# Finer wool yarn spinning

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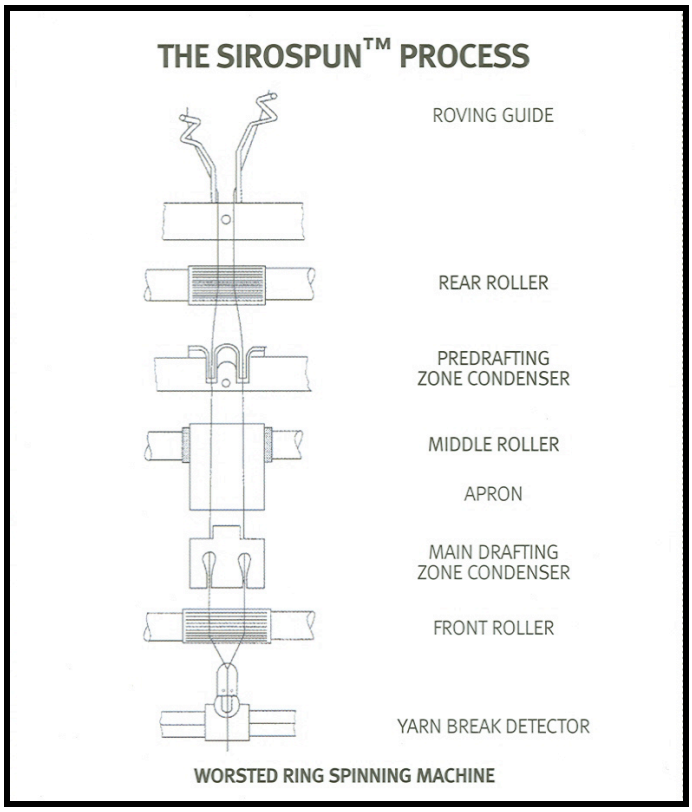
# The development of Solospun

## Weavable singles – Sirospun to Solospun

Traditionally for weaving, two singles ring-spun yarns are twisted together to form two-fold, or two-ply yarns. Twisting to produce the two-fold yarn binds the surface fibres of the singles yarns into the twisted structure so it is smoother and more resistant to abrasion during weaving. CSIRO Textile and Fibre Technology developed the Sirospun system, which in essence is the combination of spinning and two-folding in a single step on the spinning machine. Sirospun uses the torque/friction forces involved in self-twist to bind two drafted roving strands together initially, and then apply twist to the two-fold structure in the conventional ring-spinning manner. Sirospun was formally released in 1980.

The earliest version of Sirospun involved the introduction of an additional roller just below the point of conversion of the two strands. This roller had a recess around part of its circumference, allowing the intermittent propagation of twist from the revolving spindle/bobbin along the two converging strands. The periodic variations in the twist enabled the binding together of the strands into a structure suitable for weaving. An elegant feature of the design was that if one strand broke, the other strand would be pulled out of the recessed section of the roller and also broken. A simplified procedure was then developed, but this needed a device to break out the remaining strand if one of the strands should accidentally be broken. A simple, effective break-out device was developed that acted as a twist block when pulled off centre by the remaining strand, so breaking it.

Sirospun is especially suited to the production of lightweight, trans-seasonal Cool Wool fabrics and was promoted by the Woolmark Company for this purpose. The Woolmark Company promoted Cool Wool as a lightweight worsted fabric with a soft or dry handle, supple drape, clean finish and ‘hard’ twist yarn, ideal for a wide range of climates and temperatures. Sirospun has two major advantages: the cost of two-folding is eliminated and the productivity per spindle on the spinning frame is effectively doubled.



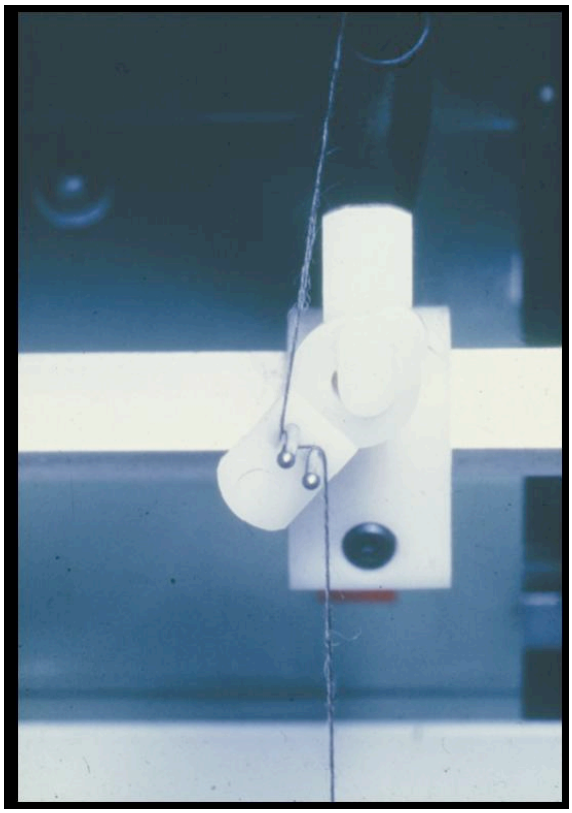



*Figure 1: Sirospun spinning process and Sirospun yarn break-out device.*

During 1998 a new spinning technology, Solospun™, was released and subsequently displayed at the 1999 Paris ITMA Exhibition. This technology was developed in collaboration between CSIRO Textile and Fibre Technology, the Woolmark Company and Canesis (formerly WRONZ), based on an initial clip-on roller attachment developed at CSIRO. As the name suggests, Solospun™ is a spinning technology that produces a

weavable singles yarn in a single step from a single roving. The Solospun™ technology is a simple, inexpensive, clip-on attachment to standard long-staple (worsted) spinning frames. The hardware consists of a bracket that holds a friction pad and a pair of Solospun™ rollers (Figure 2). The bracket clips on to the shaft of each pair of top front draft rollers of the spinning frame, with each Solospun™ roller being positioned just below and parallel to, but not in contact with, its corresponding top front draft roller. The Solospun™ rollers are rotated by being in contact with the bottom front draft rollers. Unlike Sirospun, Solospun™ is spun from a single roving strand, therefore, there is no longer a need for a double roving creel or break-out devices. However, the principle of inserting twist into individual strands prior to twisting them together to trap fibre ends can be attributed to the knowledge gained during the development of Sirospun.

Solospun™ differs from condensed or compact spinning in both application and principle. It achieves fibre security through the actions of localised twist in sub-strands and fibre migration. Condensed spun yarns, on the other hand, may still require two-folding or sizing to be suitable as warp yarns. Less twist is required, which reduces fabric streakiness and higher spinning speeds are possible with much better spinning performance than can be achieved when spinning the singles yarns needed for a similar resultant two-fold yarn. The overall result is a very significant reduction in yarn production time and costs.

As illustrated in Figure 3, the Solospun™ roller's operation is to interrupt the path of the drafted fibre strand, nipping it against the bottom front draft roller. The surface of the Solospun™ rollers is made up of four segments. As shown in the sequence in Figure 3, a 'land', which is flush with the roller surface and runs parallel to the roller axis, separates each segment. Between each land is a series of slots that are offset in each adjacent segment. The Solospun™ rollers act as intermittent twist blocks, preventing twist from reaching the fibres emerging from the front draft roller nip. The slots in the Solospun™ rollers divide the drafted fibre strand into a number of sub-strands as shown, which, through the intermittent twist-blocking action of the roller lands, converge at varied angles and rates to achieve a subtly entangled structure with locally differing twist levels.

Figure 3 illustrates how the varied angles and rates are achieved in one-quarter turn of the roller. Following the sequence from left to right, new sub-strands are formed after the main, drafted fibre strand has been nipped by one of the roller lands. As the land rotates away from the nip point, the sub-strands move down into the slots. As this occurs, the angles between the sub-strands increase. The continuing changes in these angles result in increased fibre migration and fibre trapping. When the next land reaches the nipping point, a new set of sub-strands is formed in the offset slots of the following quarter segment. This process is repeated every quarter turn, so that, depending on their length, fibres may undergo many changes in sub-strand position during twisting into the yarn. This action confers greater fibre security as fibres are trapped by neighbouring strands and by migration within and between strands. Consequently, in comparison to equivalent singles yarns, Solospun™ yarns have fewer protruding fibre ends per unit length and increased abrasion resistance, making them weavable without the need for two-folding or weaving assists such as size, typically used in the cotton sector and increasingly used in the worsted sector.

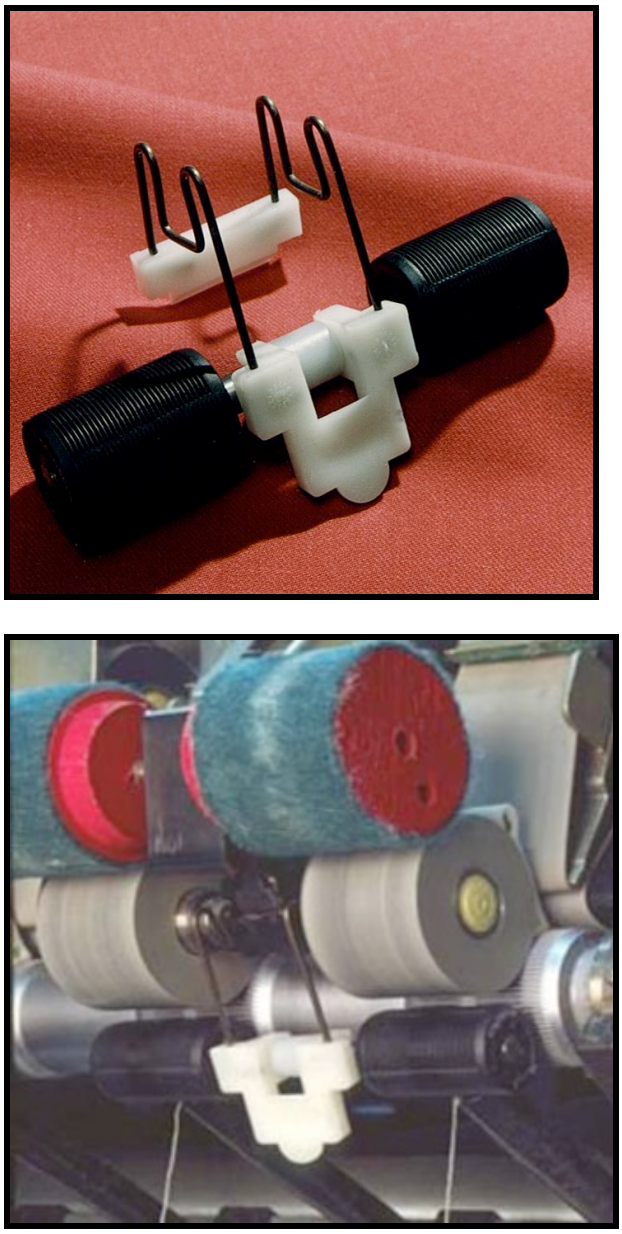
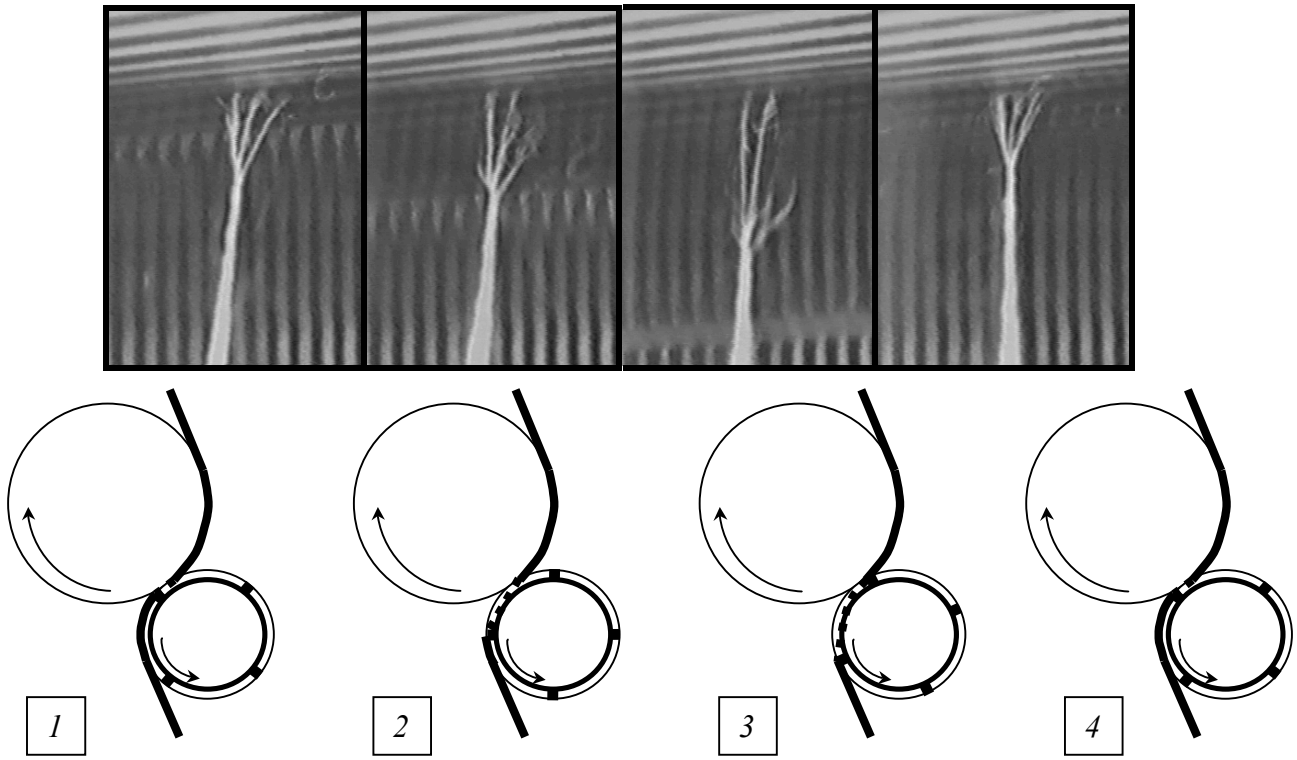


*Figure 2: Solospun components.*




*1:* *A set of sub-strands form as a Solospun roller land passes the bottom draft roller nip point.*

*2 and 3:* *The sub-strands move down into the slots and lengthen, varying the angles between each sub-strand.*

*4:* *A new set of sub-strands form as the next Solospun roller land passes the bottom roller nip point.*

*Figure 3: Solospun spinning process.*

## Benefits

When compared to conventionally produced yarns, Solospun gives the following benefits:

- economic benefits –
    - higher spinning productivity and efficiency
    - elimination of twisting and associated processes
    - higher winding productivity and efficiency
    - possible use of coarser micron wools
- product benefits –
    - finer yarns at lower cost
    - softer yarns at lighter weight.

## Cost comparison

Table 1 shows a typical example of cost savings using Solospun. In this case 2/64 Nm conventional two-fold yarn is replaced with 1/32 Nm Solospun, both with the same wool and with a coarser, cheaper wool permitted by the use of Solospun.

| | 2/64 Nm Twofold 19.5 µm (US$/kg) | 1/32Nm Solospun™ 19.5 µm (US$/kg) | 1/32Nm Solospun™ 21.5 µm (US$/kg) |
|---|---|---|---|
| **Top*** | 9.81 | 9.81 | 7.68 |
| **Drawing** | 0.16 | 0.14 | 0.14 |
| **Roving** | 0.12 | 0.06 | 0.06 |
| **Spinning** | 3.95 | 1.97 | 1.99 |
| **Steaming** | 0.04 | 0.04 | 0.04 |
| **Winding** | 0.46 | 0.23 | 0.23 |
| **Twisting** | 1.10 | 0 | 0 |
| **Steaming** | 0.04 | 0 | 0 |
| **Overheads** | 0.51 | 0.26 | 0.26 |
| **TOTAL** | 16.19 | 12.51 | 10.44 |
| **Saving $** | - | 3.59 | 5.74 |
| **Saving %** | - | 22% | 35% |

*Table 1: Spinning cost comparison.*

The savings in processing costs occur with the elimination of twisting and its associated processes and an improvement in spinning performance due to the greater number of fibres in the cross-section of the Solospun yarn. This greater fibre number also allows the use of coarser micron wool to make the same (resultant) yarn count. In the example in Table 1, a 21.5 µm wool replaces the 19.5 µm wool that would usually be used in the equivalent two-fold yarn. A slight drop in spinning efficiency occurs but overall greater savings of 36% are realised. Cost is not the only consideration, of course, and handle, comfort and quality will always influence fibre choice.

## References

‘Solospun – The Long-Staple Weavable Singles Yarn'; M.W. Prins, P.R. Lamb, N. Finn; *Proceedings of the Textile Institute, 81st World Conference*, Melbourne, Australia, April 2001.

Solospun, Weavable Singles Spinning at http://www.solsopun.com.

# Questions

1. Which CSIRO spinning system was the forerunner of Solospun?
    a. Hand spinning
    b. Self-twist
    c. Sirospun
    d. Conventional ring spinning
2. Unlike Sirospun, how many roving strands is a Solospun yarn spun from?
    a. One
    b. Two
    c. Three
    d. Four
3. How is fibre security achieved in a Solospun yarn?
4. What is the role of the slots in the Solospun clip-on rollers?