

## S650MC

High-strength steels for cold-forming,  
thermomechanically-rolled

Material no.	1.8976
according to	DIN EN 10149-2
Tensile strength class	D

### General

The steel grades are used for cold-formed components of the most varied designs. Their fields of application include the manufacture of :

- Longitudinal beams
- Frames
- Cold-pressed parts
- Cold-rolled sections
- and Structural pipes

The user of these steel grades must make sure that his calculation, design and processing methods are appropriate for the material. The forming process used must be suitable for the intended application and comply with the state-of-the-art; it is of fundamental importance to the processing behaviour of these steel grades.

These steel grades offer excellent bending, flanging, cold-bordering and folding properties in both longitudinal and transverse direction. The bending radii specified below should be observed as minimum values.

### Heat treatment

Normalised and stress relief annealing above 580 °C with long holding times results in a reduction of yield strength and tensile strength as compared to the 'as-delivered' condition which is why such heat treatments should be avoided. It also follows that these steel grades are not suitable for hot-forming. If low-voltage annealing is necessary to compensate the welding stresses, the recommended annealing time between 530 °C and 580 °C is 30 minutes for all product thicknesses and steel grades.

### Chemical composition<sup>1)</sup> (in percent by weight)

	min.	max.
C		0.12 %
Si		0.60 %
Mn		2.00 %
P		0.025 %
S		0.015 % <sup>2)</sup>
Al <sub>total</sub>	0.015 %	
Nb		0.09 % <sup>3)</sup>
V		0.20 % <sup>3)</sup>
Ti		0.22 % <sup>3)</sup>
Mo		0.50 %
B		0.005 %

1) Heat analysis

2) If agreed in the order, the sulphur content is 0.010 % max.

3) The maximum content of Nb + V + Ti shall not exceed 0.22 %

### Mechanical properties<sup>4)</sup>

Yield strength <sup>5)</sup> R <sub>eH</sub>	≥ 650 MPa
Tensile strength R <sub>m</sub>	700 – 880 MPa
Total elongation A <sub>80</sub> <sup>6)</sup>	≥ 10 %
Total elongation A <sub>5</sub> <sup>6)</sup>	≥ 12 %

1) The tensile test values given in the table apply to longitudinal samples.

2) In case the thickness is > 8 mm, the yield strength values may be reduced by 20 MPa.

3) It applies to nominal thickness e:  
e < 3 mm: A<sub>80</sub>  
e ≥ 3 mm: A<sub>5</sub>

If agreed in the order, the notch impact energy is proved using longitudinal samples at - 20 °C. The average notch impact energy from 3 samples must be 40 J minimum. One individual value may fall short of the required minimum value by not more than 30 %. The sample width shall equal the product thickness if the latter is between 6 and 10 mm. The tests are performed by using samples similar to Charpy-V samples. The required minimum values are to be reduced proportionally to the sample width.

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### Bending radius<sup>7)</sup>

Nom. thick. e	Bending radius
≤ 3 mm	1.0 x e
3 < e ≤ 6 mm	1.5 x e
> 6 mm	2.0 x e

7) For bending angles ≤ 90 °C.

### Welding

These steel grades can be welded both manually and using automatic equipment by means of all electrical welding processes provided the general technical rules are observed. No major hardness increases appear in the heat-affected zone. Pre-heating is not necessary under normal welding conditions and down to work-piece temperatures of +5 °C. Below +5 °C, pre-heating to 150 °C is recommended.

The welding wires and electrodes approved in the respective strength category must be used as filler metals.

In addition to this, the general meaning of the detailed information provided in 'Stahl-Eisen-Werkstoffblatt' (Iron and steel material sheet) 088 must be observed.

### Available dimensions

Hot-rolled coils unpickles, mill edge

Thickness in mm	Width in mm
2.00 – 2.24	900 – 1,300
2.25 – 2.99	900 – 1,350
3.00 – 3.99	900 – 1,450
4.00 – 4.99	900 – 1,500
5.00 – 5.99	900 – 1,650
6.00 – 19.99	900 – 1,700

Thicknesses ≤ 25 mm and < 2.00 mm on request.  
Widths ≤ 2000 mm on request.

Hot-rolled coils pickled, mill edge

Thickness in mm	Width in mm
2.00 – 2.24	900 – 1,300
2.25 – 2.99	900 – 1,350
3.00 – 3.99	900 – 1,450
4.00 – 4.99	900 – 1,500
5.00 – 9.99	900 – 1,530
10.00 – 10.99	900 – 1,400
11.00 – 11.99	900 – 1,250
12.00 – 12.49	900 – 1,150

Thicknesses < 2.00 mm and > 12.70 mm on request.  
Trimmed edge material on request.

Hot-rolled coils, slit lengthwise

Thickness in mm	Width in mm
2.00 – 2.99	100 – 640
3.00 – 4.60	100 – 690
4.61 – 6.00	100 – 740

Widths ≤ 100 mm on request.  
Thicknesses > 6 mm on request.

### Condition of delivery, scope of testing and certificate

The provisions of DIN EN 10149-2 shall apply for delivery and inspection, chapters 7.2 and 8. The products are delivered in a condition obtained by normalised rolling.

Test certificates according to DIN EN 10204 can be supplied as follows: EDP, remote data transmission, fax, e-mail, paper.