

THE SPRING RESEARCH ASSOCIATION

AN INVESTIGATION INTO THE EFFECT OF
PRESTRESSING AND SOLID STRESS ON THE
RELAXATION BEHAVIOUR OF
COMPRESSION SPRINGS

by

M. R. Southward, B.Sc.

Report No. 233

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OF COMPRESSION SPRINGS

SUMMARY

Springs made from 2.3 mm wire to BS 1408C Range 3 with three solid stresses, 1000 N/mm^2 , 1150 N/mm^2 and 1300 N/mm^2 , were tested for relaxation at various working stresses. In each case, one working stress was chosen near to the solid stress of the spring under test.

It was concluded that prestressing does not significantly affect relaxation.

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1. INTRODUCTION

When helical compression springs are deflected by a fixed amount and subjected to prolonged exposure at an elevated temperature, there is a tendency for them to settle or relax. The investigation carried out here was to find the effect of prestressing on the relaxation properties of a spring.

2. MATERIAL AND SPRING DESIGN

The wire selected for this investigation was to BS 1408C Range 3, with a diameter of 2.3 mm (0.092 in.).

Three spring designs were used, each with the same mean coil diameter and number of coils, but with free lengths selected to give solid stresses after prestressing of 1000 N/mm^2 , 1150 N/mm^2 and 1300 N/mm^2 . Details of the designs are given in Table I.

3. EXPERIMENTAL PROCEDURE

Springs from each design were compressed on Monel bolts at selected stresses at a temperature of 75°C for 72 hours. The stress levels selected were 50 N/mm^2 , 100 N/mm^2 , 200 N/mm^2 , 400 N/mm^2 , 600 N/mm^2 , 800 N/mm^2 , 1000 N/mm^2 and 1200 N/mm^2 . However, not all the designs were tested at the last two stress levels due to the limited solid stress.

Five springs were used for each stress level. Firstly, their free lengths were measured. Each spring was

then compressed to its selected load and the length measured. After measuring, the spring was placed on a Monel bolt, with nut and washer assembly, and compressed to its selected load by ensuring that its length was the same as that determined by previous load testing.

On completion of the loading, all the bolts, with springs attached, were placed in an air-circulating oven at 75°C for 72 hours. A time of 72 hours, in the case of carbon and low alloy steels, is sufficient to allow practically all the relaxation to occur. After removal from the oven and cooling, the springs were unloaded and then tested to find the load at their original compressed length. From the change in load, the percentage relaxation was calculated and tabulated.

4. RESULTS

The average result for each batch was calculated and is shown in Table II.

5. DISCUSSION

Referring to Table II and Fig. 1, there appears to be no significant variation in relaxation with change in solid stress. This can be stated since the difference in the values between groups is less than or the same as the variation within the batch results. Since the springs in the group with a solid stress of 1000 N/mm² were virtually unstressed, it can be noted that prestressing does not significantly affect relaxation.

An exercise was carried out during these relaxation tests to note any changes in the spring other than the change in length. The results showed no change in spring diameter and no change in spring rate. Thus, change in spring length was the only significant factor to affect relaxation results.

6. CONCLUSION ,

Prestressing does not significantly affect relaxation.

TABLE I SPRING DESIGNS A, B AND C

	Design A	Design B	Design C
Wire diameter (mm)	2.3	2.3	2.3
Mean coil diameter (mm)	18.7	18.7	18.7
Total No. of coils	5.5	5.5	5.5
Active No. of coils	3.5	3.5	3.5
Free length after pre-stressing (mm)	28.0	31.9	34.1
Solid stress after pre-stressing (N/mm ²)	1000	1150	1300
Solid stress as percentage of tensile strength	56.5	65	73.5

TABLE II RELAXATION DATA FOR SPRING DESIGNS A, B AND C

Working Stress (N/mm ²)	Solid Stress (N/mm ²)		
	1000	1150	1300
1200	-	-	13.8 %
1000	-	9.3 %	8.7 %
800	5.2 %	5.0 %	5.2 %
600	3.3 %	3.4 %	3.6 %
400	2.8 %	2.6 %	2.7 %
200		1.82 %	
100		1.58 %	
50		0.75 %	

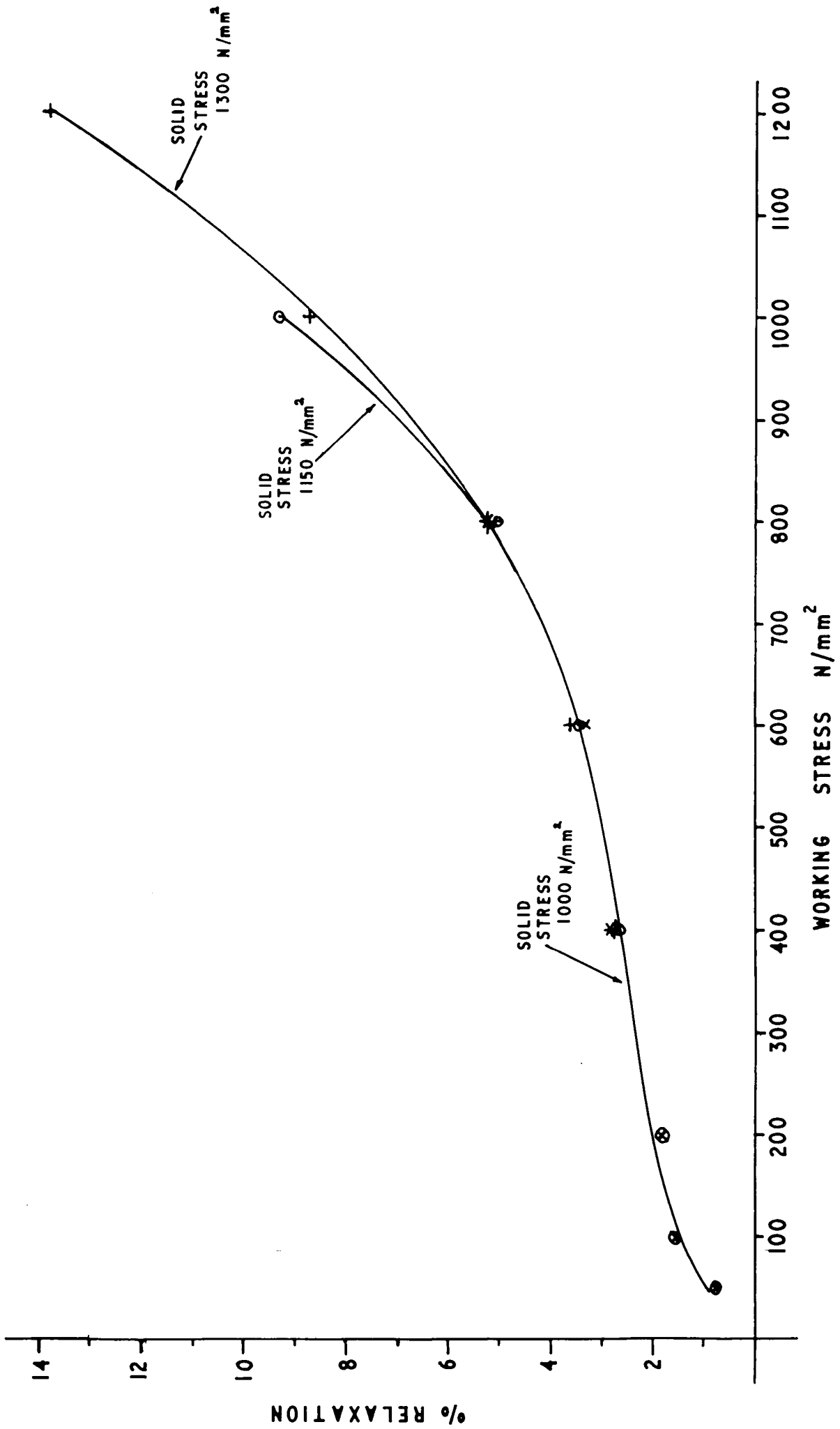


FIG I GRAPH OF % RELAXATION AGAINST WORKING STRESS