

volumes could be handled at the nip to counteract crushing in the paper web.

A limiting factor in the design of multi-layer, highly dewatered felts was the requirement for flexibility to allow quick installation. The felts were often stiff and difficult for machine staff to handle. Roland's requirement for effective dewatering and fast installation was a press felt with a seam, and contact was made with Nordiskafilt.

"It was with great joy that we noted Nordiskafilt was on board," recalls Roland Lilja.

After initial discussions, Nordiskafilt developed five different seam proposals which were tested. After the first success, the seamed felt became established in all brown paper grades and especially in pulp machines.

"In addition to quicker and easier felt changes, the seamed felt has a major advantage — machine run times became on average twice as long," says Roland. "We doubled the run time from one month to two. Normally, the cost of an endless felt is 45-47 kronor per ton of paper produced. With the seamed felt, the cost drops to about 32 kronor per ton."



The simple box that helps the operator connect a felt with a seam.

#### Concern about marking

In the beginning, we discussed a lot whether the seam would leave marks and thereby result in paper of too low

quality.

"Today we can confirm that seam marking is not a problem, not even in white grades," says Sivert Andersson, Sales Manager at Nordiskafilt. Tissue paper is the only product area where the seamed felt has not achieved any success.

Today, Roland Lilja is the Production Manager at the fluting mill, which includes PM 4. That machine produces fluting, i.e., the inner layer in corrugated board. His spirit of experimentation has not waned over the years. A year ago, he was part of another technical breakthrough. At that time, the last press felt in the drying section was pulled in, thereby eliminating the very web-break-sensitive free draw between the press and drying sections.

This application has been optimized, and field run times have increased by about 50 percent. This felt run would not have been feasible without seamed press felts.

"Demand for our fluting has been very strong this year," he reports. "Most of it is exported to North Africa and Southern Europe. It may be related to the fact that the corrugated box is replacing the wooden crate as fruit packaging."

Anders Forsström

## 10,000 seamed felts from Albany/Nordiskafilt

#### All grades

The overwhelmingly dominant area of use at the introduction of seamed felts was in pulp and kraft paper machines, as the demands for mark-free paper were generally limited. As the seam has gradually been refined, growth has increased in other paper grades, as shown in Figure 2, where Albany's/Nordiskafilt's accumulated production is distributed by paper type.

#### Mature product

A question that is often asked is whether the seamed felt has become a mature product and reached its maximum in terms of application possibilities. The answer to this question must be a clear no. Growth is expected to increase primarily due to

the following:

- An international overview reveals certain geographical areas where the typical advantages of the seamed felt have not yet been fully utilized.
- The new generation of seamed felts represents a major leap in terms of mark resistance, wear resistance in the seam zone, and strength. This means the area of application is significantly expanded.

Finally, it can be said that nearly all development work on seamed felts has focused on improving the seam, while the overall design of the seamed felt has largely corresponded with other types of felts. This means that the degree of design freedom the seam provides has not yet been fully utilized. In the long term, we can therefore expect new clothing elements to be developed where the seam is a necessity in order to achieve improved dewatering, runnability, and paper quality.

Jan Rexfelt

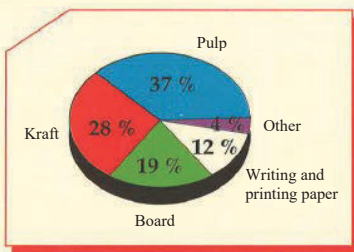


Figure 2. Distribution of Albany's/Nordiskafilt's accumulated production of seamed felts among different paper grades.

## A new generation of seamed felt

As previously mentioned, 1982 was a milestone in the history of Nordiskafilt. In collaboration with Skärblacka, the first seamed felt, Combikraft, was born.

What has happened since then with the seamed felt is that the product's further development should be regarded as an evolution — that is, continual minor improvements. This was the case until about a year ago, when a significant step was taken in seam development and a new, considerably improved generation of felts saw the light of day. The limitations of older seams compared to the improvements of the new generation will be highlighted here.

#### Previous seams

The earliest seams had long loops, i.e., cross-threads in the weave were missing on both sides of the centerline of the seam. This had three consequences, as shown in Figure 1, which in some cases caused issues.

1. The two zones where cross-threads were missing could in some cases lead to marking due to lower press pressure in these zones.
2. The lower fiber anchoring in the above zones led to increased batt wear in the seam zone. The batt flap could be sucked into the suction box slot, further worsening the wear. This event has often been recorded as a "gunshot" sound across the suction box.
3. High batt wear in the seam area contributed to an increased risk of mechanical wear, resulting in deteriorated strength properties.

From a papermaking perspective, it is clear that severe wear across the seam area causes marking in the paper. But even with negligible wear, the inhomogeneity that the seam represents in the felt structure is clearly capable of contributing to marking. To address this, the first step was to analyze the various causes of seam marking in greater detail.

#### Problem solved

Marking in the paper web may be identified as:

- a. a dark mark, which may be due to:
  - i. too high pressure over the seam, resulting in more fiber-to-fiber bonding in the paper.
  - ii. overly dense edges around the seam, leading to higher hydraulic

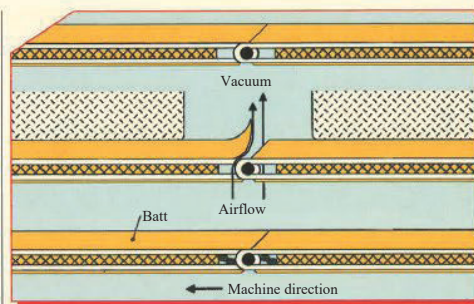


Figure 1. Consequences in the earliest seams.



Figure 2. Comparison between two seam halves using old and new

pressure and thus lower compression pressure compared to the rest of the felt. This becomes more noticeable if the seam provides too little pressure.

- c. incorrect flap angle, which quickly leads to high wear over the suction box and in itself causes a light mark. Additionally, the gap also leads to a narrow dark mark due to micro-shrinkage on the seam side without a flap.
2. A lighter mark, which usually

results from too low pressure over the seam. This leads to fewer fiber-to-fiber bonds. Marking caused by low pressure may result from various inhomogeneities in the seam structure, but a typical example is the use of the wrong seam thread or excessive flap wear.

In summary, the most common causes of marking can be attributed to an overly open seam, long loops, and a long flap, which quickly cause wear in the seam area.

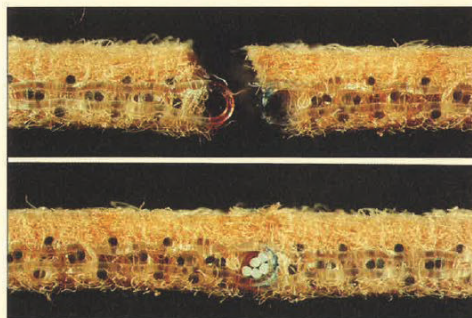


Figure 3. The felt in its finished form. The batt-like yarn is barely visible.

#### New generation of seamed felt

The above analysis shows that a significant improvement in the seam is based on achieving greater homogeneity in the seam zone combined with improved batt anchoring. The solution to these problems came during the winter of 1990 and has resulted in a patented process.

Through the use of a special weaving technique, we have managed to bridge the top of the loops with an invoven batt-like yarn that acts as a flap covering the loops. In Figure 2, two seam halves using old and new technology can be directly compared. The diameter of the batt-like yarn on top of the loops is in the same size range as the batt fiber diameter. During the subsequent needling process, this yarn is largely integrated into the batt structure. In Figure 3, which shows the finished felt, this yarn is barely visible.

This change, combined with an optimization of the seam thread design, has resulted in such a significant reduction in marking that it is clearly justified to speak of a new generation of seamed felt.

Regarding the strength properties of the seam, the initial strength remains unchanged since the material in the loops is the same. However, during operation, the strength properties are better maintained than before, as the new design protects the loops against mechanical wear significantly better. At first glance, one might think that the new seamed felts would be harder to connect due to the shorter loops. This is not the case. Shorter and more uniform loops mean the loops are generally straighter and easier to connect.

#### Paper machine operations

The positive residual results achieved during the development of the new seam have more than been confirmed during paper machine operations. As an example, Figure 4 shows photographs of four seams on used felts in the pick-up position and second press from Skärblacka PM 9. All felts had a run time of about 60 days. Describing the differences between the old and new generation seamed felts in words is unnecessary. Instead, the old saying applies: "a picture is worth a thousand words."

Björn Rydén

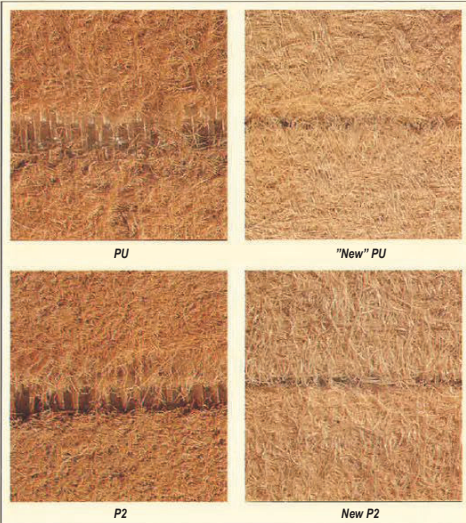


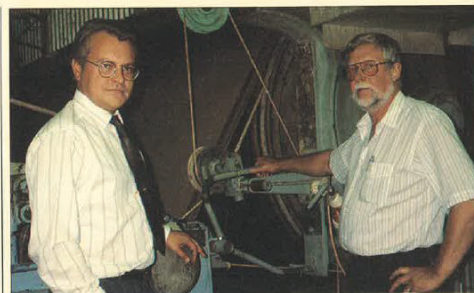
Figure 4. Four seams on used felt in the pick-up position and second press from Skärblacka PM 9. All felts had a run time of about 60 days. On the left are felts from the pick-up and second press of older design, and on the right are corresponding felts of the new generation design.

## Sleepless night gave seamed felt

One October night ten years ago, a group of pioneers kept vigil over the first trial run of a seamed felt. This exciting event took place at Skärblacka on sack paper machine PM 9. The trial went well, and technical history was made. Today, the seamed felt is an established product in most brown paper contexts.

— "The seamed felt — the press felt that is seamed in place on the machine — represented a revolution in the press section," says Roland Lilja, one of the pioneers. Roland was, at that time ten years ago, operations manager of PM 9, a seven-meter-wide sack paper machine at Skärblacka mill. At that time, the mill was owned by Fiskeby AB. Today the owner is MoDo.

The first seamed felt was installed in



Sivert Andersson and Roland Lilja in front of PM 9 at Skärblacka mill.

the second press and ran for twenty-three operating days. Roland's idea and dream of the seamed felt had been realized.

During the latter part of the 1970s, development had focused on increased linear pressure and harder press rolls.

As a result, the demands on the dewatering capacity and longer run times of press felts increased. To meet these demands, the development of press felts moved toward a design of incompressible felts with high void volume to handle more water —

## 10,000 seamed felts from Albany/Nordiskafilt

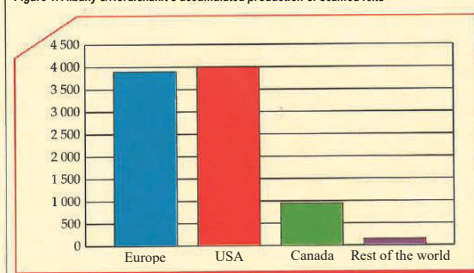
Since the first development of seamed felt at Nordiskafilt ten years ago, this product has spread widely across the world. Even though seamed felt is now manufactured under license by all major felt producers, the statistics and experiences of the Albany Group can certainly be considered representative of an international overview.

#### Success in the USA

For obvious reasons, initial growth was concentrated in Scandinavia and Europe. However, since 1985, the strongest growth has occurred in the United States. This means that the accumulated production of seamed felt in Europe and the US is now at about the same level, see Figure 1. That production from other units is low does not mean that consumption outside Europe and North America is equally low, as significant export occurs. The use of seamed felt varies greatly between different countries, largely due to the following:

- The composition of the machine base. For some machines, the introduction of seamed felt results in major savings, while other machines already have sophisticated systems for felt changes.
- The types of paper that dominate production in different countries.
- Local demands for, for example, mark-free surfaces. An example of this is Japan, where seamed felt usage still remains very low.

Figure 1. Albany's/Nordiskafilt's accumulated production of seamed felts



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## TRANSLATION CERTIFICATION

Date: 6/4/2025

To whom it may concern:

This is to certify that the attached translation is an accurate representation of the documents received by this office. The translation was completed from:

- Swedish

To:

- English

The documents are designated as:

- #103217\_4128\_001

Prince Williams, Project Coordinator in this company, attests to the following:

"I declare under penalty of perjury that the foregoing is true and correct. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.."

A handwritten signature in black ink, appearing to read "Prince Williams", written over a horizontal line.

Signature of Prince Williams