INTERNATIONAL STANDARD

**ISO 22705-2**

First edition
2023-02

# Springs — Measurement and test parameters —

## Part 2: Cold formed cylindrical helical extension springs



*Ressort - Mesures et paramètres d'essai —*

*Partie 2: Ressort hélicoïdal de traction cylindrique formé à froid*



Reference number
ISO 22705-2:2023(E)



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Published in Switzerland

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# Foreword

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

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# 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*



## 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) |
| $F_1, F_2, \ldots$ | N | specified spring loads for the specified spring lengths, $L_1, L_2, \ldots$ |
| $F_n$ | 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 $F_n$ |
| $L_1, L_2, \ldots$ | mm | specified spring lengths for the spring loads, $F_1, F_2, \ldots$ |
| $L_H$ | 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, $F_n$ |
| $s_1, s_2, \ldots$ | mm | specified spring deflections for the specified spring loads, $F_1, F_2, \ldots$ |
| $s_h$ | mm | deflection of spring (stroke) between two loads |
| $u$ | mm | distance between the coils |

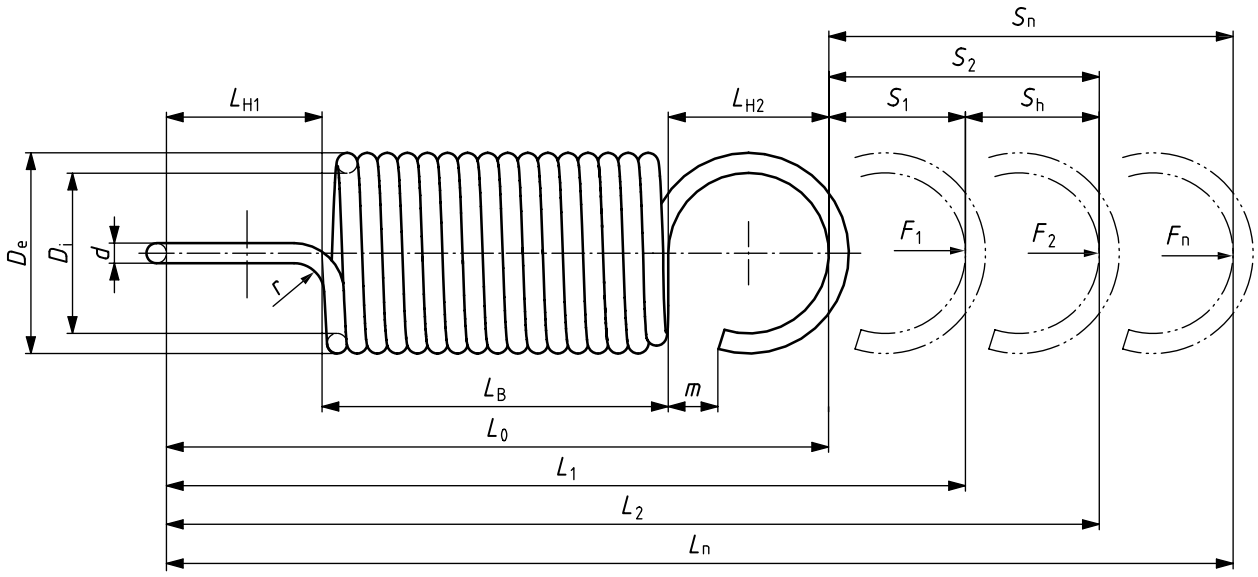



**Figure 1 — Symbols for helical extension spring**

## 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

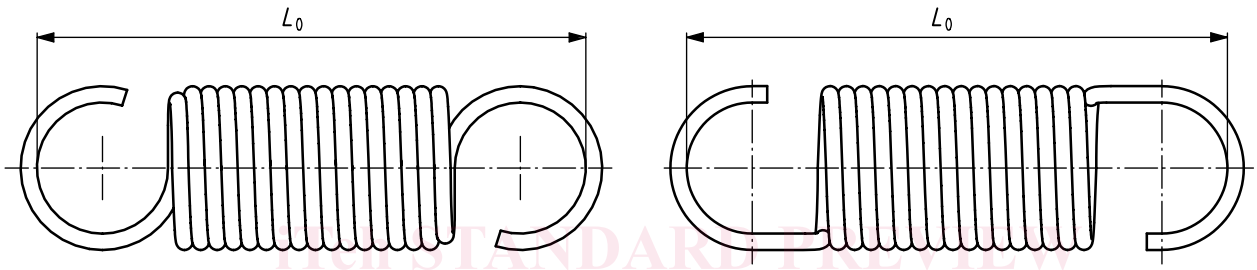
## 8.1 Free length ($L_0$)

### 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 ($2d$).




**a) Full loop** **b) Raised hook**

**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).

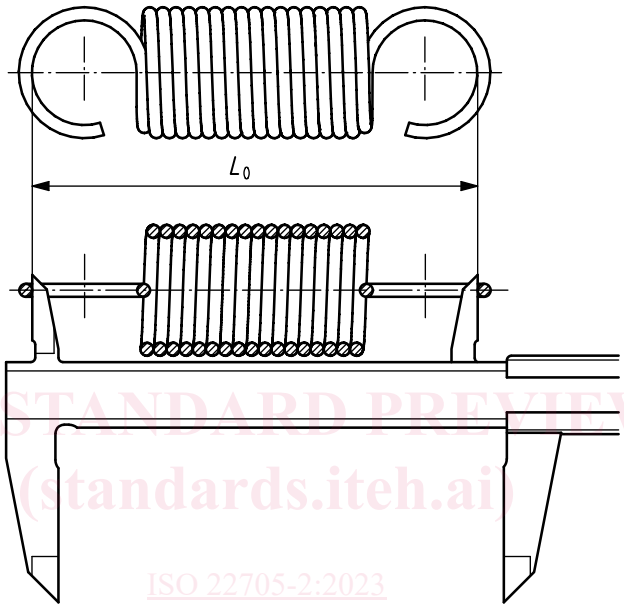
When there is a spring self-weight effect, the measurement of free length should be carried out in horizontal position on an appropriate flat surface.

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.

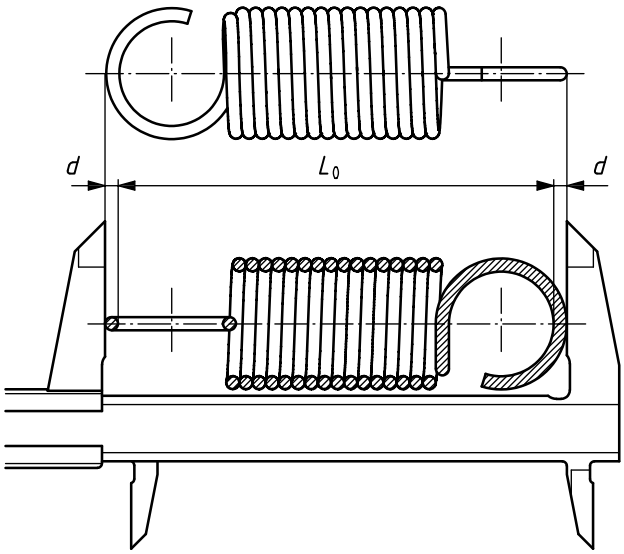
Calliper: the unloaded spring is held with the inner measuring legs of the calliper between the highest points of the inner edges of the loops (see Figure 3).

GO/NO GO gauges can be used as shown in Figure 4.



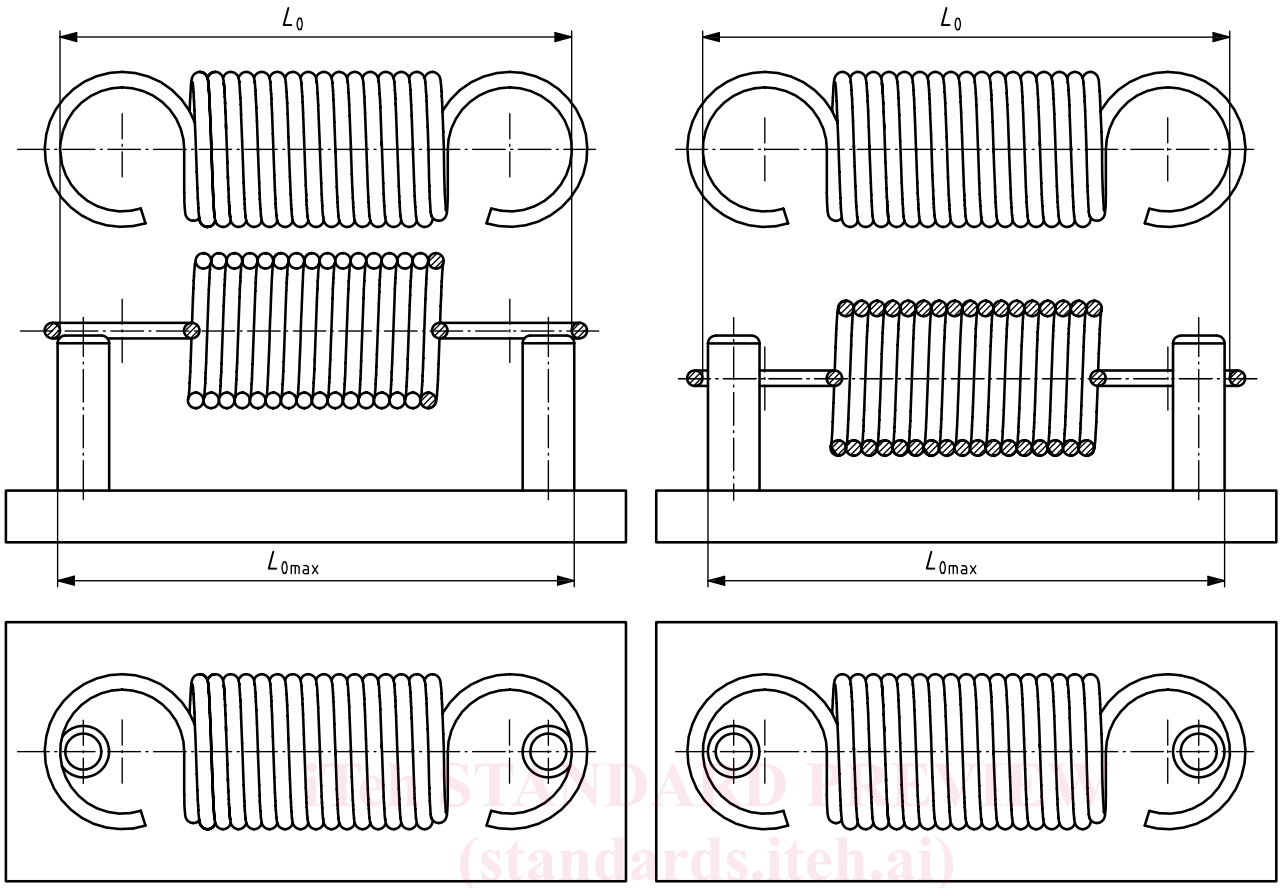



**a) Loop position 0°**



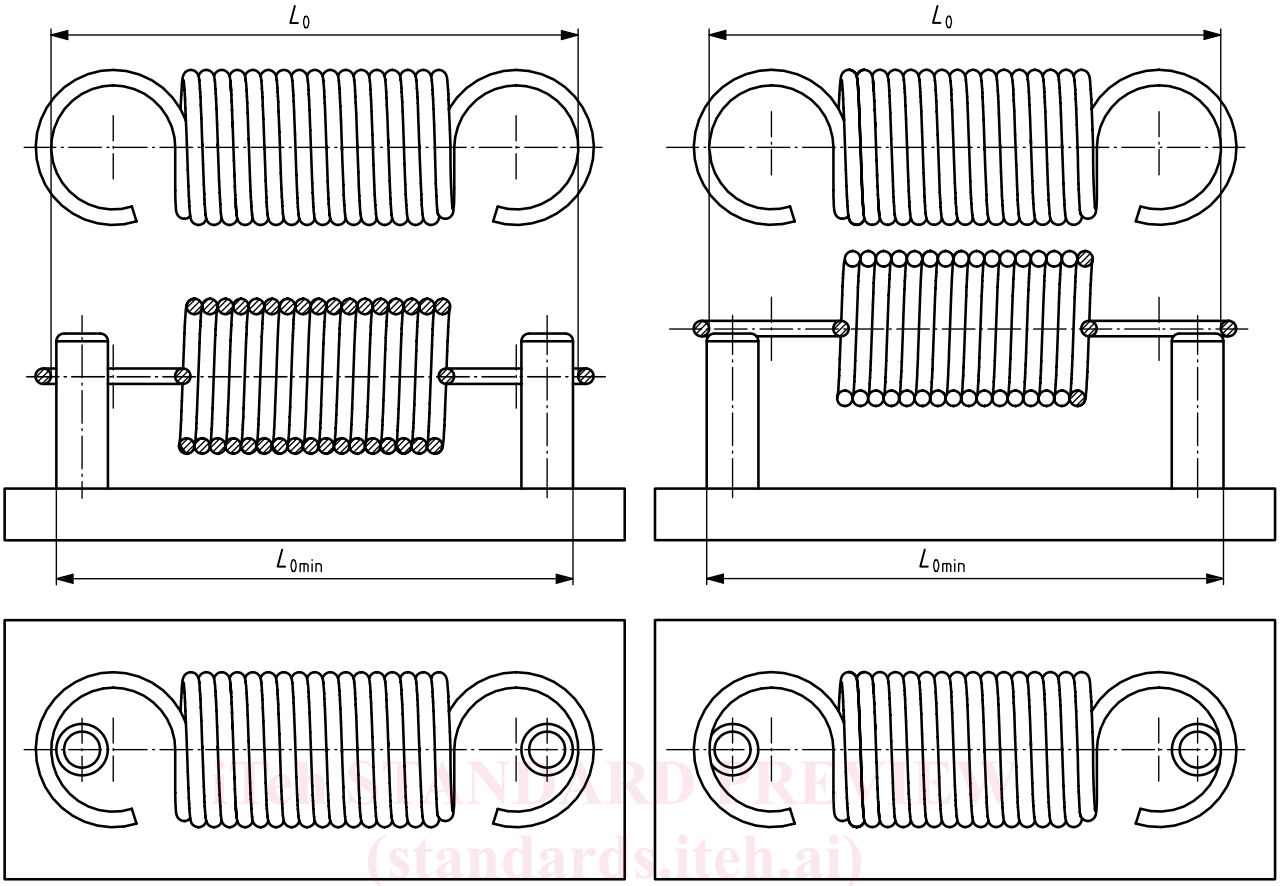

**b) Loop position 90°**

**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**




**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: $L_B = L_0 - L_{H1} - L_{H2}$