



Ingeo™ Fibre Apparel Product Guidelines

Fiber to Fabric

1. Introduction to Ingeo™ fibers
2. Fiber to yarn
3. yarn to fabric

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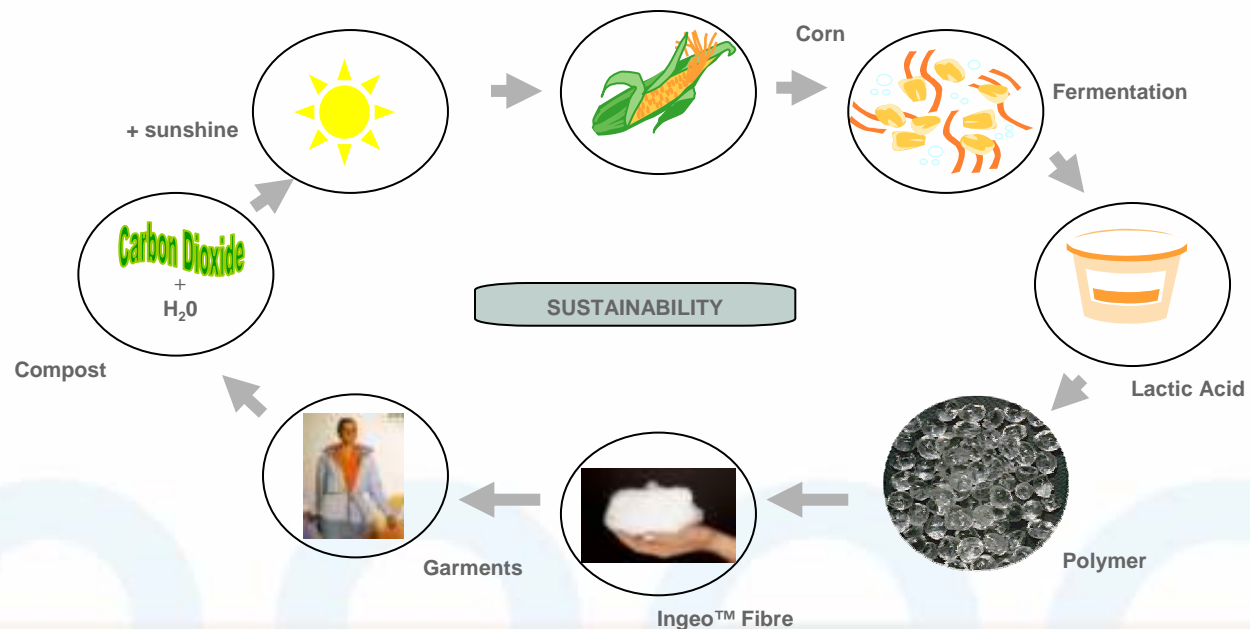


Apparel Products

1. Introduction to Ingeo™ fibers



- The only synthetic fibre commercially available in bulk quantities, that is made entirely from annually renewable raw materials - not oil



Not only from nature - but also back to nature



From nature, and back to nature - plus performance:

- **Excellent wicking properties**
 - **Moisture management**
 - **Low odor retention**
 - **Does not support bacterial growth**
 - **Hypoallergenic**
 - **Rapid soil release**
 - **Quick drying**
 - **Excellent after wash appearance**
- ⇒ Comfort
- ⇒ Fresh
- ⇒ No skin irritation
- ⇒ Easy care

And all supported by detailed technical bulletins



Ingeo™ fibre

**From nature, and back to nature
- plus performance:**

Positive performance appeal (bedding)

➤ **High loft which is maintained**

⇒ **Long life durability**

➤ **Difficult to ignite**

➤ **Low heat of burning**

➤ **Low smoke emission**

⇒ **Fire safety regulations**

Technical bulletins available to support all these properties



..... selected technical bulletins

Subject	Bulletin number
Apparel	
Odour release	290904
Hohenstein Institute testing	260904
Washing and dry cleaning performance	50904
Fibre & fabric properties	180904
Home textiles	
Fibre fill compression testing	200904
Duvet / comforter performance	130904
Pillow performance	320904
Furnishing flammability characteristics	110104
Non woven	
Moisture transport in Ingeo™ fibre non woven fabrics	380904
Wipes regularity technical bulletin (toxicology)	390904
Wipes commercial production information	110804
Multi product	
Compostability	120904
Ingeo™ fibre fabric UV resistance	370904

These and more available on www.ingeofibers.com



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2. Fiber to Yarn





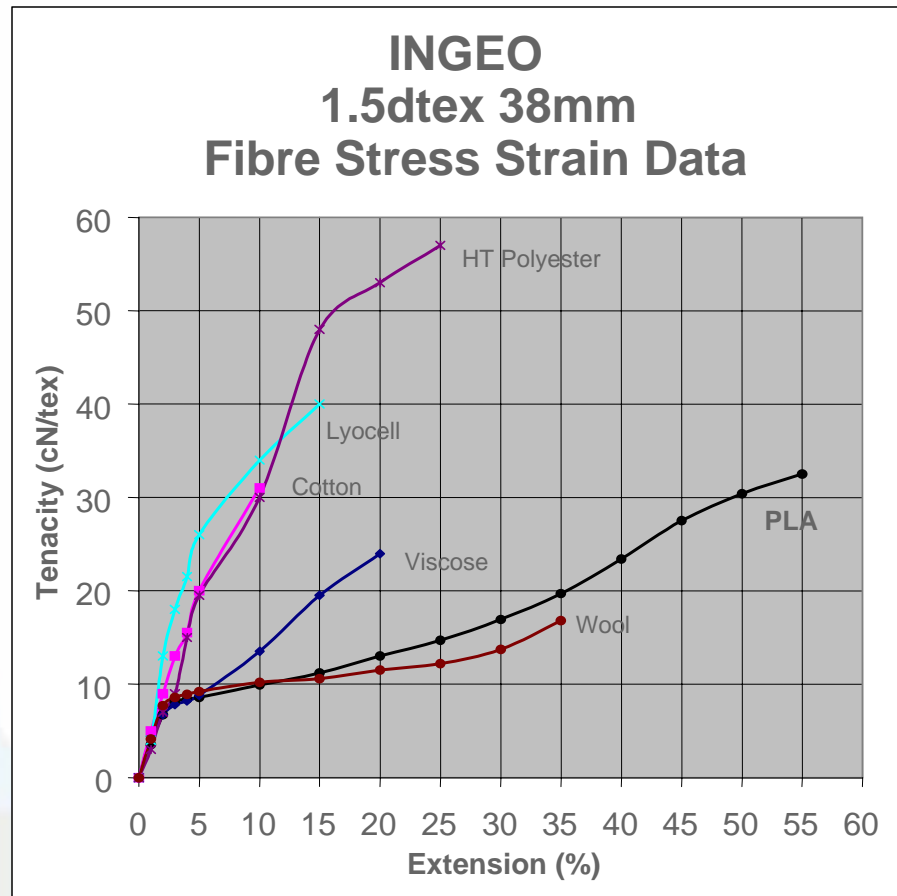
Ingeo™ fibre properties

	Staple	Filament	
		POY	DTY
Fibre, dtex	1.5	120/68	70/68
Tenacity, cN/tex	30 - 35	23-26.5	26 - 30
Elongation, %	50 - 60	50 - 75	20 - 30
Moisture Regain, %	0.4 – 0.6	0.4 – 0.6	0.4 – 0.6
Crimp, per 10cm	30 – 35	----	----
Cross Section	Round	Round	Round
Surface	Smooth	Smooth	Smooth
Density, g/cm ³	1.25	1.25	1.25
Melt Point, °C	170	170	170
Boiling water shrinkage	18% (yarn)	----	~15%

Comparative Staple Fibre Properties

	Synthetic Fibres			INGEO	"Natural" Fibres			
	Nylon 6	PET	Acrylic		Rayon	Cotton	Silk	Wool
Specific gravity	1.14	1.39	1.18	1.25	1.52	1.52	1.34	1.31
Tenacity (cN/tex)	42 - 48	45 - 55	30 - 35	30 - 35	20 - 25	20 - 40	32 - 38	12 - 20
Moisture content (%)	4 - 4.5	0.2 - 0.4	1.0 - 2.0	0.4 - 0.6	11 - 13	7 - 8	10.0	14 - 18
Melting point (°C)	215	255	320	170	none	none	none	none

Fibre Stress Strain Data





INGEO™ Short Staple Spinning

- Fibre characteristics similar to other thermoplastic fibres:
 - controlled crimp
 - smooth surface
 - low moisture regain
- Processing conditions usually similar to 100% polyester.
- Be aware of low melt point / high friction generating heat
- Yarns:
 - Good regularity
 - Few imperfections
 - High elongation

DETAILED TECHNICAL MANUAL AVAILABLE

- **Blending**
 - Required for consistent dye uptake
 - Blending with other fibres possible
- **Opening**
 - One opening
 - Too much opening
 - Increased neps
 - Fibre damage
- **Finish**
 - Already applied
 - No need for overspray

- **Carding**
 - Similar to PET settings
 - Cotton type cards too aggressive
 - 23 – 27°C, 50 – 55% RH
 - Speeds, 35 – 50Kg/hr
 - Regularity <4.0CV%
 - Nep count low, often zero

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- **Drawing**
 - Two passages
 - Minimum nip pressures
(tongue and groove rollers in particular)
 - Speeds, 400m/min with 4 – 5gm/m sliver
 - Regularity around 2.5CV%
- **Roving**
 - Twist levels as PET (around 0.8TM)
 - Speeds up to 1,200rpm
 - Regularity 4.0 – 4.5 CV%

- **Spinning**

- 23 – 28°C, 45 – 50% RH
- Twist
 - 3.60TF for knitting
 - 3.85TF for weaving
- Regularity
 - Ne10, 8 - 8.5CV%
 - Ne 30, 12-13CV%

- **Splicing**

- Settings as PET for most types
- Strength around 85% of parent yarn (min 60%)

- **Steaming**
 - If needed - to reduce knit fabric spirality
 - 80°C for 20 mins
 - Good vacuum and consistent control
 - Minimal effect on disperse dye uptake
- **Winding**
 - Reduce speeds to prevent surface abrasion
 - Care on winding tensions - usually reduced
 - Lower melting point waxes advised



Short Staple Yarn Properties

1.5dtex 38mm INGEO Fibre - Ring Spun - Cones				
Count (Ne)	10	20	30	40
Tenacity (cN/tex)	19-20	18-19	16.5-18.5	14.5-16
Elongation (%)	30-32	28-30	25-27	24-26
CV% (UT3/4)	8-8.5	10.2-11	12-13	14-15
Thins -50%	0	0	0-1	15-25
Thicks +50%	1-2	2-4	10-13	25-40
Neps +200%	1-2	2-4	15-25	30-50
Hairiness (UT3H)	-	-	7-8	-



INGEO™ Long Staple Spinning

- 3.3dtex variable (Bias) cut 80-110mm semi dull fibre
- Carded and combed tops – no stretch breaking tow
- Care with additives to prevent accidental weakening of fibres
- Conventional blending and gilling, usually with wool
- Rubbed or twisted roving
- Spinning to normal limits (typically 48Nm) with normal worsted twist
- Folding, winding and waxing as for polyester/wool blends

Yarn properties dependent on the wool, but similar to those for 100% wool generally



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3. Yarn to Fabric

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Ingeo™ Fabric Formation - Knitting

- **No major issues**
- **Knit as for most other yarns**
- **Stitch lengths:**
 - **Staple yarns - similar or slightly longer than for cotton**
 - **Filament yarns - up to 20% longer than for PET**
 - **Experiment to give desired aesthetic / performance**
- **Avoid excessive takedown tensions**
- **Circular or flat bed knitting**



Ingeo™ Fabric Formation - Weaving

- **No special techniques have been found necessary.**
- **Some guidelines:**
 - **Warping** ⇒ **high yarn elongation - minimum yarn tension (0.3 - 0.35g/denier)**
 - **Sizing** ⇒ **avoid strong alkaline conditions in desize:**
 - **PVA sizing (or other water soluble size)**
 - **typical size conditions:**
 - 8-10% PVA**
 - Size box temperature 35 to 40° C**
 - Drying temperature of 75 to 85° C**
 - Slight warp sheet overfeed (~6%)**

- **Weaving** ⇒ no major issues - use minimum warp tension
 - use good weft yarn tension control
- **Fabrics** ⇒ structures to allow for ~15% shrinkage, greige to finished
 - ⇒ Ingeo™ is sensitive to hot ironing, so consider:
 - natural fibre warp faced constructions (safe ironing on warp face)
 - formal wear products (minimum/cool ironing)



More information at www.ingeofibers.com



humanity, nature and technology in balance





IMPORTANT NOTES:

1) The information provided in this document is given in good faith based on the best knowledge of current technology.

The information provided can only be taken as a start point for trials to establish production routes for Ingeo™ fibre products.

Cargill Dow cannot be held responsible for any claims arising from the information contained within this document, howsoever caused.

2) Yarns produced from different merges, and from different suppliers of INGEO(TM) PLA fibers, may vary in dye uptake, which can influence the reproducibility of shades. It is therefore recommended that before carrying out any production dyeing on new merges or fiber from new suppliers, that the dye recipe is verified by a laboratory check.

This is a similar procedure to other man made fibers, and so similar practices should be adopted to control color reproducibility at the final coloration stage.

INGEO (TM) is a trademark of NatureWorks LLC, 15305 Minnetonka Boulevard, Minnetonka, MN 55345-1512, USA

