Redesigning a Functional Jacket

How to reduce cutting waste, work time and the length of seams

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Bachelor's thesis

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ABSTRACT

In the thesis a waterproof jacket was redesigned for Sweet Protection AS. The existing Supernaut jacket was studied to find out the ways to reduce the amount of cutting waste, the combined length of the seams and the work phases, and so make ecological and economical savings.

Being a production model, the focus of the redesign was to keep the current functional performance and the fit of the jacket and concentrate on the solutions in the structure.

The patterns for the jacket were redesigned and the structure developed to be simpler. The most complicated parts in the original jacket were the hood and the sleeves, so most effort was put to simplify these. A new marker was created using the redesigned patterns.

Overall the redesign was successful, the fabric consumption and the length of the seams was decreased. However, there was a slight increase in the cutting waste. The marker in the thesis was designed using only the patterns for one jacket in size L and it is possible that the increase can be partly solved by designing the marker for the whole series.

Another interesting subject for further development could be to study how the patterns could be designed to fit better together on a marker and still retain the good fit of the garment.

Keywords Design, clothing, technical wear, pattern design

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TIIVISTELMÄ

Alppihiihto on kasvava laji. Harrastajat haluavat urheiluvaatteidensa olevat teknisesti toimivia ja hyvännäköisiä, mutta nykyään kiinnitetään huomiota myös tuotantoon ja ympäristöystävällisyyteen.

Opinnäytetyössä kehitettiin veden pitävän takin rakennetta. Työn tilaajana oli Sweet Protection AS. Työn tavoitteena oli vähentää takin valmistamisessa syntyvän leikkuujätteen määrää, teipattavien saumojen yhteenlaskettua pituutta sekä työn- ja työvaiheiden määrää.

Olemassa olevan takin istuvuus oli jo hyvä ja sen ei haluttu muuttuvan. Tavoitteisiin pyrittiin suunnittelemalla kaavoitus uudellen sekä etsimällä yksinkertaisempia ratkaisuja säätöihin ja muihin yksityiskohtiin. Lopuksi leikkuusuunnitelma rakennettiin uudelleen

Takin osat analysoitiin yksitellen, ja tutkittiin missä kohdin kaavojen osia olisi mahdollista yhdistää ja millaisia vaihtoehtoja löytyisi korvaamaan monimutkaiset rakenteet.

Kankaan kokonaiskulutusta onnistuttiin vähentämään ja teipattavien saumojen pituus lyheni. Leikkuujätteen määrä kuitenkin hieman kasvoi. Leikkuusuunnitelma tässä opinnäytetyössä suunniteltiin vain yhdelle takille. Tulos voisi olla tehokkaampi, jos leikkuusuunnitelma tehtäisiin käyttäen kokonaista kokolajitelmaa.

Tuotteen suunnittelua kaavoituksen näkökulmasta voisi myös tutkia lisää ja etsiä mahdollisuuksia kehittää muodoltaan paremmin yhteensopivia kaavoja säilyttäen kuitenkin vaatteen hyvä istuvuus.

Avainsanat Muotoilu, vaatetus, toiminnallinen vaate, kaavoitus

Sivut 27 s. + liitteet 3 s.

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1 INTRODUCTION

Skiing industry today is a multimillion business. More and more people are going to slopes every year. Being active in winter conditions that are cold, windy, snowy or wet, demands a lot from the equipment, especially the clothing.

According to Odén (2005, 156), skiing requires clothing that is comfortable, dry and warm, to be enjoyable and safe. The materials have to be functional and the fit good. New technology to address these issues is being developed continuously. However, skiing clothes are not driven only by functionality, but style and trends need to be considered, too.

Today's skiers want to be stylish but also take into account environmental issues. Thus, a company cannot concentrate solely on the performance of a piece of clothing, but the load on the environment has to be considered as well. Often, the ecological solutions make sense from an economical point of view, see for example Chouinard (2006, 126). Reducing waste, energy consumption and hazardous materials can lead both to ecological improvements and to economical success in the long term. However, the specific mechanisms why this may be so are outside the scope of this thesis.

Skiing clothes have been designed for almost a century now and the overall designs are quite well known and mature. As such the development is more concentrated on style and details. With the above considerations, Sweet Protection AS, below referred to as Sweet, is continuously redesigning their clothing line. As a part of this process, in this thesis the redesign of a skiing jacket is studied and reported. Because the jacket is a production model, the focus of the redesign is to achieve the current functional performance of the jacket with simpler and more effective solutions. Main focus will be on the following points:

Reduce waste. By having fewer pieces of patterns with optimized shape and well designed marker the amount of cutting waste can be reduced.

Simplify the technical details. In a typical ski jacket technical details, such as cord locks or hood, require a large amount of work and materials. By simplifying these structures both resources and work can be reduced.

Reduce the length of seams. In a waterproof jacket all the seams need to be taped to cover the needle holes. By reducing the combined length of taped seams the amount of work and materials is cut down.

These three points together should give answers to the research questions:

- Is it possible to reduce the amount of waste, work and seams in the Supernaut jacket?
- Is it possible to re-shape the patterns without changing the shape and performance of the jacket?

Results are evaluated quantitatively when comparing the amount of cutting waste and the length of seams and qualitatively when discussing the fit.

1.1 The purpose of the study

The aim of the thesis is to study the already existing Supernaut Jacket and find ways to develop patterns and structure to better fulfil the expectations; less cutting, less seams and less work by reducing the combined length of seams, looking for simpler solutions for details and adjustments, and with the careful design of the marker.

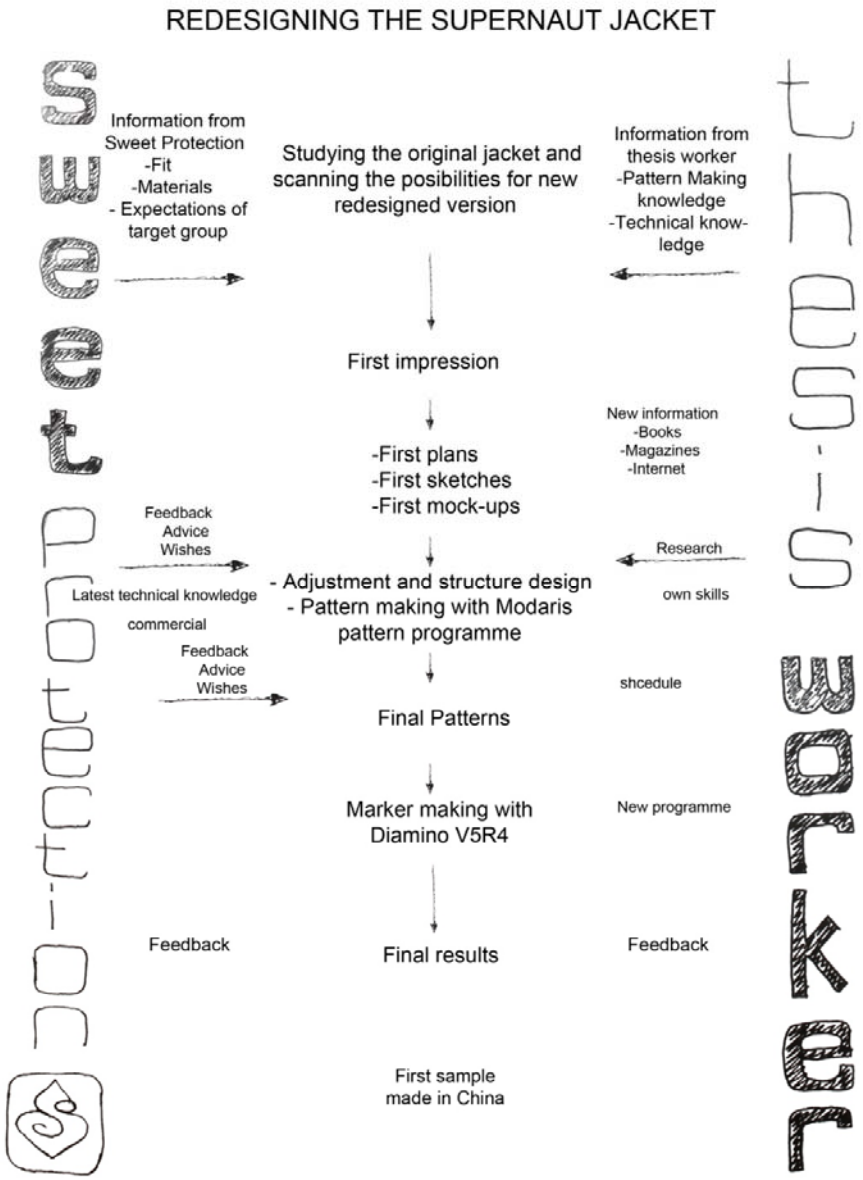
1.2 Background information and restrictions

The thesis is based on the information about the current production situation of the Supernaut Jacket received from Sweet. This information was obtained by interviews and includes data about fabric consumption, detailing and construction. Also the sample of the original jacket was used.

Other background information was collected from books, manuals, magazines and the Internet.

The focus of this thesis is on simplifying the structure of the patterns, the adjustments and the detailing of the Supernaut jacket. Evaluating the economical and ecological impacts of such savings are left out of the thesis.
Also, the actual design process is not covered in the thesis, despite the fact that by changing the pattern the look of the jacket will change. All improvements have to be agreed upon with Sweet.

1.3 Methods and sources



The theoretical framework is based on Anttila´s research method Realistic Evaluation (2007, 88). The thesis explains what is included in to thesis project and summarises the whole project, the product and the results (Vilkka & Airksinen 2003, 65).

The quantitative research method is used when comparing the results of cutting waste and length of the seams, and the qualitative method when discussing the fit, see Figure 1.

1.4 Glossary

Cutting = The leftover fabric
Marker = Blueprint for how pieces are cut out from the fabric.

2 SWEET PROTECTION AS

Sweet Protection AS is a Norwegian outdoor company producing skiing, snowboarding and kayaking clothes and protective gear.

2.1 History

Sweet was established in 2000. The company was founded by a group of friends. For decades they had produced their own gear for skateboarding, snowboarding and kayaking. As early as 1986, a founder and design manager Ståle Møller made Bushmade skateboards even though skateboarding was prohibited in Norway until 1989. In 1997 Møller designed a new kayaking helmet for Erik Martinsen to use in the freestyle kayak world championships. The design was different than what had been seen in the kayaking scene and soon grew popular. Right from the beginning Sweet got Terje Håkonsen , one of the best known snowboarders, in to their team to develop the helmets. In 2003 Sweet took part in ISPO for the first time and immediately won the Brand New Award for the best newcomer. (Sweet Protection 2010-11 26.3.2011.)

Figure 1 Method - grab

2.2 Business model

"Stronger, Lighter, Better" is the ideology of Sweet Protection. Starting with kayaking helmets, the product range has expanded to skiing and snowboarding helmets and other protective gear together with technical clothing. Sweet aims to use the best fabrics and latest technology to create top-class products.

Sweet Protection produces two different active wear lines; Resolution and Autonomy. Resolution includes their most technical wear and Autonomy is designed more for freestyle.
(Sweet Protection 2010-11 26.3.2011.)

Sweet seeks to produce garments with as little impact on environment as possible, by producing long-lasting, high-quality products. Sweet seeks also to use eco-friendly fabrics when it is possible and does not compromise the quality of the product. The company's ethical guidelines and declared goals are listed in the Code of Conduct, which is based on the internationally recognized International Labour Organization and United Nations conventions and treaties.
(Sweet Protection 2010-11 26.3.2011.)

3 WATERPROOF GARMENTS / TECHNICAL WEAR

According to back country guide Jimmy Odén it is important that the shell layer is waterproof and breathable when skiing. A good cut makes it possible to operate also when the climate is harsh, see figure 2. A sturdy hood, long enough hem and good fit, which enable movement, create comfort with the right layers underneath. (Odén 2008, 156)

Figure 2 Winter conditions

3.1 Fabric

There are two main ways to make fabrics waterproof and maintain breathability; laminating the fabric with microporous membrane (polytetraflouroethylene) or coat the fabric with hydrophilic coating. With both methods the fabrics become water and windproof, yet maintaining their breathability.

The functionality of the micro porous membrane is based on tiny cracks in the membrane. Water drops are too big to penetrate the membrane, but smaller water vapour molecules can vaporize out. When hydrophilic coating is used the body moisture is carried away by the hydrophilic molecules, see figure 3. (Risikko & Marttila-Vesalainen 2006, 58-59.)

There are different structures for waterproof laminates, see figure 4; in three- layer laminate (3L) a shell fabric, a membrane and a lining are all laminated together; in two layer-laminate (2L) the shell fabric is laminated with the membrane and the lining is separate; and in the third solution all three layers are separated and the membrane is laminated with a thin fabric and placed in the middle to be secured. 3L structure is the most durable and the structure where all the layers are separate is the softest. (Risikko & Marttila-Vesalainen 2006, 60-61.)

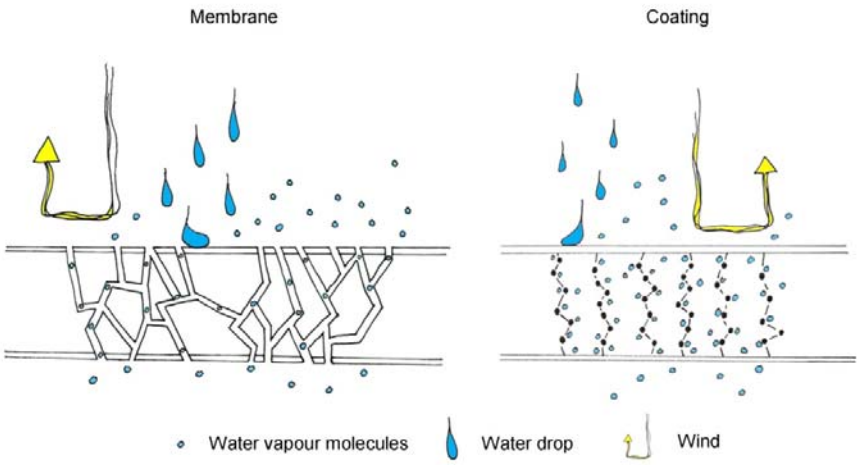


Figure 3 Waterproof structure

The most common way to test the fabric´s waterproofness is to use EN 20811 standard Textiles - Determination of resistance to water penetration – Hydrostatic pressure test. The test is based on a water column pressure, which shows the pressure against the fabric and is reported according to an SI-system in Pa/m2 unit. To be considered as a waterproof material the minimum pressure has to exceed 8000 Pa. Normally, if the garment is designed for demanding conditions, the fabric can handle over 100 000 Pa, which means 10m water column. (Risikko & Marttila-Vesalainen 2006, 63.)

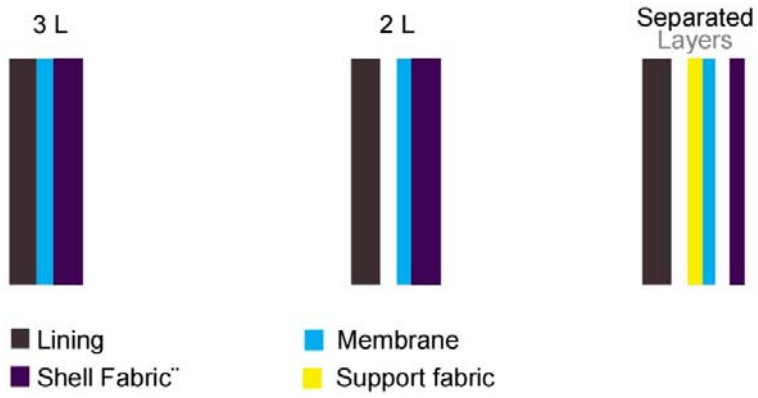


Figure 4 Structures for waterproof laminates

One way to test the fabric´s breathability is Ret test – Resistance to moisture vapour transmission – Sweating hot plate ISO-11092. In the lab test the fabric is placed on a heated porous metal plate. Water is channelled on to the plate to simulate perspiration. The plate is kept in the same temperature throughout the test. When passing the fabric, the water causes an evaporative heat loss which cools the plate and more energy is needed to keep the temperature constant. The sum of the energy used to heat the plate and the difference in pressure on different sides of the fabric give the Ret number. The smaller the number the better the breathability, see Table 1.
(Trailblazer Outdoors 2010-11 26.3.2011; International Organization for Standardization 27.3.2011.)

Table 1. Ret number

Ret	Performance
0 - 6	Very good or Extremely Breathable
6–13	Good or Very Breathable
13–20	Satisfactory or Breathable
20–30	Unsatisfactory or Slightly Breathable
30+	Unsatisfactory or Not Breathable

The fabric used in the Supernaut jacket is 3L Gore-tex Pro Shell fabric. The waterproofness in this fabric is created using the microporous membrane. Sweet uses Gore-tex fabrics because at the moment they produce waterproofed fabrics with the best performance (Møller, interview, 10.1.2011).

According to Tech & Style magazine (September 2010, 87) Gore-tex Pro Shell fabric belongs to the most technical category and is designed for professional or extreme use. It can keep out a 28 m water column, which means ca. 280 000 PA/m2, and its breathability level in 3L fabric is 2,5-6, see Table 1.

3.2 The design of waterproof garments

According to Risikko and Marttila-Vesalainen (2006, 63) the functionality of a waterproofed jacket is the sum of the technical fabrics and well designed fit and details. There are always holes in a waterproof jacket; the collar, sleeves and hem. With the right structure the water can be kept out. The holes have to be adjustable and zippers either waterproof, or covered with a panel. The collar or hood has to be designed so that the water does not funnel in. Typically, sleeves are adjusted with Velcro straps and the hem with elastic band. A jacket designed for winter sports normally also includes powder skirt and wrist gaiters.

When sewing a waterproof fabric the needle makes tiny holes into the fabric. Those holes have to be covered on the rear side with a waterproof tape. It is also possible to glue the pieces together, but this is a more expensive way to construct a waterproof garment. (Risikko & Marttila-Vesalainen 2006, 64.)

3.3 Supernaut jacket

The supernaut jacket is a men's skiing jacket with waterproof material and a cut for active use, Figure 5. It is made with 3L Gore-tex Pro Shell fabric. The hood is shaped to fit also with a helmet. All the cord lock housings are waterproof and designed to work in winter conditions, like the whole jacket with adjustable powder skirt in the hem and wrist gaiters in the sleeves. Ventilations are placed in the armpit. There are two large pockets in the front with weatherproofed zippers and two inside pockets with zippers for valuables and music devices. One pocket in the left sleeve is for an electronic key card. The sleeves and the hem are adjustable. (Sweet Protection 2010-11 27.12.2010.)

After testing the sample of the Supernaut jacket it was seen that the overall performance of this jacket was good. The fabric worked even when hiking on the mountain in wet conditions. The fit was good except that the sleeves and the hem could have been longer.

Figure 5 Technical details of the Supernaut Jacket

4 PATTERN MAKING

Patterns create the fit, style and performance. The garment has to be comfortable and well fitting giving freedom to move without too much space inside the garment. In this thesis the focus is on size L.

4.1 Pattern making for technical jacket

There are different ways of designing patterns for the technical jacket and is highly dependent on usage. The fit also creates the look, so when creating a commercial garment the spirit of the time has to be considered. According to McCann and Mörsky (1998, 3) it is good to attach the sleeve to the jacket so that it is possible to move your hands up and down without moving the hem. It means that there must be loose fabric in the armpit. That suited well the style of the `90s when the skiing style was loose, but today the fit has gone slimmer and ventilations are more often placed under the arm. The functional jackets produced by Sweet are cut in T-shape to avoid too much fabric under the arm (Møller, interview 10.1.2011).

There are several details supporting the performance in the cut of the technical jacket; the hood is shaped to support action, shoulder seams are often relocated away from the highest point, the shape in the sleeves supports the movement, the sleeves and hem are longer, the back of the hem is longer to cover the lower back, pockets are placed to be available also when the jacket is used with abackpack and hip belt. A powder lock, wrist gaiters and a pocket for a key card in the left sleeve are common in jackets designed for winter conditions.

4.1.1 Measuring

Already when taking measurements, it is important to pay attention to movement. Normally the human body is measured when standing still. This results in static measurements, see Figure 6, which are normally used when designing patterns for street wear. When designing garments for work or sports, dynamic measurements, see Figure 7, are more important. These measurements are taken in movement or when the human body is in poses which are typical for work or sports. This creates the right space for movement. (Risikko & Marttila-Vesalainen 2006, 95-102.)

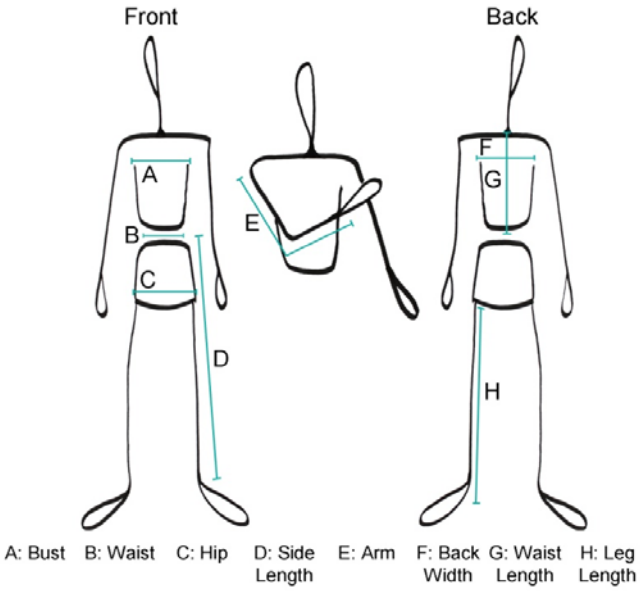


Figure 6 Static measurements

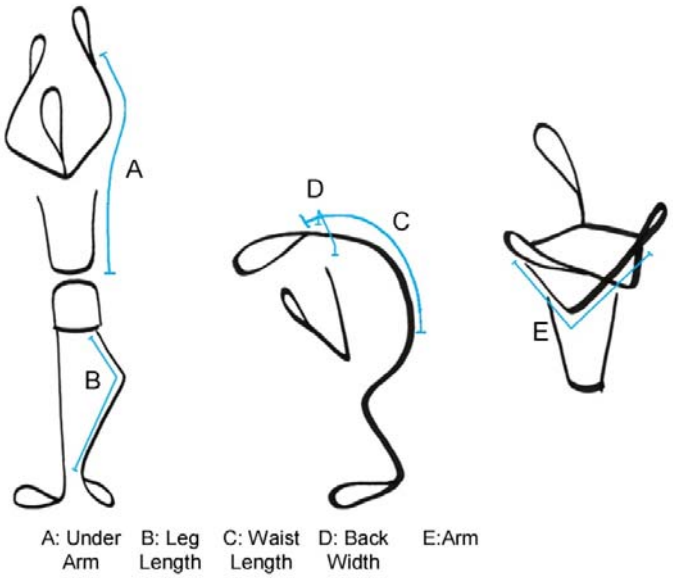


Figure 7 Active measurements

4.2 Patterns

Generally, when pattern pieces are small the number of cutting waste will be smaller and it is easier to find a good fit, but at the same time the combined length of seams will grow. It is important to find a good balance between these three factors.

4.2.1 Original patterns

The fit of the original Supernaut jacket is considered good by Sweet. It has been tested by the team riders and it has fulfilled the requirements Sweet has set, see Figure 5. Therefore when re-designing the jacket the attention will be in changing the construction but keeping the fit.

According to Møller (interview 20.12.2010), the fabric usage for the Supernaut jacket is 2.34m and they utilize 82% of the fabric. The combined length of the seams is 16,6 m (16595 mm) of which 13,2 m (13168 mm) are taped seams and it takes 10.5 hours to produce this jacket. The shell of the original jacket is constructed from 47 pieces.

Picture 1 Original patterns

4.3 Background research for the details and structure

The project started by research, which concentrated on the challenges with the hood and sleeve, adjustments, pockets and ventilations. The idea was to avoid metal rings, darts and too bulky and complicated solutions to create a comfortable fit and keep the style of Sweet. Laser cutting and weatherproof zippers demand more work and are therefore not preferable. A couple of interesting details and adjustable ideas were found, Figure 8.

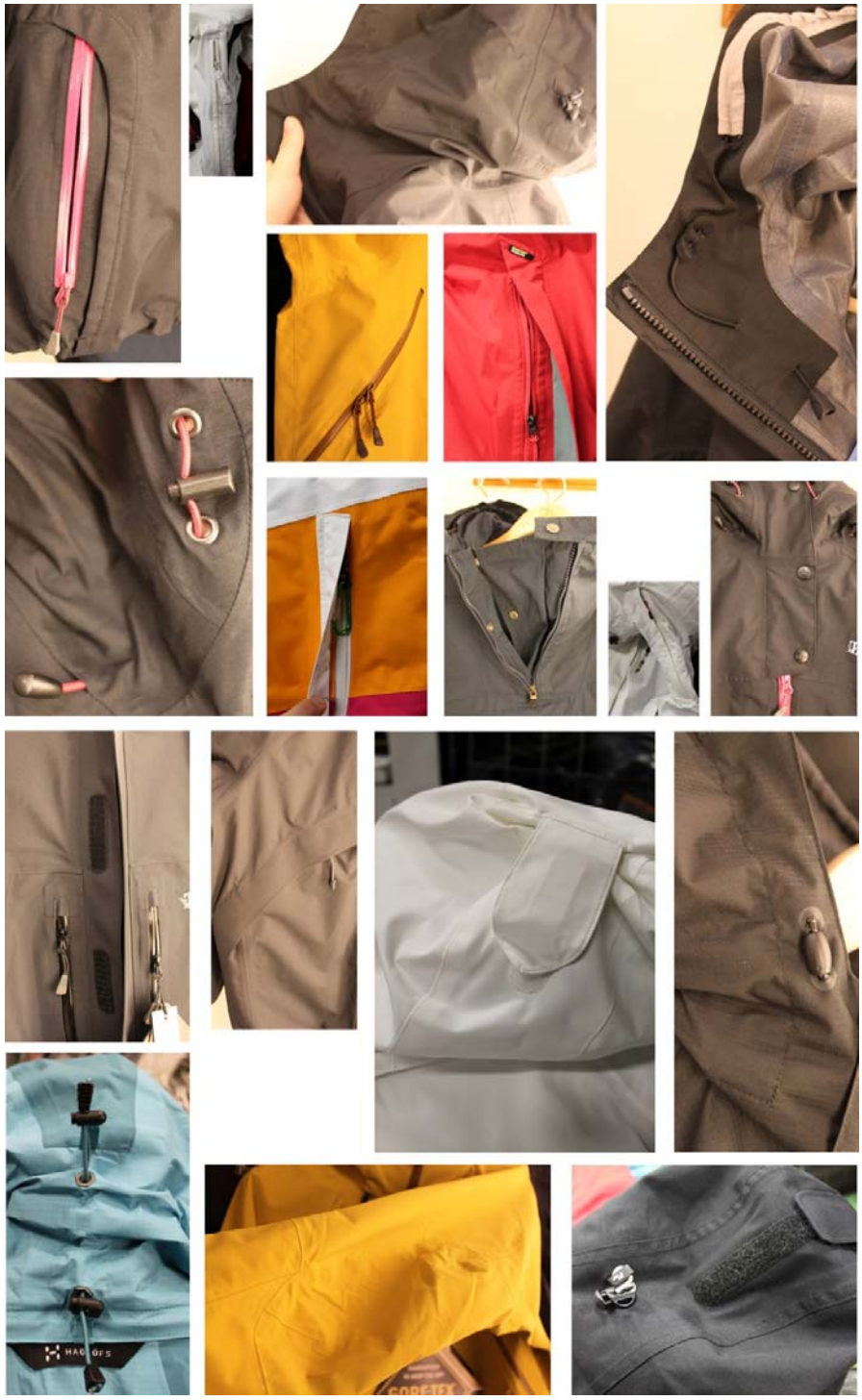


Figure 8 Material from background research

4.4 Re-designing

At Sweet, the patterns are made with the 3D modelling programme Rhinoceros and the patterns were delivered in .dxf format. For Sweet the 3D modelling program is the most multifunctional when creating patterns for clothing and also models for protective gear. The pattern design programme Modaris was used when redesigning the patterns in this thesis. At the beginning the original patterns were printed out and digitized to Modaris.

In the first meeting with Sweet, the overall style for the jacket was agreed. The re-designed jacked would be really simple style, Figure 9. Hidden zippers will be tested in ventilations, to see if the drawer can be changed to a bigger one.

Figure 9 Agreed jacket sketch

Originally, the adjustments in the hood and the hem were designed to be simple silicone cord locks, like in one of the research details, Figure 8. This design is already used in some other Sweet clothes.

However, Sweet presented a structure that would be even simpler. This structure would be hidden and in line with the style of the jacket. Elastic

cord would go through this silicone cord lock, so that pulling the cord would tighten the hood or the hem. Squeezing the cord lock, would release the elastic band and loosen the hood or the hem. The holes needed for elastic band are buttonholes.

4.4.1 Sleeve

In the original patterns the sleeve consists of eight pieces, the pocket for the key card was laser cut and there was a weatherproof zipper. The work was started reducing the seams by connecting parts 1, 2 and 3, see Figure 10, and reshaping the seam connecting the upper and lower sleeve. The ventilation panel was stretched to cover the whole length of the sleeve and the rest of the original shape was added into this seam. The panel was also made wider to make the seam run over the elbow. The sleeve extension (5) was connected to the stretched ventilation panel, see Figure 10. In the final left sleeve there is an extra seam created for a key card pocket; this seam does not exist on the right sleeve, Figure 15. During the design phase three mock-ups were made (appendix 2) and version number 2 was chosen.

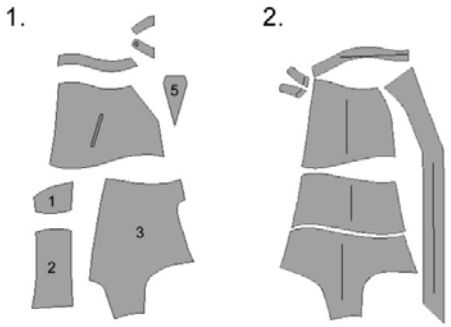


Figure 10 Patterns for the original sleeve (1.) and the redesigned sleeve (2.)

4.4.2 Hood

The cord lock housings in the original jacket demanded 12 operations each. (Møller, interview 20.12.2010).The hood had three cord locks that were replaced. The patterns were simplified by dividing the centre hood

piece (2) in three and connecting the pieces into 1, 3 and 4, see Figure 11. By dividing the pattern equally the round shape of the hood was retained. The lower back seam was lifted up to reduce the seam length and the adjustment was changed. Two mock-ups were made (appendix 3) and version number 1 was chosen.

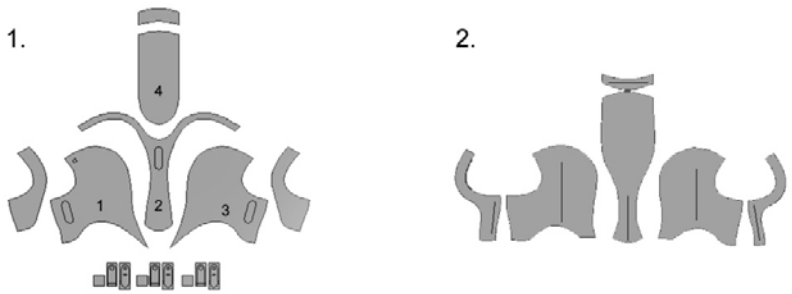


Figure 11 Patterns for original hood (1.) and redesigned hood (2.)

4.4.3 Front and back

In the original jacket the front pockets were laser cut and there was a weatherproof zipper. In the hem there were two cord lock housings, which were replaced. At the beginning, the lower side panel (2), see Figure 12, was divided into three and connected to the front, ventilation and back pieces to reduce the seams. However, in the first meeting with Sweet it was decided that there should not be side seam at the height where the backpack´s hip belt settles itself. The lower side panel was then connected as a whole to the front piece and the side seam was made to curve back.

Small changeswere made to fix the seams to meet under the arm, see Figure 14.

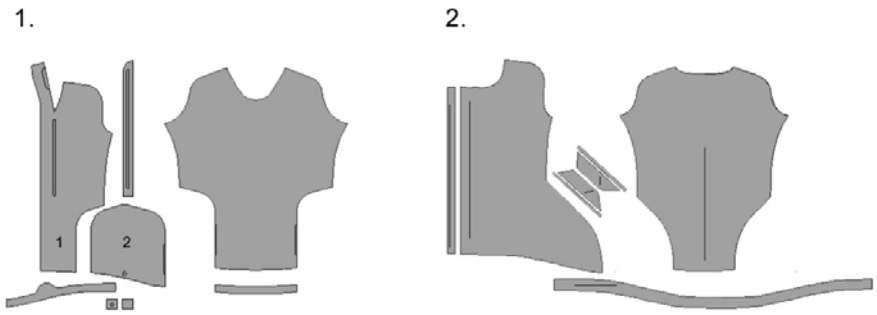


Figure 12 Patterns for original front and back (1.) and redesigned front and back (2.)

The centre front was extended at the right side to make the panel cover the zipper. There is a napoleon pocket placed underneath the panel. Four sketches were made from the front pockets, see Figure 13, and Sweet chose number three. However, they had a wish to attach the pocket bags by glueing instead of stitching. The place for the front pockets was tested to fit with a backpack.

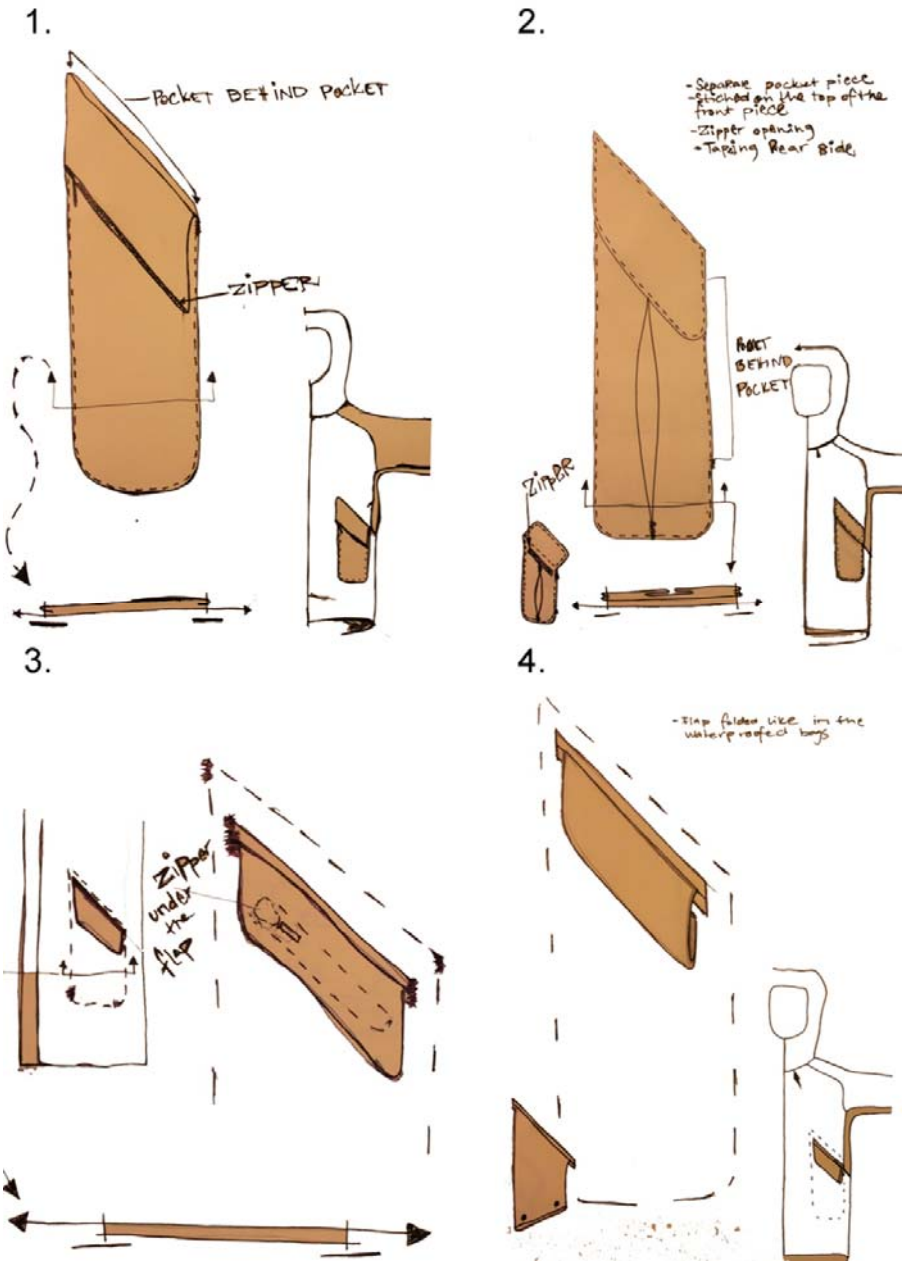


Figure 13 Sketches for the front pocket

4.4.4 Connecting pieces

The compatibility between the pattern pieces was measured. Because of the new wider ventilation piece the side seam of the front piece was also moved 2 cm inwards. When placing the parts to be connected to the ventilation piece into line, it turned out that they did not fit perfectly.

The ventilation piece was measured to create the right length for the sleeves, and the other pieces were adapted to fit, see Figure 14. The facings are also made from the main fabric and they were created by cutting a 4 cm wide panel from the edge of the hood pieces, sleeves and the hem.

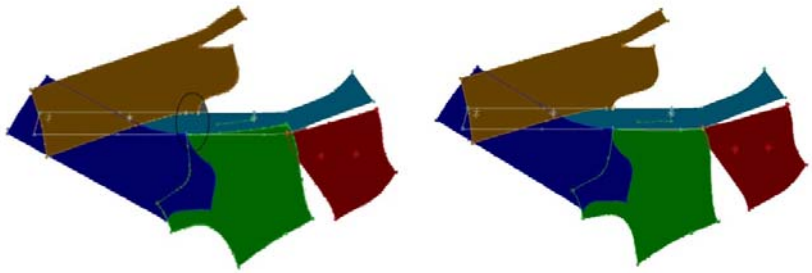


Figure 14 Connection challenge

4.4.5 Redesigned patterns

The fabric usage for the redesigned jacket is 2.17 m and 80% of the fabric is utilized. The combined length of the seams is 18.5 m, of which 11.4 m are taped seams. The shell of the redesigned jacket is constructed from 35 pieces.

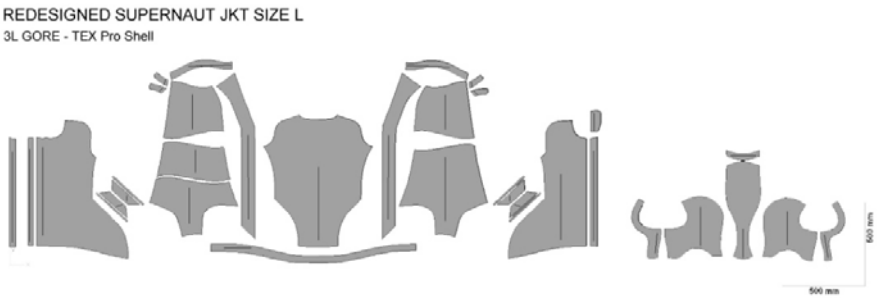


Figure 15 The patterns for the redesigned jacket

5 MARKER

A marker is a blueprint for how pieces are cut out from the fabric. In this thesis the marker was created by Diamino V5R4 programme, by Lectra. The programme provides the possibility to create a precise material requirement calculation. When patterns are created in Modaris, the fabric used for each piece is defined. When opening the file in Diamino, the different fabrics are recognized, and worked one by one (Lectra 2.4.2011).

5.1 New solution

While making the patterns, the marker designing was also tested. With the first version of re-designed patterns the automatic function was tested, but the results did not meet the expectations, see Figure 16. The utilized fabric was only 58.37% and fabric usage was 3.317 m.

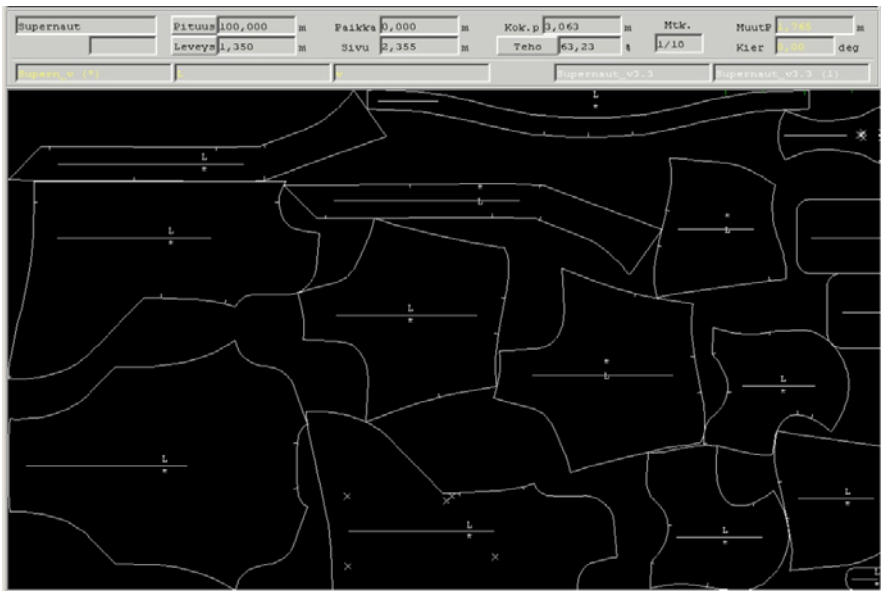


Figure 16 Marker made with automatic function

The next experiments were made by placing the patterns by hand, first exactly according to grain line and then by slightly rotating to make the pieces fit better. The last way was the most successful, see Table 2, and it was selected for the final patterns shown Figure 17. The results with the

first version patterns and the final patterns are not comparable, because some pieces were taken out while working. However, it is seen in Table 2 that the small pieces left out from the final version reduce the amount of cutting.

Table 2. Marker results

Marker style/ patterns	Fabric usage	Utilized	Cutting
Automatic / version one	3,317 m	58,37 %	41,63 %
By hand- straight grain line / version one	3,063 m	63,23 %	36,77 %
By hand- adjusted grain line / version one	2.273 m	80,29 %	19.71%
By hand- adjusted grain line / final patterns	2,168 m	80,13 %	19,87 %

The seam allowance used generally in these patterns is 6 mm (Møller, interview 10.1.2011). The Gore-tex Pro Shell fabric is attached together with the membrane and it does not stretch as fabrics without a membrane. This is the reason why it is possible to adjust the angle used when cutting out the pieces. However, it has to be checked that the colour does not vary with different angles.

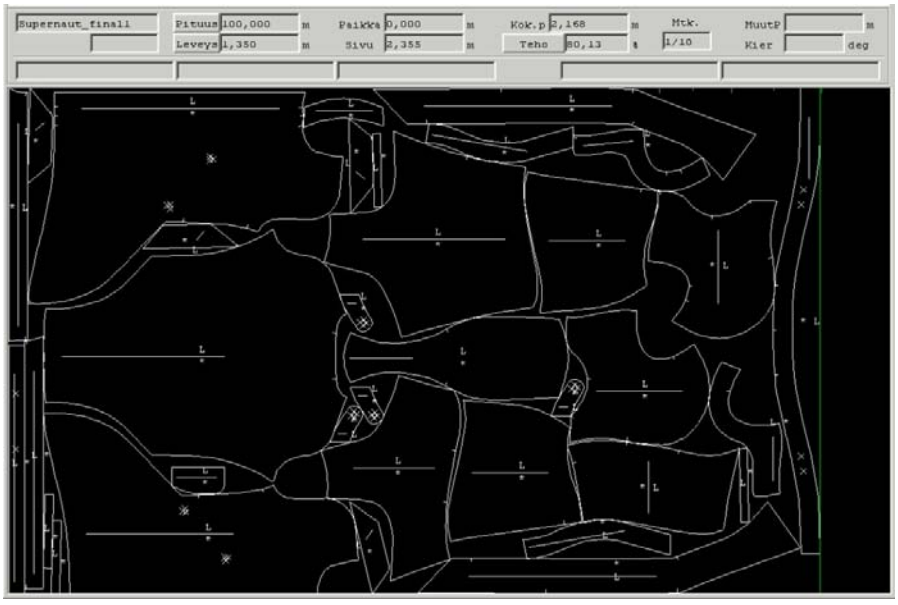


Figure 17 Final marker with redesigned patterns

6 RESULTS AND CONCLUSIONS

The results obtained in the thesis are encouraging. The overall structure of the jacket was simplified and the material consumption was decreased. Also the number of expensive work steps involving laser cutting was reduced.

It seems that the shape of the jacket was not dramatically changed with the new patterns; however, that is not certain before the sample jacket has arrived. There is still room for improvement, though. In some measurements, there were actually decreases in performance.

The quantitative results can be seen in Table 3. The material consumption was reduced by 0,17 m or approximately 7%. This 7% direct saving in material costs can be considered significant.

Disappointingly, the utilized percentage decreased by two percentage points, which means 0.02 m^2 more cutting. However, the result is not directly comparable to original figures. The marker made in this thesis was designed using patterns only for one jacket in size L. In production, the marker is typically designed for the whole series, and therefore results in more efficient cloth consumption, as there are more different sized patterns giving more freedom to pattern placement.

Table 3. Results

	Supernaut Original	Supernaut Redesigned	Difference
Fabric consumption (m)	2,34	2,17	0,17
Utilized	82 %	80 %	0,02
Cutting	18 %	20 %	-0,02
Seam Length	16,6	18,5	-1,9
Seams to be taped	13,2	11,4	1,8
Other seams	3,4	7,1	-3,7
Area (m2)	3,16	2,93	0,23
Utilised area (m2)	2,59	2,34	0,25
Cutting Area (m2)	0,57	0,59	-0,02

The combined length of the seams to be taped was decreased by 1,8 m, but the length of all the seams together was increased by 1,9 m. However, this can be explained almost completely by the panel for the front zipper, which demands more seams.

Overall, the style and the fit of the jacket was considered good (Appendix 1). However, the final fit cannot be evaluated before the first production sample has arrived. According to Møller, the redesigned jacket will be presented as an option for the collection 2012-13. However, the jacket is not yet ready. The shape and construction will be checked and redesigned after the first sample has arrived. If the jacket is chosen to the collection, the second sample will be tested by the team riders, who will give feedback about the performance.

The most important further development issue is clearly in the marker. Other results were generally positive, but the new marker design resulted in larger cutting than with the original jacket. It is possible that this can be partly solved by designing the marker for the whole series, but this is not certain and needs to be studied more.

An nteresting further development subject could be to study ways to include the marker optimisation into the design process already in the pattern design phase; that is, to take into account how the patterns will fit together already when designing them. This, however, is difficult and somewhat contradictory to the overall design goal of making comfortable skiing clothes, as often such changes to patterns will affect the fit. A possible way forward would be to combine the results of this thesis to the ”zero-waste” type of thinking, see for example Rissanen and Gwilt (2011).

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Appendix 1

FEEDBACK BY THE COMISSIONING ORGANISATION

FEEDBACK BY THE COMMISSIONING ORGANISATION

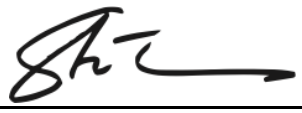
Commissioning organisation	**SWEET PROTECTION AS / Ståle Norman Møller**
Student	**Jenni Fisk**
Degree programme	**Design**
Topic of thesis	**Redesigning a functional jacket**

As representative of the commissioning organisation of the thesis, I hereby submit this statement regarding the following issues:

Goal achievement, usability of results, skills and conclusions, student's degree of activity

Jenni Fisk received a design brief on the project where the main goal was to redesign the jacket with focus on reduced consumption and waste, and more cost effective and less process sensitive production. It had to be achieved without loosing the functional benefits and the aesthetic appeal to a very demanding target group. The task is solved in a very professional manner, and the documentation of the process is very well executed. The styling of the jacket carries the values of the brand, and expresses the pure and functional approach in an appealing manner to the target group. Jenni Fisk has understood the main goals and objectives of the projects, and has worked very independently throughout the project. She has approached me at important crossroads for consultation and then moved on to achieve very pleasing results. She communicates efficiently, and is easy to work with. This shows that Jenni Fisk not only displays convincing craftsmanship of the trade, but also shows the ability to run a project in an efficient and professional manner. We're very pleased with the result.

Date and signature of representative of commissioning organisation

15/4-2011 

Appendix 2

THE MOCK-UPS FOR THE SLEEVE

Appendix 3

THE MOCK-UPS FOR THE HOOD