INTERNATIONAL STANDARD

ISO 4950-2

Second edition
1995-08-15

AMENDMENT 1
2003-12-01

High yield strength flat steel products —

Part 2: Products supplied in the normalized or controlled rolled condition

AMENDMENT 1

Produits plats en acier à haute limite d'élasticité —

Partie 2: Produits livrés à l'état normalisé ou de laminage contrôlé

AMENDEMENT 1

Reference number
ISO 4950-2:1995/Amd.1:2003(E)

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Foreword

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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.

Amendment 1 to ISO 4950-2:1995 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 3, *Steels for structural purposes.*

Introduction

It appeared during the systematic review, that strip and coils should be deleted from the scope of this International Standard because they are relevant to ISO/TC 17/SC 12, consequently ISO/TC 17/SC 3 decided to prepare an amendment to correct this International Standard accordingly.

High yield strength flat steel products —

Part 2:
Products supplied in the normalized or controlled rolled condition

AMENDMENT 1

Cover page and page 1, title

Modify the title of ISO 4950-2:1995 as follows:

"High yield strength steel plates and wide flats — Part 2: plates and wide flats supplied in the normalized or controlled rolled condition"

Page 1, Clause 1

1st paragraph, 3rd line, replace "… flat steel products …" by "… steel plates and wide flats …".

2nd paragraph, replace the text with the following:

"It applies to steel plates hot-rolled on reversing mills and hot-rolled wide flats in the thickness range 3 mm to 150 mm, in steels supplied after normalized or controlled rolling, having a minimum specified yield strength of 355 N/mm^2 to 460 N/mm^2 for thicknesses up to and including 16 mm."

Page 3, Table 3

Delete footnote 2) and renumber footnotes 3) and 4) as 2) and 3) respectively.

Page 4, Annex A

2nd paragraph, delete "and strip".

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International Standard ISO 4950-2 was prepared by Technical Committee ISO/TC 17, *Steel,* Subcommittee SC 3, *Steels for structural purposes.*

This second edition cancels and replaces the first edition (ISO 4950-2: 1981), which has been technically revised.

ISO 4950 consists of the following parts, under the general title *High yield strength flat steel products*:

— *Part 1: General requirements*

— *Part 2: Products supplied in the normalized or controlled rolled condition*

— *Part 3: Products supplied in the heat-treated (quenched + tempered) condition*

Annex A of this part of ISO 4950 is for information only.

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High yield strength flat steel products —

Part 2:

Products supplied in the normalized or controlled rolled condition

1 Scope

This part of ISO 4950 specifies the chemical composition and the mechanical properties of high yield strength flat steel products supplied in the normalized or/equivalent condition. For the method of manufacture, acceptance conditions and marking of these products, see ISO 4950-1.

It applies to hot-rolled plates, wide strip in coils of width greater than or equal to 600 mm, and wide flats in the thickness range 3 mm to 150 mm, in steels supplied after normalizing or controlled rolling, having a minimum specified yield strength of 355 N/mm^2 to 460 N/mm^2 for thicknesses up to and including 16 mm.

This part of ISO 4950 does not apply to products covered by other standards, such as

— flat products from continuous mills (see ISO 4996),

— flat products for subsequent forming operations (see ISO 5951),

— plates for pressure vessels (see ISO 9328-4).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 4950. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 4950 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4950-1:1995, *High yield strength flat steel products — Part 1: General requirements.*

ISO 4996:1991, *Hot-rolled steel sheet of high yield stress structural quality.*

ISO 5951:1993, *Hot-rolled steel sheet of higher yield strength with improved formability.*

ISO 9328-4:1991, *Steel plates and strip for pressure purposes — Technical delivery conditions — Part 4: Weldable fine grain steels with high proof stress supplied in the normalized or quenched and tempered condition.*

3 Manufacture

3.1 Deoxidation process

All steels shall be from casts with added elements that are capable of producing a fine grain. In addition, steels of quality DD shall be supplied as non-rimming steel, while steels of quality E shall be supplied as fully killed steel.

3.2 Delivery condition

The products shall be delivered in the normalized or normalized and tempered condition or, unless otherwise agreed at the time of ordering, in an equivalent condition obtained by controlled rolling[1].

1) Plates produced by controlled rolling may be subject to deterioration of their properties if they are subsequently hot formed.

Table 1 — Chemical composition (ladle analysis)

Grade	Quality	Chemical composition [% (*m/m*)][1]												
		C max.	Mn[2]	Si max.	P max.	S max.	Nb[3]	V[3]	Al (total)[3] min.	Ti[3]	Cr max.	Ni max.	Mo max.	Cu[4] max.
E 355	DD	0,18	0,9 to 1,6	0,50	0,030	0,030	0,015 to 0,060	0,02 to 0,10	0,020	0,02 to 0,20	0,25	0,30	0,10	0,35
	E	0,18	0,9 to 1,6	0,50	0,025	0,025	0,015 to 0,060	0,02 to 0,10	0,020	0,02 to 0,20	0,25	0,30	0,10	0,35
E 460	CC	0,20	1,0 to 1,7	0,50	0,040	0,040	0,015 to 0,060	0,02 to 0,20	0,020	0,02 to 0,20	0,70	1,0	0,40	0,70
	DD	0,20	1,0 to 1,7	0,50	0,030	0,030	0,015 to 0,060	0,02 to 0,20	0,020	0,02 to 0,20	0,70	1,0	0,40	0,70
	E	0,20	1,0 to 1,7	0,50	0,025	0,025	0,015 to 0,060	0,02 to 0,20	0,020	0,02 to 0,20	0,70	1,0	0,40	0,70

1) As the chemical composition influences the welding characteristics, if the purchaser so requests, the producer shall, at the time of the order being placed, indicate the type of steel which he will supply and the maximum values or the range of the alloying elements which will be used in that steel.

2) For products of thickness up to and including 6 mm, the manganese content may be reduced by 0,2 % (*m/m*).

3) The steels shall contain, in the percentage 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.

4) By agreement at the time of ordering, the maximum copper content may be 0,30 % (*m/m*).

4 General requirements

4.1 Chemical composition

4.1.1 Ladle analysis

Table 1 gives the chemical composition limits for the ladle analysis.

All elements other than those mentioned in table 1 and added intentionally shall be indicated to the purchaser.

4.1.2 Product analysis

A product analysis may be required by the purchaser; in this case, it shall be specified when ordering.

Table 2 gives the permitted deviations for the product analysis relative to the values for ladle analysis given in table 1.

4.2 Mechanical properties

The steels in the normalized and tempered or controlled rolled conditions, shall comply with the mechanical properties specified in table 3 when they are determined on test pieces prepared in accordance with the requirements of 5.3 of ISO 4950-1:1995.

4.3 Weldability

A maximum value of the carbon equivalent (Ceq), expressed as a percentage by mass, based on the International Institute of Welding (IIW) formula, i.e.:

$$Ceq = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Ni+Cu}{15}$$

may be agreed on ordering (where C, Mn, Cr, Mo, V, Ni and Cu are the contents, expressed as percentage by mass, of the respective elements).

Table 2 — Permissible deviations for the product analysis relative to the specified ladle analysis

Values in percentage by mass

Element	Specified limits	Permissible deviation[1]
C	≤ 0,20	+ 0,02
Mn	≤ 1,70	± 0,10
Si	≤ 0,50	+ 0,05
P and S	≤ 0,040	+ 0,005
Nb	≤ 0,060	± 0,005
V	≤ 0,20	+ 0,02 − 0,01
Ti	≤ 0,20	+ 0,02 − 0,01
Cr	≤ 0,70	+ 0,05
Ni	≤ 1,0	+ 0,05
Mo	≤ 0,40	+ 0,05
Cu	≤ 0,35 > 0,35	+ 0,05 + 0,07

1) The deviations apply either above or below the specified limits of the range, but not simultaneously.

Table 3 — Mechanical properties

Grade	Quality	Specified yield strength R_{eH} ($R_{p0,2}$) min. N/mm² [1]							R_m [2] N/mm² [1]				A min. %	KV [3] [4] min. J					
														0 °C		− 20 °C		− 50 °C	
		$e \leq 16$	$16 < e \leq 35$	$35 < e \leq 50$	$50 < e \leq 70$	$70 < e \leq 100$	$100 < e \leq 125$	$125 < e \leq 150$	$e \leq 70$	$70 < e \leq 100$	$100 < e \leq 125$	$125 < e \leq 150$		L	T	L	T	L	T
E 355	DD	355	345	335	325	305	295	285	470 to 630	450 to 610	440 to 600	430 to 590	22			39	21		
	E	355	345	335	325	305	295	285	470 to 630	450 to 610	440 to 600	430 to 590	22					27	16
E 460	CC	460	450	440	420	—	—	—	550 to 720	—	—	—	17	39	—				
	DD	460	450	440	420	400	390	380	550 to 720	530 to 700	520 to 690	510 to 680	17			39	21		
	E	460	450	440	420	400	390	380	550 to 720	530 to 700	520 to 690	510 to 680	17					27	16

R_{eH}: upper yield stress;

$R_{p0,2}$: 0,2 % proof stress;

R_m: tensile strength;

A: percentage elongation after fracture on original gauge length $L_o = 5{,}65\sqrt{S_o}$ (where S_o is the original cross-sectional area);

KV: impact strength of ISO V-notch test pieces;

e: thickness of test piece, in millimetres.

1) 1 N/mm² = 1 MPa

2) In the case of wide strip, only the minimum value of the tensile strength range is applicable.

3) Average of three tests; no individual result shall be less than 70 % of the specified minimum average value.

4) The values of impact energy KV are specified in both directions (longitudinal and transverse), but unless otherwise stated in the order, verification is carried out in the longitudinal direction.

Annex A

(informative)

Minimum values of impact energy KV

The values given in table A.1. apply to qualities DD and E (regardless of grade).

For plates and strip, the values in the longitudinal and transverse directions apply. For wide flats, only the longitudinal direction values apply unless otherwise agreed at the time of enquiry and order.

Unless otherwise agreed, the impact energy values shall be tested at

– 20 °C for steel of quality DD,

– 50 °C for steel of quality E.

Table A.1 — Minimum values of impact energy for products of thickness 10 mm < e < 150 mm

Quality of steel	Direction of test piece taken	Minimum impact energy (J) at temperatures							
		– 50 °C	– 40 °C	– 30 °C	– 20 °C	– 10 °C	0 °C	+ 10 °C	+ 20 °C
DD	Longitudinal				39	43	47	51	55
	Transverse				21	24	31	31	31
E	Longitudinal	27	31	39	47	51	55	59	63
	Transverse	16	20	24	27	31	31	35	39

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Descriptors: iron and steel products, structural steels, high yield strength steels, hot-rolled products, metal plates, wide strips, wide flats, specifications, mechanical properties, chemical composition, grades (quality), delivery condition.

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