Hacksaw blades —

Part 2: Specification for cutting performance

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Engineering Sector Board to Technical Committee MTE/8, upon which the following bodies were represented:

Association of Engineering Distributors Ltd.
British Engineers Cutting Tools Association
British Hacksaw and Bandsaw Manufacturers' Association
Gauge and Tool Makers' Association
Ministry of Defence

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Contents

Foreword

This Part of BS 1919 has been prepared under the direction of the Engineering Sector Board.

First published in 1953, BS 1919 was revised in 1967, partly to achieve a rationalization of sizes but also as a step towards metrication. The standard was further revised in 1974 to take into account international agreement within ISO on hacksaw blades and to add the flexible type of high speed hacksaw blade.

BS 1919 was further revised in 1983 to include the important bimetal types of hacksaw blade and requirements for both power and hand hacksaw blades.

The present revision of BS 1919 divides the 1983 edition into two Parts.

This Part of BS 1919 has been produced in advance of the related standard ISO 2336 that is being prepared by the International Organization for Standardization (ISO). BS 1919-1 specifies the dimensions of hand and machine hacksaw blades and also includes the static bend test for hand blades only.

This Part of BS 1919 together with Part 1 supersedes BS 1919:1983, which is withdrawn.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 1919 specifies the performance requirements and methods of test of hand hacksaw and machine hacksaw blades specified in BS 1919-1.

Examples of equipment for testing hacksaw blades are given in Annex B.

2 Normative references

This standard incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this Part of BS 1919 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

3 Definitions

For the purposes of this British Standard the definitions given in BS 1919-1:1993 apply.

4 Cutting performance

When tested in accordance with Annex A, the wear rate of the hand or machine blade and the total time taken to complete the number of cuts shall not exceed the values given in Table 1 and Table 2 for the type of blade tested.

The blade shall not produce a cut more than 3 mm out of square.

The blade shall not break.

A new blade shall be used for each test.

Table 1 — Test conditions and acceptance limits for hand blade cutting tests

Blade type	Blade dimensions			Speed	No. of cuts	Test bar		Wear rate	Total time
	Thickness mm	Pitch mm	No. of teeth	Strokes/min		No. of strips	Thickness of strip mm		
High speed steel: all hard and bimetal	0.63	1.8	14	70	10	10	2.6 ± 0.05	33	92
	0.63	1.4	18	70	10	10	2.6 ± 0.05	37	112
	0.63	1.0	24	70	10	9	2.6 ± 0.05	40	124
	0.63	0.8	32	70	10	8	2.6 ± 0.05	40	132
High speed steel: flexible	0.63	1.8	14	70	8	10	2.6 ± 0.05	73	122
	0.63	1.4	18	70	8	10	2.6 ± 0.05	78	132
	0.63	1.0	24	70	8	9	2.6 ± 0.05	118	146
	0.63	0.8	32	70	8	8	2.6 ± 0.05	120	149
Low alloy steel: flexible	0.63	1.8	14	35	8	5	2.6 ± 0.05	44	134
	0.63	1.4	18	35	8	5	2.6 ± 0.05	40	123
	0.63	1.0	24	35	8	5	2.6 ± 0.05	34	147
	0.63	0.8	32	35	8	4	2.6 ± 0.05	37	127

Table 2 — Test conditions and acceptance limits for power blade cutting tests (high speed steel, all hard and bimetal)

Blade dimensions				Speed	No. of cuts	Test bar		Wear rate	Total time
Length	Width	Thickness	Pitch			No. of strips	Thickness of strip		
mm	mm	mm	mm	Strokes/min			mm		
300 and 350	25	1.25	1.8	124	10	15	2.6 ± 0.05	66	66
300 and 350	25	1.25	2.5	124	10	20	2.6 ± 0.05	56	61
350 400 450	32	1.60	2.5	124	10	20	2.6 ± 0.05	65	87
350 400 450	32	1.60	4.0	124	10	25	2.6 ± 0.05	47	60
400 450	40	2.00	4.0	124	10	25	2.6 ± 0.05	81	80
400 450	40	2.00	6.3	124	10	25	2.6 ± 0.05	69	76

Annex A (normative)
Methods for testing the performance of hand and power hacksaw blades

A.1 Principle

The cutting performance of hand and power blades is assessed by subjecting sample blades to an accelerated test using calibrated hacksawing machines to control the variables in friction, stroke characteristics and loads.

The standard test bar is chosen to induce sufficient wear to the blade and to provide by its homogeneous structure reproducible machining characteristics.

A.2 Test bar

A test bar consisting of lengths of cold rolled 18/8 stainless steel strip, type 304 S15 in accordance with Table 2 of BS 1449-2:1983, having the following analysis.

Carbon	≤ 0.06 %
Silicon	≥ 0.2 %
	≤ 1.00 %
Manganese	≥ 0.50 %
	≤ 2.00 %
Chromium	≥ 17.50 %
	≤ 19.00 %
Nickel	≥ 8.00 %
	≤ 11.00 %
Sulfur	≤ 0.03 %
Phosphorus	≤ 0.045 %

The strip shall be 25.0 mm ± 0.15 mm in width, 2.6 mm ± 0.05 mm in thickness. The hardness shall be 180 ± 12 HV 30, and the finish shall be type 2B. The material shall have rolled or prepared edges. Ragged sheared edges are to be avoided.

A.3 Apparatus

A.3.1 *Test machine for hand blades*

A power hacksaw machine as follows:

a) in good condition, particularly in respect of stroke alignment and freedom from excessive vibration;

b) with main slides sufficiently free from friction to prevent variations in dynamic loads;

c) with the main pivot on the same axis as the crank drive shaft;

d) which cuts on the forward stroke;

e) which presents the blade at an inclination of 1° 15' ± 10' relative to the machine slides in the direction of cut (see Figure B.1);

f) with a stroke length of 153 mm ± 1 mm;

g) with a cutting speed of 70 strokes/min ± 2 strokes/min when blades of high speed steel and bimetal type are to be tested;

h) with a cutting speed of 35 strokes/min ± 2 strokes/min when blades of low alloy type are to be tested;

i) with location facilities for the test bar so that when the machine is stroking, the test bar is positioned no closer than 50 mm from the blade pin holes;

j) which does not lift the reciprocating arm on the return stroke;

k) which exerts static loads on the test bar at the top of the cut in accordance with Table A.1.

NOTE A commercially available light power hacksaw machine with gravity feed which is capable of meeting these requirements is described in B.1.

A.3.2 *Test machine for power blades*

A power hacksaw machine as follows:

a) in good condition, particularly in respect of stroke alignment and freedom from excessive vibration;

b) which cuts on the return stroke;

c) which presents a blade at an inclination of 1° 40' ± 10' relative to the machine slides in the direction of cut (see Figure B.2);

d) with a machine speed of 124 ± 2 cutting strokes/min;

e) with a stroke length of 133 mm ± 1 mm;

f) with location facilities for the test bar so that when the machine is stroking the test bar is positioned no closer than 50 mm from the blade pin holes;

g) with lift-off on the non-cutting stroke synchronized so that no dynamic load is applied during the non-cutting stroke, and so that no dynamic load relief is applied during the cutting stroke;

h) which exerts static loads onto the test bar in accordance with Table A.2;

i) which supplies a coolant, consisting of 100 g/1 of $Na_2CO_3.10H_2O$ in water, to the blade immediately above the test bar at a rate of 2 l/min minimum.

NOTE A commercially available power hacksaw machine with a gravity feed which is capable of meeting these requirements is described in **B.2**.

Table A.1 — Static load at top cut for hand blades

Position of bow	Static load Kg
Start of stroke	3.3 ± 0.1
Mid-stroke	5.7 ± 0.1
End of stroke	8.4 ± 0.1

Table A.2 — Static load at top cut for power blades

Position of bow	Static load Kg
Start of stroke	69 ± 0.1
Mid-stroke	72 ± 0.1
End of stroke	75 ± 0.1

A.4 Preparation of test blades

There is no preparation required for hand blades. Correct power blades to a length of 350 mm if necessary.

NOTE 1 Power blades, because of their variation in length from 300 mm to 450 mm and the capacity limit of hacksawing machines, may need to be corrected to a blade length of 350 mm. A suitable procedure is described in **B.5**.

NOTE 2 Testing in the unaltered length is valid if the bow capacity of the machine allows, and alteration of blade clamping mechanisms in the machine is also feasible.

A.5 Test procedure

Calibrate the test machine to the loads given in Table A.1 for hand blades and Table A.2 for power blades.

Once the load has been adjusted to give the load specified, ensure that the jaw of the test bar clamp that is nearest the main pivot of the machine remains in a fixed position, irrespective of the number of test bar strips being used in the blade testing.

Position lengths of strip in accordance with Table 1 for hand blades, or Table 2 for power blades, edge upwards in the machine workpiece vice to form a pack approximately 25 mm deep.

NOTE The actual width of the pack is determined by the number and thickness of strips given in Table 1 and Table 2.

A.6 Assessment of results

Calculate the wear rate and total time as given in a) and b).

a) *Wear rate.* Wear is represented by the recorded number of strokes plotted sequentially against section number. The average increase in wear per section cut is the slope of the plotted curve.

A mathematical value for this is derived by first performing a least squares linear regression which is designed to minimize the sum of the squares of the deviations of the actual recorded data points from the straight line of best fit and then calculating the slope of the line. This can be done automatically using a scientific calculator with linear regression facilities, or manually using the following formula:

$$\text{Wear rate} = \frac{N\Sigma\ nX_n - \Sigma n\ \Sigma X_n}{N\Sigma n^2 - (\Sigma n)^2} \sum_{n=1}^{N}$$

where

Σ is the sum between $n = 1$ and $n = N$;

N is the number of cuts;

n is the cut number;

X_n is the number of strokes per cut.

Use of a test sheet as shown in Figure C.1 and Figure C.2 simplifies the calculation for practical purposes.

b) *Total time.* The total time shall be calculated by dividing the cumulative number of strokes for the allotted number of sections to be cut by the number of strokes per minute performed by the machine.

A.7 Test report

Cutting performance test results shall state the nominal dimensions and tooth pitch of the blade, the type of blade, the stroking rate per minute of the machine and the number of strips used in the pack of test bars.

The following information shall be included in the test report:

a) wear rate (to the nearest whole number);

b) total time (to the nearest minute);

c) number of cuts completed by the blade;

d) amount by which the blade cut out of square (if the amount exceeded 3 mm).

Annex B (informative)
Examples of equipment for testing hacksaw blades

B.1 Machine for hand blade testing

Commercially available power hacksaw machines may be used for performance testing but some modifications are essential to ensure reproducibility.[1)]

The dynamic loads generated by small hacksaw machines vary appreciably with variations in friction of the main slides; consequently the standard square slides fitted to machines should be replaced with two round slide bars running in linear re-circulating ball bearings. The housings for the bearings and the slide bar clamp should be jig bored. To eliminate play, the two main pivot bearings should be replaced by phosphor bronze bearings.

1) For information on the availability of proprietary hacksaw machines, write to Customer Services Information, BSI, 389 Chiswick High Road, London.

The static load exerted by the reciprocating arm including the connecting rod is measured by a spring balance hanging vertically above the test bar, and attached to the blade with the bottom of the blade at the height of the top to a test bar, as shown in Figure B.1. During these measurements, the connecting rod pin is removed and replaced by a temporary loose pin of a smaller diameter. To eliminate the effect of friction in the main pivot, it is necessary to take the average of two spring balance measurements, one for lifting and one for lowering. With the spring balance and the bow set in the correct positions, the bow is raised by hand and gently lowered until its weight is supported by the spring balance; the lowering load is then measured. The "lifting" load is measured after the bow has been depressed by hand and gently allowed to rise.

B.2 Machine for power blade testing

A commercially available power hacksaw machine[2)] can be utilized for performance testing but certain modifications are essential to ensure reproducibility. The modifications are as follows.

a) To achieve adequate synchronization of the lift-off on the non-cutting stroke, the dash pot requires the following modifications and additions.

1) The oil flow control valve should be made more sensitive by fitting a micrometer pitch screw.

2) Play should be taken out of the dash pot linkages by fitting bushes to the dash pot pivot shaft and means to prevent lateral movement of the dash pot should be provided.

3) The hydraulic booster linkage should be replaced by self-aligning roller bearings.

4) In order to maintain constant dash pot oil viscosity, a viscosity-improved hydraulic oil having a viscosity of 100 cSt[3)] at 40 °C should be used. The dash pot should be surrounded by a thermostatically controlled water bath maintained at least 20 °C above ambient temperature. The temperature required to attain the viscosity that provides accurate synchronization of lift-off may vary from machine to machine but in practice lies between 60 °C and 80 °C. Once the optimum temperature has been determined it should be controlled to ± 20 °C. The water bath heater should be switched on for at least 2 h before testing blades; furthermore the machine should be set in motion for at least 5 min with the bow in the upper position, and then the bow should be caused to lower and rise at least 10 times whilst stroking prior to testing. Lift-off synchronization should be checked by tracing the path of the bow by means of a pencil attached to the bow at regular intervals whilst testing.

b) To minimize the rate of wear, the oilite bearings of the main pivot require replacing by phosphor bronze bearings.

c) To achieve an adequate supply of coolant, a larger pump is required

d) To supply at least 2 l/min, a larger tank with a capacity of at least 27 l is required.

e) To achieve the correct loading the static loads should be set as in Table A.2.

The static load is measured by a spring balance hanging vertically above the test bar and attached to the blade when the bottom of the blade is at a height corresponding to the top of the test bar as shown in Figure B.2. The connecting rod pin should be removed and replaced by a temporary loose pin of smaller diameter whilst the load is being measured.

To eliminate the effect of friction in the main pivot, it is necessary to take the average of two spring balance measurements, one for lowering, and one for lifting. The former is taken by raising the bow and gently lowering it until its weight is supported by the spring balance; the latter lifting load is measured after the bow has been depressed by hand and gently allowed to rise.

f) To clamp the pack of the test bars at both sides of the saw cut, a special test bar clamp, shown in Figure B.3 is required.

g) To lower the saw frame gently on to the test bars a light hand-operated hoist is recommended (an 8:1 motor cap hoist with nylon cord is available from motor accessory shops and has been found very suitable).

[2)] For information on the availability of proprietary hacksaw machines, write to Customer Services Information, BSI, 389 Chiswick High Road, London.

[3)] 1 cSt = 1 mm^2/s.

B.3 Measurement of blade angle

Measurement of blade angle with respect to the main slides may be carried out in the following manner. A blade with its back edge machine ground so that it is straight over its whole length is tensioned in the bow with its back edge uppermost. A stop is introduced so that the main slides rest parallel with respect to the vice bed; this can be checked with a spirit level. The bow should remain unsupported and free to reciprocate. A dial gauge with a magnetic base is located on the vice bed in a suitable single position is used to measure arbitrary vertical heights from the top of the machined face of the blade when the bow is at each end of its stroke. The difference between these two measurements divided by the actual stroke length will give the tangent of the blade angle relative to the main slides. To compensate for possible errors in positioning of pin holes the blade is re-tensioned in the bow in the opposite direction, the above procedure is repeated, and the average of the results is taken to be the measured blade angle.

B.4 Measurement of blade tension

The number of turns of the blade tensioning screw necessary to apply the specified stress to a blade of a given size may be determined as follows.

Apply to the blade the specified stress of 170 N/mm^2 ± 40 N/mm^2 in a tensile testing machine and measure the extension over a 50 mm gauge length near the blade centre by means of an extensometer so that the number of turns of the blade tensioning screw necessary to give the required extension can be determined.

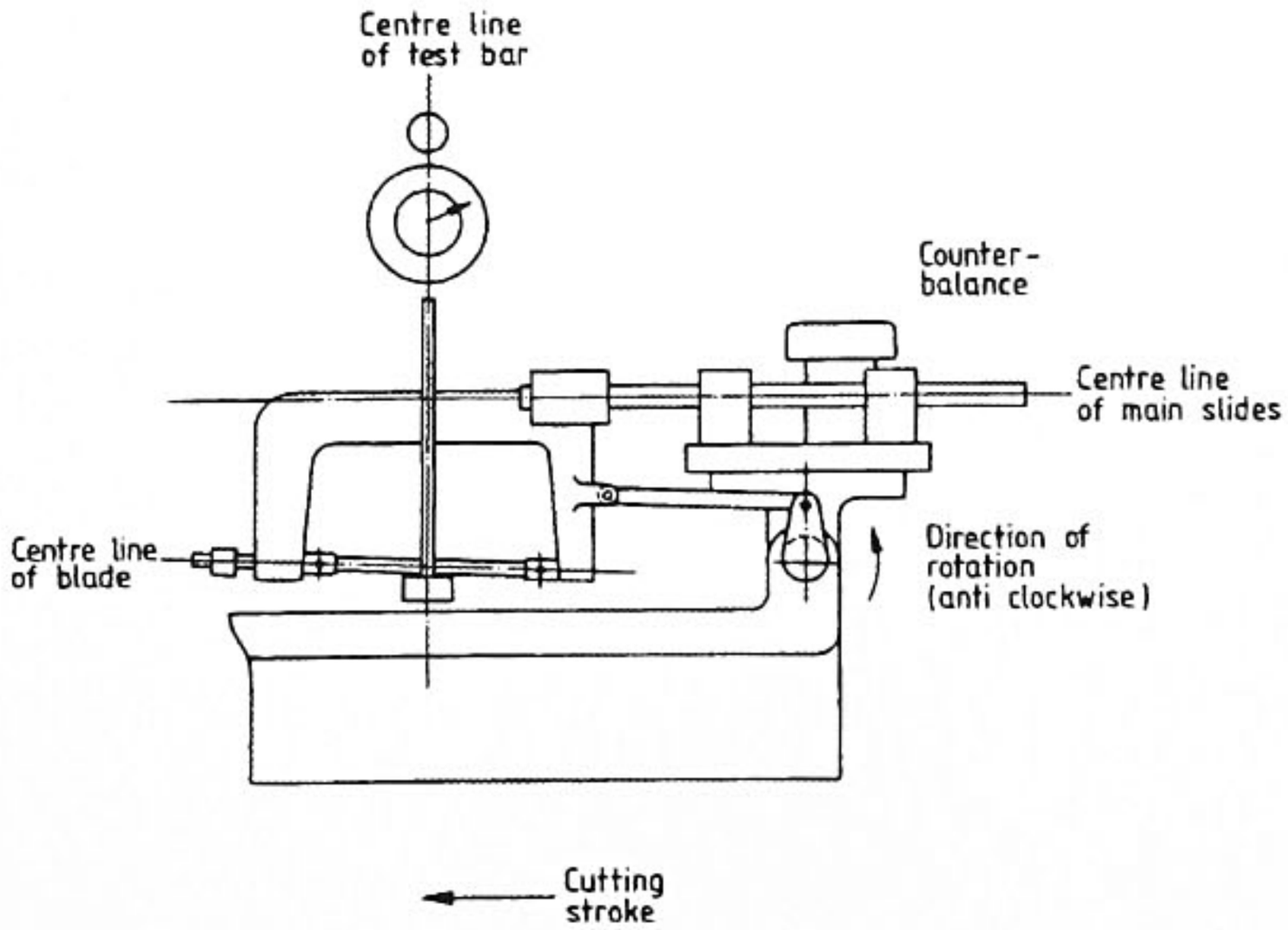
NOTE When determining the load necessary to give the specified stress, the cross-sectional area is measured from the root of the tooth.

B.5 Guidance for preparation of power blade samples to gauge length

The capacity of the testing machine for power blades may provide a length limitation prohibiting the testing of blades of 400 mm and 450 mm length. Blades should be shortened to a gauge length of 350 mm (overall length 380 mm), and the pinhole should be redrilled to correct size and position. The shortening process should be carried out by the manufacturer.

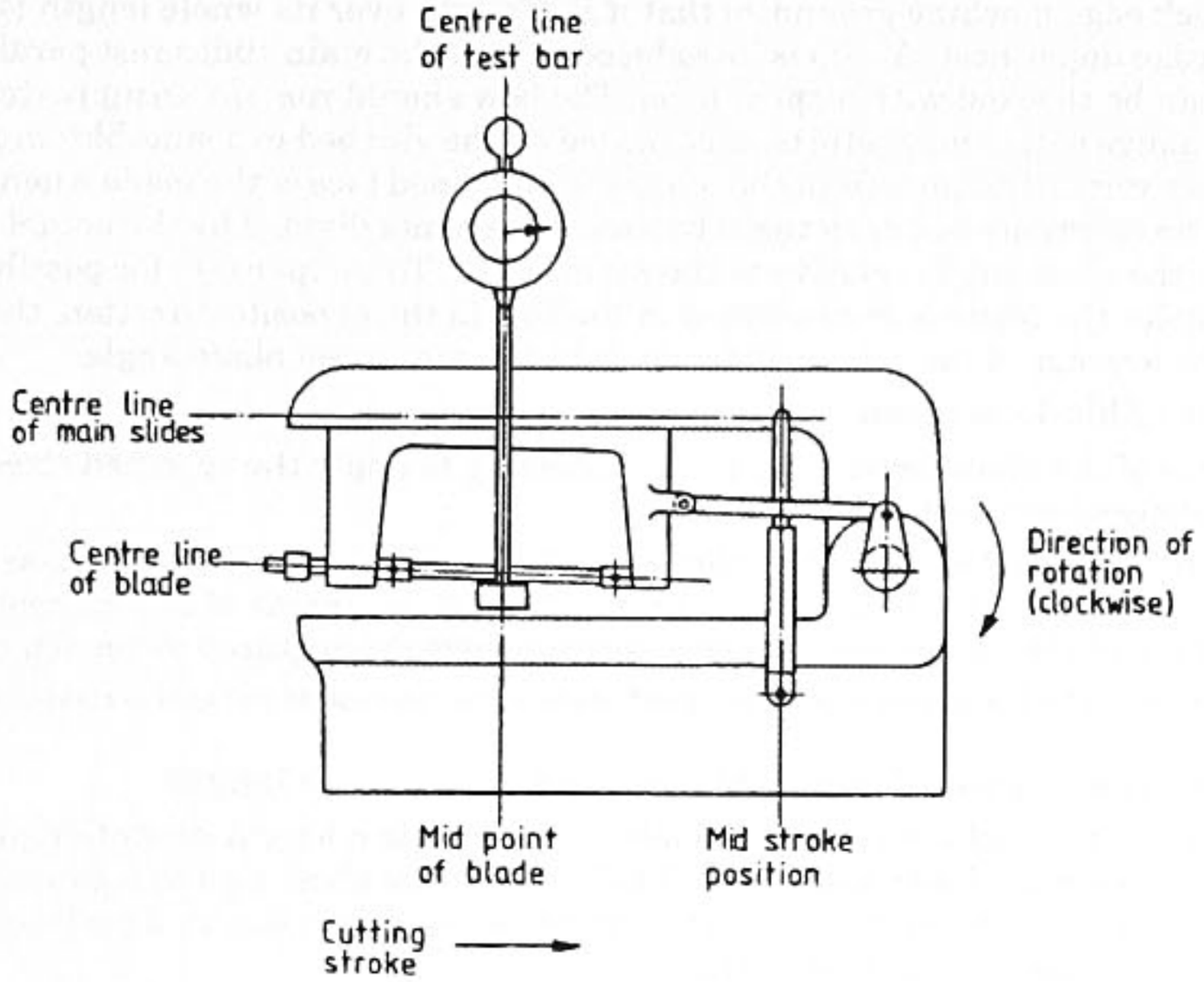
However, if the blades are to be shortened for test by the user then the shortened blade should be correctly softened in the area of the pin hole without reducing the hardness of the teeth blade in the areas to be submitted to the cutting test. Failure to do so invalidates the test.

If the testing machine cannot accommodate blades of 300 mm in length, then the blade clamping mechanism(s) within the machine should be extended.



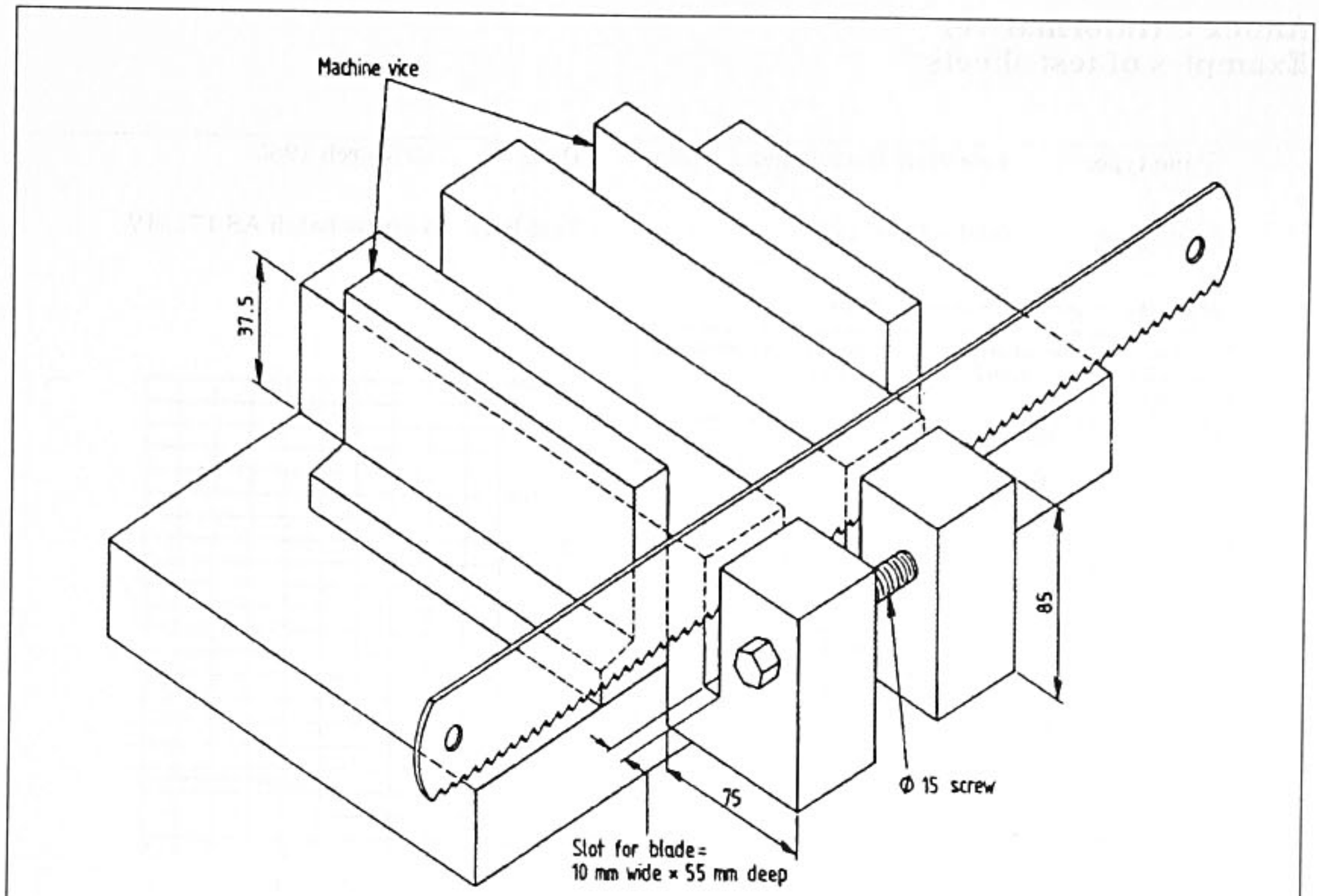
NOTE The blade shall be at an angle of 1° 15' ± 10' relative to the machine slides in the direction of cut.

Figure B.1 — Method of measuring static load (hand blade test)



NOTE The blade shall be at an angle of 1° 40' ± 10' relative to the machine slides in the direction of cut.

Figure B.2 — Method of measuring static load (power blade test)



All dimensions are in millimetres

Figure B.3 — Test bar clamp

Annex C (informative)
Examples of test sheets

Blade type: Low alloy flexible hand blade

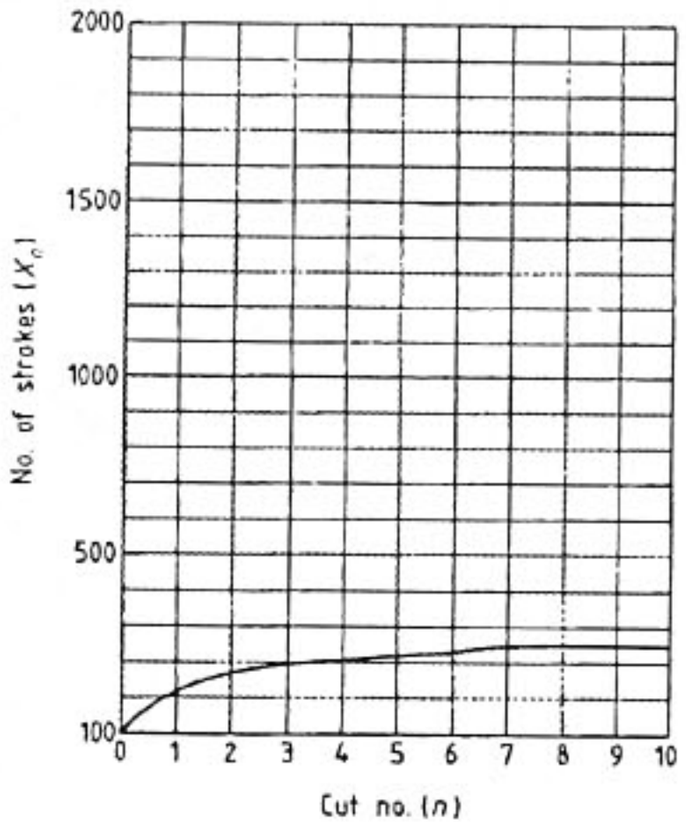
Date: 19 March 1983

Blade size: 0.63 × 0.8 F (32)

Test bar: 4 strips batch AS 171 HV

Machine speed: 35 strokes/min.

Cut number *(n)*	No. of strokes *(Xn)*	Product *(n Xn)*	Comments
1	221	221	
2	268	536	
3	296	888	
4	305	1 232	
5	315	1 575	
6	335	2 010	
7	350	2 450	
8	366	2 928	
Total	2 459	11 840	



$$\text{Wear rate} = \frac{(8 \times 11840) - (36 \times 2459)}{336} = 18$$

$$\text{Total time} = \frac{2459}{35} = 70 \text{ min}$$

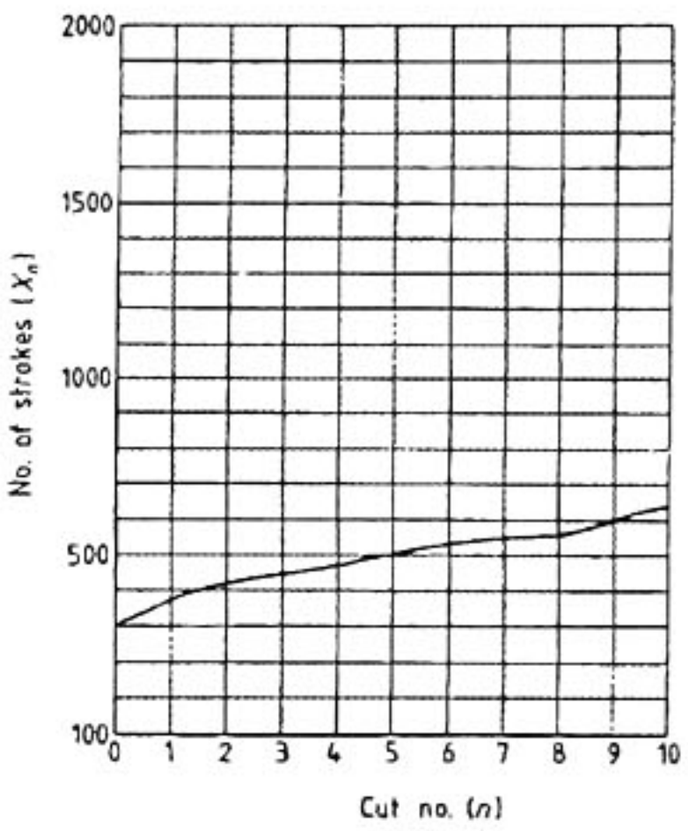
Comments:

Figure C.1 — Test record sheet for 8 cut test

Blade type:	Power blade 350 mm × 25 mm	Date:	13 March 1983
Blade size:	1.25 × 1.8 P(14)	Test bar:	15 strips batch HS 17H

Machine speed: 124 strokes/min.

Cut number *(n)*	No. of strokes *(Xn)*	Product *(n Xn)*	Comments
1	370	370	
2	410	820	
3	438	1 314	
4	478	1 912	
5	498	2 490	
6	514	3 084	
7	533	3 731	
8	567	4 536	
9	600	5 400	
10	619	6 190	
Total	5 027	29 847	



$$\text{Wear rate} = \frac{(10 \times 29847) \times (55 \times 5027)}{825} = 27$$

$$\text{Total time} = \frac{5027}{124} = 41 \text{ min}$$

Comments:

Figure C.2 — Test record sheet for 10 cut test

List of references (see clause 2)

Normative references

BSI standards publications

BRITISH STANDARDS INSTITUTION, London

BS 1919, *Hacksaw blades.*

BS 1919-1:1993, *Specification for hand and machine hacksaw blades.*

BS 1449, *Steel plate, sheet and strip.*

BS 1449-2:1983, *Specification for stainless and heat-resisting steel plate, sheet and strip.*

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