

Testing Methods

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Testing Procedures

Must be

- * Consistent
- * Reliable
- * Reproducible

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Conditioning

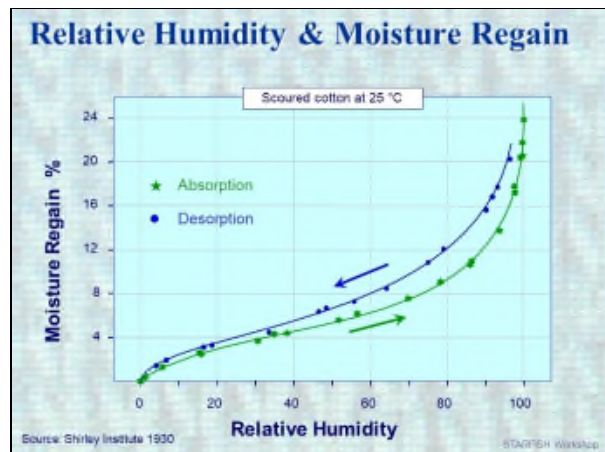
Standard conditions: 20 °C and 65% RH

Measurements affected by moisture content

- * Fabric weight
- * Courses & Wales
- * Yarn count
- * Stitch Length
- * Strength
- * Shrinkage

STARFISH assumes standard conditions

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Yarn Testing

Yarn quality is a key control factor

Spinners do extensive testing

- > Develop relationship with spinner
- > Ask for his test data
- > Learn what they mean

Knitter should at least monitor yarn count

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Test Methods for Yarns

Count : ISO 2060 ASTM D 1907

Twist : ASTM D 1422

Friction : ASTM D 3108

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Yarn Count

20 skeins per sample

- > 1 skein per package
- > 1 package per box

Number of samples

- > established supplier : 1
- > new supplier : 5

CV% within and between samples

Use Quality Control Charts

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Yarn Twist

Difficult test - should be automated

Spinner's data may be more reliable
... especially for OE rotor yarns

Use the same samples as for count

$\alpha_e = \text{turns per inch} / \sqrt{Ne}$

$\alpha_{tex} = \text{turns per cm} \cdot \sqrt{tex}$

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Yarn Friction

- Should not be a problem
 - ... with a good supplier
- New suppliers
 - ... should be checked
- Friction coefficient
 - ... between 0.10 and 0.15

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Other Yarn Testing

- Regularity, Evenness, Hairiness
 - visual assessment
 - blackboard wrappings
 - ASTM Grade standards
 - knitting test

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Knitting Test

- Small diameter single-feeder machine
- Include standard yarn
 - fabric appearance
 - dyeing behaviour
 - neps / specks
 - spirality / barré




Lowen-Haupt® FAX Lab Knitting Machine

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Knitting Test

- Small diameter single-feeder machine
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Source: Uster® Technologies AG

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Fabric Testing

- Routine Quality Control
 - check process control systems are working correctly
 - tests required by customer

Minimum testing because product performance is guaranteed by correct design and precise process control

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Fabric Testing

- Quality Assurance
 - check new yarn batches OK
 - check instrumentation OK
 - check testing procedures OK
 - calibrate process machinery

More detailed testing because this is how we ensure that control systems are working properly

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Fabric Testing

STARFISH test methods

- * Stitch Length
- * Yarn Count
- * Course & Wale densities
- * Weight per unit area
- * Shrinkage

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Stitch Length Technique

Usually measure consecutive courses


- * Identify different tape drives
- * Identify different courses in pattern
- * Identify different yarns

All technicians using the same technique

NB. Accurate marking, Visible wales

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Measuring Stitch Length



Cut inside marks for exactly 100 wales

- at least 2 specimens
- at least 10 courses
- at least 5 repeats

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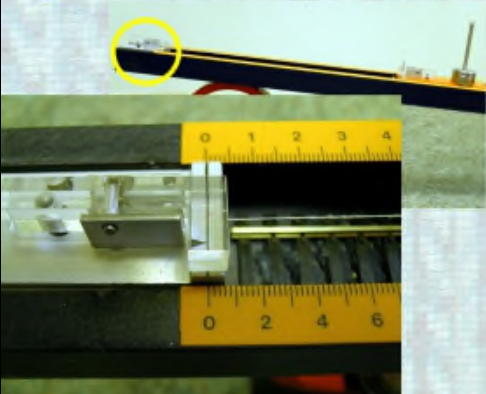
Measuring Stitch Length



Solenar Malleometer 3 LFA

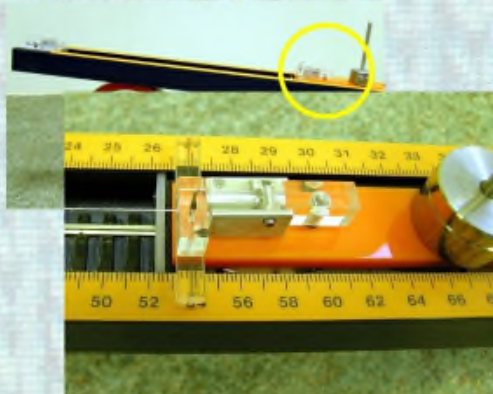
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Measuring Stitch Length



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Measuring Stitch Length



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Yarn Count

In conjunction with Stitch Length

- cut inside the marks
- remove 100 threads
- repeat at least twice
- calculate total length in metres
- determine weight in grams

$$\text{tex} = 1000 \cdot \text{Weight} / \text{Length}$$

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Course & Wale Density

are Key Process Control Parameters

- Courses are counted along a wale
- Wales are counted along a line perpendicular to the wales

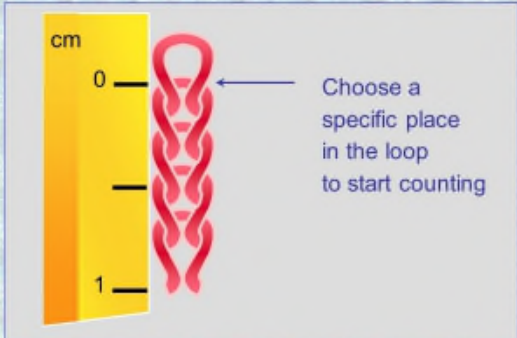
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Courses & Wales Technique

- Identify a specific point in the loop
- Establish a technique for estimating part - loops
- Estimate the last stitch to at least one quarter of a loop
- Make use of the structural cell
- All technicians - identical technique

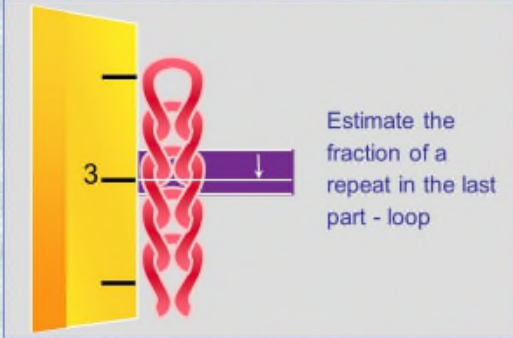
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Counting Loops



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Counting Loops



Estimate the fraction of a repeat in the last part - loop


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Structural Knitted Cell

Use with complicated constructions when some courses are not visible

e.g. Double Crosstuck

One cell equals four courses



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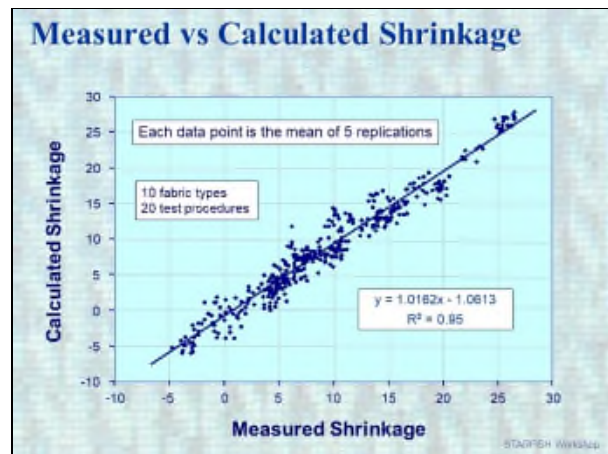
Course and Wale Density

Accurate determination of courses and wales


Can reduce the need for routine shrinkage testing




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Area Weight



BL 100

230/100

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Area Weight

NOT a Key Process Control Parameter

Important to customer and producer

- fabric yield and cost
- loss of weight in preparation

Accurate determination needs technique

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Weight Measurement Problems

Weight is affected by moisture content
... errors of up to ~ 4 %

Circular cutters not always accurate
... if in doubt check area of specimen

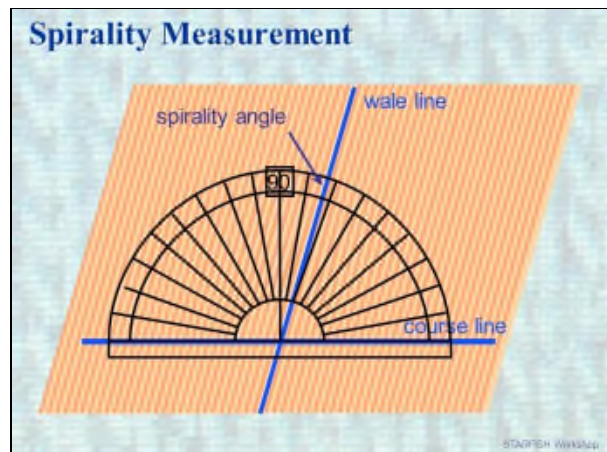
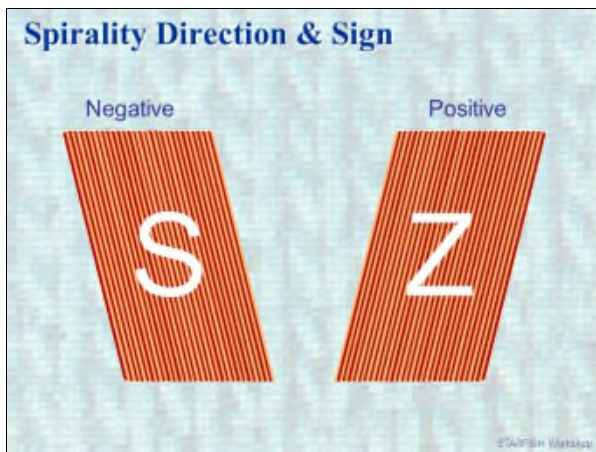
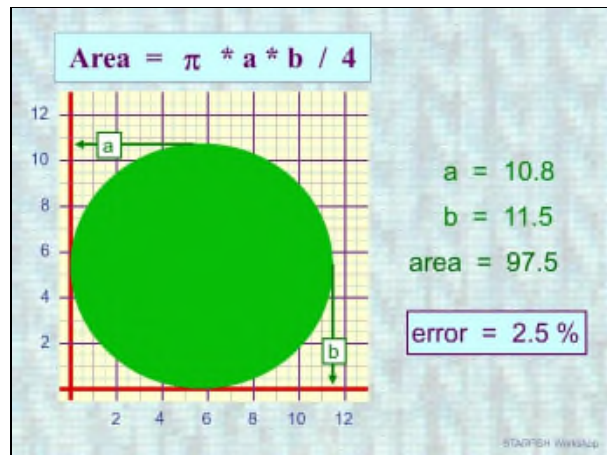
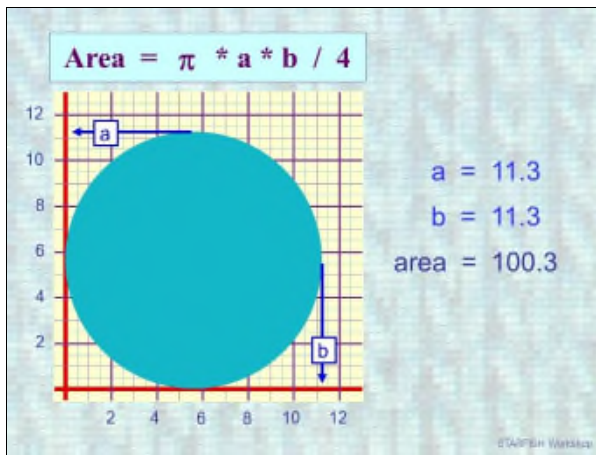
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Area Weight Technique

Avoid distortion errors

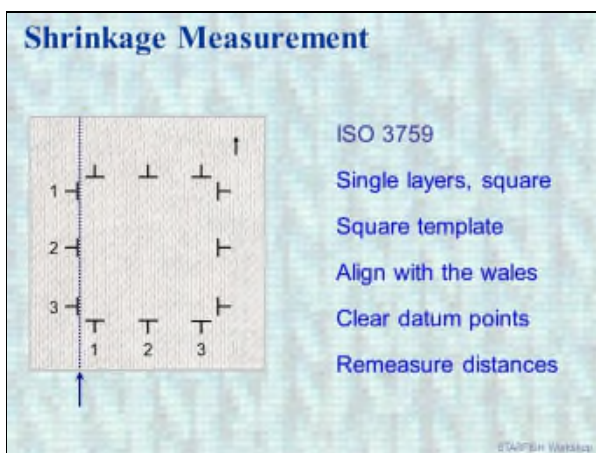
- Change blades & boards regularly
- Cut one specimen at a time
- Cut at least three specimens
- Allow specimens to relax

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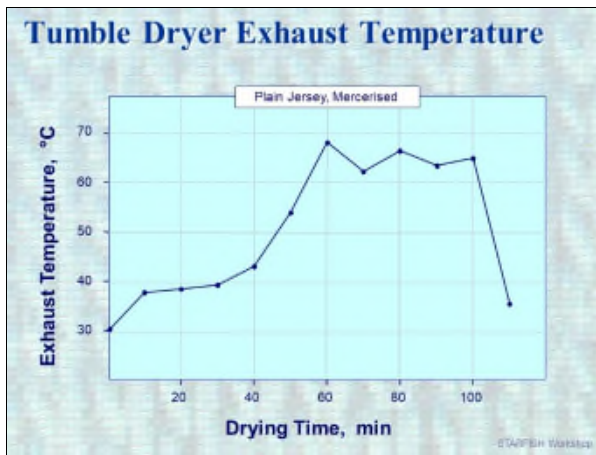


- ### Spirality Technique
- Mark a wale line
 - Mark a course line
 - Place protractor at intersection
 - Measure the angle between the wale and the perpendicular
 - Repeat at least four more times
 - Use an eyeglass when marking lines
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- ### Shrinkage Testing
- NOT a Key Production Control Parameter
- Not a very reliable parameter
- Try to eliminate from routine testing
- May be needed for calibration purposes
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- ### STARFISH Reference Relaxation
1. Full wash programme at 60 °C
 2. Tumble dry (completely dry)
 3. Rewet on rinse cycle
 4. Tumble dry (completely dry)
 5. Repeat 3 and 4 three more times
 6. Condition
- Fabric is now in the "Reference State"
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STARFISH Shrinkage Method

Each Sample

- five specimens 70 x 70 cm
- measuring area 50 x 50 cm

Each Specimen

- three marks for length
- three marks for width

Average all 15 measurements

Routine Shrinkage Measurement

Reference method too expensive

Use the 2 : 2 : 2 Method

- Two specimens
- Two pairs of marks
- Two cycles

Other conditions the same

Establish relationship to Reference Method

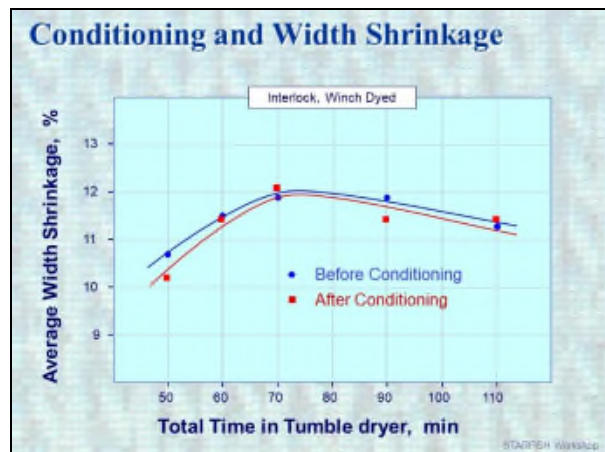
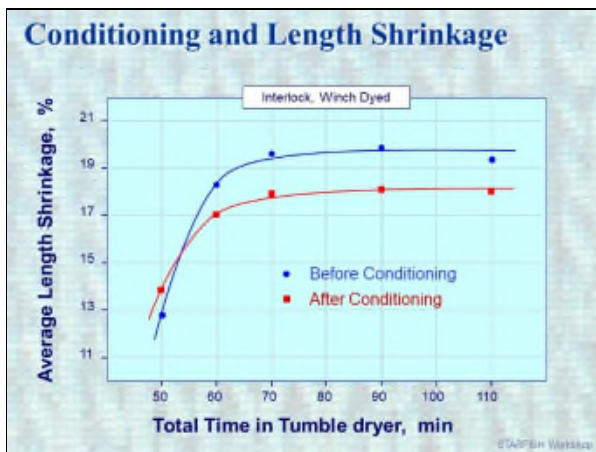


- ### Factors Affecting Shrinkage
- * Specimen size
 - * Number of specimens
 - * Conditioning
 - * Number of cycles
 - * Drying conditions
 - * Previous laundering history

Specimen Size

Measuring Area	Standard Deviation
50 x 50 cm	0.6 to 1.1
25 x 25 cm	0.8 to 1.5

Use 5 specimens for 50 x 50
Use 6 specimens for 25 x 25



Effect of Test Conditions

- Line drying
 - ... generates less shrinkage
- Tumble drying
 - ... is more reproducible
- Length shrinkage
 - ... increases with number of cycles
- Width shrinkage
 - ... may reduce with number of cycles

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Reproducibility

Typical STARFISH laboratory results

	CV%	Accuracy Target %	Minimum Specimens
Courses & Wales	1.6 - 2.0	2.0	6
Stitch Length	0.5	0.5	6
Weight	2.0	3.0	4

$$\text{Accuracy} = t * CV / \text{sqrt}(N)$$

t is the Student's t statistic

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Quality Control of Testing

- Testing is expensive
- It must be dependable
- Systematic, random sampling
- Monitor reproducibility
- Internal consistency checks

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Internal Consistency Checks

- Standard statistics
- Control Charts for CV%
- Calculation checks
 - > Weight
 - > Courses & Wales
- Blind check-tests

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Calculation Checks

When full tests have been carried out
e.g. calibration, product development

- > Fabric Weight is calculated from courses, wales, tex, stitch length
- > Reference courses & wales from shrinkages and as del. courses & wales

Measured and calculated values should agree

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