RUBY NOZZLES FOR TRIM SQUIRTS AND FOR OSCILLATING HP SHOWERS

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Part A:　　　　　TRIMMING THE SHEET

Part B:　　　　　HIGH PRESSURE SHOWERING

- PRINCIPLE ELEMENTS TO OBSERVE
- POTENTIAL IMPROVEMENTS
- NEW TECHNOLOGIES

RETHINK PAPER:
Lean and Green

A) Principle points regarding trim nozzles

1. *Edge trimming and sheet break frequency are directly related.*
2. *For a perfect edge trim, a very high degree of jet laminarity is necessary.*
3. *Double jet nozzles are required when running higher machine speeds.*
4. *Sufficient water pressure ensures small jet diameter for good edge cut.*
5. *Stock buildup on nozzles may cause problems, but can be reduced greatly.*
6. *Good water quality will prevent trim nozzles from plugging.*
7. *Perfect nozzle position geometry will result in safe operation.*
8. *Simple and safe nozzle holders reduce downtime and make wire change easier.*
9. *Do not forget the Tail Cutter.*

SHEET BREAK

What is "Jet Laminarity" ?

Left:

A non-laminar jet is called **TURBULENT**.

It will break up into individual droplets very soon after having left the nozzle orifice.
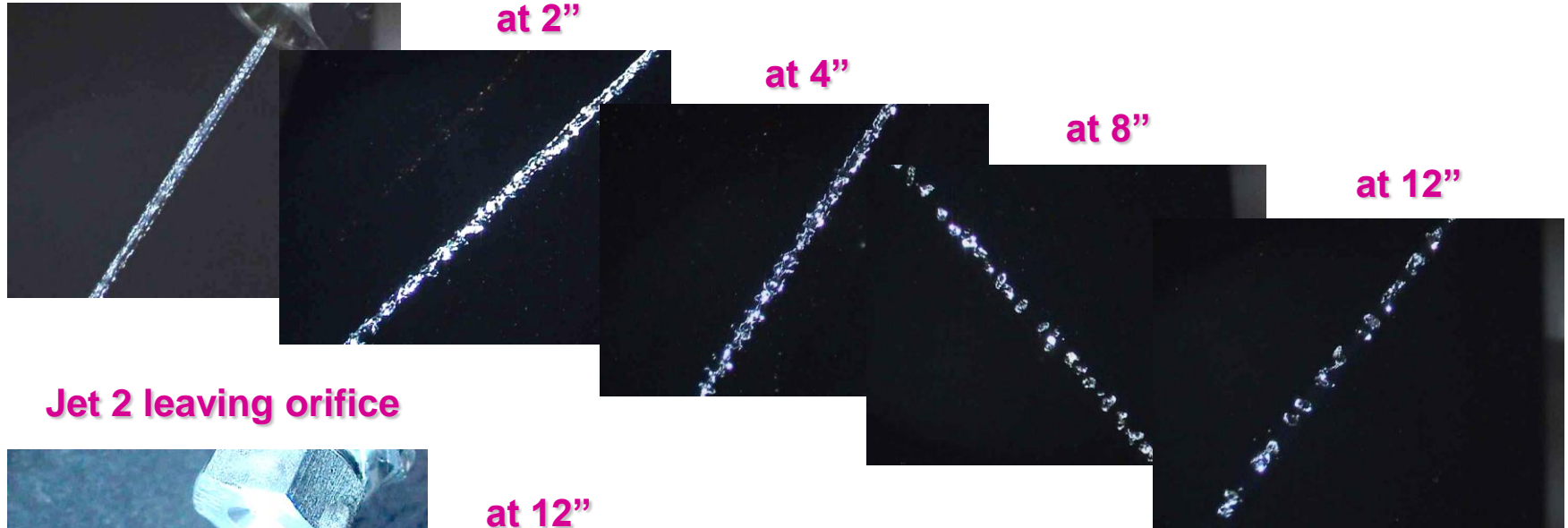
This affects the trim cut quality and safe operation.

Right:

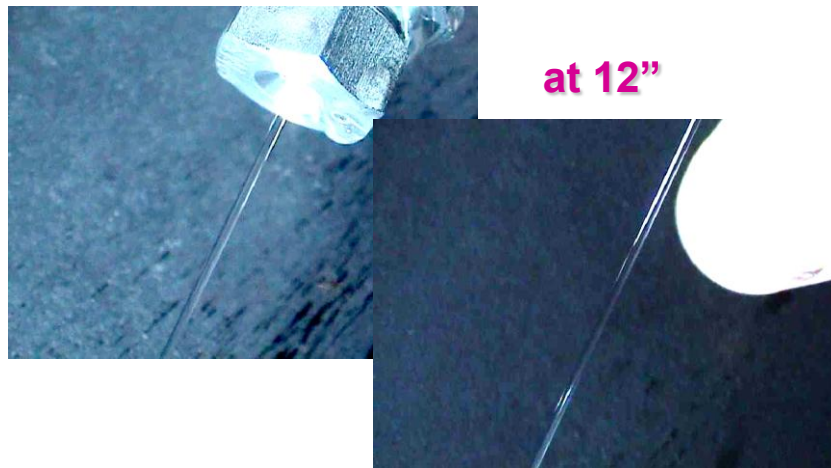A laminar jet keeps its perfect shape on a great length.

The edges of the trim cut are uniform and straight.

What is "Jet Laminarity" ?

Jet 1 leaving orifice

at 2"

at 4"

at 8"

at 12"

Jet 2 leaving orifice

at 12"

**The second jet has a high degree of laminarity.**

Only Ruby tipped nozzles can reach the precision required.
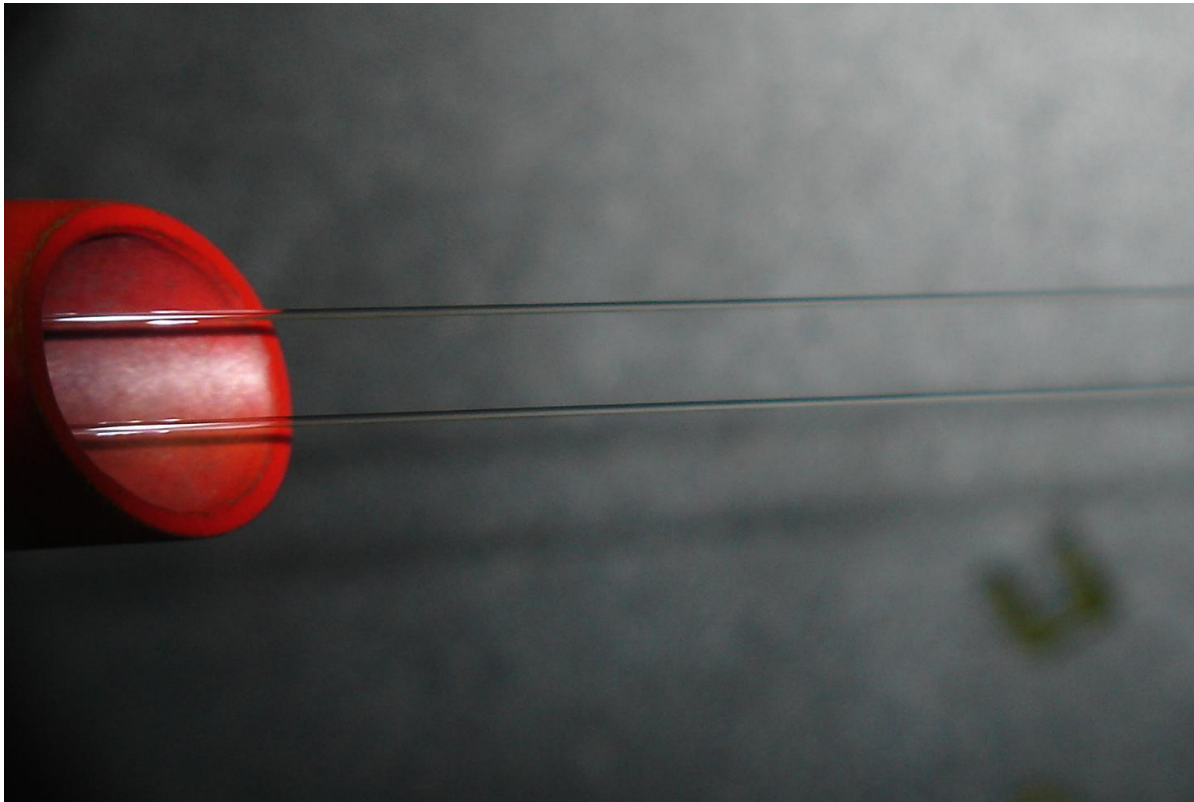
TAPPI

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Modern Trim Nozzle
No more Teflon tape!

Modern trim nozzles use O-rings for sealing and have a metric cylinder thread.

This technology has been adopted as new standard worldwide.

Double Jet Nozzles providing excellent jet laminarity by using Ruby inserts.
New development: Triple Jet Nozzles

- Perfect jet laminarity

- Lifetime far beyond any conventional trim nozzle

Trim Nozzles must be operated at the right water pressure!

Ample primary pressure must be available and
The operating pressure must be set according to the needs:

- Sheet weight
- Type of paper
- Speed

Jet diameter and water pressure for trim squirts (double and triple jet nozzles)

Vwire (m/min)	sheet weight (g/m²)				
	< 50	50 - 80	80 - 120	120 - 170	> 170
< 500	0.5	2 x 0,4	2 x 0,4	2 x 0,5	2 x 0,6
500 - 700	2 x 0,4	2 x 0,4	2 x 0,4	2 x 0,5	2 x 0,6
750 - 1000	2 x 0,4	2 x 0,4	2 x 0,4	2 x 0,5	2 x 0,6
1000 - 1250	2 x 0,4	2 x 0,4	2 x 0,4	2 x 0,5	
	3 x 0,3	3 x 0,3	3 x 0,3	3 x 0,35	
1250 - 1500	2 x 0,4	2 x 0,4	2 x 0,4		
	3 x 0,3	3 x 0,3	3 x 0,3		
1500 - 1750	2 x 0,4	2 x 0,4	2 x 0,45		
	3 x 0,3	3 x 0,3	3 x 0,3		
> 1750	2 x 0,4	2 x 0,4			
	3 x 0,3	3 x 0,3			

color code pressure (bar)
12
15
20
25
30
35
40

Don't forget the Tail Cutter!

If the travelling squirt is installed on the forming fabric, the nozzle
has to do exactly the same good job as the trim nozzles.

Logically, it will do so if the nozzle is the same type and if
operating pressure and nozzle geometry are the same as on the
Drive Side trim squirt – the tail finally has a FS and a DS edge.

_____

If the Tail Cutter is installed overhead under the Pickup Felt,
a single jet nozzle with a rather big diameter (.025" to .030")
should be used, set to the lowest possible operating pressure:
200 psi or less, depending on speed and sheet weight.

This means that individual pressure setting for the tail cutter is required.
The strobe light should be used to set the nozzle to the most suitable inclination
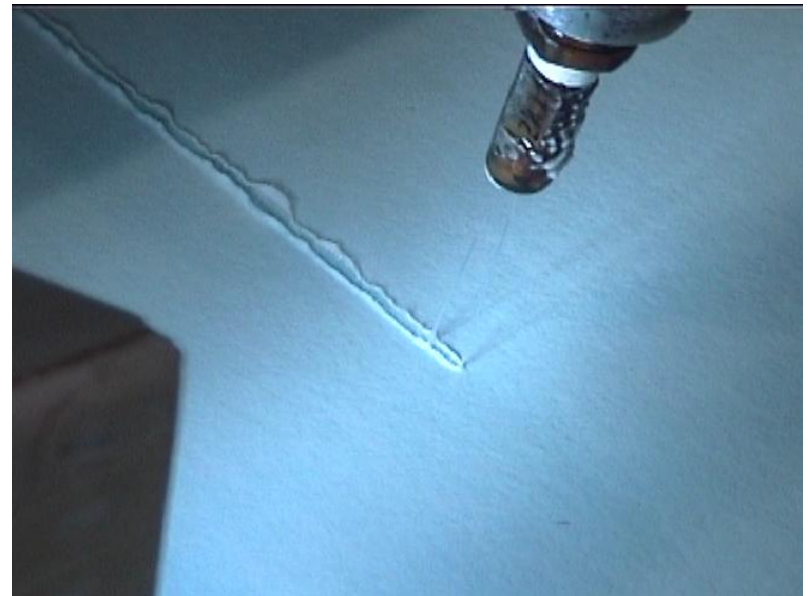both in MD and CMD, to obtain a clear cut and a tail with good edges.

Insufficient pressure results in a poor cut and imposes using big diameter nozzles.

For fast machines a pressure of 400 to 500 psi (around 30 bar) is required to obtain a high jet speed, and by this a high kinetic jet energy despite a small jet diameter.
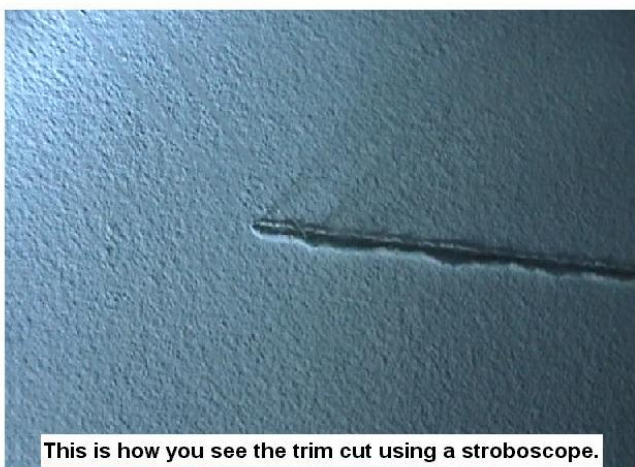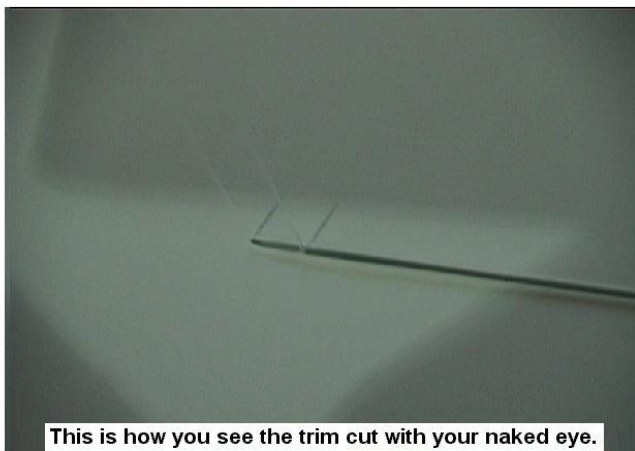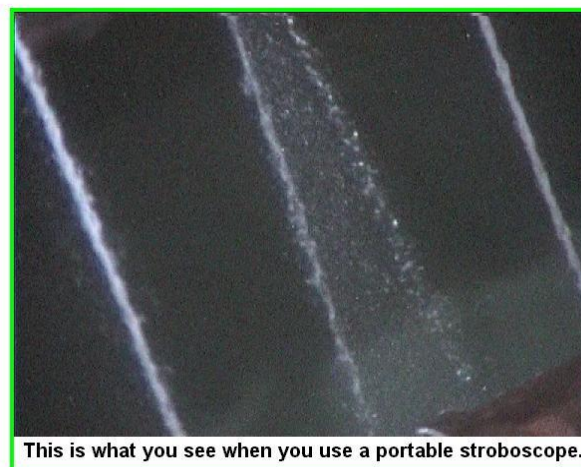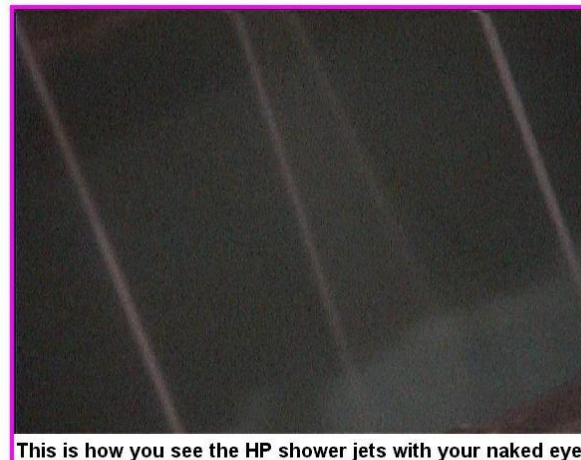
Good trim cut

Cut could be improved

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Be sure to use a portable stroboscope whenever you inspect or set nozzles.

ABOUT THE USEFULNESS OF A STROBOSCOPE

This is how you see the trim cut with your naked eye.

This is how you see the trim cut using a stroboscope.

ABOUT THE USEFULNESS OF A STROBOSCOPE

This is how you see the HP shower jets with your naked eye.

This is what you see when you use a portable stroboscope.

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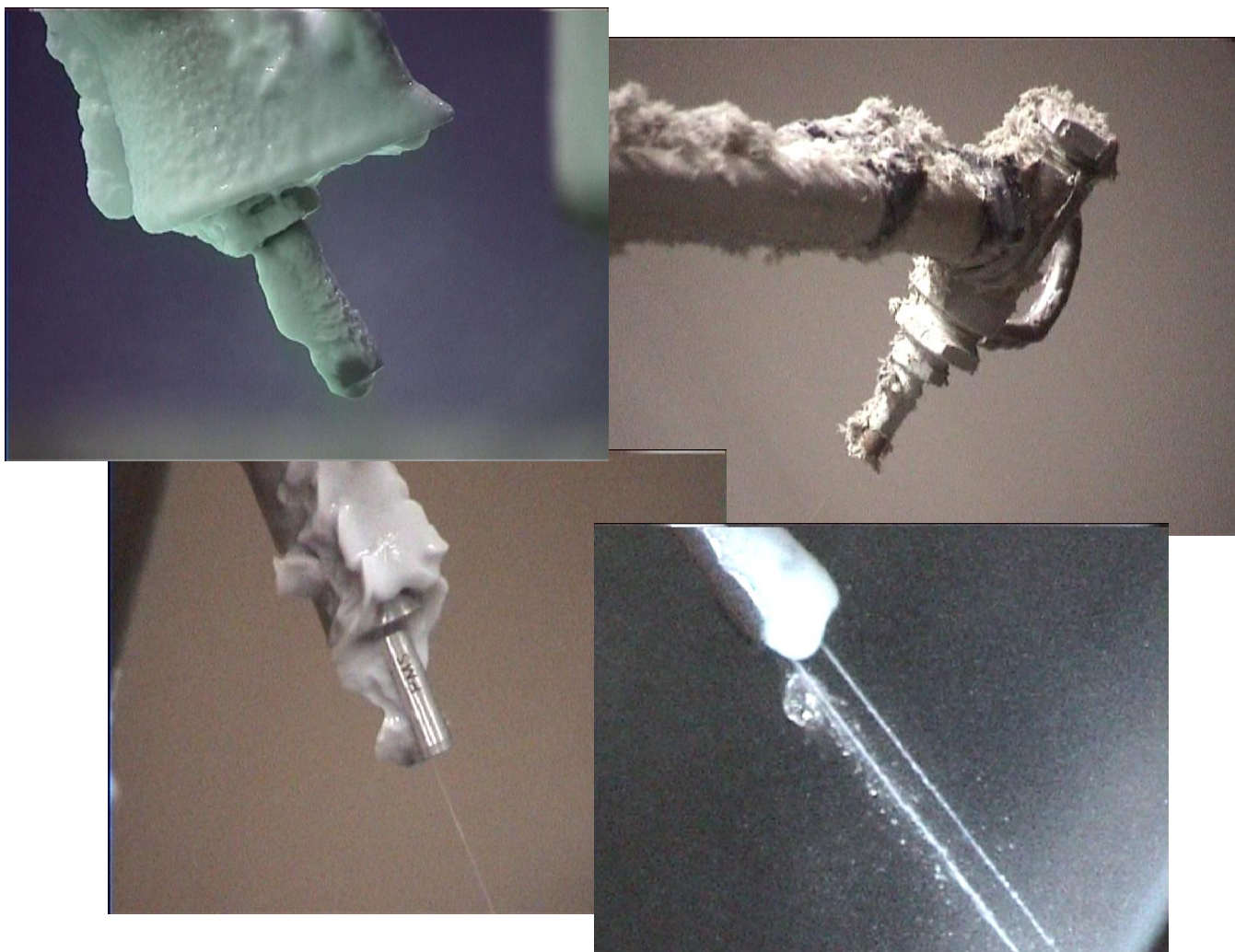# Edge problems may be related to trim nozzle performance

Testliner machine in Korea

Pickup problems due to poor trim nozzle performance

Trim separation after 1st press of Fine Paper Machine: Fiber bridges due to poor trim nozzle performance

Problem: Fiber build-up on the trim nozzle

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Build-up on conventional trim nozzle


How to avoid this ?

Water feed system designed specifically for trim nozzle water supply

- efficient dual pre-filtration
- double wall storage tank with level control sensors
- temperature control for water heating or cooling
- ceramic 3-plunger pumps with pulsation damping
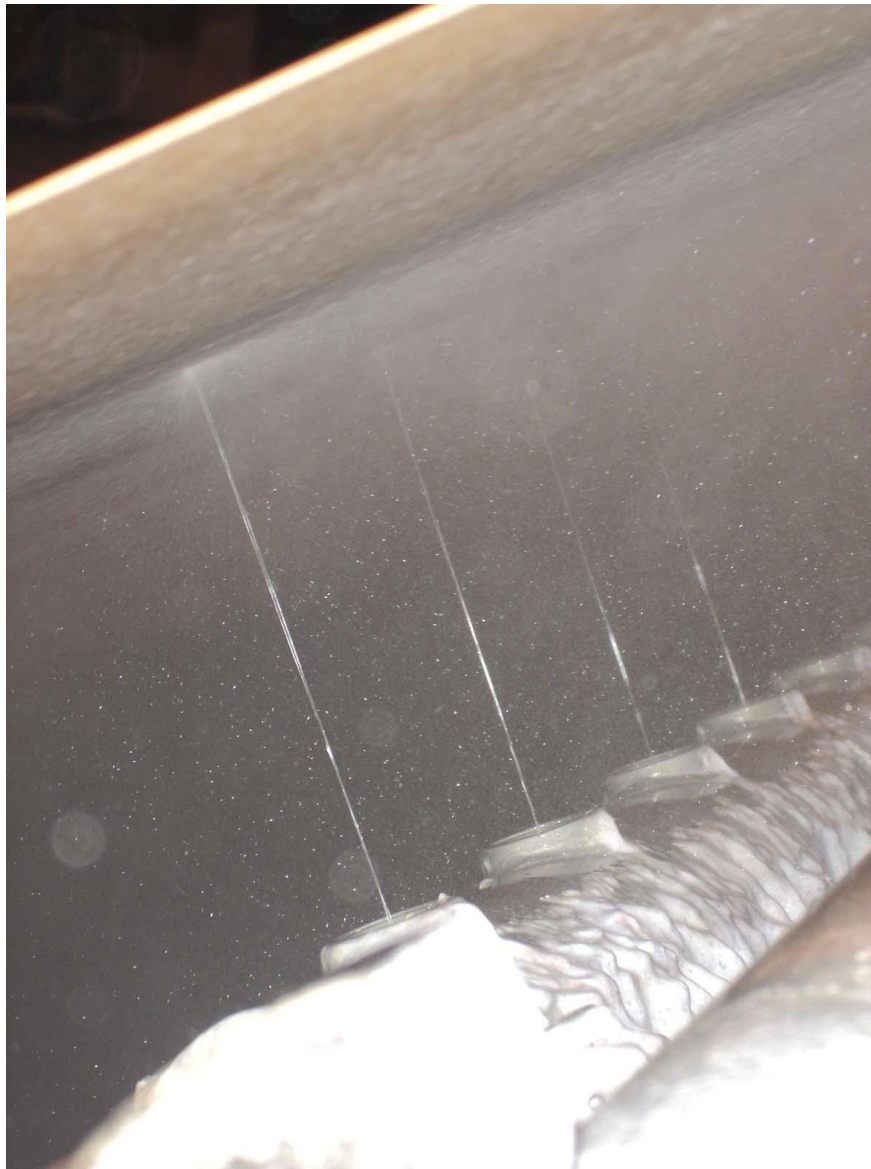- low energy drives with frequency converters
- automatic pressure control

Modern Trim Nozzle systems are required to reach these targets:

- Maximum operator safety
- Increased Paper Machine productivity
- Less breaks – more tons on the reel

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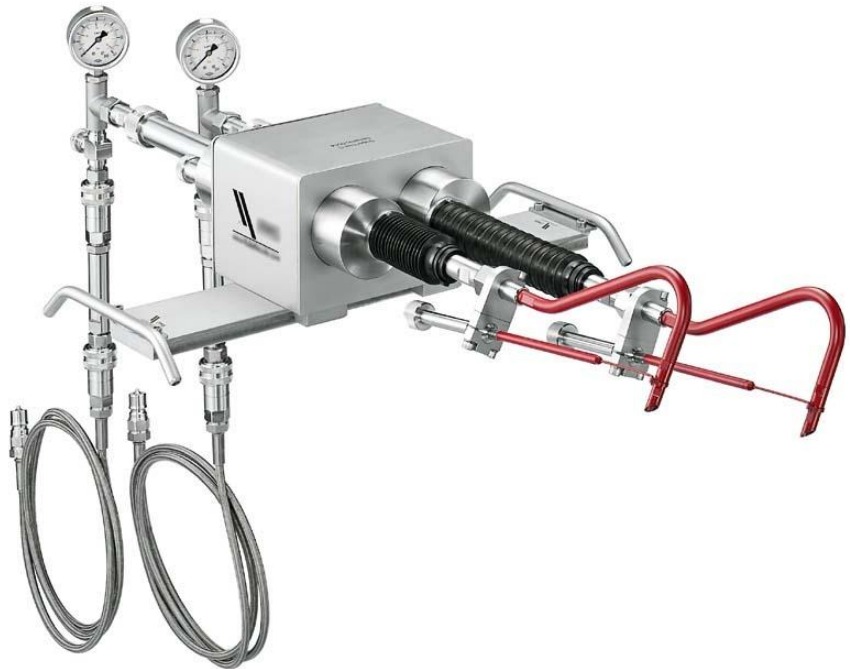
B) Principle points regarding HP Shower nozzles

1. Nozzles must create very laminar jets for efficient and gentle cleaning.

2. Jets must be identical across the machine width for good CMD profile.

Modern Ruby HP nozzles

3. Nozzle plugging must be avoided.
   - Water filtration and treatment
   - Vacuum connection for purging pipe
   - Dedicated filter on each HP Shower pipe
   - Regular cleaning of pipe through FS ball valve using pipe cleaning nozzle

4. HP shower position may affect efficiency and operating issues.

Wire guiding roll

HP shower
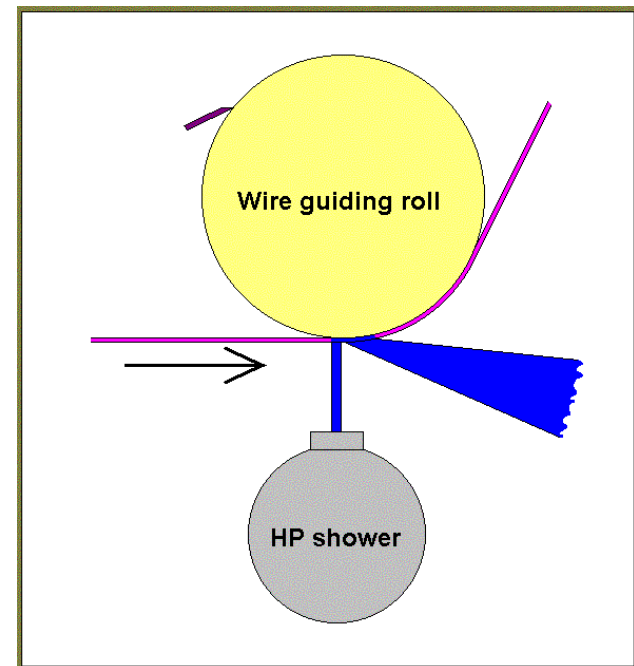
5. Oscillation has to be state-of-the-art for efficiency and CMD uniformity.

$$V_{osc} = \frac{\text{PM speed (m/min)} \cdot \text{Jet diameter (mm)}}{\text{Cloth length (m)} \cdot 60} = \text{mm/sec}$$

6. Reducing nozzle diameters allows significant water saving.

Water Consumption of Needle Jet Nozzles (litres/minute)								
	Water Pressure (bar)							
Jet dia. (mm)	5	10	15	20	25	30	35	40
0.30	0.10	0.14	0.17	0.20	0.22	0.25	0.27	0.28
0.40	0.17	0.23	0.28	0.33	0.37	0.41	0.44	0.46
0.50	0.25	0.36	0.44	0.51	0.57	0.62	0.68	0.72
0.60	0.36	0.51	0.63	0.73	0.81	0.90	0.97	1.02
0.70	0.49	0.69	0.86	1.00	1.12	1.24	1.31	1.38
0.80	0.64	0.87	1.08	1.27	1.45	1.62	1.71	1.79
0.90	0.80	1.11	1.37	1.61	1.83	2.04	2.15	2.25
1.00	1.03	1.41	1.76	2.06	2.35	2.60	2.82	2.97
1.20	1.53	2.04	2.48	2.88	3.27	3.71	4.04	4.32
Jet Velocity (m/min)	1,300	1,800	2,220	2,590	2,915	3,240	3,480	3,670

Thank you for your attention!