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Contents

page

Foreword 4

1 Scope 5

2 Normative references 5

3 Terms, symbols, units and their abbreviations 6
3.1 Terms 6
3.2 Symbols, units and their abbreviations 7
3.3 Definition of the geometrical characteristics 9

4 Classification of the product 10

5 Requirements 10
5.1 Service conditions 10
5.2 Functional requirements 10
5.3 Essential requirements 16

6 Product specification 17
6.1 Technical specification 17
6.2 Design characteristics 18
6.3 Material 19
6.4 Mechanical characteristics of the spring 20
6.5 Surface protection 21

7 Test methods 21
7.1 General 21
7.2 Axial force-deflection testing 21
7.3 Transverse stiffness test 22
7.4 Test of free transverse deflection 24
7.5 Test of geometrical characteristics 24
7.6 Test of general and essential requirements 25
7.7 Mechanical requirements 26
7.8 Surface protection 26

8 Quality of the product 27
8.1 General 27
8.2 Product qualification procedures and samples 27
8.3 Control and monitoring of production quality 28
8.4 Final acceptance requirements 29
8.5 Non conformity 30

9 Marking 31

10 Packaging 31

Annex A (normative) Helical cylindrical compression springs with constant inclination, formed from cylindrical steel bars and featuring formed and ground ends 32
A.1 Object 32
A.2 Inner and outer diameters 32
A.3 Ends of the spring 33
A.4 Contact line 33
A.5 Geometrical tolerances 33
A.6 Distance between the coils 35

Annex B (normative) Materials for hot formed and treated helical suspension springs 38
B.1 General 38
B.2 Material for helical suspension springs, steel 38

Annex C (normative) **Repeatability of prestressing by means of shot peening** **39**
C.1 Object **39**
C.2 Check of the intensity **39**
C.3 Check of the covering **42**

Annex D (normative) **Examination for inclusions** **43**
D.1 Object **43**
D.2 Test methods **43**

Annex E (normative) **Magnetic detection of surface imperfections of helical springs formed from cylindrical steel bars** **45**
E.1 Object **45**
E.2 Methods **45**
E.3 Special precautions **45**

Bibliography **46**

Foreword

This document (EN 13298:2003) has been prepared by Technical Committee CEN/TC 256 "Railway Applications" the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by September 2003, and conflicting national standards shall be withdrawn at the latest by September 2003.

In this European Standard the annexes A to E are normative.

The preparation of this European Standard started in early 1992 with the aim to integrate the existing documents such as UIC 822 (International Union of Railways) and internal documents of various railway companies into a concise standard.

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard is applicable to helical steel suspension springs used in the suspension of rail vehicles.

It deals specially with cylindrical compression springs made from round section steel bars of constant diameter and with constant inclination of coiling.

It deals also with helical springs with different shapes (e.g. conical and/or inclination of coiling not constant and/or steel bar with other cross sections, etc.).

This standard gives guidance for:

— design;

— specification of technical and quality requirements;

— the approval procedure and quality assurance of production methods;

— the examinations and tests to be carried out;

— the delivery conditions.

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 473, *Non-destructive testing – Qualification and certification of NDT personnel – General principles.*

EN 10002-1, *Metallic materials – Tensile testing – Part 1: Method of test at ambient temperature.*

EN 10045-1, *Metallic materials – Charpy impact test – Part 1: Test methods.*

EN 10083-1, *Quenched and tempered steels – Part 1: Technical delivery conditions of special steels.*

EN 10228-1, *Non-destructive testing of steel forgings – Part 1: Magnetic particle inspection.*

prEN 10089:1998, *Hot-rolled steels for quenched and tempered springs – Technical delivery conditions.*

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

EN ISO 2162-2:1996, *Technical product documentation – Springs – Part 2: Presentation of data for cylindrical helical compression springs (ISO 2162-2:1996).*

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

EN ISO 4288, *Geometrical Product Specification (GPS) – Surface texture: Profile method - Rules and procedures for the assessment of surface texture (ISO 4288:1996).*

EN ISO 10289, *Methods for corrosion testing of metallic and other inorganic coatings on metallic substrates – Rating of test specimens and manufactured articles subjected to corrosion tests (ISO 10289:1999).*

EN ISO 14284, *Steel and iron – Sampling and preparation of samples for the determination of chemical composition (ISO 14284:1996).*

ISO 4967:1998, *Steel – Determination of content of non-metallic inclusions – Micrographic method using standard diagrams.*

ISO 9227, *Corrosion tests in artificial atmospheres – Salt spray tests.*

ISO/TR 10108, *Steel – Conversion of hardness values to tensile strength values.*

ISO 10209-1, *Technical product documentation – Vocabulary – Part 1: Terms relating to technical drawings: general and types of drawings (ISO 10209-1:1992).*

EURONORM 103, *Iron and steel - Macrographic determination of the ferritic or austenitic grain size of steels.*

EURONORM 104, *Determination of the decarburization depth of unalloyed and low-alloy structural steels.*

UIC 515-4, *Passenger rolling stock - Trailer bogies - Running gear - Bogie frame structure strength test*[1)].

DIN 50 602:1985, *Metallographic examination; microscopic examination of special steels using standard diagrams to assess the content of non-metallic inclusions.*[2)]

NF A 04-106:1984, *Iron and steel – Methods of determination of content of non metallic inclusions in wrought steel – Part II: Micrographic method using standard diagrams.*[3)]

SS 11 11 16: 1987, Steel – Method for assessment of the content of non-metallic inclusions – Microscopic method – Jernkontoret's inclusion chart II for the assessment of non-metallic inclusions.[4)]

3 Terms, symbols, units and their abbreviations

3.1 Terms

For the purposes of this European Standard, the terms and definitions given in EN ISO 2162-3 and the following apply.

3.1.1
spring
term "helical suspension spring, steel" refers to the finished product. For simplification purposes, in the text of the present standard, the term "spring" is used for all types of helical compression springs, made from steel, independent of their category

3.1.2
transverse deflection (bowing)
natural transverse movement of the axis of the spring under an axial force, while the top and the bottom surface of the spring remain parallel and the spring is free to move laterally. The transverse force Φ_C is the force required to move the spring back to the initial centred position

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1) Can be obtained from: UIC Direction Générale, 16 rue Jean Rey, F-75015 Paris.

2) Can be purchased from: Beuth Verlag GmbH, Burggrafenstr. 6, 10772 D-Berlin.

3) Can be purchased from: Association française de normalisation (AFNOR), 11, av. Francis de Pressensé, F-93571 Aint-Denis La Plaine CEDEX.

4) Can be purchased from: SIS-Standardiseringen i Sverige, box 64 55, S-11 3 82 Stockholm.

3.1.3
clearance factor
clearance between the active coils with reference to the wire diameter on a cylindrical helical spring with constant inclination, made with circular wire and featuring closed and ground ends

3.1.4
decarburization
loss of carbon on the metal surface during the hot forming of the spring

3.1.5
space requirements
volume occupied by the spring under its various operational conditions

3.1.6
creep
loss of the spring length under a defined static or dynamic force in a defined time

3.1.7
contact line
line located between each end coil and the adjacent active coil of the cylindrical helical spring with constant inclination, made with circular wire and featuring closed and ground ends (form D according to ISO 2162-2), in the loaded condition

3.1.8
active coil
complete spiral turn of the wire with constant diameter, which remains without contact with adjacent coils within the entire working envelope of the spring

3.2 Symbols, units and their abbreviations

The majority of the symbols, used in this standard and described in Table 1, are in accordance with EN ISO 2162-2.

Table 1 — Symbols and their definition

No	Symbol	Unit	Description
1	A	%	Elongation at rupture
2	A_R	%	Allowable deviation of axial stiffness
3	d	mm	Diameter of the steel bar
4	D	mm	Mean diameter of the winding (average coiling diameter)
5	D_e	mm	Outer spring diameter
6	D_i	mm	Inner spring diameter
7	e	mm	Clearance between the active coils
8	$F_j(F_1, F_2,..)$	N	Axial static force, applied on the spring, with:
	F_A	N	Minimum operational force
	F_B	N	Maximum operational force
	F_{cth}	N	Theoretical force, corresponding to the solid length of spring
	$F_{cj}(F_{C0},F_{C1})$	N	Defined test loads for determination of bowing (transverse displacement)
	F_M	N	Force at minimum allowable length
	F_U	N	Lower test force for determination of stiffness K_S (or flexibility)
	F_V	N	Upper test force for determination of stiffness K_S (or flexibility)
9	g	m/s^2	Earth acceleration (gravity)
10	G	MPa	Shear modulus (default value is G = 79 000 MPa)
11	L_0	mm	Free length of spring
	$L_j(L_1, L_2, ..)$	mm	Length of the spring when subjected to an axial force F_j,
	L_A	mm	Length of the spring when subjected to the axial force F_A
	L_B	mm	Length of the spring when subjected to the axial force F_B
	L_C	mm	Solid length of spring
	L_M	mm	Minimum allowable length of spring
	L_U	mm	Length of the spring when subjected to an axial force F_U
	L_V	mm	Length of the spring when subjected to an axial force F_V
12	n	-	Number of active coils
13	n_t	-	Total number of coils
14	Q_j	N	Transverse static force, applied to the spring to produce a translation of r_j (transverse displacement of the two supporting surfaces)
15	r_j	mm	Translation (transverse displacement of the two supporting surfaces
	r_E	mm	Maximum possible transverse displacement (to bump stops)

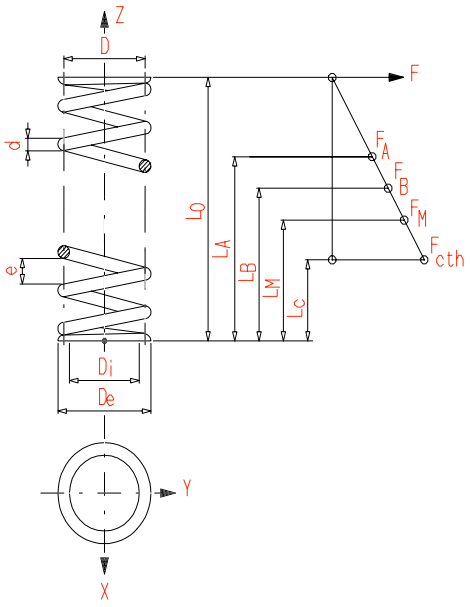
Table 1 *(continued)*

16	$R_{p0,2}$	MPa	Yield limit at 0,2%
17	R_m	MPa	Ultimate strength (tensile strength)
18	K_s	N/mm	Axial stiffness
19	$1/K_s$	mm/N	Axial flexibility
20	K_t	N/mm	Transverse stiffness
21	$1/K_t$	mm/N	Transverse flexibility
22	s_h	mm	Axial displacement of the spring between two axial loads F_j
23	α	-	Coefficient of clearance between active c
24	Φ_c	N	Transverse bowing force of the spring at the defined axial force F_j
25	Θ_c	d°	Angle between two directions of bowing of a spring, submitted to two different axial loads.
26	σ_{max}	MPa	Residual compression stress
27	δ	mm	Depth under surface

3.3 Definition of the geometrical characteristics

In the this standard the characteristics of the spring are defined with reference to its axis.

The axial characteristics are defined along the Z-axis, the transverse characteristics are defined in the X-Y-plane (see Figure 1).



material cross section: circular

direction of coiling: right hand

end-form: closed, ground (form D acording to EN ISO 2162-2:1993)

type of spring: cylindrical compression spring with constant inclination of coiling (no. 4-1 according to EN ISO 2162-1:1993)

Figure 1 — Example of the presentation of a spring with its axial characteristics