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International Standard



4950/2

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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

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**High yield strength flat steel products —  
Part 2 : Products supplied in the normalized or controlled  
rolled condition**

*Produits plats en acier à haute limite d'élasticité — Partie 2 : Produits livrés à l'état normalisé ou de laminage contrôlé*

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## Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4950/2 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in October 1979.

It has been approved by the member bodies of the following countries :

Austria	Hungary	Poland
Bulgaria	India	Romania
Canada	Ireland	South Africa, Rep. of
China	Italy	Sweden
Czechoslovakia	Japan	Switzerland
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The member bodies of the following countries expressed disapproval of the document on technical grounds :

Australia  
Belgium

# High yield strength flat steel products — Part 2 : Products supplied in the normalized or controlled rolled condition

## 1 Scope

This International Standard specifies the chemical composition and the mechanical properties of high yield strength flat steel products supplied in the normalized or controlled rolled condition.

## 2 Field of application

This International Standard applies to hot-rolled plates, wide strip in coils of width greater than or equal to 600 mm, as well as wide flats of width greater than or equal to 600 mm up to 1 250 mm, in the thickness range of 3 to 70 mm, in steels supplied after normalizing or controlled rolling, having a minimum specified yield strength of 355 to 460 N/mm<sup>2</sup> for the thicknesses up to and including 16 mm.

## 3 Reference

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

## 4 Manufacture

### 4.1 Deoxidation process

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

### 4.2 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.<sup>1)</sup>

## 5 General requirements

### 5.1 Chemical composition

#### 5.1.1 Ladle analysis

Table 1 gives the composition limits for the ladle analysis.

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

Table 1 — Chemical composition (ladle analysis)<sup>1)</sup>

Grade	Quality	Chemical composition, %												
		C max.	Mn <sup>2)</sup>	Si max.	P max.	S max.	Nb <sup>3)</sup>	V <sup>3)</sup>	Al total min. <sup>3)</sup>	Ti <sup>3)</sup>	Cr max.	Ni max.	Mo max.	Cu max. <sup>4)</sup>
E 355	CC	0,20	0,9—1,6	0,50	0,040	0,040	0,015—0,060	0,02—0,15	0,015	0,02—0,20	0,25	0,30	0,10	0,35
	DD	0,20	0,9—1,6	0,50	0,035	0,035	0,015—0,060	0,02—0,15	0,015	0,02—0,20	0,25	0,30	0,10	0,35
	E	0,18	0,9—1,6	0,50	0,030	0,030	0,015—0,060	0,02—0,15	0,015	0,02—0,20	0,25	0,30	0,10	0,35
E 390	CC	0,20	1,0—1,6	0,50	0,040	0,040	0,015—0,060	0,02—0,20	0,015	0,02—0,20	0,30	0,70	0,30	0,50
	DD	0,20	1,0—1,6	0,50	0,035	0,035	0,015—0,060	0,02—0,20	0,015	0,02—0,20	0,30	0,70	0,30	0,50
	E	0,20	1,0—1,6	0,50	0,030	0,030	0,015—0,060	0,02—0,20	0,015	0,02—0,20	0,30	0,70	0,30	0,50
E 420	CC	0,20	1,0—1,7	0,50	0,040	0,040	0,015—0,060	0,02—0,20	0,015	0,02—0,20	0,40	0,70	0,40	0,60
	DD	0,20	1,0—1,7	0,50	0,035	0,035	0,015—0,060	0,02—0,20	0,015	0,02—0,20	0,40	0,70	0,40	0,60
	E	0,20	1,0—1,7	0,50	0,030	0,030	0,015—0,060	0,02—0,20	0,015	0,02—0,20	0,40	0,70	0,40	0,60
E 460	CC	0,20	1,0—1,7	0,50	0,040	0,040	0,015—0,060	0,02—0,20	0,015	0,02—0,20	0,70	1,0	0,40	0,70
	DD	0,20	1,0—1,7	0,50	0,035	0,035	0,015—0,060	0,02—0,20	0,015	0,02—0,20	0,70	1,0	0,40	0,70
	E	0,20	1,0—1,7	0,50	0,030	0,030	0,015—0,060	0,02—0,20	0,015	0,02—0,20	0,70	1,0	0,40	0,70

1) 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.

2) For products of thickness up to and including 6 mm, the minimum Mn content may be reduced by 0,2 %.

3) 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.

4) By agreement at the time of order, the maximum copper content may be 0,30 %.

### 5.1.2 Product analysis

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

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

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

Element	Specified limits	Permissible deviation <sup>1)</sup>
C	< 0,20	+ 0,03
Mn	0,7—1,7	± 0,10
Si	< 0,50	+ 0,05
P and S	< 0,040	+ 0,005
Nb	0,015—0,060	± 0,005
V	0,02—0,20	+ 0,02 - 0,01
Ti	0,02—0,20	+ 0,02 - 0,01
Cr	< 0,70	+ 0,05
Ni	< 1,0	+ 0,05
Mo	< 0,40	+ 0,05
Cu	< 0,50	+ 0,05
	> 0,50—0,70	+ 0,07

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

When maxima only are specified, the deviations are positive only.

## 5.2 Mechanical properties

Table 3 specifies the mechanical properties in the normalized, normalized and tempered or controlled rolled condition, determined on test pieces prepared in accordance with the requirements of sub-clause 6.2 of ISO 4950/1.

Table 3 — Mechanical properties

Grade	Quality	Specified yield strength, min. N/mm <sup>2</sup> <sup>3)</sup>				$R_m$ <sup>1)</sup> N/mm <sup>2</sup> <sup>3)</sup>	A min. on $L_0 = 5,65\sqrt{S_0}$ %	$KV$ , min. <sup>2)</sup> J		
		$e < 16$	$16 < e < 35$	$35 < e < 50$	$50 < e < 70$			0 °C	-20 °C	-50 °C
E 355	CC	355	355	345	325	470—630	22 <sup>4)</sup>	40	40	27
	DD	355	355	345	325	470—630	22 <sup>4)</sup>			
	E	355	355	345	325	470—630	22 <sup>4)</sup>			
E 390	CC	390	380	370	350	490—650	20	40	40	27
	DD	390	380	370	350	490—650	20			
	E	390	380	370	350	490—650	20			
E 420	CC	420	410	400	380	520—680	19	40	40	27
	DD	420	410	400	380	520—680	19			
	E	420	410	400	380	520—680	19			
E 460	CC	460	450	440	420	550—720	17	40	40	27
	DD	460	450	440	420	550—720	17			
	E	460	450	440	420	550—720	17			

- 1) In the case of wide strip (coils), only the minimum value of the tensile strength range is applicable.
- 2) Average of three tests; no individual result shall be less than 70 % of the specified minimum average value.
- 3) 1 N/mm<sup>2</sup> = 1 MPa.
- 4) For thicknesses over 35 mm, the elongation value is reduced to 20 %.

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