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Hot-rolled twin-roll cast steel sheet of structural quality and high strength steel

Tôles en acier de construction et en acier à haute résistance laminées à chaud par coulée entre cylindres

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15179 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

Hot-rolled twin-roll cast steel sheet of structural quality and high strength steel

1 Scope

This International Standard specifies the characteristics of hot-rolled twin-roll cast steel sheet of structural quality and high strength steel. The product is intended for applications where specific mechanical properties are required. It is generally used in the delivered condition and is intended for bolted, riveted or welded structures. This product is produced on a wide strip mill, not a plate mill.

Structural quality twin-roll cast steel sheet is a carbon steel produced to specified mechanical properties and is available in a number of grades (see Table 5).

High strength twin-roll cast steel sheet, strengthened by microalloys, is produced to specified mechanical properties and is available in a number of grades and classes (see Table 6).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 16160, *Hot-rolled steel sheet products — Dimensional and shape tolerances*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
microalloying element
element, such as niobium, vanadium, titanium, added singly or in combination to obtain higher strength levels combined with better formability, weldability and toughness as compared with non-alloy steel produced to equivalent strength

3.2
hot-rolled descaled steel sheet
hot-rolled steel sheet from which oxide or scale has been removed, commonly by pickling in an acid solution

3.3
mill edge
normal side edge without any definite contour produced in hot rolling

NOTE Mill edges may contain some irregularities, such as cracked or torn edges or thin (feathered) edges.

3.4
sheared edge
edge product normal edge obtained by shearing, slitting or trimming a mill edge product

NOTE Normal processing does not necessarily provide a definite positioning of the slitting burr.

3.5
twin-roll cast steel sheet
steel sheet produced by casting to near final thickness directly from the liquid metal with minimal hot rolling to achieve the final thickness

4 Thickness

4.1 This product is commonly produced in thicknesses from 0,7 mm to 2,0 mm, inclusive, and widths of up to 2 000 mm maximum.

4.2 Hot-rolled sheets less than 600 mm wide may be slit from wide sheets and may be considered sheets.

5 Conditions of manufacture

5.1 Steelmaking

Unless otherwise agreed by the interested parties, processes used in making the steel and in manufacturing hot-rolled sheet are left to the discretion of the manufacturer. On request, the purchaser shall be informed of the steel-making process being used.

5.2 Chemical composition

The chemical composition (heat analysis) shall not exceed the values given in Tables 1, 2 and 3.

5.3 Chemical analysis

5.3.1 Heat analysis

A heat analysis of each heat of steel shall be carried out by the manufacturer in order to determine the percentage of all appropriate elements listed in Tables 1, 2 and 3. On request, this analysis shall be reported to the purchaser or his representative.

5.3.2 Product analysis

A product analysis may be carried out by the purchaser in order to verify the specified analysis of the product. For killed steels, the sampling method shall be agreed upon between the interested parties at the time of ordering. The product analysis tolerances shall be in accordance with Table 4.

Table 1 — Chemical requirements — Heat analysis structural quality[a]

Mass fractions in per cent maximum

	Class	C	Mn	P	S	Si
All grades	A	0,25	1,35	0,040	0,035	–

[a] Where the "–" appears in this table, there is no requirement, but the analysis shall be reported.

Table 2 — Chemical requirements[a] — Heat analysis — High strength steel

Mass fractions in per cent maximum

Designation	C	Mn	P	S	Si[a]	V[d] min.	Ti[d] min.	Nb[d] min.	N[a]
HSS[c]									
Grade 310 Class 1[b]	0,22	1,35	0,04	0,04	–	0,008	0,008	0,008	–
Grade 310 Class 2	0,15	1,35	0,04	0,04	–	0,008	0,008	0,008	–
Grade 340 Class 1[b]	0,23	1,35	0,04	0,04	–	0,008	0,008	0,008	–
Grade 340 Class 2	0,15	1,35	0,04	0,04	–	0,008	0,008	0,008	–
Grade 380 Class 1[b]	0.25	1,35	0,04	0,04	–	0,008	0,00	0,008	–
Grade 380 Class 2	0,15	1,35	0,04	0,04	–	0,008	0,008	0,008	–
Grade 410 Class 1	0,26	1,50	0,04	0,04	–	0,008	0,008	0,008	–
Grade 410 Class 2	0,15	1,50	0,04	0,04	–	0,008	0,008	0,008	–
Grade 450 Class 1	0,26	1,50	0,04	0,04	–	0,008	0,008	0,008	–[c]
Grade 450 Class 2	0,15	1,50	0,04	0,04	–	0,008	0,008	0,008	–[c]
Grade 480 Class 1	0,26	1,65	0,04	0,04	–	0,008	0,008	0,008	–[c]
Grade 480 Class 2	0,15	1,65	0,04	0,04	–	0,008	0,008	0,008	–[c]
Grade 550 Class 1	0,26	1,65	0,04	0,04	–	0,008	0,008	0,008	–[c]
Grade 550 Class2	0,15	1,65	0,04	0,04	–	0,008	0,008	0,008	–[c]

[a] Where the "–" appears in this table, there is no requirement, but the analysis shall be reported.

[b] For each reduction of 0,01 % below the specified carbon maximum, an increase of 0,06 % manganese above the specified maximum shall be permitted up to a maximum of 1,50 %.

[c] The purchaser has the option of restricting the nitrogen content. It should be noted that, depending on the microalloying scheme (for example use of vanadium) of the producer, nitrogen is permitted as a deliberate addition. Consideration should be given to the use of nitrogen-binding elements (for example vanadium and titanium).

[d] The producer shall add at least one or more of the elements V, Ti or Nb.

Table 3 — Limits on additional chemical elements[a] — Structural quality

Mass fractions in per cent

Element	Cu max.	N max.	Cr max.	Nb max.	Mo max.	V max.	Ti max.
Heat analysis	0,50	0,30	0,30	0,008	0,15	0,008	0,008
Product analysis	0,53	0,33	0,34	0,018	0,16	0,018	0,018

[a] Each of the elements listed in this table shall be included in the report of the heat analysis. Where the amount of copper, nickel, chromium or molybdenum is less than 0,02 %, the analysis shall be reported as 0,02 %.

Table 4 — Product analysis tolerances

Element	Maximum of specified element %	Tolerance over the maximum specified %
Carbon	≤ 0,26	0,04
Manganese	≤ 01,65	0,05
Phosphorus	≤ 0,04	0,01
Sulfur	≤ 0,04	0,01
NOTE The maximum tolerance in this table is the allowable excess over the specified requirement and not the heat.		

5.4 Weldability

This product is normally suitable for welding if appropriate welding conditions are selected. For non-descaled steel, it may be necessary to remove the scale or oxide depending upon the welding method. As the carbon increases above 0,15 %, spot welding becomes increasingly difficult.

5.5 Application

It is desirable that hot-rolled twin-roll cast steel sheet be identified for fabrication by the name of the part or by the intended application. Proper identification of the part may include visual examination, prints or description, or a combination of these.

5.6 Mechanical properties

5.6.1 At the time that the steel is made available for shipment, the mechanical properties shall be as stated in Tables 5 and 6, where they are determined on test pieces obtained in accordance with the requirements of Clause 7.

5.6.2 Either Re_L or Re_H may be specified, but not both.

Table 5 — Mechanical properties of structural quality twin-roll cast steel sheet

Grade	R_e min.[a] MPa	R_m min. MPa	A, min.[b] $e \leq 2$ mm	
			$L_o = 50$ mm	$L_o = 80$ mm
HR275	275	380	15	14
HR340	340	340	9	8
HR380	380	380	8	7
HR410	410	410	7	6
HR480	480	480	6	5
HR550	550	550	5	4

R_e = lower yield strength

R_m = tensile strength

A = percentage elongation after fracture

L_o = gauge length on test piece

e = thickness of steel sheet, in millimetre(s)

1 MPa = 1 N/mm^2

[a] The yield stress specified in this table shall be the lower yield stress, R_{el}. The values may also be measured by 0,5 % total elongation proof stress (proof stress under load) or by 0,2 % offset where a definite yield phenomenon is not present. Where upper yield stress, R_{eH}, is specified, the values shall be 20 N/mm^2 above the R_{el} values for each grade.

[b] Use either $L_o = 50$ mm or $L_o = 80$ mm to measure elongation. For material up to and including 0,6 mm in thickness, the elongation values in this table shall be reduced by 2.