

Corrugated Technical Overview

Board Flutes and Callipers

Flutes letters indicate the height (pitch) of the corrugation in the board

Common Flutes: A, C, B, E, F, G, N, Micro

'A' flute



'B' flute



'C' flute



'E' flute



'F' flute



'G' flute



Multi-wall board (Double & Triple Wall) usually combine different flutes for additional strength (i.e. B/C Double or A/C/E Triple)

The heavier the board weight, the more force required to pull the board through the corrugator.

Corrugated Technical Overview

Common Board Types

- *Two liners (1 Top & 1 Bottom) + One Medium*



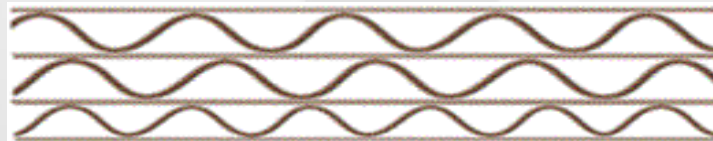
Double Wall

- *Three liners (1 Top, 1 Bottom & 1 Shared Middle) + Two Mediums*



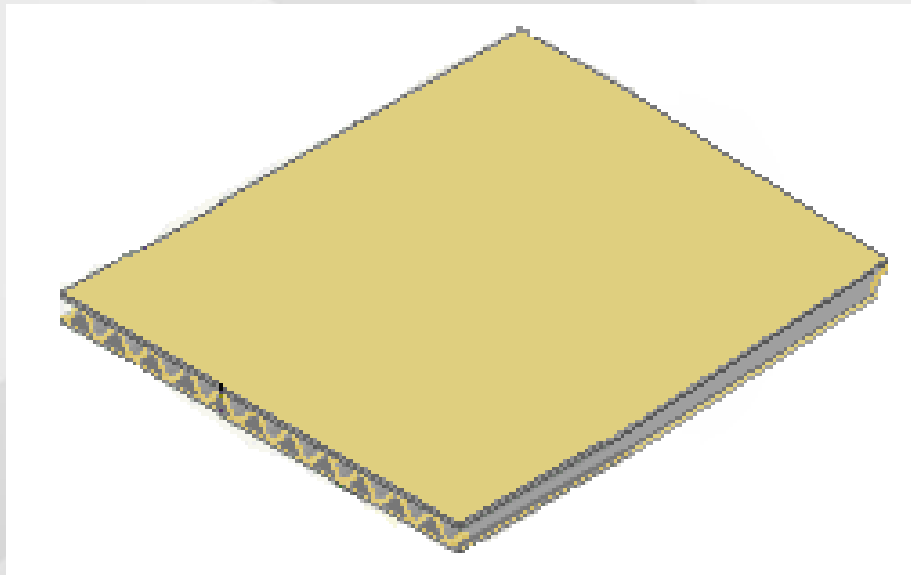
Triple Wall

- *Four liners (1 Top, 1 Bottom & 2 Shared Middle) + Three Mediums*

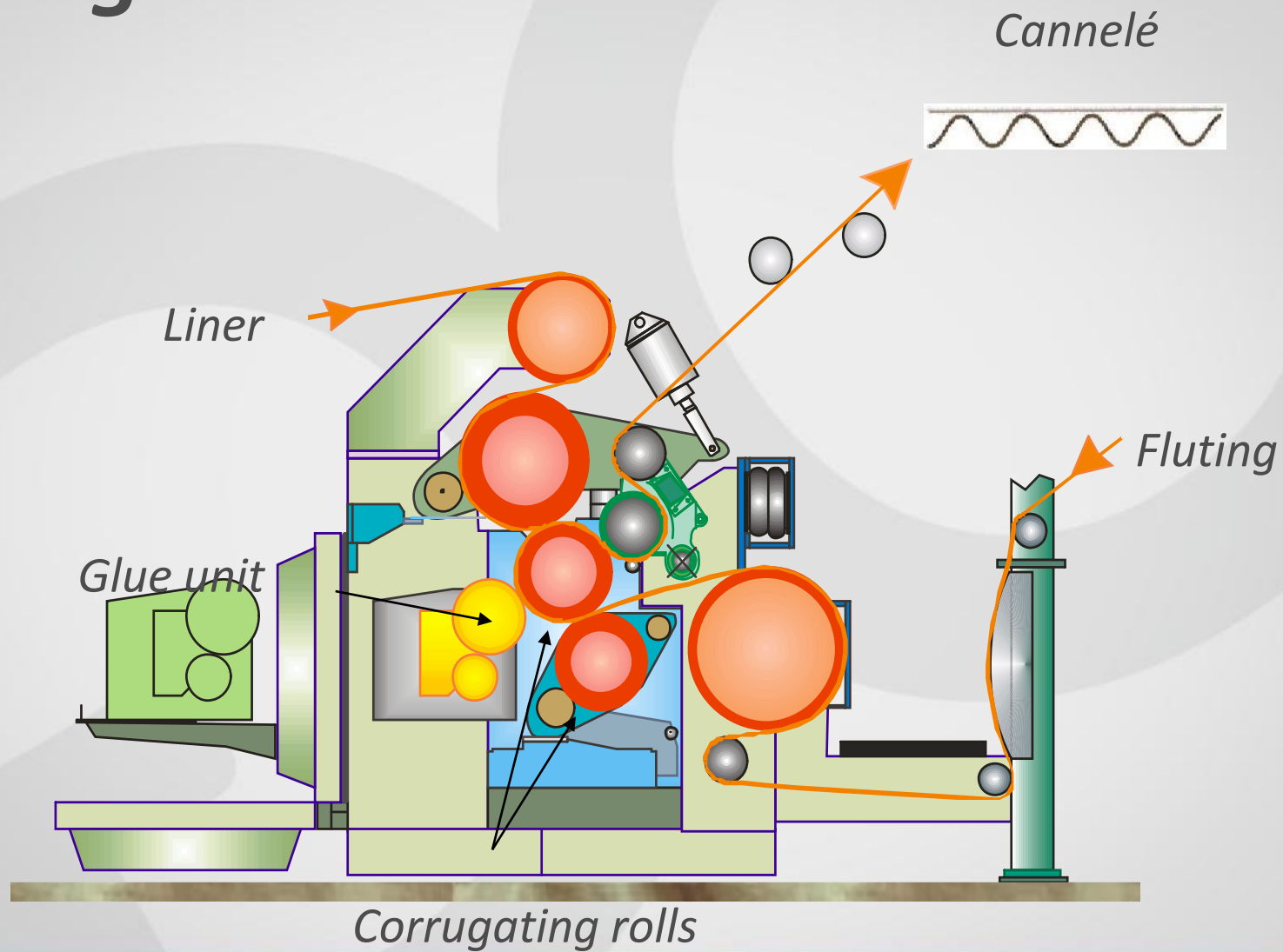


Types of Paper

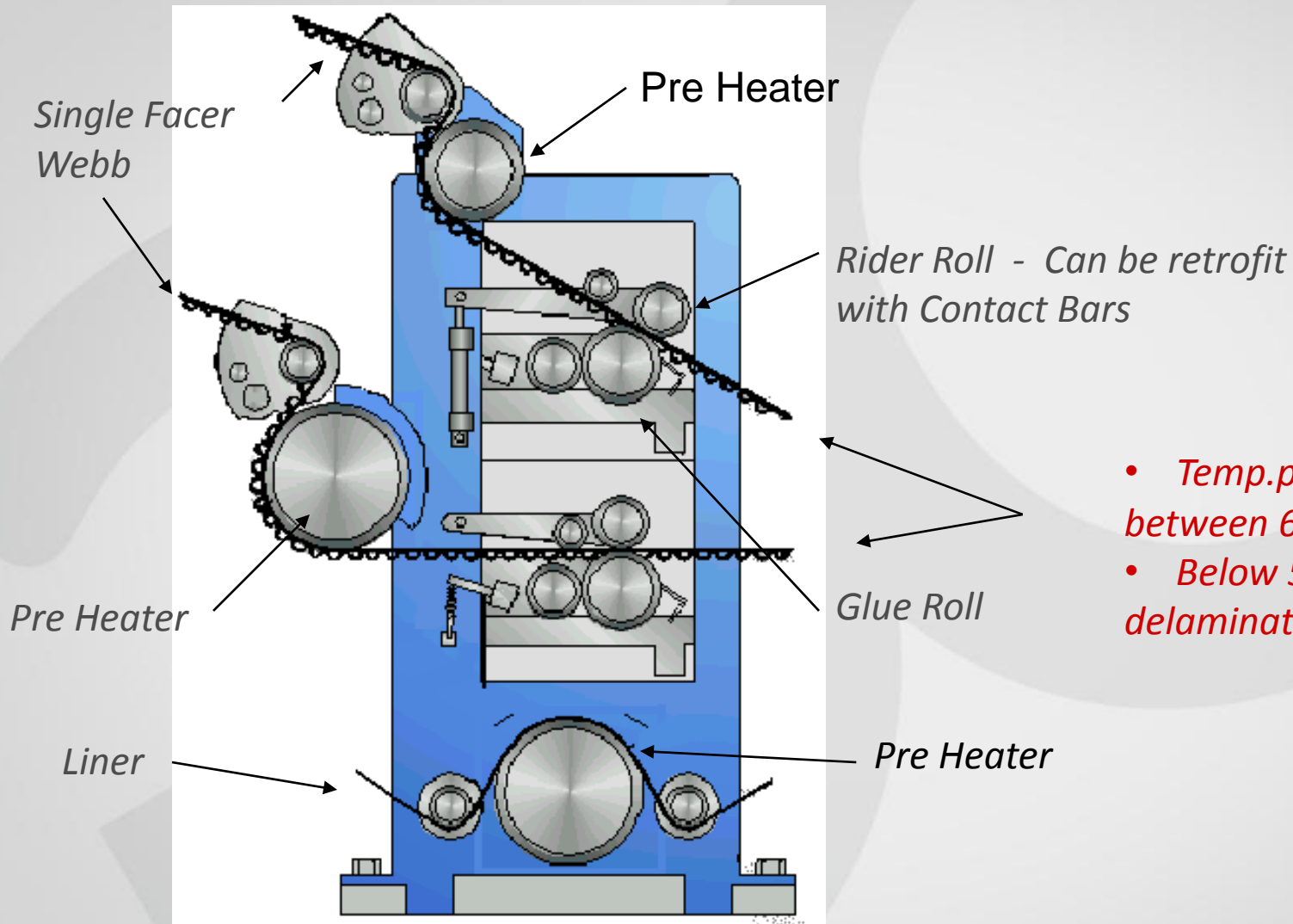
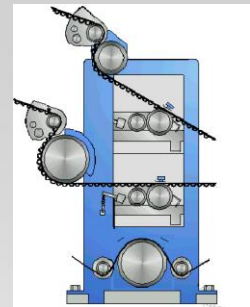
- *Liners – The outside of the corrugated sheet*
- *Mediums – The inside of the corrugated sheet*



Corrugator Unit

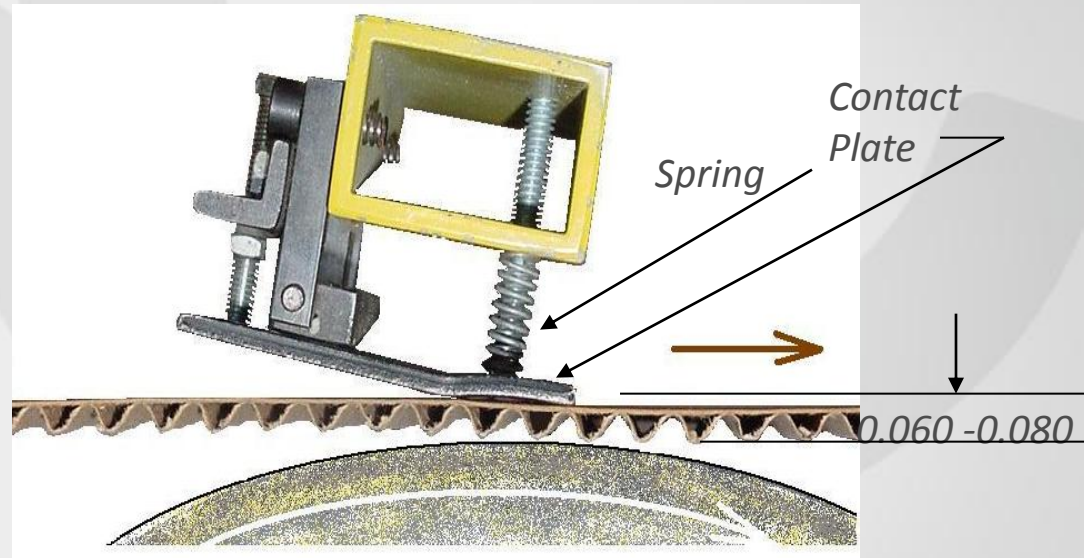
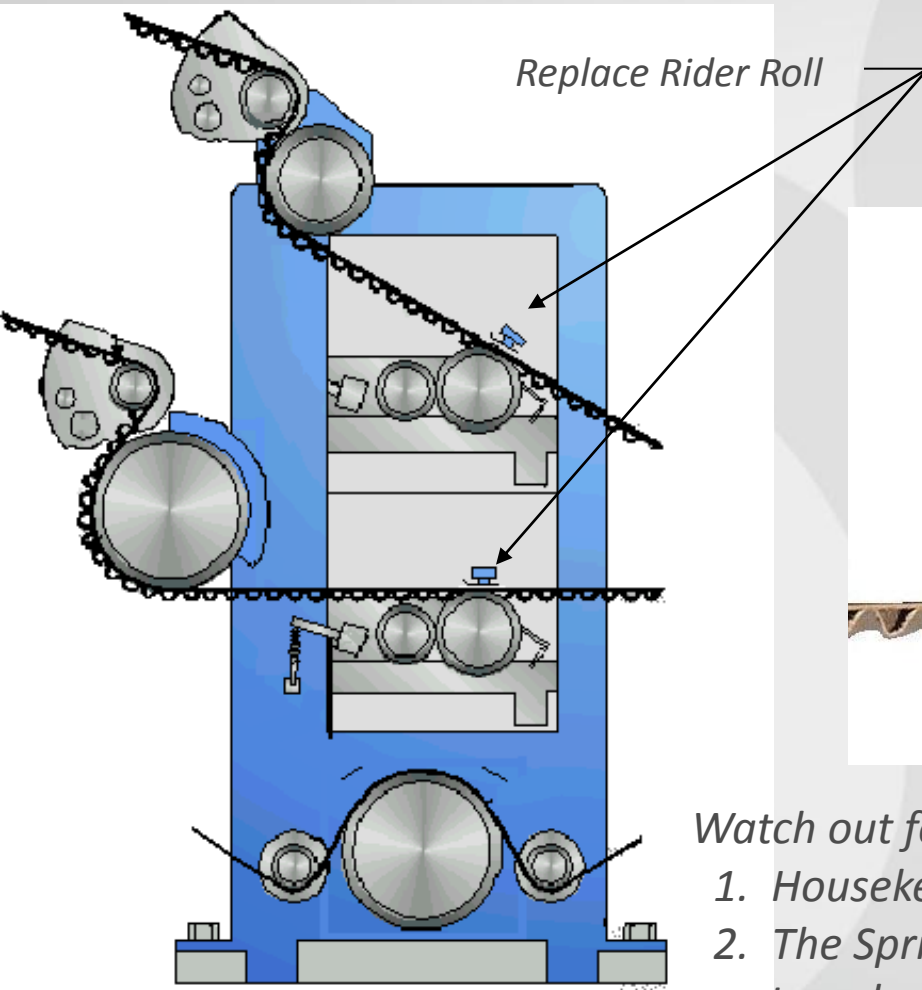
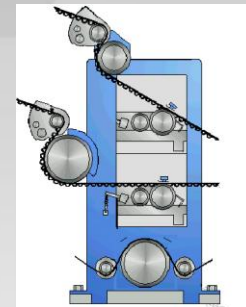


The Glue Machine



- Temp.paper should be between 60° and 65° C
- Below 55° C, risk of delamination

Contact Bars



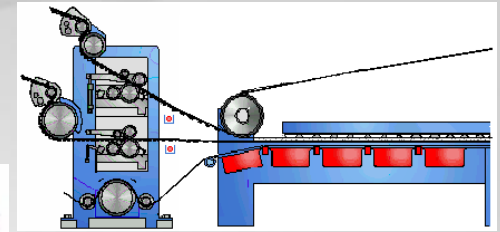
Watch out for:

1. Housekeeping – the Spring & Plate should move
2. The Spring needs to be in the middle of its travel.

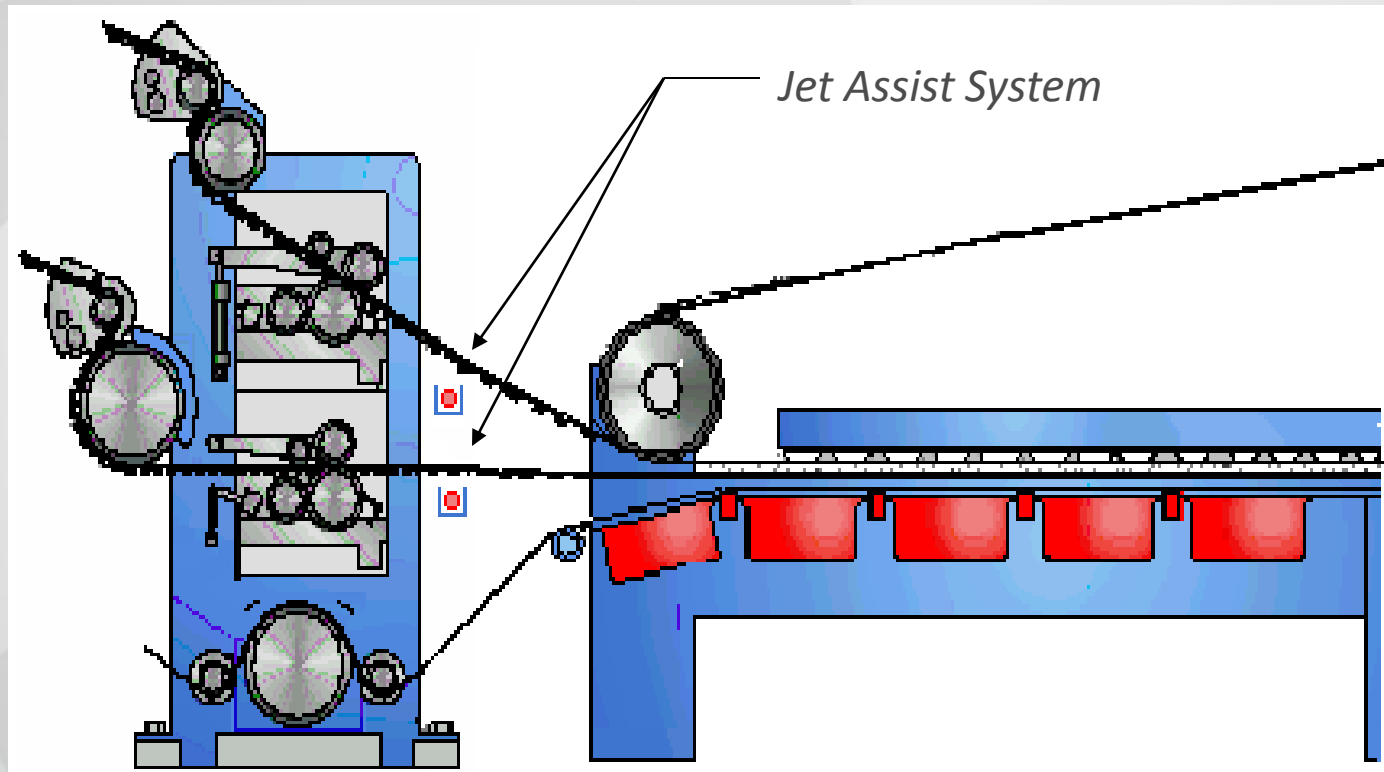
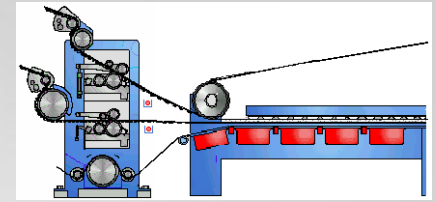
Double gluer varibond

 agnati

 VARYBOND
Glue Machine



Jet Assist System



Jet Assist System

Used to Assist in achieving Higher Run Speeds on Double Wall and Heavy Weight Board

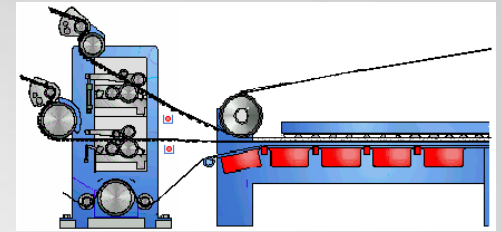
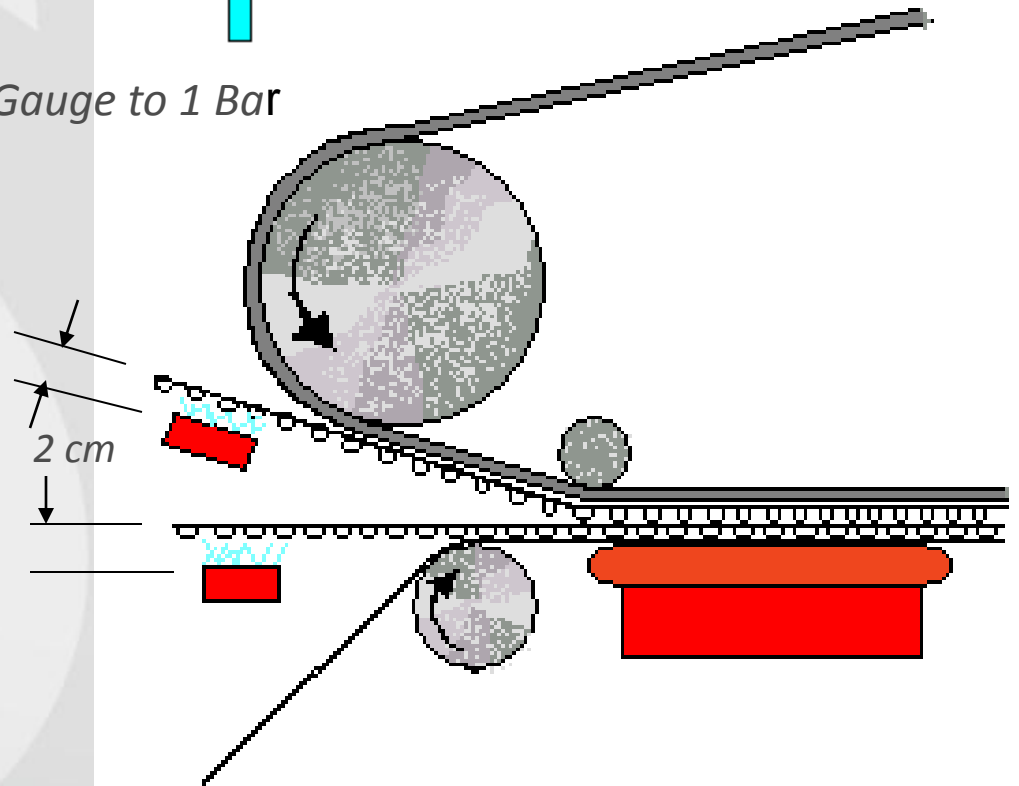
Achieves it by:

- 1. Using Low Pressure Steam 0,5 Bar. (Low pressure to avoid blowing the glue from the flute tips.)*
- 2. Heats the adhesive close to the gel point to facilitate bonding at the double backer.*
- 3. Should only be use at speeds greater than 300 fpm. Ideally, it should be automatic to turn on when speed is achieved.*

0,5 Bar



Gauge to 1 Bar



Corrugating Machines

The hot plates in corrugating machines have basically remained unchanged for nearly a century.

The most significant changes have been in the drive and pressure systems (these latter having influenced the belt manufacturers)

There are three main systems of applying pressure to the board:

- 1. Pressure rollers*
- 2. Press Shoes*
- 3. Sandwich systems*

BALLAST ROLLS SYSTEMS

Description:

- *Heavy steel rollers*

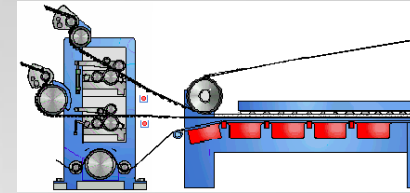
Advantages:

- *Rolling coefficient causes little wear on the back of the belt*

Disadvantages:

- *Not always is guaranteed a constant pressure on the back of the board or belt.*
- *Does not compensate for the normal loss in caliper at the edges of the belt.*
- *Maintenance of bearings is high. Bad bearings can cause guiding problems and excessive wear on the belt.*
- *Roller vibration can cause collapse of the flute, particularly in the seam area.*

Double Facer Section



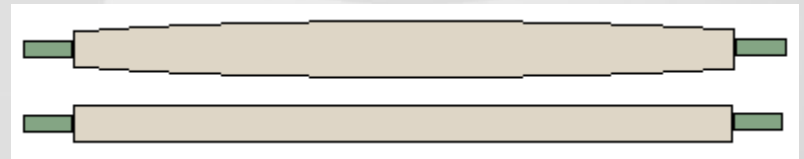
Ballast Rolls

- High maintenance item
 - Housekeeping
 - Bearings

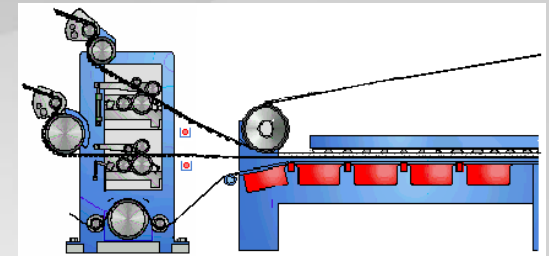


Langston has I, II, III, & IV

- Can have Different Sizes and Different Profiles (Crowned)

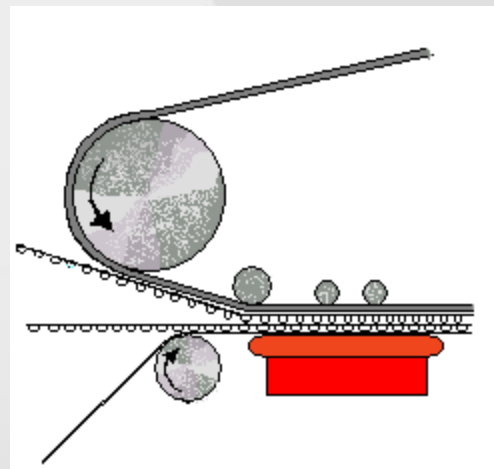


Ballast Rolls

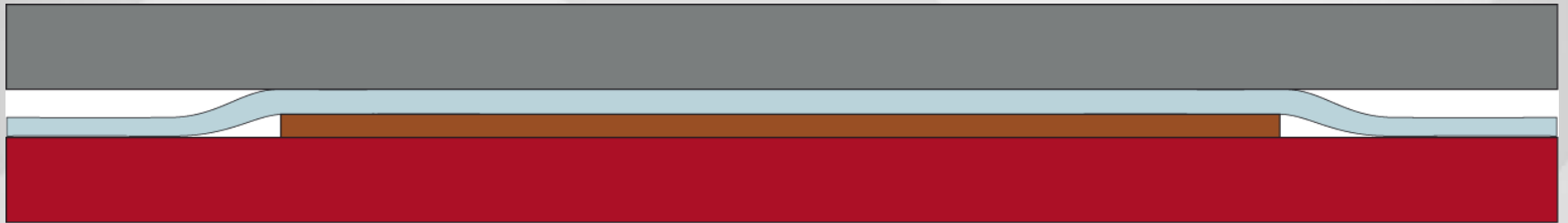


1st Ballast Roll is normally bigger in Diameter and Heavier than rest of ballast rolls

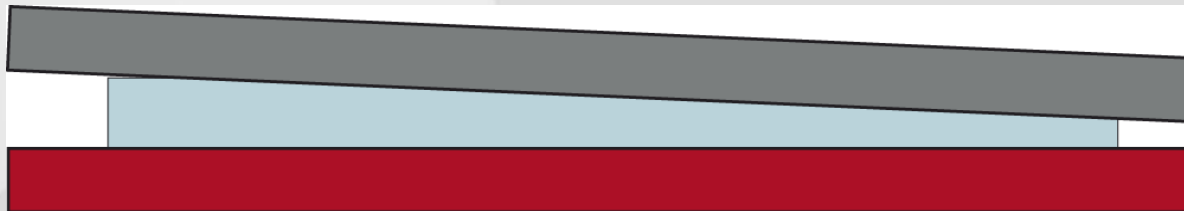
The intent is to have the combined board make contact with the hot plates quickly by weighing the corrugator belt. Without it, the belt would not angle down quickly. The 1st roll is needed even if the double backer has a “hot shoe” type of system.



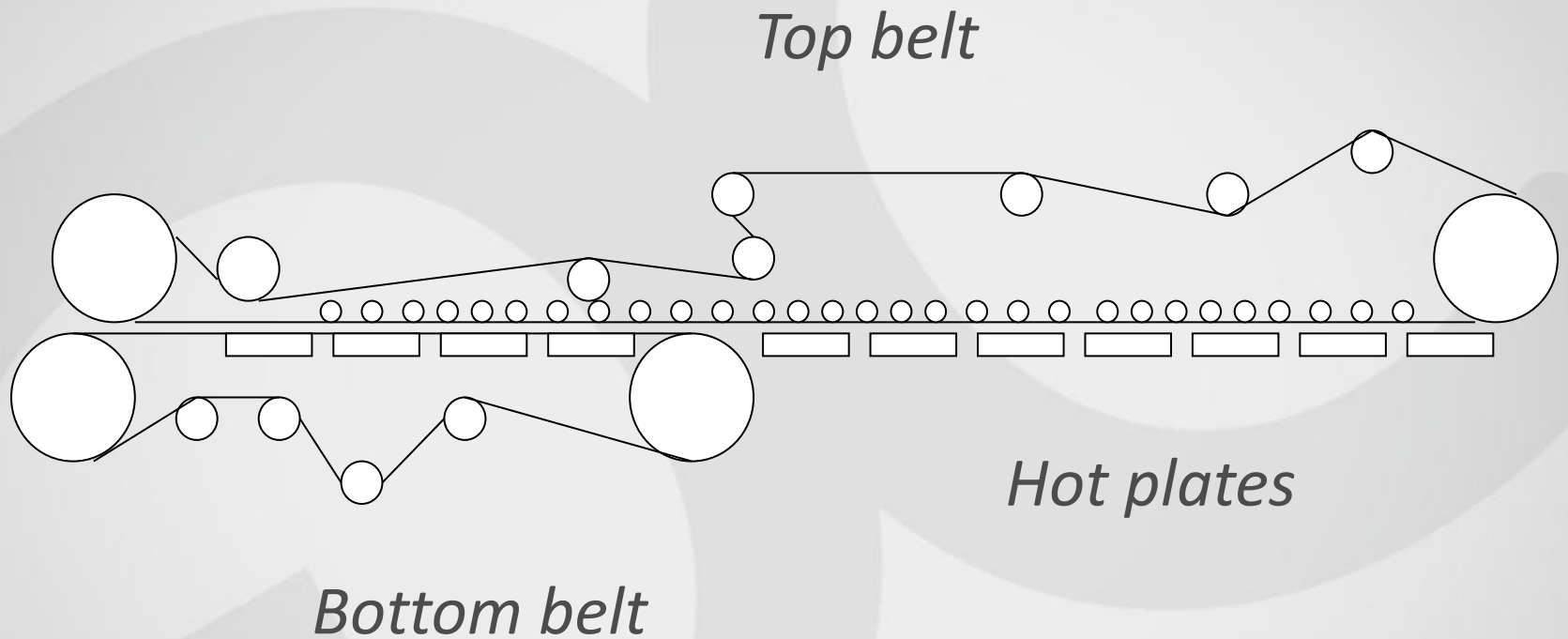
Pressure distribution by a roller machine



Thickness variation on roller machine



Traditional Machine



PRESSURE SHOES

Description:

- *Steel plates (shoes) installed on springs or air bellows.*

Advantages:

- *Excellent pressure control on the whole machine width.*
- *Can compensate for the normal loss in calliper of belt due to wear.*

Disadvantages:

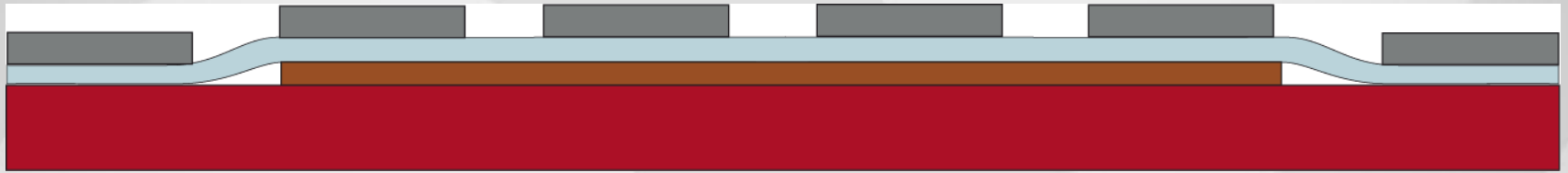
- *Can cause excessive wear on the back of the belt and high energy consumption.*
- *On the edges and with narrower board they can tilt downwards and damage the belt*

Pressure shoes

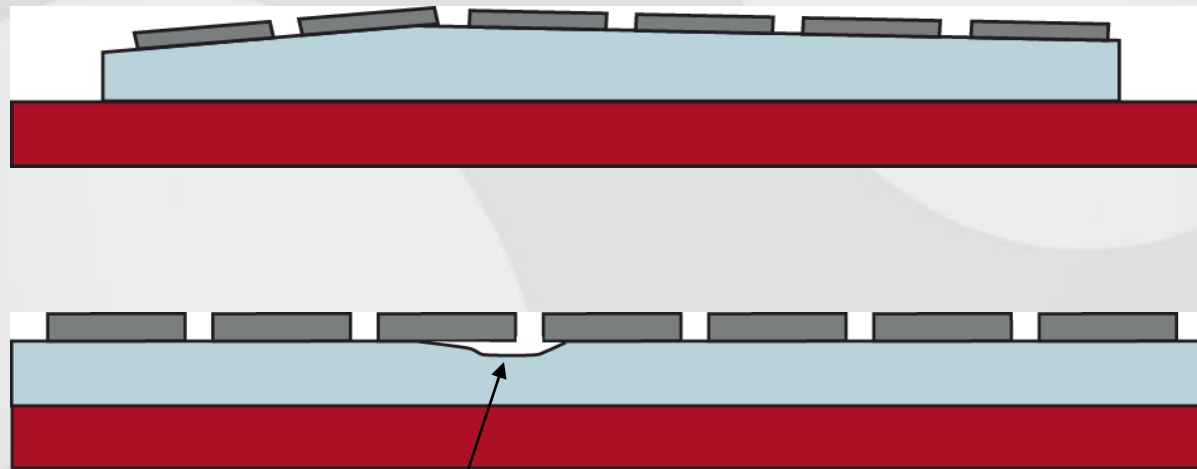
*They can Adjust
to Belt Wear or
Hot plates
deformation*



Pressure distribution on a shoe machine



Thickness variation on shoe machine



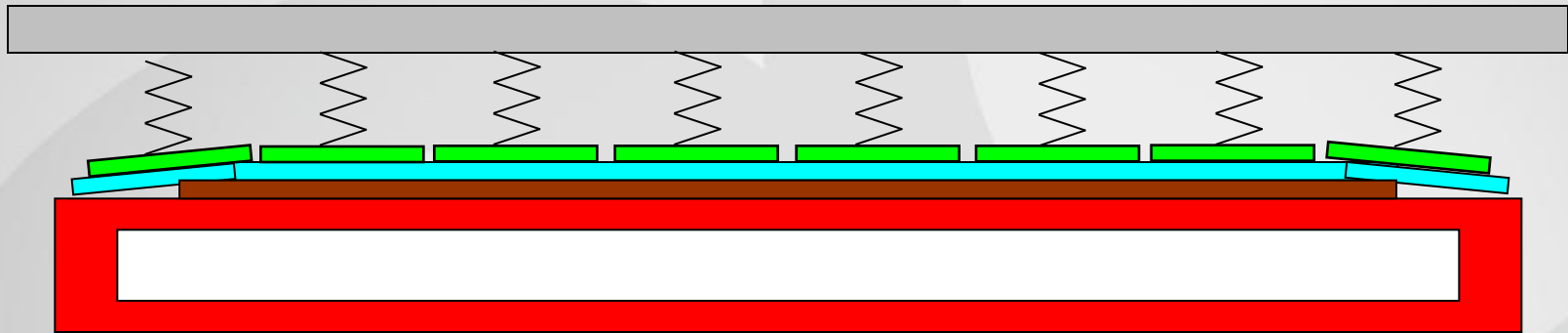
Cannot compensate for localized belt thickness variations

NORMAL SHOE PRESS

THE BELTS TENDS TO STOP GOOD
EVACUATION OF EVAPORATED WATER

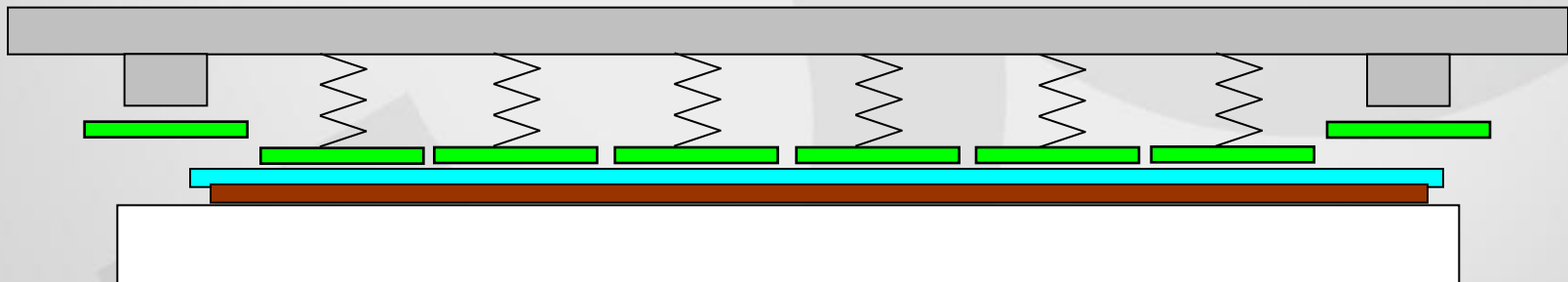
EXAMPLE 1

SHOES BLOCK OFF THE EDGE OF
THE BOARD AND DAMAGE THE BELT

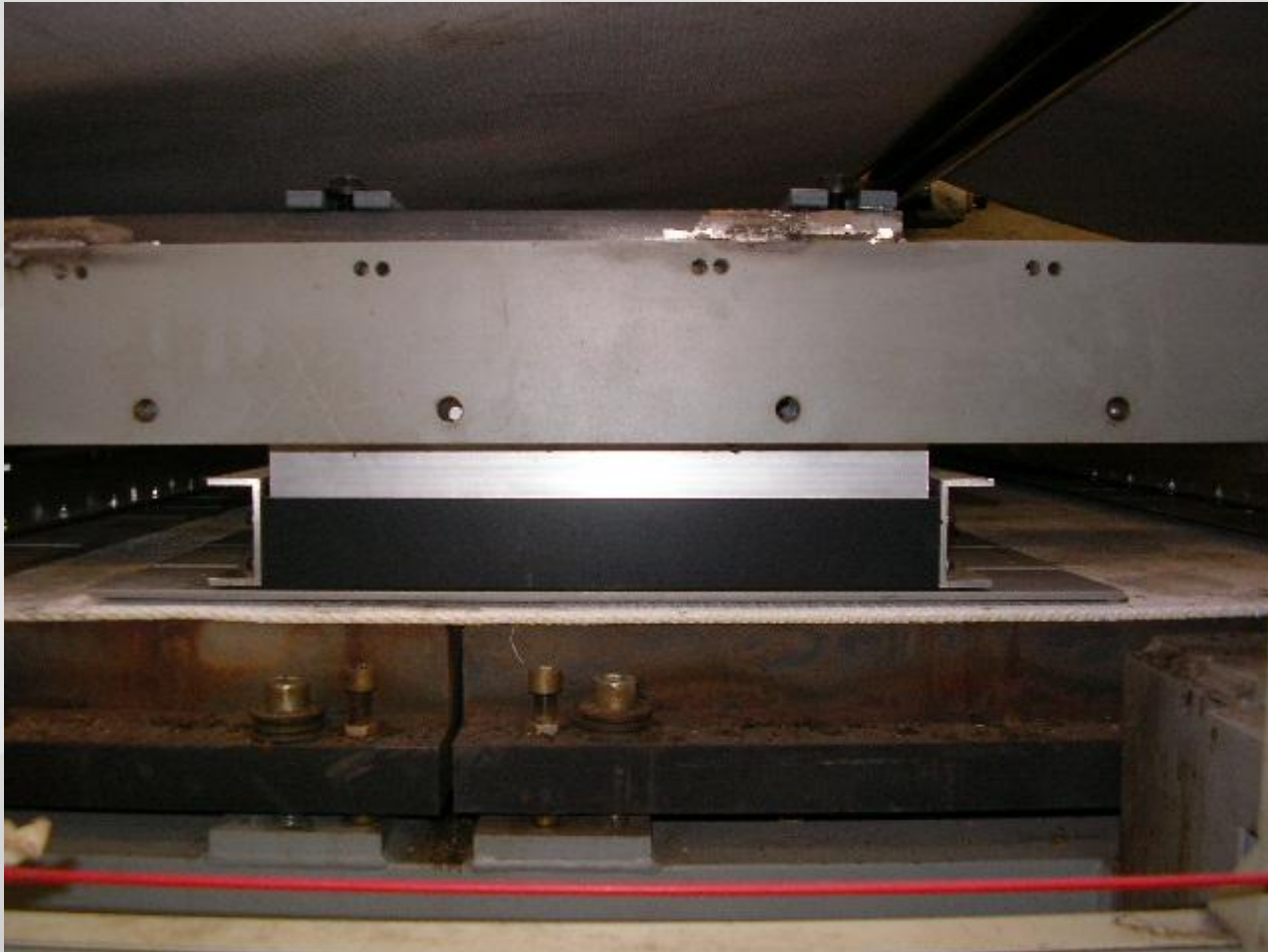


EXAMPLE 2

SHOES ARE RAISED RESULTING
IN LACK OF BONDING ON THE EDGES



S-PRESS

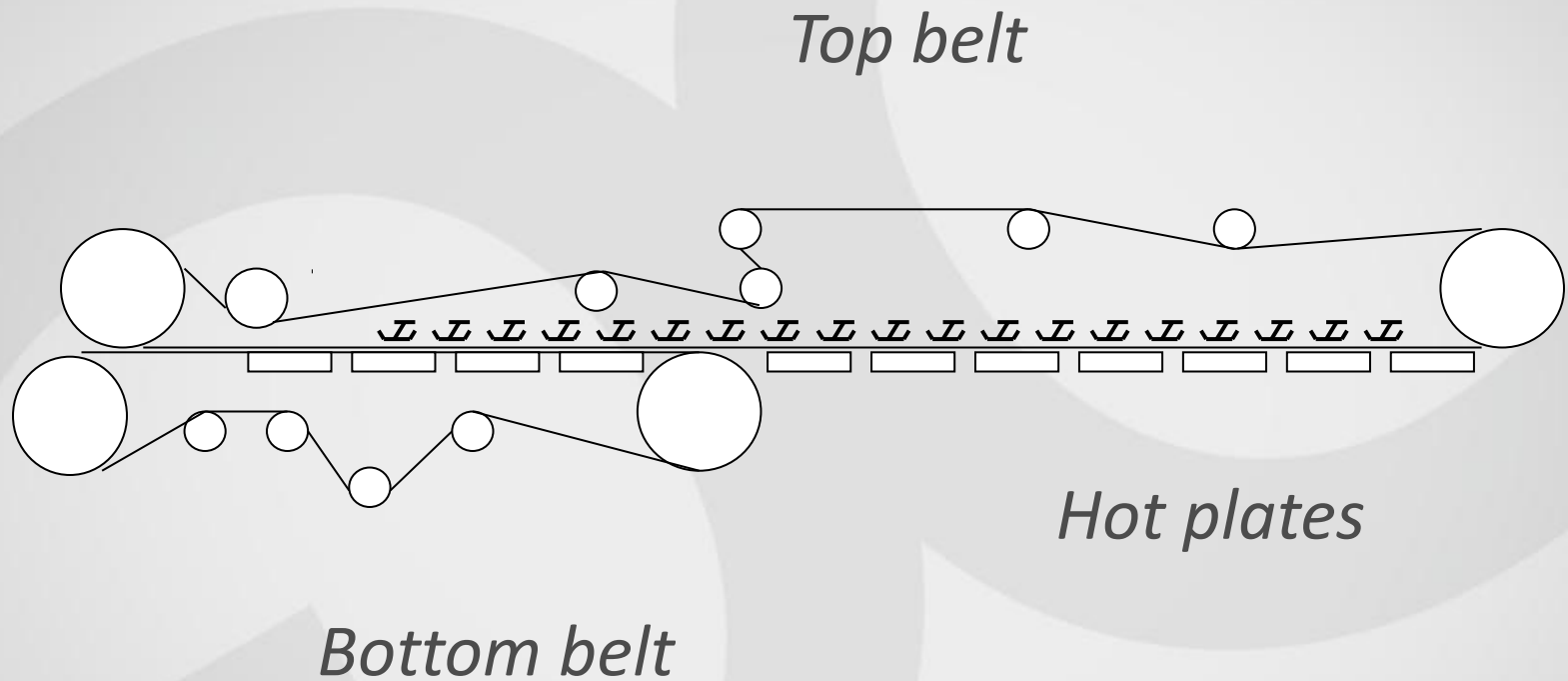


S-PRESS

100% COVERAGE RIGHT UP TO THE EDGE
OF ANY PAPER WIDTH



Pressure Shoes Machine



Sandwich System

Description:

- *Various pressure systems on hot plates but the belt is present and working only in the traction section (or cold section).*

Advantages:

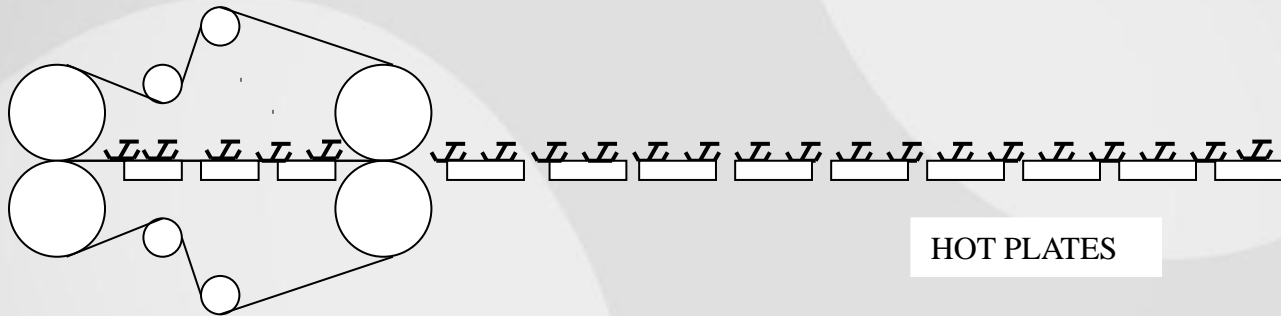
- *Excellent air movement around the board while in contact with the hot plates.*

Disadvantages:

- *Operators can easily get burned by accidental contact with hot plates during the thread in of the paper.*
- *Direct contact between pressure shoes and board can cause streaks in the liner with consequent reduction of printing quality*
- *To pull board it is necessary to use vacuum systems with high energy consumption and costly belts with high traction properties.*

Sandwich system

TRACTION BELT



HOT PLATES

Belt construction

Traditional belts for corrugating machines

1. *Woven belts*

2. *Needled belts*

3. *Multi Spirals*

WOVEN BELTS

Construction:

- *4-6 layer bases of 100% polyester yarns.*

Advantages:

- *Good running life.*
- *Good coefficient of friction between belt and board.*

Disadvantages:

- *They are prone to elongate above 1%, sometimes requesting a re-seaming to reduce excessive length.*
- *Very low permeability (6-8 CFM)*
- *More prone to marking of the board in the seam area (it is not possible to have a protective flap)*
- *The important weight requires higher energy consumption of the drive motor.*

NEEDED BELTS

Construction:

- *2-4 layer base 100% polyester needed with special 100% synthetic fibres*

Advantages:

- *Higher permeability compared to woven belts (12 – 24 CFM)*
- *It is possible to make a flap covering the seam to guarantee absence of seam marking.*
- *They run very well on high speed machines.*

Disadvantages:

- *Belt edges are prone to some loss of calliper due to abrasion effect from starch residues*

OBJECTIVES OF A CORRUGATOR BELT

- *To remove humidity in the least possible time and more uniformly as possible.*
- *To resist abrasion particularly on the edges*
- *To be very stable and to run perfectly straight in the machine*
- *To have and keep a very uniform thickness*
- *To have a very strong non marking seam.*
- *To reduce the energy consumption.*



A Quantum Leap in Corrugator Belt Design and Function

How can



help your corrugator?

Very High Permeability- fast drying

Uniform thickness throughout life- even pressure distribution

Completely Self Cleaning- less maintenance and improved safety

How can



help your corrugator?

Completely Seamless- less marking

Saves Energy- lower production costs

Improved board quality- less claims

Documented Board Calliper Increase- improved board parameters

Supporting Technical Data from Field Studies

ELECTRIC ENERGY CONSUMPTION

SPIRAL BELT VS. STD BELT

	DATA (DATE)	M/MIN FPM	COLLA GRUPPO (SF GAP)	COLLA PIANI (DB GAP)	FRENA TURA CARTA (MED BRAKE PRES.)	FRENO PONTE (BRIDGE GUIDE AIR PRES)	PATTINI PIANI (DB BRAKE PRES)	LUCE CARTA (WEB WIDTH)	SPESSORE CARTONE (CALIPER)	PRESSIONE ENTRATA TAGLIERINA SUP/INF (PULL ROLL TOP/BTM)		GRAMMATURA CARTA (PAPER GRADES)	AMPERAGGIO MOTORE (AMPS)	ONDA (FLUTE)
			MM μ "	MM μ "	%	BAR/PSI	BAR/PSI	MM/ "	MM/ μ	SUP.%	INF.%	g/m2 - LBS		
Std Felt	23/03/2005	153 m/min 504 fpm	0.18 mm 0.007 μ "	0.203 mm 0.008 μ "	28%	4,5 bar 64 psi	2,8 bar 40 psi	2160 mm 85 "	2,87 mm 113 μ	30%	47%	127+112+127g/m2 26-23-26 lbs	105	B
Spirabelt	11/04/2005	160 m/min 525 fpm	0.18 mm 0.007 μ "	0.203 mm 0.008 μ "	28%	2,8 bar 40 psi	2,38 bar 34 psi	2235 mm 88 "	2,94 mm 116 μ	30%	50%	26/23/26 lbs	51	B
CASO 1														
Std Felt	23/03/2005	207 m/min 608 fpm	0.203 mm 0.008 μ "	0.203 mm 0.008 μ "	28%	4,9 bar 70 psi	1,85 bar 26 psi	1550 mm 61 "	2,89 mm 114 μ	30%	50%	150+127+150g/m2 31-26-30 lbs	105	B
Spirabelt	11/04/2005	152 m/min 500 fpm	0.18 mm 0.007 μ "	0.18 mm 0.007 μ "	28%	2,9 bar 42 psi	2,1 bar 30 psi	2000 mm 79 "	2,97 mm 7 μ	32%	48%	31/26/30	54	B
CASO 2														
Std Felt	23/03/2005	131 m/min 430 fpm	0.203 mm 0.008 μ "	0.203 mm 0.008 μ "	20%	2,52 bar 36 psi	2,94 bar 42 psi	2235 mm 88 "	4,01 mm 158 μ	28%	46%	170+112+170g/m2 35-23-35 lbs	105	C
Spirabelt	12/04/2005	161 m/min 531 fpm	0.203 mm 0.008 μ "	0.203 mm 0.008 μ "	22%	2,52 bar 36 psi	2,8 bar 40 psi	2000 mm 79 "	4,06 mm 160 μ	36%	45%	35/23/35	51	C
CASO 3														

THE REASONS FOR ELECTRIC ENERGY SAVING

- *Lower weight of belt*
- *Lower coefficient of friction belt/pressure plates*
- *Lower tension required in the belt (3-4 KN/mt)*
- *Less pressure needed at pressure plates
(particularly at traction section)*

What does this means in \$\$\$?

CALCULATION OF ENERGY SAVING THANKS TO SPIRABELT											
KW=	(HPx0,746xWORKING HRS)/MOTOR EFFICIENCY					WORKING HRS/YEAR/SHIFT	2080				
KW=	(WATTS x WORKING HRS)/1000					COST OF ENERGY/KWH	0,06 USD/KWH				
						COST OF ENERGY/KWH	0,15 EURO/KWH				
TO CHANGE AMPS INTO WATTS (3 PHASE)						WATTS= VOLTSxAMPS x 1,732					
EXAMPLES(usa)											
	VOLTS	AMPERES		WATTS							
SPIRABELT	480	59	1,73	48.994	WATT						
STD BELT	480	98	1,73	81.379	WATT						
DIFFERENCE				32.386	WATT						
	WATT		HRS/YEAR								
SAVING/SHIFT	32.386	X	2080	/	1000	=	67362,05	KWH	X	0,06	= 4.042 USD
SAVING/2 SHIFTS	32.386	X	4160	/	1000	=	134724,1	KWH	X	0,06	= 8.083 USD
SAVING/3 SHIFTS	32.386	X	6240	/	1000	=	202086,1	KWH	X	0,06	= 12.125 USD
EXAMPLES (Europe)											
	VOLTS	AMPERES		WATTS							
SPIRABELT	380	180	1,73	118.332							
STD BELT	380	270	1,73	177.498							
DIFFERENZA				59.166	WATT						
	WATT		HRS/YEAR								
SAVING/SHIFT	59.166	X	2080	/	1000	=	123065,3	KWH	X	0,15	= 18.460 EURO
SAVING/2 SHIFTS	59.166	X	4160	/	1000	=	246130,6	KWH	X	0,15	= 36.920 EURO
SAVING/3 SHIFTS	59.166	X	6240	/	1000	=	369195,8	KWH	X	0,15	= 55.379 EURO

Steam Consumption SpiraBelt™ vs Standard Belt

Considering:

- 100% the total steam produced, in general:*
- 60% will be used by glue kitchen, corr. rolls, pre heaters etc.*
- 40% will be used by double backer*
- A 10% reduction of heat by SpiraBelt™ will imply*

***A SAVING OF 4% OF TOTAL STEAM COSTS!!
But much bigger savings have been reported***

The reasons for steam saving with SpiraBelt™ vs a standard belt

SpiraBelt™ allows the board to dry faster

This means the board dries in the first or second section if hot plates temperature remains constant

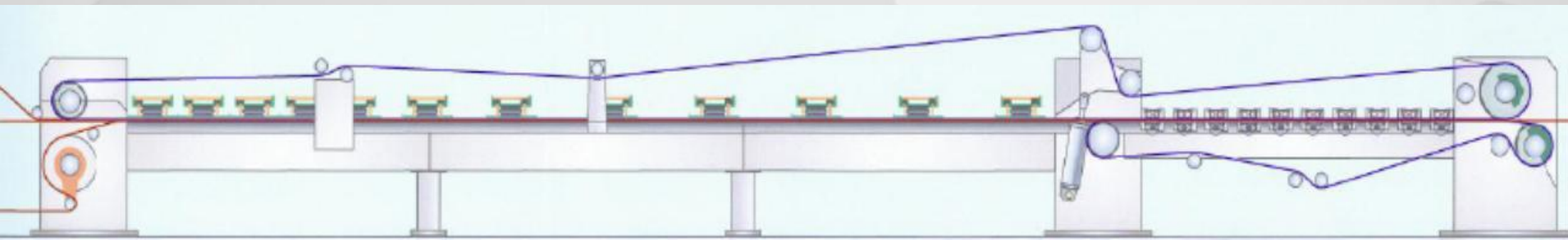
This causes the board to over dry and to accumulate static electricity, increasing board drag on hot plates

To prevent this, lower temperature settings are required, increasing in the three sections:

Example: 4 bar, 6 bar, 8 bar (not the reverse)

This allows to reduce the amount of glue applied

TEMPERATURE SETTINGS



*1st section
low temp
2-4 bar*

*2nd section
Higher temp
2-8 bar*

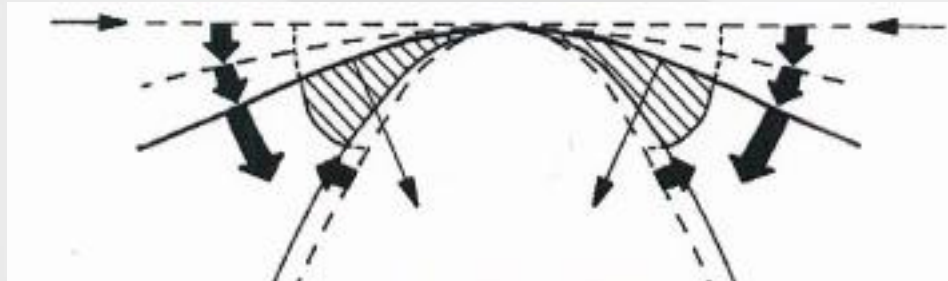
*3rd section
Highest temp
4-10 bar*

15-20 mt equal to 3-7 seconds

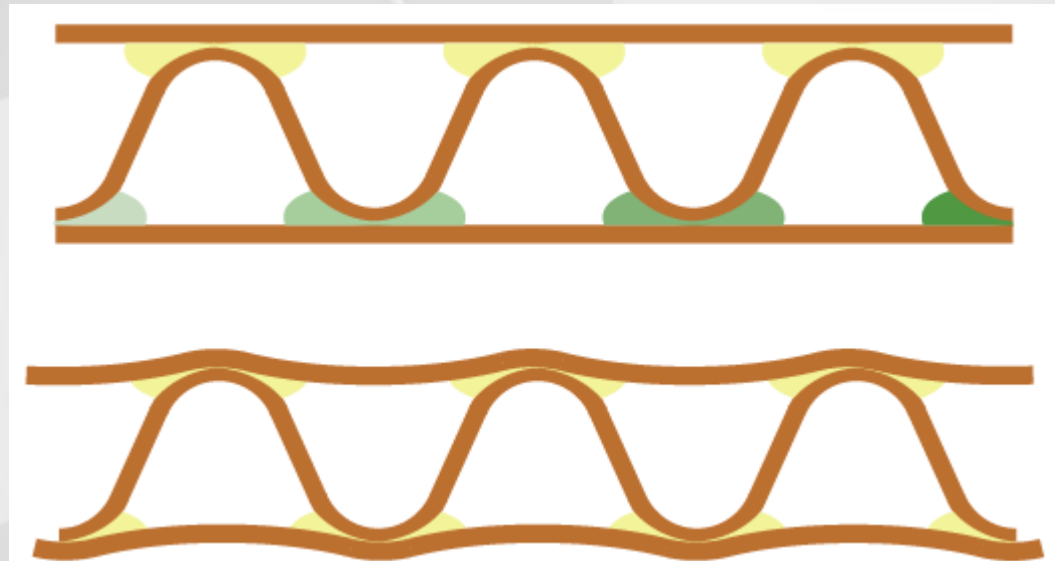
THE REASONS FOR IMPROVED BOARD QUALITY

- *There are no seam marks*
- *The board exits the double backer perfectly bonded, crisp but not too dry*
- *There are no delaminations at cut off knife*
- *The board is flatter*
- *The board comes off colder and can be transformed into boxes right away. No need to condition it. No risk of condensation damaging the board*
- *Less glue = less risk of washboard*

Classic Washboard due to excessive glue



Washboard



€ NUMBERS IN A MODERN CORRUGATING MILL

A modern corrugating mill producing sheet board (not boxes) has an average waste of 7% in total

- This waste comes from 2-2,5% from trim and 4,5-5% from waste on the corrugator (this includes waste on bobbins, start up waste etc.)*
- A modern mill working in three shifts produces approximately 180 millions m² of board, therefore approximately 60 millions m² per shift*
- This accounts to approximately 30,000 tons of paper/shift/year.*
- At cost/ton of paper ranging from 350 to 500 Euro/ton this accounts to 10,5 to 15 millions euro/year per shift.*

A reduction of 1% in waste is equivalent from 105,000 to 150,000 € /year/shift

Spirabelt

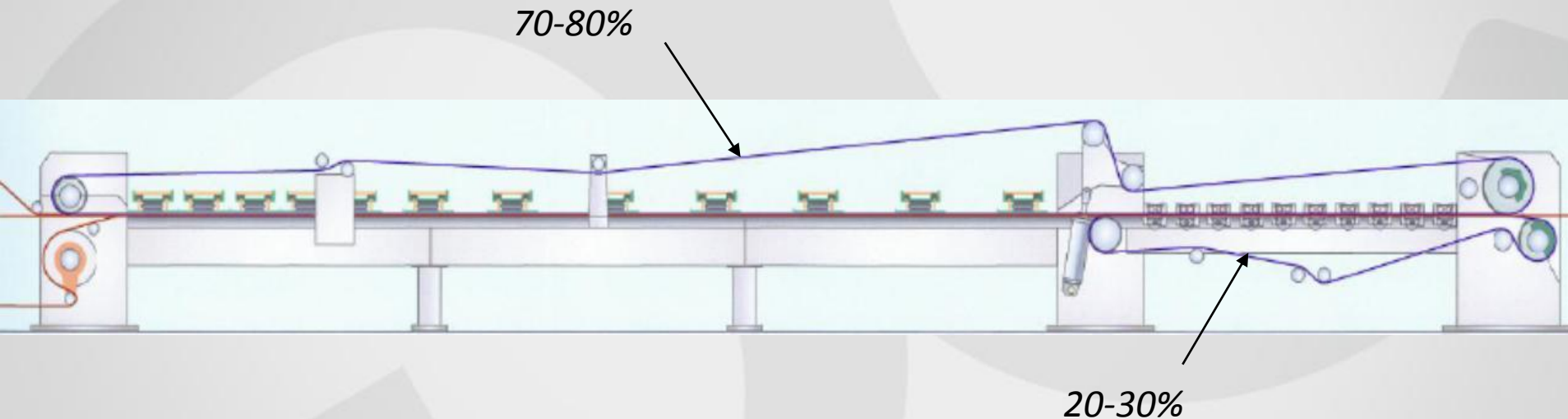
PATENTED

Based on our experience, we are now able to pinpoint the perfect customer for SpiraBelt™

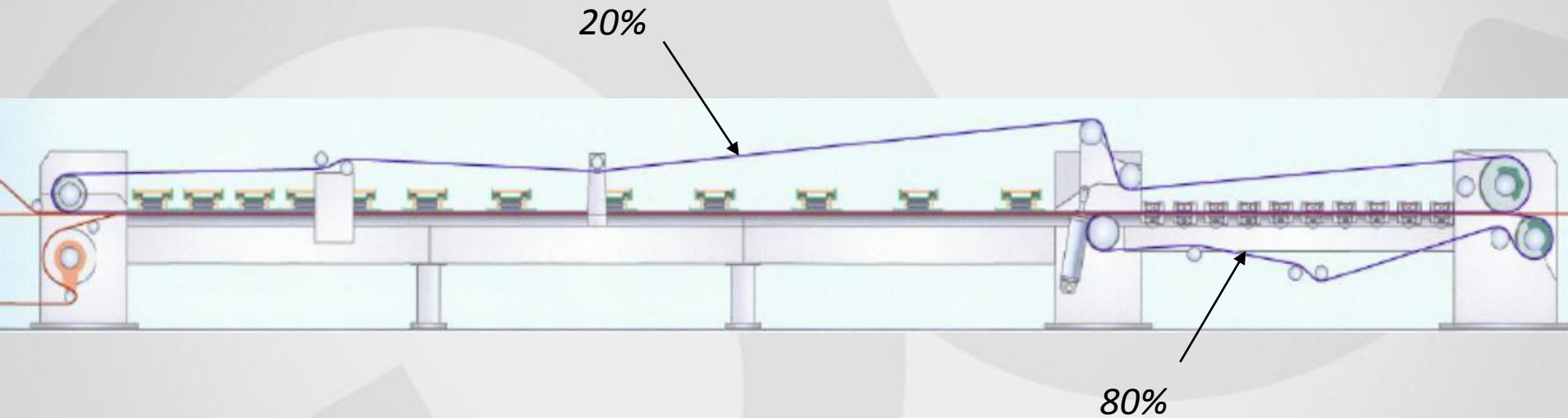
Ideal Corrugator Setup:

- *All corrugators equipped with flat pressure systems (we are checking if OK also on roller machines)*
- *Machines that have a high traction bottom belt*
- *The belt lifting system is in good working order*
- *Pressure plates are well aligned, clean, square and are pressing uniformly on belt (make sure the pressure plates system can adapt to a thinner belt!!)*
- *Rolls are cleaned and square*
- *The machine has only ONE drive motor (Fosber can have TWO motors)*
- *Capacity to reduce steam pressure lower than 1 bar*

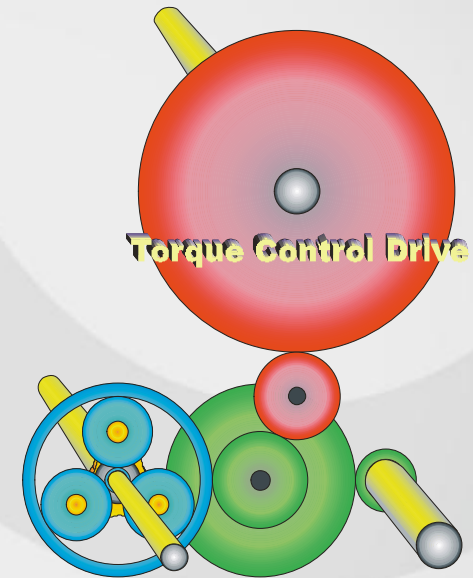
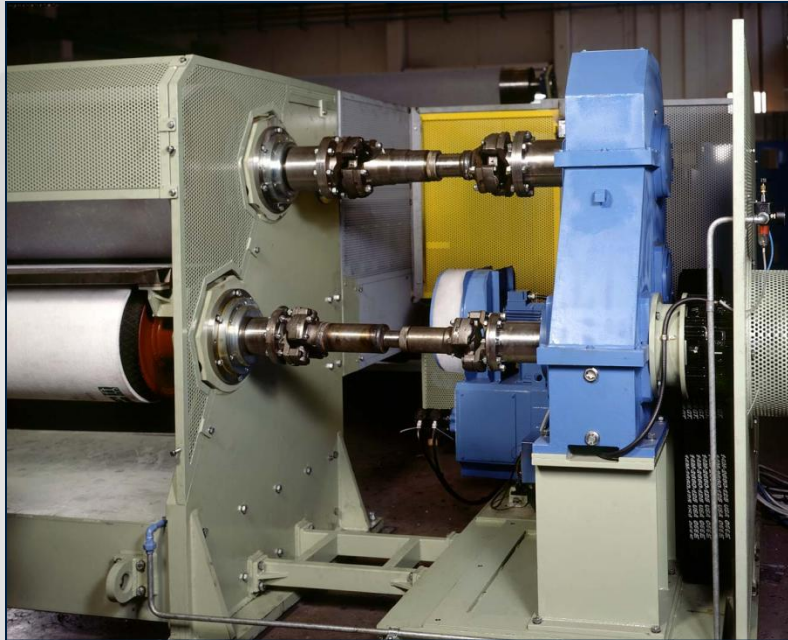
Forces applied when using traditional belts



Forces applied when using SpiraBelt™



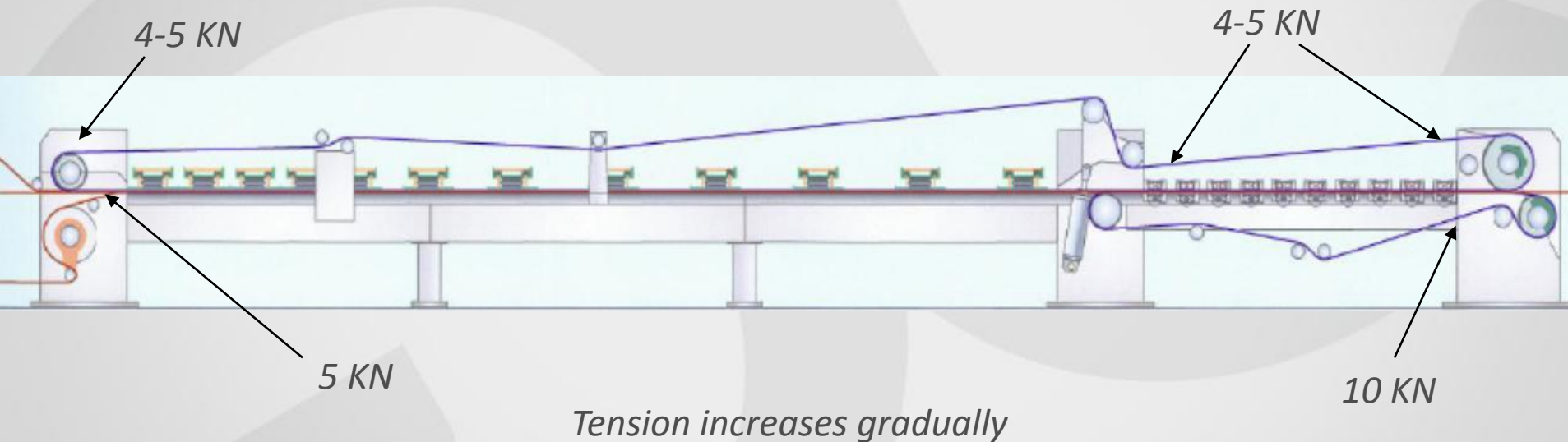
Example of differential transmission



*Some machines have TWO motors: make sure you get this information
With two motors Spirabelt cannot be used.*

Tension variation on top belt

*On the hot plates a standard belt can stretch up to 100 mm
SpiraBelt™ does not stretch at all*



PROVEN BENEFITS OF SPIRABELT

- *IMPROVED BOARD QUALITY*
- *LOWER ELECTRIC AND STEAM CONSUMPTION*
- *REDUCED GLUE CONSUMPTION*
- *REDUCED WASTE*
- *IMPROVED SAFETY*
- *LESS MAINTENANCE COSTS (No Seam problems, less bearings change, no cleaning necessary, faster installation with less people)*

CUSTOMERS HAVE SAID:

EUROPAK ALBARRAQUE (Portugal)

Easy to handle and to install

Considerable reduction in energy consumption at main drive

Considerable reduction in steam required for perfect bonding

Bonding takes place in 0 hour instead of 4 hours

MONDI PINETOWN (SAF):

Marked improvement of board quality when producing micro board and using difficult, sealed papers.

Remarkable reduction in energy (electric and steam)

Excellent stability and planarity

Waste has considerably reduced; final calculation at the end of the year

SCA VERNAMO (Sweden)

Can only run with SpiraBelt™ and will never turn back to standard belts

SCA PORCARI (ITALY)

We can produce heavy triple wall at more than 150 m/min and the board comes out of the hot plates already perfectly dry; no delamination at the slitter scorer