KISSsoft 2019 – Tutorial 14

Analyzing compression springs according to DIN EN 13906-1

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Sharing Knowledge

Contents

1 Starting KISSsoft

1.1 Starting the software

You can call KISSsoft as soon as the software has been installed and activated. Usually you start the program by clicking «Start→Program Files→KISSsoft 2019→KISSsoft». This opens the following KISSsoft user interface:

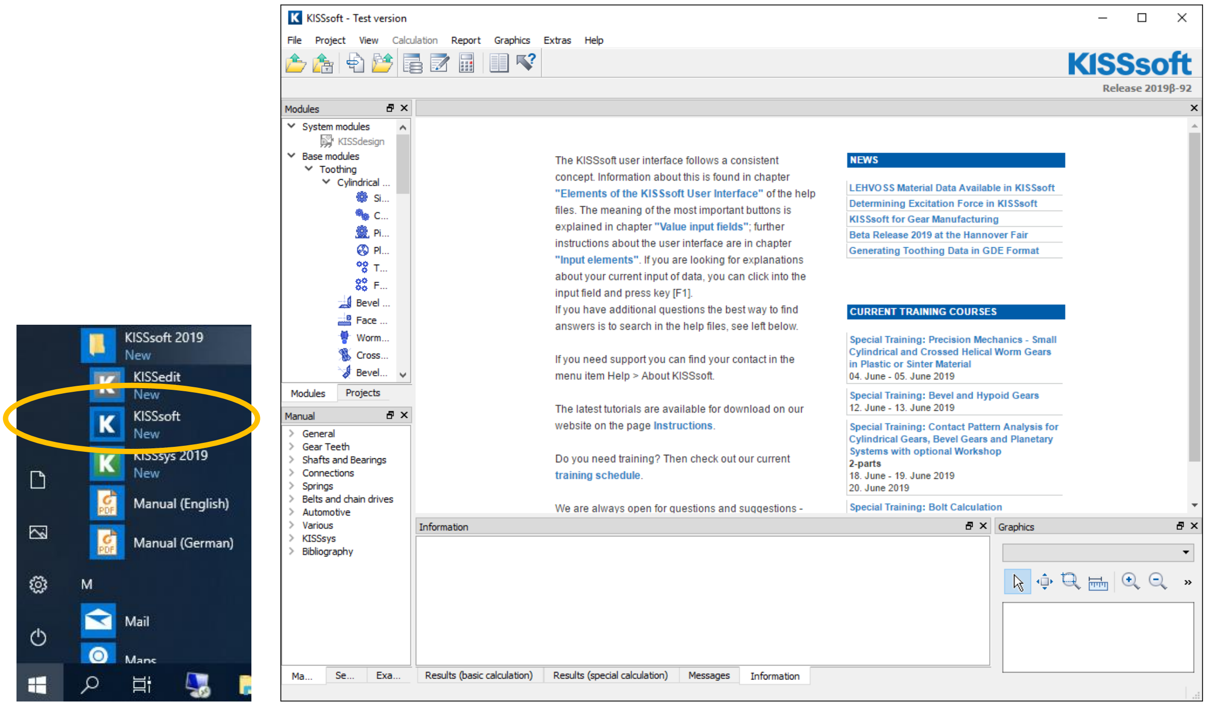

Figure 1. Starting KISSsoft, initial window

1.2 Selecting a calculation

In the **Modules** tree window, select the «Modules» tab to call the calculation for compression springs:

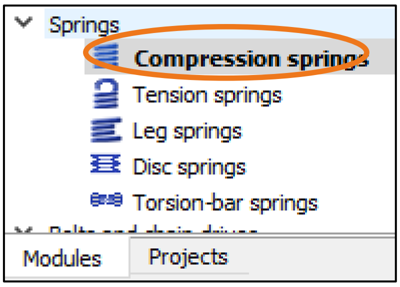

Figure 2. Selecting springs, compression springs

2 Analyzing Compression Springs

2.1 Task

Analyze a cold formed compression spring 4 x 40 x 235 made of spring steel. Search for this data:

- Spring rate R
- Shear stress τ_{k2} at F_2 =300N
- Spring travel difference s_h

This tutorial describes how you input the following data:

Wire diameter d	4.0mm
Coil diameter D	40.0mm
Effective coils n	12.5
Spring length L_0	235.0 mm
Material	Wire C (DIN 17223-1), untreated
Ends of spring	even
Tolerances	DIN EN 15800 Quality standard 1

Figure 3. Geometry and material

Spring force F_1	150 N
Spring force F_2	300 N
Operating temperature	20.0 °C
Stress	dynamic
Support	fixed/ fixed

Figure 4. Operating data

2.2 Inputting operating data

As shown below, you can input operating data directly in the input window. Here you can input either the forces or the travels.

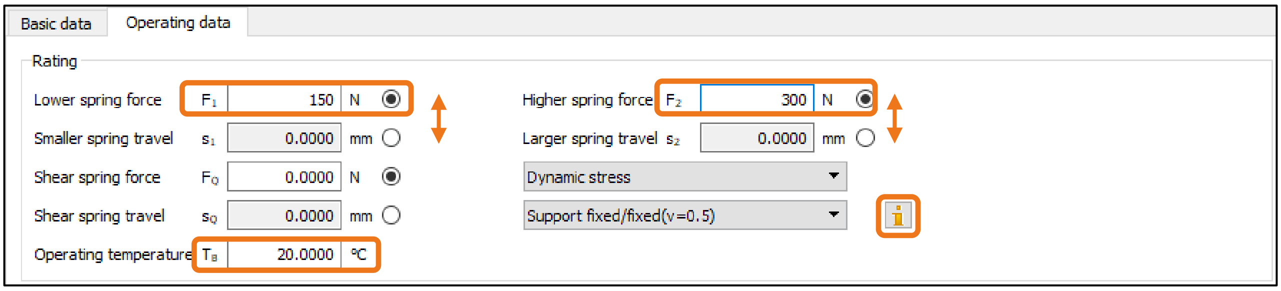

Figure 5. Input window, «Operating data» group

The types of support are displayed in a help graphic that you open by clicking next to the support field. The support coefficient v is used for calculating the buckling spring travel sk. If the buckling safety factor is not reached, then the spring must be guided, otherwise it will buckle.

If the spring must be guided, the KISSsoft system issues a warning message when you perform the calculation to inform you of this fact.

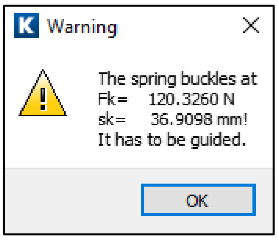

Figure 6. Warning shown if the spring will buckle and must be guided

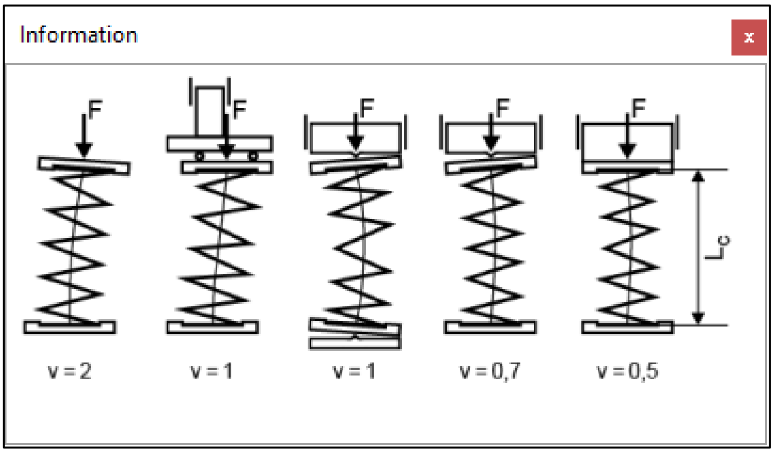

Figure 7. Support types with the corresponding support coefficients

2.3 Inputting the geometry and selecting materials

The KISSsoft database includes a wide range of different compression springs, all of which comply with the specifications in DIN 2098, Supplementary Sheet 1. This example uses a spring selected from this list.

However, if the spring you require is not present, simply select **«Own input»** and input your own parameters for a spring. You will find more detailed information about this below.

To find a suitable spring, first click **«Update»**. The system now calculates and displays values that match your input, such as spring travel, spring forces. This helps you make the best possible choice.
Click the right-hand mouse button in the spring selection list to determine which values are to be displayed.

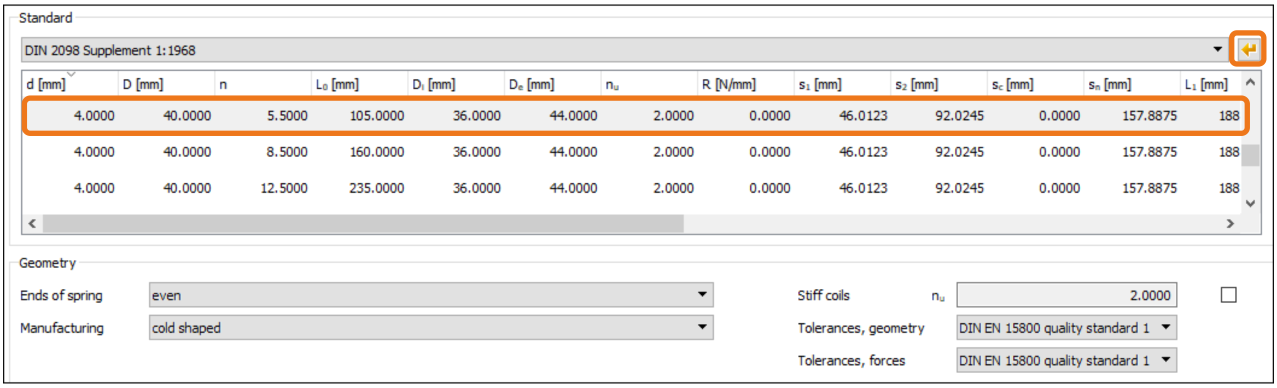

Figure 8. Selecting a spring in the tab “Basic data” area “Standard”

You can then either select or input the shape of the spring ends, the manufacturing method, and the tolerances, in the area below the table.

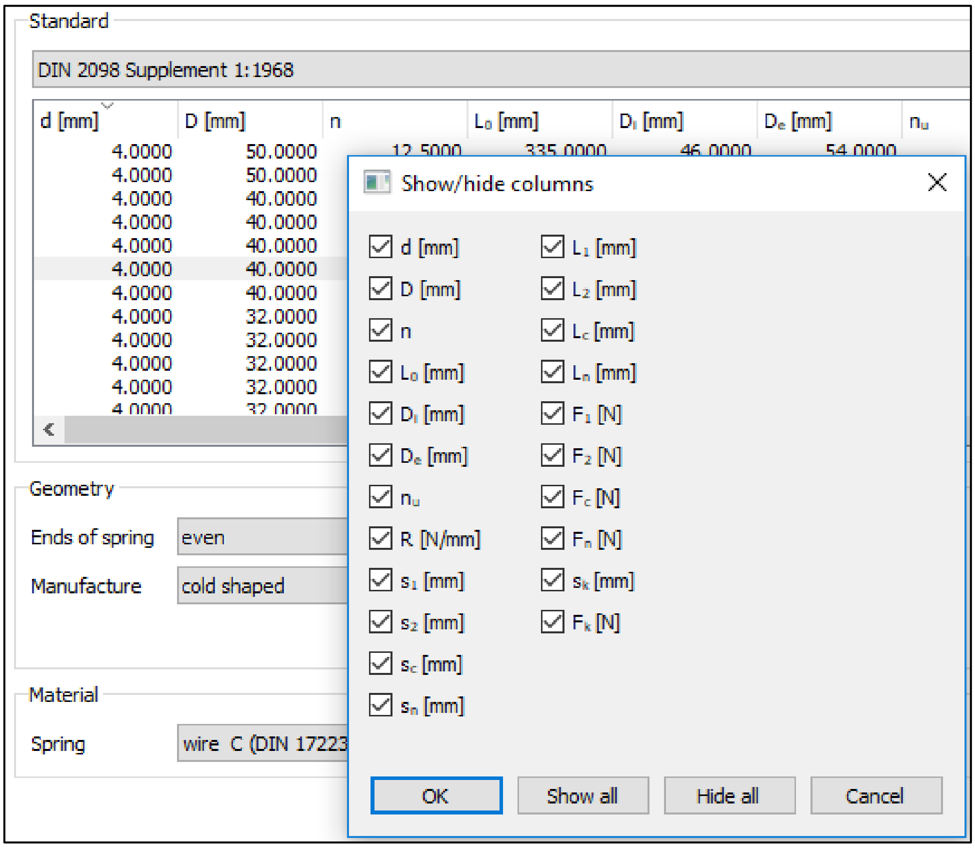

Figure 9. Clicking the right-hand mouse button to select the values to be displayed

You can select the material either from a drop-down list or input your own values. If you set the flag in the **«shot peened» checkbox**, the calculation will take into account the fact that the spring has been shot peened.

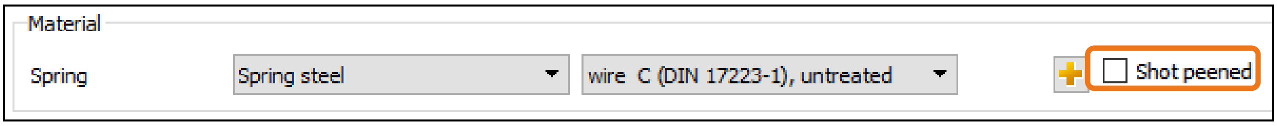

Figure 10. Selecting the material

2.4 Calculation

After you have input all the necessary data, either click Σ in the tool bar or press «F5» to calculate and then display the values.

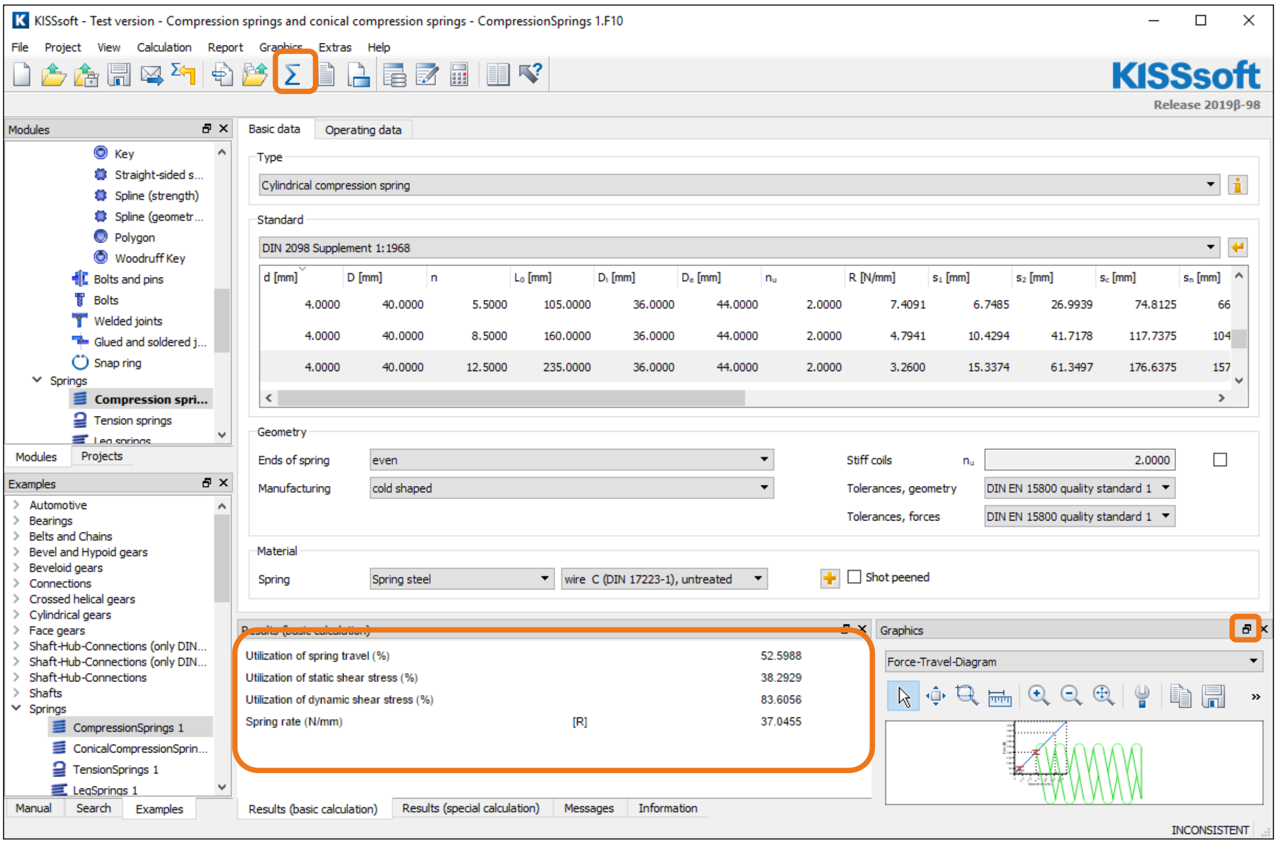

Figure 11. Calculating a compression spring

The results show, among other things, the relevant spring rate. These values are displayed in the lower right-hand part of the graphic. The system provides a graphic for the force travel diagram and, for dynamic loads, displays the Goodman diagram (if a suitable diagram is not present, one will be approximated). To increase the scale of the graphic, click the zoom button (outlined in orange on right).

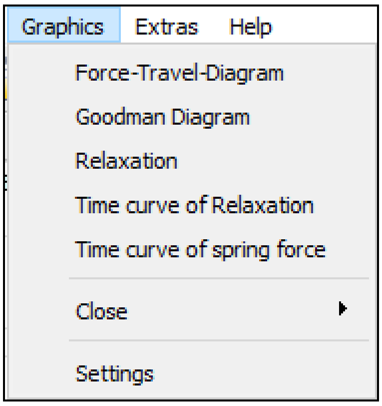

Figure 12. Available graphics

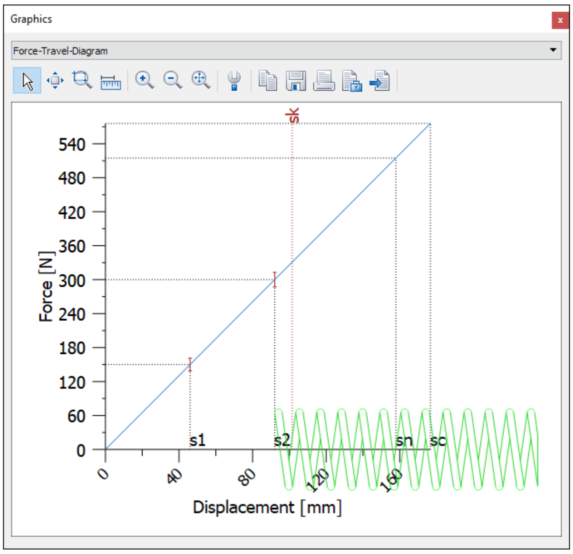

Figure 13. Force-Travel diagram

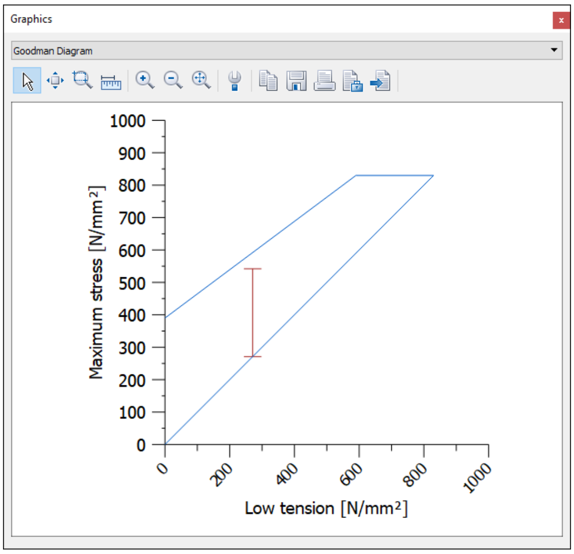

Figure 14. Goodman diagram

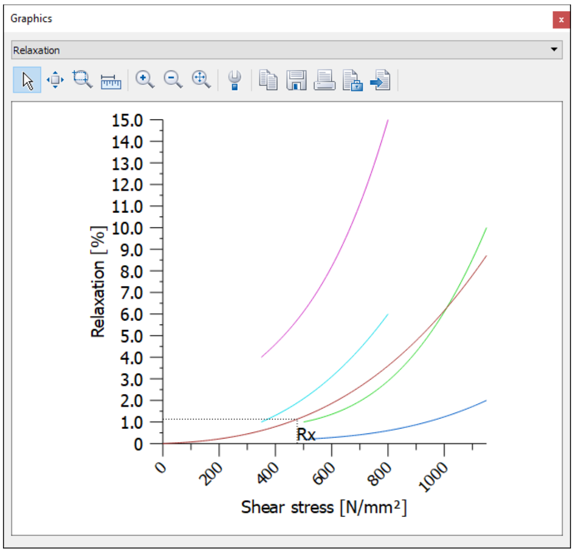

Figure 15. Relaxation

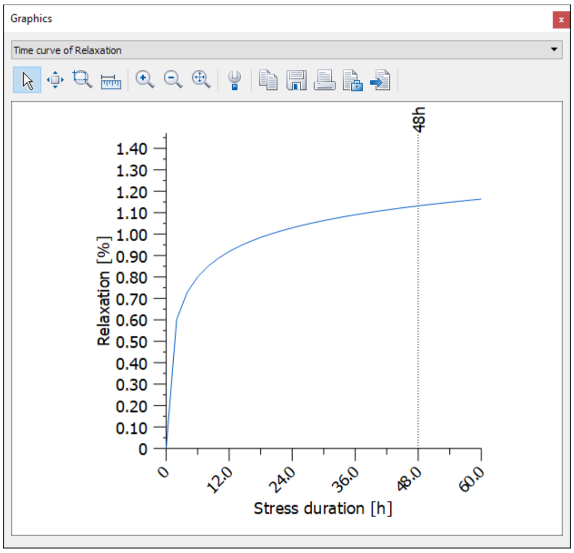

Figure 16. Relaxation time curve

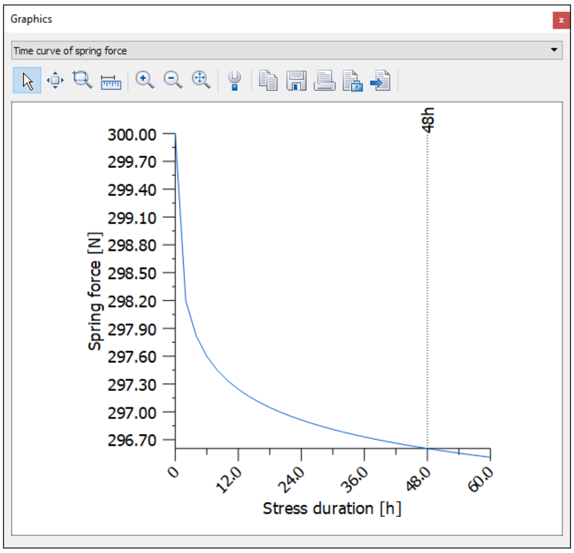

Figure 17. Time curve of spring force

To get an overview of all the values, create a report by either clicking or pressing «F6».

Compression springs [F010]

Calculation method: DIN EN 13906-1:2013

INPUTS:

Spring geometry

Wire diameter (mm)	[d]	4.000
Tolerance according to DIN 2076 C:1990 (mm)	[Tol_d]	0.025
Coil diameter (mm)	[D]	40.000
Inner diameter (mm)	[Di]	36.000
External diameter (mm)	[De]	44.000
Length of relaxes spring (mm)	[L0]	235.000
Effective coils	[n]	12.500
Stiff coils	[nu]	2.000
Total number of coils	[nt]	14.500
Spring ends surface flattened		
Bearings coefficient		0.500

Material

Material wire C (DIN 17223-1)
cold shaped
not shot peened

Shearing modulus at 20°C (N/mm²)	[G20]	81500.000
Tensile strength (N/mm²)	[Rm]	1740.000
Shearing Modulus depending on temperature (1/°C)	[alphaE]	-0.00028

Load

Lower spring force (N)	[F1]	150.000
Higher spring force (N)	[F2]	300.000
Operating temperature (°C)	[TB]	20.000
dynamic loading		

RESULTS:

Spring rate (N/mm)	[R]	3.260
Maximal useable length (mm)	[Ln]	77.113
Maximum spring travel (mm)	[sn]	157.887
Sum of minimal distance	[Sa]	18.750
Shear stress at Fn (N/mm²)	[taun]	819.192
Force for maximal spring-travel (N)	[Fn]	514.713
Theoretical force at length of block (N)	[Fcth]	575.838
Block length (mm)	[Lc]	58.363 (- 0.362)
Shear stress at block length (N/mm²)	[tauc]	916.475
Permissible shear stress at block length (N/mm²)	[tauc_zul]	974.000

Stress coefficient	[kappa]	1.135
Travel tension	[taukh]	270.994
Permissible travel tension (N/mm²)	[taukh_zul]	321.103
The spring is safe for buckling in the used range		
Spring travel for buckling (mm)	[sk]	101.548
Spring force for buckling (N)	[Fk]	331.047
Shear modulus at service temperature (°C)	[G]	81500.000
Diameter increase (mm)	[DeltaD]	0.658
Eigen frequency (Hz)	[fe]	72.548
Mass (g)	[mass]	181.184

Load 1

Spring force (N)	[F1]	150.000
Spring travel (mm)	[s1]	46.012
Spring length (mm)	[L1]	188.988
Shear stress (N/mm²)	[tau1]	238.732
Adjusted shear stress (N/mm²)	[tau1k]	270.994

Load 2

Spring force (N)	[F2]	300.000
Spring travel (mm)	[s2]	92.025
Spring length (mm)	[L2]	142.975
Shear stress (N/mm²)	[tau2]	477.465
Adjusted shear stress (N/mm²)	[tau2k]	541.987
Relaxation (F2,48h) (%)	[Rx]	1.132
Spring force after 48h (N)	[F2Rx]	296.605

Utilization of shear stress (static)	0.490
Utilization of shear stress (dynamic)	0.844

Tolerances

Geometry:
according to DIN EN 15800:2009 quality standard
1

Permissible deviation from

Coil diameter (mm)	[AD]	0.300
Spring length (mm)	[AL0]	3.050
Perpendicular line (mm)	[e1]	7.050
Parallel line (mm)	[e2]	0.660

Forces:
according to DIN EN 15800:2009 quality standard
1

Permissible deviation from

Lower spring force (N)	[AF1]	11.300
Higher spring force (N)	[AF2]	12.800

2.5 Inputting your own spring data

If you want to analyze a special spring, or a spring that is not already present, click **«Own input»** and input your own values. Here, you can also use the spring rate (R=ΔF/Δs) to size the wire diameter and the effective coils.

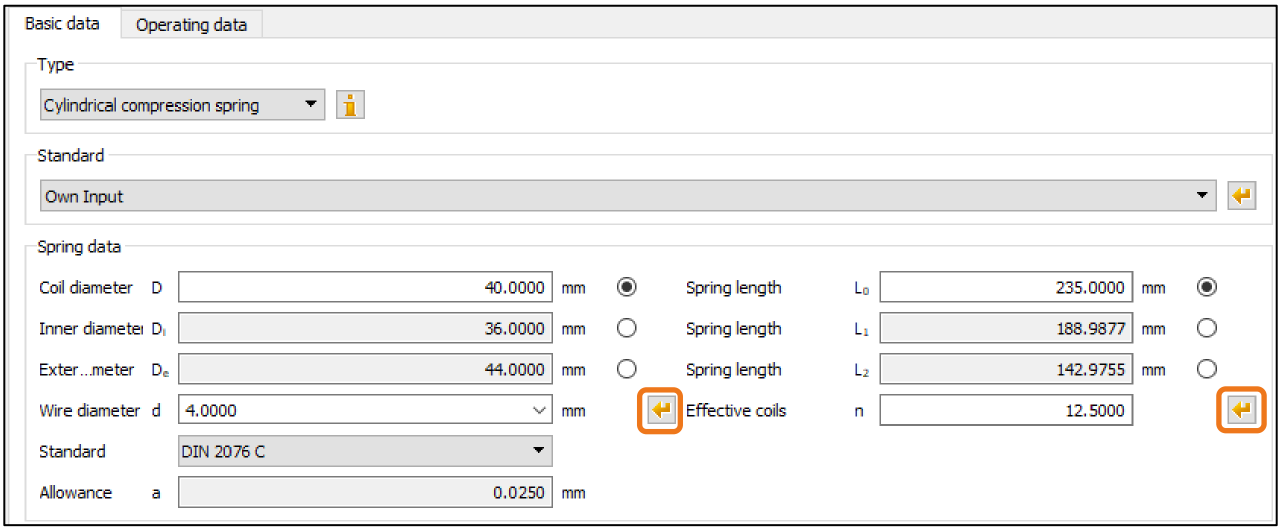

Figure 18. Inputting spring geometry

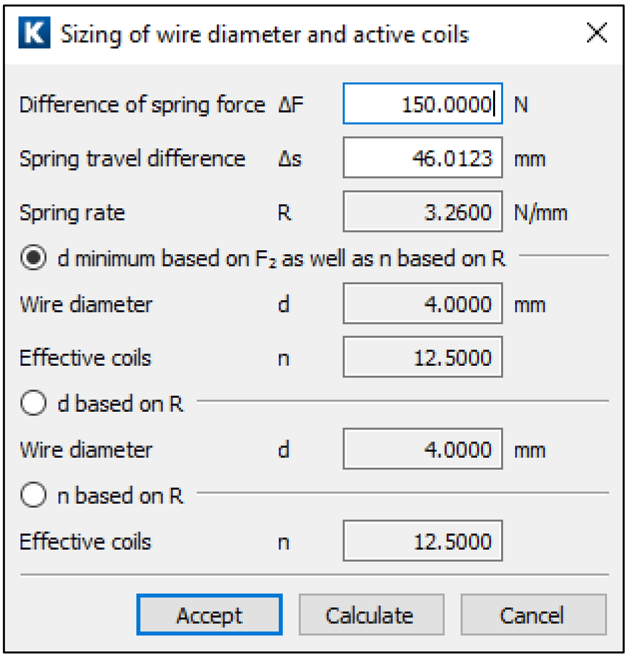

Figure 19. Sizing