

Cleaning and Conditioning

Tissue Machine Fabrics



Increase tissue machine efficiency and improve machine hygiene and moisture profile.

Forming Section

Forming fabric cleaning system – M-clean

The M-clean™ forming fabric cleaning system traverses on a beam across the width of the tissue machine forming fabric. Intensified (high-pressure) water flows with the objective of imparting enough energy to remove contaminants that are adhered to the fabric. The M-clean forming fabric cleaning system is an efficient and effective tool for removing stickies thereby minimizing down time to chemically or manually wash the fabric. Water can also be saved with the use of full width HP showers.

Sheet knock-off – Shower 1

Showers used to remove the tissue sheet and/or fiber transferred from the sheet onto the fabric. Flushing away easy-to-remove contaminants using medium-pressure, high-volume showers.

Inside high pressure – Shower 2

An oscillating, high-pressure, needle jet shower located on the inside of the run displaces difficult-to-remove contaminants from the void volume of the fabric and is most often operated intermittently. The flooded nip cleaning shower (6) may be an application alternate.

Sheet side high pressure – Shower 3

An oscillating, high-pressure, needle jet shower installed on the fabric sheet side. Removing fiber and contaminants, it is recommended to be operated continuously.

Running Void Volume

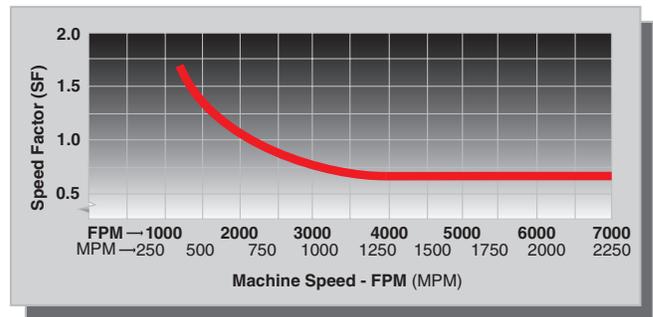
$$RVV \text{ GPM} = \frac{C \times W \times S \times V}{19.25}$$

$$RVV \text{ LPM} = C \times W \times S \times V$$
 Where
 C = Caliper of Fabric (inches/mm) W = Fabric Width (inches/m)
 S = Fabric Speed (FPM/MPM) V = Fabric Void Factor (use 0.6)

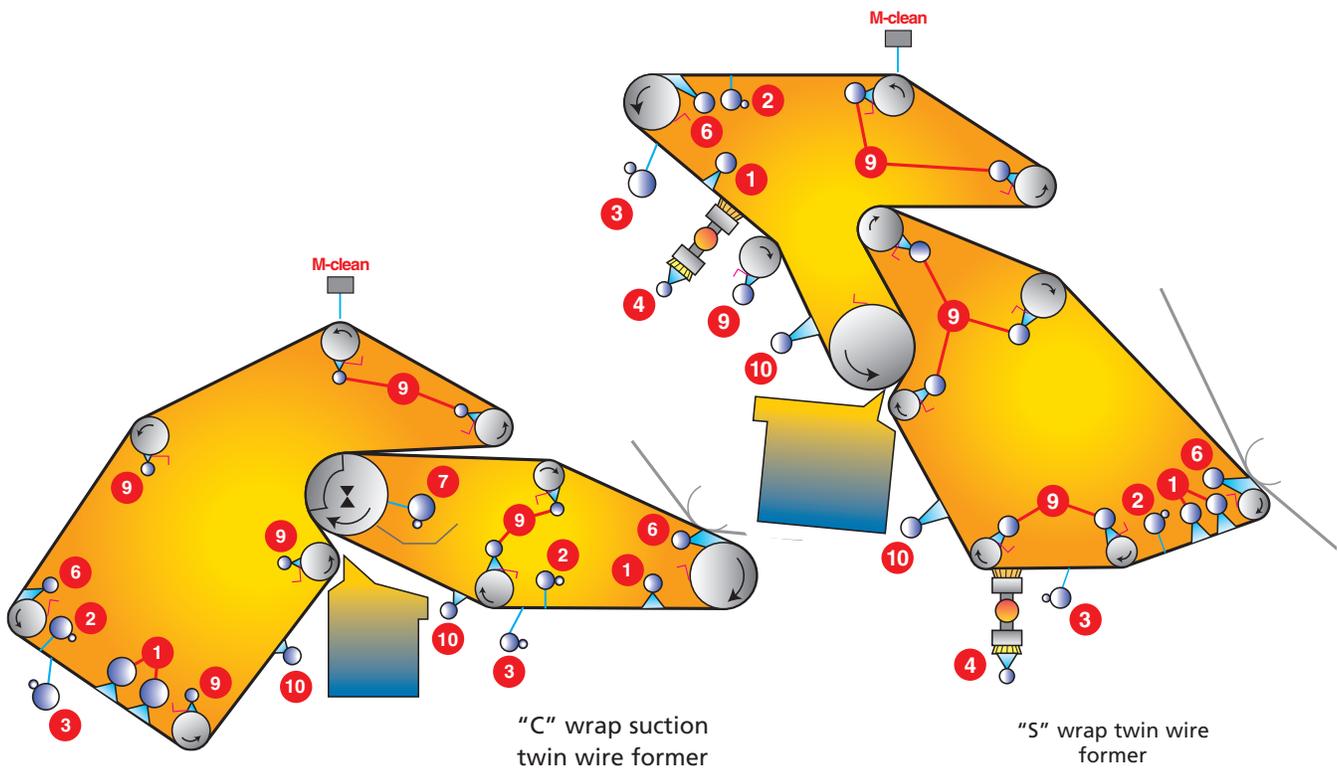
Flooded Nip Shower Flow

$$KO \text{ GPM} = RVV \text{ GPM} \times SF$$

$$KO \text{ LPM} = RVV \text{ LPM} \times SF$$
 Where SF = Speed Factor from Graph 1



Graph 1



Shower Applications

Fabric Brush cleaning Assembly – Shower 4

Most contaminants have been removed from the fabric after shower treatment. In more difficult cleaning applications, such as those with a furnish containing high amounts of recycled fiber, a brush is used as a final cleaning device. Shower (4) cleans the contamination from the brush after it is rotated away from the fabric.

Breast Roll-Apron – Shower 5

The breast roll cleaning shower carries water up over the apron of the headbox to prevent build-up.

Flooded Nip – Shower 6

Used primarily on higher speed twin wire machines with multi-layer fabrics. It is installed to direct water flow into the nip between the roll and the fabric, resulting in more uniform water distribution and greater hydraulic forces—enhancing fiber and contaminant removal. It can be used alone or with shower (1), depending on the type and amount of contamination. The formulas shown on page 2 can be used to calculate the volume of water required.

Suction Pressure Roll – Shower 7

An oscillating, needle jet shower applied to machines where a suction pressure roll is used as a sheet dewatering device. It cleans the roll shell holes ensuring uniform CD vacuum.

Headbox – Shower 8

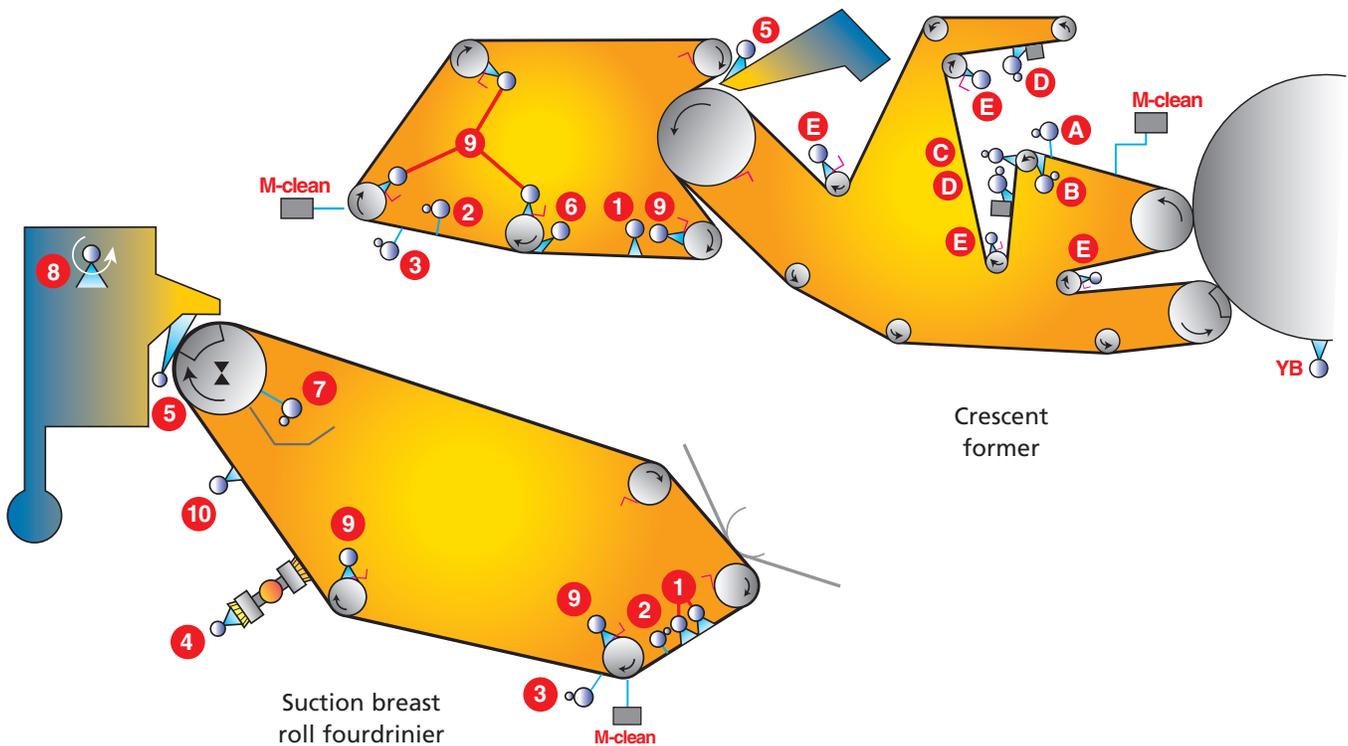
A rotating headbox shower that breaks down foam and prevents stock build-up on the headbox sides. Not used in hydraulic type headboxes, it is required only for “air pad” pressurized type headboxes.

Doctor Lubrication – Shower 9

Provides water to suspend contaminants transferred from the fabric onto the fabric return roll. Suspended contaminants are more easily removed by the doctor. The water film also lubricates between the doctor blade and the roll.

Chemical/Treatment – Shower 10

Chemicals and fabric treatments are applied to the fabric sheet side just before the headbox. This shower provides a means to add the treatments uniformly across the fabric at very low flow rates.



See pages 6 and 7 for press section showers.

Tissue Forming Fabric

Tissue machines typically have shorter fabric lengths than machines used to manufacture publishing and brown grades of paper. They also run considerably faster. As a result, their forming fabrics can quickly become contaminated, requiring a specialized cleaning and conditioning strategy. Additional showers are needed for greater water volume and, in extreme cases, a brush may be used to remove stickies and contaminants that are not water soluble. There are several types of forming designs now being used to manufacture tissue products and, although machine configurations may differ, a successful fabric cleaning and conditioning strategy is similar for each design.

Showers

The illustration on pages 2 and 3 show a "C" wrap twin wire former, an "S" wrap twin wire former, a suction breast roll fourdrinier, and a crescent former. In each configuration, the showers are identified with a number or letter relating to shower application descriptions and Table 1 technical specifications.

Oscillation

For uniform coverage and prevention of fabric streaking, Kadant offers a family of electromechanical oscillators designed to advance one nozzle impact width per fabric revolution and reverse instantly to minimize dwell time.

High-Pressure Showers

The High-Pressure Shower (HPS) is the most critical shower in the forming section. Extensive research and experience lends an understanding of how showers clean forming fabrics with minimum damage. High-pressure shower jet nozzles must be kept clean, open, and provide uniform fabric coverage.

Graph 2 relates the fabric cleaning effect versus the distance from the nozzle to the forming fabric. Graph 3 contrasts the nozzle distance with the time to damage the fabric. Graph 4 emphasizes the fact that high shower pressures can damage fabrics faster than lower pressures.

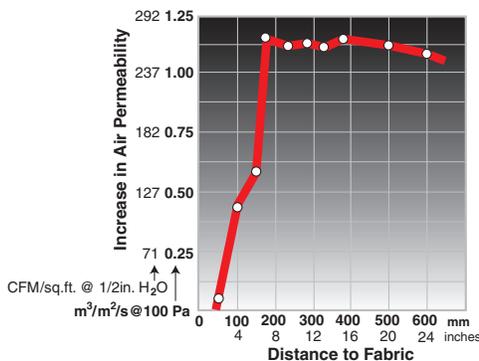
To optimize cleaning and minimize fabric damage, consider these steps:

- ◆ Use sheet side HPS's continuously and inside HPS's intermittently
- ◆ Use 0.040 inch (1 mm) needle jet nozzles
- ◆ Locate nozzles 4 to 8 inches (100 to 200 mm) from the fabric with jets impinging 0 to 15° into the run
- ◆ Match oscillator speed with fabric length and speed
- ◆ Do not exceed 425 psi (3 MPa) water pressure in a regular full width shower

GRAPH 2

Conditions:

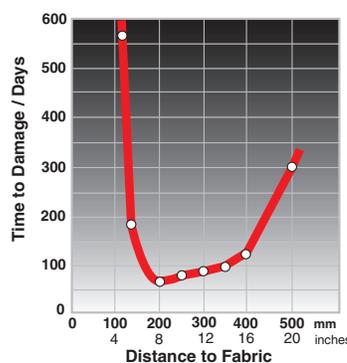
Nozzle Diameter - 0.040 in. (1 mm)
 Pressure - 435 psi (3 MPa)
 Jet - Against Sheet Side
 Time - 30 minutes



GRAPH 3

Conditions:

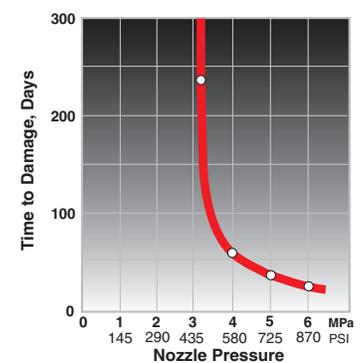
Nozzle Diameter - 0.040 in. (1 mm)
 Pressure - 725 PSI (5 MPa)
 Jet - Against Sheet Side



GRAPH 4

Conditions:

Nozzle Diameter - 0.040 in. (1 mm)
 Jet - Against Sheet Side



Replacing a full width shower with a transversal shower has been shown to be the most effective way to save energy by reducing water consumption. It also cleans the fabric better.

Forming Section Showers

TABLE 1

Shower Location	Application	Function	Shower Type	Nozzle Spacing	Operating Pressure	Flow GPM/in. (LPM/cm)	*Nozzle Size	*Distance to Fabric
1	Fiber/sheet knock-off	Fiber/sheet knock-off	Stationary 45° fan	3" (75 mm)	200–400 psi (1.4–2.8 MPa)	1.0–2.0 GPM/in (1.5–3.0 LPM/cm)	0.125" (3.2 mm)	4" (100 mm)
2	Inside high pressure	Fabric cleaning	Oscillating needle jet	3" (75 mm)	250–400 psi (1.7–2.8 MPa)	0.18–0.23 GPM/in (0.27–0.35 LPM/cm)	0.040" (1.0 mm)	4"–6" (100–150 mm)
3	Side sheet high pressure	Fabric cleaning	Oscillating needle jet	3" (75 mm)	250–400 psi (1.7–2.8 MPa)	0.18–0.23 GPM/in (0.27–0.35 LPM/cm)	0.040" (1.0 mm)	4"–8" (100–200 mm)
4	Brush cleaning	Brush cleaning	Stationary 45° fan	3" (75 mm)	60–80 psi (0.4–0.6 MPa)	0.87–1.0 GPM/in (1.3–1.5 LPM/cm)	0.125" (3.2 mm)	4" (100 mm)
5	Breast roll apron	Headbox and apron cleaning	Stationary 45° fan	6" (150 mm)	30–40 psi (0.2–0.3 MPa)	0.06–0.07 GPM/in (0.9–1.0 LPM/cm)	0.055" (1.4 mm)	8" (200 mm)
6	Flooded nip	Knock-off cleaning	Stationary 30° fan	3" (75 mm)	80–150 psi (0.6–1.0 MPa)	Calculate R.V.V. See Formula	0.188" (4.8 mm)	12" (300 mm)
7	Suction roll	Cleaning	Oscillating needle jet	3" (75 mm)	350–600 psi (2.4–4.1 MPa)	0.21–0.25 GPM/in (0.31–0.38 LPM/cm)	0.040" (1.0 mm)	4" (100 mm)
8	Headbox	Foam killing & prevention of stock build-up	Rotating 90° fan	10" (250 mm)	20–40 psi (0.1–0.3 MPa)	0.04–0.05 GPM/in (0.06–0.08 LPM/cm)	0.055" (1.4 mm)	X
9	Doctor lubrication	Doctor lubrication	Stationary 45° fan	6"–8" (150–200 mm)	25–30 psi (0.17–0.20 MPa)	0.07–0.09 GPM/in (0.11–0.14 LPM/cm)	0.055" (1.4 mm)	8" (200 mm)
10	Chemical treatment	Chemical application	Stationary 45° fan	6" (150 mm)	40–60 psi (0.3–0.4 MPa)	0.07–0.09 GPM/in (0.11–0.14 LPM/cm)	0.055" (1.4 mm)	8" (200 mm)
A	Sheet side high pressure	Fabric cleaning	Oscillating needle jet	6" (150 mm)	150–300 psi (1.0–2.0 MPa)	0.06–0.07 GPM/in (0.09–1.05 LPM/cm)	0.040" (1.0 mm)	4"–8" (100–200 mm)
B	Flooding	Flood & chemical application	Oscillating 45° fan	3" (75 mm)	40–60 psi (0.3–0.4 MPa)	Must be calculated. See text.	0.090" (2.3 mm)	4" (100 mm)
C	Sheet side chisel	Fabric cleaning	Oscillating 15° fan	3" (75 mm)	200–300 psi (1.4–2.0 MPa)	0.18–0.23 GPM/in (0.27–0.35 LPM/cm)	0.040"-15° (1.0 mm-15°)	4" (100 mm)
D	Suction pipe lubrication	Wear surface seal & lube	Oscillating 45° fan	6"–8" (150–200 mm)	25–30 psi (0.17–0.20 MPa)	0.07–0.09 GPM/in (0.11–0.14 LPM/cm)	0.055" (1.4 mm)	8" (200 mm)
E	Doctor lubrication	Doctor lubrication	Stationary 45° fan	6"–8" (150–200 mm)	25–30 psi (0.17–0.20 MPa)	0.07–0.09 GPM/in (0.11–0.14 LPM/cm)	0.055" (1.4 mm)	8" (200 mm)
YB	Yankee spray boom	Additive application	Double tube	Please consult our application engineering group.				
M-clean	M-clean cleaning system	Water saving, spot cleaning, & stickies removal	Please consult our application engineering group.					

* Data is for reference only. Dimensions may vary as machine requirements dictate.

Shower Applications – Press Section

Sheet side high pressure – Shower **A**

An oscillating high-pressure needle jet shower located on the face side of the press fabric, recommended for continuous operation to remove contaminants from fabric surface in conjunction with the uhle box. The M-clean cleaning system is an alternate choice.

Flooding – Shower **B**

A fan shower used for wetting and chemical application. For long dwell, it is recommended to be located as close to the pressure roll nip and as far away from the fabric suction pipe as possible. By locating this shower on the inside of the fabric, directed into the roll nip, the resultant hydraulic force causes the water and chemical to penetrate into the base of the fabric.

The total volume of water applied is 0.1 pound of water per pound of fabric (0.1 gram water per gram fabric). Since the volume of the lube and high-pressure showers is constant, they are added together and subtracted from the calculated value. The difference represents the flow for which the flooding showers should be designed. See Table 2 for an example calculation.

High-pressure fan – Shower **C**

An oscillating shower with 15° fan nozzles rather than jet nozzles. It chisels contaminants from the face of the fabric after they've been loosened by shower (A). It is typically installed 4" to 6" (100 to 150 mm) from the sprayed surface and angled 15° against the direction of run with operating pressures of 200 to 300 psi (1.4 to 2.0 MPa).

Suction pipe lubrication – Shower **D**

A fan shower providing lubrication between the fabric and the wear surface of the suction pipes. The water layer also creates a seal between the fabric and suction pipe resulting in more uniform vacuum distribution.

Doctor lubrication – Shower **E**

A stationary fan shower providing water to suspend contaminants transferred from the press fabric to the roll where they are removed by a doctor. The water film also lubricates between the doctor blade and roll.

Yankee boom shower – Shower **YB**

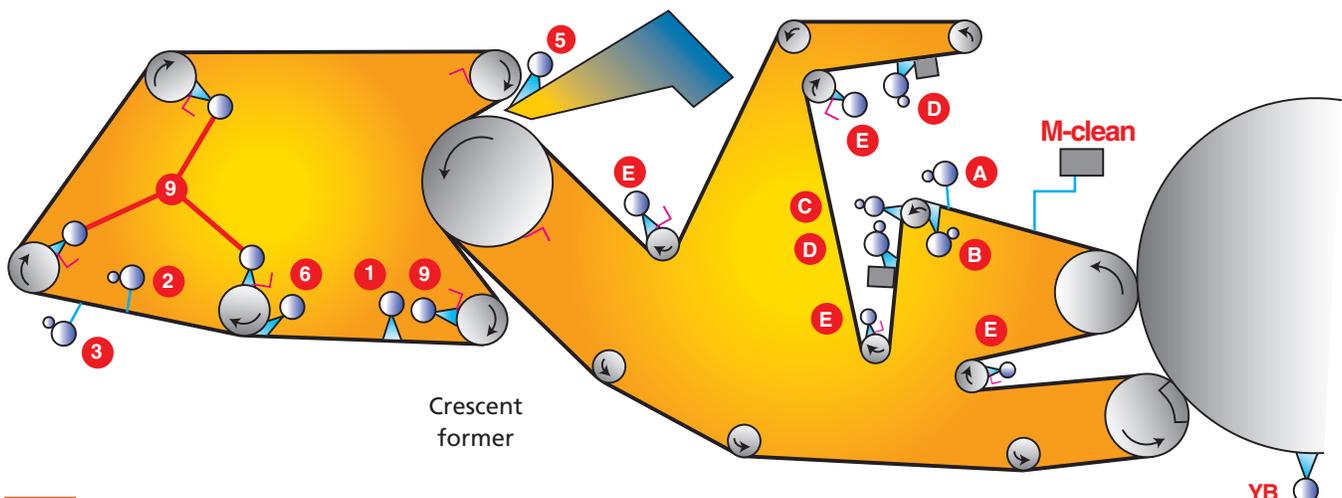
Kadant designs and manufactures these double-tube showers to the individual mill's specifications.

Press fabric cleaning system – M-clean

An M-clean cleaning system used to keep the proper conditioning of the felt in conjunction with the uhle box. Can also be used to replace the shower (A) if water consumption is an issue. Programmable for spot cleaning.

Total Flow Rate =
$C \times \text{Fabric Width (inches)} \times \text{Fabric Weight (oz/ft}^2) \times \text{Speed (FPM)}$
Where
$C = 0.000063$
1 meter = 39.37 inches
1 GSM = 0.00328 oz/ft ²
1 meter/min. = 3.281 FPM
1 liter/min. = 0.2642 US GSM
Flooded Nip Flow =
Total Flow minus (Lube showers +HP Needle +HP Fan)
Example
Calculate Flooded Nip Shower flow for a 222" wide, 4.5 oz/ft ² fabric at 6000 fpm:
1. Total Flow = $0.000063 \times 222" \times 4.5 \times 6000 = 378$ US GSM (1430 LPM)
2. Suction Pipe Lube Flow = 0.05 GPM $\times 222" = 11$ GPM
3. HP Needle Flow = 0.50 GPM per nozzle $\times 36$ nozzles = 18 GPM
4. HP Fan Flow = 0.61 GPM per nozzle $\times 73$ nozzles = 45 GPM
5. Flooded Nip Flow = $378 - (11+11+18+45) = 293$ US GSM (1109 LPM)

Table 2



Press Section Showers

TABLE 3

Shower Location	Application	Function	Shower Type	Oscillation	Nozzle Spacing	Operating Pressure PSI (MPa)	Flow GPM/in. (LPM/cm)	*Nozzle Size	*Distance to Fabric
A	Sheet side high pressure	Sheet side cleaning	Needle Jet	Yes	6" (150 mm)	100–250 psi (0.7–1.7 MPa)	0.06–0.07 GPM/in. (0.09–1.05 LPM/cm)	0.040" (1.0 mm)	4"–6" (100–150 mm)
B	Flooding	Felt wetting chemical application	Fan	Optional	3"–6" (75–150 mm)	40–60 psi (0.3–0.4 MPa)	Must be calculated	0.055"–0.093" (1.4–2.36 mm)	3"–6" (75–150 mm)
C	High-pressure fan	Chisel	15° Fan	Yes	3" (75 mm)	200–350 psi (1.4–2.4 MPa)	0.18–0.23 GPM/in. (0.27–0.35 LPM/cm)	0.040"–0.055" (1.0–1.4 mm)	4"–6" (100–150 mm)
D	Uhle pipe lube shower	Wear surface lubrication & sealing	15° Fan	Optional	6"–8" (150–200 mm)	20–30 psi (0.15–0.2 MPa)	0.18–0.23 GPM/in. (0.27–0.35 LPM/cm)	0.070"–0.107" (1.8–2.72 mm)	6"–9" (150–225 mm)
E	Doctor lube shower	Doctor blade lubrication	Fan	No	6"–8" (150–200 mm)	30–40 psi (0.2–0.3 MPa)	0.05–0.07 GPM/in. (0.075–0.105 LPM/cm)	0.070"–0.141" (1.8–3.6 mm)	6"–9" (150–225 mm)
ALT.	Pick-up lube shower	Pick-up lubrication	Fan	No	6" (150 mm)	30–40 psi (0.2–0.3 MPa)	0.07–0.10 GPM/in. (0.105–0.150 LPM/cm)	0.107"–0.141" (2.72–3.6 mm)	6"–9" (150–225 mm)
YB	Yankee spray boom shower	Yankee coating	Please consult our application engineering group.						
M-clean	M-clean cleaning system	Water saving & spot cleaning	Please consult our application engineering group.						

* Dimensions are for reference only. Dimensions may vary as machine requirements dictate.



Press Section Chemical Cleaning

A Cleaning Strategy for Recycled Fiber

The increased use of recycled fiber results in greater amounts of contaminant getting into the process. Because of their nature, these contaminants are more difficult to remove than contaminants associated with virgin fiber. Therefore, it is important to adopt a cleaning strategy that involves all components discussed in this document. All cleaning and conditioning systems must be used on a continuous basis starting when the press fabric is new.

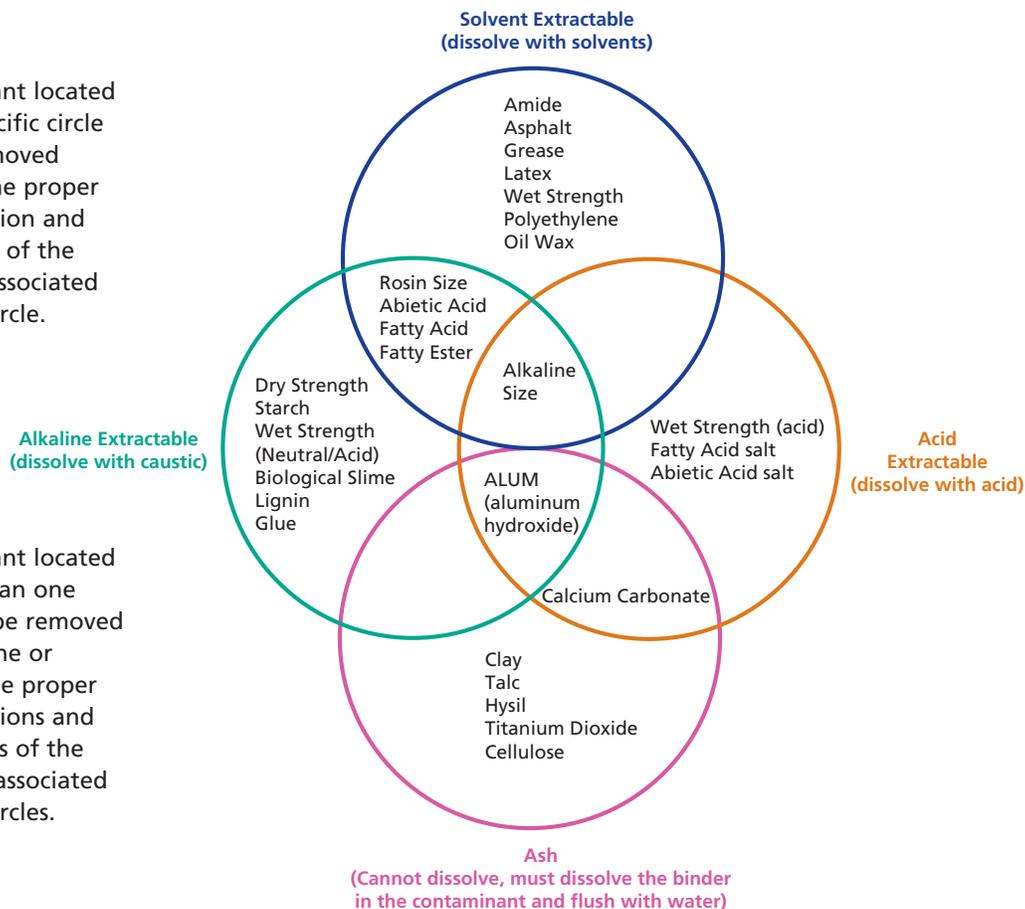
In addition, when running recycled fiber, it is important to include chemicals in the cleaning and conditioning strategy. Different chemicals are available for different types of contaminants and cleaning problems. Caution must be exercised in choosing a chemical to prevent an unfavorable reaction with other chemicals in the process.

Developing A Chemical Felt Cleaning Strategy

1. Identify the contaminants that need to be removed or prevented from building up
 - Understand chemicals and contaminants coming into the system
 - Obtain used fabric analysis to determine contaminants
 - Determine if prevention or removal is best strategy
2. Refer to contaminant removal circles for chemical selections
 - Work with chemical suppliers to develop concentrations and dwell times required
3. Select proper chemical showers and location
 - Engineered full coverage and uniform coverage is a must (oscillation may be necessary)
 - Locate shower to allow chemical to penetrate fabrics (roll/felt nips) and provide maximum dwell time
 - Identify which side of fabric contaminants are concentrated and adjust strategy accordingly

Chemical Selection Sheet for Contaminant Removal

1. Contaminant located in one specific circle can be removed utilizing the proper concentration and dwell time of the chemical associated with the circle.



2. Contaminant located in more than one circle can be removed utilizing one or more of the proper concentrations and dwell times of the chemicals associated with the circles.

Profile Management

A special note – moisture profile management

Moisture profile management refers to techniques that ensure the most uniform distribution possible of water applied to fabrics from showers. When installed and operating, a fan shower should be located so that the fan sprays do not overlap one another by more than $\frac{1}{8}$ to $\frac{1}{4}$ inch (3 to 6 mm). Ensuring the proper location of the shower as explained is important. However, recent studies have proven that all fan type showers distribute water non-uniformly, despite how accurately installed and positioned. Figure 1 illustrates very clearly the degree of non-uniform water distribution from a full width, stationary multi-nozzle fan shower. This non-uniform distribution of water causes moisture streaks in both the fabric and sheet.

Figure 2 illustrates exactly the same shower when oscillated rather than being stationary. The tremendous improvement in uniformity of water distribution is obvious. The improvement will be reflected in the moisture profile of the press fabric and the sheet.

As a result of this, it is now a standard recommendation to oscillate all showers in a press section. This includes not only the high pressure cleaning showers but also the flooding and lubricating showers.

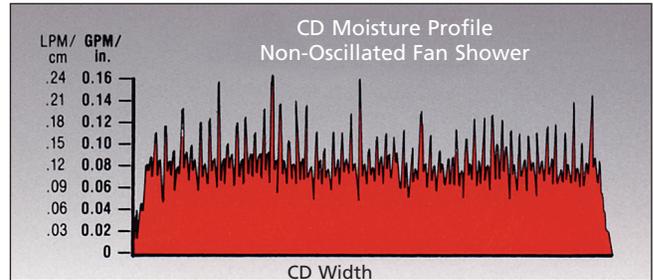


Figure 1

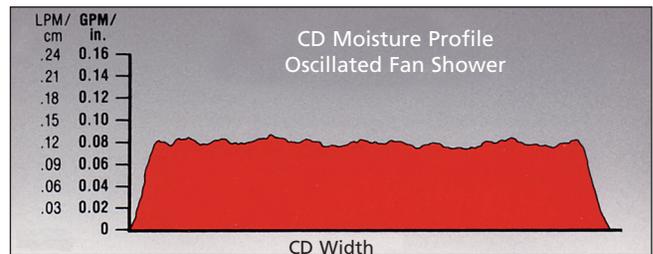
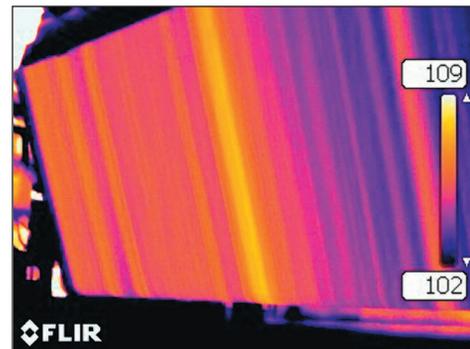


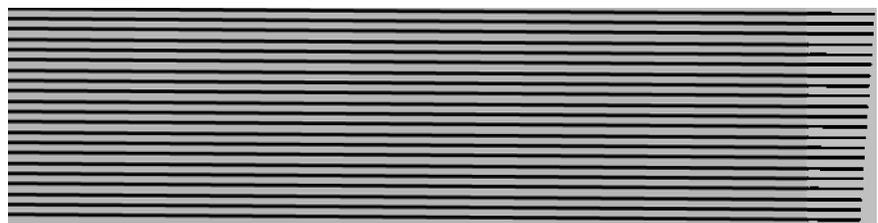
Figure 2



Thermography showing poor crank-arm oscillation



Crank-arm oscillation pattern
(not recommended)



EMO III oscillation pattern

Improved cleaning and conditioning for better moisture profile management and increased productivity

The low frequency (low speed), instantly reversing EMO III™ or Genesis Ultra™ electromechanical oscillators are designed and proven to provide optimum fluid distribution for cleaning and conditioning machine fabrics. Conventional piston drive and crank arm oscillators operate at fast speeds with excessive dwell at stroke reversal. This produces non-uniform fabric cleaning and wear, vividly illustrated by the shower pattern photo shown above. The zero dwell and precise control consistently provide uniform shower coverage. Optimum fabric cleaning yields optimum machine performance for improved web profile, surface finish, and density.

White Water vs. Fresh Water

Environmental concerns, energy savings potential, and the desire to improve efficiency are reasons why many paper mills today are using recycled white water for all showers in the forming section. Despite these benefits, there are some issues which should be considered.

Shower nozzle plugging can be detrimental. To minimize plugging, the shower system must be designed to use recycled white water. The illustration below shows the components that typically constitute a correctly designed and applied white water system.

The RotoFlex™ resource recovery strainer initially separates fiber and contaminants from the water supply.

A white water tank collects the filtered accept water and must include a sludge removal drain. The pump suction outlet must be located well above the bottom of the tank.

Pipe runs should be designed to avoid dead spots or pockets. Minimum flow velocity should be 9 to 10 feet (2.7 to 3 meters) per second. Bleed valves installed at the end of each shower pipe will maintain this minimum velocity in the piping and the shower. Flush valves should be located prior to in-line filters, permitting all pipes to be flushed before start-up and after machine shut-downs.

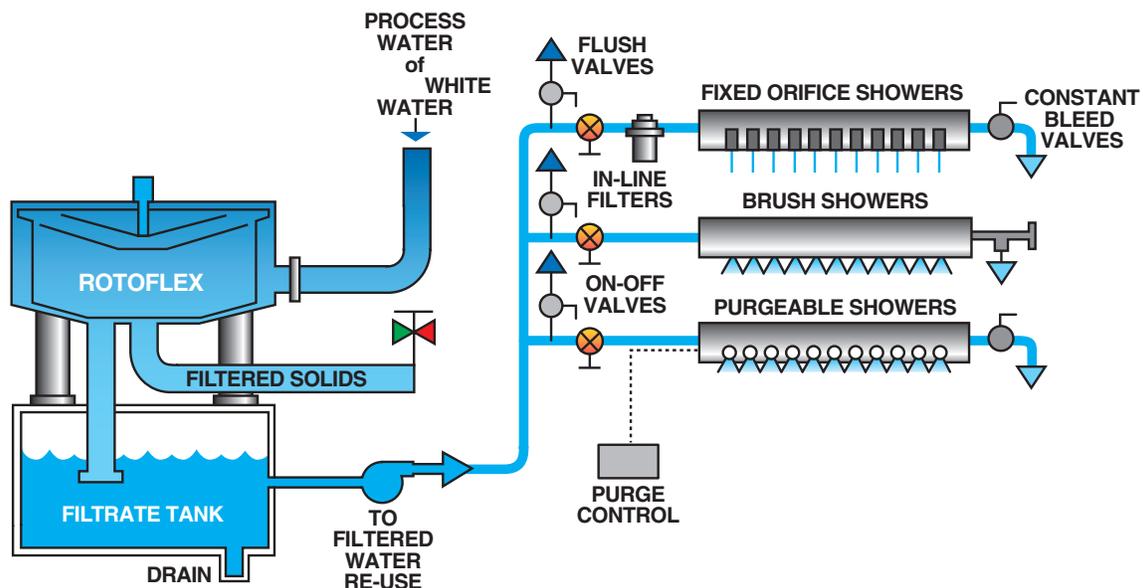
Kadant Solutions in-line filters will protect shower nozzles from blocking due to pipe scale and fiber flocs.

Shower Water Quality

Solids Loading PPM (Mg/L)	Application of Water Strained with 100 Mesh per inch (40 per CM) Mesh Screen
0 – 50	Equivalent to filtered fresh water.
50 – 75	Usable in 0.040" (1 mm) and larger fixed orifice nozzles with minimal problems.
75 – 100	Usable in 0.055" (1.4 mm) and larger fixed orifice nozzles with minimal problems.
100 – 200	Usable in 0.125" (3 mm) and larger fixed orifice nozzles with minimal problems.
200 – 500	Brush type shower recommended.
500 – Up	Purgeable showers recommended.

Close attention to these details is important. It is equally important to analyze the quality of the accept water when selecting shower hardware. The chart shown above provides guidelines relative to solids loading versus shower type and style.

With cleaner water, fixed orifice nozzles can sometimes be used without blockage problems. As solids loading increases, it is necessary to select a shower with nozzles that can be cleaned while running. Brush or purgeable showers provide on-the-run nozzle cleaning features.

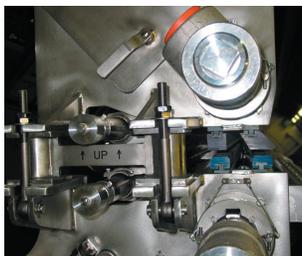


Tissue Products



Shower Systems

Shower systems provide the essential components of an effective cleaning and conditioning system for today's tissue machine fabrics. Moisture profile management, properly balancing shower pressure and flow dynamics as well as effective and efficient cleaning is critical to maximize tissue machine performance.



Mist Elimination Systems

A new development is the application of mist elimination technology on high-speed modern tissue machines. Effectively applying mist elimination systems will reduce wet end breaks, positively impact overall machine hygiene, improve safety, and minimize mist that can adversely affect machine room infrastructure.



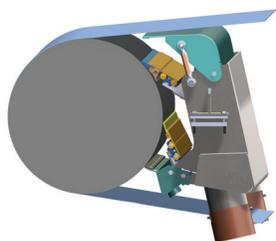
Fabric Brush Assembly

On tissue machines where secondary fiber and stickies are present, the Kadant fabric brush assembly offers an additional tool in fighting forming fabric contamination. The tissue maker can remove face-side contaminants easily and effectively.



M-clean Cleaning System

The M-clean cleaning system high-pressure cleaner is a modular cleaning system for paper, tissue, and towel machine forming, press, and dryer fabrics. It combines high-pressure cleaning with an effective evacuation system and air knife system.



Doctor Systems

Kadant is a global leader in doctor technology. The AirSet™ B blade holder is especially effective on tissue machine suction pressure rolls by utilizing air to enhance the vacuum behind the blade tip to maximize water removal from the roll. The AirSet B blade holder retrofits easily with existing holders.



Yankee Creping Doctors

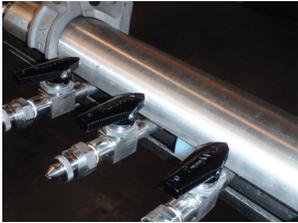
The family of Conformatric™ creping holder's robust design allows use on today's high-speed tissue machines under high doctor loading pressures in the Yankee creping positions. The design permits on-the-run profile adjustment, rapid blade changes, and improved holder hygiene.

Cleaning Products



Yankee Dryer Cleaner

The Yankee Roll Cleaner™ device safely and effectively removes coatings and release agent build-up from tissue machine Yankee dryer surfaces. The Yankee Roll Cleaner is available with application-specific abrasive pads to clean and polish dryer surfaces.



Yankee Spray Boom Showers

Even distribution of Yankee coatings and release agents is critical in tissue machine performance and extending Yankee dryer life. With a variety of nozzles, filtration systems, and as a global leader in creping technology, Kadant Solutions provides unique application expertise.



Felt Cleaning Assemblies

Water removal and moisture profile management require an in-depth understanding of modern press fabric designs, vacuum systems, and showering. Kadant Solutions will properly size and apply vacuum in the most energy efficient method to optimize press fabric performance.



VersaTrim™ Shower System

Clean and precise trimming is essential to operate high-efficiency and high-speed tissue machines. The VersaTrim shower system provides an easily adjustable and accurate trim squirt system. Also available is a skid mounted pump system and filters for nozzle protection.



Electromechanical Oscillators

Kadant offers a family of oscillation systems that offer control, reliability, and safety to the shower system. Synchronizing oscillation speed to machine speed is critical in managing moisture profile and efficient cleaning of tissue machine fabrics.



Auto-Brush Rotators

The auto-brush rotator provides the operator with a remote method to actuate the internal brush on a shower to clean clogged nozzles and not put any workers at risk. Simple, effective, and safe.