Helical cylindrical tension spring of round wires and bars [in]

i	Calculation without errors.
ii	☐ Project information

?	Input parameters section

1.0 ☑ Selection of load conditions, spring operational and production parameters.

1.1	**Spring production parameters**		
1.2	Spring design	Spring with prestressing, wound on a winding bench	▼
1.3	Design of spring ends	B ... Full loop	▼
1.4	Direction of coil winding	Right	▼
1.5	Number of end coils	n_C	0,0

A   B   C   D   E

F   G   H   I   J

K   L   M   N   O
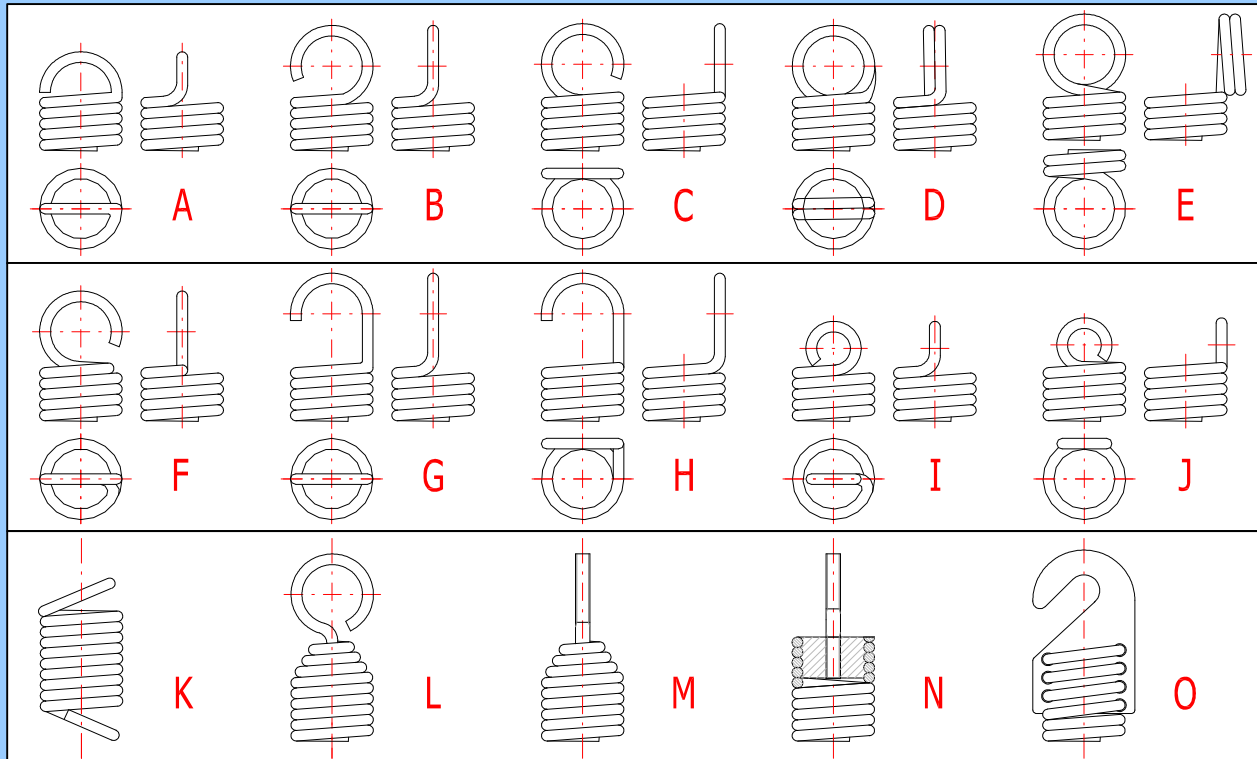
1.6	**Operational parameters of working cycle**		
1.7	Operational loading mode	Light service	▼
1.8	Working temperature	T	200,0	[° F]
1.9	Working environment	Non corrosive	▼
1.10	Desired level of safety	s_s	1,05
1.11	Method of stress curvature correction	Without correction	▼

2.0 ☑ Options of spring material.

2.1	Production method :	Cold formed springs	▼
2.2	Spring material :	Music wire ASTM A228	▼
2.3	**Field of use of the selected material**		
2.4	Suitability for fatigue load	Excellent	
2.5	Relative strength	High	
2.6	Corrosion resistance	Insufficient	
2.7	Max. operational temperature	250	[° F]
2.8	Delivered wire diameters	0,005 - 0,25	[in]
2.9	**Mechanical and physical properties of the material**		
2.10	Modulus of elasticity in shear	G_{20}	11750	[ksi]
2.11	Modulus of elasticity at operational temperature	G	11481	[ksi]

2.12	Density	ρ		490	[lb/ft³]

2.13	**Strength characteristics of the material**		
2.14	Ultimate tensile strength	S_u	246	[ksi]
2.15	Permissible torsional stress	τ_A	123	[ksi]
2.16	Permissible limit bending stress	σ_D	172,2	[ksi]

3.0 ☑ Spring design.

3.1	**Desired parameters of the working cycle**			Deviat. [%]	
3.2	Maximum working loading	F_8	100,0	5,0	[lb]
3.3	Minimum working load	F_1	30,0	30,0	[lb]
3.4	Fully loaded spring length	L_8	4,000	5,0	[in]
3.5	Required working stroke	H	1,000	0,0	[in]
3.6	Preloaded spring length	L_1	3	6,67	[in]
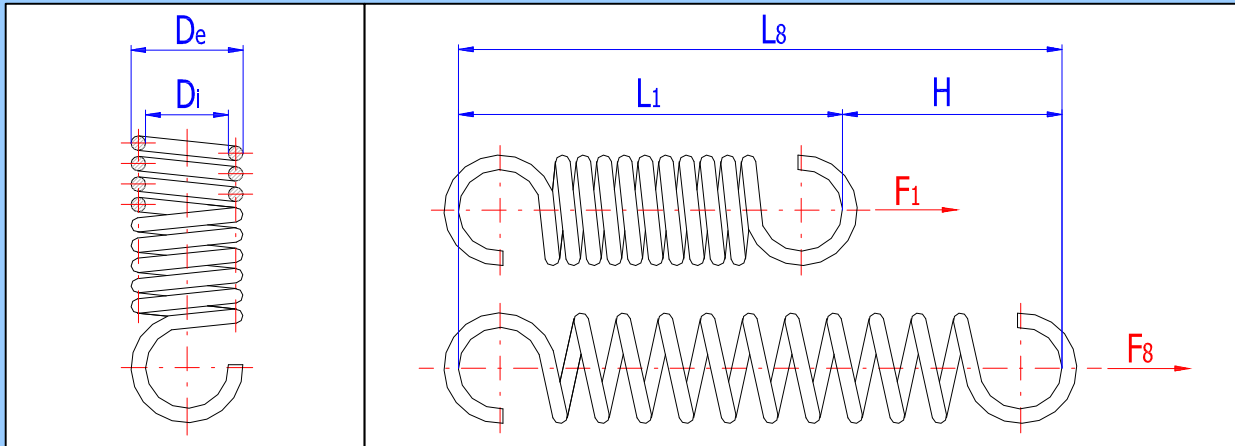
3.7	**Filters of the designed solution**			
3.8	☐ Maximum permissible spring outer diameter	D_{emax}	1,500	[in]
3.9	☐ Minimum permissible spring inner diameter	D_{lmin}	0,500	[in]
3.10	Permissible division of the number of active coils		1/4 ▼	
3.11	Permissible exceeding of spring limit dimensions		0,0	[%]
3.12	Perform a preliminary check of loading of spring hook		Yes ▼	
3.13	Keep to the chosen design of spring ends		Yes ▼	
3.14	Keep to the required level of safety with the strength check		Yes ▼	
3.15	Quality criterion		Deviation from desired dimensions ▼	
3.16	Number of design iteration		Medium ▼	
3.17	**Options of solutions**			
3.18	Sort design result by		Qualities of solutions ▼	
3.19	Run design calculation			

3.20	ID	D	D_e	D_i	d	n	L_0	L_1	L_8	F_1	F_8	τ_8	s_s	m	LH	quality
	1.	1.117	1.273	0.960	0.1563	9.00	3.130	3.133	4.133	30.0	98.3	73	1.68	0.213	B 0.78	0.10 ▼

Results section

4.0 ☑ Summarized list of designed spring parameters.

|	
4.1	Refresh results from the selected spring design

- ◉ L0
- ○ L1
- ○ L8
- ○ L9
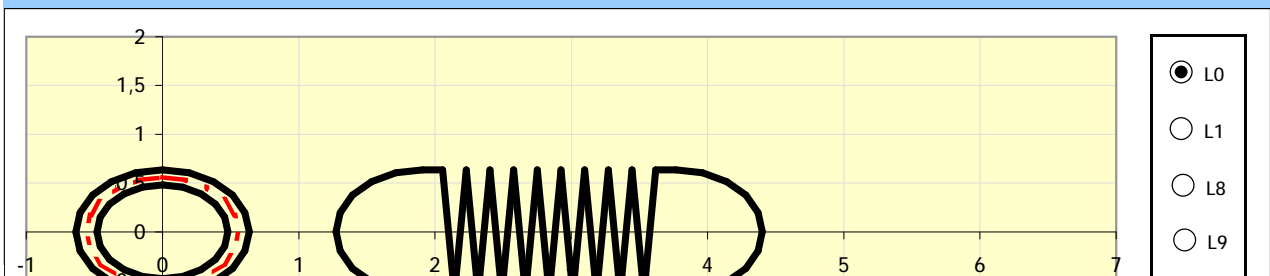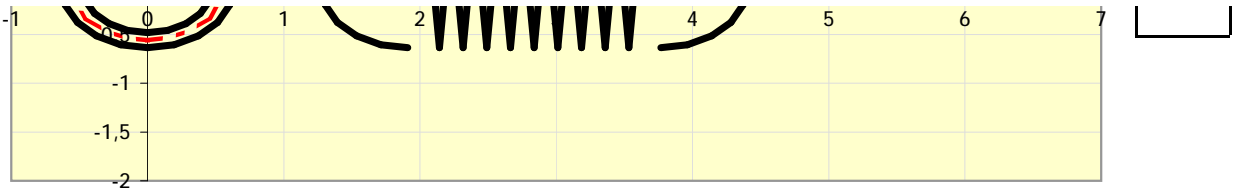
4.2	**Spring loading**				
4.3	Minimum working loading	F_1		30,00	[lb]
4.4	Maximum working loading	F_8		98,33	[lb]
4.5	**Spring dimensions**				
4.6	Mean spring diameter	D		1,1167	[in]
4.7	Recommended limits of wire diameter	d_{min} / d_{max}	0,0698	0,2500	[in]
4.8	Wire diameter	d		0,1563	[in]
4.9	Outer / inner spring diameter	D_e / D_i	1,273	0,9604	[in]
4.10	Spring index	c		7,14	
4.11	Number of active coils	n		9	
4.12	Length of active spring section	L_K		1,5630	[in]
4.13	Recommended limits of hook height	L_{Hmin} / L_{Hmax}	0,7683	1,0564	[in]
4.14	Height of spring hook	L_H		0,7837	[in]
4.15	Recommended limits of free spring length	L_{0min} / L_{0max}	1,1167	16,7505	[in]
4.16	Free spring length	L_0		3,1304	[in]
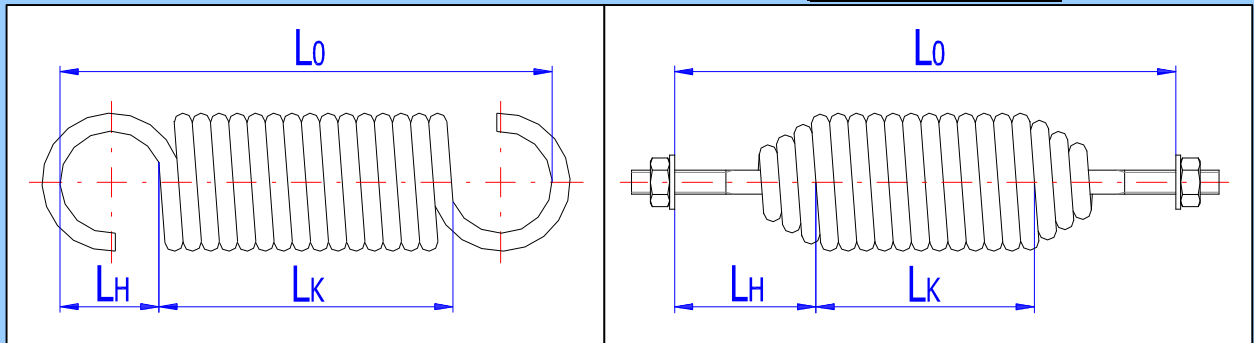
4.17	**Parameters of unloaded spring**			
4.18	Prestressing force	F_0	29,8	[lb]
4.19	Spring inner prestressing	τ_0	22,2	[ksi]
4.20	Pitch of coils	t	0,1563	[in]
4.21	**Parameters of preloaded spring**			
4.22	Spring deflection	s_1	0,0029	[in]
4.23	Spring length	L_1	3,1333	[in]
4.24	Spring stress	τ_1	22,34	[ksi]
4.25	**Parameters of fully loaded spring**			
4.26	Spring deflection	s_8	1,0028	[in]
4.27	Spring length	L_8	4,1332	[in]
4.28	Spring working stroke	H	0,9999	[in]
4.29	Spring stress	τ_8	73,23	[ksi]
4.30	**Parameters of spring limit state**			
4.31	Spring limit loading	F_9	165,20	[lb]
4.32	Limit deflection / length of spring	s_9 / L_9	1,9813	5,1117	[in]
4.33	**Spring mechanical and physical properties**			
4.34	Spring constant	k	68,34	[lb/in]
4.35	Spring deformation energy	W_8	5,35	[ft lb]
4.36	Natural spring frequency	f	195,93	[Hz]

4.37	Developed wire length	l	39,18	[in]
4.38	Spring weight	m	0,213	[lb]
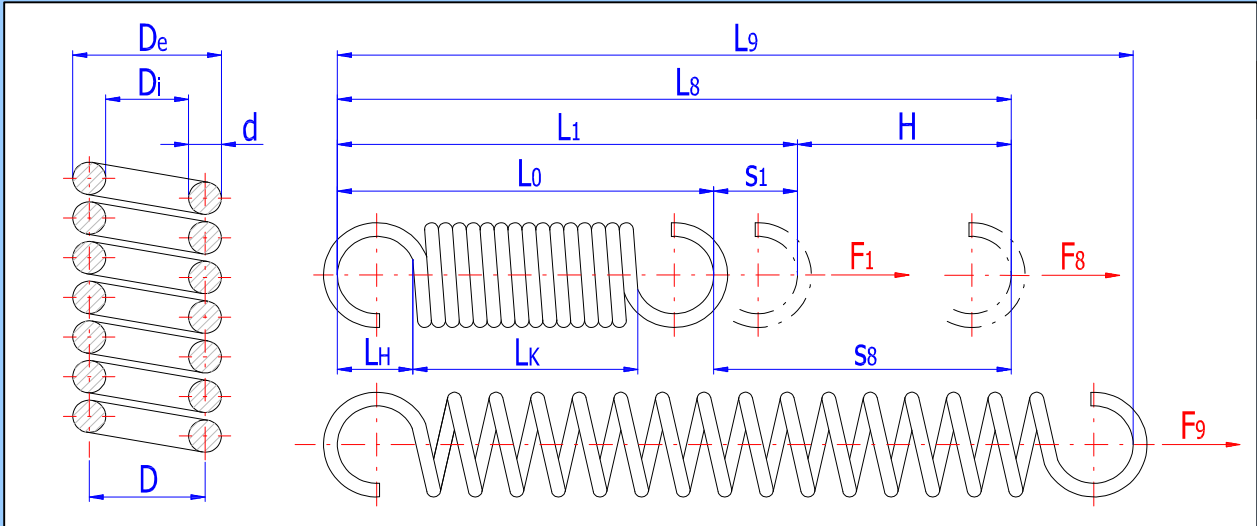
4.39	**Spring strength check**			
4.40	Curvature correction factor	K_s	1,0000	
4.41	Corrected stress of fully loaded spring	τ_{8C}	73,23	[ksi]
4.42	Permissible torsional stress	τ_A	123	[ksi]
4.43	Level of safety		1,680	

5.0	☑ **Designed spring parameters for specified working load or spring length resp.**			
5.1	**Spring parameters for the given working loading**			
5.2	Spring loading	F_x	50,0	[lb]
5.3	Spring deflection	s_x	0,2956	[in]
5.4	Spring length	L_x	3,4260	[in]
5.5	Spring stress	τ_x	37,24	[ksi]
5.6	**Spring parameters for the given working length**			
5.7	Spring length	L_x	3,500	[in]
5.8	Spring deflection	s_x	0,3696	[in]
5.9	Spring produced force	F_x	55,06	[lb]
5.10	Spring stress	τ_x	41,00	[ksi]
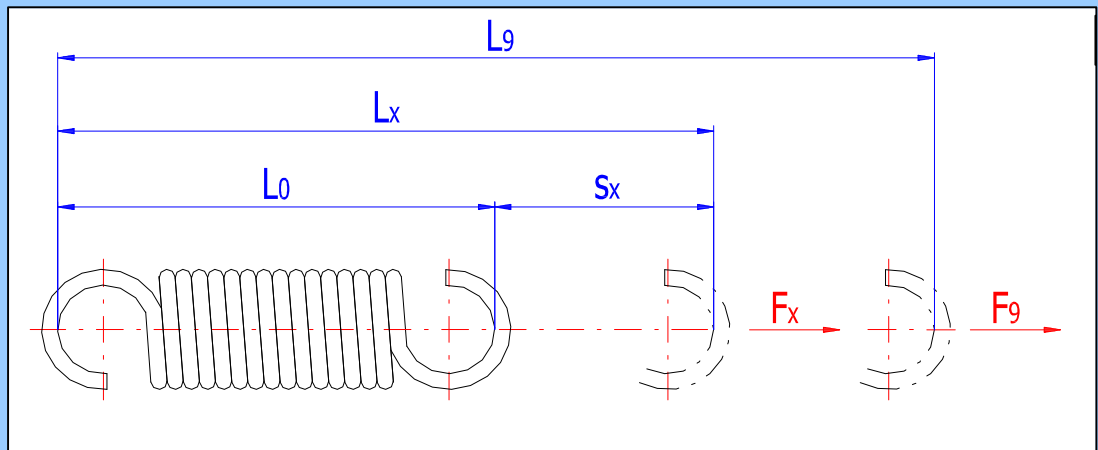
6.0	☑ **Calculation and strength check of loading of spring hook.**			
6.1	**Check of bending stress in spring hook**			
6.2	Inner radius of spring hook	r_b	0,4802	[in]
6.3	Maximum bending stress	σ_{max}	170,29	[ksi]
6.4	Permissible bending stress of spring material	σ_A	172,2	[ksi]

6.5	Check of stress in transition bend				
6.6	Inner radius of spring hook transition bend	r_s	0,2344		[in]
6.7	Maximum shear stress	τ_{max}	97,64		[ksi]
6.8	Allowable shear stress	τ_A	123		[ksi]
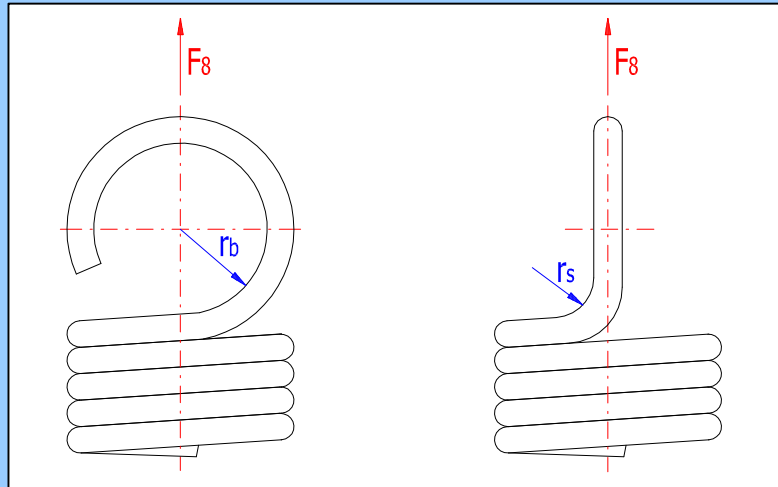
	Supplements section				
7.0	☑ Spring check calculation.				
7.1	Uploading of input data from main calculation				
7.2	Parameters of working cycle				
7.3	Maximum working loading	F_8	98,33		[lb]
7.4	Minimum working loading	F_1	30,00		[lb]
7.5	Spring working stroke	H	0,9999		[in]
7.6	Spring strength check				
7.7	Mean spring diameter	D	1,1167		[in]
7.8	Recommended limits of wire diameter	d_{min} / d_{max}	0,1350	0,2792	[in]
7.9	Wire diameter / from table	d	0,1563 0,25 ▼		[in]
7.10	Outer / inner spring diameter	D_e / D_i	1,273	0,9604	[in]
7.11	Spring index	c	7,14		
7.12	Permissible torsional stress	τ_A	123		[ksi]
7.13	Corrected stress of fully loaded spring	τ_{8c}	73,2		[ksi]
7.14	Level of safety		1,680		
7.15	Parameters of unloaded spring				
7.16	Prestressing force	F_0	29,8		[lb]
7.17	Spring inner prestressing	τ_0	22,20		[ksi]
7.18	Pitch of coils	t	0,1563		[in]
7.19	Spring design				
7.20	Recommended min. number of active coils	n_{min}	8,97		
7.21	Number of active coils	n	9,00		
7.22	Length of active spring section	L_K	1,5630		[in]
7.23	Recommended limits of hook height	L_{Hmin} / L_{Hmax}	0,7683	1,0564	[in]
7.24	Height of spring hook	L_H	0,7837		[in]
7.25	Recommended limits of free spring length	L_{0min} / L_{0max}	1,1167	16,7505	[in]
7.26	Free spring length	L_0	3,1304		[in]
7.27	Length of min. / max. loaded spring	L_1 / L_8	3,1333	4,1332	[in]
7.28	Deflection of min. / max. loaded spring	s_1 / s_8	0,0029	1,0028	[in]
7.29	Transfer of solution into main calculation				
8.0	☑ Work forces calculation.				

8.1	Uploading of input data from main calculation			
8.2	**Parameters of working cycle**			
8.3	Fully loaded spring length	L_8	4,1332	[in]
8.4	Preloaded spring length	L_1	3,1333	[in]
8.5	Spring working stroke	H	0,9999	[in]
8.6	**Spring dimensions**			
8.7	Mean spring diameter	D	1,1167	[in]
8.8	Wire diameter / from table	d	0,1563 0,1563 ▼	[in]
8.9	Outer / inner spring diameter	D_e / D_i	1,273 0,9604	[in]
8.10	Spring index	c	7,14	
8.11	Number of active coils	n	9,00	
8.12	Length of active spring section	L_K	1,5630	[in]
8.13	Height of spring hook	L_H	0,7837	[in]
8.14	Free spring length	L_0	3,1304	[in]
8.15	Deflection of min. / max. loaded spring	s_1 / s_8	0,0029 1,0028	[in]
8.16	**Parameters of unloaded spring**			
8.17	Prestressing force	F_0	29,8	[lb]
8.18	Spring inner prestressing	τ_0	22,20	[ksi]
8.19	Pitch of coils	t	0,1563	[in]
8.20	**Spring loading**			
8.21	Maximum working loading	F_8	98,3	[lb]
8.22	Minimum working loading	F_1	30,0	[lb]
8.23	**Spring strength check**			
8.24	Permissible torsional stress	τ_A	123	[ksi]
8.25	Corrected stress of fully loaded spring	τ_{8c}	73,2	[ksi]
8.26	Level of safety		1,680	
8.27	Transfer of solution into main calculation			
9.0	☑ **Spring working lengths calculation.**			
9.1	Uploading of input data from main calculation			
9.2	**Spring loading**			
9.3	Maximum working loading	F_8	98,33	[lb]
9.4	Minimum working loading	F_1	30,00	[lb]
9.5	**Spring dimensions**			
9.6	Mean spring diameter	D	1,1167	[in]
9.7	Wire diameter / from table	d	0,1563 0,0625 ▼	[in]
9.8	Outer / inner spring diameter	D_e / D_i	1,273 0,9604	[in]
9.9	Spring index	c	7,14	
9.10	Number of active coils	n	9,00	
9.11	Length of active spring section	L_K	1,5630	[in]
9.12	Height of spring hook	L_H	0,7837	[in]
9.13	Free spring length	L_0	3,1304	[in]
9.14	**Parameters of unloaded spring**			
9.15	Prestressing force	F_0	29,8	[lb]
9.16	Spring inner prestressing	τ_0	22,20	[ksi]
9.17	Pitch of coils	t	0,1563	[in]
9.18	**Parameters of working cycle**			
9.19	Deflection of min. / max. loaded spring	s_1 / s_8	0,0029 1,0028	[in]
9.20	Fully loaded spring length	L_8	4,1332	[in]
9.21	Preloaded spring length	L_1	3,1333	[in]

9.22	Spring working stroke	H	0,9999		[in]
9.23	**Spring strength check**				
9.24	Permissible torsional stress	τ_A	123		[ksi]
9.25	Corrected stress of fully loaded spring	τ_{8c}	73,2		[ksi]
9.26	Level of safety		1,680		
9.27	Transfer of solution into main calculation				

10.0	☑ **Calculation of fatig loaded spring.**				
10.1	Uploading of input data from main calculation				
10.2	**Operational parameters, parameters of calculation**				
10.3	Operational loading mode		Continuous loading ▼		
10.4	Desired spring service life in thousands of cycles	N	Infinite life ▼		
10.5	Desired level of safety	s_f	1,05		
10.6	Method of stress curvature correction		Correction by Wahl ▼		
10.7	**Spring loading**				
10.8	Maximum working loading	F_8	98,33		[lb]
10.9	Minimum working loading	F_1	30,00		[lb]
10.10	**Spring dimensions**				
10.11	Mean spring diameter	D	1,1167		[in]
10.12	Wire diameter / from table	d	0,1563	0,177 ▼	[in]
10.13	Outer / inner spring diameter	D_e / D_i	1,273	0,9604	[in]
10.14	Spring index	c	7,14		
10.15	Number of active coils	n	9,00		
10.16	Length of active spring section	L_K	1,5630		[in]
10.17	Height of spring hook	L_H	0,7837		[in]
10.18	Free spring length	L_0	3,1304		[in]
10.19	**Parameters of unloaded spring**				
10.20	Prestressing force	F_0	29,8		[lb]
10.21	Spring inner prestressing	τ_0	22,20		[ksi]
10.22	Pitch of coils	t	0,1563		[in]
10.23	**Parameters of working cycle**				
10.24	Deflection of min. / max. loaded spring	s_1 / s_8	0,0029	1,0028	[in]
10.25	Fully loaded spring length	L_8	4,1332		[in]
10.26	Preloaded spring length	L_1	3,1333		[in]
10.27	Spring working stroke	H	0,9999		[in]
10.28	**Spring strength check**				
10.29	Curvature correction factor	K_f	1,2081		
10.30	Corrected stress of preloaded spring	τ_{1c}	26,99		[ksi]
10.31	Corrected stress of fully loaded spring	τ_{8c}	88,47		[ksi]
10.32	Ultimate shear strength	S_{us}	196		[ksi]
10.33	Permissible torsional stress	τ_A	123		[ksi]
10.34	Endurance limit in shear	τ_e	71,3		[ksi]
10.35	Endurance limit by finite life	τ_f	71,3		[ksi]
10.36	Max. fatigue strength for the given loading	τ_{max}	88,5		[ksi]
10.37	Level of safety		1,000		
10.38	Transfer of solution into main calculation				

196
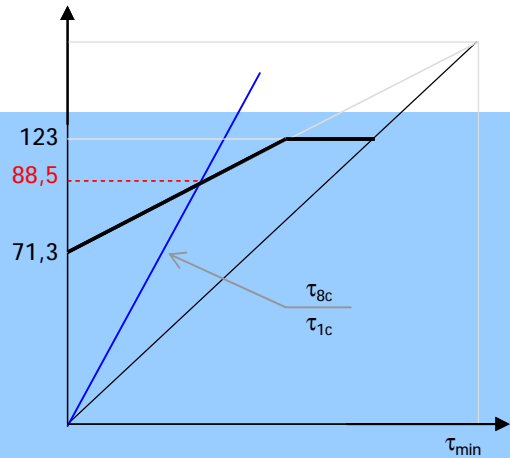
11.0 ☑ **Graphical output, CAD systems**

11.1	2D drawing output to:	DXF File ▼	
11.2	2D Drawing scale	Automatic ▼	

11.3   Spring length in the drawing and the model   3,130

11.4   Text description (Information for BOM)

Row 1 (BOM attribute 1)   Tension spring   ☑

Row 2 (BOM attribute 2)   D=1,1167; d=0,1563; n=9; L0=3,13

Row 3 (BOM attribute 3)   Music wire ASTM A228

11.5   Table of parameters