**SLOVENSKI STANDARD**
# SIST EN 13906-3:2014

**01-april-2014**

**Nadomešča:**
**SIST EN 13906-3:2009**

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**Vijačne valjaste vzmeti iz okrogle žice in palic - Izračun in načrtovanje - 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 13906-3:2014**

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**ICS:**

| | | |
|---|---|---|
| 21.160 | Vzmeti | Springs |

**SIST EN 13906-3:2014** **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 13906-3

January 2014

ICS 21.160

Supersedes EN 13906-3:2001

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

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

This European Standard was approved by CEN on 10 November 2013.

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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 CEN-CENELEC Management Centre has the same status as the official versions.



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

**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**



Ref. No. EN 13906-3:2014 E

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## Foreword

This document (EN 13906-3:2014) has been prepared by Technical Committee CEN/TC 407 “Project Committee - Cylindrical helical springs made from round wire and bar - Calculation and design”, the secretariat of which is held by AFNOR.

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 July 2014, and conflicting national standards shall be withdrawn at the latest by July 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13906-3:2001.

This European Standard has been prepared by the initiative of the Association of the European Spring Federation ESF.

This European Standard constitutes a revision of EN 13906-3:2001 for which it has been technically reviewed. The main modifications are listed below:

— updating of the normative references;

— technical corrections.



EN 13906 consists of the following parts, under the general title *Cylindrical helical springs made from round wire and bar — Calculation and design*:



— *Part 1: Compression springs*;

— *Part 2: Extension springs*;

— *Part 3: Torsion springs*.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

# 1 Scope

This European Standard specifies the calculation and design of cold and hot 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 | Hot coiled torsion spring[a] |
|---|---|---|
| Wire or bar diameter | $d \leq 20$ mm | $d \geq 10$ mm |
| Number of active coils | $n \geq 2$ | $n \geq 2$ |
| Spring index | $4 \leq w \leq 20$ | $4 \leq w \leq 12$ |

[a] The user of this European Standard shall pay attention to the design of hot coiled springs, because there can be differences between the design and a real test.

# 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 10089, *Hot-rolled steels for quenched and tempered springs - Technical delivery conditions*



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

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



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

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

EN ISO 26909:2010, *Springs - Vocabulary (ISO 26909:2009)*

ISO 26910-1, *Springs - Shot peening - Part 1: General procedures*

# 3 Terms and definitions, symbols, units and abbreviated terms

## 3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 26909:2010 and the following apply.

**3.1.1**
**spring**
mechanical device designed to store energy when deflected and to return the equivalent amount of energy when released

[SOURCE: EN ISO 26909:2010, 1.1]

**3.1.2**
**torsion spring**
spring that offers resistance to a twisting moment around the longitudinal axis of the spring

[SOURCE: EN ISO 26909:2010, 1.4]

**3.1.3**
**helical torsion spring**
torsion spring normally made of wire of circular cross-section wound around an axis and with ends suitable for transmitting a twisting moment

[SOURCE: EN ISO 26909:2010, 3.14]

## 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 $\alpha$ 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 $\alpha$ 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 |
| $E$ | $N/mm^2$ (MPa) | modulus of elasticity (or Young's modulus) |
| $F$ | N | spring force |
| $F_1, F_2$ ... | N | spring forces for the torsional angles $\alpha_1, \alpha_2$ ... and related lever arms $R_A, R_B$ at ambient temperature of 20 °C |
| $F_n$ | N | spring force for the maximum permissible angle $\alpha_n$ and the lever arms $R_A, R_B$ |
| $L_K$ | mm | body length of the unloaded spring for close-coiled springs (excluding ends) |
| $L_{K0}$ | 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) |
| $l_A, l_B$ | mm | length of ends |
| $M$ | N mm | spring torque |

| Symbols | Units | Terms |
|---|---|---|
| $M_1, M_2$ ... | N mm | spring torque for the angles $\alpha_1, \alpha_2$ ... and related lever arms $R_A, R_B$ at ambient temperature of 20 °C |
| $M_n$ | N mm | spring torque for the maximum permissible angle, $\alpha_n$ |
| $M_{max}$ | 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 $D/d$) |
| $R, R_A, R_B$ | mm | effective lever arms of spring |
| $R_m$ | N/mm$^2$ (MPa) | minimum value of the tensile strength |
| $R_{MR}$ | Nmm/ Deg | angular spring rate (increase of spring torque per unit angular deflection) |
| $r, r_A, r_B$ ... $r_n$ | mm | inner bending radii |
| $\overline{W}$ | mm$^3$ | sectional moment |
| $W$ | N mm | spring work |
| $w = \frac{D}{d}$ | - | spring index |
| $z$ | - | decimal values of the number of active coils $n$ |
| $\alpha$ | Deg | torsional angle |
| $\alpha_1, \alpha_2$ ... | Deg | torsional angle corresponding to spring torque $M_1$, $M_2$ ... to the spring forces $F_1$, $F_2$ ... |
| $\alpha_n$ | Deg | maximum permissible torsional angle |
| $\alpha'$ | Deg | corrected torsional angle α in the case of a long, unclamped radial end |
| $\alpha''$ | Deg | corrected torsional angle α in the case of a long, unclamped tangential end |
| $\alpha_h$ | Deg | angular deflection of spring (stroke) between two positions $\alpha_1$ and $\alpha_2$ |
| $\alpha_{max}$ | Deg | maximum torsional angle which occurs occasionally in practice, in test or by mounting of the spring |
| $\beta$ | Deg | increase of torsional angle α due to deflection of a long, unclamped radial end |
| $\beta'$ | Deg | increase of torsional angle α due to deflection of a long, unclamped tangential end |
| $\gamma$ | Deg | angle of tangential legs of unloaded spring |
| $\delta_0$ | Deg | angle of active coils of unloaded spring |
| $\varepsilon_0$ | Deg | relative end fixing angle for unloaded spring |
| $\varepsilon_1, \varepsilon_2$ ... $\varepsilon_n$ | Deg | relative end fixing angle, corresponding to torsional angles $\alpha_1, \alpha_2$ ... $\alpha_n$ |
| $\rho$ | kg/dm$^3$ | density |
| $\sigma$ | N/mm$^2$ (MPa) | uncorrected bending stress (without the influence of the wire curvature being taken into account) |
| $\sigma_1, \sigma_2$ ... | N/mm$^2$ (MPa) | uncorrected bending stress for the spring torques $M_1$, $M_2$ |

| Symbols | Units | Terms |
|---|---|---|
| $\sigma_n$ | N/mm² (MPa) | uncorrected bending stress for the spring torque $M_n$ |
| $\sigma_q$ | N/mm² (MPa) | corrected bending stress (according to the correction factor $q$) |
| $\sigma_{q1}, \sigma_{q2}$ ... | N/mm² (MPa) | corrected bending stress for the spring torque's $M_1, M_2$ ... |
| $\sigma_{qh}$ | N/mm² (MPa) | corrected bending stress for the stroke $\alpha_h$ |
| $\sigma_{qH}$ | N/mm² (MPa) | corrected bending stress range in fatigue strength diagram |
| $\sigma_{qO}$ | N/mm² (MPa) | corrected maximum bending stress in the fatigue strength diagram |
| $\sigma_{qU}$ | N/mm² (MPa) | corrected minimum bending stress in the fatigue strength diagram |
| $\sigma_{zul}$ | N/mm² (MPa) | permissible bending stress |
| $\varphi_A, \varphi_B, \varphi_C$ | Deg | bending angle of the end |

## 4 Theoretical torsion spring diagram



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

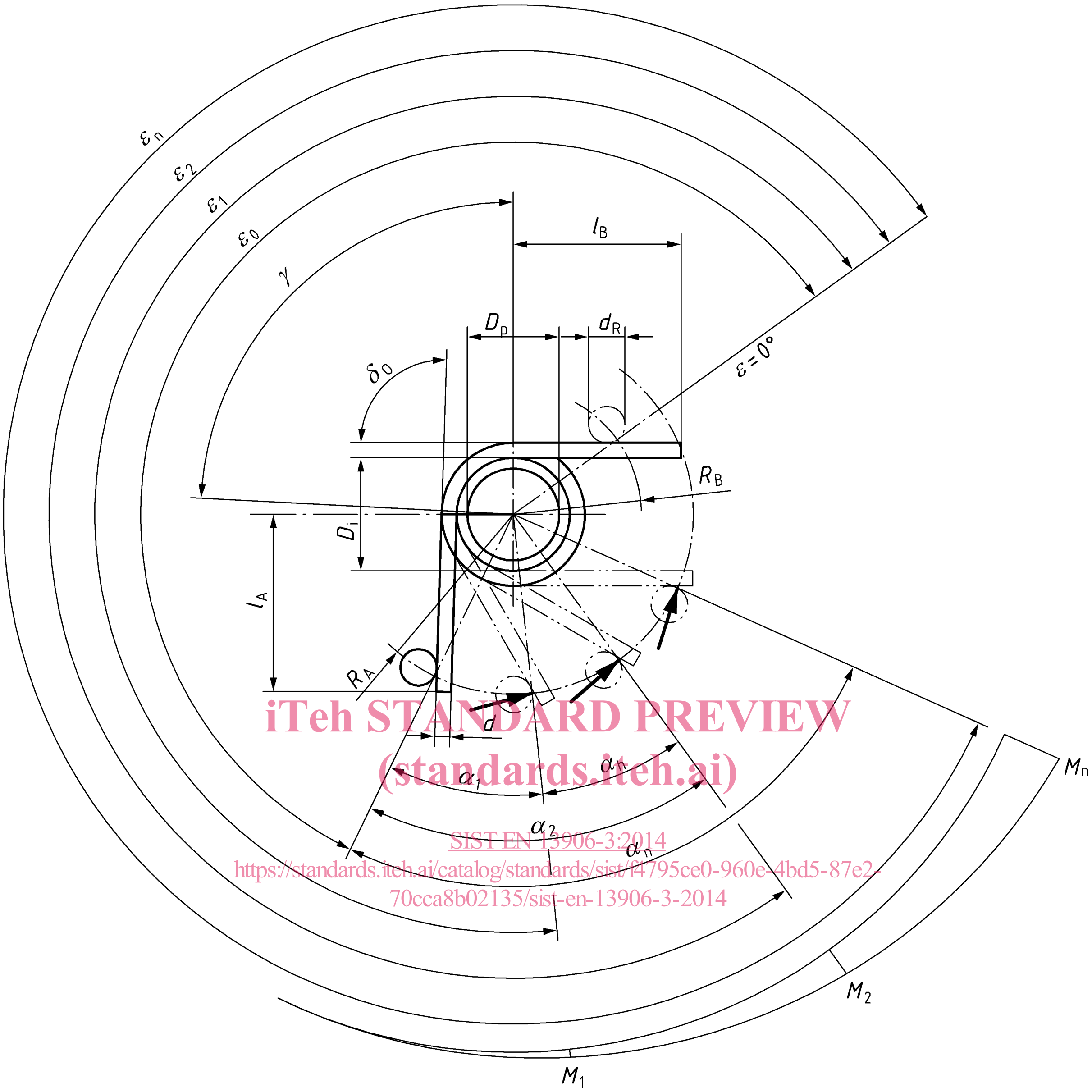




**Figure 1 — Theoretical torsion spring diagram**

Figure 2 to Figure 4 show different types of torsion springs and/or their end. The recommended arrangements are given in 5.3.

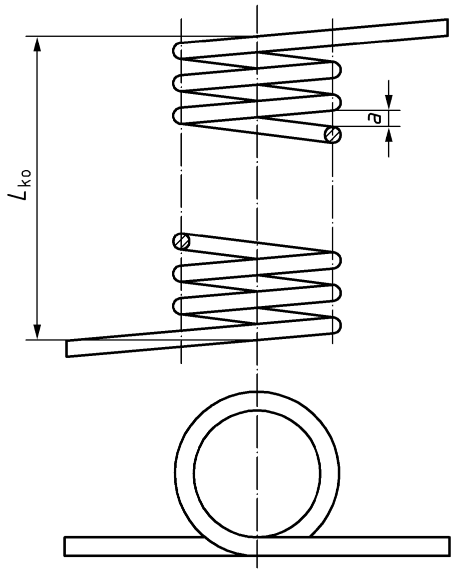


**Figure 2 — Open coiled torsion spring**

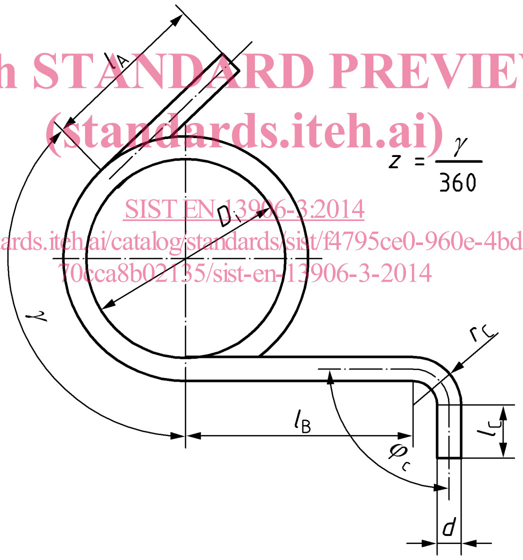




**Figure 3 — Torsion spring with tangential ends**