European Assessment Document for

Steel spring elements

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Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD covers compression steel spring elements as shown in figure 1.1.1. The exact denomination of the steel spring element depends on the quantity and type of the used helical compression springs. The helical compression springs are made of steel wire according to EN 10270-1[1], EN 10270-2 or EN 10089 and are calculated, dimensioned and manufactured according to EN 13906-1. The steel used for the product is uncoated or treated with an inorganic coating, but not with an organic coating.
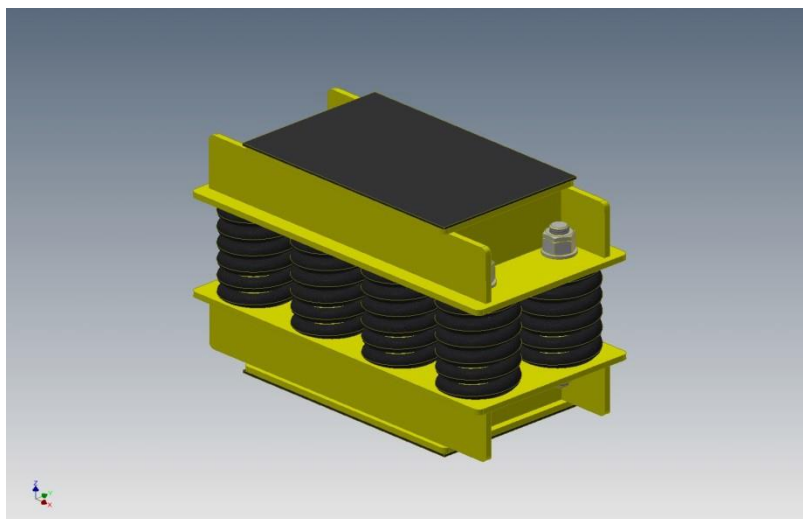

Figure 1.1.1: Example of the compression steel spring element

Steel spring elements are composed of upper and lower housings, made of welded structural steel and calculated in accordance with EN 1993-1-1, with a defined quantity of helical compression springs inserted in between, depending on the intended load capacity. In addition, there is the possibility to insert narrower (inner) springs in wider (outer) springs to achieve a higher load capacity in small spaces. For positional stability and shear connection, springs are placed in or around spring guides welded on the upper or lower housing.

The arrangement of the compression springs can be executed in one or more rows in the steel spring element. The outer and inner springs can be placed individually or inserted into each other.

The steel spring element is adapted to static or quasi-static loads.

The product is not covered by a harmonised European standard (hEN).

For transport and installation as well as for prestressing of the steel spring element to a predefined installation height, the housings are connected and screwed together with steel bolts.

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

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[1] All undated references to standards or to EADs in this EAD are to be understood as references to the dated versions listed in chapter 4

1.2 Information on the intended use of the construction product

1.2.1 Intended use

Steel spring elements are used for passive isolation of buildings and building parts from undesired vibrations, tremors and structure-borne noise caused by the environment (rail traffic, industrial machines, etc.). The structures that require isolation are stored on the steel spring elements and thus decoupled from the ground and its movements.

Also, the active isolation of building parts from retransmission of vibrations to other parts is possible (parking areas, supply areas, etc.). For this method, the concerned area is stored on steel spring elements and thus isolated from the remaining building structure.

The springs and housing are intended to be used in environmental conditions where they are protected against corrosion. Hence this aspect is not addressed in the EAD.

The steel spring elements are able to transfer the occurring forces similarly in vertical and horizontal directions due to the physical properties of the used springs.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the steel spring elements for the intended use of 50 years when installed in the works. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[2].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

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[2] The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.1.1 shows how the performance of the steel spring elements are assessed in relation to the essential characteristics.

Table 2.1.1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability			
1	Vertical stiffness	2.2.1	Level (R [N/mm])
2	Vertical load-bearing capacity	2.2.2	Level (F_n [N])
3	Horizontal stiffness	2.2.3	Level (R_Q [N/mm])
4	Horizontal load-bearing capacity	2.2.4	Level (F_Q [N])
Basic Works Requirement 2: Safety in case of fire			
5	Reaction to fire	2.2.5	Class

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as "shall be stated in the ETA" or "it has to be given in the ETA" shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

2.2.1 Vertical stiffness

The vertical stiffness of the compression steel spring element R is the sum of the vertical stiffness of the single springs determined by using the formula according to EN 13906-1, clause 9.4:

$$R = \sum_{i=1}^{m} \frac{G_i \cdot d_i^4}{8 \cdot D_i^3 \cdot n_i} \qquad (2.2.1.1)$$

with:

D: mean diameter of coil
d: nominal diameter of wire
G: modulus of rigidity (see EN 13906-1, Table3)
n: number of active coils
m: number of springs

2.2.2 Vertical load-bearing capacity

The load bearing capacity F_n of the steel spring element is the product of the vertical stiffness R of the steel spring element and the vertical displacement s_n.

$$F_n = R \cdot s_n \tag{2.2.2.1}$$

with

$$s_n = s_c / 1.35 \tag{2.2.2.2}$$

s_c : spring deflection, for the solid length L_c (EN 13906-1, clause 9.10 and EN 13906-1, Figure 1)

2.2.3 Horizontal stiffness

The horizontal stiffness of the compression steel spring element R_Q is the sum of the horizontal stiffness R_{Qi} of the single springs determined by using the formulas according with EN 13906-1, clause 9.13.

$$R_Q = \sum_{i=1}^{m} R_{Qi} \tag{2.2.3.1}$$

with

$R_{Q,i}$: transverse stiffness of the single spring which is defined by

$$R_{Q,i} = \zeta \left[\zeta - 1 + \frac{\frac{1}{\lambda}}{\frac{1}{2} + \frac{G}{E}} \sqrt{\left(\frac{1}{2} + \frac{G}{E}\right) \cdot \left(\frac{G}{E} + \frac{1-\zeta}{\zeta}\right)} \tan\left\{ \lambda \cdot \zeta \sqrt{\left(\frac{1}{2} + \frac{G}{E}\right) \cdot \left(\frac{G}{E} + \frac{1-\zeta}{\zeta}\right)} \right\} \right]^{-1} \cdot R \tag{2.2.3.2}$$

$$\lambda = \frac{L_0}{D} \qquad \text{slenderness ratio} \tag{2.2.3.3}$$

$$\zeta = \frac{s}{L_0} \qquad \text{relative spring deflection} \tag{2.2.3.4}$$

L_0 : nominal free length of spring
s: spring deflection in vertical direction
E: modulus of elasticity (EN 13906-1, Table 3)

2.2.4 Horizontal load-bearing capacity

The horizontal load-bearing capacity F_Q of the steel spring element depends on the vertical load. This results in a horizontal load-bearing capacity of the steel spring elements of

$$F_Q = \sum_{i=1}^{m} \frac{d_i^3}{8(L_i - d_i)} \left[\pi \, 0.56 \, R_m - \frac{G \, d_i \, s}{D_i^3 \, n_i} (D_i + s_Q) \right] \tag{2.2.4.1}$$

with:
D: mean diameter of coil
d: nominal diameter of wire
R_m minimum value of tensile strength
G: modulus of rigidity (EN 13906-1, Table 3)
n: number of active coils
s: vertical deflection
s_Q: transverse deflection
L: length of spring loaded by F
m: number of springs

2.2.5   Reaction to fire

The steel spring elements are considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire in accordance with the Commission Decision 96/603/EC, as amended by Commission Decisions 2000/605/EC and 2003/424/EC, without the need for testing on the basis of it fulfilling the conditions set out in that Decision and its intended use being covered by that Decision.

Therefore, the performance of the product is class A1.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is Commission Decision 98/214/EC, amended by 2001/596/EC.

The system is **2+**.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the steel spring elements in the procedure of assessment and verification of constancy of performance are laid down in Table 3.2.1.

Table 3.2.1   Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
1	Check of initial raw materials	Inspection certificate 3.1 in accordance with EN 10204	In accordance with control plan	---	Every production unit
2	Geometry and dimension of the compression steel spring elements	Measuring	In accordance with control plan	10	When starting the production or a new production line
3	Control tests on the finished product				
	- Welding	EN ISO 5817	Quality level: D	1%	Every production unit
	- Vertical load bearing capacity of the steel spring element (load-displacement-curve)	Measuring, allowable tolerances between the test result and the calculation result (clause 2.2.2) shall be determined in the control plan	In accordance. with control plan	1%	Every production unit
	- Horizontal load bearing capacity of the steel spring element (load-displacement-curve)	Measuring, allowable tolerances between the test result and the calculation result (clause 2.2.4) shall be determined in the control plan	In accordance with control plan	1%	Every production unit

3.3   Tasks of the notified body

The corner stones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for the steel spring elements are laid down in Table 3.3.1.

Table 3.3.1   Control plan for the notified body; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control *(for systems 1+, 1 and 2+ only)*					
1	Ascertain that the manufacturing plant, personnel, equipment and factory production control are suitable to ensure a continuous and orderly manufacturing of the compression steel spring elements.	see control plan	In accordance with control plan	---	When starting the production
Continuous surveillance, assessment and evaluation of factory production control *(for systems 1+, 1 and 2+ only)*					
2	Verifying that the system of factory production control and the specified manufacturing process are maintained taking account of the control plan. In particular, review that aspects presented in the Table 3.2.1 are being controlled effectively.	---	In accordance with control plan	---	Once per year

4   REFERENCE DOCUMENTS

EN 1993-1-1:2005+AC:2009	Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings
EN 10089:2002	Hot rolled steels for quenched and tempered springs - Technical delivery conditions
EN 10204:2004	Metallic products - Types of inspection documents
EN 10270-1:2011 +A1:2017	Steel wire for mechanical springs - Part 1: Patented cold drawn unalloyed spring steel wire
EN 10270-2:2011	Steel wire for mechanical springs - Part 2: Oil hardened and tempered spring steel wire
EN 13906-1:2013	Cylindrical helical springs made from round wire and bar – Calculation and design – Part 1: Compression springs
EN ISO 5817:2014	Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections (ISO 8517:2014)