Outstanding abrasion resistance

Boron steel grades offer excellent resistance against abrasive wear

ArcelorMittal's boron steel grades offer a one-of-a-kind microstructure and hardness which is capable of standing up to the most abrasive wear.

Properties

ArcelorMittal's boron grades represent a breakthrough in durable steels and are a cost-effective solution to prolong the life of your final products. Hardened using a water quenching process and hot rolling-controlled thermo-mechanical treatment, our boron steel range offers a remarkable degree of hardness which gives the final product:

- A uniform microstructure
- Outstanding mechanical loading
- Excellent resistance to abrasive wear

Applications for boron steels

Boron steels are typically used in applications which require high wear or abrasion resistance. Although they are often used to form agricultural parts such as plough discs, boron steels also have applications in mining, concrete mixers, and automotive safety parts.

ArcelorMittal Europe – Flat Products offers an extensive boron range including 20MnB5 AM FCE, 22MnB5 AM FCE, 28MnB5, 30MnB5 AM FCE, 33MnCrB5 AM FCE and 38MnB5 AM FCE. In addition, grade 36MnB5 AM FCE is available on request.

The choice of grade depends on:

- Required hardness of the finished part
- Resistance to abrasive wear needed
- Complexity of the forming process

All grades can be hot or cold formed. They are typically delivered to the customer in ready-to-use condition.

In their 'as-delivered' condition, boron grades are a cost-effective solution for applications which require resistance to smaller wear particles. Thanks to their composite microstructure, these grades offer remarkably good abrasion resistance.

Effect of quenching

ArcelorMittal's boron steel is all about cost, durability and creating a longer lifetime for your parts.

The extreme hardness of ArcelorMittal's boron steel grades is achieved by water quenching after heat treatment. This has the consequence to obtain grades harder than produced using oil or gas quenching and makes them particularly suitable for agricultural uses which demand high resistance to wear.

The effluent from the water quenching process requires less treatment than the effluent produced using oil or gas quenching. This makes the water quenching method very environmentally friendly.

Untreated boron grades

ArcelorMittal's untreated boron steel grades are supplied in untreated form. This enables customers to achieve the level of strength and hardness required to form complex parts which can withstand severe wear conditions.

All of ArcelorMittal's boron grades are delivered in as-rolled state, meaning untreated condition. Depending on the final application, a thermal treatment can be applied. The thermal treatment increases the hardness of the steel and is required for applications such as agricultural parts.

Untreated boron steels are a cost-effective solution which offer the same standard of durability and longevity as ArcelorMittal's treated grades. A typical application for untreated grades is concrete mixing equipment.

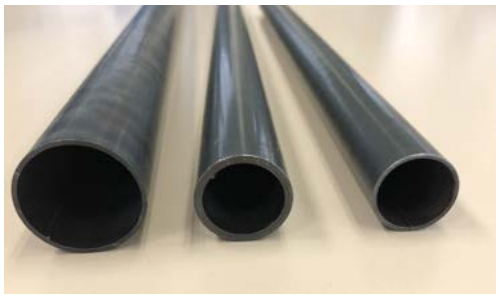
Boron steel advantages

- High wear and abrasion resistance results in improved durability, less material weight loss, low maintenance, longer life, and reduced costs
- Suitable for the environmentally friendly water quenching processes
- Excellent hardening performance (also possible with both oil and gas quenching).

Image courtesy of Forges de Niaux

Applications

- Agricultural machinery and tools such as discs and ploughshares
- Public works machinery
- Mining
- Cutting equipment
- Safety beams in vehicles
- Concrete mixer drums *(with 30MnB5 AM FCE and 33MnCrB5 AM FCE)*



Tubular parts manufactured from 22MnB5
Courtesy of Flinsa

Brand correspondence

ArcelorMittal offers boron steel grades which correspond to grades defined in the EN 10083-3:2006 standard.
ArcelorMittal also offers grades with enhanced properties which are outside the scope of EN 10083-3:2006.

ArcelorMittal	EN 10083-3:2006
20MnB5 AM FCE	20MnB5
22MnB5 AM FCE	-
*28MnB5**	-
30MnB5 AM FCE	30MnB5
30MnB5 EN 10083	30MnB5
33MnCrB5 AM FCE	33MnCrB5
38MnB5 AM FCE	38MnB5

Grades in italics: not included in the standard
** Grade prepared to customer specification*

Mechanical properties

The following table shows the typical mechanical properties of a 6 mm specimen of the grade (tested in the rolling direction) before water quenching (delivery condition) and after quenching.

	Delivery condition			Quenched			
	R_e (MPa)	R_m (MPa)	A (%)	Hardness HRC	R_e (MPa)	R_m (MPa)	A (%)
20MnB5 AM FCE	350	520	27	45	1100	1450	11
22MnB5 AM FCE	350	520	27	45	1100	1500	10
28MnB5	420	620	26	49	1200	1650	9
30MnB5 AM FCE and EN 10083	440	660	25	50	1200	1700	8
33MnCrB5 AM FCE	495	750	20	54	1300	2000	7
38MnB5 AM FCE	480	760	18	55	1300	2000	7

Upgrading from 30MnB5 AM FCE to 38MnB5 AM FCE increases the hardness of the quenched parts by approximately 10 percent.
Abrasion tests demonstrate that this equates to a 40 percent improvement in wear resistance.

Dimensions

Sheets, coils and slit strips are available as-rolled or pickled conditions.

Mill finish

Steel grade	20MnB5 AM FCE	22MnB5 AM FCE	28MnB5	30MnB5 AM FCE, EN 10083	33MnCrB5 AM FCE	38MnB5 AM FCE
Thickness (mm)*	1.5-16	1.7-15	1.8-16	1.7-16	1.8-13	1.8-16
Width (mm)*	600-1575	685-2150	600-1575	600-2150	800-1550	600-1575

**Indicative dimensional range, contact ArcelorMittal for detailed feasibility*

Pickled

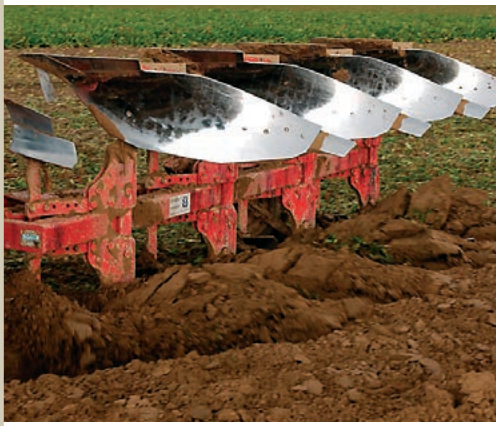
Steel grade	20MnB5 AM FCE	22MnB5 AM FCE	30MnB5 AM FCE, EN 10083	33MnCrB5 AM FCE
Thickness (mm)*	1.5-6.2	1.7-8	1.7-6	1.8-6.2
Width (mm)*	800-1300	660-2130	660-1280	800-1300

**Indicative dimensional range, contact ArcelorMittal for detailed feasibility*

Chemical composition

Steel grade	C (%)	Mn (%)	P (%)	S (%)	Si (%)	Al (%)	Ti (%)	B (%)
20MnB5 AM FCE	0.190 - 0.230	1.15 - 1.35	≤ 0.020	**≤ 0.005**	0.15 - 0.35	**≥ 0.020**	**0.020 - 0.050**	**0.0015 - 0.0045**
22MnB5 AM FCE	0.200 - 0.250	1.10 - 1.40	≤ 0.025	**≤ 0.008**	0.15 - 0.35	**≥ 0.015**	**0.020 - 0.060**	0.0020 - 0.0050
28MnB5	0.260 - 0.300	1.10 - 1.40	≤ 0.020	≤ 0.010	0.20 - 0.35	≥ 0.020	0.020 - 0.050	0.0020 - 0.0050
30MnB5 AM FCE	0.270 - 0.330	1.15 - 1.45	≤ 0.025	≤ 0.004	0.20 - 0.30	**≥ 0.015**	**0.020 - 0.050**	0.0010 - 0.0050
30MnB5 EN 10083	0.270 - 0.330	1.15 - 1.45	≤ 0.025	**≤ 0.035**	≤ 0.40	-	-	0.0008 - 0.0050
33MnCrB5 AM FCE	0.300 - 0.360	1.20 - 1.50	≤ 0.025	**≤ 0.015**	≤ 0.40	**≥ 0.015**	**0.020 - 0.050**	**0.0008 - 0.0050**
38MnB5 AM FCE	0.360 - 0.420	1.15 - 1.45	≤ 0.025	**≤ 0.005**	0.17 - 0.35	**≥ 0.015**	**0.020 - 0.050**	**0.0010 - 0.0050**

Grades in italics: not included in the standard
Values in bold: tighter than the standard



Continuous transformation and cooling characteristics (TRC)

TRC characterisation of 22MnB5 AM FCE

- Recommended austenitising temperature is 880 °C
- Temperature at beginning of quenching process (maximum cooling rate) is 750 °C
- TRC diagrams available on request.

TRC characterisation of 30MnB5 AM FCE

- Recommended austenitising temperature is 830 °C to 850 °C
- Temperature at beginning of quenching process (maximum cooling rate) is 730 °C
- TRC diagrams available on request.

TRC data for other steel grades are available on request.

Endurance to last a lifetime

ArcelorMittal's boron steel grades can withstand abrasive wear for the long term. The steel's level of endurance is determined following heat treatment and quenching.

For example, a 2.65 mm thick sample of 22MnB5 AM FCE was tested using cyclic tensile loading with a load ratio of Rs = 0.1 following different heat treatments. Specimens were austenitised at 950 °C for five minutes. The following table shows the results.

22MnB5 AM FCE heat treated during 5 minutes at 950°C followed by:	Max. stress σd (MPa) typical value		Max. stress σd (MPa) typical value
Water quenching	562	S355MC AM FCE	385
Oil quenching	578		
Water quenching + heat treatment at 200°C for 20 minutes	651		

The results of this test indicate that ArcelorMittal's boron steel grades have a fatigue resistance that is *40 to 60 percent higher* after quenching than the S355MC low alloy grade.

We are here to help you

Our expert engineers and researchers are here to help. For all of your welding, cutting and forming topics, let our experts find a solution for you.

Contact us at industry.arcelormittal.com/boronsteels

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