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Steel and steel products — Location and preparation of samples and test pieces for mechanical testing

(ISO 377:1997)

Acier et produits en acier — Position et préparation des échantillons et éprouvettes pour essais mécaniques (ISO 377:1997)

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European Committee for Standardization
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Foreword

The text of the International Standard ISO 377:1997 has been prepared by Technical Committee ISO/TC 17 “Steel” in collaboration with Technical Committee ECISS/TC 9 “Technical conditions of delivery and quality control”, the secretariat of which is held by IBN/BIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 1998, and conflicting national standards shall be withdrawn at the latest by January 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of the International Standard ISO 377:1997 was approved by CEN as a European Standard without any modification.

NOTE Normative references to International Standards are listed in Annex ZA (normative).

**INTERNATIONAL
STANDARD**

**ISO
377**

Second edition
1997-07-15

**Steel and steel products — Location
and preparation of samples and test
pieces for mechanical testing**

*Acier et produits en acier — Position et préparation des échantillons
et éprouvettes pour essais mécaniques*



Reference number
ISO 377:1997(E)

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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.

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 377 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 20, *General technical delivery conditions, sampling and mechanical testing methods*.

This second edition of ISO 377 cancels and replaces ISO 377-1:1989, which has been technically revised.

Annex A forms an integral part of this International Standard.

1 Scope

This International Standard specifies requirements for the identification, location and preparation of samples and test pieces intended for mechanical tests on steel sections, bars, rod, flat products and tubular products as defined in ISO 6929. If agreed in the order this standard may also apply to other metallic products. It does not apply to non-destructive tests.

These samples and test pieces are for use in tests which are carried out in conformity with the methods specified in the product or material standard or, in the absence of this, in the test standard.

Where the requirements of the order or product standard differ from those given in this International Standard, then the requirements of the order or product standard apply.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard 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 3785:—, *Metallic materials — Designation of test piece axes*¹⁾.

ISO 6929:1987, *Steel products — Definitions and classification*.

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 6929 and the following apply.

3.1 test unit

number of pieces or the tonnage of products to be accepted or rejected together, on the basis of the tests to be carried out on sample products in accordance with the requirements of the product standard or order (See Figure 1.)

3.2 sample product

item (e.g. bar, sheet, coil) selected for inspection and/or testing (See Figure 1.)

3.3 sample

sufficient quantity of material taken from the sample product for the purpose of producing one or more test pieces (See Figure 1.)

NOTE In certain cases, the sample may be the sample product.

3.4 rough specimen

part of a sample having undergone mechanical treatment, for the purpose of producing a test piece (See Figure 1.)

3.5 test piece

part of a sample or rough specimen, with specified dimensions, machined or unmachined, brought to a required condition for submission to a given test (See Figure 1.)

NOTE In certain cases, the test piece may be the sample or the rough specimen.

3.6 reference condition

condition of a sample, rough specimen or test piece having undergone a heat treatment to represent the intended final condition of the product

NOTE In such cases the sample, rough specimen or test piece is called the reference sample, reference rough specimen or reference test piece.

4 General requirements

4.1 Representative testing

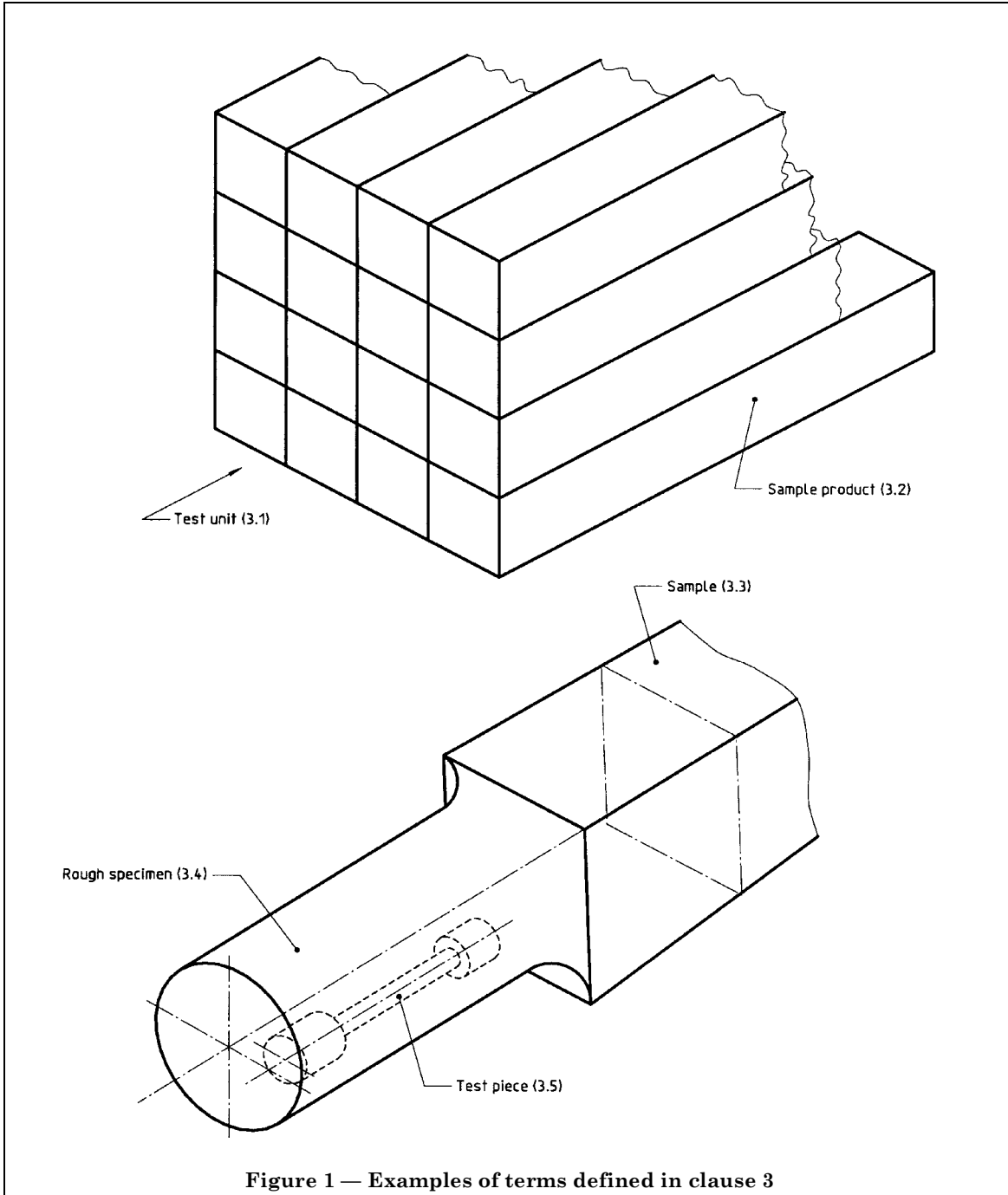
Sample, rough specimens and test pieces selected in accordance with Annex A, shall be considered to be representative of the product.

NOTE As a result of their production sequence i.e. melting, casting hot and/or cold forming, heat treatment etc., steel products are not homogeneous. The mechanical properties of samples taken from other locations may be different.

4.2 Identification of sample products, samples, rough specimens and test pieces

Sample products, samples, rough specimens and test pieces shall be marked to ensure traceability to the original product and their location and orientation in that product. For this purpose, if, during the preparation of the sample, rough specimen and/or test pieces, removal of the marks cannot be avoided, transfer of these marks shall be carried out before the existing marks are removed or in the case of automatic preparation equipment before the test piece is removed from the equipment. In the case of specific inspection and testing and where requested by the purchaser the transfer of the marks shall be carried out in the presence of the purchaser's representative.

¹⁾ To be published. (Revision of ISO 3785:1976)



In the case of fully automatic in line preparation and testing systems, marking of samples, rough specimens and test pieces is not necessary if an adequate control system exists, which clearly defines the procedures to be followed in the event of system failure.

5 Preparation of samples and selection of test pieces

5.1 Selection and dimensions of samples and location of test pieces

The sample shall be selected so that the test piece can be located as indicated in Annex A. The sample shall have sufficient dimensions to allow sufficient test pieces required for carrying out specified tests, and for any retests which may be necessary.

5.2 Direction of axis of test pieces

The direction of the test piece axis relative to the principle direction of working shall be as specified in the appropriate product standard or order. The designation of the test piece axis shall be in accordance with ISO 3785.

5.3 Condition and separation of samples

5.3.1 General

The material or product standard shall specify whether the test is intended to determine the properties,

- a) in the as-delivered condition (see 5.3.2) or
- b) in the reference condition (see 5.3.3).

5.3.2 Testing in the as-delivered condition

A sample intended for testing in the as-delivered condition shall be separated from the product either

- a) after the forming and heat treatment processes have been completed or
- b) before the heat treatment process, in which case the heat treatment of the separated sample shall be carried out under the same conditions as that of the product.

Separation of the sample shall be carried out in such a manner so as not to change the characteristics of that part of the sample used to provide the test pieces.

Where flattening or straightening of the sample is unavoidable in the preparation of the test piece, it shall be carried out cold unless otherwise specified in the product standard.

5.3.3 Testing in the reference condition

5.3.3.1 Sample

A sample intended for testing in the reference condition shall be separated from the product at the stage of manufacture specified in the product standard or order.

Separation of the sample shall be carried out in such a manner so as not to change the characteristics of that part of the sample used to provide the test pieces after heat treatment.

NOTE When flattening or straightening is necessary it may be carried out either hot or cold before any heat treatment. When carried out hot it should be at a temperature below the final heat treatment temperature.

5.3.3.2 Rough specimen

A rough specimen intended for testing in the reference condition shall be prepared as follows.

- a) Mechanical treatment prior to heat treatment: when the sample is to be made smaller for the process of heat treatment, the product standard shall specify the dimensions to which the rough specimen shall be reduced and the reduction process e.g. forging, rolling, machining.
- b) Heat treatment: the heat treatment of the rough specimen shall take place in an environment where the uniformity of the temperature is adequately assured and the temperature is measured by means of a calibrated instrument. The heat treatment shall be in accordance with the requirements of the product standard or of the order.

6 Preparation of test pieces

6.1 Cutting and machining

Cutting and machining of samples and rough specimens for the preparation of test pieces shall be carried out taking such precautions as necessary to avoid superficial work hardening and heating of the material likely to change the mechanical characteristics. After machining, any marks left by the tool which might interfere with the results of the test shall be removed, either by grinding (with ample coolant supply) or by polishing, provided that the chosen method of finishing maintains the dimensions and shape of the test piece within the tolerances specified in the standard for appropriate test.

The tolerances on the dimensions of the test pieces shall be those specified in the appropriate test methods.

6.2 Reference heat treatment

When the required reference heat treatment is to be carried out on the test piece the provisions for heat treatment shall be the same as for the rough specimen [see 5.3.3.2 b)].

Annex A (normative) Location of samples and test pieces

A.1 General

This annex applies to the location of test pieces for the following product forms

- sections;
- bars and rod;
- flat products;
- tubular products.

The location of test pieces for tensile and impact tests are indicated in Figure A.1 to Figure A.15. For bend tests the width position is as for the tensile test pieces.

Where more than one test piece is required they may be placed adjacent to each other in the location specified.

A.2 Sections

A.2.1 Location of test pieces across the width of section

The location of test pieces shall be in accordance with Figure A.1.

NOTE 1 For sections with tapered flanges; if agreed at the time of enquiry and ordering the sample may be taken from the web [see Figure A.1 b) and Figure A.1 d)] or the sample from the tapered flange may be machined.

NOTE 2 For unequal leg angles, samples may be taken from either leg.

A.2.2 Location of test pieces in thickness of section

A.2.2.1 Tensile test pieces

The location of tensile test pieces shall be in accordance with Figure A.2. Full thickness test pieces [see Figure A.2 a)] shall be used whenever machining and test equipment allows.

A.2.2.2 Impact test pieces

The location of impact test pieces shall be in accordance with Figure A.3.

A.3 Round bars and rod

A.3.1 Tensile test pieces

The location of tensile test pieces shall be selected in accordance with Figure A.4. Full section test pieces [see Figure A.4 a)] shall be used whenever machining and test equipment allows.

A.3.2 Impact test pieces

The location of impact test pieces shall be selected in accordance with Figure A.5.

A.4 Hexagonal bar

A.4.1 Tensile test pieces

The location of tensile test pieces shall be selected in accordance with Figure A.6.

Full section test pieces [see Figure A.6 a)] shall be used wherever machining and test equipment allows.

A.4.2 Impact test pieces

The location of impact test pieces shall be selected in accordance with Figure A.7.

A.5 Rectangular bar

A.5.1 Tensile test pieces

The location of tensile test pieces shall be in accordance with Figure A.8.

Full section or rectangular test pieces [see Figure A.8 a), Figure A.8 b) or Figure A.8 c)] shall be used whenever machining and test equipment allow.

A.5.2 Impact test pieces

The location of impact test pieces shall be in accordance with Figure A.9.

A.6 Flat products

A.6.1 Tensile test pieces

The location of tensile test pieces shall be in accordance with Figure A.10.

Full section test pieces [see Figure A.10 a)] shall be used whenever machining and test equipment allow.

Where transverse tensile test pieces are specified and the width of flat product is not sufficient to take the test piece from the $\frac{w}{4}$ location, then the centre of the test piece shall be as near to $\frac{w}{4}$ as possible.

A.6.2 Impact test pieces

The location of impact test pieces shall be in accordance with Figure A.11. For products of thickness ≥ 40 mm the location [Figure A.11 a), Figure A.11 b) or Figure A.11 c)] shall be specified in the product standard or in the order.

A.7 Tubular products

A.7.1 Tubes and circular hollow sections

A.7.1.1 Tensile test pieces

The location of tensile test pieces shall be selected in accordance with Figure A.12. Full section test pieces [Figure A.12 a)] shall be used whenever machining and test equipment allow.

For welded tubes, when testing the weld using strip test pieces, the weld shall be at the centre of the test piece.

NOTE 1 The full section test piece as shown in Figure A.12 a) is also applicable for a tube:

- flattening test;
- drift expanding test;
- flanging test;
- ring expanding test;
- ring tensile test;
- bend test in full section;

NOTE 2 Test pieces shown in Figure A.12 b) are used for strip bend test.

If not specified in the product standard or in the order the sampling position is at the discretion of the manufacturer.

A.7.1.2 Impact test pieces

The location of impact test pieces shall be in accordance with Figure A.13. The locations apply to both seamless and welded tubes.

If not specified in the product standard or in the order the sampling position is at the discretion of the manufacturer.

The orientation of test pieces is determined by the dimensions of the tube. Where a test piece is required in the transverse position the widest possible size between 10 mm and 5 mm shall be produced.

The minimum (nominal) diameter D_{mm} of the tube necessary to obtain such a test piece is given by:

$$D_{\text{min}} = (T - 5) + \frac{756,25}{T - 5}$$

where T is the wall thickness.

Where the smallest permitted transverse test piece is not obtainable, the widest possible longitudinal size between 10 mm and 5 mm shall be used.

A.7.2 Rectangular hollow sections

A.7.2.1 Tensile test pieces

The location of tensile test pieces shall be in accordance with Figure A.14. Full section test pieces [see Figure A.14 a)] shall be used whenever machining and test equipment allow.

A.7.2.2 Impact test pieces

The location of impact test pieces shall be in accordance with Figure A.15.

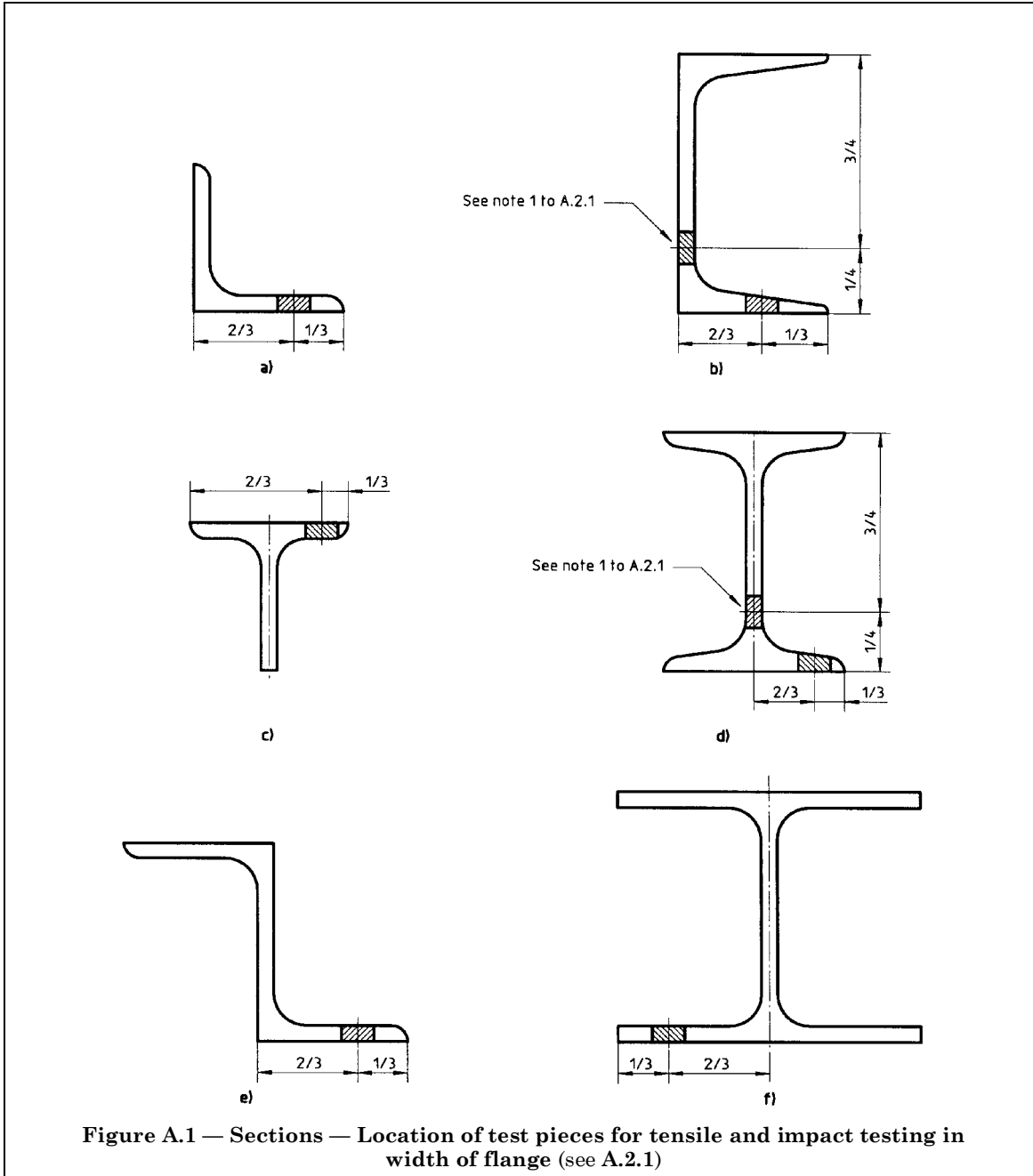
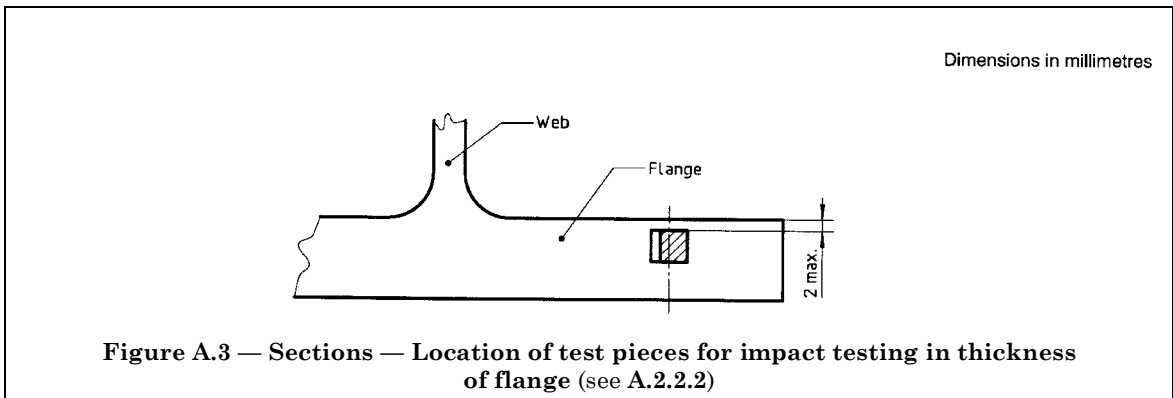
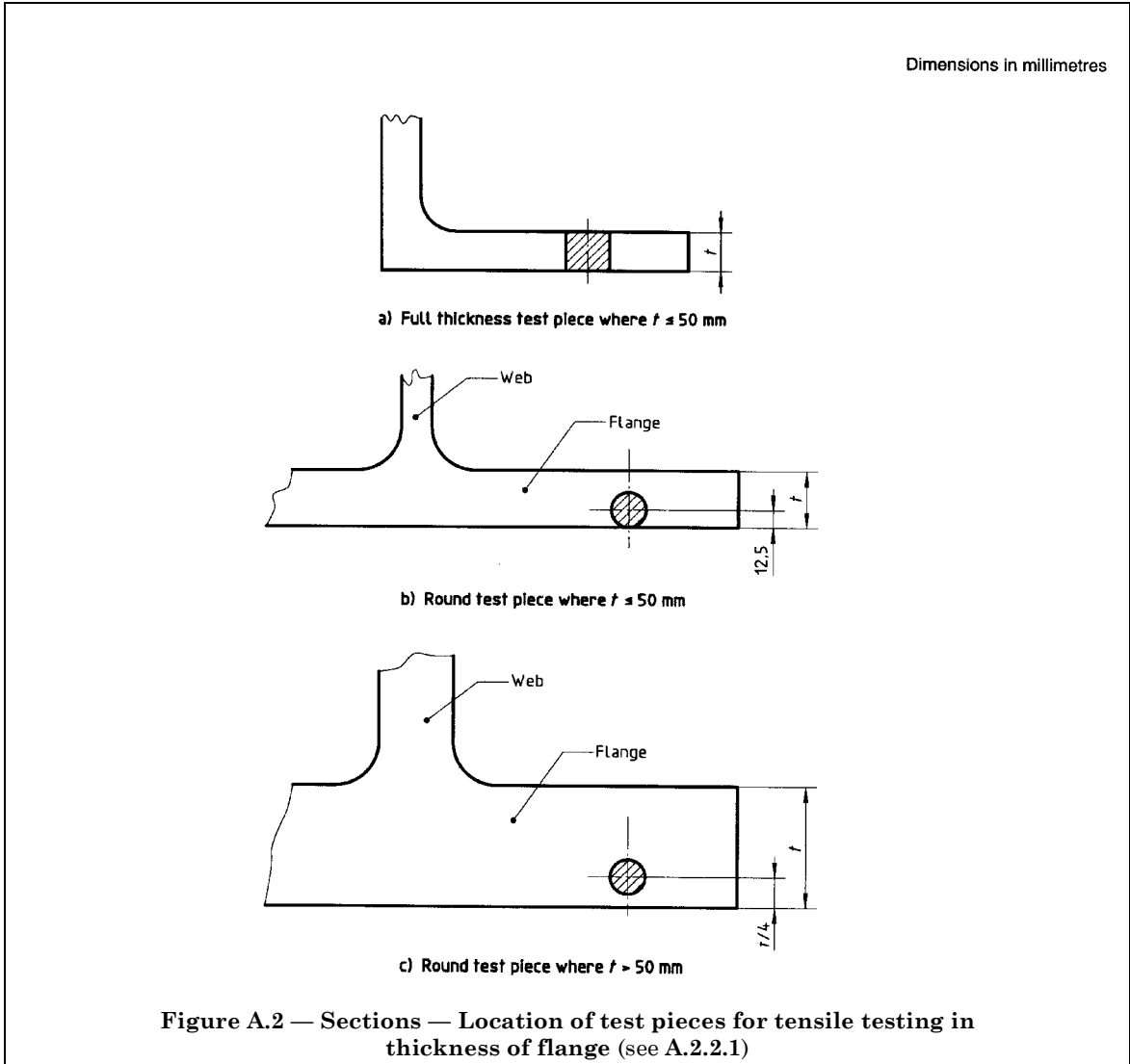
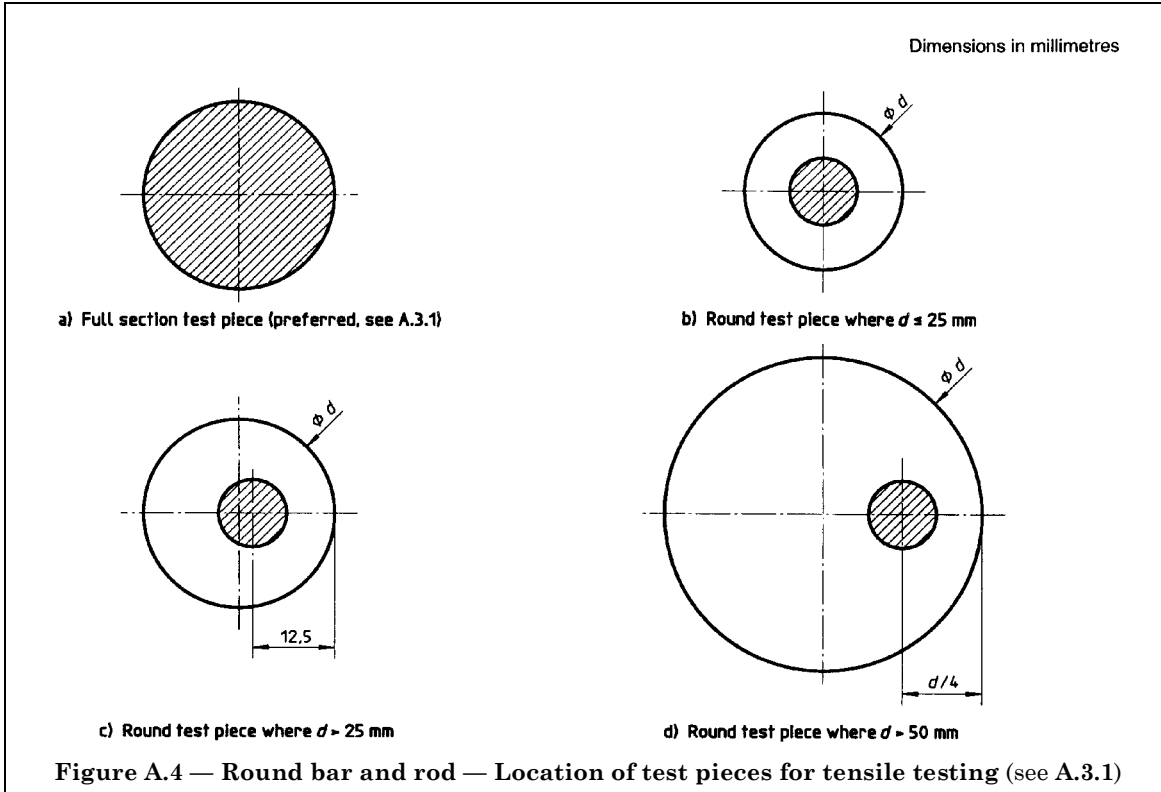
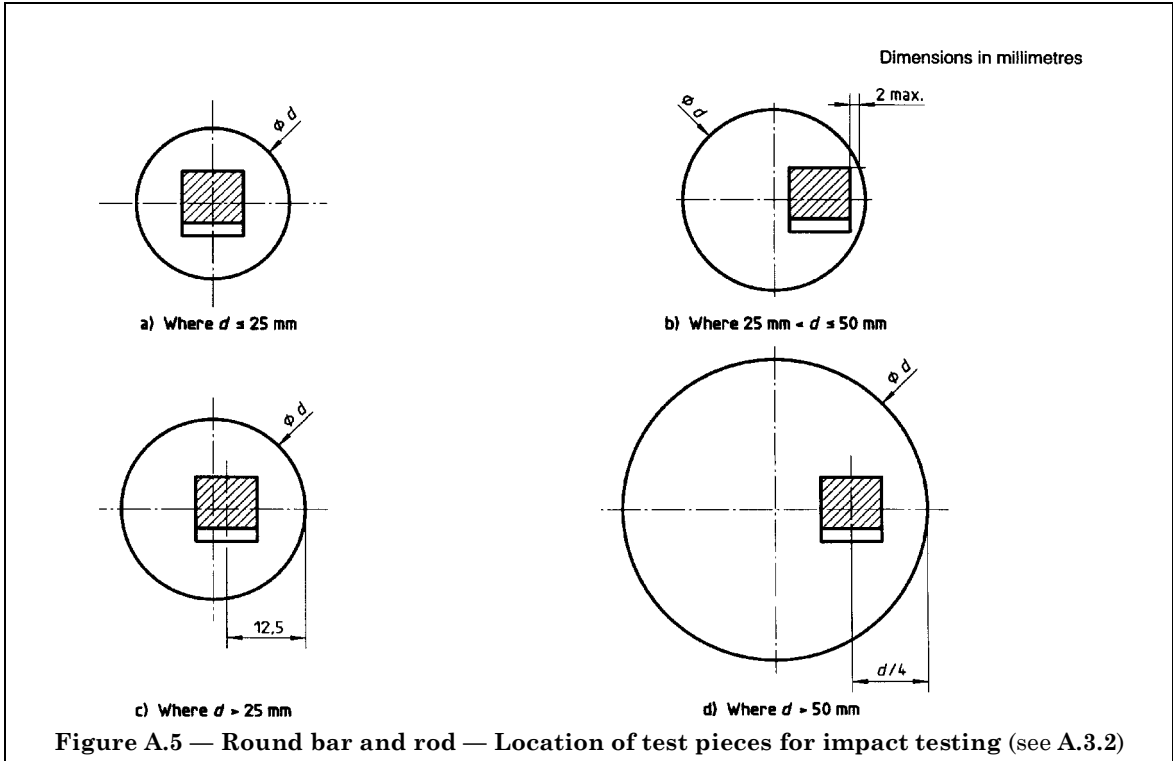
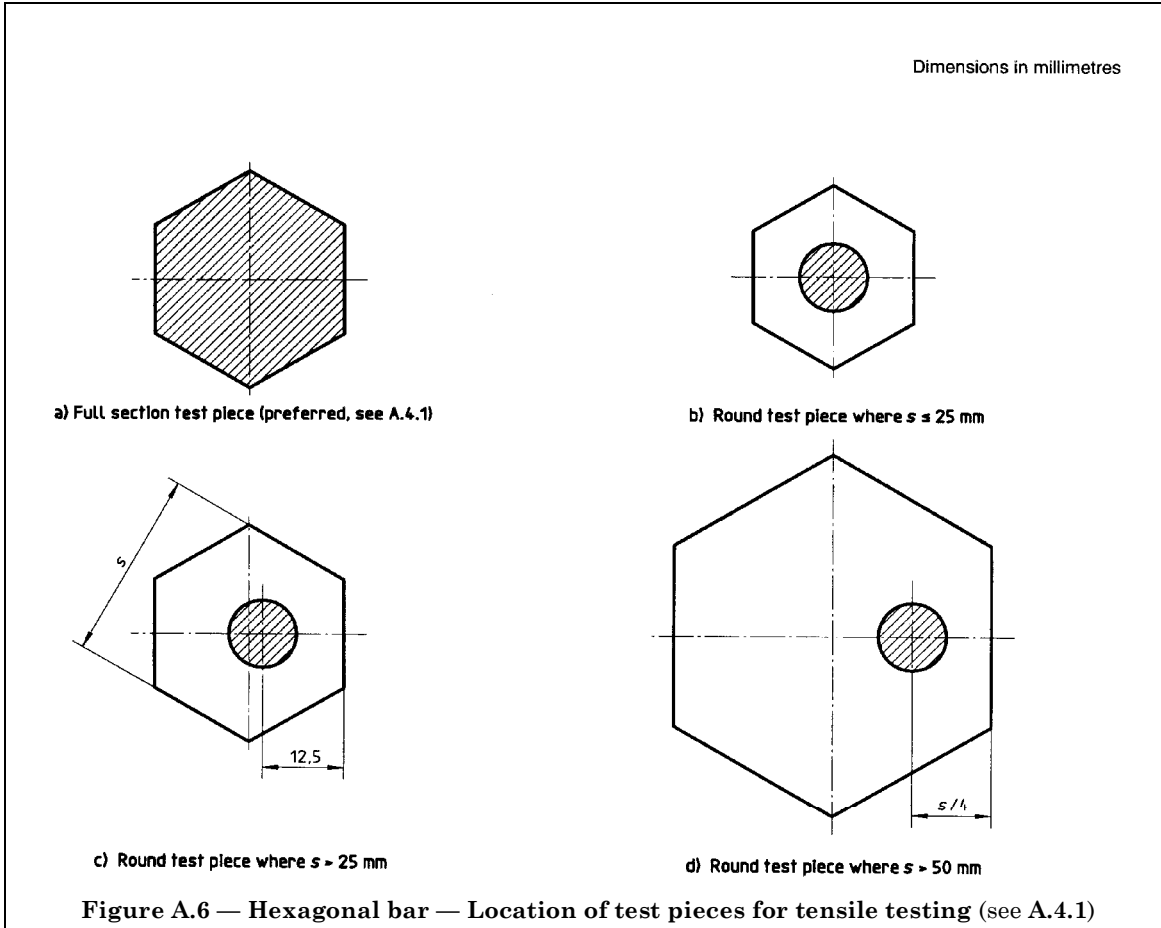


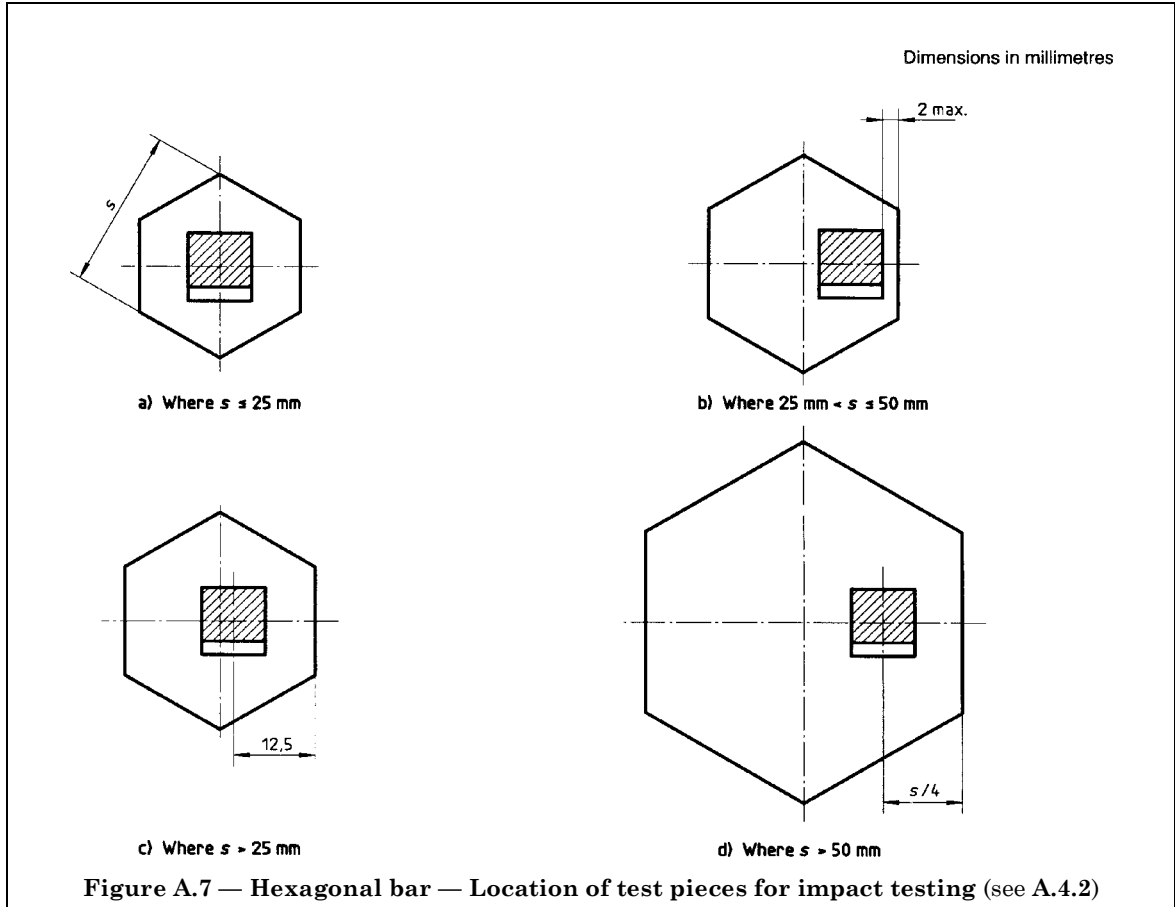
Figure A.1 — Sections — Location of test pieces for tensile and impact testing in width of flange (see A.2.1)

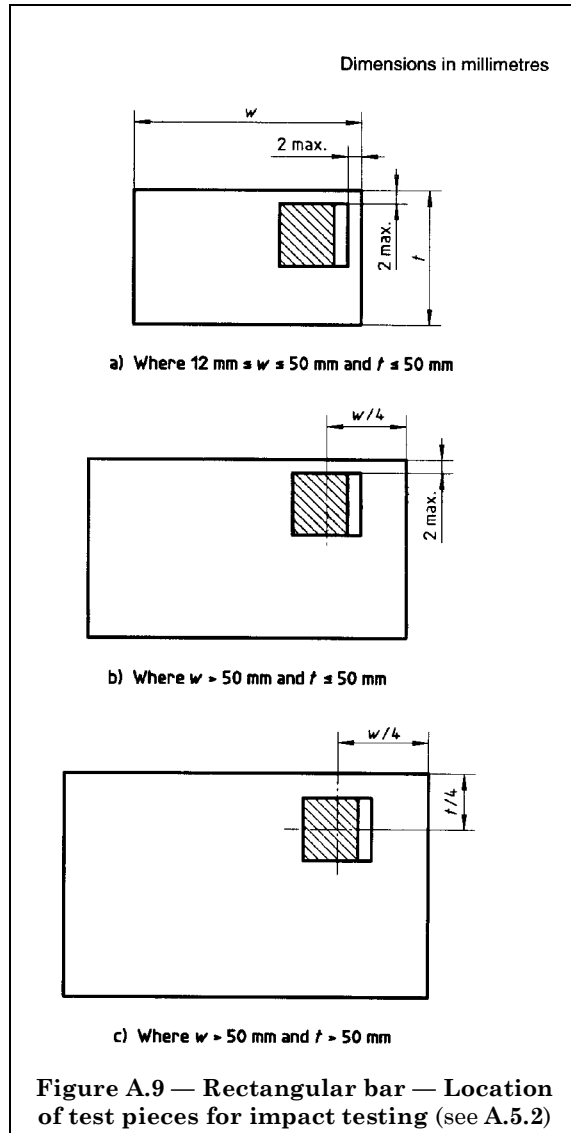
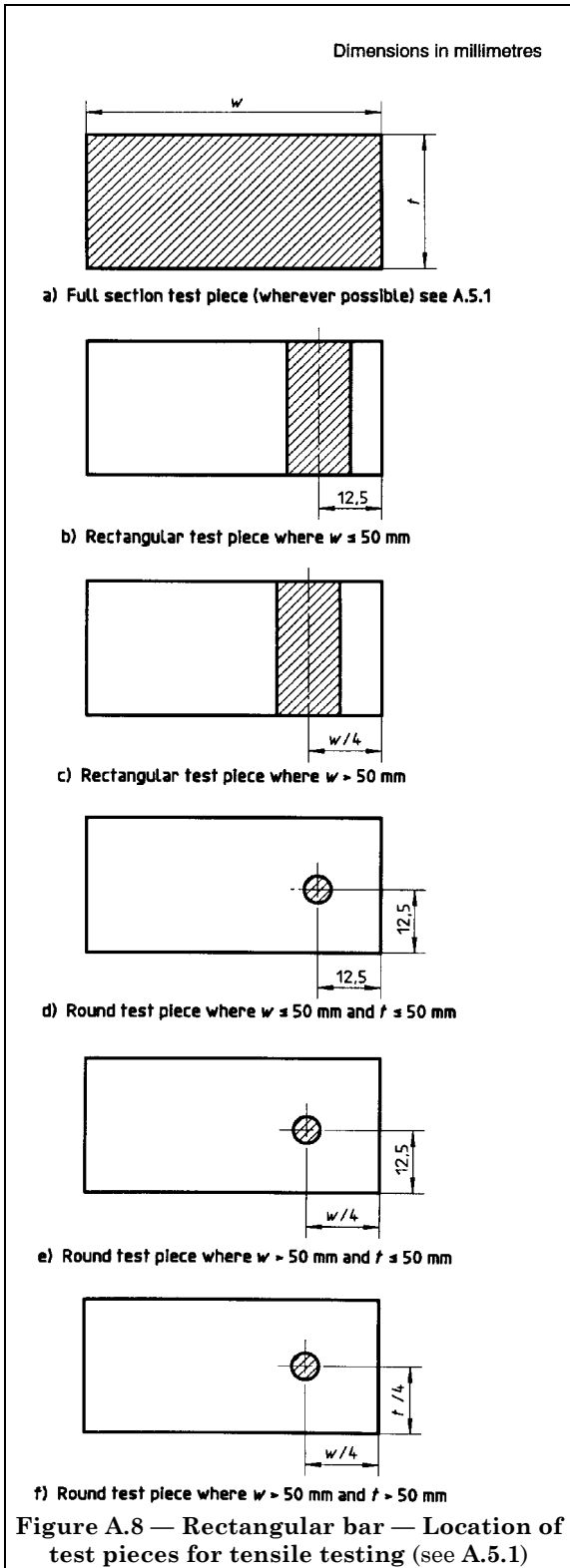


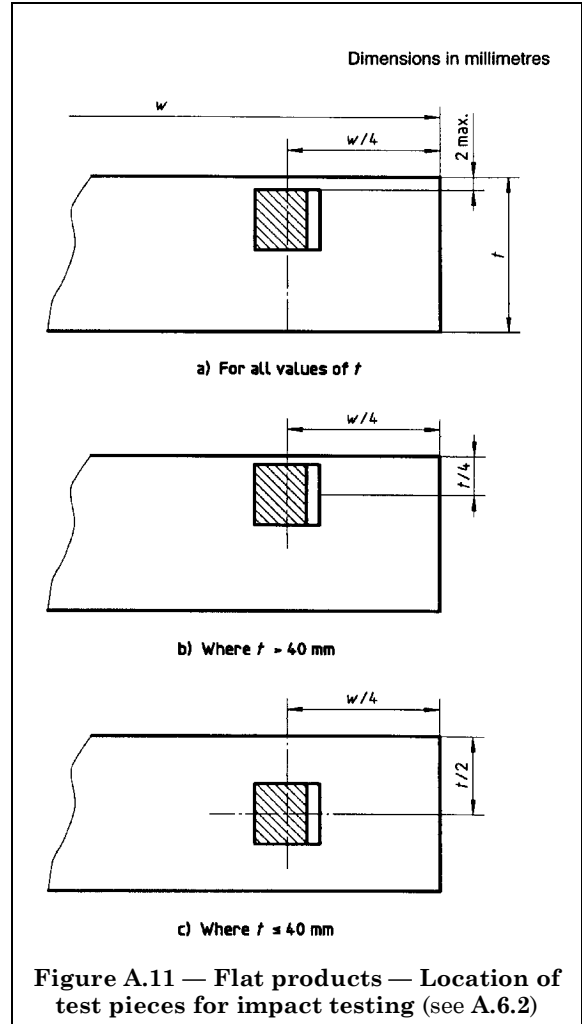
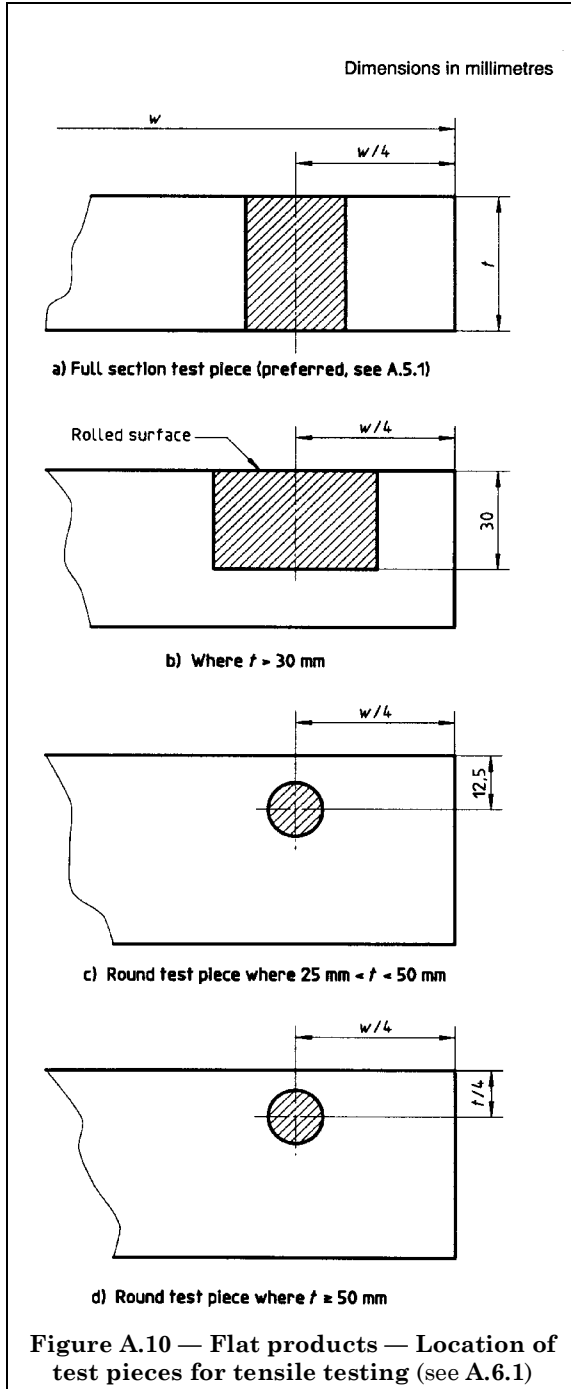


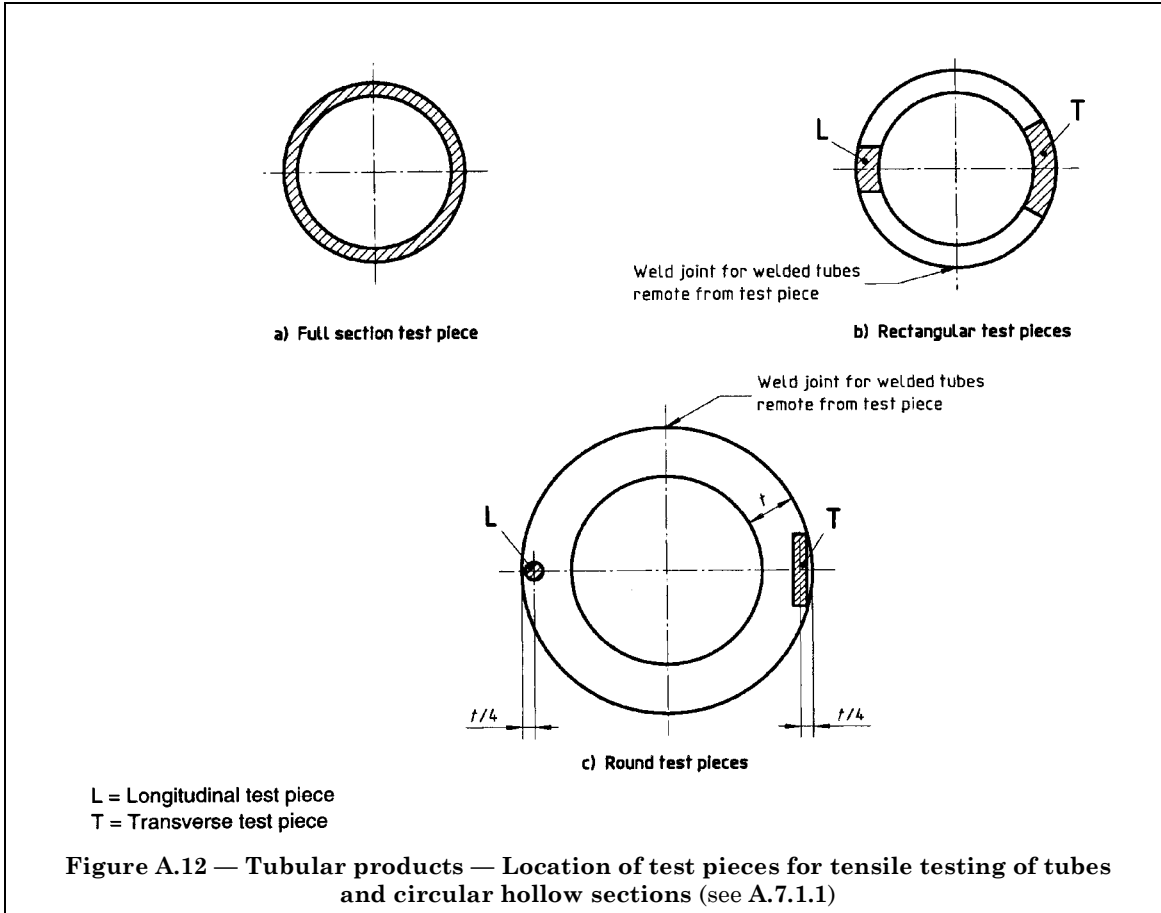




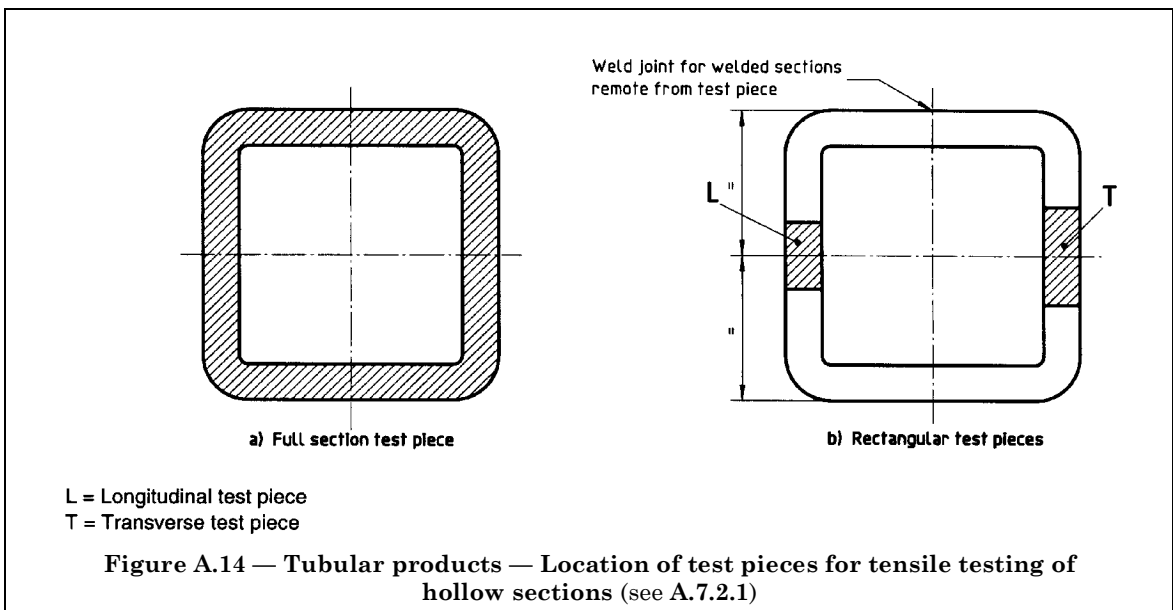
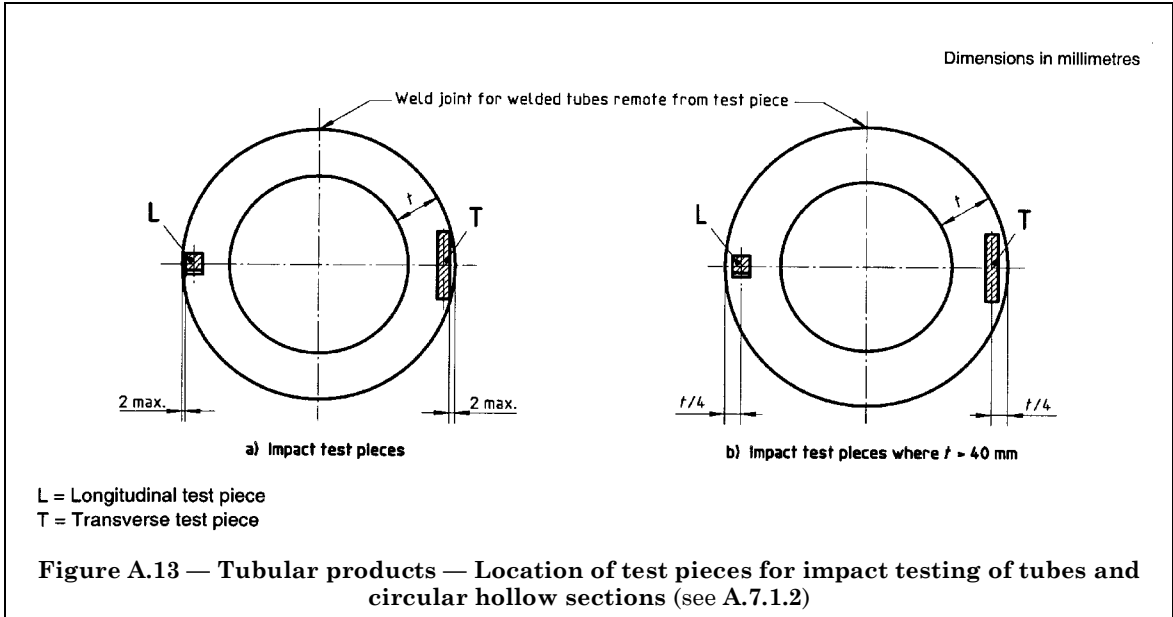


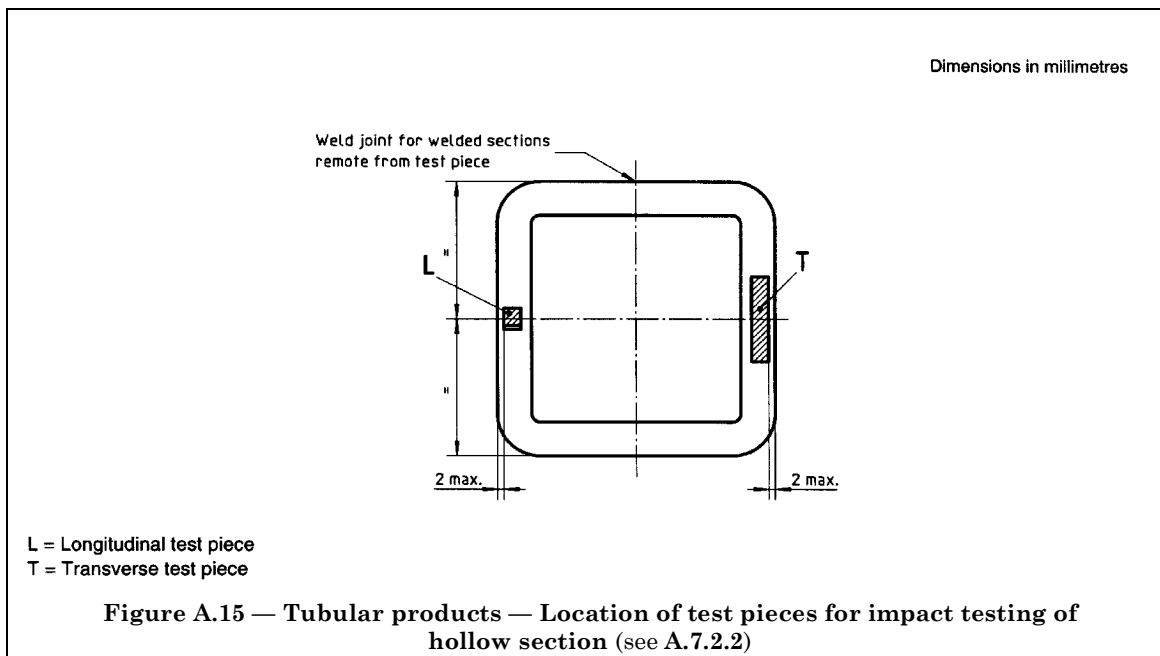






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Annex ZA (normative)**Normative references to international publications with their relevant European publications**

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN</u>	<u>Year</u>
ISO 3785	1976	<i>Steel — Designation of test piece axes</i>	EN ISO 3785	1995