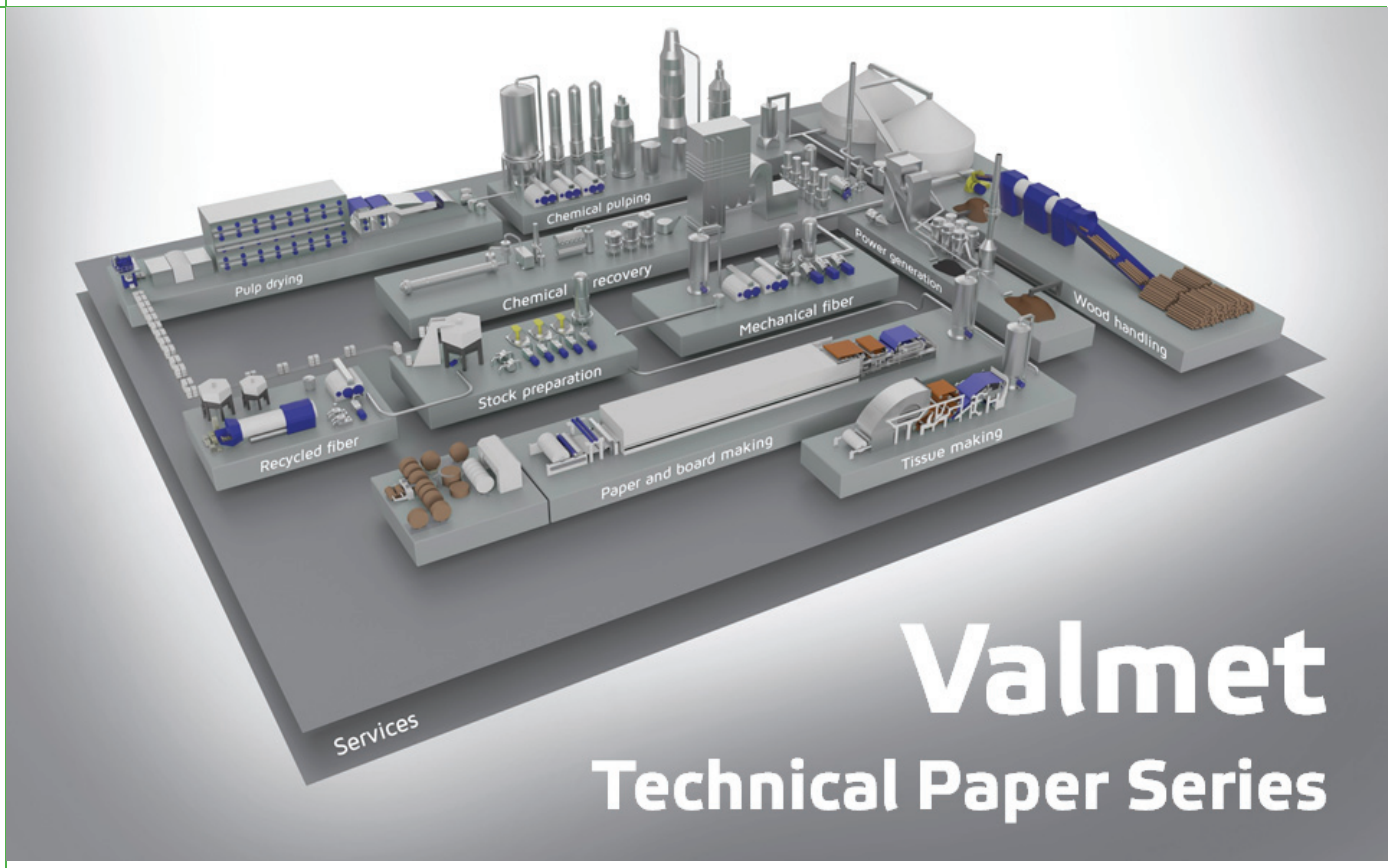


Practical Roll Techniques: Improving Cover Life

Executive Summary

Roll covers are expensive and recovering a roll requires that the roll be out of the mill for several weeks for replacement. Extending roll cycle time and following cover operating instructions can significantly improve operating costs.

Roll cover lifetime and performance are affected by many factors including operating parameters such as heat, load, and furnish. Cover material and its compatibility with the doctor blade material used also plays a part. Often, the overall condition of the machine or press plays the largest factor in the cost associated with roll covers. Even the best roll cover will not perform well if a holistic view of the application is not used.

This paper provides practical tips to extend roll cover life, starting with a rundown of common roll cover problems and methods used to avoid damage. The effects of heating, cooling, and doctoring on roll cover life are reviewed and recommendations are given. Finally, proper cleaning guidelines are summarized.

Common cover problems

In this section, we introduce several types of cover damage with their causes. There will be examples of each.

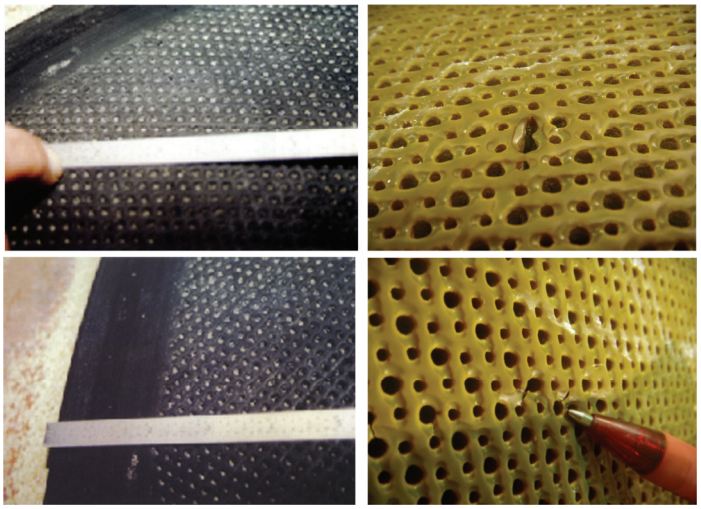


Figure 1 – Examples of chemical attack on roll covers

Chemical attack

Chemical attack can be defined as, "absorption of and/or reaction to, a chemical substance that alters the mechanical properties of a compound or roll cover." It can affect hardness, abrasive resistance, and actual chemical makeup of either the cover or the bonding system.

Very often, chemical damage may be visible. However, the images in **Figure 1** (left upper and lower) show a suction roll cover that has been exposed to a chemical attack for a prolonged period of time. In this case, it was chlorine and it resulted in severe softening of a polyurethane cover. The result was accelerated wear, seen as "hole-cupping," water absorption, and multiple lacerations. The lacerations are understandable as the cover could be cut with a fingernail.

Drilling or grooving a cover increases the surface that is exposed to paper making chemicals – this includes exposing the bond line at both the base layer to shell interface and the cover to base layer interface. This exposure takes place within the drilled holes themselves. As you might expect, the higher flux of chemicals through a suction roll increases the risk of chemical attack.

Cover hardness, or P&J, is often affected by chemicals. Softening often occurs, but sometimes it is realized as a hardening. Generally, if a cover softens, it is accompanied by swelling through absorption. Other evidence of chemical attack is an "oily or tacky" surface that can be both seen and felt. This often is observed with rubber or polyurethane covers that are exposed to ketone or kerosene in order to remove build up.

We invite Valmet roll service customers to have chemical suppliers submit samples of new or questionable chemicals for direct chemical testing with various Valmet cover samples. This testing is called immersion testing. Cover samples, or buttons, are submerged in the chemical at elevated temperatures to simulate the effects of long term exposure over a shorter time span.

Figure 2 – Examples of high pressure cleaning wand damage to roll covers

External shower damage

The pictures in **Figure 2** represent the damage that can result from the improper use of external cleaning high pressure handheld washers often used with suction

rolls. Damage can occur both in the machine with process showering or out of the machine when attempting to clean the suction roll shell or cover. Process showers should be oscillating needle-jet showers across the roll face in the cross-direction. The stroke typically varies based on shower spacing. Damage typically results from improper alignment, excessive water pressure, or both.

Occasionally this type of damage can result even with proper pressure and alignment. This would be the case if the cover were already softened through chemical attack. Note that the illustrated damage in **Figure 3** is directional. Or stated another way, the damage is on the same side of the through hole, consistently. This directionality is a strong clue that the damage is coming from a shower. Other strong clues could be consistent spacing and/or a spiral pattern.

Shower pressure is adequate if it keeps the cover surface clean of fines and debris. **Figure 3** shows an example of damage caused to a rubber covered roll due to an oscillating shower. In this example there were 54 bands of chewed up rubber, with each band being 6" wide. Coincidentally, there were 54 nozzles on the shower spray bar, which oscillated 6". After installing a pressure gauge it was found that the gauge was pinning at 100 psi, although the recommended spray pressure was only 20 psi. In the close-up image a band of damage can clearly be seen.

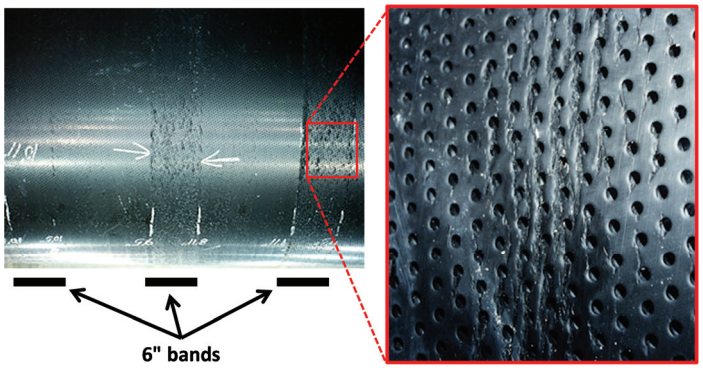


Figure 3 – Damaged caused to rubber covered roll due to excessive shower pressure

Suction holes often require that the internal cleaning showers be used during start up and shut down. Any time a machine is in crawl, the suction roll internal cleaning shower should be run. This improves roll cycle time, as well as process parameters such as draw and moisture profile. External shower coverage also requires attention. Often overlap is necessary to ensure coverage even with one nozzle that is plugged but it must be remembered that overlap doubles the exposure of the cover surface to pressurized water.

Proper shower alignment is also important. The proper angle for cleaning is 90°, i.e. perpendicular to a roll's tangent. Should a combination of issues be in play, such as chemical attack and improper shower angle or pressure, a cover's life span can be greatly reduced.

Finally, we must discuss roll cleaning during reconditioning of a roll. The safest way to clean a suction roll while it is being rebuilt is to not exceed the typical fire water pressure of 80 psi. High volumes of 80 psi water can clean a roll quite well. However, inevitably this will be followed up by someone using a pressure washer. This is not advisable. A high pressure washer can cut a soft roll in a matter of seconds. The wand must be on fan. The pressure must be at a minimum. The wand must neither move in the direction of the fan nor remain still.

Impact damage

Impact damage results when a cover is compressed violently due to semi-compressible or incompressible material passing through a loaded nip. The result is instantaneous localized overloading that generates

extreme pressure, heat and stress. Typical instances are sheet wraps, wads, hardware, tools, etc., that pass through the nip. Sometimes this damage is catastrophic and immediate, causing cover material to shatter, fragment, and melt. At the same time the base layer can crack and the bonding layer can fail. Often in this situation, it is not the damage that you see that is the real problem. It is the damage you don't see. It is commonplace for a damaged roll to be cleaned and returned to service only for it to fail on its next roll cycle.

Impact damage to rubber covers

Frequently, damage may be seen only as a slight indentation or imprinting of the roll cover. However, the cover must be inspected thoroughly to identify any cracking or, looseness and to be sure that the integrity of the base layer is intact. Sounding the cover in the area with a small hammer and potentially even using a stethoscope can expose the hollow sound of a loose cover. Sometimes, even this will not catch the damage with the right combination of a loud floor and a softer cover that has taken on water in the loose area.

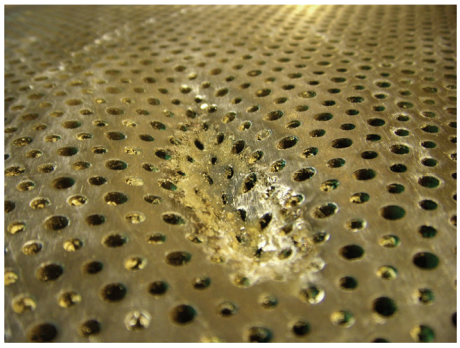


Figure 4 – Example of impact damage to rubber cover

With impact damage, there is always some sort of internal damage. Valmet recommends that the cover is uniformly ground at least .062" (1.6 mm) below visible damage. If the damage extends below the visible impact area then the amps on the grinder will jump as it hits the loose spot. If this is the case, the cover must be replaced. Feel free to consult your Valmet representatives with cover damage questions.

Impact damage to polyurethane covers

The 8 P&J grooved polyurethane cover shown in **Figure 5** has experienced pretty severe impact damage. In this case, being in the center of the roll it is a best guess that it came from pulling on a seamed wet felt. It can be seen that material has been lost through both friction and heat. The key to the loss in reliability is seen in the (right) picture where there is a gap developing between the top stock and the base layer. Here water will begin pumping into the bond layer eventually causing bond failure in a band. Any cover damage will worsen and expand with continued usage.

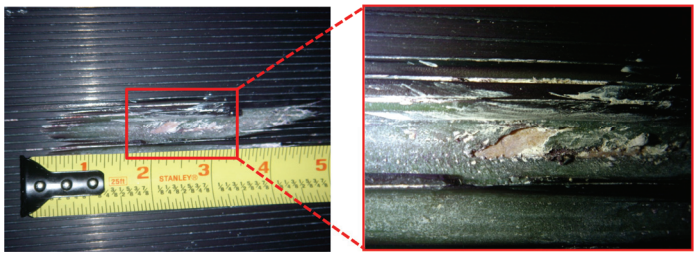


Figure 5 – Example of impact damage to polyurethane covers

Unlike rubber, polyurethane often does not show damage as readily. Sometimes cracks, wad damage, or overheating do not show up with immediate visible evidence. So this material must be inspected with some level of diligence. In the most obvious cases, such as a felt wrap, it will melt from the outside in or be severely worn. In this case, grooves and drilled holes can be filled with melted poly. The roll may clean up, but as mentioned previously regarding rubber it is the damage that is not seen that can be dangerous. Sometimes, impact damage can be seen as a bulging loose spot or even an indent.

Cover looseness is not always as easily detected as what is shown in these pictures. The two most frequently used methods are sounding the roll and gauging the amps while in a grinder. As with rubber, after a poly cover is damaged and serviced, there is no definite way to guarantee that it will run reliably on its next run cycle.

Impact damage to composite covers

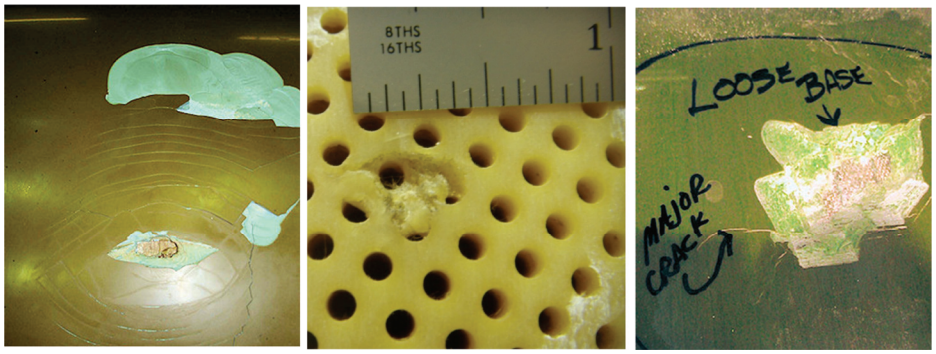


Figure 6 – Examples of impact damage to composite covers

Composite covers are the choice for the most demanding positions in the paper machine: calendar rolls, supercalender rolls and extended nip press sections. Damage (**Figure 6**) can result from impact of a wad or other debris passing through the high intensity nips. However, it cannot always be easily detected.

Figure 7 – Example of impact damage to ceramic roll

Some impact damage may be seen as only a slight indentation in the cover surface. A heavier impact may cause visible, circumferential cracking but severe impact could possibly cause catastrophic and immediate failure. Sufficient impact can cause sudden fracturing.

The continued use of this cover after damage will extend and deepen any damage. Friction between the fractured surfaces expands the cover from a third degree of freedom being added to the material as it goes through its nip or work cycles.

Often, the heat buildup internally causes material loss under the surface of the cover as the fractured area heats up, melts and seeps through the surface. During a cover cut off, this area will be darkened or even charred. Regular cover inspections along with nip monitoring devices (**Figure 8, left image**) can warn of such impact damage.

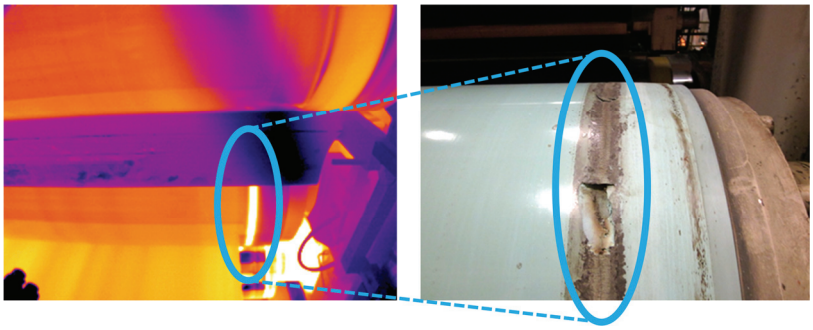


Figure 8 – Example of thermal spike on composite calender cover

In **Figure 8**, an example is shown of localized temperature spikes (left), causing thermal expansion on a composite calender cover. On the right is the resulting damage from the temperature spike near the end of the roll.

Local overload

Localized overloading of rubber covers

Severe localized overloading frequently results in damage similar to that shown in **Figure 9**. Although each case is unique, similar damage results from improper roll crowning, lack of adequate roll cover end relief (or dubbing) or failure of a hydraulically crowned roll.

Figure 9 – Examples of localized overloading of rubber covers

Remember that one crown amount is good for one, and only one, load. It follows that if the load in a given nip is increased without the necessary increase in crown, the result would be overload on the ends. By the same token, if the load were decreased without reducing crown, the roll cover would be overloaded in the center. The combination of proper crown and load is the only way to distribute the load evenly across the nip.

Although the length of time to failure varies with specific process conditions, the vehicle is uneven heat generation. Under normal nip conditions, heat is distributed evenly across the face length of the roll. When loads and crowns are not properly matched, the following mechanical sequence results in a cover failure:

- Overloading generates intense localized heat.
- This weakens the physical properties of the cover material and the bonding layer between the top stock and the base layer.
- Cover components react to the intense heat by swelling, softening, and/or delaminating as the cover layers begin to separate.
- Shell/cover or base/cover bond weakens to the point of failure.
- Cover partially or fully releases from the roll body.
- If caught it ends here but if not the heat generation and bond failure continues at an exponential rate until a catastrophic failure occurs.

As an OEM, Valmet can assist with nearly any roll loading or crowning questions.

Localized overloading of polyurethane covers

Similar to the preceding discussion around impact damage, the toughness of poly covers can temporarily conceal damage resulting from localized over loading of a nipped roll cover. The top left photograph in **Figure 10** (next page) illustrates cover surface cracking, but greater damage beneath the cover surface is seen only after partially removing the cover (bottom left image).

Localized overloading of typical polyurethanes follows a similar mechanical sequence as the rubber covers due to similarities in the way the bond layers work. In some extreme upset conditions, such as a press wreck, polyurethane can melt on the outside surface.

Figure 10 – Examples of localized overloading of polyurethane covers

Localized overloading is typically avoidable through proper end relief and crowning. Regular nip impressions provide the necessary information to verify that nips are even, or the nip impressions give proper direction for adjusting crowns if the nips are in an overload situation.

Localized overloading of composite covers

The dark circumferential bands of cross machine direction (CD) surface cracks that have appeared on this supercalender cover (**Figure 11**) are the result of prolonged localized overloading. Causes of this type of damage include:

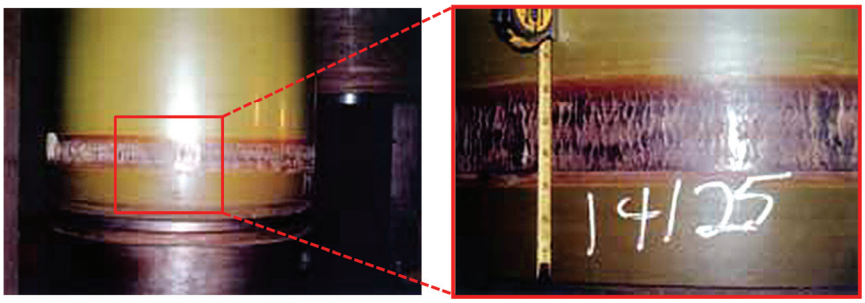


Figure 11 – Examples of localized overloading of composite covers

- Insufficient cover end relieving
- Unequal, or biased, loading of one end
- Inappropriate crowning of a profiling roll in the calendar stack
- Localized high temperature area in a heated intermediate roll

The Valmet composite cover is designed to withstand the high pressure of the supercalender, soft nip calendar and other demanding positions but typically it is the variation in the pressure across the nip that causes problems. Valmet recommends that the pressure in the nip varies by no more that 4% from one end to the other. A drawing for recommended composite roll cover dubbing is available from your Valmet representative.

Hole plugging

Blind drilled press roll covers remove water most effectively when the cover surface is ground on an adequate schedule, when the holes are sufficiently deep and when they are clean. It is common knowledge that cover damage can result when grinding is not appropriate. However, considerable roll cover damage can also result from operating a blind drilled cover with holes that have become filled with dirt, debris or fines.

The material in the plugged holes (**Figure 12**) becomes solid columns of dirt, PCC or fines. While passing through the nip, cover deflection is temporarily and severely altered as a result of attempted compression of this solid material. Unusual expansion of the blind drilled holes in the nip causes heat, hole deformation, accelerated cover wear, and eventually, hole-to-hole cracking and/or total cover failure.

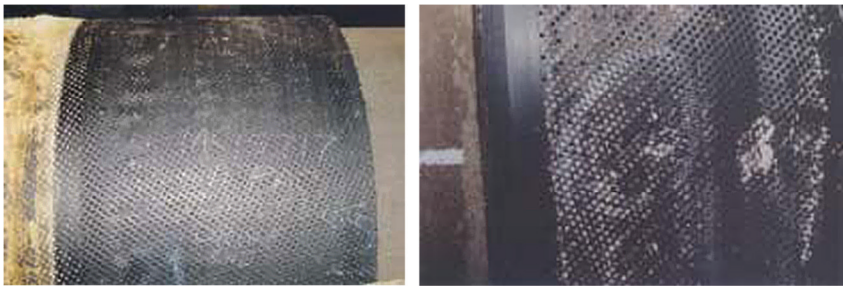


Figure 12 – Examples of hole plugging in drilled press roll covers

As discussed earlier with shower damage, normal practice to clean blind drilled hole covers is to use high pressure water. A lot of care must be taken; the safest method is to use high volumes of fire water, which usually does not exceed 80 psi. If a high pressure washer must be used, do it with extreme care, maintaining the lowest pressure setting with a fan nozzle and make sure that the nozzle does not sit still or move in a direction parallel to the fan. It is very easy to cut a soft cover with a high pressure shower.

Figure 13 – Example of longitudinal corrugation (barring) of roll cover

CD corrugations (barring)

Cross machine corrugation, also known as barring, is illustrated in **Figure 13**. The cause for the barring to the composite calender roll shown in the figure was a CC roll hydraulic pump which had a 1.3 second pulsation.

The initial cause of barring is vibration that can originate from a number of sources, including, but not limited to:

- Eccentricity (out-of-roundness) of a cover, roll core, bearing fit, head fit, etc.
- Impact or cover wear damage that has flattened or worn one particular part of a cover
- Leaving a doctor oscillator in run and the doctor loaded on a soft cover while the machine is down
- MD sheet variation (or corrugations) can excite equipment further down the machine (**Figure 14**).
- Unacceptable roll balance
- Flooding the water cooling system

Figure 14 – Example of MD sheet variation that can excite equipment downstream

- Weakened or loose machine frame
- Loading a press roll while the roll is the in the stop mode. This includes forgetting to unload a press after conducting nip impressions.

Barring can often be observed while the roll is still in operation, if it is bad enough. However, in the beginning stages it is helpful to chalk the roll cover to make it stand out. In many cases, the diameter of the cover, the barring pattern, and the machine speed can help pin point the source of the vibrations.

Many observers stop at the thought that barring is a surface defect. Nothing could be further from the truth. The cover, especially if it is soft, will have memory of the pattern well below where the surface appears to have regained its profile. When the cover develops this type of cover compression memory, it is called, "taking a set." If enough of the cover is not removed during a grind, the barring pattern will return even if the root cause vibration has been eliminated. So grinding a roll with barring becomes extremely important; extra cover must be removed to prevent the return of the corrugations. The amount of material removal needed is cover material dependent. Therefore, check with your Valmet service representative for further details on how much cover should be ground in a barring situation.

End lifting / shell corrosion

The roll cover edges on either end are the areas most exposed to potential damage. This includes normal damage per previous discussions but also exposure to the process environment.

All sorts of precautions are taken to limit damage to the ends of the cover: proper crowning, end relief (or dubbing), placing a radius on a roll ground flat, and even shell construction techniques that prevent water from getting to the interior of the roll bond. Yet the chemicals, heat, and moisture of the process still cause bond deterioration at the edges as seen in **Figure 15**.

Figure 15 – Example of end lifting of rubber cover (left) and shell corrosion of a roll cover (right)

Critical thick shelled press rolls are often grooved near the shell ends so that the cover/shell interface forms a "water stop." Should there be cover lifting, anything between the shell and the cover is stopped at this point from going farther into the interior of the cover/shell interface.

Historically, thinner shelled felt and wire return rolls do not have the stops. For this reason, during machine outages these rolls should be inspected at both ends. As wire tension increases on multi-layer forming wires, roll deflection increases greater than original design. For this reason, in some cases we have added water stops to help with end lifting problems on forming fabric return rolls.

Damage from handling

Figure 16 – Examples of roll cover damage which occurred during handling

Often roll covers are replaced as a result of improper storage or handling rather than through normal wear in a paper machine. Accidental damage (**Figure 16**) can be caused by haste, carelessness or a lack of understanding proper roll handling practices. Valmet provides operation and maintenance handbooks with all of its new roll covers. Following these instructions and exercising appropriate caution is a must when moving rolls. This is for the safety of employees, as well as protecting a roll cover investment.

Figure 16 shows two examples or roll damage during handling. In the left example, although the pictured roll body was moved slowly into place, the roll cover was damaged from bumping the framework during a roll installation. The mass of the roll body caused the bone hard base layer to fracture when it contacted the framework. This relatively small area of damage compromised the integrity of the entire cover. In many cases, this can result in a cover replacement. The example shown on the right in **Figure 16** is of a ceramic roll sent to the roll shop to be ground and polished. The damage shown in the figure occurred while the mill was removing the roll from the paper machine. As a result, the roll had to be recovered.

Figure 17 – Damage may occur due to improper packaging during transport.

It's important to protect your roll cover investment during shipment. After carefully removing a roll, shipping it in an inadequate container will negate your investment. **Figure 17** shows an example of a shipping box used by a mill to ship a $100,000 pressure roll cover to a Valmet roll shop for refinishing. When the roll was received at the roll shop the saddle was cracked, boards were broken, cross-members were loose and there was trash on the bottom of the box that had rubbed against the press roll during transport.

Your Valmet representative can provide instruction and technical bulletins or arrange training concerning roll maintenance, storage, and handling.

Cover damage control

Web breaks, wads or foreign objects passing through a nipped press cannot always be avoided; hopefully through following standard operations and diligent housekeeping they can be minimized. If during a web break, the paper wraps one of the rolls, it is likely that the covers experience several impact events or wad burns. Wads and foreign objects passing through two nipped rolls can also dramatically damage the cover

or its bond layer. Polymeric stiffness is a strain rate dependent phenomenon. So the structural integrity may be severely damaged by sudden dramatic increases in stress. After a press or calender wreck, it is recommended that a thorough visual inspection of the cover should be performed. No cover should be allowed to continue in operation for an extended period of time after a wreck. As soon as possible, it should be removed, serviced, and ground to guarantee that it has not been permanently damaged.

Because residual stresses are persistent in rubber and polyurethane covers, if not noticed and attended immediately, rupture type damage will likely grow over time. To slow down or prevent damage from growing, blunt or round the ends of the crack. This can be done by using a hand sander or a Dremel tool. After removal from the machine, any regrind or service work should be taken care of as soon as possible. It is important to grind off enough cover thickness to reach the good, undamaged cover underneath. At that point, remove at least an additional .060" from the radial cover thickness. Ensure all of the damage has been removed!

WARNING:

Running a damaged roll cover is a severe risk in terms of reliability and safety.

Thermal monitoring

In recent years, thermal imaging cameras and infrared pyrometers are being used to monitor various production operations, including the stability or integrity of roll covers. Regular monitoring of the cross machine surface temperature profile is a recommended practice. Isolated changes in that profile, such as localized hot spots or isolated hot bands, will be an indication of an upcoming cover failure. It could also indicate some change in the process that is adversely affecting the cover or potentially even paper quality.

When changes in cover hardness or cover configuration are being considered for an operation, the data obtained from the regular monitoring of the cover surface temperature can be inserted into a predictive maintenance program, flagging major differences from previous bench marks. Or the data can be inserted into predictive modeling programs used by Valmet to make sure that critical cover or bond interface temperatures have not been reached. If there are questions concerning maximum temperature thresholds of your cover contact your Valmet representative for more information. **Appendix A** shows an example of a thermal spike on a roll cover as it would appear in a Valmet roll cover audit report.

Steaming

Polyurethane and rubber covers will swell, change hardness, and rapidly deteriorate when exposed to steam improperly. When considering the use of a steam box or a steam shower, as a precaution, check with your roll cover supplier to ensure that any roll covers being used in conjunction with, or in the vicinity of the steam source are adequately resistant to steam exposure, and to review operating procedures for the steam box or steam shower.

It is important to emphasize that the use of a steam shower will not only have effect on operations, but also on each of the roll covers being used in conjunction with, or in the vicinity of the steam source. It

raises the paper and the ambient temperatures. Roll covers, even those downstream of the steam box, may need to be monitored more closely and even possibly be reground more often due to accelerated aging affects.

Rolls installed near a steam source should have inspections that include changes in surface conditions including hardness and crown on a scheduled basis. This is especially true after original installation of a steam box. If a steam shower is to be used it may require a cover which is more heat resistant. This could include a change in cover compound or hardness.

When using a steam shower, you can institute prudent procedures to maximize the life of the roll covers being used and maximize your production. Some general guidelines to follow are:

- Take steps to ensure that the steam shower never impinges directly on any roll cover surface.
- Avoid application of steam outside the sheet width. Do not allow the steam to impinge directly on the felt or the roll ends.
- Avoid applying steam in a highly localized area or bandwidth. Doing so may cause a corresponding localized thermal expansion in covers. Cover failures can result!
- In the event of a web break, shut off the steam immediately.
- During start-up and shutdown, avoid practices that can cause thermal shock of the roll covers. This is a very important consideration near non-felted center roll positions and composite calender rolls. For example, never spray cold water onto a roll cover surface that is hot from recent steam exposure.
- If the rolls are not turning, ensure the steam shower is shut off. If necessary, install appropriate interlock controls to guarantee this.

The following are some additional guidelines for use of a steam box with a covered suction roll:

- Steam should never blow directly into the suction through holes.
- Steam showers should not be used on suction rolls when the vacuum is not in use or the felt is not in place.
- A low pressure, lubricating shower may be applied in front of the primary doctor outside of the end deckle to cool the cover and prevent excessive thermal expansion outside of the sheet run. It helps prevent wear in the dub.
- Adjust the steam box application width or deckle 1.5-2.0" narrower than the sheet width.
- When necessary, the steam flow to the edge blocks must be restricted as well, to even out the temperature.
- Adapt the linear load combinations according to the roll crowning by using the desuperheater or cooling system.
- Drop the temperature of the incoming steam down to 248-257 °F.
- The ideal starting point for the suction roll dubbing is at the web edge. In practice, the dubs usually start 0.5-1.0" outside the web edge, leaving some room for deckle adjustment with the trim squirts.
- The properties of a roll cover change due to chemical reactions, and the change is accelerated by temperature increases. To increase the service life of a roll cover, let the roll dry at ambient temperature (above freezing) protected from sunlight between normal service intervals. This,

accompanied by proper grinding procedures, should help remove chemicals absorbed during service cycles.

- Understand that any history of chemical attack to a suction roll cover will be accelerated by a steam box.
- It is recommended that the steam consumption be limited to 500kg/h per meter in width.
- Keep the suction roll internal lubrication shower functional.
- Dark spots in the cover indicate:
    - the use of unsuitable chemical
    - uneven linear pressure
    - the temperature has risen in that CD position, or
    - CD position has been exposed to impact or overload from the process.
- The adjustable vacuum deckles should be moved to a point in line with the sheet edge (vacuum should not extend beyond the edge of the sheet) (**Figure 18**). This is to prevent this suction roll from pulling steam through the felt and into the cover. Steam passing through the sheet condenses and the latent heat is transferred to the sheet only.

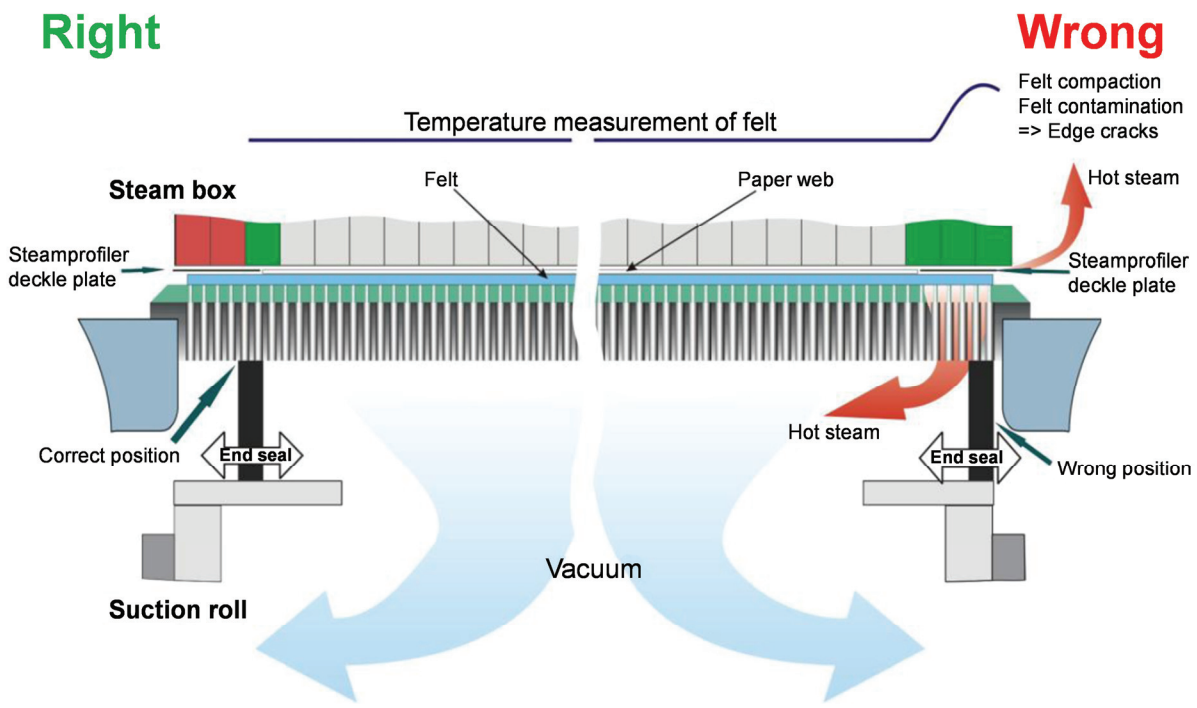


Figure 18 – Position of deckle plates and end seal

Figure 18 shows the correct positioning of deckle plates on the steam box, as well as the correct positioning of edge deckles in a suction roll.

Following are some additional guidelines for use of steam boxes with a PressJade ceramic center roll:

- PressJade covers are hard and retain the hardness during temperature changes. It is recommended to keep the temperature below 200 °F.
- PressJade cover materials do not generate heat through work load or hysteresis.
- PressJade covers do not tolerate sudden temperature changes. Therefore, when the cover is near a steam box use care with water. See notes concerning hot roll covers and dryer cans being exposed to cold water.
- When the steam box is in operation, it is recommended that the center roll surface, and other press rolls in the nip cluster around the steam box, be monitored with an IR camera as part of a predictive or preventive maintenance program.

Roll cooling

Covered rolls operating in nipped positions will generate heat. The internal structural friction that occurs within the cover as it works, deforming in the nip, generates heat. If the operating environment, speed, web and load are severe enough and do not have the proper heat exchange or flux, cover temperatures can run away exponentially.

Because bond line strengths and cover physical properties tend to be weaker at elevated temperatures, if working temperatures are not controlled reduction in cover cycle time or cover life will occur. In more extreme cases, cover failure will occur. To control the heat flux from a cover generating heat, cooling water can be circulated through the shell. This is called internal water cooling.

With the introduction of polyurethane, the need for water cooling has been reduced. However, at certain temperatures, speeds and loads it is still necessary. Effective water cooling can increase roll cycle time and overall life time. Cooling also prevents or reduces thermal crowning, keeping the load profile more uniform, and also producing more uniform moisture profiles.

Parameters for water cooling

A good water cooling system, when applicable, improves your process and prevents unwanted reliability and quality issues. However, it is important to remember that colder is not always better. The minimum inlet temperature for rubber is 95 °F (35 °C). The inlet water temperature should be within 20 °F of the sheet temperature (process temperature). The recommended maximum outlet temperature should not exceed 150 °F (65 °C).

Most presses run around 120 – 140 °F (49-60 °C). In some cases where steam boxes are used this temperature can increase to 150 °F (65 °C) or higher. In these cases, where process temperature is intentionally increased, if water cooling is also used, the project is not complete until the cooling water temperature is increased also. If this is not done, then the ΔT will induce mass transport of water vapor to cover bond lines and it will condense there, either at the base layer or the shell interface.

Water permeation

This condensation is commonly known as water permeation and it results in a worm-like pattern of looseness between two layers of the cover. This pattern comes from the trapped water being forced in one

direction over and over again through the nip. With excessive temperature differences between the cooling water and the process, this accelerates, causing premature cover failures.

Water permeation can be observed in some cases on the surface of the cover and MD cracking in the roll cover. Often, they are seen as the cover dries in preparation for grinding. If proper cooling water guidelines are followed, then cover lifespan, performance, and sheet quality will increase accordingly.

Predictive models require accurate data

Through the years, advances have been made in the study of nip dynamics and heat generation in the nip. This has led to the development of predictive models, capable of providing estimations of stresses and heat generation within a cover through finite element analysis on the specific cover. It is only as accurate as the information provided, however, so care must be taken to use accurate process data. Valmet has developed a tool called NipSim which can accurately determine the need for cooling water in specific applications.

The NipSim tool is also used in the development process. Today, cover compositions are designed to withstand higher loads, temperatures, and speeds than covers developed even five to six years ago. As a result, in some applications water cooling may not be needed. Whether or not a cover requires cooling water is not a sales tool but a physical fact. It is both cover- and process-related. Although Valmet can assist you in determining whether cooling can be removed, remember that if cooling is needed, it is needed for process and product quality, as well as the cover.

As always, guidelines are general in nature and do not substitute for proper monitoring of the process. Tracking process data assists with accurate heat and load calculations. It also assists with determining proper cooling water flow and inlet temperature. Keeping accurate process data not only helps with roll cover related issues but it also helps recognize process changes, or process upsets.

Doctoring of roll covers

Doctoring of rolls can have a significant impact on the number of breaks, a direct correlation with efficiency, but it can also impact roll cover cycle time and life span. With the right choice of blades and proper setup, doctoring can assist in improving reliability and availability.

Valmet's doctor blade service includes a full range of doctor blade types, including new blade materials with exceptional wear resistance. Doctor blade materials compatible with each Valmet roll cover, including proper setup instructions, can be determined by consulting your Valmet roll cover brochure or by reviewing the data sheet for a specific cover. Recommended Valmet doctor blades for Valmet roll covers are shown in **Appendix B**. Additional information on doctoring can be found in other Valmet white papers, including *'Doctoring 101'* and *'Doctor Blades'*.

A few keys to doctoring success are:

- Use the material and angle recommended in the Valmet cover brochure or data sheet.
- Monitor doctor blade wear and understand that angle changes significantly with wear.
- Keep the doctor blade clean. Good housekeeping reduces damage to roll covers and improves runnability. Make sure doctors are cleaned out with a water hose from the drive side, as well as the tending side.

- While a machine is down, unload the doctor blade from covered rolls. This is especially important if the doctor oscillates and the cover is soft.
- Always inspect a blade when it is removed from a working roll position. Uneven wear indicates some sort of problem. (See Blade Troubleshooting Chart in *'Doctor Blades'* white paper.)
- Always inspect the holder during a doctor change on a working roll. Make sure it is clean, nothing is loose and that no part of it is contacting the roll.
- Once the new blade is installed, make sure the loading is even by either tapping the edge to make sure it is loaded, or looking for light between the roll and the blade, or both.
- Run the blade load per manufacturer's instructions. If holder, roll, or blade design is changed there is a good chance that design load or angle will also change.

Cleaning rolls during production

Manual on-machine cleaning

If a roll cover is nipped and rotating, it is dangerous to attempt manual cleaning of the roll surface. If contamination is observed on a roll cover and manual cleaning is the only alternative, the machine should be stopped and the nip opened. Only after the roll has stopped rotating should cleaning be attempted.

Because some chemical cleaning solutions can damage a cover (depending on compatibility), their use is not recommended without first consulting with the cover manufacturer. Normal cleaning should be done using plain, warm water. Warm soap solutions may also be used. Do not use steam to clean a cover surface. The direct use of steam can cause thermal shock, resulting in cover damage.

If contemplating the use of a chemical cleaner consult with your Valmet representative before proceeding. Because the bond line and bonding interfaces can be directly exposed to chemical attack, the use of chemical cleaners to clean out suction roll holes is not recommended. If used correctly, there are some acid, alkaline and non-chlorinated hydrocarbon cleaners that can be used to manually clean the surface of roll covers. For example, with rubber covers, deinked pulp fouling can be removed with aromatic hydrocarbons such as toluene. However on some other cover types, such as ceramics, long term exposure to this type of chemical can damage the cover. Generally speaking, the use of chlorinated hydrocarbons is a bad idea for most cover types.

Under all circumstances, it is important to remember before exposing a cover to chemicals that it is very important to check with your Valmet representative concerning compatibility. It is also important to remember to minimize exposure to the chemical and thoroughly flush with water when cleaning is complete. Remember the discussion earlier about thermal shock. A hot cover should not be rinsed with cold water.

When using chemical cleaners, be sure to follow the manufacturer's handling practices and use the proper PPE. Be sure to read the operation instructions and the Material Safety Data Sheet for handling and disposal practices.

Remember, the safest way to clean a cover is with water. For manual cleaning of grooved and / or drilled roll covers high pressure water can be used. The safest on-machine method is with firewater. It flows in high volumes but is generally 80 psi or less.

In some cases where plugging is severe, high pressure washers may be used. Valmet suggests that this practice is best completed at one of our roll service centers, as we use standardized procedures. However, sometimes cleaning a roll in the machine is the only option for emergency situations. In these situations here are some keys to remember for rubber and polyurethane covers:

- Set the high pressure washer on minimum pressure setting.
- Place the nozzle on fan.
- Never let the wand sit still in one place; keep it moving or you will cut the cover.
- Maintain at least 4-5" between the wand tip and the cover surface or you will cut the cover.
- Take frequent breaks and observe your work to inspect for potential damage.

If you are using a high pressure on-machine shower to clean a roll surface, remember the earlier section on high pressure shower damage to covers. Make sure that the shower is oscillating. Never run the high pressure cleaning shower if the roll is not at least at crawl speed (>250 fpm). It is always best to start cautiously. Start by reducing the shower pressure using the distributed control system (or manual valve if necessary). Also, just like using the high pressure washer mentioned above, take frequent breaks to make sure you are not damaging the cover.

Hand drill cleaning of a drilled cover

Hand drilling is not a recommended method for cleaning drilled covers. It is extremely labor intensive and it is a practice that most personnel are not trained to do. Therefore, it is subject to many uncontrollable variables. It is also extremely risky. Damage to the cover is probable. One of the forms of pressure washing discussed previously is preferable. If water cleaning does not work, then drill cleaning the roll at one of your Valmet roll service centers is recommended.

Off-machine cleaning

In general, the same practices and precautions must be followed off-machine as were discussed for on-machine cleaning. For cleaning suction rolls, the safest method is drill cleaning in the drill rig at one of Valmet's roll service centers.

Typically, it is not recommended to use high pressure water on a suction roll shell from the inside diameter if the roll is covered with rubber or polyurethane. Excessive pressure applied from the inside of a suction shell can damage the bond line of a cover. In some cases, a rotary jet can be used successfully but the process must be monitored closely and the pressure should be kept to that of mill water, i.e. <=100 psi.

Cleaning hard coated rolls

Hard coatings do not set any extra limitations on overall machine or clothing cleaning practices. Before beginning wet the roll - and then keep it wet during the process. The roll or dryer cylinder must be cooled below 122 °F (50 °C) before the cleaning or rinsing process begins. Also, make sure any cleaning process is followed by a flushing / rinsing sequence.

For in-place cleaning of a ceramic roll reference the on-site cleaning procedure described in the *'Practical Roll Techniques - Grinding and Balancing'* white paper.

DryOnyx Z and GuideOnyx Z coatings can be washed using the following cleaning agents:

- Neutral pH washing detergents and soaps
- Aqueous solutions with modified surface active agents; Max. hydrocarbon concentration is 2%.

Do not use the following cleaning methods or agents with DryOnyx Z or GuideOnyx Z coatings:

- High pressure washing
- Steam washing
- Chlorinated hydrocarbons; saturated or unsaturated
- Volatile alcohols or esters
- Ketones
- Turpentine
- Acid solutions under 2 pH
- Basic solutions over 11 pH

The surface of the roll has to be free of grease, oil or any other impurities, therefore the surface must be cleaned with suitable solvents that do not leave a film on the roll surface. On hard coatings other than DryOnyx Z or Guide Onyx Z, denatured alcohol (ethylene), or acetone can be used. Always complete the cleaning by completely flushing the roll surface with water.

Do not use petroleum, which may leave the surface oily, and do not scratch the cover with any sharp, hard material. Before mounting the roll in the machine, ensure the surface is clean. Stickies or other impurities such as adhesives may be removed using a thin scraper tool without applying excessive pressure. Take extra care not to score the surface.

Five basic rules to improve cover performance

For optimum performance and maximum roll cycle time:

1. **Keep the cover clean.**

   Contamination on the cover surface increases the local nip load at that point or cross directional position in the cover. This will eventually cause damage to the cover or cause quality problems with the sheet.

2. **Avoid high roll operating temperatures.**

   For most rubber or polyurethane covers, the ideal maximum surface temperature should not exceed 158 °F (70 °C). Valmet does offer covers that can withstand significantly higher temperatures. For these applications, consult your Valmet representative.

3. **Monitor the roll cover surface temperature.**

   Localized hot spots or hot bands may indicate operational changes or potential cover failure. Determining baseline temperatures and recognizing significant changes from baseline can save money by improving reliability and quality.

4. **Regularly check cover crown profile.**

   A cover can look good visually but may actually be wearing irregularly. Regular checks of the crown on service intervals can aid in determining the appropriate cycle time in the machine. Once the bench mark has been established it can be used to troubleshoot operations.

5. **Avoid process upsets and other causes of impact damage.**

   In a situation which causes a felt to wreck or paper to wrap, it is dangerous to continue operations. Remove a damaged cover from service. It is probable that a cover damaged from the outside also sustained some sort of internal or bond line damage. Even if the cover appears OK, running a roll cover which sustained internal damage could cause a major reliability incident later.

Summary

Operational excellence can only be achieved with careful attention to extending the life of wear items, including roll covers. Longer roll cover lifetimes require the ability to recognize and avoid damage.

Roll cover damage is most often the result of improper handling, process upsets, or chemical incompatibility. Damage may also be the result of decisions made with respect to running covers in certain process conditions such as excessive heat, poor roll cooling practices, incorrect cleaning, or inappropriate doctoring. Following recommended operational practices and referencing this white paper can minimize these problems.

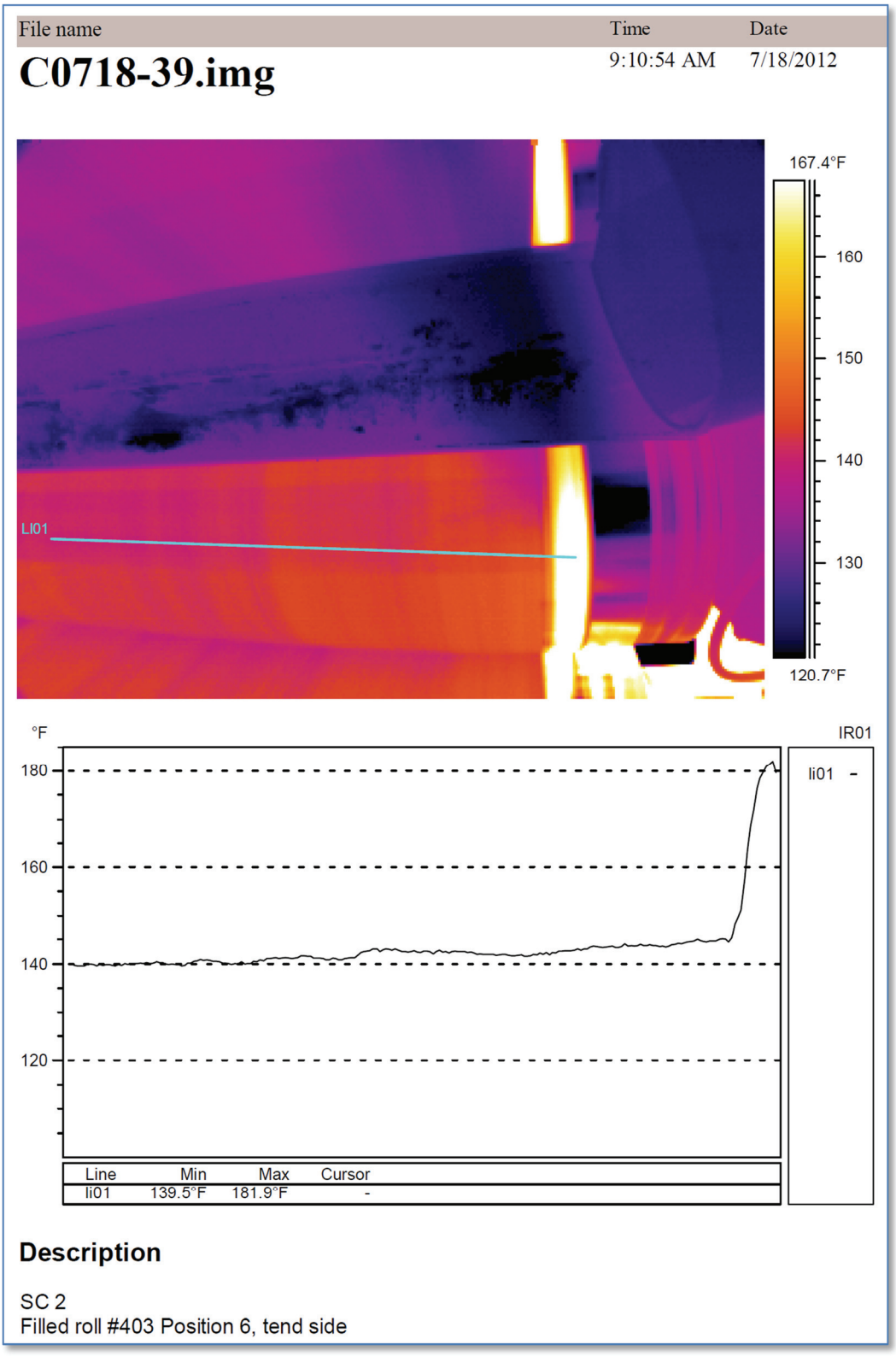
This white paper combines technical information obtained from Valmet personnel and published Valmet articles and papers.

Valmet provides competitive technologies and services to the pulp, energy and paper industries. Valmet's pulp, paper and power professionals specialize in processes, machinery, equipment, services, paper machine clothing and filter fabrics. Our offering and experience cover the entire process life cycle including new production lines, rebuilds and services.

We are committed to moving our customers' performance forward.

Appendix A – Example Page from Valmet Roll Cover Audit Report

Example shows how thermal imaging was used to locate a hotspot on a composite calender roll.



Appendix B – Doctor Recommendations for Valmet roll covers

		Blade Product Families														
		No Doctor	ValPoly	ValPoly Black	ValDual	ValGlass	ValCar COMBI	ValEco	ValRx	ValDur	ValEco T	ValSteel	ValBrite HT		Key	
														R	R - Rubber	
														P	P - Polyurethane	
														C	C - Composite	
														HC	HC - Hard / Ceramic Coating	
														GS	GS - Grooved Stainless Steel	
	Cover	● = primary, o = optional												Blade Angle	Min/Max PLI	Comments
C	Blue BelTex®					o		●	o					19	0.3/0.6	25 Degrees with metal blades
C	Caljaguar™							●	o					19	0.3/0.6	Standard ValEco blades (4.1 or 10.1) in high temp./high wear situations. Seldom metal blades (19 deg. max.). Minimize doctor use.
C	Caljaguar™ H							●	o					19	0.3/0.6	Standard ValEco blades (4.1 or 10.1) in high temp./high wear situations. Seldom metal blades (19 deg. max.). Minimize doctor use.
HC	CalOpal™							●	o					26	0.85/1.7	ValEco 4.1 or ValEco 10.1, also ValEco T4 condition blade may be used. ValZone sheet take-off position with larger blade angle.
C	CalPanther™							●	o					19	0.3/0.6	Standard ValEco blades (4.1 or 10.1) in high temp./high wear situations. Seldom metal blades (19 deg. max.). Minimize doctor use.
C	CalPanther™ H							●	o					19	0.3/0.6	Standard ValEco blades (4.1 or 10.1) in high temp./high wear situations. Seldom metal blades (19 deg. max.). Minimize doctor use.
C	CalPanther™ S							●	o					19	0.3/0.6	Standard ValEco blades (4.1 or 10.1) in high temp./high wear situations. Seldom metal blades (19 deg. max.). Minimize doctor use.
P	CalPuma™		●	●										20	0.4/0.6	Avoid Metal Blades
R	CoteEagle™	●														On Blade Coater steel blades are used
R	CoteEagle™ Z	●														On Blade Coater steel blades are used
R	CoteEagle™ ZL	●														On Blade Coater steel blades are used
P	CoteFalcon™	●														Doctors not used on sizers
R	CouchRite	●														
R	CouchRite II	●														
R	DriveShark™ Z		●	●										20	0.3/0.6	
R	DriveShark™ Z S		●	●										20	0.3/0.6	
HC	DryOnyx™ Z							●	o		o			23,27	0.5/1.4	Start-up blade ValEco 10.1, running blade ValEco 4.1, no epoxy containing or metal blades.
R	Flexibos™ HT		●	●										20	0.5/0.8	
GS	G-Cover™					o	o	●						25	0.5/0.8	Never use metal blades, do not oscillate
HC	G-Mate™ Z						o	●	o					25	0.5/0.8	Never use metal blades, do not oscillate
R	GreenGranite®						o	o	●					25	1.2/1.7	
C	GuideColt CG™							●	o					25	0.5/0.8	
C	GuideColt G™							●	o					25	0.5/0.8	Do not oscillate
C	GuideColt™							●	o					25	0.5/0.8	
R	GuideMustang™					●	o	●	o					25	0.5/0.8	ValGlass should be used unless wear dictates ValRx
R	GuideMustang™ CG					●	o	●	o					25	0.5/0.8	ValGlass should be used unless wear dictates ValRx
R	GuideMustang™ G					●	o	●	o					25	0.5/0.8	ValGlass should be used unless wear dictates ValRx, do not oscillate
R	GuideMustang™ W	●														
HC	GuideOnyx™ Z						o	●	o					22	0.5/1.1	Start-up blade ValEco 10.1, no epoxy containing or metal blades.
R	HyCoe®		●	●										25	0.3/0.6	
R	HyCoe® 5000		●	●										25	0.3/0.6	
R	HyCoe® 5000 S		●	●										25	0.3/0.6	
R	HyCoe® S		●	●										25	0.3/0.6	
R	Jet Roc® G					●			o					25	0.5/0.8	ValGlass should be used unless wear dictates ValRx, do not oscillate
R	JetRoc®					●			o					25	0.5/0.8	ValGlass should be used unless wear dictates ValRx
R	JetRoc® CG					●			o					25	0.5/0.8	ValGlass should be used unless wear dictates ValRx
R	JetRoc® W	●														
P	PressBear™		o	o	●	o	o	o						20	0.5/0.8	
P	PressBear™ BD		o	o	●	o	o	o						20	0.5/0.8	Do not oscillate
P	PressBear™ G		o	o	●	o	o	o						20	0.5/0.8	Do not oscillate
P	PressBear™ S		o	o	●	o	o	o						20	0.5/0.8	Do not oscillate
P	PressFox™		o	o	●	o	o	o						20	0.5/0.8	
P	PressFox™ BD		o	o	●	o	o	o						20	0.5/0.8	Do not oscillate
P	PressFox™ G		o	o	●	o	o	o						20	0.5/0.8	Do not oscillate

Appendix B – Doctor Recommendations for Valmet roll covers (cont.)

		Blade Product Families														Key	
		No Doctor	ValPoly	ValPoly Black	ValDual	ValGlass	ValCar COMBI	ValEco	ValRx	ValDur	ValEco T	ValSteel	ValBrite HT			R	R - Rubber
																P	P - Polyurethane
																C	C - Composite
																HC	HC - Hard / Ceramic Coating
																GS	GS - Grooved Stainless Steel
	Cover	● = primary, o = optional												Blade Angle	Min/Max PLI	Comments	
HC	PressJade™ D						o	●	o	o	o			29	1.7/2.3	ValEco T only for secondary blade, check correct showers	
HC	PressJade™ F						o	●	o	o	o			29	1.7/2.3	ValEco T only for secondary blade, WC coated steel blade may used	
HC	PressJade™ W						o	●	o	o	o			29	1.7/2.3	ValEco T only for secondary blade, WC coated steel blade may used	
R	PressMaster® 5000		●	●										20	0.5/0.8		
R	PressMaster® II		●	●										20	0.5/0.8		
R	PressOtter™	●															
P	PressOtter™ U	●															
C	PressRhino™						o	●	o					26	1.1/2.3		
R	PressTaurus™		●	●	o									20	0.5/0.8		
R	PressTaurus™ BD		●	●	o									20	0.5/0.8		
R	PressWolf™ ZL		●	●										20	0.3/0.5		
R	PressWolf™ ZL BD		●	●										20	0.3/0.5		
R	PressWolf™ ZL S		●	●										20	0.3/0.5		
R	RayFlex® 5000	●														normally no doctor	
R	RayFlex® II	●														normally no doctor	
R	RayLease II™	●														normally no doctor	
R	RayLease III	●														normally no doctor	
R	RayLease IV™	●														normally no doctor	
R	RayRoc®						o	●	o					25	1.2/1.7	On sizing no doctoring	
R	RayRoc® II				●	●								25	1.2/1.7	On sizing no doctoring	
R	RealSeal				●	●										Use air doctor only	
R	SelfSkinner®		●	●										20	0.3/0.5	Doctor only if necessary	
R	SelfSkinner® 5000		●	●										20	0.3/0.5	Doctor only if necessary	
R	SelfSkinner® II		●	●										20	0.3/0.5	Doctor only if necessary	
HC	SizeGem	●					o	o	o					29	1.1/2.2	Usually not doctored	
R	SizeHawk ZL	●														Usually not doctored	
C	SizeRhino	●														Usually not doctored	
P	SpoolMate™	●															
C	Summit Series™							●	o					20	0.3/0.6	Standard ValEco blades (4.1 or 10.1) in high temp./high wear situations. Seldom metal blades (19 deg. max.). Minimize doctor use.	
C	Supertex Series™							●	o					20	0.3/0.6	Standard ValEco blades (4.1 or 10.1) in high temp./high wear situations. Seldom metal blades (19 deg. max.). Minimize doctor use.	
HC	TracMate™	●															
R	T-Roc Special™					●	o		o					25	0.5/0.8	ValGlass should be used unless wear dictates ValRx	
HC	TuffMate		●	●												Usually foil doctored for press section	
P	VacuFox™ S		●	●	o									20	0.5/0.8	Oscillation not necessary, foil doctor press alternative	
R	VacuTaurus		●	●	o									20	0.5/0.8	Do not oscillate	
C	VenTex®							●	o					25	0.5/0.8	Oscillation not necessary	
R	VentSure®					o	o	●	o					25	0.5/0.8		
R	VentSure® II					o	o	●	o					25	0.5/0.8		
R	WelPress®		●	●										20	0.5/0.8	Do not oscillate	
R	WelPress® 5000		●	●	o									20	0.5/0.8	Do not oscillate	
C	WelPress® ENP C						o	●	o					25	0.5/0.8	Do not oscillate	
R	WelPress® II		●	●	o									20	0.5/0.8	Do not oscillate	
P	WinGazelle	●															
R	X-Press®		●	●										20	0.5/0.8	Do not oscillate	
R	X-Press® 5000		●	●										20	0.5/0.8	Do not oscillate	
C	X-Press® C							●	o					25	0.5/0.8	Do not oscillate	
R	X-Press® II		●	●										20	0.5/0.8	Do not oscillate	