INTERNATIONAL STANDARD

ISO 4951-3

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High yield strength steel bars and sections —

Part 3: Delivery conditions for thermomechanically-rolled steels

Barres et profilés en acier à haute limite d'élasticité —

Partie 3: Conditions de livraison des aciers obtenus par laminage thermomécanique

Reference number
ISO 4951-3:2001(E)

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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 3.

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 part of ISO 4951 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 4951-3 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 3, *Steels for structural purposes*.

This first edition of ISO 4951-3, together with ISO 4951-1 and ISO 4951-2, cancels and replaces ISO 4951:1979 the content of which has been revised and augmented.

ISO 4951 consists of the following parts, under the general title *High yield strength steel bars and sections*:

— *Part 1: General delivery requirements*

— *Part 2: Delivery conditions for normalized, normalized rolled and as-rolled steels*

— *Part 3: Delivery conditions for thermomechanically-rolled steels*

High yield strength steel bars and sections —

Part 3:
Delivery conditions for thermomechanically-rolled steels

1 Scope

This part of ISO 4951 specifies the requirements for hot-rolled bars and sections of diameter or thickness $\leqslant$ 150 mm in high yield strength steels in the thermomechanically-rolled condition in the grades and qualities given in Table 1 and Table 2 for use in bolted, riveted or welded structures[1)].

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 4951. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 4951 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 404:1992, *Steel and steel products — General technical delivery requirements.*

ISO 4951-1:2001, *High yield strength steel bars and sections — Part 1: General delivery requirements.*

ISO 10474:1991, *Steel and steel products — Inspection documents.*

3 Terms and definitions

For the purposes of this part of ISO 4951, the terms and definitions given in ISO 4951-1 apply.

4 General requirements

4.1 Steelmaking method

The steelmaking method shall comply with that specified in ISO 4951-1.

4.2 Deoxidation process

The deoxidation process shall comply with that specified in ISO 4951-1.

1) Compared with mild steels, these steels may require special precautions for welding. See the guide *Welding and weldability of C-Mn micro-alloy steels*, published by subcommission IX-G of the International Institute of Welding (document IIS/IIW 843-84).

4.3 Delivery condition

The products covered by this part of ISO 4951 shall be delivered in the thermomechanically rolled condition as specified in ISO 4951-1.

4.4 Surface condition

4.4.1 Surface appearance

The surface appearance shall comply with that specified in ISO 4951-1.

4.4.2 Removal of discontinuities

The removal of discontinuities shall comply with that specified in ISO 4951-1

4.4.3 Repairs by welding

The repairs by welding shall be made under the conditions given in ISO 4951-1.

5 Technical requirements

5.1 Chemical composition

5.1.1 Ladle analysis

The chemical composition determined by ladle analysis shall comply with the values given in Table 1.

5.1.2 Product analysis

If requested by the purchaser at the time of enquiry and order, a product analysis shall be carried out.

The values for the permissible deviations of the product analysis from the specified limits of the ladle analysis are given in Table 1 of ISO 4951-1:2001.

5.2 Mechanical properties

The steels in the delivery conditions specified in 4.3 shall comply with the mechanical properties given in Table 2 when these are determined on test pieces prepared in accordance with the requirements of 6.3.

6 Inspection and testing

6.1 General

The products shall be supplied in accordance with 6.1 of ISO 4951-1:2001.

6.2 Test unit

The requirements specified in 6.2 of ISO 4951-1:2001 shall be applied.

6.3 Position and orientation of sample

The position and orientation of sample shall be in accordance with 6.3 of ISO 4951-1:2001.

Table 1 — Chemical composition (ladle analysis) [a]

Grade	Quality	Chemical composition, %											
		C	Si	Mn	P	S	Nb[b]	V[b]	Al_{total}[c]	Ti	Ni	Mo[d]	N
		max.	max.	max.	max.	max.			min.	max.	max.	max.	max.
E 355	M	0,16	0,50	1,6	0,035	0,030	0,005-0,050	0,01-0,10	0,020	0,05	0,30	0,20	0,015
	ML	0,16	0,50	1,6	0,030	0,025	0,005-0,050	0,01-0,10	0,020	0,05	0,30	0,20	0,015
E 420	M	0,18	0,50	1,7	0,035	0,030	0,005-0,050	0,01-0,12	0,020	0,05	0,60	0,20	0,020
	ML	0,18	0,50	1,7	0,030	0,025	0,005-0,050	0,01-0,12	0,020	0,05	0,60	0,20	0,020
E 460	M	0,18	0,60	1,7	0,035	0,030	0,005-0,050	0,01-0,12	0,020	0,05	0,70	0,20	0,025
	ML	0,18	0,60	1,7	0,030	0,025	0,005-0,050	0,01-0,12	0,020	0,05	0,70	0,20	0,025

[a] As the chemical composition influences the welding characteristics, the purchaser shall be informed, if he so requests at the time of enquiry and order, of the type of steel which will be supplied and the maximum values or the range of the alloying elements which will be used in that steel.

[b] The steels shall contain, in the percentages indicated in the table, at least one of the grain-refining elements. If these elements are used in combination, the content for at least one of them shall be not less than the specified minimum value.

[c] If sufficient N-binding elements, such as Nb or V, are present, the minimum total Al content does not apply.

[d] The total sum of Cr, Cu and Mo shall not be higher than 0,60 %.

Table 2 — Mechanical properties[a]

Grade	Quality	Specified yield strength R_{eH} min. N/mm²			Tensile strength R_m N/mm²	Percent elongation A min.	Impact energy KV min. J	
		Thickness d in mm					Test temperature	
		$d \leqslant 16$	$16 < d \leqslant 40$	$40 < d \leqslant 150$		$L_o = 5{,}65\sqrt{S_o}$	0 °C	− 20 °C
E 355	M	355	345	335	450-610	22	47	
	ML	355	345	335	450-610	22		47
E 420	M	420	400	390	500-660	19	47	
	ML	420	400	390	500-660	19		47
E460	M	460	440	430	530-720	17	47	
	ML	460	440	430	530-720	17		47

[a] For products of thickness > 150 mm, the values shall be agreed at the time of the enquiry and order.

7 Test methods

7.1 Tensile test

The requirements specified in 7.1 ISO 4951-1:2001 shall be applied.

7.2 Impact test

The requirements specified in 7.2 of ISO 4951-1:2001 shall be applied.

7.3 Chemical analysis

The requirements specified in 7.3 of ISO 4951-1:2001 shall be applied.

7.4 Retests

Retests shall be in accordance with 7.4 of ISO 4951-1:2001.

8 Inspection documents

The type of inspection documents required shall be chosen from those defined in ISO 10474 and then specified in the order.

9 Sorting and reprocessing

The requirements of clause 9 of ISO 404:1992 shall apply.

10 Non-destructive test

If the purchaser requires non-destructive tests to verify the soundness of the products, the requirements of ISO 4951-1 shall apply.

11 Marking

The marking shall comply with the requirements of ISO 4951-1.

12 Information to be supplied by the purchaser

Information to be supplied by the purchaser shall be in accordance with ISO 4951-1 with in addition, if appropriate:

— type of steel which will be supplied (Table1 note a);

— maximum values or range of alloying elements used (Table1 note a).

ICS 77.140.60; 77.140.70

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