

Hot rolled Steel Plates, Sheets and Coils

Ultrasonic testing

Ruukki is a metal expert you can rely on all the way, whenever you need metal based materials, components, systems or total solutions. We constantly develop our product range and operating models to match your needs.

Hot rolled plates are available from Ruukki as ultrasonically tested to EN 10160 or other specifications subject to separate agreement. Ultrasonic testing must be agreed upon in conjunction with the order.

- **General technical requirements for delivery scope**

By agreement, these technical requirements for delivery become supplemental to the general quality requirements for steel (e.g. EN 10025 steel grades), where individual plates must be verified as being free from inherent defects such as laminations and inclusions. As a rule, ultrasonic testing can always be carried out on steel flat products of minimum 6 mm thickness.

A steel plate is considered as ultrasonically tested when the material is guaranteed by the manufacturer free from defects with reference to an ultrasonic testing carried out to the extent specified, table 1.

Ultrasonic testing in accordance with EN 10160 is applied to plates of minimum 6 – 200 mm nominal thickness. Ultrasonic testing of flats under 6 mm thickness can be carried out by separate agreement. The standard considers the flat product body and edges as separate scanning areas. It further distinguishes four quality classes (S_0 , S_1 , S_2 , S_3) for the flat product body, and five edge zone classes (E_0 , E_1 , E_2 , E_3 , E_4).

The ultrasonic testing class for plates is selected as combinations of the body and edge zone quality classes. The combinations are specified, for example, by the designer of the steel structure in each case.

Scope of testing

Unless otherwise agreed, the manufacturer will have each individual plate tested. The manufacturer may select the testing procedure and a suitable stage of production for the testing. The testing can be carried out using either a single hand-held probe or an ultrasonic testing apparatus with several transducers.

In order to determine the scope of testing, it is possible to refer to relevant standards for the testing procedure, or to specify individually:

- scanning procedures and permissible defect sizes
- spacing of scan lines (grid size)
- width of edge zones to be examined
- types of probe to be used.

Claims

Steel plates can be made subject to complaints about inherent defects only when such defects substantially influence the intended use of plate. In order to afford to the supplier an opportunity to assure the justification of the claim, the orderer (user) of the plate must present to the supplier the defective plate or parts thereof.

The orderer (user) is entitled to file a claim on the basis of a subsequent ultrasonic testing only in such cases where the item of steel plate was ordered for delivery as ultrasonically tested. Then the user must also prove that the defects found seriously impair the working or use of the plate.

Testing apparatus

The probe used can be hand held or mounted on a continuous testing apparatus. It depends on the thickness of plates to be tested whether a single or double transducer probe is used. For thickness 6 – (60) mm, the probe is of the double transducer type and for thickness 60 – 200 mm, it is of the single or double transducer type.

- **Qualification of testing personnel**

The inspection is carried out by qualified personnel, on the responsibility of a person duly certified to meet level 3 of EN 473.

- **Testing of the flat product body**

For quality class S_0 and S_1 flat products, scanning comprises continuous examination along the lines of a grid made of a 200 mm square parallel to the edges of the flat product. For quality class S_2 and S_3 flat products, the grid measure is 100 mm.

The 100% scanning of the entire flat product body or the coverage of a given part of the flat product is subject to separate agreement in connection with the order.

- **Testing of the flat product edges**

The zone width over the four edges of the flat product to be examined depends on plate thickness.

- Thickness 6 – (50) mm, inspection zone width 50 mm
- Thickness 50 – (100) mm, inspection zone width 75 mm
- Thickness 100 – 200 mm, inspection zone width 100 mm.

- **Comparison of standards for ultrasonic testing**

The inspection methods and quality classifications vary from one standard to another. For the purposes of both price-setting and actual inspection, Ruukki applies certain parallelisms as presented in table 2.

• **Acceptance criteria for testing with double transducer probes the body of flat products of < 60mm thickness**

Table 1

Quality class EN 10160	Sensitivity and range setting mm	Unacceptable individual discontinuity Area considered mm ²	Acceptable clusters of discontinuities Area considered mm ²	Maximum density in a 1 m x 1 m square Number
S ₀	Ø 5	S > 5000	1000 < S ≤ 5000	20
S ₁	Ø 5	S > 1000	100 < S ≤ 1000	15
S ₂	Ø 5	S > 100	50 < S ≤ 100	10
S ₃	Ø 5	S > 50	20 < S ≤ 50	10

This table can be used for thicknesses ≥ 60 mm if an appropriate method other than the 6 dB method is used for the sizing of discontinuities.

Acceptance criteria for testing with single transducer probes the body of flat products

Quality class EN 10160	Sensitivity and range setting mm	Unacceptable individual discontinuity Area considered or number	Acceptable clusters of discontinuities Area considered S, or number N	Maximum density in a 1 m x 1 m square Number
S ₀	Ø 11	S > 5000 mm ²	1000 mm ² < S ≤ 5000 mm ²	20
S ₁	Ø 11	S > 1000 mm ²	100 mm ² < S ≤ 1000 mm ²	15
S ₂	Ø 8	Discontinuities where the flaw echo has an amplitude greater than the characteristic curve for Ø 11 mm holes	N ₂ (flaw size between the characteristic curves for Ø 8 mm and Ø 11 mm holes)	10
S ₃	Ø 5	Discontinuities where the flaw echo has an amplitude greater than the characteristic curve for Ø 8 mm holes	N ₃ (flaw size between the characteristic curves for Ø 5 mm and Ø 8 mm holes)	10

Acceptance criteria for flat product edge zone testing with double transducer probes

Quality class EN 10160	Sensitivity and range setting mm	Permissible individual discontinuity		Minimum discontinuity considered L _{mix} mm	Permissible number of discontinuities smaller than the maximum area S _{max} and longer than L _{mix} per 1 m length
		Maximum dimension L _{max} mm	Maximum area S _{max} mm ²		
E ₀	Ø 5	100	2000	50	6
E ₁	Ø 5	50	1000	25	5
E ₂	Ø 5	40	500	20	4
E ₃	Ø 5	30	100	15	3
E ₄	Ø 5	20	50	10	2

For product with thickness ≥ 60 mm a counting of the discontinuities is carried out using the characteristic curves for the Ø 11 mm, Ø 8 mm and Ø 5 mm flat-bottomed holes:

- In class E₃, the number of discontinuities giving echoes with an amplitude between characteristic curves for the Ø 8 mm and Ø 11 mm holes is 3/m length.
- In class E₄, the number of discontinuities giving echoes with an amplitude between characteristic curves for the Ø 5 mm and Ø 8 mm holes is 2/m length.

• **Ultrasonic testing Standards**

Table 2

EN 10160	EURONORM 160-85 1985	SEL 072-77 1977	ASTM A578 – 96 1996/2001	ASTM A 435 – 90 1990/2001
E ₂	A	Tafel 2 Klasse 3	–	–
S ₁	A	Tafel 1 Klasse 3	Level A Level B Level C	Accepted
S ₂	B	Tafel 1 Klasse 2	–	–
S ₃	C	Tafel 1 Klasse 1	Level A + S1 Level B + S1 Level C + S1	–

For accurate comparison, the original standards are to be used.

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