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# Springs — Measurement and test parameters —

## Part 1:
## Cold formed cylindrical helical compression springs

*Ressort — Mesures et paramètres de test —*

*Partie 1: Ressort hélicoïdal de compression cylindriques formé à froid*


ICS: 21.160






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# Contents

Page

# 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 excluding dynamic testing for general characteristics of cold formed helical compression springs made from round wire.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 purpose of this document, the terms and definitions given in ISO 26909 and the following apply.

**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 end 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]

**3.1.7**
**test parameter**
parameter with a tolerance for which there is an immediate conclusion after test (OK or not OK)

Note 1 to entry: Test can be done without measurement (i. e. with go/no-go gauges)



## 3.2 Symbols and abbreviated terms

Table 1 includes symbols, units and abbreviated terms in accordance with ISO 16249 and used throughout this standard.

**Table 1 — Symbols and abbreviated terms**

| Symbols | Units | Designations |
|---|---|---|
| $D=\frac{D_e+D_i}{2}$ | mm | mean diameter of spring |
| $D_d$ | mm | mandrel diameter (inner guide) |
| $D_e$ | 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 |
| $e_1$ | 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 |

**Table 1** *(continued)*

| Symbols | Units | Designations |
|---|---|---|
| $L_n$ | mm | minimum acceptable test length for $F_n$ |
| $L_0$ | mm | free length |
| $L_1$, $L_2$,... | mm | specified spring lengths for the spring loads, $F_1$, $F_2$,... |
| $n$ | – | 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) load, $F_n$ |
| $s_n$ | mm | maximum test spring deflection for the spring load, $F_n$ |
| $s_1$, $s_2$,... | mm | specified spring deflections for the specified spring loads, $F_1$, $F_2$,... |

## 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 (mandrels, guide sleeves, ring groove, etc.) are used, the properties (geometry, material, etc.) shall be agreed upon between the manufacturer and the customer to include special cases such as snapping end coils, buckling, bulging, etc. The alignment of guiding and supporting devices is aimed to improve the reproducibility of the measures.

## 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 for the case that both ends are ground (see Figure 1); other cases should be agreed upon between the manufacturer and the customer.

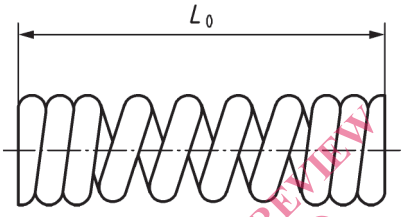



**Figure 1 — Free length ($L_0$), for the case that both ends are close and ground**



### 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)

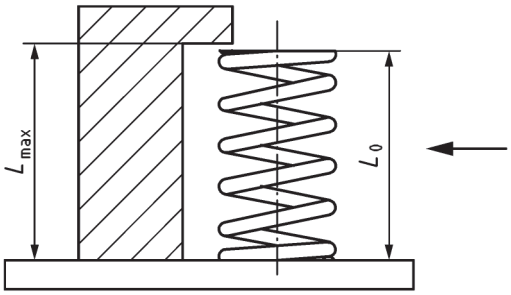
### 8.1.4 Time of measurement and testing

The characteristic shall be evaluated at ambient temperature as delivered.

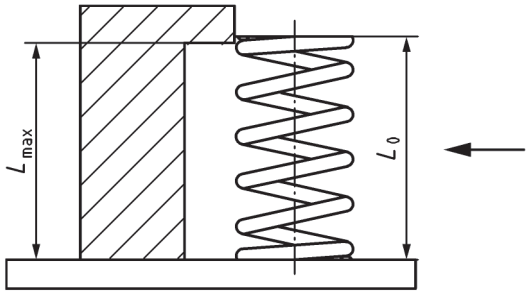
### 8.1.5 Method of measurement and testing

The measurement can be carried out without contact using optical procedures, capacitive or electrically by contact (with minimal force) 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 2 and 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.

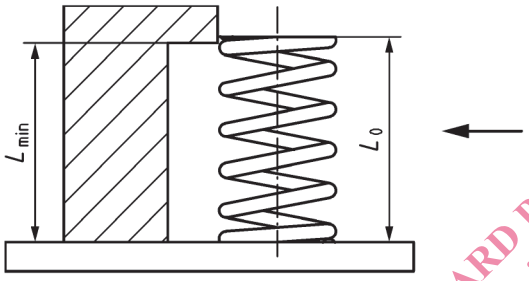
When there is a spring self-weight effect, the measurement of free height should be agreed upon between the manufacturer and the customer.



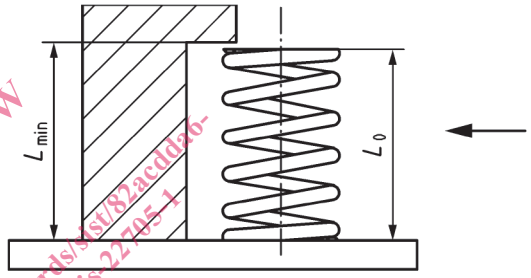

a) Tolerance upper limit check with gauge, ($L_0 \leq L_{max}$) (GO/good)




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




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



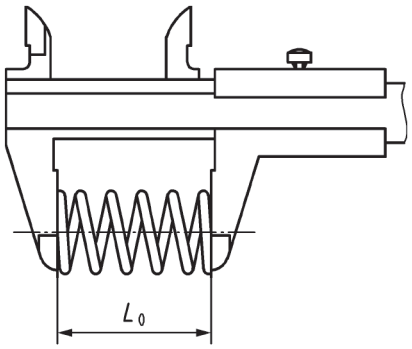

d) Tolerance lower limit check with gauge ($L_0 < L_{min}$) (GO/bad)



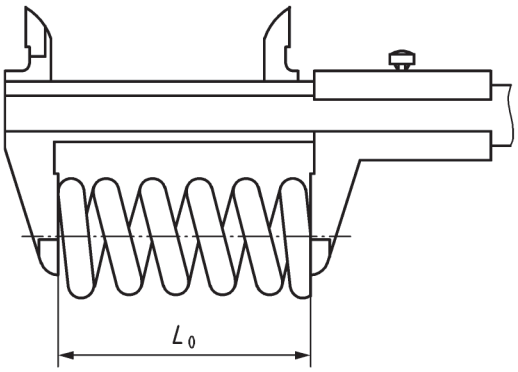
**Figure 2 — Method of testing the free length ($L_0$) with gauges (examples)**

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

Springs that are not preset shall only be measured after the force test, or they shall be set to the length $L_{min}$ ($F_{max}$) before the test. If no load or force is specified, measurement can be done without any preliminary test.




a) Measurement of a parallel spring (both ends are ground) with caliper




b) Measurement of a spring (one end open and one end ground) with caliper

**Figure 3 — Method of measurement of the free length $L_0$ with calliper (exemplary)**