SLOVENSKI STANDARD
SIST EN 13906-3:2009

01-julij-2009

Vijaļ ne valjaste vzmeti iz okrogle ġice in palic - Izraļ un in naļ rtovanje - 3. del: Torzijske vzmeti

Cylindrical helical springs made from round wire and bar - Calculation and design - Part 3: Torsion springs

Zylindrische Schraubenfedern aus runden Drähten und Stäben - Berechnung und Konstruktion - Teil 3: Drehfedern

Ressorts hélicoïdaux cylindriques fabriqués à partir de fils ronds et de barres - Calcul et conception - Partie 3: Ressorts de torsion

Ta slovenski standard je istoveten z: **EN 13906-3:2001**

ICS:

21.160	Vzmeti	Springs

SIST EN 13906-3:2009 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13906-3

December 2001

ICS 21.160

English version

Cylindrical helical springs made from round wire and bar - Calculation and design - Part 3: Torsion springs

Ressorts hélicoïdaux cylindriques fabriqués à partir de fils ronds et de barres - Calcul et conception - Partie 3: Ressorts de torsion

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This European Standard was approved by CEN on 5 January 2001.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 13906-3:2001 E

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Foreword

This European Standard has been prepared by CMC.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2002, and conflicting national standards shall be withdrawn at the latest by June 2002.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This European Standard has been prepared by the initiative of the Association of the European Spring Federation ESF and is based on the German Standard DIN 2088 - "Helical springs made of round wire and rod; cold coiled torsional springs (leg springs); calculation and design" edition 1992-11, which is known and used in many European countries.

1 Scope

This standard specifies the calculation and design of cold coiled cylindrical helical torsion springs with a linear characteristic, made from round wire and bar of constant diameter with values according to Table 1.

Table 1

Characteristic	Cold coiled torsion spring
Wire or bar diameter	$d \leq 17$ mm
Coil diameter	$D \leq 340$ mm
Length of active coils	$L_{K0} \leq 630$ mm
Number of active coils	$n \geq 2$
Spring index	$4 \leq w \leq 20$

NOTE Quality Standards for cold coiled torsion springs will be developed later.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 10270-1:2001, *Steel wire for mechanical springs – Part 1: Patented cold drawn unalloyed spring steel wire.*

EN 10270-2:2001, *Steel wire for mechanical springs - Part 2: Oil hardened and tempered spring steel wire.*

EN 10270-3:2001, *Steel wire for mechanical springs - Part 3: Stainless spring steel wire.*

EN 12166, *Copper and copper alloys - Wire for general purposes.*

EN ISO 2162-1:1996, *Technical product documentation - Springs - Part 1: Simplified representation (ISO 2162-1:1993).*

EN ISO 2162-3:1996, *Technical product documentation - Springs - Part 3: Vocabulary (ISO 2162-3:1993).*

3 Terms and definitions, symbols, units and abbreviated terms

3.1 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1.1
spring
mechanical device designed to store energy when deflected and to return the equivalent amount of energy when released [2.1 from EN ISO 2162-3:1996]

3.1.2
torsion spring
spring that offers resistance to a twisting moment around the longitudinal axis of the spring [2.15 from EN ISO 2162-3:1996]

3.1.3
helical torsion spring
torsion spring that normally made from wire of circular cross-section wound around an axis with ends suitable for transmitting a twisting moment [2.11 from EN ISO 2162-3:1996]

NOTE In the following text of this Standard the term spring is used with the meaning of helical torsion spring.

3.2 Symbols, units and abbreviated terms

Table 2 contains the symbols, units and abbreviated terms used in this standard.

Table 2

Symbols	Units	Terms
A_D	mm	coil diameter tolerance of the unloaded spring
a	mm	gap between active coils of the unloaded spring
$D = \frac{D_e + D_i}{2}$	mm	mean diameter of coil
D_d	mm	mandrel diameter
D_e	mm	outside diameter of the spring
$D_{e\alpha}$	mm	outside coil diameter of the spring when deflected through and angle α in the direction of the coiling
D_h	mm	housing diameter
D_i	mm	inside diameter of the spring
$D_{i\alpha}$	mm	inside coil diameter of the spring when deflected through and angle α in the direction of the coiling
D_p	mm	test mandrel diameter
d	mm	nominal diameter of wire (or bar)
d_{max}	mm	upper deviation of d
d_R	mm	diameter of loading pins
E	N/mm²	modulus of elasticity (or Young's modulus)
F	N	spring force
F_1, F_2 ...	N	spring forces for the torsional angles α_1, α_2 ... and related lever arms R_1, R_2 ... at ambient temperature of 20°C
F_n	N	spring force for the maximum permissible angle α_n and the lever arms R_n
L_K	mm	body length of the unloaded spring for close-coiled springs (excluding ends)
L_{KO}	mm	body length of the unloaded spring for open-coiled springs (excluding ends)
$L_{K\alpha}$	mm	body length of close-coiled spring deflected through an angle α (excluding ends)
l	mm	developed length of active coils (excluding ends)

Table 2 (continued)

Symbols	Units	Terms
l_1, l_2	mm	length of ends
M	N mm	spring torque
$M_1, M_2 ...$	N mm	spring torque for the angles $\alpha_1, \alpha_2 ...$ and related lever arms $R_1, R_2 ...$ at ambient temperature of 20°C
M_n	N mm	spring torque for the maximum permissible angle, α_n
M_{max}	N mm	maximum spring torque, which occurs occasionally in practice, in test or during assembly of the spring
N	-	number of cycles up to rupture
n	-	number of active coils
q	-	stress correction factor (depending on D/d)
R, R_1, R_2	mm	effective lever arms of spring
R_M	N/mm²	minimum value of the tensile strength
R_{MR}	Nmm/Deg	angular spring rate (increase of spring torque per unit angular deflection)
$r, r_1, r_2 ... r_n$	mm	inner bending radii
$\overline{w}$	mm³	sectional moment
W	N mm	spring work
$w = \frac{D}{d}$	-	spring index
z	-	decimal values of the number of active coils n
α		torsional angle
$\alpha_1, \alpha_2 ...$	Deg	torsional angle corresponding to spring torque M_1, M_2 ... to the spring forces F_1, F_2 ...
α_n	Deg	maximum permissible torsional angle
α'	Deg	corrected torsional angle α in the case of a long, unclamped tangential end
α''	Deg	angle de torsion α corrigé pour une branche longue, tangente, non serrée
α_h	Deg	angular deflection of spring (stroke) between two positions
α_{max}	Deg	maximum torsional angle which occurs occasionally in practice, in test or by mounting of the spring
β	Deg	increase of torsional angle α due to deflection of a long, unclamped radial end
β'	Deg	increase of torsional angle α due to deflection of a long, unclamped tangential end
γ	Deg	relative end angle of unloaded spring
δ_0	Deg	relative end angle of loaded spring
ε_0	Deg	relative end fixing angle for unloaded spring
$\varepsilon_1, \varepsilon_2 ... \varepsilon_n$	Deg	relative end fixing angle, corresponding to torsional angles $\alpha_1, \alpha_2 ... \alpha_n$
ρ	kg/dm³	density
σ	N/mm²	uncorrected bending stress (without the influence of the wire curvature being taken into account)
$\sigma_1, \sigma_2 ...$	N/mm²	uncorrected bending stress for the spring torque's M_1, M_2
σ_n	N/mm²	uncorrected bending stress for the spring torque M_n

Table 2 (concluded)

Symbols	Units	Terms
σ_q	N/mm²	corrected bending stress (according to the correction factor q)
σ_{q1}, σ_{q2} ...	N/mm²	corrected bending stress for the spring torque's M_1, M_2 ...
σ_{qh}	N/mm²	corrected bending stress for the stroke α_h
σ_{qH}	N/mm²	corrected bending stress range in fatigue
σ_{qO}	N/mm²	corrected maximum bending stress in the fatigue strength diagram
σ_{qU}	N/mm²	corrected minimum bending stress in the fatigue strength diagram
σ_{zul}	N/mm²	permissible bending stress
$\phi_1, \phi_2 \ldots \phi_n$	Deg	???
ϕ_1, ϕ_2	Deg	decimal value for parts of coil of unloaded spring

4 Theoretical torsion spring diagram

The illustration of the torsion spring corresponds to Figure 6.1 from EN ISO 2162-1:1996. The theoretical torsion spring diagrams are given in Figure 1.

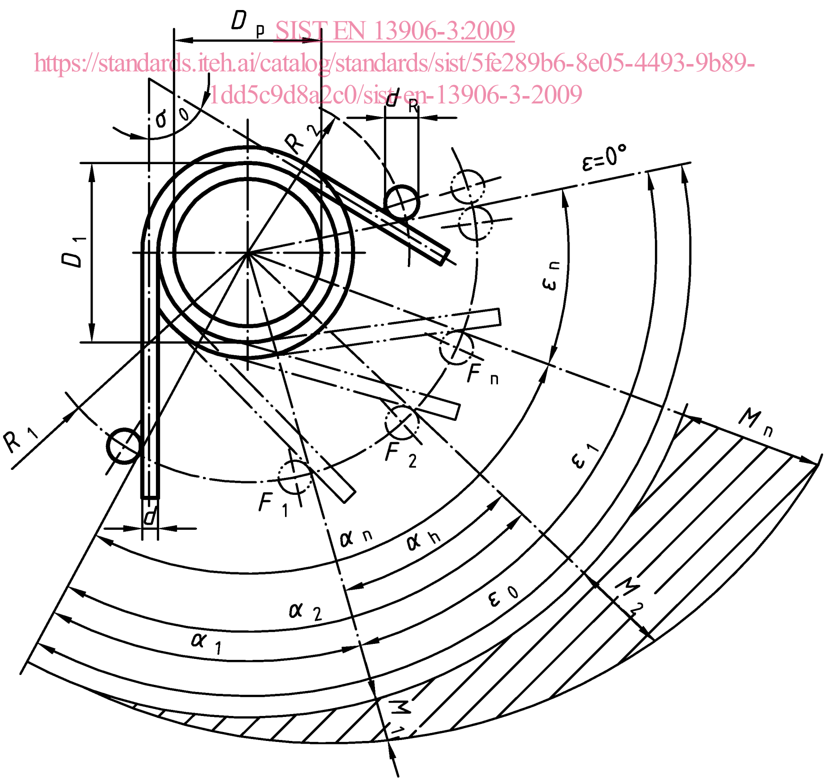

Figure 1 — Theoretical torsion spring diagram

Figures 2 to 7 shaw different types of torsion springs and/or their end; Figures 5 to 7, given recommended arrangements.

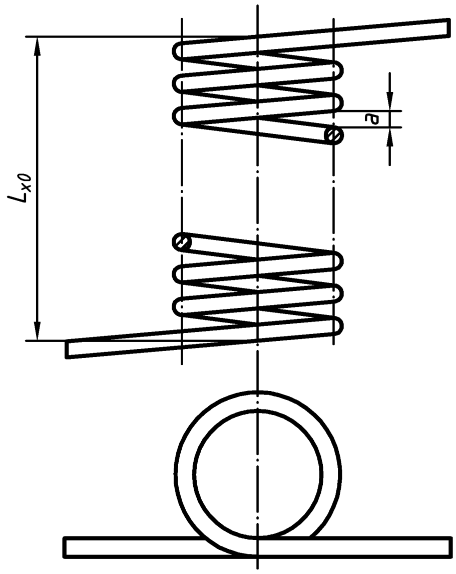

Figure 2 — Open coiled torsion spring

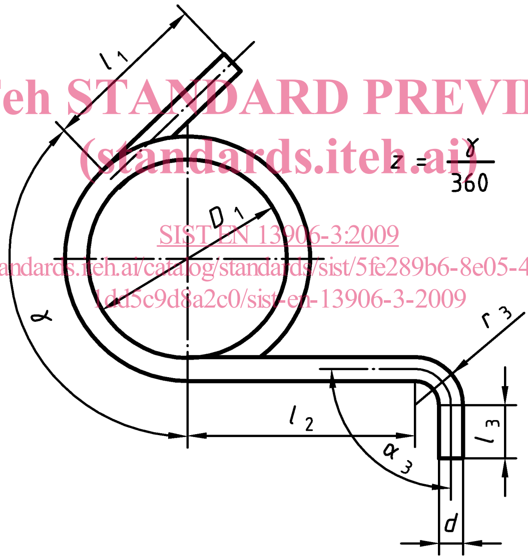

Figure 3 — Torsion spring with tangential ends

$$Z = \frac{\gamma - \varphi_1 - \phi_2}{360}$$

$$\Phi_1 = \text{arcsin}\frac{2r_1 + d}{D_\mathrm{i} + 2(d + r_1)}$$

$$\Phi_2 = \text{arcsin}\frac{2r_2 + d}{D_\mathrm{i} + 2(d + r_2)}$$

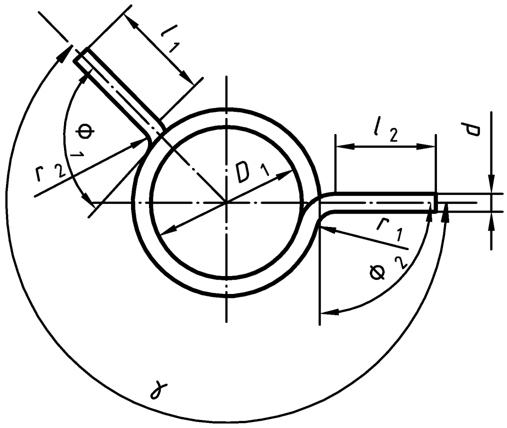

Figure 4 — Torsion spring with radial ends

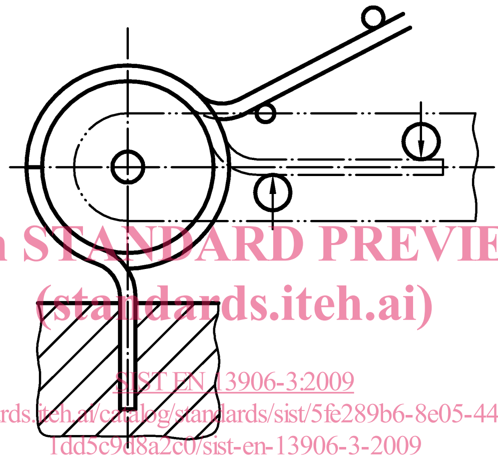

Figure 5 — Recommended arrangement showing clamped ends

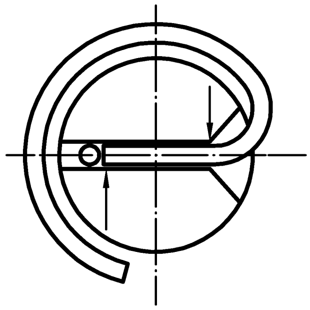

Figure 6 — Recommended arrangement showing a clamped end on a mandrel