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SPECIAL REPORT N°1

Watch the next step to larger roll diameters

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About the project

Over the past 25 years paper roll diameters have progressively increased in a series of steps from 1000 mm to 1100 to 1150 and then 1250 mm Ø which has been the norm for most new press installations during the last 15 years. This trend has been driven by printers wishing to improve their efficiency through handling and splicing fewer rolls and has been accomplished by improvements in paper making, logistics and paster technologies. Commercial and newspaper printers have begun to ask what advantages and constraints are associated with now moving from 1250 to 1500 mm Ø rolls.
PrintCity's Web Systems Group has investigated the impact of changing to larger diameter paper rolls by drawing on the cross-industry expertise of member companies and other specialists. Whilst some printers have already changed from 1250 mm to 1500 mm Ø rolls, many companies are unsure about the impact of changing size. This evaluation covers the complete value chain - from paper making, roll cores, transport, logistics at the print plant and the paster - but does not make specific recommendations as to whether printers should switch to the larger size rolls because viability will depend on each individual company's circumstances.

The right size?

In this report we refer to a roll diameter of 1500 mm (59”) but in North America the diameter is 60” (1524 mm); and internal core diameter of 76 mm (3”) and 150 mm (6”). There are no significant differences between these 'standards' for the purposes of this study.

Impacts of larger diameter

Impact	Better	Worse
High	✔✔✔	✗✗✗
Moderate	✔✔	✗✗
Low	✔	✗
Neutral	=	

Further actions

PrintCity's Web Systems project team has identified a number of areas where the group will continue to work together to improve the viability and performance of using larger diameter rolls, including:
• Developing a draft protocol on issues related to core specifications, testing, identification and labelling in order to propose that relevant international bodies amend and introduce more appropriate standards.
• Optimising chuck and core interaction.
• Identifying best practises to improve performance throughout the production cycle.
The optimum method to improve performance is a cross-industry approach involving relevant suppliers and organisations

Executive summary

Impact of change from 1250 mm to 1500 mm Ø rolls

Principal advantages: Potentially lower operating costs from reduced paper waste, lower splice tape consumption, more efficient press time utilisation and possibly reduced manning with:
• 31% fewer rolls to handle, store and strip
• 31% fewer splices to prepare
• 31% fewer roll changes, associated waste and web break risk

Principal constraints: Higher investment costs because all related equipment must be sized for the larger dimension and 44% greater roll weight:
1. Paper mill trimming efficiency, handling, rewinding and wrapping lines may need to be substantially upgraded to allow widespread availability of larger roll sizes.
2. Logistics required to handle and store rolls at paper mill, in transit and at printer.
3. More robust pasters with larger dimensions and automated roll loading.
4. In some cases, more expensive or larger cores will be required.

The economic viability of change will be different for commercial printers, wide web width newspapers and single-width newspaper operations. In addition, each plant will have its own variables including operating hours, manning levels, number of pasters, run lengths, variety of paper types and local logistics.

Relationship between roll weight - width - core

The 1500 mm Ø roll increases the weight and size of a paper roll by 44% and all roll handling, cores and pasters must be sized and specified accordingly.

Roll core quality

The roll core is the essential link in the production chain at the paper mill (winding and rewinding) and the paster (acceleration, braking and unwinding). The challenge for cores and chucks for 1500 mm Ø rolls is that together they must handle the 44% increase in weight that doubles the inertia at an E-stop, and requires torque to be increased by 62% (in comparison to 1250 mm).

The current 76 mm size core should be suitable for many 1500 mm Ø web offset rolls. However, higher grade, more expensive or larger diameter cores may be required in some wide web width and weight combinations where the relationship between the core and the chucks becomes a critical issue, and on which there is no clear industry consensus at this time. For this reason, paster manufacturers like MAN Roland and MEGTEC have taken the decision to set performance limitations even where the risks to people and machines are minimal:

1: Very heavy rolls: Currently defined as being over 3,5 tonnes will require larger 150 mm paperboard cores to ensure secure torque during E-stops. A benefit from larger cores is that they provide a better run/roundness with less residual paper layers on the core.

2: Very wide web widths (both 1250 and 1500 mm Ø rolls): Currently defined as being over 2000 mm wide and web speeds over 11 m/s. An expiring roll on a 76 mm Ø paperboard core can reach its resonance frequency and under certain circumstances this will cause a web break and possibly a core can break just prior to splicing. Although this risk is small, machine manufacturers are obliged to apply a principle of precaution by defining what cores can be used and providing safety protection around the paster. Solutions include using a specified 76 mm Ø paperboard core quality with a sufficient E-modulus/density ratio; or aluminum cores (currently a non-standard and very limited regional proposal); or 150 mm Ø paperboard cores.

These limitations could change in the future because manufacturers are researching improved solutions that may include higher performance cores and different chuck designs.

Early adopters' comments

Newspaper: The Augsburger Allgemeine commissioned their new MAN Roland XXL COLORMAN newspaper press this year. The press will run 1500 mm Ø rolls with a web width of 2100 mm at up to 12,75 m/s. The newspaper's Deputy Technical Director, Eike Bühring, explains that their choice to use larger rolls is based on the increased efficiency of materials utilisation (particularly paper), a reduction in missplices, and decreased roll movements. He believes that with larger diameter rolls and very wide webs it is essential to improve the overall logistics.

Commercial heatset: George R. Newkirk of MEGTEC USA comments: "Major North American heatset printing companies are either considering, or have already purchased, 60" diameter rolls to use on large format presses. They believe that larger rolls are an advantage on wide webs widths (72"/1828 mm, 75"/1905 mm and possibly 81"/2057 mm) that will be the dominant future formats and want to prepare for this change now. Their key considerations are that fewer splices will allow manpower reduction on presses, combined with reduced annual materials costs from lower paper waste and consumption of splicing tape."

Photo UPM.

Photo UPM.

Photo Megtec.

Photo Sappi.

Paper making

The two key issues for paper makers are trimming efficiency and the core types required. Paper suppliers will frequently need to make substantial investments to manufacture and handle the larger 1500 mm Ø. The consequences for the customer will initially be a more restricted choice of paper mills; higher minimum order quantity for 1500 mm Ø rolls; and perhaps higher price if the roll widths do not cut out efficiently from the parent roll; cores may be more expensive.

Delivery logistics

Increased delivery costs might be incurred for some 1500 mm Ø roll weight/web width combinations if they use transport payload capacity less efficiently. In some cases, more transport will be needed to deliver a given tonnage of paper, probably leading to increased costs. The current automatic roll loading/unloading systems are not adapted to the different loading patterns required for this size.

Logistics in printing plants

The increased roll size means less movement of rolls and more stable production conditions. Currently installed equipment may not be able to handle the larger dimensions and weight of bigger rolls and, consequently, investment may be needed to safely increase capacity limits. The principal impacts for different applications are:

Commercial heatset: Handling of larger rolls will require higher capacity roll trucks and clamps, adapted paper store and driveway layout, and higher capacity automated roll loading at the paster.

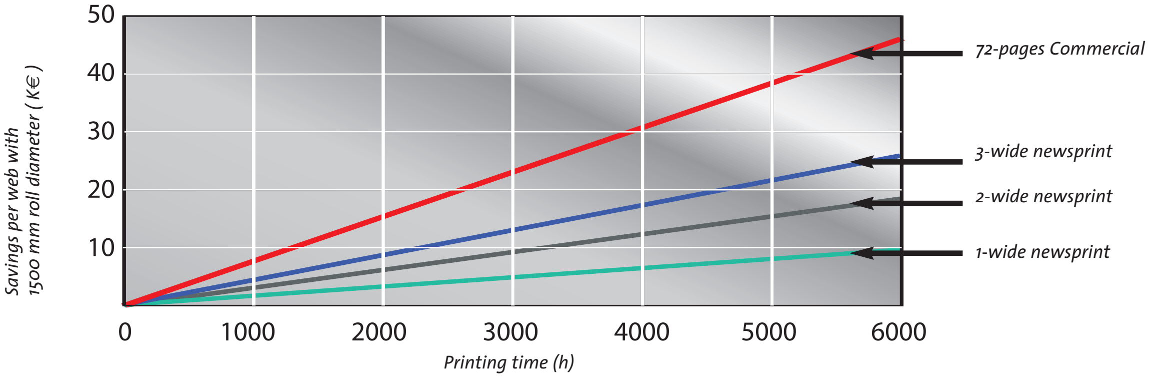
Single-width newspapers: The larger rolls will require higher capacity fork roll trucks and clamps (but not a significant cost) with an adapted paper store and drive way layout.

Double- and triple-width newspapers: Large volume newspaper installations tend to use customised automated roll handling and logistics systems. The impacts will be variable on different components of the system some will be cost neutral, others will increase costs or in some cases reduce costs.

Pasters

Pasters for larger roll sizes need to be of a much more robust construction to handle the increased roll weight that doubles the inertia at an E-stop and requires torque to be increased by 62%. The higher inertia also requires more powerful acceleration motors. New chuck designs may be needed to handle the much higher torque from the rolls and in certain cases quick changeover chucks to handle 76 and 150 mm Ø cores. These changes will lead to a higher investment cost. New paster designs for this size use a highly compact turret configuration to support the paster arms that allow 1500 mm Ø rolls to be handled in almost the same space taken today by 1250 mm Ø models.

Economics Return on Investment (ROI)



The economic viability of switching to larger roll diameters in the short to medium term will need to be carefully assessed as it will require printers to invest in new pasters and roll handling equipment.

Return on investment (ROI)

These very approximate financial scenarios show an ROI of 3 to 5 years - these scenarios assume that delivery costs are unchanged but this may be an important cost factor. ROI is highly variable it depending on many factors and small changes can dramatically change the result. Investment and operating costs vary between printing plants and each company should conduct its own detailed feasibility study taking into account all relevant factors (width and number of webs, number of operating hours, manning and wages, hourly press cost, splicing efficiency rate, cost of paper, type and cost of logistics).

Principal implications

1. Initially 1500 mm Ø rolls will probably only be economic for very high volume printers (magazines, directories and newspapers) investing in new press lines for printing large tonnages of paper with a narrow range of basis weight, grade and web width.
2. Printers adding a new press with 1500 mm Ø rolls to a plant that has older machines running 1250 mm Ø will also have to purchase and manage both roll diameters. This will constrain flexibility to switch jobs from the machine with 1500 mm Ø to other machines (but not vice versa).
3. In the short to medium term, only a limited number of paper makers will have capacity to make and process 1500 mm Ø rolls and where required with 150 mm Ø cores. Many mills will have to make substantial investment upgrades that will probably take several years to complete. It is therefore essential for printers to verify which of their current paper suppliers can supply larger roll diameters for all paper grades. The two key issues for paper makers are trimming efficiency and the core types required. Increased delivery costs may be incurred on some roll weight/web width combinations due to less efficient payload utilisation.
4. The combination of increased web width and roll diameters can be dramatic. For example: 100 x 1250 mm rolls for a 1400 mm web width reduces to 66 rolls for 2100 mm web width and this falls to 46 with 1500 mm - a reduction in the number of rolls to be processed by over half for an equivalent total tonnage. This effect is valid for all applications.

	COMMERCIAL	NEWSPAPER			
Web/width mm	1980	1980	700	1500	2100
Total webs	1	2	8	6	4
Shifts	3	3	2	2	2
Total cost savings	37 562 €	75 124 €	68 730 €	88 415 €	77 866 €
Total extra investment	145 000 €	270 000 €	210 000 €	380 000 €	330 000 €
ROI months	46	43	45	63	61

The potential cost savings at the printing press are related to the number of operating hours and the number of webs - the chart shows savings per web that may be possible to offset the higher capital investments costs of paper handling equipment.
Source MEGTEC.

Impact on roll core quality

ROLL CORES	Better	Same	Worse	
Cores - roll weights over 3,5 tonnes			✗✗✗	Safety issue. Higher core cost.
Cores - web widths > 2000 mm and speed > 11 m/s			✗✗✗	Safety issue. Higher core cost.
Cores - all other roll dimensions		=		

Paster chuck torque transmission is not proportional with length - both the type of design and expansion pressure have variable influences. Photo Sonoco-Alcore.

The roll core is the essential link in the production chain at the paper mill (winding and rewinding) and the paster (acceleration, braking and unwinding). The challenge for cores and chucks for 1500 mm Ø rolls is that together they must handle the 44% increase of weight that doubles the inertia at an E-stop, and requires torque to be increased by 62% (in comparison to 1250 mm). Current 76 mm Ø size cores should be suitable for many 1500 mm Ø web offset rolls, but higher grade or larger cores may be required for some wide webs and heavy rolls.

Normally paper suppliers ensure that the cores on which paper is supplied conforms to the printer's needs that are determined by the web width, roll diameter and weight, and speed of each press core performance criteria become critical as these parameters become larger. High performance cores are available from some suppliers that provide higher critical speeds, less vibration and deformation and reduced risk of delamination. These cores are straighter and stiffer with tighter tolerances for internal and external diameters (as a prerequisite for optimal winding quality), use higher grade materials and are manufactured to more exacting specifications.

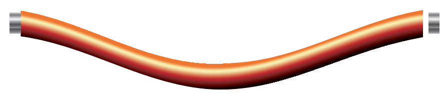
Today the current status is:
1. Beware of misleading comparisons with publication gravure that uses rolls < 2640 mm wide with a 76 mm Ø paperboard core because these rolls are 1250 mm Ø and are not comparable with 1500 mm Ø for offset that has double the inertia at an E-stop.
2. Using longer paster chucks may resolve some issues but torque transmission is not proportional with length and both the type of design and expansion pressure have variable influences.
3. There is a need for a single global standard to specify core qualities and testing methods (currently different and incompatible methods are used). A common labelling protocol on the roll to define core quality is also recommended as paper may be switched between machines or printing plants.
4. It is not possible today to reliably differentiate between highly variable qualities of paperboard cores at the time of loading a roll onto the paster. This should also be the subject of a global standard.
5. Core manufacturers cannot give a categorical guarantee of core performance because many conditions of use are beyond their control. This means that safety responsibility is passed to the paster manufacturer and the printer.
6. The use of larger core diameters, non-standard internal and external core diameters, or non-paperboard materials will complicate the paper manufacturing and logistics processes.

These limitations may change in the future but this will be conditional on a completely proven core/chuck interface that addresses all operational and safety issues. It might also be possible to reliably identify the quality of a paperboard core at the time of loading a roll onto the paster by using either colour-coded cores (to an international standard); or by RFID tags in the cores to allow automatic screening that only specified cores can be loaded but using this technology will require appropriate safety conditions.

Under today's conditions, paster manufacturers like MAN Roland and MEGTEC, have taken the decision to set performance limitations under the principal of precaution - even where the risks to people and machines are minimal:

1: Very heavy rolls: Currently defined as being over 3,5 tonnes and requiring 150 mm Ø paperboard cores to ensure adequate torque during E-stops. This is a standard size for gravure web widths over 2640 mm; however, many of the winders producing offset grades are either unsuitable to run 150 mm Ø cores or cannot work with them in combination with 76 mm Ø. A benefit from larger cores is that they provide a better run/roundness with less residual paper layers on the core and tend to provide better roundness. The cost difference between a high performance 76 mm core and a 150 mm core is minimal.

2: Very wide web widths (1250 and 1500 mm Ø rolls): Currently defined as being over 2000 mm Ø wide at web speeds over 11 m/s. An expiring roll on a 76 mm Ø paperboard core can reach its resonance frequency and under certain circumstances this will cause a web break and possibly a core break just prior to splicing. The consequences of a core break to the machine are minor; however, the consequences to people are a risk of serious injury or death. Although this risk is small, machine manufacturers are obliged to define what cores can be used and to provide adequate safety protection around the paster similar to that used in publication gravure. The overriding property that influences the risk of core break when attaining resonance frequency is the ratio of E-modulus over density. A high E-modulus and low density jointly increase the natural frequency and reduce the risk of a core break.



At web widths above 2000 mm and web speeds over 11 m/s rest rolls with a diameter of 76 mm can reach their resonance frequency and under certain circumstances a paperboard core can break just prior to splicing. This is usually preceded by a web break. Source MAN Roland.

Prevention of accident risks for wide & fast webs (1250 & 1500 mm Ø rolls)

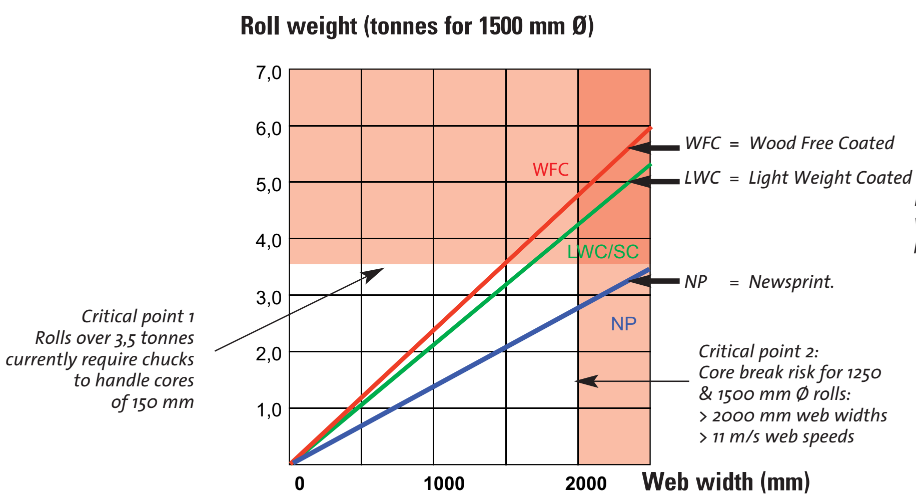
76 mm Ø Paperboard cores: Requires a specified core quality with a sufficient E-modulus ratio to its specific weight. However, a web and core break risk may arise from a variation of these values; cores with too high humidity or that delaminate; and loose, or soft winding of the inner paper layers (depending on their grade and substance). Because these variations are invisible a roll with inadequate properties can be loaded onto the paster with a consequent risk. Therefore, paperboard cores can only be used when nobody is in the danger-area if critical frequencies can be reached and "worst case" protection measures are required for personal safety. Printers should implement standard operating procedures to prevent non-conforming materials and/or poor working practices being used.

Reusable 76 mm Ø aluminium cores have a sufficient E-modulus ratio to specific weight and are being tested by some double-width newspaper printers but this is a non-standard option that will be complex to put into operation because (a) they are difficult for paper mills to automatically process and rewind, (b) logistics will restrict which paper mills can handle these cores for a specific printing plant location, and (c) safety issues, ownership, responsibilities and cost impacts are not yet fully established.

150 mm Ø Paperboard cores: Cores with an interior diameter of 150 mm and an exterior diameter of 176 mm have only 60% of the rotation frequency of 76 mm cores. The larger diameter significantly increases stiffness for the same material properties and a core break can be excluded under all conditions.

E-modulus quality control measurement - a high E-modulus and low density reduce the risk of a core break. Photo Sonoco-Alcore.

Paster chuck torque transmission is not proportional with length - both the type of design and expansion pressure have variable influences. Photo Sonoco-Alcore.



Under current conditions MAN Roland and MEGTEC have set performance limitations at two critical points even if the risks to people and machines are minimal. Source MAN Roland/Megtec

Paper making impact

PAPER MILL ABILITY TO PROCESS 1500 MM ROLLS				VARIABLE BETWEEN MILLS
	Better	Same	Worse	
Paper dimension efficiency from parent roll			✗✗	Depends on each paper machine
Winder trimming efficiency			✗✗✗	Depends on existing equipment
Adequate rewinder equipment - size and quality			✗✗✗	Depends on existing equipment
Availability paperboard cores to defined specifications		=		
Ability to rewind on 150 mm cores			✗✗✗	Depends on existing equipment
Packing line dimensions			✗✗	Depends on existing equipment
Conveyor dimensions			✗✗	Probable upgrade
Hi-bay storage capacity			✗✗	Difficult to change existing dimensions
Automated roll loading trucks/containers			✗✗	Not currently possible
Minimum order requirements			✗	Related to parent roll and rewinder

Photo UPM.

Photo Sappi.

Photo Sappi.

Rolls of 1500 mm Ø are standard in the converting industry. Two newspaper presses are already running with them. However, many mills are not yet equipped to handle heatset web offset and newspaper rolls in this size and many will need to make substantial capital investment to do so.

Larger diameter rolls represent a challenge for paper manufacturers who need to ensure that their manufacturing operations the paper machine, finishing, internal logistics, trimming, dimensioning, and delivery logistics are adequate and capital investment may be necessary to overcome existing constraints. The two most significant challenges are trimming and core types.

Paper making quality

The paper making process, and particularly winding, will require even more attention to maintain good profiles across the web to ensure that rolls correctly unwind at very high speeds. The friction properties of different papers play an important role and become more critical as roll diameters increase. There are two general rules for paper making quality:

- **the wider the web, the better the paper profiles must be**, and
- **the bigger the roll diameter the better the profiles must be**.

Achieving optimal profiles is more difficult on older machines and an upgrade investment may be needed.

New dimensions

A key issue is paper dimensioning at the mill. The diameter of the parent roll usually yields 1, 2 or 3 customer rolls. Normally the parent roll produced has enough paper to make three sets of 1250 mm Ø rolls in the winder. If the same method is used for 1500 mm, the diameter of the parent roll becomes so large that moving it from the paper machine to the winder may become difficult or impossible particularly for coated paper. Some plants may find it difficult to move even a two-set parent roll of 1500 mm Ø.

Trimming

Trimming becomes more difficult with a new larger diameter. An increased 1% of trim loss means 5 - 10 tonnes/day reduced output and consequent higher production costs. Two criteria are extremely important for efficient trimming: 1, Customer roll widths when combined must make a set that is as close as possible to 100 % of the width of the parent roll (varies from 6 to 10 m wide); 2, Only one diameter can be wound at a time - mixing 1500 and 1250 mm Ø rolls is not possible.

Trimming efficiency tends to decline as customer roll width increases. A possible consequence may be that the order volume for 1500 mm Ø rolls in a given web width and grade may need to be determined by the paper machine's trimming efficiency. Coldset papers tend to be easier to trim because newspapers require both full and partial web widths. Trimming coated rolls will be a bigger problem. A further complication is any requirement for different core diameters (internal and external). Adding a new larger diameter roll size increases product variation making production planning more complicated, e.g. print jobs that are printed on more than one press may need mixed diameters.

Winders and rewinders

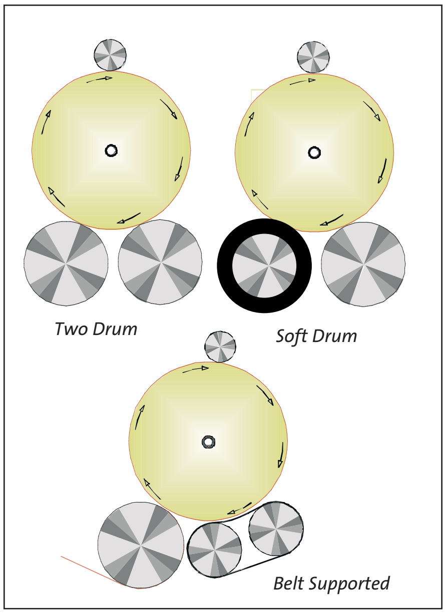
Almost all new winders at paper mills are capable of making a roll with 1500 mm Ø. However, the capacity of slitter-winders (and rewinders) to produce this diameter is limited for older installations. The heavier parent roll may require new rewind stands, stronger electric drives, gears with more accurate tension and improved speed controls. Not all winder types can handle the bigger 150 mm Ø cores (or combine them) that may be required by some roll dimensions this will be more difficult for newsprint than other grades. Single drum winders can mix 76 and 150 mm Ø cores but two drum winders cannot. The implications are both investment and possibly higher paper core costs.

Roll packing & wrapping

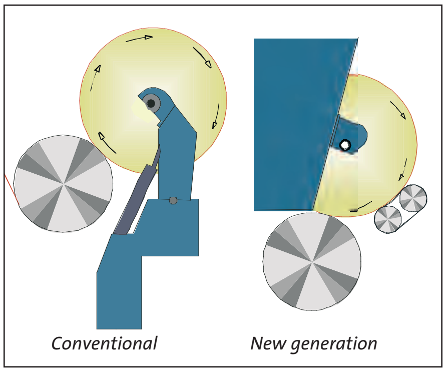
Many mills have roll wrapping lines and conveyors that are not designed for larger roll sizes and in some cases the heavier weight rolls may also exceed the capacity of conveyors and wrapping equipment. Although wrapping lines are often designed for a 1500 mm roll diameter they have not been used in this size for heavy coated papers.

In-mill logistics

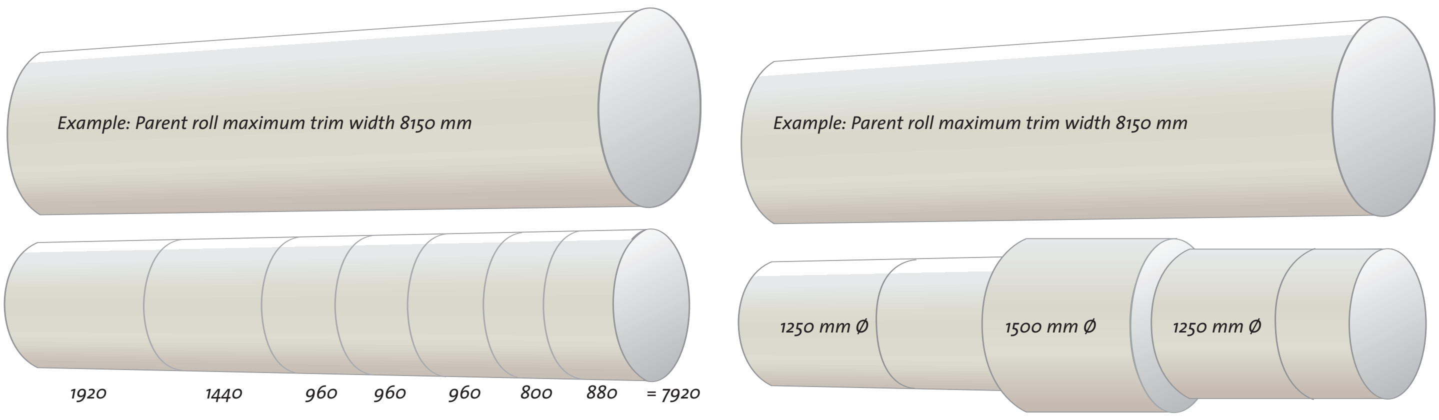
Larger diameters and heavier roll weights may require redesign of the whole logistics chain. The dimensions of internal storage at paper mills particularly automated intermediate storage systems and the delivery chain handling equipment may not be adequate for larger roll sizes and increased weight and may require investment in upgrades. This will also apply to roll clamp truck dimensions, their turning geometry and warehouse layout.



Two drum winders



Single drum winders. Source Metso.

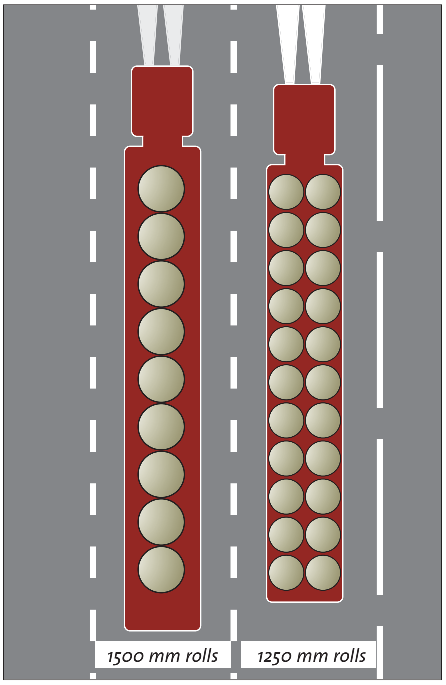


1, Customer roll widths when combined must make a set that is as close as possible to 100 % of the width of the parent roll (varies from 6 to 10 m wide).

2, Only one diameter can be wound at a time - mixing 1500 and 1250 mm rolls is not possible.

Logistics

LOGISTIC	Better	Same	Worse	
Overall impact positive	✔✔✔			Number of rolls handles reduced by 31%
Overall impact negative			✗	Roll weight increased by 44%
Maximum use of truck/container weight capacity			✗	Depends on web width & weight
Highly automated systems				
Roll unloading facilities			✗✗	Not currently possible
Conveyor dimensions			✗	Upgrade to higher diensions & weight
Hi-bay storage		=		Total storage tonnage/cost equal
Hi-bay storage cranes		=	✗	Higher capacity add 30000 € each
Automated splice preparation	✔✔			Fewer units required
Capacity AGV roll transport		=		Fewer units, but add 10-20% to unit cost
Capacity other intermediate transport		=		Minimal impact
Waste handling		=		Minimal impact
Manning reduction		=		Minimal impact on an automated system
Low automated systems				
Higher capacity roll trucks and clamps			✗	Minimal impact
Storeage, wider access alleys and curves			✗	Minimal impact
Assisted roll handling at paster			✗	Minimal impact
Manning reduction	✔			Increases with number of pasters



Delivery logistics

The dimensions of road delivery trailers and containers may pose a problem with 1500 mm Ø rolls depending upon the web width and specific paper weight. 1250 mm Ø rolls are loaded side-by-side for efficient space and payload utilisation.

1500 mm Ø can only be arranged in a staggered pattern, or vertically/horizontally along the length of the trailer. In some cases this will lower utilisation of maximum payload and more transport will be needed to deliver a given tonnage of paper thereby increasing costs.

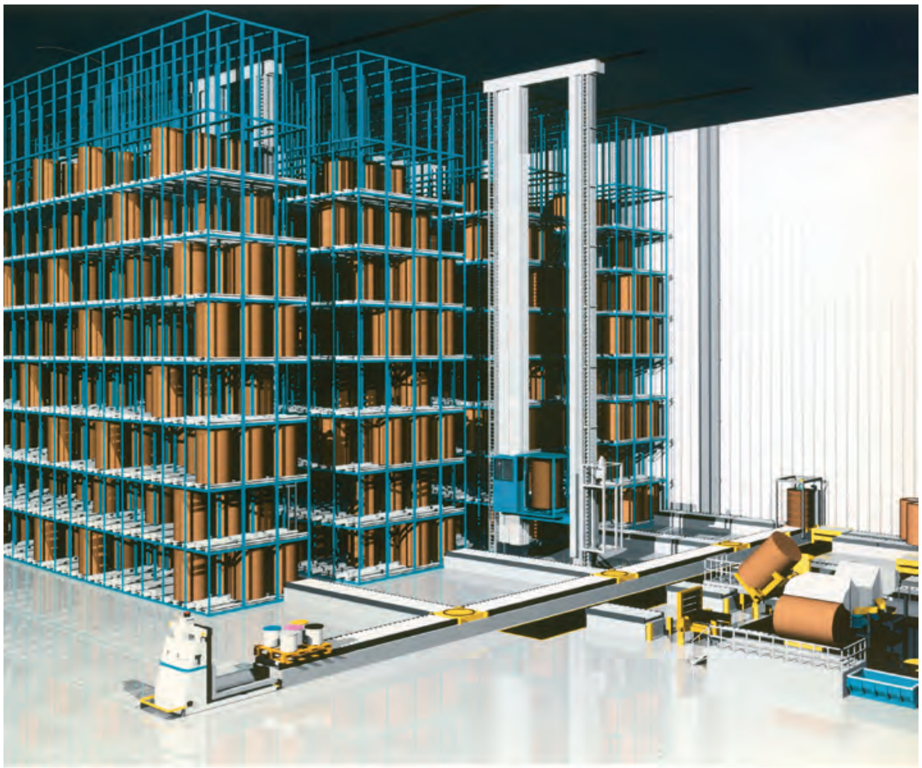
Truck loading/unloading

Current automatic roll loading/unloading systems are not adapted to these types of loading patterns. Neither will it be possible to drive roll lift trucks onto the truck and a special roll truck with telescopic clamps will be needed; this will increase loading and unloading time and tend to increase costs.

Printing plant logistics

The increased roll size means 31% fewer movement of rolls and more stable production conditions.

Existing installed equipment might not be able to handle the larger dimensions and weight of bigger rolls and investment may be needed to safely increase capacity limits. The dimensions of conveyors, corners and turning radius will need to be assessed and local area floor loading weight needs to be checked to confirm it can withstand a 44% increase in weight load. Pre-storage areas in front of the press may be reduced by up to 20% because fewer rolls are required than for the equivalent weight in 1250 mm Ø. Larger rolls will need a longer climatic adjustment period, particularly cold rolls. The clamping forces for roll trucks will need to set and monitored regularly but experience to date shows no other difficulties in this area.



Drawing MAN Roland.

There should be little cost impact on storage for 1500 mm Ø rolls for the same total tonnage as 1250 mm . Photo MAN Roland.

Commercial heatset printing applications: For most plants using roll lift trucks the handling of larger rolls will require higher capacity forklift trucks and clamps, adapted paper store and driveway layout, and higher capacity automated roll loading at the paster. The weight capacity of roll lift trucks will need to be increased from about 3 000 kg to around 6 000 kg to safely handle heavy rolls. This will increase purchase cost from about 45 000 € to about 60 000 €. In addition, the centre of gravity is 125 mm further outside of the truck and this has to be taken in account when choosing the roll lift truck a consequence may be an increased turning radius for trucks, which will then require wider alleys. Larger capacity roll clamps will also be more expensive. On the other hand, 31% less rolls need to be handled, which should reduce the number of trucks and drivers required.

Single-width newspaper printing applications: The handling of larger rolls will require roll lift truck capacity to be increased from 1 to 1,5 tonnes (which will not be a significant cost) with an adapted paper store and driveway layout. Assisted roll loading at the paster may be desirable.

Double- and triple-width newspaper printing applications: Large volume newspaper installations tend to use customised automated roll handling and logistics systems that provide significant operating benefits:

- Direct cost saving through personnel reduction
- Standardisation for higher operational safety and reliability
- Structured total material logistics to optimise productivity
- High flexibility in working hours
- Safety orientated, better work practices and conditions.

Conveyors will need to be able to handle increased roll weight and width, whilst turns require more space. Photo MAN Roland.

Intermediate transport systems will need a larger capacity to handle increased weight but fewer units may be needed to handle 31% fewer rolls. Photo MAN Roland.

Photo MAN Roland.

Photo MAN Roland.

The impact of changing to 1500 mm Ø rolls for a new installation will vary for different components:

Truck unloading:
Current automatic roll loading/unloading systems are not adapted to the different truck roll loading patterns for 1500 mm Ø. Solution will need to be developed. Cost impact may be high.

Conveyors:
Conveyors for newsprint will need a larger capacity to handle weight increase from around 2,5 tonnes to 4 tonnes. The width and turns will need to be increased accordingly. Cost impact low to moderate.

Main storage:
There should be little cost impact on high bay storage for 1500 mm Ø rolls for the same total tonnage as 1250 mm Ø. The additional weight capacity for stacker cranes will add around 40 000 € per unit. Minimum back-up security means that the same number of cranes will probably be required and there will be no savings. If at a later stage it is decided to revert to 1250 mm Ø there will not be enough storage spaces.

Intermediate transport:
Transport systems will need a larger capacity to handle weight increase from around 2,5 tonnes to 4 tonnes. AGVs will need a larger turning space, higher roll weight capacity. Cost impact add around 10% to AGV unit cost but possibly fewer units needed due to 31% less rolls to handle.

Splice preparation:
31% less rolls to prepare should reduce the number of stations and operators required. Cost impact moderate reduction in capital and running costs, probable reduced manning.

Paster loading/unloading:
The heavier roll weights will require an increase in transfer capacity. Cost impact low to moderate depending on system used.

Waste handling:
No significant impact, except 31% fewer cores to handle.

Photo Megtec.

Impact at paster

IMPACT AT PASTER	Better	Same	Worse	
Overall impact	✔✔✔			31% fewer splices
More robust paster construction			✗✗✗	Variable cost to w/width & application
Higher capacity acceleration & braking			✗	Moderate cost increase
Chucks with higher torque transmission			✗	Moderate cost increase
Over 3,5 tonnes roll weight changeable 76 & 150 mm Chucks			✗✗✗	Moderate cost increase
> 2000 mm webs at > 11 m/s need added safety devices			✗✗	Moderate cost increase
Automated roll loading			✗	Moderate cost increase
Installed length, height, width,		=		Design dependent minimal extra size
Pit depth		=		Design dependent minimal extra size

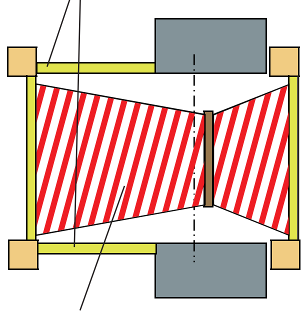
Pasters for larger roll sizes need to be of a much more robust construction to handle the 44% increase in roll weight that doubles the inertia at an E-stop and requires torque to be increased by 62%. The higher inertia also requires more powerful acceleration motors. In addition, the paster must be highly stable with low vibration. New chuck designs may be needed to handle the much higher torque to and from the rolls. All of these changes will lead to a higher investment cost.

The optimum technical solution for very heavy roll weights and wide webs is to use 150 mm roll cores. This requires that pasters for these applications should be fitted with quick change chucks to rapidly switch between 76 and 150 mm diameters. To minimise the total length and height, the roll arms for 1500 mm pasters are supported on a turret (rather than a central bull shaft) that allows the rolls to be much closer together.
This ensures that there are only minimal changes to the overall dimensions - which is particularly important for newspapers with multiple pasters. The minimum roll size for unloading remains 450 mm . However, the roll rotation pit will need to be deeper.

Offset v Gravure?

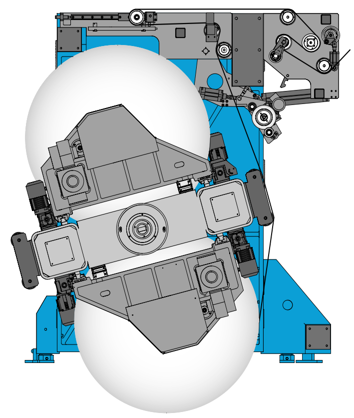
Beware of misleading comparisons with publication gravure pasters that handle rolls < 2640 mm wide with a 76 mm Ø paperboard core because these rolls are 1250 mm Ø and are not comparable with 1500 mm Ø for offset that has double the inertia at an E-stop. Gravure pasters usually have longer chucks, belt assisted acceleration and safety cages because of the risk of core explosion. Manufacturing offset pasters to gravure specifications is not financially viable and the applications are also different.

Using longer paster chucks may resolve some issues but torque transmission is not proportional with length (most of the load is at the flange) and both type of design and expansion pressure have variable influences. Longer chucks may increase the risk of chuck damage during automatic roll loading and will significantly increasing overall paster width.

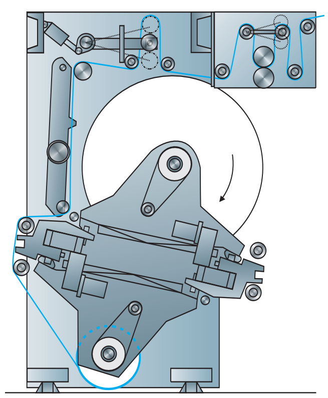


Safety protection for 76 mm cores used on web widths < 2000 mm and speed < 11 m/s. The objectives are to protect people from flying debris if a core breaks whilst avoiding operating and handling problems at the paster. A design to satisfy this uses roll doors instead of the safety cells required for an auto roll loading system. During the loading and unloading cycle the doors operate automatically. The safety system is only activated at high production speed. Access is possible under most production conditions with push button door opening and closing. An open door is optically and acoustically signaled before reaching the critical frequency. If the door is not closed the press speed will slow to 9 m/s.

Examples of new paster designs developed for 1524 mm Ø rolls include:



Heatset commercial applications
MEGTEC DLC 5000 flying paster for
< 1524 mm rolls
< 2080 mm wide
< 5000 kg roll weight
< 18 m/s maximum speed



Newspaper applications
MAN Roland CD15XXL-60 flying paster for
1524 mm rolls
< 2520 mm wide
< 3700 kg roll weight
< 15 m/s maximum speed
Reel Diameter

Economic impacts

	Better	Same	Worse	
Reduced mis-splices & higher press availability	✔✔✔			Substantial additional benefit
Reduced splice preparation time for total volume	✔✔			Manning reduction related to N° of pasters
Reduced splice preparation costs paper waste & tape used	✔✔✔			More preparation care required
Reduced damaged rolls reduces paper waste	✔			More handling care required
Reduced paper waste left on core after splicing	✔			From stiffer or larger cores

Higher investment costs of roll handling, storage and paster systems will need to be offset by reduced running costs. Some operating cost scenarios have been modelled to give an idea of potential ROI (Return on Investment). These assume a 99% splicing efficiency rate, higher core cost, and unchanged paper and delivery costs. Principal cost savings come from a 31 % reduction of mis-splices, less splice preparation waste and tape, and reduced operator working time per web from fewer rolls to prepare.

The following examples of cost savings are for a heatset 72-page press running 24h x 6 days x 51 weeks at 70% net production = 5140 hours/year, printing at 14 m/s, 1980 mm web width printing 54 gsm LWC (specific weight 1,2). Running 1500 mm Ø rolls reduces number of rolls run per year from 9 536 to 6 664; and the time between roll changes increases from 32 to 46 minutes. Other impacts are:

Roll preparation and waste: Larger diameter rolls will have increased stripping waste per roll both from handling damage and splice preparation. However, under equal conditions bigger rolls have less waste because the stripping waste per roll only increases by 20% whilst the total number of processed rolls decreases by 31%. Processing fewer rolls also requires less preparation time and splice tape. Best practice roll handling and preparation becomes relatively more important for larger diameter rolls to reduce waste because the potential damage per roll increases with diameter. Assumes 1 % of the rolls are damaged and paper cost is 0,70 €/kg.

	COST		COST REDUCTION
Roll damage	**1250 mm**	**1500 mm**	
5 mm deep	4 430 €	3 720 €	710 €
10 mm deep	6 180 €	5 190 €	990 €
15 mm deep	9 230 €	7 760 €	1 470 €
20 mm deep	12 260 €	10 310 €	1 950 €

Splice preparation: Potential cost saving is 12 140 € per web (assumes 5 minutes to prepare a roll, splice tape 0,50 €/m, 0,70 kg white paper stripping waste). However, this sum is only obtainable if there is a staff reduction or fewer splice preparation machines.

Rest rolls: Residual white paper waste left on cores is reduced because there are 31% fewer cores from 1500 mm Ø than from 1250 mm Ø for an equivalent tonnage. Residual core waste can also be reduced with stiffer cores that reduce length of paper left on the core.

	MISSED SPLICES		LOST PRODUCTION TIME	
Roll diameter	**1250 mm**	**1500 mm**	**1250 mm**	**1500 mm**
Rolls/year	9536	6664	9536	6664
98,0% splice success	190	133	95 h	67 h
98,5% splice success	143	100	72 h	50 h
99,0% splice success	95	67	48 h	34 h
99,5% splice success	48	33	24 h	17 h

Missed splices: Using larger diameter rolls gives the equivalent of 0,5% increased splice success rate. In addition to these savings there is also reduced waste for each web break and restart. These figures show the importance of using best practices to increase splicing efficiency in existing operations (automated splice preparation systems usually optimise splice efficiency levels). Cost savings increase at low splice efficiency rates because there are 31% fewer splices made with larger rolls. Roll cores that are more rigid tend to reduce missed splice frequency.

ANNUAL OPERATING COST SAVINGS	WEB(S)/PRESS(ES)	1250 MM ROLLS	1500 MM ROLLS	SAVING/YEAR
72-pages Heatset Commercial				
3 shifts / 1980 mm web width / 54 gsm LWC	1	161 884 €	124 322 €	37 562 €
Annual operating costs	2	323 768 €	248 644 €	75 124 €
1-width Newspaper	1	30 229 €	21 638 €	8 591 €
2 shifts / 700 mm web width / 45 gsm	4	120 917 €	86 552 €	34 365 €
Annual operating costs	6	181 376 €	129 828 €	51 548 €
	8	241 834 €	173 104 €	68 730 €
2-width Newspaper	1	53 346 €	38 610 €	14 736 €
2 shifts / 1400 mm web width / 45 gsm	2	106 691 €	77 220 €	29 472 €
Annual operating costs	4	213 383 €	154 439 €	58 943 €
	6	320 074 €	231 659 €	88 415 €
3-width Newspaper	1	71 409 €	51 943 €	19 466 €
2 shifts / 2100 mm web width / 45 gsm	2	142 819 €	103 886 €	38 933 €
Annual operating costs	3	214 228 €	155 829 €	58 399 €
	4	285 638 €	207 772 €	77 866 €

Commercial heatset: This example assumes an average running speed of 14 m/s over three shifts with a € 1 000 hourly rate and current LWC paper cost and shows an annual cost reduction of around € 40 000 per web. Larger diameter rolls will initially be interesting for very high volume magazine and directory printers using large tonnages of the same paper weight, grade and web width. The ROI will be higher when new press lines are ordered; the replacement of pasters on existing presses will be less attractive. Printers making an early change to 1500 mm Ø rolls will also have to continue to purchase and manage 1250 mm Ø rolls used on existing presses until they are replaced.

Newspapers: These examples use the same methodology as Commercial, with current newsprint paper cost and assume no increase in delivery costs. The consolidated savings of multiple webs per press become substantial along with the possibility of reduced manning. The key variables are the total operating hours and paper tonnage per year. The use of 1500 mm Ø rolls should be advantageous to a newspaper investing in new presses with a high number of webs and annual operating hours.

Single-width: The example assumes an average running speed of 10 m/s with an hourly cost of € 225 per printing tower. The ROI will need to consider the slightly increased costs of roll handling within the plant but these are relatively low. However, there are no pasters currently available for 1500 mm Ø rolls for this application.

Double-width & Triple-width: The examples assumes an average running speed of 12 m/s with an hourly cost of € 300 and € 400 per printing tower respectively. The ROI will need to consider the increased costs on automated roll handling within the plant.
Triple-width presses reduce the number of pasters per press by one third in comparison to double-width. If this is combined with using 1500 mm Ø rolls the potential manning and materials savings are substantial. Increasing both roll width and diameter reduces total roll movements by 50% (compared to double-width 1250 mm Ø) to increase logistics efficiency and ROI.

Return on investment (ROI)

These cost saving are incorporated into the ROI scenarios on page 5 that indicate an ROI of 3 to 5 years. However, ROI is highly variable it depending on many factors and small changes can dramatically change the result. Investment and operating costs vary between printing plants and each company should conduct its own detailed feasibility study taking into account all relevant factors (width and number of webs, number of operating hours, manning and wages, hourly press cost, splicing efficiency rate, cost of paper, type and cost of logistics).

Printers' check list to assess viability of change to 1500 mm Ø rolls

This list will assist printers in assessing the total impact of changing to 1500 mm under their specific operating conditions. It will help them identify relevant cost impacts from which to calculate the ROI from such a change.

IMPACT ON PROCESS	RECOMMENDED ACTION	COSTS	
ARE SPECIAL CORES NEEDED WEB WIDTH/ROLL WEIGHT ?		ADDED	LOWER
		+	-
Cores - roll weights over 3,5 tonnes	Check requirments with the paster manufacturer		
Cores - web widths > 2000 mm and speed > 11 m/s	Check requirments with the paster manufacturer		
PAPER MILL ABILITY TO PROCESS 1500 MM ROLLS			
Availability of special cores	Check with your paper suppliers for each paper grade used		
Availability of 1500 mm paper rolls	" " " " " " " " " "		
- Newsprint	" " " " " " " " " "		
- Super Calendered (SC)	" " " " " " " " " "		
- Coated papers	" " " " " " " " " "		
Web width dimension efficiency cut-out from parent roll	" " " " " " " " " "		
Minimum order requirements related to cut-out from parent roll	Related to parent roll and rewinder		
Identify cost implications on paper supply	Check with your paper suppliers for each paper grade used		
DELIVERY TO PRINTING PLANT			
Roll delivery for web width/roll weights needed.	Cost implications of payload inefficiency		
LOGISTICS AT PRINTING PLANT			
Highly automated systems (e.g. wide web newspapers)			
Roll unloading facilities	Method and cost impact		
Conveyor dimensions	Costs to upgrade to higher dimensions & weight		
Hi-bay storage	Total storage tonnage/cost probably equal		
Hi-bay storage cranes	Higher capacity add € 30 000 each		
Automated splice preparation	Are fewer units required, cost/manning savings ?		
Capacity AGV roll transport	Reduced units? but add 10-20% to unit cost		
Capacity other intermediate transport	Any cost impact?		
Waste handling	Any cost impact?		
Manning reduction	Can manning be reduced? If yes cost savings.		
Non automated logistics			
Higher capacity roll trucks and clamps	Additional investment cost compared to 1250 mm Ø		
Storeage, wider access alleys and curves	Impact of additional space required		
Assisted roll handling at paster	Additional investment cost compared to 1250 mm Ø		
Manning reduction	Define in relation to 31% reduction in roll movements		
IMPACT AT PASTER			
More robust paster	Additional investment cost compared to 1250 mm Ø		
Over 3500 kg roll weight = changeable 76 & 150 mm Chucks	Cost implications		
2000 mm webs at > 11 m/s need added safety devices	Additional investment cost compared to 1250 mm Ø		
Automated roll loading	Additional investment cost compared to 1250 mm Ø		
Installed length, height and width	Impact on total space required for press-paster		
Ready roll staging area dimensions	Impact on total space required		
Manning reduction	Define in relation to 31% fewer rolls		
IMPACT ON MATERIAL CONSUMPTION & PRESS AVAILABILITY	**INCREASES WITH N° PASTERS PER PRESS**		
Reduced mis-splices & higher press availability	Define savings		
Reduced splice preparation time for total volume	Is there a manning reduction related to N° of pasters?		
Reduced splice preparation costs paper waste & tape used	Define savings		
Reduced damaged rolls reduces paper waste	Define savings		
Reduced paper waste left on core after splicing	Define savings		