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## Steel — Hardenability test by end quenching (Jominy test)

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 17, Steel, Subcommittee SC 7, *Methods of testing (other than mechanical tests and chemical analysis)*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 459, *ECISS, European Committee for Iron and Steel Standardization*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 642:1999), which has been technically revised.

The main changes are as follows:

- ~~updated the~~ normative references ~~updated~~;
- ~~added a~~ new symbol, *J<sub>d</sub>*, in ~~Table 1~~; ~~Table 1~~;
- ~~minimum recommended reduction ratio of 5:1~~, see ~~6.1~~; ~~6.1~~;
- ~~revision of revised~~ the test piece dimensions, see ~~6.1~~, ~~6.2~~; ~~6.1~~, ~~6.2~~ and ~~Figures 1~~; ~~Figures 1~~ and ~~2~~; ~~2~~;
- ~~revision of revised~~ the heat treatment requirements, see ~~6.3~~; ~~6.3~~;
- ~~revised configuration of fixing and centring device~~, see ~~7.3~~; ~~7.3~~ and ~~Figure 3~~; ~~Figure 3~~;

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- revised text concerning water temperature, see [7.4](#); [7.4](#);
- revised requirement for nitric acid solution concentration, see [9.2](#); [9.2](#);
- revised codification of test result, see [10.4](#); [10.4](#) and [Figure 6](#); [Figure 6](#);
- revised [A.2](#) and [Figures A.2](#) and [A.3](#);
- revised [A.2](#) and [Figures A.2](#) and [A.3](#);
- revised [Annex C](#) [Annex C](#) and Bibliography;
- editorial clarifications;
- reduced the number of bibliographical references reduced.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

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# Steel — Hardenability test by end quenching (Jominy test)

## 1 Scope

This document specifies a method for determining the hardenability of steel by end quenching (Jominy test) by using a test piece 25 mm in diameter and at least 100 mm long.

By agreement and for a defined field of application, the test described in this document can be replaced by the calculation of the Jominy curve ~~in accordance with~~ according to an accepted mathematical model.

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

## 4 Symbols and designations

Symbols and designations used in this document are shown in [Table 1](#).

Table 1.— Symbols and designations

Symbol	Designation	Value
$L$	Test length of test piece	$(97 \pm 0,5)$ mm
$D$	Diameter of test piece	$(25^{+0,5}_0)$ mm
$t$	Time during which test piece is maintained at heating temperature	$(30^{+5}_0)$ min
$t_m$	Maximum time lag between removal of test piece from furnace and start of quenching	5 s
$T$	Temperature of points on the surface, situated at certain distances from the quenched end	—
$T_A$	Temperature of austenitizing	—
$a$	Internal diameter of vertical water supply pipe	$(12,5 \pm 0,5)$ mm
$h$	Height of water jet without test piece in position	$(65 \pm 10)$ mm
$d_w$	Distance from end of water supply pipe to lower end of test piece	$(12,5 \pm 0,5)$ mm

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Symbol	Designation	Value
$e_s$	Depth of flats for measurement of hardness	(0,4 to 0,5) mm
$d_s$	Distance, in millimetres, from quenched end to points where hardness is measured	-
$Jd$	Measured hardness at distance $d$ , in HRC or HV	-
$J_{xx-d}$	Jominy hardenability index at distance $d$ , in Rockwell HRC-mm	-
$JHV_{xx-d}$	Jominy hardenability index at distance $d$ , in Vickers HV 30-mm	-

## 5 Principle

The test consists of:

- a) heating a cylindrical test piece to a specified temperature in the austenitic range for a specified period of time;
- b) quenching it by spraying water on one of its ends under specified conditions;
- c) measuring the hardness at certain given points (see 9.4, 9.4), on flats made along the axis of the test piece, in order to determine the hardenability of the steel by variations of this hardness.

By agreement and for a defined field of application, the test described in this document can be replaced by the calculation of the Jominy curve in accordance with an accepted mathematical model (see Annex C-Annex C). In case of dispute, the test shall be carried out.

## 6 Form of test pieces and their preparation

### 6.1 Sampling

In the absence of specific requirements in the product standard, and unless otherwise agreed on the order and regardless of the thickness (or diameter) of the product, the sampling of test piece from the product can be made:

- either by hot rolling or forging of test piece with 30 mm to 32 mm diameter;
- or by machining of a test piece with diameter  $(25^{+0,5}_0)$  mm whose axis shall be at  $(20^{+5}_0)$  mm from one of the surfaces of the product (see Figure 1-Figure 1).

In case of products from continuous casting, a minimum reduction ratio 5:1 is recommended before sampling.

In all the forming processes preceding the machining of the test piece, the deformation of the product from all sides should be as uniform as possible.

In the case of a separately cast reference test piece, the original cross section before deformation shall be at least three times that corresponding to the required diameter of 30 mm to 32 mm.

By special agreement, the test piece can be obtained by a suitable casting process and tested in the as-cast condition.

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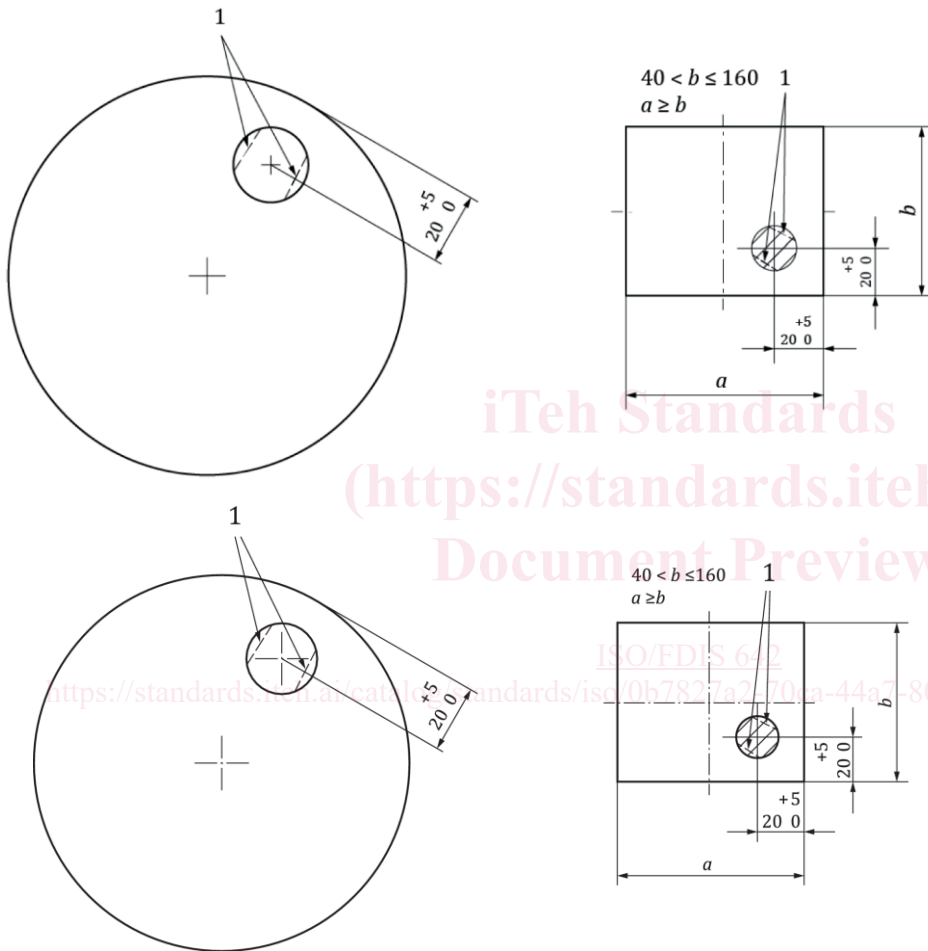
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The flats of the test piece shall have their axes at approximately the same distance from the product surface (see Figure 1, Figure 1). For this purpose, the test piece shall be marked so that its position in the round bar can be clearly recognized.

Dimensions in millimetres

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Key

1 test flats for measuring the hardness

Figure 1.— Sampling of the test piece for machining

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## 6.2 Dimensions

6.2.1 The test piece shall consist of a round bar machined to a diameter of 25 mm and a length of at least 100 mm.

6.2.2 The end of the test piece which will not be quenched shall be 30 mm to 32 mm or 25 mm in diameter, depending upon the form of that end. Two examples, test pieces with a flange or an undercut (to permit rapid centring and fitting in position for the quenching operation by means of an appropriate support) are shown in [Figure 2](#). [Figure 2](#).

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