BRITISH STANDARD

BS 3507:1976

Specification for

Orthodontic wire and tape and dental ligature wire

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Co-operating organizations

The Dental Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and professional organizations:

Association of Dental Hospitals of Great Britain and Northern Ireland
British Dental Association
British Dental Trade Association
Dental Education Advisory Council
Department of Health and Social Security*
Department of Trade and Industry-Laboratory of the Government Chemist*
Department of Trade and Industry-National Engineering Laboratory
Ministry of Defence
Royal Society of Medicine
Scottish Home and Health Department

The Government departments marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this standard:

British Institute of Surgical Technicians
British Society for the Study of Orthodontics
British Steel Industry
Dental Laboratories Association

This British Standard, having been prepared under the direction of the Dental Industry Standards Committee, was published under the authority of the Executive Board on 30 April 1976

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Contents

Foreword

This British Standard was prepared under the authority of the Dental Industry Standards Committee as part of a programme for preparation of standards relating to dental materials, instruments and equipment.

The purpose of the specification is to standardize a range of sizes and to specify the quality of wire and tape used for orthodontics, particularly in relation to strength and ductility, and in this respect little has changed since publication of the first edition in 1962. A number of developments in orthodontic techniques have, however, taken place and these, together with the increase in experience pertaining to the testing of the wires and tapes, have prompted the present complete revision of this standard.

The use of multi-strand wires in orthodontics has become much more popular in the UK during recent years and sufficient data on their physical characteristics have now been obtained to include a separate section giving relevant performance and dimensional requirements. These wires have certain very special properties, and a new approach to testing has been developed to give the type of information that is of significance in their clinical application.

Because of the continuing use of a wide variety of tape sizes, it has been decided that consumer interest would be served best by omitting any specific range of nominal dimensions and requiring only that the sizes stated by the manufacturer conform to certain limits on tolerance.

The introduction of new corrosion-resistant alloys for use in orthodontics is now a very real possibility. With this in mind the various references to stainless steel, which formed part of the previous edition of this standard, have been modified to permit the use of alternative alloys.

Throughout this British Standard, SI units and their multiples and submultiples have been used. Information on the International System of units (SI) is given in BS 3763 "*The International System of units (SI)*" and PD 5686 "*The use of SI units*". Tables of conversion are given in Supplement No. 1 "Additional tables for SI conversions" to BS 350 "*Conversion factors and tables*' Part 2 "*Detailed conversion tables*".

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 4, 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 British Standard relates to

a) hard drawn wire for orthodontic use;

b) extra hard drawn wire for orthodontic use;

c) multi-strand wire for orthodontic use;

d) tape for orthodontic use;

e) soft wire (ligature wire) for use in dentistry.

2 References

The titles of the British Standards referred to in this standard are listed on the inside back cover.

3 General

3.1 Defects. The wire or tape shall be manufactured in accordance with good practice and shall be free from harmful defects such as seams and laps.

3.2 Coils. Wire supplied in coils shall lie flat without any substantial corkscrew set.

3.3 Weldability. If the wire or tape is not suitable for welding this shall be clearly indicated.

4 Hard drawn wire

4.1 Materials. The wire shall be made from a suitable austenitic stainless steel that has a chromium content of not less than 13 % by mass, or an alloy other than stainless steel of suitable corrosion resistance.

NOTE Grade 302S25 stainless steel specified in BS 970-4 would be suitable.

If an alloy other than stainless steel is used, the manufacturer shall be able to produce, on request, evidence of adequate clinical trials having been carried out to establish the alloy's suitability for use in the oral environment.

4.2 Size range. The diameter shall be designated in millimetres and the size range shall be in accordance with Table 1.

4.3 Tensile strength. When tested in accordance with BS 4545, the tensile strength shall be in accordance with Table 1 of this standard.

4.4 Resistance to failure on bending. When tested in accordance with the method described in clause **9**, hard drawn wire shall withstand without breaking the number of complete bending cycles specified in Table 2.

4.5 Condition. The wire shall be in the cold drawn condition.

4.6 Finish. The wire shall have a clean smooth finish.

Table 1 — Hard drawn wire. Size range and tensile strength

Diameter	Tolerance	Tensile strength
mm	mm	N/mm^2
1.5 1.25 1.15	± 0.025	1 500 to 1 700
1.0 0.9 0.8	± 0.012	1 700 to 1 900
0.7 0.6 0.5	± 0.012	1 850 to 2 050
0.45 0.4 0.35 0.30	± 0.012 ± 0.012 ± 0.012 ± 0.006	2 000 to 2 200
0.25 0.20 0.15	± 0.006	2 200 to 2 400

Table 2 — Hard drawn wire. Resistance to failure on bending

Size	Deflection from zero position, angle α (see Figure 1)	Minimum number of bending cycles
mm	degrees	
1.5 1.25 1.15	30	4
1.0 0.9 0.8 0.7	30	12
0.6 0.5 0.45 0.4 0.35 0.3	40	15
0.25 0.20 0.15	40	20

5 Extra hard drawn wire

5.1 Material. The wire shall be made from a suitable austenitic stainless steel that has a chromium content of not less than 13 % by mass, or an alloy other than stainless steel of suitable corrosion resistance.

NOTE Grade 302S25 stainless steel specified in BS 970-4 would be suitable.

If an alloy other than stainless steel is used, the manufacturers shall be able to produce, on request, evidence of adequate clinical trials having been carried out to establish the alloy's suitability for use in the oral environment.

5.2 Size range. The diameter shall be designated in millimetres and the size range shall be in accordance with Table 3.

5.3 Tensile strength. When tested in accordance with BS 4545, the tensile strength of extra hard drawn wire shall be not less than 2 500 N/mm^2.

5.4 Resistance to failure on bending. When tested in accordance with the method described in clause **9**, extra hard drawn wire shall withstand without breaking the number of complete bending cycles specified in Table 4 (see also **9.1.3**).

5.5 Condition. The wire shall be in the cold drawn condition.

5.6 Finish. The wire shall have a clean smooth finish.

Table 3 — Extra hard drawn steel wire. Size range

Diameter	Tolerance
mm	mm
0.55 0.50 0.45 0.40 0.35 0.30	± 0.012

Table 4 — Extra hard drawn steel wire. Resistance to failure on bending

Size	Deflection from zero position, angle α (see Figure 1)	Minimum number of bending cycles
mm	degrees	
0.55 0.50 0.45 0.40 0.35 0.30	40	15

6 Multi-strand wire

6.1 Formation. Multi-strand wire shall be formed from a number of individual strands evenly twisted together. A non-toxic adhesive may be used.

When the wire is cut, the individual strands shall not unravel.

6.2 Material. The wire shall be made from a suitable austenitic stainless steel that has a chomium content of not less than 13 % by mass, or an alloy other than stainless steel of suitable corrosion resistance.

NOTE Grade 302S25 stainless steel specified in BS 970-4 would be suitable.

If an alloy other than stainless steel is used, the manufacturer shall be able to produce, on request, evidence of adequate clinical trials having been carried out to establish the alloy's suitability for use in the oral environment.

6.3 Size range. The effective diameter[1)] shall be designated in millimetres and the size range shall be in accordance with Table 5.

6.4 Flexural rigidity. When tested in accordance with **9.2**, the flexural rigidity of a wire shall be within ± 10 % of the value stated by the manufacturer (see **10.2**).

6.5 Minimum elastic radius. When tested in accordance with **9.3** the radius of the mandrel round which a suitable length of wire may be wrapped without acquiring a permanent set shall be not greater than that stated in Table 6 for the relevant wire diameter.

6.6 Finish. The wire shall be supplied in straight lengths that show no significant spiral.

Table 5 — Multi-strand wire. Size range

Diameter	Tolerance
mm	mm
0.55 0.50 0.45 0.40 0.375	+ 0 – 0.025

Table 6 — Minimum elastic radius

Diameter	Radius of mandrel
mm	mm
0.55	20
0.50	15
0.45	12
0.40	11
0.375	10

[1)] Effective diameter is the internal diameter of the smallest tube through which the wire would pass.

7 Orthodontic stainless steel tape

7.1 Material. The tape shall be made from a suitable austenitic stainless steel that has a chromium content of not less than 13 % by mass or an alloy other than stainless steel of suitable corrosion resistance.

7.2 Size range. The size (width and thickness) shall be designated in millimetres and shall be within the following tolerances:

a) width

up to and including 8.0 mm	± 0.1 mm
above 8.0 mm	± 0.125 mm

b) thickness

up to and including 0.15 mm	± 0.004 mm
above 0.15 mm	± 0.006 mm

7.3 Tensile strength. When tested in accordance with BS 4545, the tensile strength of the tape shall be not more than 850 N/mm^2.

7.4 Condition. The tape shall be in the fully softened condition.

7.5 Finish. The tape shall have a high polish on one side and a clean smooth finish on the other side.

8 Ligature wire (soft wire) for use in dentistry

The composition and performance requirements for ligature wire described in this clause are intended to cover its application to "non-surgical" procedures. Ligature wire used in a submucous or subcutaneous situation becomes, in practical terms, an implant and as such there are obviously a number of other special qualities that this specification would have to take into account, were it intended to be applied to wires used for such purposes.

8.1 Material. The material shall comply with the formulation of 304S15 or 316S16 stainless steel specified in BS 970-4, or be an alloy other than stainless steel of suitable corrosion resistance.

If any alloy other than stainless steel is used, the manufacturer shall be able to produce, on request, evidence of adequate clinical trials having been carried out to establish the alloy's suitability for use in the oral environment.

8.2 Size range. The diameter shall be designated in millimetres and the size range shall be in accordance with Table 7.

Table 7 — Ligature wire (soft wire). Size range

Diameter	Tolerance
mm	mm
0.70 0.60 0.50 0.45 0.40	± 0.012
0.30 0.25 0.20 0.15	± 0.006

8.3 Tensile strength. When tested in accordance with BS 4545 and using a test specimen of 250 mm gauge length, the tensile strength of the wire shall be not more than 850 N/mm^2. The elongation shall be not less than 30 %.

8.4 Condition. The wire shall have a clean smooth surface and be in the fully softened condition.

9 Test methods

9.1 Determination of resistance to failure on bending.

9.1.1 *Apparatus.* An apparatus of the type illustrated in Figure 1, which can be used for gripping a wire test piece and bending it through a specified angle. The apparatus illustrated comprises

a) a vice with the upper edges of the jaws radiused to 0.5 mm;

b) a protractor scale which can be used for measuring the bending angle;

c) a pin vice.

9.1.2 *Procedure.* Use a wire test piece of approximately 7 mm length and grip one end firmly in the pin vice so that at least 4 mm of wire is left exposed. Grip this exposed wire firmly in the jaws of the vice so that the distance between the top surface of the vice and the end of the (pin vice) chuck is 1.0 mm as set by a slotted slip gauge.

Starting with the specimen upright in a position of zero deflection, bend first left and then right to the relevant angle specified in Table 2 or Table 4. The cycle from left deflection to right and back to left again shall constitute one bending cycle. Carry out this bending at a rate of half a cycle per second and in such a manner as to prevent rotation and collapse of the specimen.

9.1.3 *Retests.* If the original specimen selected does not pass this test, two further specimens representing the same batch shall be tested in the same manner. The wire shall be deemed to comply with the requirements of this specification only if both additional test specimens meet the relevant requirements.

9.2 Procedure for determining flexural rigidity (EI).

Determine the flexural rigidity using a cantilever beam test as follows:

Use a straight wire test piece of not less than 120 mm length and put a small V-shaped kink as near one end as possible. Clamp the other end in a rigid framework so that the wire is horizontal with the V kink vertical and its apex 100 ± 1 mm from the jaws of the clamp. Suspend a piece of wire of mass 0.125 ± 0.010 g from the V kink and measure to an accuracy of ± 0.02 mm the vertical deflection of the apex of the V using a Vernier microscope.

Calculate the flexural rigidity (EI), in N mm^2, from the formula

$$EI = \frac{FL^3}{3d}$$

where

F is the force (N);

L is the length of wire (mm);

d is the deflection (mm).

9.3 Procedure for determining minimum elastic radius.

Determine the minimum elastic radius with a straight wire test piece of approximately 130 mm length.

Bend this wire one complete turn round a mandrel, of the size detailed in Table 6 for the diameter of wire being tested, hold and then allow a slow, controlled release.

Check the test piece against a similar length of untested wire for any permanent set.

10 Marking

10.1 All wires and tapes. Packages of orthodontic wire and tape and of dental ligature wire shall be marked with the following:

a) the name or trade mark of the manufacturer or supplier;

b) the size designation in millimetres in accordance with this British Standard;

c) the number of this British Standard, i.e. BS 3507.

10.2 Multi-strand wires. Packages of multi-strand wire shall be marked with a nominal value for flexural rigidity, in N mm^2, determined using the test procedure described in **9.2**.

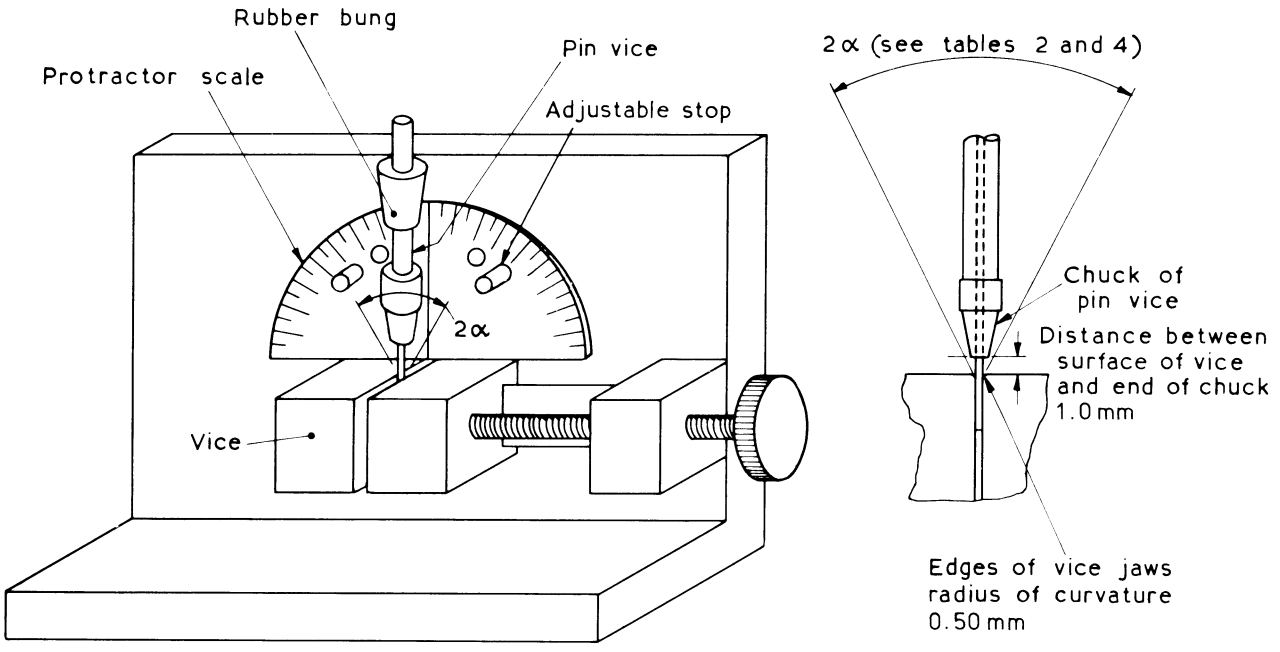

Figure 1 — Diagram illustrating suitable apparatus for determination of resistance to failure on bending

Publications referred to

This standard makes reference to the following British Standards:
BS 970, *Wrought steels in the form of blooms, billets, bars and forgings.*
BS 970-4, *Stainless, heat resisting and valve steels.*
BS 4545, *Methods for mechanical testing of steel wire.*

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