Management of Quality in Knitting

Part 2: Specification & Control

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Management of Quality in Knitting

- Identify key control parameters
- Establish appropriate specifications
- Identify potential sources of variation
- Establish reliable monitoring procedures

Variations in grey fabric
cannot be eliminated during finishing

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Key Control Areas

For Each Fabric Quality

- Yarn Quality
  type, count, twist
- Average Stitch Length

these determine the Reference Dimensions

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Yarn Quality

- Fibre Quality
- Yarn Type
- Count & Count Variation
- Twist & Twist Variation
- Irregularity & Imperfections
- Strength & Strength Uniformity
- Friction

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Yarn Specification

- Yarn properties are inter-dependent
- Low variation is often more important than high mean values
- High quality usually means high price
- Consider the end product

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Control of Yarn Quality

Difficult for the knitter

- Depends on reliability of ALL suppliers
- Good relationships essential
- Quality checks must be installed

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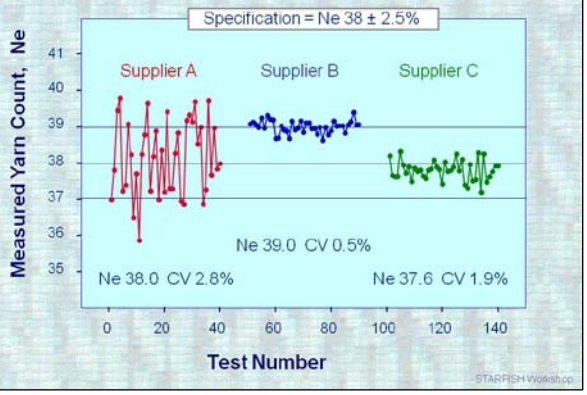
Yarns from Different Spinners



Effect of Yarn Count Variation

Fabric: Interlock 20g 30d 1884n
Knit Spec: Ne 1/38, SL 3.4 mm
Process: Winch-jet: Mid Tension, White
Finish Spec: 14.5 c/cm, 68 cm tub (200 gsm)

Variation due to Yarn Count only

Weight, gsm	195 to 207
Length Shr.%	-4.4 to -5.5
Width Shr.%	-4.4 to -6.0

No allowance for variation in SL or Processing

Yarn Count Variation

If fabrics finished to the same weight and width

Range in Length Shrinkage increases
to between -1.6% and -8.5%

Variation in Ne between deliveries
of ± 3% is not unusual

For Ne 38, range is Ne 39.14 to Ne 36.86

Actual range was Ne 39.2 to Ne 36.9

Monitoring Yarn Quality

- Obtain test data from ALL suppliers
- Identify and check EACH delivery
  for count, twist & friction before knitting
  NB moisture content
- COMPARE with agreed Specification
- Establish PROCEDURES
  for out of tolerance deliveries

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Monitoring Yarn Quality

- Use charts to monitor suppliers
- Establish NORMAL variation
  for each supplier over time
- Establish appropriate tolerances
- Establish guide-lines for action
- Communicate results to suppliers

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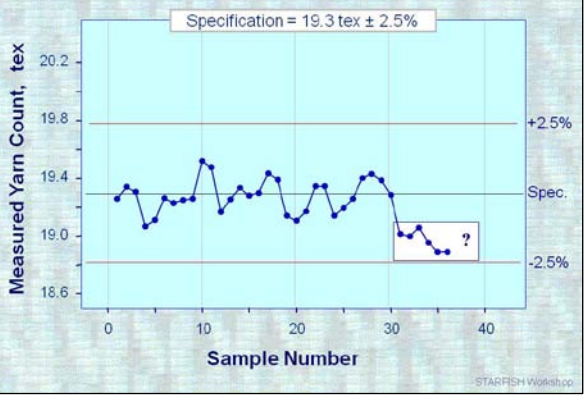
Monitoring Yarn Count



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Control of Yarn Quality

New Suppliers

should get more stringent checking

until their reliability is proved

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Control of Yarn Quality

Finally

- Pay attention to yarn storage
  e.g. temperature and relative humidity
- Check for damaged cones or boxes
- NEVER MIX LOTS

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Good Yarn Makes Good Fabric

- Lowest price is seldom the lowest cost
- Dependability of supply is valuable
- Consistency is important
- Limit the number of suppliers

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Knitting Specification

For each quality on each knitting machine the key production control parameters are

- Course Length (SL * Needles)
  - determines reference dimensions
- Courses per Roll (revs * feeders)
  - determines roll length & weight

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Control of Course Length

- Positive (driven) Feed
- Instrumentation
- Control Procedures

Memminger-Iro: MPF_L

Memminger-Iro: MLT-Wesco

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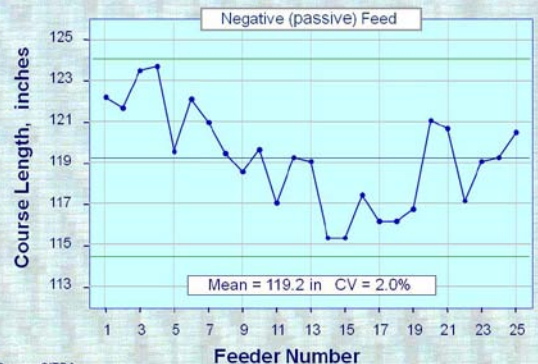
Variation Between Feeders



Source: SITRA

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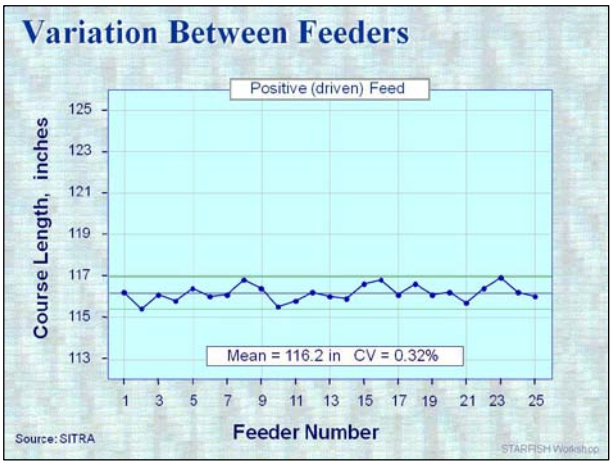
Variation Between Feeders

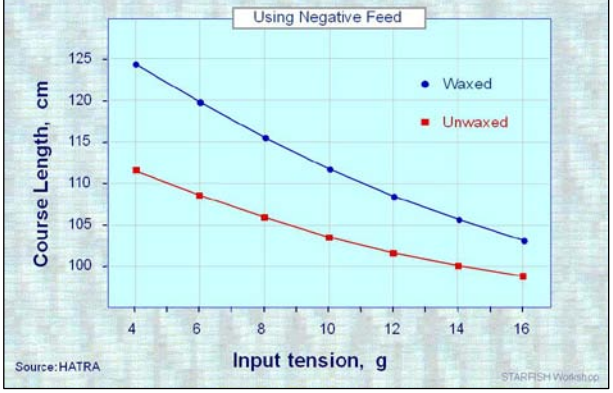


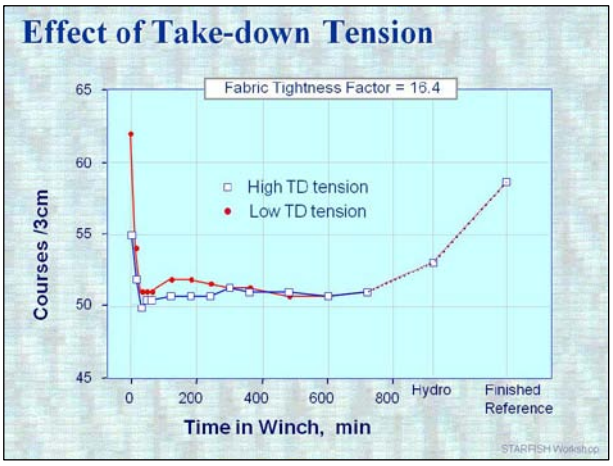
Control of Course Length

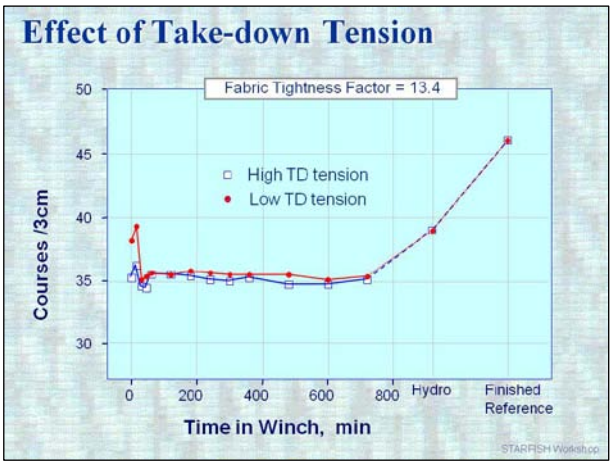
Yarn input tension and take-down tension

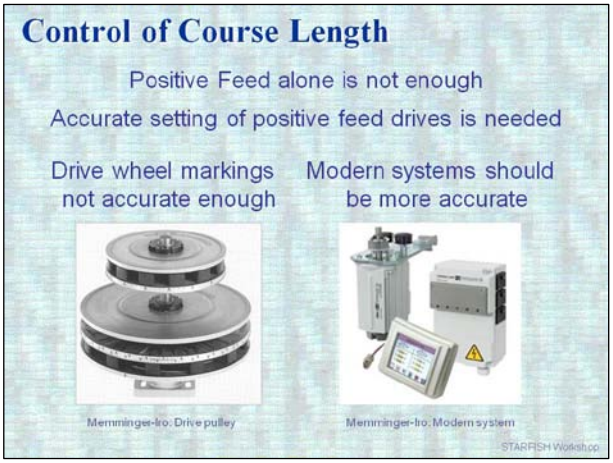
- Can influence knitting efficiency and fabric appearance therefore proper control is important
- But they do not affect stitch length provided positive feed is used

Effect of Yarn Input Tension









Control of Course Length

Positive Feed alone is not enough

- Accurate setting of positive feed drives
  - drive wheel markings are not accurate enough
- Regular Maintenance
  - wax and fly contamination
- Independent Checks
  - using appropriate instrumentation

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Course Length Instruments: Examples

Direct length per revolution measurement

- Wesco (Memminger-IRO)
- Unilength (Meiners-del)
- Schmidt LMC



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Course Length Instruments: Examples

Indirect and integral systems

- SDL yarn length & speed meter
- Decotex (Memminger-Iro)
- Intus (Mayer & Cie)
- Knit Master (Barco)




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Course Length Instruments

- Check Results by measuring stitch length of yarns taken from fabric
- Calibrate Instruments on a regular basis
- Establish Accuracy and Variability using Control Charts

Course Length Instruments: Variation

Course Length & Needles

- Number of needles can vary between different makes and models
- Stitch Length depends on Course Length
  SL = Course Length / Needles
- Needles must also be specified when Course Length is the Control Parameter
- Fabric Width depends on No. of Needles
  Width = Needles / Wales

Variation in Cylinder Needles

SJ 30" Diam, 20 Gg	Needles	% Diff
Theoretical	1884	
Falmac "B" Series	1848	-1.9
Monarch VXC-73S	1860	-1.3
Pai Lung FS3A/T	1872	-0.6
Vanguard 1SJ4	1920	+1.9

Course Length & Stitch Length

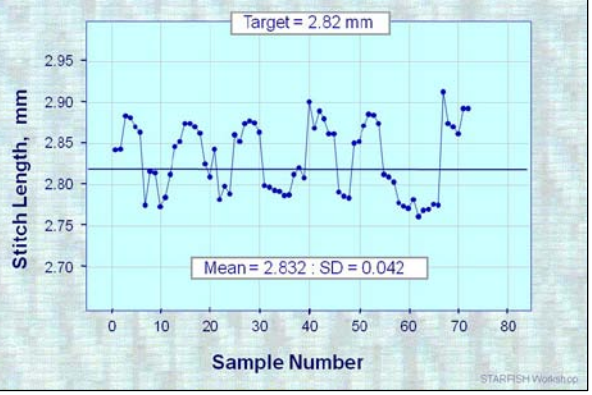
- Use Course Length
  to set-up and control production
  on individual machines

CL may be different, depends on needles

- Use Stitch Length
  to specify quality and compare
  production across all machines

Stitch Length should be the same on all

Monitoring Stitch Length



Stitch Length Variation

Fabric: 1 x 1 Rib 14g 20d 876n
Knit spec: Ne 1/30, SL 2.82 mm
Process: Winch-jet: Mid tension, Medium
Finish spec: 17.6 c/cm, 41 cm tub, 200 gsm

Variation due to Stitch Length only

Weight, gsm	194 to 206
Length Shr%	-0.8 to -8.1
Width Shr%	-5.1 to -9.6

No allowance for variation in Ne or Processing

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Control of Course Length

Prevention better than Cure

Check average CL before production and record the results

- establish variation between feeders
- establish variation between machines
- determine minimum number of feeders to be checked

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Control of Course Length

Making Measurements

- Regular checks throughout production to ensure the quality is maintained
- Record results so that average values and the variation can be monitored
- Calculate Standard Deviation of means for each machine, quality & yarn lot

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Control of Course Length

Frequency of Checking

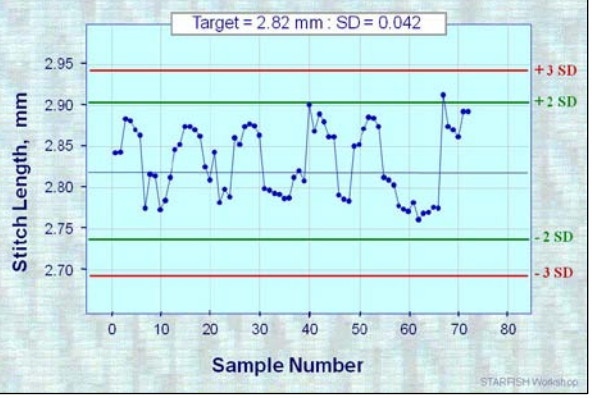
- Initially may need to be intensive until true variation established
- Reduction only with clear proof
- Increase frequency after maintenance, new parts, new yarn lot
- Effective monitoring will quickly detect deterioration or drift

Control of Course Length

Tolerances and Control Limits

- Must be Realistic and Achievable
- Optimum levels take time to establish
  - Normal Tolerance is ± 2 SD
    95 in 100 within Normal Tolerance
  - Action Tolerance is ± 3 SD
    1 in 300 outside Action Tolerance

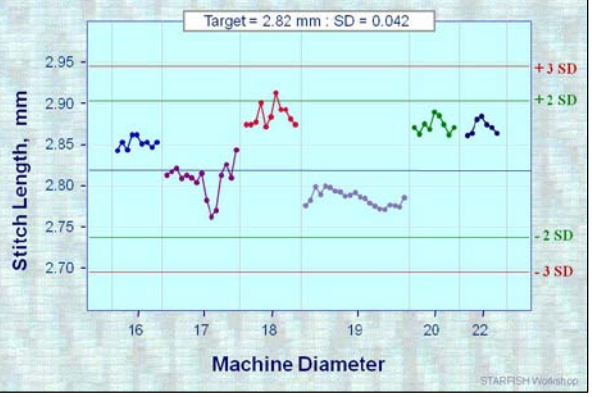
Monitoring Stitch Length



Control of Course Length

- Practical Control Tolerances (± 3 SD)
  - reflect current capabilities
  - closer tolerances do not improve control
- If Practical Tolerances are too high
  - first identify and reduce variation
  - then calculate new tolerances

Monitoring Stitch Length



Stitch Length Sorted by Machine

Diam	SL mm	SD	CV%
16	2.850	0.007	0.25
17	2.806	0.021	0.76 ?
18	2.884	0.013	0.45
19	2.785	0.010	0.35
20	2.873	0.011	0.39
22	2.785	0.009	0.31
all data	**2.832**	**0.042**	**1.49**

Control of Course Length

- Maintain a Consistent Standard
- Check on-line instrumentation regularly
  - internal lab measurements of SL
  - external calibration
  - monitor using Control Charts
- QC independent from production

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Control of Roll Weight and Length

- Consistent roll Weight
  - planning, monitoring & control
  - storage & handling
  - easy composition of dyelots
- Consistent roll Length
  - improves lay planning
  - reduces cutting waste
  - reduces costs

Both can be accurately controlled based on Yarn Count & Course Length

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Roll Weight and Yarn Tex Count

Roll Weight (kg) =

$$\text{tex} * \text{CL(cm)} * \text{feeders} * \text{revs} * 10^{-8}$$

therefore

$$\text{tex} = \frac{\text{roll weight (kg)} * 10^{8}}{\text{CL(cm)} * \text{feeders} * \text{revs}}$$

$$\text{tex} = \frac{590.54}{\text{Ne}} \qquad \text{Ne} = \frac{590.54}{\text{tex}}$$

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Roll Length

Roll Length = Total Courses / Course Density

Total Courses = Feeders * No. of Revs

- Knitting Control Parameter = Revs
- Use *finished* Course Density to calculate total courses to knit
- Don't forget construction effects e.g. Two-thread fleece

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Quality Checks on Grey Fabric

Grey (machine state) dimensions are

- Unstable
- Unreliable

They are influenced by

- Take-down tensions
- Stretcher board settings

which do not affect Reference Dimensions

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Quality Checks on Grey Fabric

- Grey area weight
  is NOT a reliable check of fabric quality
- Roll Weight
  can be useful, but only if
  - Course length is accurately controlled
  - Exact no of courses is known

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