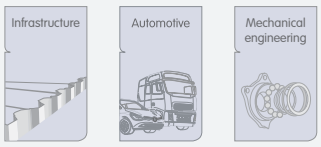
Alloyed steel grades

		C	Si	Mn	Cu	Cr	Ni	V	Mo	Nb	N
		%	%	%	%	%	%	%	%	%	%
Name	Standard	typ	typ	typ	typ	max.	max.	typ	max.	max.	typ
CrMo5	ISO 24598	0.12	0.25	0.90	-	6.00	-	-	0.65	-	-
Mn4Ni2CrMo	ISO 16834	0.12	0.80	1.80	-	0.50	2.50	-	0.50	-	-
G2Ni2	ISO 14341	0.08	0.80	1.40	-	-	2.70	-	-	-	-
CrMo2Si	ISO 21952	0.07	0.50	1.00	-	2.50	-	-	1.00	-	-
SUNCC3	ISO 14171	0.10	0.30	1.00	0.50	0.30	0.750	-	-	-	-
2C1MV	ISO 24598	0.120	0.120	0.80	-	2.60	-	0.30	1.00	0.022	-
CrMo91	ISO 24598	0.120	0.60	1.00	-	9.00	0.500	0.20	1.00	0.065	0.045

Alloyed spring

Key properties

- Grade analysis: Si and Cr
- Steel cleanliness/superclean
- Microstructure homogeneity
- Surface quality



Springs are produced from medium or high carbon steels with a very high yield strength obtained by heat treatment after processing.

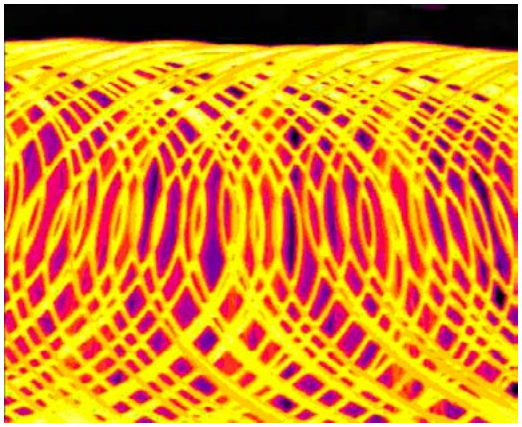
Yield strength is the essential property of the elastic behaviour of the spring as it allows the part formed with these grades to return to its original shape after significant bending or twisting. The principal alloying elements used to achieve high yield strength are silicon, manganese, chromium and vanadium.

The torsional fatigue loads of the spring require high levels of cleanliness, surface quality and very low decarburisation to increase fatigue resistance.

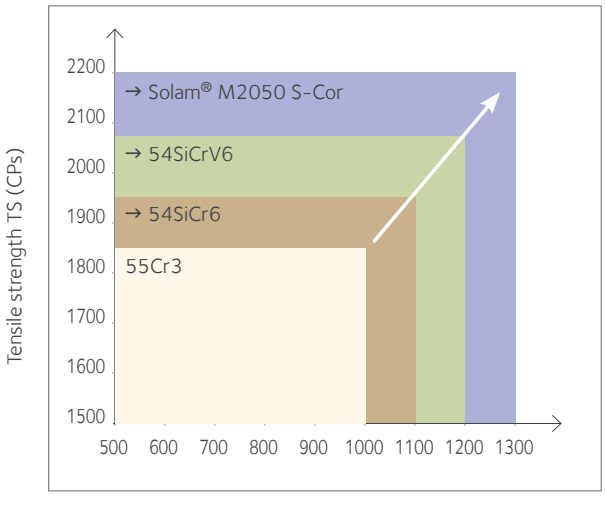
Superclean grades are obtained by a specific production process and are used for transmission, clutch and valve springs.

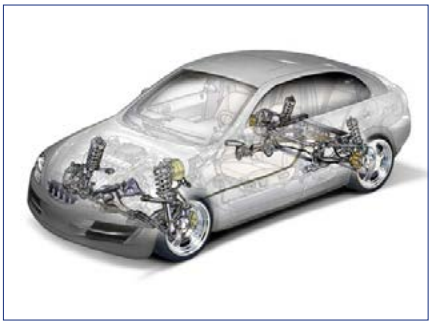
Advanced steel grade SOLAM® M2050 S-Cor, specially developed for suspension springs reduces component weight by up to 20% by increasing mechanical properties (tensile strength of 2050 MPa) and improving fatigue resistance after corrosion as compared to the standard grade 54SiCrV6.

Very high cooling homogeneity obtained in Duisburg wire rod mill



Grade evolution for spring with high mechanical properties



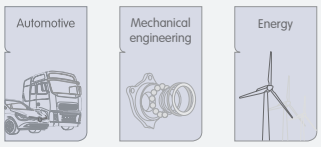


Typical steel grades (acc. to EN 10089)

		C	Si	Mn	P	S	Cr	Ni	Mo	V
		%	%	%	%	%	%	%	%	%
Name	Material No.	–	–	–	max.	max.	max.	max.	max.	max.
38Si7	1.5023	0.35-0.42	50-1.80	0.50-0.80	0.025	0.025	–	–	–	–
60SiCrV7	1.8153	0.56-0.64	1.50-2.00	0.70-1.00	0.025	0.025	0.20-0.40	–	–	0.10-0.20
52CrMoV4	1.7701	0.48-0.56	max. 0.40	0.70-1.10	0.025	0.025	0.90-1.20	–	0.15-0.30	0.10-0.20
52SiCrNi5	1.7117	0.49-0.56	1.20-1.50	0.70-1.00	0.025	0.025	0.70-1.00	0.50-0.70	–	–
54SiCr6	1.7102	0.51-0.59	1.20-1.60	0.50-0.80	0.025	0.025	0.50-0.80	–	–	–
55Cr3	1.7176	0.52-0.59	max. 0.40	0.7-1.00	0.025	0.025	0.7-1.00	–	–	–
60Cr3	1.7177	0.55-0.65	max. 0.40	0.70-1.10	–	–	0.60-0.90	–	–	–
60CrMo3-3	1.7241	0.56-0.64	max. 0.40	0.70-1.10	0.025	0.025	0.70-1.00	–	0.25-0.35	–
61SiCr7	1.7108	0.57-0.65	1.60-2.00	0.70-1.00	0.025	0.025	0.20-0.45	–	–	–

Free cutting

Key properties
- Machinability
- Grade analysis
- Surface quality



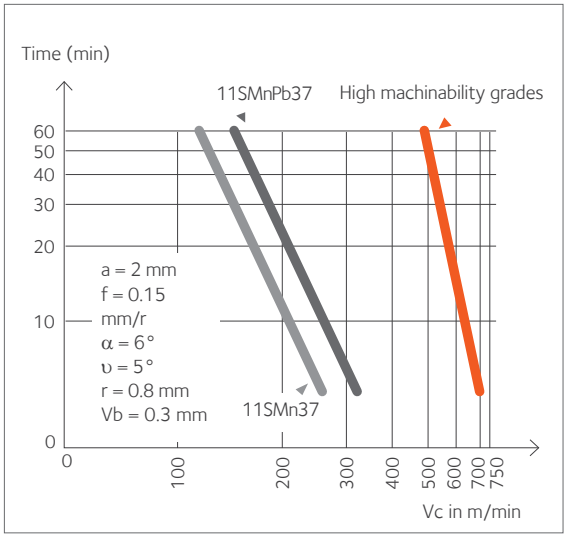
The metallurgy of free cutting steels is first determined by their expected machinability. The second parameters to take into account are the final mechanical properties required.

Very high mechanical properties can require alloying elements, heat treatment such as quenching and tempering, or surface treatment such as inductive hardening or case hardening.

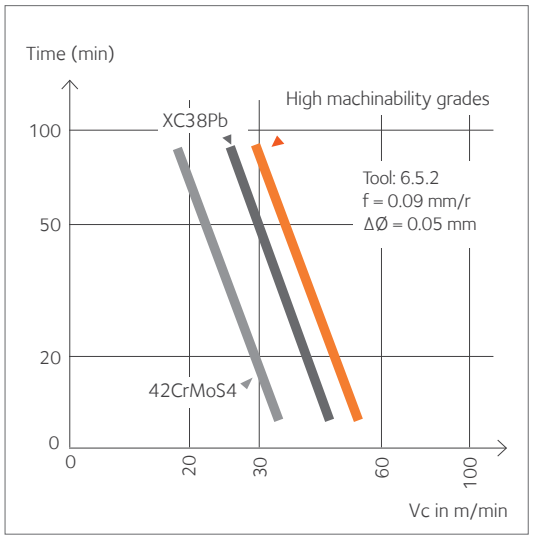
Machining behaviour is obtained through specific alloying. Historically, lead (Pb) was the element used to improve machinability for its lubricating effect. Nowadays, lead-free grades have been developed using calcium, tellurium, bismuth, selenium, etc. Sulphur influences inclusion morphology and improves tool life.

Special steel grades have been developed for improved fatigue requirements while keeping high machinability levels.

Grades development for improved machinability for low and medium carbon grades

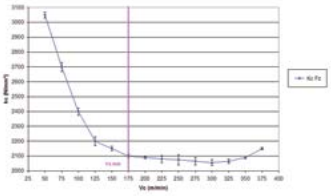


Low carbon grades



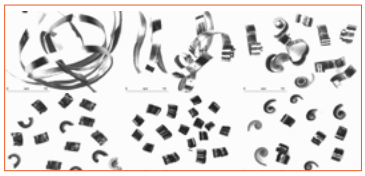
Medium carbon grades

Machinability evaluation:
matching tool and material

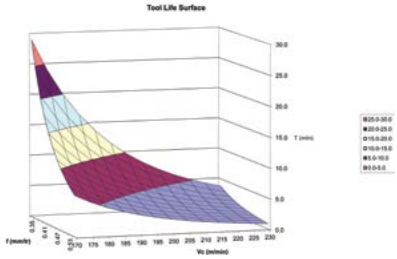


Vc : Cutting speed m/min
Kc : Specific energy N/mm²
T = Time (min)
f = feed (mm/revolution)

Cutting forces measurement



Chips characterisation



Tool life surface

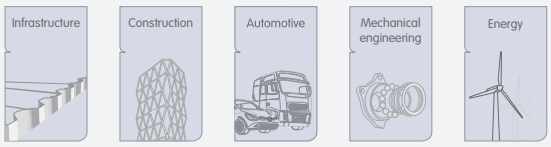
Typical steel grades (mostly per EN 10087)

		C	Si	Mn	P	S	Pb
Name	Material No.	%	%	%	%	%	%
11SMn30	1.0715	max. 0.14	max. 0.05	0.90-1.30	max. 0.11	0.27-0.33	–
11SMnPb30	1.0718	max. 0.14	max. 0.05	0.90-1.30	max. 0.11	0.27-0.33	0.20-0.35
11SMn37	1.0736	max. 0.14	max. 0.05	1.00-1.50	max. 0.11	0.34-0.40	–
11SMnPb37	1.0737	max. 0.14	max.0.05	1.00-1.50	max. 0.11	0.34-0.40	0.20-0.35
SAE1215	1.9704	max. 0.05	–	0.75-1.05	0.04-0.05	0.26-0.35	–
SAE12L14	1.0718	max. 0.15	–	0.85-1.15	0.04-0.05	0.26-0.35	0.15-0.35
C10Pb	-	0.06-0.12	max. 0.04	0.25-0.50	max. 0.045	max. 0.045	0.15-0.30
10S20	1.0721	0.07-0.13	max. 0.04	0.70-1.10	max. 0.06	0.15-0.25	–
10S20Pb	1.0722	0.07-0.13	max. 0.04	0.70-1.10	max. 0.06	0.15-0.25	0.20-0.35
16MnCrS5Pb	-	0.14-0.15	max. 0.40	1.00-1.30	max. 0.025	max. 0.035	0.20-0.35
35S20	1.0726	0.32-0.39	max. 0.04	0.70-1.10	max. 0.06	0.15-0.25	–
35SPb20	1.0756	0.32-0.39	max. 0.04	0.70-1.10	max. 0.06	0.15-0.25	0.15-0.25
36SMn14	1.0764	0.32-0.39	max. 0.04	1.30-1.70	max. 0.06	0.10-0.18	–
36SMnPb14	1.0765	0.32-0.39	max. 0.04	1.30-1.70	max. 0.06	0.10-0.18	0.15-0.25
38SMn28	1.0760	0.35-0.40	max. 0.04	1.20-1.50	max. 0.06	0.24-0.33	–
38SMnPb28	1.0761	0.35-0.40	max. 0.04	1.20-1.50	max. 0.06	0.24-0.33	0.15-0.25
44SMn28	1.0762	0.40-0.48	max. 0.04	1.30-1.70	max. 0.06	0.24-0.33	–
44SMn2Pb28	1.0763	0.40-0.48	max. 0.04	1.30-1.70	max. 0.06	0.24-0.33	0.15-0.25
46S20	1.0727	0.42-0.50	max. 0.04	0.70-1.10	max. 0.06	0.15-0.25	–
46SPb20	1.0757	0.42-0.50	max. 0.04	0.70-1.10	max. 0.06	0.15-0.25	0.15-0.25
C45Pb	-	0.42-0.50	max. 0.40	0.50-0.80	max. 0.045	max. 0.045	0.15-0.30

Cold heading

Key properties

- Cold ductility and final mechanical properties
- Microstructure homogeneity
- Surface quality



Screws, bolts, rivets, etc. are produced by cold heading: a process of high productivity using punch and dies to transform a steel wire rod at room temperature. A specific quenching and tempering process regularly follows cold heading in order to reach the final mechanical properties.

Ductility and strength required for cold heading are obtained by a wide range of low carbon, alloyed and boron grades produced according to international standards. Bainitic grades are also used in specific applications.

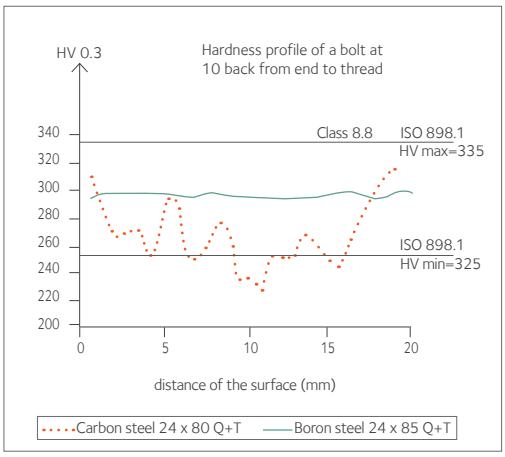
The steel grade is accordingly alloyed with elements such as manganese, chromium, boron and molybdenum depending on the final class targeted (8.8, 9.8, 10.9, 12.9). The chemical analysis is a trade-off between the necessary ductility prior to processing and the final properties obtained after quenching and tempering.

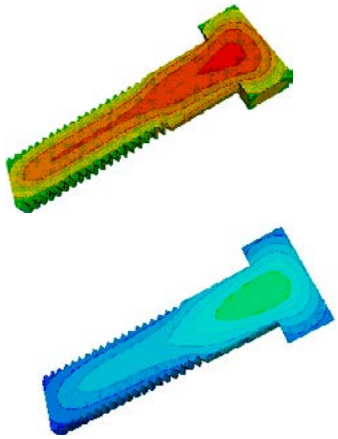
Specific grades have been developed for engine bolts with an ultimate tensile strength of over 1500 MPa and improved hydrogen resistance for a range from M6 to M14. The ultimate tensile strength of such grades can be adjusted in the range of 1200 - 1500 MPa with the adjustment of the tempering process to meet the requirements of 12.9 class bolts.

Typical steel grades (EN 10263)

		Class							C	Si	Mn	P	S	Cr	Ni	Mo	Al	V	B
Name	Material No.	4.6	5.6	6.8	8.8	9.8	10.9	12.9	%	%	%	%	%	%	%	%	%	%	ppm
C4C	1.0303	X	X	X					0.02-0.06	max. 0.10	0.25-0.40	max. 0.02	max. 0.025	–	–	–	0.02-0.06	–	–
C8C	1.0213	X	X	X					0.06-0.10	max. 0.10	0.25-0.45	max. 0.02	max. 0.025	–	–	–	0.02-0.06	–	–
C10C	1.1214	X	X	X					0.08-0.12	max. 0.10	0.30-0.50	max. 0.025	max. 0.025	–	–	–	min. 0.02	–	–
C15C	1.1234	X	X	X					0.13-0.17	max. 0.10	0.35-0.60	max. 0.025	max. 0.025	–	–	–	min. 0.02	–	–
C20C	1.0411	X	X	X					0.18-0.22	max. 0.10	0.70-0.50	max. 0.025	max. 0.025	–	–	–	0.02-0.06	–	–
C22	1.0402	X	X	X					0.20-0.24	max. 0.15	0.40-0.60	max. 0.015	max. 0.015	–	–	–	–	–	–
6MnB6					X				0.06-0.10	0.05-0.40	1.30-1.60	max. 0.025	max. 0.025	max. 0.30	–	–	–	–	100-200
17MnB4	1.5520				X				0.15-0.20	max. 0.30	0.90-1.20	max. 0.025	max. 0.025	max. 0.30	–	–	–	–	8-50
20MnB4	1.5525				X	X	X		0.18-0.23	max. 0.30	0.90-1.20	max. 0.025	max. 0.025	max. 0.30	–	–	–	–	8-50
23MnB4	1.5535				X	X	X		0.20-0.25	max. 0.30	0.90-1.20	max. 0.025	max. 0.025	max. 0.30	–	–	–	–	8-50
28B2	1.5510				X	X	X		0.25-0.30	max. 0.30	0.60-0.90	max. 0.025	max. 0.025	max. 0.30	–	–	–	–	8-50
30MnB4	1.5526				X	X	X		0.27-0.32	max. 0.30	0.80-1.10	max. 0.025	max..0.025	max. 0.30	–	–	–	–	8-50
32CrB4	1.7076							X	0.30-0.34	max. 0.30	0.60-0.90	max. 0.025	max. 0.025	0.90-1.20	–	–	–	–	8-50
38B2	1.5515							X	0.35-0.40	0.15-0.30	0.60-0.90	max. 0.025	max. 0.025	max. 0.30	–	–	–	–	8-50
36CrB4	1.7077							X	0.34-0.38	max. 0.30	0.70-1.00	max. 0.025	max. 0.025	0.90-1.20	–	–	–	–	8-50
30CrMoB1								X	0.28-0.32	max. 0.30	0.80-1.10	max. 0.015	max. 0.015	0.15-0.30	–	0.08-0.15	0.02-0.06	–	8-50
27MnSiVS6	1.5232								0.25-0.30	0.15-0.80	1.20-1.60	max. 0.025	0.02-0.06	–	–	–	–	0.08-0.20	–
34CrMo4	1.7220							X	0.30-0.37	max. 0.30	0.60-0.90	max. 0.025	max. 0.025	0.90-1.20	–	0.15-0.30	–	–	–
34CrNiMo6	1.6582							X	0.30-0.38	max. 0.30	0.50-0.80	max. 0.025	max. 0.025	1.30-1.70	1.40-1.70	0.15-0.30	–	–	–
41CrS4	1.7039							X	0.38-0.45	max. 0.30	0.60-0.90	max. 0.025	0.02-0.04	0.90-1.20	–	–	–	–	–

20MnB5 screw: hardness profile, thermal simulation



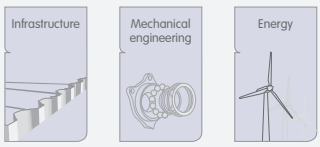


Courtesy of Gévelot

Chains

Key properties

- Steel cleanliness
- Elongation
- Weldability



Chains are produced by hot or cold forming and further quenching and tempering.

Precise alloying is required for weldability but also to reach the minimum notch impact energy required.

Typical steel grades

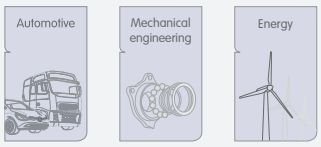
Name	Material No.	C	Si	Mn	P	S
15Mn3Al	1.0468	0.12-0.18	≤0.20	0.70-0.90	max. 0.025	max. 0.025
21Mn4Al	1.0470	0.18-0.24	max. 0.25	0.80-1.10	0.025	0.025
21Mn5	1.0495	0.18-0.24	max. 0.25	1.10-1.60	0.025	0.025
27MnSi5	1.0412	0.24-0.30	max. 0.25	1.10-1.60	0.025	0.025

Forging

Quenched and tempered steels, case hardening steels, micro-alloyed steels, bainitic steels

Key properties

- Grade analysis for final mechanical properties along with quenchability
- Cleanliness in case of fatigue loads



Carbon and Carbon Manganese Steels

Carbon Steel grades are the most common steels used for forging applications. Low carbon steels (carbon between 0.1 to 0.25%) are the easiest to cold form due to their soft and ductile nature. Medium carbon steels (carbon between 0.26 and 0.59%) are typically used in medium and large parts forgings. High carbon steels (carbon above 0.6 %) are used for applications in which high strength, hardness and wear resistance are necessary, such as wear parts, gear wheels, chains and brackets.

Quenched and tempered steels (Q+T)

Quenched and tempered steel grades are hardenable steels. They are alloyed with chromium and molybdenum for example, to favour transformation of austenite into martensite during the quenching process. The forging part is quenched in water, polymer or oil to obtain the required hardness. The tempering process enables the mechanical properties and toughness to be adjusted.

Typical steel grades (mostly EN 10083)

		C	Si	Mn	Cr	Mo	Ni	V	B
Name	Material No.	%	%	%	%	%	%	%	ppm
25CrMo4	1.7218	0.22-0.29	max. 0.40	0.60-0.90	0.90-1.20	0.15-0.30	–	–	–
30MnB5	1.5531	0.27-0.33	max. 0.40	1.15-1.45	–	–	–	–	8-50
34CrNiMo6	1.6582	0.30-0.38	max. 0.40	0.50-0.80	1.30-1.70	0.15-0.30	1.30-1.70	–	–
38Cr2	1.7003	0.35-0.42	max. 0.40	0.50-0.80	0.40-0.60	–	–	–	–
41Cr4	1.7035	0.38-0.45	max. 0.40	0.60-0.80	0.90-1.20	–	–	–	–
42CrMo4	1.7225	0.38-0.45	max. 0.40	0.60-0.90	0.90-1.20	0.15-0.30	–	–	–
C45	1.0503	0.43-0.50	max. 0.40	0.50-0.80	max 0.40	max. 0.10	max. 0.40	–	–
50CrMo4	1.7228	0.46-0.54	max. 0.40	0.50-0.80	0.90-1.20	0.15-0.30	–	–	–
51CrV4	1.8159	0.47-0.55	max. 0.40	0.70-1.10	0.90-1.20	–	–	0.10-0.25	–

To be noticed that some carbon grades are also included in the EN 10083: steels for quenching and tempering and available from C22 to C60.

Case hardening steels

Case hardening steels are used for parts that require high surface wear resistance while retaining a soft core that absorbs stresses without cracking. After forging and machining, the outer layer is carburised and/or carbo-nitrided and then locally hardened by quenching. The grades are usually low-carbon steels to which suitable alloying elements have been added. A special characteristic of this kind of grade is the Jominy curve, which needs to be well controlled.

Typical steel grades (mostly EN 10084)

		C	Si	Mn	Cr	Mo	Ni
Name	Material No.	%	%	%	%	%	%
C15	1.0401	0.12-0.10	max. 0.40	0.30-0.80	–	–	–
17Cr3	1.7016	0.14-0.20	max. 0.40	0.60-0.90	0.70-1.00	–	–
16MnCrS5	1.7139	0.14-0.19	max. 0.40	1.00-1.30	0.80-1.10	–	–
18CrNiMo7-6	1.6587	0.15-0.21	max. 0.40	0.50-0.90	1.50-1.80	0.25-0.35	1.40-1.70
20NiCrMo2	1.6523	0.17-0.23	max. 0.40	0.65-0.95	0.35-0.70	0.15-0.25	0.40-0.70
20MnCr5	1.7147	0.17-0.22	max. 0.40	1.10-1.40	1.00-1.30	–	–
25MoCr4	1.7325	0.23-0.29	max. 0.40	0.60-0.90	0.40-0.60	0.40-0.50	–
27CrMo4	1.7218	0.22-0.29	max. 0.40	0.60-0.90	0.90-1.20	0.15-0.30	–
27MnCr5	1.7147	0.23-0.29	max. 0.40	1.10-1.40	0.80-1.10	–	–

Micro-alloyed steels (AFP)

Micro-alloyed steel grades allow the production of parts with higher strength, obtained without subsequent heat-treatment after forging. Typical additions include niobium, vanadium and titanium, which increases yield strength by precipitation hardening, while offering finer grain structures. These two outcomes increase the strength of the forged parts compared to conventional carbon steels.

Typical steel grades (mostly EN 10267)

		C	Si	Mn	S	V	N
Name	Material No.	%	%	%	%	%	%
19MnV6	1.1301	0.15-0.22	0.15-0.80	1.20-1.60	0.02-0.06	0.08-0.20	0.01-0.02
30MnVS6	1.1302	0.26-0.33	0.15-0.80	1.20-1.60	0.020-0.060	0.08-0.20	0.01-0.02
38MnVS6	1.1303	0.34-0.41	0.15-0.80	1.20-1.60	0.020-0.060	0.08-0.20	0.01-0.02
46MnVS6	1.1304	0.42-0.49	0.15-0.80	1.20-1.60	0.02-0.06	0.08-0.20	0.01-0.02
C70S6		0.66-0.73	0.15-0.35	0.40-0.90	0.02-0.07	max. 0.04	–

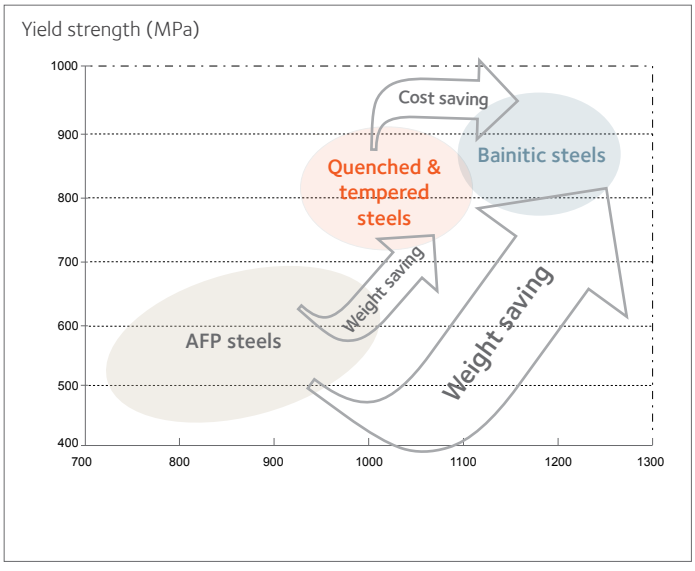
Bainitic steels

Bainitic steels are designed for applications that require both high mechanical properties and process cost reductions, compared with Q+T grades. Very high strength can be achieved (UTS > 1100 MPa) without heat treatment: controlled cooling after forging steers the austenite transformation into the bainitic region. The desired level of strength is reached by fine-tuning the alloying elements taking into account the customer's processes and the size of the part. Bainitic steels achieve higher mechanical properties than micro-alloyed grades as well as demonstrating uniform hardness throughout the steel.

Typical steel grades

	C	Mn	Cr	UTS
Designation	%	%	%	%
Solam® B1100	max. 0.2	max. 1.9	max. 1.5	> 1100 MPa
Solam® B1150IH	max. 0.4	max. 1.8	max. 0.8	> 1150 MPa

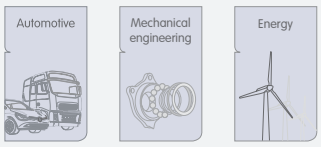
Comparison of mechanical & quenchability properties of AFP, Q+T and bainitic grades



Bearing

Key properties

- Steel cleanliness
- Steel homogeneity
- Hardness



Bearing steels are exposed to fatigue and high contact loads. Final hardness can be obtained by through-hardening, case hardening or inductive heat treatment.
The most common bearing grades for through-hardening are 100Cr6 families. Those grades combine the advantages of carbon and chromium to achieve heat treatment efficiency and final mechanical properties. Since such grades require annealing before transformation, thermo-mechanical rolling for fine grain size distribution represents an advantage in terms of reducing annealing time.

Steel production requires expertise and strong process control: to achieve high performance, the heat treatment has to be very homogeneous throughout the part. Grade and structure homogeneity is therefore key in order to avoid any segregation during casting or decarburisation in reheating operations.

High fatigue loads require surface quality and low inclusion content. Two metallurgical treatments are available to achieve this. Aluminium killed steel follows a clean metallurgical process to obtain a very low oxygen content. Sillicon killed steel produces grades with good deformability inclusions. The sizes of such inclusions are reduced during the rolling process.

In standard steel production, the reduction ratio is the final process required to enable a fine and homogeneous structure prior to transformation.

The final heat treatment of 100Cr6 grades gives possibilities for either bainitic or martensitic final structure depending on the trade-off required between toughness and hardness. The grade is thus alloyed with molybdenum and/or manganese to favour bainite and/or martensite.

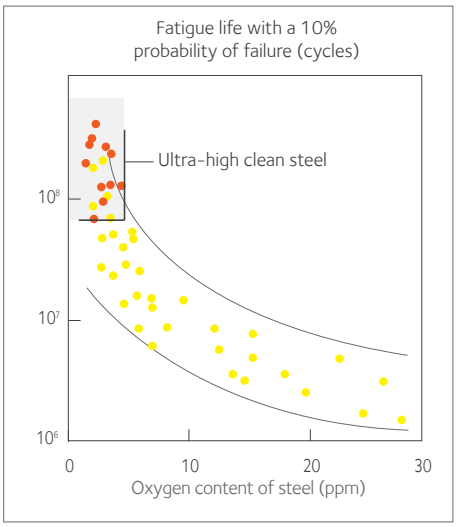
The same considerations on homogeneity and inclusions apply to C55 and C70 for induction hardening.

Typical through-hardening bearing steel grade (ISO 683-17)

	Material No.	C	Si	Mn	Cr	Mo
Name	–	%	%	%	%	%
100Cr6	1.3505	1.00	0.25	0.35	1.50	–
100CrMo7	1.3537	1.00	0.25	0.35	1.80	0.25

Typical induction-hardening bearing steel grade (ISO 683-17)

	Material No.	C	Si	Mn	Cr	Mo
Name	–	%	%	%	–	–
C56E2	1.1219	0.55	0.25	0.80	–	–
C70Mn4	1.1244	0.75	0.25	1.00	–	–



fatigue life and oxygen content

Sustainable development

3.39 m

tonnes of steel recycled representing 53.6% of ArcelorMittal Europe - Long Products bars & rods production *

4.6 m

tonnes of CO_2 saved from steel we recycled

Energy efficiency is becoming more and more important in buildings, vehicles and appliances. Steel can make a real difference here, especially when it is effectively recycled, which is why it is so crucial to understand the environmental impact of our steel in relation to the many 'lives' it may have during its life cycle, both in the past and in the future. How to quantify the environmental benefits of recycling has been a recurring point of contention when defining government policies on environmental impact.

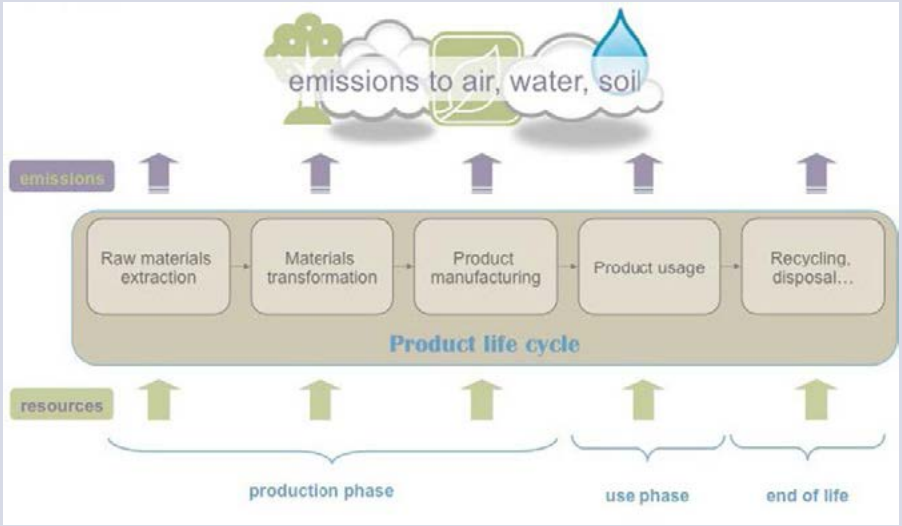
The life cycle approach (LCA) is an important tool to assess and quatify the potential environmental footprint of products along the entire life cycle in order to help industry improve efficiency where it matters most.

LCA therefore enables us to model the recycling potential of steel products at the end-of-life phase. Unless we use this approach, any evaluation of a product's sustainability will inevitably be constrained by a short-term outlook and does not account for the capability of steel to be a permanent material all along its future lives.

Take cars for example. European legislation relating to vehicles focuses only on exhaust emissions, rather than considering the overall balance between the CO_2 produced during the production of a vehicle's component materials and their use phase.

ArcelorMittal LCA approach is also taking into account the savings that can be made while the car is on the road by using lightweight materials (refer to p.37) and the potential for recycling at the end of its life.

Steel LCA approach



* Bars & rods production in 2015: 6.31 million t.

Quality range Bars & Rods

	Duisburg (Germany)	Gandrange (France)	Hamburg (Germany)	Ostrava (the Czech Republic)	Sonasid (Morocco)
Drawing and cold rolling					
Low carbon	✓	✓	✓	✓	✓
Medium carbon	✓	✓	✓	✓	
High carbon	✓	✓	✓		
Prestressed concrete	✓		✓		
Steel cord			✓		
Welding					
Non-alloyed	✓		✓		
Alloyed	✓		✓		
Spring					
High carbon	✓	✓	✓		
Alloyed spring	✓	✓	✓		
Superclean	✓				
Free-cutting					
Leaded	✓	✓			
Unleaded	✓	✓	✓		
Cold heading	✓	✓	✓		
Chains	✓	✓	✓		
Forging					
Carbon steels	✓	✓			
Steels for quenching and tempering	✓	✓			
Case hardening steel	✓	✓			
Micro-alloyed steel	✓	✓			
Bainitic steel	✓	✓			
Bearing	✓	✓	✓		

Quality range concrete reinforcement and geotechnical

	Duisburg	Gandrange	Hamburg	Ostrava	Sonasid
Rebar				✓	✓
Mesh			✓	✓	✓
Threaded bars				✓	
Krybar					

Certifications

	Duisburg	Gandrange	Hamburg	Ostrava	Sonasid
ISO 9001	✓	✓	✓	✓	✓
ISO-TS 16949	✓	✓			
ISO 14001	✓	✓	✓	✓	✓
OHSAS 18001	✓	✓	✓	✓	✓
ISO 50001	✓	✓	✓		

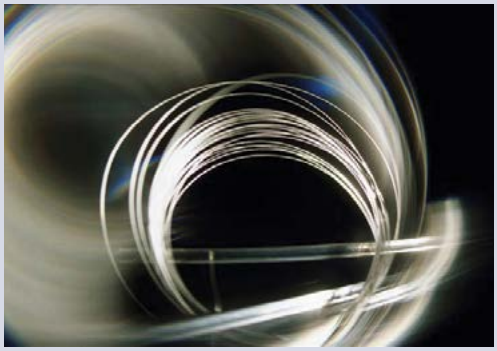
Sosnowiec (Poland)	Veriña (Spain)	Warszawa (Poland)	Zaragoza (Spain)	Zenica (Bosnia Herzegovina)	Zumárraga (Spain)	
						Drawing and cold rolling
✓	✓	✓		✓	✓	Low carbon
✓	✓	✓		✓	✓	Medium carbon
✓	✓	✓		✓	✓	High carbon
✓	✓				✓	Prestressed concrete
✓	✓					Steel cord
						Welding
✓	✓			✓	✓	Non-alloyed
						Alloyed
						Spring
✓	✓	✓			✓	High carbon
✓	✓	✓				Alloyed spring
						Superclean
						Free-cutting
					✓	Leaded
✓	✓	✓			✓	Unleaded
✓	✓	✓			✓	Cold heading
✓	✓				✓	Chains
						Forging
			✓		✓	Carbon steels
		✓			✓	Steels for quenching and tempering
		✓			✓	Case hardening steel
		✓			✓	Micro-alloyed steel
		✓				Bainitic steel for forging
		✓				Bearing

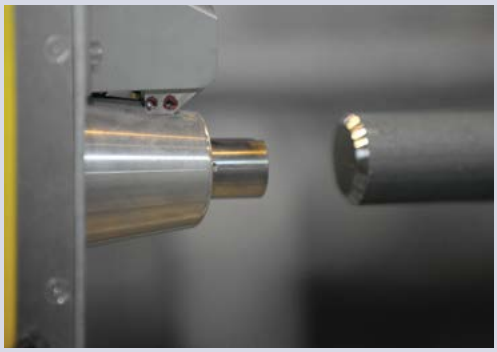
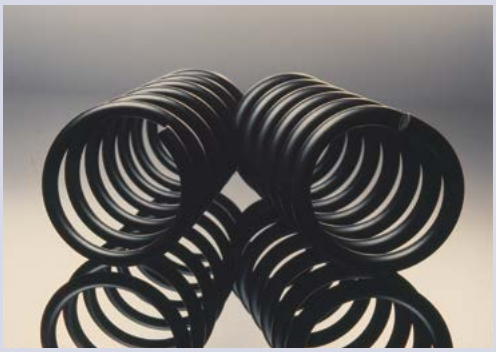
bars

Sosnowiec	Veriña	Warszawa	Zaragoza	Zenica	Zumárraga	
		✓	✓	✓	✓	Rebar
✓				✓	✓	Mesh
						Threaded bars
		✓				Krybar

Sosnowiec	Veriña	Warszawa	Zaragoza	Zenica	Zumárraga	
✓	✓	✓	✓	✓	✓	ISO 9001
✓	✓	✓			✓	ISO-TS 16949
✓	✓	✓	✓	✓	✓	ISO 14001
✓	✓	✓	✓	✓	✓	OHSAS 18001
✓	✓		✓		✓	ISO 50001




ArcelorMittal



ArcelorMittal

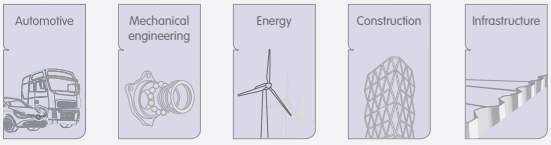






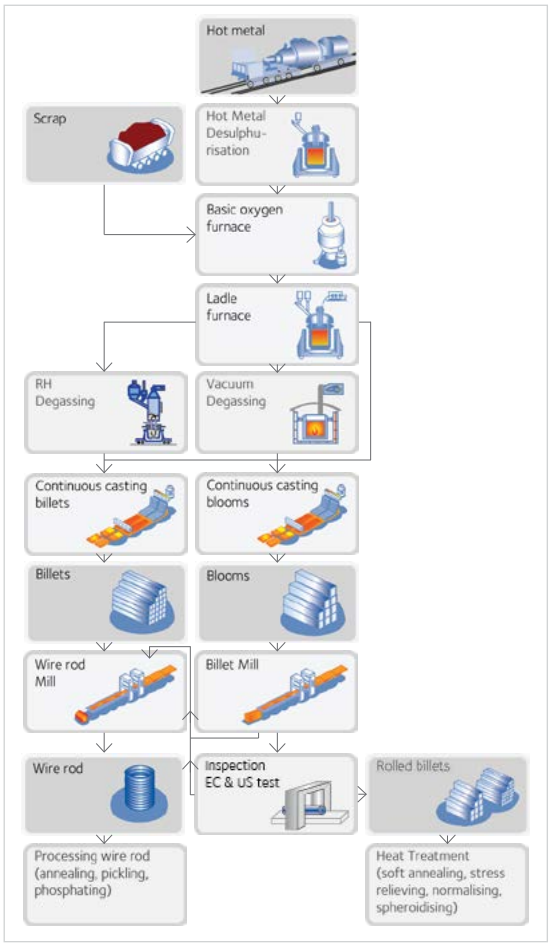
ArcelorMittal Duisburg

Vohwinkelstraße 107; D-47137 Duisburg



ArcelorMittal Duisburg plant is located in the Ruhr region in north-west Germany. ArcelorMittal Duisburg works to develop new applications and new products for the automotive, energy and mechanical industries.

The billet mill produces high quality billets and SBQ for the forging industry. The new wire rod mill supplies the automotive market with cold heading, spring grades, bearing and other special wire rod grades.



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)
  - 1 Bloom caster with soft reduction
  - 1 Billet caster
- Billet rolling mill:
  - Reversing breakdown and finishing stand
- Inspection line for bars & billets:
  - Conditioning with ultrasonic and surface testing (TOM)
  - Annealing (up to 9 m in 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 including loop
  - 104 m long Stelmor line
- Wire rod processing (annealing, pickling, phosphating) upon request

Casted semis

- Blooms (mm): ▭ 385 x 265 length (m): 4.3 - 12.3
- Blooms (mm^2): ■ 320 length (m): 4.3 - 12.3
- Billets (mm^2): ■ 155 length (m): 12 - 16 (<12 m on request)

Finished products

- Wire rod (mm): ● 5.5 to 25 (steps of 0.5 mm)
- Bars (mm^2): ■ 63 to 200 (round corner square)
- Bars (mm): ● 100 to 170

Coil length (mm) (max.): 2300

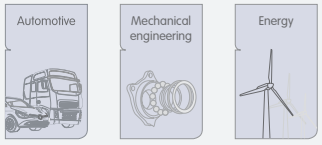
Coil weight (t) (max.): 3
(2t, 2.5t on request)

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

Bundle weight (t) (max.): 10

ArcelorMittal Gandrange

Boîte postale 3; F-57360 Amnéville



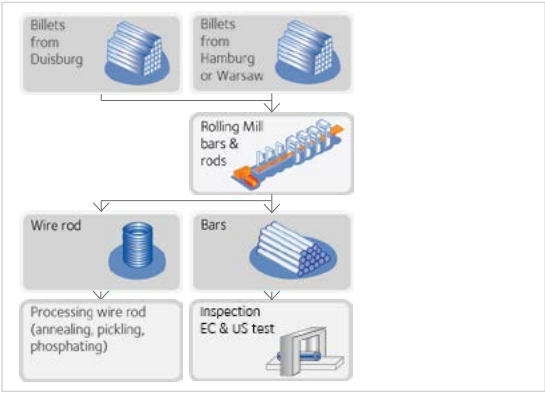
ArcelorMittal Gandrange plant is located in the Lorraine region in north-east France.

The production facilities of Gandrange consist of a hot rolling mill producing bars and wire rod (round and hexagon) in a wide range of grades and dimensions.

This combined mill also has a state-of-the-art sizing block and a new integrated bar conditioning line with surface and ultrasonic testing.

Strongly positioned in the field of bar and wire rod products, the site works to develop new applications and new products for the automotive, energy and mechanical industries (forging, cold heading, bright drawing...).

The site has high flexibility in steel input with semis provided by Duisburg, Hamburg and Warsaw.



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 line for bars:
  - Multi-roll straightener
  - Sawing and chamfering devices (45° or 60° from 0.2 to 4mm)
  - Surface control (Circoflux)
  - Ultrasonic control device
- 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)

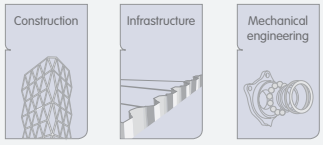
- Bars (mm): ● 15 - 100 (steps of 0.1 mm)
  ⬢ 14.3 - 70.4 (hexagons)

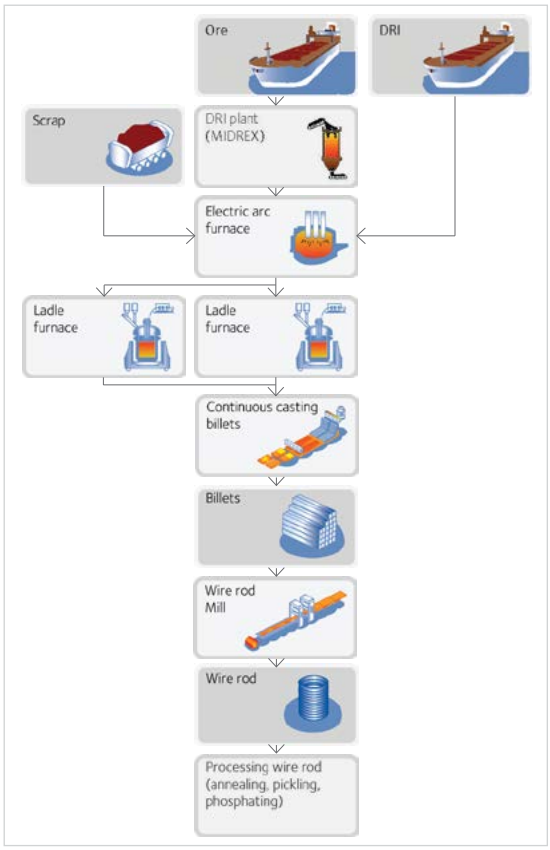
Length (m): 5 - 16
Strapping: 4 - 8 steel bands
Labelling: 2 per bundle

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

ArcelorMittal Hamburg

Dradenaustraße 33; D-21129 Hamburg





ArcelorMittal Hamburg plant is located at Germany's largest sea port which is an important logistical advantage. The production site of Hamburg consists of an electric arc furnace, two ladle furnaces, a continuous caster and a 2-strand wire rod mill.

Thanks to its direct reduction plant (DRI), the steel shop is able to produce high quality at an optimum cost. The scrap and DRI mix is modified according to customer technical requirements.

ArcelorMittal Hamburg is acknowledged as a global leader in high-quality wire rod production. It is also a pioneer in melt shop productivity and energy efficiency.

Facilities

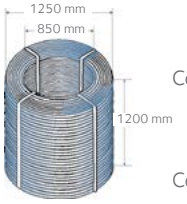
- DRI: Direct reduction plant
- Steel plant:
  - Electric arc furnace
  - 2 ladle furnaces
  - 7-strand billet caster
- Wire rod rolling mill:
  - High speed 2-strand
  - 26 stands including pre-block and no-twist Morgan block
- Wire rod processing (annealing, pickling, phosphating) upon request

Casted semis

- Billets (mm^2): ■ 120; 125; 130; 140 lengths (m): 5 - 16

Finished products

- Wire rod (mm): ● 5.5 - 16

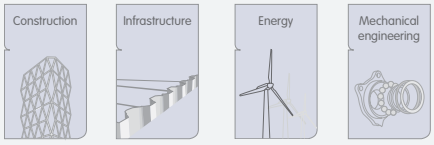


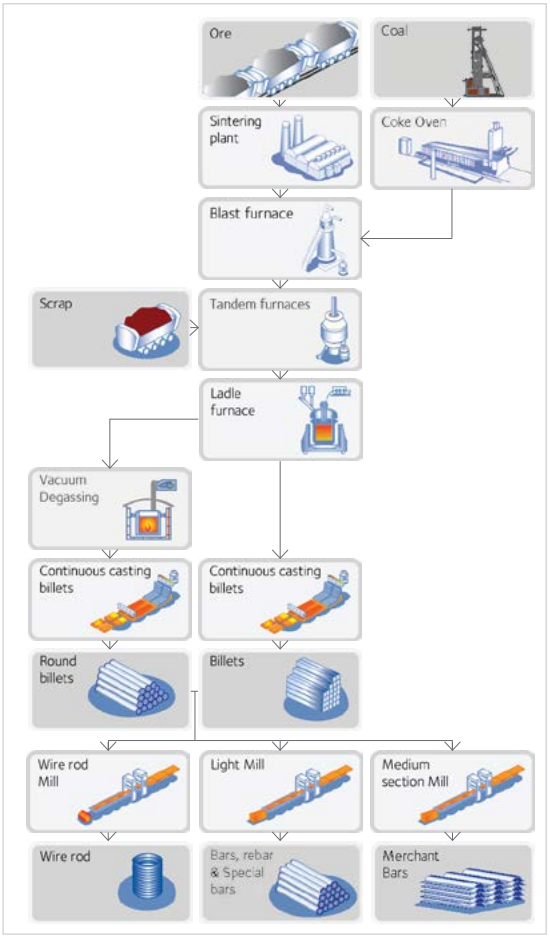
Coil length (mm) (max.): 1200

Coil weight (t) (max.): 1.5

ArcelorMittal Ostrava

Vratimovská 689; CS-707 02 Ostrava-Kunčice





ArcelorMittal Ostrava plant is located in the northeastern part of the Czech Republic. Ostrava production site consists of an integrated plant with a liquid phase (coke oven, sintering plant, blast furnace) and a steel plant.

ArcelorMittal Ostrava is the largest integrated steel company in the Czech Republic. It supplies a wide range of flat and long steel products.

The site recent investment in a larger round, continuous caster enables it to deliver a wider range of products for the pipe industry as well as for the production of leaf springs for the automotive industry.

Facilities

- Upstream:
  - Coke oven
  - Sintering plant
  - Blast furnaces
- Steel plant:
  - Tandem furnaces
  - Ladle furnaces
  - Vacuum degasser
  - Caster n°1: 6-strand* ■ 180² ● 160; 200; 270; 350; 400
  - Caster n°3: 6-strand** ■ 115²; 130²; 160²; ● 130
- Wire rod rolling mill :
  - 2-strand
  - 24 duo-stands including finishing block with 4 duo-stands
- Bar rolling mills:
  - Light section mill: 2 strands with 29 duo-stands
  - Medium section mill: cross country 9 duo-stands

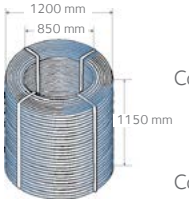
*including EMS; **vacuum degassing and EMS are not possible.

Casted semis

- Square billets (mm²): ■ 115; 130; 160; 180 — length (m): 4 - 12
- Round billets (mm): ● 130; 160; 200; 270; 350; 400 — length (m): 8.8 - 12 (standard length)
  length (m): 4.0 - 5.5 (upon request for diameters 160 to 400)

Finished products

- Wire rod (mm): ● 5.5 - 14
- Rebar in wild coils (mm): ● 8



Coil length (mm) (max.): 1150

Coil weight (t) (max.): 1.2

- Bars (mm): ● 10 - 110 — length (m): 4 - 16
- Rebar (mm): ● 10 - 50 — length (m): 6 - 16 (24*)
- Threaded bars (mm): ● 15 - 75 — length (m): 6 - 16 (24*)

Length (m): 4 - 16
Strapping: wire rod
Labelling: content upon agreement

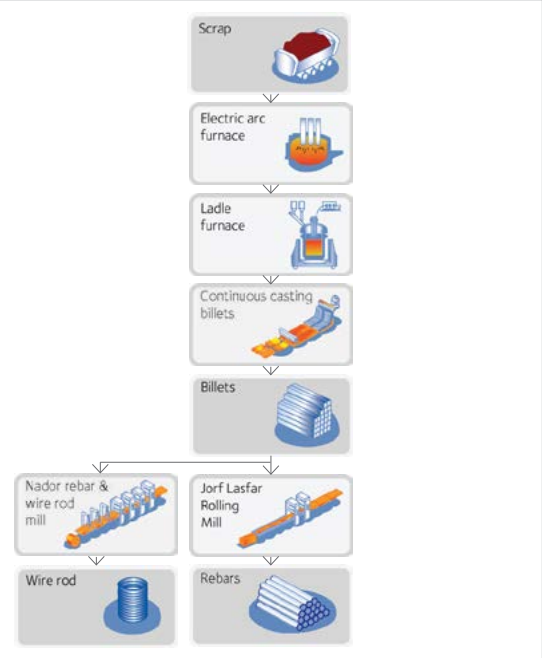
Bundle weight (t) (max.): 5

*upon request

ArcelorMittal Sonasid

Jorf Lasfar; P.O.Box 856 and 857 El Jadida; Jorf Lasfar
Nador; P.O.Box551; Route National N°2. km 18; El Aaroui; Nador

Construction



The two plants of ArcelorMittal Sonasid are located in the north and west of Morocco. Sonasid is the leading supplier of rebar and wire rod in North Africa.

The production sites of Sonasid consist of one electric arc furnace, one continuous caster, one wire rod and one bar mill.

Sonasid principally produces steel bars and rods. These products include reinforcing bars for construction, billets and wire rods.

Facilities

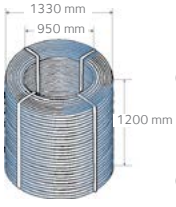
- Steel plant: Jorf Lasfar
  - Shredder
  - Electric arc furnace
  - Ladle furnace
  - 5-strand billet caster
- Wire rod rolling mill: Nador
  - 2-strand wire rod mill
- Bar rolling mill: Jorf Lasfar
  - 3-strand slitting rebar rolling mill

Casted semis

- Billets (mm^2): ■ 130; 140 length (m): 12 - 13

Finished products

- Wire rod (mm): ● 5.5 - 16
- Rebar in wild coils (mm): ● hot rolled 6 - 16
  ● cold rolled 6 - 12



Coil length (mm) (max.): 1200

Coil weight (t) (max.): 2

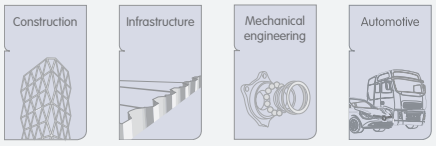
- Rebar (mm): ● 8 - 40

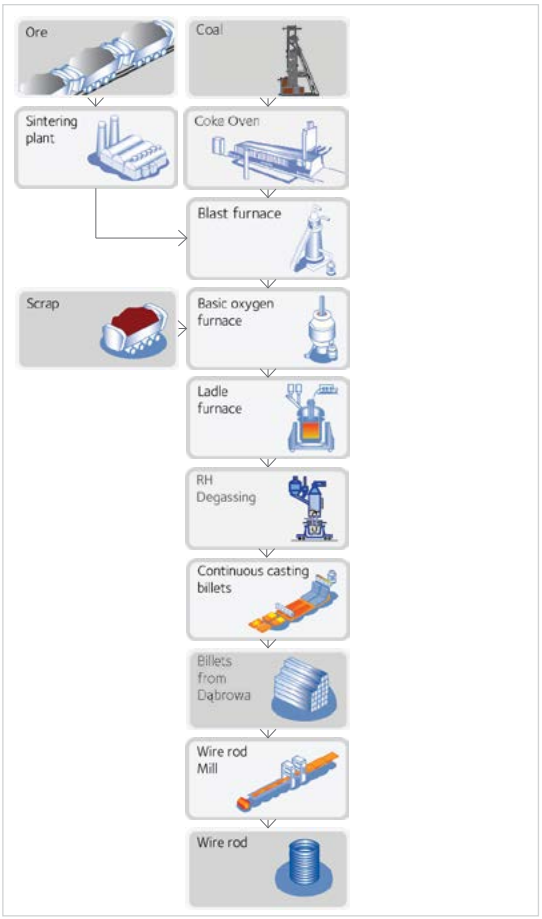
Length (m): 12 (other lengths upon request)
Strapping: 7
Labelling: 1

Bundle weight (t) (max.): 2

ArcelorMittal Sosnowiec

ArcelorMittal Poland Sosnowiec; Ul. Niwecka 1; P- 41-200 Sosnowiec





ArcelorMittal Sosnowiec plant consists of a modern wire rod mill.

Billets sourced from the integrated plant in Dąbrowa Gornicza are subject of advanced metallurgical rooting including a ladle furnace, vacuum degassing and a continuous caster (modernised in 2013).

Sosnowiec is a leading supplier of high quality wire rod to worldwide market and has the knowledge and expertise to produce wire rod for demanding applications.

With its strong position in carbon grades including prestressed concrete, welding and cold heading quality, the site develops grades for the most demanding applications in the automotive industry.

Facilities

- Upstream: Dąbrowa Górnicza
  - Coke oven
  - Sintering plant
  - Blast furnace
- Steel plant: Dąbrowa Górnicza
  - Oxygen converter
  - Ladle furnace
  - RH degassing
- Wire rod rolling mill: Sosnowiec
  - High speed 2-strand SMS (Morgan)/Danieli WR (2006)
  - 110 m long, Stelmor cooling conveyor

Casted semis

- Blooms (mm): ▭ 400 x 280 ; 300 x 280 — length (m): 4.2 - 12
- Blooms (mm): ▭ 220 x 190 — length (m): 5 - 13.5
- Billets (mm^2): ■ 130 — length (m): 8.5 - 13.5
- Billets (mm^2): ■ 140 — length (m): 8 - 13.5
- Billets (mm^2): ■ 160 — length (m): 7 - 13.5

Finished products

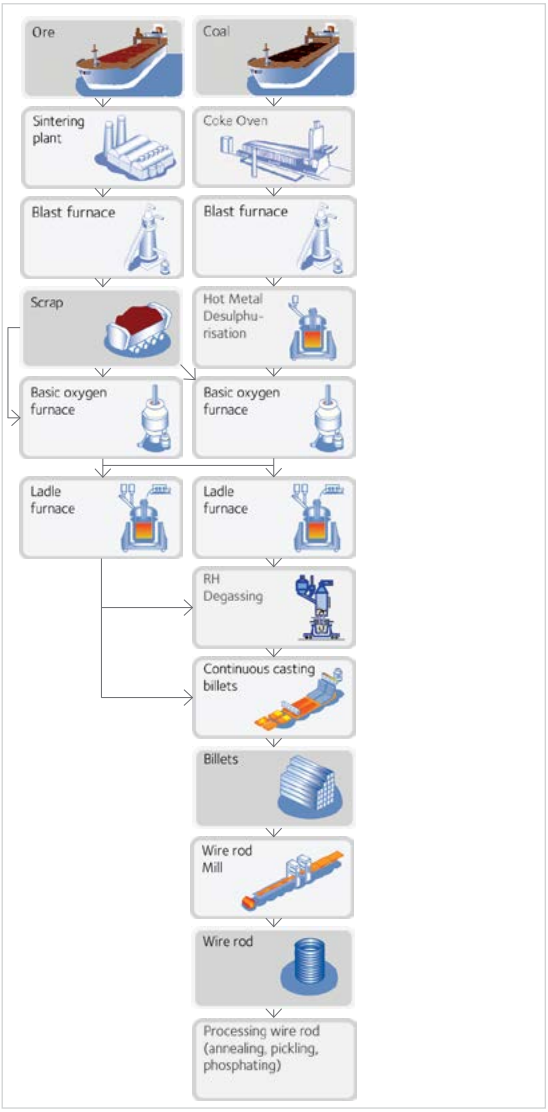
- Wire rod (mm): ● 5.5 - 21

Coil length (mm) (max.): 2015

Coil weight (t) (max.): 2.4

ArcelorMittal Veriña

ArcelorMittal Asturias (Gijón); Veriña de Abajo; E-33200 Gijón



ArcelorMittal Veriña plant is located in the Asturias region in north-west Spain in a strategic location with port services close to the factory.

The Gijón site consists of a steel plant with two oxygen converters, secondary metallurgy (including two ladle furnaces and an RH degasser), a bloom caster and a billet caster, as well as a wire rod mill and a rail mill.

The site produces high quality wire rod for the most demanding applications (steelcord, cold heading applications, springs for shock absorbers, etc.).

Gijón is the only Spanish producer of high-speed rail and head hardened rail. Both products are subject to the most stringent quality and reliability requirements.

Facilities

- Upstream:
  - Coke oven
  - Sintering plant
  - Blast furnaces
- Steel plant:
  - Oxygen converter
  - RH degassing
  - Two ladle furnaces
  - Kiss system to avoid slag carriover from the ladle to the tundish
  - 6-strand billet caster
- Wire rod rolling mill:
  - High speed 2-strand
  - 32 stands including pre block and reducing sizing mill
  - Zumbach Gauge monitoring (rod tolerance and ovality control)
  - Eddy current equipment for surface control of defects along the coil length
- Wire rod processing (annealing, pickling, phosphating) upon request

Casted semis

- Billets (mm^2): ■ 150 length (m): 15 (<15 m on request)

Finished products

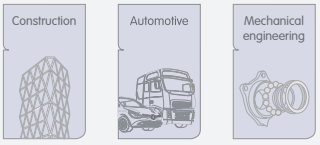
- Wire rod (mm): ● 5 - 20

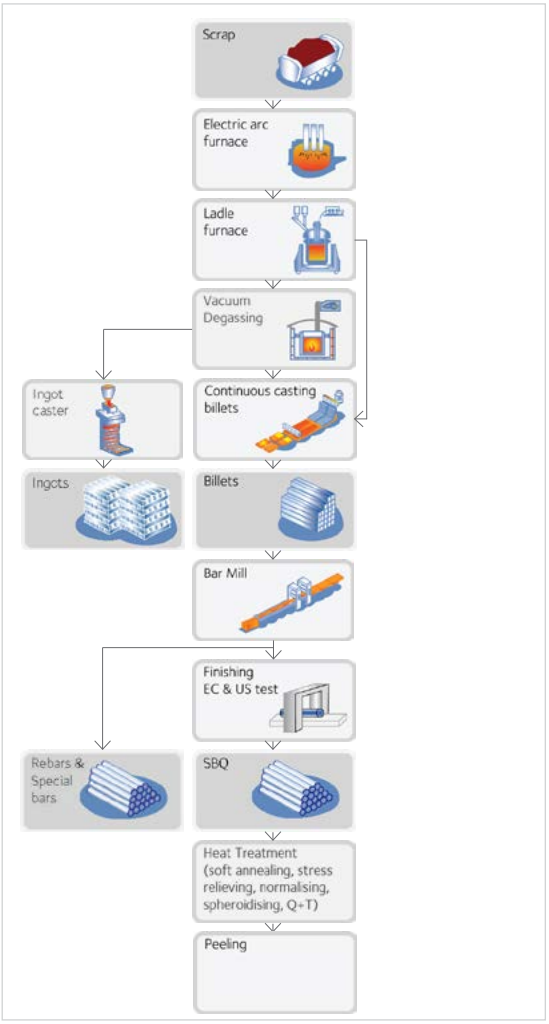
Coil length (mm) (max.): 2200

Coil weight (t) (max.): 2.6

ArcelorMittal Warszawa

Ul. Kasprowicza 132; P-01-949 Warszawa





ArcelorMittal Warszawa plant is located at the northern edge of Warsaw.

Warszawa production site consists of an electric arc furnace, a ladle furnace, vacuum degassing, an ingot caster, a continuous caster, a bar mill and finishing lines.

Warszawa produces special quality bars 20 - 80 mm in diameter and rebars 10 - 40 mm in diameter.

Facilities

- Steel plant:
  - Electric arc furnace with eccentric bottom tapping
  - Ladle furnace
  - Vacuum degassing
  - 4 strand billet caster
- Bar rolling mill:
  - 18 stands in continuous system roll line
- 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
  - Peeling

Casted semis

- Blooms (mm^2): ■ 220 length (m): 4 - 9
- Billets (mm^2): ■ 140; 160 length (m): 4 - 14.8

Finished products

- Bars (mm): ● 20 - 80
- Rebar (mm): ● 10 - 40

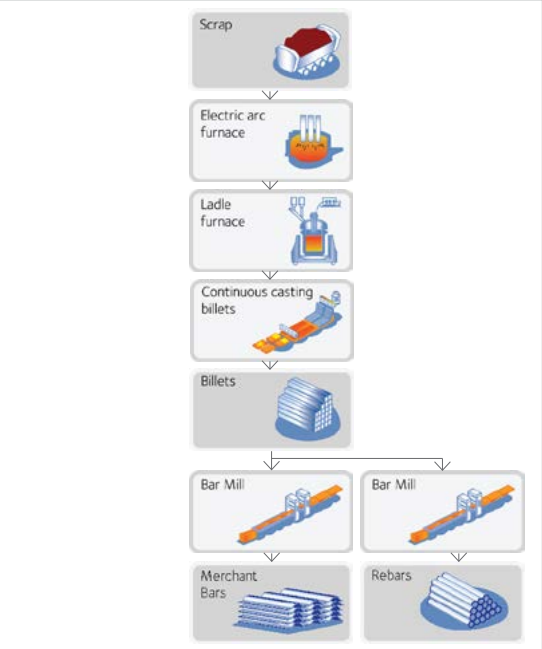
Length (m): 3.5 - 12
Strapping: min. 3 steel bands
Labelling: customer specifications (min. 2)

Bundle weight (t) (max.): 10

ArcelorMittal Zaragoza

Parque Tecnológico de Reciclado "López Soriano"; Avenida José López Soriano; 100; La Cartuja baja; E- 50720 Zaragoza

Construction



ArcelorMittal Zaragoza plant is located in the Aragón region in north-east Spain.

Zaragoza production site consists of an electric arc furnace, a ladle furnace, a continuous caster and two bar mills producing rebars and merchant bars.

ArcelorMittal Zaragoza moved its industrial activity to a new location in 2007, thereby increasing its production capacity and product range.

Facilities

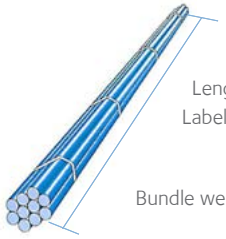
- Steel plant:
  - Electric arc furnace
  - Ladle furnace
  - 5-strand billet caster
- Rolling mill:
  - 2 bar mills

Casted semis

- Billets (mm): 160 x 120; 220 x 130 — length (m): 8 - 13
- Billets (mm^2): 120; 140

Finished products

- Rebar (mm): 10 - 32

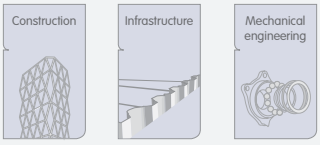


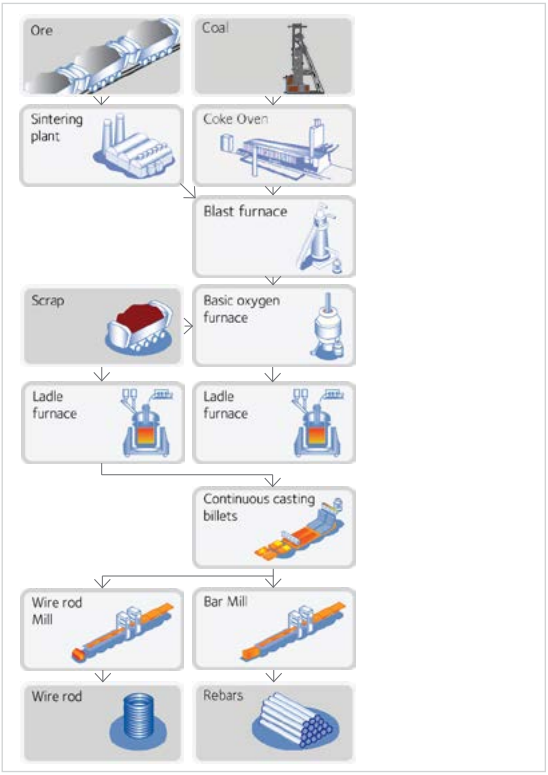
Length (m): 6 - 16
Labelling: 1 per bundle

Bundle weight (t) (max.): 2.5

ArcelorMittal Zenica

Bulevar Kralja Tvrtka I, no. 17; 72000 Zenica





ArcelorMittal Zenica plant is located in the Zenica-Doboj canton in the centre of Bosnia and Herzegovina.

Zenica production site consists of an integrated plant with a liquid phase (coke oven, sintering plant, blast furnace) and a steel plant. The ore is supplied by the nearby Prijedor Mine.

The plant is unique with facilities including both integrated route and electric arc furnace.

- Investment in rebar coil, availability early 2016

Facilities

- Upstream:
  - Coke plant
  - Sintering plant
  - Blast furnace
- Steel plant:
  - Oxygen converter
  - Basic oxygen furnace
  - Ladle furnace
  - 6-strand continuous caster
- Wire rod rolling mill
- Rebar rolling mill
- Finishing: Mesh plant

Casted semis

- Billets (mm^2): ■ 120; 130 length (m): 9 - 12

Finished products

- Wire rod (mm): ● 5.5 - 12
- Rebar in wild coils (mm): ● 6 - 12
- Rebar (mm): ● 8 - 32

Coil length (mm) (max.): 1250

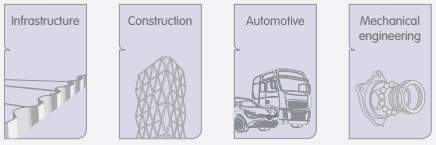
Coil weight (t) (max.): 1.3

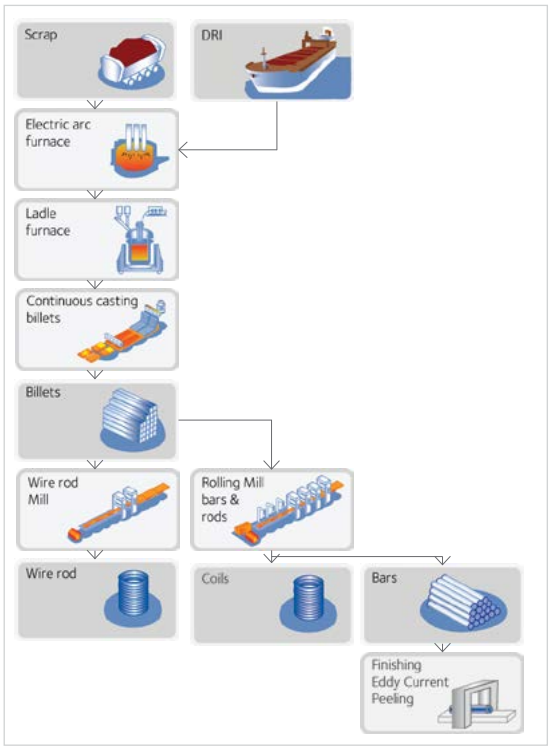
Length (m): 6 - 16
Strapping: double 4.2 mm wire rod or 6 places
Labelling: plastic label

Bundle weight (t) (max.): 2.5

ArcelorMittal Zumárraga

ArcelorMittal Gipuzkoa (Zumárraga); Bulevar Artiz, 34; Zumárraga; E-20700 Gipuzkoa





ArcelorMittal Zumárraga plant is located in the province of Gipuzkoa in the Basque Country, Spain.

The production site of Zumárraga consists of an electric arc furnace working with scrap and automatic addition of HBI and DRI, one continuous caster (with two billet formats) and two rolling mills.

The site is well equipped to produce SBQ and is taking advantage of its EMS units and its quenching unit on the wire rod mill. It offers a full range of diameters in coils and a wide range of steel grades.

Facilities

- Steel plant:
  - Electric arc furnace
  - Ladle furnace
  - Electro-magnetic stirring
  - 6-strand billet caster
- Wire rod rolling mill:
  - High speed 2-strand wire rod rolling mill
  - 28 stands including block and miniblock
- Bar and coil mill:
  - 1 strand, 18 stands
  - 1 bar line and 1 Garrett line
- Finishing line:
  - Surface inspection
  - Peeling

Casted semis

- Billets (mm): 210 x 160 length (m): 12
- Billets (mm^2): 160

Finished products

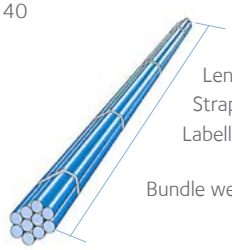
- Wire rod (mm): 5.5 - 52
- Rebar (mm): Wild coils: 8 - 12
  Compact coils: 8 - 12

Coil length (mm) (max.): Stelmor: 1800
Garrett: 1500

Rebar in coil (mm) (max.): wild coil: 1800
compact coil: 700

Coil weight (t) (max.): 3

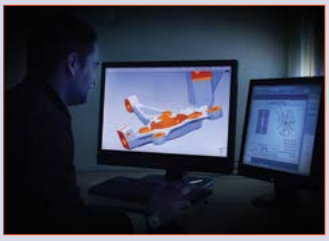
- Bars (mm): 28 - 104
- Rebar (mm): 8 - 12 (straightened bars)
  20 - 40



Length (m): 5 - 14
Strapping: 4 - 6 steel bands
Labelling: 2 per bundle

Bundle weight (t) (max.): 3

Product development



ArcelorMittal's product development approach is based on the long-term co-development agreements we have with our customers and on the daily technical support we provide. From ArcelorMittal Global's Research and Development Centres to European plants, our experts are committed to improving steel processing and engineering.

Deep understanding of operational drivers and product evolutions are key elements to improve products and services for our customers, and to invent products for tomorrow's applications. Fine-tuning processes and product quality evolution are at the origin of numerous cost reduction and performance improvement.

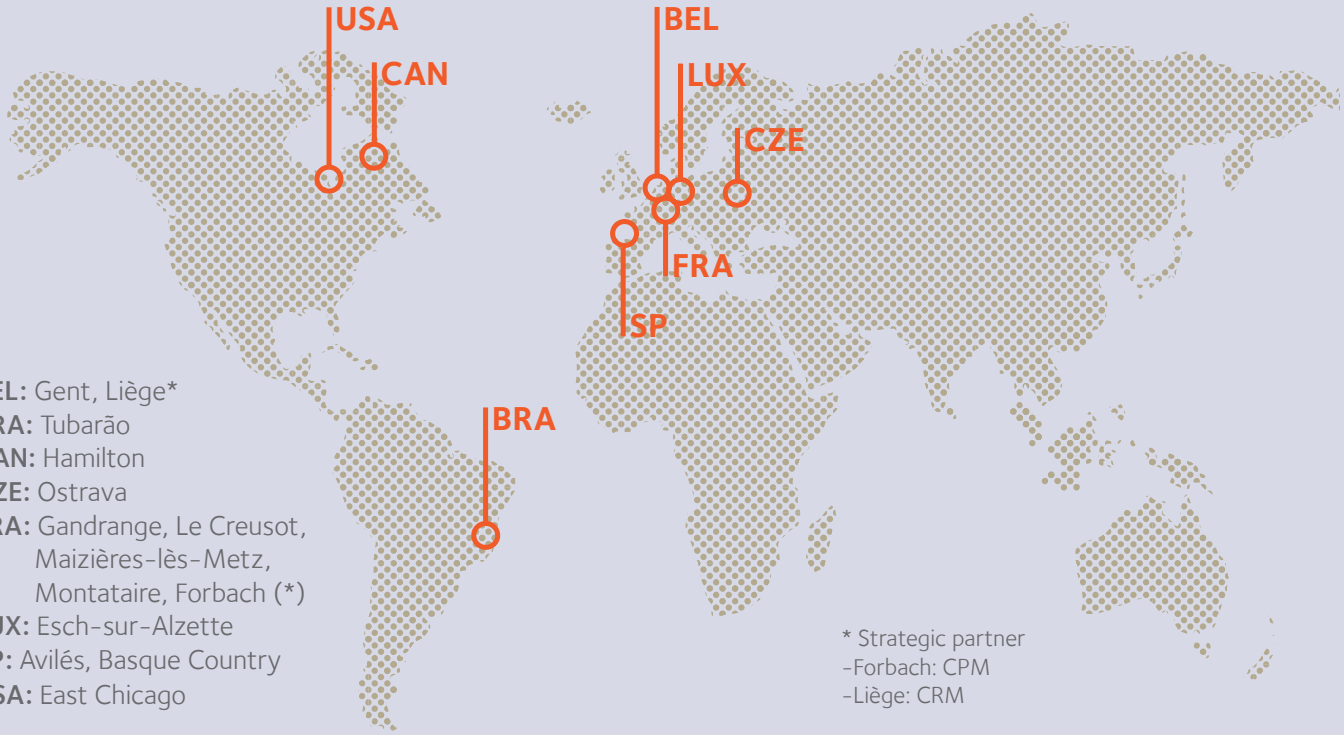
Our research and development teams provide support to our customers to establish a sound knowledge on the key expectations from our products such as cleanliness, structure homogeneity, mechanical characteristics, corrosion resistance, etc.

Beyond this, research and development mission is to innovate new steel solutions to address future segment needs. Some of them are already currently used by our customers: bainitic grades for forging (Solam®), high plasticity and high strength grades for cold heading (FreeForm®), high machinability grades.

We have also developed models describing in detail the overall steel production process, from liquid metallurgy to hot rolling and cold forming connecting microstructural behaviour, thermomechanical process to steel product or part performance. Final thermal treatment simulations help our partners to reach very high process control and increase its robustness. Specific pilot plants for casting, rolling, drawing and heat treatment complement numerical simulations by providing material for physical evaluation.

Drawability and machinability are specific areas of research and product development with dedicated pilot benches, as well as specific and instrumented lathes, new ultrasonic tank to optimise cleanliness.

Global R&D centres



BEL: Gent, Liège*
BRA: Tubarão
CAN: Hamilton
CZE: Ostrava
FRA: Gandrange, Le Creusot, Maizières-lès-Metz, Montataire, Forbach (*)
LUX: Esch-sur-Alzette
SP: Avilés, Basque Country
USA: East Chicago

* Strategic partner
-Forbach: CPM
-Liège: CRM

Global R&D

Over 1.300 full-time researchers in 12 Labs, spending in 2015 amounting to $227 million of which 33.9% is dedicated to Auto.

Missions

- Pro-active approach of future needs in automotive industry
- Innovative solutions taking advantage of Flat & Long synergies
- Development of products, steel solutions and processes from their pre-design phase through their implementation and lifetime at our customers and at our plants
- Assistance to plants for complex technical issues

Activities

- Broad, comprehensive portfolios and programmes addressing business needs
- Expanding Worldwide network of laboratories in Europe & America
- Partnerships with focused engineering schools & universities laboratories

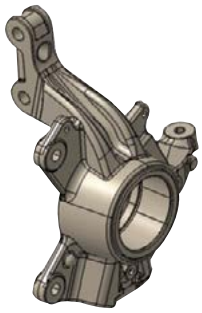
Our labs are equipped with the most recent technologies for macro/micro characterisation (field emission gun SEM, macro-probe, torsion & fatigue machines (new Charpy & Brugger impact test), dilato-plastometer, corrosion chambers...) and provide support through process instrumentation (thermal cameras, pyrometers, force sensors, etc.). Specific surface expertise can be provided for wire: surface morphology (new 3D non contact profiler), composition (new H_2 analyser) and aptitude to coating.

Our customers can rely on the expertise of ArcelorMittal's Global R&D Centres, as well as on our international network of experts available on every continent, to manage the world's largest steel product portfolios.

Example of part & steel design

Process applied to the steering knuckle function

- Cast iron baseline compared to two design ideas providing different bearing fixings
- Weight estimation including bearing and fixing bolts
- Forged lightweight solutions with high strength bainitic steel grade



Cast iron baseline: 6.4 kg

Cast iron
(UTS = 400 MPa)

Baseline comparison:
5.2 kg (-19%)

SOLAM® B1100
(UTS = 1100 MPa)

Baseline comparison:
5.5 kg (-14%)

SOLAM® B1100
(UTS = 1100 MPa)

Product range Bars & Rods

Semis		Duisburg (Germany)	Gandrange (France)	Hamburg (Germany)	Ostrava (the Czech Republic)	Sonasid (Morocco)
Steel production	Steel origin	Iron ore		Scrap/DRI	Iron ore	Scrap
	Steel plant	BOF		EAF	BOF	EAF
	Vacuum degassing	✓			✓	
	Electro-magnetic stirring	✓		✓	✓	
	Casted semis (mm)	▬ 385 x 265 ■ 155², 320²		■ 120², 125², 130², 140²	● 130; 160; 200; 270; 350; 400 ■ 115², 130², 160², 180²	■ 130², 140²

Wire rod			Duisburg (Germany)	Gandrange (France)		Hamburg (Germany)	Ostrava (the Czech Republic)	Sonasid (Morocco)
Wire rod rolling	Finished products		Wire rod	Wire rod		Wire rod	Wire rod	Wire rod
			●	●	⬣	●	●	●
	Dimensions (mm) (min.)		5.5	15	14.3	5.5	5.5	5.5
	Dimensions (mm) (max.)		25	52	42.5	16	14	16
	Coil presentation	Coil forming	Loop Cooling Conveyor	Garrett		Stelmor	Chain conveyor	Stelmor
		Coil weight (t) (max.)	3	2.5		1.5	1.2	2
		Coil length (mm) (max.)	2300	1500		1200	1150	1200
	On-line inspection	Surface control	✓	✓		✓		
		Dimensions gauge	✓	✓		✓	✓	
Processing wire rod			on request	on request		on request		

Bars			Duisburg (Germany)		Gandrange (France)		Hamburg (Germany)	Ostrava (the Czech Republic)	Sonasid (Morocco)
Bar rolling	Finished products		Round Corner Square	Special Bar Quality	Special Bar Quality			Merchant Bar Quality	
			■	●	●	⬣		●	
	Dimensions (mm) (min.)		63²	100	15	14.3		10	
	Dimensions (mm) (max.)		200²	170	100	70.4		110	
	Conditioning	Bundle weight (t) (max.)	10		8			5	
		Bundle length (m) (max.)	16		16			16	
	On-line inspection	Surface control			✓				
		Dimensions gauge			✓			✓	
Inspection & Finishing	Off-line inspection	Surface control	✓		✓				
		US	✓		✓				
	Heat treatment	Q+T							
		Annealing	✓						
	Peeling				on request				

	Duisburg (Germany)	Gandrange (France)	Hamburg (Germany)	Ostrava (the Czech Republic)	Sonasid (Morocco)
Dimension tolerances	EN10060 EN 10108 DIN 59115	EN10060 EN 10108 DIN 59115	EN 10017 STAB EN 10108 OCD	EN 10017 EN10060 EN 10108 DIN 59110 DIN 59115	ISO 16120

Rebars		Ostrava		Sonasid		Warszawa	Zaragoza	Zenica		Zumárraga			
Finished products		in wild coils	in bars	in wild coils	in bars	in bars	in bars	in wild coils	in bars	in wild coils	in compact coils	in straight-ened bars	in bars
Diameter (mm)		8	10-50	6-16	8-40	10-40	10-32	6-12	8-32	8-12	8-12	8-12	20-40
Conditioning	Bundle weight (t) (max.)		5		2	10	2.5		2.5			3	3
	Bundle Length (m) (max.)		16		12	12	16		16			14	14
	Coil weight (t) (max.)	1.2		2				1.3		3	2.8		
	Coil length (mm) (max.)	1150		1200				1250		1800	700		

Semis

Sosnowiec (Poland)	Veriña (Spain)	Warszawa (Poland)	Zaragoza (Spain)	Zenica (Bosnia Herzegovina)	Zumárraga (Spain)		
Iron ore	Iron ore	Scrap	Scrap	Iron ore	Scrap/DRI	Steel origin	Steel production
BOF/EAF	BOF	EAF	EAF	BOF	EAF	Steel plant	
✓	✓	✓				Vacuum degassing	
✓	✓	✓			✓	Electro-magnetic stirring	
▭ 220 x 190; 300 x 280; 400 x 280 ■ 130²; 140²; 160²	■ 150²	■ 140²; 160²; 220²	▭ 160 x 120; 220 x 130 ■ 120²; 140²	■ 120²; 130²	▭ 210 x 160 ■ 160²	Casted semis (mm)	

Wire rod

Wire rod	Wire rod			Wire rod	Wire rod		Finished products	Wire rod rolling
●	●			●	●	●		
5.5	5			5.5	5.5	24	Dimensions (mm) (min.)	
21	20			12	24	52	Dimensions (mm) (max.)	
Stelmor	Stelmor			Stelmor	Stelmor	Garrett	Coil forming	Coil presentation
2.4	2.6			1.3	3	3	Coil weight (t) (max.)	
2015	2200			1250	1800	1500	Coil length (mm)(max.)	
✓	✓				✓		Surface control	On-line inspection
✓	✓				✓		Dimensions gauge	
	✓						Processing wire rod	

Bars

		Special Bar Quality			Special Bar Quality	Finished products	Bar rolling
		●			●		
		20			28	Dimensions (mm) (min.)	
		80			104	Dimensions (mm) (max.)	
		10			3	Bundle weight (t) (max.)	Conditioning
		12			14	Bundle length (m) (max.)	
					✓	Surface control	On-line inspection
		✓			✓	Dimensions gauge	
		✓			✓	Surface control	Off-line inspection	Inspection & Finishing
		✓				US	
		✓				Q+T	Heat treatment
		✓				Annealing	
		on request			✓	Peeling	

EN 10017 EN 10060 EN 10108 DIN 59110 DIN 59115	EN10060 EN 10108 DIN 59115	EN 10060 EN 10060P	EN 10080 UNE 36065	EN 10060 EN 10108 DIN 59115	EN 10017 EN 10060 EN 10061 EN 10108 DIN 59115	Dimension tolerances

other Semis

Belval (Luxembourg)	Hunedoara (Romania)		
Scrap	Scrap	Steel origin	Steel production
EAF	EAF	Steel plant	
	✓	Vacuum degassing	
▭ 270 x 155	▭ 270 x 240; 310 x 280 ● 180; 200; 250; 270; 310	Casted semis (mm)	

Sales offices

Central Sales/Export
66, rue de Luxembourg
4221 Esch-sur-Alzette - Luxembourg
T: +352 53 13 34 32
xavier.monfort@arcelormittal.com

Countries: Austria, Germany, the Netherlands and Switzerland
Wörthstrasse 125
47053 Duisburg - Germany
T: +49 203 606 73 54
F: +49 203 606 73 71
constantin.vonlivonius@arcelormittal.com
joachim.scheibe@arcelormittal.com

Countries: Belgium, France, Luxembourg
66, rue de Luxembourg
4221 Esch-sur-Alzette - Luxembourg
T: +352 53 13 34 61
F: +352 5313 45 3461
jean-pascal.leloire@arcelormittal.com

Country: Bosnia and Herzegovina, Croatia, Albania, Montenegro, Serbia, Kosovo, FYROM, Slovenia
Kralja Tvrtka I no.17,
72 000 Zenica - Bosnia & Herzegovina
T: +38732 467 051
F: +38732 467 065
akshaya.gujral@arcelormittal.com
salesamz@arcelormittal.com

Country: Bulgaria
26 Antim street, floor 1, office 6
1303 Sofia - Bulgaria
T: +359 2 87 09 028
F: +359 2 87 05 226
georgi.genov@arcelormittal.com

Countries: the Czech Republic, Hungary, Slovakia, Slovenia, Estonia, Latvia, Lithuania
Warszawa
ul. Kasprowicza 132
01-949 Warszawa - Poland
T: +48 22 835 80 20
F: +48 22 835 81 93
miroslaw.czub@arcelormittal.com
janusz.muszynski@arcelormittal.com

Ostrava
Vratimovská 689
70702 Ostrava - Kunčice
The Czech Republic
T: +420 59 568 4130
shahab.husain@arcelormittal.com

Countries: Denmark, Finland, Iceland, Norway, Sweden
Birger Jarlsgatan 41A
111 45 Stockholm - Sweden
T: +46 8 5348 0948
michael.wild@arcelormittal.com

Country: Greece & Cyprus
9. Saki Karagiorga Str.,
166 75 Glyfada, Greece
T: +30 21 09 604 279
F: +30 21 09 611 824
aleksandar.rankovic@arcelormittal.com
nota.koutsou@arcelormittal.com

Country: Italy
Viale Brenta, 27/29
20139 Milano - Italy
T: +39 02 80650 234
F: +39 02 80650 250
angelo.agnelli@arcelormittal.com
marco.cuccadu@arcelormittal.com

Country: Morocco
Twin Center 18e étage Tour A,
Angle Bb Zerktouni et Massira Al Khadra
Casablanca - Morocco
T: +212 522 95 41 00
F: +212 522 95 44 69
a.baraka@sonasid.ma

Country: Poland
ul. Niwecka 1
41-200 Sosnowiec - Poland
T: +48 32 736 11 17
F: +48 32 736 14 11
barbara.stefaniak@arcelormittal.com
janusz.muszynski@arcelormittal.com

ul. Kasprowicza 132
01-949 Warszawa - Poland
T: +48 22 835 80 10
T: +48 22 835 80 20
F: +48 22 835 81 93
mikolaj.wronski@arcelormittal.com
miroslaw.czub@arcelormittal.com
janusz.muszynski@arcelormittal.com

Country: Romania
9 Intrarea Tudor Stefan 2nd Floor, AP.4,
Sector 1. Bucharest 11655 - Romania
T: +40 31 40 54 792
F: +40 21 23 17 138
daniela.voicuagache@arcelormittal.com

Countries: Spain and Portugal
Ctr. Toledo. Km. 9,200
E-28021 Madrid - Spain
T: +34 91 797 23 00
F: +34 91 596 94 88
elina.martin@arcelormittal.com

T: +34 943 72 00 11
F: +34 943 72 01 01
juan-carlos.hurtado@arcelormittal.com

T: +34 985 18 74 03
juan.demiguel@arcelormittal.com

Countries: Turkey, the Middle East, Near East, Africa, CIS, the Indian Subcontinent
Nispetiye Cadessi No 22
Özden Is Merkezi Kat 2
Levent 34330 Istanbul, Turkey
T: +90 212 317 4922
F: +90 212 317 4981
cansu.cobanoglu@arcelormittal.com

Countries: UK and Ireland
Fore 2, Huskisson Way,
Shirley, Solihull,
West Midlands
B90 4SS - United Kingdom
T: +44 121 713 6670
F: +44 121 733 1299
andrew.dejong@arcelormittal.com

To receive a copy of Bars & Rods brochure, please contact:

ArcelorMittal Europe
Long Products
66, rue de Luxembourg
L-4221 Esch-sur-Alzette
T.: +352 5313 3457

barsandrods.arcelormittal.com

Printed in March 2016