
**Springs — Measurement and test
parameters —**

Part 2:
**Cold formed cylindrical helical
extension springs**

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Ressort - Mesures et paramètres d'essai —

Partie 2: Ressort hélicoïdal de traction cylindrique formé à froid

ISO 22705-2:2023

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Springs — Measurement and test parameters —

Part 2:

Cold formed cylindrical helical extension springs

1 Scope

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3611, *Geometrical product specifications (GPS) — Dimensional measuring equipment: Micrometers for external measurements — Design and metrological characteristics*

ISO 13385-1, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Part 1: Design and metrological characteristics of callipers*

ISO 16249, *Springs — Symbols*

ISO 26909, *Springs — Vocabulary*

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3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1.1

helical extension spring

extension spring normally made of wire of circular cross-section, wound around an axis, with or without spaces between its coils (open or closed wound)

[SOURCE: ISO 26909:2009, 3.13, modified — limited to wires with circular cross-section]

3.1.2

test parameter

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

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

3.2 Symbols and abbreviated terms

For the purposes of this document, the symbols given in ISO 16249, Figure 1 and [Table 1](#) apply.

Table 1 — Symbols and abbreviated terms

Symbols	Units	Designations
D_e	mm	outside diameter of spring
D_i	mm	inside diameter of spring
d	mm	diameter of wire
d_{\max}	mm	maximum diameter of wire
d_{wire}	mm	actual wire diameter
F	N	spring load or force
$F_i = F_1 - s_1 R$	N	initial tension force (preload) (see Annex B)
F_1, F_2, \dots	N	specified spring loads for the specified spring lengths, L_1, L_2, \dots
F_n	N	maximum permissible spring force for the maximum permissible spring length L_n
F_{\max}	N	maximum specified spring load
F_{\min}	N	minimum specified spring load
L_0	mm	free length
L_n	mm	maximum acceptable spring length measured spring hooks inner radii for F_n
L_1, L_2, \dots	mm	specified spring lengths for the spring loads, F_1, F_2, \dots
L_H	mm	distance from inner radius of loop to spring body
L_B	mm	body length when unloaded but subject to initial tension force
L_{\max}	mm	maximum specified spring length
L_{\min}	mm	minimum specified spring length
m	mm	hook opening
n	-	number of 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)
r	mm	bending radius
s	mm	deflection of spring
s_n	mm	maximum test spring deflection for the spring loads, F_n
s_1, s_2, \dots	mm	specified spring deflections for the specified spring loads, F_1, F_2, \dots
s_h	mm	deflection of spring (stroke) between two loads
u	mm	distance between the coils

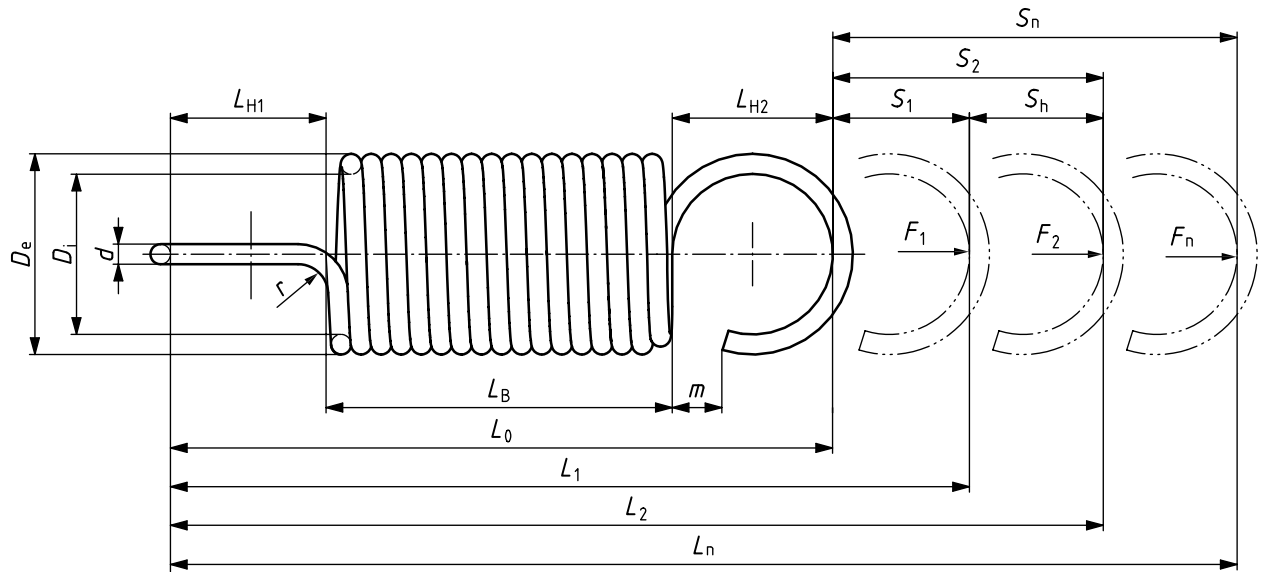


Figure 1 — Symbols for helical extension spring

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. The alignment of guiding and supporting devices is aimed to improve the reproducibility of the measures (e.g. diameter of pins inserted inside the hooks to measure the loads).

7 Measuring and testing equipment

Suitable measuring equipment shall be selected. Measuring equipment shall conform to 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 extension 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

The free length L_0 is the length between the two internal hooks when no load is applied (see [Figure 2](#)); other cases should be agreed upon between the manufacturer and the customer. If it's not possible to measure L_0 inside the hooks, it shall be measured outside the hooks minus two times wire diameter ($2d$).

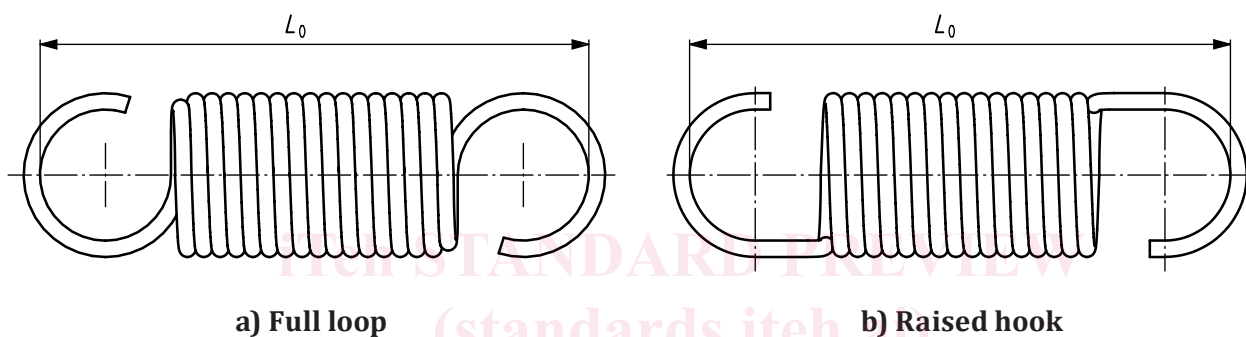


Figure 2 — Free length (L_0)

8.1.3 Measuring and/or testing equipment

The following measuring equipment can be used:

- micrometer gauge;
- calliper;
- electronic measuring sensor;
- manual/automatic force gauge;
- optical measuring instruments/ 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

The measurement can be carried out without contact using optical procedures, capacitive or electrically by contact (with minimal force) without deflection or by contact with the measuring surfaces (at a known/unknown measuring force).

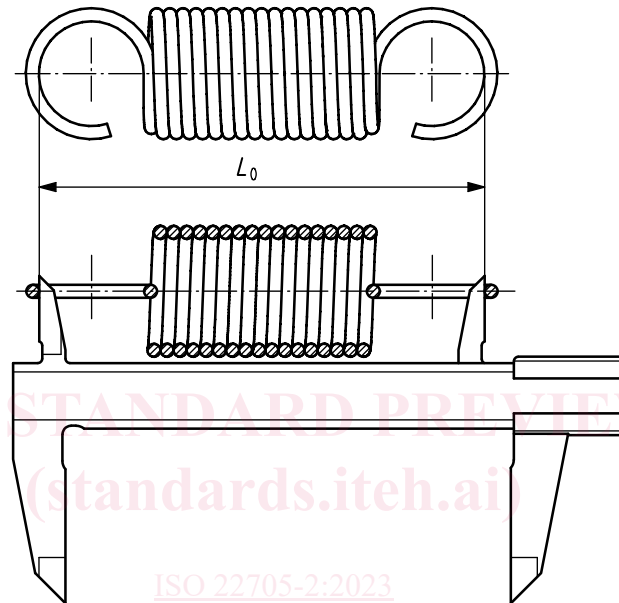
When there is a spring self-weight effect, the measurement of free length should be carried out in horizontal position on an appropriate flat surface.

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

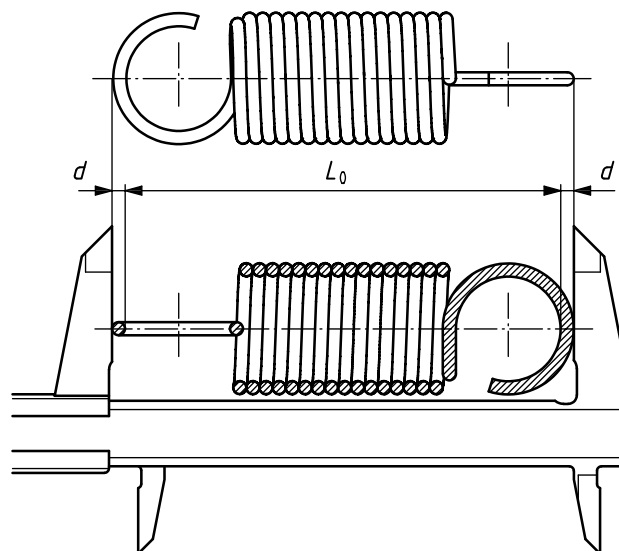
NOTE Generally, extension springs do not have a setting process because it reduces the initial tension force.

Calliper: the unloaded spring is held with the inner measuring legs of the calliper between the highest points of the inner edges of the loops (see [Figure 3](#)).

GO/NO GO gauges can be used as shown in [Figure 4](#).

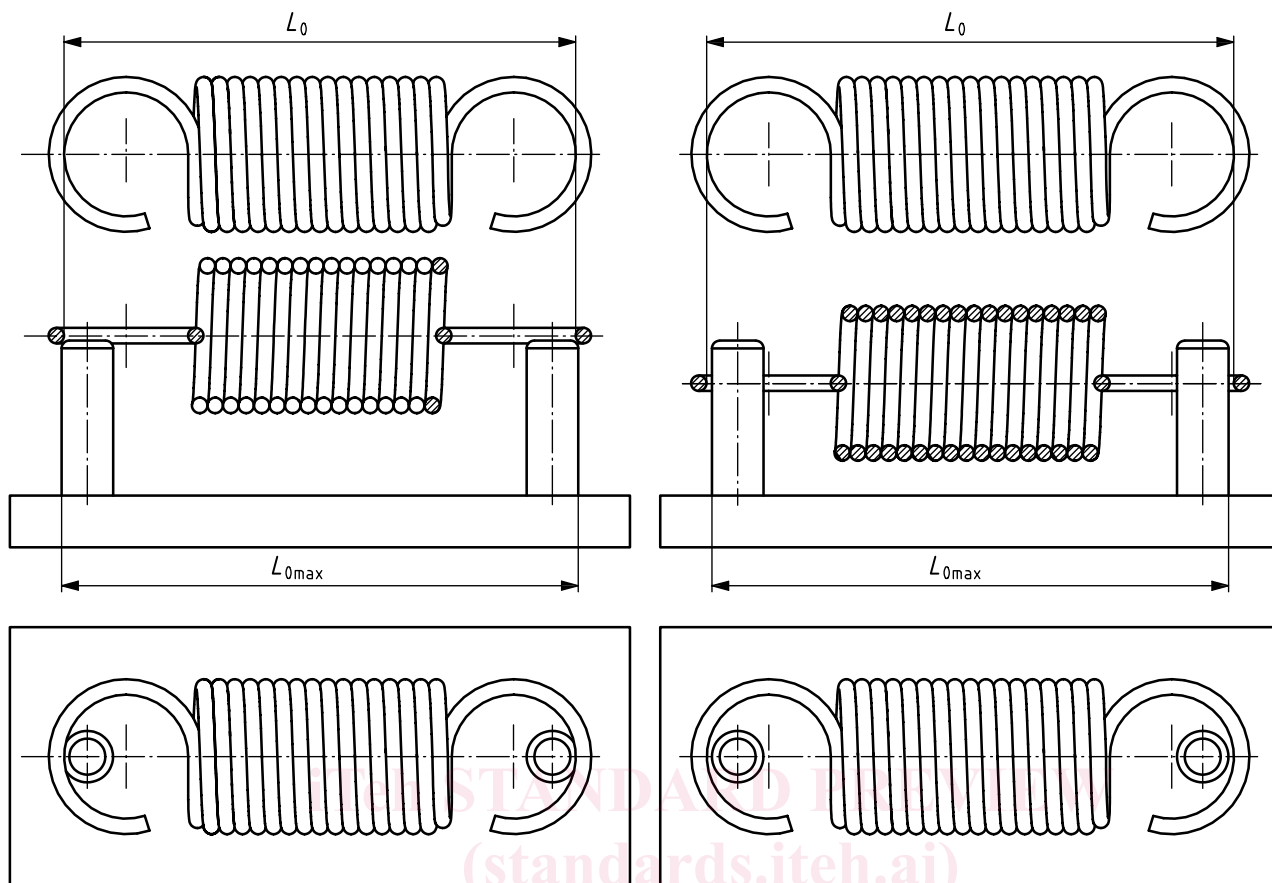


a) Loop position 0°



b) Loop position 90°

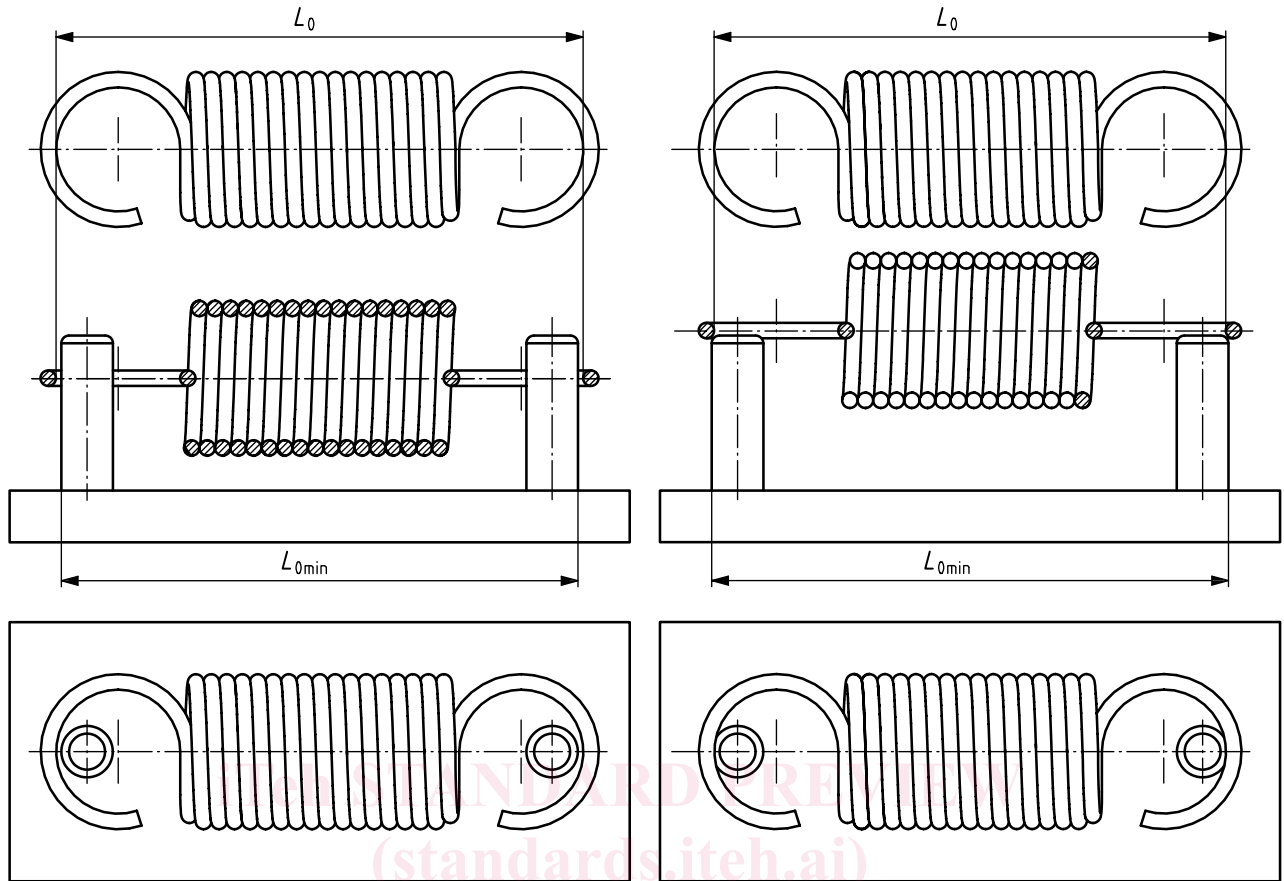
Figure 3 — Method of measurement with calliper (example)



a) Tolerance upper limit check with gauge
 $(L_0 \leq L_{0max})$ NO GO/within tolerance

b) Tolerance upper limit check with gauge
 $(L_0 > L_{0max})$ GO/out of tolerance

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c) Tolerance lower limit check with gauge
 $(L_0 \geq L_{0min})$ GO/within tolerance

d) Tolerance lower limit check with gauge
 $(L_0 < L_{0min})$ NO 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 of 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 Body length (L_B)

8.2.1 General

The body length L_B is a measurement and test parameter.

8.2.2 Type of characteristic

The body length L_B is the maximum overall length of the entire spring body (excluding hooks), measured perpendicular to the axis of the spring when no load is applied (see Figure 5).

Where it is not possible to measure the L_B the following formula is applied: $L_B = L_0 - L_{H1} - L_{H2}$