

Data sheet: A3.7

Structural Steel Plate and Strip to EN 10025

General description

ArcelorMittal South Africa produces and markets hot rolled structural steel plate and coil to EN 10025 in the following thickness ranges:

Plate = 5mm - 100mm
Coil from 1,6mm - 13mm. (Vanderbijlpark)
Coil from 1,5mm - 6mm. (Saldanha)

Other thicknesses may be available on enquiry

In addition, structural steel plate and strip to American, other European and Japanese specifications are available on enquiry. Refer to Table 4 for a list of the corresponding former national designations.

Steel to EN 10025-2 is intended for structural work where **no significant forming or bending** must be done. The steels described in this data sheet are intended for use in welded, bolted and riveted structures for service at ambient temperatures. The weldments should not be normalised but stress relieving after welding (PWHT) is permitted. Products delivered in the N condition may be hot formed and normalised after delivery. N condition refers to both normalising rolling and normalising.

The grade designations of EN 10025 refer to the minimum yield strength of each grade for thicknesses less than or equal to 16mm. Above 16mm, the yield strength decreases as the thickness increments increase. The steel grade should be selected in accordance with the strength requirements as indicated in Table 3. The JR, JO, J2 suffixes refer to different impact requirements. An average impact energy value of 27 joules must be achieved on full size specimens in the longitudinal direction in all applicable cases. The suffix AR refers to the As-rolled condition. If the material is normalised then the indication '+N' will appear as a suffix.

The EN 10025 structural steel grades are all readily weldable by means of the usual metal arc processes.

Steel making

Steel is manufactured via the basic oxygen furnaces (BOF). All steel is desulphurised to maintain a high degree of cleanliness and is made fully killed and fine-grained from continuously cast slabs. Full shrouding techniques and automatic mould level control are applied to ensure superior internal and surface quality.

For further information, contact:

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Chemical composition

Table 1 shows the chemical composition as specified by EN 10025-2. The limits are set rather wide to give the steel producer maximum scope to apply its manufacturing techniques. It should also be noted that, because thicker plates cool at a slower rate during and after rolling or normalising than thinner plates, they will emerge at lower strength levels if the chemical composition is not enriched to counteract this effect (even though the specification does allow for some strength reduction with thickness).

Table 1: Chemical composition (ladle analysis, percent) as specified in EN 10025-2

Grade	Method of de-oxidation ^{5,6}	Maximum carbon content for nominal product thickness <i>t</i> (mm)			Mn max	Si max	P max	S max	Cu ⁴ max	N ¹ max
		<i>t</i> ≤ 16	> 16 <i>t</i> ≤ 40	<i>t</i> > 40						
S 235 JR +AR	opt.	0,17	0,17	0,20	1,40	-	0,035	0,035	0,55	0,012
S 235 JO +AR	FN	0,17	0,17	0,17	1,40	-	0,030	0,030	0,55	0,012
S 235 J2 +N	FF	0,17	0,17	0,17			0,025	0,025	0,55	-
S 275 JR +AR	FN	0,21	0,21	0,22	1,50	-	0,035	0,035	0,55	0,012
S 275 JO +N	FN	0,18	0,18	0,18	1,50	-	0,030	0,030	0,55	0,012
S 275 JO +AR	FN	0,18	0,18	0,18	1,50	-	0,030	0,030	0,55	0,012
S 275 J2 +N	FF	0,18	0,18	0,18			0,025	0,025	0,55	-
S 355 JR +N	FN	0,24	0,24	0,24	1,60	0,55	0,035	0,035	0,55	0,012
S 355 JR +AR	FN	0,24	0,24	0,24	1,60	0,55	0,035	0,035	0,55	0,012
S 355 JO +N	FN	0,20	0,20 ³	0,22	1,60	0,55	0,030	0,030	0,55	0,012
S 355 JO +AR	FN	0,20	0,20 ³	0,22	1,60	0,55	0,030	0,030	0,55	0,012
S 355 J2 +N	FF	0,20	0,20 ³	0,22	1,60	0,55	0,025	0,025	0,55	-
S 355 NL	FF	0,18	0,18	0,18	1,65	0,50	0,025	0,020	0,55	0,015
3 355 K2 +N	FF	0,20	0,20	0,22	1,60	0,55	0,025	0,025	0,55	-
S 460 N ⁷	FF	0,22	0,22	NA	1,80	0,65	0,030	0,025	0,06	0,027

Notes:

1. The maximum value for nitrogen does not apply if the chemical composition shows minimum total aluminium content of 0,020% or if sufficient other nitrogen binding elements are present. The nitrogen binding elements shall be mentioned in the inspection document.
3. For grades suitable for cold roll forming carbon = 0,22% max.
4. Cu content above 0.4% may cause hot shortness during forming
5. FN = Rimming steel not permitted
6. FF = Fully killed steel containing nitrogen binding elements (such as aluminium, niobium, or vanadium) in sufficient quantities to bind the available nitrogen.
7. EN10025-3

Carbon equivalent

Table 2: Maximum carbon equivalent (CEV) as specified in EN 10025-2.

Grade	Max CEV in % for nominal thickness in mm		
	≤ 30	> 30 ≤ 40	> 40 ≤ 80
S 235 JR	0.35	0.35	0.38
S 235 JO	0.35	0.35	0.38
S 235 J2	0.35	0.35	0.38
S 275 JR	0.40	0.40	0.42
S 275 JO	0.40	0.40	0.42
S 275 J2	0.40	0.40	0.42
S 355 JR	0.45	0.47	0.47
S 355 JO	0.45	0.47	0.47
S 355 J2	0.45	0.47	0.47
S 355 K2	0.45	0.47	0.47
S 355 NL	0.43	0.45	0.45
S 460 N	0.53	0.53	NA

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The formula to be used is: $CE = C + \frac{Mn}{6} + \frac{Cr}{5} + \frac{Mo}{5} + V + \frac{Ni}{15} + \frac{Cu}{15}$

Mechanical properties

The mechanical properties comply with the values of Table 3. It can be seen that the mechanical strength requirements are constant within each grade for a given thickness range. The impact test requirements, however, differ in accordance with the prescribed test temperature as indicated by the suffix for each grade designation.

Table 3: Mechanical properties as specified in EN 10025-2

Grade	Minimum yield strength (MPa) for thickness t (mm)				Tensile strength (MPa) for thickness t (mm)		Elongation (%)						Charpy V-notch impact test ^{1,2}	
							80 mm		5,65√ S_0				Test Temperature (°C)	Minimum Average energy (J)
							Nominal thickness t (mm)							
$t \leq 16$	$16 < t \leq 40$	$40 < t \leq 63$	$63 < t \leq 100$	$t < 3$	$3 \leq t \leq 100$	$1,5 < t \leq 2$	$2 < t \leq 2,5$	$2,5 < t < 3$	$3 \leq t \leq 40$	$40 < t \leq 63$	$63 < t \leq 100$			
S 235 JR +N ¹	235	225	215	215	360 - 510	340 - 510	17	18	19	24	23	22	20	27
S 235 JR +AR ¹													20	27
S 235 JO +N													0	27
S 235 JO +AR													0	27
S 235 J2 +N													-20	27
S 235 J2 +AR													-20	27
S 275 JR +N	275	265	255	245	430 - 580	410 - 560	15	16	17	21	20	19	20	27
S 275 JR +AR													20	27
S 275 JO +N													0	27
S 275 JO +AR													0	27
S 275 J2 +N													-20	27
S 275 J2 +AR													-20	27
S 355 JR +N	355	345	335	325	510 - 680	490 - 630	14	15	16	20	19	18	20	27
S 355 JR +AR													20	27
S 355 JO +N													0	27
S 355 JO +AR													0	27
S 355 J2 +N													-20	27
S 355 J2 +AR													-20	27
S 355 K2 +N										22	22	21	-20	40
S 355 NL ³													-20	27
S 460N	460	440	430	410	NA	540 - 720	NA	NA	NA	17	17	17	-20	40

Notes:

Tensile test values apply to transverse direction only. S_0 is the original cross-sectional area.

- The impact properties of quality JR products are verified only when specified at the time of order placement. Impact tests are performed on full size specimens (greater than or equal to 10mm) in the longitudinal direction.
- Using test piece of width less than 10mm, the minimum values given in table 2 shall be reduced in direct proportion to the cross sectional area of the test piece. Minimum thickness for Charpy tests is 6mm.
- For S 355 NL impact testing is performed in the transverse direction.

Dimensions

The plate mill can produce products from 5mm to 100mm thick depending on the grade. See thickness ranges in Plate Price List. The available dimensions for such plates are given in the data sheet: Plate Mill Product Dimensions (file reference A1.3).

The hot strip mill can produce products from 1,6mm to 13,0mm thick depending on the grade. From Saldanha thicknesses from 1,5mm can be supplied. See thickness ranges in Hot Rolled Price List. The dimensions available are given in the data sheet: Hot Strip Mill Product Dimensions (file reference A1.1).

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Tolerances

Material 6mm and thicker produced at the plate mill is supplied with dimensional tolerances in accordance with EN 10029. If not specified tolerances will be according to "Class A". Material produced on the hot strip mill is supplied with dimensional tolerances in accordance with EN 10051.

Surface inspection

All plates manufactured through the plate mill, are inspected and defects repaired in accordance with EN 10163-2 Class B Subclass 3, unless otherwise agreed.

Ultrasonic testing

If specified at the time of order, ultrasonic testing shall be carried out in thickness ≥ 6.00 mm in accordance with EN10160.

Certification

All material described in this data sheet is supplied with analysis and test certificates.

Weldability

When welding thick plates, reference should be made to BS EN 1011-2:2001 'Welding - Recommendations for welding of metallic materials Part 2: Arc welding of ferritic steels'.

The carbon equivalent value (CE) should be calculated from the values of the chemical composition indicated on the test certificates for the plates concerned.

The formula to be used is: $CE = C + \frac{Mn}{6} + \frac{Cr}{5} + \frac{Mo}{5} + \frac{V}{5} + \frac{Ni}{15} + \frac{Cu}{15}$

Supply conditions

All material described in this data sheet is supplied in terms of Price Lists 110, 120 and 121 and ArcelorMittal South Africa's General Conditions of Sale.

Comparison table

Table 4: List of corresponding former national designations

BS 4360: 1986	Din 17100	EN 10025: 1993	SANS 1431	EN 10025: 2004
Gr 40 A	RSt 37-2	S 235 JRG2	240WA	S 235 JR
Gr 40 B	St 37-3 U	S 235 JO	240WC	S 235 JO
Gr 40 C	St 37-3 N	S 235 J2G3 or G4		S235 J2
Gr 43 A	St 44-2	S 275 JR		S 275 JR
Gr 43 B	St 44-3 U	S 275 JO		S 275 JO
Gr 43 C	St 44-3 N	S 275 J2G3 or G4		S275 J2
None	None	None	300WA	None
Gr 50 A				
Gr 50 B		S 355 JR	350WA	S 355 JR
Gr 50 C	St 52-3 U	S 355 JO	350WC	S 355 JO
Gr 50 D	St 52-3 N	S 355 J2G3 or G4	350 WD	S355 J2
Gr 50 DD		S 355 K2G3 or G4	350 WD	S355 K2

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Table 5: Abbreviations

Abbreviation	Description
JR	Impact test @ room temperature (Optional)
J0	Impact test @ 0 degrees (27J)
J2	Impact test @ -20 degrees (27J)
K2	Impact test @ -20 degrees (40J); (Also correspond to 27J @ -30 degrees)
G1	Rimming steel (Ingots)
G2	Rimming steel is not permitted (FN for EN 10025: 2004)
G3	Normalised
G4	Supply condition at the manufacturers discretion
+ AR	Supplied in As Rolled condition
+ N	Supplied in Normalized condition
M	Thermomechanical rolled
M / N	Impact testing at a temperature not lower than -20 °C
ML1 / NL1	Impact testing at a temperature not lower than -40 °C
ML2 / NL2	Impact testing at a temperature not lower than -50 °C
Other	
C	Cold forming (Bend test)
P	Steels for Pressure purposes
S	Structural steel
Z	Mechanical properties in the through thickness direction (Z-tensile test) as per EN 10164

Examples: S275JR + AR
S355J2C + N
S355J0 +N (Z35)

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