

SGS Wool Testing Services

Info-bulletin

Fibre Curvature

What is fibre curvature?

Currently there is **no** internationally agreed definition. We use: *“the average amount of curvature, measured over 0.2 mm length, for fibre snippets presented to the OFDA”*. The units of measurement are “degrees per mm”. The Sirolan Laserscan uses a different measurement principle, but now also provides average curvature measurements in the same units.

Fibre curvature is closely related to crimp. In the early 1990's some fundamental research was carried out in Australia which demonstrated a relationship between fibre curvature, staple crimp, and processing performance. Interest in the measurement has grown significantly since then.

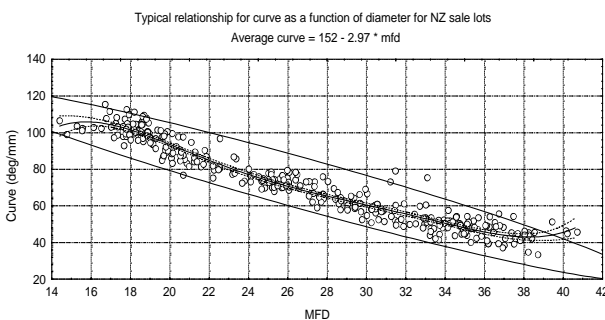
Straight fibres (e.g. some goat fibres) have a curvature of zero, and highly curved fibres (e.g. finely crimped merinos) may individually have curvatures of several hundred degrees per mm, which means that if the individual fibre was uniformly curved in the same direction along its length, it would complete a full circle in less than 1mm of length.

How is curvature measured?

In both the OFDA and Laserscan, curvature can be measured on over a thousand individual snippets during the process of measuring fibre diameter. In both cases the individual measurements are assigned to curvature classes, and at the end of the measurement, statistics are calculated for the sample. Normally the average curvature is reported.

What values can be expected?

When averaged over a sample, mean curvature values range from over 100 deg/mm for fine merinos to less than 40 deg/mm for coarse crossbreds. This can be seen in the following plot for some typical NZ sale lots:

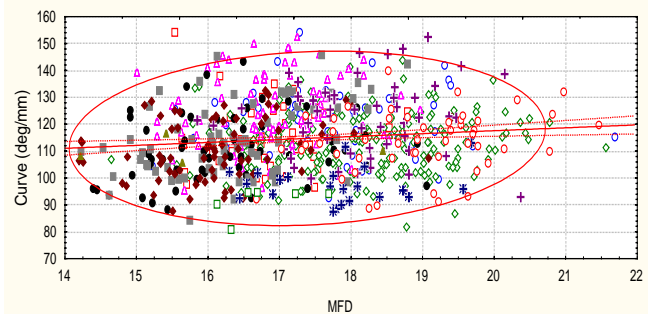


These measurements were made using an OFDA 100 on a range of core samples from auction lots. (The ellipse encloses 95% of the results, and the curve, with its confidence limits, indicates the best fit to this data.) There were many wool types included, but it can be seen that there is a fairly tight relationship between average curvature and mean fibre diameter when taken across this sample of the clip.

Typical relationships between Curve & diameter on merino fleeces

Average Curve = $95.8 + 1.09 * \text{mfd}$

Data shown for 12 individual flocks



When we come to examine individual fleece samples, the picture is slightly different. The plot above shows a sample of curve measurements undertaken on 12 groups of fleece samples. Here it would seem that within this small group of Merinos, there is no useful correlation between curvature and diameter. Even within individual groups of animals there are no obvious trends, suggesting that curve and diameter are independent traits, thus negating the historical use of crimp as an indicator of fineness.

The average curvature measured in these sets of samples was about 115 deg/mm, but the overall range for individual animals varied from 80 to over 150 deg/mm.

What use are curvature measurements?

Despite the increasing amount of interest in the measurement, there are no clear guidelines on what the measurement means! Whilst this may be because different “styles” suit different processing outcomes, it is also clear that there's not much experience available on which to make sound judgements. Much of the work published to date has dealt with crimp, and whilst there's reasonable correlation between crimp frequency and curvature, there is less known about the effects of crimp definition and crimp depth.

It's known that higher crimp wools are harder to process at virtually all stages, but on the other hand they may produce some consumer products that are judged more desirable. Generally, higher crimp gives bulkier yarns and fabrics. In knitwear, high crimp can help to improve “softness”, but this also requires lower yarn twist, and greater processing skills.

Preliminary Australian research on wools of less than 19.5 micron tentatively suggests that higher than normal fibre curvature is associated with poorer yarn evenness and diminished spinning performance in terms of ends-down. It has also been observed that lower crimp wools provide smoother, leaner and an apparently preferred handle in finished fabrics.

These two viewpoints may be a reflection of different emphases – the former relating to knitwear, the latter leaning towards worsted fabrics.

Finally, the measurement of curvature and diameter allows us to predict bulk (see Bulletin 5.1).