LOEPFE

MASTERS IN TEXTILE QUALITY CONTROL

YARNMASTER®

FACTS

LABPACK – ONLINE LABORATORY FOR SPINNING SHOPS

045911/003e

SPINNINGSOLUTIONS

LABPACK – ONLINE LABORATORY

YARNMASTER®
DIGITAL ONLINE QUALITY CONTROL

A clear change in yarn manufacture has been emerging over the past years: Quality assurance and control have shifted from the laboratory directly on-line into the production process.

The LabPack strengthens LOEPFE's market leadership in yarn clearers and online quality monitoring.

LabPack counts the so-called imperfections and monitors and evaluates the yarn surface.

Advantages

This complete quality monitoring provides information on raw material and machine parameters, for example on wear in the traveler system. A further advantage is reliable detection, and separation when necessary, of off-standard bobbins during the winding process.

IMPERFECTIONS

Staple fiber yarns often have "imperfections" as frequent smaller yarn faults or irregularities. These can be divided into three groups:

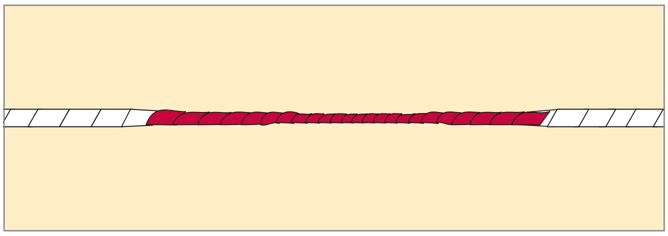
- Thin places
- Thick places
- Neps

These types of faults are either in the nature of the raw material or originate in a suboptimal manufacturing process. Isolated faults of this type are not regarded as disturbing in the yarn but do however have a negative effect on cloth appearance when too many are present.

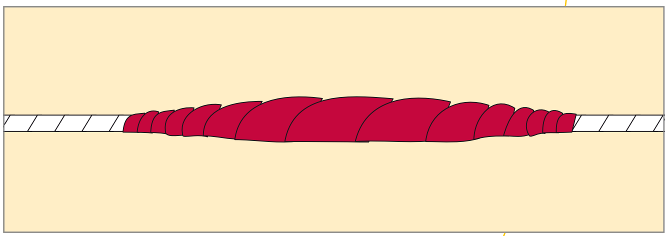
→ Thin and thick places

Together with the impairment of the optical appearance of the textile surface, the number of thin and thick places is an important information on the condition of the raw material and/or manufacturing process.
An increase in the number of thin places does not necessarily mean that the number of machine standstills increases accordingly during weaving and knitting with this yarn: In many cases, thin places indicate larger yarn twists. This means that the yarn tensile strength must not necessarily decrease proportional to the reduction in the fiber count.

With thick places, the relations are the other way round: The higher fiber count in the yarn cross-section results in a higher resistance to torsion. Thick places therefore frequently have less yarn twist. The yarn tensile strength in the area of the thick places is therefore very rarely proportional to the fiber count. Thick places can be weak points in the weaving and knitting shops that lead to machine standstills. These considerations are particularly applicable to ringspun yarns.



Thin place



Thick place

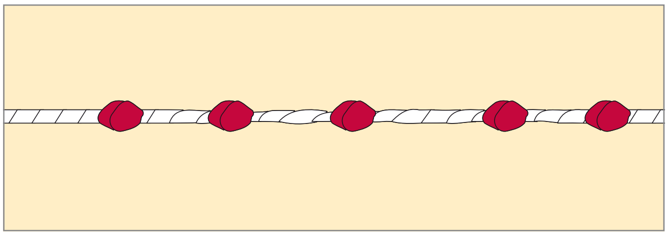
➔ Neps

Apart from the strong influence on the optical appearance of textile surface structures, neps from a certain size upwards also lead to problems in the knitting machine sector. Not only the size but also the number of neps are decisive criteria as to whether the yarn is usable or not.

Neps in the raw material are mainly foreign bodies such as, for example, shell or plant residues, whereas neps in production are created during the spinning process through unsuitable machine settings and a bad ambient climate. For example, when the ambient climate is too dry or deflection points as well as when fiber parallelism is too high can create neps during manufacturing.

Some of the neps in the raw material remain in the finished yarn depending on the manufacturing process. Most of the raw material neps are separated during combing. This means neps in the finished yarn are mainly from the manufacturing process.

Reliable analysis of imperfections (IPI) therefore not only allows optimizing manufacturing processes but also to draw conclusions on the quality of the fiber material used.



Neps

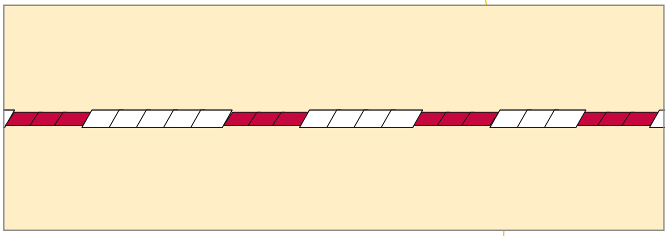
Figure 1:
Imperfection analysis (IPI)

➔ Irregularity (small)

Yarn irregularity identifies general diameter fluctuations in the yarn such as thicker and thinner places.

Yarn uniformity is the most important criterion for smooth production processes with regard to thread characteristics such as, for example, thick places or fiber fly as well as the physical yarn characteristics such as fluctuations in yarn count, tensile strength, elongation and twist.

Increased yarn irregularities have a negative influence on quality and therefore lead to interruptions in downstream processing such as, for example, through an increase in thread breaks. Furthermore, yarn irregularities lead to an unsatisfactory or even inferior result for woven and knitted fabrics.



Irregularities

Counting imperfections

LOEPFE's quality assurance system LabPack delivers, online, the number of imperfections (neps, thick and thin places) per 1000 m as well as the irregularities (small per m) of a yarn.

Tests have clearly shown that the LOEPFE online counting of imperfections and irregularities of a ring yarn during the winding process provides important information on the yarn quality.

Comparisons document a correlation in the number of imperfections counted by both test methods offline as well as online with LOEPFE's YarnMaster® system.

Even though the number of effectively registered imperfections using both test methods deviated from one another due to the different measuring systems (optical/capacitive), a correlation factor of 0.92 was determined.

Apart from the diameter-relative imperfections already mentioned, the YarnMaster® yarn clearer also classifies length imperfections (see chart).

Figure 2:
Lab-Data evaluation from YarnMaster® control unit.

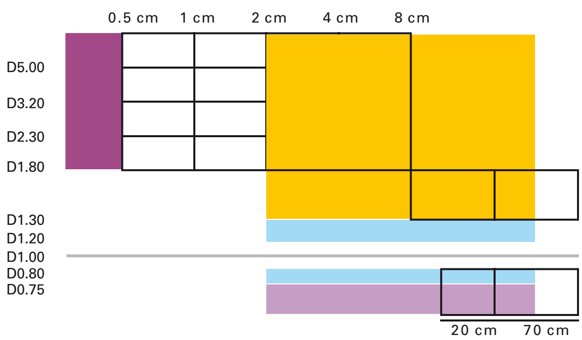


Figure 3:
Ranges for diameter-relative imperfections

- *Frequent events: Nep imperfections*
- *Frequent events: Thick place imperfections*
- *Frequent events: Thin place imperfections*
- *Very frequent events: Small (irregularity)*

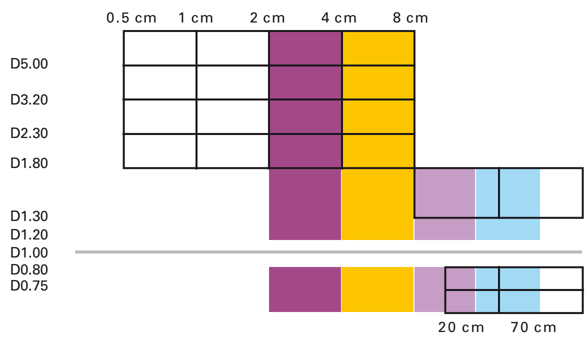


Figure 4:
Ranges for length-relative imperfections

- *Imperfections 2–4 cm*
- *Imperfections 4–8 cm*
- *Imperfections 8–20 cm*
- *Imperfections 20–70 cm*

SURFACE INDEX

The surface of a yarn is characterized by irregularities (thick and thin) as well as hairiness and neps. In order to be able to forecast yarn behavior in the weaving or knitting shop, single quality characteristics such as yarn irregularity are not sufficient to assess the yarn. Low yarn irregularity alone cannot indicate the appearance of a textile surface: Higher yarn hairiness is often first especially clear after dyeing where warp and filling yarns show different absorption capacities for the dye.

Only a combination of various quality criteria such as, for example, hairiness or irregularity allow a reliable statement. The quality characteristics merge within the surface index SFI – a part of the LabPack. This allows users to monitor quality changes in surface characteristics online. The most important relations and terms are described in the following.

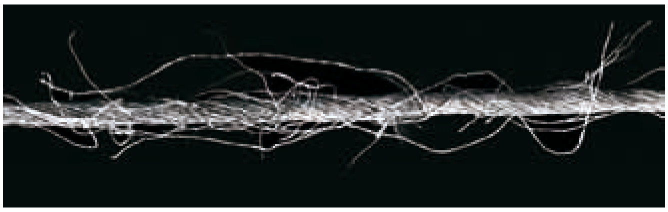


Figure 5:
Microscopic picture of a hairy yarn

Hairiness

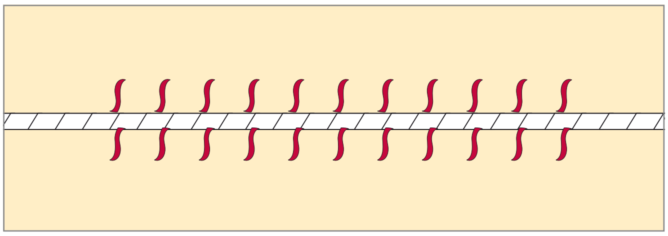
Hairiness is defined by the plurality of fiber loops and ends sticking out of a yarn. Hairiness as characteristic for spun fiber yarns is a parameter that mainly depends on the characteristics of the raw material, spinning shop preparation, spinning process and method used.

A certain hairiness can be produced as required in downstream processing depending on the application. This can, on the one hand, give the fabric a certain effect such a soft touch. On the other hand, higher or variable hairiness within a lot can cause an undesired cloudy appearance for the knitted fabrics after dyeing and finishing.

Higher hairiness in warp yarns can also impede filling insertion especially on airjet weaving machines. Hairy warp yarns can stick together and hinder filling yarns from passing through the weaving shed.

Hairiness occurs through:

- Wide spinning triangle
- High distortion
- Friction on deflection points (e.g. traveler)
- Unsuitable coverings/aprons
- Dry rooms
- Static electricity



Hairiness

Definitions

Quality variable SFI defines the sum signal of the fibers protruding from a yarn within a measured length of 1 cm yarn. The yarn core diameter is hidden *(Figure 6)*.

Surface index SFI/D used in yarn clearing is defined as the sum signal of the fibers protruding from the core diameter of a yarn. The core diameter of the yarn is set to 100% in this case *(Figure 7)*.

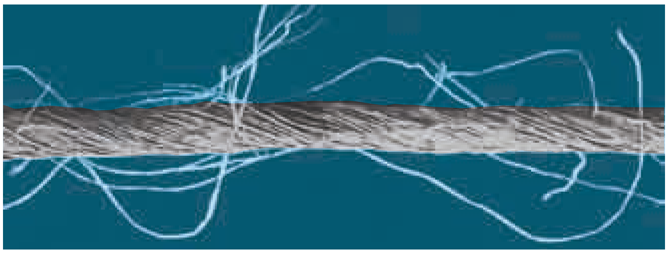


Figure 6:
The yarn diameter is hidden
Sum signal SFI

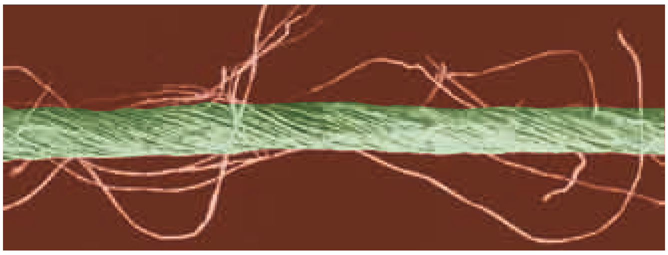


Figure 7:
Yarn core diameter 100%
Sum signal SFI/D

Online quality monitoring

Quality value SFI enables making a 100% quality statement as to the surface characteristics of the yarn to be wound. The comparison between the LOEPFE SFI quality values and a competitor's product (H) shows that both test methods correlate (∅ correlation coefficient r = 0.91).

The chart shown is based on a series of measurements with differing ring yarn qualities and counts.

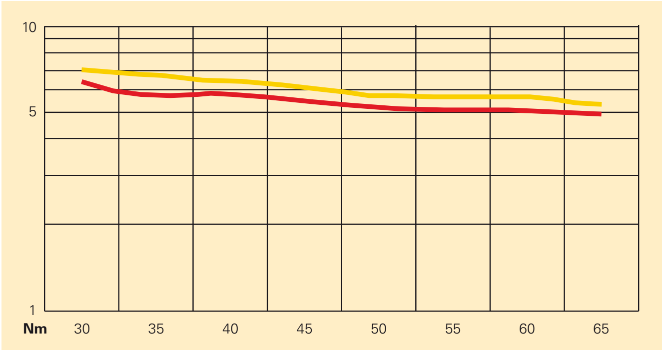


Figure 8:
∅ correlation coefficient r = 0.91

→ Yarn clearing

During yarn clearing, surface index SFI/D relative to the diameter allows reliable detection of quality changes with regard to the surface characteristics of the yarn to be wound. When the values are above or below limits set as percentages (±) relative to the SFI/D reference value, off-standard bobbins are detected and eliminated from production.

The reference value serves as starting point for SFI/D monitoring. This is either determined continuously by the clearer or entered by the user (constant) as shown in *(Figure 9)*.

The floating SFI/D reference value *(Figure 10)* adapts to the general yarn surface level of a style. This compensates, for example, surface fluctuations caused by the climatic conditions and does not lead to excessive cutting counts. Single bobbins with high deviations from the mean value are detected reliably.

The user defines the constant SFI/D reference value. This value remains unchanged during the complete production and is not adapted automatically by the clearer. Stable production conditions such as, for example, climatic conditions, must be presumed when using this setting.

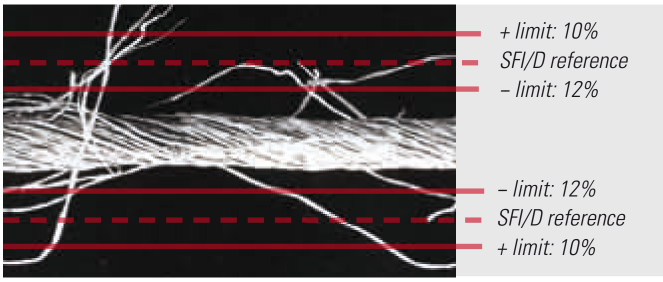


Figure 9:
Limit values

Figure 10:
Reference value setting

→ Characteristic relations

Yarn twist

Surface index SFI sinks as yarn twist increases because more fiber ends projecting out of the yarn surface are bound.

Yarn count

The higher the yarn count, the lower the breaking strength of a yarn. Fine yarns have a lower number of fibers in yarn cross-section. Increasing yarn twist provides the required tensile strength. Tests have shown that the SFI sinks as yarn fineness increases. The reduction in the diameter of fine yarns has the following effect on SFI/D values: The relation of the sum signal (SFI/D), which reflects the fiber ends projecting out of the yarn, increases as the yarn diameter decreases.

→ Variable CV channel (VCV)

Disturbing diameter variations caused by drafting faults, soiled rollers or sporadically occurring irregularities can be detected.

As opposed to laboratory practice where check lengths of 400 or 1000 m are normally used for CV determination, the check length of the VCV can be varied continuously between 1 and 50 m. This allows specific detection of disturbing diameter variations in this length range.

The clearer calculates continuously the VCV values from the yarn pieces with the set check length and compares these against the mean value.

PRACTICAL APPROACH

➔ Detection of off-standard bobbins

Continuous monitoring and optimization of the production process are decisive factors for constant yarn quality.

Yarn clearing is vital to meet the increasing demands on yarns. Extensive tests by yarn manufacturers combined with direct cooperation with the customer serve to determine the clearing limits for the respective yarn.

The "SFI/D deviation" determined continuously according to *Figure 11* is available to ensure fast, efficient application of yarn clearing using the surface index.

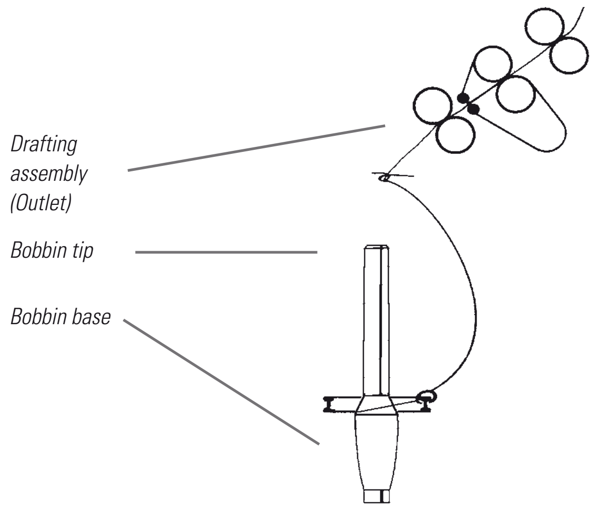
This value, specified as a percentage, shows the average surface distribution of the wound yarn and simplifies determination or optimization of the SFI/D limits (±).

Figure 11:
SFI/D deviation

➔ Normal SFI distribution of the bobbin

Tests show that the surface index within a bobbin (base/tip) is spread up to ± 10%. This can mainly be attributed to the tension differences during ring spinning. The yarn tensile strength fluctuates during bobbin winding and the ring rail stroke. The tensile strength peaks are very large in the area of the bobbin base. Increasing tension leads to deterioration in yarn irregularity and IPI values.

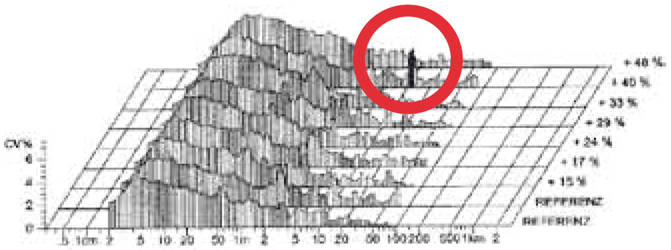
These relations must be taken into account when setting the limit values because such fluctuations do not normally have a negative influence on quality in the textile surface structure.



→ Detection of periodical faults, high imperfections and irregularity

SFI/D deviations up to 40 % can be determined for a periodical fault such as, for example, a moiré effect, that shows a strong increase in imperfections and/or irregularity of a yarn.

In this example, a strong increase in irregularity (CVm) and imperfections (IPI) leads to an SFI/D deviation of +48 %. This can be seen clearly as cloudiness on the knitted fabric surface.



A mass spectrograph shows a periodical fault with 11 m period length.

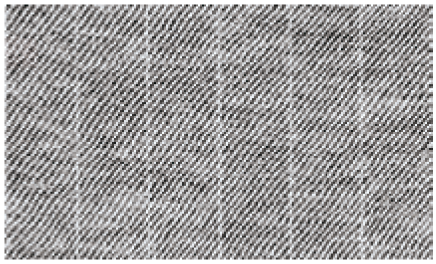


Figure 12:
Knitted fabric with reference yarn

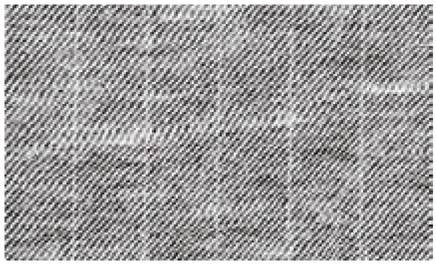


Figure 13:
Knitted fabric with +48 % SFI/D deviation

Experience values for SFI yarn clearing

Yarn type	Experience value SFI/D setting	Measured SFI/D deviation	Fault type	Cause
Combed ring yarn 100% CO	Setting: ±20% Deviation: ±10%	+20% to +34%	Periodical fault (Moiré)	Ring spinning machine: Drafting assembly (upper roller defective)
	Setting: ±20% Deviation: ±10%	+30%	Imperfections IPI (neps)	Ring spinning machine: Ring traveler system (runner defective)
Compact yarn	Setting: ±25% Deviation: ±15%	+40%	Periodical fault (Moiré)	Ring spinning machine: Drafting assembly (lower apron defective)
	Setting: ±25% Deviation: ±15%	+42%	IPI, CV (irregularity), hairiness	Ring spinning machine: Drafting assembly (soiling in compression zone)
	Setting: ±25% Deviation: ±15%	+27%	IPI, CV	Ring spinning machine: Drafting assembly (compression apron defective)
Core yarn (CO/Elastan)	Setting: ±30% Deviation: ±25%	+31%	Periodical fault (Moiré)	Ring spinning machine: Drafting assembly (upper roller defective)
	Setting: ±30% Deviation: ±25%	+37%	IPI, CV	Ring spinning machine: Ring traveler system or roving

➔ Data collection and evaluation

Offline collection and evaluation of quality data in a laboratory often involve high material and personnel effort. A meaningful alternative is to combine online quality monitoring with a central system for data collection *(Figure 14)*.

The LOEPFE MillMaster® allows data storage and chronological quality tracking based on graphical representation over a longer period.

The evaluated data volume is an excellent factor for exact quality documentation. The LOEPFE MillMaster® provides an exact description of the quality because it processes a huge flood of data and shows the results in graphic form that is easy to understand.

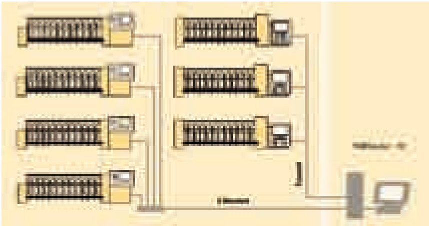


Figure 14:
Central data collection system MillMaster®

Figure 15:
MillMaster® quality progress evaluation

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