
International Standard



4950/1

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High yield strength flat steel products — Part 1 : General requirements

Produits plats en acier à haute limite d'élasticité — Partie 1 : Prescriptions générales

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

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 4950/1 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in August 1979.

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

| <u>ISO 4950-1:1981</u> | | |
|------------------------|----------------|-----------------------|
| Australia | Finland | Norway |
| Austria | France | Romania |
| Brazil | Germany, F. R. | South Africa, Rep. of |
| Bulgaria | Hungary | Sweden |
| Canada | India | Switzerland |
| China | Ireland | Turkey |
| Czechoslovakia | Italy | United Kingdom |
| Denmark | Korea, Rep. of | USSR |
| Egypt, Arab Rep. of | Netherlands | |

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Belgium
Japan
USA

High yield strength flat steel products — Part 1 : General requirements

1 Scope

This International Standard specifies the method of manufacture, the acceptance testing and the marking of high yield strength flat steel products.

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 thickness over 3 to 70 mm and width greater than or equal to 600 mm less than 1 250 mm, in steels of specified yield strength (minimum 355 N/mm²) in the thicknesses and conditions specified in ISO 4950/2 and ISO 4950/3 for use in bolted, rivetted or welded structures.¹⁾

3 References

ISO 82, *Steel — Tensile testing.*

ISO 148, *Steel — Charpy impact test (V-notch).*²⁾

ISO/R 377, *Selection and preparation of samples and test pieces for wrought steel.*³⁾

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

ISO 2566/1, *Steel — Conversion of elongation values — Part 1 : Carbon and low alloy steels.*

ISO 4950/2, *High yield strength flat steel products — Part 2 : Products supplied in the normalized or controlled rolled condition.*

ISO 4950/3, *High yield strength flat steel products — Part 3 : Products supplied in the heat-treated (quenched and tempered) condition.*

4 Definitions

Until the International Standard (currently in preparation) defining metallurgical products is available, the terms "plates" "wide strips" (coils) and "wide flats" are defined in the annex.

5 Manufacture

5.1 Steelmaking method

5.1.1 Unless otherwise agreed at the time of enquiry and order, the steelmaking method is left to the choice of the manufacturer within the limitation of 5.1.2.

5.1.2 The steel shall be produced in an open hearth furnace, in an electric furnace, or by an oxygen process. Other methods may be used by agreement between the interested parties. The steelmaking method shall be stated to the purchaser on request, at the time of delivery.

5.2 Surface appearance — Defects

5.2.1 Surface appearance

The products shall have a smooth surface consistent with the rolling process used; they shall not show any defects which may prejudice processing or their appropriate application.

5.2.2 Removal of defects

5.2.2.1 Surface defects may be removed by the manufacturer before despatch, provided that the remaining thickness is within the minimum tolerances and that the resultant cavity is blended with the remaining surface.

Every precaution should be taken during grinding to avoid local heating giving rise to cracks and structural transformations.

1) Compared with mild steels, these steels may require special precautions for welding. (See in particular the guide for welding and weldability of C-Mn and C-Mn micro-alloy steels published by Sub-commission IX-G of the International Welding Institute — document IIS/IIW 382-71.)

2) At present at the stage of draft. (Revision of ISO/R 148.)

3) Under revision.

5.2.2.2 Unless specified otherwise in the order, deeper surface defects which reduce the thickness to less than the minimum permitted by the tolerances may be removed by grinding, chipping or air-arc gouging, followed by deposition of weld metal, subject to the following conditions :

- a) The total area of the chipped or ground surface of any piece prior to welding shall not exceed 2 % of the total surface area of that piece.
- b) The reduction of thickness of the material resulting from the removal of defects prior to welding shall not exceed 20 % of the nominal thickness.
- c) All welding shall be performed by competent welders using low-hydrogen welding electrodes appropriate for the grade being repaired. The electrodes shall be protected from moisture during storage and use. The manufacturer shall establish and follow documented welding procedures which are appropriate to the material being welded.
- d) The weld and adjacent heat-affected zone shall be sound and free of cracks, the deposited metal being thoroughly fused to all surfaces and edges without undercutting or overlap. Any visible cracks, porosity, lack of fusion or undercut in any layer shall be removed prior to deposition of the succeeding layer. Weld metal shall project by at least 2 mm above the rolled surface after welding, and the projecting metal shall be removed by chipping or grinding, or both, to make it flush with the rolled surface and to produce a workmanlike finish.
- e) The manufacture shall draw up an inspection programme for the work to verify that
 - 1) defects have been completely removed;
 - 2) the limitations specified above have not been exceeded;
 - 3) established welding procedures have been followed;
 - 4) any weld metal is of acceptable quality as defined above.
- f) If materials are intended to be supplied in the heat treated condition (including normalizing), it shall be specifically agreed with the purchaser whether welding is to be carried out prior to heat treatment.

5.2.2.3 The sites of repair welds shall be carefully recorded and pointed out to the purchaser on demand.

6 Acceptance testing — Sampling

The products covered by this International Standard may be the subject of acceptance tests in accordance with the conditions specified in clause 5 of ISO 404 relating to the chemical composition and mechanical properties of the product. Verification of the chemical composition of the product is only carried out if this is agreed and stated in the order.

6.1 Acceptance test unit

Products shall be tested separately for each cast and heat treatment condition. The acceptance test unit shall be 40 t or part thereof. However, by agreement at the time of ordering, the acceptance unit may be the parent sheet or coil.

6.1.1 For each acceptance test unit and thickness range as indicated in table 3 of ISO 4950/2 and ISO 4950/3, a series of tests shall be carried out comprising

- one tensile test (or more, in accordance with 6.1.3.1, in the case of products of thickness up to and including 16 mm);
- one set of three impact tests at the specified temperature;

and, if specified in the order,

- one product analysis.

6.1.1.1 A certificate stating the cast analysis shall be supplied to the purchaser.

6.1.2 The purchaser or his representative may select, at the time of rolling, the items from which test samples shall be taken for verification of the properties (see ISO 404).

6.1.3 Unless otherwise agreed, the procedure shall be as follows:

6.1.3.1 Tensile test samples

For each specified thickness range, a test sample shall be taken from the thickest product, except that for the range $e \leq 16$ mm the maximum thickness of the products shall be not greater than twice the minimum thickness.

6.1.3.2 Impact test samples

For each thickness range, a test sample shall be taken from the thickest product.

6.2 Position and orientation of test samples (see ISO/R 377)

Test samples shall be taken midway between the axis in the direction of rolling and the edge of the rolled product.

6.2.1 Tensile test pieces

The longitudinal axis of the tensile test piece shall be perpendicular to the direction of rolling, except for products with a width of less than 600 mm, for which it shall be parallel to the direction of rolling.

6.2.2 Impact test pieces

The longitudinal axis of the impact test piece shall always be parallel to the direction of rolling.

7 Test methods

7.1 Tensile test (see ISO 82)

The test piece shall normally be a proportional prismatic or cylindrical test piece having an original gauge length L_0 given by the formula :

$$L_0 = 5,65 \sqrt{S_0}$$

where S_0 is the original cross-sectional area of the gauge length.

A prismatic test piece of rectangular cross-section shall have a maximum gauge width of 40 mm, and its thickness shall be that of the product; if the product thickness exceeds 30 mm, however, it may be reduced to 30 mm by planing or milling on one face.

A cylindrical test piece may be used for products more than 30 mm thick; it shall be 10 to 30 mm in diameter and its original gauge length shall be determined by the above formula; the longitudinal axis of the test piece shall be positioned at 1/6 of the thickness of the product.

A non-proportional test piece with a fixed initial gauge length (for example 200 mm) may be used, with reference being made to a conversion table (see ISO 2566/1). However, in case of dispute, only the results obtained on a proportional test piece shall be used.

The yield strength specified in table 3 of ISO 4950/2 and ISO 4950/3 is either the upper yield stress, R_{eH} , or the proof stress (0,5 % total elongation) $R_{t0,5}$. The specification of the material is complied with in this respect if either value satisfies the specified value of yield strength. If the 0,2 % proof stress (non-proportional elongation) $R_{p0,2}$, the lower yield stress, R_{eL} , or proof stress (total elongation) R_{tX} is specified on the order, this specification is complied with in this respect if the value obtained by such measurement satisfies the specified yield strength values in table 3.

7.2 Impact test

7.2.1 The impact test shall normally be carried out on products having a thickness greater than or equal to 12 mm. The test piece shall be machined so that the face nearest to the rolled surface is not more than 2 mm from it; the notch shall be perpendicular to the rolled surface.

If agreed at the time of enquiry and order, impact tests may be carried out on products having a thickness less than 12 mm; the dimensions of the test pieces shall be in accordance with the requirements of ISO 148, namely 10 mm × 7,5 mm and 10 mm × 5 mm, and the specified energy values shall be fixed by agreement. However, by agreement at the time of enquiry and order, the test pieces may have a width equal to the thickness of the product, subject to a minimum thickness of 5 mm.

7.2.2 The test shall be carried out using a V-notch test piece supported at both ends (see ISO 148), the value to be taken into account being the average of the results obtained from

three test pieces cut adjacent to each other from the same product, unless there are reasons for a retest (see 7.4).

7.3 Faulty tests

When a test does not give the required result because of an error in execution, the test shall be cancelled. Error in execution means : incorrect machining; incorrect mounting in the test machine; a malfunction of the test machine, or any other anomaly independent of the metal itself.

7.4 Retests

If, during inspection, a test does not give the required result, additional tests, unless otherwise agreed, may be carried out as follows :

7.4.1 Defective test pieces

If a defective test piece gives satisfactory results, the batch shall be accepted, but the corresponding item (from which the test sample was taken) may be subjected to an individual examination for soundness.

7.4.2 Tensile test

7.4.2.1 If a test piece does not give the required values, the corresponding item is deemed not to comply with the specification, unless two other test pieces from the same item are tested and give satisfactory results. In this case, the item and the batch are deemed to comply with the specification.

7.4.2.2 If one or both of the additional test pieces does not satisfy the requirements, the corresponding item is deemed not to comply with the specification.

7.4.2.3 The remainder of the batch may be accepted provided that two items representing the batch in question are subjected to tests in accordance with the specification and give satisfactory results.

In the contrary case, the requirements of clause 9 may be applied.

7.4.3 Impact test

7.4.3.1 If the average of the three impact values is less than the specified minimum average value, or if one individual value is less than 70 % of this specified value, three additional test pieces shall be taken from the same sample and tested. The average value of the six results shall be not less than the specified minimum average value. Not more than two individual values shall be less than the specified minimum average value and not more than one individual value shall be less than 70 % of this value.

7.4.3.2 If an item presented for the first time is considered not to comply with the specification, the remainder of the material may be accepted provided that two representative items are tested in accordance with the specification and give satisfactory results.

In the contrary case, the requirements of clause 9 may be applied.

7.5 Chemical analysis

7.5.1 In case of dispute, the method used for the chemical analysis shall be in accordance with the requirements stated in the corresponding International Standards. If no International Standard exists, the method to be used shall be agreed between the parties concerned.

7.5.2 If a product analysis is specified on the order, the number of samples to be taken shall be agreed between the parties concerned.

The samples may be taken from the test pieces used to verify the mechanical properties or from the full thickness of the product at the same location as the test pieces. In case of dispute, only the analysis of material from the full thickness of the product shall apply.

For the selection and preparation of samples for chemical analysis, the requirements of sub-clauses 3.2 and 3.3 of ISO/R 377 shall be applied.

8 Documents

The requirements of sub-clauses 5.2 and 5.3 of ISO 404 shall be applied. The type of certificate required shall be specified in the order.

9 Resubmission (see sub-clause 6.5 of ISO 404)

9.1 The manufacturer may resubmit for inspection products that have been rejected during earlier inspection because of unsatisfactory properties, after he has subjected them to a

suitable processing (sorting, heat treatment) details of which, on request, will be disclosed to the purchaser. In this case, tests shall be carried out as if they applied to a new acceptance unit.

9.2 The manufacturer has the right to present items rejected during a first examination for re-examination for another quality or grade.

10 Non-destructive tests

If the purchaser requires non-destructive tests to check the soundness of the products by means of radiographic, ultrasonic, magnetic or penetrant methods, these tests shall be agreed at the time of enquiry and order. This agreement shall include details of the test methods and interpretation of results.

11 Marking

Unless otherwise agreed at the time of enquiry and order, products shall bear the following marks :

— the identification symbols for the grade and quality of the steel;

— the brand of the manufacturer;

and, where necessary,

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a symbol, letters or numbers which relate the test certificates, test pieces and products to each other.

In the case of products of small unit mass and which are consigned in bundles, the information specified above may be marked on a tag securely attached to each bundle or may be marked on the topmost item in the bundle.

Annex

Description of products

(Forms part of the standard.)

For the purposes of this International Standard, the following descriptions are given for flat products :

| English term | French term | Dimensions | Description |
|--------------------------|---------------|--|---|
| plates | tôles fortes | $e > 3$ mm $l > 600$ mm | Hot-rolled by continuous or non-continuous process; always cut to length (may be resheared) |
| wide strips | larges bandes | $e > 3$ mm $l > 600$ mm | Continuously hot-rolled; in coil |
| strips ¹⁾ | feuillards | $e > 3$ mm $l < 600$ mm | Continuously hot-rolled; in coil or cut lengths |
| wide flats ²⁾ | larges-plats | $e > 3$ mm $150 \text{ mm} < l < 1\,250$ mm | Products hot-rolled on four sides |

1) Strips are not covered by this International Standard.

2) This International Standard covers only wide flats of width greater than or equal to 600 mm and less than 1 250 mm.

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