



Tech-Spring Report 4B EFFECT OF PRESTRESSING ON FATIGUE LIFE

Introduction

A batch of compression springs made from BS EN 10270-2 SiCrVD quality was obtained. The springs had not been shot peened, but were of a design that would shorten appreciably when cold prestressed.

The springs were fatigue tested at corrected stress levels suitable to cause the springs to fail by fatigue initially, and were then re-tested at stress levels at which they would survive.

Prior to fatigue testing the springs were

- a) Not prestressed
- b) Prestressed to 25mm
- c) Prestressed to solid (i.e. 20.5mm approximately and 800N)

The spring design was as shown in Figure 1. The fatigue test results were as shown in Table 1.

Batch - Not Prestressed

Corr. Stress Range / MPa	U/B at 10 million	Life to Failure
100-650	2	-
100-675	4	-
100-700	1	4,937,010
100-750	1	3,712,240
100-800	-	2 @ 3,570,250

Batch - Prestressed to 25mm

Corr. Stress Range / MPa	U/B at 10 million	Life to Failure
100-700	2	-
100-750	2	-
100-775	2	6,580,280
		8,634,600
100-800	-	6,496,180
		2,125,080

Batch - Prestressed to Solid

Corr. Stress Range / MPa	U/B at 10 million	Life to Failure
100-750	4	-
100-775	2	4,969,280
		6,186,110
100-800	1	3,290,610

Table 1 Fatigue Test Results

Conclusion

Prestressing improved the fatigue stress limit of these springs from 100-675MPa to 100-750MPa. No further benefit was accrued by prestressing beyond a length of 25mm. Further batches of springs are required to repeat these tests, which should include hot prestressing in the future.

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Date: 26/02/2007
Time: 08:59:16
Initials:

Identifier: Prestress trial
Details: 810

Spring Type Round Wire Compression

Designed To: BS 1726-1: 1987
Tolerance Standard: BS 1726-1: 2002

Material

EN 10270 Pt2 Silicon -Cr
Youngs Mod (E): 206000 N/mm²
Rigidity Mod (G): 79500 N/mm²
Density: .00000785 Kg/mm³
Unprestress: 0-53 %
Prestress: 53-70 %

End Type: Closed and Ground
Dead Coils: 1.80
Tip Thickness: 50.00 %
End Fixation: Both Ends Fixed and Guided

Calculated Data

Solid Length: 20.54 mm
Solid Load: 687.68 N
Solid Stress: 1385.9 N/mm²
Stress Factor: 1.22
Active Coils: 4.70
Spring Index: 6.48
Helix Angle: 8.07 Deg
Buckling Possible: STABLE
Buckling Definite: STABLE
Spring Pitch: 9.13 mm
Inside Diameter: 17.33 mm
Mean Coil Dia.: 20.49 mm
Wire Length: 421.58 mm
Weight / 100: 2.60 Kg
Natural Freq: 34412 RPM

Design Parameters

Wire Diameter: 3.16 mm
Outside Diameter: 23.65 mm
Total Coils: 6.50
Spring Rate: 24.51 N/mm (Calculated)
Free Length: 48.60 mm

Stress Data

	Lower Tensile	Solid	Operating Positions			
			% Tensile	1	2	3
FDSiCr	1910	73 O	61 P	51 U	5 U	39 U
TDSiCr	1910	73 O	61 P	51 U	5 U	39 U
VDSiCr	1910	73 O	61 P	51 U	5 U	39 U
Specified						

Operating Data

	Operating Positions			
	1	2	3	4
Length	25.00	29.00	46.58	33.42
Load	578.38	480.35	49.51	372.03
Deflection	23.60	19.60	2.02	15.18
Stress	1166	968	100	750
Stress % Solid	84	70	7	54
Load Tol. Grade 1	34.18	32.21	23.60	30.05
Load Tol. Grade 2	51.26	48.32	35.40	45.07
O.D. Expansion	0.239	0.199	0.0205	0.154

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Figure 1 Spring Design