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

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

- Corrugating rolls
- Glue unit
- Liner
- Fluting
- Cannelé
The Glue Machine

- Rider Roll - Can be retrofit with Contact Bars
- Pre Heater
- Glue Roll
- Single Facer Webb
- Liner

- Temp. paper should be between 60 °C 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
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.
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

- Can have Different Sizes and Different Profiles (Crowned)

Langston has I, II, III, & IV
1\textsuperscript{st} 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 1\textsuperscript{st} 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

Top belt

Bottom belt

Hot plates
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

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

HOT PLATE
Pressure Shoes Machine

Top belt

Bottom belt

Hot plates
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.
NEEDLED BELTS

Construction:
• 2-4 layer base 100% polyester needled 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 Spirabelt 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 Spirabelt 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

<table>
<thead>
<tr>
<th>CASE 1</th>
<th>DATA (DATE)</th>
<th>M/MIN (FPM)</th>
<th>COLLA GRUPPO (SF GAP)</th>
<th>COLLA PIANI (DB GAP)</th>
<th>FRENATURA CARTA (MEDI BRAKE PRES.)</th>
<th>FRENO PONTE (BRIDGE GUIDE AIR PRES.)</th>
<th>PATTINI PIANI (DB BRAKE PRES.)</th>
<th>LUCE CARTA (WEB WIDTH)</th>
<th>SPESORE CARTONE (CALIPER)</th>
<th>PRESSIONE ENTRATA TAGLIERINA SUP/INF (PULL ROLL TOP/BTM)</th>
<th>GRAMMATURA CARTA (PAPER GRADES)</th>
<th>AMPERAGGIO MOTORE (AMPS)</th>
<th>ONDA (FLUTE)</th>
</tr>
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<tbody>
<tr>
<td>CASO 1</td>
<td>Std Felt</td>
<td>23/03/2005</td>
<td>153 m/min 504 fpm</td>
<td>0.18 mm 0.007 µ&quot;</td>
<td>0.203 mm 0.008 µ&quot;</td>
<td>28% 4.5 bar 64 psi 2.8 bar 40 psi 2160 mm 85 &quot; 2.87 mm 113 µ</td>
<td>30% 47% 127+112+127 g/m2 26-23-26 lbs</td>
<td>105 B</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Spiralbelt</td>
<td>11/04/2005</td>
<td>160 m/min 525 fpm</td>
<td>0.18 mm 0.007 µ&quot;</td>
<td>0.203 mm 0.008 µ&quot;</td>
<td>28% 2.8 bar 40 psi 2.38 bar 34 psi 2235 mm 88 &quot; 2.94 mm 116 µ</td>
<td>30% 50% 26/23/26 lbs</td>
<td>51 B</td>
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<td>Std Felt</td>
<td>23/03/2005</td>
<td>207 m/min 608 fpm</td>
<td>0.203 mm 0.008 µ&quot;</td>
<td>0.203 mm 0.008 µ&quot;</td>
<td>28% 4.9 bar 70 psi 1.85 bar 26 psi 1550 mm 61 &quot; 2.89 mm 114 µ</td>
<td>30% 50% 150+127+150 g/m2 31-26-30 lbs</td>
<td>105 B</td>
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<tr>
<td></td>
<td>Spiralbelt</td>
<td>11/04/2005</td>
<td>152 m/min 500 fpm</td>
<td>0.18 mm 0.007 µ&quot;</td>
<td>0.18 mm 0.007 µ&quot;</td>
<td>28% 2.9 bar 42 psi 2.1 bar 30 psi 2000 mm 79 &quot; 2.97 mm 7 µ</td>
<td>32% 48% 31/26/30</td>
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<td>131 m/min 430 fpm</td>
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<td>0.203 mm 0.008 µ&quot;</td>
<td>20% 2.52 bar 36 psi 2.94 bar 42 psi 2235 mm 88 &quot; 4.01 mm 158 µ</td>
<td>28% 46% 170+112+170 g/m2 35-23-35 lbs</td>
<td>105 C</td>
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<tr>
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<td>Spiralbelt</td>
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<td>161 m/min 531 fpm</td>
<td>0.203 mm 0.008 µ&quot;</td>
<td>0.203 mm 0.008 µ&quot;</td>
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<td>36% 45% 35/23/35</td>
<td>51 C</td>
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</table>
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)
### CALCULATION OF ENERGY SAVING THANKS TO SPIRABELT

\[
KW = \frac{(HP \times 0.746 \times WORKING\ HRS)}{MOTOR\ EFFICIENCY}\ \\
KW = \frac{(WATTS \times WORKING\ HRS)}{1000}
\]

<table>
<thead>
<tr>
<th>WORKING HRS/YEAR/SHIFT</th>
<th>2080</th>
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<tbody>
<tr>
<td>COST OF ENERGY/KWH</td>
<td>0.06 USD/KWH</td>
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<tr>
<td>COST OF ENERGY/KWH</td>
<td>0.15 EURO/KWH</td>
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TO CHANGE AMPS INTO WATTS (3 PHASE)

\[
WATTS = VOLTS \times AMPS \times 1.732
\]

### EXAMPLES (USA)

<table>
<thead>
<tr>
<th></th>
<th>VOLTS</th>
<th>AMPERES</th>
<th>WATTS</th>
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<tbody>
<tr>
<td>SPIRABELT</td>
<td>480</td>
<td>59</td>
<td>48.994</td>
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<tr>
<td>STD BELT</td>
<td>480</td>
<td>98</td>
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**DIFFERENCE**

\[
32.386\ WATT
\]

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<thead>
<tr>
<th>SAVING/SHIFT</th>
<th>WATT</th>
<th>HRS/YEAR</th>
<th>KWH</th>
<th>X</th>
<th>0.06</th>
<th>USD</th>
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</thead>
<tbody>
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<td>KWH</td>
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<td>SAVING/2 SHIFTS</td>
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<tr>
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<td>202086.1</td>
<td>KWH</td>
<td>0.06</td>
<td>12.125 USD</td>
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### EXAMPLES (Europe)

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<tr>
<th></th>
<th>VOLTS</th>
<th>AMPERES</th>
<th>WATTS</th>
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<tbody>
<tr>
<td>SPIRABELT</td>
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<td>180</td>
<td>118.332</td>
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<tr>
<td>STD BELT</td>
<td>380</td>
<td>270</td>
<td>177.498</td>
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**DIFFERENZA**

\[
59.166\ WATT
\]

<table>
<thead>
<tr>
<th>SAVING/SHIFT</th>
<th>WATT</th>
<th>HRS/YEAR</th>
<th>KWH</th>
<th>X</th>
<th>0.15</th>
<th>EURO</th>
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<td>369195.8</td>
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<td>55.379 EURO</td>
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</table>
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
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.
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

- 70-80%
- 20-30%
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.

Tension increases gradually.

4-5 KN

5 KN

4-5 KN

10 KN
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