

Bambro Tex Technical Guidance Documents

Technical Data of Bamboo Fiber and Bamboo Yarn
Bamboo Fabric Weaving Process
Pretreatment & Dyeing



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Part I: BambroTex Technical Guidance Documents

1. Characteristics of bamboo fiber

Strength:

- Natural anti-bacteria
- Green & Biodegradable
- Breathable and Cool
- Soft hand feeling
- Luxurious shiny appearance

Weakness:

- Low tensile strength (wet tensile strength is lower: 60% of dry tensile strength)
- Weak cohesion in spinning

Testing condition: Temperature : 20° C Relative humidity: 65%

Item	Reference data
Dry tensile strength (cN/tex)	2.33
Wet tensile strength (cN/tex)	1.37
Dry elongation at break (%)	23.8
Linear density percentage of deviation (%)	-1.8
Percentage of length deviation (%)	-1.8
Over length staple fiber (%)	0.2
Over cut fiber(mg/100g)	6.2
Residual sulfur(mg/100g)	9.2
Defect(mg/100g)	6.4
Oil-stained fiber(mg/100g)	0
Coefficient of dry tenacity variation (CV)(%)	13.42
Whiteness (%)	69.6
Oil content (%)	0.17
Moisture regain (%)	13.03
Rate	Grade A

2. Bamboo yarn

Technical data of typical bamboo yarn						
Knitting yarn	Count	Coefficient of twist	Tensile strength (CN)	Yarn evenness (cv%)	Thick yarn / 1 000 meters	Thin yarn / 1 000 meters
100% Bamboo	32s	340	220	13.24	20	4
	40s	350	170	14.78	68	25
70% bamboo	32s	340	185	13.12	18	5
30% Cotton	40s	350	150	13.60	47	12

Technical data of typical bamboo yarn						
Weaving yarn	Count	Coefficient of twist	Tensile strength (CN)	Yarn evenness (cv%)	Thick yarn / 1 000 meters	Thin yarn / 1 000 meters
100% Bamboo	32s	360	240	13.16	20	3
	40s	380	160	14.63	50	19
70% bamboo	32s	360	181	13.06	17	5
30% Cotton	40s	390	181	13.55	30	11

Anti-bacteria function:

The content of bamboo fiber in blended yarns influences the anti-bacterial behaviour of the final product. The higher the bamboo content the better the anti-bacterial properties. Commonly we suggest maintaining 70% bamboo fiber in blended yarn to reach a satisfying anti-bacteria effect.

Tensile strength:

As bamboo fiber' tensile strength is low, we recommend using yarn count ranging from Ne8 - Ne60. When using 50s-60s count pure bamboo yarn, we suggest doubling the yarn.

Tips in bamboo yarn producing process

Bamboo yarn producing is very similar to traditional viscose producing. You only need to make minor adjustments when producing.

- 1) As bamboo fiber tends producing flyings in roving and drawing, we recommend adopting a high humidity(65%-70%) and a low temperature (25° C)in workshop. If bamboo fiber is too dry before feeding, we recommend adopting a vapour pre-treatment to improve its humidity.
- 2) As bamboo fiber shows weak cohesion, we recommend adopting high coefficient of twist. Low card web tension and low roving tension is recommended.
- 3) In order to control hairiness in spinning, we recommend using high-quality steel ring and ring traveler.

3. Bamboo fabric weaving

- 1) To meet weaving requirement on tensile strength and to have excellent efficiency we recommend using bamboo yarn with a twist coefficient in the range of 350 to 410 turns per meter. This ensures to reduce floss on yarn surface and it helps to also improve yarn tensile strength.
- 2) As bamboo yarn's moisture regain rate and elongation is relatively high, you should maintain even and relatively low tension during the process of warping and sizing of the yarn.

When weaving high-count high-density woven fabrics with fine yarns, we recommend to choose arc process flow in warping, control each sections

elongation in sizing, and maintain low tension in both warping and sizing. In this way, It helps avoiding broken ends caused by increased elongation in weaving.

- 3) For single yarn weaving, you should choose a suitable sizing agent ~~in sizing~~. Bamboo fibers are hydrophilic fibers. They are easy to be sized. So it is better to choose denatured starch as main component of sizing agent. In order to decrease hairiness, we recommend to choose some acrylic acid as part of sizing agent rather than PVA. Acrylic acid can improve yarn softness and makes it easy dividing the yarn. Careful: do not add too much acrylic acid as excess of acrylic acid will cause humidity absorbance and viscosity regain.
- 4) Bamboo fiber is sensitive to moisture regain. We recommend that you keep a medium moisture regain rate. Bamboo fibers is breakable when moisture regain is too low. However bamboo fibers tensile strength also decrease dramatically when moisture regain rate is too high. The suitable moisture regain rate is 8-9%. Additionally please make sure to maintain a medium speed when sizing.
- 5) You should maintain lower tensions when weaving. We recommend weaving at relative humidity: 65-75%. You can adopt lower relative humidity when yarn's moisture regain rate is high. Vice versa.

Note: Bamboo yarn tends to elongate, it may cause weft stripiness.

4. Pretreatment and Dyeing

- 1) Because bamboo fiber is regenerated cellulose fiber, it is sensitive to both acid and alkali. So you must notice the volume of alkali in pretreatment.
- 2) Because bamboo fiber fabric has lower wet tensile strength, you should adopt lower tensions or negative tensions during dyeing & pretreatment.
- 3) Recommending to choose reactive dye-stuffs in dyeing. Reactive dye can react with bamboo fiber molecular under weak alkali condition.
- 4) General principles in dyeing & pretreatment:
 - Light-singeing:
You should choose a mild condition in singeing in order to avoiding damaging bamboo fiber.
 - Enzyme-desizing
We require a high desizing rate above 80%.
 - Light-Scouring
For 100% bamboo fiber fabric/yarn you may skip the process of scouring, because pure bamboo fiber contains little trash and pigment. If you insist on scouring, you

need to make sure the volume of calcined soda does not exceed 10g/L.

Note: Both excess calcined soda and oxydol can damage bamboo fiber

- Light - mercerizing

Because bamboo fiber owns an excellent natural shine it does not need mercerizing. However you can use light-mercerizing so as to improve absorbing rate of dyes.

Please note that acid and alkaline resistance ability of bamboo fiber is weak.

- Dyeing

Bamboo fiber's wet tensile strength is low. It swells acutely in water. Bamboo textiles are suitable to be dyed on jigger or winch loose rope dyeing machine.

Note : In dyeing, the volume of calcined soda can not exceed 25g/L. The temperature can not exceed 100° C.

In drying you should keep low temperatures and maintain low tensions.

Part II: Dyeing and Pretreatment Test

All dyeing agents mentioned in following article originate from Ciba Specialty Chemicals Inc (<http://www.cibasc.com/view.asp>)

1. Experimental subject specification:

- 1) 100% bamboo fiber fabric 30s*30s 100*60 63 inches
- 2) 60% bamboo 40% cotton blended fabric 20s*20s 88*60 54 inches
- 3) 70% bamboo 30% cotton blended yarn 30s/2

2. Pretreatment

2.1 Gassing of pure bamboo fabric or bamboo/cotton blended fabric

The surface of pure bamboo fabric or bamboo/cotton blended fabric may have a lot of floss, cotton seed shell, or tiny ball top. If gassing does not process completely, cloth cover will not get a satisfying result. In subsequent dyeing, the remaining floss may cause dye unevenness, color fading, and even defects on cloth cover.

Gassing technics:

Gassing Speed: 80-100 m/min

Burner Temperature: 1100° C

Note: Burner fire should be even. Gassing result should reach Grade 3-4.

2.2 Desizing, scouring and bleaching

2.2.1 Enzyme-Desizing

As we mainly use starch as sizing agent when weaving, we should choose high-activation, high-stability and selective enzymes which can target on starch sizing agent. And we also need to make sure this enzymes will not damage bamboo fiber. We require that the enzyme will not be damaged by axunge or waxiness. This enzymes need to be kept active in a certain range of pH (such as pH5-pH9). We recommend Tinozym L40 Enzyme agent.

Press Enzyme-desizing Technics and Formulations (mL/kg)

Tinozym L40	2-5
Ultravon GP (humectation & wash agent)	3-4
Mangle expression:	100%
Soakage temperature:	room temperature – 90° C
Stacking time:	6-18 hr
washed by hot water	

Non-continuous Enzyme-desizing Technics and Formulations (mL/kg)

Tinozym L40	1-3
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Ultravon EL (humectation & floatation agent)	1-2	
Bath ratio:		5:1- 20:1
Temperature:		60° C - 90° C
Time:	30–60 min	
Washed by hot water		

2.2.2 Scouring & Bleaching

Bamboo fiber's natural color is little yellow. The whiteness degree of bamboo fiber is lower than cotton. For fabric woven with bamboo/cotton blended yarn, if scouring & bleaching does not meet requirement, the whiteness degree of cloth cover will be uneven.

Because bamboo fiber is sensitive to both acid and alkali, you must reduce the volume of caustic soda. You need removing pigment in a relative mild technics condition.

Requirement of refining agent:

Little bubble, anti-catalysis and no damage to bamboo fiber. It need to be able to both stabilize hydroperoxidation, and disperse pigment which may adhere to cloth cover. Refining agent also needs to removed easily in washing.

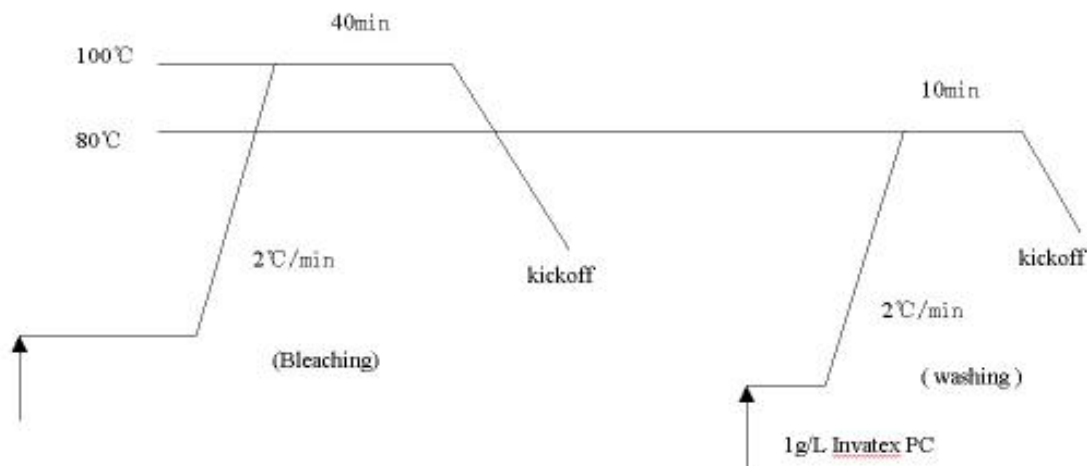
We recommend Tinoclarite CSW as a ideal refining agent.

Technics and formulations (g/L):

- For fabric:

Tinoclarite CSW	2-4
Caustic soda	1-3
Hydroperoxidation (35%) , ml/L	8-10
Temperature ,° C	90-98
Time ,min	40-60
- For yarn:

Tinoclarite CSW	1-2
Caustic soda	1
Hydroperoxidation (35%) , ml/L	5 - 8
Temperature,° C	90-98
Time, min	40-60

Chart 1. Scouring-Bleaching

2.3 Mercerization

For bamboo fabrics and bamboo/cotton blended fabrics, mercerization not only improves fibers' absorbance of dyestuffs, but also it can increase the brightness of the dyed fabrics due to plain surface and even luster. Furthermore it is also able to upgrade the garments properties such as draping, softness to a substantial degree.

We recommend using case rollers or clippers mercerization machines.

Technics and formulations (g/L):

Caustic soda:	210-240
Temperature:	room temperature
Time:	40-60s.

2.4. Dyeing

Dyeing of 100% bamboo yarn or fabric:

In terms of chemical structure, both bamboo fiber and cotton are cellulosic fibers which follow the same dyeing mechanism, thus all dyestuffs which are suitable for cotton fiber can be used to dye bamboo too.

It is relatively easy to dye 100% bamboo yarn or bamboo fabric.

Dyeing of bamboo/cotton blended fabric:

However, compared with cotton fiber, bamboo fiber belongs to multi-hole texture fiber which has a bit lower dyeing degree and slow dye taking-up speed than cotton fiber. When dyeing bamboo/cotton blended textile, it may result in iridescent or double color.

Therefore it is necessary to select the right dyestuff which has similar dyeing dynamics curve, similar absorbance, and similar fasting temperature/time to both bamboo and

cotton.

Dyestuff choose:

As bamboo fiber is one kind of eco-friendly fibers, high fastness and environmental protection reactive dyestuffs should be firstly taken into account in order to improve the productivity, reduce dyeing difficulties, lessen washing, increase dyeing degree and meet the requests on color fastness, especial sunlight fastness.

We recommend Cibacron Yellow FN-2R, Red FN-R and Blue FN-R as trichroism. To both bamboo and cotton these dyestuff follow very similar dyeing dynamics curves.

For dyeing Marine or Black, we recommend CIBACRON Marine W-B and Black W-NN BC.

Dyeing with these dyestuff can guarantee color fastness to washing Grade 4-5 and color fastness to sunlight Grade 5-6.

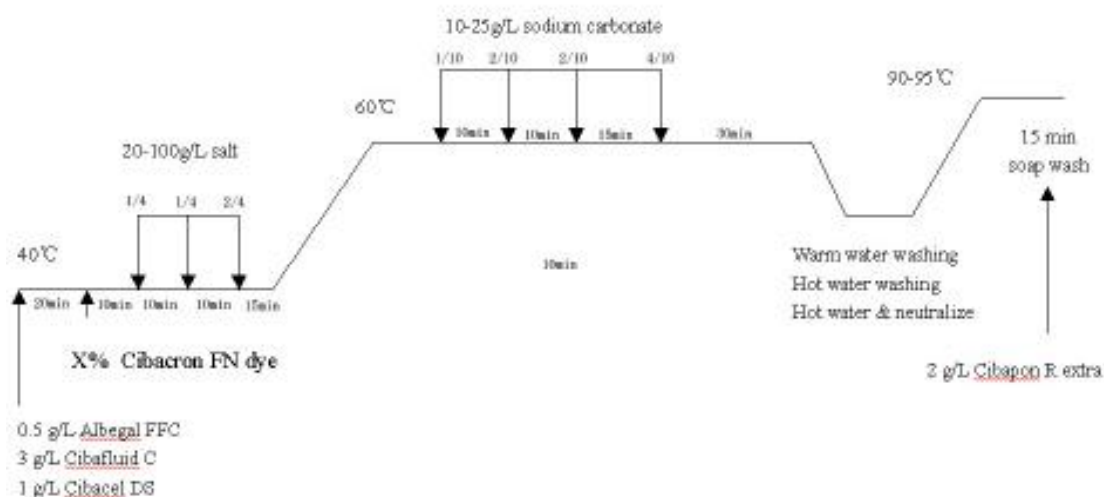
Soap Washing:

Requirement on Soap washing agent:

- prohibit disperse & dyestuff from re-dyeing bamboo fiber
- adjust water hardness
- be less foaming and be bio-degradable.

We recommend Cibapon R extra as soap washing agent.

Chart 2. Dyeing



2.5.Finishing

Concerning finishing of bamboo fabrics and bamboo/cotton blended fabrics, normally intermittent drying should be applied. We suggest not adopting direct drying such as through single cylinder or multi-cylinder dryers. If the temperature is not controlled well, direct drying may cause many defects such as fabric yellowing, harsh hand feeling, weft sloping and high shrinkage.

As result, we choose stentering frame and rotor drummer dryers to dry, to fix width and over feed-in (over 5%-10%), temperature should be kept around 130° C
For drying dyed yarns, it is suggested to use infrared loose drying in order to ensure even evaporating , upgrade hand feeling, avoid cohering and tenacity decreasing which may affect the subsequent processing.

2.5.1. Processing flow

- (1) Dyed fabrics—stentering & shape setting ---softening(steeeping 2 times & press 2 times) ---over-feed drying ---finished fabrics
- (2) Dyed yarns --- softening ----infrared loose drying---finished yarns

2.5.2. Softening process

Softening process should be applied to dyed bamboo fabrics and bamboo/cotton blended fabrics. For dyed bamboo yarn, a little silicon oil should also be added in order to improve its smoothness and weaving ability.

The purpose of using softening agent:

- reduce friction among bamboo fibers and improve its smoothness.
- uniform bamboo fiber's surface exertion; improve fabric tensile strength and abrasive resistance
- improve bamboo fiber's elasticity and drapability.
- softening agent need to be able to prohibit bamboo textile reacting with dyes in dyeing process.
- softening agent need to be able to prevent bamboo textile yellowing in drying process.

We recommend using Ultratex FSA (Ph 5) as softening agent.

For fabric:

Ultratex FSA : 20 g/L (steeping 2 times and press 2 times)

For yarn:

Ultratex FSA : 1%-2% of yarn weight.

Part III: 70% bamboo 30% cotton blended yarn producing Test

Tips in bamboo yarn producing process

Bamboo yarn producing is very similar to traditional viscose producing. You only need to make minor adjustments when producing.

- ” As bamboo fiber tends producing flyings in roving and drawing, we recommend adopting a high humidity(65%-70%) and a low temperature (25° C)in the workshop. If bamboo fiber is too dry before feeding, we recommend adopting a vapour pre-treatment to improve its humidity.
- ” As bamboo fiber shows weak cohesion, we recommend adopting high coefficient of twist. Low card web tension and low roving tension is recommended.
- ” In order to control hairiness in spinning, we recommend using high-quality steel ring and ring traveler.

The following process is an example of producing bamboo/cotton blended yarn on our cotton system. We only suggest customers to use it as a general guidance and to try to work out the best setting on their own equipment. However, it does not necessarily guarantee producing success on each specific machine. Customer still need to test on their own machines to find the most suitable techniques.

In order to obtain high evenness of blended yarn, we recommend the following flow process:

Bamboo fiber— opening & cleaning—carding

Cotton— opening & cleaning—carding--combing

1. Opening and cleaning process

1.1 Bamboo fiber opening and cleaning

Tex of bamboo lap:	440700
Dry weight of bamboo lap:	300 g/m
Wet weight of bamboo lap:	440.7 g/m
Length designed of bamboo lap:	30.6 m
Real length of bamboo lap:	31.21 mtrs
Gear for length fixing:	34T
Rotate speed of lap roller:	10.25 r/min
Time for lap forming:	4.2 min/piece
Total drawing of lappers:	2.04 times
Rotate speed of beater of bale plucker:	700 r/min
Rotate speed of carding beater:	600 r/min
Rotate speed of fan:	7355 r/min
Rotate speed of integrated beater:	920 r/min
Gap between Stripe beater of blender & grids:	inlet: 14mm, outlet: 18mm

Gaps between carding beater, opener beater and grips:	from inlet to outlet:16,17-18.5-20-22 mm
Gaps between carding beater and grips of opener:	from inlet to outlet: 7.2-6.3-4.7 mm
Gaps between grips of lapper:	5.2 mm

1.2 Cotton opening and cleaning

Tex of cotton lap:	390600
Dry weight of cotton lap:	360g/m
Wet weight of cotton lap:	390.6g/m
Length designed of cotton lap:	30.6m
Real length of cotton lap:	31.21mtrs
Fixed length:	117
Rotate speed of lap roller:	12.3 r/min
Time for lap forming:	3.5 min/piece
Total drawing of lappers:	2.713 times
Rotate speed of beater of bale plucker:	700 r/min
Rotate speed of beater in the first porcupine:	536 r/min
Rotate speed of beater in the second porcupine:	480 r/min
Rotate speed of fan:	1355 r/min
Rotate speed of integrated beater:	920 r/min
Gaps between Stripe beater of blender & grids:	inlet: 12mm, outlet: 16mm
Gaps between beater in the first porcupine and grips:	from inlet to outlet: 12-13-14.5-16-18mm
Gaps between grips in the first and the second porcupine:	3.9-8.7-7.6-6.5 12.6-8-6.7-6mm
Gaps between grips of lappers:	7.2mm

2. Carding process (carder machine type: A186H)

2.1 bamboo fiber carding process

Tex of bamboo sliver:	4859
Dry weight of bamboo sliver :	25.5g/5m
Wet weight of bamboo sliver:	24.3g/5m
Rotate speed of take-in :	960r/min
Rotate speed of cylinder:	360r/min
Speed of cover board:	114mm/min
Rotate speed of doffer:	20r/min
Gap between feeder-in board and take-in:	12"/1000
Height of dust knife: same as frame	

Angle of dust knife:	90°
Gap between dust knife and take-in:	15"/1000
Gap between take-in and small under-casing:	3"/8 1"/16
Gap between take-in and cylinder:	7"/1000
Gap between cylinder and back knife plate:	26"/1000 15"/1000
Gap between cylinder and cover board:	12" 11" 10" 10" 15" /1000
Gap between cylinder & front upper knife plate:	26"/1000 34"/1000
Gap between cylinder & front downer knife plate:	34"/1000 22"/1000
Gap between cylinder and doffer:	5"/1000
Chord of small under-casing:	175.6 mm
Press of feeder-in :	5.0 kg/cm
Total mechanical drawing:	92.77

2.2 Cotton carding process

Tex of cotton sliver:	4014.5
Dry weight of cotton sliver :	18.5 g/5m
Wet weight of cotton sliver:	20.1g/5m
Rotate speed of take-in :	960r/min
Rotate speed of cylinder:	360r/min
Speed of cover board:	147mm/min
Rotate speed of doffer:	18r/min
Gap between feeder-in board and take-in:	9"/1000
Height of dust knife: same as frame	
Angle of dust knife:	90°
Gap between dust knife and take-in:	12"/1000
Gap between take-in and small under-casing:	4"/16 1"/16
Gap between take-in and cylinder:	5"/1000
Gap between cylinder and back knife plate:	22"/1000 14"/1000
Gap between cylinder and cover board:	8" 7" 6" 6" 7"/1000
Gap between cylinder & front upper knife plate:	38"/1000 34"/1000
Gap between cylinder & front downer knife plate:	34"/1000 19"/1000
Gap between cylinder and doffer:	5"/1000
Chord of small under-casing:	175.6 mm
Press of feeder-in :	4.5 kg/cm
Total mechanical drawing:	92.7

3. Sliver-lap drawing process (sliver-lap drawing machine type: FA3556)

Tex of small lap:	5055
Dry weight of small lap:	46.60g/m
Tension drawing of feeder-in :	0.981

Drawing in main drawing section:	1.48
Drawing of lap forming:	1.00
Total mechanical drawing:	1.512
Gap between drawing rollers:	9mm
Speed of lap forming:	63.22m/min
Length of small lap:	155mtrs
Number of slivers after process:	20

4. Combing process (combing machine type: FA251C)

Tex of combing sliver:	3856
Dry weight of sliver:	17.77g/5m
Speed of combing machine:	175times/min
Rotate speed of brush:	1194 r/min
Rotate speed of fan:	2354 r/min
Tension drawing of lap feed-in:	1.062
Mode of feed in:	forward
Length of feed-in:	6mm/time
Drawing of lap web tension:	10.584
Total mechanical drawing:	78.33
Back section of main drawing roller:	1.758
Gap of main drawing rollers:	7/14mm
Clockwise time of separate roller:	29.5
Position of fixed pivot :	37.6mm
Gap of combs:	17"/1000
Gap of dropping:	19mm
In-out gap of top comb:	4mm
High-low gap of top comb:	0.4mm
Gap between top comb and roll:	0.75
Depth of brush into cylinder:	3.0mm
Gap between brush and triangle stream plate:	5mm
Diameter of trumpet:	front: 5.0± 4 back: 5.5 ± 4
Diameter of adjust ring on presser stick:	15mm
Number of feed-in small lap:	8

5. Drawing process (drawing machine type: FA303)

	Standard dry weight (g/m)	Number after drawing	Actual total drawing	Drawing in back section	Gap between rollers (mm)	Trumpet (mm)	Adjust ring (mm)	Speed of drawing (mm/min)
Pre-drawing of bamboo	20.75	7	7.16	1.67	12/20	3.8	15	159
Pre-drawing of cotton	18.20	8	8.13	1.72	6/12	3.6	14	224
First drawing	18.42	4B+2C	6.1	1.71	12/20	3.8	15	199
Second drawing	18.15	8	8.56	1.32	12/22	3.6	15	203
Third drawing	17.22	8	8.44	1.25	12/22	3.4	15	203

Press on rolls (one side):

front roll: 30kg , presser stick: 6kg, mid roll: 32kg, back roll: 30kg

6. Roving process (roving machine type: A456G)

Tex of roving:	492.38
Dry weight of roving:	4.41 g/10m
Wet weight of roving:	4.928 g/10m
Mechanical drawing:	7.9
Back section drawing:	1.211
Gap between roller:	27/41
Position of front roll:	5mm forward
Position of mid iron roll:	2mm backward
Position of back rolls:	vertical meeting
Press on front roll:	260n/double spindle
Press on mid iron roll:	150n/double spindle
Press on back roll:	200n/double spindle
Twist of roving:	3.02/10cm
Coefficient of twist of roving:	67
Axial density:	3.70/cm
Longitudinal density:	26.93 layers/cm
Length of roving:	2000 mm
Rotate speed of roving spindle:	684 r/min
Rotate speed of front roller:	265 r/min
Specification of trumpet:	15.5x3.3 mm
Specification of mid section collector:	8 mm
Specification of front section collector:	8 mm
Specification of gudgeon: operating length:	34 mm

7. Spinning process (Spinning Machine type: FA502)

Tex of yarn:	14.72
Dry weight of yarn:	1.32 g/100m
Wet weight of yarn:	1.47 g/100m
Total mechanical drawing:	34.8
Back section drawing:	1.25
Gap between rollers:	18/35
Position of front roll:	2mm forward
Position of mid iron roll:	2mm backward
Position of back rolls:	vertical meeting
Presser of front roll:	140n/double spindle
Presser of mid iron roll:	100n/double spindle
Presser of back roll:	140n/double spindle
Calculating twist:	91/10cm
Calculating coefficient of twist of yarn:	350
Ascend of winding:	0.275 mm
Thread pitch of winding:	0.549 mm
Rotate speed of spindle:	15334 r/min
Rotate speed of front roller:	205 r/min
Specification of ring:	w321 34#
Specification of collector:	2.0mm
Specification of steel rail:	PG1
Specification of gudgeon:	SX2—6833
Mode of front rolls:	72° double layer soft rubber bar

8. Coning process (Coning machine type: 1332M Yarn cleaner type: QS-6A)

Speed of coning :	520m/min
Weight of tension gasket:	6.8g
Count of yarn:	40s/1
Coefficient of material:	7.5
Susceptibility of short nubs:	170%
Length of short nubs:	2.2cm
Susceptibility of long nubs:	60%
Susceptibility of snicks:	-50%