FORMING FABRIC CLEANING

Each forming fabric is designed with a specific set of characteristics to suit a particular paper machine. Regular and efficient cleaning of the fabric will maintain these characteristics and thereby assist in achieving an efficient and economic fabric life.

Fabrics can be cleaned by mechanical or chemical means and frequently by a combination of both. The cleaning can be continuous or for short periods at regular intervals. It is also usual to clean the whole fabric with chemical solvents during machine shutdowns.

CHEMICAL CLEANING

Continuous chemical cleaning is possible by using a metering pump feeding into the water supply, but it can be very expensive. It is more usual to program the cleaning into one or two intensive periods during each shift. It is recommended to use a fabric coating if the contamination is proving particularly troublesome.

It is common to chemically clean the fabrics at machine shutdowns and a number of different methods for applying cleaning agents are available including:

- A gravity fed shower
- A felt applicator saturated with solution
- An application roll mounted under the return roll
- A spray from hand held pump tank units
- A foam generator to achieve a thorough exposure to the chemicals

The method chosen should be compatible with the type of chemical used.

In all cases, the machine is run at crawl speed and the solution applied until the fabric has been well saturated for 20-30 minutes. It is then given a shower rinse at normal machine speeds.

CLEANING CHEMICALS

Cleaning chemicals fall into three main groups:

- Acid based
- Alkali based
- Organic based

Type	Strength	Contaminants
ACID BASED Hydrochloric acid Sulfuric acid	 10-20% 10%	 General cleaner – Rosin size, Mineral deposits. As Hydrochloric acid Either acid can be combined with a suitable detergent to act as a wetting and foaming agent **CAUTION : Use chemicals in accordance to the manufacturers' directions. Chemicals may pose health risks , damage risks or the risk of fire.**
ALKALI BASE Sodium Hydroxide	 Up to 10%	 Pitch, Rosin, Mineral deposits, Stock or Fibers, some Latex
ORGANIC BASE Kerosenes Xylene, Toluene Trichlorethylene Methy ethyl ketone Proprietary Cleaning Agents	 Usually 100% Usually 100% Usually 100% Usually 100% As directed by Manufacturer	 Asphalt and Tar Pitch, Latex, Bitumen Usually spot treated Various

WARNINGS

- **DO NOT** use any acid or strong alkali base cleaner on any fabric with POLYAMIDE (e.g., nylon) yarns. Concentrated acids and alkalies will also degrade polyester yarns if subjected to long exposure. When concentrated acids are being used on the machine, keep machine running at crawl speed with knockoff showers on.
- **DO NOT** use nylon or wire brushes. Use only soft bristle brushes.
- Acrylic fabric coatings can be damaged by TRICHLORETHYLENE.
- Strong acids and alkalies can remove coating materials.
- Ensure that the chemical used is thoroughly rinsed from the fabric after cleaning.
- Follow safety precautions when handling acids or alkalies.
- Observe fire and ventilation precautions when using organic cleaners. Follow warnings given by the manufacturer.
- Remove applicator before speeding up machine to rinse off solvent.

CAUTION : Chemical cleaning agents can cause a health risk to personnel and/or present the risk of fire. All chemicals should be used in accordance to the manufacturers' recommendations and environmental and safety regulations.

MECHANICAL CLEANING

Various types of water showers are used in mechanical cleaning, either to blast deposits out of the fabric with needle jets, or to flood them out in a hydraulic nip. It is impossible to lay down rigid guidelines as to the best type of shower – and its position, as all installations will be governed by many factors, including the type of machine, the stock being used, the fabric construction and fabric economics.

The type and positioning of showers is determined to a large extent by:

(a) The type of fabric normally used

(b) Whether the machine is fourdrinier, twin-wire or hybrid type.

GENERAL POINTS

Careful attention should be paid both to the selection of the correct type and sizing of cleaning showers and to their maintenance. Inefficient operation of the cleaning showers can mar the performance of an otherwise efficient machine, and, if the showers are incorrectly set, they can damage the fabric or result in premature fabric failure.

If at all possible, showers should be located where they can be seen easily and accessed readily to change the nozzle plates, etc. This is not always easy on a modern paper machine.

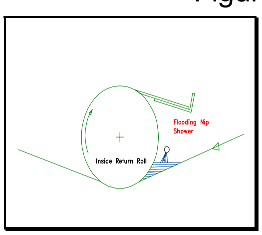
The exact location and operation will depend upon individual circumstances, but there are some general considerations that apply to any installation.

Single layer structures are usually less demanding in their cleaning requirements than multilayer fabrics and any differences are noted in the text.

TYPES OF CLEANING SHOWER

Flooded Nip Shower

Figure 1



The theory behind the flooded nip shower is to force a large volume of water between the fabric and an internal roll. The action of the nip will create a considerable hydraulic force that will push the water through the fabric.

If used only for fabric cleaning, it is an expensive process in terms of water consumption. **However, some fabric designs need a flooded nip shower to achieve adequate sheet knockoff and to prevent the sheet from being carried back along the return roll.**

Provided a continuous flooded edge shower is used, one can have some type of interlock that will ensure that the full width flooded nip shower is used only when the sheet breaks. This will save water and reduce the time taken to operate the system manually.

In this case, the header and pipe work should be kept full of water and any valves used must not present restriction to flow.

The fitting of a vacuum purge facility to evacuate the shower head is highly desirable so that the accumulation of solids built up from using white water can be flushed out periodically.

It is most important that sufficient water volume is used to completely fill the voids in the fabric. The volume needed is given by the formula:

Volume(GPM) = 1.1(Speed (FPM) x Width x Fabric Caliper x Void Volume (%)x 7.48)
or approximately 0.0286 (Machine Speed x Width x Fabric Caliper)

For a 236 inch wide machine running at 1640 FPM with a typical Weavexx duplex fabric, one would therefore need:

Volume (GPM) = 0.0286 (1640 x 236 x .027) = <u>299 GPM</u>

The line connecting the water supply to the shower should ideally be the same size as the shower pipe header and the header should be fed from both ends.

Pressure should be at least 30 PSI and preferably 50 PSI. It can be as high as 80 PSI without causing any problems.

We recommend the use of at least 3 MM (1/8") diameter nozzles. At 40 PSI, they will consume 1.95 GPM each, meaning 150 nozzles are needed across the 236 in. machine or a 1.5 in. pitch between the nozzles.

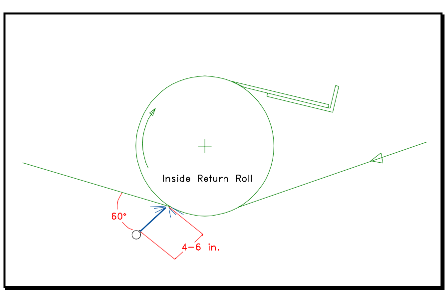
The water supply may need to come from an independent line to avoid depleting other showers when in use. Because of the large nozzle size, clarified white water (CWW) with up to 2 Lbs./1000 gallons (200 grams/1000 liter) of solids can be used. This should be at the same temperature and pH as the wire pit.

In some cases, it is imperative to fit deflectors to ensure that the flooded nip shower does not go into an adjacent felt position. Another deflector may be useful at the end of the couch pit location to ensure that any carryback of fiber finds its way into the couch pit and not into the wire pit.

The best shower position for all normal knockoff applications is at the ingoing nip of the Forward Drive Roll. The ingoing nip of an Inside Return Roll is an alternative if only fabric cleaning is required. In this case, one should ensure that the wrap on the roll exceeds 12-15° to avoid problems from fabric aquaplaning on the water film.

High Pressure Cleaning Showers

Figure 2



Forming fabrics are far too often taken off due to poor operation caused by plugging with contaminants and fibers which could have been removed with efficient, high pressure, needle shower cleaning.

In modern multilayer fabric designs, there are more voids to fill up with fibers and contaminants because of their complicated middle structures. It is, therefore, even more important to ensure that the fabric openness is maintained during the fabric's working life.

An inside needle jet at approximately 600 PSI (40 bar) is normally adequate for good cleaning of single layer fabrics. For multilayer fabrics, an outside high pressure needle shower angled at approximately 60° into the direction of fabric travel at about 250-300 PSI (17-20 bar) is more effective in keeping the surface clean.

It should be noted that high pressure water jets can easily damage worn and fibrillated machine side yarns. The pump for the high pressure shower should be interocked to the fabric drive and the supply to the high pressure shower should be interlocked to the shower oscillator.

For feed water, one can use clarified white water of similar temperature and pH as the wire pit.

Choice of Oscillator Speed

The correct type of oscillator is vital if the showers are to purge the complete fabric surface. We recommend an electro-mechanical oscillator with uniformly smooth speed in both directions to ensure thorough cleaning over the full width and minimal dwell.

The correct speed of oscillation is most important. Setting the speed to a certain number of strokes per minute regardless of application results in a variety of cleaning conditions, none of them desirable.
The worst condition is synchronization or “tracking” where the nozzles repeatedly track over one area of the fabric with most of the fabric not getting cleaned at all.

The following diagrams show why the correct speed is so important. Consider a shower jet diameter of 1 and a fabric width of 10 (Figure 3). If the oscillation stroke rate is 1 nozzle width per revolution, the whole fabric is cleaning in 10 revolutions.

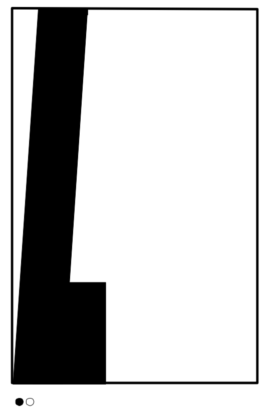


Figure 3

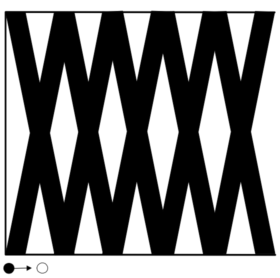


Figure 4

If the stroke rate is increased to 2 nozzle widths per fabric revolution (Figure 4), the pattern would repeat on 10 fabric passes and some areas of the fabric would never get cleaned.

Continuing to increase stroke rates produces different cleaning patterns as follows:

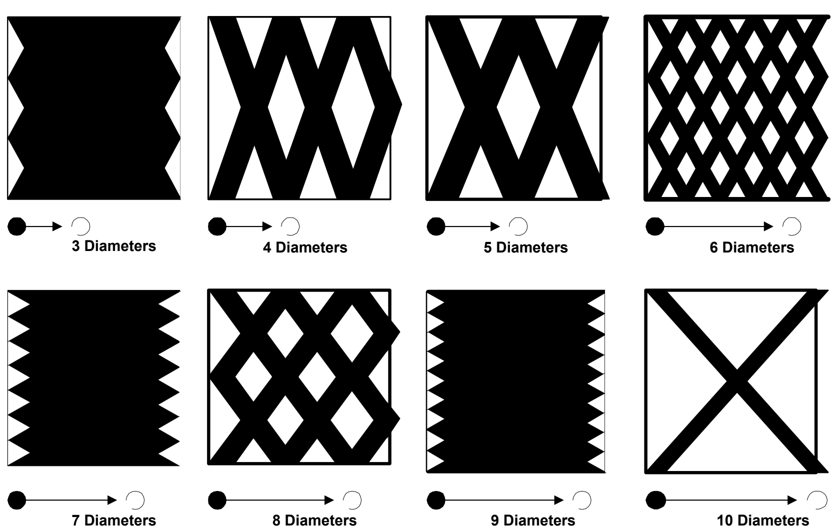


Figure 5

NOZZLE DIAMETER

Tests have shown that plugging of the jet orifice increases when nozzle diameter is less than .04 inches. When the diameter is above .04 inches, water consumption increases significantly without a proportional increase in the cleaning effect. The extra kinetic energy in the jet also increases the risk of damage to the fabric.

We recommend nozzles of .04 inches diameter at 6 inch centers and a stroke length of 12 inches.

WATER PRESSURE

Pressures should always be kept as low as possible, commensurate with good cleaning.

We recommend pressures between 150 and 400 PSI for both single layer and multilayer constructions. The cleaning effect increases with higher pressures but so does the risk of fabric damage.

NOZZLE TO FABRIC DISTANCE

This distance has been shown to have a decisive effect on the cleaning efficiency. We recommend 4 -6 in. distance from the nozzles to the fabric. At shorter distances, the risk of damage increases and at longer distances, the jet starts to break up into droplets and the cleaning effect is lost.

TRIM SQUIRTS

Because most multilayer designs have close to or above 100% cover, the normal trim squirts (both stationary and the traveling tail cutters) may produce a ragged cut which will increase the tendency to sheet breaks.

In general, reducing the size of the nozzle diameter to 0.015 – 0.018 in. (0.35 – 0.45 MM) will improve the quality of the cut.

Other things that can improve operation of trim squirts are:

- Angle the nozzle in the machine direction – 10-20° with direction of travel. This will reduce the tendency to splash-back.
- Angle the nozzles in the cross machine direction – 10-30° towards the sheet edge. This will reduce bounce back.
- Locate the squirts as near as possible to the sheet. A distance of 100 MM (4 inches) or less is ideal. At greater distances the jet tends to break up before it cuts the sheet.
- A trim squirt after the couch will in some cases, particularly on high speed machines, give some benefits – as it avoids the re-knit effect of the couch vacuum or lump breaker.

Trim squirts should always be interlocked to ensure that they shut off when the fabric is stationary. **Improper operation of trim squirts can damage fabrics.**

SHOWER POSITIONING – Fourdrinier and Hybrid Machines

Figure 6 shows a typical cleaning shower set up for a fourdrinier or hybrid machine. Note that the number and positioning of the showers is subject to individual preference and budgetary canostraints. The machine configuration, ease of access and amount of cleaning required will tend to dictate the exact positions.

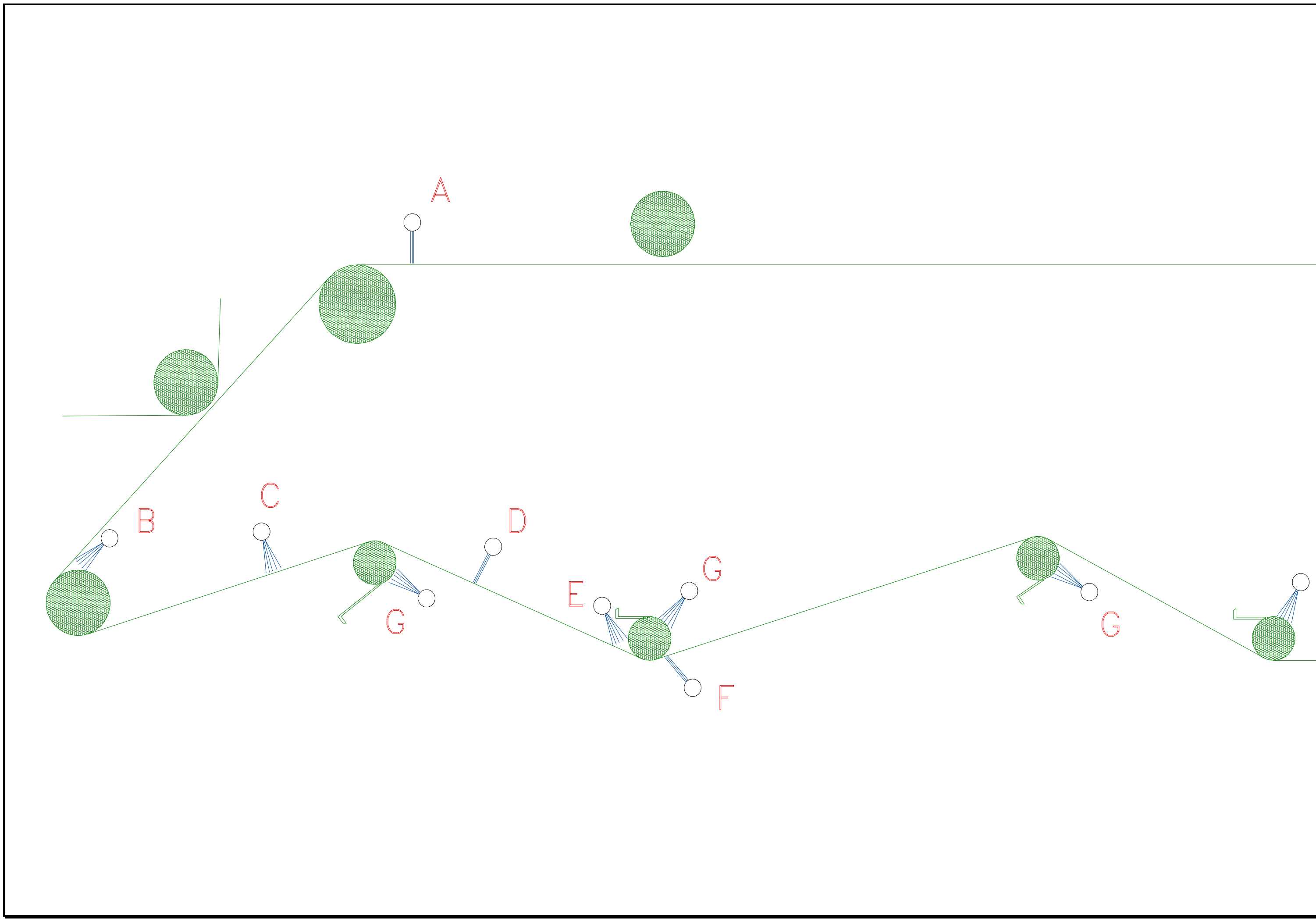


Figure 6

Recommended positions for showers on fourdrinier and hybrid machines.

(A) Edge trim showers (Trim squirts)
(B) Flooded nip shower on Forward Drive Roll for knockoff and cleaning
(C) Full width knockoff shower and edge trim knockoff shower
(D) High pressure needle shower inside fabric (single layer fabrics only)
(E) Alternative position for flooded nip shower for cleaning
(F) High pressure needle shower just as fabric leaves inside roll (multilayer fabrics)
(G) Lubricating showers

It may be necessary to fit deflectors in order to direct the sheet into the couch pit.

SHOWERING POSITIONING – Twin-wire Machines

Modern twin-wire machines are usually well equipped with both cleaning and knockoff showers. Figure 7 shows the usual arrangement on this type of machine.

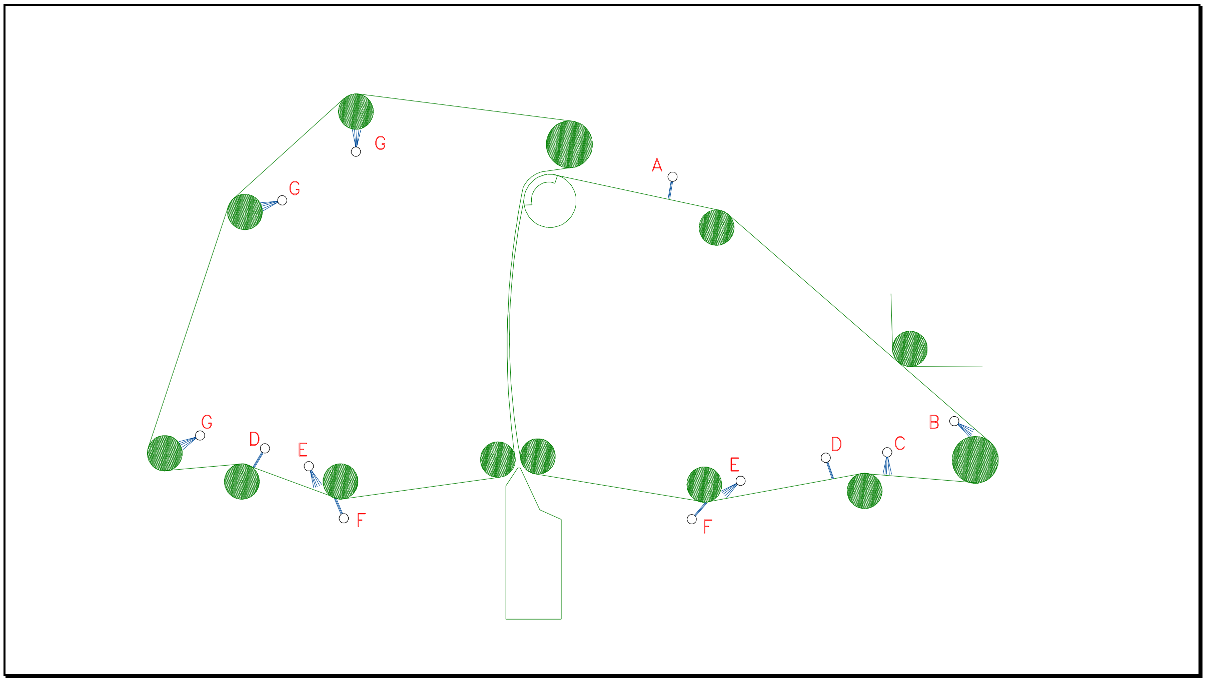


Figure 7

Recommended positions for showers on twin-wire machines.

(A) Edge trim showers (Trim squirts)
(B) Flooded nip shower on Forward Drive Roll for knockoff and cleaning
(C) Full width knockoff shower and edge trim knockoff shower
(D) High pressure needle shower inside fabric (single layer fabrics only)
(E) Alternative position for flooded nip shower for cleaning
(F) High pressure needle shower just as fabric leaves inside roll (multilayer fabrics)
(G) Lubricating showers

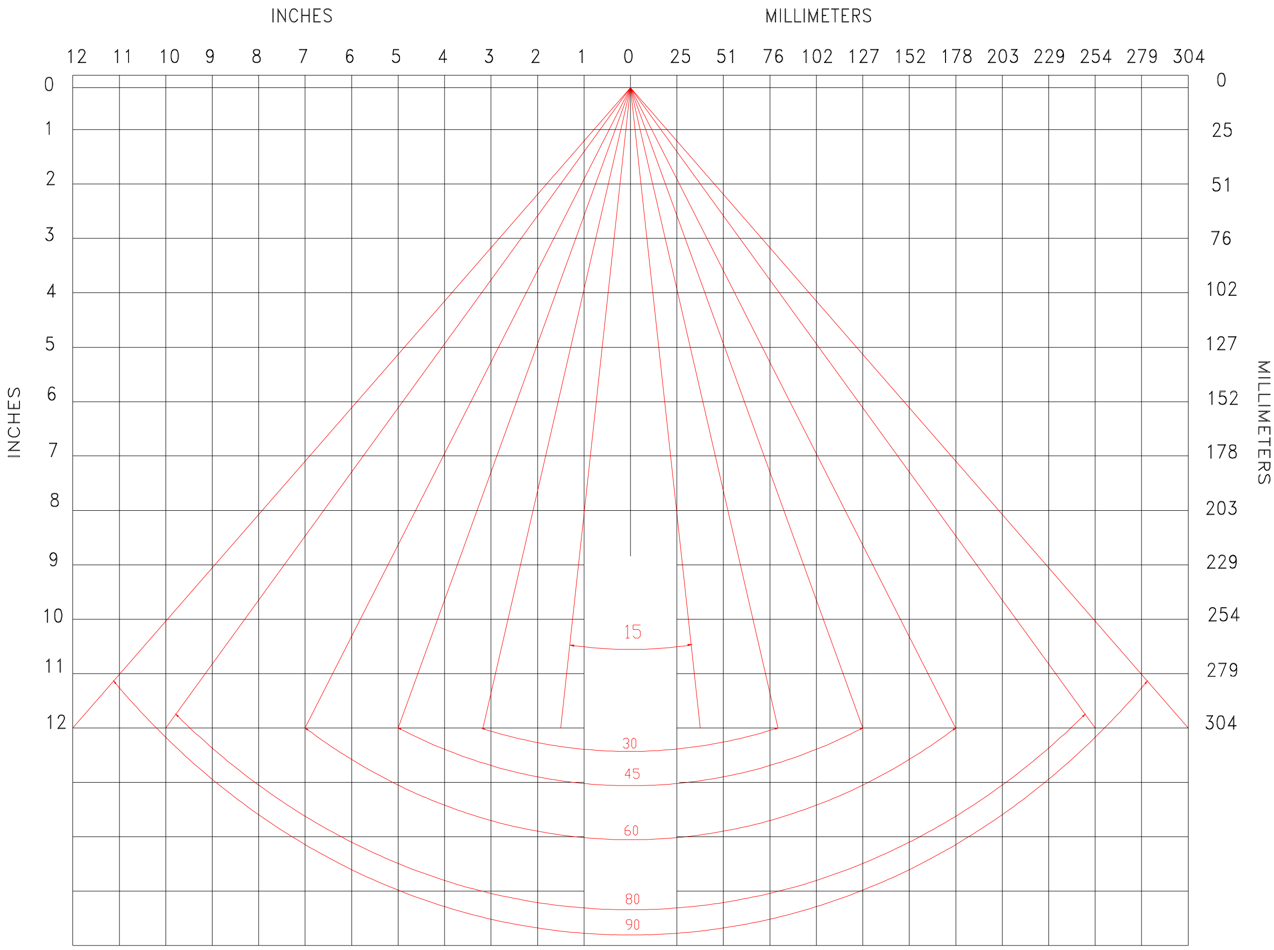
It may be necessary to fit deflectors in order to direct the sheet into the couch pit.

FOURDRINIER SHOWER REQUIREMENTS

Shower Description	Type of Nozzle	Type of Water	PSI	Gal/Min Per in.
Fabric return roll showers Nozzle spacing: 10 in. 1.50 GPM @ 60 PSI 0.095 in. Nozzle	40° Fan	CWW	40-60	.16
Lump breaker shower Nozzle spacing: 12 in. 0.87 GPM @ 20 PSI 0.095 in. Nozzle	90° Fan	CWW	20	.07
Headbox shower Nozzles spirally placed Nozzle spacing: 20 in. 1.70 GPM @ 60 PSI 0.095 in. Nozzle	60° Fan	CWW (Warm)	40-60	.087
Formation shower 0.095 in. holes drilled on 0.50in. centers		CWW (Warm)	2-4	
Trim squirts 2 nozzles per side	0.015 - 0.018 in.	FW	80-150	
Edge trim knockoff showers Nozzle spacing: 4 in. For 12 - 18 in. /Side 2.8 GPM @ 200 PSI 0.095 in. Nozzle	30° Fan	CWW	80-250	Total .57
Fabric cleaning shower Oscillating needle Nozzle spacing: 6 in. stroke: 12 in. 0.87 GPM @ 600 PSI 0.04 in. Nozzle	0.04 in.	CWW	150-600	.15
Fabric cleaning shower Oscillating needle type (for difficult environment) Nozzle spacing: 3 in. stroke: 12 in. 0.87 GPM @ 600 PSI 0.04 in. Nozzle	0.04 in.	CWW	150-600	.30
Dandy roll shower Oscillating needle type Nozzle spacing: 6 in. stroke: 12 in. 0.40 GPM @ 120 PSI 0.04 in. Nozzle	0.04 in.	FW (Warm)	75-120	.07
Couch roll shower Oscillating needle type Nozzle spacing: 6 in. stroke: 12 in. 1.15 GPM @ 1000 PSI 0.04 in. Nozzle	0.04 in.	FW	500-1200	.20
Breast roll shower Nozzle spacing: 6 in. 1.8 GPM @ 80 PSI 0.095 in. Nozzle	45° Fan	CWW (Warm)	60-80	.30
Sheet knockoff shower Nozzle spacing: 4 in. 3.2 GPM @ 300 PSI 0.095 in. Nozzle	30° Fan	CWW (Warm)	80-250	.82
Flooding nip shower Nozzle spacing to suit flow required 1.95 GPM @ 40 PSI 0.125 in. Nozzle	30° Fan	CWW (Warm)	30-80	Calc

CWW = Clarified White Water FW = Fresh Water

FAN SPRAY NOZZLE COVERAGE



RELEVANT CALCULATIONS

HIGH PRESSURE SHOWER CLEANING TIME

T=(L x C)/S

- T, time in minutes
- L, fabric length in feet
- C, number of cycles[1]
- S, fabric speed in fpm

[1]practically established standard is 400 cycles for .040” diameter nozzles on 6” spacings, per CVN Systems, Greeneville, TN

EXAMPLE: 115’ Fabric, traveling at 2000 fpm, with .050” diameter nozzles on 7” centers.

C = 400 x (7/6) x (.040/.050) = 373
T = (115 x 373)/2000 = 21.4 minutes

HIGH PRESSURE SHOWER OSCILLATOR SPEED

$$R = \frac{S}{L} \times D$$

where R = Rate, S = Speed, L = Loop length of the felt, D = Shower Nozzle Diameter

FLOODED NIP SHOWER REQUIREMENTS

$$\text{VOLUME (GPM)} = \frac{1.1 \text{ X SPD (fpm) X WIDTH (in.) X THICK (in.) X VOID VOL (\%) X } 7.48}{144}$$

or GPM = Approximately 0.0286 X SPD X WIDTH X THICKNESS