



DIWA 353

WELDABLE STEEL FOR HIGHER TEMPERATURE SERVICE

Material specification DH-E24-E*) Edition July 2010

DIWA 353 is a weldable steel for higher temperature service. It is characterized by high 0.2% proof stress at elevated temperatures. DIWA 353 is produced using basic oxygen steelmaking process. Its properties are achieved by normalizing and tempering. It is used as plate or formed part for boilers, pressure vessels, piping and other fabricated parts operating at temperatures up to 400 °C.

Product description

Range of application

DIWA 353 is equivalent to steel type 13MnNiMo5-4, Material No. 1.8807. In Germany, it is defined as 13MnNiMo5-4 in VdTÜV-material data sheet 384 for supervised installations e.g. for pressure vessel installations in accordance with the AD-2000 Merkblätter for temperatures from -10 °C up to 400 °C. Application according to corresponding standards has to be checked for each separate case.

This material specification applies to heavy plates with thicknesses from 6 to 150 mm; higher thicknesses can be agreed upon.

Chemical analysis in %

	C	Si	Mn	P	S	Ni	Mo	Cr	Nb	Al tot
Heat	≤ 0.15	0.10-0.50	1.00-1.60	≤ 0.020	≤ 0.003	0.60-1.00	0.20-0.40	0.20-0.40	≤ 0.020	≥ 0.015
Product	≤ 0.17	0.05-0.56	0.95-1.70	≤ 0.025	≤ 0.004	0.55-1.05	0.15-0.44	0.15-0.45	≤ 0.025	≥ 0.015

Fully killed, fine grained steel with metallurgical treatment in the ladle.

Delivery condition

Normalized and tempered, unless otherwise agreed.

Mechanical properties in the delivery condition

Tensile test at ambient temperature (transverse test specimens)

Plate thickness [mm]	Yield strength R_{eH} [MPa], minimum	Tensile strength R_m [MPa]	Elongation A_5 %, minimum
≤ 50	400	570-740	18
> 50 ≤ 100	390	570-740	18
> 100 ≤ 125	380	570-740	18
> 125 ≤ 150	375	570-740	18

For thicknesses > 150 mm values have to be agreed upon in the state of inquiry.

Improved deformation properties perpendicular to the surface

For plate thicknesses * 15 mm, the fulfillment of one of the three quality classes Z15, Z25 or Z35 in accordance with EN 10164 or similar rules can be stipulated on the order. These quality classes correspond to a minimum reduction of area on through-thickness tensile test specimens of 15, respectively 25, respectively 35 % (minimum value for the average of 3 tests).

*) The latest edition of this material data sheet is available at <http://www.dillinger.de/>



0.2% proof stress at elevated temperatures (transverse test specimens)

Plate thickness [mm]	Minimum yield strength $R_{p0,2}$ [MPa] at test temperature					
	100 °C	200 °C	250 °C	300 °C	350 °C	400 °C
≤ 50	393	378	373	363	353	309
> 50 ≤ 100	373	358	353	343	333	304
> 100 ≤ 125	363	348	343	333	324	299
> 125 ≤ 150	353	338	333	324	314	294

For thicknesses > 150 mm values have to be agreed upon in the state of inquiry.

Impact test with Charpy-V transverse specimens

Test temperature in °C	0	20
Minimum impact value in J	31	39

The specified value is the minimum value for the average of 3 tests. No individual value is to be less than 70% of the specified minimum. For boiler drum plates no individual value is to be less than 85% of the specified minimum.

In case of application for boiler drums this is to be agreed on the inquiry.

For plate thicknesses below 10 mm the test will be carried out on Charpy-V-type specimens with reduced width. The minimum impact value will be reduced proportionally to the reduction of the specimens' cross section.

Testing

Sampling, testing method and tests are in accordance with the provisions in EN 10028 and VdTÜV-material data sheet 384 except that, unless otherwise agreed, the 0.2% proof stress test at elevated temperatures is carried out at 350 °C and 400 °C instead of 300 °C. The plates are delivered with inspection certificate 3.2 or 3.1 in accordance with EN 10204. The document type and, in case of inspection certificate 3.2, the inspection representative are to be stated on the order.

Identification of plates

Unless otherwise agreed the marking is carried out with low stress steel stamps with at least the following information:

- steel grade (DIWA 353 or 13MnNiMo54)
- heat number
- number of mother plate and individual plate
- the manufacturer's symbol
- authorized inspection representative's sign

Fabrication properties

The entire processing and application techniques are of fundamental importance to the reliability of the products made from this steel. The user should ensure that his design, construction and processing methods are aligned with the material, correspond to the state-of-the-art that the fabricator has to comply with and are suitable for the intended use. The customer is responsible for the selection of the material. The recommendations in accordance with EN 1011-2 should be observed.

Forming properties and weldability

DIWA 353 can be hot or cold formed and can be welded and flame cut according to the general procedures. The guidelines according to EN 1011-2 and VdTÜV-material data sheet 384 shall be observed. Welding conditions should lead to cooling time $t_{8/5}$ 10 - 30 s. For more detailed information please refer to our brochure "Technical Information DIWA 353".



Heat treatment

Normalizing ¹⁾ 870-950 °C	Tempering ¹⁾ 580-690 °C	Stress relieving 530-600 °C ²⁾	
After equalization over the whole section holding time: 15 min for t ≤ 50 mm 30 min for t > 50 mm. Cooling in still air.	After equalization holding time at least 30 min, but not exceeding 180 min. Cooling in still air.	Thickness mm	Time ³⁾ min
		≤ 15	≥ 15
		> 15 ≤ 30	≥ 30
		> 30 ≤ 150	about 60

1) Temperatures and times are concerning the product.

2) Where the stress relief temperature has to be above 580 °C this has to be clarified in the state of inquiry.

3) Normally the maximum holding time shall be restricted to 150 min. If the holding time exceeds 90 min or in case of repeated heat treatment the lower range of recommended temperatures shall apply. If stress relieving and tempering are joined together in one process, the tempering conditions apply.

Temperatures and holding time are determined by the steel manufacturer as a function of the plate thickness and the chemical composition. In order to preserve the mechanical properties the fabricator should ensure that the subsequent heat treatments correspond to those applied by the manufacturer (indicated in the plate inspection document).

General technical delivery requirements

Unless otherwise agreed, the general technical delivery requirements in accordance with EN 10021 apply.

Tolerances

Unless otherwise agreed, tolerances are in accordance with EN 10029, with class B for the thickness and class N for the flatness.

Surface condition

Unless otherwise agreed, the provisions in accordance with class B2 of EN 10163 are applicable.

General notes

If special requirements, which are not listed in this material specification, are to be met by the steel due to its intended use or processing, these requirements are to be agreed before the order.

The information in this data sheet is a product description. This data sheet is updated if necessary. The latest version is available from the mill or as download at www.dillinger.de.

Sales

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