

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 642

HARDENABILITY TEST BY END QUENCHING STEEL
(JOMINY TEST)

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BRIEF HISTORY

The ISO Recommendation R 642, *Hardenability test by end quenching steel (Jominy test)*, was drawn up by Technical Committee ISO/TC 17, *Steel*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question by the Technical Committee began in 1958 and led, in 1965, to the adoption of a Draft ISO Recommendation.

In January 1966, this Draft ISO Recommendation (No. 919) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

Argentina	France	Romania
Australia	Germany	Spain
Austria	Hungary	Sweden
Belgium	India	Switzerland
Brazil	Israel	Turkey
Canada	Italy	U.A.R.
Chile	Japan	United Kingdom
Czechoslovakia	Korea, Rep. of	U.S.A.
Denmark	Netherlands	Yugoslavia
Finland	Norway	

No Member Body opposed the approval of the Draft.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in December 1967, to accept it as an ISO RECOMMENDATION.

HARDENABILITY TEST BY END QUENCHING STEEL (JOMINY TEST)

1. PRINCIPLE OF TEST

The test consists in

- 1.1 heating a test piece to a given temperature for a specified period of time;
- 1.2 cooling it by spraying water on its end;
- 1.3 either assessing the hardness between two selected points, or measuring it at certain given points along its length, in order to determine the hardenability of the steel by variations of this hardness.

2. SYMBOLS AND DESIGNATIONS

Reference number	Symbol	Designation	Value
1		Total length of test piece	100 ± 0.5 mm
2		Diameter	25 ± 0.5 mm
3		Time during which the test piece is maintained at the heating temperature	30 ± 5 minutes
4		Maximum time lag between removal of the test piece from the furnace and the start of quenching	5 seconds
5		Temperature of the cooling water	5 to 30 °C
6		Internal diameter of vertical water supply pipe	12.5 ± 0.5 mm
7		Height of water jet without test piece in position	65 ± 10 mm
8		Distance from tip of nozzle to the bottom of test piece	12.5 ± 0.5 mm
9		Depth of flats for the measurement of hardness	0.4 mm *
10	<i>d</i>	Distance in millimetres from points where hardness is measured to quenched end	mm
11	J xx- <i>d</i>	Jominy hardenability index at distance <i>d</i>	in Rockwell HRC-mm
11 a	J HVxx- <i>d</i>	<i>ditto</i>	in Vickers HV 30-mm

* In certain cases, the product specification may require a greater depth.

3. TYPE OF TEST PIECES AND THEIR PREPARATION

3.1 Dimensions of the test piece

3.1.1 The test piece consists of a round bar machined to 25 mm diameter and 100 mm long.

3.1.2 The unmachined end of this test piece* is 32 or 25 mm in diameter depending upon whether the test piece has a flange or an undercut (so as to permit rapid centralizing and fitting into place, at the time of quenching, by means of an appropriate support (see Fig. 1)).

3.1.3 The test piece should, if necessary, be marked (on the opposite end to the end to be used for hardening) to enable the position to be identified in relation to the original bar.

3.1.4 Such marking is necessary, in particular, when the steel under consideration has only a low depth of hardness and the hardenability of the material between the centre and the surface of bars greater than 50 mm in side or in diameter has to be determined.

In this case, the test piece is generally taken from the bar in such a manner that its axis, parallel to the axis of the bar, is situated midway between the centre and the surface. The flats specified in clause 6.1 can then be made so that the material situated approximately at the same distance in the bar as the axis of the test piece is under investigation.

3.2 The forged or rolled test pieces are given a normalizing treatment before final machining. For special requirements other heat treatments can be used.

3.2.1 In cases where it is of special interest to know the hardenability of the steel in the softened condition, the test piece may be treated accordingly.

3.2.2 Except by special agreement, the normalizing treatment should be carried out under conditions specified in the product specification for the steel.

3.2.3 The rough bar should be treated so that the machined test piece is completely free from decarburization, even from traces thereof.

3.3 The cylindrical surface of the test piece is machined by fine turning; the surface of the test piece end to be hardened should have a reasonably fine finish, preferably obtained by further polishing.

* Depending upon the dimensions of the sample bar from which the test piece is taken, the rough bar can be reduced to the above dimensions by rolling or forging. It can also be obtained directly by casting; in this case, it is cast at the same time as the cast sample is taken, and this is taken at the end of the steelmaking process.

4. APPARATUS

The apparatus consists of a device for hardening the test piece.

- 4.1 The hardening device, shown in Figure 3, page 10, consists essentially of a means of fixing and centralizing the test piece placed vertically above the water supply pipe. The water supply pipe contains a quick action tap.
- 4.2 The relative positions of the end of the water supply pipe (12.5 ± 0.5 mm internal diameter) and of the test piece support should be such that the distance between the end of the water supply pipe and the test piece face to be hardened should be 12.5 ± 0.5 mm (see Fig. 3).
- 4.3 The test piece support should enable precise centralizing of the test piece above the end of the water supply pipe and the holding of it during spraying. It should be dry while the test piece is being placed in position; splashing of water should be kept away from the test piece while it is being placed in position and before the actual quenching operation starts.
- 4.4 The height of the water jet above the end of the water supply pipe without the test piece in position should be 65 ± 10 mm* (see Fig. 4). The water temperature in the pipe should be between 5 and 30 °C.
- 4.5 The hardening device should be protected from draughts.

5. TEST REQUIREMENTS

5.1 Heating of the test piece

- 5.1.1 The test piece is heated uniformly and then maintained for 30 ± 5 minutes at the specified temperature (see product standard or special agreement). For particular types of furnaces, this duration can be laid down as a result of previous experience establishing the minimum time necessary for the centre of the piece to reach the desired temperature (this temperature can be verified by means of, for example, a thermocouple placed in a hole drilled along the axis of the test piece at the head end).
- 5.1.2 Precautions should be taken to avoid any decarburization of the test piece, or its carburization or a marked oxidation with formation of scale. For example, a furnace with a controlled atmosphere can be used or the test piece can be placed in a mild steel vessel, as shown in Figure 2, page 9. The bottom of this vessel should be covered either with graphite granules or with cast iron shot on which the test piece will rest.

5.2 Hardening of the test piece

- 5.2.1 The time between removal of the test piece from the furnace and the commencement of spraying should not exceed 5 seconds.
- 5.2.2 The water supply tap should open rapidly.
- 5.2.3 The time of spraying should be at least 10 minutes. After this time, the cooling of the test piece can be completed by immersing it in cold water.

* To determine the force of the water jet, the dimension of the circle covered by water diverted by the test piece and falling on a horizontal plane 60 mm below the end of the pipe can be measured. The diameter of the moistened circle should be 210 mm.