

**Designing Nonwovens: Craft and Industrial Perspectives**

**Appendices**

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by

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Doctoral Thesis

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Stage 1 Practical Research Sampling Documentation

List of Tables

Table 1: Web Formation and Printbonding Investigations, Web Making and Bonding Details

Table 2: Spraybonding Investigation, Bonding Details

Table 3: Thermal Bonding Investigation, Web Formation Details and Bonding Details

Table 4: Design Development, Fabric Making Details

**Table 1: Web Formation and Printbonding Investigations, Web Making and Bonding Details**

Sample Number	Fibre	Fibre Preparation		Web Formation		Printing	
		Quantity of Fibre Used	Notes	Weight of Web	Number of Layers	Notes	
H1	Viscose	15g	Teased Carded by Hand	14g	1	Binder printed onto one side	
H2	Viscose	10g	Teased Carded by Hand	10g	1	Binder printed onto one side	
H3	Viscose	10g	Teased Carded by Hand	7g	2	Binder printed onto one side	
H4	Ramie	30g	Teased Carded by Hand	14g	1	Sprayed with starch before printing Binder printed onto one side	
H5	Ramie	15g	Teased	-	-	Sprayed with starch before printing Binder printed onto one side	
H6	Ramie	15g	Teased	-	1	Sprayed with starch before printing Binder printed onto both sides	
H7	Viscose	10g	Teased Carded by Hand	9g	2	Sprayed with water before printing Binder printed onto on both sides	
H8	Wool/linen Mix	15g	Teased Carded by Hand	10g	1	Sprayed with starch before printing Binder printed onto one side	
H9	Wool/linen Mix	15g	Teased Carded by Hand	10g	1	Sprayed with starch before printing Binder printed onto both sides	

Table 1 (Continued): Web Formation and Printbonding Investigations, Web Making and Bonding Details

Sample Number	Fibre	Fibre Preparation		Web Formation		Bonding: Print Bonding	
		Fibre Quantity	Notes	Weight of Web	Number of Layers	Notes	
H10	Tri lobal Nylon	10	Fibre Cut into shorter lengths	7g	1	Binder printed onto one side	
H11	Tencel	15g	Fibre Cut into shorter lengths	-	1	Netting incorporated Binder printed onto one side	
H12	Polyester	10g	Teased Carded by Hand	9g	2	Sprayed with water before printing Binder printed onto one side	
H13	Ployester	10g	Teased Carded by Hand	9g	2	Sprayed with water before printing Binder printed onto both sides	
H14	Polyester lux	10g	-	7g	1	Netting incorporated Binder printed onto one side	
H15	Polyester	10g	-	10g	1	Netting incorporated Binder printed onto one side	
H16	Polyester	10g	-	8g	1	Binder printed onto one side	

Table 2: Spraybonding Investigation, Bonding Details

Sample Number	Fibre	Fibre Preparation		Web Formation		Bonding: Spray Bonding (Diluted Solutose C)
		Fibre Quantity	Notes	Weight of Web	Number of Layers	
H17	Tencel	15g	Cut into smaller lengths/chunks	-	2	Sprayed on one side
H18	Trylobal Nylon	10g	Cut into smaller lengths/chunks	7g	2	Sprayed on one side
H19	Polyester Lux	10g	None	7g	1	Sprayed on one side
H20	Tencel	15g	Cut into smaller lengths/chunks	-	2	Sprayed on both sides
H21	Trylobal Nylon	10g	Cut into smaller lengths/chunks	7g	2	Sprayed on both sides
H22	Polyester Lux	10g	None	7g	1	Sprayed on both sides

Table 3: Thermal Bonding Investigation, Web Formation Details and Bonding Details

Sample Number	Fibre Type(s)	Fibre Preparation		Web Formation		Bonding: Thermal Bonding			
		Quantity of Fibre/Fibre Blend	Notes	Weight of Web	Number of Layers	Temperature (°C)	Dwell Time (Seconds)	No. Times Pressed	Notes
H23	Silk/Polyester Bi-component	5g Silk 5g Polyester	Silk Cut into smaller lengths/chunks Teased Carded/Blended by Hand	10g	½	180	10	1	-
H24	Silk/Polyester Bi-component	5g Silk 5g Polyester	Silk Cut into smaller lengths/chunks Teased Carded/Blended by Hand	10g	½	180	10	2	Reverse side of face up for second Press
H25	Silk/Polyester Bi-component	5g Silk 5g Polyester	Silk Cut into smaller lengths/chunks Teased Carded/Blended by Hand	10g	2	180	10	2	Reverse side of face up for second Press
H26	Silk/Polyester Bi-component	5g Silk 5g Polyester	Silk Cut into smaller lengths/chunks Teased Carded/Blended by Hand	10g	-	-	-	-	-
H27	Silk/Polyester Bi-component	5g Silk 5g Polyester	Silk Cut into smaller lengths/chunks Teased Carded/Blended by Hand	10g	2	180	10	1	-

Table 3 (continued): Thermal Bonding Investigation, Web Formation Details and Bonding Details

Sample Number	Fibre Type(s)	Fibre Preparation		Web Formation		Bonding: Thermal Bonding			
		Quantity of Fibre/Fibre Blend	Notes	Weight of Web	Number of Layers	Temperature (°C)	Dwell Time (Seconds)	No. Times Pressed	Notes
H28	Silk/Polyester Bi-component	5g Silk 5g Polyester	Silk Cut into smaller lengths/chunks Teased Carded/Blended by Hand	10g	½	50	10	1	-
H29	Silk/Polyester Bi-component	5g Silk 5g Polyester	Silk Cut into smaller lengths/chunks Teased Carded/Blended by Hand	10g	½	80	10	1	-
H30	Silk/Polyester Bi-component	5g Silk 5g Polyester	Silk Cut into smaller lengths/chunks Teased Carded/Blended by Hand	10g	1	80	10	2	Reverse side of face up for second press
H31	Silk/Polyester Bi-component	5g Silk 5g Polyester	Silk Cut into smaller lengths/chunks Teased Carded/Blended by Hand	10g	1	80	10	1	-
H33	Ramie/Polyester Bi-component	6g Ramie 8g Polyester	Polyester drum carded and ramie fibres carded on top	12g	½	180	10	1	-
H34	Ramie/Polyester Bi-component	6g Ramie 8g Polyester	Polyester drum carded and ramie fibres carded on top	12g	½	180	10	4	Pressed twice on each side
H35	Ramie/Polyester Bi-component	6g Ramie 8g Polyester	Polyester drum carded and ramie fibres carded on top	12g	1	180	10	1	-

Table 3 (continued): Thermal Bonding Investigation, Web Formation Details and Bonding Details

Sample Number	Fibre Type(s)	Fibre Preparation		Web Formation		Bonding: Thermal Bonding			Notes
		Quantity of Fibre/Fibre Blend	Notes	Weight of Web	Number of Layers	Temperature (°C)	Dwell Time (Seconds)	No. Times Pressed	
H36	Ramie/Polyester Bi-component	6g Ramie 8g Polyester	Polyester drum carded and ramie fibres carded on top	12g	1	180	10	6	Pressed three times on each side
H37	Ramie/Polyester Bi-component	6g Ramie 8g Polyester	Polyester drum carded and ramie fibres carded on top	12g	2	180	10	1	-
H38	Ramie/Polyester Bi-component	6g Ramie 8g Polyester	Polyester drum carded and ramie fibres carded on top	12g	½	50	10	2	Reverse side of face up for second Press
H39	Ramie/Polyester Bi-component	6g Ramie 8g Polyester	Polyester drum carded and ramie fibres carded on top	12g	½	80	10	1	-
H40	Trilobal Nylon/Polyester Bi-component	13g Trilobal Nylon 15g Polyester	Web of each fibre made separately and layered together	-	1	100	10	1	-
H41	Trilobal Nylon/Polyester Bi-component	13g Trilobal Nylon 15g Polyester	Web of each fibre made separately and layered together	-	2	100	10	1	Nylon layers between Polyester layers
H42	Trilobal Nylon/Polyester Bi-component	13g Trilobal Nylon 15g Polyester	Web of each fibre made separately and layered together	-	2	100	10	1	Polyester layers between Nylon layers

Table 3 (continued): Thermal Bonding Investigation, Web Formation Details and Bonding Details

Sample Number	Fibre Type(s)	Fibre Preparation		Web Formation		Bonding: Thermal Bonding			
		Quantity of Fibre/Fibre Blend	Notes	Weight of Web	Number of Layers	Temperature (°C)	Dwell Time (Seconds)	No. Times Pressed	Notes
H43	Trilobal Nylon/Polyester Bi-component	13g Trilobal Nylon 15g Polyester	Nylon web made by teasing fibres by hand rather than drum carding	-	-	100	10	1	-
H44	Wool, Silk, Linen, Mix/Polyester Bi-component	8g Wool 2g Polyester	Fibres teased and blended by hand before drum carding	9g	½	50	10	4	Pressed twice on each side
H45	Wool, Silk, Linen, Mix/Polyester Bi-component	8g Wool 2g Polyester	Fibres teased and blended by hand before drum carding	9g	½	80	10	4	Pressed twice on each side
H46	Wool, Silk, Linen, Mix/Polyester Bi-component	8g Wool 2g Polyester	Fibres teased and blended by hand before drum carding	9g	1	180	10	1	-
H47	Wool, Silk, Linen, Mix/Polyester Bi-component	8g Wool 2g Polyester	Fibres teased and blended by hand before drum carding	9g	1	180	10	2	Pressed once on each side
H48	Wool, Silk, Linen, Mix/Polyester Bi-component	8g Wool 2g Polyester	Fibres teased and blended by hand before drum carding	9g	2	180	10	1	-
H49	Wool, Silk, Linen, Mix/Polyester Bi-component	8g Wool 2g Polyester	Fibres teased and blended by hand before drum carding	9g	2	180	10	2	Pressed once on each side

Table 3 (continued): Thermal Bonding Investigation, Web Formation Details and Bonding Details

Sample Number	Fibre Type(s)	Fibre Preparation		Web Formation		Bonding: Thermal Bonding			
		Quantity of Fibre/Fibre Blend	Notes	Weight of Web	Number of Layers	Temperature (°C)	Dwell Time (Seconds)	No. Times Pressed	Notes
H50	Viscose (Lenzing)/ Polyester bi-component	6g Viscose 4g polyester	Fibres teased and blended by hand before drum carding	10g	½	50	10	2	Pressed once on each side
H51	Viscose (Lenzing)/ Polyester bi-component	6g Viscose 4g polyester	Fibres teased and blended by hand before drum carding	10g	½	80	10	2	Pressed once on each side
H52	Viscose (Lenzing)/ Polyester bi-component	6g Viscose 4g polyester	Fibres teased and blended by hand before drum carding	10g	½	80	10	4	Pressed twice on each side
H53	Viscose (Lenzing)/ Polyester bi-component	6g Viscose 4g polyester	Fibres teased and blended by hand before drum carding	10g	1	180	10	1	-
H54	Viscose (Lenzing)/ Polyester bi-component	6g Viscose 4g polyester	Fibres teased and blended by hand before drum carding	10g	2	180	10	1	-
H55	Viscose (Lenzing)/ Polyester bi-component	6g Viscose 4g polyester	Fibres teased and blended by hand before drum carding	10g	2	180	10	1	-
H56	Viscose (Lenzing)/ Polyester bi-component	6g Viscose 4g Polyester	Fibres teased and blended by hand before drum carding	10g	4	180	10	1	-

Table 3 (continued): Thermal Bonding Investigation, Web Formation Details and Bonding Details

Sample Number	Fibre Type(s)	Fibre Preparation		Web Formation		Bonding: Thermal Bonding			
		Quantity of Fibre/Fibre Blend	Notes	Weight of Web	Number of Layers	Temperature (°C)	Dwell Time (Seconds)	No. Times Pressed	Notes
H57	Polyester Lux/ Polyester Bi- component	6g Lux 3g Bi- component	Fibres teased and blended by hand before drum carding	9g	1	100	10	2	Pressed once on each side
H58	Polyester Lux/ Polyester Bi- component	6g Lux 3g Bi- component	Fibres teased and blended by hand before drum carding	9g	4	100	10	2	Pressed once on each side
H59	Polyester Lux/ Polyester Bi- component	6g Lux 3g Bi- component	Fibres teased and blended by hand before drum carding	9g	4	100	10	1	-
H60	Polyester (montefibre)/ Polyester Bi- component	6g Polyester (Montefibre) 3g Bi- component	Fibres teased and blended by hand before drum carding	9g	1	180	10	1	-
H61	Polyester (montefibre)/ Polyester Bi- component	6g Polyester (Montefibre) 3g Bi- component	Fibres teased and blended by hand before drum carding	9g	1	180	10	2	Pressed once on each side
H62	Polyester (montefibre)/ Polyester Bi- component	6g Polyester (Montefibre) 3g Bi- component	Fibres teased and blended by hand before drum carding	9g	1	180	10	4	Pressed twice on each side

Table 4: Design Development, Fabric Making Details

Design Aim	Blending and layering fibres with contrasting tone and or texture to create visual texture in the resulting web and fabric/ Embedding additional fibres/fibre motifs onto the surface of the web									
Sample Number	Fibre Type(s), Quantity and Blend	Fibre Preparation	Web Formation			Thermal Bonding				
		Notes	Weight of Web	No. Layers	Notes	Temp (°C)	Dwell Time (Seconds)	No. Times Pressed	Notes	
H63	3g Polyester Bi-component blended with 7g Dark grey Silk. 3g Polyester Bi-component 7g Wool linen Mix.	Fibres Teased to open. Silk and wool blended separately with bi-component using hand cards	9g	½ layer of each web	Two separate webs made (one silk/polyester and one wool mix/polyester). Each spilt in half and layered together	180	10	1	Pressed on the wool mix side	
H64	3g Polyester Bi-component blended with 7g dark grey Trilobal Nylon. Small quantity of light Grey Trilobal Nylon.	Dark grey nylon cut into smaller lengths and blended with bi-component using hand cards, light grey nylon teased open	8g	1	Dark grey nylon and polyester blend carded to create base web, light grey nylon arranged by hand on the surface of the web and lightly tacked using a barbed needle	180	10	2	Pressed once on each side	
H65	3g Polyester Bi-component Blended with 7g dark grey silk. Small quantity of Wool/Linen/Silk Mix.	Polyester and silk teased to open and blended using hand cards.	9g	1	Silk and polyester blend carded to create base web. Small quantity of wool mix added to the surface of the web on card	100	10	1	-	

Table 4 (continued): Design Development, Fabric Making Details

Design Aim	Blending and layering fibres with contrasting tone and or texture to create visual texture in the resulting web and fabric/ Embedding additional fibres/fibre motifs onto the surface of the web									
Sample Number	Fibre Type(s), Quantity and Blend	Fibre Preparation	Web Formation		Thermal Bonding					
		Notes	Weight of Web	No. Layers	Notes	Temp (°C)	Dwell Time (Seconds)	No. Times Pressed	Notes	
H66	3g Polyester Bi-component 7g silk. Additional silk fibres	Polyester and silk cut into smaller lengths teased to open and blended using hand cards. Additional silk fibre cut into chunks	8	1	Silk and polyester blend carded to create base web. Additional silk fibres added to the surface of the web on card and lightly tacked using a barbed needle	100	10	1	-	
H67	3g Polyester Bi-component 7g Dark grey ramie. Additional crimped, white Tencel® fibres		10	2	Ramie and polyester blend carded to create base web. Tencel® fibres added to the surface of the web on card and lightly tacked using a barbed needle	180	10	2	Pressed once on each side	

Table 4 (continued): Design Development, Fabric Making Details

Design Aim	Embedding additional fibres motifs onto the surface of the web									
Sample Number	Fibre Type(s), Quantity and Blend	Fibre Preparation	Web Formation			Thermal Bonding				
		Notes	Weight of Web	No. Layers	Notes	Temp (°C)	Dwell Time (Seconds)	No. Times Pressed	Notes	
H68	3g Polyester Bi-component blended with 7g Viscose (Lenzing), additional Silk fibres	Viscose and polyester teased to open and blended with polyester using hand cards	10g	1	Viscose and polyester blend carded to create base web. Silk fibres tacked onto the surface of the web once it had been pressed once	180	10	3	Pressed once before additional fibres were tack on, then pressed twice on each side	
H69	3g Polyester Bi-component blended with 7g Dark Grey Ramie, additional white Ramie fibres	Ramie cut into short lengths, teased to open and blended with polyester using hand cards	9g	1	Ramie and polyester blend carded to create base web. Ramie fibres tacked onto the surface of the web once it had been pressed once	180	10	3	Pressed once before additional fibres were tack on, then pressed twice on each side	

Table 4 (continued): Design Development, Fabric Making Details

Design Aim	Embedding additional fibres between layers of web and onto the surface of the web									
Sample Number	Fibre Type(s), Quantity and Blend	Fibre Preparation	Web Formation			Thermal Bonding				
		Notes	Weight of Web	No. Layers	Notes	Temp (°C)	Dwell Time (Seconds)	No. Times Pressed	Notes	
H70	3g Polyester Bi-component blended with 7g Light grey Viscose (Lenzing) Additional Dark Grey Ramie Fibres	Viscose and polyester teased to open and blended with polyester using hand cards	10g	3	Viscose and polyester blend carded to create base web. Additional Ramie fibres added between layers of the web. Further fibres tacked onto the surface of the web once it had been pressed once	180	10	3	Pressed once before additional fibres were tack on, then pressed twice on each side	
H71	3g Polyester Bi-component 7g Light grey Viscose (Lenzing) Additional Dark Grey Ramie Fibres	Viscose and polyester teased to open and blended with polyester using hand cards	10g	3	Viscose and polyester blend carded to create base web. Additional Ramie fibres added between layers of the web. Further fibres tacked onto the surface of the web in a circular motif once it had been pressed once	180	10	3	Pressed once before additional fibres were tack on, then pressed twice on each side	

Table 4 (continued): Design Development, Fabric Making Details

Design Aim	Adding novel fibres to the web during web formation to create pattern and texture									
Sample Number	Fibre Type(s), Quantity and Blend	Fibre Preparation		Web Formation			Thermal Bonding			
		Notes		Weight of Web	No. Layers	Notes	Temp (°C)	Dwell Time (Seconds)	No. Times Pressed	Notes
H72	3g Polyester Bi-component blended with 7g dark grey silk. Small quantity of Wool/Linen/Silk Mix, additional metallic fibres (Angelina Hot melt?)	Polyester and silk teased to open and blended using hand cards.		9g	2	Silk and polyester blend carded to create base web. Small quantity of wool mix added to the surface of the web on card. Metallic fibres added between layers of web	100	10	2	Pressed once on each side
H73	3g Polyester Bi-component blended with 7g Cashmere, additional metallic fibres (Angelina Hot melt?)	Polyester and cashmere teased to open and blended using hand cards.		9g	2	Cashmere and polyester blend carded to create base web. Metallic fibres added between layers of web	180	10	2	Pressed once on each side
H74	3g Polyester Bi-component blended with 7g Cashmere, additional metallic fibres (Angelina Hot melt?)	Polyester and cashmere teased to open and blended using hand cards.		9g		Cashmere and polyester blend carded to create base web. Metallic placed on top of the web before bonding	180	10	2	Pressed once on each side

Table 4 (continued): Design Development, Fabric Making Details

Design Aim		Creating fabrics with contrasting reverse sides through layering webs of different fibre or tone									
Sample Number	Fibre Type(s), Quantity and Blend	Fibre Preparation		Web Formation			Thermal Bonding				
		Notes	Weight of Web	No. Layers	Notes	Temp (°C)	Dwell Time (Seconds)	No. Times Pressed	Notes		
H78	3g Polyester Bi-component blended with 7g Dark grey Ramie, 3g Polyester Bi-component blended with 7g wool/linen/silk mix.	Ramie and wool mix teased to open and blended separately with polyester using hand cards for two separate webs	10g 8g	1 ½	Two separate webs made – one with ramie and polyester blend on with wool mix and polyester. Wool mix web split and half layered on top of ramie web	180	10	2	Pressed once on each side		
H79	3g Polyester Bi-component blended with 7g wool/linen/silk, 3g Polyester Bi-component blended with 7g dark grey Trilobal Nylon. Small quantity of light Grey Trilobal Nylon.	Wool mix and polyester teased to open and blended using hand cards, dark grey nylon cut into smaller lengths and blended with bi-component using hand cards, light grey nylon teased open	10g	3	Dark grey nylon and polyester blend carded to create base web, light grey nylon arranged by hand on the surface of the web and lightly tacked using a barbed needle. Wool mix web carded separately and layered on top of Nylon web	180 °C	10	2	Pressed once on each side		

Table 4 (continued): Design Development, Fabric Making Details

Design Aim	Incorporating yarns and threads at the web forming stage to incorporate stripes into the fabric									
Sample Number	Fibre Type(s), Quantity and Blend	Fibre Preparation	Web Formation			Thermal Bonding				
		Notes	Weight of Web	No. Layers	Notes	Temp (°C)	Dwell Time (Seconds)	No. Times Pressed	Notes	
H80	3g Polyester bi-component blended with 7g wool/linen/silk.	Blended in drum card before web formation.	-	1 (split)	Yarns sandwiched between fibre layers before thermal bonding.	180	10	2	-	
H81	3g Polyester bi-component blended with 7g Ramie (dyed).	Blended in drum card before web formation	-	1 (split)	Yarns sandwiched between fibre layers before thermal bonding.	180	10	2	-	
H82	3g Polyester bi-component blended with 7g silk (dyed).	Blended in drum card before web formation.	-	1 (split)	Yarns sandwiched between fibre layers before thermal bonding.	180	10	2	-	

1.Printing and Dyeing Information

1.1 Print Paste Recipes

1.1.1Procion Dye

0 – 6%	Procion Dye
8%	Urea
X%	Hot Water
	Stirred well to dissolve dye
65% - 70%	Stock Thickener- Manutex F

100%

1.1.2 Acid Dye

0 – 3%	Acid Dye
1 – 5%	Glydote BN
5%	Glycerine
	Pasted well
X%	Boiling Water
	Stirred well to dissolve dye
55 – 60%	Gum Tragacanth Thickener
2%	Ammonium Oxalate

100%

1.2 Dye Procedures

Celluosic Fibres	Direct Dye
Wool and Silk	Acid Dye
Polyester Bicomponent	Disperse Dyes (Limited to Terasil Yellow 4G, Pink 3G, Blue BGE.01 200%, Red 3BL.01 150% and Blue 3RL.02 150%)

1.2.1 Procedure for Dying with Direct and Acid Dyes

- Fibre/Fabric is weighed
- Quantity of dye is calculated:  
Dye (g) = weight of fibre/fabric (g) x % of dye (depth of shade)

- Dye is weighed, a little cold water is added and pasted well, boiling water is added and stirred to completely dissolve the dye
- Quantity of water for dye bath is calculated:  

$$\text{Water (ml)} = \text{weight of fibre/fabric (g)} \times 40$$
- Quantity of Salt (for Direct Dye) or Acetic Acid (for Acid Dye) is calculated  

$$\text{Salt / Acid (g)} = \text{weight of fibre/fabric} \times 10\% - 30\% \text{ (dependent on depth of shade)}$$

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100%

- Fibre/fabric is wet thoroughly in warm water
- Half of the dye solution is added to bucket (bath) of water and stirred
- Wetted out fibre/fabric is added and stirred continuously whilst heated to boiling point
- After five minutes the fibre/fabric is removed and the salt / acid is added, fibre/fabric is returned to the bath for 5 minutes
- Fibre/fabric is removed and remaining dye solution is added, fibre/fabric is returned to bath and boiled for a further 30 -45 minutes to fix the dye

## 1.2.2 Procedure for Dyeing Bi-component Polyester with Terasil Dyes

- Fibre/Fabric is weighed
- Quantity of dye is calculated:  

$$\text{Dye (g)} = \text{weight of fibre/fabric (g)} \times \% \text{ of dye (depth of shade)}$$

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100

- Quantity of water is calculated:
- $\text{Water (ml)} = \text{weight of fibre/fabric (g)} \times 40$
- Quantity of assistants is calculated
- 0.25g/l Albegal FFA
- acetic acid to pH 5.0
- 0 – 2g/l Univadine DIF (dependant on depth of shade)
- 0 – 2g/l Irgasol DAM pdr (dependent on depth of shade)
- Fibre is thoroughly wetted in cold water and added to dye bath
- At 25°C fibre is removed and assistants are added, fibre is returned to bath for 15 minutes at 25°C
- Temperature of dye bath is raised to 45°C at 1°C/minute
- Fibre remains in bath at 45°C for 30 – 60 minutes

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**Stage 2 Practical Research Sampling Documentation**

**List of Tables**

Table 5: Pilot Scale Work with Texon UK, Web Making Details

Table 6: Pilot Scale Work with Texon UK, Calendering Details

Table 7: Pilot Scale Work with Texon UK, Heat Pressing Details

Table 8: Work with the Nonwovens Research Group University of Leeds, Web Making Details

Table 9: Work with the Nonwovens Research Group University of Leeds, Calendering and Needle-punching Details

Table 10: Work with the Nonwovens Research Group University of Leeds, Heat Pressing Details

Table 11: Work with the Centre for Materials Research and Innovation at Bolton University, Web Making Details

Table 12: Work with the Centre for Materials Research and Innovation at Bolton University, Web Bonding Details

Table 5: Pilot Scale Work with Texon UK, Web Making Details

Sample Number	Fibre Type and Quantities	Notes on Web Forming	Form of Bonding (Further Details in table 6 and 7)
T1	Hoest T254 16g	Ramie fibres placed between layers of web on the lap drum during web formation	Heat Press
T2	Hoest T254 16g	Ramie fibres placed between layers of web on the lap drum during web formation	Needle Punched Heat Pressed
T3	Hoest T254 3g Ramie 25g	Ramie fibres placed between layers of web on the lap drum during web formation	Calendered
T4	Hoest T245 12g Viscose 50g	Ramie fibres placed between layers of web on the lap drum during web formation	Calendered
T5	Hoest T245 12g Viscose 50g	Ramie fibres placed between layers of web on the lap drum during web formation	Calendered
T6	Hoest T245 10g Ramie 20g	Ramie fibres placed between layers of web on the lap drum during web formation	Calendered
T7	Polyester 40g	Ramie fibres placed between individual webs following carding and layering	Needle Punched
T8	Hoest T245 3.3g Wool/Silk/Linen Mix 30g	Yarn wound in between layers of web on the lap drum during web formation	Calendered
T9	Hoest T245 1.5g Wool/Silk/Linen Mix 13g	Yarn wound in between layers of web on the lap drum during web formation	Calendered
T10	Hoest T245 12g Viscose 50g	Yarn wound in between layers of web on the lap drum during web formation	Calendered
T11	Hoest T254 3g Ramie 7g	Fabric pieces placed between layers of web on the lap drum during web formation	Calendered
T12	Hoest T245 7g Viscose 13g	Fabric pieces placed between layers of web on the lap drum during web formation	Calendered
T13	Hoest T254 Ramie	Fabric placed between layers of web on the lap drum during web formation	Calendered
T14	Hoest T254 60g Viscose 120g	Fabric pieces placed between layers of web on the lap drum during web formation	Calendered
T15	Hoest T254 18g Viscose 36g	Fabric pieces placed between layers of web on the lap drum during web formation	Calendered

Table 5 (continued): Pilot Scale Work with Texon UK, Web Making Details

Sample Number	Fibre Type and Quantities	Notes on Web Forming	Form of Bonding (Further details in Tables 6 and 7)
T16	Hoest T254 64g Trilobal Nylon	Carded to create a layer of tri-lobal nylon between layers of binder fibre. Crimped fibre pieces placed between layers of web on the lap drum during web formation	Needle Punched Heat Pressed
T17	Hoest T254 5g Silk 20g Wool/Linen/Silk Mix 5g	Fibres placed on feed belt to create graduated tone and texture in the resulting web	Needle Punched Heat Pressed
T18	Hoest T254 18g Silk 36g	(Sample dyed following construction)	Heat Pressed
T19	Hoest T254 18g Silk 36g		Heat Pressed
T20	Hoest T254 3g Silk 7g		Calendered
T21	Hoest T254 60g Wool 120g	Fabric pieces placed between layers of web on the lap drum during web formation	Calendered
T22	Heavy silk	Heavy silk	

Table 6: Pilot Scale Work with Texon UK, Calendering Details

Sample Number	Calendering Parameters		
	Temperature (° C)	Gap Setting (mm)	No. Of Passes
T3C	150	0.35	1
T4C	120	0.2	1
T5C	120	0.2	1
T6C	150	0.2	1
T8C	150	0.35	1
T9C	150	0.35	1
T10C	150	0.2	1
T11C	150	0.18	1
T12C	150	0.35	1
T13C	150	0.35	2
T14C	150	0.6	1
T15C	150	0.6	1
T20C	150	0.18	1
T21C	150	0.6	1

Table 7: Pilot Scale Work with Texon UK, Heat Pressing Details

Sample Number	Heat Pressing Parameters		
	Temperature (° C)	Dwell Time (secs)	No. Of Presses
T1HP	180	10	1
T2HP	180	10	1
T16HP	115	10	1
T17HP	115	10	1
T18HP	180	10	2
T19HP	180	10	2

Table 8: Work with the Nonwovens Research Group University of Leeds, Web Making Details

Sample Number	Fibre Type and Quantities	Notes on Web Forming	Form of Bonding (Further details in tables 9 and 10)
N1	Ramie (dark grey) 30g Tri-lobal Nylon 30g Polyester Bi-co 40g	40% ratio of bi-component blended with each base fibre Carded so that one web sat on top of the other	Heat Pressed Calendered Needled/Calendered
N2	Ramie 30g Tri-lobal Nylon 30g Silk 30g Polyester Bi-co 60g	40% ratio of bi-component blended with each base fibre Fibres placed on feed belt to create graduated texture in the resulting web	Heat Pressed Calendered Needled/Calendered
N3	Ramie (dark grey) 30g Ramie (light grey) 30g Silk (light grey) 30g Polyester Bi-co	40% ratio of bi-component blended with each base fibre Fibres placed on feed belt to create graduated texture and colour in the resulting web	Heat Pressed Calendered Needled/Calendered
N4	Tri-lobal Nylon 50g Polyester Bi-co 100g	Carded to create a layer of tri-lobal nylon between layers of binder fibre. Floral fabric shapes scattered between layers of web on the feed belt during web formation	Heat Pressed Calendered Needled/Calendered
N5	Wool/Linen/Silk Mix 30g Polyester Bi-co 20g	40% ratio of bi-component blended with the base fibre Floral fabric shapes scattered randomly between layers of web on the feed belt during web formation Aim: visual depth	Heat Pressed Calendered Needled/Calendered
N6	Wool/Linen/Silk Mix 100g Polyester Bi-co 50g	33% ratio of bi-component blended with the base fibre Floral fabric shapes scattered along one side of the web between layers on the feed belt during web formation Aim: simple Compositional Consideration	Heat Pressed Calendered Needled/Calendered

**Table 8 (continued): Work with the Nonwovens Research Group University of Leeds, Web Making Details**

<b>Sample Number</b>	<b>Fibre Type and Quantities</b>	<b>Notes on Web Forming</b>	<b>Form of Bonding (Further details in tables 9 and 10)</b>
<b>N7</b>	Ramie 25g Polyester Bi-co 25g	50% ratio of bi-component blended with the base fibre. Ramie fibres placed between individual webs following carding and layering	Heat Pressed Calendered Needled/Calendered.
<b>N8</b>	Ramie 25g Polyester Bi-co 25g	50% ratio of bi-component blended with the base fibre Ramie fibres scattered randomly between layers of web on the feed belt during web formation	Heat Pressed Calendered Needled/Calendered.
<b>N9</b>	Viscose 100g Polyester Bi-co 50g	33% ratio of bi-component blended with the base fibre 2 pieces of cut fabric pieces placed between layers of web whilst on the feed belt	Heat Pressed Calendered Needled/Calendered.
<b>N10</b>	Viscose 300g Polyester Bi-co 200g	40% ratio of bi-component blended with the base fibre Cut fabric shapes scattered randomly between layers of web on the feed belt during web formation.	Heat Pressed Calendered Needled/Calendered.

Table 9: Work with the Nonwovens Research Group University of Leeds, Calendering and Needle-punching Details

Sample Number	Needling Parameters	Calendering Parameters			
	Needle Penetration Depth (mm)	Temperature (° C, top roller/bottom roller)	Pressure (Tones)	Speed/ Dwell Time (metres per minute)	No. Of Passes
N1.1		100/100	1.5	3	1
N1.2	?	100/100	1	3	1
N1.3	?	100/100	0.8	3	1
N1.4	?	100/100	1.5	4	1
N1.5	?	100/100	1	4	1
N1.6	?	100/100	1	6	1
N2.1	10	100/100	1	3	1
N2.2	8	100/100	1	4	1
N2.3	6	100/100	1	3	1
N3.1	10	100/100	1	3	1
N3.2	10	100/100	1.5	3	1
N3.3	6	100/100	2	3	1
N3.4	6	100/100	2	4	1
N3.5	8	100/100	1.5	4	1
N3.6	8	100/100	1	4	1
N4.1	6	100/100	2	3	1
N4.2	8	100/100	1	6	1
N4.3	10	100/100	1	6	1
N4.4	10	100/100	1	4	1
N4.5	10	100/100	2	3	1
N5.1	6	100/100	2	3	1
N5.2	8	100/100	1.5	4	1
N5.3	10	100/100	1.5	4	1

Table 9 (continued): Work with the Nonwovens Research Group University of Leeds, Calendering and Needle-punching Details

Sample Number	Needling Parameters	Calendering Parameters	Pressure (Tones)	Speed/ Dwell Time (metres per minute)	No. Of Passes
N6.1	Needle Penetration Depth (mm) 6	Temperature (° C, top roller/bottom roller) 100/100	1.5	4	1
N6.3	6	100/100	2	3	1
N6.4	8	100/100	1.5	4	1
N6.5	8	100/100	2	4	1
N6.6	8	100/100	2	3	1
N6.7	10	100/100	1.5	4	1
N6.8	10	100/100	2	4	1
N6.9	10	100/100	2	3	1
N6.10	6	100/100	2	4	1
N6.12	8	100/100	1.5	3	1
N6.13	8	100/100	2	4	1
N6.14	10	100/100	1	3	1
N8.1	10	100/100	1	4	1
N8.2	10	100/100	1.5	3	1
N8.3	10	100/100	1	5	1
N8.4	10	100/100	1	5	1
N8.5	10	100/100	1	6	1
N8.6	10	100/100	2	6	1
N9.1	10	-	-	-	-
N9.2	8 top side 10 bottom side	100/100	1.5	3	1
N9.3	8 top side 10 bottom side	100/100	2	3	1
N9.4	8 top side 10 bottom side	100/100	2	4	1

Table 9 (continued): Work with the Nonwovens Research Group University of Leeds, Calendering and Needle-punching Details

Sample Number	Needling Parameters	Calendering Parameters	Pressure (Tones)	Speed/ Dwell Time (metres per minute)	No. Of Passes
N9.5	Needle Penetration Depth (mm) 8 top side 10 bottom side	Temperature (° C, top roller/bottom roller) 100/100	2	3	1
N9.6	8 top side 10 bottom side	100/100 (cross direction)	2	3	1
N9.7	8 top side 10 bottom side	100/100 (cross direction)	2	3	1
N9.8	6 top side 10 bottom side	100/100	-	3	1
N10.1	6	100/100	2	3	1
N10.2	6	100/100	1	3	1
N10.3	8	100/100	2	4	1
N10.4	8	100/100	2	4	1

Table 10: Work with the Nonwovens Research Group University of Leeds, Heat Pressing Details

Sample Number	Heat Pressing Parameters		
	Temperature (° C)	Dwell Time (secs)	No. Of Presses
N1.7	130	10	1
N2.4	130	10	1
N3.4		-	-
N4.6	130	10	1
N5.4	130	10	2
N6.5	130	10	2
N7.1	130	10	1
N8.7	130	10	1
N9.9	115	10	1
N10.5	130	10	2

Table 11: Work with the Centre for Materials Research and Innovation at Bolton University, Web Making Details

Sample Number	Fibre Type and Quantities	Notes on Web Forming	Form of Bonding (Further details see Table 12)
C1.1	Wool/Linen/Silk/Mix 90% Polyester Bi-co 10%	Yarns placed between layers of web whilst on the feed belt between card and lapper	Needled and Calendered
C1.2	Wool/Linen/Silk/Mix 50% Polyester Bi-co 50%	Yarns placed between layers of web whilst on the feed belt between card and lapper	Needled and Calendered
C1.3	Wool/Linen/Silk/Mix 77% Polyester Bi-co 33%	Yarns placed between layers of web whilst on the feed belt between card and lapper	Needled and Calendered
C1.4	Wool/Linen/Silk/Mix 44% Polyester Bi-co 66%	Yarns placed between layers of web whilst on the feed belt between card and lapper	Needled and Calendered
C2.1	Viscose 10% Polyester Bi-co 90%	Fabric shapes placed between layers of web whilst on the feed belt between card and lapper	Needled and Calendered
C2.2	Viscose 50% Polyester Bi-co 50%	Fabric shapes placed between layers of web whilst on the feed belt between card and lapper	Needled and Calendered
C2.3	Viscose 77% Polyester Bi-co 33%	Fabric shapes placed between layers of web whilst on the feed belt between card and lapper	Needled and Calendered
C2.4	Viscose 44% Polyester Bi-co 66%	Fabric shapes placed between layers of web whilst on the feed belt between card and lapper	Needled and Calendered
C3.1	Ramie 10% Polyester Bi-co 90%	Fabric shapes placed between layers of web whilst on the feed belt between card and lapper	Needled and Calendered
C3.2	Ramie 50% Polyester Bi-co 50%	Fabric shapes placed between layers of web whilst on the feed belt between card and lapper	Needled and Calendered
C3.3	Ramie 77% Polyester Bi-co 33%	Fabric shapes placed between layers of web whilst on the feed belt between card and lapper	Needled and Calendered
C3.4	Ramie 44% Polyester Bi-co 66%	Fabric shapes placed between layers of web whilst on the feed belt between card and lapper	Needled and Calendered
C4.1	Silk 10% Polyester Bi-co 90%	Failed to card due to static	NA
C4.2	Silk 50% Polyester Bi-co 50%	Failed to card due to static	NA
C4.3	Silk 77% Polyester Bi-co 33%	Not manipulated	Needled and Calendered

Table 11 (continued): Work with the Centre for Materials Research and Innovation at Bolton University, Web Making Details

Sample Number	Fibre Type and Quantities	Notes on Web Forming	Form of Bonding (Further details in Table 12)
C4.4	Silk Polyester Bi-co	Not manipulated	Needled and Calendered
C5.1	Ramie Tri-lobal Nylon Polyester Bi-co	Carded so that one web sat on top of the other	Needled and Calendered
C5.2	Ramie Tri-lobal Nylon Polyester Bi-co	Carded so that one web sat on top of the other	Needled and Calendered
C5.3	Ramie Tri-lobal Nylon Polyester Bi-co	Carded so that one web sat on top of the other	Needled and Calendered
C5.4	Ramie Tri-lobal Nylon Polyester Bi-co	Carded so that one web sat on top of the other	Needled and Calendered

Table 12: Work with the Centre for Materials Research and Innovation at Bolton University, Web Bonding Details

Sample Number	Calendering Parameters				
	Needle Penetration Depth (mm)	Temperature (° C, top roller/bottom roller)	Pressure (Tones)	Speed/ Dwell Time (metres per minute)	No. Of Passes
C1.1.1	12	85/85	1	3	1
C1.1.2	12	100/100	1	3	1
C1.2.1	12	85/85	1	3	1
C1.2.2	12.	100/100	1	3	1
C1.3.1	12	85/85	1	3	1
C1.3.2	12	100/100	1	3	1
C1.4.1	12	85/85	1	3	1
C1.4.2	12	100/100	1	3	1
C2.1.1	12 (both sides)	100/100	2	4	1
C2.1.2	12 (both sides)	100/100	2	3	1
C2.1.3	12 (both sides)	100/100	1.5	4	1
C2.2.1	12 (both sides)	100/100	1.5	4	1
C2.3.1	12 (both sides)	100/100	1.5	4	1
C2.4.1	12 (both sides)	100/100	1.5	4	1
C3.1.1	12	85/85	1	3	1
C3.1.2	12	100/100	1	3	1
C3.2.1	12	85/85	1	3	1
C3.2.2	12	100/100	1	3	1
C3.3.1	12	85/85	1	3	1
C3.3.2	12	100/100	1	3	1
C3.4.1	12	85/85	1	3	1
C3.4.2	12	100/100	1	3	1
C4.2.1	12 (both sides)	85/85	1	3	1
C4.2.2	12 (both sides)	100/100	1	3	2
C4.3.1	12 (both sides)	85/85	1	3	1
C4.3.2	12 (both sides)	100/100	1	3	2
C4.4.1	12 (both sides)	85/85	1	3	1

Table 12 (continued): Work with the Centre for Materials Research and Innovation at Bolton University, Web Bonding Details

Sample Number	Calendering Parameters				
	Needle Penetration Depth (mm)	Temperature (° C, top roller/bottom roller)	Pressure (Tones)	Speed/ Dwell Time (metres per minute)/	No. Of Passes
C4.4.2	12 (both sides)	100/100	1	3	2
C5.1.1	12	85/85	1	3	1
C5.1.2	12	100/100	1	3	1
C5.2.1	12	85/85	1	3	1
C2.2	12	100/100	1	3	1
C5.3.1	12	85/85	1	3	1
C5.3.2	12	100/100	1	3	1
C5.4.1	12	85/85	1	3	1
C5.4.2	12	100/100	1	3	1

Stage 3 Practical Research Sampling Documentation

List of Tables

Table 13:	Embossing: Initial Investigations, Heat Pressing Details y
Table 14:	Embossing: Process Parameter Investigations, Fabric Making Details
Table 15:	Embossing: Process Parameter Investigations, Embossing Details and Observations
Table 16:	Embossing: Process Parameter Investigations, Embossing Details and Observations (2)
Table 17:	Embossing: Process Parameter Investigations, Embossing Details and Observations (3)
Table 18:	Printing: Initial Investigations, Procian and Acid Printing Details
Table 19:	Printing: Initial Investigations, Flocking Details and Observations
Table 20:	Printing: Initial Investigations, Foiling Details and Observations
Table 21:	Printing: Initial Investigations, Devoré Details and Observations
Table 22.1:	Process Parameter Investigations, Devoré Details and Observations
Table 22.2:	Process Parameter Investigations, Devoré Details and Observations
Table 22.3:	Process Parameter Investigations, Devoré Details and Observations
Table 22.4:	Process Parameter Investigations, Devoré Details and Observations
Table 22.5:	Process Parameter Investigations, Devoré Details and Observations
Table 22.6:	Process Parameter Investigations, Devoré Details and Observations
Table 23:	Laser Cutting and Marking Initial Investigations, Laser Cutting Details
Table 24:	Laser Cutting and Marking Initial Investigations, Laser Cutting Details
Table 25:	Process Parameter Investigations, Laser Marking Details and Observations
Table 26:	Process Parameter Investigations, Laser Marking Details and Observations
Table 27:	Process Parameter Investigations, Laser Marking Details and Observations

Table 13: Embossing: Initial Investigations, Heat Pressing Details

Sample Number (Original sample reference and table reference)	Embossing Details (Heat Press)		
	Plate	Temperature (°C)	Dwell Time (secs)
E1.1 (H31)	Steel (negative/female)	160	20
E1.2 (T14)	Steel	180	35
E1.3 (H72)	Steel	180	35
E1.4 (H75)	Steel	180	35
E1.5 (T22)	Steel	180	35
E1.6 (T14 and T16)	Steel	180	35
E1.7 (T16)	Steel	180	35
E1.8 (T8)	Steel	180	35
E1.9 (H72)	Steel	180	35
E1.10 (T10)	Steel	180	35
E1.11 (T10)	Steel	180	35
E1.12 (T14)	Steel	180	20
E1.13 (T14)	Steel	180	40
E1.14 (T14)	Steel	180	60
E1.15 (T14)	Copper	160	20
E1.16 (H70)	Copper	160	20
E1.17 (T10)	Copper	160	20
E1.18 (T14)	Copper	160	40
E1.19 (H70)	Copper	160	40
E1.20 (T10)	Copper	160	40
E1.21 (T14)	Copper	160	60
E1.22 (H70)	Copper	160	60
E1.23 (T10)	Copper	160	60
E1.24 (T8)	Lino	150	20
E1.25 (T8)	Lino (fabric wetted prior to embossing)	150	20
E1.26 (T14)	Lino (fabric wetted prior to embossing)	150	20
E1.27 (T14)	Lino	150	20

**Table 14: Embossing: Process Parameter Investigations, Fabric Making Details**

<b>Fabric Number</b>	<b>Fibre Type and Blend</b>	<b>Needle Depth (mm)</b>	<b>Advance Rate (mm per stroke of needle bed)</b>	<b>Number of Times Punched</b>	<b>Weight of Fabric Prior to Thermal Bonding (gsm<sup>2</sup>).</b>	<b>Thickness of Sample Prior to thermal Bonding (mm)</b>
E2.1	115g Viscose 50g Bi-component	5	15	2	260	3.90
E2.2	115g Viscose 50g Bi-component	5	15	1	242	4.20
E2.3	115g Viscose 50g Bi-component	12.5	15	1	250	3.40
E2.4	115g Viscose 50g Bi-component	12.5	15	2	280	3.52
E2.5	115g Viscose 50g Bi-component	10	15	1	280	3.50
E2.6	115g Viscose 50g Bi-component	2.5	15	1	253	3.08
E2.7	115g Viscose 50g Bi-component	5	10	2	228	3.77
E2.8	115g Viscose 50g Bi-component	5	22	2	259	4.95
E2.9	105g Ramie 45g Bi-component	5	15	2	223	3.48
E2.10	105g Ramie 45g Bi-component	5	15	1	-	-
E2.11	105g Ramie 45g Bi-component	2.5	15	1	285	3.55
E2.12	105g Ramie 45g Bi-component	10	15	1	258	3.49
E2.13	105g Ramie 45g Bi-component	5	10	1	264	3.43

**Table 14 (continued): Embossing: Process Parameter Investigations, Fabric Making Details**

<b>Fabric Number</b>	<b>Fibre Type and Blend</b>	<b>Needle Depth (mm)</b>	<b>Advance Rate (mm per stroke of needle bed)</b>	<b>Number of Times Punched</b>	<b>Weight of Fabric Prior to Thermal Bonding (gsm<sup>2</sup>) Nearest whole no.</b>	<b>Thickness of Sample Prior to thermal Bonding (mm) to 1dp</b>
E2.14	105g Ramie 45g Bi-component	5	10	2	248	3.17
E2.15	135g Ramie 15g Bi-component	5	15	2	-	-
E2.16	105g Ramie 45g Bi-component	5	15	2	-	-
E2.17	75g Ramie 75g Bi-component	5	15	2	-	-
E2.18	45g Ramie 105g Bi-component	5	15	2	-	-

Table 15: Embossing: Process Parameter Investigations, Embossing Details and Observations

Sample Number	Thermal Bonding Prior to Embossing				Embossing Details					
	Temp (°C)	Dwell Time (secs)	No. of Times Pressed	Temp (°C)	Dwell Time (secs)	No. Times pressed	Other details	Observations		
E2.18.1a	-	-	-	100	10	1	Metal pieces placed on top of fabric	Fabric not bonded Emboss evident at first but 'falls out'		
E2.18.1b	-	-	-	100	10	1	Metal pieces placed on top of fabric Wetted before embossed	Fabric not bonded Marks evident but no emboss		
E2.18.1c	-	-	-	100	10	1	Plate on top Wetted before embossed	Fabric not bonded Slight emboss		
E2.18.2a	100	10	1	100	10	1	Metal pieces placed on top	Fabric bonded Very stiff handle Smooth Surface Marks evident but no emboss		
E2.18.2b	100	10	1	100	10	1	Plate on top Wetted before embossed	Fabric bonded Very stiff handle Smooth surface No emboss evident but lumpy surface		
E2.18.2c	100	10	1	100	10	1	Metal pieces placed on top Wetted before embossed	Fabric bonded Very stiff handle Smooth surface Emboss evident but not defined		

Table 15 (continued): Embossing: Process Parameter Investigations, Embossing Details and Observations

Sample Number	Thermal Bonding Prior to Embossing			Embossing Details				Observations
	Temp (°C)	Dwell Time (secs)	No. of Times Pressed	Temp (°C)	Dwell Time (secs)	No. Times pressed	Other details	
E2.18.2d	100	10	1	100	10	1	Plate on top Wetted before embossed	Fabric bonded Very stiff handle Smooth surface Emboss evident but not defined
E2.17.1a	100	10	1	100	10	1	Metal pieces placed on top Pressed side face down Wetted before embossed	Fabric bonded Stiff handle Soft/tex surface Emboss evident and defined
E2.17.1b	100	10	1	100	10	1	Plate on top Pressed side face down Wetted before embossed	Fabric bonded Stiff handle Soft/tex surface Emboss evident and defined
E2.17.2a	100	10	2	100	10	1	Metal pieces placed on top Wetted before embossed	Fabric bonded Stiff handle Smooother surface than previous Emboss evident less defined previous

Table 15 (continued): Embossing: Process Parameter Investigations, Embossing Details and Observations

Sample Number	Thermal Bonding Prior to Embossing			Embossing Details				Observations
	Temp (°C)	Dwell Time (secs)	No. of Times Pressed	Temp (°C)	Dwell Time (secs)	No. Times pressed	Other details	
E2.17.2b	100	10	2	100	10	1	Plate on top Wetted before embossed	Fabric bonded Stiff handle Smoother surface than previous surface Emboss evident, less defined than previous
E2.16.1a	100	10	1	100	10	1	Metal pieces placed on top Pressed side face down Wetted before embossed	Fabric bonded Soft handle Soft surface Emboss evident and defined
E2.16.1b	100	10	1	100	10	1	Plate on top Pressed side face down Wetted before embossed	Fabric bonded Soft handle Soft surface Emboss evident
E2.16.2a	100	10	2	100	10	1	Metal pieces placed on top Wetted before embossed	Fabric bonded Soft handle Smoother than previous surface Emboss evident, less defined than previous

Table 15 (continued): Embossing: Process Parameter Investigations, Embossing Details and Observations

Sample Number	Thermal Bonding Prior to Embossing				Embossing Details					
	Temp (°C)	Dwell Time (secs)	No. of Times Pressed		Temp (°C)	Dwell Time (secs)	No. Times pressed	Other details	Observations	
E2.16.2b	100	10	2		100	10	1	Plate on top Wetted before embossed	Fabric bonded Soft handle Smoother than previous surface Emboss evident	
E2.15.1a	100	10	1		100	10	1	Metal pieces placed on top Pressed side face down Wetted before embossed	Fabric bonded Very soft handle Very soft surface Emboss evident but not defined	
E2.15.1b	100	10	1		100	10	1	Plate on top Pressed side face down Wetted before embossed	Fabric bonded Very soft handle Very soft surface Emboss not evident	
E2.15.2a	100	10	2		100	10	1	Metal pieces placed on top Wetted before embossed	Fabric bonded Stiffer handle than previous but still soft Smoother surface than previous but still soft Emboss evident and defined	

Table 15 (continued): Embossing: Process Parameter Investigations, Embossing Details and Observations

Sample Number	Thermal Bonding Prior to Embossing			Embossing Details				
	Temp (°C)	Dwell Time (secs)	No. of Times Pressed	Temp (°C)	Dwell Time (secs)	No. Times pressed	Other details	Observations
E.2.15.b	100	10	2	100	10	1	Plate on top Wetted before embossed	Fabric bonded Stiffer handle than previous but still soft Smooother surface than previous but still soft Emboss evident

Table 16: Embossing: Process Parameter Investigations, Embossing Details and Observations (2)

Sample Number	Embossing Details				Observations	
	Temp (°C)	Dwell Time (secs)	No. Times Pressed	Other details		
E2.16.3	100	20	1	Plate on top Wetted before embossed	Fabric bonded Soft handle Soft/tex surface Emboss evident	
E2.16.4	100	40	1	Plate on top Wetted before embossed	Fabric bonded Stiffer handle than previous but still soft Smoother surface than previous but still soft Emboss evident and more defined than previous	
E2.16.5	100	60	1	Plate on top Wetted before embossed	Fabric bonded Stiffer handle than previous but still soft Smoother surface than previous but still soft Emboss evident and more defined than previous Some yellowing on surface	
E2.16.6	150	10	1	Plate on top Wetted before embossed	Fabric bonded Handle similar to previous Surface similar to previous Emboss evident, definition as previous	
E2.16.7	150	20	1	Plate on top Wetted before embossed	Fabric bonded Handle stiff Surface smooth Emboss evident and more defined than previous	
E2.16.8	150	40	1	Plate on top Wetted before embossed	Fabric bonded Handle stiffer than previous Surface smoother than previous Emboss evident and more defined than previous Some yellowing on surface	

Table 16 (continued): Embossing: Process Parameter Investigations, Embossing Details and Observations (2)

Sample Number	Embossing Details				Observations	
	Temp (°C)	Dwell Time (secs)	No. Times Pressed	Other details		
E2.16.9	150	60	1	Plate on top Wetted before embossed	Fabric bonded Handle as previous Surface as previous Emboss as previous Slightly more yellowing on surface	
E2.16.10	180	10	1	Plate on top Wetted before embossed	Fabric bonded Handle slightly less stiff than previous Surface slightly softer/tex than previous Emboss evident, slightly less defined	
E2.17.3	100	20	1	Plate on top Wetted before embossed	Fabric bonded Handle stiff Surface soft/tex Emboss evident and defined	
E2.17.4	100	40	1	Plate on top Wetted before embossed	Fabric bonded Handle stiffer than previous Surface smoother than previous Emboss evident and more defined than previous	
E2.17.5	100	60	1	Plate on top Wetted before embossed	Fabric bonded Handle previous Surface slightly smoother than previous Emboss as previous	
E2.17.6	150	10	1	Plate on top Wetted before embossed	Fabric bonded Handle as previous Surface as previous Emboss evident, slightly less defined than previous	

Table 16 (continued): Embossing: Process Parameter Investigations, Embossing Details and Observations (2)

Sample Number	Embossing Details			Observations	
	Temp (°C)	Dwell Time (secs)	No. Times Pressed	Other details	
E2.17.7	150	20	1	Plate on top Wetted before embossed	Fabric bonded Handle stiffer than previous Surface smoother than previous Emboss evident, slightly more defined than previous Some yellowing on surface As previous
E2.17.8	150	40	1	Plate on top Wetted before embossed	
E2.17.9	150	60	1	Plate on top Wetted before embossed	Fabric bonded Very stiff handle, stiffer than previous Surface as previous Emboss evident and slightly more defined/higher than previous Some yellowing on surface
E2.17.10	180	10	1	Plate on top Wetted before embossed	Fabric bonded Very stiff handle, stiffer than previous Surface slightly smoother than previous Emboss evident, slightly less defined/high as previous Slight yellowing on surface
E2.18.3	150	10	1	Plate on top Wetted before embossed	Fabric bonded Very stiff handle Surface smooth Emboss evident and defined
E2.18.4	180	10	1	Plate on top Wetted before embossed	As previous Some yellowing

Table 16 (continued): Embossing: Process Parameter Investigations, Embossing Details and Observations (2)

Sample Number	Embossing Details				Observations
	Temp (°C)	Dwell Time (secs)	No. Times Pressed	Other details	
E2.15.3	150	10	1	Plate on top Wetted before embossed	Fabric bonded Soft handle Soft/tex surface Emboss evident and defined Slight yellowing
E2.15.4	180	10	1	Plate on top Wetted before embossed	Fabric bonded Soft handle Soft/tex surface Emboss evident and defined Slight yellowing

Table 17: Embossing: Process Parameter Investigations, Embossing Details and Observations (3)

Sample Number	Thermal Bonding Prior to Embossing			Embossing Details				Observations
	Temp (°C)	Dwell Time (secs)	No. Times Pressed	Temp (°C)	Dwell Time (secs)	No. Times Pressed	Other details	
E2.1.1a Viscose	100	10	1	150	10	1	Plate on top Wetted before embossed Grid and floral patterns	Fabric bonded Soft handle Soft surface (slightly lumpy background) Emboss evident and defined Yellowing in background surface
E2.1.1b	100	10	2	150	10	1	As previous	Fabric bonded Stiffer handle than previous Smooth background surface (soft raised areas) Emboss evident and more defined than previous Some yellowing in background
E2.2.1a	100	10	1	150	10	1	As previous	Fabric bonded Softer handle than previous (at 'a' settings) Soft surface (slightly lumpy background and loose fibres) Emboss evident and defined Yellowing in background surface
E2.2.1b	100	10	2	150	10	1	As previous	As previous (at 'b' settings)

Table 17 (continued): Embossing: Process Parameter Investigations, Embossing Details and Observations (3)

Sample Number	Thermal Bonding Prior to Embossing		Embossing Details				Observations
	Temp (°C)	Dwell Time (secs)	No. Times Pressed	Temp (°C)	Dwell Time (secs)	No. Times Pressed	Other details
E2.3.1a	100	10	1	150	10	1	As previous
E2.3.1b	100	10	2	150	10	1	Fabric bonded Soft handle (stiffer than previous at these settings) Soft surface (slightly lumpy background and loose fibres) Emboss evident and defined Yellowing in background As previous (at 'b' settings)
E2.4.1b	100	10	2	150	10	1	As previous (at 'a' settings) Slightly lumpier background As previous (at 'b' settings)
E2.5.1b	100	10	2	150	10	1	Fabric bonded Much stiffer handle (than all previous at these settings) Much smoother surface (than all previous at these settings) Emboss evident and more defined (than all previous at 'a' settings) Yellowing in background As previous (at 'b' settings) More yellowing As previous (at 'a' settings) As previous (at 'b' settings)
E2.5.1b	100	10	2	150	10	1	As previous
E2.6.1a	100	10	2	150	10	1	As previous
E2.6.1b	100	10	2	150	10	1	As previous

Table 17 (continued): Embossing: Process Parameter Investigations, Embossing Details and Observations (3)

Sample Number	Thermal Bonding Prior to Embossing		Embossing Details				Observations
	Temp (°C)	Dwell Time (secs)	No. Times Pressed	Temp (°C)	Dwell Time (secs)	No. Times Pressed	Other details
E2.7.1a	100	10	2	150	10	1	As previous
E2.7.1b	100	10	2	150	10	1	As previous
E2.8.1b	100	10	2	150	10	1	As previous at 'b' settings
E2.9.1b Ramie	100	10	2	150	10	1	As previous
E2.10.1b	100	10	2	150	10	1	As previous

Table 17 (continued): Embossing: Process Parameter Investigations, Embossing Details and Observations (3)

Sample Number	Thermal Bonding Prior to Embossing			Embossing Details				Observations	
	Temp (°C)	Dwell Time (secs)	No. Times Pressed	Temp (°C)	Dwell Time (secs)	No. Times Pressed	Other details		
E2.11.1b	100	10	2	150	10	1	As previous	Fabric bonded Stiffer handle than previous Slightly smoother surface than previous Embossing evident and defined Yellowing on background	
E2.12.1b	100	10	2	150	10	1	As previous	Fabric bonded Stiffer handle (than all previous in ramie) Surface as previous Embossing as previous Some yellowing on the surface	
E2.13.1b	100	10	2	150	10	1	As previous	Fabric bonded Slightly Softer handle (than all previous in ramie) Softer surface (than all previous in ramie) Embossing evident and defined, soft loose fibres on surface Some yellowing	

Table 17 (continued): Embossing: Process Parameter Investigations, Embossing Details and Observations (3)

Sample Number	Thermal Bonding Prior to Embossing		Embossing Details				Observations	
	Temp (°C)	Dwell Time (secs)	No. Times Pressed	Temp (°C)	Dwell Time (secs)	No. Times Pressed		
E2.14.1b	100	10	2	150	10	1	As previous	Fabric bonded Slightly stiffer handle than previous Slightly smoother surface than previous Embossing evident and defined More yellowing than all previous in ramie)

Table 18: Printing: Initial Investigations, Procian and Acid Printing Details

Sample Number (Fabric reference)	Printing Details (Conventional Printing)		
	Print Paste	Fixing	Washing off
P2.1.1 (C3.1)	1% Procian Dye (Grey) 8% Urea 70% Manutex F 21% Hot Water	Steamed for 15 minutes	Cold/hot rinses Gentle ironing on low setting
P2.1.2 (C3.3)	As above	As above	As above
P2.1.3 (C3.4)	As above	As above	As above
P2.1.4 (C2.1)	As above	As above	As above
P2.1.5 (C2.3)	As above	As above	As above
P2.1.6 (C2.4)	As above	As above	As above
P2.1.7 (2.3.1.1)	1% Acid Dye (Alizarine Grey) 5%Glydote BN 5%Glycerine 27% Boiling Water 60%Gum Tragacanth Thickener 2%Ammonium Oxalate	Steamed for 45 mins	As above
P2.1.8 (C1.2)	As above	As above	As above
P2.1.9 (C1.3)	As above	As above	As above
P2.1.10 (C1.4)	As above	As above	As above
P.1.11a (C4.1)	As above	As above	As above

Table 18 (continued): Printing: Initial Investigations, Procian and Acid Printing Details

Sample Number (Fabric reference)	Printing Details (Conventional Printing)		
	Print Paste	Fixing	Washing off
P2.1.11b (C4.1)	1% Acid Dye (Alizarine Grey) 5%Glydote BN 5%Glycerine 27% Boiling Water 60%Gum Tragacanth Thickener 2%Ammonium Oxalate	Steamed for 45 mins	Cold/hot rinses Gentle ironing on low setting
P2.1.12 (C4.2)	As above	As above	
P2.1.13 (C4.3)	As above	As above	
3.3.1.14 (C4.4)	As above	As above	
P2.1.15 (T10)	1% Procion Dye (Grey) 8% Urea 70% Manutex F 21% Hot Water	Steamed for 15 mins	As above
P2.1.16 (N8)	As above	As above	As above
P2.1.17 (T1)	As above	As above	As above
P2.1.18 (N10)	As above	As above	As above
P2.1.19 (T8)	1% Acid Dye (Alizarine Grey) 5%Glydote BN 5%Glycerine 27% Boiling Water 60%Gum Tragacanth Thickener 2%Ammonium Oxalate	Steamed for 45 mins	As above

Table 19: Printing: Initial Investigations, Flocking Details and Observations

Sample Number (Fabric reference)	Fibre Type and % of binder fibre	Flocking Details		Observations
		Temp (°C)	Dwell Time	
FL1a (C2.1)	Viscose 90% Polyester Bi-Component 10%	180	10	Fibres adhered to the printed areas Some flecks of fibre adhered to back ground surface
FL1b (C2.1)	Viscose 90% Polyester Bi-Component 10%	180	20	Fibres adhered to the printed areas Substantial flecks of fibre adhered to back ground surface
FL2a (C2.2)	Viscose 50% Polyester Bi-Component 10%	180	10	Fibre adhered to the printed areas Fibres adhered to entire background surface
FL2b (C2.2)	Viscose 50% Polyester Bi-Component 10%	180	20	Fibre adhered to the printed areas Dense covering of fibres adhered to entire background surface
FL3a (2.3.2.4)	Viscose 44% Polyester Bi-Component 66%	180	10	Fibre adhered to the printed areas Dense covering of fibres adhered to entire background surface
FL3a (C2.4)	Viscose 44% Polyester Bi-Component 66%	180	20	Fibre adhered to the printed areas Dense covering of fibres adhered to entire background surface
FL4a (C3.1)	Ramie 90% Polyester Bi-Component 10%	180	10	Fibre adhered to the printed areas Fibres adhered to entire background surface
FL4b (C3.1)	Ramie 90% Polyester Bi-Component 10%	180	20	Fibre adhered to the printed areas Fibres adhered to entire background surface
FL5a (C3.2)	Ramie 50% Polyester Bi-Component 50%	180	10	Fibre adhered to the printed areas Fibres adhered to entire background surface

**Table 19 (continued): Printing: Initial Investigations, Flocking Details and Observations**

Sample Number (Fabric reference)	Fibre Type and % of binder fibre	Flocking Details		Observations
		Temp (°C)	Dwell Time	
FL5b (C3.2)	Ramie 50% Polyester Bi-Component 50%	180	20	Fibre adhered to the printed areas Dense covering of fibres adhered to entire background surface
FL6a (C3.4)	Ramie 44% Polyester Bi-Component 66%	180	10	Fibre adhered to the printed areas Dense covering of fibres adhered to entire background surface
FL6b (C3.4)	Ramie 44% Polyester Bi-Component 66%	180	20	Fibre adhered to the printed areas Very Dense covering of fibres adhered to entire background surface Little distinction between print and background
FL7a (C4.1)	Silk 90% Polyester Bi-Component 10%	180	10	Fibres adhered to the printed areas Substantial flecks of fibre adhered to back ground surface
FL7b (C4.1)	Silk 90% Polyester Bi-Component 10%	180	20	Fibre adhered to the printed areas Fibres adhered to entire background surface
FL8a (C4.2)	Silk 50% Polyester Bi-Component 50%	180	10	Fibre adhered to the printed areas Fibres adhered to entire background surface
FL8b (C4.2)	Silk 50% Polyester Bi-Component 50%	180	20	Fibre adhered to the printed areas Fibres adhered to entire background surface
FL9a (C4.4)	Silk 44% Polyester Bi-Component 66%	180	10	Fibre adhered to the printed areas Dense covering of fibres adhered to entire background surface
FL9b (C4.4)	Silk 44% Polyester Bi-Component 44%	180	20	Fibre adhered to the printed areas Dense covering of fibres adhered to entire background surface

**Table 19 (continued): Printing: Initial Investigations, Flocking Details and Observations**

Sample Number (Fabric reference)	Fibre Type and % of binder fibre	Flocking Details		Observations
		Temp (°C)	Dwell Time	
FL10a (C1.1)	Wool/Linen/Silk Mix 90% Polyester Bi-Component 10%	180	10	Fibres adhered to the printed areas Some flecks of fibre adhered to back ground surface
FL10b (C1.1)	Wool/Linen/Silk 90% Polyester Bi-Component 10%	180	20	Fibres adhered to the printed areas Substantial flecks of fibre adhered to back ground surface
FL11a (C1.2)	Wool/Linen/Silk Mix 50% Polyester Bi-Component 50%	180	10	Fibre adhered to the printed areas Fibres adhered to entire background surface
FL12b (C1.2)	Wool/Linen/Silk 50% Polyester Bi-Component 50%	180	20	Fibre adhered to the printed areas Fibres adhered to entire background surface
FL12a (C1.4)	Wool/Linen/Silk Mix 44% Polyester Bi-Component 66%	180	10	Fibre adhered to the printed areas Dense covering of fibres adhered to entire background surface
FL12b (C1.4)	Wool/Linen/Silk 44% Polyester Bi-Component 66%	180	20	Fibre adhered to the printed areas Very Dense covering of fibres adhered to entire background surface Little distinction between print and background
FL13a (C5.2)	Ramie 25% Tri-lobal nylon 25% Polyester Bi-Component 50%	180	10	Fibre adhered to the printed areas Dense covering of fibres adhered to entire background surface
FL13b (C5.2)	Ramie 25% Tri-lobal nylon 25% Polyester Bi-Component 50%	180	20	Fibre adhered to the printed areas Dense covering of fibres adhered to entire background surface
FL14a (C5.4)	Ramie 22% Tri-lobal nylon 22% Polyester Bi-Component 66%	180	10	Fibre adhered to the printed areas Dense covering of fibres adhered to entire background surface
FL14b (C5.4)	Ramie 22% Tri-lobal nylon 22% Polyester Bi-Component 66%	180	20	Fibre adhered to the printed areas Very Dense covering of fibres adhered to entire background surface Little distinction between print and background

**Table 20: Printing: Initial Investigations, Foiling Details and Observations**

Sample Number (Fabric reference)	Fibre Type and % of binder fibre	Foiling Details		Observations
		Temp (°C)	Dwell Time	
FO1 (C3.1)	Ramie 50% Polyester Bi-Component 50%	180	10	Foil adhered to the printed areas Some foil adhered to back ground surface
FO2 (C3.2)	Ramie 50% Polyester Bi-Component 50%	180	10	Foil adhered to the printed areas Substantial quantity of foil adhered to back ground surface creating a rubbery surface
FO3 (C3.4)	Ramie 44% Polyester Bi-Component 66%	180	10	Foil adhered to the printed areas Dense covering of foil adhered to back ground surface creating a rubbery surface
FO4 (C1.1)	Wool/Linen/Silk Mix 90% Polyester Bi-Component 10%	180	10	Foil adhered to the printed areas Some foil adhered to back ground surface
FO5 (C1.2)	Wool/Linen/Silk Mix 50% Polyester Bi-Component 50%	180	10	Foil adhered to the printed areas Some foil adhered to back ground surface
FO6 (C5.4)	Ramie 22% Tri-lobal nylon 22% Polyester Bi-Component 66%	180	10	Foil adhered to the printed areas Substantial quantity of foil adhered to back ground surface creating a rubbery surface
FO7 (2.3.5.4)	Ramie 22% Tri-lobal nylon 22% Polyester Bi-Component 66%	180	10	Foil adhered to the printed areas Substantial quantity of foil adhered to back ground surface creating a rubbery surface
FO8 (C4.1)	Silk 90% Polyester Bi-Component 10%	180	10	Foil adhered to the printed areas Some foil adhered to back ground surface
FO9 (C4.2)	Silk 50% Polyester Bi-Component 50%	180	10	Foil adhered to the printed areas Some foil adhered to back ground surface
FO10 (C4.4)	Silk 44% Polyester Bi-Component 66%	180	10	Foil adhered to the printed areas Some foil adhered to back ground surface
FO11 (C2.1)	Viscose 90% Polyester Bi-Component 10%	180	10	Fibres adhered to the printed areas Some flecks of fibre adhered to back ground surface
FO12 (C2.4)	Viscose 44% Polyester Bi-Component 66%	180	10	Fibre adhered to the printed areas Dense covering of fibres adhered to entire background surface

Table 21: Printing: Initial Investigations, Devoré Details and Observations

Sample Number (Fabric reference)	Fibre Type and % of binder fibre	Fabric Weight (approx gsm <sup>2</sup> )	Devoree Details		Observations
			Temp (°C)	No. 'Blasts' (2 seconds each)	
D1 (C3.1)	Ramie Polyester Bi-co 10% 90%	-	180	3	Printed areas almost completely broken down Difficult to wash off due to delicacy and light weight of fabric resulting in residue paste on the surface Fabric breaking down and distressed
D2 (C3.2)	Ramie Polyester Bi-co 50% 50%	-	180	3	Printed areas significantly broken down resulting in sheer pattern compared to base fabric Handle crisp and crunchy Fabric retains it's structural integrity
D3 (C3.3)	Ramie Polyester Bi-co 77% 33%	-	180	3	Printed areas more significantly broken down than previous resulting in sheer pattern compared to base fabric Some residue paste on surface Handle crisp and crunchy Fabric retains it's structural integrity
3D4 (C3.4)	Ramie Polyester Bi-co 44% 66%	-	180	3	Printed areas not visually clear, no clear evidence of fabric breakdown Residue paste on surface creating a yellowing effect Very crisp and crunchy handle Fabric retains it's structural integrity

**Table 21 (continued): Printing: Initial Investigations, Devoré Details and Observations**

Sample Number (Fabric reference)	Fibre Type and % of binder fibre	Fabric Weight (approx gsm <sup>2</sup> )	Devoree Details		Observations
			Temp (°C)	No. 'Blasts' (2 seconds each)	
D5 (C2.1)	Viscose Polyester Bi-co	10% 90%	180	3	Printed areas significantly etched resulting in a three dimensional effect Needle punch marks evident on surface of printed areas Printed areas translucent when filtering light Soft surface and handle Fabric retains it's structural integrity
D6 (C2.2)	Viscose Polyester Bi-co	50% 50%	180	3	Printed areas significantly etched less than previous resulting in a subtle three dimensional effect Needle punch marks less evident on surface of printed areas than previous Fabric pieces revealed in printed areas Soft base surface, printed areas smoother/stiffer Stiffer handle than previous Fabric retains it's structural integrity
D7 (C2.3)	Viscose Polyester Bi-co	77% 33%	180	3	Printed areas significantly etched resulting in a three dimensional effect Needle punch marks less evident on surface of printed areas (as previous) Printed areas translucent when filtering light Soft surface and handle Fabric retains it's structural integrity

Table 21 (continued): Printing: Initial Investigations, Devoré Details and Observations

Sample Number (Fabric reference)	Fibre Type and % of binder fibre	Fabric Weight (approx gsm2)	Devoree Details		Observations
			Temp (°C)	No. 'Blasts' (2 seconds each)	
D8 (C2.4)	Viscose Polyester Bi-co	-	180	3	Printed areas not significantly etched Printed areas yellowed Fabric pieces highlighted in printed areas Stiff handle and surface Fabric retains it's structural integrity
D9* (C5.1)	Ramie Tri-lobal Nylon Polyester Bi-co	-	180	3	Printed areas significantly broken down, highlighted by contrasting fibre colour and creating a subtle three-dimensional surface. Some residue paste on remaining fibres When viewed from reverse side printed areas create a sheer pattern. Surface quality impacted by residue paste Handle soft Fabric retains it's structural integrity
D10* (C5.2)	Ramie Tri-lobal Nylon Polyester Bi-co	-	180	3	Cellulose fibres evidently removed in printed areas resulting in a very slight three-dimensional surface Printed areas significantly yellowed Residue paste in printed areas Handle and surface stiff Fabric retains it's structural integrity

**Table 21 (continued): Printing: Initial Investigations, Devoré Details and Observations**

Sample Number (Fabric reference)	Fibre Type and % of binder fibre	Fabric Weight (approx gsm <sup>2</sup> )	Devoree Details		Observations
			Temp (°C)	No. 'Blasts' (2 seconds each)	
D11* (C5.3)	Ramie Tri-lobal Nylon Polyester Bi-co	-	180	3	Printed areas significantly broken down, highlighted by contrasting fibre colour and creating a subtle three-dimensional surface. Significant yellowing in printed areas Some residue paste on remaining fibres When viewed from reverse side printed areas create a sheer pattern. Surface quality impacted by residue paste Handle softer than previous Fabric retains it's structural integrity
D12* (C5.4)	Ramie Tri-lobal Nylon Polyester Bi-co	-	180	3	Cellulose fibres evidently removed in printed areas resulting in a very slight three-dimensional surface Printed areas significantly yellowed Residue paste in printed areas Handle and surface stiff Fabric retains it's structural integrity
D13 (C1.3)	Hoest T254 3g Ramie 25g	-	180	3	Printed areas significantly broken down/etched resulting in sheer pattern compared to base fabric Additional ramie fibres also etched in printed areas Handle crisp and crunchy Fabric retains it's structural integrity

Table 21 (continued): Printing: Initial Investigations, Devoré Details and Observations

Sample Number (Fabric reference)	Fibre Type and % of binder fibre	Fabric Weight (approx gsm <sup>2</sup> )	Devoree Details		Observations
			Temp (°C)	No. 'Blasts' (2 seconds each)	
D14** (C2.1)	-	-	-	-	Printed areas significantly etched resulting in a three dimensional effect Pattern and surface effect highlighted by contrasting fibre colour Fabric motifs revealed in etched areas Needle punch marks evident on surface of printed areas Printed areas translucent when filtering light Soft surface and handle Fabric retains it's structural integrity

\* printed on the ramie side of the web

\*\* fabric dyed following construction but before printing

Table 22.1: Process Parameter Investigations, Devoré Details and Observations

Sample Number (Fabric reference)	Summary of fabric making details	Devoré Details				Observations
		Printing notes	Pressing Temp (°C)	No. Blasts (2 Secs each)	Washing/drying notes	
DT1a (E2.1.9)	Fibre: Ramie 70% Bi-co 30% Needling: x2 Avd 15 Np: 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried	Devoré successful Surface quality retained Handle relatively soft and flexible
DT1b (E2.1.10)	Fibre: Ramie 70% Bi-co 30% Needling: x 1 Avd 15 Np: 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried	Devoré successful, slightly more depth than previous Surface quality more disrupted than previous (more loose fibres on the surface) Stiffer than previous
DT1c (E2.11)	Fibre: Ramie 70% Bi-co 30% Needling: x 2 Avd 15 Np 2.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried	Devoré successful, slightly less depth than both previous Surface quality similar to previous Handle, relatively soft and flexible Small brown water marks on edges

Table 22.1 (continued): Process Parameter Investigations, Devoré Details and Observations

Sample Number (fabric reference)	Summary of fabric making details	Devoré Details				Observations
		Printing notes	Pressing Temp (°C)	No. Blasts (2 Secs each)	Washing/drying notes	
DT1d (E2.12)	Fibre: x 2 Ramie 70% Bi-co 30% Needling: x 1 Avd 15 Np 10mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried	As previous Surface quality slightly more disrupted than previous (more loose fibres on the surface)
DT1e (E2.13)	Fibre: Ramie 70% Bi-co 30% Needling: x 1 Avd 10 Np: 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried	As previous Surface quality slightly less disrupted than previous (less loose fibres on the surface)
DT1f (E2.1.14)	Fibre: Ramie 70% Bi-co 30% Needling: x 2 Avd 10 Np: 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried	Devoré successful, slightly less depth than all previous Surface quality retained Handle relatively flexible Small brown water marks on edges

Table 22.1 (continued): Process Parameter Investigations, Devoré Details and Observations

Sample Number (fabric reference)	Summary of fabric making details	Devoré Details				Observations
		Printing notes	Pressing Temp (°C)	No. Blasts (2 Secs each)	Washing/drying notes	
DT1g (E2.1.1)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried	Devoré successful but quite shallow 'etch' Surface quality slightly 'lumpy' Handle, relatively flexible Small brown water marks on edges
DT1h (E2.1.2)	Fibre: Viscose 70% Bi-co 30% Needling: on 1 side Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried	Devoré successful, deeper 'etch' than previous Surface quality lumpier than previous Surface quality lumpier than previous Handle relatively flexible Small brown water marks on edges
DT1i (E2.1.3)	Fibre: Viscose 70% Bi-co 30% Needling: on 1 side Avd 15 Np 7.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried	As previous Surface quality less lumpy No brown marks

**Table 22.1 (continued): Process Parameter Investigations, Devoré Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Devoré Details			Observations
		Printing notes	Pressing Temp (°C)	No. Blasts (2 Secs each)	Washing/drying notes
DT1j (E2.1.4)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 15 Np 7.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried
DT1k (E2.1.5)	Fibre: Viscose 70% Bi-co 30% Needling: on one side Avd 15 Np 10 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried
DT1l (E2.1.6)	Fibre: Viscose 70% Bi-co 30% Needling: on one side Avd 15 Np 7.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried

As previous  
Surface quality less lumpy than previous but more 'worn' (loose fibres on the surface)

Successful devoré, depth of etch as previous  
Surface quality much better – smoother and less lumpy than all previous  
Handle, relatively flexible  
Some brown marks on edges

Successful devoré, shallower than previous  
Surface quality lump and loose fibres on the surface  
Handle, relatively flexible  
No brown marks

Table 22.1 (continued): Process Parameter Investigations, Devoré Details and Observations

Sample Number (fabric reference)	Summary of fabric making details	Devoré Details				Observations
		Printing notes	Pressing Temp (°C)	No. Blasts (2 Secs each)	Washing/drying notes	
DT1m (E2.1.7)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 10 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried	Successful devoré, defined and good depth of etch Surface quality smooth Handle, relatively flexible No brown marks
DT1n (E2.1.8)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 22.5 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Drip dried	Successful devoré. good depth of etch Surface quality poor, lumpy and loose fibres on the surface Handle, relatively flexible Some brown marks on edges

Table 22.2: Process Parameter Investigations, Devoré Details and Observations

Sample Number (fabric reference)	Summary of fabric making details	Devoré Details				Observations (General comparisons with last sample set – previous table)
		Printing notes	Pressing Temp (°C)	No. Blasts (2 Secs each)	Washing/drying (Notes)	
DT2a– DT2f (E2.1.9– E2.1.14)	Ramie fabrics, as previous table	Printed on un pressed side	150	3	Washed in resin bath Drip dried	Successful devoré, similar depth of etch, slightly more defined than previous Surface quality similar to previous Handle similar to previous Some brown water marks at edges as previous
DT2g– DT2m (E2.1.1 – E1.8)	Viscose fabrics, as previous	Printed on un - pressed side	150	3	Washed in resin bath Drip dried	Successful devoré, slightly deeper more defined 'etch' Surface quality generally less lumpy but more slightly looser fibres on the surface Handle similar to previous Some brown water marks at edges as previous

Table 22.3: Process Parameter Investigations, Devoré Details and Observations

Sample Number (fabric reference)	Summary of fabric making details	Devoré Details				Observations (General comparisons with last sample set – previous table)
		Printing notes	Pressing Temp (°C)	No. Blasts (2 Secs each)	Washing/drying (Notes)	
DT3a– DT3f (E2.1.9– E2.1.14)	Ramie fabrics, as previous	Printed on pressed side	150	3	Washed in resin bath Pressed in paper maker press to aid drying	Successful devoré, slightly shallower but more defined etch than all previous Surface quality generally smoother and more consistent than all previous Handle similar to previous No brown water marks at edges as previous
DT3g– DT3m (E2.1.1– E2.1.8)	Viscose fabrics, as previous	Printed on pressed side	150	3	Washed in resin bath Pressed in paper maker press to aid drying Drip dried	As above

Table 22.4: Process Parameter Investigations, Devoré Details and Observations

Sample Number (fabric reference)	Summary of fabric making details	Devoré Details				Observations (General comparisons with last sample set–previous table)
		Printing notes	Pressing Temp (°C)	No. Blasts (2 Secs each)	Washing/drying (Notes)	
DT4a–DT4f (E2.1.9–E2.1.14)	Ramie fabrics, as previous	Printed on un-pressed side	150	3	Washed in resin bath Pressed in paper maker press to aid drying	No visible differences between these samples and the previous ramie samples (experiment 3)
DT4g–DT4m (E2.1.1–E2.1.8)	Viscose fabrics, as previous	Printed on un - pressed side	150	3	Washed in resin bath Pressed in paper maker press to aid drying Drip dried	Devoré successful, depth of etch slightly deeper and more defined than all previous Surface as previous Handle as previous No brown water marks on edges

**Table 22.5: Process Parameter Investigations, Devoré Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Devoré Details				Observations (General comparisons with last sample set – previous table)
		Printing notes	Pressing Temp (°C)	No. Blasts (2 Secs each)	Washing/drying (Notes)	
DT4a– DT4f (E2.1.9– E2.1.14)	Ramie fabrics, as previous but bonded on both sides	Printed pressed side	150	3	Washed in resin bath Pressed in paper maker press to aid drying	Devoré successful on all samples, depth and quality of etch similar to experiment 4 samples Handle similar to all previous Surface quality slightly smoother and more consistent than all previous Some discoloration on printed areas (b and e) No brown water marks on edges
DT4g– DT4m (E2.1.1– E2.1.8)	Viscose fabrics, as previous but bonded on both sides	Printed pressed side	150	3	Washed in resin bath Pressed in paper maker press to aid drying Drip dried	Devoré successful on all samples, deeper and more defined than all previous Handle similar to all previous Surface quality slightly smoother and more consistent than all previous Some discoloration on printed areas (h) No brown water marks on edges

Table 22.6: Process Parameter Investigations, Devoré Details and Observations

Sample Number (fabric reference)	Summary of fabric making details	Devoré Details				Observations (General comparisons with last sample set – previous table)
		Printing notes	Pressing Temp (°C)	No. Blasts (2 Secs each)	Washing/drying (Notes)	
DT6o (E2.15)	Fibre: Ramie 90% Bi – co 10% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Pressed in paper maker press to aid drying	Successful devoré, defined and good depth of etch Surface quality smooth and consistent Handle soft and flexible No brown water marks
DT6p (E.2.16)	Fibre: Ramie 70% Bi – co 30% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Pressed in paper maker press to aid drying	Successful devoré, less defined and less depth of etch than previous Surface as previous Handle stiffer than previous No brown water marks
DT6q (3.2.17)	Fibre: Ramie 50% Bi – co 50% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Pressed in paper maker press to aid drying	Successful devoré but very shallow etch Surface smoother than previous Handle stiffer than previous No brown water marks

Table 22.6 (continued): Process Parameter Investigations, Devoré Details and Observations

Sample Number (fabric reference)	Summary of fabric making details	Devoree Details				Observations (General comparisons with last sample set – previous table)
		Printing notes	Pressing Temp (°C)	No. Blasts (2 Secs each)	Washing/drying (Notes)	
DT6r (E2.18)	Fibre: Ramie 30% Bi – co 70% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Printed on pressed side	150	3	Washed in resin bath Pressed in paper maker press to aid drying	Devoré evident but very shallow depth of etch Printed areas discolored Surface smoother than previous Handle stiffer than previous No brown water marks

Table 23: Laser Cutting and Marking Initial Investigations, Laser Cutting Details

Sample Number (fabric reference)	Summary of fabric making details	Laser cutting details (FB730)		Observations
		Power	Speed	
LC1 (T1)	<b>Fibre:</b> Ramie (dyed) 30% (30g) Tri-lobal Nylon 30% (30g) Hoest T254 40% (40g) <b>Needling:</b> Light, to tack <b>Thermal bonding:</b> 180°C, 10 secs x 2?	Standard	Standard	Clean cut Visibly singed edges – yellowish/brown marks (less prominent on dyed fibres)
LC2 (T6)	<b>Fibre:</b> Hoest T254 100% (64g) Tri-lobal Nylon (additional between layers) <b>Needling:</b> Light, to tack <b>Thermal bonding:</b> Heat press 115°C, 10 secs x 1	Standard	Standard	Clean cut Visibly singed edges – pale yellowish marks This areas between cuts brittle
LC3 (T15)	<b>Fibre:</b> Viscose (dyed) 66% (36g) Hoest T254 34% (18g) <b>Needling:</b> None <b>Thermal bonding:</b> Calender , 150°C x 1	Standard	Standard	Clean cut Visibly singed edges – brown marks Depth of fabric gives a larger singed surface area Singe spreads away from cut line giving a halo effect
LC4 (T14)	<b>Fibre:</b> Viscose (dyed) 66% (120g) Hoest T254 34% (60g) <b>Needling:</b> None <b>Thermal bonding:</b> Calender , 150°C x 1	Standard	Standard	Clean cut Visibly singed edges – brown marks, less prominent than previous due to darker colour of fibres and more condensed surface

Table 23 (continued): Laser Cutting and Marking Initial Investigations, Laser Cutting Details

Sample Number (fabric reference)	Summary of fabric making details	Laser cutting details (FB730)		Observations
		Power	Speed	
LC5 (N10)	Fibre: Viscose (dyed) 60% (300g) Hoest T254 40% (200g) Needling: None Thermal bonding: Heat press, 130°C, 10 secs x 2	Standard	Standard	Clean cut Visibly singed edges – dark yellowish/brown marks Depth of fabric gives a larger singed surface area Singe spreads away from cut line giving a halo effect
LC6 (T8)	Fibre: Wool/linen/Silk 30% (10g) Hoest T254 70% (30g) Needling: None Thermal bonding: Calendered 150°C x 1	Standard	Standard	Clean cut Visibly singed edges – dark brown marks Singe spreads away from cut line giving a halo effect
LC7 (T18)	Fibre: Silk 66% (36g) Hoest T254 34% (18g) Needling: None Thermal bonding: Heat pressed 180°C, 10 secs x 2	Standard	Standard	Clean cut Visibly singed edges – dark brown marks, less prominent than previous due to darker colour of fibres Singe more visible on the inside of the cut
LC8 (T6)	Fibre: Ramie 66% (20g) Hoest T254 34% (10g) Needling: None Thermal bonding: Calendered 150 x 1	Standard	Standard	Clean cut Visibly singed edges – yellowish/brown marks Singe spreads away from cut line giving a halo effect

Table 23 (continued): Laser Cutting and Marking Initial Investigations, Laser Cutting Details

Sample Number (fabric reference)	Summary of fabric making details	Laser cutting details (FB730)		Observations
		Power	Speed	
LC9 (T7)	<b>Fibre:</b> Ramie                      66% (20g) Hoest T254                34% (10g) <b>Needling:</b> Check stage 2 text <b>Thermal bonding:</b> None	Standard	Standard	Cut not consistently clean Visibly singed edges – yellowish/brown marks Singe spreads away from cut line giving a halo effect
LC10 (T9)	<b>Fibre:</b> Wool/linen/silk        90% (13g) Hoest T254                10% (1.5g) <b>Needling:</b> None <b>Thermal bonding:</b> Calendered 150 x 1	Standard	Standard	Clean cut Visibly singed edges – dark brown marks Singe spreads away from cut line giving a halo effect

Table 24: Laser Cutting and Marking Initial Investigations, Laser Cutting Details

Sample Number (fabric ref)	Summary of fabric making details (Top fabric)	Summary of fabric making details (bottom fabric)	Layering Details	Laser Marking details (FB730)		Observations Washing off
				Power	Speed	
LM1 (N4)	Fibre: TL Nylon 33% (50g) Bi-co 64%(100g) Needling: None Thermal bonding: 150°C, x 1	-	-	20%	Standard	Depth of mark good – marks through a number of layers highlighting embedded fabric pieces Defined edges Marked areas are singed and yellowish Marked fibres have a hard 'droplet' appearance – not removed or reduced in the washing off process
LM2 (T10) (T13)	Fibre: Viscose 80% (50g) T254 20% (12g) Needling: None Thermal bonding: Calendered, 50°C x 1	Fibre: Ramie - T254 - Lace layer Needling: None Thermal bonding: Calendered, 50°C x 2	Heat pressed at 160°C for 30 seconds	30%	Standard	Depth of mark good – does not reveal contrasting bottom layer due to singeing Defined edges Marked areas have visible raster lines Marked areas are singed and yellowish brown Majority of singeing washed off but surface degraded

Table 24 (continued): Laser Cutting and Marking Initial Investigations, Laser Cutting Details

Sample Number (fabric ref)	Summary of fabric making details (Top fabric)	Summary of fabric making details (bottom fabric)	Layering Details	Laser Marking details (FB730)		Observations Washing off
				Power	Speed	
LM3 (T14) (T16)	Fibre: Viscose (dyed) 66% (120g) Hoest T254 34%(60g) Needling: None Thermal bonding: Calender , 150°C x 1	Fibre: Hoest T254 100% (64g) Tri-lobal Nylon (additional between layers) Needling: Light, to tack (NP doc previous?) Thermal bonding: Heat press 115°C, 10 secs x 1	Heat pressed at 160°C for 30 seconds	20%	Standard	Depth of mark shallower than all previous-- does not reveal contrasting bottom Marked areas have visible raster lines Marked areas are singed and brown Defined edges Majority of singeing washed off but surface degraded
LM4 (T16)	Fibre: Ramie - T254 - Lace layer Needling: None Thermal bonding: Calendered, 50°C x	-	-	20%	Standard	Depth of mark good Undefined edges Marked areas are singed and yellowish/brown Marked fibres have a hard 'droplet' appearance Not washed

**Table 24 (continued): Laser Cutting and Marking Initial Investigations, Laser Cutting Details**

Sample Number (fabric ref)	Summary of fabric making details (Top fabric)	Summary of fabric making details (bottom fabric)	Layering Details	Laser Marking details (FB730)		Observations Washing off
				Power	Speed	
LM5 (T15) (T1)	<b>Fibre:</b> Viscose (dyed) 66% (36g) Hoest T254 34% (18g) Paper doily between layers <b>Needling:</b> None <b>Thermal bonding:</b> Calender , 150°C x 1	<b>Fibre:</b> Hoest T254 16g Ramie fibres between layers <b>Needling:</b> None <b>Thermal bonding:</b> Heat press, 180°C, 10 secs x 1	Heat pressed at 160°C for 30 seconds	20%	Standard	Depth of mark good – marks through a number of layers highlighting embedded fabric pieces, but does not mark through to bottom layer Defined edges Marked areas are singed and yellowish/brown Majority of singeing washed off main fabric but remains on paper doily
LM5b (reverse) (T15) (T1)	<b>Fibre:</b> Viscose (dyed) 66% (36g) Hoest T254 34% (18g) Paper doily between layers <b>Needling:</b> None <b>Thermal bonding:</b> Calender , 150°C x 1	<b>Fibre:</b> Hoest T254 16g Ramie fibres between layers <b>Needling:</b> None <b>Thermal bonding:</b> Heat press, 180°C, 10 secs x 1	Heat pressed at 160°C for 30 seconds	20%	Standard	Depth of mark good – marks through a number of layers. Defined edges Marked areas are singed and yellowish/brown Majority of singeing washed off but surface degraded, removes embedded ramie fibres

Table 24 (continued): Laser Cutting and Marking Initial Investigations, Laser Cutting Details

Sample Number (fabric ref)	Summary of fabric making details (Top fabric)	Summary of fabric making details (bottom fabric)	Layering Details	Laser Marking details (FB730)		Observations Washing off
				Power	Speed	
LM6 (H14) (T3)	<b>Fibre:</b> Ramie 35% (7g) Wool mix 35%(7g) Bi-co 30%(6g) <b>Needling:</b> None <b>Thermal bonding:</b> Heat press 180°C, 10 secs, x 2	<b>Fibre:</b> Ramie 90% (25g) Bi-co 10%(3g) <b>Needling:</b> None <b>Thermal bonding:</b> Calender 150°C, x 1	Heat pressed at 160°C for 30 seconds	50%	Standard	Depth of mark good – marks through entire top fabric revealing contrasting bottom fabric Defined edges Marked areas are singed and yellowish/brown but less obvious due to dark bottom fabric Not washed

Table 25: Process Parameter Investigations, Laser Marking Details and Observations

Sample Number (Fabric reference)	Summary of Fibre Content	Laser cutting details (Diamond 64™)		Observations
		Pulse Period/Pulse Width	Speed mm/s	
LC2.1 (C1.1)	Wool/Linen/Silk/Mix 90% Polyester Bi-co 10%	70/30	200,300 and 500	Successfully cut Visible singeing at all speeds No obvious differences between speeds
LC2.2 (C1.2)	Wool/Linen/Silk/Mix 50% Polyester Bi-co 50%	As above	200,300 and 500	Successfully cut Visible singeing at all speeds but less prominent than previous Singeing slightly less prominent at 500
LC2.3 (C1.3)	Wool/Linen/Silk/Mix 77% Polyester Bi-co 33%	As above	200,300 and 500	Successfully cut Visible singeing at all speeds but slightly more prominent than previous No obvious differences between speeds
LC2.4 (C1.4)	Wool/Linen/Silk/Mix 44% Polyester Bi-co 66%	As above	200,300 and 500	Successfully cut Visible singeing at all speeds but less prominent than all previous No obvious differences between speeds
LC2.5 (C3.1)	Ramie 10% Polyester Bi-co 90%	As above	200,300 and 500	Successfully cut Visible singeing at 200 and 300 on embedded fabric pieces Visible singeing at 200 and 300 on base fabric No visible singeing at 500 on base fabric
				Successfully cut Visible singeing at all speeds on embedded fabric pieces No visible singeing at 500 on base fabric
LC2.7 (C3.3)	Ramie 77% Polyester Bi-co 33%	As above	200,300 and 500	Visible singeing at 200 and 300 on embedded fabric pieces Visible singeing at all speeds on base fabric but less prominent at 500

Table 25 (continued): Process Parameter Investigations, Laser Marking Details and Observations

Sample Number (fabric reference)	Summary of Fibre Content		Laser cutting details (Diamond 64™)		Observations
			Pulse Period/Pulse Width	Speed mm/s	
LC2.8 (C3.4)	Ramie Polyester Bi-co	44% 66%	70/30	200,300 and 500	Successfully cut Visible singeing at all speeds on base fabric but less prominent at 500 and all singeing less prominent than all previous
LC2.9 (C2.1)	Viscose Polyester Bi-co	10% 90%	As above	200,300 and 500	Successfully cut Visible singeing at all speeds on base fabric
LC2.10 (C2.2)	Viscose Polyester Bi-co	50% 50%	As above	200,300 and 500	Successfully cut Visible singeing at all speeds on base fabric
LC2.11 (C2.3)	Viscose Polyester Bi-co	77% 33%	As above	200,300 and 500	Successfully cut Visible singeing at all speeds on base fabric more prominent than all previous Haloing effect at all speeds
LC2.12 (C.2.4)	Viscose Polyester Bi-co	44% 66%	As above	200,300 and 500	Successfully cut Visible singeing at all speeds on base fabric slightly less prominent than all previous
LC2.13 (C5.1)	Ramie Tri-lobal Nylon Polyester Bi-co	45% 45% 10%	As above	200,300 and 500	Successfully cut No visible singeing on tri-lobal surface Slight visible singeing on ramie surface No obvious differences between speeds
LC2.14 (2.3.5.2)	Ramie Tri-lobal Nylon Polyester Bi-co	25% 25% 50%	As above	200,300 and 500	Successfully cut No visible singeing on tri-lobal surface Slight visible singeing on ramie surface No obvious differences between speeds
LC2.15 (C5.3)	Ramie Tri-lobal Nylon Polyester Bi-co	33% 33% 33%	As above	200,300 and 500	Successfully cut No visible singeing on tri-lobal surface Slight visible singeing on ramie surface No obvious differences between speeds

**Table 25 (continued): Process Parameter Investigations, Laser Marking Details and Observations**

Sample Number (fabric reference)	Summary of Fibre Content	Laser cutting details (Diamond 64™)		Observations
		Pulse Period/Pulse Width	Speed mm/s	
LC2.16 (C5.4)	Ramie	70/30	200,300 and 500	Successfully cut
	Tri-lobal Nylon			No visible singeing on tri-lobal surface
	Polyester Bi-co			Slight visible singeing on ramie surface No obvious differences between speeds
LC2.17 (C2.2)	Silk	As above	200,300 and 500	Successfully cut
	Polyester Bi-co			Visible singeing at all speeds No obvious differences between speeds
LC2.18 (C2.3)	Silk	As above	200,300 and 500	Successfully cut
	Polyester Bi-co			Visible singeing at all speeds No obvious differences between speeds
LC2.19 (C2.4)	Silk	As above	200,300 and 500	Successfully cut
	Polyester Bi-co			Visible singeing at all speeds, slightly less prominent than previous No obvious differences between speeds

Table 26: Process Parameter Investigations, Laser Marking Details and Observations

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)		Observations
		Power (%)	Velocity	
LM2.1a (E2.1.1)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80,100	380	At power 30 very faint singeing, quite difficult to peel back, shallow 'etch', soft etched surface At power 50 faint singeing, easier to peel back, deeper etch than at power 30, soft etched surface At power 100 and 80 visible singeing, easier to peel back, deeper etch than at power 50, soft etched surface (This varies a little dependent upon the area of the fabric that is etched)
LM2.1b (E2.1.1)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Marked on pressed side 80	380	Visible singeing, a little easier to peel back than previous depth of etch as previous (at power 80), soft etched surface
LM2.1c (E2.1.1)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 2	Marked on un pressed side 80	380	As previous (at power 80), slightly less singeing

**Table 26 (continued): Process Parameter Investigations, Laser Marking Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)		Observations
		Power (%)	Velocity	
LM2.2a (E2.1.2)	<b>Fibre:</b> Viscose 70% Bi-co 30% <b>Needling:</b> on 1 side Avd 15 Np 5 mm Strokes 150 per min <b>Thermal bonding:</b> 100°C, 10 secs x 1	30,50, 80          Marked on pressed side	380	At power 30 very faint singeing, more difficult to peel back than at power 80, shallow etch, soft etched surface At power 50, visible singeing, deep etch, soft etched surface At 80 greater visible singeing, deeper etch, soft etched surface (Extent of singeing and depth dependent on are area of fabric) No significant differences between this and previous sample at these settings except slightly easier to peel back
LM2.2b (E2.1.2)	<b>Fibre:</b> Viscose 70% Bi-co 30% <b>Needling:</b> on 1 side Avd 15 Np 5 mm Strokes 150 per min <b>Thermal bonding:</b> 100°C, 10 secs x 1	30,80          Marked on un pressed side		At power 30 only a fine layer of web can be peeled back, etch is faint and undefined At power 80, easier to peel back than previous (3.4.4.1.b), deeper etch, soft etched surface
LM 2.2c (E2.1.2)	<b>Fibre:</b> Viscose 70% Bi-co 30% <b>Needling:</b> on 1 side Avd 15 Np 5 mm Strokes 150 per min <b>Thermal bonding:</b> 100°C, 10 secs x 2	30,50,80          Marked on smooth side		At power 30, very faint singeing, peels off easily, shallow etch, soft etched surface At power 50, faint singeing, easier to peel back than previous (3.4.4.1.c), deep etch, soft etched surface At power 80, visible singeing, easier to peel back than previous (3.4.4.1.c), deeper etch, soft etched surface

**Table 26 (continued): Process Parameter Investigations, Laser Marking Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO <sub>2</sub> , 10 watt)		Observations
		Power (%)	Velocity	
LM2.3a (E2.1.3)	Fibre: Viscose 70% Bi-co 30% Needling: on 1 side Avd 15 Np 12.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80		At power 30, very faint singeing, peels off more easily than all previous, shallow etch, soft etched surface At power 50, faint singeing, peels off more easily than all previous, deep etch, soft etched surface At power 80, visible singeing, peels off more easily than all previous, deeper etch, soft etched surface
LM2.3b (E2.1.3)	Fibre: Viscose 70% Bi-co 30% Needling: on 1 side Avd 15 Np 12.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Marked on pressed side 30,50,80		At power 30, no singeing only a fine layer of web can be peeled back, etch is faint and undefined At power 50, faint singeing, deep etch, soft etched surface At power 80, peels off more easily than previous (3.4.4.2.b), deeper etch, soft etched surface (Nature of singeing corresponds with quality of surface)
LM2.3c (E2.1.3)	Fibre: Viscose 70% Bi-co 30% Needling: on 1 side Avd 15 Np 7.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 2	Marked on un pressed side 30,50,80		At power 30 and 50 as previous (3.4.4.2.c) at these settings At power 80, visible singeing as previous (3.4.4.2.c) but lightly more difficult to peel back and surface slightly less smooth

**Table 26 (continued): Process Parameter Investigations, Laser Marking Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)		Observations
		Power (%)	Velocity	
LM2.4a (E2.1.4)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 15 Np 12.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80		At power 30, more difficult to peel back than all previous at these settings, faint singeing, shallow etch, soft etched surface At power 50, visible singeing, more difficult to peel back than all previous, deep etch, soft etch surface but some needle marks visible At power 80, greater visible singeing, more difficult to peel back than all previous, deep etch, soft etch surface but some needle marks visible
LM2.4b (E2.1.4)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 15 Np 12.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Marked on pressed side 30,80		At power 30, faint singeing, more difficult to peel back than all previous at these settings, shallow etch, soft etched surface, more defined than all previous at these settings At power 80, visible singeing, more difficult to peel back than all previous at these settings, deeper etch, soft etch surface
LM2.4c (E2.1.4)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 15 Np 12.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 2	Marked on un pressed side 30,50,80		At power 30, as previous at these settings (3.4.4.3.c) but a little more difficult to peel back ad slightly less smooth surface At 50 and 80 as previous at these settings (3.4.4.3.c) but a little more difficult to peel back ad slightly less smooth surface and some needle marks evident

**Table 26 (continued): Process Parameter Investigations, Laser Marking Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)		Observations
		Power (%)	Velocity	
LM2.5a (E2.1.5)	Fibre: Viscose 70% Bi-co 30% Needling: on one side Avd 15 Np 10 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80		At power 30 as previous at these settings (3.4.4.5.a) At power 50 and 80 as previous at these settings but slightly less singeing (3.4.4.5.a)
LM2.5b (E2.1.5)	Fibre: Viscose 70% Bi-co 30% Needling: on one side Avd 15 Np 10 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Marked on pressed side 30,50,80		At power 30, 50 and 80, as previous at these settings (3.4.4.4.b) but smoother surfaces
LM2.5c (E2.1.5)	Fibre: Viscose 70% Bi-co 30% Needling: on one side Avd 15 Np 10 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 2	Marked on un pressed side 30,50,80		At power 30, very faint singeing, more difficult than all previous to peel back, shallow etch, needle marks visible in etched surface At power 50, faint singeing, more difficult than all previous to peel back, deep etch, needle marks visible in etched surface At power 80, visible singeing, more difficult than all previous to peel back, deeper etch, needle marks visible in etched surface

**Table 26 (continued): Process Parameter Investigations, Laser Marking Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)		Observations
		Power (%)	Velocity	
Lm2.6a (E2.1.6)	Fibre: Viscose 70% Bi-co 30% Needling: on one side Avd 15 Np 12.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80		At power 30, faint singeing, does not peel back successfully At power 50, visible singeing, shallow etch, needle marks visible in etched surface At power 80, greater visible singeing, deeper etch, needle marks visible and textured quality in etched surface.
LM2.6b (E2.1.6)	Fibre: Viscose 70% Bi-co 30% Needling: on one side Avd 15 Np 12.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Marked on pressed side 30,50,80		At power 30, very faint singeing, only just peels back successfully, shallow etch, fibres pulled to the surface creating fluffy etched surface At power 50, faint singeing, shallow etch, fibres pulled to the surface creating fluffy etched surface, needle marks visible At power 80, visible singeing, shallow etch, fibres pulled to the surface creating fluffy etched surface, needle marks visible
LM2.6c (E2.1.6)	Fibre: Viscose 70% Bi-co 30% Needling: on one side Avd 15 Np 12.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 2	Marked on un pressed side 30,50,80		At power 30, faint singeing, does not peel back successfully At power 50 faint singeing, shallow etch, fibres pulled to the surface creating fluffy etched surface, needle marks visible At power 80 visible singeing, shallow etch, fibres pulled to the surface creating fluffy etched surface, prominent needle marks

Table 26 (continued): Process Parameter Investigations, Laser Marking Details and Observations

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)		Observations
		Power (%)	Velocity	
LM2.7a (E.2.1.7)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 10 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80		At power 30, very faint singeing, easy to peel off, shallow etch, soft etched surface At power 50, faint singeing, easy to peel off, deep etch, soft etched surface At power 80, visible singeing, deeper etch, soft etched surface
		Marked on pressed side		
LM2.7b (E.2.1.7)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 10 Np - 0.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80		At power 30, very faint singeing, easy to peel off, very shallow etch, soft etched surface At power 50, faint singeing, easy to peel off, deep etch, soft etched surface At power 80, visible singeing, deeper etch, soft etched surface
		Marked on un pressed side		Less surface contrast between main and etched surface than previous
LM2.7c (E2.1.7)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 10 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 2	30,50,80		At power 30, very faint singeing, difficult to peel off, shallow etch, soft etched surface At power 50, faint singeing, easy to peel off, deep etch, soft etched surface At power 80, visible singeing, deeper etch, soft etched surface
		Marked on smooth side		

**Table 26 (continued): Process Parameter Investigations, Laser Marking Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)		Observations
		Power (%)	Velocity	
LM2.8a (E2.1.8)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 22.5 Np 5 mm check Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80		
LM4.8b (E2.1.8)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 22.5 Np 5 mm check Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	Marked on pressed side 30,50,80		At power 30 and 50 as previous (3.4.4.7.b) At power 80 as previous (3.4.4.7.b) but slightly more singeing and deeper etch  Less surface contrast between main and etched surface than previous (3.4.4.7.b)
LM2.8c (E2.1.8)	Fibre: Viscose 70% Bi-co 30% Needling: on both sides Avd 22.5 Np 0.5 mm ? check Strokes 150 per min Thermal bonding: 100°C, 10 secs x 2	Marked on un pressed side 30,50,80		At power 30,50 and 80 as previous (3.4.4.7.c)

**Table 27: Process Parameter Investigations, Laser Marking Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)		Observations
		Power (%)	Velocity	
LM2.9a (E2.1.9)	Fibre: Ramie 70% Bi-co 30% Needling: x2 Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80      Marked on pressed side	380	At power 30, no singeing, quite difficult to peel off, shallow etch At power 50, very faint singeing, peels ways easily, deep etch At power 80, faint singeing, peels away easily, deeper etch  Less visible contrast in terms of surface between etched area and main surface than on viscose samples
LM2.9b (E2.1.9)	Fibre: Ramie 70% Bi-co 30% Needling: x2 Avd 15 Np -0.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80      Marked on un pressed side	380	At power 30, no singeing, only a fine layer of fibre peels away, undefined etch At power 50, no singeing, peels away easily, deep etch but less defined than previous At power 80, faint singeing, peels away easily, deeper etch
LM2.9.c (E2.1.9)	Fibre: Ramie 70% Bi-co 30% Needling: x2, Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 2	30,50,80      Marked on smooth side	380	At power 30, no singeing, very shallow etch At power 50, no singeing, quite difficult to peel away, deep defined etch At power 80, faint singeing, deeper defined etch, cuts through to back of fabric

Table 27 (continued): Process Parameter Investigations, Laser Marking Details and Observations

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)		Observations
		Power (%)	Velocity	
LM2.10a (E2.1.10)	Fibre: Ramie 70% Bi-co 30% Needling: x 1 Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80      Marked on pressed side	380	At power 30, no singeing, not successfully peeled away At power 50, very faint singeing, difficult to peel away, deep etch, rough etched surface At power 80, faint singeing, difficult to peel away, deeper etch, rough etched surface
LM2.10b (E2.1.10)	Fibre: Ramie 70% Bi-co 30% Needling: x 1 Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80      Marked on un pressed side	380	At power 30, 50 and 80 the same as previous (3.4.4.10.a) but cuts through fabric at power 80
LM2.10c (E2.1.10)	Fibre: Ramie 70% Bi-co 30% Needling: x 1 Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 2	30,50,80      Marked on smooth side	380	At power 30, no visible mark At power 50, faint singeing, difficult to peel away, rough surface and loose fibres in etched area At power 80, visible singeing, difficult to peel away, rough surface and loose fibres in etched area

**Table 27 (continued): Process Parameter Investigations, Laser Marking Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)			Observations
		Power (%)	Velocity		
LM2.11a (E2.1.11)	Fibre: Ramie 70% Bi-co 30% Needling: x 2 Avd 15 Np 7.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80     Marked on pressed side	380		At power 30, no singeing, peels away more easily than previous (3.4.4.10.a), shallow etch At power 50, very faint singeing, peels away more easily than previous (3.4.4.10.a), deep etch At power 80, faint singeing, peels away easily, deeper etch leaving only a thin layer of base fabric.
LM2.11b (E2.1.11)	Fibre: Ramie 70% Bi-co 30% Needling: x 2 Avd 15 Np 7.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80     Marked on un pressed side	380		At power 30, 50 and 80 as previous (3.4.4.11a)
LM2.11c (E2.1.11)	Fibre: Ramie 70% Bi-co 30% Needling: x 2 Avd 15 Np 7.5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 2	30,50,80     Marked on smooth side	380		At power 30, no visible mark At power 50, very faint singeing, more difficult to peel away than all previous, deep etch, rough etched surface At power 80, faint singeing, more difficult to peel away than all previous, deeper etch, rough etched surface

**Table 27 (continued): Process Parameter Investigations, Laser Marking Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)		Observations
		Power (%)	Velocity	
LM2.12a (E2.1.14)	Fibre: Ramie 70% Bi-co 30% Needling: x 2 Avd 10 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80     Marked on pressed side	380	At power 30, faint mark, not successfully peeled away At power 50, very faint singeing, easier to pull away than all previous (ramie), deep etch, soft etched area At power 80, faint singeing, easier to pull away than all previous (ramie), deeper etch, soft etched area
LM2.12b (E2.1.14)	Fibre: Ramie 70% Bi-co 30% Needling: x 2 Avd 10 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80     Marked on un pressed side	380	At power 30, no singeing, only a fine layer of fibre peeled away, undefined etch At power 50, no singeing, only a fine layer of fibre peeled away, shallow etch, less defined than all previous (ramie) At power 80, faint singeing, easy to peel away, deeper etch, soft etched area
LM2.12c (E2.1.14)	Fibre: Ramie 70% Bi-co 30% Needling: x 2 Avd 10 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 2	30,50,80     Marked on smooth side	380	At power 30, faint mark, no singeing, easier to peel away than previous (3.4.4.11.c and 3.4.4.10.c), shallow etch, soft etched area At power 50, very faint singeing, easier to peel away than previous (3.4.4.11.c and 3.4.4.10.c), deep etch, soft etched area At power 80, faint singeing, easier to peel away than previous (3.4.4.11.c and 3.4.4.10.c), deeper etch, soft etched area

**Table 27 (continued): Process Parameter Investigations, Laser Marking Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)		Observations
		Power (%)	Velocity	
LM2.13a (E2.1.15)	<b>Fibre:</b> Ramie 90% Bi – co 10% <b>Needling:</b> on both sides Avd 15 Np 5 mm Strokes 150 per min <b>Thermal bonding:</b> 100°C, 10 secs x 1	30,50,80       Marked on pressed side	380	At power 30, faint mark, easy to peel away, only a thin layer of fibre peeled away, shallow etch At power 50, faint singeing, easy to peel away, rough etched surface At power 80, visible singeing, easy to peel away, rough etched surface
LM2.13b (E2.1.15)	<b>Fibre:</b> Ramie 90% Bi – co 10% <b>Needling:</b> on both sides Avd 15 Np 5 mm Strokes 150 per min <b>Thermal bonding:</b> 100°C, 10 secs x 1	30,50,80       Marked on un pressed side	380	At power 30, very faint mark, easy to peel away, only a very thin layer of fibre peeled away, soft etched surface At power 50, faint singeing, easy to peel away, soft etched surface At power 80, visible singeing, easy to peel away, soft etched surface
LM2.14a (E2.1.16)	<b>Fibre:</b> Ramie 70% Bi – co 30% <b>Needling:</b> on both sides Avd 15 Np 5 mm Strokes 150 per min <b>Thermal bonding:</b> 100°C, 10 secs x 1	30,50,80       Marked on pressed side	380	At power 30, very faint mark, not successfully peeled away At power 50, very faint singeing, more difficult to peel away than all previous, deep etch, rough etched surface and loose fibres At power 80, visible singe, more difficult to peel away than all previous, deeper etch, rough etched surface and loose fibres

**Table 27 (continued): Process Parameter Investigations, Laser Marking Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)			Observations
		Power (%)		Velocity	
LM2.14b (E2.1.16)	Fibre: Ramie 70% Bi – co 30% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80		380	At power 30, no visible singe, more difficult than previous to peel away (3.4.4.13.a and 3.4.4.13.b), shallow etch, smooth etched area At power 50, very faint visible singe, more difficult than previous to peel away (3.4.4.13.a and 3.4.4.13.b), deep etch, smooth etched surface At power 80, very faint singe, more difficult than previous to peel away (3.4.4.13.a and 3.4.4.13.b), deeper etch, loose fibres on etched surface
LM2.13a (E2.1.15)	Fibre: Ramie 90% Bi – co 10% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80		380	At power 30, faint mark, easy to peel away, only a thin layer of fibre peeled away, shallow etch At power 50, faint singeing, easy to peel away, rough etched surface At power 80, visible singeing, easy to peel away, rough etched surface
LM2.13b (E2.1.15)	Fibre: Ramie 90% Bi – co 10% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80	Marked on un pressed side	380	At power 30, very faint mark, easy to peel away, only a very thin layer of fibre peeled away, soft etched surface At power 50, faint singeing, easy to peel away, soft etched surface At power 80, visible singeing, easy to peel away, soft etched surface

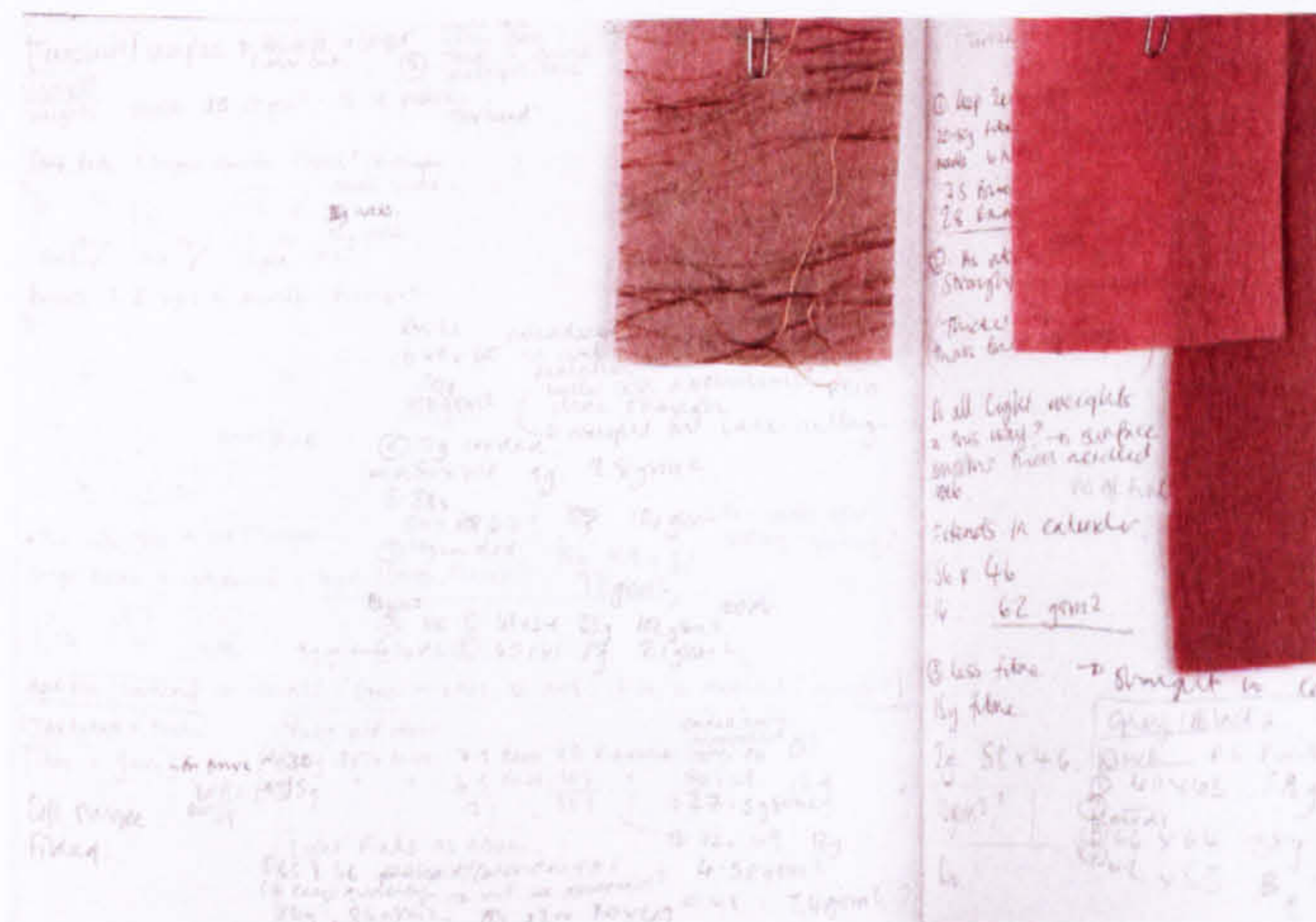
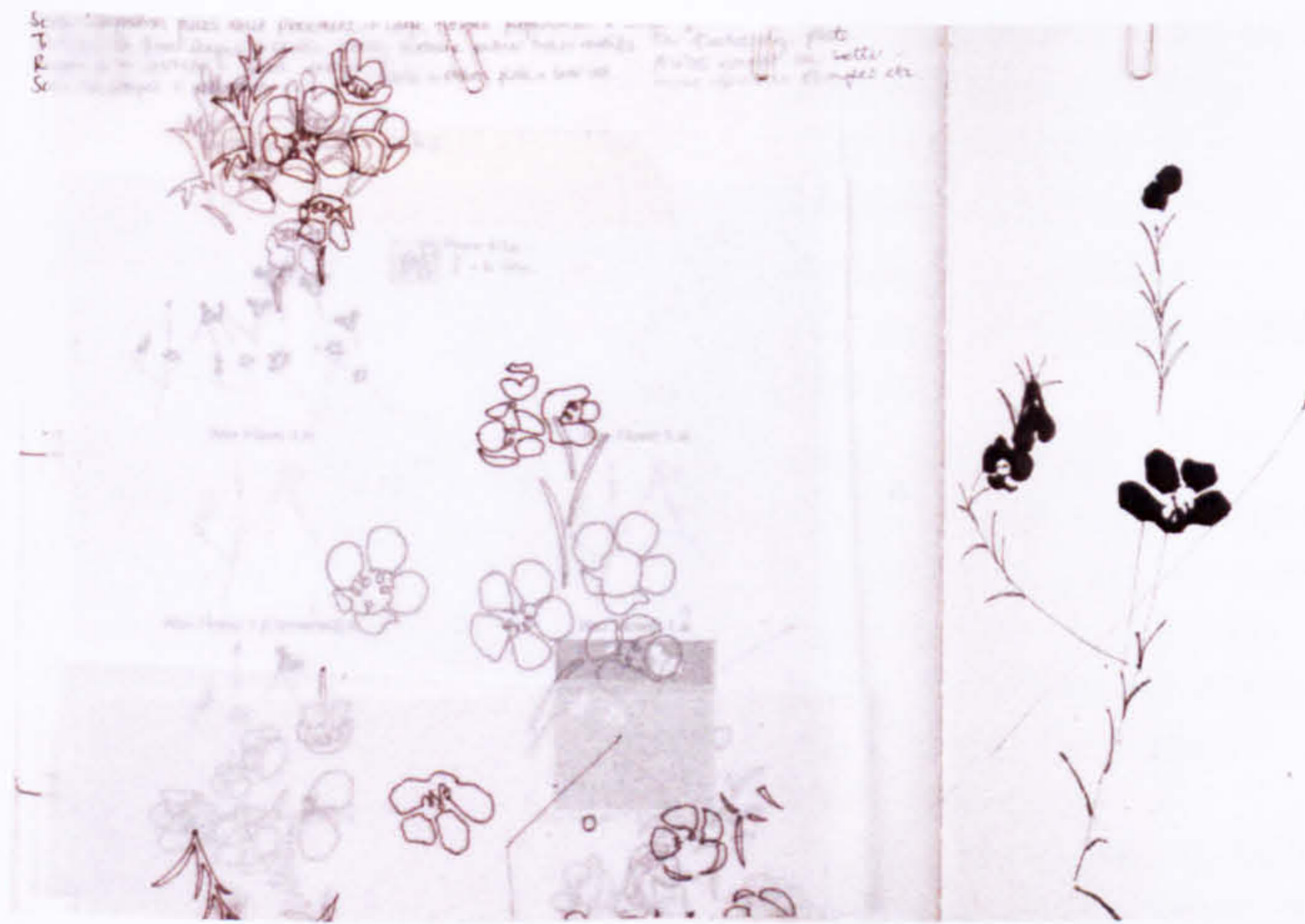
**Table 27 (continued): Process Parameter Investigations, Laser Marking Details and Observations**

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)		Observations
		Power (%)	Velocity	
LM2.14a (E2.1.16)	Fibre: Ramie 70% Bi – co 30% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80	380	At power 30, very faint mark, not successfully peeled away At power 50, very faint singeing, more difficult to peel away than all previous, deep etch, rough etched surface and loose fibres At power 80, visible singe, more difficult to peel away than all previous, deeper etch, rough etched surface and loose fibres
LM2.14b (E2.1.16)	Fibre: Ramie 70% Bi – co 30% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80  Marked on un pressed side	380	At power 30, no visible singe, more difficult than previous to peel away (3.4.4.13.a and 3.4.4.13.b), shallow etch, smooth etched area At power 50, very faint visible singe, more difficult than previous to peel away (3.4.4.13.a and 3.4.4.13.b), deep etch, smooth etched surface At power 80, very faint singe, more difficult than previous to peel away (3.4.4.13.a and 3.4.4.13.b), deeper etch, loose fibres on etched surface
LM2.15a (E2.1.17)	Fibre: Ramie 50% Bi – co 50% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80  Marked on pressed side	380	At power 30, mark faint, not successfully peeled away At power 50, no singeing, slightly easier than previous to peel back (3.4.4.14), deep etch, smoother etched surface than previous (3.4.4.14) At power 80, faint singeing, slightly easier than previous to peel back (3.4.4.14), deeper etch, smoother etched surface than previous

Table 27 (continued): Process Parameter Investigations, Laser Marking Details and Observations

Sample Number (fabric reference)	Summary of fabric making details	Laser marking details (Synrad CO2, 10 watt)		Observations
		Power (%)	Velocity	
LM2.15b (E2.1.17)	Fibre: Ramie 50% Bi – co 50% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80	380	At power 50, very faint singeing, easier to peel away than previous (3.4.4.15.a), deep etch, rougher etch surface than previous (3.4.4.15.a) At power 80, faint singeing, easier to peel away than previous (3.4.4.15.a), deeper etch, rougher etch surface than previous (3.4.4.15.a)
LM2.16a (E2.1.18)	Fibre: Ramie 30% Bi – co 70% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80  Marked on un pressed side	380	At power 30 faint mark, not successfully peeled away At power 50, no singeing, more difficult to peel away than previous (3.4.4.15.a), deep etch, etched surface as previous (3.4.4.15.a) At power 80, faint singeing, more difficult to peel away than previous (3.4.4.15.a), deeper etch, etched surface as previous (3.4.4.15.a)
LM2.16b (E2.1.18)	Fibre: Ramie 30% Bi – co 70% Needling: on both sides Avd 15 Np 5 mm Strokes 150 per min Thermal bonding: 100°C, 10 secs x 1	30,50,80  Marked on un pressed side	380	At power 50, no singeing, easier to peel away than previous (3.4.4.16.a), deep etch, etched surface as previous but less contrast with main surface At power 80, very faint singeing, easier to peel away than previous (3.4.4.16.a), deeper etch, etched surface as previous but less contrast with main surface
LM2.17 DD30	See DD30 Appendix 6			

## 1. Sketch Book Examples



## 1. Fabric Documentation Sheets, Design Development

Sample Number: DD1



### Sample Making Details

#### Fibre Type and Blend

Cut Ramie (dyed) 35g (70%)

M1440 Polyester bi-co 15g (30%)

#### Fibre Preparation

Carded once prior to web formation to blend

#### Web Forming

Carded and cross lapped

Layering: horizontal cross lapper, out put belt running at 6m/min

Laser cut fabric shapes added between card and cross lapper

#### Web Bonding

Needled and thermally bonded

Needling: 6mm penetration depth, 150 strokes/min

Thermal bonding: Heat pressed at 150°C for 10 second on both sides

#### Other

Devoré printed

Sample Number: DD2



### Sample Making Details

#### Fibre Type and Blend

Cut ramie fibre 35g (70%)

M1440 Polyester Bi-co (30%)

#### Fibre Preparation

Carded once to blend

#### Web Forming

Carded and cross lapped

Layering: horizontal cross lapper, out put belt not running

Dried/pressed flowers added between card and cross lapper

#### Web Bonding

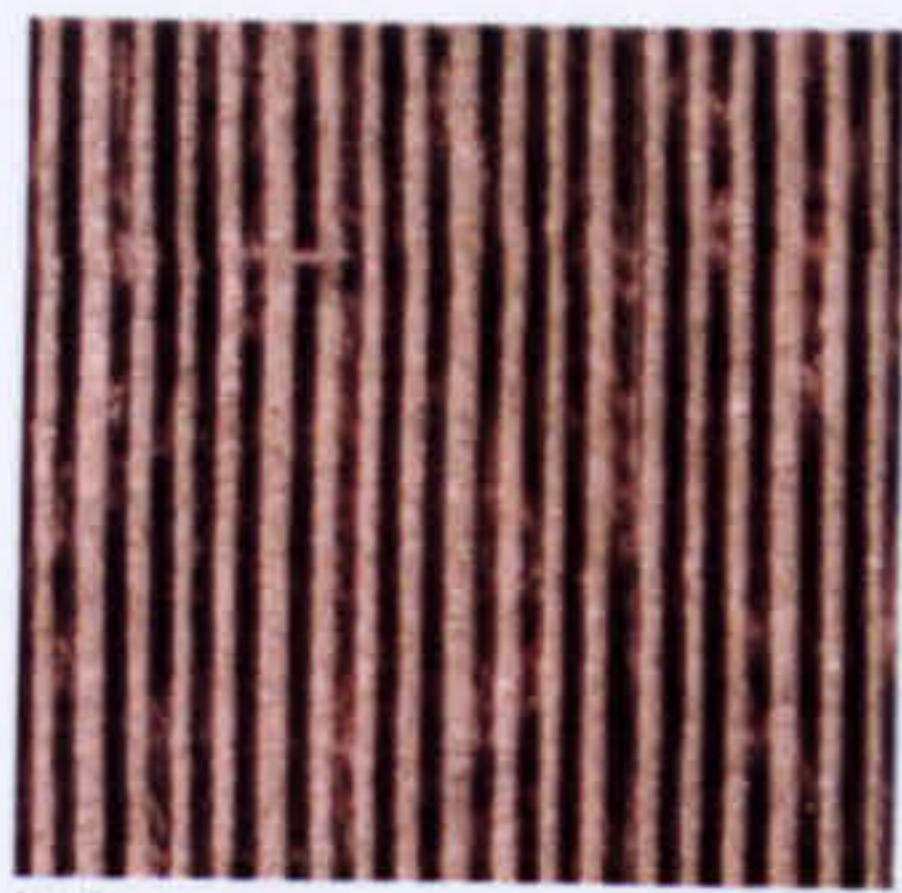
Needled and thermally bonded

Needling: 6mm penetration depth, 150 strokes per min

Thermal bonding: Heat pressed at 150°C for 10 seconds

#### Other

Sample Number: DD3



(2)

Sample Making Details

Fibre Type and Blend

Flax/wool mix 35g (70%)

M1440 Polyester bi-co 15g (30%)

Fibre Preparation

Carded once to blend

Web Forming

Carded and cross lapped

Layering: horizontal cross lapper, delivery speed 11.5m/min, out put belt running at 0.8m/min

Hessian strips added between card and cross lapper

Web Bonding

Needled and thermally bonded

Needling: 6mm penetration depth, 150 strokes/min

Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

Other

(2) Flocked

Sample Number: DD4



Sample Making Details

Fibre Type and Blend

Cut ramie 45g (70%)

M1440 Polyester bi-co 15g (30%)

Fibre Preparation

Carded once to blend

Web Forming

Carded and cross lapped

Layering: horizontal cross lapper out put belt running at 7m/min

Cut paper yarn added between card and cross lapper

Web Bonding

Needled and thermally bonded

Needling: 6mm penetration depth, 150 strokes/min

Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

Other

Sample Number: DD5



(2)

**Sample Making Details**

**Fibre Type and Blend**

Cut ramie (dyed) 21g (70%)  
M1440 Polyester bi-co 9g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper, out  
put belt not running  
Laser cut fabric shapes added between  
card and cross lapper

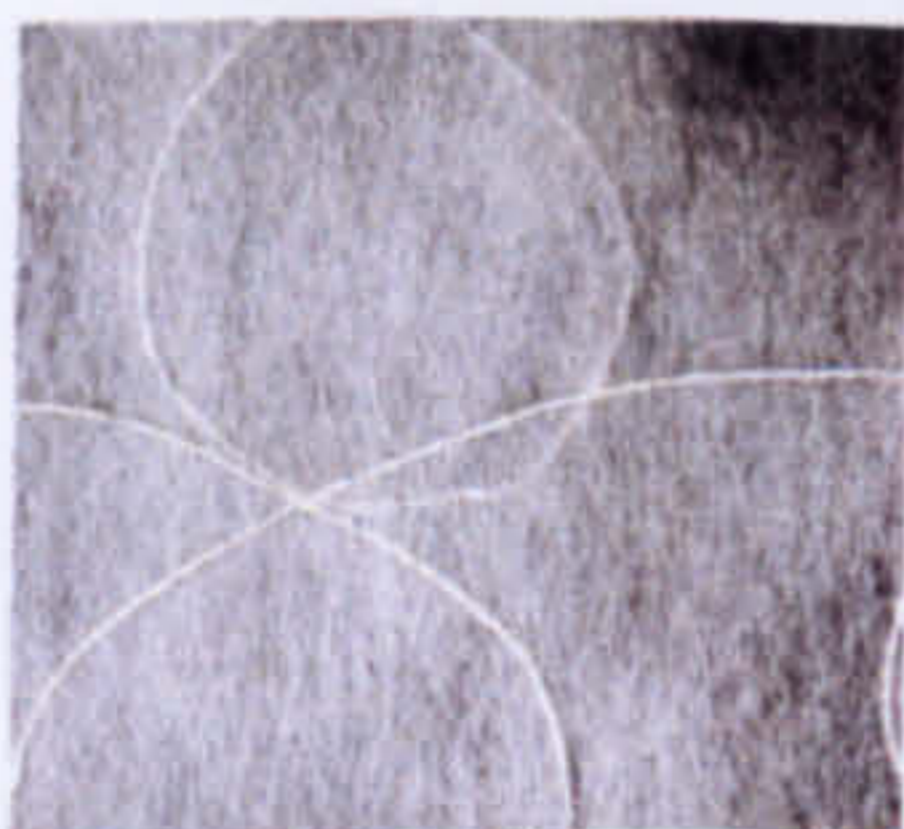
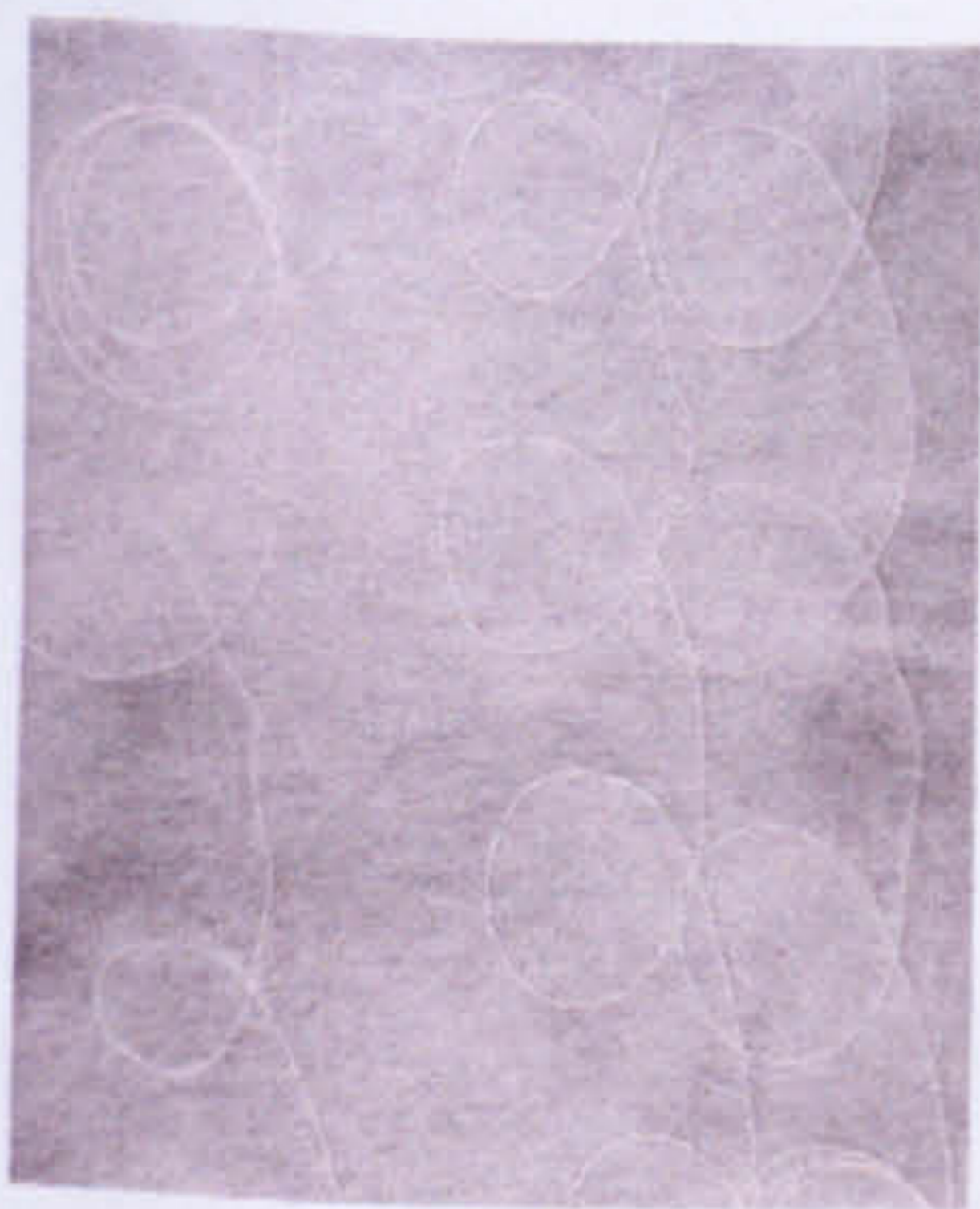
**Web Bonding**

Needled and thermally bonded  
Needling: 6mm penetration depth, 150  
strokes/min  
Thermal bonding: Heat pressed at  
100°C for 10 seconds on both sides

**Other**

Devoré printed  
(2) No finishing

Sample Number: DD6



**Sample Making Details**

**Fibre Type and Blend**

Cut ramie fibre 35g (70%)  
M1440 Polyester bi-co 15g (70%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper, out put  
belt running at 3m/min  
Thick paper yarn added by hand between  
card and cross lapper

**Web Bonding**

Needled and thermally bonded  
Needling: 8mm penetration depth, 150  
strokes per min  
Thermal bonding: Heat pressed at 100°C  
for 10 seconds on both sides

**Other**

**Sample Number: DD7****Sample Making Details****Fibre Type and Blend**

Flax/viscose blend (50/50) 127.5g (85%)  
M1440 Polyester bi-co 22.5g (15%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and perpendicularly layered  
Layering: layered onto a lap drum direct from carding

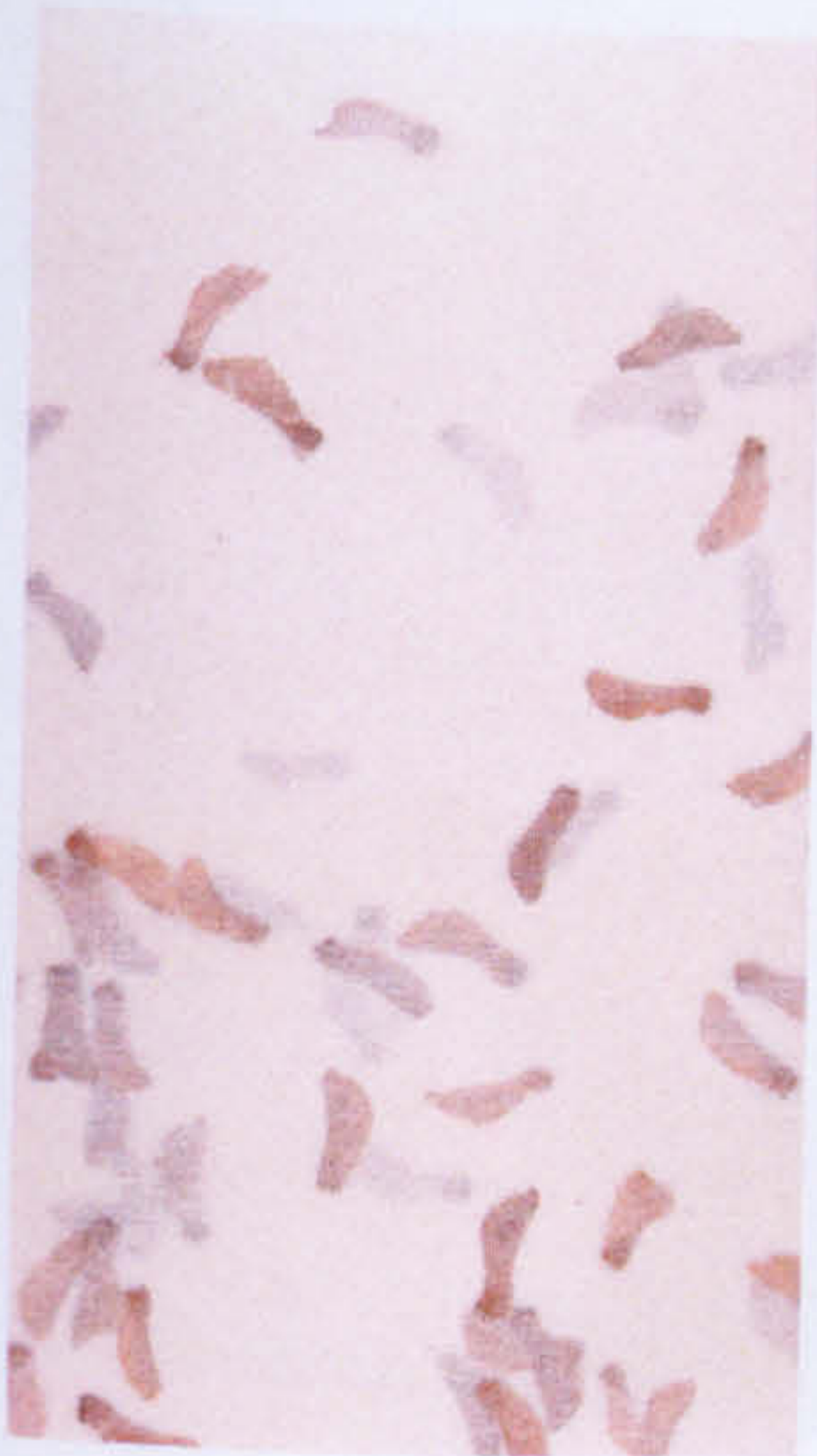
Linen yarn placed between layers on lap drum

**Web Bonding**

Needled and thermally bonded:

Needling: 6mm needle penetration, 15mm advance), 150 strokes/min both sides

Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Sample Number: DD8**

(2)

**Sample Making Details****Fibre Type and Blend**

Wool/silk mix (fleece) 70g (70%)  
M1440 Polyester Bi-co 30g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and Cross lapped

Layering: Horizontal cross lapper, out put belt not running

Sycamore pods added between card and cross lapper.

**Web Bonding**

Needled and thermally bonded

Needling: 10mm penetration depth, 150 strokes/min

Thermal bonding: Heat pressed for 100°C for 10 seconds on both sides

**Other**

(2) Embossed using lino cut plate

Sample Number: DD9



## Sample Making Details

### Fibre Type and Blend

Cut ramie (dyed) 100g (75%)  
M1440 Polyester bi-co 30g (25%)

### Fibre Preparation

Carded once to blend

### Web Forming

Carded and perpendicularly layered  
Layering: layered onto a lap drum direct from carding  
Hemp stricks placed between fibre layers on lap drum

### Web Bonding

Needled and thermally bonded:  
Needling: 6mm needle penetration, (15mm advance), 150 strokes/min  
Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

Sample Number: DD10



## Sample Making Details

### Fibre Type and Blend

Cut Ramie (dyed) 35g (70%)  
M1440 Polyester bi-co 15g (30%)

### Fibre Preparation

Carded once prior to web formation to blend

### Web Forming

Carded and cross lapped  
Layering: horizontal cross lapper, out put belt running at 6m/min  
Laser cut fabric shapes added between card and cross lapper

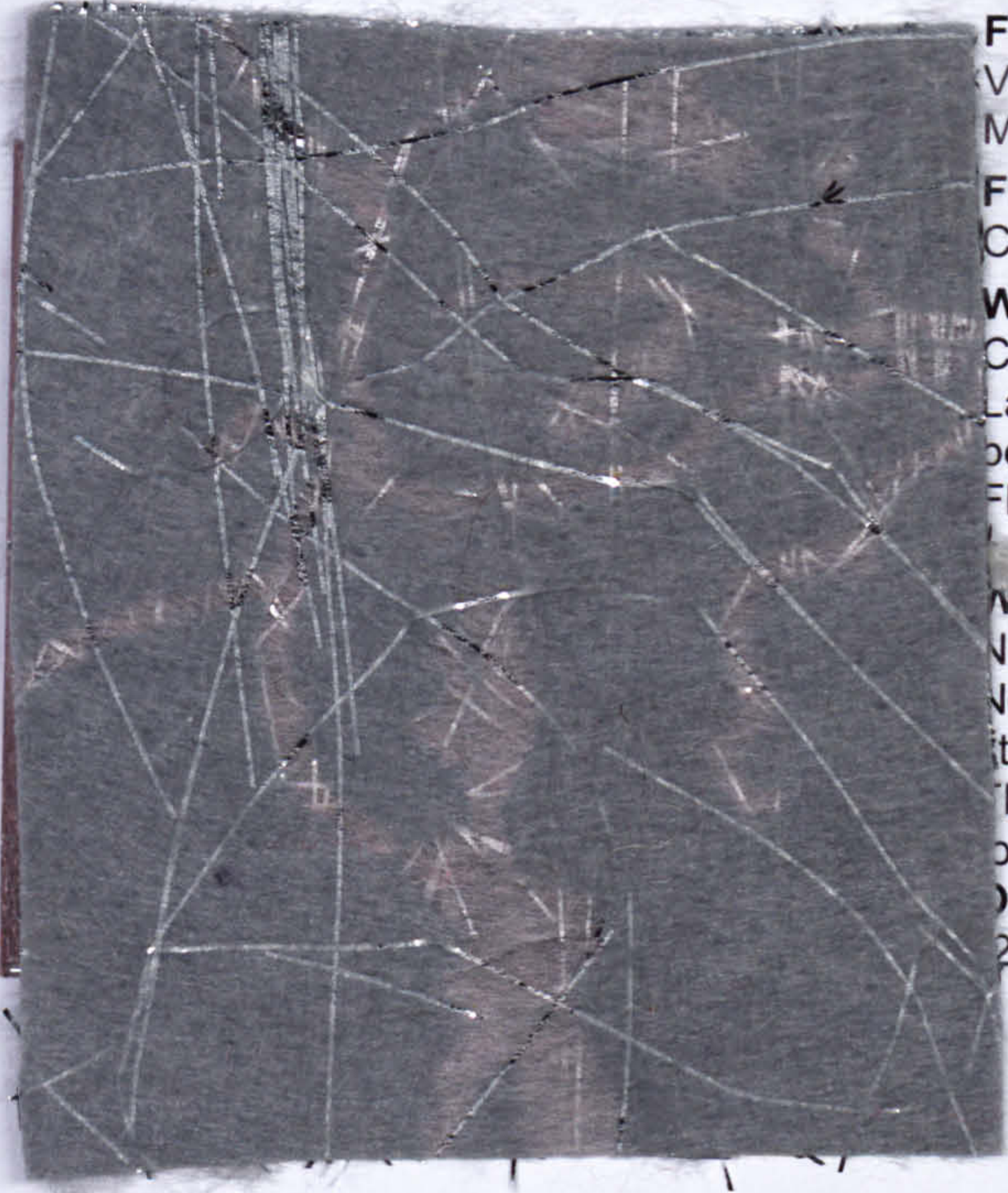
### Web Bonding

Needled and thermally bonded  
Needling: 6mm penetration depth, 150 strokes/min  
Thermal bonding: Heat pressed at 150°C for 10 second on both sides

### Other

(2) Embossed

Sample Number: DD11



**Sample Making Details**

**Fibre Type and Blend**

Viscose (dyed) 70g (70%)  
M1440 Polyester bi-co 30g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper, out put  
belt not running  
Flat lurex threads added between card  
and cross lapper

**Web Bonding**

Needled and thermally bonded  
Needling: 8mm penetration depth, 150  
strokes/min  
Thermal bonding: Heat pressed at 150°C  
for 10 seconds on both sides

**Other**

(2) Devoré Printed

Sample Number: DD12



**Sample Making Details**

**Fibre Type and Blend**

Cut ramie (dyed) 70g (70%)  
M1440 Polyester bi-co 30g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapper  
Layer: horizontal cross lapper, out put  
belt not running  
Shredded paper added between card and  
cross lapper

**Web Bonding**

Needled and thermally bonded  
Needling: 6mm penetration depth, 150  
strokes/min, both sides  
Thermal bonding: heat pressed, 100°C  
for 10 seconds both sides

Sample Number: DD13



**Sample Making Details**

**Fibre Type and Blend**

Flax 127.5g (78%)  
M1440 Polyester bi-co 22.5g (15%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and perpendicularly layered  
Layering: layered onto a lap drum direct from carding  
Linen yarn wound between layers on lap drum

**Web Bonding**

Needled and thermally bonded:  
Needling: 3mm needle penetration, (15mm advance), 150 strokes/min, both sides  
Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

Sample Number: DD14



**Sample Making Details**

**Fibre Type and Blend**

*Fabric 1*  
Cut ramie fibre 42g (70%)  
M1440 Polyester bi-co 18 (30%)

*Fabric 2*  
Cut ramie (dyed) 35g (70%)  
M1440 Polyester bi-co 15g (30%)

**Fibre Preparation**

*Fabric 1 and 2*  
Carded once to blend

**Web Forming**

*Fabric 1 and 2*  
Carded and cross lapped  
*Fabric 1*

Layering: horizontal cross lapper, out put belt running at 0.75 m/min  
White paper yarn warp fed from beam (in front of card) into layers between card and cross lapper

*Fabric 2*  
Layering: horizontal cross lapper, out put belt running at 0.9 m/min

**Web Bonding**

*Fabric 1 and 2*  
Needled and thermally bonded:  
Needling: 6mm penetration depth, 150 strokes per minute  
Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Laser cut - cutting speed mm/min, pulse period, pulse width  
Laminated – heat pressed at 150°C for 20 seconds

Sample Number: DD15



**Sample Making Details**

**Fibre Type and Blend**

Cut ramie (dyed) 100g (77%)  
M1440 Polyester bi-co 30g (23%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and perpendicularly layered  
Layering: layered onto a lap drum direct from carding  
Chenille and silk yarn wound between layers on lap drum

**Web Bonding**

Needled and thermally bonded:  
Needling: 3mm needle penetration, (15mm advance), 150 strokes/min, both sides  
Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Sample Number: DD16



**Sample Making Details**

**Fibre Type and Blend**

Wool 100g (77%)  
M1440 Polyester bi-co 30g (23%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and perpendicularly layered  
Layering: layered onto a lap drum direct from carding  
Bouclé yarn wound between layers on lap drum

**Web Bonding**

Needled and thermally bonded:  
Needling: 3mm needle penetration, (15mm advance), 150 strokes/min, both sides  
Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Sample Number: DD17



**Sample Making Details**

**Fibre Type and Blend**

Flax 140g (70%)  
M1440 Polyester 60g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper, out put belt running at 0.75m/min  
Flat paper yarn warp fed from beam (in front of card) into layers between card and cross lapper

**Web Bonding**

Needled and thermally bonded  
Needling: 10mm penetration depth, 150 strokes/min  
Thermal bonding: Heat pressed at 100°C for 10 seconds

**Other**

(2) Printed with direct dye

Sample Number: DD18



(2)



**Sample Making Details**

**Fibre Type and Blend**

Cut ramie (dyed) 70g (70%)  
M1440 Polyester bi-co 30g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper, out put belt running at 0.8m/min  
Flat lurex yarn warp fed from beam (in front of card) into layers between card and cross lapper

**Web Bonding**

Needled and thermally bonded  
Needling: 6mm penetration depth, 150 strokes/min  
Thermal bonding: Heat pressed at 100°C for 10 seconds

**Other**

(2) Two fabric pieces cut, laser cut and laminated using heat press, 150°C for 20 seconds

Sample Number: DD19



**Sample Making Details**

**Fibre Type and Blend**

Cut ramie fibres (dyed) 63g (88%)  
M1440 Polyester bi-co 9g (22%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper, out put belt not running  
Lurex and wool yarn warp fed from beam (in front of card) into layers between card and cross lapper

**Web Bonding**

Needled and thermally bonded  
Needling: 6mm penetration depth, 150 strokes/min  
Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Devore printed with fine stripe design

Sample Number: DD20



**Sample Making Details**

**Fibre Type and Blend**

Viscose fibre 50g (83%)  
M1440 Polyester bi-co 10g (17%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and perpendicularly layered  
Layering: layered onto a lap drum direct from carding  
Snarl yarn wound between layers on lap drum

**Web Bonding**

Needled and thermally bonded:  
Needling: 3mm needle penetration, (15mm advance), 150 strokes/min, both sides  
Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Devoré printed

Sample Number: DD21

Sample Making Details

Fibre Type and Blend

Flax/viscose fibre blend (50/50) 175g (70%)

M1440 Polyester bi-co 75g (30%)

Fibre Preparation

Carded once to blend

Web Forming

Carded and cross lapped

Layering: horizontal cross lapper, out put belt running at 0.75 m/min

Linen yarn warp fed from beam (in front of card) into layers between card and cross lapper

Web Bonding

Needled and thermally bonded

Needling: 6mm penetration depth, 150 strokes/min

Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

Other

2) Printed with direct dye

3) Devoré printed



Sample Number: DD22

Sample Making Details

Fibre Type and Blend

Flax/viscose fibre blend (50/50) 128g (85%)

M1440 Polyester bi-co 22 (15%)

Fibre Preparation

Carded once to blend

Web Forming

Carded and perpendicularly layered

Layering: layered onto a lap drum direct from carding

Linen yarn wound between layers on lap drum

Web Bonding

Needled and thermally bonded:

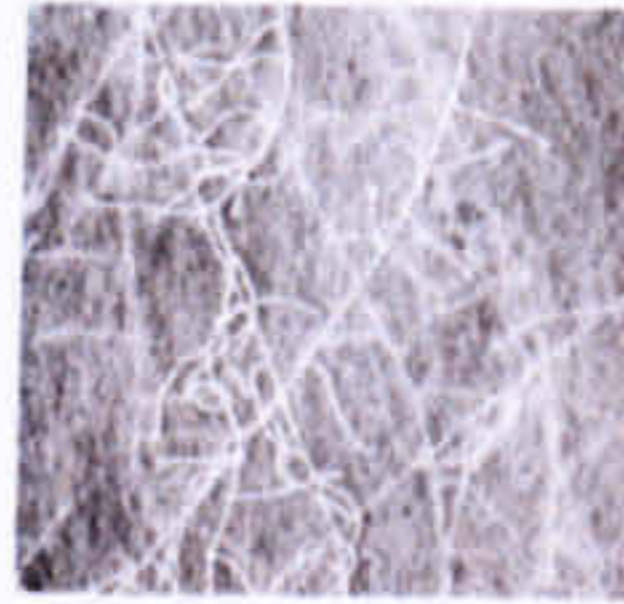
Needling: 3mm needle penetration, (15mm advance), 150 strokes/min, both sides

Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

Other



## Sample Number: DD23



## Sample Making Details

**Fibre Type and Blend**

Cut ramie fibres 14g (70%)  
M1440 Polyester bi-co 6g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and perpendicularly layered

Layering: layered onto a lap drum direct from carding

Snarl yarn wound between layers on lap drum

**Web Bonding**

Needled and thermally bonded:

Needling: 3mm needle penetration, (15mm advance), 150 strokes/min, both sides

Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Snarl Yarn

## Sample Number: DD24



## Sample Making Details

**Fibre Type and Blend**

Cut ramie fibre (dyed) 28g (70%)  
M1440 Polyester bi-co 12g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and perpendicularly layered

Layering: layered onto a lap drum direct from carding

Mohair loop yarn wound between layers on lap drum

**Web Bonding**

Needled and thermally bonded:

Needling: 3mm needle penetration, (15mm advance), 150 strokes/min

Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Devoré printed

Sample Number: DD25

## Sample Making Details

## Fibre Type and Blend

Viscose (dyed) 140g (70%)

M1440 Polyester bi-co 60g (30%)

## Fibre Preparation

Carded once to blend

## Web Forming

Carded and cross lapped

Layering: horizontal cross lapper, in belt

1.5 m/min, out put belt running at

3m/min

10 clear, flat lurex threads added

between card and cross lapper

## Web Bonding

Needled and thermally bonded

Needling: 8mm penetration depth, 150

strokes/min

Thermal bonding: Heat pressed at 150°C

for 10 seconds on both sides

Other

Devoré printed and laser cut



Sample Number: DD26

## Sample Making Details

## Fibre Type and Blend

Viscose (dyed) 90g (72%)

M1440 Polyester bi-co (dyed) 35g (28%)

## Fibre Preparation

Carded once to blend

## Web Forming

Carded and perpendicularly layered

Layering: layered onto a lap drum direct from carding

Cut Lurex yarn wound between layers on lap drum

## Web Bonding

Needled and thermally bonded:

Needling: 3mm needle penetration, (15mm advance), 150 strokes/min both sides

Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

## Other

Devoré printed



Sample Number: DD27

**Sample Making Details****Fibre Type and Blend**

Linen/silk fibre blend 75g (60%)  
M1440 Polyester bi-co 50g (40%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper, in belt  
11.5 m/min, out put belt running at  
0.8m/min

Goats hair added between card and  
cross lapper

**Web Bonding**

Needled and thermally bonded  
Needling: 6mm penetration depth, 150  
strokes/min

Thermal bonding: Heat pressed at 150°C  
for 10 seconds on both sides

**Other**

Laser marked and peeled(various  
settings)

Sample Number: DD28

**Sample Making Details****Fibre Type and Blend**

Viscose (dyed) 140g (70%)  
M1440 Polyester bi-co (dyed) 60g  
(30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper,  
in belt 11.5 m/min, out put belt  
running at 0.8m/min

Cut Lurex yarn added between  
card and cross lapper

**Web Bonding**

Needled and thermally bonded  
Needling: 8mm penetration depth,  
150 strokes/min

Thermal bonding: Heat pressed at  
150°C for 10 seconds on both  
sides

**Other**

(2)Laser marked and  
peeled(various settings)

(3) Devoré printed

## Sample Number: DD29



## Sample Making Details

**Fibre Type and Blend**

Linen/ramie mix (50/50) 75g (44%)

Swaledale wool 50g (30%)

M1440 Polyester bi-co 45g (26%)

**Fibre Preparation**

Linen/ramie and bi-co carded once to blend

Swaledale and bi-co carded once to blend

**Web Forming**

Carded and perpendicularly layered  
Fibres arranged on feed sheet to create a 'sandwich' of wool between linen/ramie layers

Layering: layered onto a lap drum direct from carding

**Web Bonding**

Needled and thermally bonded:

Needling: 6mm needle penetration, (15mm advance), 150 strokes/min

Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Devoré printed

## Sample Number: 30



## Sample Making Details

**Fibre Type and Blend**

Cut ramie fibre 25g/Linen Tops 2g (37%)

Herdwick wool 18g (25%)

M1440 Polyester bi-co 27.5g (38%)

**Fibre Preparation**

Ramie/linen and bi-co carded once to blend

Herdwick and bi-co carded once to blend

**Web Forming**

Carded and cross lapped

Fibres arranged on feed sheet to create a 'sandwich' of wool between linen/ramie layers

Layering: horizontal cross lapper, in belt 11.5 m/min, out put belt not running

**Web Bonding**

Needled and thermally bonded:

Needling: 8mm needle penetration, (15mm advance), 150 strokes/min

Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Devoré printed

Sample Number: DD31



**Sample Making Details**

**Fibre Type and Blend**

Flax 21g (70%)  
M1440 Polyester bi-co 9g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper, in belt 11.5 m/min, output belt not running  
Gummed silk added between card and cross lapper

**Web Bonding**

Needled and thermally bonded:  
Needling: 6mm needle penetration, (15mm advance), 150 strokes/min  
Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Devoré printed

Sample Number: DD 32



**Sample Making Details**

**Fibre Type and Blend**

cut ramie fibres (dyed) 60g (60%)  
alpaca 21g (21%)  
M1440 Polyester bi-co 19g (19%)

**Fibre Preparation**

ramie and bi-co (15%) carded once to blend  
alpaca and bi-co (30%) carded once to blend

**Web Forming**

carded and perpendicularly layered  
fibres arranged on feed sheet to create a 'sandwich' of alpaca between ramie layers

layering: layered onto a lap drum direct from carding

**Web Bonding**

needled and thermally bonded:  
needling: 6mm needle penetration, (15mm advance), 150 strokes/min  
thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Devoré printed

Sample Number: DD33

**Sample Making Details****Fibre Type and Blend**

Herdwick wool (55g) (50%)  
 Alpaca 30g (27%)  
 M1440 Polyester bi-co 25.5g (23%)

**Fibre Preparation**

Herdwick wool and bi-co (15%) carded once to blend  
 Alpaca and bi-co (30%) carded once to blend

**Web Forming**

Carded and perpendicularly layered  
 Fibres arranged on feed sheet to create a 'sandwich' of alpaca between wool layers  
 Layering: layered onto a lap drum direct from carding

**Web Bonding**

Needled and thermally bonded:  
 Needling: 6mm needle penetration, (15mm advance), 150 strokes/min  
 Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Laser marked (Power 40%, Velocity 100) and 'peeled'

Sample Number: DD34

**Sample Making Details****Fibre Type and Blend**

Cut ramie fibres (dyed) 60g (60%)  
 Alpaca 21g (21%)  
 M1440 Polyester bi-co 19g (19%)

**Fibre Preparation**

Ramie and bi-co (15%) carded once to blend  
 Alpaca and bi-co (30%) carded once to blend

**Web Forming**

Carded and perpendicularly layered  
 Fibres arranged on feed sheet to create a 'sandwich' of alpaca between ramie layers  
 Layering: layered onto a lap drum direct from carding

**Web Bonding**

Needled and thermally bonded:  
 Needling: 6mm needle penetration, (15mm advance), 150 strokes/min  
 Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Laser marked (Power 40%, Velocity 100) and 'peeled'

Sample Number: DD35

**Sample Making Details****Fibre Type and Blend**

Un-carded cotton 60g (66%)

Silk 30g (27%)

M1440 Polyester bi-co 27g (23%)

**Fibre Preparation**

Cotton and bi-co (30%) blended once to card

Silk and bi-co blended once to card

**Web Forming**

Carded and perpendicularly layered

Fibres arranged on feed sheet to create a 'sandwich' of silk between cotton (approximately 40% of cotton fibre on top and 60% on the bottom)

Layering: layered onto a lap drum direct from carding

**Web Bonding**

Needled and thermally bonded:

Needling: 6mm needle penetration, (15mm advance), 150 strokes/min

Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Devoré printed.

Sample Number: DD36

**Sample Making Details****Fibre Type and Blend**

Flax (80%)/silk (10%)/merino (10%) blend 55g (54%)

Silk 21g (21%)

M1440 Polyester bi-co 25g (25%)

**Fibre Preparation**

Flax/silk/merino and bi-co (30%) carded once to blend

Silk and bi-co (30%) carded once to blend

**Web Forming**

Carded and perpendicularly layered

Fibres arranged on feed sheet to create a 'sandwich' of silk between flax blend (approximately 40% of flax blend on top and 60% on the bottom)

Layering: layered onto a lap drum direct from carding

**Web Bonding**

Needled and thermally bonded:

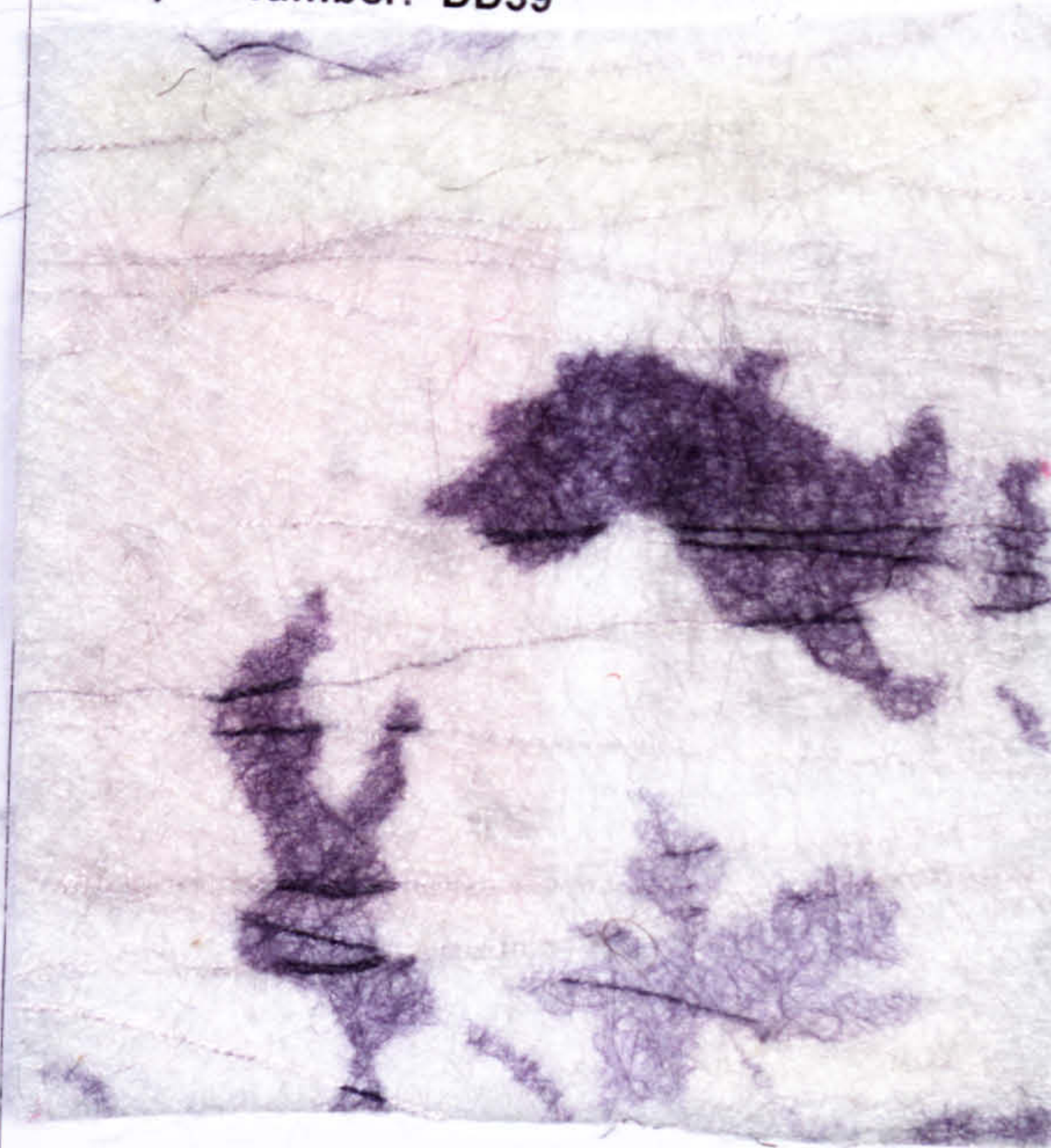
Needling: 6mm needle penetration, (15mm advance), 150 strokes/min

Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Devoré Printed

Sample Number: DD39

**Sample Making Details****Fibre Type and Blend**

Cut ramie fibres 70g (70%)  
M1440 Polyester bi-co 15g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper, in belt  
11.5 m/min, out put belt not running  
Yarns added by hand between card and  
cross lapper

**Web Bonding****Web Bonding**

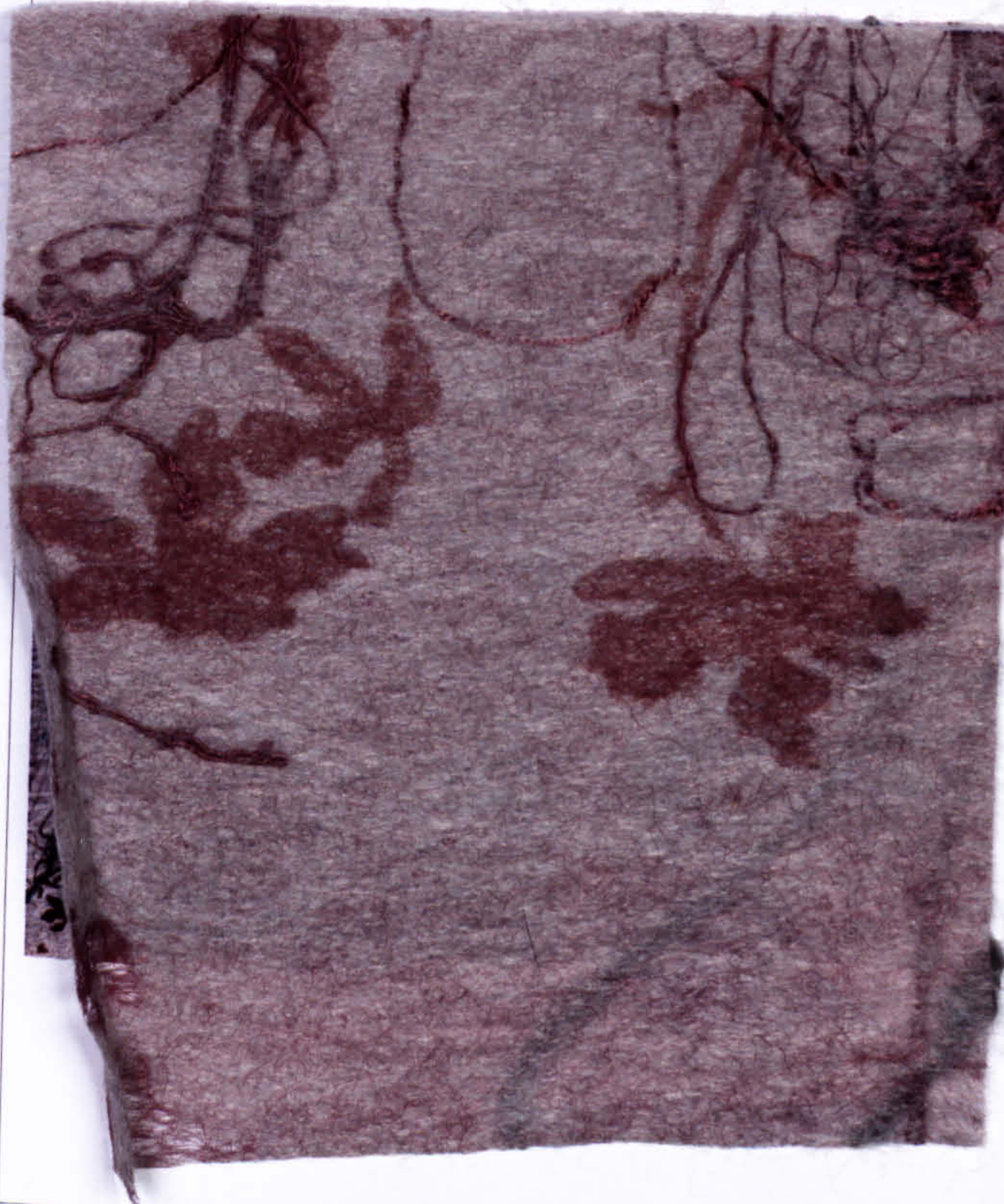
Needled and thermally bonded:  
Needling: 6mm needle penetration, 150  
strokes/min

Thermal bonding: Heat pressed at  
100°C for 10 seconds on both sides

**Other**

Printed with procian dye

Sample Number: DD40

**Sample Making Details****Fibre Type and Blend**

Viscose (dyed) 70g (70%)  
M1440 Polyester bi-co (dyed) 30g  
(30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper,  
in belt 11.5 m/min, out put belt not  
running

Yarns added by hand between  
card and cross lapper

**Web Bonding**

Needled and thermally bonded:  
Needling: 6mm needle  
penetration, 150 strokes/min  
Thermal bonding: Heat pressed at  
100°C for 10 seconds on both  
sides

**Other**

Devoré printed and piece dyed  
(2) Printed with direct dye

Sample Number: DD41

**Sample Making Details****Fibre Type and Blend**

Cut ramie fibres (dyed) 21g (70%)  
M1440 Polyester bi-co 9g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper, in belt  
11.5 m/min, out put running at 0.9m/min

**Web Bonding**

Needled and thermally bonded:  
Needling: 6mm needle penetration, 150  
strokes/min

Thermal bonding: Heat pressed at  
100°C for 10 seconds

**Other**

Cut into two fabric pieces, devoré  
printed and laminated using heat press,  
150°C for 20 seconds

Sample Number: DD42

**Sample Making Details****Fibre Type and Blend**

Cut ramie (dyed) 35g (70%)  
M1440 (dyed) 15g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper, in belt  
11.5 m/min, out put running at 0.5m/min

**Web Bonding**

Needled and thermally bonded:  
Needling: 6mm needle penetration, 150  
strokes/min

Thermal bonding: Heat pressed at  
100°C for 10 seconds

**Other**

One pink and one red fabric produced,  
both devoré printed and laminated  
using heat press, 150°C for 20 seconds

Sample Number: DD43

**Sample Making Details****Fibre Type and Blend**

Cut ramie fibres (dyed) 60g (40%)

Silk (dyed) 30g (20%)

M1440 Polyester bi-co 60g (40%)

**Fibre Preparation**

Carded once to blend

40% ratio of bi-component blended with each base fibre

**Web Forming**

Carded and cross lapped

Carding: fibres placed on feed belt to create graduated texture and colour

Layering: vertical cross lapper

**Web Bonding**

Needled and thermally bonded

Needling: -

Thermal bonding: 130°C for 10 seconds

**Other**

Cut into two pieces, laser cut and laminated using heat press at 150°C for 20

Sample Number: DD44

**Sample Making Details****Fibre Type and Blend**

Cut ramie fibres (dyed) 21g (35%)

Herdwick 21g (35%)

M1440 Polyester bi-co 18g (30%)

**Fibre Preparation**

Each base fibre blended with 30% bi-co

**Web Forming**

Carded and cross lapped

Carding: two separate fabrics created

Layering: horizontal cross lapper, in belt 11.5 m/min, out put running at 0.9m/min

**Web Bonding**

Needled and thermally bonded:

Needling: 6mm needle penetration, 150 strokes/min

Thermal bonding: Heat pressed at 100°C for 10 seconds

**Other**

Two individual fabric created, ramie fabric laser cut and layered to the herdwick fabric using heat press at 150°C for 20 seconds

Sample Number: DD45



Sample Making Details

**Fibre Type and Blend**

Cut ramie fibre (dyed light grey) 35g  
Cut ramie fibre (dyed dark grey) 35g  
M1440 Polyester bi-co 30g

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and perpendicularly layered  
Two separate fabrics made.

**Web Bonding**

Needled and thermally bonded:  
Needling: 6mm needle penetration,  
(15mm advance), 150 strokes/min  
Thermal bonding: Heat pressed at  
100°C for 10 seconds on both sides

**Other**

Two separate fabrics made (of the  
same weight), laser cut and laminated  
using heat press at 150°C for 20  
seconds

Sample Number: DD46



Sample Making Details

**Fibre Type and Blend**

Viscose (dyed) 105g (70%)  
M1440 Polyester bi-co 45g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and perpendicularly layered  
Layering: layered onto a lap drum direct  
from carding  
Lurex filaments added to the lap drum

**Web Bonding**

Needled and thermally bonded:  
Needling: 6mm needle penetration,  
(15mm advance), 150 strokes/min  
Thermal bonding: Heat pressed at  
100°C for 10 seconds on both sides

**Other**

Devoré printed, embossed using a laser  
cut steel plate and heat press at 150°C  
for 25 seconds

Sample Number: DD47



Sample Making Details

Fibre Type and Blend

Cut ramie fibres (dyed) 35g (70%)  
M1440 Polyester bi-co (dyed) 15g (30%)

Fibre Preparation

Carded once to blend

Web Forming

Carded and perpendicularly layered  
Layering: layered onto a lap drum direct from carding

Web Bonding

Needled and thermally bonded:  
Needling: 6mm needle penetration, (15mm advance), 150 strokes/min  
Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

Other

Embossed using a laser cut steel plate and heat press at 150°C for 25 seconds

Sample Number: DD48



(2)



(3)

Sample Making Details

Fibre Type and Blend

Cut ramie fibres (dyed) 17.5g (35%)  
Wool/linen/silk mix 17.5g (35%)  
M1440 Polyester bi-co 15g (30%)

Fibre Preparation

Each base fibre blended with 30% bi-co

Web Forming

Carded and cross lapped  
Layering: horizontal cross lapper, output belt not running to create distinct layers.

Web Bonding

Needled and thermally bonded:  
Needling: 10mm needle penetration, 150 strokes/min  
Thermal bonding: heat pressed at 100°C for 10 seconds x 2

Other

Two piece of sample devoré printed on ramie side and layered in the heat press, 150°C for 20 seconds

(2) Laser cut, layered and transfer printed.

(3) Single layer printed on wool side

Sample Number: DD49



**Sample Making Details**

**Fibre Type and Blend**

Cut ramie (dyed) 35g (70%)  
M1440 (dyed) 15g (30%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and cross lapped  
Layering: horizontal cross lapper, in belt 11.5 m/min, out put running at 0.5m/min

**Web Bonding**

Needled and thermally bonded:  
Needling: 6mm needle penetration, 150 strokes/min  
Thermal bonding: Heat pressed at 100°C for 10 seconds

**Other**

One red and one pink layer laser cut and laminated in heat press, 150°C for 20 seconds

Sample Number: DD50



**Fibre Type and Blend**

Cut ramie (dyed) 100g (77%)  
M1440 Polyester bi-co 30g (23%)

**Fibre Preparation**

Carded once to blend

**Web Forming**

Carded and perpendicularly layered  
Layering: layered onto a lap drum direct from carding

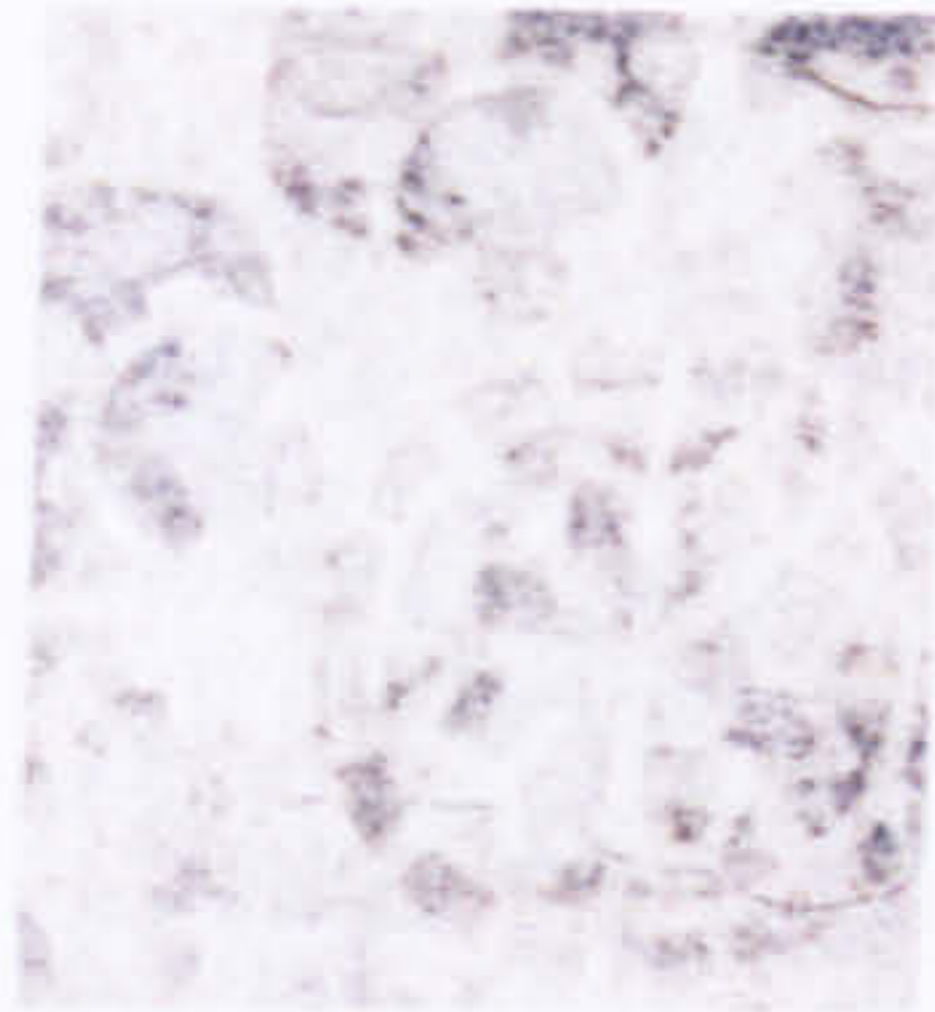
**Web Bonding**

Needled and thermally bonded:  
Needling: 3mm needle penetration, (15mm advance), 150 strokes/min, both sides  
Thermal bonding: Heat pressed at 100°C for 10 seconds on both sides

**Other**

Embossed used laser cut steel plate

## Sample Number: DD51



## Sample Making Details

**Fibre Type and Blend**

Cut ramie fibres (dyed) 70g (70%)  
M1440 Polyester bi-co 30g (30%)

**Fibre Preparation**

Ramie fibre blended with bi-co

**Web Forming**

Carded and cross lapped, yarns added between card and cross lapper  
Layering: horizontal cross lapper, in belt 11.5 m/min, out put running at 0.9m/min

**Web Bonding**

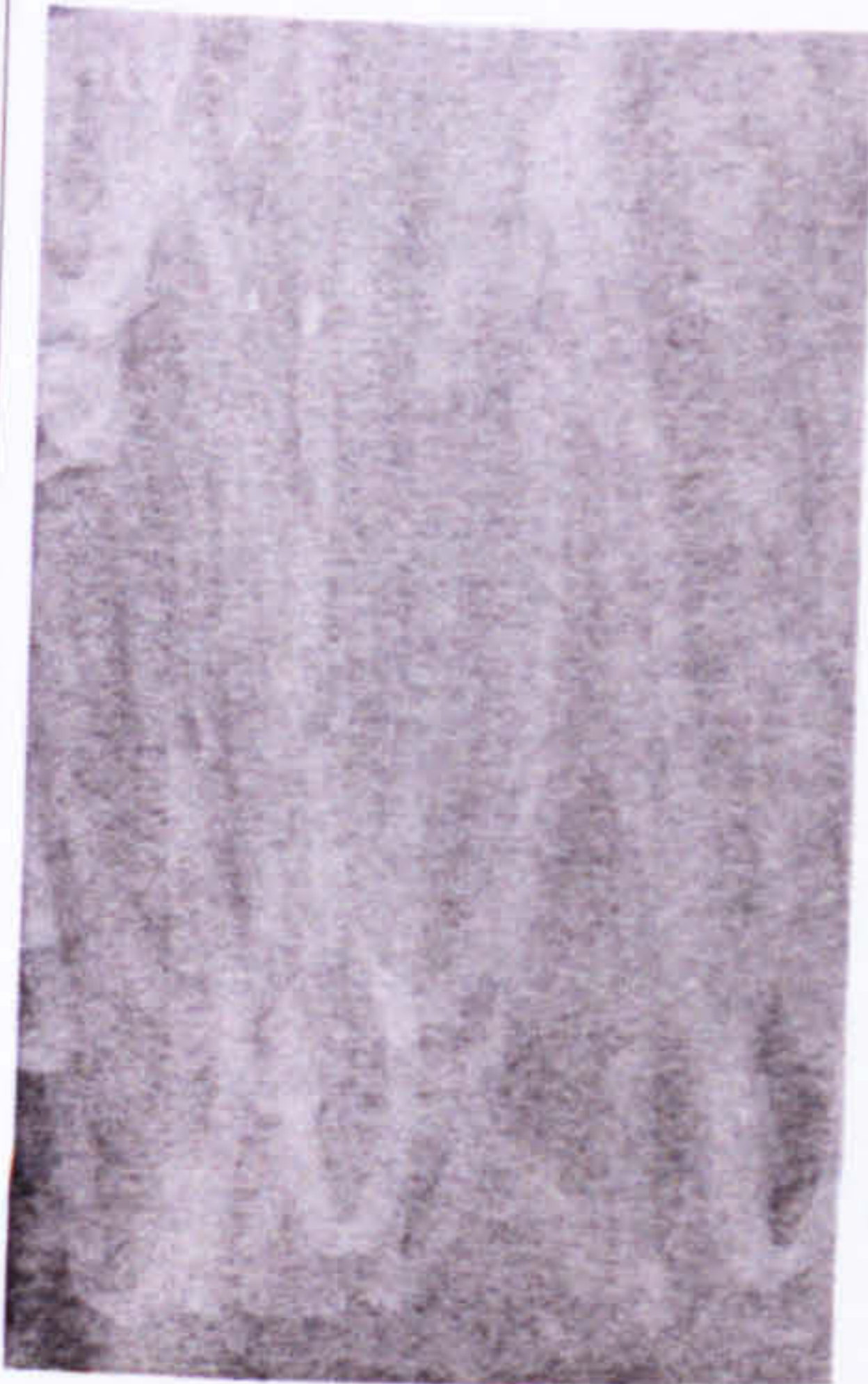
Needled and thermally bonded:  
Needling: 6mm needle penetration, 150 strokes/min

Thermal bonding: Heat pressed at 100°C for 10 seconds both sides

**Other**

Two pieces of fabric devoré printed, laser cut and layered using heat press, 150°C for 20 seconds

## Sample Number: DD52



## Sample Making Details

**Fibre Type and Blend**

Cut ramie fibres (dyed) 35g (70%)  
M1440 Polyester bi-co 15 (30%)

**Fibre Preparation**

Fibre blended once to blend

**Web Forming**

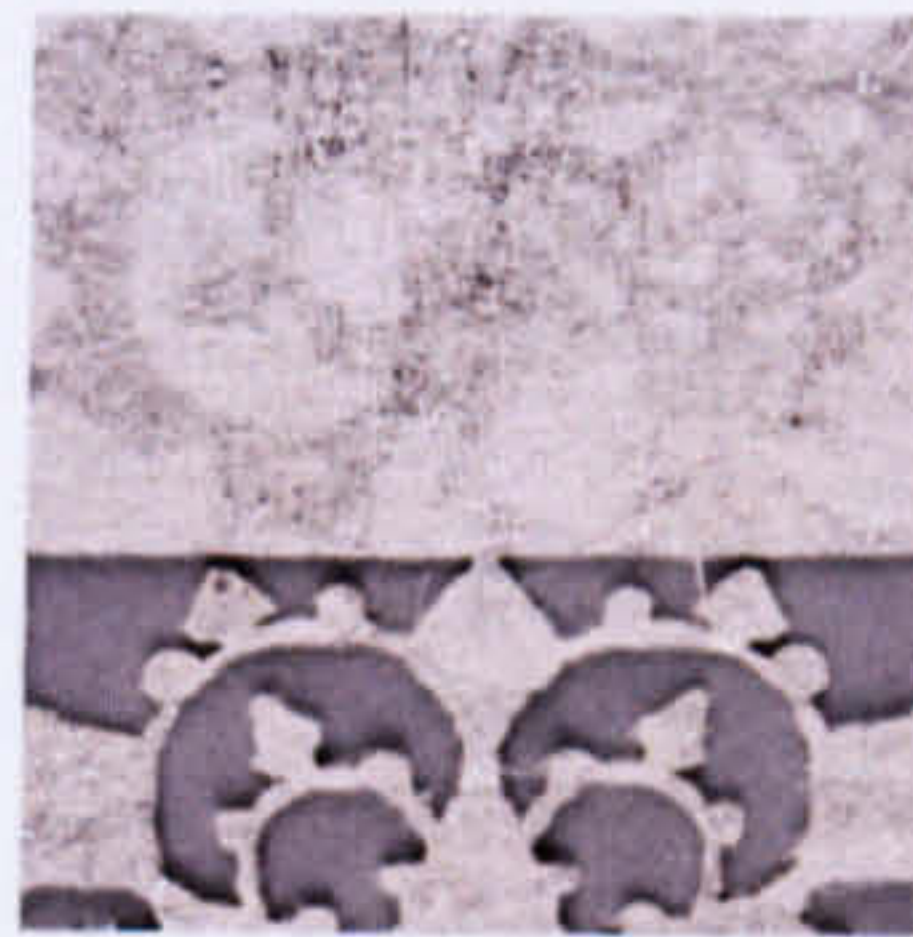
Carded and cross lapped  
Layering: horizontal cross lapper, in belt 11.5 m/min, out put running at 0.9m/min  
Pre-made ribbon yarn warp added between card and cross-lapper

**Web Bonding**

Needled and thermally bonded:  
Needling: 6mm needle penetration, 150 strokes/min

Thermal bonding: Heat pressed at 100°C for 10 seconds

**Other**

**Sample Number: DD53****Sample Making Details****Fibre Type and Blend**

Cut ramie fibres (dyed) 70g (70%)  
M1440 Polyester bi-co 30g (30%)

**Fibre Preparation**

Ramie blended with 30% bi-co

**Web Forming**

Carded and cross lapped

Lurex added between card and cross lapper

Layering: horizontal cross lapper, in belt 11.5 m/min, output belt not running

**Web Bonding**

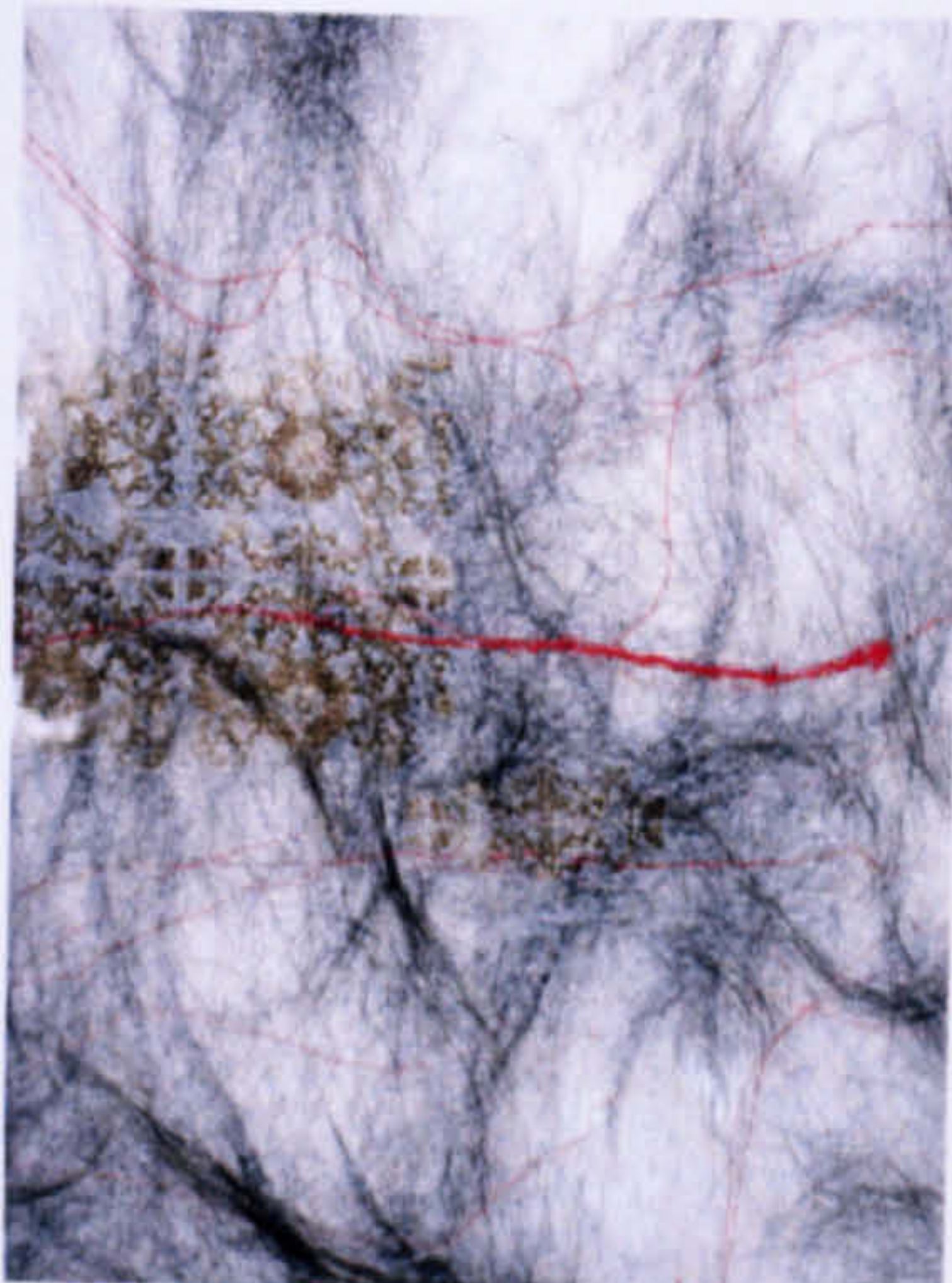
Needled and thermally bonded:

Needling: 10mm needle penetration, 150 strokes/min

Thermal bonding: Heat pressed at 100°C for 10 seconds both sides

**Other**

Devoré printed and laser cut.

**Sample Number: DD54****Sample Making Details****Fibre Type and Blend**

Linen tops 30g (67%)  
M1440 Polyester bi-co 15g (33%)

**Fibre Preparation**

Linen blended with bi-co

**Web Forming**

Carded and cross lapped

Goats hair added between card and cross lapper.

Layering: horizontal cross lapper, in belt 11.5 m/min, out put running at 0.9m/min

**Web Bonding**

Needled and thermally bonded:

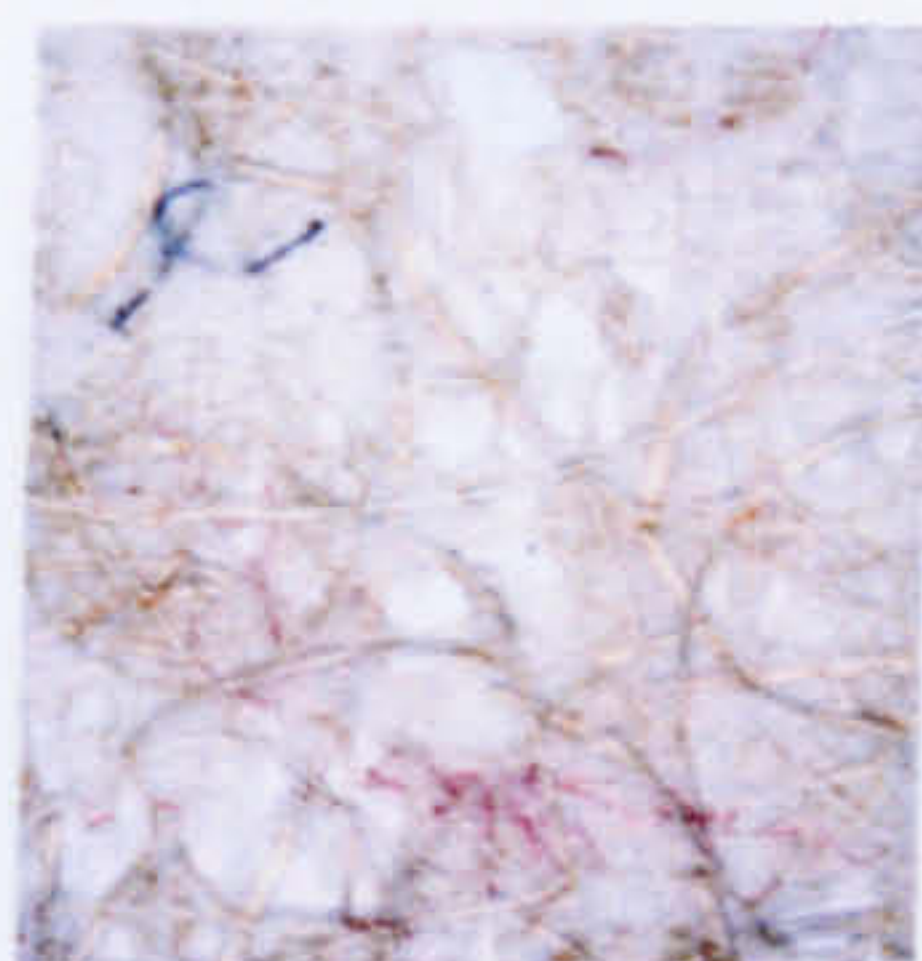
Needling: 6mm needle penetration, 150 strokes/min

Thermal bonding: Heat pressed at 150°C for 10 seconds both sides

**Other**

Laser cut at low speed.

**Sample Number: DD55**



### Sample Making Details

#### Fibre Type and Blend

Wool/linen/mix 70g (70%)

M1440 Polyester bi-co 30g (30%)

#### Fibre Preparation

Wool/linen/mix carded with bi-co to blend

#### Web Forming

Carded and cross lapped

Yarns added between card and cross lapper

Layering: horizontal cross lapper, in belt 11.5 m/min, out put running at 0.9m/min

#### Web Bonding

Needled and thermally bonded:

Needling: 6mm needle

penetration, 150 strokes/min

Thermal bonding: Heat pressed at 100°C for 10 seconds

#### Other

Two fabric pieces laser cut and layered using heat press, 150°C for 20 seconds x 2.

## **1. Documentation of Pilot Focus Groups**

### **1.1 Set 1: Focus Groups with Textile and Furniture Design Students**

This set of focus groups were conducted after the first stage of the practical work.

#### **1.1.1 Participants**

The groups were conducted with final year Textile Design and Furniture Design undergraduate students at Loughborough University School of Art and Design. For the purpose of the research, these students were considered as semi-professionals within their fields. It was considered that design education in which they were involved would enable them to analyse materials and objects systematically enabling them to offer individual opinions from a specific design perspective. It was anticipated that Textile Design student's would be able to offer comments based on an understanding of important aspects of textile design including handle, surface, colour, and fibre type, as well as being able to regard the fabrics in relation to textile processes and products. It was thought that furniture design students might offer comments from the perspective of product design relating to end use, fabric durability and making up processes.

Within this set, three focus groups were conducted. The first group, which was conducted with five Multi - Media Textile Design students, acted as a pilot study with which to test and adjust the methods used. The second group was conducted with four Printed Textile Design students and the third with six Furniture Design students. It was considered that keeping the participants in groups from their design discipline would allow a level of shared perspective and familiarity, enabling free flowing discussion (Morgan, 1997, p.35).

The first two groups were conducted in a tutorial room and the third in the participant's design studio.

#### **1.1.2 Discussion Content and Structure**

The discussion contents related to the aims of this stage of work and the analytical framework employed within the research based on the 'aesthetic', 'method' and 'association' aspects of Papanek's function model (Papanek, 1985 p.7). The aspect of 'use' was also considered at this stage. The aim of the groups most specifically was to generate responses to and feedback on the aesthetic qualities of the fabrics produced and their potential end uses. Within this, any associations with other products and textiles that the fabrics prompted were sought, as discussed in Chapter 3 this is importantly linked to aesthetics. The discussion was therefore structured in the following way:

1. Fabric viewing and handling
2. Participants asked for their initial responses to the fabrics
3. Questions relating to aesthetic and physical qualities of the fabrics
4. Questions relating to associations
5. Questions relating to potential end-uses of the fabrics

This structure reflects the 'funnel' approach to focus groups as discussed by Morgan (1997, p.41). As the term 'funnel' suggests, the approach enables open or unprompted responses to be given in the initial stages of focus group and allows the discussion to become more focused on issues that the researcher is interested in as the session progresses. A 'moderator's guide', was used as a tool with which to direct the discussion according to this pre-planned structure the (Langford and McDonagh 2003. p.31). Specific questions within this structure were adapted and developed as the groups progressed.

### **1.1.3 Documentation and Focus Group Tools**

#### **1.1.3.1 Audio - Taping**

Morgan writes that the principle means of capturing observations in focus groups is through audio-taping (Morgan, 1997, p. 54). Within this research, the first two focus groups were taped and additional notes made by the researcher during and shortly after the discussions. The studio location of the third group did not allow a quality recording to be taken therefore 'response forms' were introduced alongside discussion to ensure that all participants' comments and observations were recorded accurately. The essence of the discussion that followed was captured through note-taking.

#### **1.1.3.2 Response Forms**

The response forms were structured in the same way as the discussion. During product handling participants were asked to note down responses to a series of questions within the main discussion headings.

#### **1.1.3.3 Product (Sample) Handling**

'Product Handling' is considered by Langford and McDonagh as a primary tool for design concept evaluation (2003, p. 175). It enables participants to scrutinize products without actually using them; stimulating a retail showroom scenario and enabling immediate gut reactions to be identified (Langford and McDonagh, 2003, p. 24). However, it is acknowledged that the method does not provide true insight into the problems encountered with the product in question during actual use (ibid).

Within this research, Product Handling enabled the participants to form gut reactions to the fabrics from both visual and tactile perspectives. It was also a means of immersing the participants within the subject at hand and allowed them to form ideas and opinions before discussion began. The fabrics were accessible to participants for reference purposes throughout the discussion.

#### 1.1.4 Analytical Technique

The technique used to analyse the data generated from the focus groups followed the *general* procedure outlined by authors such as Miles and Hubberman (1994) for analysing qualitative data as highlighted by Morgan (1997, p. 58). The procedure, as discussed in Chapter 3, involves the three key activities of data reduction, data display and verification (Miles and Hubberman in Robson, 1993. p. 456).

Within this framework the analysis drew on Bruseberg and McDonagh's comments that much analysis of focus groups consists of transcribing ideas and thoughts from various forms of documentation, arranging comments into suitable groups and identifying themes and categories relating to user responses (Langford and McDonagh, 2003, p.41). They suggested that this process need not be overly extensive involving verbatim transcriptions or discourse analysis but should aim to capture the 'essence' of the discussion (ibid). However, they do highlight that this process needs to be undertaken by the researcher her/him self as it requires an understanding of the research issues under investigation (ibid, p. 98). Further to this they note that, if conducted by the designer, this process can spark creative thinking through response to the participants' emotional reactions and language (ibid, p. 41). This can potentially enable appropriate design development.

Within this research, summarised transcriptions from recordings and response sheets were made. A 'Category Analysis', as described by Bruesburg and McDongah (2003, p. 43), was carried out. This was developed by grouping ideas and comments from the summarised transcriptions under the 'discussion headings' (ref to previous section). Under each of these headings, key themes were identified and supplemented by the specific comments made during the discussion and on the response forms. To gain an idea of the importance of each of the themes, the frequency of specific comments was noted. Where strong agreement with a participants comment was made by other participants through gestures or affirmative comment, one was added to the relevant comment frequency.

### 1.1.5 Results and Discussion

The focus group discussions were grouped under the main headings used within the discussion guide. Categories and themes emerging from the discussion were developed within these headings. These themes are discussed below in relation to the evaluative headings of 'aesthetic', 'associations', 'method' and 'use'. In order to draw meaning from the results and to articulate this meaning, the theoretical ideas relating to craft, industry and design that were outlined in the Contextual Framework Chapter are drawn upon. In doing this the implications of the results in regard to the research questions are highlighted.

#### 1.1.5.1 'Aesthetic'

##### *Initial Responses*

Initial comments regarding the **aesthetic qualities** of the fabrics related predominantly to the **tactile qualities** of the fabrics. An initial 'urge' to feel and touch the fabrics was identified by a number of participants (FG2, FG3) along with a perception of them as being 'soft', 'smooth' and 'delicate'. In terms of **visual qualities**, a number of specific comments were made relating to colour, the quality of the 'edges' of the fabric (FG3). In each group the translucency of the fabrics noted as a prominent and positive quality and in particular the contrast between opaque and translucent qualities in a single fabric (FG2). A number of positive and negative descriptors were used by the participants in the initial stages of the discussion. Some fabrics were described as 'nice', 'lovely' (FG2, FG1) and 'beautiful' (FG1) whilst others were perceived as having 'little about them' (FG1).

##### *Categories and Themes*

Having given their initial responses, the participants were asked further questions about the aesthetic qualities of the fabrics; in particular what they perceived the prominent qualities of the fabrics to be. The responses to the fabrics were grouped into 8 main categories; Tactile Qualities and Variety in Surface and Weight, Interaction with Light, Delicacy and Disparity, Layers, Fabric Edges, and the use of Yarns and Emotional Responses.

##### *Tactile Qualities and Variety in Surface and Weight*

In all three groups, the most comments made were in regard to the tactile qualities of the fabrics and the variety in fabric surface and weight within the collection. The urge to touch and feel the fabrics was further highlighted (FG1, FG3) and a number of descriptive words relating to touch were used for example 'soft', 'crinkled' and 'fluffy'. In regard to surface, the sense of variety was highlighted (FG2, FG3), each fabric was perceived as having a different quality. In particular the contrast between 'matt' and 'shiny', translucent and opaque, often

within a single fabric was noted as an interesting and appealing quality (FG2). It was suggested that this aspect of the fabrics had further scope for manipulation (FG3).

The variety in tactile and surface quality noted, perhaps suggests that the processes used to produce the fabrics (outlined in Chapters 4 and 5), afford the possibility to manipulate to as, Pye suggested, realise 'deliberate intentions about the very small details and qualities of surfaces' (as outlined in the Contextual Framework Chapter) and potentially leading to the 'prized' qualities for which handwork is valued.

## ***Interaction with Light***

The way in which the fabrics interacted with lighted was noted in the participant's initial responses to the fabrics and emerged as a common theme in regard to the prominent qualities of the fabrics. It was perceived as a positive quality and prompted suggestions to use the fabrics within lighting, this pointed to the appeal of the fabrics for 'designed' products.

## ***Delicacy and Disparity***

The delicate quality of the fabrics also emerged as a common theme. In relation to this, it was noted in two of the discussion groups (FG1, FG2), that there was a certain disparity between the appearance of some of the fabrics and their actual tactile qualities. One participant commented that the fabrics 'don't feel how they look' and another that certain fabrics were 'unexpectedly hard' (FG3) and 'appeared thinner than they actually are' (FG1). This was raised later in the discussion in relation to fabric's structural integrity.

This idea of disparity between 'look' and 'feel' could suggests the potential of the fabrics to 'draw in' viewers, perhaps pointing to the certain appeal of the fabric's from an aesthetic standpoint.

## ***Layers, Edges and Yarns***

Further aspects of the fabric collections that were identified by the groups as being particularly interesting included; the layered quality of the fabrics, the graduating edges of the fabrics and the use of yarns within the fabrics. Participants commented that the fabrics with yarns embedded in them appeared to have more 'structure'. It was noted that the way in which the yarns were trapped between layers of fibre at various depths created a faded quality. This was perceived as an appealing quality and perhaps pointed again to the potential to realise specific 'details' in regard to surface and visual qualities within the fabric structures.

The idea of visual 'structure' was picked up upon in later focus group discussions and emerged as an important theme in regard to later collections.

## ***Emotional***

As well as commenting upon the formal qualities of the fabrics, participants made comments that suggested an emotional response to the fabrics. One participant commented that the fabric had a 'calming effect' (FG2) and another that the fabrics were 'warm' (FG1). This perhaps, suggests the potential to use the processes in question to develop 'entities that are meaningful' and therefore have a particular aesthetic value as described by Papanek (1985).

Further to this, as in the initial response stage, a number of positive descriptors were used to describe the fabrics including; 'elegant', 'precious', 'beautiful', 'pure' and 'minimal' (FG3).

## **1.1.5.2 Associations**

### ***Initial Responses***

Associations that the fabrics prompted with other materials and products became apparent through out the discussion. In the initial stage of the discussions, references to hand made paper and paper pulp were made (FG2) and when asked to discuss the prominent aesthetic qualities of the fabrics, a number of associations were made by participants in their descriptions and discussions of the fabrics. Reference's were made to paper, tissue, leather, marble, plastic, paintings and stitched surfaces. Further to this, the handle of the fabrics prompted reference to synthetics.

The response given by the participants when asked specifically to consider what associations the fabrics held or prompted, were grouped into five main categories; natural materials, man-made materials, traditional fabrics, paper and felt and product related.

### ***Natural and Man-made Materials***

The majority of the associations made referred to natural materials including sheepskin, leather, wool (FG2, FG3, FG1) and hair (FG2). Associations with man-made materials included a number of references to fibreglass and wire wool (FG3, FG2).

The strong associations with natural materials, perhaps suggests that the fabrics had moved away to some extent from the synthetic nature of traditional industrially manufactured nonwovens.

### ***Traditional and Industrial Fabrics***

Some associations with traditional and industrial fabrics were made including; silk chiffon and interfacing products (FG2).

### ***Paper and Felt***

The most frequent associations made in each of the groups were with paper and felt. This is unsurprising – as highlighted in the initial earlier in the thesis, the links between nonwoven production technologies and those used in the paper, felt and plastic industries result in an extricable link between the qualities of nonwovens and those of paper, felt and plastic. To reiterate, the aim of the research is to exploit the opportunities distinct to nonwoven technologies and the resulting products, but it is acknowledge that in doing this the technological roots of the fabrics will always determine their basic construction and most basic qualities.

### ***Product Related***

Associations made by the participants with products rather than materials included link with products that could be considered as 'designed' objects and those that might be considered as functional components. Links made with designed objects included associations with; lampshades and wall-coverings. Links made with functional components included associations with; sofa cushioning, bean bag stuffing and quilts (FG3). Further associations included washing 'machine fluff' (FG3).

As noted, by Papanek, the associations made with the designed object in question may predispose the user to either valuing or holding antipathy towards that object. Associations with products such as beanbag stuffing and washing machine fluff, may predispose users to a certain antipathy towards the fabrics as 'aesthetically pleasing' materials. However, those held with traditional materials such as silk, wool and wool may predispose users to a certain value.

Papanek also notes that if the 'association' aspect of a product can be re-designed new market areas can be opened up (see Chapter 3). In order open up the potential for the fabrics to be used within the high-end decorator market any associations with industrial nonwovens perhaps need to be re-designed. The associations with natural materials, traditional fabrics and designed objects such as wool, silk, chiffon and wall-coverings, points to the potential for the materials to be valued differently to industrial nonwoven fabrics. However, the links made with industrial fabrics and 'functional product components' such as interlinings and beanbag

stuffing highlights a strong link with industrial nonwovens possibly pointing to a lower associated value.

#### 8.2.5.3 Use

Towards the end of the focus group sessions, participants were asked to consider what they would envisage the fabrics being used for. The ideas put forward were categorised into five product categories including; Lighting and Window Treatments, Surfaces, Moulded Products, Furniture and Fashion.

Although a number of potential applications were suggested within these categories, the structural integrity of the fabrics was commented upon in relation to the extent to which the fabrics could be used. All three groups emphasised specific limitations of the fabrics in use. One of the participants highlighted that the strength of the fabrics limited what they could be used for and another noted that the fabrics had 'no structure' (FG3). It was noted that the fabric strength varied from sample to sample within the collection (FG3).

The comments made in regard to this related to the end uses suggested but also to the ability of the fabrics to be further processed and how the fabric's would be cared for in use.

#### ***Lighting and Window Treatments***

The way in which the fabrics interacted with light prompted participants to suggest applications such as light shades, blinds, and curtains. It was suggested that any product that diffused man-made or natural light would be an appropriate application and would exploit the translucent qualities of the fabrics.

#### ***Surfaces***

A number of applications relating in general to 'surfaces' were suggested. These included; room-dividers, screens, table surfaces and mats. This suggested that the surface qualities and flat two dimensional nature of the fabrics would be exploited.

#### ***Fashion and Accessories***

The possibility to mould the fabrics was questioned by a number of participants and in light of that, a number of moulded products were suggested as possible end uses. Suggestions included hats, jewellery, and accessories. Within fashion, accessories for occasional wear were proposed as possible applications.

### ***Fashion and Furniture***

The possibility to use the fabrics within furniture and interiors both decoratively for example throws and cushion-covers, and as functional components, for example cushioning was suggested.

However, the fabrics were considered too weak for use within furniture in general. The durability of fabrics to withstand the wear and tear of an interior environment was questioned. It was suggested that where products would undertake little physical interaction in use, the fabrics could be appropriately applied (FG3). The furniture students also noted that they did think the majority of the fabrics would withstand the workshop processes involved in furniture construction.

Laminating the fabrics to other materials was suggested as a means of strengthening them but it was noted that the inherent qualities of the materials might be lost if this was done.

Similar issues were noted by the textile's students in regard to fashion. The ability of the fabrics to withstand wear and tear was questioned particularly in regard to mass manufactured fashion. The ability of the fabrics to withstand further processes such as print and embroidery was questioned (FG1 and FG2). Further to this fabric care was questioned. Participants wanted to know how the fabrics would react if something were spilt on them and how they would be cleaned. The propensity of the fabrics to collect dust was also raised as a potential limitation and their level of heat resistance questioned.

#### **1.1.5.4 Method**

At the start of and throughout each discussion, the participants were keen to find out what the fabrics were, how the fabrics had been made and what materials had been used. A number of the participants, particularly the textile design students, were unfamiliar with nonwoven fabrics and were intrigued to know about the processes and technologies involved before they would go on to then give their comments on the fabrics.

The level of intrigue in regard to the process, relates to Rees' suggestion (1997, p.122 - 123) that regarding the accessibility of objects in relation to how identifiable the processes used to make them are. The keenness of the participants to identify the production processes that had been used suggested that an understanding of the processes used to make the fabrics enabled a greater level of personal connection between participant and fabric. It is interesting to question whether the industrial (or semi-industrial) nature of processes, as revealed to participants, leads to association of the fabrics with, as Rees (1997, 177) refers, a 'creative individual' and therefore a high value or to an industrialised notion of production and an

understanding of the object a mass produced product, therefore suggesting a lower market value.

### 1.1.5.5 Reflections on Method

The focus group method and the use of the various documentation tools were successful in generating general feedback on the fabric collection as a whole from various perspectives. However, the methods used did not enable feedback to be gained in relation to specific fabrics. This was partly due to the large number of fabrics presented to the participants but also due to the fact that there was no system in place for the participants or researcher to document specific sample numbers.

The introduction of response sheets in the third focus groups was successful in capturing feedback on each of the discussion points from each participant in the group. It was noted at this stage that this method could potentially be used to enable more specific documentation to be achieved.

1. Samples Used in Focus Groups as Documented in Appendix 6

1.1 Samples used in Focus Groups with Textile Design and Design Professionals

Group 1		
DD1	DD15	DD48(2)
DD2	DD16	DD48 (3)
DD3 (2)	DD25	DD49
DD4	DD28 (3)	DD51
DD6	DD40	DD52
DD8	DD40 (2)	DD53
DD9	DD42	DD55
DD10	DD43	
DD11	DD48	

Group 2	
DD1	DD11
DD2	DD39
DD4	DD40
DD5	DD43
DD6	DD48
DD8	

1.2 Samples used in Interviews with Interior Product Design Professionals

DD7	DD21(3)
DD12	DD30
DD13	DD37
DD14	DD38
DD17(2)	DD41
DD10	DD44
DD10(2)	
DD19	
DD21	

1.2 Interviews with Nonwoven Manufacturers

T2  
T8  
T9  
T14  
T16  
T12

1. Example of Focus Group Category Analysis

<b>Group:</b> Textile Design Practitioners, Researchers and Academics	<b>Number of Participants</b> 6 Penny Alfrey (Design Historian) Deborah Sugg Ryan (Design Historian) Nick Rodgers (Textile Designer and Academic) Emma Rooney (Textile Designer and Researcher) Graham Lee (Textile Designer and Researcher)	
<b>Date</b> 14.07.05 <b>Duration</b> 1.5 hrs approx	<b>Location</b> Textile Design Studio Loughborough University School of Art and Design	
<b>Category Analysis (DISCUSSION AND FEEDBACK FORMS)</b>		
<b>Categories and Themes</b>	<b>Comments Frequency</b>	
<b>INITIAL RESPONSES</b> DELICATE/FRAGILE: Delicacy (1); fragility (1); INTRIGING: prompt further inspection (2) drawn to samples where construction/techniques not known (2); complex (1); TACTILE: all very tactile (1); predominant throughout (1); initially drawn to soft samples rather than hard edged crunchy samples (1); wanting to touch and pick up (1); softness to some samples (1); APPLICATION: none immediately obvious (1); where would they be used? (2); range of possible product areas (1); some samples have immediate relevance to fashion and interiors (1); Some fine art related (1); some mainstream (1); CONCEPTUAL: memory (2); ageing (1); evolving (1); fragmentary (1); masculine; comforting (1); ASSOCIATIONS: hair – repulsion (2); some fabrics over familiar (1); predominant feel of felted fabric (1); wool (1); VARIATION / UNIFORMITY: generally varied collection (1); generally the same feel throughout the collection in terms of handle except those that have been laser cut (1);	2 5  5  7  6 5  2	
<b>TACTILE QUALITIES</b> Needs developing to relate more closely with FG2 SOFTNESS: evident in some samples (1); softness is comforting - relates to felted quality (2); STIFFNESS: some stiff (1); hard crunchy samples perceived as less appealing (1); DELICACY: identified (3); suggests decorative applications (1); associations with tissue (1); NO VARIATION: all samples generally have the same feel (2); different fibres don't give evidently different tactile qualities (1); overall quality is smooth and felted (3) – method of production is not mysterious (1); variation within collection in relation to different fibres not as obvious as a comparable woven collection (1); VARIATION: a range of qualities/very varied (2); laser cut samples have a different quality; varied in terms of weight, density subtlety (4); 3D elements needed to create variation (1);	3  2 5 8  7	

<b>VISUAL QUALITIES</b>	
COMPLEXITY (+ve): prominent quality (1) visually stimulating; prompt further inspection but over complex pieces would need the right context (gallery) (2); intriguing; complex; interesting when patterns fade in and out due to fibres (1);	4
COMPLEXITY (- ve): too many techniques obviously combined in places – doesn't work (7); when the number of techniques used are not obvious or less apparent it works (3); overcomplicated (1); when too simplistic they don't work (1);	12
TRAPPED ELEMENTS: associated with dated stationary - 'over familiar' - negative (not intrinsically bad but requires the right market) (1);	1
IMAGERY AND TECHNIQUE/PROCESS (- ve): transfer of historic imagery onto new surface with no mediation – negative (1); use of historic imagery used in combination with new technology highlights polarity between image and process perceived – obvious (3), negative (1); imagery/motif as a tool for experimentation identified as acceptable in current context (2); sophisticated florals better than stylised florals (1);	10
LAYERING (+ ve): liked (1); provokes concepts of memory and loss (1);	2
LAYERING (- ve): too much (1);	1
EDGES: identified as interesting (1); some burnt edges work better than other in relation to patterning; suggests concepts of ageing and evolving (1); devoré and laser provide small scale gradation which works well (2); fading and merging edges of prints work well (2); mottled effect interesting;	6
TRANSLUCENCY: (1); interesting (1); works when subtle (1);	3
COLOUR: blues/greys more contemporary (3); gradation prominent and seductive – positive quality (2); grey/blue more appropriate for interiors (1); reds perceived as harsh (5); reds prompt associations with cleaning products (1); reds don't work tonally (1); neutrals successful (3); fading aspect works (1);	17
EMBEDDED YARNS (+ ve): could work as a method of drawing the viewer in (in an installation context) (1); linear elements work (1);	2
EMBEDDED YARNS (- ve): creates a distraction (from pattern) (2); contrast between thread and pattern too strong (1);	3
NATURAL MATTER: combinations of dried flowers with technical processes perceived as an interesting mix (1); conservation issues raised; prompts associations with handmade paper (1); are they stable? (1); stability/conservation could be used as a conceptual tool (1);	4
INTERACTION WITH LIGHT: light transforms initially dull looking fabrics; light reveals hidden elements – perceived as positive (4); perceived as an intrinsic quality; predominant quality (1); fabrics become more than printed felts; light highlights intricate laser cut patterning – perceived as positive (1);	6

<p><b>AESTHETIC – OTHER</b>  <b>VARIATION:</b> collection varied in terms of weight and density (1); range of qualities evident in collection (1); variation in subtlety (1);  <b>SENSE OF CRAFT:</b> (1); echo hand crafted element with sophisticated technological additions (1);  <b>ETHERAL QUALITIES:</b> some have quite an ethereal quality (2); relates to the way the fabrics work best (1); some are almost aquatic (1); mysterious (1); faded qualities prompt associations with the historic; felt perceived as a medium that lends itself to the ethereal, understatement and suggestion (1);  <b>SCALE/PERSPECTIVE</b> when viewed from a distance undefined imagery looks veiled (1); placement and scale needs to be considered in relation to specific applications(1);  <b>'STRUCTURED' /'UNSTRUCTURED':</b> sense of structure more obvious in some than others (2); 'unstructured' move away from conventional felts – positive (1); structure prompts associations with other types of constructed textiles; some participants 'drawn' to the unstructured'/less obvious (2); unstructured perceived as having more application potential - more appropriate in a decorative scheme (1);  <b>VISUAL CONTROL;</b> less controlled samples with a random element work better; random element is a unique quality (can not always be achieved in other textile processes) (2);  <b>UNDERSTATEMENT AND SUBTLETY:</b> identified as a prominent quality (2); understated approach generally preferred – specifically in terms of structural qualities and combination of imagery and technical processes (1); less explicit elements perceived as positive (1); when imagery is understated it is intriguing (1);  <b>LASER CUTTING:</b> intricacy works well (1); mark created is over defined in comparison with felt (where merging and blending processes are emphasised (1); combining felt and laser seen as a challenge (1); some samples demonstrate elementary use of laser highlighting negative aspects of laser cutting (1); using it to reveal seen as positive (1); use follows dominant trends rather than sensitive interpretation(1); delicate laser work works well (2);  <b>PATTERN:</b> patterning is dominant (1);</p>	<p>1</p> <p>2</p> <p>6</p> <p>2</p> <p>6</p> <p>2</p> <p>5</p> <p>8</p> <p>1</p>
<p><b>END USE / APPLICATION</b>  <b>DECORATIVE APPLCATIONS:</b> particularly delicate samples (1); wall-hangings (1)  <b>WINDOW TREATMENTS:</b> (4); Blinds (1);  <b>LIGHTING:</b> (5);  <b>SURFACES:</b> wallcoverings (1); tablemats; floor-coverings (2); screens (to filter light) (2);  <b>FURNISHING FABRICS:</b> possibly upholstery(1); laser cut fabrics particularly relevant; cushions (2);  <b>ECO PRODUCTS:</b> possibility of a range of products (prompted by associations with scraps) (1);  <b>ARCHITECTURAL:</b> (1);  <b>FASHION:</b> bags (2); structured garments (1); boots(1); scarves (1); fabric lengths; clothing in general; moulded garments (1); jackets and coats (1); hats (1); linings (1);</p>	<p>2</p> <p>5</p> <p>5</p> <p>5</p> <p>3</p> <p>1</p> <p>1</p> <p>9</p> <p>1</p>

OTHER: integrating conductive wires (1);	
<b>POTENTIALS AND LIMITATIONS IN RELATION TO END USE</b>	
TECHNICAL/PERFORMANCE PROPERTIES: uncertainty about stability; tensile strength (1); fire retardency questioned (2); concern raised propensity for dust /dirt collection (2); draping quality questioned (1); sound absorption (1); wear and tear / durability (2);	12
FINISHING: extent of finishing the samples could withstand questioned (1); how would coating affect the handle of the samples? (1); coatings might have environmental implications (1);	
DESIGN: placement and scale needs to be considered in relation to application (1);	1
OTHER: excluded from certain products because of structural integrity – those products with heavy human interaction/wear and tear (2); conservation of organic matter questioned (1); mass produced can be enhanced (1);	4
LIGHT FILTERING: positive visuals when fabrics filter light (3); highlights pattern (1);	4
VARIATION: similarity of fabrics might limit applications (1);	1
VISUAL APPEAL: visually stimulating and contemplative (1);	1
<b>VALUE/MARKET POSITION</b>	
GENERAL: place in market perceived as relating to production methods (1); marketing, presentation and branding impact on people's perception of value/worth (2); difficult to assess in isolation from product/presentation (1); premature to think about market due to lack of knowledge of manufacturing possibilities (1);	5
PRODUCT RANGE: some products excluded due to the structural integrity of the fabrics – not suitable for products with lots of wear (1);	1
CRAFT ASSOCIATIONS: valued in some cases (1); doesn't necessarily equate with a luxury market (1); process might suggest one-off applications (1); hand made/ crafted/one-off (2); small scale production/designer maker (1); top end due to rarity (1);	7
MASS/MID MARKET: some fabrics perceived as having mainstream qualities/mass produced quality – particularly the simpler samples (3); all ideas could be mass produced and geared toward /designed for production (1); concept of adding aesthetic value to the mass produced perceived as interesting (1); some samples perceived as mid market (2);	
LUXURY (+ ve and – ve): the economics of the process might necessitate a luxury market (1); people with no background in textiles might find it difficult to recognise value in the fabrics (1); felts can be seen in high-end contexts (1); some participants perceived some samples as suitable for a luxury market (3); some participants thought none of the samples were suitable for a luxury market; process might suggest one-off applications (1); hand made/ crafted/one-off (2); small scale production/designer maker(1); top end due to rarity (1);	12

ADDED VALUE: more developed 3D qualities suggested as a means of adding value (current 3D surfaces not resolved as yet) (2); embossing seen as positive but unresolved as yet; metallic materials add superficial value (1); eco properties could add value particularly if they combined function and aesthetic (3);	6
<b>ASSOCIATIONS</b> PRODUCT DESIGN: the 'new' /interactive wallpapers (2); contemporary trends of re-visiting the historic (1); heavier fabrics reminiscent of table settings (1); PRODUCT: cleaning products (colour) (2); jay cloths (1); lining fabrics (1); insulation products (1); PAPER: paper-like – prompts associations with craft (1); handmade paper (embedded elements) (1); light samples reminiscent of paper but still felt like (1); FELT: felt identity not lost (1); collection demonstrates range of possibilities with felt (1); veiled quality associated with felt/felting (1); overall felted quality to collection (1); NONE: strong designs are unique and hold no associations (1); CULTURAL: Japanese/Oriental associations (2); historic textiles – lace work (1); ASSOCIATION WITH HAIR: hairy quality identified as prominent (2); hairy quality off putting (4); hairy quality interesting (2); context critical to successful use – not suitable for domestic context (3); potential for use in installations (3); blonde or silver hair may have less negative associations (1); needs to be managed and controlled (1) ;'itchy' (2); psychological associations with un cleanliness – negative (2); too much (1);	4  5  3  4  1  3  21