

Cylindrical helical springs made from rectangular and square section wire and bar — Guide to calculation and design —

Part 2: Torsion springs

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Committees responsible for this British Standard

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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 1988 to take account of current manufacturing processes.

BS 1726-3:1988, was withdrawn on the publication of BS EN 13906-3 in 2001. The provisions for the design, specification, tolerances and testing of rectangular section torsion springs are now published in this separate standard.

Together with BS 1726-3:2002 and BS EN 13906-3:2001, this new standard, BS 8726-2, supersedes BS 1726-3:1988, which is withdrawn.

BS 8726 is published in two parts:

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

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Summary of pages

This page consists of a front cover, an inside front cover, page i and ii, pages 1 to 18, an inside back cover and a back cover.

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1 Scope

This British Standard provides guidance on the design of parallel sided helical torsion springs manufactured from rectangular and square section wire and bar.

1.1 Limitation on material section dimensions

This standard applies only to springs made from rectangular section material where the ratio of radial dimension, b , to the axial dimension, h , termed the shape factor, m , is not greater than 2.5 and not less than 0.4.

NOTE 1 This applies because, outside the shape factor range 2.5 to 0.4, it is difficult to coil a spring accurately.

NOTE 2 There are numerous methods of calculating the parameters necessary for the design of springs and initially the designer is free to use any one of these.

This standard differentiates between springs that have or have not been stress relieved after forming, designated group A springs, and springs, the material of which has undergone a structural change by heat treatment after forming, designated group B springs.

This British Standard gives two methods of specifying springs for general purposes and one method of testing springs

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 8726-1, *Cylindrical helical springs made from rectangular and square section wire and bar — Guide to calculation and design — 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 8726 the terms and definitions given in BS 8726-1 apply.

3.2 Symbols

Symbol	Term	Unit
b	radial dimension of rectangular section material	mm
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
e	tolerance on size of material cross-section	mm
E	modulus of elasticity (see Annex A)	N/mm ²
F_T	tolerance factor for torque	—
h	axial dimension of rectangular section material	mm
h'	maximum axial dimension of rectangular section material after coiling	mm

Symbol	Term	Unit
$h_{\max.}$	maximum axial dimension of rectangular section material allowing for material size tolerance	mm
k	material constant for calculation of distortion and axial dimension of rectangular section material after coiling	—
K_r	stress correction factor for rectangular section wire	—
l	combined effective length of legs	mm
L_o	free body length of spring	mm
$L_{o, \text{tol.}}$	tolerance on free body length	mm
L_t	loaded body length of spring	mm
m	shape factor	mm
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
a	relative leg orientation under torque	degrees
a_o	relative leg orientation in free state	degrees
$a_{\text{tol.}}$	tolerance on relative leg orientation	degrees
θ	angular rotation of spring	degrees
σ	bending stress in spring	N/mm ²

4 General

When designing a spring, certain characteristics have to be determined, e.g. shear stress, rate, natural frequency, buckling and the tolerances that can be permitted to ensure that it functions as required, but which will allow it to be produced economically.

It should be borne in mind that, in general, the surface quality of rectangular material is inferior to that obtainable on round material due to problems in wire drawing. For this reason it is recommended that rectangular section springs should be used in static applications only.

5 Methods of calculation

5.1 Stress correction factor

Stress correction factor K_r , for rectangular section material, is given by the equation:

$$K_r = \frac{c}{c - 0.67}$$

where

$$c = D/b$$

5.2 Stress

The bending stress for rectangular section material is given by the equation:

$$\sigma = \frac{6TK_r}{hb^2}$$

NOTE The formula does not take account of friction and deflections within the legs.

5.3 Torsional rate

The torsional rate for rectangular section material is given by the equation:

$$S_\theta = \frac{\Delta T}{\theta} = \frac{Ehb^3}{2160nD}$$

NOTE The formula does not take account of friction and deflection within the legs.

5.4 Torsion spring legs

A torsion spring consists of the body or active part and the legs which serve to convey the torque from the body to the mechanism. The legs can take four basic forms as shown in Figure 1 although combinations of any two of these forms can be used in one spring.

There are conventions for the relative orientation of the legs at each end of a spring. These are shown in Figure 2.

It is recommended that the maximum combined effective leg length does not exceed 10 % of the actual material length in the coils.

In cases where the length of leg is greater than 10 % of the length of material in the body of the spring, some deflection can occur within the leg and this should be taken into consideration as significant inaccuracies in the measurement of rate can occur.

NOTE A fully dimensioned 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.

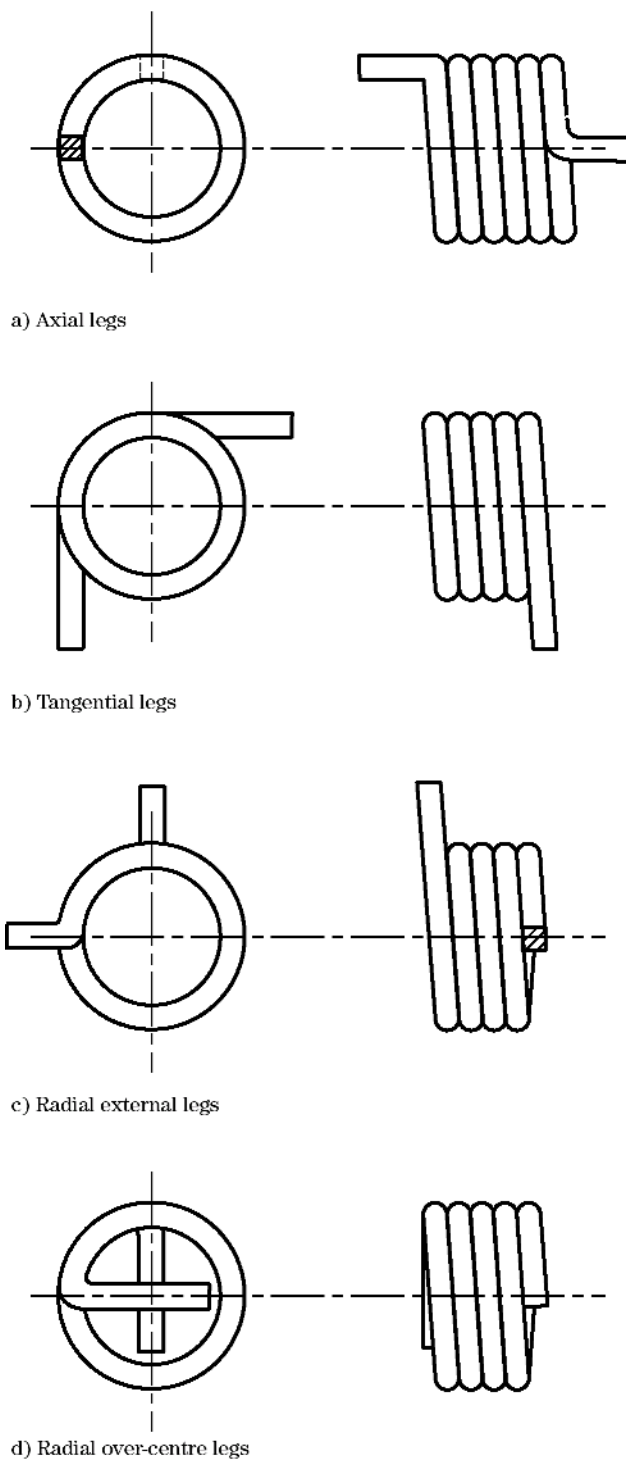


Figure 1 — Forms of legs