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Springs — Measurement and test parameters —

Part 1: Cold formed cylindrical helical compression springs

Ressort - Mesures et paramètres d'essai —

Partie 1: Ressort hélicoïdal de compression cylindrique formé à froid

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Foreword

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This document was prepared by Technical Committee ISO/TC 227, *Springs*.

A list of all parts in the ISO 22705 series can be found on the ISO website.

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Springs — Measurement and test parameters —

Part 1:
Cold formed cylindrical helical compression springs

1 Scope

This document specifies the measurement and test methods for the general characteristics of cold formed helical compression springs made from round wire, excluding dynamic testing.

2 Normative references

There are no normative references in this document.

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

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

[SOURCE: ISO 26909:2009, 1.1]

3.1.2
compression spring
spring that offers resistance to a compressive force applied axially

Note 1 to entry: In the narrow sense, a compression spring indicates a helical compression spring.

[SOURCE: ISO 26909:2009, 1.2]

3.1.3
coil spring
coil-shaped spring

[SOURCE: ISO 26909:2009, 3.11]

3.1.4
helical compression spring
compression spring made of wire of circular cross-section, wound around an axis with spaces between its coils

[SOURCE: ISO 26909:2009, 3.12, modified — limited to wires with circular cross-section]

3.1.5
cold formed spring
spring formed at ambient temperature

[SOURCE: ISO 26909:2009, 1.12]

3.1.6
active coils
total number of coils less the inactive coils

Note 1 to entry: This is the number of coils used in computing the total deflection of a spring.

[SOURCE: ISO 26909:2009, 5.70, modified — extended to all inactive coils]

3.1.7
test parameter
parameter with a tolerance for which there is an immediate conclusion after the test (within tolerance or out of tolerance)

Note 1 to entry: Test can be performed without measurement (i.e. with GO/NO-GO gauges).

3.2 Symbols and abbreviated terms

Table 1 includes the symbols and abbreviated terms used throughout this document.

Table 1 — Symbols and abbreviated terms

Symbols	Units	Designations
D_e	mm	outside diameter of spring
$D_{e,max}$	mm	maximum outside diameter of spring
$D_{e,min}$	mm	minimum outside diameter of spring
D_i	mm	inside diameter of spring
$D_{i,max}$	mm	maximum inside diameter of spring
$D_{i,min}$	mm	minimum inside diameter of spring
d	mm	diameter of wire
d_{max}	mm	maximum diameter of wire
d_{wire}	mm	actual wire diameter
e_1	mm	perpendicularity
e_2	mm	parallelism
F	N	spring load or force
F_c	N	spring load at solid length, L_c
F_{max}	N	maximum specified spring load
F_{min}	N	minimum specified spring load
F_n	N	spring load for the minimum test length, L_n
F_1, F_2,...	N	specified spring loads for the specified spring lengths, L_1, L_2,...
L_c	mm	solid length
L_{max}	mm	maximum specified spring length
L_{min}	mm	minimum specified spring length
L_n	mm	minimum acceptable test length for F_n
L_0	mm	free length
$L_{0,max}$	mm	maximum free length
$L_{0,min}$	mm	minimum free length
L_1, L_2,...	mm	specified spring lengths for the spring loads, F_1, F_2,...

Table 1 *(continued)*

Symbols	Units	Designations
n	–	active coils
n_t	–	total number of coils
p	mm	spring pitch
$R=\frac{\Delta F}{\Delta L}=\frac{\Delta F}{\Delta s}$	N/mm	spring rate (see Annex A)
s	mm	deflection of spring
s_c	mm	deflection of spring for the solid length, L_c
s_h	mm	deflection of the spring (stroke) between two loads, ΔF
s_n	mm	maximum test spring deflection for the spring load, F_n
$s_1, s_2,\ldots$	mm	specified spring deflections for the specified spring loads, $F_1, F_2,\ldots$
u	mm	distance between the coils

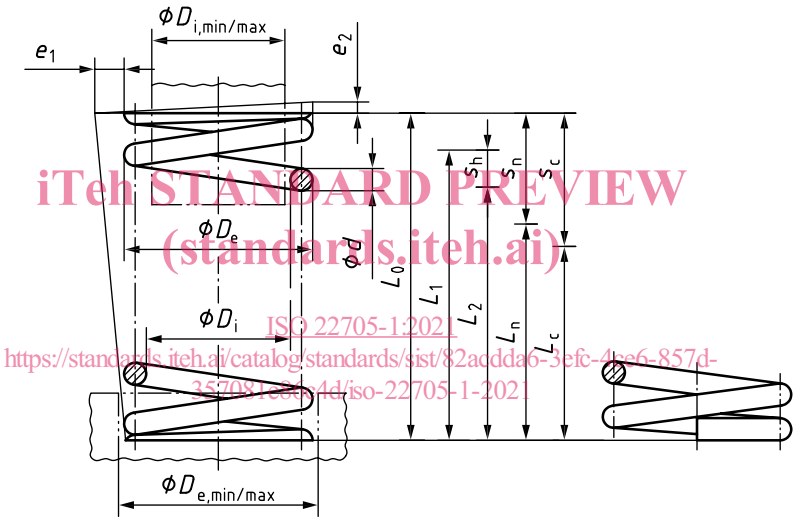


Figure 1 — Symbols for helical compression springs

4 Environmental conditions

The spatial distribution and equipment of the facility shall permit a reliable implementation of the measurements and tests. Measurements and tests should be carried out at ambient temperature in a normal workshop environment. Special tests (e.g. in air-conditioned rooms or other special environments) shall be agreed upon between the manufacturer and the customer. Measuring and testing equipment should be subject to regular inspection.

5 Qualifications of the person(s) performing the work

The measurements and tests shall be carried out by a person who has been instructed/trained in the use of the measuring and testing equipment, as well as regarding methods and test requirements.

The qualifications or additional knowledge and skills should be documented in appropriate qualification or training documents, depending on the requirements.

6 Geometries of guiding and supporting devices

If guiding and supporting devices (e.g. test pins, guide sleeves, ring grooves) are used, the properties (e.g. geometry, material) shall be agreed upon between the manufacturer and the customer to include special cases such as snapping end coils, buckling or bulging. The alignment of guiding and supporting devices is aimed to improve the reproducibility of the measurements.

7 Measuring and testing equipment

Suitable measuring equipment shall be selected. Measuring equipment shall conform to ISO standards, if such are available (e.g. ISO 3611 and ISO 13385-1).

If there is a customer requirement, the methods and measuring equipment shall be agreed on separately.

8 Measurement and test parameter for technical cold formed cylindrical compression springs

8.1 Free length (L_0)

8.1.1 General

The free length L_0 is a measurement and test parameter.

8.1.2 Type of characteristic

L_0 is the length across the entire spring body when no load is applied and only when both ends are ground (see Figure 2); other cases should be agreed upon between the manufacturer and the customer.

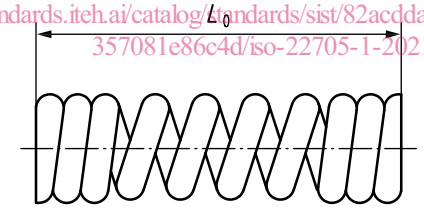


Figure 2 — Free length (L_0) where both ends are closed and ground

8.1.3 Measuring and/or testing equipment

The following measuring equipment can be used:

— micrometer gauge;

— calliper;

— dial gauge/indicating calliper;

— electronic measuring sensor;

— manual/automatic force gauge;

— optical measuring instruments/protractor/measurement microscope/camera systems.

The following testing equipment can be used:

— attributive gauges (GO/NO-GO gauges).

8.1.4 Conditions of measurement and testing

The free length L_0 shall be evaluated at ambient temperature as delivered.

8.1.5 Method of measurement and testing

a) Variable measurement

The measurement can be carried out without contact using optical procedures, capacitive or electrically by contact (with minimal force) or by contact with the measuring surfaces (at a known/unknown measuring force). Preferably, the measurement should be carried out over the entire face (see Figure 3). If this is not possible, then a second measurement can be carried out with a 90° offset. In this case, it shall be clarified whether the maximum value, the minimum value or the average value is to be specified.

When there is a spring self-weight effect, the measurement of free height should be agreed upon between the manufacturer and the customer.

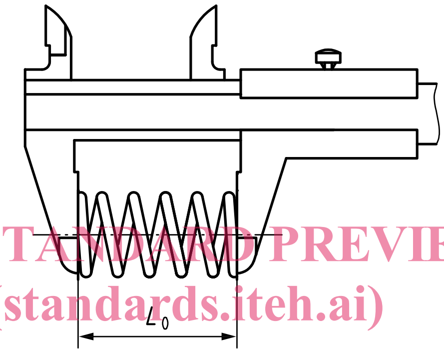
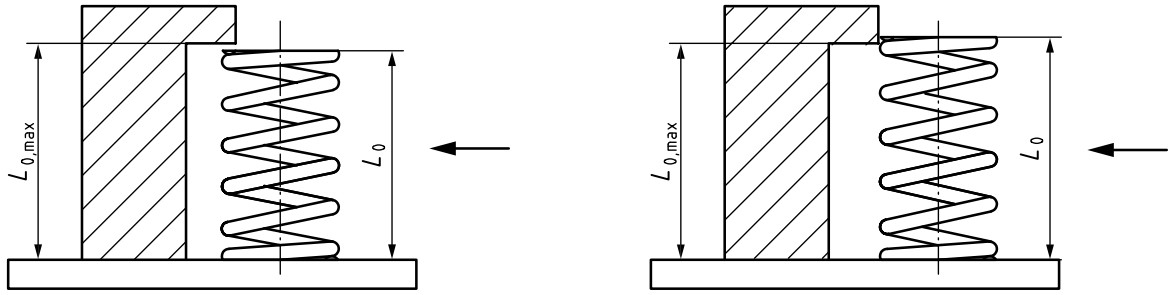


Figure 3 — Method of measurement of the free length (L_0) with calliper (example)

If the customer specifies a setting length for the test spring, the setting conditions for the test spring shall be agreed upon between the manufacturer and the customer.

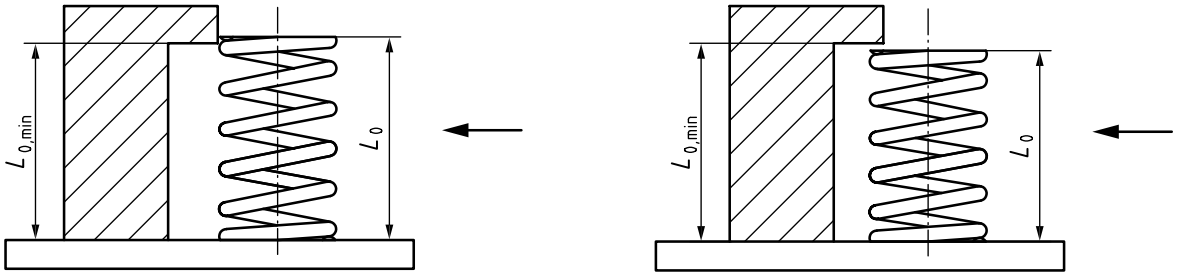
Unless otherwise specified, springs that are not pre-set shall only be measured after the spring load test. If no spring load or force is specified, measurement can be done without any preliminary test.

b) Attributive testing (with GO/NO-GO gauges, see Figure 4)



a) Tolerance upper limit check with gauge ($L_0 \leq L_{0,max}$) (GO/within tolerance)

b) Tolerance upper limit check with gauge ($L_0 > L_{0,max}$) (NO GO/out of tolerance)



c) Tolerance lower limit check with gauge ($L_0 \geq L_{0,min}$) (NO GO/within tolerance)

d) Tolerance lower limit check with gauge ($L_0 < L_{0,min}$) (GO/out of tolerance)

Figure 4 — Method of testing the free length (L_0) with gauges (examples)

8.1.6 Test location on the product

The test direction is in the axial direction to the finished spring. When measuring equipment is used that induces a measuring force, then the applied force should not deflect the spring.

When optical measuring equipment (camera systems) is used, the measurement axis is perpendicular to the spring axis.

8.2 Outside diameter (D_e)

8.2.1 General

The outside diameter D_e is a measurement and test parameter.

8.2.2 Type of characteristic

D_e is the value of the outside diameter through the whole spring body (see Figure 5).

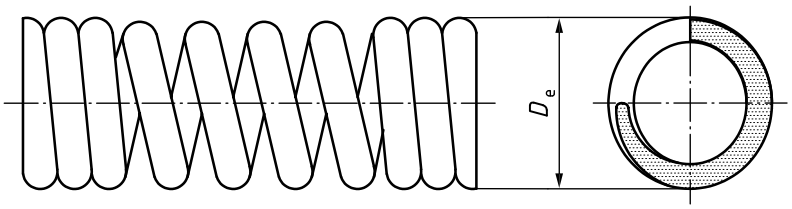


Figure 5 — Outside diameter (D_e)