Optimising fabric quality, finishing processes and machinery through the use of fabric objective measurement

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What is this talk all about?

- Fabric quality.
- The role of finishing in optimising fabric quality.
- Optimisation of finishing techniques:
  - most evaluation of fabrics and process optimisation is done by subjective evaluation of the finished or partially finished fabric.
- This talk will outline the use of simple techniques of fabric objective measurement to supply quantitative data on which decisions affecting finishing and fabric quality can be based.

Lecture in two parts

- Part 1
  - Fabric quality – Can it be measured?
  - Fabric Objective Measurement.
  - Prediction of faults – examples of faults.
- Part 2
  - Optimisation of finishing operations using FOM.
  - Correction of faults.

What determines fabric quality

- Optimised handle.
- Evenly and reproducibly coloured.
- Gives good appearance in garment.
- Good appearance in wear:
  - does not shrink in laundering
  - does not distort in wear.
- Appropriate functional properties:
  - good abrasion resistance, tear strength etc.
  - FIT FOR PURPOSE.
- Can quality be measured?
  - No, but you can measure many of the properties that affect quality.

Processes in wool finishing

WET

- Pre-setting
- Scouring
- Milling
- Drying

DRY

- Conditioning
- Pressing
- Cropping
- Raising
- Decatising

Effects of finishing processes

- Wanted effects:
  - cleaning
  - flat finish
  - drying
  - control of fabric dimensions
  - optimised dimensional stability
  - optimised handle
  - properties consistent with good garment appearance
  - required functional properties.

Effects of finishing processes

- Side effects:
  - stretching
  - distortion
    - running marks
    - skew
    - cockling
  - stiffness, wrong handle
  - impaired dimensional stability.

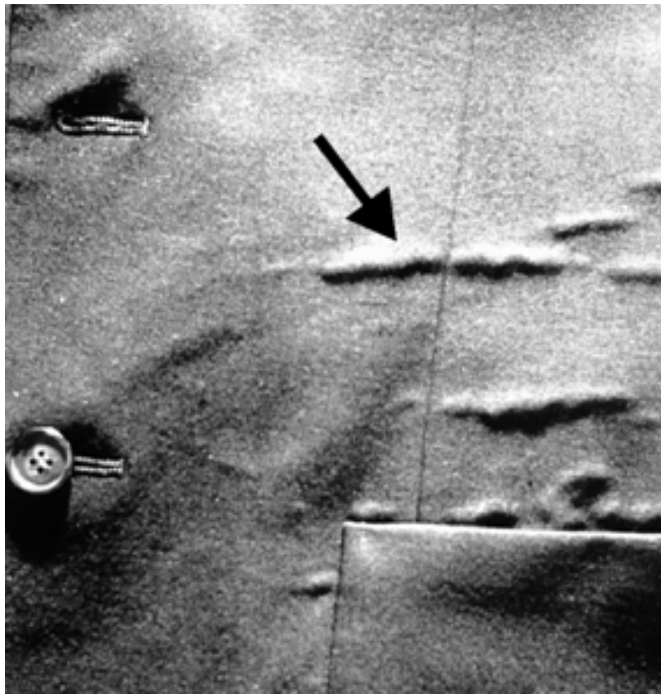
What is fabric objective measurement?

- The term given to the measurement of those low-stress properties of wool fabrics related to its aesthetic characteristics:
  - handle
  - appearance after garment manufacture
  - appearance in wear.
- Usually involves a number of instruments and measurements.

Why do we need fabric objective measurement?

- We need to predict:
  - performance
  - Appearance.
- Cost of fabric ~150.
- Cost of refinishing ~15.
- Cost of suit ~1000.

- The picture on the right illustrates that *it is often too late when the fabric has been cut.*

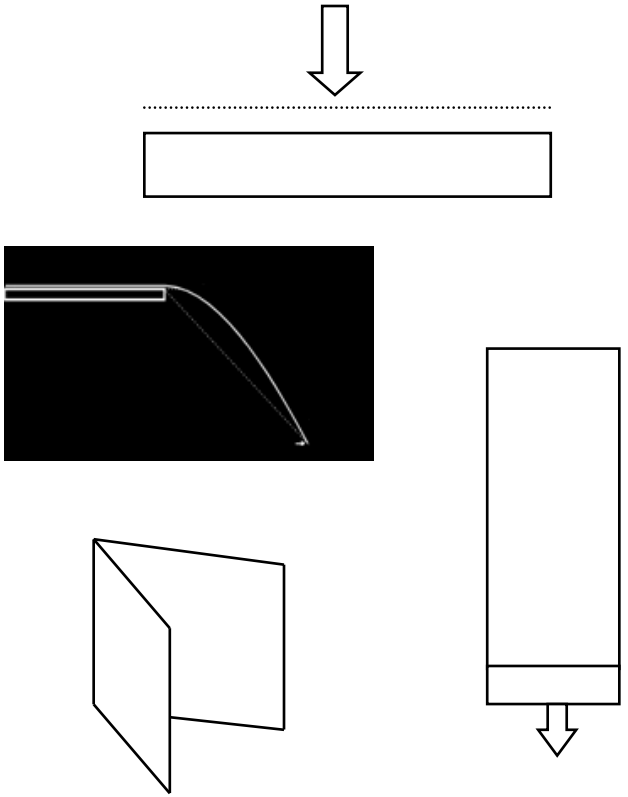


Fabric objective measurement is a great tool for finishers

- Ensure that a fabric is ‘on track’.
- Ensure that machinery is operating optimally.
- Assist in choice of finishing routes:
  - Which route gives optimum balance of handle and cost?
  - Which route is most appropriate for that ‘special’ customer?

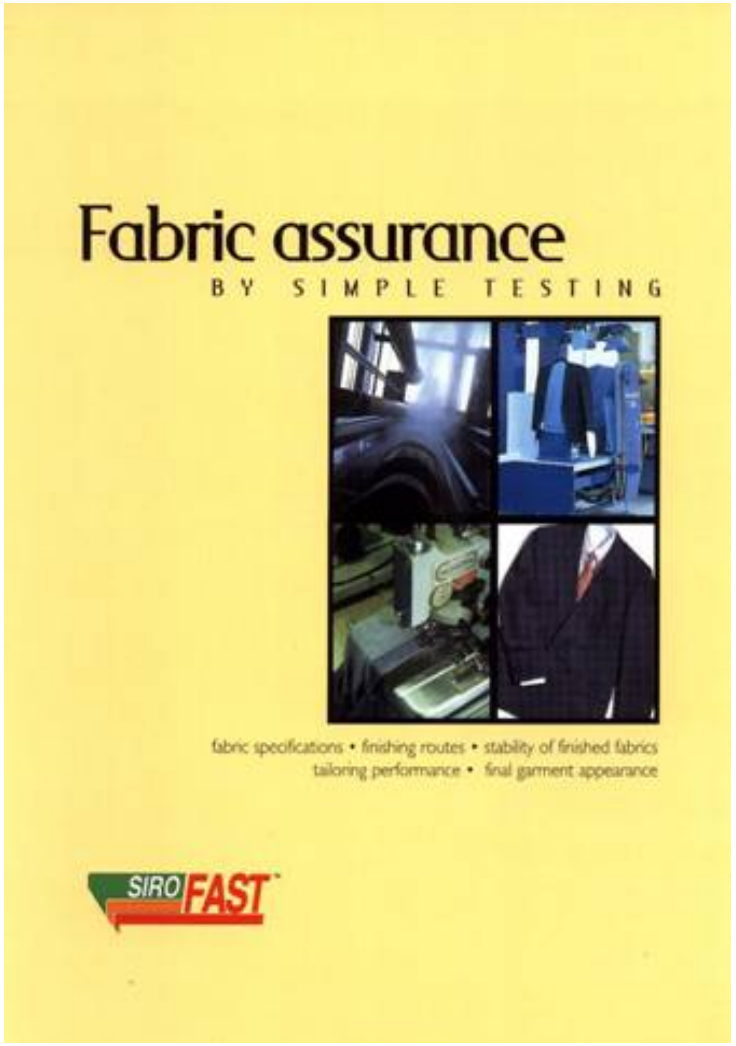
What fabric properties are associated with fabrics aesthetics?

- Thickness, compressibility.
- Bending properties.
- Extensibility.
- Dimensional stability.
- Pressing performance.
- Surface properties.



SiroFAST

- A set of instruments developed by CSIRO Textile and Fibre Technology in Australia.
- Uses simple instruments to measure important fabric properties.
- Simple to use.
- Suited to a mill environment.
- Gives detailed information for interpretation of data and correction of fabrics.



SiroFAST-1 Thickness Meter

- Measures the thickness of the fabric under two separate loads.
- Measurements made before and after fabric relaxation (in water or steam).
- Predicts:
  - fabric softness
  - fabric 'fullness'
  - stability of the finish.

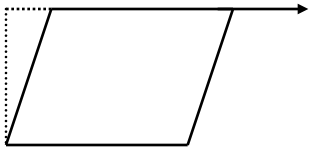
SiroFAST-2 Bending Meter

- Measures the bending length of fabric.
- The bending length is used to calculate the bending rigidity of the fabric – a measure of STIFFNESS.

SiroFAST-3 Extensibility Meter

- Measures fabric extensibility in warp, weft and bias direction.
- From the bias extensibility the shear rigidity of the fabric can be calculated – a measure of STIFFNESS.
- Predicts 'stretchiness' and 'stiffness'.

Shear deformation.

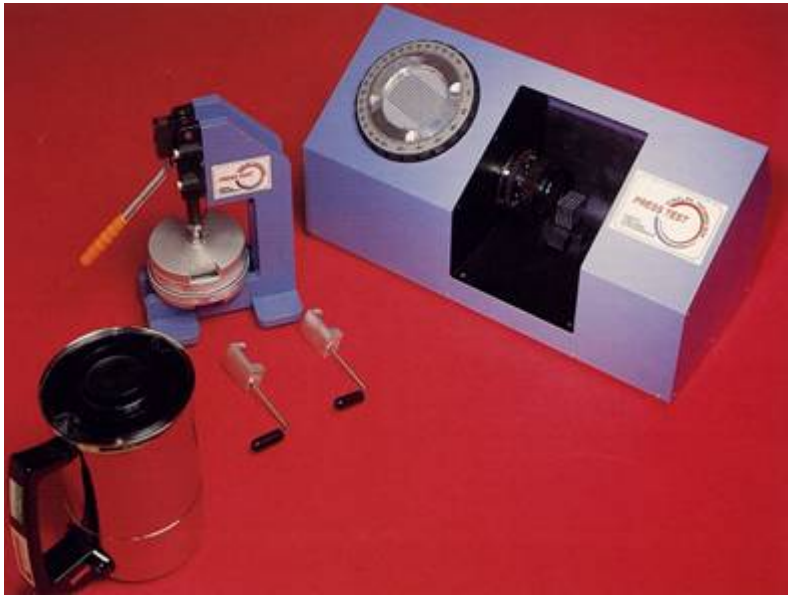


SiroFAST-4 Dimensional Stability Test

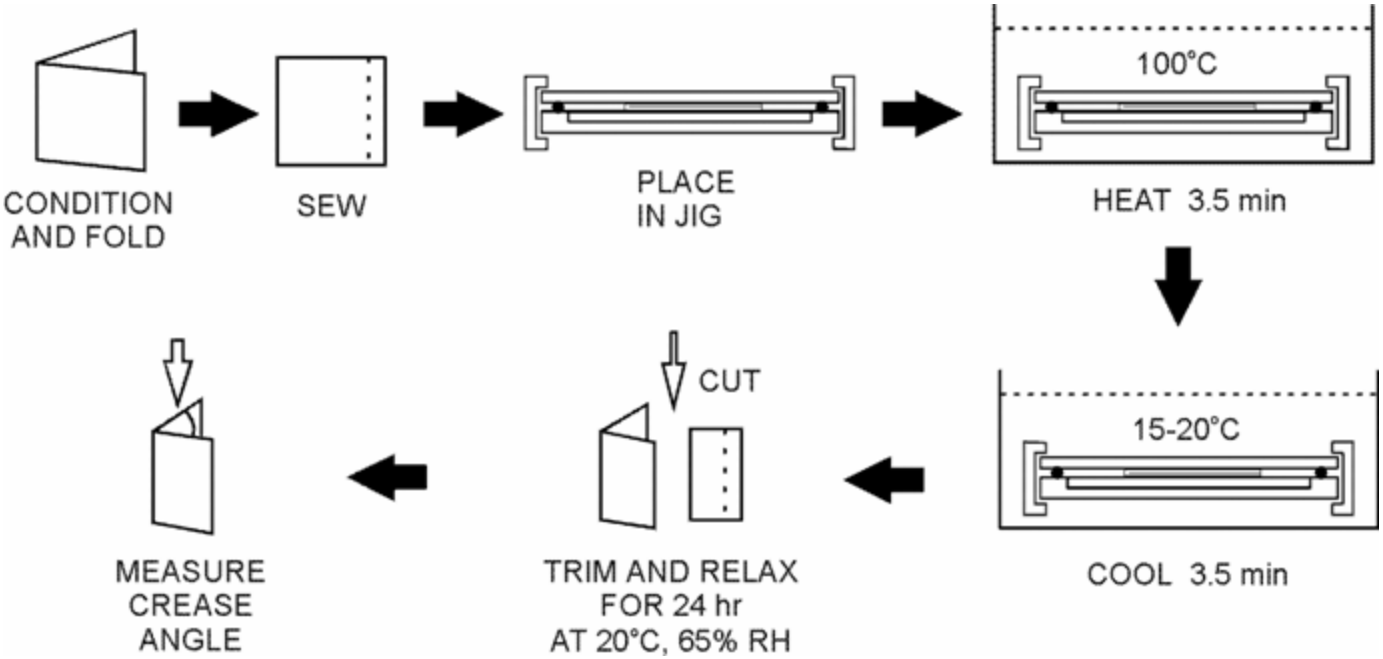
- Measures both components of the dimensional stability of wool:
  - relaxation shrinkage
  - hygral expansion.
- A simple test method - does not require an 'instrument'.
- Predicts:
  - shrinkage in garment making
  - panel distortion in humid atmospheres.

Sirolan PressTest

- Determines the ease in which fabric can be pressed to form a good crease, flat seam or sharp pleat.
- Measures the angle adopted by a 180-degree fold that is pressed under standardised conditions and allowed to relax.

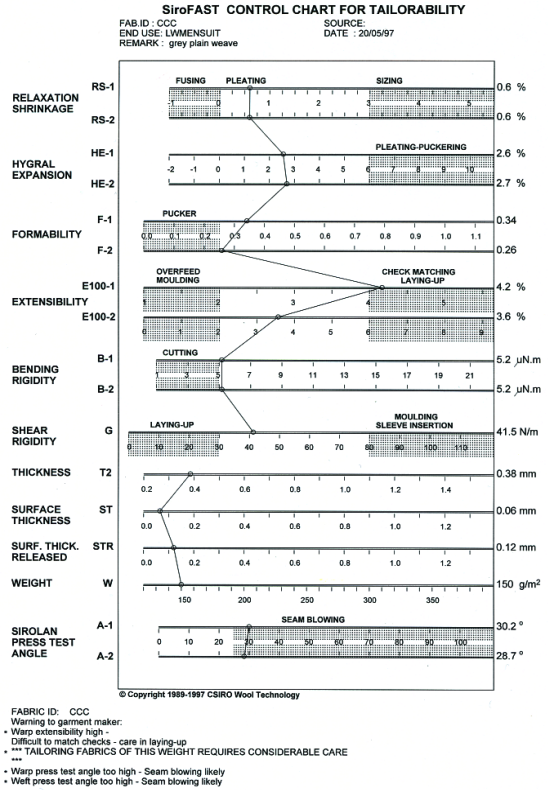


Technique used in Sirolan PressTest

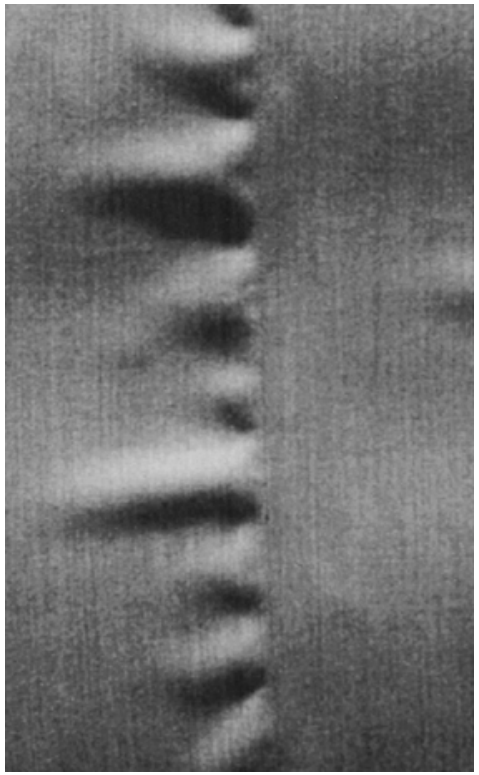


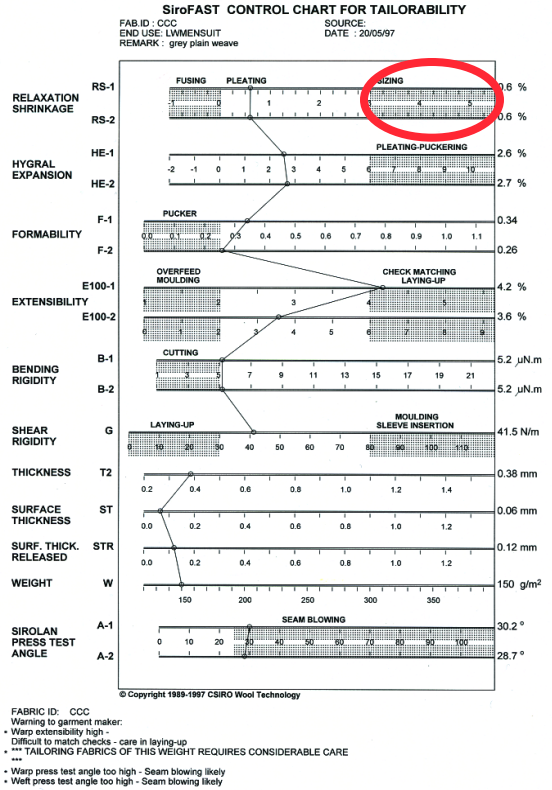
Interpreting SiroFAST data

- The key to the use of fabric objective measurement is not in doing the tests but *interpreting the data.*
- SiroFAST data is interpreted through the use of a chart or 'fingerprint'.
- This chart can be used to:
  - identify fabric faults
  - predict the consequences of that fault
  - identify re-finishing routes.

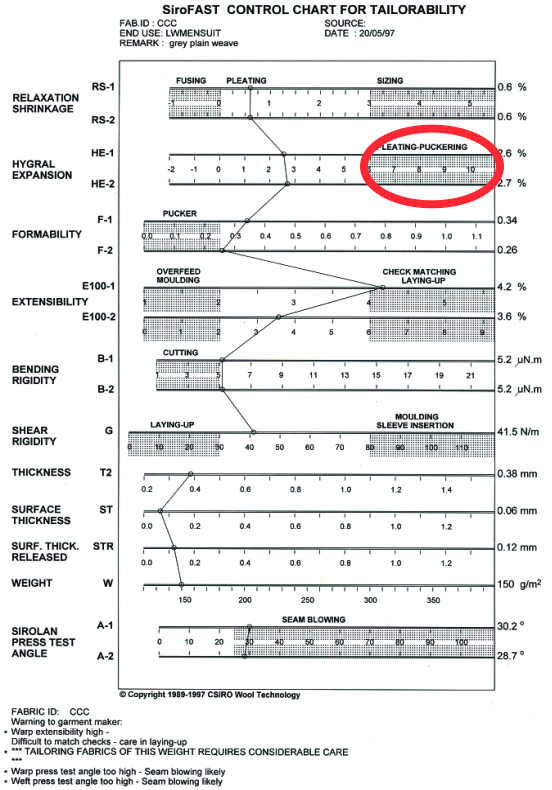


Effect of excessive relaxation shrinkage

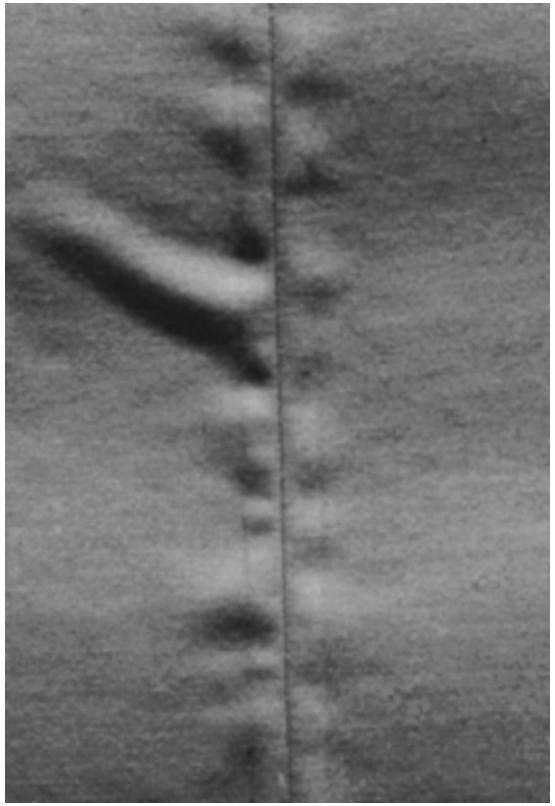


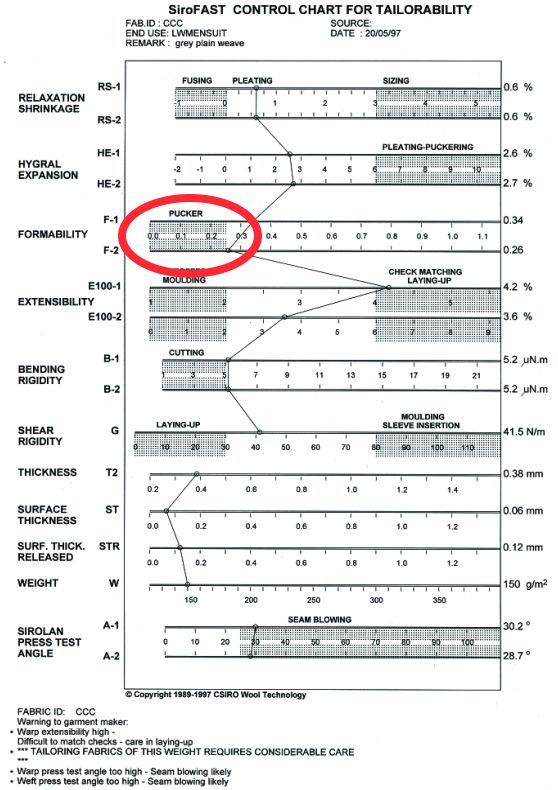


Effect of excessive hygral expansion

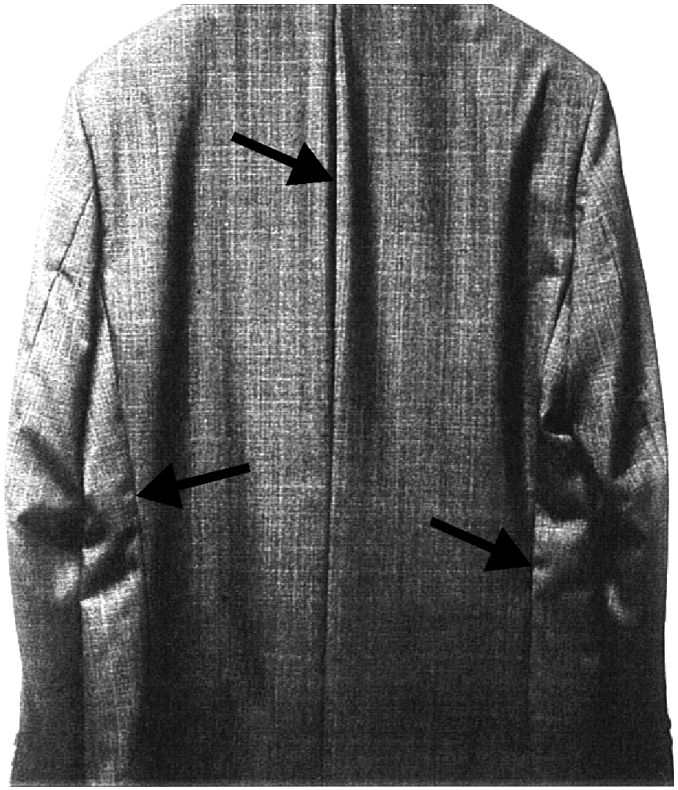


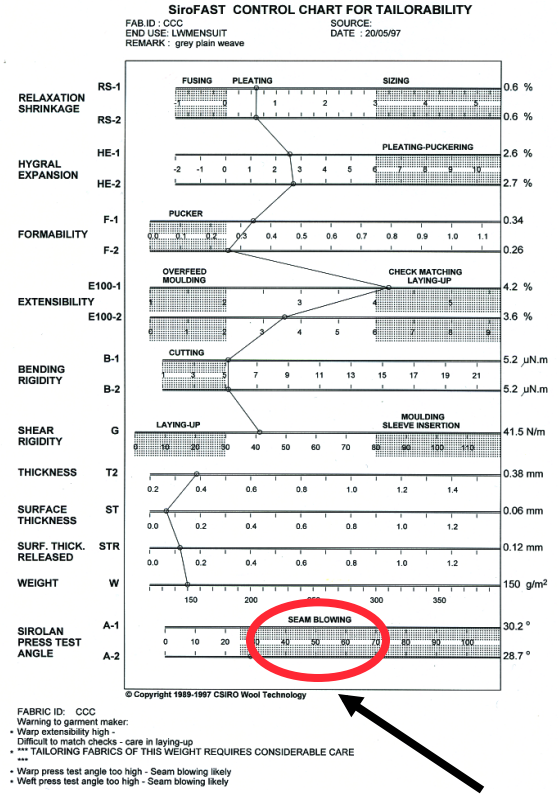
Effect of inadequate warp formability





Effect of poor pressing performance





Kawabata evaluation system - fabrics

- SiroFAST is not the only set of instruments for Fabric Objective Measurement.
- KES-F developed in Japan in 1960s.
- Four instruments:
  - tensile shear
  - bending
  - compression
  - surface properties (e.g. friction).

Simple instruments

Thickness Meter.

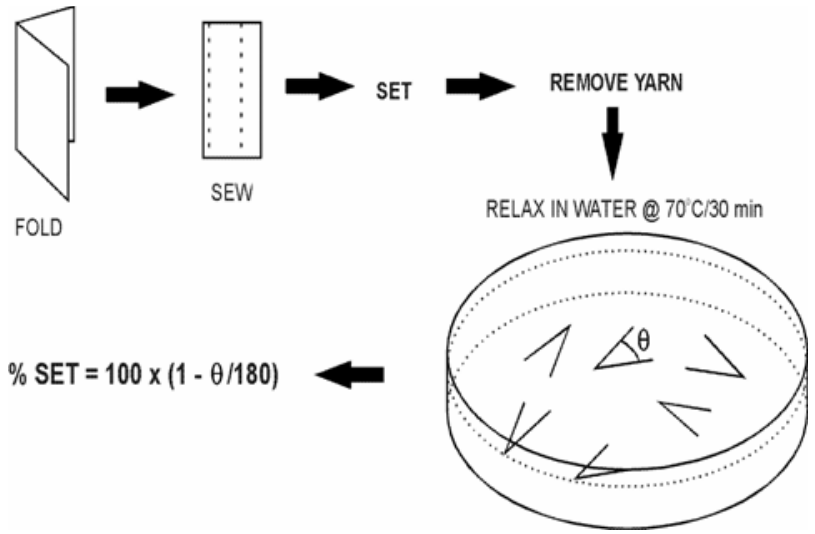
Shirley bending meter.

Tensile tester.

Other important test methods

- Crease angle test.
- For measuring PERMANENT set imparted in finishing operations, including piece dyeing.

Not to be Confused with Sirolan PressTest.



Other important test methods

- Moisture content:
  - moisture meter
  - oven dry weight.
- Air permeability:
  - used to assess fabric flatness.
- Colour/yellowness:
  - measured using a spectrophotometer.

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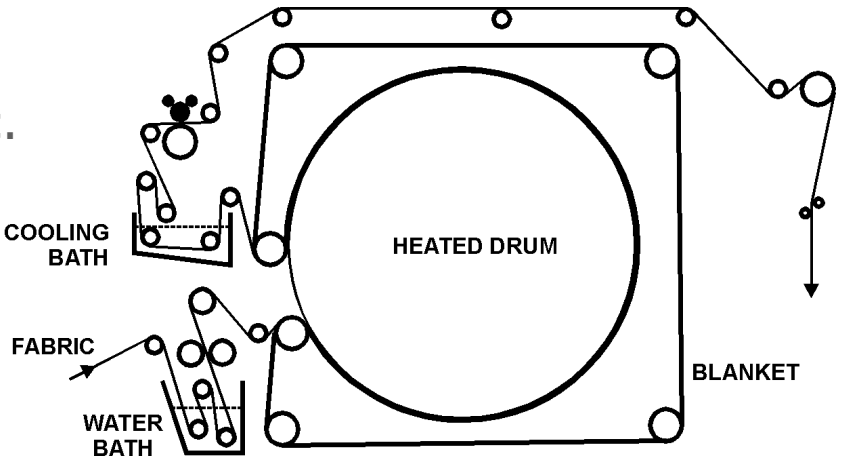
Steps in objective evaluation of finishing processes and machines

- Determine the primary effect required.
- Use objective test that measures that effect.
- Determine unwanted effects.
- Use objective test that measures unwanted effects.
- Optimise process to MAXIMISE required effect and MINIMISE unwanted effect.

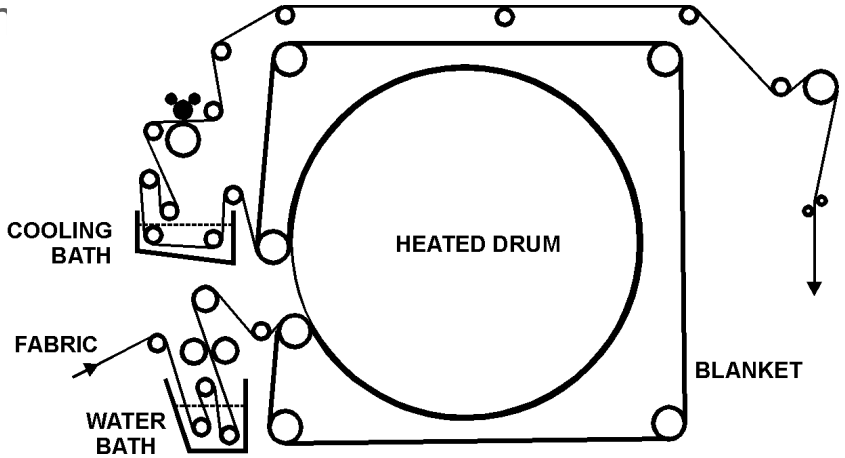
Presetting

- Required effects:
  - remove residual strains in fabric
  - permanently flat set the fabric.
- Appropriate tests:
  - permanent set using crease angle test (crease sewn into fabric prior to process)
  - shear properties (bias extensibility using SiroFAST-3).



Presetting

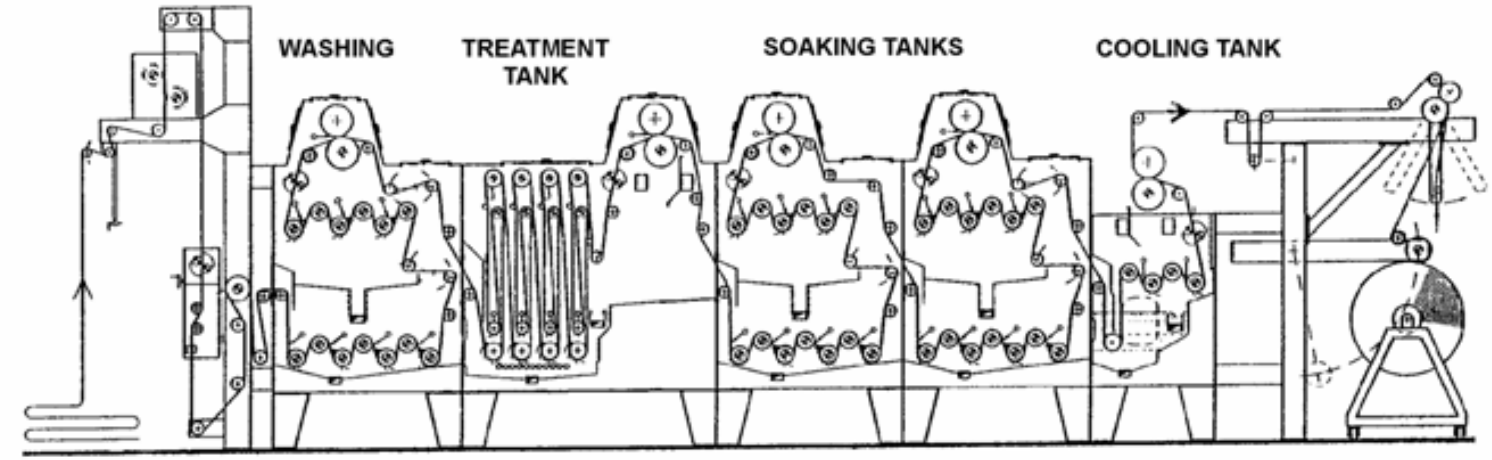
- Side effects:
  - stretch the fabric (especially ir the warp direction)
  - compact the fabric in the weft – loss of width.



- Appropriate tests:
  - warp and weft dimensions
  - warp and weft extensibility
    - **SiroFAST-3.**

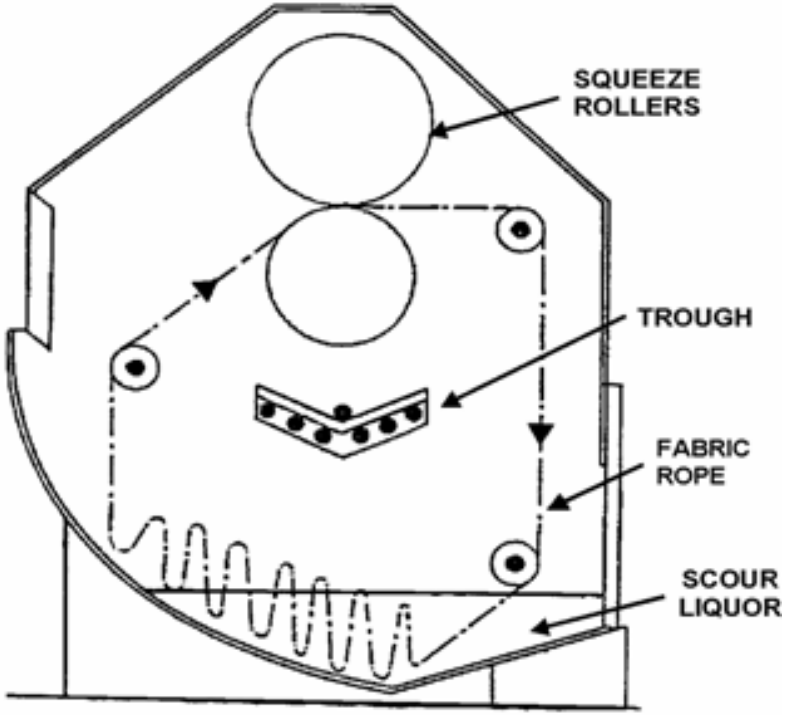
Scouring

- Required effect:
  - clean the fabric.
- Appropriate test:
  - residual oil/grease.



Scouring

- Side effects:
  - uncontrolled relaxation leading to puckering
  - stretching in warp direction
  - Felting.
- Appropriate tests:
  - visual assessment
  - fabric dimensions
  - fabric extensibility
    - SiroFAST-3
  - fabric thickness
    - SiroFAST-1.

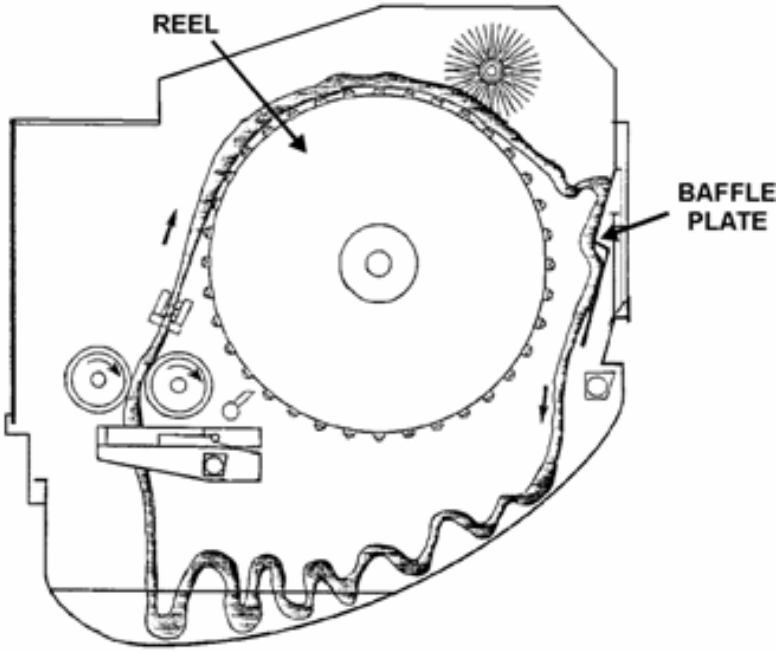


Will this rope scour stretch the fabric less than the continuous scour? Why?

Fabric development

- Required effects:
  - softer handle
  - reduction in hygral expansion.

- Appropriate tests:
  - fabric thickness (SiroFAST-1)
  - bias extensibility (SiroFAST-3)
  - hygral expansion (SiroFAST-4).



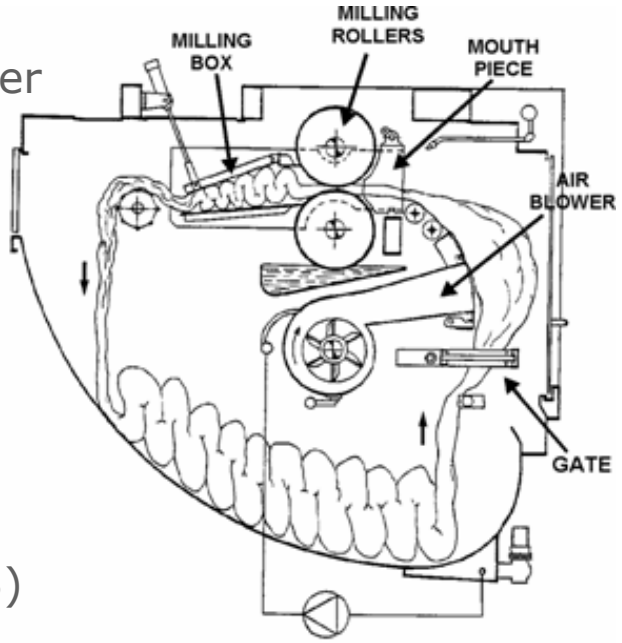
Fabric development

- Side effects:
  - stiffening
  - surface modification
  - formation of running marks.
- Appropriate tests:
  - shear rigidity/bias extensibility
  - surface thickness
  - visual observation.

Milling

- Required effects:
  - surface modification, especially surface cover
  - increased strength
  - stiffening
  - reduction in hygral expansion.

- Appropriate tests:
  - fabric thickness (SiroFAST-1)
  - tensile test
  - shear rigidity-bias extensibility (SiroFAST-3)
  - hygral expansion (SiroFAST-4).



Milling

- Side effects:
  - running marks.
- Appropriate tests:
  - visual inspection after relaxation.
- Solutions to running marks:
  - when imparted, difficult to remove.
- Prevention:
  - set or relax fabric prior to milling
  - re-lay the fabric during process
    - air blowers
    - double gating.
- Correction of running marks:
  - flat set (effectively) fabric after milling
    - crab (still wet)
    - wet decatise
    - pressure decatise.

Piece dyeing

- Required effects:
  - colouration.
- Appropriate tests:
  - colour measurement for shade
  - visual inspection for evenness
  - fastness tests
    - wash fastness
    - perspiration fastness
    - rubbing fastness.
- Side effects:
  - permanent setting
  - increase in hygral expansion
  - uncontrolled relaxation.
- Appropriate tests:
  - permanent set using crease angle
  - hygral expansion (SiroFAST-4).

Piece dyeing

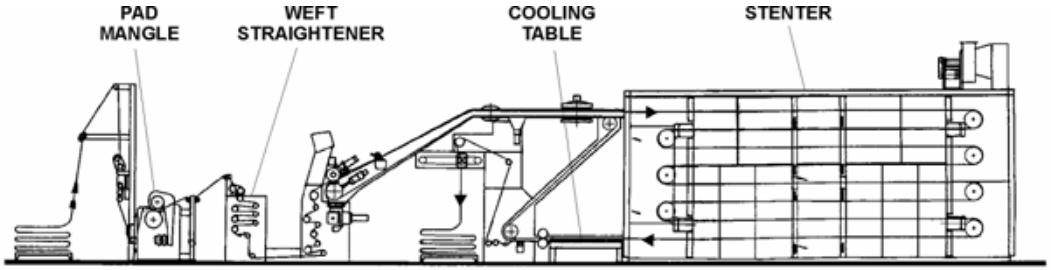
- Jacket with high hygral: expansion after dyeing
  - all-wool gaberdines
  - all-wool plain weaves.

- Solutions:
  - dye using anti-setting agents
  - light mill after dyeing
  - stretch and pressure decatise.

Drying

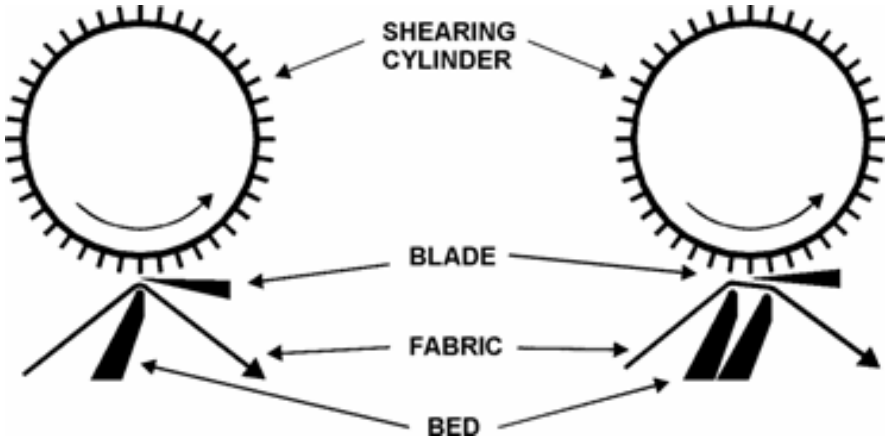
- Required effects:
  - reduction in moisture
  - temporary setting of fabric dimensions
  - control/*engineering* of relaxation shrinkage
  - control/*engineering* of fabric extensibility.

- Appropriate tests:
  - moisture content
  - fabric dimensions
  - fabric extensibility (SiroFAST-3)
  - relaxation shrinkage (SiroFAST-4).



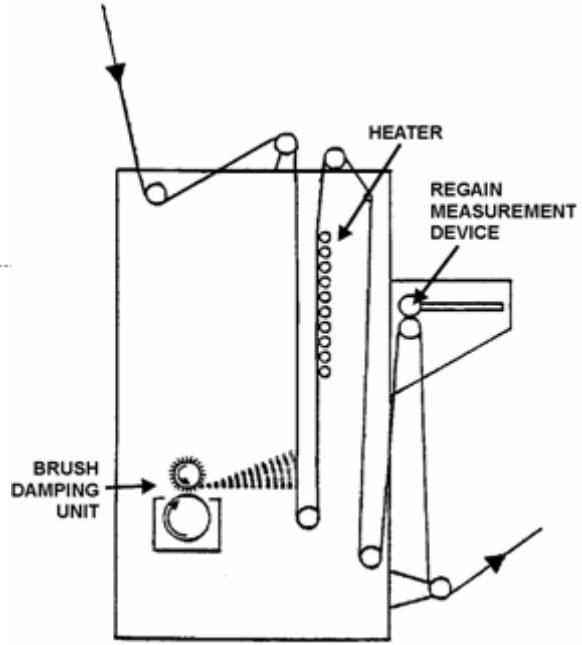
Cropping - shearing

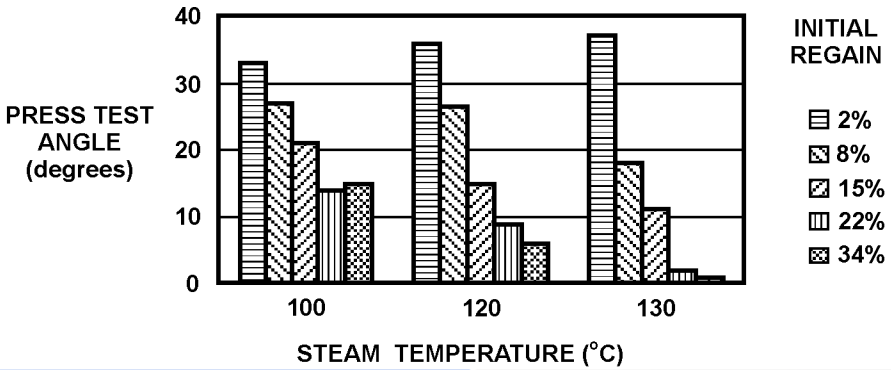
- Required effects:
  - removal of surface fibre.
- Side effects:
  - warp stretching (minor).
- Appropriate tests:
  - visual inspection.



Conditioning

- Required effects:
  - increase moisture content of fabric
  - increased permanent set in decatising
  - improved pressing performance after decatising.
- Appropriate measurements:
  - moisture content
  - permanent set using crease angle
  - press test angle.



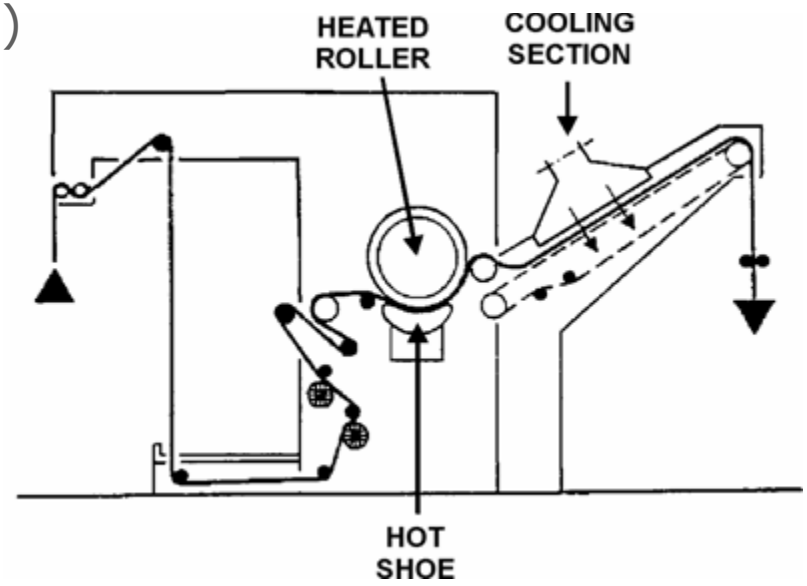


Conditioning

- Unwanted effects:
  - release of temporary set
  - reappearance of running marks.
- Appropriate tests:
  - increase in surface thickness SiroFAST-1).

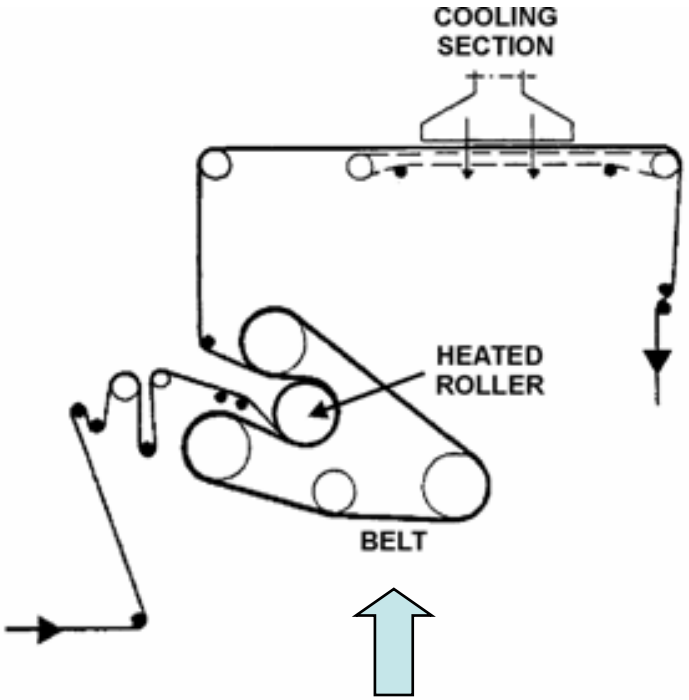
Pressing

- Required effects:
  - flatten fabric (temporary set)
  - smoother handle.
- Appropriate tests:
  - fabric thickness, surface thickness (SiroFAST-1)
  - surface contour (KES-F4)
  - surface friction (KES-F4).



Pressing

- Side effects:
  - stretching fabric in warp direction.
- Appropriate tests:
  - warp dimensions
  - warp relax
  - shrinkage
  - warp extensibility.

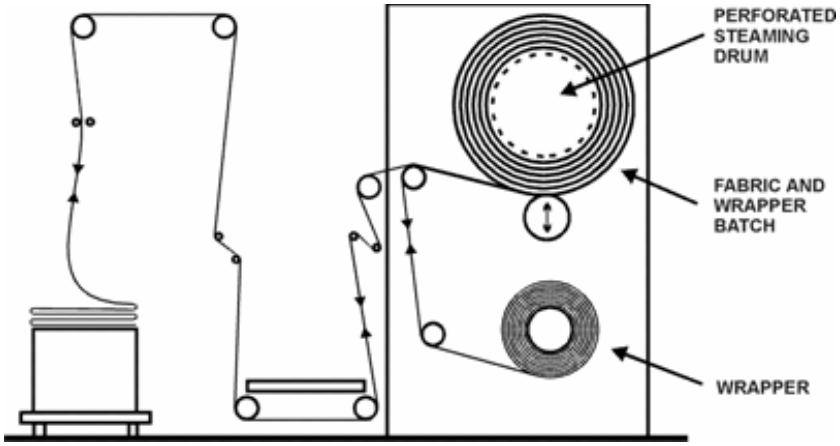


Belt press

Will this stretch the fabric more or less than the rotary press ?

Decatising

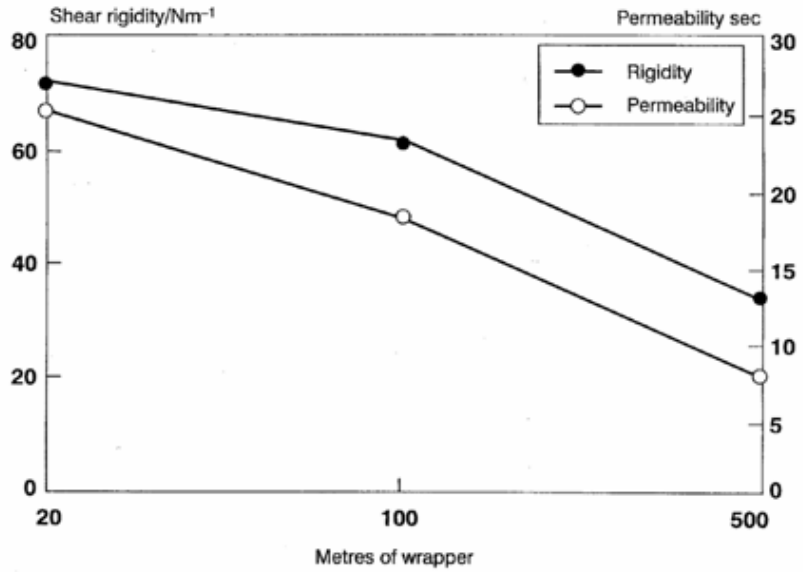
- Required effects:
  - *permanently* flat set the fabric
  - improve dimensional stability
  - improve suppleness
  - improve smoothness.
- Appropriate tests:
  - crease angle test
  - relaxed surface thickness SiroFAST-1)
  - relaxation shrinkage (SiroFAST-4)
  - bias extensibility (SiroFAST-3)
  - surface thickness (SiroFAST-1)
  - surface contour and friction (KES-F4).



Decatising

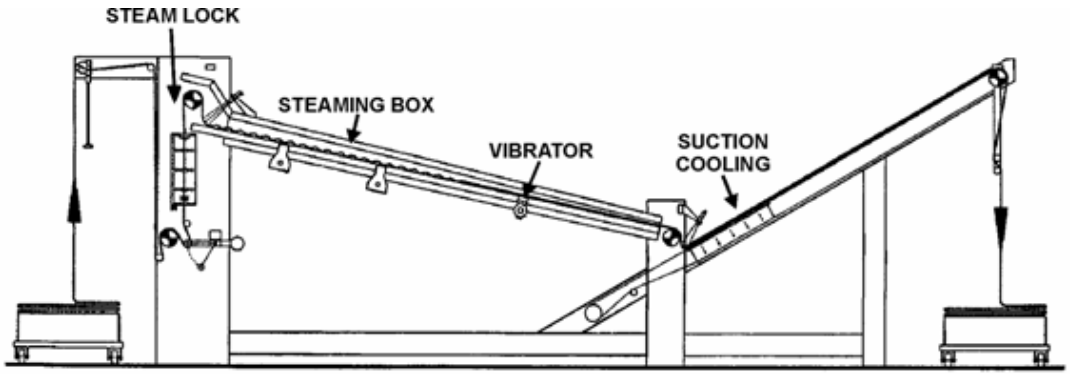
- Side effects:
  - uneven treatment (end-to-end)
  - stretch in warp direction
  - yellowing.

- Appropriate tests:
  - bias extensibility (end-to-end)
  - thickness (end-to-end)
  - air permeability (end-to-end)
  - warp dimensions
  - warp extensibility (SiroFAST-3)
  - colour/yellowness.



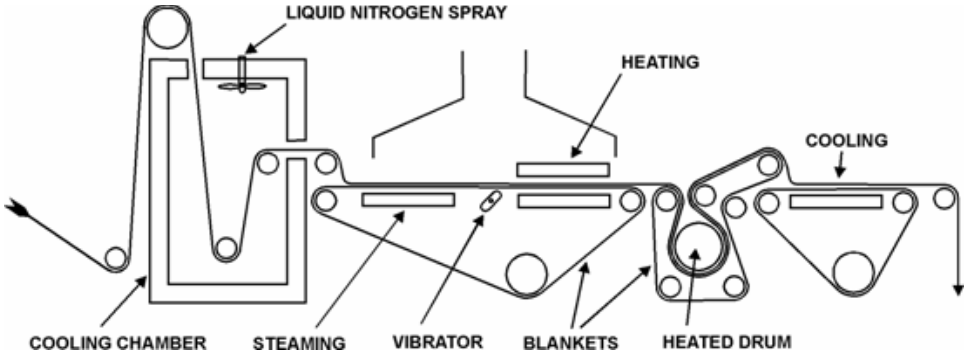
Relaxation - sponging

- Required effects:
  - reduce relaxation shrinkage
  - reduce lustre.
- Appropriate tests:
  - relaxation shrinkage (FAST-4)
  - fabric dimensions
  - surface thickness (SiroFAST-1).



Relaxation - sponging

- Side effects:
  - remove surface finish
  - stretching.



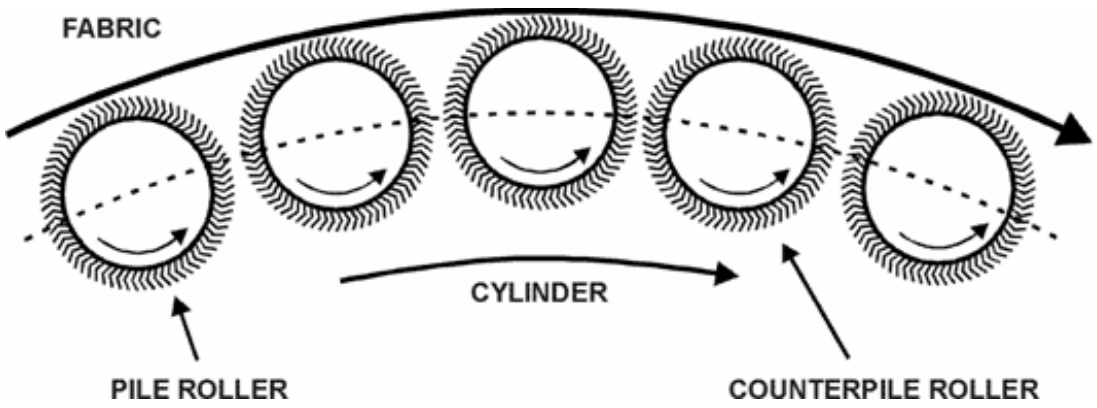
- Appropriate tests:
  - surface thickness (SiroFAST-1)
  - warp dimensions
  - relaxation shrinkage (SiroFAST-4).

Juki Sponger.

Will this relax the fabric more effectively than the steam table? Why?

Raising

- Required effects:
  - increase in surface fibre
  - increase in thickness.
- Appropriate tests:
  - surface thickness
  - fabric thickness (SiroFAST-1).



- Side effects:
  - stretching of fabric in warp direction
  - increase in warp relaxation shrinkage.
- Appropriate test:
  - warp dimensions
  - warp extensibility (siroFAST-3)
  - relaxation shrinkage (SiroFAST-4).

Summary

- Most wool finishing processes and machinery can be objectively evaluated.
- The quantitative data takes much of the subjectivity out of decisions.
- A range of test procedures can be used to measure both desirable and unwanted effects.

Key properties affecting quality that can be controlled in finishing

Fabric type	Colour-woven light-weight	Milled flannel	Piece dyed gaberdine	Woollen
Weight	*X*	*(X)*	*(X)*	*(X)*
Relaxation shrinkage	X	XX	XX	XX
Hygral expansion			XX	
Finish stability		XX	XX	XX
Press test angle	XX	X		
Warp formability	XX	X		