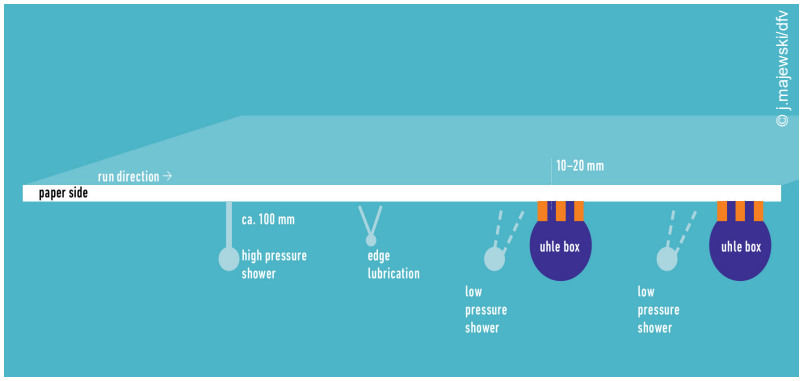
Felt conditioning done correctly
Increase lifetime, improve runnability

Do you know that felt conditioning plays a key role in the increased efficiency of your production? On the other hand, if conditioning is either neglected or incorrectly set up, this can lead to premature removal of the clothing. We often notice that this issue does not always receive the attention that it deserves. For this reason, we would like to highlight some recommendations that can help to keep clothing in good shape for as long as possible.

How should the showers be set up?

Generally speaking, conditioning starts with a high pressure shower. If necessary, this is followed by an edge shower. This should then be followed by a low pressure shower and a Uhle box. This order should be strictly adhered to. With this setup, the felt surface is adequately lubricated before coming into contact with the aggressive ceramic coatings of the Uhle box covers. All these elements generally interact with the paper side of the felt.



1 | Felt conditioning done correctly | www.heimbach.com

High-pressure shower for deep cleaning

Dirt, fines and fillers are introduced into the process via the paper stock, which can subsequently lead to compaction of the felt. This can result in diminished dewatering over the lifetime of the felt. Numerous settings must be taken into account to ensure that mechanical felt cleaning is effective. The more precisely this is carried out, the more efficient the felt performance.

Cleaning must be continuous and even

The basic objective is the removal of dirt and deposits from the inside of the felt in a continuous and balanced manner. This needs to be done over the entire length and width of the clothing. It is important to ensure that every square centimetre of the felt is cleaned equally well. If this is not done, it is likely that there will be different levels of contamination and, therefore, different levels of felt compaction. This can then lead to cross-profile variations in the felt and paper, or can incur locally increased wear. And, last but by no means least, to premature removals.

The needle jet

The high-pressure needle jet must always be laminar. This is the only way to ensure that the full energy of the jet reaches the felt surface. A turbulent jet that is inclined to break up before reaching the felt will lose energy and therefore be unable to apply its full cleaning power (Fig. 1). Heimbach also recommends a distance of 100 mm from the shower nozzle outlet to the felt surface is respected. Heimbach has had good experiences when the needle jet works at a 90-degree angle to the press felt.

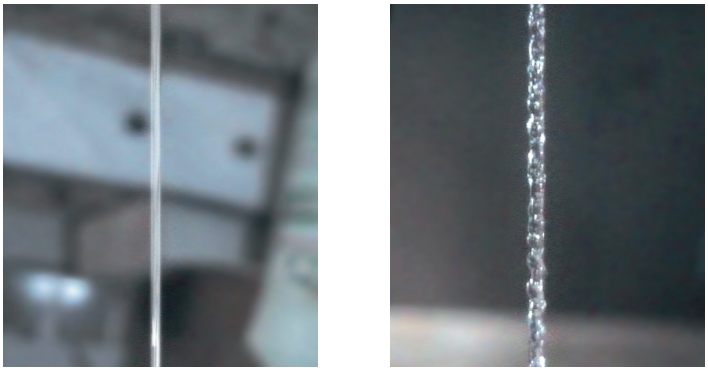


Fig. 1: Turbulent versus laminar jet © PMS

The nozzles

All nozzles need to be in perfect condition in order to ensure that the felt is evenly cleaned across its full width. They must not be either polluted or clogged (Fig. 2).

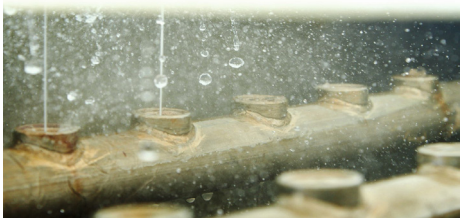


Fig. 2: Functioning and clogged nozzles

Unfortunately, this is often not the case in practice. Accordingly, felts are frequently encountered in the most varied degrees of contamination (Fig. 3). The distance between individual nozzles should ideally be between 100 and 150 mm. The exact distance depends on the required cleaning intensity in the respective felt position.

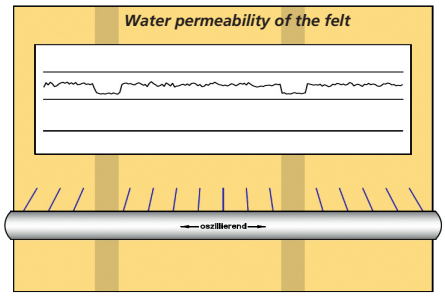


Fig. 3: Irregular cross direction profile due to misplaced HP nozzles

As for nozzle quality, two further questions arise: What should be the optimum diameter? How high should the pressure applied reach? For some years now, the trend has been towards smaller-diameter nozzles. They certainly offer better cleaning – provided they do not become prematurely clogged due to poor water quality. Diameters between 0,7 and 0,9 mm are common today.

Nozzle size	Water pressure (bar)														
	1	2	3	4	6	8	10	15	20	30	40	50	60	70	80
0,4	0,08	0,12	0,15	0,17	0,21	0,24	0,27	0,33	0,38	0,46	0,54	0,60	0,66	0,71	0,76
0,6	0,16	0,22	0,27	0,31	0,38	0,44	0,49	0,60	0,70	0,85	0,90	1,10	1,20	1,30	1,39
0,7	0,20	0,28	0,34	0,40	0,48	0,56	0,63	0,77	0,89	1,08	1,25	1,40	1,53	1,66	1,77
0,8	0,30	0,40	0,50	0,60	0,70	0,80	0,90	1,10	1,30	1,60	1,80	2,00	2,20	2,40	2,50
0,9	0,35	0,50	0,61	0,71	0,87	1,00	1,12	1,37	1,58	1,94	2,24	2,50	2,74	2,96	3,17
1,0	0,50	0,70	0,90	1,00	1,20	1,40	1,60	2,00	2,20	2,70	3,10	3,50	3,80	4,20	4,40
1,2	0,60	0,90	1,30	1,50	1,60	1,80	2,00	2,50	2,90	3,50	4,00	4,50	4,90	5,30	5,70
1,5	1,00	1,40	1,70	2,00	2,40	2,80	3,00	3,80	4,30	5,30	6,10				
2,0	1,80	2,50	3,10	3,60	4,40	5,00	5,60	6,90	7,90	9,70	11,20				
2,5	2,80	4,00	4,90	5,60	6,90	7,90	8,90	10,80	12,60	15,50	17,90				
3,0	4,50	6,30	7,80	9,00	11,00	12,60	14,10	17,50	20,00	24,00	28,00				

Fig. 4: Water flow depending on nozzle diameter and water pressure © www.stamm-showers.com

The specified flow rates apply to both high-pressure and low-pressure jet nozzles. The jet or fan angle is also negligible when determining the flow rate per nozzle. It's easy to see the water saving potential when using smaller nozzle diameter (see Fig. 4).

Nowadays, the most efficient needle jet is achieved with sapphire or ruby materials. Stainless steel is also widely used as a nozzle material and is somewhat cheaper. Ultimately, it's a cost/benefit question for the papermaker.
It's a sign of nozzle wear when the needle jet changes from laminar to turbulent. This is usually caused by contamination from the medium, wear from brushes (especially with stainless steel) or incorrect maintenance.

The oscillation

This leads on to another important aspect of felt conditioning: the correct oscillation of the high-pressure shower pipe. In order to reach every single point of the felt with a thin needle jet, the high-pressure shower must constantly traverse across the width. For the most homogenous deep clean to be effective, a single or multiple of the nozzle spacing should be selected as the stroke. The shower must not stand still at the turning points.

For uniform deep cleaning of the press felt, the correct setting of the oscillation speed v_{osc} of the high-pressure shower is required.

$$v_{osc}\ [\text{cm/min}] = \frac{\text{PM speed [m/min]}}{10} * \frac{\text{jet diameter [mm]}}{\text{clothing length [m]}}$$

The oscillation speed should be synchronised with the different production speeds of the paper machine. This is the only way to ensure optimal felt cleaning and a homogeneous moisture cross-profile during the entire production process.

The water quality

Central to the service life of the shower nozzles is the quality of water in use. Heimbach advises fresh water or alternatively super-clear filtrate. The aim is always to keep the amount of suspended particles introduced into the system via the water as low as possible. Otherwise, there is a risk that nozzles can become clogged or nozzle filters polluted. The water temperature should ideally be > 40 °C, which is not always possible.

The water pressure

As much as necessary, but as little as possible! The higher the pressure, the more the stress on the felt surface. Of course, finer fibres will have less resistance than coarser ones (Fig. 5). Overall, the felt should be treated under moderate pressure (up to 10 bar) over the first few days with the intensity then increased over clothing lifetime. For continuous HP cleaning, 25 bar should be regarded as the upper limit. For short periods, around 30 bar can be acceptable. Permanent operation at 30 bar pressure can lead to a rougher felt surface and finally to premature fiber loss (Fig. 6+7).

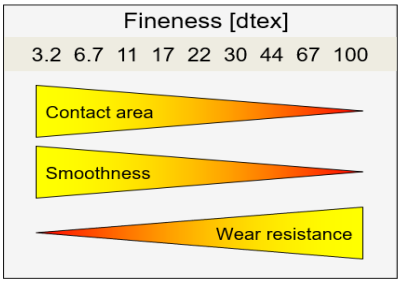


Fig. 5: Felt fiber properties

Fig. 6: Felt surface at 15 bar continuous operation

Fig. 7: Fiber stress at 30 bar significantly higher

Ultra-high pressure showers for even better felt life

The above specifications should not, however, be set in stone. This is because newly developed ultra-high pressure shower systems now promise new opportunities. We have now seen numerous positive results on packaging grades when using units with a nozzle diameter of 0,25 mm and a pressure of 50 to 160 bar. These two factors result in a significantly increased impact force of the jet on the press felt to be cleaned. Contaminations can be removed more easily in this way. This has not led to any noticeable decrease in felt wear, but has provided positive results in terms of cleaning – and fresh water consumption.

Low-pressure showers for lubrication

With its fan nozzles, a low-pressure shower will introduce large quantities of water to the felt. This keeps the felt moisturised throughout and provides a potent lubricating effect before the Uhle box. For this reason, low-pressure showers are used continuously and over the entire lifetime of the felt.

Uniform water application

For ideal low-pressure spray shower operation, we recommend that the following parameters are respected: Water should be applied from all fan nozzles with a slightly overlapping jet at a distance of 100 up to 150 mm maximum from the felt surface and at a slightly inclined angle to the direction of felt travel. The recommended nozzle distance is 150 mm. The lubricating water is applied at a pressure of approx. 3-5 bar, resulting in a water requirement of approx. 10 l/min/m felt width. Higher paper machine speeds require slightly more lubricating water.

If water is applied unevenly (Fig. 8+9), trouble can develop quite rapidly. First of all, moisture fluctuations will occur in the felt, which will be reflected in damp and dry areas (Fig. 10). The irregularities can be quickly picked up by measuring water content, or in many cases can be seen by the naked eye.

Fig. 8: Disturbed fan jet

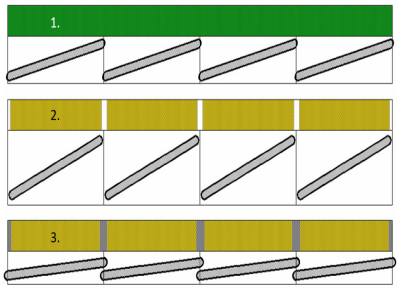
Fig. 9: Uneven water application

Fig. 10: Result: wet streaks in the felt

Wet/dry streaks such as these in the felt rapidly transfer to the sheet, leading to irregular cross direction moisture profiles.

Slightly overlapping fan jet

The graphic (Fig. 11) illustrates clearly the importance of an overlap of fan jets. Either no overlap, or too much, will cause irregularities in cross machine profiles.



1. Good profile 2. Dry streaks 3. Wet streaks

Fig. 11: Set-up of flat jet nozzles for an even application of water © PMS

Dry streaks can, in some cases, lead directly to increased felt wear (Fig. 12+13). This is due to a lack of lubrication and the resulting increased friction over the Uhle box cover. This then can be a cause of premature felt removal.

Fig. 12: Zonal felt wear visually identifially in the used felt

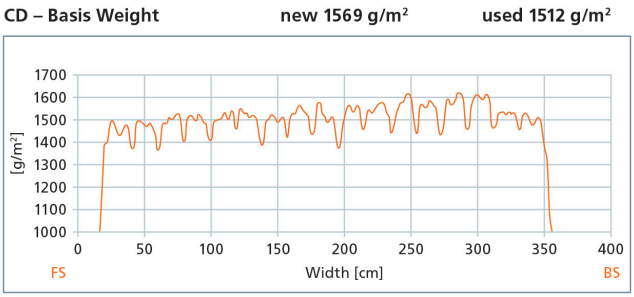


Fig. 13: Zonal felt wear recognizable in the basis weight profiles taken from the removed felt

Unlike the high-pressure shower, the low-pressure version does not oscillate. Clear filtrate water is generally used to pressurise the fan nozzles with water.

Low-pressure showers with fan nozzles are also used for lubrication of various doctors in the paper machine. Attention should also be paid to these showers, as they can indirectly have a negative impact on the moisture cross profiles in case they are poorly adjusted.

Uhle boxes for dewatering

Uhle boxes have the added task of indirectly dewatering the sheet via the press felts. Using vacuum, some of the water transported in the clothing is sucked away by the units. This means high stress for the felt, as it is in permanent contact with the Uhle box due to the set vacuum. We should also note that this happens at speeds up to 2,000 m/min. In this case, contact also means friction, which not infrequently leads to loss of batt from the felt.

Correct adjustment of the edge deckles

With the Uhle box, there is always a risk of adjustment errors which could cause the press felt to suffer premature wear, causing early removal from the paper machine. In one case, a felt had to suffer premature removal, as the whole of the fibre batt had been removed in the edge area (Fig. 14). This was due to incorrect setting and positioning of the edge deckles (Fig. 15).

These should ideally be aligned with the plastic or ceramic blades of the Uhle box. Otherwise, the felt rubs permanently against the edge of the raised deckles and as a result continuously wears away the fibre batt.

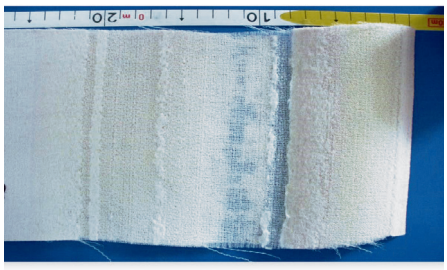


Fig. 14: Total loss of batt in the felt edge area

Fig. 15: Raised edge deckles on the Uhle box

Special care with seam felts

Heimbach often observes that edge deckles are not optimally set. Just as with the low-pressure shower units, a deficiency like this can lead to uneven moisture – this time in the sensitive edge area of the press felt. Slotted Uhle boxes usually work with two slots. The edge deckles of the slots should be slightly offset from each other and not set in the same alignment (Fig. 16).

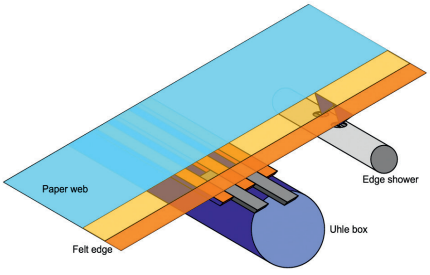


Fig. 16: Ideal edge deckle settings on Uhle box

Uneven moistening in front of the Uhle box, e.g. due to suboptimal installation of the edge deckles, is critical, especially when seam felts are used: Such fluctuations put a lot of stress on the MD yarns and seam loops. As a result there will be risk of seam opening (Fig. 17).

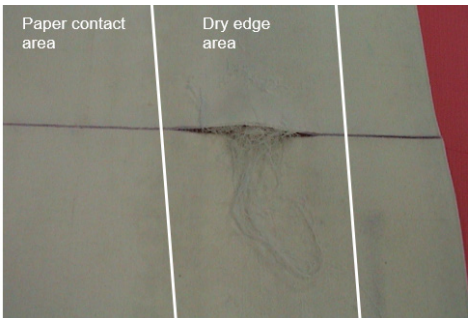


Fig. 17: Broken MD yarns in the sensitive felt edge area due to uneven moistening

In order to ensure good moistening of the sensitive paper contact area/felt edge area, separate edge showers are sometimes installed in front of the Uhle box. These showers have 2-4 nozzles and are operated if necessary.

Correct vaccum settings

There is no rule of thumb for the correct vacuum in a Uhle box. It can be stated, however, that higher vacuums generally lead to higher felt wear. This is one of the main reasons why Heimbach clearly favours nip dewatering at medium and high speeds. The total dwell time over two Uhle boxes, each with a slot width of 20 mm and a machine speed of 1500 m/min, is only 1.6 ms. This is a very short period of time. With nip dewatering, it's possible to run with a substantially reduced vacuum or even completely dispense with Uhle boxes. This reduces felt wear but also saves energy.

Replace worn, sharp-edged covers

It is important to ensure that nothing is deposed on the Uhle box cover that could lead to burn marks in the press felt. This can disturb the moisture cross-profile. Worn or sharp edged covers must be replaced as they can have a negative impact on felt service life. Particularly seam felts and their seam overlapping are endangered here.

Slotted or drilled Uhle box covers?

Slotted covers remain the standard here. Common slot widths are 15-20 mm. It is, however, true that drilled covers have become more popular. With this design the vacuum is applied through several rows of drilled holes instead of slots. An advantage of this design is the even felt support across the entire width. When using slotted Uhle box covers, there is a risk of sucking the felt into the slots at high vacuums. This risk does not exist with the hole pattern (Fig. 18). In many cases, the drilled Uhle box cover can be operated at a lower vacuum.
As clothing experts, we can certainly see the benefits of this cover design type: be it through reduced felt wear or improved cross profiles of felt and sheet.

Fig.: 18: Drilled Uhle box ©Valmet

Summary

Continuous felt conditioning is essential. It is the key to efficient production with long running times and maximum dewatering.

Do you have any questions or would you like more information?

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