

Testing Methods

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Testing Procedures

Must be

- * Consistent
- * Reliable
- * Reproducible

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Conditioning

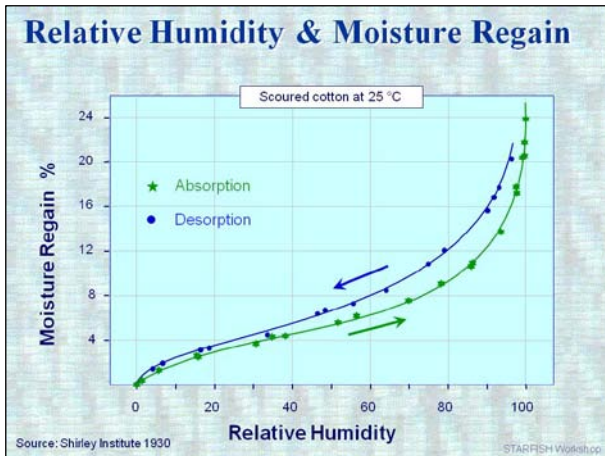
Standard conditions: 20 °C and 65% RH

Measurements affected by moisture content

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

Test Methods for Yarns

Count : ISO 2060 ASTM D 1907

Twist : ASTM D 1422

Friction : ASTM D 3108

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



Lawson-Hemphill FAK Lab Knitting Machine

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Knitting Test

Small diameter single-feeder machine

Include standard yarn

- fabric appearance
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- spirality / barré



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

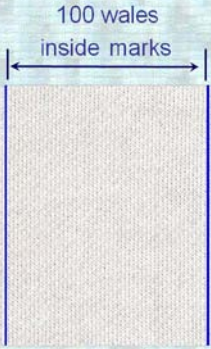
- * Identify different tape drives
- * Identify different courses in pattern
- * Identify different yarns

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

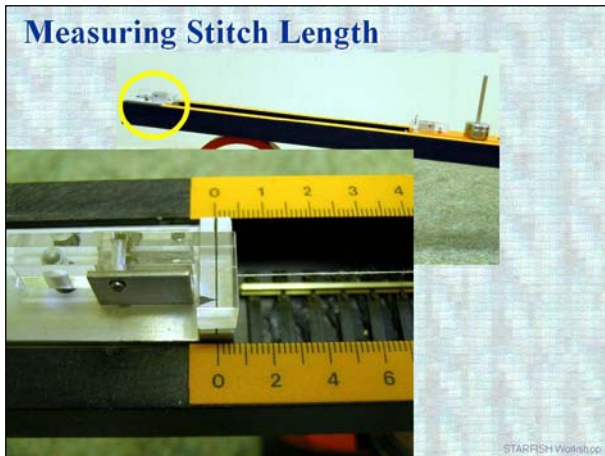
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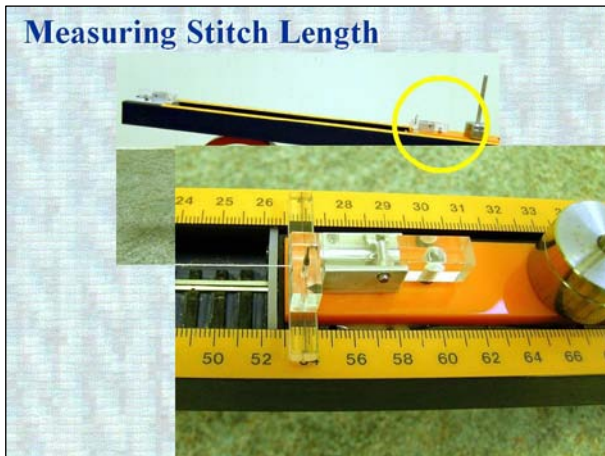
Measuring Stitch Length



Sodenst: Maillaufeser 3 LFA

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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

tex = 1000 . Weight / 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

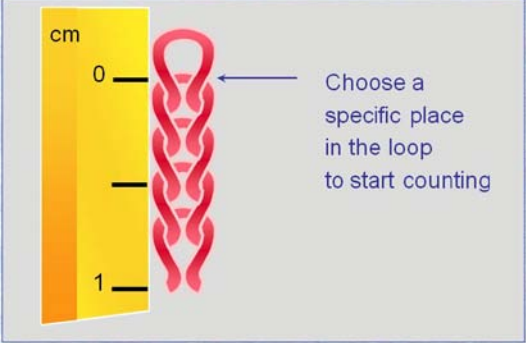
Estimate the last stitch to at least one quarter of a loop

Make use of the structural cell

All technicians - identical technique

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Counting Loops



cm

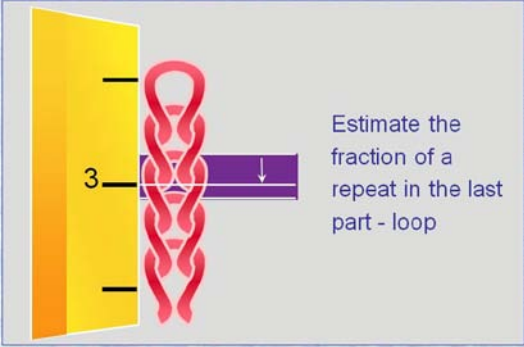
0

1

Choose a specific place in the loop to start counting

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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

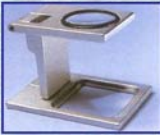



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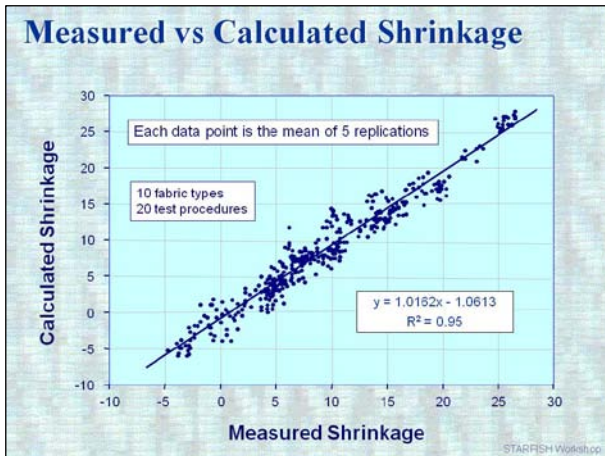
Course and Wale Density

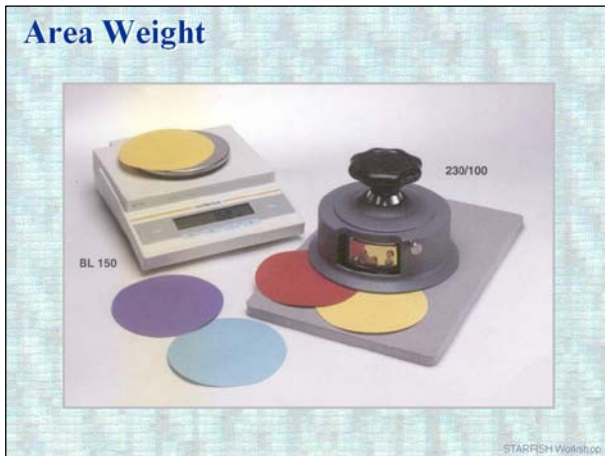
Accurate determination of courses and wales

Can reduce the need for routine shrinkage testing



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Area Weight

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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The text is presented in a clean, sans-serif font. The title 'Area Weight' is in a larger, bold font. The bullet points are preceded by blue arrowheads. A small logo 'STARFISH Workshop.co' is in the bottom right corner.

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

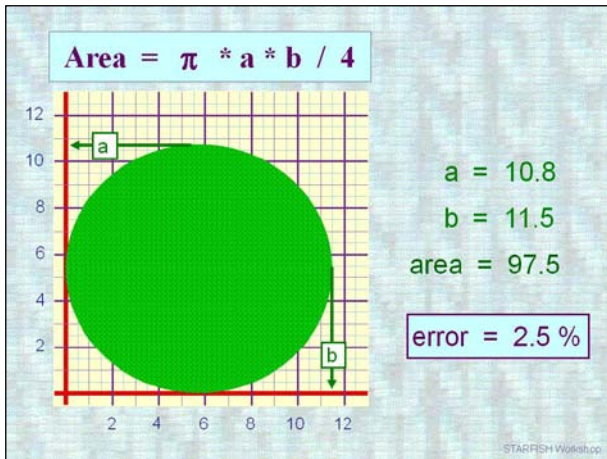
- Change blades & boards regularly
- Cut one specimen at a time
- Cut at least three specimens
- Allow specimens to relax

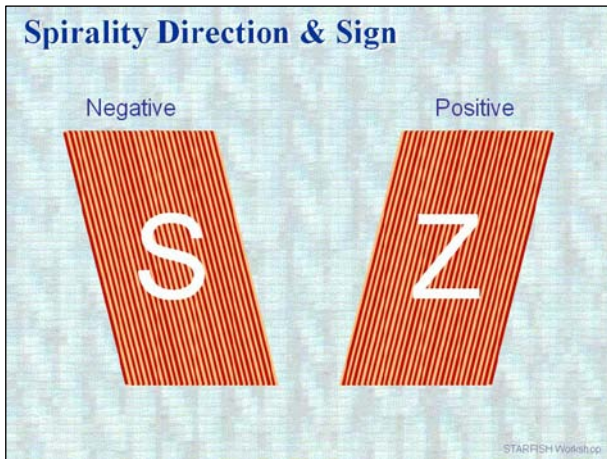
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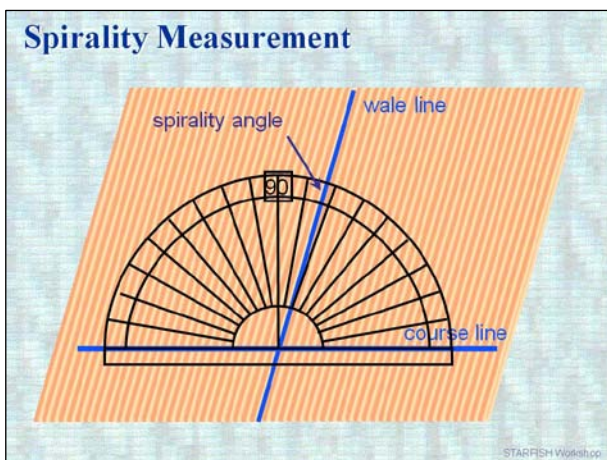
Area = $\pi * a * b / 4$

a = 11.3
b = 11.3
area = 100.3

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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

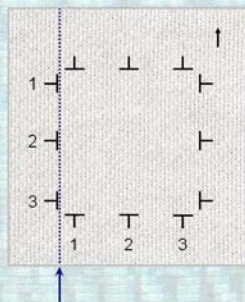
Not a very reliable parameter

Try to eliminate from routine testing

May be needed for calibration purposes

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Shrinkage Measurement



ISO 3759

Single layers, square

Square template

Align with the wales

Clear datum points

Remeasure distances

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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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Tumble Dryer Exhaust Temperature



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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

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Routine Shrinkage Measurement

Reference method too expensive

Use the 2 : 2 : 2 Method

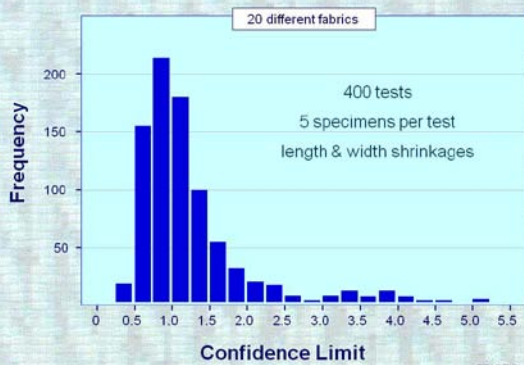
- Two specimens
- Two pairs of marks
- Two cycles

Other conditions the same

Establish relationship to Reference Method

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Confidence Limits in Shrinkage Testing



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Factors Affecting Shrinkage

- * Specimen size
- * Number of specimens
- * Conditioning
- * Number of cycles
- * Drying conditions
- * Previous laundering history

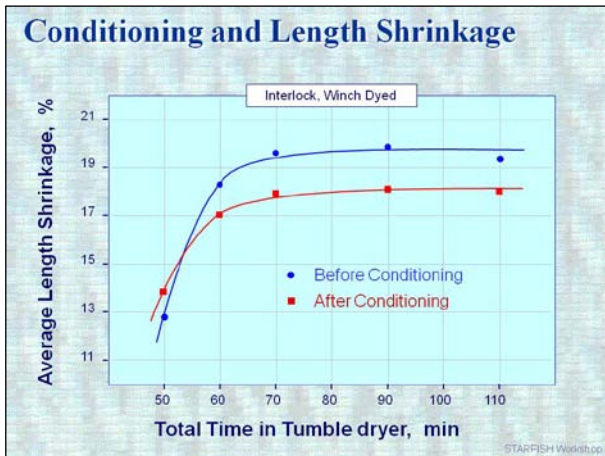
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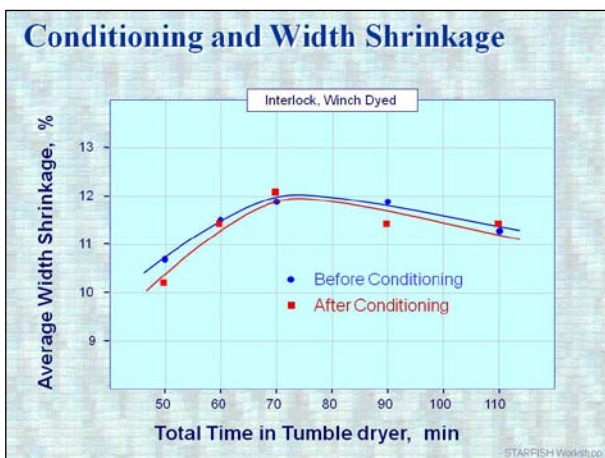
Specimen Size

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

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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

Accuracy = t * CV / 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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