
**High yield strength steel bars and
sections —**

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

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

*Partie 2: Conditions de livraison des aciers à l'état normalisé, de laminage
normalisant et brut de laminage*

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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 4951-2 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 3, *Steels for structural purposes*.

This first edition of ISO 4951-2, together with ISO 4951-1 and ISO 4951-3, 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 2:

Delivery conditions for normalized, normalized rolled and as-rolled steels

1 Scope

This part of ISO 4951 specifies the requirements for hot-rolled bars and sections of diameter or thickness ≤ 150 mm in high yield strength steels in the normalized, normalized rolled or as-rolled delivery conditions in the grades and qualities given in Table 1 and Table 2 for use in bolted, riveted or welded structures¹⁾.

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.

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).

4.2 Deoxidation process

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

4.3 Delivery condition

The products covered by this part of ISO 4951 may be delivered:

- a) in the normalized condition or in an equivalent condition obtained by normalizing rolling;
- b) in the as-rolled condition.

If not specified in the order, the delivery condition is left to the discretion of the manufacturer.

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 specified in ISO 4951-1.

For materials supplied in the normalized condition, it shall be specifically agreed with the purchaser whether repair welding is to be carried out prior to the heat treatment.

5 Technical requirements

5.1 Chemical composition

5.1.1 Ladle analysis

The chemical composition determined by ladle analysis shall comply with the specified 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 as specified in Table 1 of ISO 4951-1:2001.

5.2 Mechanical properties

The steels in the delivery conditions as 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.

NOTE In the case of angles and beams, the thickness of the product means the thickness of the flange measured on the cross-section where the test pieces are taken for the mechanical test (see ISO 4951-1).

Table 1 — Chemical composition (ladle analysis) ^a

Grade	Quality	Chemical composition, %												
		C	Si	Mn	P	S	Nb ^b	V ^b	Al ^{total} ^c	Ti	Cr	Ni	Mo	Cu
		max.	max.		max.	max.			min.	max.	max.	max.	max.	max.
E 355	CC	0,18	0,50	0,9-1,65	0,035	0,035	0,005-0,050	0,01-0,20	0,020	0,03	0,30	0,50	0,10	0,35
	DD	0,18	0,50	0,9-1,65	0,030	0,030	0,005-0,050	0,01-0,20	0,020	0,03	0,30	0,50	0,10	0,35
E 420	CC	0,20	0,60	1,0-1,7	0,035	0,035	0,005-0,050	0,01-0,20	0,020	0,03	0,30	0,80	0,10	0,70 ^d
	DD	0,20	0,60	1,0-1,7	0,030	0,030	0,005-0,050	0,01-0,20	0,020	0,03	0,30	0,80	0,10	0,70 ^d
E 460	CC	0,20	0,60	1,0-1,7	0,035	0,035	0,005-0,050	0,01-0,20	0,020	0,03	0,30	0,80	0,10	0,70 ^d
	DD	0,20	0,60	1,0-1,7	0,030	0,030	0,005-0,050	0,01-0,20	0,020	0,03	0,30	0,80	0,10	0,70 ^d

^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 If the Cu content is greater than 0,35 %, then the Ni content shall be at least half of the Cu content.

Table 2 — Mechanical properties

Grade	Quality	Specified yield strength R_{eH} ^a min. N/mm ²						Tensile strength R_m N/mm ²		Percent elongation A min. $L_0 = 5,65\sqrt{S_0}$	Impact energy KV, min. ^b J Test temperature	
		Thickness d in mm						$d \leq 100$	$100 < d \leq 150$		0 °C	-20 °C
		$d \leq 16$	$16 < d \leq 40$	$40 < d \leq 63$	$63 < d \leq 80$	$80 < d \leq 100$	$100 < d \leq 150$					
E 355	CC	355	345	335	325	315	295	470-630	450-610	22	40	
	DD	355	345	335	325	315	295	470-630	450-610	22		40
E 420	CC	420	400	390	370	360	340	520-680	500-660	19	40	
	DD	420	400	390	370	360	340	520-680	500-660	19		40
E 460	CC	460	440	430	410	400	—	550-720	—	17	40	
	DD	460	440	430	410	400	—	550-720	—	17		40

^a See 7.1.

^b Average of three tests, no individual result shall be less than 70 % of the specified minimum average value.

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.

7 Test methods

7.1 Tensile test

The requirements specified in 7.1 of 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.