Cautionary Tales Part XVII

Employee Motivation

How could a cautionary tale on technical aspects of spring manufacture be relevant to employee motivation? This tale will help employees to recognise that production problems they encounter with strip materials may sometimes be outside their control, and that continuing to do battle with strip in some circumstances is not worthwhile – they are never going to produce good springs from it.

When setting up a regular job with a new supply of strip, it may be that misalignment or wear of tools means that the strip cracks or springs are dimensionally out of tolerance. Adjustments to the tooling will correct these problems, ensuring that punch and die clearances are correct, bend radii are within permitted limits and springback allowances are appropriate. Occasionally, these adjustments will not completely solve the problem and meeting spring dimensional tolerances remains a problem whereas the last time the job was run tolerances were not a problem.

The natural reaction of a spring manufacturer will be to reject the strip, and that of the strip producer will be to say that the strip meets all specification requirements – the strip producer often replaces the strip, but doesn't accept responsibility for the complaint. To shed light on this type of unsatisfactory situation, *IST* developed a test called "Dynacon" in which the elastic/ plastic deformation properties of the strip are assessed and the frictional properties of the strip surface are characterised. It is the latter of these two properties which *IST* have most frequently found to lie at the root of the problem, and frictional properties of the strip surface are not mentioned in any international specification for strip materials.

There follows a case study in which the spring manufacturer purchased annealed 0.040" thick 0.7% carbon steel strip for the production of a part with a 180° bend in it. Setting the job up to consistently achieve the required +/- 3° proved to be difficult and required sorting good from bad. Life testing of the part gave a risk of failure after 40,000 cycles when a minimum of 65,000 was required. Visually, the good parts looked satisfactory with no burrs remaining after barrelling and the heat treated structure and hardness was correct.

Dynacon testing of the strip showed the elastic/ plastic properties were normal, but there was excessive variation in the frictional properties of the surface and the friction was higher than usual. Further investigation revealed that the high friction was due to minute surface tears in the strip surface – the tears being invisible under a binocular microscope, but were clearly evident when examined on a scanning electron microscope, as shown in figure 1. These tears would undoubtedly have lead to the high friction, and would have been sufficient to jeopardize the life test results despite the fact that metallographic examination of these tears showed them to be very shallow.

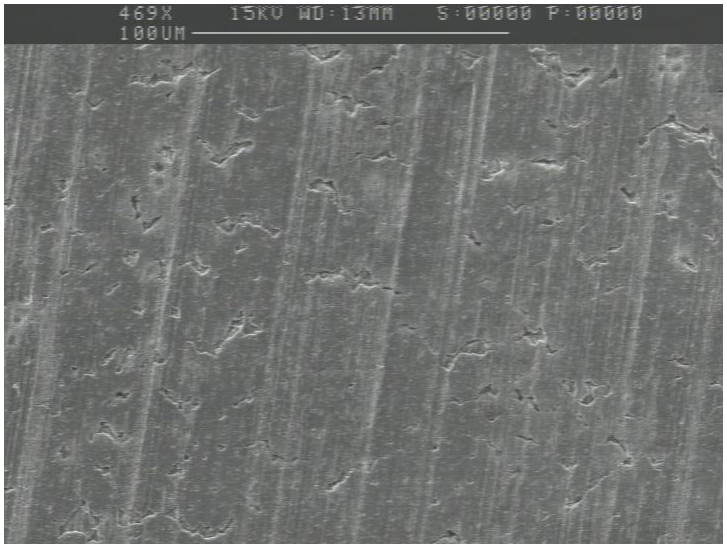

Figure 1 Broken strip surface x 400

Without the results of the Dynacon test there would have been no reason to examine the strip surface. The moral of this cautionary tale is that the morale of spring forming employees will be much improved when they discover that they were having problems with a batch of strip because it had a fault such as the one illustrated here, and the problem was not due to their setting up of the forming equipment.

This type of fault would not have been picked up on any release testing at the strip producers. Other faults that Dynacon testing has picked up that again were not detected on release testing of strip include

- Rippled surface that lead to fractures during forming.
- Strip that was unusually prone to galling during forming.
- Strip that required higher forming forces and this lead to excessive variability of shape during heat treatment.
- Stainless steel strip that had small corrosion pits.
- Variations in thickness and/or hardness.

Mark Hayes is the Senior Metallurgist at the Institute of Spring Technology (IST) in Sheffield, England. Hayes manages IST's European Research Projects, the spring failure analysis service, and all metallurgical aspects of advice and training courses given by the Institute.

Readers may contact him by telephone at (011) 44 114 2760771 or (011) 44 114 252 7984 (direct dial), fax (011) 44 114 2726344 or e-mail at m.hayes@ist.org.uk.