## The Problem of Spirality in Single Jersey Fabrics

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## Definition of Spirality

Perpendicular — Spiral angle

Course line

Wale line

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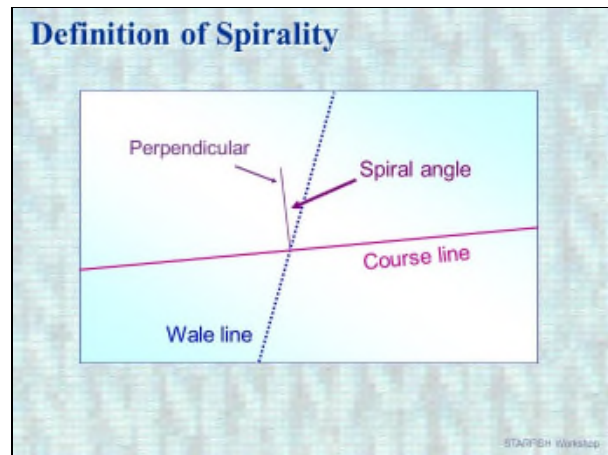
## Sources of Spirality

* Knitting Machine
  - feeder density
  - direction of rotation

* Yarn Characteristics
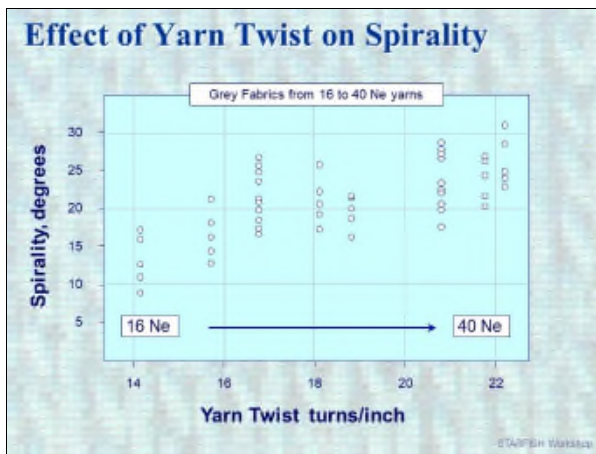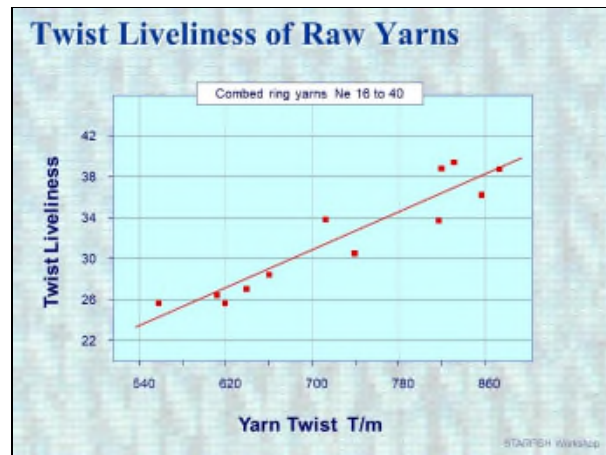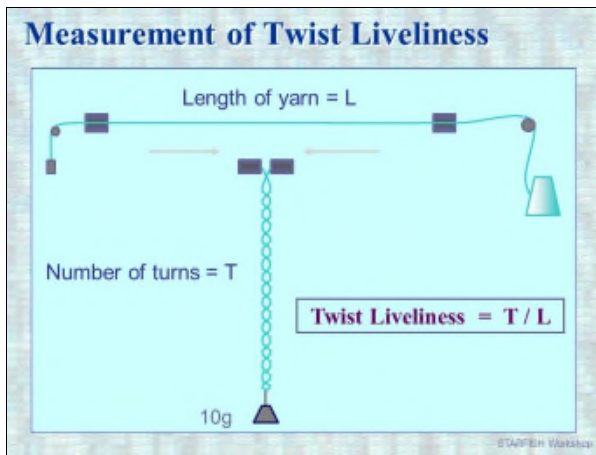  - twist liveliness

* Fabric Construction
  - tightness factor

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## The Feeder Effect

$$\tan(Sf) = Drop / Width$$

Drop = Feeders / Courses per cm
Width = Needles / Wales per cm

Course line

Feeder Drop

Sf      Feeder Skew

$$\tan(Sf) = (F * W)/(C * N)$$

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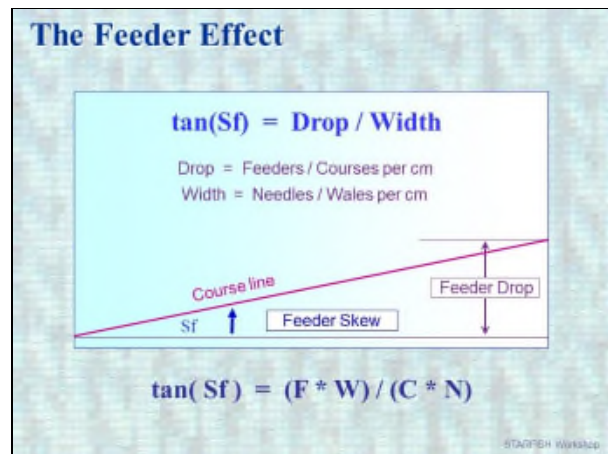
## Feeder Skew: Examples

| No. of Feeders = | | | 30 | 60 | 90 | 120 |
|---|---|---|---|---|---|---|
| Ne | gg | diam | | Skew Angle | | |
| 30 | 28 | 30 | 0.5 | 1.0 | 1.4 | 1.9 |
| 20 | 20 | 30 | 0.7 | 1.3 | 2.0 | 2.6 |
| 20 | 20 | 24 | 0.8 | 1.7 | 2.5 | 3.3 |

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## Twist Liveliness of Yarns

Twist liveliness causes

- Difficulties in yarn processing

- Distortions in fabrics

- Uneven loops in knitted & pile fabrics

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## Distortion in Knitted Fabrics

Caused by yarn twist liveliness

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## Twist Liveliness Depends on

* Number of turns per cm

* Yarn type and quality

* Fibre type and fineness

* Wet processing / heat setting

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## Measurement of Twist Liveliness

Length of yarn = L

Number of turns = T

**Twist Liveliness = T / L**

10g

## Twist Liveliness of Raw Yarns

Combed ring yarns Ne 16 to 40

Twist Liveliness (y-axis): 22, 26, 30, 34, 38, 42
Yarn Twist T/m (x-axis): 540, 620, 700, 780, 860

## Effect of Yarn Twist on Spirality

Grey Fabrics from 16 to 40 Ne yarns

Spirality, degrees (y-axis): 5, 10, 15, 20, 25, 30
Yarn Twist turns/inch (x-axis): 14, 16, 18, 20, 22

16 Ne → 40 Ne

## Twist Liveliness & Yarn Type
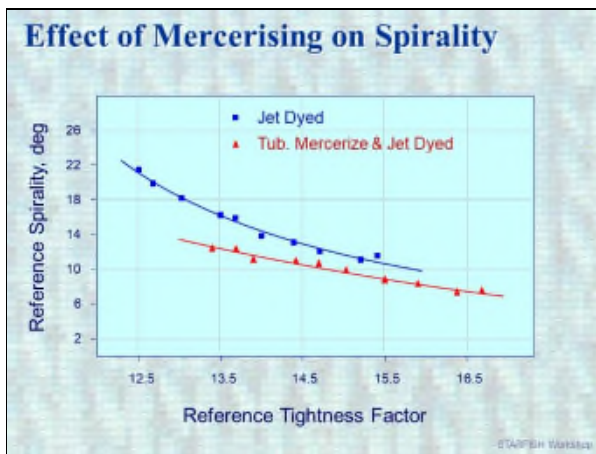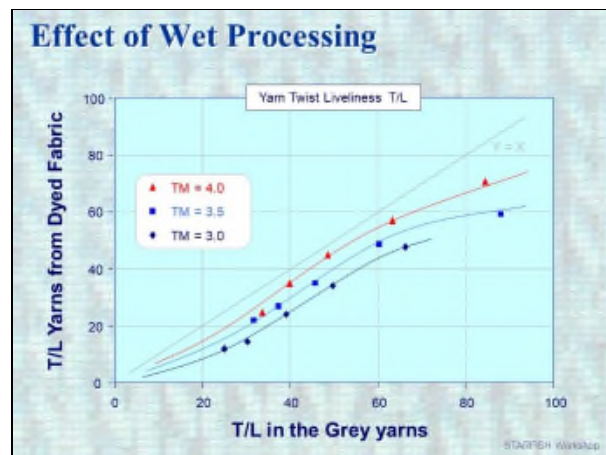
Rotor yarns are less lively than ring yarns

Two-fold yarns have no twist liveliness

Fine fibres are less lively than coarse fibres
   but they are normally used in fine yarns
   which have a higher level of twist

Synthetic fibres can be heat set
   to eliminate twist liveliness

## Elimination of Spirality

❊ Use balanced twofold yarns

❊ Use alternate S & Z yarns

❊ Use combined S & Z yarns

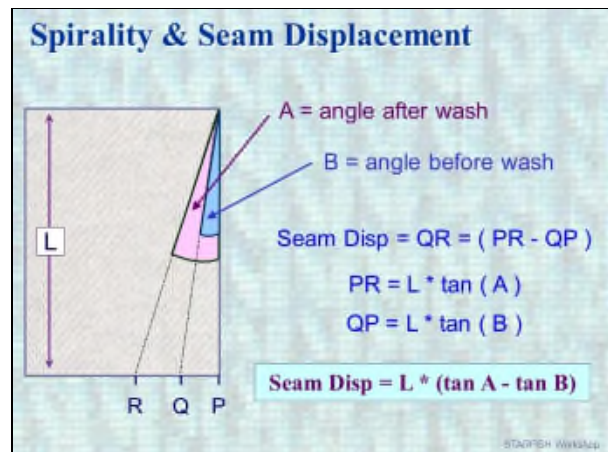Different fabric appearance and dimensions

Not usually a practical solution

## Effect of Wet Processing

Yarn Twist Liveliness T/L

T/L Yarns from Dyed Fabric (y-axis): 0, 20, 40, 60, 80, 100

▲ TM = 4.0
■ TM = 3.5
• TM = 3.0

T/L in the Grey yarns (x-axis): 0, 20, 40, 60, 80, 100

Y = X

## Effect of Mercerising on Spirality

■ Jet Dyed
▲ Tub. Mercerize & Jet Dyed

Reference Spirality, deg (y-axis): 2, 6, 10, 14, 18, 22, 26
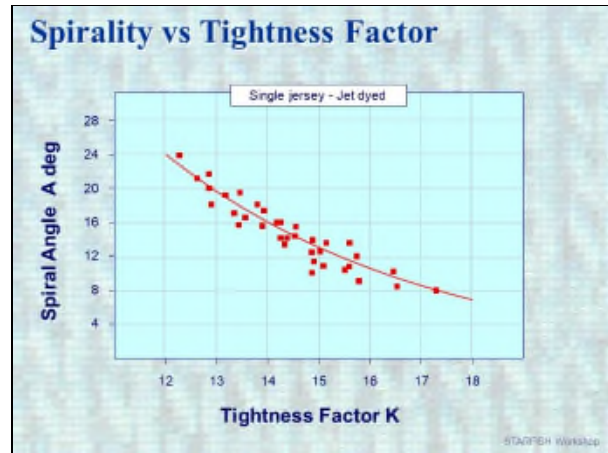Reference Tightness Factor (x-axis): 12.5, 13.5, 14.5, 15.5, 16.5

## Fabric Construction

Measured spiral angle depends on

➢ distortions during processing

➢ the relaxation procedure

For consistent results
measure in the Reference State

## Effect of Yarn Count & Stitch Length



Plain Jersey Jet dyed

Reference Spiral Angle deg vs Stitch Length cm

Ne 40, Ne 32, Ne 20

## Spirality vs Tightness Factor



Single jersey - Jet dyed

Spiral Angle A deg vs Tightness Factor K

## Garments: Seam Displacement



Wash

SD

## Spirality & Seam Displacement



A = angle after wash

B = angle before wash

Seam Disp = QR = ( PR - QP )

PR = L * tan ( A )

QP = L * tan ( B )

Seam Disp = L * ( tan A - tan B )

## Seam Displacement Calculation
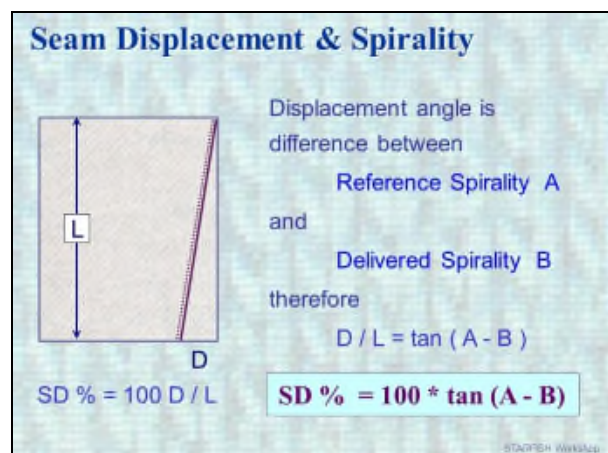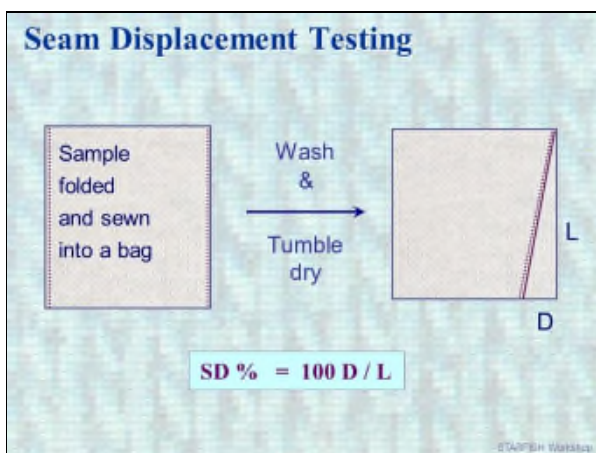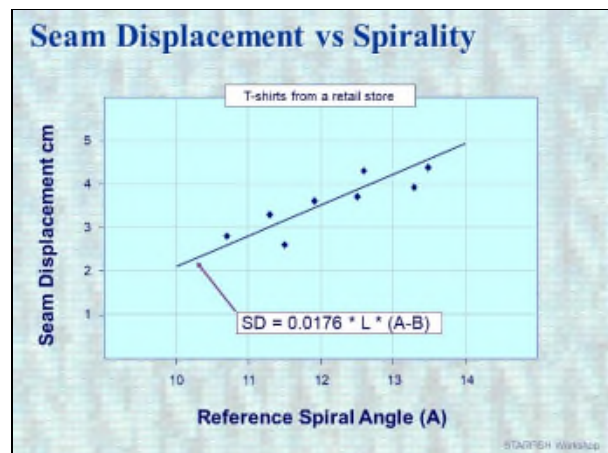
$$SD = L * ( \tan A - \tan B )$$

but for small angles

$$( \tan A - \tan B ) = \frac{\tan A ( A - B )}{A}$$

and

$$\frac{\tan A}{A} \sim= 0.0176$$

Therefore

$$SD = 0.0176 * L * ( A - B )$$

## Seam Displacement vs Spirality



T-shirts from a retail store

Seam Displacement cm vs Reference Spiral Angle (A)

$$SD = 0.0176 * L * (A-B)$$

## Seam Displacement Testing



Sample folded and sewn into a bag

Wash & Tumble dry

L

D

$$SD \% = 100 \, D / L$$

## Seam Displacement & Spirality



Displacement angle is difference between

Reference Spirality  A

and

Delivered Spirality  B

therefore

$$D / L = \tan ( A - B )$$

L

D

$$SD \% = 100 \, D / L$$

$$SD \% = 100 * \tan ( A - B )$$

## Seam Displacement: Prediction

If Reference Spirality is known
and Delivered Spirality is measured

Then garment seam displacement
can be calculated from

$$SD\ \% = 100 * \tan(A - B)$$

## Effect of Skew on Spirality



Pos. spirality

Positive skew

Wale line

Fabric axis

## Effect of Skew on Spirality



Wale line

Negative skew

Fabric axis

Neg. spirality

## Effect of Bow on Spirality



Spirality increased

Spirality reduced

Course line

Wale line

Wale line

## Good Sewings Are Important



## Spirality, Skew and Bow

Will cause drastic

Distortion in Garments

## Spirality and Shrinkage

Courses and length shrinkage
are measured along the wales

Wales and width shrinkage
are measured perpendicular to wales

These may not correspond exactly
with the length and width of a garment

Maximum error is about 3 percentage points



C T I