

Cylindrical helical springs made from round wire and bar — Guide to methods of specifying, tolerances and testing —

Part 3: Torsion springs

ICS 21.160

Committees responsible for this British Standard

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British Impact Treatment Association
Institute of Spring Technology

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Foreword

BS 1726-3 was first published in 1951 and revised in 1964 to incorporate much of the essential information from ADE Design Data Sheets, which were no longer available from HM Stationery Office and for which copyright permission to republish was obtained. The standard was revised in 1987 to take account of current manufacturing processes.

BS EN 13906-3 was published in 2001 and under the rules of CEN the UK is obliged to withdraw conflicting standards.

This edition of BS 1726-3 includes those provisions of the previous edition not included in the EN standard.

Together with BS 8726-2:2002 and BS EN 13906-3:2001, this edition of BS 1726-3 supersedes BS 1726-3:1988, which is withdrawn.

BS 1726 is published in three parts:

- *Part 1: Compression springs;*
- *Part 2: Extension springs;*
- *Part 3: Torsion springs.*

BS 8726-2:2002 contains the provisions for design of compression springs made from square and rectangular material previously contained in BS 1726-3.

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.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document consists of a front cover, an inside front cover, pages i and ii, pages 1 to 15 and a back cover.

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1 Scope

This Part of BS 1726 provides guidance on the specification, tolerancing and testing of parallel sided helical torsion springs manufactured from round wire and bar.

It applies to springs which may or may not be stress relieved after forming (hereinafter referred to as group A springs) and to springs the material of which has undergone a structural change by heat treatment after forming (hereinafter referred to as group B springs).

This standard gives two methods of specifying springs for general purposes and one method of testing springs.

NOTE It is not recommended that torsion springs be loaded in the opposite direction to that of coiling. If this is necessary then discussions should take place between purchaser and supplier.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 887, *Specification for precision vernier callipers.*

BS 969, *Specification for limits and tolerances on plain limit gauges.*

BS EN ISO 7500-1, *Tension/compression testing machines — Verification and calibration of the force measuring system.*

BS 1726-1, *Cylindrical helical springs made from round wire and bar — Guide to methods of specifying, tolerances and testing — Part 1: Compression springs.*

BS EN 13906-3, *Cylindrical helical springs made from round wire and bar — Calculation and design — Part 3: Torsion springs.*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this Part of BS 1726 the definitions given in BS 1726-1 apply.

3.2 Symbols

Symbol	Term	Unit
c	spring index	mm
D	mean coil diameter	mm
ΔD	change in mean coil diameter	mm
D_o	outside diameter	mm
$D_{tol.}$	mean coil diameter tolerance	mm
d	material diameter	mm
$d_{max.}$	maximum diameter of circular section material allowing for material size tolerance	Hz
e	tolerance on size of material cross-section	mm
E	modulus of elasticity	N/mm ²
F_T	tolerance factor for torque	—
K_o	stress correction factor for circular section wire	—
l	combined effective length of legs	mm
L_o	free body length of spring	mm
$L_{o, tol.}$	tolerance on free body length	mm
L_t	loaded body length of spring	mm
m	shape factor	mm

Symbol	Term	Unit
n	number of active coils in spring	—
Δn	change in number of active coils during loading	—
N	total number of coils in spring	—
p	pitch	mm
$R_{\min.}$	minimum allowable inside radius of any bend	mm
S_{θ}	nominal torsional rate	N·mm/degree
t	thickness of any surface coating	mm
T	torque at any angle	N·mm
$T_{\text{tol.}}$	tolerance on torque	N·mm
ΔT	change in torque	N·mm
α	relative leg orientation under torque	degrees
α_0	relative leg orientation in free state	degrees
$\alpha_{\text{tol.}}$	tolerance on relative leg orientation	degrees
θ	angular rotation of spring	degrees
σ	Bending stress in spring	N/mm ²

4 Specifying springs for general purposes

4.1 General

There are two methods by which a customer may specify a spring. In the first method the customer presents the supplier with a complete design and indicates what manufacturing processes, such as stress relieving, prestressing and shot peening, should be carried out. In this case the information should be supplied on Data Sheet 1 (Figure 1).

When the customer does not have the information to complete Data Sheet 1, the customer should complete Data Sheet 2 (Figure 5). This is an application for a spring design in which the customer should specify the requirements from an operational point of view, giving such information as dimensional constraints, force-length parameters, fatigue life, resistance to corrosion, in order that the supplier can produce a spring design to meet these requirements.

When the spring supplier has prepared a design from the information on Data Sheet 2, the supplier will complete Data Sheet 1 and submit it to the customer for approval.

4.2 Method one (customer design)

4.2.1 Use of Data Sheet 1

Details of the required spring should be supplied on Data Sheet 1 (Figure 1) using standard nomenclature. Only the essential dimensions and properties, for which the spring is to be inspected, should be toleranced, although other features may be included for information.

SPECIFICATION FOR HELICAL TORSION SPRINGS BS 1726-3:2002 DATA SHEET 1		Part Serial No. _____
This form should be completed with reference to BS 1726-3:2002 Clause 4.2		
Torque test layout if required	5 Thermal treatment	
	(a) Stress relieving (group A)	
	No _____ Yes _____	
	If yes Time _____ min Temperature _____ °C	
(b) Heat treatment and hardness (group B)		
6 Maximum deflection		
Maximum deflection _____ Rev _____ degree		
7 Dimensional tolerances		
Outside diameter, _____ mm		± _____ mm
Free body length, _____ mm		± _____ mm
Leg length: 1 ± _____ mm ²		± _____ mm
Free relative leg orientation, _____ mm		± _____ mm
1 Material	8 To be completed only if torque testing is a requirement	
Specification No. _____	8.1 Rate	
Diameter _____ mm	S_0 _____ N·mm/degree;	
2 Direction of coiling	8.2 Torque	
Right Hand _____ Left Hand _____	at Test position 1 (TP1) _____ N·mm	
	at Test position 2 (TP2) _____ N·mm	
3 Form and length of legs	8.3 Property tolerances (Select only 2)	
Leg 1 Leg 2	Rate, ± _____ N·mm/degree	
Axial	Free relative leg orientation, ± _____ degree	
Tangential	Torque at TP1 ± _____ N·mm	
Radial Over-centre	Torque at TP2 ± _____ N·mm	
Radial Over-centre	9 Surface coating	
Lengths _____ mm _____ mm	10 Identification	
4 Nominal dimensions	11 Special requirements	
Outside diameter D_o _____ mm		
Mandrel diameter (max.) _____ mm		
Free body length, L_o _____ mm		
Number of coils, N _____		
Free relative leg orientation, α_o _____ mm		
Sheet 1 of _____	Serial/design/Part No. _____	

Figure 1 — Data sheet 1

A detailed drawing is not necessary where the required spring conforms to the standard types, as shown in Figure 2. Only for those springs that require special leg geometry is a detailed drawing necessary.

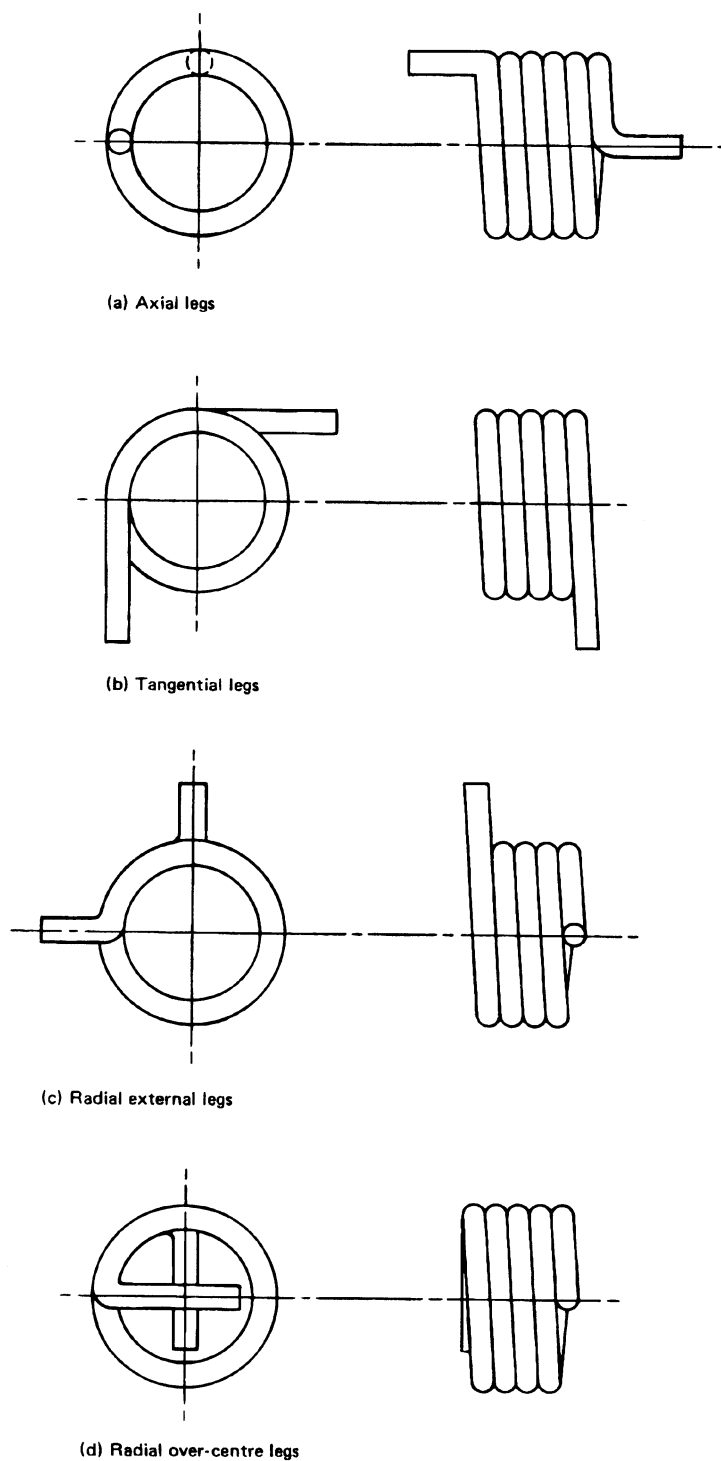


Figure 2 — Form of legs

Before completing Data Sheet 1, the designer should determine whether torque testing is a requirement. This decision affects tolerances for certain parameters (see 5.2 and 5.3), which boxes are to be completed, and the need or otherwise for a torque testing layout. If torque testing is a requirement then a test layout should be presented either on, or as a supplement to, Data Sheet 1. Complete the data sheet in accordance with 4.2.9.1.

The designer should be fully aware of the aforementioned guidelines and comply with the following.

a) Specify only those particulars which are of functional importance by marking the appropriate squares and/or by entering the relevant values in each box.

NOTE Box 8 is only to be completed if torque testing is required.

b) Avoid redundant dimensioning.

c) Refer to BS EN 13906-3 for the methods of calculation used to determine values for rate, torque, stress, etc.

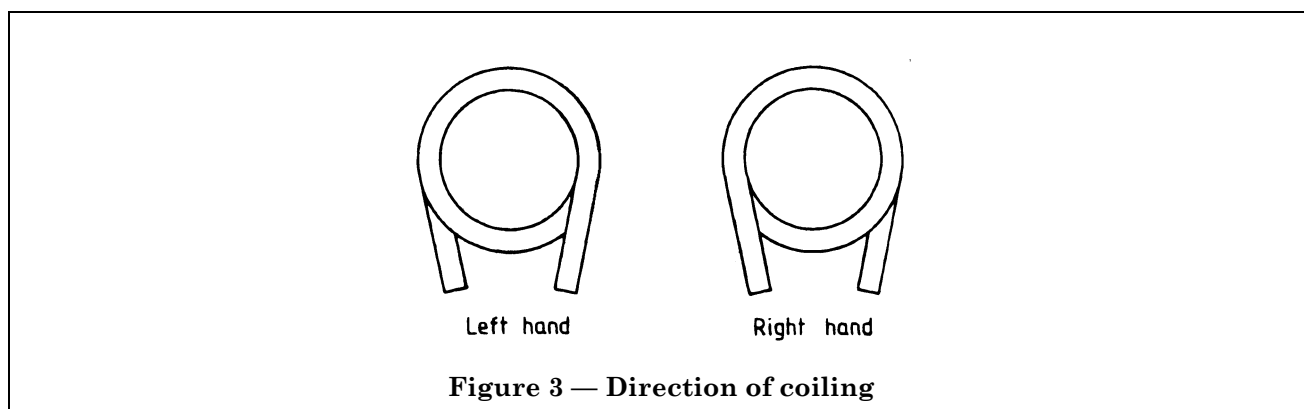
d) If space is insufficient in any box, details should be entered on a supplementary sheet and attention drawn to this fact in the appropriate box.

4.2.2 Material

Complete box 1, by giving the material type and specification code quoting the relevant British Standard wherever possible. In cases where torsion springs are produced from annealed material or are manufactured by a hot coiling method, they may require subsequent heat treatment (group B). If this is the case, specify the final hardness required and the process to be used, e.g. austemper, harden and temper.

4.2.3 Direction of coiling

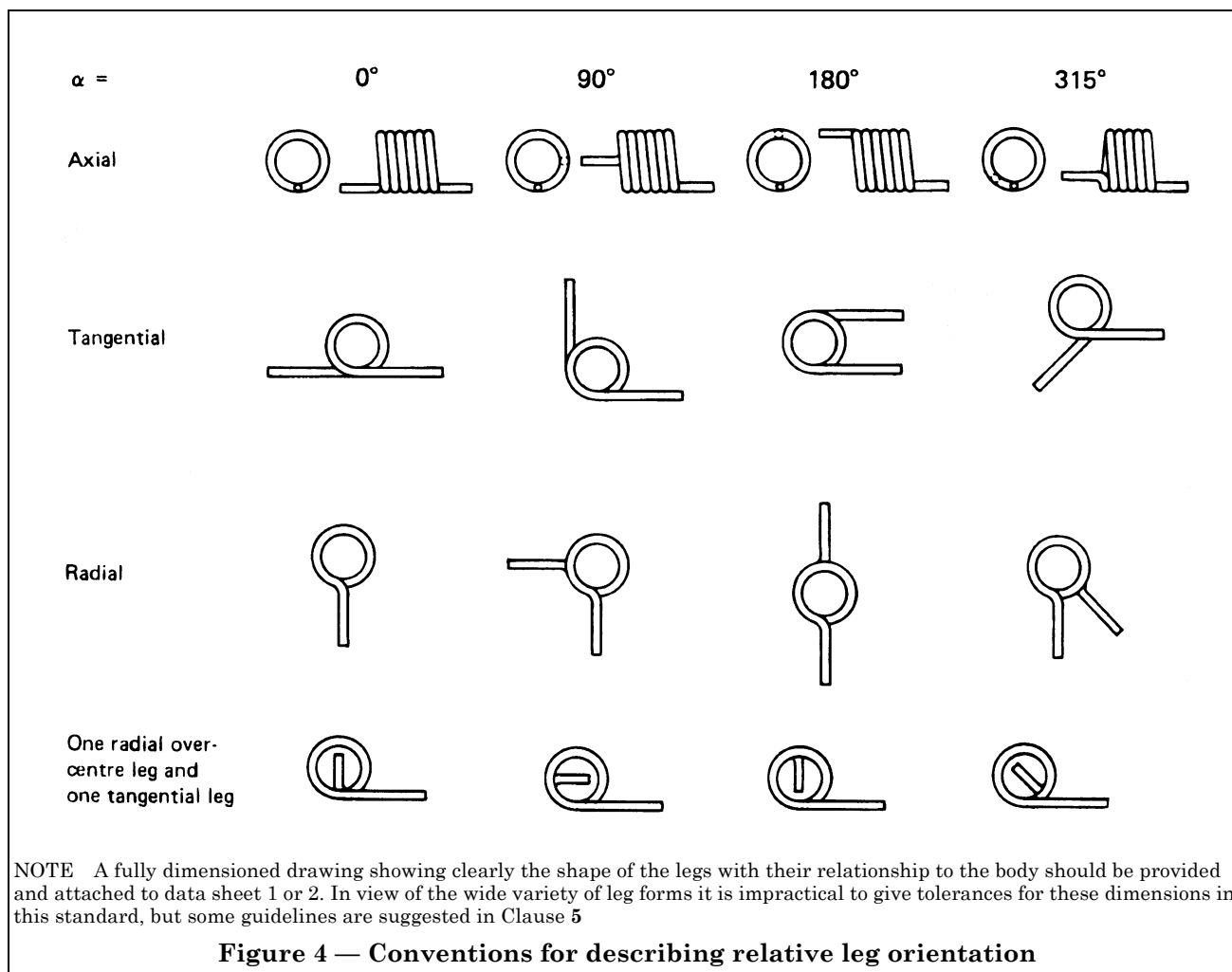
The action of the spring is dependent on the direction of coiling. Enter the direction of coiling in box 2. Figure 3 shows the convention for defining direction of coiling.



4.2.4 Form and lengths of legs

Where the legs are of a standard form (see Figure 4), indicate the form in box 3 together with the appropriate lengths. Alternatively, provide a detailed drawing on Data Sheet 1 or attach a supplementary drawing sheet.

A fully dimensional drawing showing clearly the shape of the legs with their relationship to the body should be provided and attached to Data Sheet 1 or 2. In view of the wide variety of leg forms it is impractical to give tolerances for these dimensions in this standard, but some guidelines are suggested in Clause 6.



4.2.5 Nominal dimensions

The dimensions to be entered in box 4 are for information only unless a corresponding tolerance is to be applied in box 7 and, in the case of relative leg orientation when torque testing is required, when entries should be made in box 8.

4.2.5.1 Outside diameter, D_o

Enter the outside diameter of the coil.

4.2.5.2 Mandrel diameter

Enter the maximum diameter over which the spring is to operate. This is also the size of mandrel that will be used for testing the spring if torque testing is a requirement. Due allowance should be made for a reduction in inside diameter during loading.

4.2.5.3 Free body length, L_o

Enter the free body length.

Group B springs cannot generally be produced with completely closed coils and account of this should be taken when stating free body length.

4.2.5.4 Number of coils, N

Only enter the number of full coils.

4.2.5.5 *Relative leg orientation, α_0*

The convention for the description of relative leg orientation is directly related to the number of part coils in the spring. Examples of this are shown in Figure 4.

4.2.6 *Thermal treatment*

4.2.6.1 If stress relieving is required for group A springs, the duration and temperature should be given in box 5(a).

4.2.6.2 Heat treatment and hardness requirements for group B springs should be given in box 5(b).

4.2.7 *Maximum deflection*

Indicate in box 6 the maximum elastic deflection, in revolutions and degrees, through which the legs have to move relative to each other.

A degree of prestressing is automatically present in a cold coiled torsion spring as a result of winding the coils. Consequently, it is rarely necessary to carry out a secondary prestressing operation. Springs that are hot coiled or hardened and tempered after coiling do not contain an element of prestress. If prestressing is required this should be stated in box 11.

4.2.8 *Dimensional tolerances*

The tolerances to be entered in box 7 will depend on whether torque testing is a requirement.

4.2.8.1 *Outside diameter*

Refer to either 5.2.2 or 5.3.1 for the appropriate tolerance.

4.2.8.2 *Free body length*

Refer to 5.2.3 for tolerance on free body length. This tolerance is only to be stated if torque testing is not required.

4.2.8.3 *Leg length*

Refer to 5.4.4 for leg length tolerances.

4.2.8.4 *Relative leg orientation*

Refer to 5.2.4 or 5.3.3 for the relative leg orientation tolerance. This is only to be entered if torque testing is not required.

4.2.9 *Properties*

4.2.9.1 *Torque testing*

Only complete box 8 if torque testing is required. However, to avoid over-dimensioning the spring it is necessary to be aware that no more than two parameters are needed to define torque performance.

In addition to the details in box 8 a torque testing layout should also be provided either on or as a supplement to Data Sheet 1. The example in Figure 6 indicates the information that should be included, in accordance with the following.

- a) Test angles and radii should be shown relative to the anchorage points and test mandrel, not relative to the spring (except in the case of nominal prewind from the nominal free position).
- b) Angles should be shown in the direction of increasing torque.
- c) Springs will not necessarily have relative free leg orientations that correspond precisely to the torque testing layout owing to the relative leg orientation tolerance. In such cases, for the purposes of testing, the free leg should be considered as prepositioned to the nominal free position (either by prewinding or back winding) before commencing the test.
- d) For applications where prepositioning cannot be accommodated in the assembly of which the spring is a part, the property tolerances should be agreed between customer and supplier.

4.2.9.2 Rate, S_0

Enter the specified nominal torsional rate in box 8.1. To determine the rate of the spring it will be necessary to check the torque at two agreed test positions (see **4.2.9.3**). If the rate is to be toleranced the manufacturer and supplier should agree how this is to be verified.

4.2.9.3 Torque at test positions, 1 and 2

Indicate in box 8.2 the torque(s) required at each position, as shown in Figure 6.

4.2.9.4 Property tolerances

Enter tolerances for relative leg orientation, torque and rate in box 8.3. These tolerances should be calculated in accordance with **5.3.3**, **5.4.2** and **5.4.3**.

NOTE If the designer requires tolerances which are less than those derived from this specification then the manufacturer should be informed. This may be highlighted in box 11.

4.2.10 Surface coating

Unless otherwise specified, springs should be supplied in either the natural condition or lightly oiled. Where other surface finishes are required enter these in box 9, quoting the relevant British Standard where possible.

4.2.11 Identification

If identification of individual springs is required, indicate this in box 10. It should be noted that colour marking is the most common method used.

4.2.12 Special requirements

Where the designer has requirements for the spring which cannot be detailed elsewhere on Data Sheet 1, include these under special requirements, box 11.

4.2.13 Shot peening

Shot peening requirements should be indicated in box 11.

SPECIFICATION FOR HELICAL TORSION SPRINGS BS 1726-3:2002 DATA SHEET 2			Part Serial No. _____
This form should be completed with reference to BS 1726-3:2002 Clause 4.3			
Where important, full details of the spring leg forms and/or anchoring points and/or space enveloped should be included here.			
1 Leg form <div style="text-align: center;">One Both</div> Axial _____ Tangential _____ Radial (external) _____ Radial (over-centre) _____ Other _____		5 Service temperatures Max. operating temp _____ (°C) Min. operating temp _____ (°C) Working life _____ (h)	
2 Limiting dimensions Maximum allowable outside diameter _____ mm Mandrel diameter _____ mm Maximum allowable body length _____ mm		6 Service environment	
3 Torque and rate requirements		7 Finish	
	Pre-load position	Max. working position	8 Other requirements
α	degree	degree	
T	N·mm	N·mm	
$T_{tol.}$	± N·mm	N·mm	
Loading direction	increasing torque/ decreasing torque	increasing torque/ decreasing torque	
Torsional rate $S_0 =$ _____ N·mm/degree			
Assembly adjustment Yes/No _____ degree			
4 Mode of operation Required life (cycles) _____ Operating speed _____ (cycles/min)			
Sheet 1 of _____		Serial/design/Part No.	

Figure 5 — Data sheet 2

4.3 Method two (application for spring design) using Data Sheet 2

4.3.1 General

This is an application for spring design in which the customer should specify the requirements from an operational point of view, giving such information as dimensional constraints, torque/movement parameters, fatigue life, resistance to corrosion, in order that the supplier can produce a spring design to meet these requirements. The customer should specify the requirements using Data Sheet 2 (Figure 5).

Insert relevant dimensions on the data sheet, giving only those which are dictated by the design of the mechanism in which the spring is to operate.

4.3.2 Drawings

Where details of the spring legs, anchoring points and/or the available space envelope is important, include a drawing in the space provided or as a supplement to the data sheet.

4.3.3 Leg forms

If standard leg forms are acceptable, indicate the type required in box 1. If non-standard leg forms or unusual anchoring points are required, include full details in the drawing.

4.3.4 Limiting dimensions

To ensure free operation of the mechanism, of which the spring is a part, it is necessary to provide the limiting dimensions of the spring. Enter in box 2 the maximum allowable outside diameter and the maximum allowable body length of the spring, and the mandrel diameter over which the spring is to operate (if applicable).

4.3.5 Torque and rate requirements

Springs should be designed on the assumption that they are required to operate within a range bounded by an initial preload position and a maximum working position. Enter these extremes of motion in box 3 together with any maximum and/or minimum torque requirements at these extremes, and the loading direction for torque measurements (i.e. torque increasing or decreasing), if applicable.

It is important to avoid ambiguity when defining angular positions for spring motion. Leg angular rotation should be defined, not from a specified datum, but in terms of the relative orientation of one leg from the other (see Figure 4 for the conventions for describing relative leg orientation α).

The nominal torsional rate (S_θ) is required so that the angular rotation (θ) can be determined between the specified positions. The designer should also be informed whether or not there is any assembly adjustment available within the mechanism to accommodate the relative leg orientation tolerance in the free position.

4.3.6 Mode of operation

It is assumed that normal operation will involve the spring remaining static at a loaded deflection with occasional, gradual movement to another specified loaded deflection.

If the spring is expected to withstand dynamic operation, e.g. in excess of 10 000 cycles, enter in box 4 the minimum required life for operations between extremes of motion given in box 3, together with speed of operation.

If the spring is not to cycle between the extremes of motion, the alternative levels of deflection, torque and/or stress should be provided in box 8 along with the mode of loading (if an approximation to simple harmonic motion would not be acceptable).

4.3.7 Service temperatures

The maximum and minimum temperatures to which the spring will be subjected during its working life should be specified in box 5. Where a spring is subjected to temperatures outside this range, the conditions of temperature, time and loaded torque should be specified in box 8.

4.3.8 Service environment

Where the spring is required to operate in a potentially corrosive environment enter full details in box 6.

4.3.9 Surface finish

If a particular finish is required for specific corrosive protection, identification or decorative purposes enter the details in box 7.

4.3.10 Other requirements

Enter in box 8 any special requirements for cleanliness, or magnetic or electrical resistance, and any performance criteria agreed between purchaser and supplier.

5 Tolerances

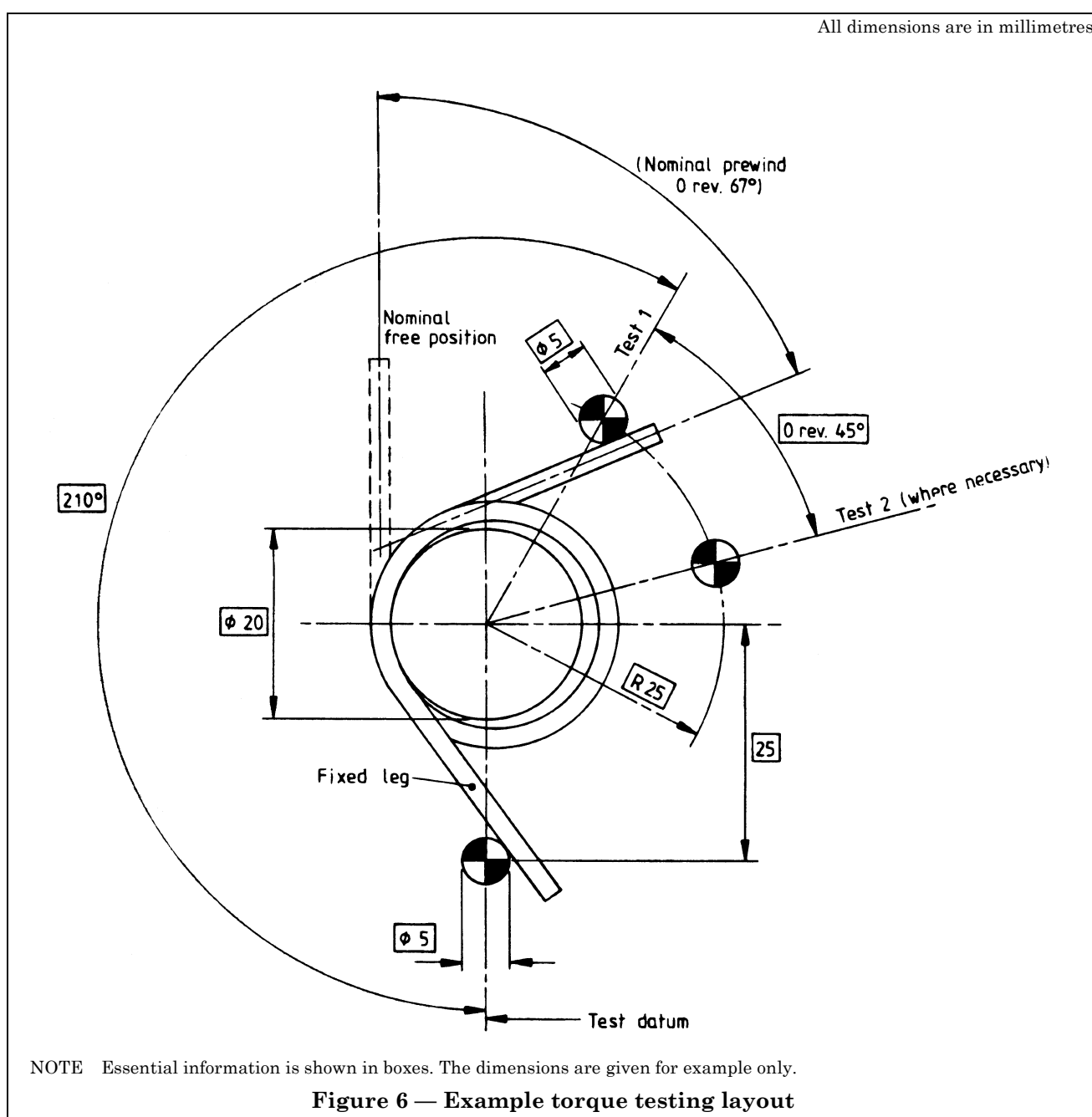
5.1 General

The tolerances given in this clause are those recommended for economic production and apply only to springs with an index in the range 3.5 to 16 (both values inclusive) and a total number of coils, N , not less than 1.5.

NOTE 1 Tolerances are based on experience gained within the spring industry, but no process control capability is implied. Where process control capability is required this will need to be agreed between the customer and the supplier.

NOTE 2 The tolerances calculated are the maximum deviations from the specified dimension.

NOTE 3 Owing to the friction between coils in close coiled torsion springs and the friction between spring and mandrel, it is not possible to measure torque precisely. Therefore in the majority of cases it is common for torsion springs to be made to dimensions only. Tolerances for the essential dimensions of the spring are given in 5.2. When torque testing is specified different tolerances are applied as given in 5.3. Tolerances for torque are given in 5.4.



5.2 Dimensional tolerances in the free state when torque testing is not specified

5.2.1 Material diameter, d

Tolerances relating to the material being used apply prior to the spring being coiled.

5.2.2 Coil diameter

The tolerance, D_{tol} , (in mm), on the mean coil diameter, D , which may be applied either to the inside or outside diameter, but not to both, is either:

$$\text{a) } \pm \frac{1\,000 + (C + 20)(D + 8)}{10\,000}; \text{ or}$$

$$\text{b) } 1.5\% \text{ of the mean coil diameter}$$

whichever is the greater.

5.2.3 Free body length

5.2.3.1 The free body length tolerance $L_{\text{o, tol}}$, (in mm) for closed coil springs is:

$$L_{\text{o, tol}} = \pm (N + 1)e$$

5.2.3.2 The free body length tolerance $L_{\text{o, tol}}$, (in mm) for open coiled springs is:

$$L_{\text{o, tol}} = \pm \frac{(L_0 + 10)(C + 25)}{1\,200}$$

NOTE In operation the overall body length will increase.

5.2.4 Relative leg orientation

The free relative leg tolerance, α_{tol} , (in degrees) is:

$$\alpha_{\text{tol}} = \pm 1.5(N)^{0.7} \sqrt{c}$$

Tolerances based on the above expression (\pm degrees) rounded to the nearest integer, are given in Table 1 below, but in cases of dispute values should be calculated directly from the expression.

Table 1 — Calculated free relative leg orientation tolerance (\pm degrees)

Number of coils N	Spring index c						
	4	6	8	10	12	14	16
2	8	8	8	8	8	9	10
3	8	8	9	10	11	12	13
4	8	10	11	13	14	15	16
5	9	11	13	15	16	17	19
6	11	13	15	17	18	20	21
8	13	16	18	20	22	24	26
10	15	18	21	24	26	28	30
15	20	24	28	32	35	37	40
20	24	30	35	39	42	46	49
25	29	35	40	45	49	53	57
30	32	40	46	51	56	61	65
50	46	57	66	73	80	87	93

5.3 Dimensional tolerances in the free state when torque testing is to be performed

5.3.1 Coil diameter

The tolerance on coil diameter is a function of the torque tolerance required (see 5.4.2).

5.3.2 Free length

Free body length is not tolerated, but a free working test can be substituted (see 6.3).

5.3.3 Relative leg orientation

When only one torque test measurement is required, relative leg orientation tolerance should be twice the value derived from the formula given in 5.2.4.

When two torque test measurements are required the relative leg orientation is only to be regarded as a reference dimension, but the value derived from the formula given in 5.2.4 has to be calculated for inclusion in the calculation of torque tolerance in 5.4.2.

5.4 Property tolerances

5.4.1 Unless otherwise specified the tolerance should be applied in the direction of coiling and increase torque and where the combined effective length of legs, l , is not greater than 10 % of the body wire length, i.e. $l \leq 0.1\pi nD$.

Any other mode of testing is to be agreed between purchaser and supplier.

5.4.2 Torque at given angle

When the torque at a given angle is required the manufacturer should be given latitude on the coil diameter, since this is the principle means of adjustment to meet torque requirements. For this reason the calculated torque tolerance is dependent on the permissible variation in coil diameter. If the designer requires the coil diameter to be maintained within close limits then a relatively large torque tolerance should be given. Inversely, a generous coil diameter tolerance permits a more restrictive torque tolerance. F_T is used in the torque tolerance calculation to cater for the designer's allowance for coil diameter variation where:

$$F_T = \frac{0.95 - \Delta D}{0.75D} \text{ or}$$

$$F_T = 1$$

whichever is the greater.

From this, torque tolerance, T_{tol} , (in N·mm) can be calculated from the expression:

$$T_{\text{tol}} = S_0 F_T \alpha_{\text{tol}}$$

with a minimum of ± 10 N·mm.

NOTE In exceptional circumstances, for light springs, with the use of high-precision testing equipment it is possible to reduce this minimum value to ± 2 N·mm subject to agreement between purchaser and supplier.

5.4.3 Rate tolerance

Where the spring rate is deemed more important than specific torques at given angles, a rate tolerance of ± 5 % can be specified between two angles and a single tolerated torque at one angle, within a range of 20 % to 80 % of the safe deflection.

5.4.4 Tolerances on legs

The minimum limiting value for the inside radius of any bend is:

$$R_{\text{min.}} = 1.5d;$$

NOTE Owing to the wide variety of legs no tolerance figures can be stated which are appropriate in all conditions. The following figures are given for guidance only.

Length of legs	± 2 % of the dimension with a minimum of ± 0.5 mm.
Angle of any bends on legs	$\pm 5^\circ$ per bend.

(Not relative orientation, see 5.2.4.)

6 Methods of testing

6.1 General

The methods of testing spring parameters are numerous and any may be used. However, it is suggested that the methods given in 6.2.1 to 6.3.3 should be used in cases of arbitration or disagreement.

Nominal dimensions and those marked for reference only need not be checked.

NOTE It is appreciated that for very small quantities the production of suitable gauges may not be economical and in these cases alternative methods should be agreed between customer and supplier.

6.2 Dimensional tests

6.2.1 General

Carry out all dimensional tests with the spring in its free state.

Deflect springs to their maximum specified angle and release before testing.

6.2.2 Material diameter

Use a micrometer with the appropriate anvil to measure the material diameter, d , to obtain an indication of its size.

NOTE The dimension obtained can be only an indication since the diameter or section size of the material will change due to slight distortion during coiling and tolerances cannot therefore apply.

6.2.3 Outside diameter or inside diameter

Use a GO–NOT GO system of gap and/or plug gauges (see BS 969), as applicable, to verify that the outside diameter and the inside diameter are within tolerance.

Unless otherwise specified the gauges should have a minimum length of $1.25 \times$ maximum pitch of the spring.

NOTE 1 The mean diameter, D , cannot be measured.

NOTE 2 The inside diameter cannot be used to determine satisfactory operation over a specified shaft.

6.2.4 Free body length

Use a precision vernier calliper (see BS 887) or GO–NOT GO gap gauges on the axis of the barrel of the spring, including fractions of a coil, to measure free body length.

6.2.5 Number of coils

Determine the number of coils by visual examination.

6.2.6 Orientation of legs

Measure the relative orientation of the legs, as defined on the drawing, with a protractor and suitable jigs.

NOTE No detailed instruction can be given for dimensions of legs as the variety is endless. For ease of measurement it is recommended that dimensions should be stated as overall rather than to centres, because although this may be theoretically correct it is impractical to measure physically to a centre.

6.3 Property tests

6.3.1 General

Deflect the spring to its maximum working position and slowly release before testing.

6.3.2 Torque

To measure torque deflect the spring to the positions given in Data Sheet 1. Use a test fixture based on the example torque test layout in Figure 6 and take the torque reading(s) in the direction of increasing torque unless otherwise specified.

Torque measuring devices should comply with the accuracy and repeatability requirements of class 1 of BS EN ISO 7500-1, or better.

6.3.3 *Spring rate*

To calculate the spring rate take two torque measurements at two agreed positions within the range of 20 % to 80 % of the safe deflection.

NOTE 1 During operation a torsion spring exhibits changes in dimensions which have to be accommodated. If it is essential to prove the free working of a torsion spring then this can only be done by using a purpose-built test fixture which simulates all aspects of the assembly.

NOTE 2 The mechanical properties of the material cannot be determined after it has been coiled.

NOTE 3 Hysteresis resulting from the loading and unloading of spring materials within their elastic range is extremely small. The apparent hysteresis however in torsion springs can be large owing to the considerable influence of friction between the coils and between the spring and mandrel. This feature is rarely measured but if a determination is required the method of test and tolerances applied are to be the subject of agreement between purchaser and supplier.

NOTE 4 Owing to the considerable effects of friction the torque/angular deflection curve is rarely linear. If this property requires to be determined then the test method and tolerances applied are to be the subject of agreement between purchaser and supplier.

NOTE 5 The amount of prestressing cannot be measured. The effectiveness of any required prestressing can be assessed by testing to drawing requirements before and after deflection to the maximum working position.

6.4 Performance verification

6.4.1 Owing to the nature of these tests and the time involved in carrying them out, test only a small sample of springs, the size of the sample being agreed between the customer and the supplier, and discard these after testing.

6.4.2 *Relaxation*

Determine the relaxation characteristics of a spring by clamping the spring to the length corresponding to the required force and exposing the spring to a period at a specified temperature. The relaxation characteristic is determined by measuring the specified force at length or length at force and comparing with a value measured before exposure.

NOTE The period and temperature at which exposure is carried out will vary according to the intended use of the spring and will need to be agreed between the customer and the supplier.

6.4.3 *Corrosion*

Obtain an indication of the effects of corrosion on the characteristics of a spring by carrying out static or dynamic tests in conditions that simulate the working environment.

NOTE The test environment and criteria for acceptance will need to be agreed between the customer and the supplier.

6.4.4 *Spring life*

Determine the spring life by carrying out tests which simulate factors that will contribute to its degradation, e.g. environment, fatigue, stress.

NOTE These tests will need to be agreed between the customer and the supplier.

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