Cautionary Tales

Part XIV Quality.

One aspect of quality that often has to be met by manufacturers of compression springs is squareness and/ or parallelism. End users often specify tight tolerances on these parameters without explaining why. Easier assembly, a better spring with a load output that is more accurately axial, and minimum non-axial forces are reasons that might be cited for specifying tight squareness and parallelism tolerances. One item from the list of technologies presented in the last cautionary tale addresses this aspect of quality.

- Measurement of non-axial forces from compression springs

When a compression spring is loaded, it is always assumed that the force vector should accurately coincide with the geometric axis of the spring. This idealised scenario cannot occur however accurately your company makes compression springs! The force will be offset slightly and at a slight angle, and there will be both shear forces and torsional moments from the loaded spring. The axial force will not generally act through the geometrical axis of the spring, and so there will be a tilting moment about the end coils as a consequence. What is more the direction and position of the force vector will change as the spring is loaded, and it will not be identical at the top and bottom end of the spring, a typical example of tilting moment being as shown in figure 1. Similarly the shear force will change in magnitude and direction as the spring is compressed. These non-axial forces may be measured on a special load tester that is equipped with six strategically arranged load cells beneath the bottom platen, an example of such a tester being shown in figure 2.

There are a number of compression spring applications where it would be highly desirable to keep non-axial forces to a minimum. This can be achieved by design and manufacture

- using a small spring index.
- using a large number of coils, without risk of buckling.
- Adjusting the number of partial coils will have a major effect
- grind the spring ends square and parallel to enable repeatability.

Spring manufacturers may find that only the last of these is within their control, and that is the point of this cautionary tale. The quality of your springs may be enhanced by grinding them more accurately, but non-axial forces are not always improved with squareness. Indeed improving squareness has even been known to have an adverse effect upon the magnitude of non-axial forces. This is because, as a compression spring is loaded, the end coils try to tilt at an angle approximating to the change in helix angle due to the loading. Hence the end coil lay-on, number of part coils, end squareness and parallelism will combine to influence the magnitude and direction of the non-axial forces and moments. A brochure explaining more about this topic is available free of charge from *IST.*

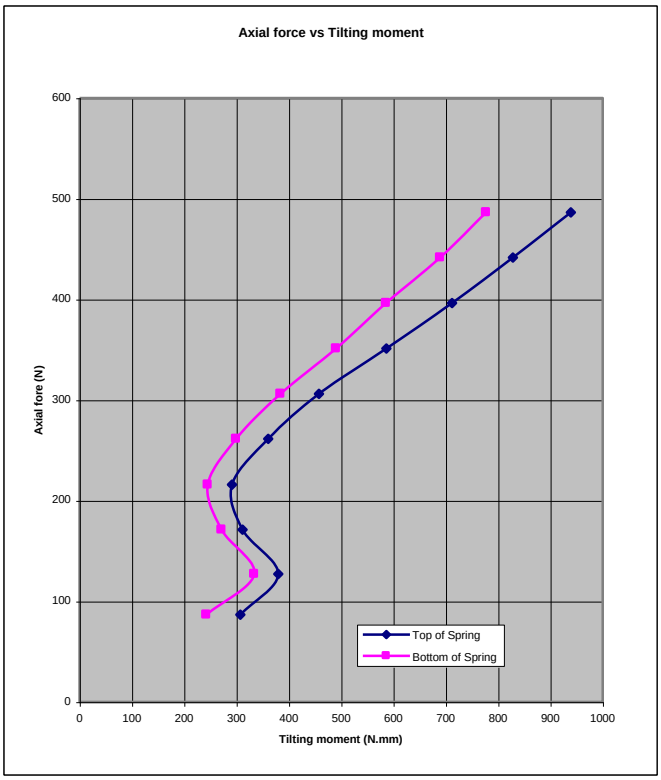

Fig 1 Change in tilting moments with axial force

Figure 2 Load tester for non-axial forces

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