1 Paper & Cores – Wrapping & Pallets

CONTENTS

IMPORTANT NOTICE!
A general guide cannot take into account the specificity of all products, procedures, laws and regulations. We therefore recommend that this guide be used only as a complement to information from suppliers, whose safety, operating and maintenance procedures along with applicable local legal regulations always take precedence over this guide. This guide is and is intended to be a presentation of the subject matter addressed. Although the authors have undertaken all measures to ensure the correctness of the material, it does not purport to list all risks or to indicate that other risks do not exist. The authors, contributors, the represented associations and participating companies do not give any guarantee thereof and no liability is assumed by reason of this guide as it is only advisory in nature and the final decisions must be made by the stakeholder. It shall not be applied to any specific circumstance, nor is it intended to be relied on as providing professional advice to any specific issue or situation.

Always check machine is in its specified safe position before working on any component (e.g. with compressed air, electrical power and gas disconnected). Only trained maintenance personnel adhering to safety regulations should perform maintenance work.

Best Practice

Poor Practice

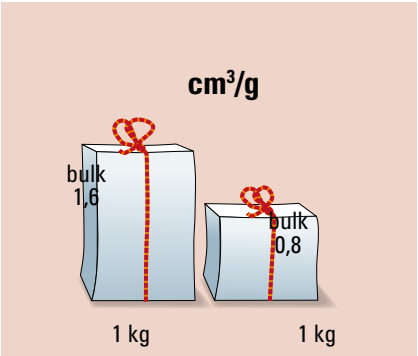
Safety Issues

Environmental & Economic Impact

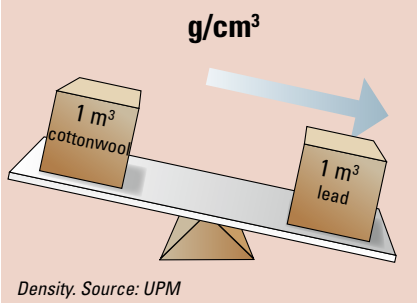
Paper & Board Characteristics

	Graphic Papers	Paper weight		Moisture	Density			
		gsm	Basis # lbs	% absolute	Very soft	Soft	Medium	Hard
NP	Newsprint	40-52	27-35	7-9%		x		
UMI	Uncoated Mechanical Improved	42-60	28-40	7-10%		x		
UMO	Uncoated Mechanical Others	28-60	19-40	~ 8%		x		
SC-A	Super Calendered	39-65	26-44	5-6%			x	x
SC-B	Soft Calendered	40-60	27-40	4,5-6%			x	x
LWC	Light Weight Coated	39-70	26-47	4-6%			x	x
MWC	Medium Weight Coated	75-115	50-77	4-6%			x	x
WFU	Woodfree Uncoated	50-300	33-200	??		x		
WFC	Woodfree Coated	60-400	40-270	??			x	x
	Cartonboard							
SBS	Coated Solid Bleached Board	220-500	150-340	6-7 %			x	
FBB	Cast Coated Folding Boxboard	220-500	150-340	6-7 %			x	
SBS	Solid Bleached Board	180-380	120-260	6-7 %			x	
SUB	Solid Unbleached Board	180-400	120-270	6-7 %			x	
CUK	Coated Unbleached Kraft Board	175-380	118-260	7-10 %			x	
FBB	Folding Boxed Board	180-400	120-270	5,5-9,5 %			x	
WLC	White Lined Chipboard	250-450	170-310	6-9 %			x	
	Other Packaging							
??	Kraftliner Containerboard	115-430	75-290	7-9 %			x	
??	Testliner Containerboard	95-220	65-150	7-9 %			x	
??	Fluted/corrugated Containerboard	90-170	90-115	7-10 %			x	
??	Sack paper	90-120	60-80	6-9 %			x	
??	Hygiene paper	16-35	10-24	5-7 %	x	x		

A generalised overview of principal paper grades and some of their variable characteristics that impact on handling and logistics.



Bulk. Source: UPM



Density. Source: UPM

Impact on Handling & Transport

Paper is a delicate high value product susceptible to damage and degradation. The numerous usage-specific paper and board products have different technical characteristics determined by many factors such as the type of fibres used, fillers, finishing and winding. The combination of a paper's characteristics and its wrapping strongly influence its handling, logistics and storage.

Bulk: Bulk expresses the specific volume of a material. It is the thickness of paper or board in relation to its weight. When paper has a high mineral content and/or it has been heavily calendered, its properties include high density and low bulk. High bulk offers greater stiffness. In the paper trade bulk is a more commonly used measure than density for indicating the compactness of paper.

Density: Density is the specific weight of a material and indicates how compact the paper has been made. Density is the inverse/reciprocal of the bulk. High density gives good smoothness. Density is the inverse/reciprocal of the bulk. Coated papers may have around 35% more mass for the same volume as uncoated paper, papers like SC with fillers also weigh more than an uncoated newsprint. This means that the maximum roll weight for materials handling equipment must be correctly dimensioned to the paper being processed and the roll clamping force adjusted for papers that are relatively harder or softer.

Basis weight: The weight of the paper in grams per square metre (g/m2) under conditioned circumstances. The entire mass is the sum of fibrous materials, fillers, process materials and water. As paper fibres both release and absorb water from their surroundings, the weight of any given paper can vary. Therefore, basis weight is determined under standard conditions, i.e. at a specified ambient moisture and temperature.

Strength: The strength of paper is measured as tensile strength, tearing strength, bursting strength, surface strength and bonding strength. Strength is always affected by the ambient humidity. The greater the moisture content, the more elastic the paper becomes. Tearing strength and breaking strength are the parameters usually measured.

Moisture: Moisture content varies with paper type. Paper wrapping is designed to maintain a moisture level; if packaging is damaged in transit it should be repaired immediately. At the printing plant paper should not be unwrapped until just before it is needed.

Characteristics with high impact on rolls:

Core: While the primary function of the core is to support the paper roll, it must also be of sufficient strength and stiffness to prevent crushing during normal handling.

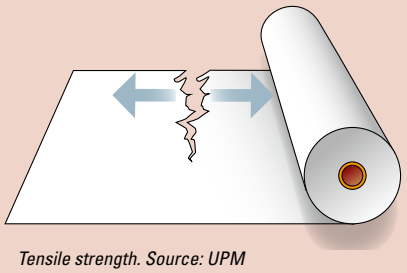
Winding parameters: A soft or hard winding will influence how compact is the roll and its clamping needs.

Friction properties: The friction between the wrapper and paper roll is influenced by how "slippery" the paper is. Some coated gloss rolls with lack of friction can lead to increased clamp pressure that can distort the roll. Fillers also influence smoothness of the surface and its friction property.

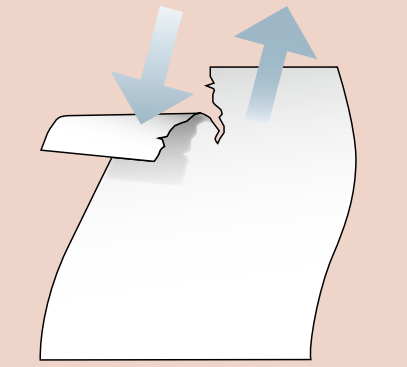
Wrapper Type: The wrapper protects the paper roll from damage, dirt and moisture. It prevents rolls from unwinding. The type of wrapping can vary; the most common wrappers are made of kraft or kraftliner paper. Plastic wrappers are also used and require different handling techniques. During clamp handling the paper rolls are carried with the friction force generated between the wrapper and clamp pads. The wrapping carries approx 30% of roll weight when optimal clamping force is used.

Clamping force: Any paper roll can be destroyed by clamping it too hard or too softly. Different paper grades tolerate different amounts of clamping force and this is influenced by the paper's raw materials, winder type and the bulk. Softer, uncoated papers require a reduced clamping force compared to harder coated papers, otherwise there is a high risk of roll and core deformation out-of-round. Insufficient clamping force may allow the paper roll to slide, drop or telescope from the clamp's grip.

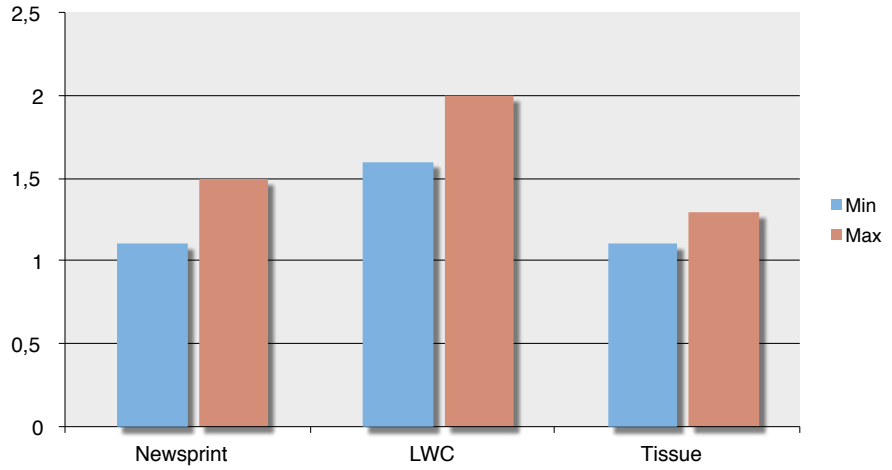
Diameter: Different roll clamps are needed to handle rolls with significantly different diameters.



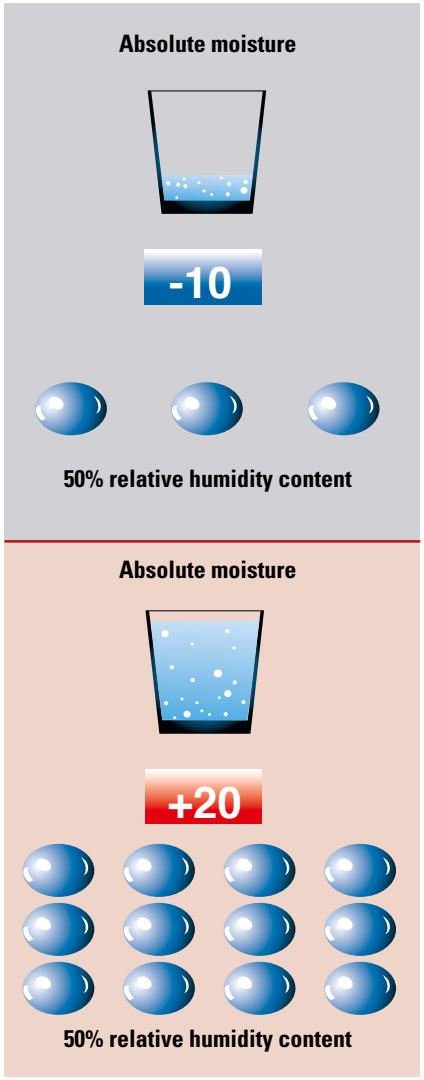
Tensile strength. Source: UPM



Tearing strength. Source: UPM



This table illustrates the relative clamping force required for different types of paper. To avoid damage the correct clamp and pressure should be used. Source: Bolzoni- Auramo.



The effect of temperature at a constant Relative Humidity. Source: UPM.

Climate & Fibre-based Products

Paper is a porous material that contains moisture as vapour in its larger pores and/or as a liquid in the minute capillaries of its structure. A paper's moisture sensitivity is related to its particular raw materials and their processing; for example, papers with low/no mineral fillers have higher moisture than a paper with high filler content like SC or WFC. Moisture content can also vary with printing process, for example WFC paper used for sheetfed offset will be different to heatset offset.

A key paper control parameter is ambient humidity, and temperature is a major element that determines relative air humidity. Paper not in balance with its storage and operating environment can lead to serious printing problems like static charge and dimension variations, along with set off, tensile weakness, folding resistance and surface smoothness difficulties. The minimum moisture content for printing paper is around 3%; below this, paper will have high static electricity that can interfere with press electrical equipment, cause missed splices, and lead to difficulties with folding and offline finishing.

Relative Humidity (RH)

Air can contain only a specific amount of moisture vapour at a given temperature and becomes saturated when it has absorbed the maximum amount of moisture it can contain at that temperature. The higher the temperature, the more moisture it can absorb. RH is the proportion of absolute moisture content in relation to the highest possible moisture content at a given temperature.

Paper will adapt itself to the humidity of the surrounding air by either absorbing or exuding moisture to achieve a humidity balance. This often occurs in tropical climates or during hot and humid summer periods in non-airconditioned warehouses and printing shops; or when damp-proof wrapping is not used during transport or storage in humid conditions. In winter, paper that is cold and then unpacked in the warm air of a pressroom causes the adjacent air temperature to drop sharply, leading to a rapid rise in air humidity. The paper edges then absorb moisture, making them swell in relation to the centre of the sheets.

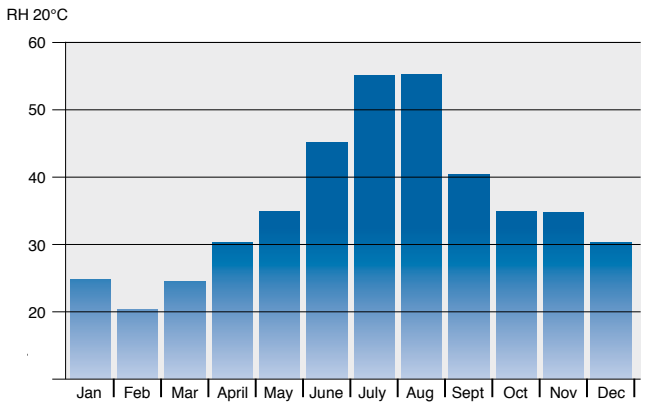
Depending on RH paper fibres will either absorb or exude moisture, causing them to swell or to shrink, particularly in the cross direction of the paper rather than in the machine direction.

Static Charge

Commonly occurs when very dry paper is processed in low air humidity conditions. The critical lower level limit is 30-40% humidity both for the paper and for the pressroom RH.

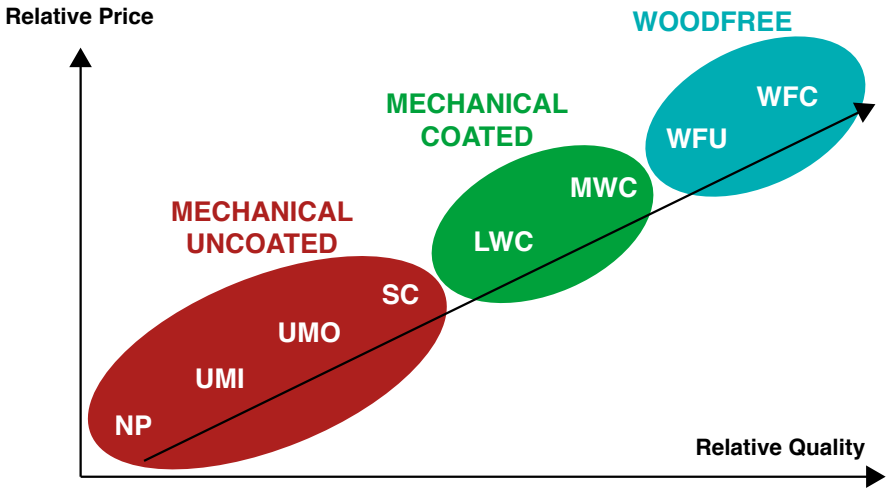
✅ Paper should remain wrapped in its damp-proof packaging throughout the logistics and storage chain. It should not be unwrapped until any difference in its temperature and RH has been balanced out with the ambient pressroom conditions. Paper stability for optimised printing is achieved at 20°C to 25°C (68-77°F) and 50-55% RH relative humidity.

Conditioning time depends on the temperature difference between warehouse/transportation and pressroom, the conductivity of the paper, and the size of the stack (roll diameter or volume of sheets on a pallet). Conditioning time for rolls also depends upon their diameter because they condition from the edges. *See paper conditioning chart Module 3* for more information on paper conditioning.



Relative humidity changes with the seasons in this northern hemisphere example. Source: UPM.

Types of Paper & Board



A simplified view of the relationship between relative price and perceived qualities. Source: icmPrint.

Paper is primarily made from pulped virgin renewable fibre and/or recycled paper waste. Some pulps are produced from other fibres like bagasse (sugar cane residue). The pulp's source and quality significantly determine a paper's characteristics and cost. There are three sources of pulp and these may also be mixed into hybrid products:

1. **Mechanical pulp:** Wood fibres are mechanically separated by pressing logs against a rotating grindstone or rollers. The usable part of the wood (yield) is about 95%, while it has a high opacity it is not very strong because the fibre is damaged; there are also many impurities in the pulp mass.

2. **Chemical pulp:** Wood chips are cooked in a chemical solution to remove lignin — the wood's natural binding agent. The fibres in the resulting pulp are very clean and undamaged. The yield of chemical pulping is about 50%. Papers made from chemical pulp are commonly called 'Woodfree'.

3. **Recycled pulp (RCP):** About 30-40% of paper is made from collected paper waste or recycled fibre (RCF). Some papers are made with 100% RCP, while others may mix virgin and recycled fibres. Papers with a high recycled content may be denser and heavier for a given volume.

Paper machines manufacture very large tambour rolls —also known as machine, jumbo or mother rolls. Source: UPM.

Multiple rolls of graphic paper can be moved with multi clamp trucks. Source: UPM.

Graphic Papers & Boards

Paper is a general term with two divisions of paper and paperboard. In Europe, paper has a maximum weight of 165 gsm while paperboard is defined as being more more than 0,3 mm thick. Some of the more important paper grades include

Woodfree (WFC/WFU): Fine printing and writing papers are made with chemical pulp (some may contain woodfree recycled fibres) available as either Woodfree Coated (WFC) or Woodfree Uncoated (WFU). These papers are available in a wide range of weights from very low basis weights to near cardboard grades. WFC uses WFU as its base upon which one or more thin mineral coatings are added to create a smooth matt, silk or glossy surface.

These fine papers are designed for demanding printing uses and the amount of coating, surface gloss and other special characteristics vary according to the final use. WFU and WFC papers can be divided into sub-grades depending on whether the paper is cut into sheets or used in rolls. WFU papers include three sub-grades: 1. cut sizes A4 to A3 (8,5" x 11"/11" x 17"); 2. folio sheets (larger than A3); and 3. rolls. WFC papers are available as sheets and rolls.

Newsprint (NP): Uncoated paper manufactured from recycled fibre (up to100% RCF) and/or mechanical pulp. Newsprint weight ranges from 40 to 52 gsm, it is white or slightly coloured (e.g. Financial Times pink), and supplied in rolls for offset (CSWO and HSWO), flexo printing and rotogravure. Widths vary from 315 mm to 4320 mm (12,4-170").

Uncoated Mechanical Improved (UMI): Contains different grades of Machine Finished (MF) paper to give a higher brightness than Newsprint. It is split into two sub-categories — high-bright and super-bright. Its basic furnish is the same as Newsprint and the basis weight starts at 40 gsm.

Uncoated Mechanical Others (UMO): Includes a wide a range of other publication paper grades, including directory paper, thin printing and book papers. The basic furnish is the same as for Newsprint, but the basis weight starts at 28 gsm.

Machine Finished Speciality (MFS): Manufactured from mechanical or recycled pulp with characteristics of good brightness, surface structure and bulk. MFS papers, both white and coloured, are used in telephone directories, technical catalogues, timetables and special weekend editions of newspapers. UMI, UMO and coloured newsprint are included in this grade.

Super Calendered (SC-A/SC-B): Magazine paper is primarily used for consumer magazines, catalogues and advertising material printed rotogravure or heatset offset. It is made from mechanical pulp and often includes a high level of recycled fibres, with a large content of mineral filler. It may have either a matt or glossy finish. This grade is split into sub-categories based on brightness and gloss SC-A, SC-A+ and SC-B.

Coated Mechanical (LWC/MWC): Available as Light Weight Coated (LWC) and Medium Weight Coated (MWC). These papers have either a glossy or matt finish and are mostly used for catalogue, magazine and advertising printing using rotogravure or heatset offset. They are made from a blend of chemical and mechanical pulp, some contain recycled fibres, to which fillers are added; they are mineral coated on both sides. LWC has a basis weight of up to 72 gsm and anything above 72 gsm is classed as either MWC or Heavy Weight Coated (HWC).

Matt Finished Coated Mechanical (MFC): A bulky matt or silk coated grade in the basis range of 48 to 70 gsm with a bulk that varies from 1,2 to 1,5.

Hygiene papers are often large diameter rolls that are soft and very delicate to handle. Source: Cascade.

Special Paper Applications

Preprint papers: A sub-category of WFU used to produce financial statements and transactional documents or for company letterheads. Preprint papers are generally printed twice, initially on a web offset press and then separately personalised by digital printing before automatic insertion into an envelope.

Envelope papers: Primarily manufactured from WFU, brown MG kraft paper and recycled fibre. WFC may be used for direct mail envelopes where higher print quality is required.

Digital printing papers: Developed to fulfil the demands of toner or inkjet printing on paper.

Label papers: These are divided into face and base papers. Face papers are either coated on one side, pigmented, or uncoated woodfree papers. Base papers are super calendered kraft paper (SCK).

Bag papers: Mostly manufactured from white kraft paper (some brown kraft is also used) that is either machine finished (MF) or machine glazed (MG). Essential characteristics include strength, good runability, purity, and printability.

Sack papers: Kraft papers made from bleached or unbleached sulphate pulp supplied in rolls. It may be either unglazed (UG) or a microcreped grade known as extensible or clupak. Paper strength is essential to minimise raw material used and for the durability of packaging; while porosity facilitates quick, dust free filling. Friction is a major asset when sacks are stacked and transported. The interior of sacks is usually made of brown paper and the outer side may be white to provide a better printable surface.

Kraft paper: High strength packaging paper made of softwood pulp with longest fibres.

Flexible packaging papers: Rolls of uncoated or coated papers and kraft papers used for flexible packaging papers, either on their own or laminated with plastic, aluminium or other materials. Major users of flexible packaging include the powdered food, tobacco and confectionery industries.

Hygiene papers: The majority is transformed on site, small quantities of mother rolls are shipped to external converting sites.

Speciality/Technical papers: Other paper and paperboard grades, such as kraft/bag papers, MG and MF kraft paper, wrapping tissue, special industrial and packaging papers (release papers, laminating and metallised base papers, overlays, etc), technical special papers, cigarette paper, electrical paper, core board, construction paper and board and other miscellaneous paper and board. Supplied in rolls and sheets.

Packaging Papers & Boards

Paper has one layer and weighs 25-300 gsm. Boards have multiple layers and weigh 170-600 gsm; they are supplied in rolls and sheets for printing and converting.

Boards are made from chemical pulp, mechanical pulp and recycled fibres. They can be divided into four main categories according to their intended use:

- Raw materials for corrugated board — the surface layer, or liner, and the corrugated part, or fluting
- Carton boards for folding cartons, boxes and liquid packaging
- Graphic boards for cards, files and folders, covers and lids
- Wallpaper base boards.

Containerboard is supplied in rolls to corrugating machines as

- Kraftliner
- Testliner (recycled linerboards)
- Fluting/corrugating medium (NSSC fluting and recycled corrugating medium)
- Linerboards can be unbleached, white surface or bleached liners.

Wood pulp

Normally transported as sheet bales, but may be flash dried bales or rolls. Bales are generally wrapped and strapped with steel wires. Common units are 6 or 8 bales strapped together with unitizing wires, however, bale sizes and unitising methods are not standardized. Units intended for top lifting are strapped with strong steel wires that can only be lifted by specialized equipment— lifttruck forks may not be used. Bale clamps should not be used to clamp across lifting wires because this will weaken them endangering future lifts.

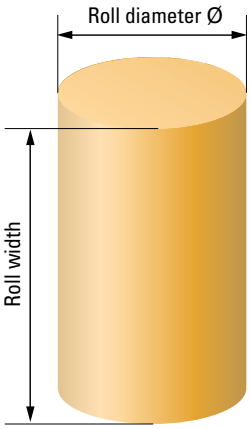
Recycled Paper (RCP)

Collected paper waste is classified into light grades (print products, office papers, etc) and dark grades (packaging material). RCP is loaded into wired units similar to pulp but without protective wrappers or lifting wires — their dimensions and weights are not standardized. They are handled as single, or sets of single bales. Bales are usually soft and uneven making them difficult to transport and stacks have a risk of instability. The bale weight and moisture content are criteria for quality measurement.

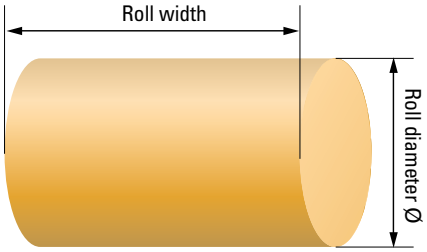
Source: Ecograf..

Dedicated clamps are required to handle RCP bales. Source: Ecograf..

The Paper Roll



Standing (vertical) roll core 'eye' to sky



Lying (horizontal) roll core parallel to ground

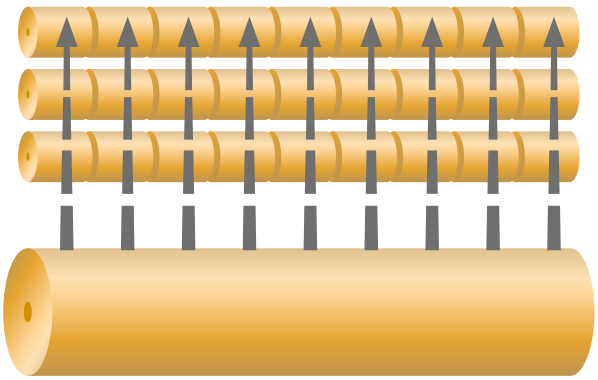
Paper machines manufacture very large tambour rolls (also known as machine, jumbo or mother rolls) that are converted into multiple smaller rolls on a winder around a cardboard core. The web is split into narrower widths, parallel to the winding direction, and winds sets of rolls of a smaller diameter and shorter length. Each one of these rolls has a number that represents its position across the width of the machine roll and is recorded on the roll and roll package label under 'Set & Deckle position'. *See page XX* for more information on labels.

Dimensions

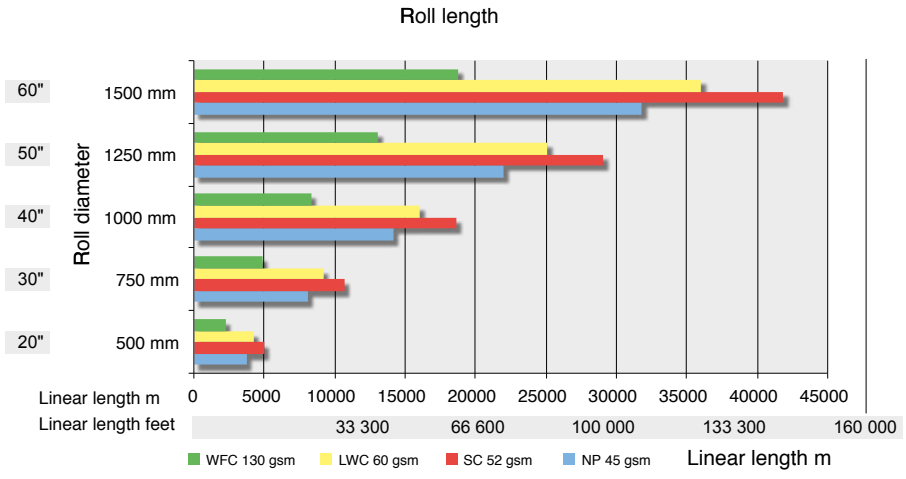
Paper rolls come in a wide variety of sizes, weights and grades that influence handling and transport.

Outside roll diameters: Some label and digital presses use 400-700 mm (16-28"); publication applications usually 1000-1250 mm (40-50"), some at 1500 mm (59"); 1500-1800cm (59-71") for sacks and some packaging; and 2000-3000 mm (79-118") for hygienic paper.

The trend for printing and converting machines is to use the largest roll diameters possible in order to decrease the number of splices and related waste. However, availability depends upon the supplier mill's trimming capacity and market demand. Moving to larger roll diameters can have a significant impact across the supply chain — heavier and larger rolls require correspondingly dimensioned handling equipment. In some cases, such as moving from1250 mm to 1500 mm Ø (40 to 50"), the consequence is an increase in truck and container loads by 30% (PrintCity 'Watch the Step to Larger Rolls').



The diagram shows a tambour roll rewound into three sets of nine rolls each. The set and deckle position of rolls are generally found in line 8 of the paper label see page 20. Source: WOCG/icmPrint.



The linear length of paper on a roll is primarily determined by the roll diameter. The paper basis weight and bulk are the two other key components. Source: OPHAL.

✔ Before changing roll diameters check that your equipment (splicer and roll handling) has corresponding weight capacity, that your paper mills can supply, and assess any potential impact on transport logistics.

Roll widths: Range from 250 mm (10") for envelopes to 4320 mm (171") for rotogravure. Rolls widths under 500 mm are generally packed together (2, 3 or 4 reels in one pack).

Roll weights: Are determined by roll diameter, weight and paper grade. For example, a 1250 mm (50") Ø x 1000 mm (40") wide roll weighs about 1 tonne in uncoated newsprint, and 1,4 tonnes as a coated paper. Coated magazine papers range 2000-4000 kg (4410-8818 lbs) with < 6800 kg (14 990 lbs) possible), while tissue papers with large diameter weights 1500 – 3000 kg (330-660 lbs) with < 6000 (13 300 lbs) kg possible).

Jumbo & Super Jumbo Rolls

Jumbo Rolls: Widths of 2650 and 3800 mm (104-150") wide. Super Jumbo: Widths over 3800 mm (150") up to 4300 mm (169), weighing up to 6,5 tonnes.

These rolls are used only in publishing gravure in a very small number of printing plants. The paper suppliers are also relatively limited and each has a specific approach to logistics and handling. Handling of these high value rolls requires highly skilled people and proper equipment.

It is recommended to use four or three pad clamps; correct compression force is critical in order to avoid wrapper and roll damage:

1. Clamp only in the centre of a roll. Incorrect and out-of-centre clamping can cause out-of-roundness, especially when rotating roll.

2. Use correct compression force, if any sliding or wrapper stretch is noted handling must be stopped immediately and not continued until equipment is checked.

Jumbo roll held in a multiple clamp.
Source: Bolzoni Auramo.

Multiple roll packaging

Rolls with narrow widths are often packed together in a single multi-pack to obtain a package that is more efficient to handle using standard equipment and techniques across the supply chain.

Multiple rolls are packed together and stabilised with an internal core fixed to the package using core plugs on to which the core label is attached. The joined reels are then wrapped and marked to indicate a multi roll pack. Roll diameters in multi packs must be identical otherwise when the roll is clamped the larger diameter roll becomes out-of-round.

Some rolls are also delivered in multiples on pallets — *see page 19.*

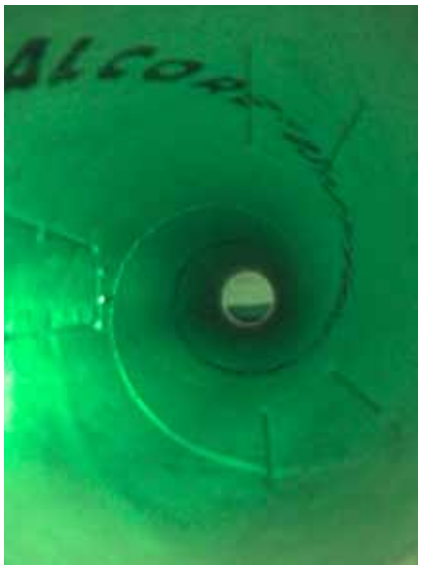
1. Multiple rolls are joined with an internal core.

2. Core plugs secure the assembled roll.

3. Marking to indicate multi pack.

Source Holmen

Roll Cores as Process Components

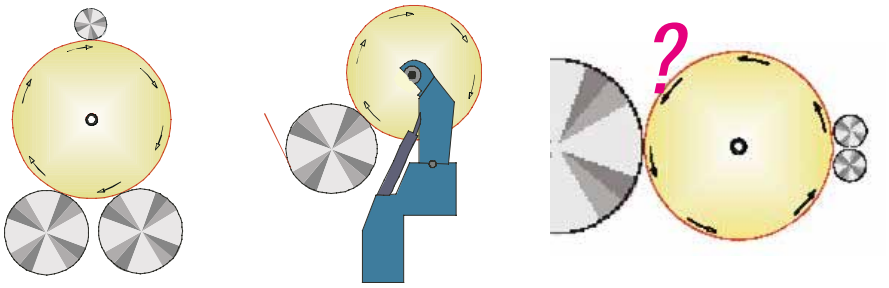


Source: Sonoco-Alcore.

Cores should be considered as an integrated renewable component, to both paper machine winder and printing press splicer, to achieve high efficiency and reduce waste across the delivery and process chain. The function of the core is to support the paper roll. It must be of sufficient strength and stiffness to prevent crushing in normal handling; while during winding and printing it must transmit torque, avoid vibration and delamination. Core quality parameters:

1. Dynamic strength
2. Critical speed for wide web presses
3. Straightness and roundness
4. Torque transmission
5. Dimension
6. Moisture
7. Handling flat crush

1. **Dynamic strength** (maximum roll weight a core can support with chucks): Loading conditions in paper machine winders vary depending on their type — double drum, supported centre drum, or unsupported centre drum.



Double drum winder *Supported centre winder* *Unsupported centre winder*

Source: Valmet.

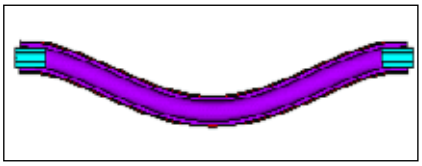
Double drum winders have no loading from the roll weight. They require a common core outside diameter to rotate all rolls at the same speed. Cores must be straight and round to prevent vibration. Poor cores may lead to elongation from the pressure and friction between the core and paper causing a misshaped indentation at the end of the roll.

Centre drum winders have cyclic loading, which can affect both the chuck area of the winder and the press paster. The core lifetime calculation (number of revolutions the core needs to carry the roll weight load without failure) depends partially on the chuck type and the support load. The dynamic strength test estimates core lifetime by loading the core in a similar way to a centre winder or press paster. The achieved loading results determine the maximum roll weight. Different paper parameters, adhesives or winding technologies influence results. (Notes: Base measurement flat crush test does not correlate to dynamic strength; double drum winders do not have to calculate this effect.)

35% lifetime used. *98% lifetime used.* *End of life.*

Core life cycle. Source & photos: Sonoco-Alcore.

2. Critical speed: High-speed presses with web widths over 2000 mm (79") require a higher critical speed (axial E-modulus of core divided by its density). If this value is incorrect the residual roll can break into several pieces, releasing enormous kinetic energy — a residual roll explosion can cause serious injuries. Therefore, splicers should be enclosed within safety cages during operation (see Module 7). (A residual roll explosion can also occur in paper machine rewinders if the emergency curve is incorrectly designed.) The explosion risk is a combination of core quality, wound paper and chuck function. The press supplier should provide printers with information about the specified physical parameters and not just the name of qualifying cores.



At web widths above 2000 mm (79") and web speeds over 11 m/s residual rolls with a core 76 mm (3") Ø can reach their resonance frequency and under certain circumstances there may be a residual roll explosion just prior to splicing. This is often preceded by a web break.

Example of high speed/wide web core requirements 76 mm (3")

Minimum requirement cores 3" for Pastomat CL

Maximum paper roll width [mm]	$\sqrt{\frac{E-Modulus_{Core}}{Density_{Core}}}$	Max. printing speed (m/s)				
		up to 13,0	13,1-14,0	14,4-15,2	15,3-16,0	16,1-17,3
	1761-1905	A	B	C	C	D
	1906-1980	B	C	E	D	D
	1981-2000	B	C	E	D	D
	2001-2060	C	D	E	D	D
	2061-2100	C	D	D	D	D
	2101-2280	E	E	E	E	E
	2281-2400	E	E	E	E	E
	2401-2520	E	E	E	E	E

Without safety cages
With safety cages
With safety cages & slow down ramp before splice

Note: Safety cages must be used when using cores in brown cells (light & dark)

This chart shows variations related to web width and printing speed for rolls on 76 mm (3") cores for different operating conditions and requirement for safety cages for various core qualities A-E. Source: KBA.

A super jumbo core V8M undergoing E-modulus testing. Source: Sonoco-Alcore.

3. Straightness & roundness: Paper mill winders produce several sets of rolls from one tambour (mother) roll and require straight and round cores to reduce vibration and meet target speed. Good values are levels below: straightness 0,5 mm/m (0,2"/40"); roundness 0,4 mm (0,16") for 150 mm (6") Ø cores) and 0,25 mm (0,64") 76 mm (3") Ø cores. Normally the winder's rider roll load will straighten 76 mm (3") Ø cores.

4. Torque transmission: The core's structure must transmit torque during acceleration and emergency stops. Web offset presses mostly use core acceleration and braking (chuck or shaft), whereas rotogravure often uses belts on the roll surface. This means that the required torque loading for a 1600 mm (62") width offset roll is double that of the largest rotogravure width of 4320 mm (170"). Chucks have different capabilities to transmit torque. A core designed to the roll weight (dynamic strength) leads to the correct core strength for torque transmission. However, lower level loading conditions (double drum winders) may require higher core strength to transmit the required torque.

5. Dimension: An key runability issue is the relationship between the core inside diameter and chuck outside diameter of the winder. Too wide a gap reduces the dynamic strength and creates "chew-out" that can destroy the inner part of the core. The same may also happen in the printing press if the cylindrical part of the chuck is too small, with only the expanding elements carrying the roll weight, leading to both slippage and eccentric rotation.

6. Moisture Content: The moisture difference between paper and core should not be too high — normally 7-8% for printing depending on application and paper grade. Cores should be wrapped like paper rolls to keep their moisture level consistent to paper.

7. Handling/Flat Crush: Modern clamp truck pressure control avoids deforming the roll or core — *see Modules 4 and 5*.

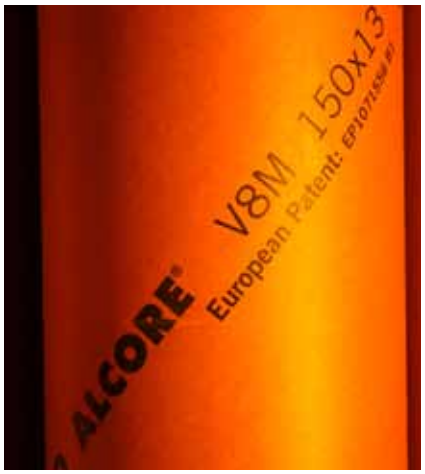
Source: Sonoco-Alcore.

Core Specifications

Normally, it is the paper supplier's responsibility to ensure that the cores on which paper is supplied conform to the printer's needs. These are determined by the web width, roll diameter and weight, and production speed. Appropriate core properties are important to safely run the winder and printing press. Only the press manufacturers in cooperation with core and paper suppliers can provide information about safe unwinding speed for roll width, weight, speed combinations and core diameter required (76 or 150 mm/3" or 6").

	CSWO	CSWO	HSWO	HSWO	Gravure	Gravure
Web width	**1250 mm Ø**	**(50") Ø**	**1250 mm Ø**	**(50") Ø**	**1250 mm Ø**	**50") Ø**
<1905 mm (75")	76x15 (1700 kg)	3x0,59" (3748 lbs)	76x15 (2800 kg)	3x0,59" (6173 lbs)	76x15 (2800 kg)	3x0,59" (6173 lbs)
<2250 mm (88")	76x15 (1900 kg)	3x0,59" (4189 lbs)	76x15 (3300 kg)	3x0,59" (7275 lbs)	76x15 (3300 kg)	3x0,59" (7275 lbs)
<2400 mm (94")	76x15 (2100 kg)	3x0,59" (4630 lbs))	150x13 (3600 kg)	6x0,51" (7937 lbs)	76x15 (3600 kg)	6x0,51" (7937 lbs)
<2750 mm(108")	-	-	150x13 (4100 kg)	6x0,51" (9040 lbs)	150x13 (4100 kg)	6x0,51" (9040 lbs)
<2860 mm (113")	-	-	150x13 (4300 kg)	6x0,51" (9480 lbs)	150x13 (4300 kg)	6x0,51" (9480 lbs)
<3680 mm (145")	-	-	-	-	150x13 (5500 kg)	6x0,51" (12 125 lbs)
<4320 mm (170")	-	-	-	-	150x13 (6500 kg	6x0,51" (14 330 lbs)

The core for each application has a given diameter x wall thickness in mm. Roll weights are based on 1250 mm (50") Ø and typical densities. Speed indicator: Core E-modulus divided by core density (65) (MPa/(kg/dm3). Conversion 76 mm .
Source: Sonoco-Alcore.



Source: Sonoco-Alcore.

- Rotogravure should preferably use 150 mm (6") Ø cores above 2450 mm (96") web width to increase safety and to reduce waste (some printers use 76 mm (3") Ø cores up to 2750 mm (108") width but this is not recommended because it limits maximum speed to 10 m/s (2000 fpm) and requires higher residual roll diameter, e.g. 140 mm (5,5").
- Using cores with higher critical speed will help unwinding, printing quality and increase safety in wider rotogravure rolls even if critical speed is not required. ERA recommends only specially qualified cores for over 3680 mm (145") web width.
- Current maximum roll weight capacity of 76 mm (3") Ø cores: web offset is 3500 kg (7 716 lbs) and rotogravure 4500 kg (9920 lbs). The application limit for 150 mm (6") Ø cores is around 7000 kg (15 432 lbs).
- Offset presses over 2250 mm (88") web width should use 150 mm (6") Ø cores for most paper grades except Newsprint that can be up to 2400 mm (95") wide if winding speed is checked.
- Web widths of >2250 mm (88") running at over 13 m/s (2600 fps) with 120 mm (4,7") splice Ø require 150 mm (6") Ø cores.

Source: Sonoco-Alcore.

Packaging and converting — Typical core requirements

The core requirements for these applications are much more variable than for graphic paper. Selection of the most cost effective core grade also depends on best practice handling and logistics being used (see modules 4 & 5).

Corrugated: Boxes made from liner and fluting rolls run at up to 450 m/min (1500 fps); most run at 100-300 m/min (333-1000 fps). Standard roll widths are 2400, 2800 and 3350 mm (95, 110, 132") usually with 1450 mm (57") Ø and max weights commonly around 4500 kg. I9920 lbs) inside core diameter is generally 100-102 mm (3,94-4,02") with a recommended wall thickness of 10 mm (0,39") for good runability in the winder; wall thickness can vary between 5-13 mm (0,2-0,5"). Design criteria include torque transmission and roll weight capacity, especially for grades below 100 gsm.

Cartonboard: There is little standardisation, with a variety of roll weights, sizes and grades. Cores are selected for end-customer requirements with key criteria of roll weight capacity and torque transmission.

Hygenic: Cores are mainly used internally and the tambour cores are often reused. Rolls are up to 3500 mm (138") Ø with a maximum weight of 4000 kg (8118 lbs). Consequently, a wide range of cores is used — 150-406 mm (6-16") Ø with wall thickness of 10-20 mm (0,39-0,79") depending on single or multiple use. Required reuse ratio and handling determine individual core requirements.

Sack paper: Uses different delivery models of pallets or rolls. Core grades vary for each application and should be individually determined to identify optimum cost efficient grade.

For core troubleshooting see Module 7

Source: Sonoco-Alcore.

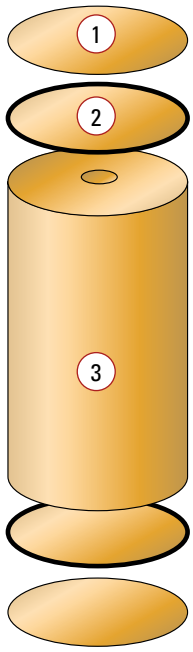
Source: Sonoco-Alcore.

Technical Details

Item	Unit	Target	Min	Max	Test Method
Inside Diameter	mm	76,6	76,4	76,7	ISO11093 -4
Outside Diameter	mm	106,4	106,0	106,8	ISO 11093 -4
Length	mm	L	-0,0	+12,0	ISO 11093 -4
Moisture	%	7	NA	8	ISO 11093 -3
Out-of-Straightness	mm/m	-	-	0,8	ISO 11093 -5
Out-of-Roundness	mm	-	-	0,3	ISO 11093 -5
Rotational Speed Factor	MPa (kg/m^3)	4,5	-	-	ISO 11093 -8/4
Flat Crush	N/100mm	3300	NA		ISO 11093-9
Max. Roll weight	kg	-	-	2400	Rolls made in mill winder 2 & 3
Max. Roll width	mm	-	-	1905	In wider width please check possible unwinding speed based on press supplier's requirement
S.A.D.S. (Dynamic Strength)	kN/100mm	13,8	12,2	-	
Core Weight	kg/m	3,6	-	-	

ISO 11093 is a method to test cores — this table indicates some of the parameters that can be tested. Source: Sonoco-Alcore.

Wrapping



Conventional wrapping components:
1. Outer head covers (end shield) with moisture barrier;
2. Inner head cover (end shield);
3. Belly wrapper with moisture barrier.
Source: OPHAL.

Appropriate packing is essential in preventing transport damage and providing moisture protection. Transport methods and destinations influence the type of packing needed. Because of differing functional requirements, papers used for wrapping rolls and for sheet paper are different.

Roll Wrapping

The wrapper protects the roll from damage, dirt and moisture, and prevents it from unwinding. All paper rolls do not have the same wrapping. The most common wrappers are made of kraft or kraftliner paper; plastic wrappers are also used. A typical wrapper consists of several paper layers and end plates, wound around the roll and glued together.

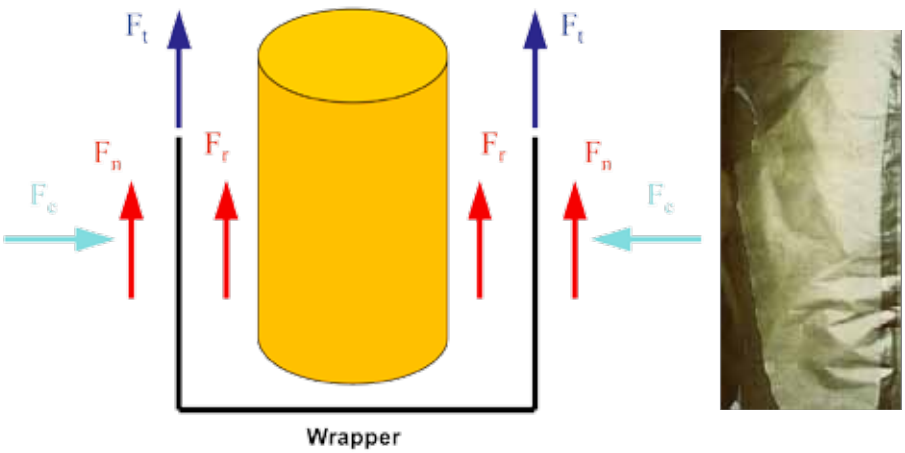
1. **Mechanical protection:** To prevent indentations from roll handling systems, and transport damages on truck, train and ship. The level of protection is influenced by the weight, quality and turns of wrapping. The wrapper also has a load-carrying function as it carries approx 30% of roll weight when clamped.
2. **Barrier Protection:** To keep moisture out and prevent wrapped paper from losing moisture. To protect the paper from dirt or hygienic hazards, and against light degradation.
3. **Identification:** Manufacturer's data for receiver/destination, size, weight, quality etc (label or inkjet) and to communicate manufacturer's brand.

✔ Correct wrapping criteria

- Inner head covers adjusted to the diameter of the roll
- Correct plug properly in position
- Core must not protrude
- Properly sealed roll
- Adequate moisture barrier
- Wrapper well stretched
- End of wrapper well secured to belly of roll
- Head covers adjusted to the roll diameter
- Sharp and sufficiently wide folding
- Outer head cover of the same diameter as the reel
- Outer head cover well centred

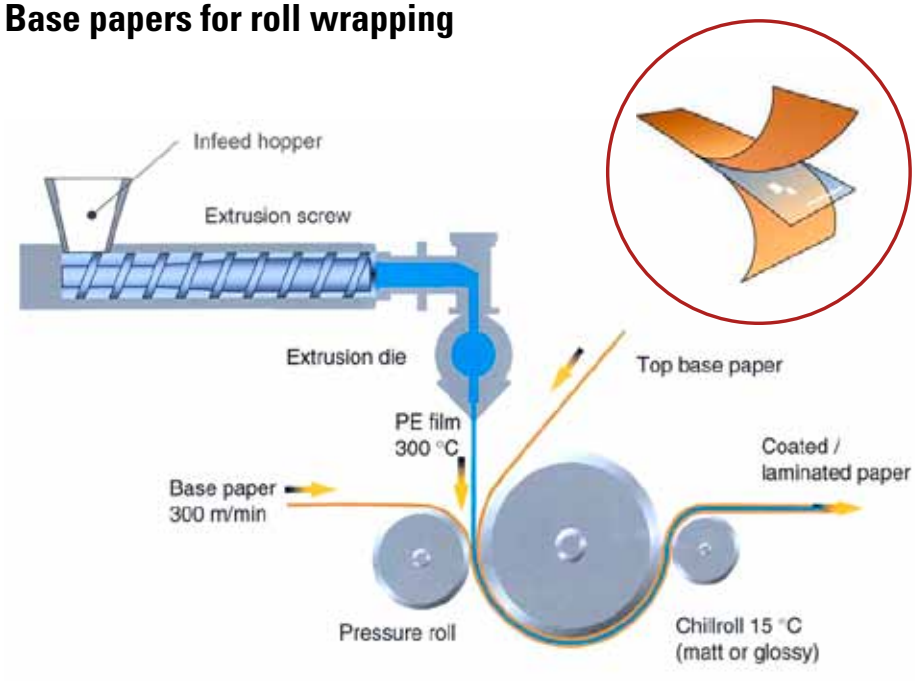
Stretch film wrapping

- Evenly wound and sealed end of film
- Inner head cover of the same diameter as the roll
- Exceptionally clean warehouses and load carriers if inner head covers are not used



Wrapper handling properties are of vital importance to clamp handling because the rolls are carried with the friction force generated between the wrapper and clamp pads. The wrapping carries approx 30% of roll weight when correct clamping force is used.
Source: Bolzoni-Auramo.

Base papers for roll wrapping

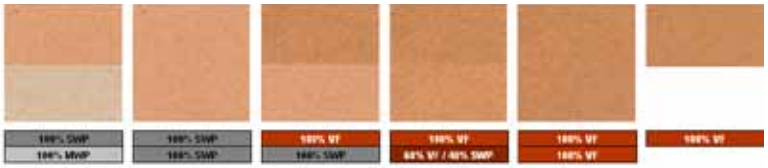


Extrusion coating of polymers placed between kraft paper layers. Source: Mondi.

Source: UPM

Base papers used for making roll wrappers will vary depending on the application features required. These paper grades are combined and laminated on extrusion lines to provide a final combination to meet specific transport needs and climate conditions. As a general comment, the higher the virgin fibre content in these grades, then the higher will be the mechanical and barrier protection of the final wrapper structure.

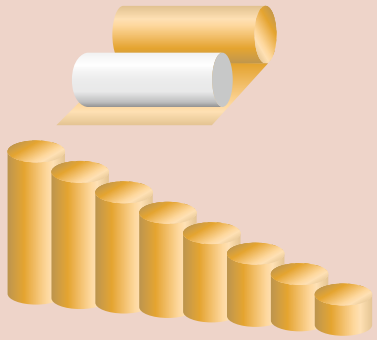
The bonding and adhesion between different paper layers comes from the polymers used and their thicknesses when applied on the extrusion line during roll wrapping manufacturing.



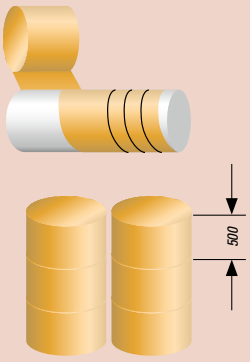
	Test Liner 3	Test Liner 2	Kraft Top Test Liner	Kraft Liner	Virgin Kraft Liner	Kraft Paper
	TL III	TLII	KTTL	KL	VKL	KP
	2 ply	2 ply	2 ply	2 ply	2 ply	1 ply
Top layer	100% SWP	100% SWP	100% VF	100% VF	100% VF	100% VF
Bottom layer	100%MWP	100% SWP	100% SWP	60% VF/40% SWP	100% VF	
Definition						
Weight (gsm)	125	125	125	125	125	125
Burst (kPa)	260-280	320-350	370+400	570-580	650-680	740-760
Price variation (%)	54%	57%	63%	68%	75%	100%

Source: Mondi.

Wrapping paper requirements



Standard wrapping system:
Requires significant stock of paper sizes

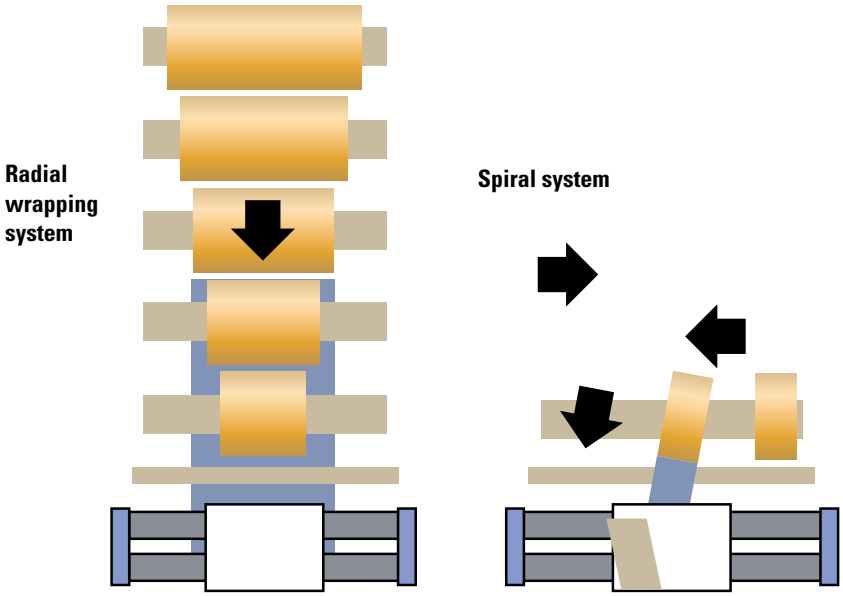


Twister:
Only one paper dimension required.
Source: Mondi.

Wrapping Materials

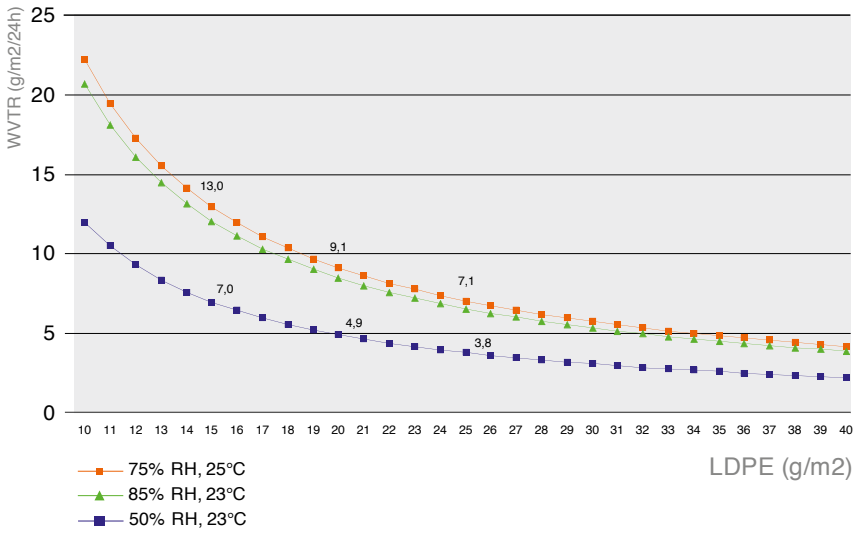
The main purpose of the wrapper and the paper roll end cap is to protect the paper roll during its transport from the paper factory to the end-customer. The layers may vary from single wrap with little overlap, up to three wraps for demanding deliveries. The wrapper can be applied in small strips ('Twister' trademark) or in bands.

Different wrapper types are used depending on the properties of the wrapping machine, customer and handling chain requirements.



Radial wrapping system requires storage of different width wrappers but provides a uniform wrapping surface. Spiral system needs just one width of wrapper to store but overlaps on the wrapped roll body could be deflected and create a small open (unwrapped) part of roll body. Source: Mondi.

Water Vapour Transmission Rates (WVTR) are used to define the paper combinations and polymer thickness for bonding/coating of the paper layers. Paper mills select the structures of the wrappers to meet end-customer requirements on WVTR — these values vary depending on different climate conditions:



Water Vapour Transmission Rate (WVTR g/m²/24h) LDPE (Low Density Polyethylene). Source: Mondi.

Wrapping operation. Source UPM

Kraft/paper wrappers: Typically, several layers of strong packaging paper (normally kraft). The wrapper can be a multi-layer structure with an outer kraft layer and a plastic layer laminated onto its inner side. This protects the paper roll from moisture, and gives relatively good protection against handling damage — it is frequently used for printing papers.

Multipack kraft/paper wrappers: Several smaller paper rolls can be placed inside the same wrapping. As these rolls typically have the same (or almost the same) diameter, the resulting handling properties are similar to single packed rolls. Normally a special label shows that the delivery is a multipack unit.

Plastic wrappers: Formed by rotating several layers of thin plastic film around the roll. Plastic wrapping protects the paper roll very effectively from moisture but does not protect the roll so well from handling damage. Multipack wrapping with plastic does not normally differ from single packing from the handling point of view. For environmental reasons, in some markets plastic roll wrapping is not accepted.

Unwrapped rolls: Paper rolls are usually only transported unwrapped inside the paper factory or at the printing/converting phase. An unwrapped paper roll is highly prone to all kinds of handling damage, contamination and moisture issues.

Unwrapped, steel banded rolls: Some factories secure unwrapped paper rolls with steel bands to prevent the paper becoming loose from the roll. Handling these rolls is similar to normal unwrapped rolls except caution must be used to avoid damaging the steel bands with the contact pads. There might also be a risk that the band damages the contact pad friction surface (particularly rubber and polyurethane surfaces).

Inner disks: Used to cover the reel ends. Material can be corrugated boards (E-Wave, Double E-Wave, board).

✅ Optimum barrier protection comes a polyethylene layer laminated between kraft paper.

A standard roll alongside a super jumbo roll. Source: UPM.

Troubleshooting Wrapping Faults

Problem		Possible cause
Loose/creased wrapper	→	Poor gluing
Head damage on other rolls when stacking	→	Protruding core
Out-of-roundness	→	Missing core plug
Wrapper bursts/roll slides out of loose wrapper	→	Air inside the wrapper

Palletised Sheet Paper

Pallet jut. Source: FMS Use No Hooks p155

Pallet Construction

The type of construction determines the strength of the pallet. Transport pallets are generally made mainly of wood (pressboard pallets have feet that are difficult to repair if damaged and plastic pallets are only economic if there is an inexpensive return delivery). Pallet construction characteristics:

- How is the pallet nailed?
- Is a transverse strip of wood nailed to the pallet feet?
- Are the dimensions of the individual strips of wood and feet adequate?
- Is the wood free of knots and damage?
- Does the wood have the prescribed moisture content?
- Has the wood been pretreated against insect attack in accordance with relevant requirements?

When carrying out repairs, loading gauge and under-clearance of the pallet must be maintained, otherwise compatibility for subsequent pallet rack warehouse storage is no longer ensured.

Recent trends include the elimination of wooden covers, while strapping has been reduced or even eliminated. This leaves room for interpretation as to whether the cargo unit can be considered as stable.

Sheet Wrapping

The paper to be packed is aligned and delivered to the ream wrapping machine. The wrapping paper is cut and wrapped around the paper and then glued in place. The packed reams are then stacked and labelled.

Pallets with sheet-size paper (reamed or bulk-packed) are wrapped vapour tight with shrinking or wrapping foil. For transport over longer distances, a covering plate is applied and the packed pallets are reinforced with loops of steel or plastic banding.

Pallets packed in vapour-tight wrapping do not require full airconditioning when in storage. They can be stored in light- and water-protected areas. Paper producers and wholesalers often use high shelf stocks, in which the pallets can be stored randomly, to be picked by computer-controlled picking systems.

Pallet with paper in sheets with quintuple strapping. Source: Use No Hooks. p156

Printing and office papers are often transported as sheets stacked on pallets. Paper rolls are sometimes also transported on pallets. Pallet and package requirements for safe handling:

- Palletised paper in reams, sheets or reels
- Packed in a waterproof wrapper
- Minimum 75 mm (3") free height under pallet for lifting forks
- Pallet should be made of wood to give adequate strength.

Dimensions

Sheet printing papers are frequently ordered to a wide range of non-standard sizes requiring non-standard pallet sizes. Smallest pallets are 420 x 450 mm (16,5x17,7") and largest are 2160 x1580 mm (85x62"). Generally, pallets are always slightly larger than the stacked sheets of paper (called pallet jut or projection), which makes friction lock loading between pallets difficult. (Pallets smaller than the paper size would ensure that pallets are locked, but are rarely used because the paper stack edges are easily damaged.) Office cut papers are generally packed into cartons that are then assembled on a standard size pallet.

Wrapping and Securing

Depending on customer requirements and the packing machine, the pallet loads are often wrapped with plastic or paper cover (*see also page 7*).

Wrapping of paper in reams and sheets often utilises polyethylene-coated papers or OPP films, both usually printed and varnished. This wrapping offers excellent protection against humidity and mechanical damage.

The wrapping promotes the manufacturer and identifies the packed paper in reams, sheets.

Plastic or steel straps are often used to keep the load well tied onto the pallet.

Sometimes a strong wooden top lid is used to protect the upper side of the pallet, especially when several pallets are to be stacked on top of each other.

With the right handling equipment pallets can be stored several pallets high. Source: Stora Enso.

XXXL Sheets

Large formats for sheetfed printing can be up to 1510 x 2010 mm (59 x 79") and require adapted handling equipment (forklift trucks) and techniques. They are usually supplied on strengthened pallets — the height and number of sheets is limited due to overall weight.

Rolls on Pallets

There are certain cases where rolls will be transported across the paper chain on pallets. This is usually related to the lack of roll clamp handling at the printer/converter — these may be converters, direct mail and digital printers, or sheetfed printers using roll-to-sheet systems.

Rolls can be delivered either vertical, i.e. strapped lying on a pallet (core is 'eye to the sea'); or standing (core 'eye to the sky').

The preparation and handling of rolls and pallets is often a manual process and leads to limitation in logistics (amounts of pallets on trailers and in containers). Vertical rolls need to be handled with care because of the risk of being deformed on the bottom, which can lead to unwinding problems at moderate to high speeds. Using angled forks will reduce stress when lifting rolls.

Handling *(see also Modules 4 and 5)*

Transporting palletised paper does not differ from normal pallet handling — except that these loads are highly vulnerable to external damage. Due to the high variety of pallet sizes and high volumes involved, fork positioners and double pallet handlers are commonly used for handling palletised paper goods. Some companies prefer load turning clamps because of their better load support.

Lying roll loaded on a pallet, where it is securely chocked and strapped down. Source: Stora Enso.

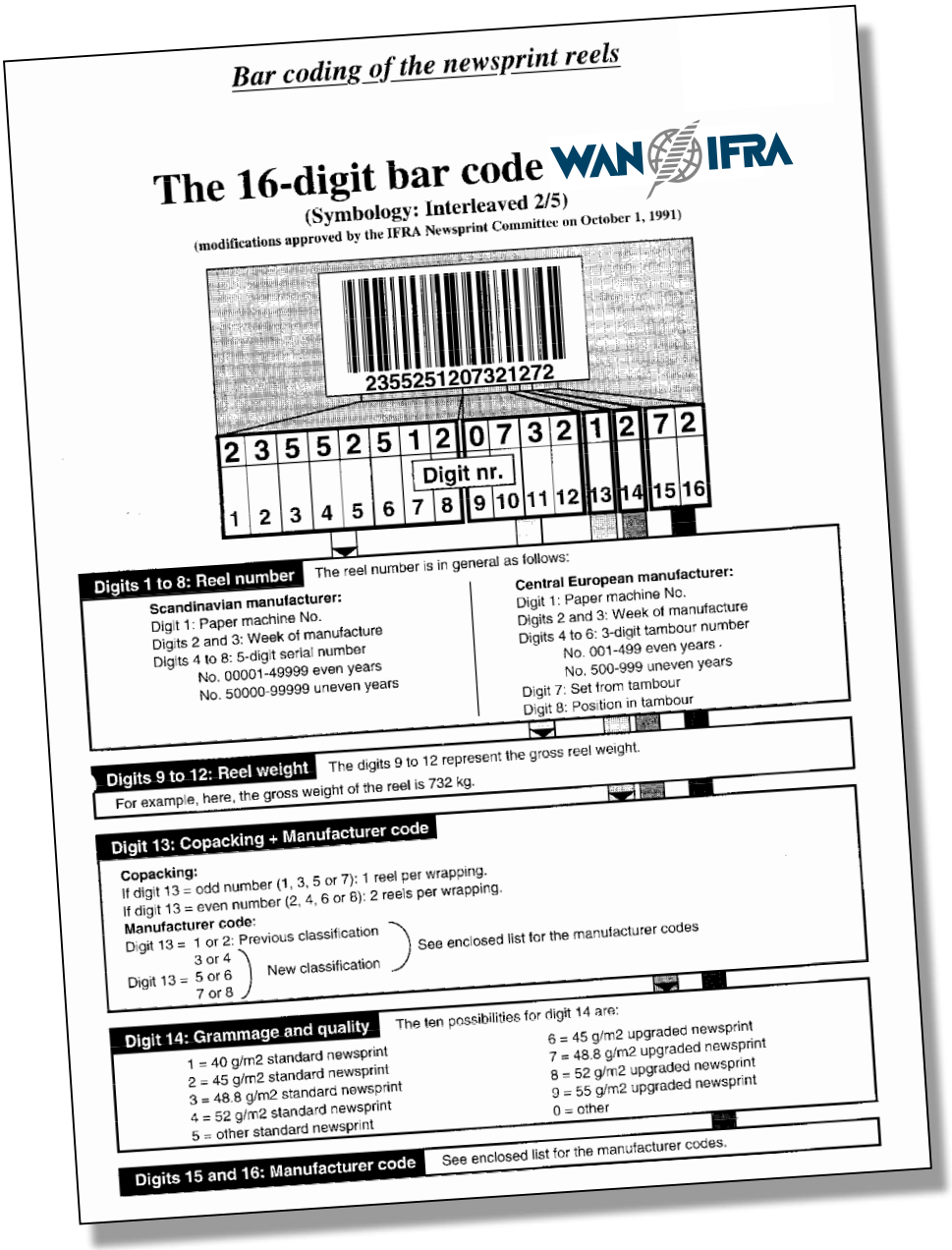
Small rolls for digital printing standing on a pallet. Source: UPM.

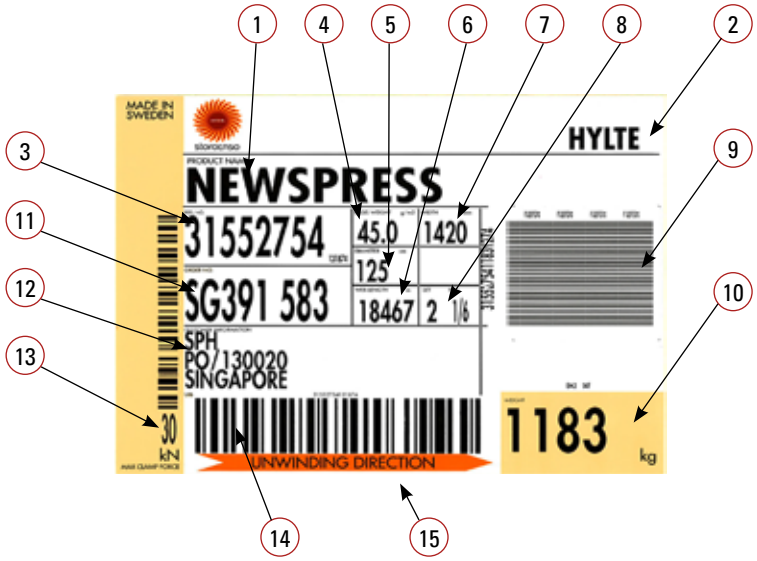
Labels & Barcodes

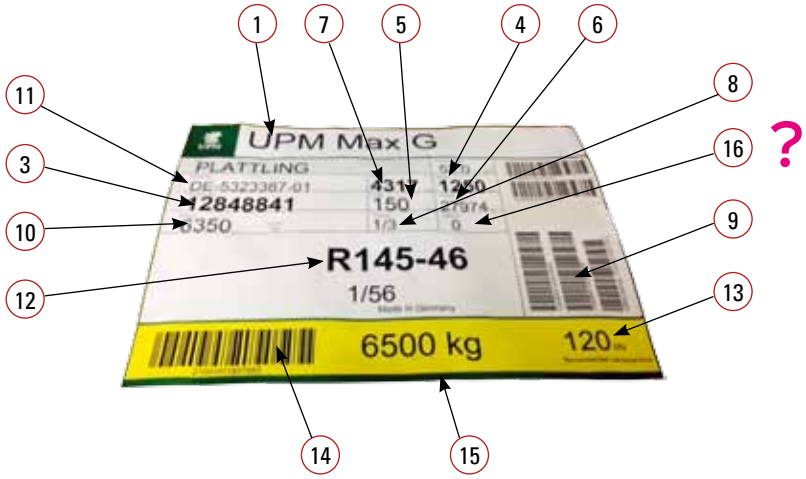
Labels for rolls and pallets contain important information about the article inside the packed unit, details about how to handle it and information relevant for the supply chain. Generally, two labels are applied as a precaution in case one is lost or damaged. In some cases, instead of a label, the information is printed directly on the wrapping material. Inkjet printing directly onto the wrapper allows the information to be repeated around the roll, eliminating the need to adjust rolls in stacks to make their roll label visible. Scanning techniques need to be able to read this lower contrast information. Damaged rolls that have had paper stripped need to be reweighed and a new label placed over old one.

Organisations like WAN-IFRA and NARI provide guidelines for label information. All paper suppliers design their own labels, but most contain a very similar set of information.

Typical Roll Label Information







Typical Roll Label Information

1	**Product name**
2	**Paper mill** Not all suppliers show mill, only company name
3	**Roll number (IFRA)** Not all mills use IFRA numbering system
4	**Basis weight** Metric or Imperial
5	**Outer diameter** Metric or Imperial
6	**Length of paper in metres** Metric or Imperial
7	**Roll width (pallet size)** Metric or Imperial
8	**Set & Deckle position**
9	**IFRA bar-codes** Partly as peel-off labels
10	**Gross weight in kgs**
11	**Supplier's order number**
12	**Customer order number/reference**
13	**Maximum clamp force in kN** Important for correct handling
14	**Unit Identifier Barcode (UIB)** Main barcode for supply chain
15	**Unwinding direction** Arrow shows direction for unwinding

Paper label and inkjet marking around the packages. Source: Holmen.

Peel-off label example. Source: Holmen.

Label examples. Camera. Source: Holmen.

Label examples. Laser scanner. Source: Holmen.

Inkjet marking and labels

Inkjet marking on belly. This example shows:

Red type: warning text indicates multiple rolls in package, recommended clamp pressure, heavy rolls.

Black group: barcode using Code 128 symbology for laser scanning to identify packages. The information is also in clear text between every second barcode and underneath. Other colours may be used for special remarks. Source: Mondi.

Peel-off labels

Generally there are three labels around the roll. Each one has three peel-off labels to provide default identification of the pack/roll using a 16-digit IFRA code.

Roll end labels

One label is centred on the roll end for automatic identification by standard labelling information it includes three peel-off labels and a barcode for automatic identification with camera or laser scanner. Default identification of the pack/roll using a 16-digit IFRA code.

Sheet Pallet Packages

Sheet paper label example. Source: Holmen.

Standard Electronic Documents — papiNet

papiNet is a global e-business initiative for collaborative electronic business within the paper, forest products and bioproducts industry. It is an XML set of standard electronic documents designed to facilitate the flow of information among parties engaged in buying, selling, and distribution of paper, forest and bio-related products (papiNet is not in itself a database, a software application, or a product or service that can be purchased).

papiNet simplifies the paper supply chain

The papiNet standard offers the following benefits:

- Accurate data
- Reduce transactional costs
- Consistent information throughout the supply chain
- Interaction between business partners in a uniform manner
- Support for change requests due to business needs
- Simplifies the process for dealing with multiple suppliers and customers through common solutions
- Reduces manual work, resulting in fewer entry errors and improved supply chain management (e.g. replenishment, VMI)
- Real-time exchange of information and greater electronic information availability
- Everyone can participate in e-business transactions, irrespective of size or technical expertise.

papiNet is free to use!

The papiNet standard is an open standard that anyone can contribute to. It is also free to use the standard in your environment.

- papiNet puts great emphasis on the implementation of electronic business-to-business information exchange.
- papiNet users benefit from well documented messages and an extensive field glossary.
- To help understand how each message should be used there is a set of business rules, sample business scenarios, and example documents.
- All documents and data for the standard can be downloaded for free from www.papinet.org

This joint initiative is supported by papiNet Europe, a consortium of European paper and forest products companies, and papiNet NA, a group of North American paper and forest products companies, distributors, printers, and customers.

North American Member Companies

papiNet NA is a Working Group of Idealliance with the goal of involving all interested North American producers of paper and forest products and their customers in the international process to create and adopt e-business standards for the industry. The membership is a collaborative group of producers and customers, exceeding 20 companies. Prior to the formation of papiNet NA in May 2001, a group of publication paper producers, printers, and publishers had been developing XML standards under the auspices of Idealliance. This effort was combined with the European papiNet effort in late 2000, and with the American Forest & Paper Association (AF&PA) in 2001.

Membership is open to North American manufacturers of paper and wood products, distributors, converters, end-users, suppliers to the industry, including e-commerce service providers, and related industry/customer trade associations. If a company headquartered outside North America has a North American operation, the North American operation is eligible for membership.

European Member Companies

papiNet started as a project within the Publishing part of the paper industry. A number of major paper suppliers, large German publishers and printers collaborated to create a common standard for electronic business transactions. Soon, there was a requirement to develop supporting software for handling the transactions via the Internet. This work turned out so well that it was decided to enlarge the pilot project to encompass other parts of the industry. papiNet Europe currently has over 20 suppliers and extensive cooperation with customers within the industry.

Members includes: Ahlström, Burgo, ENCE, Fedrigoni, Holmen, International Paper, Korsnäs, Lecta, Mayr-Melnhof Karton, Metsä Group, Mondi, Norske Skog, Portucel/Soporcel, Sappi, SCA, SDC, SmurfitKappa, Södra, Stora Enso, UPM-Kymmene