INTERNATIONAL STANDARD

ISO 4950-3

Second edition
1995-08-15

High yield strength flat steel products —

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

Produits plats en acier à haute limite d'élasticité

Part 3: Produits livrés à l'état traité (trempé + revenu)

Reference number
ISO 4950-2:1995(E)

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.

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.

International Standard ISO 4950-3 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 4950-3: 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*

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

High yield strength flat steel products —

Part 3:

Products supplied in the heat-treated (quenched + tempered) 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 quenched and tempered condition. For the method of manufacture, acceptance conditions and marking of these products, see ISO 4950-1.

It is applicable to hot-rolled plates and wide flats having a width greater than or equal to 600 mm, in the thickness range 3 mm to 70 mm, in steel which, after quenching and tempering, has a minimum specified yield strength of 460 N/mm^2 to 690 N/mm^2 for thicknesses less than or equal to 50 mm, and 440 N/mm^2 to 670 N/mm^2 for thicknesses between 50 mm and 70 mm.

This part of ISO 4950 does not apply to products covered by other standards, such as 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 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 come from fully killed casts with added elements that are capable of producing a fine grain.

3.2 Delivery condition

The products shall be delivered in the heat-treated condition, i.e. they have undergone a quenching and then a tempering treatment. On request, the purchaser shall be informed of the heat treatment applied by the producer; if, in the course of subsequent manufacture, a heat treatment is to be carried out by the purchaser, he may find out from the producer the appropriate conditions for this heat treatment.

4 General requirements

4.1 Chemical composition

4.1.1 Ladle analysis

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

Table 1 — Chemical composition (ladle analysis)

Chemical composition [% (*m*/*m*)]							
Grade	**Quality**	**C** max.	**Mn**	**Si**	**P** max.	**S** max.	**Other elements**
E 460	DD E	0,20 0,20	0,7 to 1,7 0,7 to 1,7	⩽ 0,55 ⩽ 0,55	0,035 0,030	0,035 0,030	Depending on thicknesses and manufacturing conditions, the manufacturer may find it necessary to add one or several alloying element(s) within the limits defined below: Ni ⩽ 2 Ti ⩽ 0,20[1] N ⩽ 0,020 Cr ⩽ 2 Nb ⩽ 0,060[1] B(total) ⩽ 0,005 Cu ⩽ 1,5 V ⩽ 0,10[1] [2] Mo ⩽ 1 Zr ⩽ 0,15[1] The manufacturer shall state the type of steel supplied and also the range of alloying elements present in this steel.
E 550	DD E	0,20 0,20	⩽ 1,7 ⩽ 1,7	0,10 to 0,80 0,10 to 0,80	0,035 0,030	0,035 0,030	
E 690	DD E	0,20 0,20	⩽ 1,7 ⩽ 1,7	0,10 to 0,80 0,10 to 0,80	0,035 0,030	0,035 0,030	

1) At least one of these grain-refining elements shall be present or aluminium shall be added. In this case, the minimum total aluminium content shall be 0,020 % (*m*/*m*).

2) When there is no stress-relieving treatment, a maximum content of 0,20 % (*m*/*m*) is permitted.

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 quenched and tempered condition, 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, except with regard to the axis of tensile test pieces which is, in all cases, perpendicular to the direction of rolling.

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	+ 0,20
Mn	⩽ 1,70	± 0,10
Si	⩽ 0,80	+ 0,05 − 0,02
P	⩽ 0,035	+ 0,005
S	⩽ 0,035	+ 0,005
Cr	⩽ 2	+ 0,05
Ni	⩽ 2	+ 0,05
Mo	⩽ 1	+ 0,05
Cu	⩽ 0,50 > 0,50	+ 0,05 + 0,07
Nb	⩽ 0,060	+ 0,005
V	⩽ 0,20	+ 0,02
Ti	⩽ 0,20	+ 0,02
Zr	⩽ 0,15	+ 0,02
B	⩽ 0,005	+ 0,000 5
N	⩽ 0,020	+ 0,002
Al	⩾ 0,020	− 0,005

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

Table 3 — Mechanical properties ($e \leqslant 70$ mm)

Grade	Quality	Specified yield strength R_{eH} ($R_{p0,2}$) min. N/mm² [1]		R_m N/m m² [1]	A [2] min. %	KV [3] min. J	
		$e \leqslant 50$	$50 < e \leqslant 70$			– 20 °C	– 50 °C
E 460	DD	460	440	570 to 720	17	39	
	E	460	440	570 to 720	17		27
E 550	DD	550	530	650 to 830	16	39	
	E	550	530	650 to 830	16		27
E 690	DD	690	670	770 to 940	14	39	
	E	690	670	770 to 940	14		27

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) The use of a test piece 200 mm long, elongation being measured on a gauge length of 50 mm across the fracture, is permitted. However, in cases of dispute, only those results obtained on a proportional test piece shall be used.

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

This page intentionally left blank