Design, Print & Packaging Skillnet

www.dppskillnet.ie

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Welcome

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Paperboard Packaging
Cartons & Paperboard Packaging

The Irish PACKAGING SOCIETY
Affiliated with I•M3

2

In 1817 in England, Sir Malcolm Thornhill produced the first commercially made cardboard box although they required significant labour to produce.

Scotsman Robert Gair invented much more economical precut and creased cardboard boxes in Brooklyn in the United States in the late 1870's.

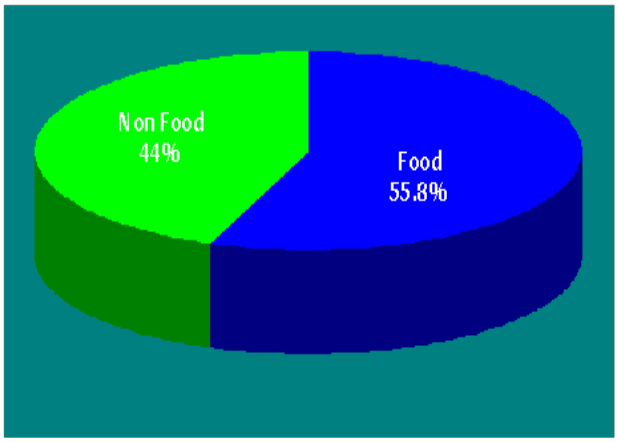
3

EU Carton Market

- 5.6 million tons
- €10.9 billion
- 167 billion Folding Cartons
- (15.9% of Global Consumption)

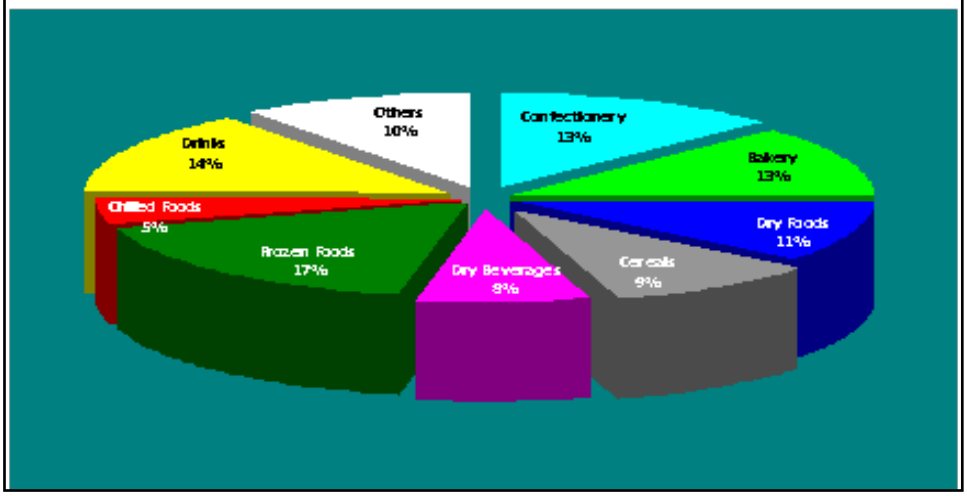
4

This graph shows the approximate split between food and non-food usage



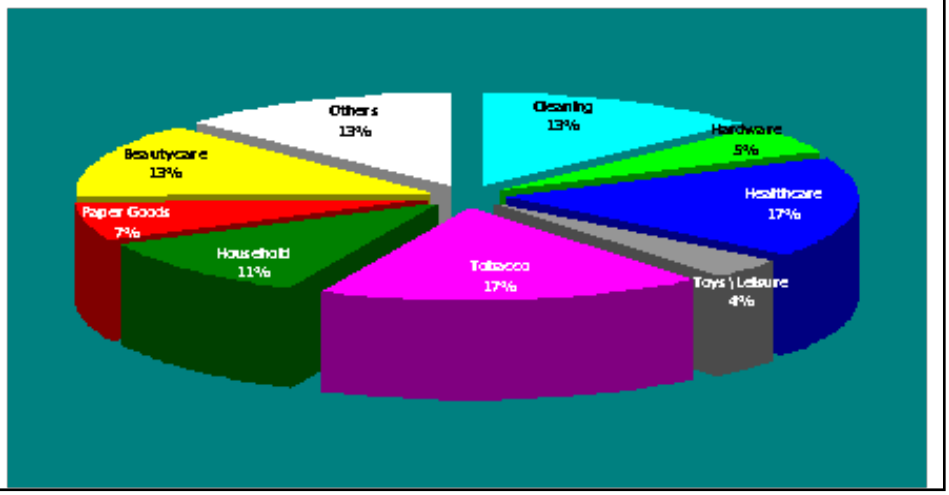
5

This graph shows the approximate split of cartons used for food packaging



6

This graph shows the approximate split of cartons used for non-food packaging



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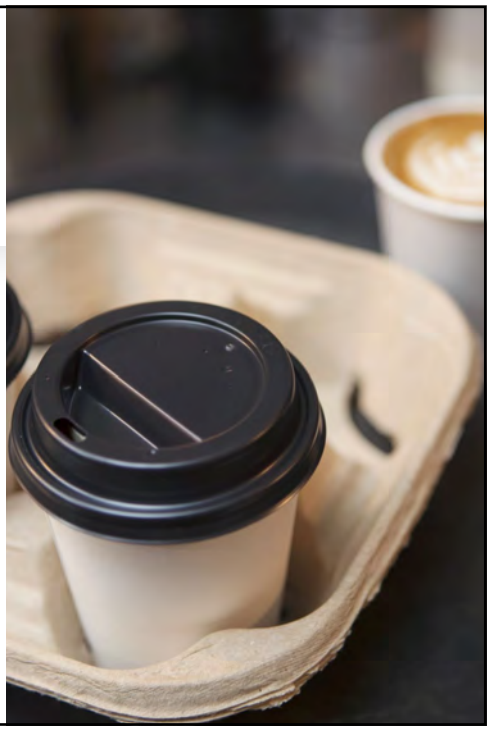
Types of Paperboard Packaging

Let's discuss



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Types of Paperboard Packaging

- Folding Cartons – Fold flat
- Rigid Boxes – Fancy Boxes made-up
- Carded Display Packaging – Blister or Skin
- Tetra pak or Combibloc style
- Spiral & Convolute Cans
- Tubs, Trays and Liquid-Resistant Boxes
- Moulded Pulp
- Corrugated Packaging
- Bags, Labels, Sacks, etc.

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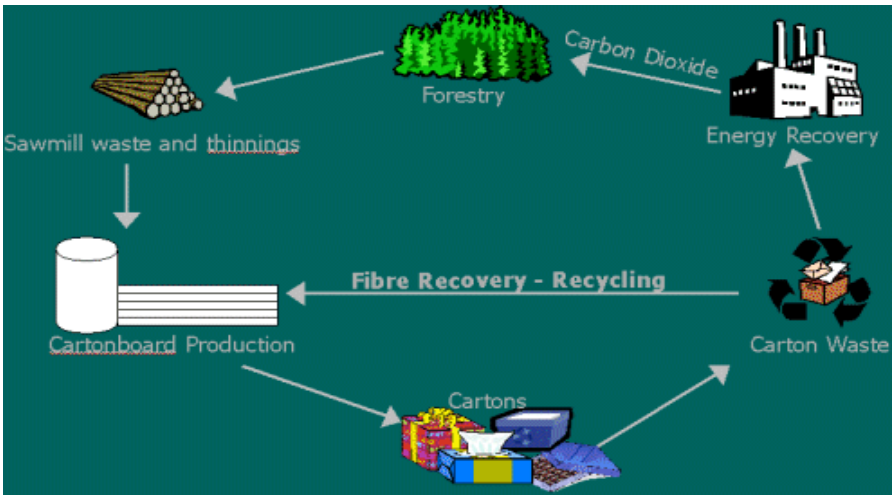
Life Cycle



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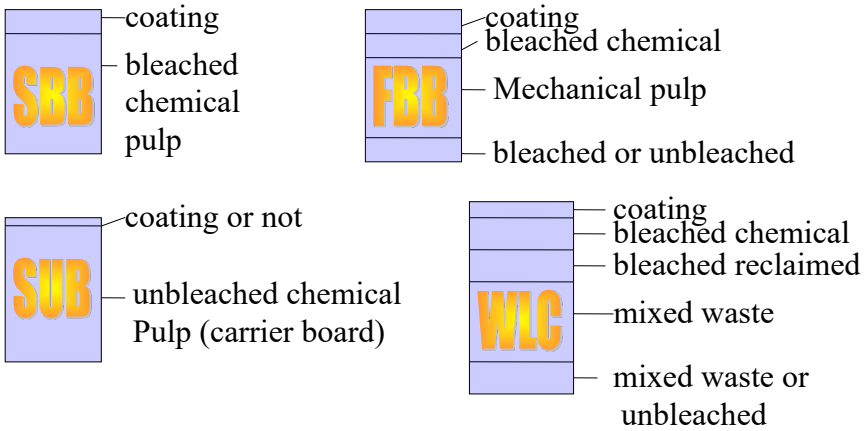
BOARD MAKE-UP



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Board Characteristics

Paperboard type	Paperboard characteristics	Creasing results
Solid Bleached Board	Dense, strong, and tough paperboard. Strong plies throughout to withstand demanding creasing.	Develops well defined permanent creases easily. Gives creases with low folding resistance and good foldability over a wide range of crease geometries. Accepts very narrow and deep creases without damage.
Folding Box Board	Low density, stiff paperboard. Strong surface plies to withstand the crease stress and deformation.	Develops well defined creases. The compressible interior gives less permanence of the crease as defined by the tools. The high stiffness in relation to the folding resistance gives good foldability.
White Lined Chipboard	Dense, intermediate to low strength and stiffness. Stronger surface plies to accept moderate creasing.	Develops creases provided the tools are matched with the chosen paperboard. The physical properties and pulp composition varies to a large extent. It is not possible to give typical values.

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Paperboard nomenclature

Overview of paperboard nomenclature

Definition (DIN 19303)		Type	Description	Pulp stock
uncoated	coated			
	AZ	SBS	Cast-coated solid bleached board with white reverse	Fully bleached chemical pulp
	AC1	FBB	Cast-coated solid boxboard with white reverse	Chemical and mechanical pulp
	AC2	FBB	Cast-coated solid boxboard with cream reverse	Chemical and mechanical pulp
UZ	GZ	SBS	Solid bleached board	Fully bleached chemical pulp
	GN1	SUS/SUB/CNK	Solid unbleached board with white reverse	Unbleached chemical pulp
	GN4	SUS	Solid unbleached board with brown reverse	Unbleached chemical pulp
UC1	GC1	FBB	Folding boxboard with white reverse	Chemical and mechanical pulp
UC2	GC2	FBB	Folding boxboard with cream reverse	Chemical and mechanical pulp
UT1	GT1	WLC	White lined chipboard with white reverse	Secondary fibres
UT2	GT2	WLC	White lined chipboard with cream reverse	Secondary fibres
UT4	GT4	WLC	White lined chipboard with brown reverse	Secondary fibres
UD1	GD1	WLC	White lined chipboard high bulk ≥ 1.45 cm^3/g	Secondary fibres
UD2	GD2	WLC	White lined chipboard high bulk < 1.45 cm^3/g, > 1.3 cm^3/g	Secondary fibres
UD3	GD3	WLC	White lined chipboard high bulk ≤ 1.3 cm^3/g	Secondary fibres

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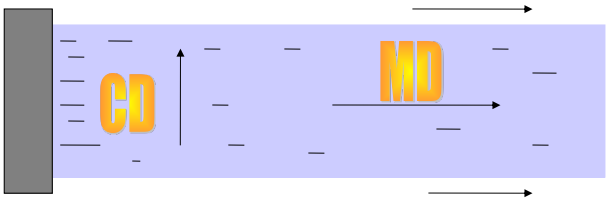
GRAIN DIRECTION

- MACHINE DIRECTION (MD)
- CROSS DIRECTION (CD)

The watery pulp deposited on a moving belt tends to align mostly in one direction. However this happens twice as much on a Cylinder machine



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Sample Carton

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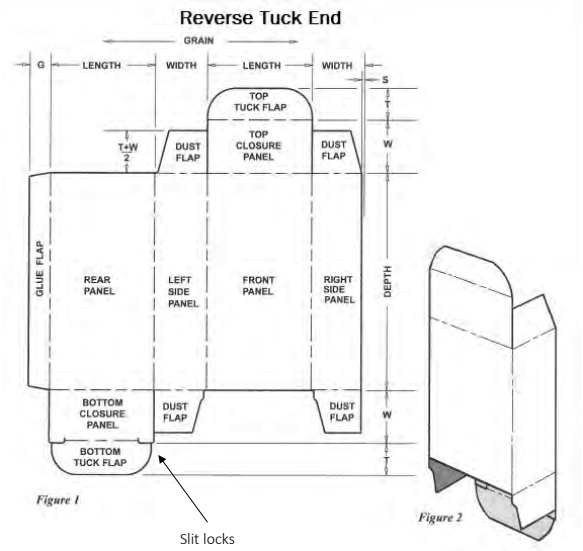
RTE carton



L x B x D
In carton production the first dimension is the length and usually the longest front panel, but with SRP it may not be the longest panel.

Solid board folding cartons are measured using the OD (outside dimensions)

17

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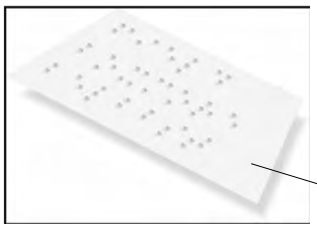
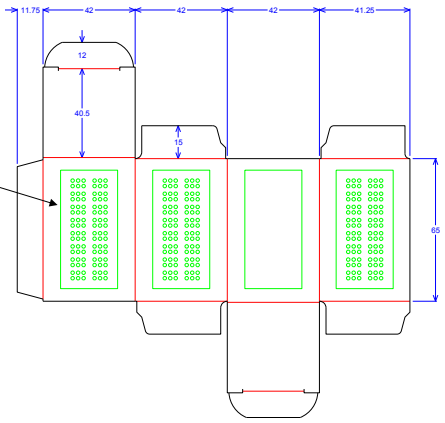
Pharma carton Keyline 1 up



Braille Position



Courtesy of **Westrock – MPS**

18

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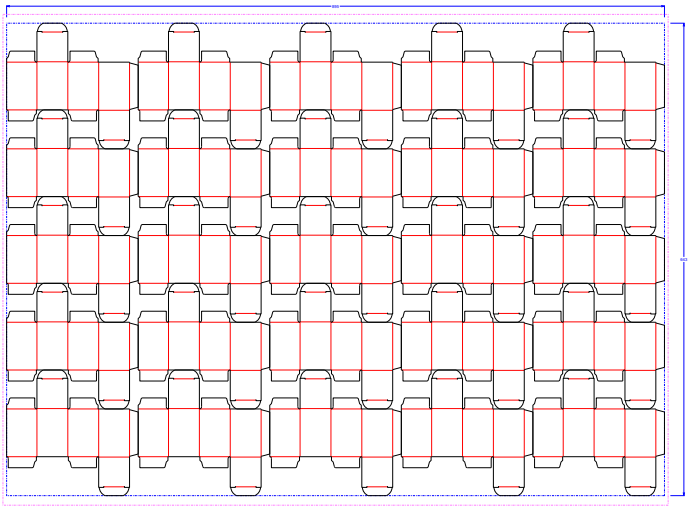
Stepped file

25 up



895 x 643mm

Courtesy of **Westrock – MPS**

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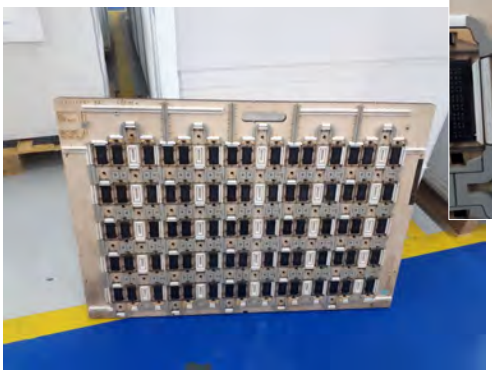
Small RTE carton die

(Forme) 25 up



Courtesy of **Westrock – MPS**

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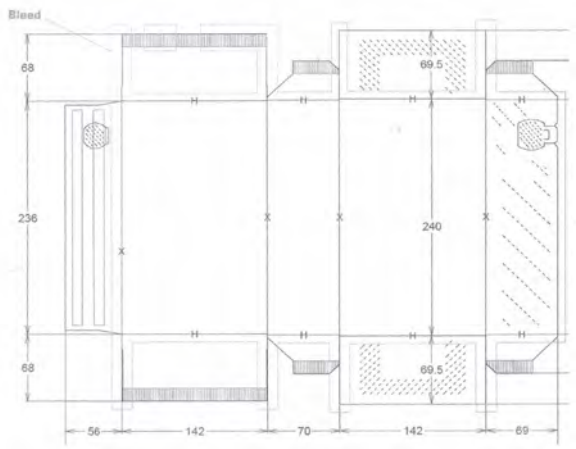
Carton Keyline Showing bleed and varnish free areas.



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Carton Design Considerations

- Will the carton hold self-contained packs?
- Will there be one entry or multiple entry?
- Is the product particularly heavy?
- Does the product need to be seen?
- Does the product need to be siftproof
- What is the method of packing
- Does the carton need a tamper seal
- Will the box be used for long term storage?

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Carton Design Considerations contd.

- Are irregular shapes an advantage?
- How will the carton be loaded?
- Through which opening will the carton be loaded?
- Will it be hand or machine erected,loaded,sealed?
- If machine loaded what are the machine spec?
- How will the consumer use the pack/product?
- How will the carton be retailed?

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Selecting the Correct Board

- Structural Strength
- Physical strength required
- Puncture resistance
- MD & CD strength
- Stiffness
- Machinability
- Glueability
- Environment (Fridge/ Cold Store etc)
- Surface structure

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Selecting the Correct Board contd.

Board Surface Issues	Colour	Smoothness
Brightness	Gloss	Surface formation
Opacity	Cleanliness	Ink Compatibility

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Carton Case Performance

- Dimensional accuracy
- Machine Erecting requirements
- Surface friction
- Product protection Properties
- Closure efficiency
- Glue seam quality (=fibre tear)

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Basic Carton Styles

- RTE reverse tuck ends
- Aero same side tuck ends
- Crash lock - self erecting
- Semi Crashlock / Bottom Lock
- Sleeve
- Trays etc.
- See FEFCO or ECMA style books

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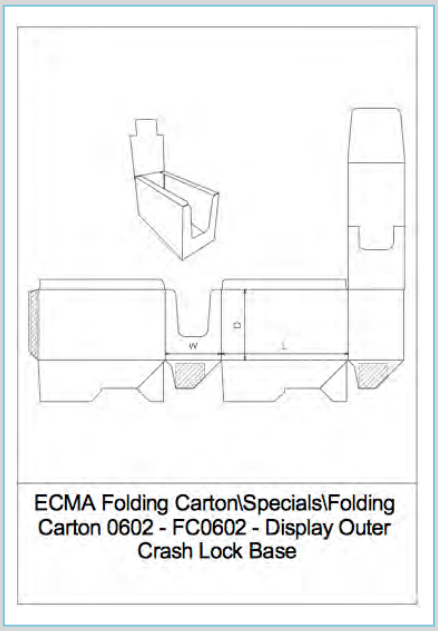
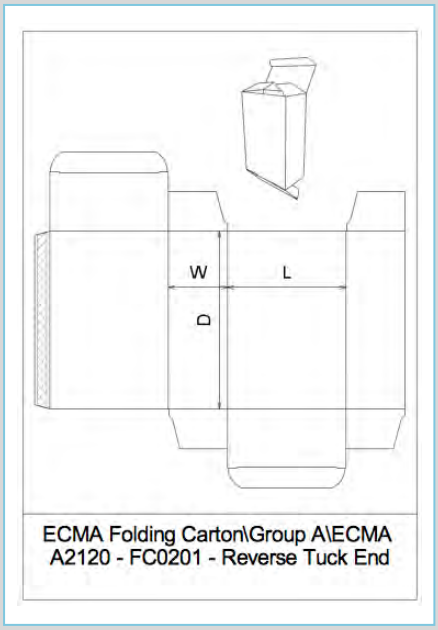


ECMA Folding Carton\Specials\Folding Carton 0602 - FC0602 - Display Outer Crash Lock Base



ECMA Folding Carton\Group A\ECMA A2120 - FC0201 - Reverse Tuck End

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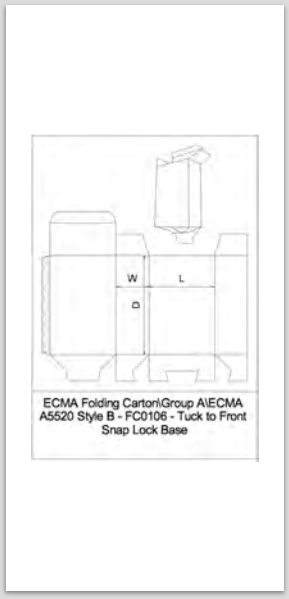
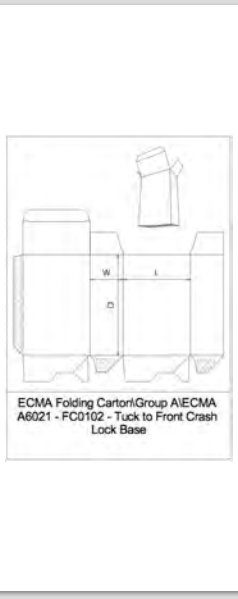
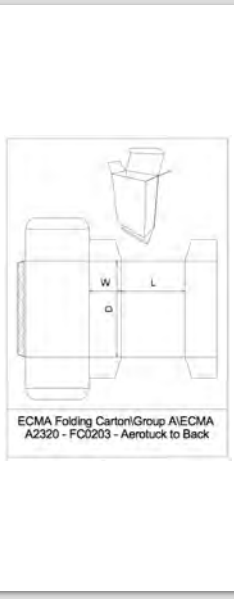


ECMA Folding Carton\Group A\ECMA A5520 Style B - FC0106 - Tuck to Front Snap Lock Base



ECMA Folding Carton\Group A\ECMA A6021 - FC0102 - Tuck to Front Crash Lock Base



ECMA Folding Carton\Group A\ECMA A2320 - FC0203 - Aerotuck to Back

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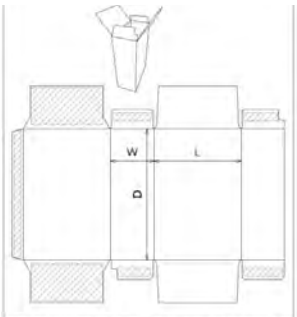
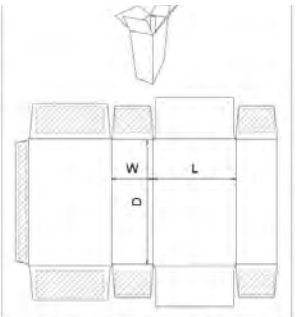
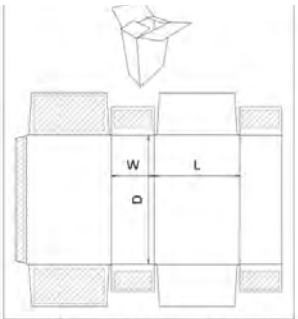
Skillets



ECMA Folding Carton\Group A\FC0505 - Captain End Load Skillet - FC0505 - Folding Carton Skillet



ECMA Folding Carton\Group A\FC0502 Bradman Lake End Load Skillet - FC0502 - Folding Carton Skillet



ECMA Folding Carton\Group A\FC0501 Jacob White End Load Skillet - FC0501 - Folding Carton Skillet

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Carton Production

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Carton Production Process

- Structural Design
- Hand Sample - Approval - Multi-up Die
- Design - Final Approved Artwork
- Proof - Film Separations - Plates or CTP or DTP
- Printing & Varnishing (over-all or spot)(coating)
- Laminating (Celloglazing)?
- Die Cutting & Stripping or Tattering
- Gluing ? + Packing, Labelling, Stretch wrapping, Shipping

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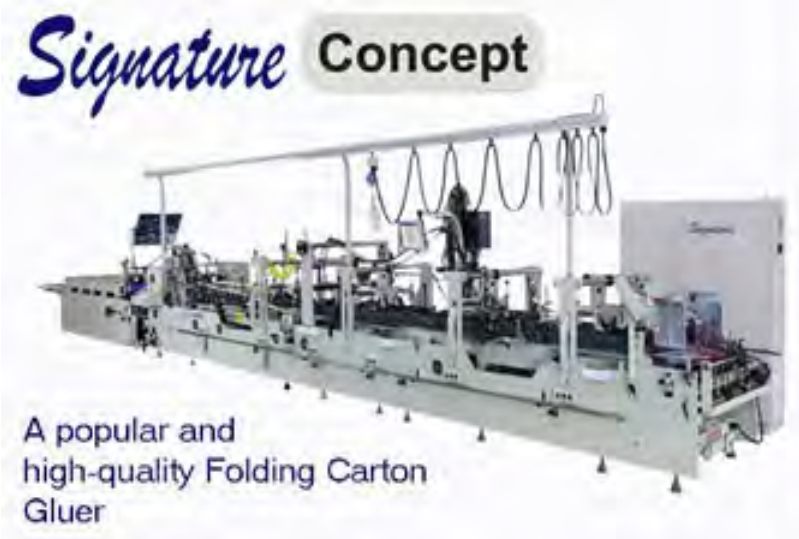
Typical Carton Gluing line



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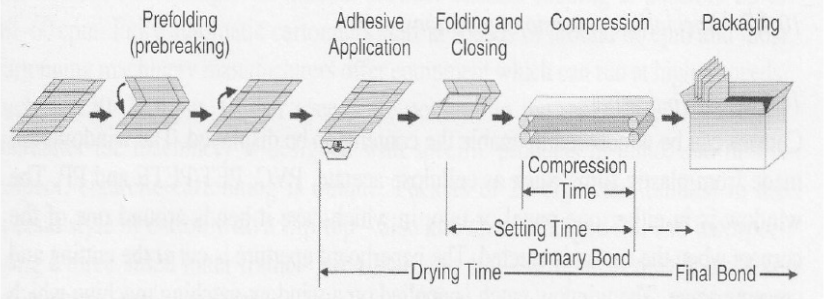
Carton Gluing Machine.



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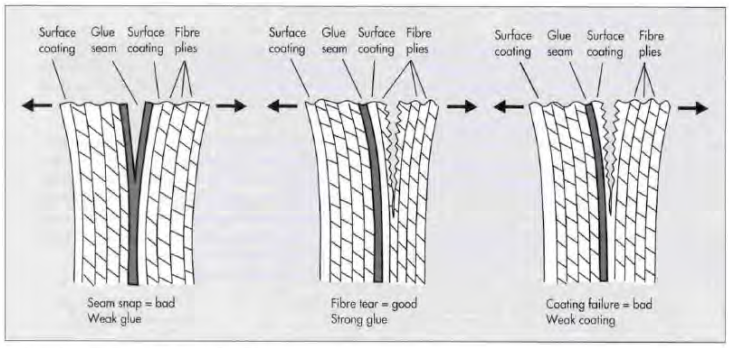
Fibre Tear



Failure when tearing two glued paperboards apart

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Carton production

- Die cutting Novacut
- https://youtu.be/gQ1LAqNyJlI
- Gluing straightline
- https://youtu.be/sq-OVy8LRAs
- Crashlock

https://youtu.be/BLGNrSMYarQ

- Window patching

https://youtu.be/IyPE6VR3nyQ

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Liquid Packaging / Tetra / Elo / Gable top etc.

Printed on reel

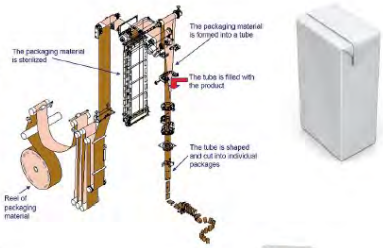
- cut and creased on line
- form fill seal process

=Brick style cartons

or

- cut and creased off line
- side welded
- bottom sealed
- filled and top sealed

=Gable top style cartons



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Carded Display Packs

- Benefits

1. High visibility
2. Ease of display and access
3. Reasonable protection
4. Good identification
5. Good information or instruction display

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Carded display types

- Blister packs

1. Rigid shape formed from a mould
2. Generally bonded to a printed and lacquered card.
3. Various versions material and styles. Blister on card, Sliding Blister, Fold over card, Sandwich or Double card, Double Blister. See book for styles p 125

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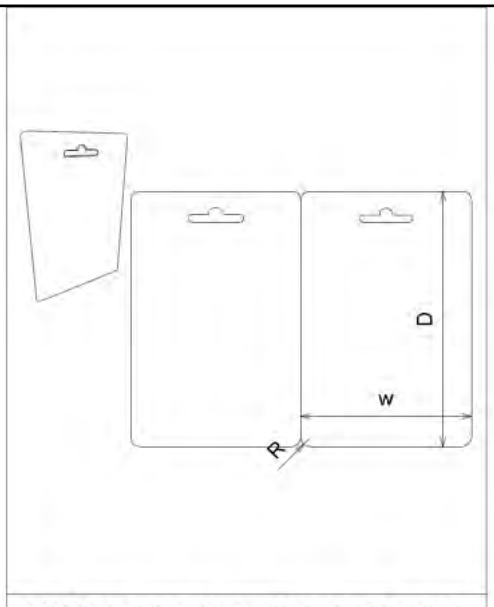

ECMA Folding Carton\Specials\Folding Carton 0619 - FC0619 - Blister Card

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Carded display types contd.

- Skin Packs

1. Product placed in position on card
2. Film heated and draped over product
3. A vacuum is activated and draws material tight around product and onto card
4. Heat activated coating bonds the film to the board where contact is made.
5. No tooling is needed/economical/holds and separates items to view

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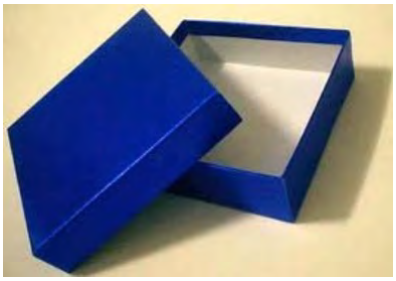
Rigid Boxes



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Rigid Boxes

- **Advantages**

1. High quality image
2. Good brand identity- ie. gift sector
3. Easy re-use
4. Good Long term storage

- **Disadvantages**

1. Bulky to store and ship
2. Slow to produce
3. Expensive as labour intensive

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Rigid Boxes Manufacture

- Low grade chip board 1200 or 1500 micron
- Board is cut to size by either die cut or corner cut and creased.
- Sides folded up and corner stayed
- Box is wrapped/covered
- Lid may be made in similar way or may be of Acetate/PET.
- Box may have insert, lined, coloured or silk.

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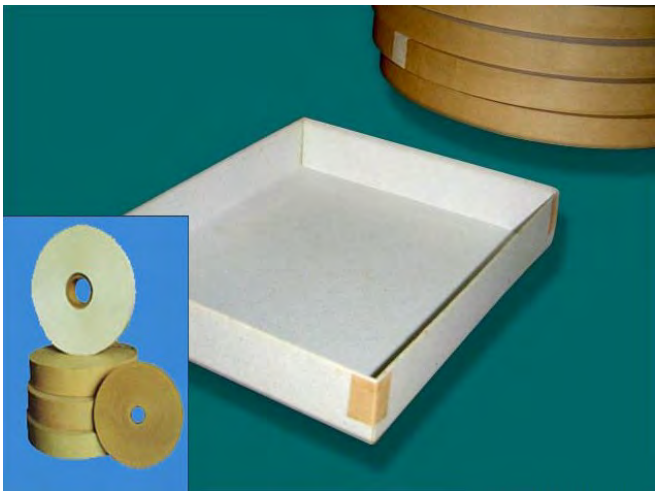
Corner Stay



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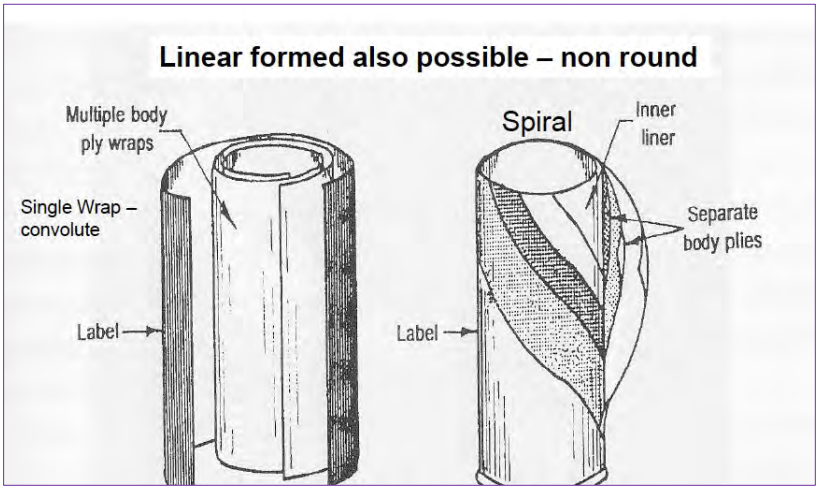
Linear and Spiral cans



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Spiral Wound

Spiral wound cans with spiral labelling

Spiral wound cans with parallel labelling.

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Spiral Wound cans

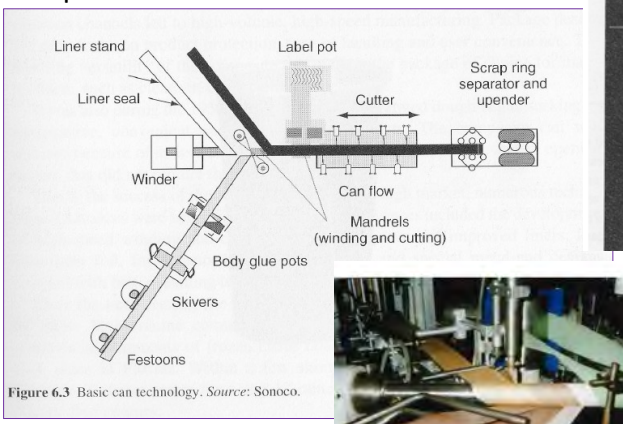
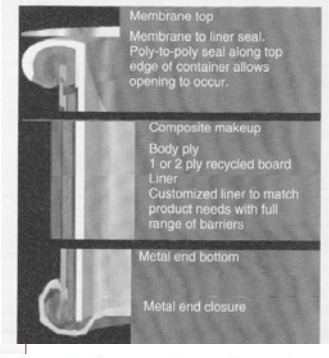


Figure 6.3 Basic can technology. *Source*: Sonoco.



The Anaconda device forms an optional device on an unwind stand in a composite can making machinery line. During the winding process the spiral seam in the inside of the tubing is sealed. Furthermore the device folds over the edge of the laminated liner web and glues it together.

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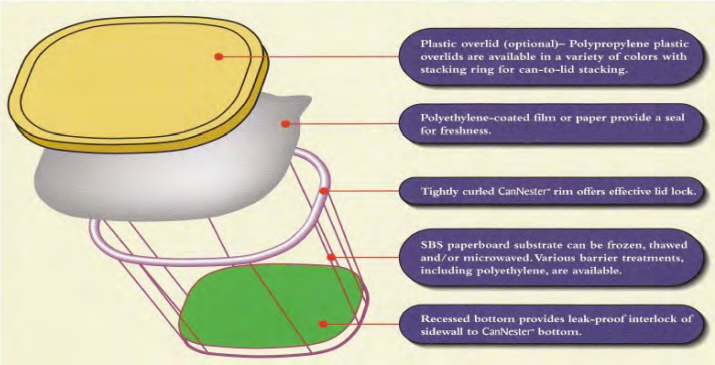
Convolute Cans

- Definition: A laminated fibre container wound perpendicular to the central axis.



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Convolute / Linear

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Consumer Packaging

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Bags and Sacks

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Bags / Sacks

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SOS

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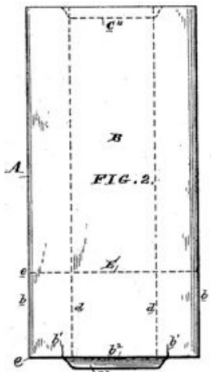
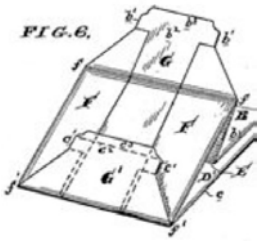
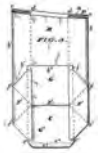
SOS Bag





- The cut tube is conveyed into the folding/delivery cylinder.
- The bottom is folded in progressive stages.



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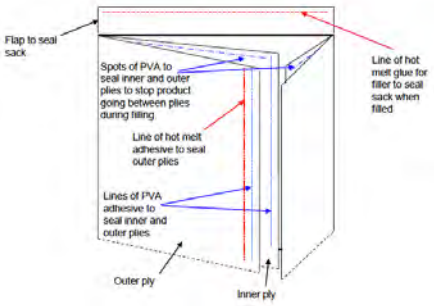
Multiwall bags / sacks

- The inner tube is formed and the side seam glued.
- The outer tube is formed around the inner tube; the seam is glued; the inner tube is attached to the outer tube.
- The multi wall tube is cut.
- The bottom end of the bag is flat folded and glued.



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Cement type sacks

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Pulp Packaging

- Cushioning provides protection function
- Can be made from low grade waste paper or virgin mechanical pulp, depending on end-use.
- Can be coloured for aesthetic effect
- Can be waxed for moisture resistance
- Increasing usage for small electrical goods

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Pulp Packaging

Manufacturing process

Stock preparation

- Pulper combines pulp and water to provide stock
- Stock contains 4% solids
- 1% of solids is resin

Manufacturing process

Wet Forming Section (Rotary)

- Forming die is immersed in a vat of stock
- A vacuum system attracts fibre into the screen of the die
- Water is drawn away through the die leaving a shaped pulp product

Manufacturing process

Drying Section

- The product (75% water) is transferred to the drying section
- Recycling hot air drying is applied – this reduces the moisture content to approximately 8%

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Test Procedures

PROPERTY	ISO	Unit	EN	SCAN-P	DIN	Tappi
Grammage	536	g/m²			53104	410
Thickness	534	µm	20534		53105	411
Density	534	g/cm³	20534		53105	411
Tensile strength	1924	kN/m		67:95	53112/1	494
Stretch	1924	%		67:95	53112/1	494
TEA (Tensile energy absorption)	1924	J/m²		67:95	-	494
Tear strength	1974	mN	21974	11:96	53128	414
Bursting strength	2758	kPa		24:77	53113/141	403
Bending resistance (Static bending force)	2493	mN		29:84	53121	543
Bending stiffness	5629	mN*m		64:90		535
Wet tensile strength	3781 (15 min)	kN/m		20:95	53112/2	456
Surface strength Denison						459
IGT, Picking velocity	3782, 3783	mm/s, m/s				
Bendsten porosity	5636/3	ml/min		60:87		
Roughness Bendtsen	8791/2	ml/min		21:67	53108	538
Roughness Bekk	474	ml/min			53107	479
Roughness PPS, H10 (Parker Print Surface)	8791	µm				
Roughness Sheffield	8791	ml/min				

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Friction	15359	-			53375	815
Cobb 60s (water absorption)	535	g/m²	20535		53132	441
WVTr (water vapour transmission rate)	2528	g/(m²*24h)				
Air resistance Gurley	5636/5	s		19:78		460
Moisture	287	%	20287		53103	412
Ash	2144	%		5:63	54371	413
Opacity	2471	%			53146	519
Brightness	2470	%			53145	452
Lightness L	Cie lab 1964	%				425
Gloss		%				480
pH cold water extract				14:65	53124	435
Measurements of empty sacks			26591-1			
Valve position in paper sacks			26591-1			
Paper sack volume	8281/1					
Dimensional tolerances for paper sacks			28367-1			
Butt drop test for paper sacks	7965/1		27965-1			
Flat drop test for paper sacks	7965/1		27965-1			

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PRO CARTON organisation stated benefits

Cartons are the only packaging made from a naturally renewable resource – wood

Over 50% of cartons used in Europe are made of recovered fibre – waste paper

Of the world consumption of wood only 12% is used for the manufacture of Paper & Board and of this 12%, only one tenth is used for cartons

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- Over 90% of the wood needed by the Paper & Board Industry in Europe comes from European forests. No rain forest trees are used

Sustainable forestry is practised in Europe and more trees are planted than felled

- The Paper & Board Industry uses only the thinnings from the forests

- Cartons are clearly the best packaging material for recycling
- They are easy to crush flat and separate for disposal

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- They are biodegradable
- They are ideal for energy to waste schemes
- They can and are readily used again to make new cartonboard.
- Over 50% of Carton production is made from recycled materials

– the highest rate for any packaging material and four times that of plastics

– Cartons also have in place the best recycling infrastructure of all the different packaging materials.

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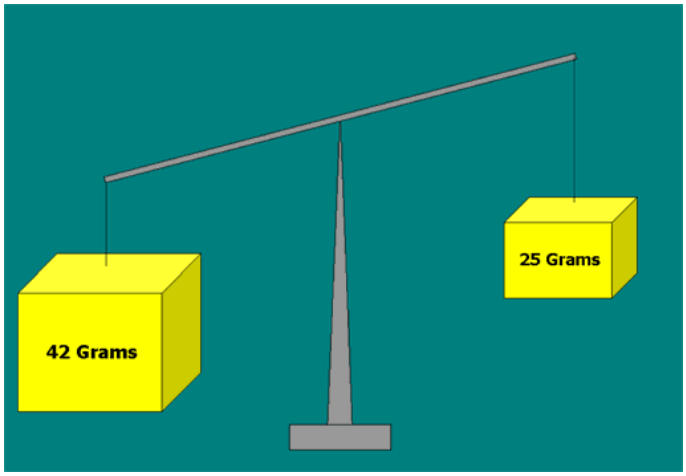
Since early 90's the average total weight of cartonboard used in a 450gsm frozen food carton reduced from 42gsm-25gsm - a reduction of 40%



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Useful reference sources

- Corrugated Packaging Alliance - www.corrugated.org.uk/
- Confederation of Paper Industries – www.paper.org.uk/
- PIRA – www.smitherspira.com/
- FEFCO – www.fefco.org
- Billerud - www.billerud.se
- Mondi – www.mondi.com
- PITA – Paper Industries Technical Association - www.pita.co.uk

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