

# SpinTrak: Automated Spinnerette Inspection Comes of Age

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Since the early days of the man-made fiber industry, it has been recognized that the spinnerette is one of the single most important components in insuring successful production. Fiber uniformity, essential for end-user applications, rests on capillary geometry.

Over the years, much effort has been spent to try to control spinnerette quality from the time of its initial manufacture, through the demands of day-to-day production. In recognition of this, spinnerette inspection has played a key role in achieving consistent high quality fiber production.

## Inspection Methods

Many different inspection technologies have been employed. These can broadly be classified into two categories: contact and non-contact inspection.

In the case of contact inspection a probe is pushed against the spinnerette surface and air or oil is then pumped through the capillary. Deviations in the expected flow are recorded.

Although these methods try to approximate the flow of polymer through the capillary, they are often impractical in a production environment due to the difficulty in maintaining a constant viscosity of the oil or air (temperature and/or humidity dependent), leakage of the seal to the spinnerette surface, and the slow, sometimes messy, nature of the inspection. In addition, due to the fact that a probe must firmly touch the surface, there exists the possibility that the inspection process itself may damage the spinnerette.

In recent years, non-contact systems employing video based microscopes have been introduced with remarkable success. These systems provide rapid and repeatable measurements involving a minimal amount of spinnerette handling. In addition a wide variety of measurements impossible with other techniques are easily available.

## The SpinTrak System

An example of such a system employing state-of-the-art vision technology, the SpinTrak™ family of spinnerette inspection systems is designed specifically to provide synthetic fiber producers with unmatched speed, accuracy and repeatability for spinnerette inspection.

The system is a robust, user-friendly spinnerette measurement device designed to be used by both

engineering and production personnel alike. It features fully automatic inspection of capillaries as small as 0.020mm to as large as 6mm in diameter.

Three SpinTrak models are available to accommodate round spinnerettes as small as < 10mm in diameter to rectangular spinnerettes as large as 500mm x 5500mm. An unlimited number of capillaries on each spinnerette can be inspected at rates from 0.3 seconds to 1.25 seconds per capillary.

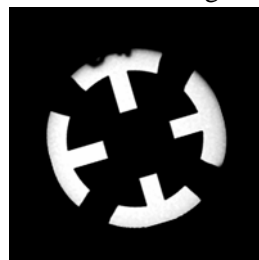
In the following paragraphs we will illustrate some examples of the measurements possible and their impact on fiber quality.

## Types of Measurements

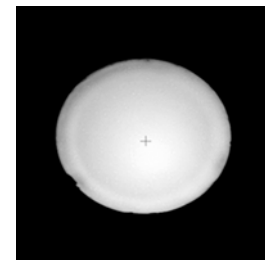
**Back light Inspection.** For each capillary five basic measurements are made:

- Total Open Area
- Maximum Diameter
- Minimum Diameter
- Perimeter
- Profile (a curvature indicator)

These measurements are good for finding defects such as dirt and out of round capillaries and surface damage caused by the impact of tools or poor spinnerette handling:



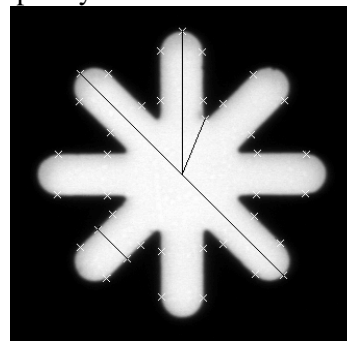
Dirt



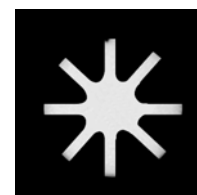
Out of Round

Spinnerette manufacturing defects such as capillaries that are not drilled perpendicular to the surface can be detected by pronounced shading around one side of the capillary.

SubCapillary™ inspection can easily measure features of complex shaped capillaries. Leg length and width or lobe radius can be automatically inspected. Yarn characteristics are directly related to this geometry.

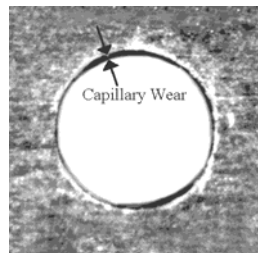


Edge wear, characterized by uneven rounded edges, can also be automatically detected.

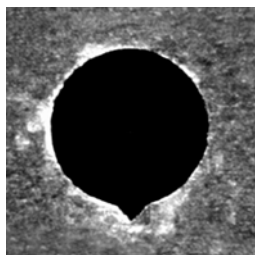


### **Front light Inspection.**

This type of inspection can find capillary edge wear caused by polymer flow or poor cleaning techniques, as well as edge chips and fractures caused by thermal shock, metal fatigue or other metallurgical problems. In addition, inorganic deposits such as TiO<sub>2</sub> can be seen.



Edge Wear



Edge Fractures

**Back-Front light Inspection.** By inspecting the capillary first with back light, then with front light, the worn edge (seen in the black ring above) can be measured. This allows an objective determination of wear to be made.

**Capillary Depth Inspection.** By inspecting the beginning of the capillary in the counterbore, and then the exit at the spinnerette surface, the length of the capillary can be measured. Capillary length uniformity can then be found.

### **System Operation**

All SpinTrak models are fully automatic and come complete with a spinnerette platform, a motorized microscope magnification system, and Windows NT based system controller running SpinTrak software.

To start, spinnerettes are loaded onto the inspection platform, the serial numbers are entered, and automatic inspection begins. Using its advanced machine vision technology, the SpinTrak inspects 100% of the capillaries on each spinnerette, magnifying and independently calculating measurements for each capillary.

Based on such criteria such as the tolerance base for each measurement, the number of allowable failed capillaries per spinnerette, and the number of allowable plugged capillaries, each spinnerette can simply be qualified as either "Passed" or "Failed." In addition, SpinTrak provides graphs and pictorials of capillary data, helping to identify cleaning and extrusion problems.

Before each inspection run, the SpinTrak automatically calibrates the optical measurement system, assuring high accuracy and repeatability. Also, when new spinnerette types are added to the production process, SpinTrak automatically learns the capillary locations by scanning the surface at low magnification.

These and other essential features, in a user-friendly software environment, allow fiber producers total control over spinnerette inspection.