

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 1143

ROTATING BAR BENDING FATIGUE TESTING

1st EDITION

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BRIEF HISTORY

The ISO Recommendation R 1143, *Rotating bar bending fatigue testing*, 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 led to the adoption of a Draft ISO Recommendation.

In June 1968, this Draft ISO Recommendation (No. 1350) 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 :

Australia	Italy	Spain
Brazil	Japan	Sweden
Canada	Korea, Rep. of	Switzerland
Czechoslovakia	Netherlands	Thailand
Denmark	Norway	Turkey
Finland	Peru	U.A.R.
Germany	Poland	United Kingdom
Hungary	Portugal	U.S.A.
India	Romania	U.S.S.R.
Israel	South Africa, Rep. of	

Two Member Bodies opposed the approval of the Draft :

Belgium
France

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in November 1969, to accept it as an ISO RECOMMENDATION.

ROTATING BAR BENDING FATIGUE TESTING

1. SCOPE

This ISO Recommendation gives the conditions for carrying out rotating bar bending fatigue tests on test pieces having a nominal diameter between 5 mm (0.2 in) and 12.5 mm (0.5 in) without deliberately introduced stress concentrations. The tests are carried out at room temperature, in air, the test piece being rotated.

Results of fatigue tests may be affected by atmospheric conditions and where controlled conditions are required, clause 2.1 of ISO Recommendation R 554, *Standard atmospheres for conditioning and/or testing – Standard reference atmosphere – Specifications*, applies.

2. OBJECT OF TEST

Tests are made to determine fatigue properties such as the S/N curve described in ISO Recommendation R 373, *General principles of fatigue testing of metals*.

3. PRINCIPLE OF TEST

Nominally identical test pieces are used, each being rotated and subjected to a bending moment. The forces giving rise to the bending moment do not rotate. The test piece may be mounted as a cantilever, with single-point or two-point loading, or as a beam, with four-point loading. The test is continued until the test piece fails or until a pre-determined number of stress cycles has been exceeded. (See section 10.)

NOTE. – For definitions of failure see ISO Recommendation R 373.

4. SYMBOLS AND DEFINITIONS

In this ISO Recommendation the following symbols are used :

Symbols	Definitions
D	The diameter of the gripped or loaded end of the test piece.
d	The diameter of the test piece where the stress is a maximum.
r	Radius* at the ends of the test section which starts the transition from the test diameter d .

Further symbols and definitions relating to fatigue testing are given in ISO Recommendation R 373.

* This radius need not be a true arc of a circle over the whole of the length between the end of the test section and the start of the enlarged ends for the test pieces shown in Figures 1, 4 and 5.

5. SHAPE AND SIZE OF TEST PIECE

5.1 Forms of test section

The test section may be

- (a) cylindrical, with tangentially blending fillets at one or both ends (see Figures 1, 4 and 5);
- (b) tapered (see Figure 2);
- (c) toroidal (see Figures 3, 6 and 7).

In each case the test section should be of circular cross-section.

The form of test section may be dependent on the type of loading to be employed. While cylindrical or toroidal test pieces may be loaded as beams, or as cantilevers with either single-point or two-point loading, the tapered form of test piece is used only as a cantilever with single-point loading. Figures 1 to 7 show, in schematic form, the bending moment and nominal stress diagrams for the various practical cases.

The volumes of material subjected to high stresses are not the same for different forms of test piece, and they may not necessarily give identical results. The test in which the largest volume of material is highly stressed is preferred.

Experience shows that, for threaded test pieces of certain material, a ratio of at least 3 : 1 between the cross-sectional areas of the test portion and the threaded section is desirable.

NOTE. – In tests on certain materials a combination of high stress and high speed may cause excessive heating of the test piece. This effect may be reduced by subjecting a smaller volume of the material to the specified stress. If the test piece is cooled, the medium should be such that it does not react with the material of the test piece.

5.2 Diameter of test pieces

All the test pieces employed for a fatigue determination should have the same nominal diameter, $d \pm 0.05$ mm (0.002 in).

The nominal value of the diameter, d , should be between 5 mm (0.2 in) and 12.5 mm (0.5 in). The recommended values of d are 6 mm (0.25 in), 7.5 mm (0.3 in), and 9.5 mm (0.375 in).

For the purpose of calculating the load to be applied to obtain the required stress, the actual minimum diameter of each test piece should be measured to an accuracy of 0.01 mm (0.0005 in). Care should be taken during the measurement of the test piece prior to testing to ensure that the surface is not damaged.

On cylindrical test pieces subject to constant bending moment (see Figures 4 and 5) the parallel test section should be parallel within 0.025 mm (0.001 in). For other forms of cylindrical test pieces (see Figure 1) the parallel test section should be parallel within 0.05 mm (0.002 in). The transition fillets at the ends of the test section should have a radius not less than $3d$. For toroidal test pieces, the section formed by the continuous radius should have a radius not less than $5d$.