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(Guest Editors)

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Practical Methods to Estimate Fabric Mechanics from Metadata - Supplementary Material

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1. Model Implementation Details

For training both models, MECHMET and MECHIM, we used the Mean Absolute Error of the parameters as the loss function, and a different set of hyper-parameters for the *bending* and *stretch* models. For MECHMET, which is a Random Forest Regressor (RFR), we did a 5-fold cross validation to find, for stretch: min_samples_leaf=0.0148, min_samples_split=0.0455, max_depth=10, n_estimators=100, max_features=0.3. For bending: min_samples_leaf=0.0045, min_samples_split=0.0055, max_depth=10, n_estimators=100, max_features=0.3. Training both models takes a few seconds. For MECHIM, we use a ResNET18 [HZRS15] as feature extractor and the following sizes for the architecture components. For stretch: MLP layers=2, with an input_size=metada_size*positional_encoding + FC_size + composition_embedding_size. The size of the layers was progressively halved until reaching the last layer, which has an output size of 3 (the three stretch parameters). For bending, MLP layers=5, and the input_size and size of the layers follows the same pattern as the MLP for stretch. The FC layer size is 5 for both models. The compositions were reduced using an MLP with 5 layers for stretch and 4 layers for bending. The size of the layers was also progressively halved until reaching the last layer, which has a size of 2. We used an Adam optimizer with learning rates of 0.001 and 0.08 for stretch and bending models, and a learning rate decay of 0.78 for both models. For training the neural network we used crops of the images of size 256x256 and performed data augmentation by random perturbations of small rotations, Gaussian blurs, and changes of saturation, contrast, and color. The training was done with a GeForce RTX 2080 Ti during approximately 150 epochs (about 20 minutes).

2. Cusick Results

In this section we show additional results of the quantitative and qualitative performance of our models in the Cusick metric space.

2.1. Cusick Quantitative Results

In Figure 1 we evaluate the error in the Cusick metrics per family. As explained in the main document, Twill and Plain families have the highest variability of errors, because they group together smaller categories of fabrics. Both models struggle with families that are underrepresented in our dataset, like Crepe or Fleece.

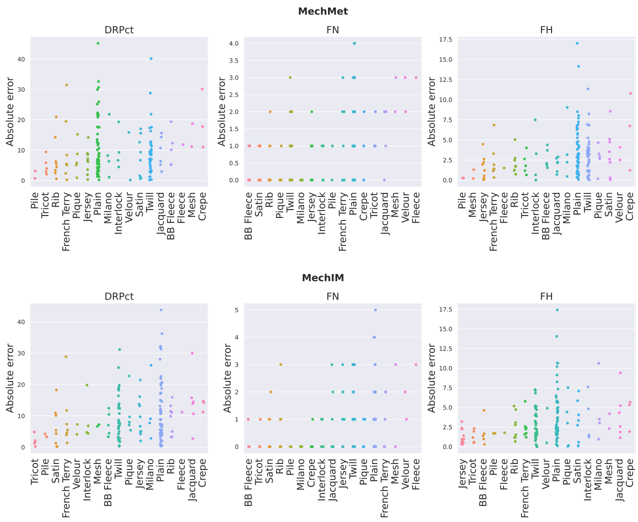
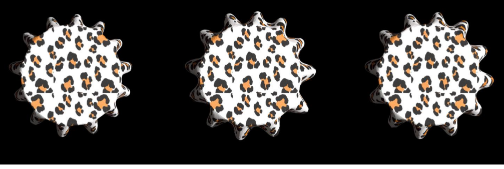


Figure 1: *Absolute errors of DRPct, FN and FH of all the fabrics per family, sorted by increasing mean family error.*

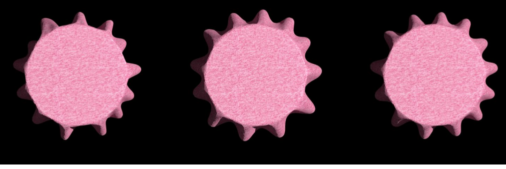
2.2. Cusick Qualitative Results

In the following pages we show a set of digitized fabrics from our test set sorted by the error of the Drape Coefficient (DRPcte) in increasing order. Each figure contains drapes of the Ground Truth (left), the MECHMET model (middle), and the MECHIM model (right).

ID-01022
Knit - Jersey
Composition: 95% viscose rayon, 5% elastane
Thickness: 0.45 mm; Weight: 199 gsm

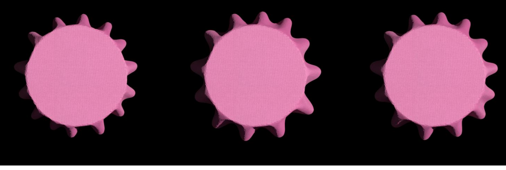


ID-20004
Knit - Jersey
Composition: 88% polyester, 12% hemp
Thickness: 0.4 mm; Weight: 150 gsm

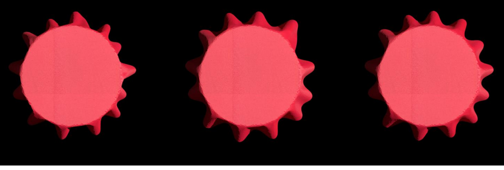


ID-01047
Knit - Jersey
Composition: 95% viscose rayon, 5% elastane
Thickness: 0.44 mm; Weight: 190 gsm

ID-01025
Knit - Jersey
Composition: 95% viscose rayon, 5% elastane
Thickness: 0.45 mm; Weight: 202 gsm



ID-00321
Knit - Interlock
Composition: 100% modal
Thickness: 0.29 mm; Weight: 150 gsm



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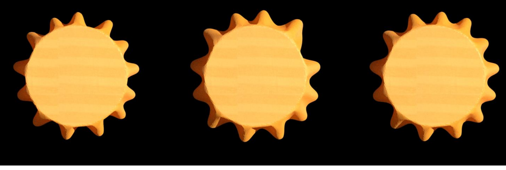
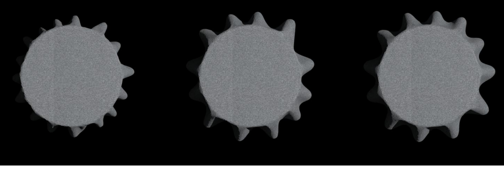
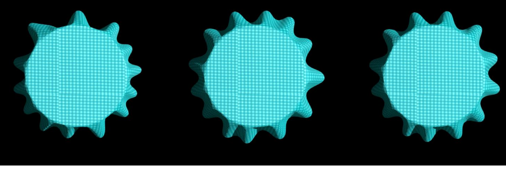
Knit - Interlock
Composition: 100% viscose rayon
Thickness: 0.31 mm; Weight: 111 gsm



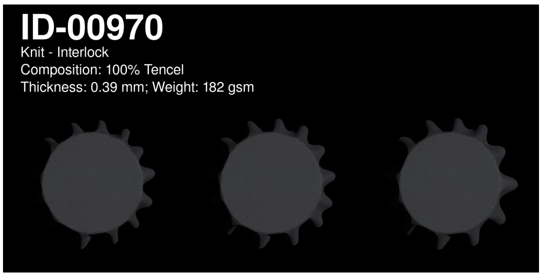
ID-60022
Knit - Interlock
Composition: 100% CD
Thickness: 0.42 mm; Weight: 127 gsm



ID-01049
Knit - Jersey
Composition: 80% nylon, 20% elastane
Thickness: 0.35 mm; Weight: 177 gsm




ID-00834
Knit - Mesh
Composition: 92% nylon, 8% elastane
Thickness: 0.31 mm; Weight: 119 gsm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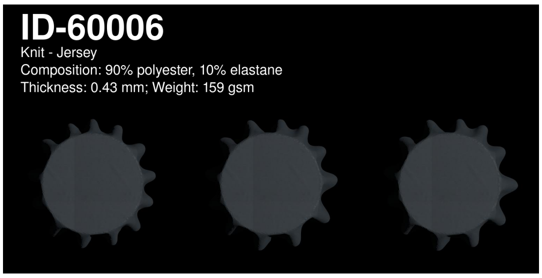
Knit - Interlock
Composition: 100% Tencel
Thickness: 0.39 mm; Weight: 182 gsm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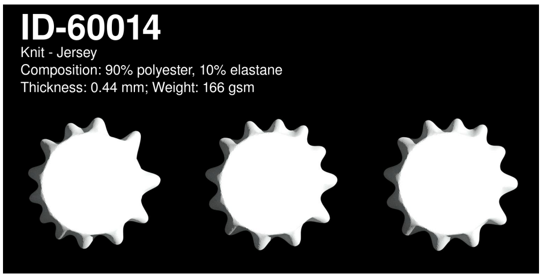
Knit - Jersey
Composition: 90% polyester, 10% elastane
Thickness: 0.43 mm; Weight: 159 gsm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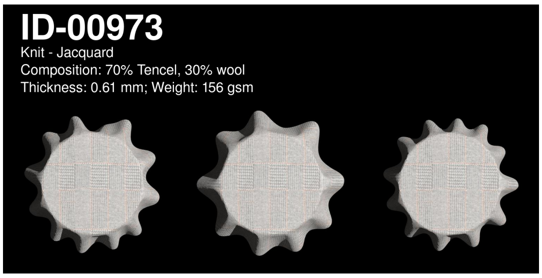
Knit - Jersey
Composition: 90% polyester, 10% elastane
Thickness: 0.44 mm; Weight: 166 gsm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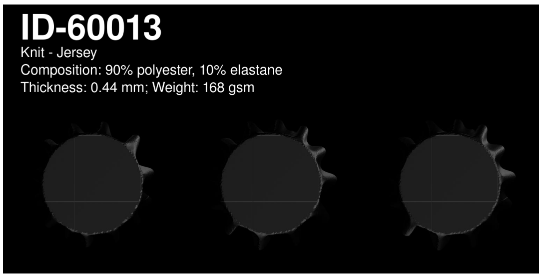
Knit - Jacquard
Composition: 70% Tencel, 30% wool
Thickness: 0.61 mm; Weight: 156 gsm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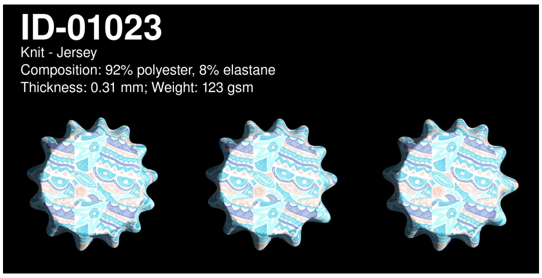
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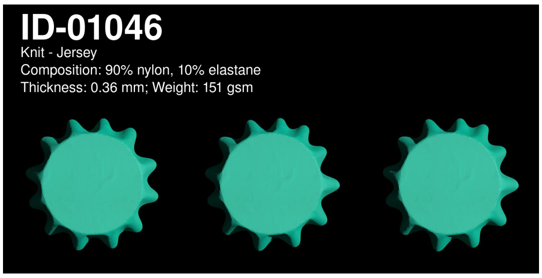
Knit - Jersey
Composition: 92% polyester, 8% elastane
Thickness: 0.31 mm; Weight: 123 gsm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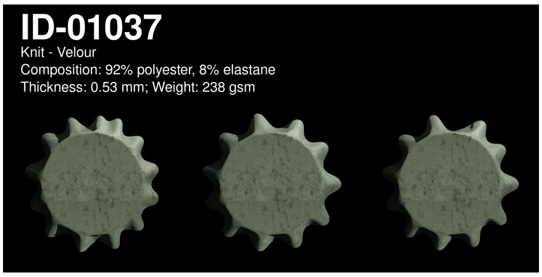
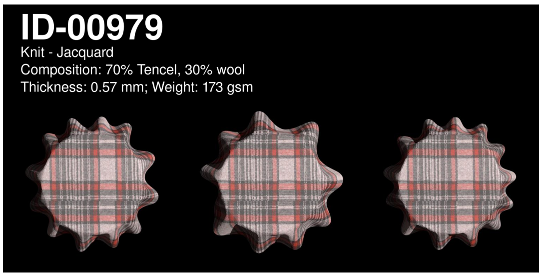
Knit - Jersey
Composition: 90% nylon, 10% elastane
Thickness: 0.36 mm; Weight: 151 gsm


ID-01037
Knit - Velour
Composition: 92% polyester, 8% elastane
Thickness: 0.53 mm; Weight: 238 gsm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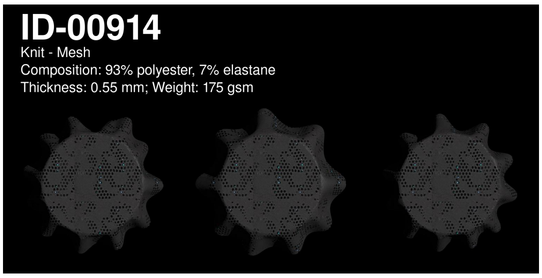
Knit - Jacquard
Composition: 70% Tencel, 30% wool
Thickness: 0.57 mm; Weight: 173 gsm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Knit - Mesh
Composition: 93% polyester, 7% elastane
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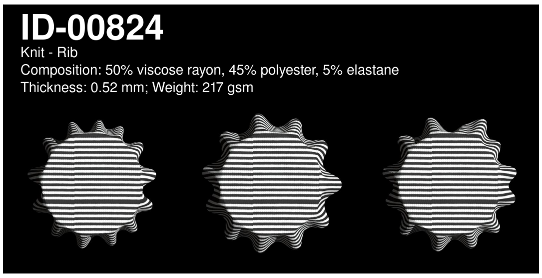
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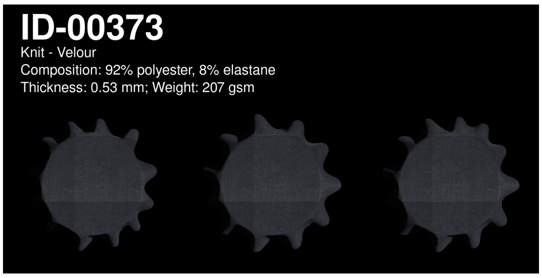
Knit - Rib
Composition: 50% viscose rayon, 45% polyester, 5% elastane
Thickness: 0.52 mm; Weight: 217 gsm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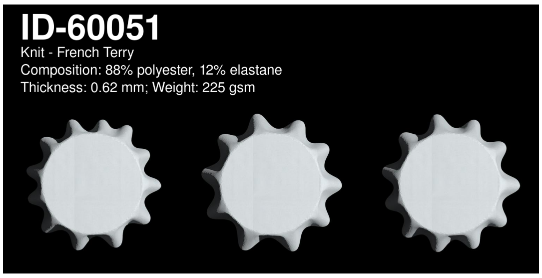
Composition: 92% polyester, 8% elastane
Thickness: 0.53 mm; Weight: 207 gsm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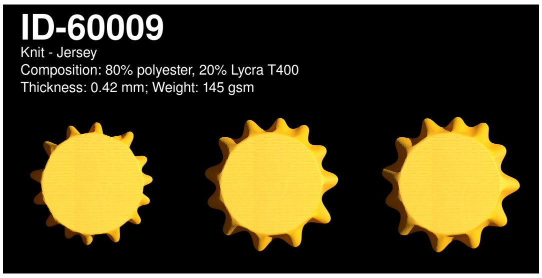
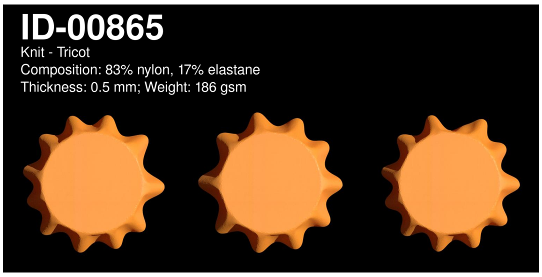
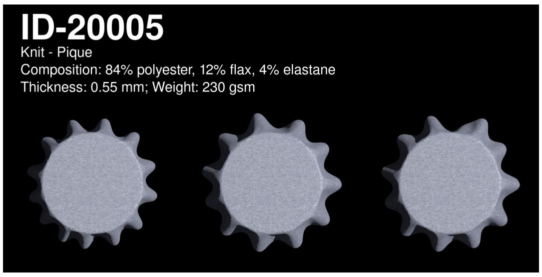
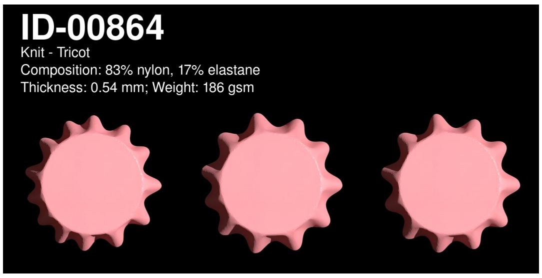
Knit - French Terry
Composition: 88% polyester, 12% elastane
Thickness: 0.62 mm; Weight: 225 gsm


ID-60009
Knit - Jersey
Composition: 80% polyester, 20% Lycra T400
Thickness: 0.42 mm; Weight: 145 gsm

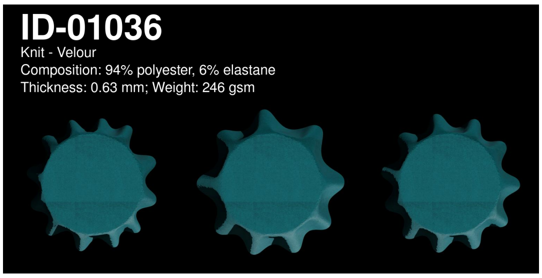

ID-10024
Knit - Jersey
Composition: 60% cotton, 40% modal
Thickness: 0.35 mm; Weight: 134 gsm


ID-00865
Knit - Tricot
Composition: 83% nylon, 17% elastane
Thickness: 0.5 mm; Weight: 186 gsm


ID-20005
Knit - Pique
Composition: 84% polyester, 12% flax, 4% elastane
Thickness: 0.55 mm; Weight: 230 gsm


ID-00864
Knit - Tricot
Composition: 83% nylon, 17% elastane
Thickness: 0.54 mm; Weight: 186 gsm


ID-60024
Knit - Tricot
Composition: 100% CD Polyester
Thickness: 0.58 mm; Weight: 178 gsm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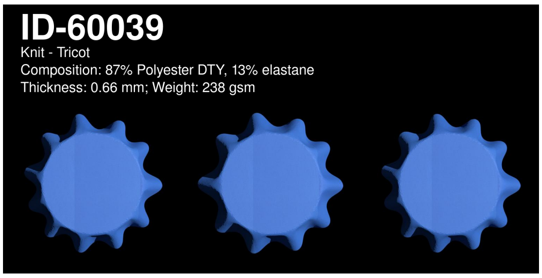
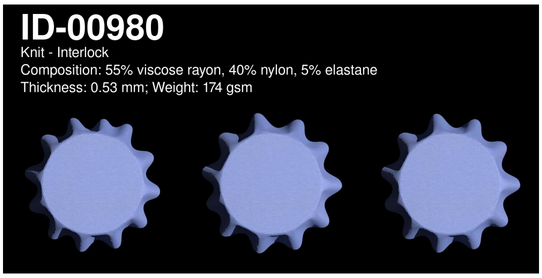
Knit - Velour
Composition: 94% polyester, 6% elastane
Thickness: 0.63 mm; Weight: 246 gsm

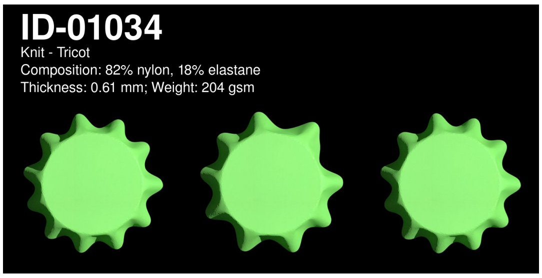

ID-60039
Knit - Tricot
Composition: 87% Polyester DTY, 13% elastane
Thickness: 0.66 mm; Weight: 238 gsm

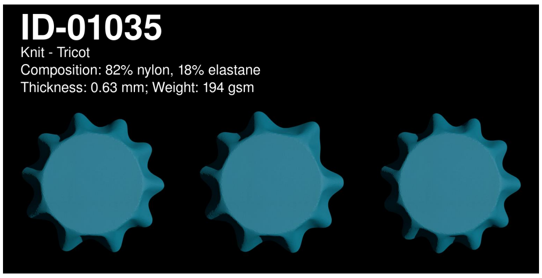

ID-00980
Knit - Interlock
Composition: 55% viscose rayon, 40% nylon, 5% elastane
Thickness: 0.53 mm; Weight: 174 gsm

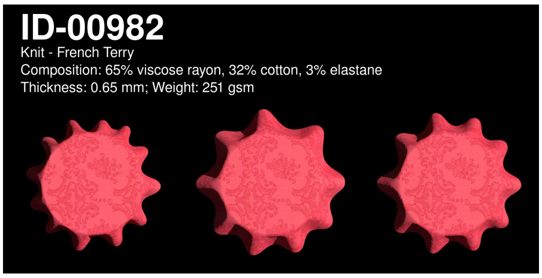

ID-00956
Knit - Pique
Composition: 50% polyester, 50% cashmereWool
Thickness: 0.47 mm; Weight: 161 gsm


ID-01033
Knit - Tricot
Composition: 82% nylon, 18% elastane
Thickness: 0.6 mm; Weight: 197 gsm

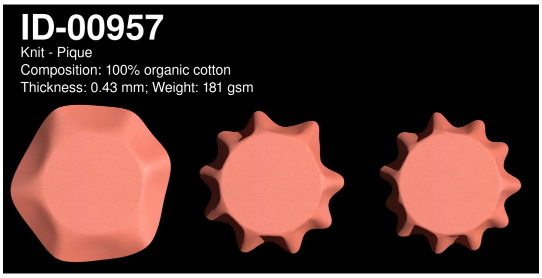

ID-01044
Knit - Jersey
Composition: 95% organic cotton, 5% elastane
Thickness: 0.43 mm; Weight: 174 gsm


ID-01034
Knit - Tricot
Composition: 82% nylon, 18% elastane
Thickness: 0.61 mm; Weight: 204 gsm

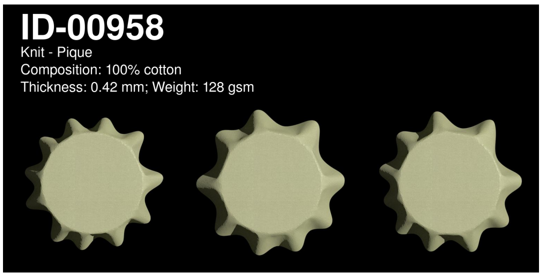

ID-01035
Knit - Tricot
Composition: 82% nylon, 18% elastane
Thickness: 0.63 mm; Weight: 194 gsm


ID-00982
Knit - French Terry
Composition: 65% viscose rayon, 32% cotton, 3% elastane
Thickness: 0.65 mm; Weight: 251 gsm


ID-01026
Knit - Jersey
Composition: 92% organic cotton, 8% elastane
Thickness: 0.52 mm; Weight: 187 gsm


ID-00957
Knit - Pique
Composition: 100% organic cotton
Thickness: 0.43 mm; Weight: 181 gsm


ID-10017
Knit - Pique
Composition: 100% cotton
Thickness: 0.57 mm; Weight: 174 gsm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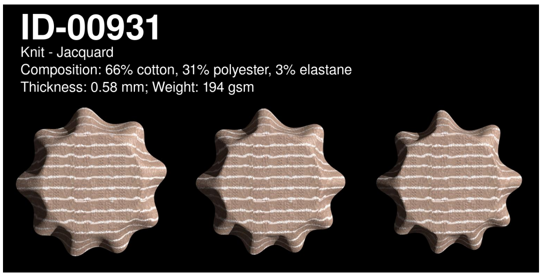
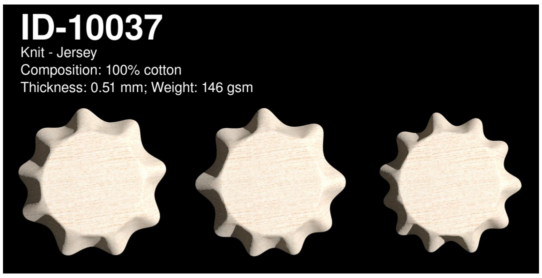
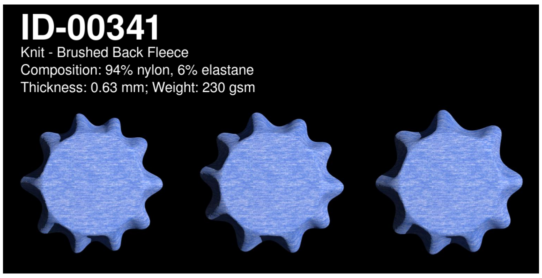
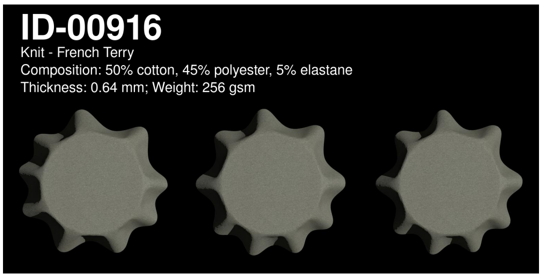
Knit - Pique
Composition: 100% cotton
Thickness: 0.42 mm; Weight: 128 gsm

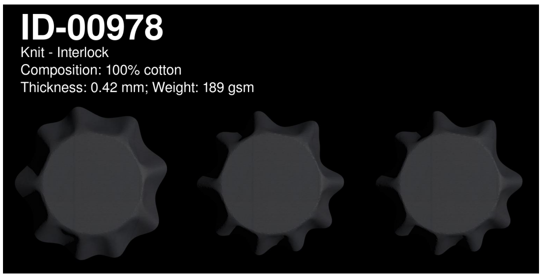

ID-00931
Knit - Jacquard
Composition: 66% cotton, 31% polyester, 3% elastane
Thickness: 0.58 mm; Weight: 194 gsm

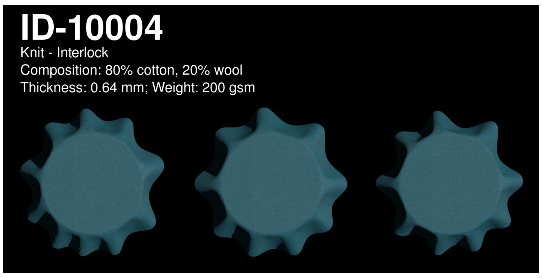

ID-10037
Knit - Jersey
Composition: 100% cotton
Thickness: 0.51 mm; Weight: 146 gsm


ID-10006
Knit - Interlock
Composition: 100% cotton
Thickness: 0.49 mm; Weight: 147 gsm


ID-00341
Knit - Brushed Back Fleece
Composition: 94% nylon, 6% elastane
Thickness: 0.63 mm; Weight: 230 gsm


ID-00916
Knit - French Terry
Composition: 50% cotton, 45% polyester, 5% elastane
Thickness: 0.64 mm; Weight: 256 gsm


ID-00978
Knit - Interlock
Composition: 100% cotton
Thickness: 0.42 mm; Weight: 189 gsm

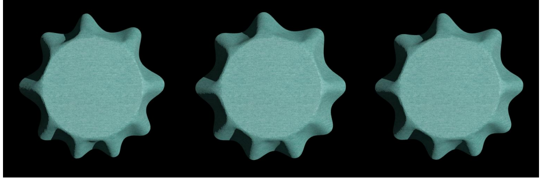

ID-10004
Knit - Interlock
Composition: 80% cotton, 20% wool
Thickness: 0.64 mm; Weight: 200 gsm

ID-00803
Knit - Rib
Composition: 50% polyester, 50% cotton
Thickness: 0.83 mm; Weight: 327 gsm

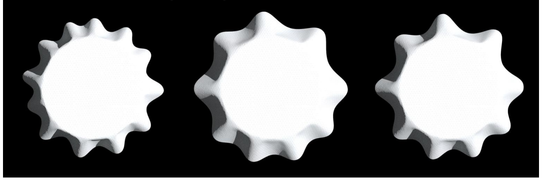
ID-00841
Knit - Milano
Composition: 64% viscose rayon, 31% acrylic, 5% elastane
Thickness: 0.63 mm; Weight: 248 gsm

ID-00838
Knit - Milano
Composition: 64% polyester, 31% acrylic, 5% elastane
Thickness: 0.69 mm; Weight: 309 gsm

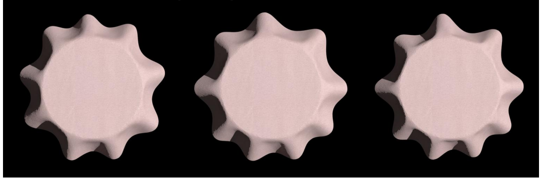
ID-00971
Knit - Interlock
Composition: 45% polyester, 30% cotton, 15% flax, 8% nylon, 2% elastane
Thickness: 0.62 mm; Weight: 174 gsm



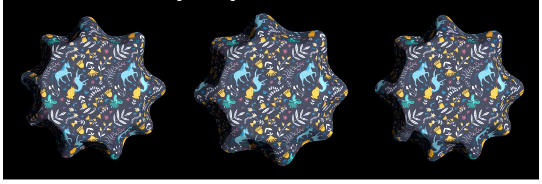
ID-50003
Knit - Mesh
Composition: 100% polyester
Thickness: 0.8 mm; Weight: 261 gsm



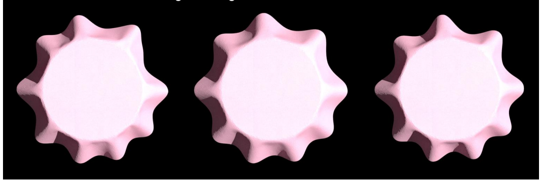
ID-10026
Knit - Rib
Composition: 97% cotton, 3% elastane
Thickness: 0.69 mm; Weight: 194 gsm

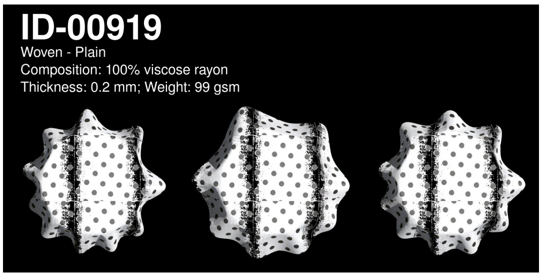


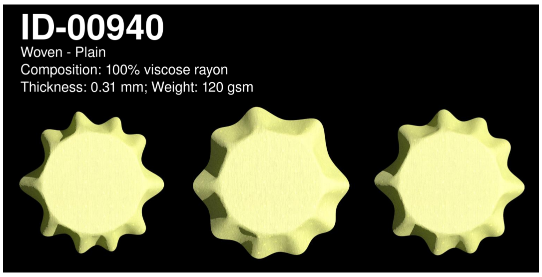
ID-00905
Knit - Brushed Back Fleece
Composition: 95% cotton, 5% elastane
Thickness: 0.68 mm; Weight: 232 gsm

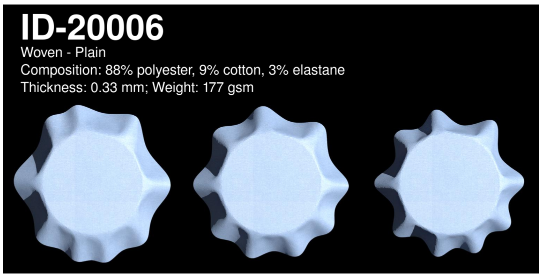


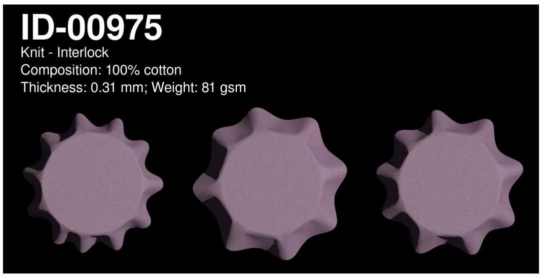
ID-01028
Knit - Brushed Back Fleece
Composition: 50% polyester, 50% cotton
Thickness: 1.08 mm; Weight: 259 gsm

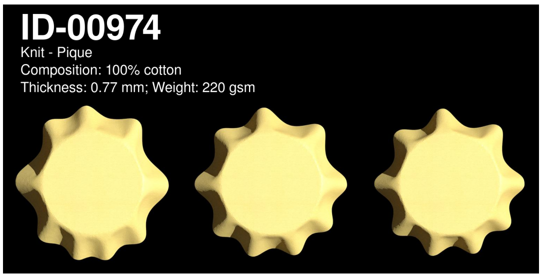



ID-00919
Woven - Plain
Composition: 100% viscose rayon
Thickness: 0.2 mm; Weight: 99 gsm

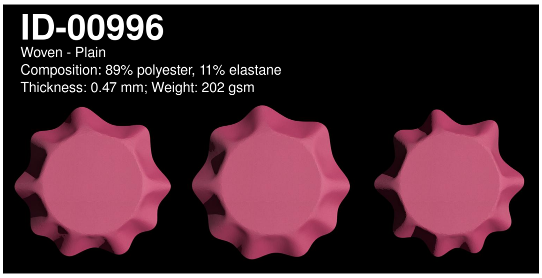

ID-00940
Woven - Plain
Composition: 100% viscose rayon
Thickness: 0.31 mm; Weight: 120 gsm

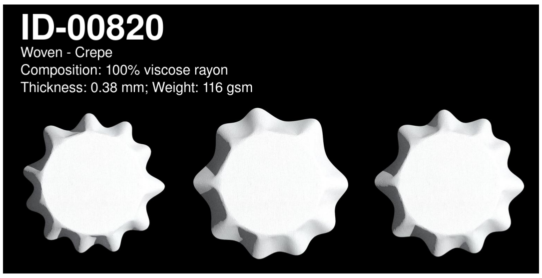

ID-20006
Woven - Plain
Composition: 88% polyester, 9% cotton, 3% elastane
Thickness: 0.33 mm; Weight: 177 gsm

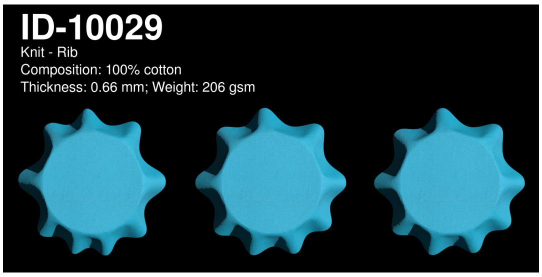

ID-00975
Knit - Interlock
Composition: 100% cotton
Thickness: 0.31 mm; Weight: 81 gsm

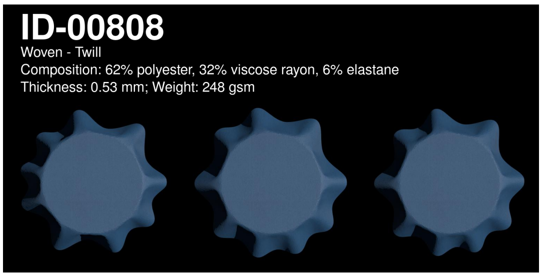

ID-00974
Knit - Pique
Composition: 100% cotton
Thickness: 0.77 mm; Weight: 220 gsm

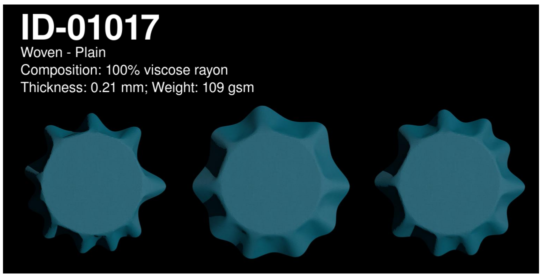

ID-00966
Knit - French Terry
Composition: 100% cotton
Thickness: 1.04 mm; Weight: 316 gsm

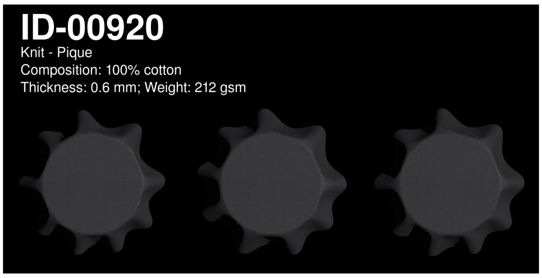

ID-00996
Woven - Plain
Composition: 89% polyester, 11% elastane
Thickness: 0.47 mm; Weight: 202 gsm

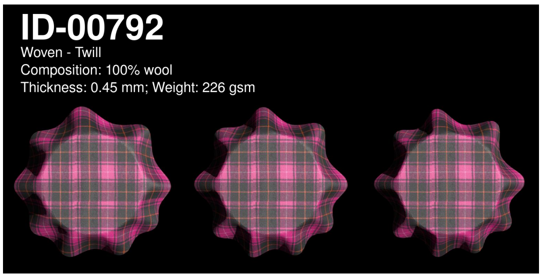

ID-00820
Woven - Crepe
Composition: 100% viscose rayon
Thickness: 0.38 mm; Weight: 116 gsm

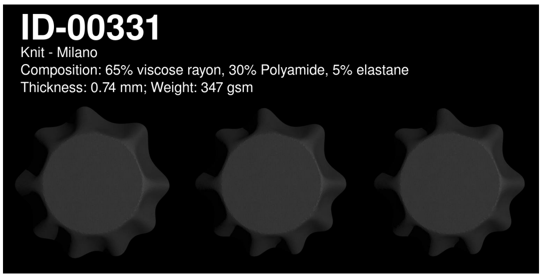

ID-10029
Knit - Rib
Composition: 100% cotton
Thickness: 0.66 mm; Weight: 206 gsm

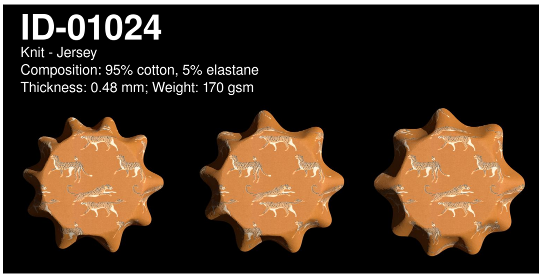

ID-00808
Woven - Twill
Composition: 62% polyester, 32% viscose rayon, 6% elastane
Thickness: 0.53 mm; Weight: 248 gsm

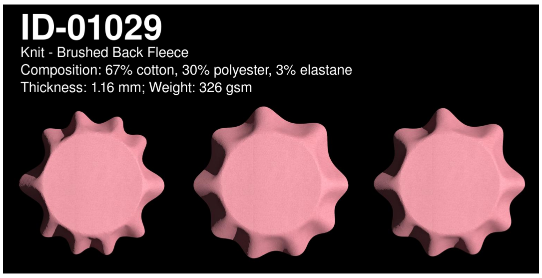

ID-01017
Woven - Plain
Composition: 100% viscose rayon
Thickness: 0.21 mm; Weight: 109 gsm

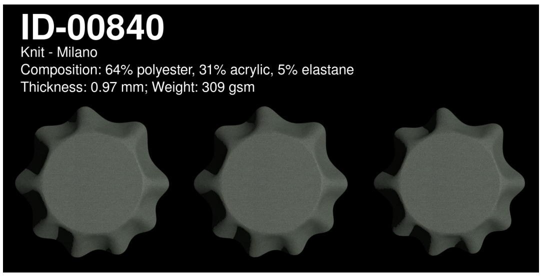

ID-00920
Knit - Pique
Composition: 100% cotton
Thickness: 0.6 mm; Weight: 212 gsm

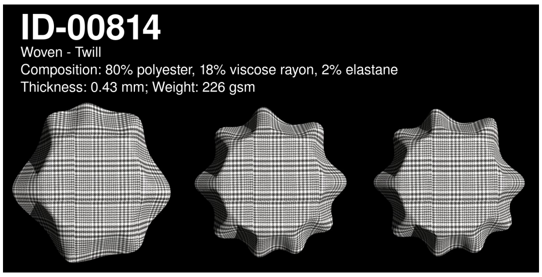

ID-00792
Woven - Twill
Composition: 100% wool
Thickness: 0.45 mm; Weight: 226 gsm

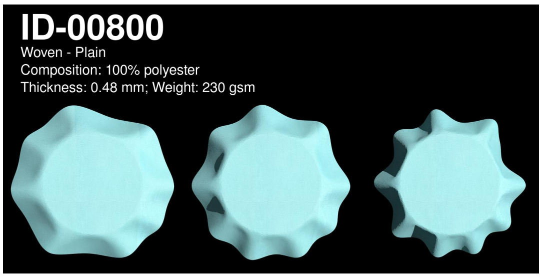

ID-00331
Knit - Milano
Composition: 65% viscose rayon, 30% Polyamide, 5% elastane
Thickness: 0.74 mm; Weight: 347 gsm

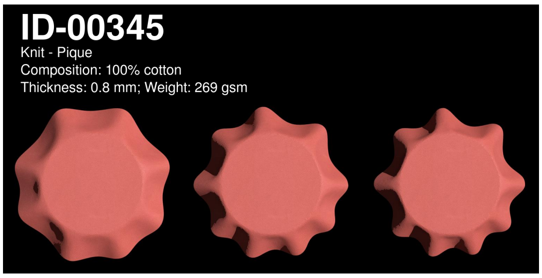

ID-01024
Knit - Jersey
Composition: 95% cotton, 5% elastane
Thickness: 0.48 mm; Weight: 170 gsm

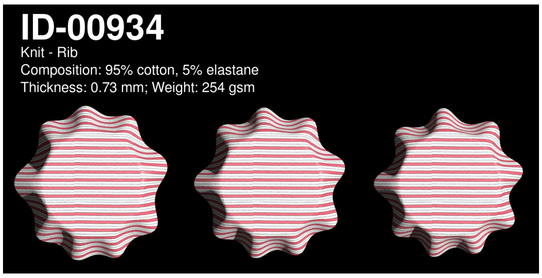

ID-01029
Knit - Brushed Back Fleece
Composition: 67% cotton, 30% polyester, 3% elastane
Thickness: 1.16 mm; Weight: 326 gsm

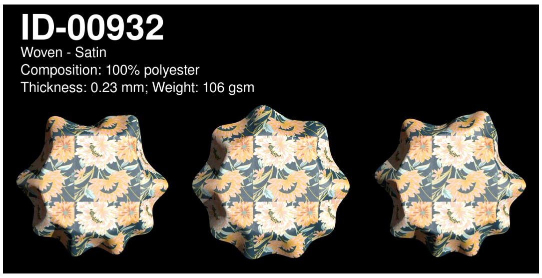

ID-00840
Knit - Milano
Composition: 64% polyester, 31% acrylic, 5% elastane
Thickness: 0.97 mm; Weight: 309 gsm


ID-00814
Woven - Twill
Composition: 80% polyester, 18% viscose rayon, 2% elastane
Thickness: 0.43 mm; Weight: 226 gsm

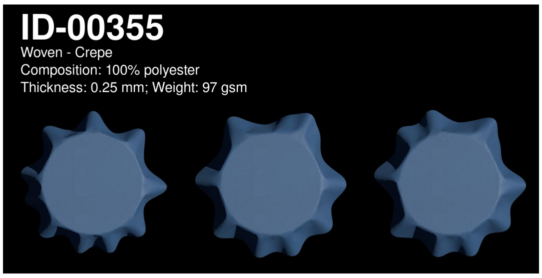

ID-00800
Woven - Plain
Composition: 100% polyester
Thickness: 0.48 mm; Weight: 230 gsm

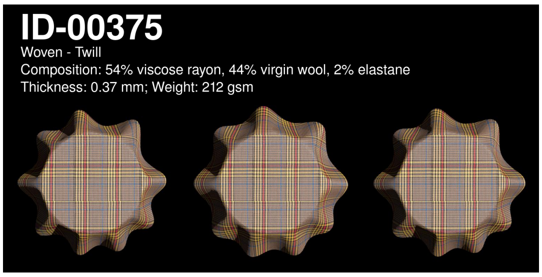

ID-00345
Knit - Pique
Composition: 100% cotton
Thickness: 0.8 mm; Weight: 269 gsm

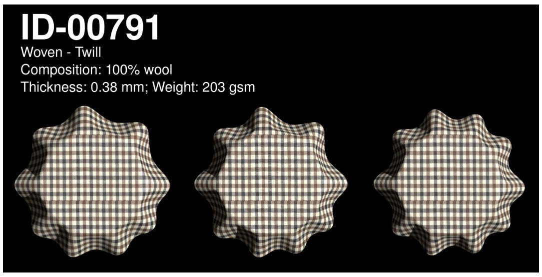

ID-00934
Knit - Rib
Composition: 95% cotton, 5% elastane
Thickness: 0.73 mm; Weight: 254 gsm

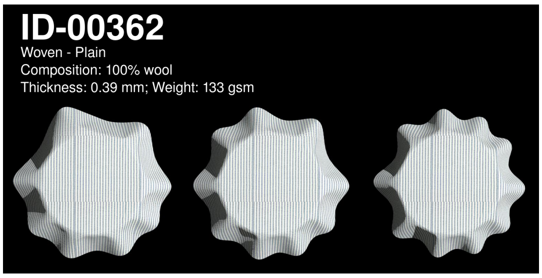

ID-00932
Woven - Satin
Composition: 100% polyester
Thickness: 0.23 mm; Weight: 106 gsm

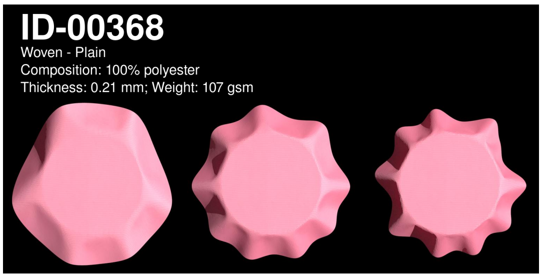

ID-60055
Knit - Brushed Back Fleece
Composition: 80% polyester, 20% cotton
Thickness: 0.9 mm; Weight: 224 gsm

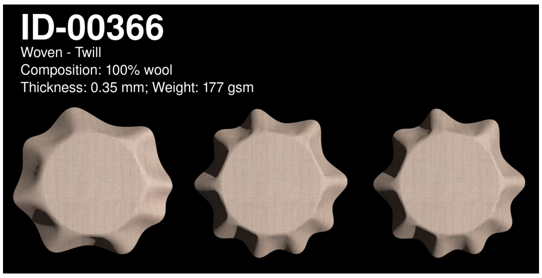

ID-00355
Woven - Crepe
Composition: 100% polyester
Thickness: 0.25 mm; Weight: 97 gsm

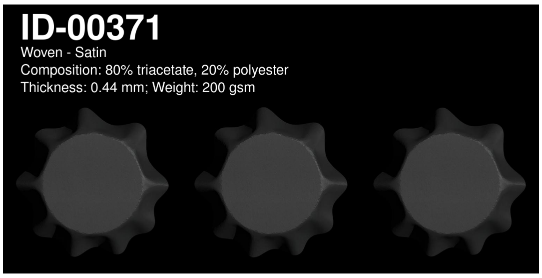

ID-00375
Woven - Twill
Composition: 54% viscose rayon, 44% virgin wool, 2% elastane
Thickness: 0.37 mm; Weight: 212 gsm

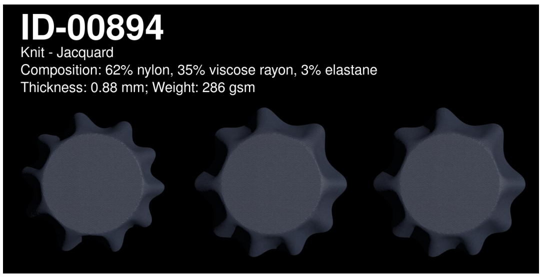

ID-00791
Woven - Twill
Composition: 100% wool
Thickness: 0.38 mm; Weight: 203 gsm

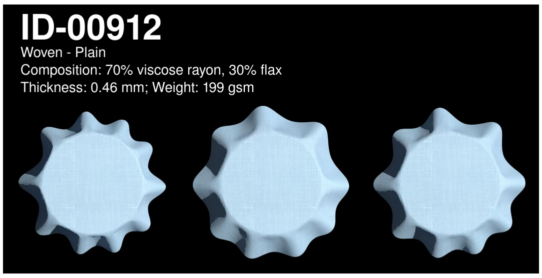

ID-00362
Woven - Plain
Composition: 100% wool
Thickness: 0.39 mm; Weight: 133 gsm

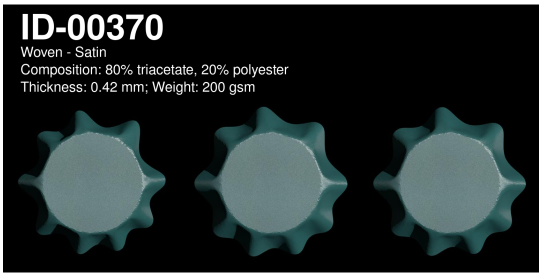

ID-00368
Woven - Plain
Composition: 100% polyester
Thickness: 0.21 mm; Weight: 107 gsm

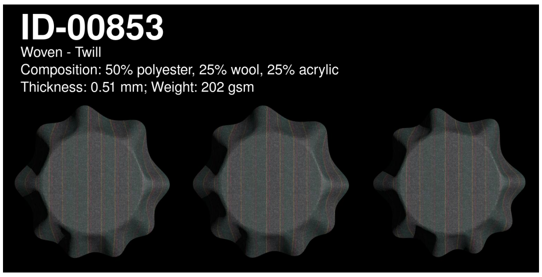

ID-00366
Woven - Twill
Composition: 100% wool
Thickness: 0.35 mm; Weight: 177 gsm

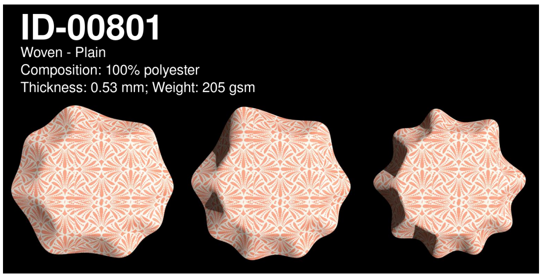

ID-00371
Woven - Satin
Composition: 80% triacetate, 20% polyester
Thickness: 0.44 mm; Weight: 200 gsm

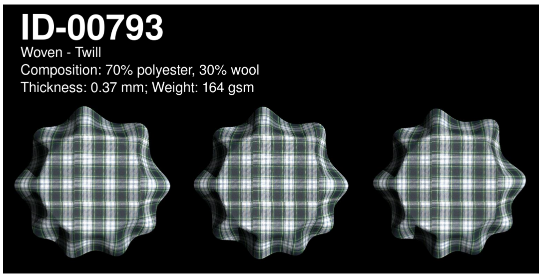

ID-00894
Knit - Jacquard
Composition: 62% nylon, 35% viscose rayon, 3% elastane
Thickness: 0.88 mm; Weight: 286 gsm


ID-00912
Woven - Plain
Composition: 70% viscose rayon, 30% flax
Thickness: 0.46 mm; Weight: 199 gsm

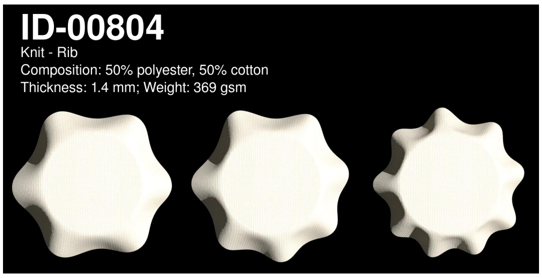

ID-00370
Woven - Satin
Composition: 80% triacetate, 20% polyester
Thickness: 0.42 mm; Weight: 200 gsm

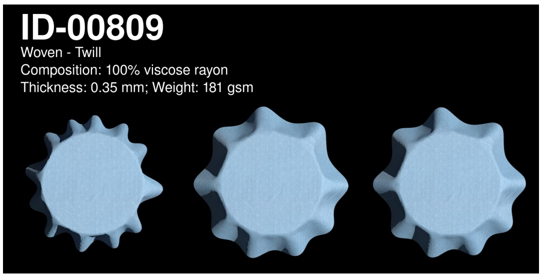

ID-00853
Woven - Twill
Composition: 50% polyester, 25% wool, 25% acrylic
Thickness: 0.51 mm; Weight: 202 gsm

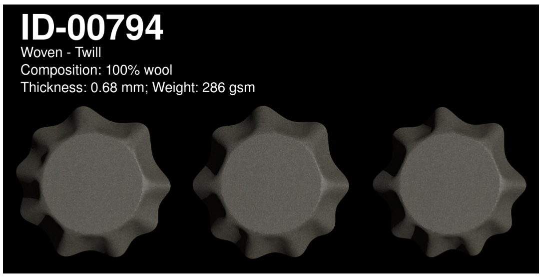

ID-00801
Woven - Plain
Composition: 100% polyester
Thickness: 0.53 mm; Weight: 205 gsm

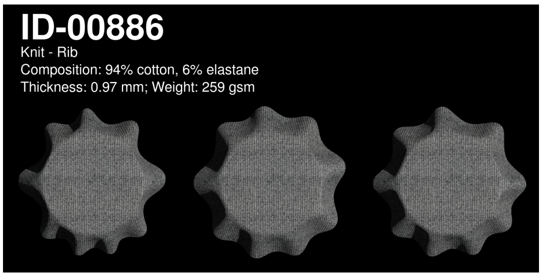

ID-00793
Woven - Twill
Composition: 70% polyester, 30% wool
Thickness: 0.37 mm; Weight: 164 gsm

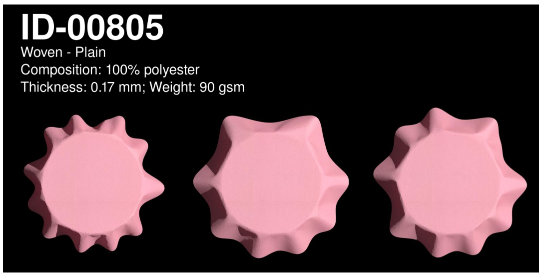

ID-00885
Knit - Rib
Composition: 94% cotton, 6% elastane
Thickness: 0.95 mm; Weight: 228 gsm

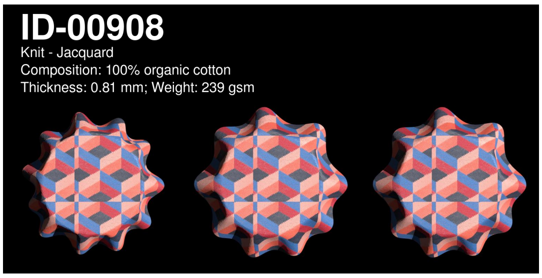

ID-00804
Knit - Rib
Composition: 50% polyester, 50% cotton
Thickness: 1.4 mm; Weight: 369 gsm

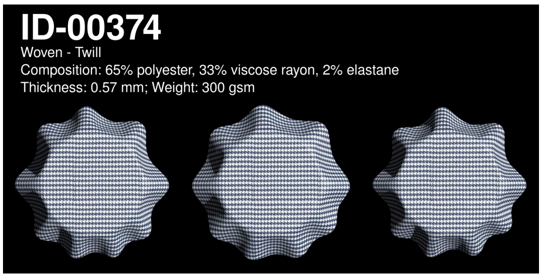

ID-00809
Woven - Twill
Composition: 100% viscose rayon
Thickness: 0.35 mm; Weight: 181 gsm


ID-00794
Woven - Twill
Composition: 100% wool
Thickness: 0.68 mm; Weight: 286 gsm


ID-00886
Knit - Rib
Composition: 94% cotton, 6% elastane
Thickness: 0.97 mm; Weight: 259 gsm


ID-00805
Woven - Plain
Composition: 100% polyester
Thickness: 0.17 mm; Weight: 90 gsm


ID-00908
Knit - Jacquard
Composition: 100% organic cotton
Thickness: 0.81 mm; Weight: 239 gsm


ID-00374
Woven - Twill
Composition: 65% polyester, 33% viscose rayon, 2% elastane
Thickness: 0.57 mm; Weight: 300 gsm

References

[HZRS15] HE K., ZHANG X., REN S., SUN J.: Deep residual learning for image recognition, 2015. arXiv:1512.03385. 1