The original SCHNORR® disc springs

Today DIN 2093 divides three manufacturing methods depending on the relevant thickness:

The large dimensional range in which disc springs are made requires very different production methods.

Group 1: t <1.25, punching, cold forming, rounding-off edges

Group 2: 1.25 ≤ t ≤ 6 mm, punching, cold forming, turning and rounding off edges or fine-blanking, cold forming and rounding off edges

Group 3: 6>t ≤14 mm, cold or hot forming, turning all sides, rounding off edges or punching, cold forming, turning and rounding off edges or fine-blanking, cold forming, rounding off edges.

Disc springs of group 2 acc. to DIN 2093 can be manufactured acc. to the following alternative processes:

- First the blank is stamped and subsequently the inner and outer diameter are turned to finished size.
- The disc spring is fine-blanked* and the punching grooves and the burr at the cutting edges are subsequently removed by tumbling/ vibrofinishing.

SCHNORR® regard the group 2 turned version as the best for most applications; due to a high level of automation they can be continuously and competetively manufactured. Alternatively, we will offer group 2 disc springs in a fine-blanked version if it is more sensible to use them from a technical or efficient point of view.

Simply stamped and ground disc springs of group 2 do not correspond to DIN 2093 and generally do not comply with the quality requirements for a disc spring. Such products should only be used after a close technical examination and for simplest static applications.

Spring load and various shape-forming processes

During the stamping process to form the disc spring, small grooves may form on the machined surface running in the stamping direction. Under load a series of tangential tensile stresses will occur particularly on the external edge of the spring.

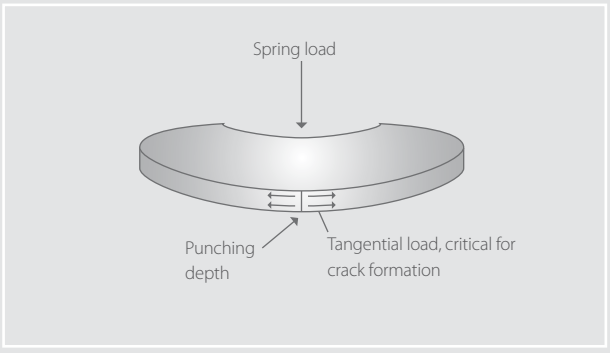

Figure 1

The inner and outer diameters of SCHNORR® disc springs are finished by lathe turning to counteract these critical conditions. That way, this critical condition is avoided. The turning pattern that inevitably occurs during the turning process runs in an uncritical tangential direction and thus into the direction of the acting tensile strength so that the danger of breakage is reduced to a minimum with SCHNORR® disc springs.

Turned variant:

During the turning procedure the stamping grooves are completely eliminated. The radial machining grooves occuring during the turning process run in the direction of the main tension of the spring and are thus not critical.

Fine-blank variant:

During fine-blanking the stamping grooves occur across the tangential tension which leads to an increased notch sensitivity (see figure 1) if these are not completely removed.

Prior to grinding

The stamping grooves are smoothed during the tumbling or vibratory grinding process.

After grinding

Stamped only variant:

During simple stamping accentuated stamping grooves occur across the main direction of tension resulting in a much higher notch sensitivity. We do not recommend this variant for dynamic requirements. Due to the punching cracks, a higher service life cannot be guaranteed.

* according to VDI directive 2906 page 5

Benefits of turned disc springs

- By turning the key surfaces of the spring, stamping cracks across the main direction of tension have been completely removed. This eliminates the risk of the notch effect.
- As the bearing surfaces are fully turned then friction between components is significantly reduced. This benefit can only be achieved by individually turning the disc springs (see figure 1b).
- Zones of work hardening which may occur on the cutting edges during fine-blanking are removed as far as possible during turning. The hardening process is clearly more uniform than with punched or fine-blanked surfaces which are then tumbling or vibratory ground only (see figure 1a and 1b).
- To achieve particularly high precision, the disc springs can be fine-turned to final dimension once again after the hardening process.
- With normal stamping and subsequent turning, material grades with a higher tensile strength than 600 N/mm² which do not have sufficient shaping capability for fine-blanking and are thus subject to the danger of crack formation can also be processed.

Formation of the edge area of a disc spring with the dimensions: 63 x 41 x 1.8, material grade: 1.4310, hardness data in HV0.1

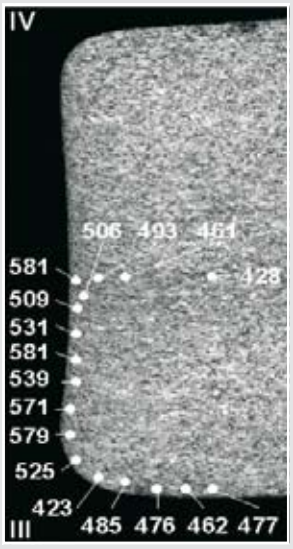

Figure 1a: punched
Minimum 423
Maximum 581

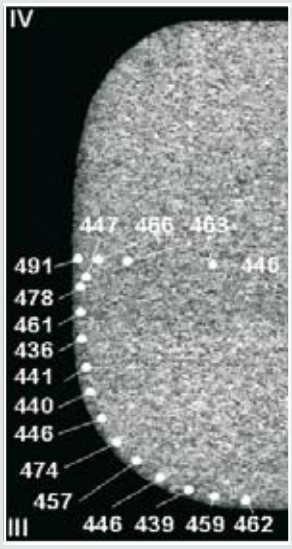

Figure 1b: punched and turned
Minimum 435
Maximum 491