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# International Standard



# 7778

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

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## Steel plate with specified through-thickness characteristics

*Tôles en acier avec caractéristiques garanties dans le sens de l'épaisseur*

First edition — 1983-09-15

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UDC 669.14-413

Ref. No. ISO 7778-1983 (E)

**Descriptors** : iron and steel products, killed steels, metal plates, specifications, tests, tension tests, test specimens, test specimen conditioning, designation.

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (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 authorized 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 7778 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in August 1982.

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

Austria	Iran	South Africa, Rep. of
Belgium	Italy	Spain
Canada	Japan	Sweden
China	Korea, Dem. P. Rep. of	Switzerland
Czechoslovakia	Korea, Rep. of	Tanzania
Egypt, Arab Rep. of	Netherlands	Turkey
France	New Zealand	United Kingdom
Germany, F.R.	Norway	USA
Hungary	Poland	USSR
India	Romania	Venezuela

The member body of the following country expressed disapproval of the document on technical grounds :

Australia

# Steel plate with specified through-thickness characteristics

## 0 Introduction

Steel plate as normally manufactured generally exhibits deformation properties in the direction perpendicular to the surface of the product which are different from those obtained in the direction of the surface. It is, however, possible to improve these deformation properties by taking particular precautions when the steel is manufactured. Experience has shown that measurement of the value for reduction of area — measured by means of a tensile test piece sampled in the direction of thickness of the product perpendicular to its surface — is the best way to characterize these properties.

However, the choice of one quality of steel exhibiting properties of this nature does not necessarily ensure the safety of a structure of which certain components are stressed perpendicular to their surface. Precautions should be taken both at the design and fabrication stage, and more particularly during welding, so as to minimize stresses in the through-thickness direction.

## 1 Scope

This International Standard specifies the criteria which shall be satisfied by the qualities of steel plate and wide flats for which through-thickness reduction of area properties are specified in the direction of thickness perpendicular to the surface and also the test conditions.

## 2 Field of application

This International Standard applies to plate and to wide flats of a thickness between 15 mm and 150 mm inclusive of fully killed steel with a specified minimum yield strength equal to or less than 500 N/mm<sup>2</sup>.

The application of this International Standard to products thinner than 15 mm or thicker than 150 mm or having minimum specified yield strengths greater than 500 N/mm<sup>2</sup> shall be the subject of agreement when ordering.

The requirements of this International Standard supplement other International Standards fixing the qualities of flat products (plate, wide flats).

## 3 Reference

ISO 82, *Steel — Tensile testing*.

## 4 Requirements

4.1 Table 1 gives the minimum average values and the individual minimum values for reduction of area which the products shall satisfy according to their class.

Table 1 — Minimum average and individual values

Class	Minimum average value <sup>1)</sup>	Minimum individual value
Z 15	15 %	10 %
Z 25	25 %	15 %
Z 35	35 %	25 %

1) Average of 3 tests.

4.2 Products delivered in accordance with this International Standard are generally the subject of ultrasonic testing in accordance with methods and criteria to be agreed when ordering.

## 5 Designation

The qualities of steel with specified through thickness properties shall be marked by adding the class number after the designation of the steel.

*Example* : E 460 — Z 25

## 6 Number and selection of test pieces

### 6.1 Batching

#### 6.1.1 Class Z 15

The tests may be carried out at the discretion of the user, either

a) per individual original product (parent plate or wide flat in the original as produced length and in the same heat-treatment condition), or

b) per batch consisting of products from the same cast which have undergone the same heat treatment and have a total mass of less than 25 t and nominal thicknesses which do not differ by more than 20 % compared with the minimum thickness of the batch.

6.1.2 Classes Z 25 and Z 35

The tests shall be carried out per original parent plate.

6.2 Sampling

For each test unit, one test coupon of dimensions sufficient to enable six tensile test pieces to be made shall be taken from the thickest product, from one end and in the central width axis. Only 3 test pieces shall be machined, the remaining three being kept in reserve in the event that supplementary tests are required (see figure 2).

7 Test methods

7.1 Test pieces

7.1.1 The reduction of area shall be measured using a cylindrical test piece. The diameter of the test piece, which depends on the thickness of the plate, is given in table 2.

The effective length *l* of the cylindrical part of the test piece shall be greater than or equal to 1,5 times its diameter.

Table 2 — Diameter of test pieces

Values in millimetres

Thickness of plate	Diameter of test piece
$e < 25$	$d_o = 6$
$25 < e < 50$	$d_o = 10$
$e > 50$	$d_o = 10$

7.1.2 When it is not possible to machine a test piece in the thickness of the plate, the gripped ends may be attached by welding. Welding may be carried out in accordance with any suitable method (e.g. friction welding), but shall be chosen in a way which results in a minimum heat affected zone. The effective length *l* shall be outside the heat affected zones.

Unless otherwise agreed when ordering, the manufacturer may use either a test piece with gripped ends attached by welding or a test piece machined in the whole thickness of the plate (see figure 1). The use of test pieces of type b or c is recommended when it is necessary to examine the surface properties of the plate.

7.2 Measurement of reduction of area

The tensile test shall be carried out in accordance with the requirements of ISO 82.

The reduction of area *Z* is defined by the equation

$$Z = \frac{S_o - S}{S_o} \times 100$$

where

$S_o$  is the original cross-sectional area of the test piece

$$S_o = \frac{\pi d_o^2}{4}$$

$S$  is the final cross-sectional area of the test piece after fracture;

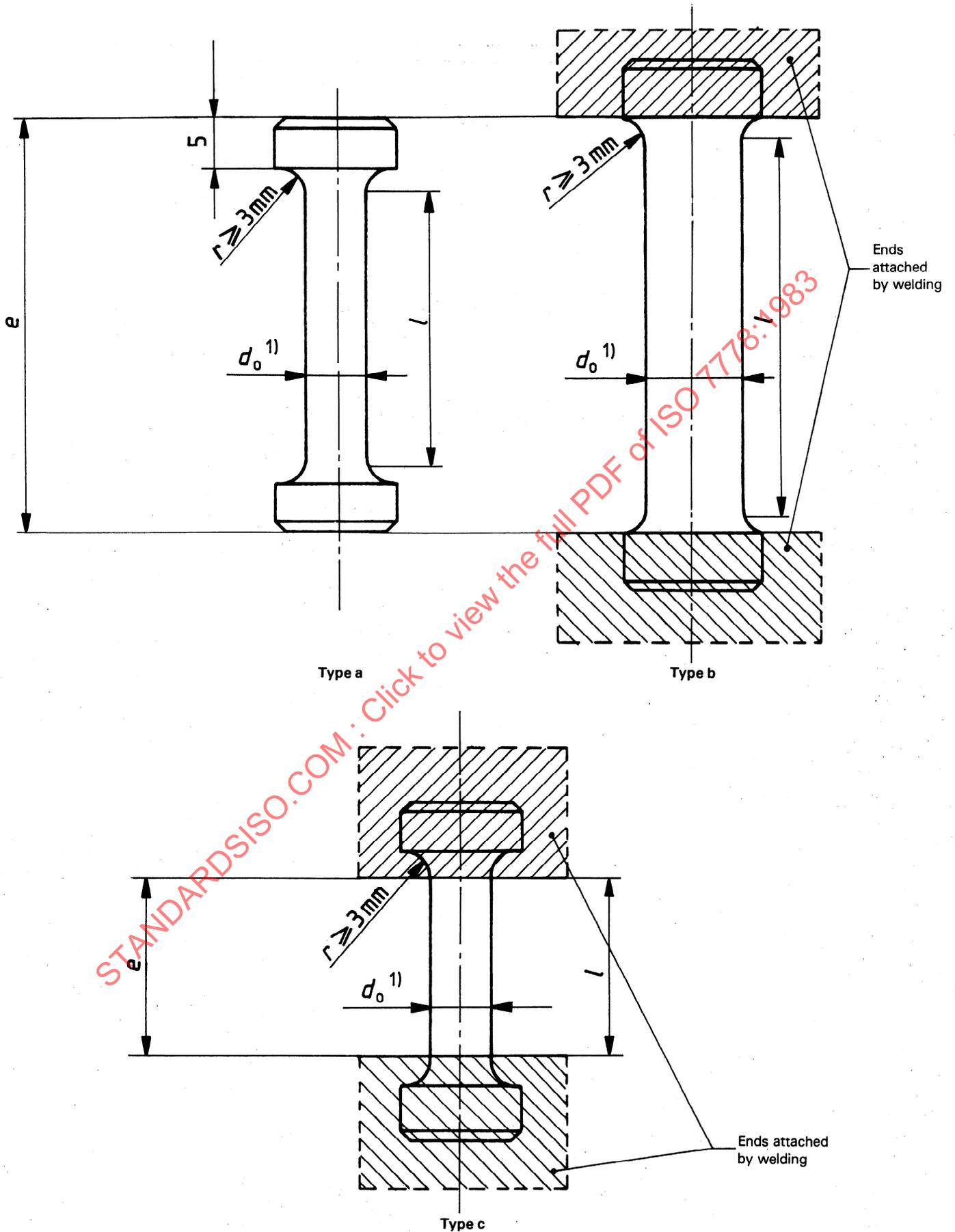
$$S = \frac{\pi}{4} \left( \frac{d_1 + d_2}{2} \right)^2$$

$d_1$  and  $d_2$  are the measurements of two perpendicular diameters, where the fracture is elliptical in shape,  $d_1$  and  $d_2$  correspond to the axes of the ellipse.

7.3 Supplementary tests

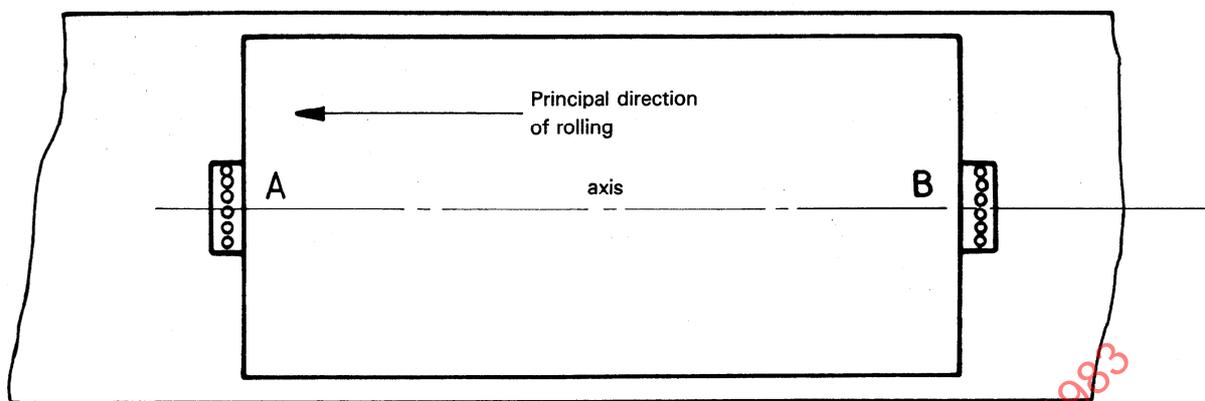
7.3.1 If a test is wrongly carried out, it is invalid. This could be the result of defective machining, bad welding, incorrect mounting in the test machine or malfunctioning of the machine. The same applies if fracture of the test piece occurs in the weld metal or in the heat affected zone.

7.3.2 If the average of the three test results is less than the specified value or if one individual result is less than the specified value, three more tests shall be carried out on the remaining test pieces. The average of the results of the six tests shall be greater than or equal to the minimum average specified value and no individual result from the new series shall be less than the minimum individual specified value.



1)  $d_0 = 6 \text{ mm}$  or  $10 \text{ mm}$  according to table 2.

Figure 1 – Sampling and preparation of test pieces



The test coupons are sampled either from A or B and with dimensions sufficient to provide 6 tensile test pieces.

Figure 2 — Sampling of test coupons

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