

Material Data Sheet

Hot rolled non-alloyed structural steel

Materials Services
Technology, Innovation
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Steel designation:	Name	Material No.
	S235JR	1.0038
	S235JRC	1.0122
	S235J2	1.0117
	S235J2C	1.0119

Scope

This data sheet applies to hot rolled flat and long products of non-alloyed quality steel.

Application

These steels are standard grades for applications such as metal construction, structural engineering and bridge building as well as hydraulic engineering, vehicle construction, mechanical engineering.

Chemical composition (heat analysis in %)

Product form	C for nominal product thickness mm			Si	Mn	P	S	N	Cu
P, L	≤ 16	> 16 ≤ 40	> 40						
S235JR	0.17	0.17	0.20	-	≤ 1.40	≤ 0.035	≤ 0.035	≤ 0.012	≤ 0.55
S235J2			0.17	-	≤ 1.40	≤ 0.025	≤ 0.025	-	≤ 0.55

P = hot rolled flat products; L = semi-finished products, bars, wire rod and profiles

Steel grade	Max. Carbon Equivalent Value %, nominal product thickness in mm				
	≤ 30	> 30 to ≤ 40	> 40 to ≤ 150	> 150 to ≤ 250	> 250 to ≤ 400
S235JR	0.35	0.35	0.38	0.40	-
S235J2	0.35	0.35	0.38	0.40	0.40

For determination of CEV the following formula shall be used: $CEV = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$

Mechanical properties at ambient temperature

Product form	Delivery condition	Min. yield strength R _{eH} ⁵⁾ for nominal thickness		Tensile strength R _m ⁵⁾ for nominal thickness		Min. percentage elongation ⁵⁾ A L ₀ = 80 mm for nominal thickness		Min. percentage elongation ⁵⁾ A L ₀ = 5,65 √S ₀ for nominal thickness		Min. impact energy ¹⁾ KV for nominal thickness ³⁾	
		mm	MPa	mm	MPa	mm	%	mm	%	mm	J
P L	2)	≤ 16	235	< 3	360 to 510	≤ 1.0	17			> 10 ≤ 150	27
	2)	> 16 ≤ 40	225	≥ 3 ≤ 100	360 to 510	> 1.0 ≤ 1.5	18	≥ 3 ≤ 40	26		
		> 40 ≤ 63	215			> 1.5 ≤ 2.0	19	> 40 ≤ 63	25		
		> 63 ≤ 100				> 2.0 ≤ 2.5	20	> 63 ≤ 100	24		
		> 100 ≤ 150	195			> 100 ≤ 150	350 to 500	> 2.5 < 3.0	21		
		> 150 ≤ 200	185	> 150 ≤ 250	340 to 490			> 150 ≤ 250	21	> 150 ≤ 250	27
		> 200 ≤ 250	175								
		> 250 ≤ 400 ⁴⁾	165	> 250 ≤ 400 ⁴⁾	330 to 480				> 250 ≤ 400 ⁴⁾	21	> 250 ≤ 400 ⁴⁾

¹⁾ S235JR values at 20 °C; S235J2 values at -20 °C.²⁾ If no agreement is made for „P“ and „L“ the delivery condition is left to the manufacturers choice.³⁾ For sections with a nominal thickness > 100 mm the values shall be agreed. Using test pieces of width less than 10 mm the minimum values given in EN 10025-2 to EN 10025-6 shall be reduced in direct proportion to the cross-sectional area of the test piece. Impact tests shall not be required for nominal thickness < 6 mm.⁴⁾ These values only apply to J2 and flat products⁵⁾ For plate, strip and wide flats with widths ≥ 600 mm the direction transverse (t) to the rolling direction applies. For all other products the values apply for the direction parallel (l) to the rolling direction.

Reference data on physical properties

Density at 20 °C kg/dm ³	Modulus of elasticity kN/mm ² at				Thermal conductivity at 20 °C W/m K	Specific thermal capacity at 20 °C J/kg K	Specific electrical resistivity at 20 °C Ω mm ² /m
	20 °C	100 °C	200 °C	300 °C			
7.85	210	205	197	190	54	461	0.15

Mean linear thermal expansion coefficient [10⁻⁶ K⁻¹] between 20 °C and

100 °C	200 °C	300 °C
11.1	12.1	12.9

Properties for design at high temperature (according to AD 2000 bulletin W1)

Nominal thickness mm	Variables K in N/mm ² at calculation temperature			
	100 °C	200 °C	250 °C	300 °C
≤ 16	187	161	143	122
>16 ≤ 40	180	155	136	117

Hot forming/Heat treatment

Hot forming		Heat treatment		
Temperature °C	Type of cooling	Normalizing ¹⁾	Stress relieving anneal ²⁾	Type of cooling
950–1100	air	850–950 °C	580–630 °C	air

¹⁾ Normalizing: Holding time 1 minute per mm plate thickness, minimum 30 minutes.

²⁾ Stress relieving anneal: Holding time 1–2 minutes per mm plate thickness, minimum 30 minutes.

Minimum recommended value of bend radius for cold flanging of flat products

Steel grade	Bending direction	Minimum recommended inside bend radius (Values applicable to bend angles $\leq 90^\circ$) for nominal thickness in mm															
		> 1 ≤ 1.5	> 1.5 ≤ 2.5	> 2.5 ≤ 3	> 3 ≤ 4	> 4 ≤ 5	> 5 ≤ 6	> 6 ≤ 7	> 7 ≤ 8	> 8 ≤ 10	> 10 ≤ 12	> 12 ≤ 14	> 14 ≤ 16	> 16 ≤ 18	> 18 ≤ 20	> 20 ≤ 25	> 25 ≤ 30
S235JRC	t	1.6	2.5	3	5	6	8	10	12	16	20	25	28	36	40	50	60
S235J2C	l	1.6	2.5	3	6	8	10	12	16	20	25	28	32	40	45	55	70

t = transverse to the rolling direction; l = parallel to the rolling direction

Roll Forming to shape of Flat Products

Steel grade	Minimum recommended inside bend radius (Values applicable to bend angles $\leq 90^\circ$) for nominal thickness t		
	t ≤ 4 mm	4 mm < t ≤ 6 mm	6 mm < t ≤ 8 mm
S235JRC S235J2C	1 t	1 t	1.5 t

Process/Welding

Standard welding process for these steel grades are:

TIG-welding

Arc welding (E)

MAG-welding massive wire

Submerged arc welding

MAG-welding cored wire

Process	Filler Metal	
TIG	Union I 52	
MAG massive wire	Union K 52 Union K56	
MAG cored wire	Union MV 70 Union BA 70 (Union RV 71)	
Arc welding (E)	Phoenix 120K Phoenix Spezial D	
SAW	Wire	Powder
	Union S 2 (Union S 2)	UV 400 (UV 306)

The steels can be welded within all thickness ranges according to the before mentioned welding processes considering the general rules of technology by hand and automatically.

The mentioned filler metals apply for highest demands. The details in brackets are for lower demands.

Burning, preheating, welding and stress relieving annealing should occur under consideration of Stahl-Eisen-material bulletin 088.

Specifications and standards concerning stress relieving anneal have to be observed.

Remark

The material is magnetizable.

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References

DIN EN 10025-1:2005-02
STAHL-EISEN-material bulletin
AD 2000 Bulletin W1
Welding filler materials

Beuth Verlag GmbH, Postfach, D-10772 Berlin
Verlag Stahleisen GmbH, Postfach 10 51 64, D-40042 Düsseldorf
Carl Heymanns Verlag KG, Luxemburger Straße 449, 50839 Köln
Böhler Schweißtechnik Deutschland GmbH, Hamm

Important note

Information given in this data sheet about property or applicability of materials respective products are no assurance of characteristics but serve for description.

Information, with which we like to advise you, relate to the experience of the producers and our own. Warranty for the results of the treatment and application of the products cannot be granted.