

3 Warehouse & Paper Store



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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 Storage



Side damage from poor clamping. Source: UPM.



Roll damaged from collision with a wall. Source: IF P&C.



End damage from debris in floor. Source: WOCG/icmPrint.



Paper damaged by water leaks. Source: UPM.

✖ Poor storage.

- €² Damaged rolls require excessive stripping and paper waste before running.
- €² Deformed rolls reduce press running speed and splicing efficiency.
- €² Rolls which cannot be run at all.

Inspection on delivery

- ✔ Paper should be inspected upon arrival and any visible defects noted on the delivery documents.

Preventing deficiencies in handling and storage will reduce paper damage and minimise losses and production difficulties arising from deformed rolls and local paper weaknesses on the edges and surface.

Safe storage of paper products requires a well-designed plant, comprehensive documented procedures that are implemented as part of best practice. Regular training of staff involved in cargo handling, fire safety and/or warehouse maintenance helps to ensure a good warehousing standard. A well maintained, clean and correctly run warehouse offers a significant first impression to a client, whether new or prospective. A printer's paper store is an integral part of its manufacturing operations.

Warehouses & Paper Stores

The two types of storage facilities have much in common but, in respect of their operations, may have different functional and environmental needs.

Bulk Paper Warehouses

These are found at paper mills, ports, intermodal points and at some very large printers. They generally have the single function of efficient storage of very large quantities of paper. These buildings are rarely conditioned for temperature and humidity. Natural ventilation is used to remove excess humidity, e.g. from paper arriving in freezing winter conditions and moving into a relatively warmer environment.

Printers' Paper Stores

These are highly variable, ranging from paper racks in a small pressroom up to a separate large area. Paper stores are generally integrated into the print manufacturing site and can include other functions such as waste collection, dispatch, etc. Ideally the paper store should be located next to the receiving dock and close to the pressroom to minimise transport distances. This configuration will require attention to contain fire risk storage and production areas. They may or may not have systems to control temperature and humidity.

Automated Paper Warehouse

Some paper mills, logistics companies and very large printers may have highly automated paper handling and internal logistics such as automated truck roll unloading, conveyor systems, hi-bay storage and cranes. For printers this might also include automated splice preparation with AGV or rail transport of the roll to the press. These systems are dedicated to a given site and are, therefore, outside the scope of this guide.

- ✔ A key automation requirement for printers is to establish the precise specifications and tolerances for paper rolls and their packaging with the equipment suppliers concerned because successful automation requires consistency in materials.



Sheet paper stored on racks for efficient use of floor space. Source: Pure Impression/icmPrint



Truck loading inside warehouse, note protection around pillar. Source: 'FMS Use No Hooks!'.

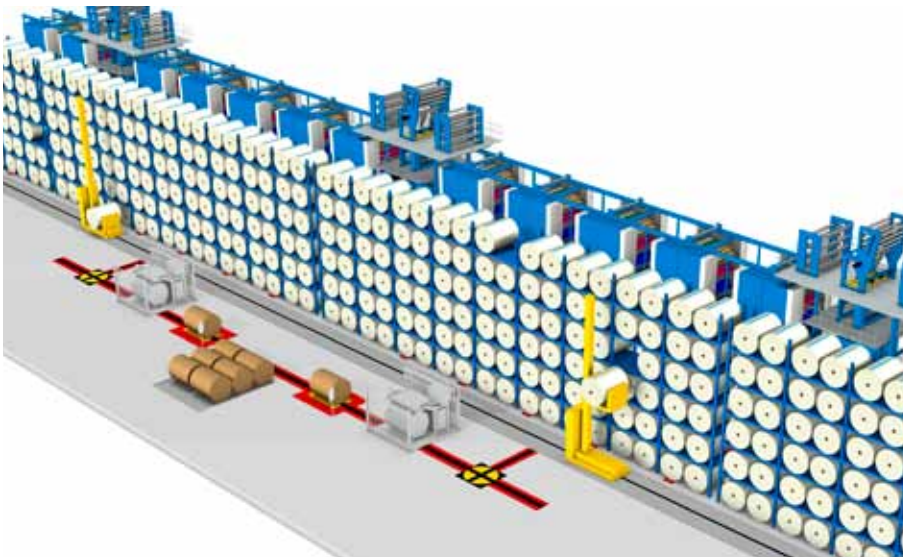


Materials Storage & Handling Layout

Materials handling requires careful analysis to ensure efficiency and minimise accident risk. It is essential to avoid double handling, backtracking, and moving other loads to get to the one needed. Good design minimises staff time to move themselves and materials around the plant. Aisles should be as straight as possible — every turn increases the risk of a collision or spilled load. Use corner-collision protection for wall edges, building columns, paper and pallets. Aisles must be dimensioned to the characteristics of the handling equipment. Design pathways and walkways to minimise the risk of collision with vehicles, fixed objects or tripping. People will take the shortest available route, so minimise the length of paths between parking, changing rooms and workstations. Routes should be clearly marked and correctly lit.



Automated truck roll unloading and conveyors. Source: Watch Next Step To Larger Roll Diameters.



Fully automated splice preparation and logistics with a high bay store at New York Daily News. Source: KBA.



AGV automated roll handling. Source: KBA.

General Storage Requirements



The paper on this truck was loaded at the mill at 50% RH at 23°C, during transportation the temperature fell to -10°C. Condensation will be formed unless it is correctly conditioned at its destination.
Source: Hapag-Lloyd.

Climate Variables for Storage

Paper that is not in balance with its storage and operating environment can create serious printing problems such as static charge and dimension variations, along with set-off, tensile weakness, folding resistance and surface smoothness. The minimum moisture content for printing is around 3%; below this, paper will have high static electricity that can cause interference to press electrical equipment, mis-splices, difficulties with folding and off-line finishing.

While intermediate warehouse storage does not require the same precise acclimatisation conditions as the printer, however most of the other general storage conditions are applicable.

X There is a significant risk in the logistics chain and storage when ambient temperatures are below freezing. The 5-8% water content in paper can easily freeze, which can lead to problems such as mis-splices, micro-blistering, ink chilling down, etc.

The temperature of paper on arrival may be lower than the dew point of local climate conditions leading to condensation on the surface of paper wrapping this will normally dry off without damage by following the storage steps [on page 12](#).

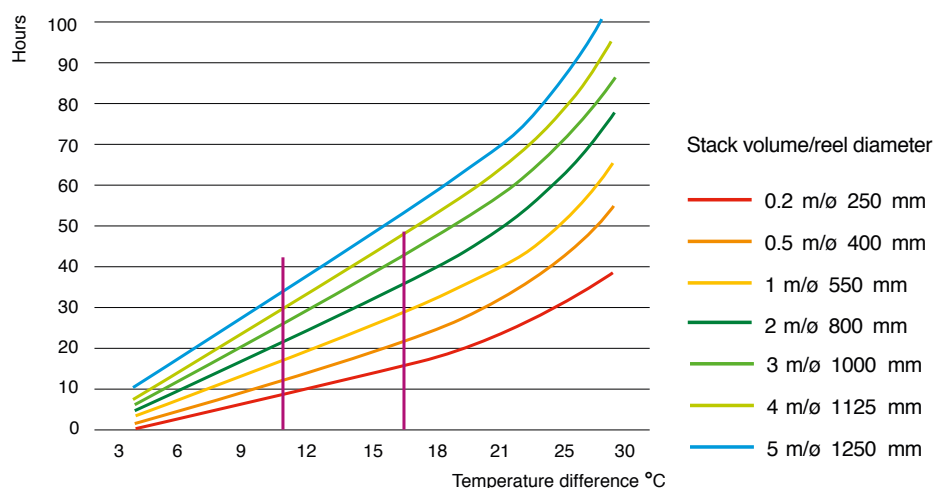
Paper stability is achieved at 20°C to 23°C (68 - 74°F) and 50 - 55% relative humidity and these conditions will improve press productivity.

Recommendations to optimise paper condition:

- Store under good ventilation conditions. Air should circulate freely around stored paper, which should not touch outside walls.
- Avoid storing paper in areas that are subject to extreme temperature changes such as heated objects, vents or cold walls. Paper should never be stored in direct contact with concrete, where it may be exposed to moisture or damp conditions.
- Storage conditions should be the same as pressroom if possible.
- Adequate acclimatisation is essential for very cold paper (see chart).
- Paper should be kept in its protective wrapper. Avoid damage to wrapping and re-wrap any paper not used.
- Prior to printing, paper rolls should be conditioned with their edge covers removed but with the body wrap left in place until preparation of the splice.

Conditioning time depends on the temperature difference between transport or warehouse environment and the 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 depends upon their diameter because they condition from the edges inwards.

For more information on temperature and humidity [see Modules 1 and 7](#).



This chart shows the conditioning time when moving paper rolls between different temperatures. The example shows 24 hours conditioning time is required when transporting a 1000 mm (40") Ø roll directly to the pressroom maintained at a temperature of +23°C (73.4°F) with an outside temperature of +13°C (55.4°F).
Source: UPM.

Building

✓ Paper warehouses and stores should have these attributes:

- Dry and well ventilated
- Clean (includes free of bird droppings and oil patches)
- Firm, even and level floor
- Sufficient working space
- Good lighting but without excessive direct exposure to daylight.
- Floor markings for aisles and numbered storage bays
- Designed for safe operation with managed fire risks
- Printer's paper storage temperature should be similar to the pressroom.
- Doors large enough to cope with all expected traffic, and when closed, must prevent entry of driven snow or water.

The building should be well constructed so that paper is completely protected even in extreme weather conditions like wind driven entry of rain or snow. The construction should be of non-combustible materials such as concrete, brick, or steel. The location, design and materials need to comply with fire regulations and insurance requirements related to the storage of high volumes of paper.

The roof must be completely watertight. Ridged roofs are recommended, because even new and well-maintained flat roofs have a tendency to leak and suffer under heavy snow burden.

Climate change is leading to unusual weather in widespread places — for example flash floods from intense high volume rainfall in a short time period can lead to high local area, river and coastal flooding risks, which requires greater attention to drainage in and around a paper store. Rainwater drainage pipes and gutters should have sufficient capacity and preferably be located on the outside — if located inside then they need to be adequately protected from collision damage from machinery and cargo.

- ✓ A grid positioned in the floor at door openings will prevent water from entering the warehouse (if connected to an adequate drain) and will also reduce sand and stones entering in vehicle tyres.

Floor

The floor should be on a higher level than the surrounding ground level with effective drains to avoid storm flooding. Floors need to be level throughout and strong enough to withstand the weight of the stored cargo and of the machines operating inside the warehouse. Paper weight varies with grade e.g. a 1000 wide x 1000 mm Ø roll (40" x 40") in newsprint weighs about 500 kg (1100 lbs) while coated paper is 1000 kg (2200 lbs).

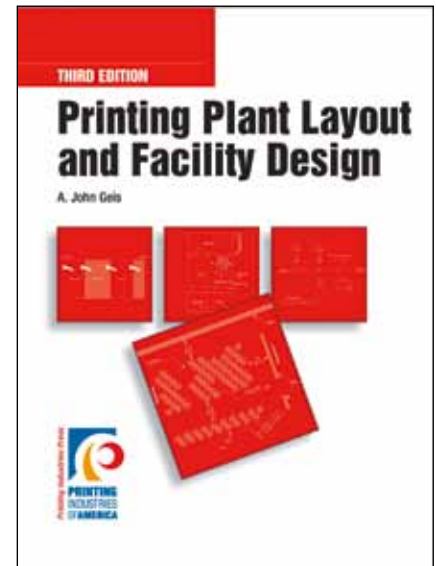
Preferred floor covering materials are polished concrete or bitumen (although less wear resistant). Concrete floors need to be sealed to prevent dusting, usually with an epoxy and urethane coating that is chemical, stain and skid resistant and easy to clean. A reflective light colour floor surface increases illumination. No loose particles are allowed on the finishing surface of the floor.

Floor conditions dictate the type of tyres used on forklift trucks. Cracked floors should be repaired, because they increase the danger of stone damages to rolls. A rough or cracked floor can cause accidents if extremely hard tyres are used. To eliminate tyre marking, non-marking tyres should be installed on new trucks when they are moved to buildings with new floors.

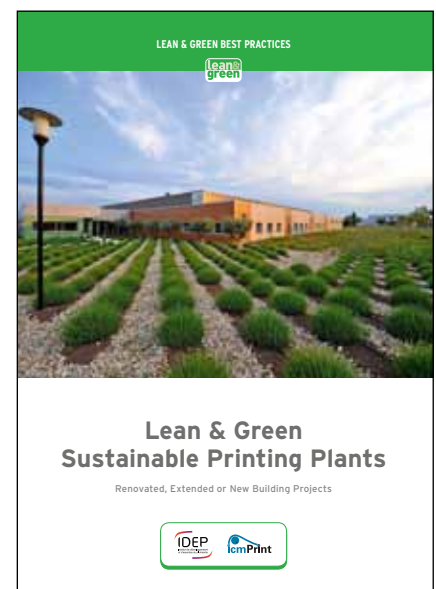
- ✓ Cracks and damages to the floor must be repaired as soon as possible. Uneven areas should be painted as hazards to prevent from loading on these areas.

- ⚠ Uneven floors put additional stress on rolls when being moved by clamp trucks as they require higher clamping pressure to prevent sliding out and this increases risk of roll distortion.

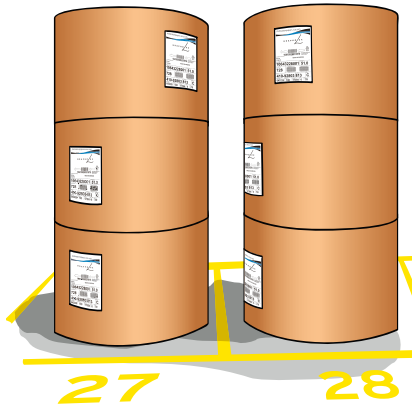
For more information on materials storage and handling layout for printing plants:



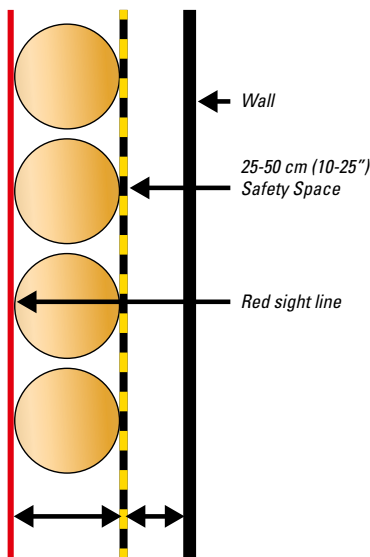
"Printing Plant Layout and Facility Design", 3rd ed.
A. John Geis, PIA 2010, which describes best practices to help printers develop optimum facility designs.
www.printing.org



"Lean & Green Sustainable Printing Plants"
www.icmprint.com



✓ Storage bays should be numbered to facilitate placement and retrieval. Source: SCA Reel Handling.



Red sight line
= Roll Diameter + Safety space

✓ Reduce collision damage when positioning rolls alongside walls by providing clamp truck drivers with a red aiming line that provides better guidance. Source UPM

✗ Using a physical barrier fixed to the floor is not recommended because the roll edge will be damaged if pushed against it. Source: UPM.

Circulation & Aisles

Doors and aisles for warehouse traffic must be wide enough for all vehicles to pass through and there must be sufficient operating space in the loading areas. Staging areas near the loading bays are recommended.

Aisles must be dimensioned to the characteristics of the handling equipment. Main aisles should be wide enough so that two laden pallet trucks can pass each other and allow a 90° turn to load/unload. There should be separate circuits for vehicles and people.

Pedestrian circulation needs to minimise risk of collision with vehicles, fixed objects or tripping. Reduce risk by minimising length of paths between parking, changing rooms and workstations, recognising that people will take the shortest available route. Routes should be clearly marked and correctly lit. Paths 1 m (3,3 ft) wide enable wheelchair access.

✓ Aisles should be as straight as possible as every turn increases the risk of a collision or a spilled load. Use corner collision protection for wall edges, building columns, rolls and pallet guards.

Markings & Working Safely

Traffic routes should be clearly marked on the floor by lines and symbols to ensure safe working and to provide a visually efficient workplace. Aisles, storage zones and machine operating areas should be defined by 75 mm (3 in) wide yellow paint/tape on floors. Storage bays should be numbered to facilitate placement and retrieval. Dedicate an area for damaged paper to be evaluated and repaired.

Adequate space is needed between rolls for roll clamp truck access.

✓ Corner and hanging ball mirrors and other safety equipment are required for dangerous places to ensure safer working. High risk areas must be restricted by painted lines or separated by fixed or moveable barriers.

A minimum safety distance of 50 cm (20") should be left in front of walls as a damage and fire protection measure. Vulnerable features like pillars, electrical cabinets etc. must be protected by guard rails or sand filled boxes painted as hazards.

Materials Reception/Dispatch

The beginning and end of manufacturing are where materials enter the production cycle and are then dispatched as finished products. Best practice criteria apply to all warehousing operations. For small printers this is often a ground-level loading door with an electric lift truck or dock lift to load and unload vehicles. Larger plants have a roofed loading bay (dock) and some include an internal loading ramp to allow access for small delivery vehicles. Some printers have a dedicated staging area in which to accumulate all parts of an order to ensure that no part of the job is misplaced. Short run job deliveries will often use small trucks or vans with lower loading height.



Dock doors should be about 10 cm (4 in) wider than truck width. The deck height of the unloading dock is variable with truck height, e.g. 50 cm (20 in) for vans and small trucks to 1,2 m (47 in) for large trucks. Solutions are doors/docks for different truck heights, an outside platform with different heights, or pit type dock levellers. Ramp angle should not be higher than 5% and have lateral protection. Doors, docks, cabinets, etc should be protected from truck collision using 150 mm (6 in) diameter steel pipes painted yellow.

- ✓ Docks should be sheltered from poor weather conditions. Dock seals between the truck and the building can pay for themselves in a year from energy savings from 'lost' hot or cold air. The border of the dock should be colour highlighted.

The service road and dock approaches need to be dimensioned to the size(s) of trucks. Continuous parallel lines on the ground about 3,4 m (10 ft) apart help guide vehicles when manoeuvring. In left-hand drive countries, trucks should circulate anti-clockwise because the driver can see the end of the truck or trailer more easily — the opposite applies to right-hand drive countries. A general guide to truck manoeuvring space is that the approach distance to the dock should be at least twice the length of the truck.

Lighting

Adequate lighting with minimum illumination of 200 lux is required. Technologies can include fluorescent tube lamps and gas discharge/luminous discharge lamps (HQL, NVA-T, HQI-T, HQI-BT types). Fluorescent tubes should only be used with electronic ballast because they use significantly less energy and last longer than tubes with ferromagnetic ballast. They should also be equipped with safety starters. All lamps must have protective covers to prevent glass splinters falling on to workers and stored paper.

Gates can be provided with a rotating spotlight to better illuminate loading platforms of containers, trucks, etc. The safety margin from the highest point of the cargo stored to the lamps is 1 m (40 in).

Energy consumption can be minimised by:

1. Building design that maximises daylight — skylights and light reflective colours for walls and floors.
2. Choice and maintenance of lighting
3. Control systems.

The three types of lighting control systems can co-exist to address different needs: (1) manual with a simple switch or a push-button that turns-off automatically after a given time; (2) presence detectors to automatically switch lights on or off, or reduce lighting levels depending upon the presence in the zone concerned (timing needs to avoid too frequent on-off cycles that can reduce lamp lifetime); (3) daylight light detection systems adjust lighting intensity to the changes in daylight to provide a consistent and comfortable light with important energy savings.

Loading Ramps

Ramps must have sufficient space for movement of forklift trucks and be designed to take the weight of the machinery and handled goods. Vehicles being loaded must be secured to prevent them from moving or tipping — manual or automatic restraining systems can be used for this. Semi-trailers that are loaded without the tractor unit attached must use adequate trailer supports.

- ✓ Loading and unloading of vehicles should take place inside the warehouse or under cover of the warehouse canopy to protect paper from adverse weather.



Moveable automatic truck loading docks with weather protection. Source: icmPrint.



✗ Ground-level loading doors with weather protection showing poor operating practices: Unused pallets should not be stored close to the building where they create a fire risk; the walkway along the outside of the wall is blocked. Source: icmPrint.



Mobile ramps may be a suitable loading solution. Source: 'FMS Use No Hooks!'



X Poor storage practices increase fire risk.
Source: IF P&C.

Fire Safety

Fire precautions are determined by local regulations, environmental sensitivity, and the requirements of the fire service and insurer. It is essential to identify all regulatory and non-regulatory requirements.

Ensure adequate free space between the warehouse and adjacent buildings. This distance depends on the fire resistance of the wall materials and on local requirements. No combustible materials or machinery can be stored between the buildings because this reduces the safety distance.

An open surface limit is imposed by regulations and insurance companies – some restrict this to 4000 m² (43 000 sq ft) separated by fire doors, others to over 6000 m² (64 500 sq ft). It is recommended that fire doors and walls should be designed to withstand a fire for 120 minutes. It is important to ascertain local regulations that influence the design, e.g. minimum distance between certain activities and limit of the site, fire resistance of construction materials, minimum height of certain separation walls, etc.

The need for extinguishing water is influenced by the water supply to the site — the fire service may require an onsite water reservoir. An underground pipe for firewater around the building is normally required. If the warehouse is equipped with indoor fire water pipes they must be well protected against collision damage. Pressurised pipes in cold environments must be adequately insulated.

Temporary containment of extinguishing water from a fire may be required to protect the local environment. Costs can be minimised by implementing this retention in the general site concept, e.g. under certain conditions the loading dock zones can provide retention.

Sprinkler systems have to be installed when required by local authorities and/or insurance companies. The system must be correctly dimensioned to meet the hazard classification of the stored goods, warehouse dimensions and local regulations. Fixed extinguishing systems in the engine compartment of all machinery is a very good and cost efficient way of preventing fire hazards.

Early detection devices are very important. An automatic alarm system must be installed and preferably be linked directly to the fire brigade or security company. Extinguishers, alarm bells, buttons, markings, etc. have to be placed according to the national building regulations. Fire instructions need to be especially clear and visible marking with signs and painted lines are essential.

Smoke venting devices must be installed in the roof, preferably combined with ceiling smoke screen sectioning to optimise their efficiency. Lightning conductors are often a regulatory requirement.

- ✓** All personnel working in the warehouse should be trained to use the fire fighting equipment and regular drills held to maintain their skills. Joint exercises with the local fire department are highly recommended. All machinery should be equipped with an automatic extinguishing system and with a portable extinguisher.



X Fire detection systems must be in good condition and not obstructed. Source: IF P&C.

Electric Truck Maintenance & Charging Station

A central maintenance and charging station is often located in or near the warehouse and should be equipped with an emergency shower and eye wash fountain for accidental acid spill.

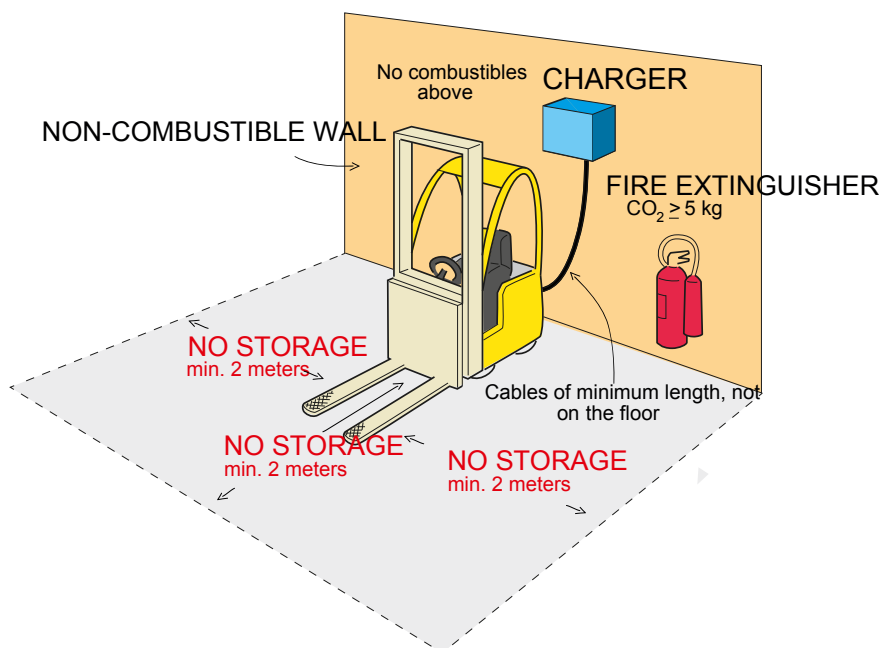
Batteries can be charged by an external unit, or by an internal charger plugged into a normal electrical socket. In either case there is a risk of a fire starting. Towards the end of a classic battery's charging cycle a hydrogen discharge creates a lighter-than-air explosive layer that accumulates close to the ceiling. A fire can start in equipment that is being charged as a result of a short-circuit caused by damaged cables, connectors, charging units, etc. Battery charging typically occurs in an out-of-the-way place and/or overnight; a fire may develop without being detected and will spread quickly if there are combustible materials close by.

Locating battery charging facilities: Charging stations should be located in a separate fire compartment to minimise smoke damage to production and storage. It is recommended to have a dedicated charging room for installations over 50 kW with forced ventilation directly to the outside at low and high levels. If a separate fire compartment cannot be provided and battery charging must take place within a larger space, the area devoted to battery charging should not exceed 50 m² unless sprinkler protection is provided. Battery charging should never be located in an area in which there is a risk of explosion, e.g. where flammable liquids are stored.

Safety equipment: Install automatic fire detection together with hand-held fire extinguisher (min. 5 kg carbon dioxide). Chargers should be fixed to a secure wall — never on combustible walls — and protected from collision. Cables should be of minimum length and held off the floor to prevent damage — spring loaded cable reels are ideal. Improve electrocution protection by installing residual current devices on battery chargers and single button emergency electrical cut-off for multiple banks of battery chargers. Lighting should be on the walls, rather than on the ceiling where stray hydrogen is most likely to be found. Avoid any non-essential electrical items in the room. Ensure a minimum distance of 50 cm (20 in) between the charger and the battery by installing wheel stop blocks.

Ventilation: Battery charging must be located in a well-ventilated area with a mechanical extraction rate that replaces the room air volume every hour. Chargers should be interlocked with the ventilation so that in the event of a ventilation failure the battery chargers will be shut off. Ventilation by natural air movement requires openings at floor and ceiling levels of at least 400 cm² per 50m³ of room volume. Hydrogen detectors in the ceiling should be interlocked with the chargers to isolate them if hydrogen is detected.

- ✓ Battery life is largely determined by the total number of charges rather than by running hours. Monitoring of charging and correct maintenance will extend battery life. Maintenance-free batteries with electrolyte gel or completely sealed units with low discharge are available. Their use should be investigated and the charging zone adapted to the chosen system.



Ensure a minimum 2 m clear area around battery charger. Area above charging stations kept clear of combustible materials. Cables should be of minimum length and held off the floor to prevent damage.
Source: IF P&C.

Warehouse Operations



Safety equipment (coloured jacket/helmet) is recommended, safety shoes for staff. Source: ERA.



Concave traffic mirrors increase safety at intersections. Source: 'FMS Use No Hooks!'



✗ Loose paper from unwrapped part rolls are a fire risk. Always rewrap rolls. Source: UPM.

✓ Safety & Security

- Staff equipped and wearing specified safety equipment (reflective vests, protective foot-, ear- and eye-wear, hard hats).
- Safety notices and procedures are clearly displayed; staff correctly trained and updated.
- Store paper separately from other products.
- Best practice operation of all equipment — *see Modules 4 & 5*.
- Fork and clamp trucks should have headlights and warning lights on when operating in a warehouse.
- Overhead and concave traffic mirrors where needed.
- Apply fire precautions.
- Clearly visible floor markings for aisles, traffic routes and storage bays.
- Separated walkways.
- All lighting works and lamps are clean.
- Clean floor free from nails, gravel, sand etc. Use a sweeping machine for large areas.
- Protect top rolls from bird droppings
- Corner guards for rolls and pallets.
- Before loading and unloading from the rear of a truck or trailer, place wheel chocks on both sides
- Security gates, fencing, monitoring, and doors function correctly. Procedures are in place to lock doors and set alarms.
- Annual surveys of electrical installations and equipment

Operational Needs

Evaluate need and availability of:

- Compressed-air connections with pressure reducers and water separators
- Sufficient electrical power points, is 380 V needed?
- Writing desks close to the loading door.
- Internal telephone connections.
- Sufficient docking stations for barcode scanners.
- Area(s) for storing cargo securing devices
- Defined area to hold and evaluate and repair damaged paper.

⚠ Fire Precautions

Smoking and use of naked lights is strictly prohibited inside the warehouse.

No rubbish should be left in and around the warehouse. Minimum safety distance to combustibles should be 8m (26 ft) and in temporary parking 4m (13 ft).

It is recommended that overnight parking of roll trucks and other vehicles should be outside the warehouse. No personal vehicles shall be taken into the warehouse.

If it is not possible to arrange the overnight parking away from the warehouse, then the machinery should have a separated parking area well clear from the stored goods.

Adequate signs in the warehouse for escape routes and location of fire extinguishers.

- ✓ All personnel working in the warehouse should be trained to use the fire fighting equipment and regular drills held to maintain their skills. Joint exercises with the local fire department are highly recommended. All machinery should be equipped with both an automatic extinguishing system and a portable extinguisher.

Hot Work

Hot work operations (e.g. welding and steel cutting) in the warehouse always require a permit with special safety measures. The correct procedures and permits have to be documented. Only designated personnel are allowed to grant permits for hot work, which can only be carried out by authorised and licensed personnel. The owner/operator of the warehouse is responsible for fire safety and for compliance with regulations.

✓ Hot work checklist

- Verify requirements of local regulations.
- Person to perform hot work is qualified and appropriately trained (e.g. valid hot work certificate).
- A designated fire watch person(s) must be appointed and equipped with appropriate fire extinguishing equipment. The fire watch must be present during the work, breaks, and after completion for a minimum of one or more hours, to be defined. Monitor possible smouldering for two to three hours after the work is completed.
- Workplace is cleared, cleaned and wetted down to make it safe for hot work. Remove garbage, flammable liquids, idle pallets etc.), and protect surrounding materials that might easily catch fire.
- Seal openings in floors, walls and ceilings.
- Approved fire extinguisher in place and easily accessible at workplace.
- Hot work equipment is fault-free and approved.
- Name of person responsible for disconnecting/reconnecting fire alarm.
- Sprinkler system is in service.

Battery Charging

Towards the end of a classic battery's charging cycle a hydrogen discharge creates a lighter-than-air explosive layer that accumulates close to the ceiling. A fire can start in equipment that is being charged as a result of a short-circuit caused by damaged cables, connectors, charging units, etc.

Ensure a minimum 2 m (7 ft) clear area around battery charger. Area above charging stations must be kept clear of combustible materials — including cables and trays and combustible ceiling materials.

- ✓ Regularly inspect the area, condition of charging units and cables — use an infrared camera when they are in use. Replace any damaged cables and equipment immediately.

Loading Ramps

Vehicles being loaded must be secured to prevent them from moving or tipping. Manual or automatic restraining systems can be used for this. Semi-trailers loaded without the tractor unit attached must have adequate trailer supports.

Good Housekeeping

✓ Regularly ensure

- Floor is dry, clean of sand, stones and other debris to avoid roll end damage. Clean large areas regularly with a sweeping machine.
- Keep birds out of the warehouse to avoid contamination.
- Industry standards regarding product safety should be complied with, particularly when handling food and liquid packaging boards or hygiene papers.
- Paper products must only be warehoused with compatible products. There should be no risk that other goods will cause any stains, odour or similar degradation.



✗ Smoking is strictly prohibited inside the warehouse. Source: IF P&C.



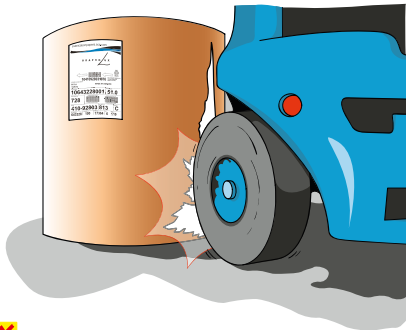
✗ Potential roll end damage source — loose screw. Source: IF P&C.



✗ Potential roll end damage source — gravel. Source: UPM.

Stacking

Paper Rolls



❌ Inadequate space for clamp access between the rolls. Source: SCA Reel Handling.

✓ Rolls should be:

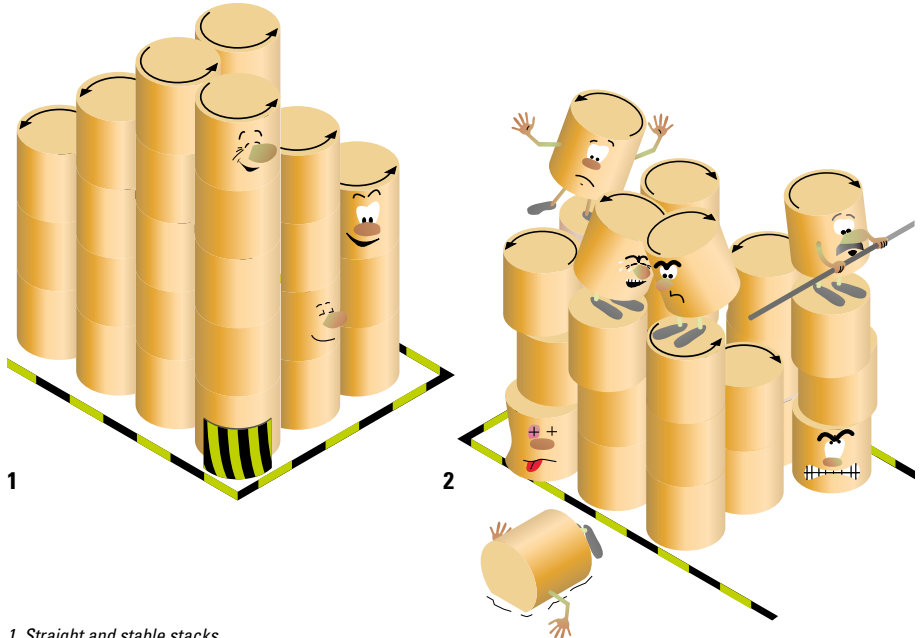
- Stacked on their ends, evenly in straight lines, with the same unwind direction.
- Place additional roll end shields on bottom roll (wrapping material).
- No overlapping — leave a safety gap between the roll columns.
- Space between rolls for clamp access.
- Space in gangways for lifter turns.
- Outer and corner rolls protected with roll guards.
- Use paper on FIFO (first in, first out) principle.
- Always keep wrapping in place. If a laboratory test is made on a roll, the wrapper must be repaired.

✓ Use handling equipment correctly

- Always use the same equipment to place and take out rolls.
- Keep the mast in the correct position.
- Carry out only one movement at a time.

See Modules 4 & 5 for complete information on handling equipment and techniques.

❌ Horizontal roll storage (lying rolls) is not normally recommended because of distortion and stacking limitations. Use only where absolutely necessary and avoid long-term horizontal storage. Use caution when breaking down.



1 Straight and stable stacks.

2 Poor stacking increases damage risk, especially edge damage. Source: WOCG/icmPrint

Paper Delivery Procedures

- ✓ **Unloading:** Use optimised techniques for unloading the specific delivery vehicle. This can be a frequent source of damage. [See Module 5.](#)
- ✓ **Inspection:** Paper should be inspected upon arrival and any visible defects should be noted on the delivery documents. Digital cameras can be used to document damage and images transmitted electronically to stakeholders. For full information [see Module 2.](#)
- €² Failure to note damage on the delivery documents could result in a claim for damaged paper being rejected. Neither does it allow fault analysis to be made to identify and resolve the cause of damage.

During winter, the temperature of paper on arrival may be lower than the dew point of local climate conditions leading to condensation on the surface of paper wrapping. Very large differences in temperature can lead to massive condensation or 'sweating' of paper units.

✓ Condensation on the wrapper will normally dry off without damage by following these storage steps:

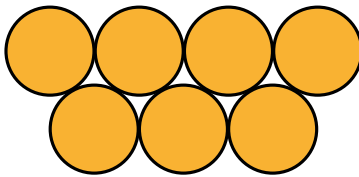
- Leave enough space between rolls/stacks to ensure good airflow
- Ensure maximum air ventilation inside the warehouse by leaving its doors open.
- If there is enough space, place rolls one-high in a lying position to avoid condensation leaking down the wrapper.
- If rolls are stacked standing, then scatter enough saw dust around bottoms of stacks to soak-up moisture.
- Leave enough time for the rolls to dry out. In general, the best way to avoid problems with cold rolls is to let them warm-up to a 'good enough' temperature of +10 °C or more.

❌ Do not open the wrapper while rolls are 'sweating' as this causes water damage to top and bottom of the roll

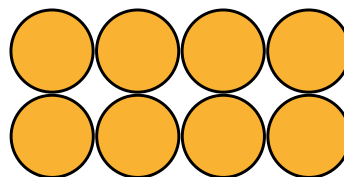
Roll Storage Patterns

✓ Normally rolls should be stacked vertically using a parallel 'soldier' pattern with adequate between rolls for roll clamp truck access.

A nested roll pattern eliminates rows, reducing the floor area required to store a larger quantity of rolls of a single type — these must be staggered to allow each roll to be lifted. However, nested patterns have a higher risk of roll damage; in many countries fire regulations do not permit nesting because space required to hose down rolls.



Nested.



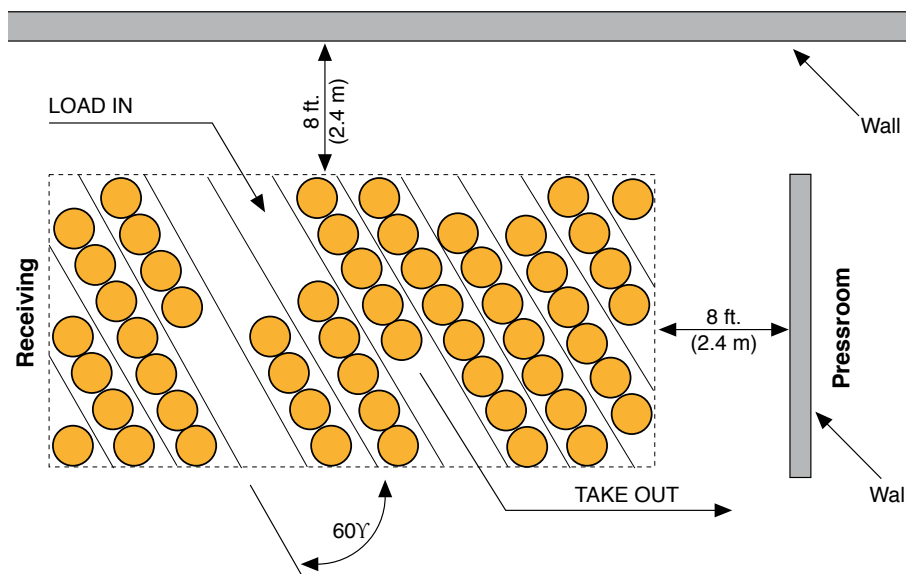
Soldier

⚠ Caution, actual roll diameter within same production batch may vary $\pm 2,5$ cm (1") that may require extra care when stacking, however, the roll label will only show the roll diameter ordered.

There are two ways to stack rolls:

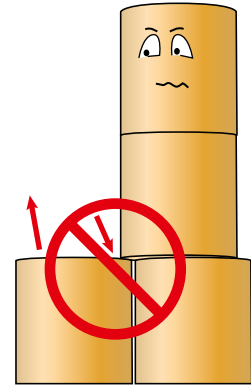
- 1 **Asymmetrical:** Rolls aligned on one side of the pile — with about a small hands-width of space (5-10 cm / 2-4") between piles. This reduces the risk of overlapping edges being damaged when the pile is unstacked. It is best suited for roll diameter tolerances of ± 2 cm (0,8").
- 2 **Symmetrical:** Rolls are centred on top of each other. Best used when there are larger variations of roll diameter. It is essential that rolls with the largest diameters are placed at the bottom.

Access aisles for roll clamp trucks are determined by roll width — add 25 cm (10 ") to full roll turn radius to minimise roll collision damage. The storage row angle can be either 60° or 90°. The 60° angle reduces aisle turning width by 38%. Adequate space is needed between every other roll to allow the clamp truck to reach the deepest position without damaging rolls on either side. Roll storage in rows from a single centre aisle to a wall can complicate access, whereas two separate roll-in roll-out aisles allow more flexible first-in first-out (FIFO) movement.

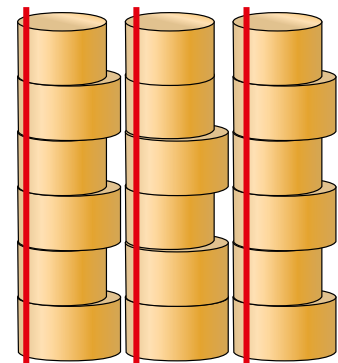


Rolls stored in 60° angled rows using FIFO first-in first-out movement with separate roll-in roll-out aisles. Source: PIA 'Printing Plant Layout and Facility Design'.

LIFO (last-in, first-out) may be preferred if recent deliveries of rolls are warmer than those stored in an unheated warehouse — this avoid these rolls becoming colder than necessary prior to printing.



✗ Overlapping stacks creates high risk for edge damages. The edge is the weakest part of the reel. Source: Stora Enso.



To avoid edge damage, stacked rolls should be aligned on one side of the pile — with about a hands-width of space (5-7 cm / 2-3") between piles. This reduces the risk of overlapping edges being damaged, when the pile is unstacked, and allows for roll diameter tolerance of ± 2 cm (0,8"). Source: UPM.



Edge damage from not placing roll vertically. Source: UPM.



Always re-wrap partly used rolls. Source: UPM.



Always repair damage wrapper before stacking. Source: UPM.

Part Rolls

Partly used rolls which are returned to storage should be protected from damage and atmospheric changes with a wrapping capable of withstanding minor bumps and acting as a moisture barrier. The ends should be protected by re-used end caps. They should have the original roll label re-attached or the roll number written on, with gsm, grade/brand.

- ✓ Part rolls should be used at the earliest opportunity to maximise warehouse space and avoid deterioration.

Stacking Heights

The maximum height of an individual stack depends on:

- Roll diameter
- Stacking pattern — soldier or block/nested
- Strength of the warehouse floor (maximum storing capacity [t/sq m or lbs/sq ft] should not be exceeded)
- Roof construction
- Restrictions from a sprinkler system (clearance below sprinkler heads).

The paper store should calculate its maximum stacking heights based on the variables of its installation, type of paper and any particular issues like seismic risks.

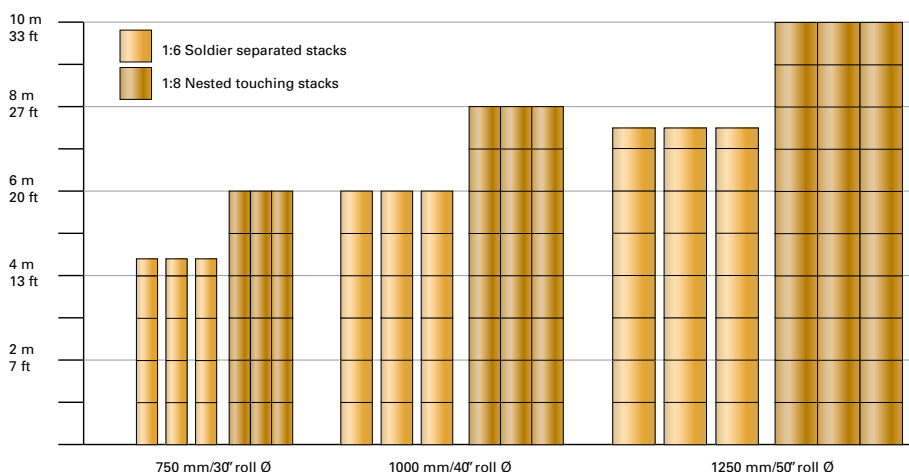
The VDI in Germany provides guidance on stacking that is a ratio of roll diameter to maximum height of 1:6 for soldier stacks, and 1:8 for block stacking where the rolls touch each other.

- ⚠ There is a high risk of accident and damage when removing top rolls from blocks, this is higher for the first and last rolls in a stack. This must be removed in accordance with best practice procedure see Module 5.

A standard 7 m (23 ft) high ceiling should be able to stack around 6,5 m of rolls. Very high ceilings of 12 m (40 ft) allows more rolls in a stack but require floors with increased load-bearing capacity and roll trucks with higher masts. However, their lowered mast height (around 3,7 m) is too high to unload road trailers or railway wagons, which means another clamp truck with a lower mast will be required.

Pulp bales can be stacked maximum four bales high (depending on the quality of the bales). The top layer should be indented by a half unit length in order to increase stability.

Stacking heights for different roll diameter in 1:6 soldier and 1:8 block patterns. Source: Intakt.



Paper Pallets

Pallets can be stacked three-high, a maximum of four layers of pallets can be stacked if plywood sheets are used between layers to reduce stress to the lower pallets and to increase stability of the stack.

The length of the forks must be adjusted with the pallet handled.

✓ Multi-level racks increase storage capacity and segregate different substrates.



Multi-level racks increase paper storage capacity per unit of floor space. Source: Pure Impression/ icmPrint.

✓ Roll and corner guards

Curved plastic protectors shield corner rolls from clamp truck damage on intersecting truck aisles. This freestanding protector should be as high as the widest portion of any roll clamp truck used and is an effective way to prevent damage from trucks making turns too sharply.

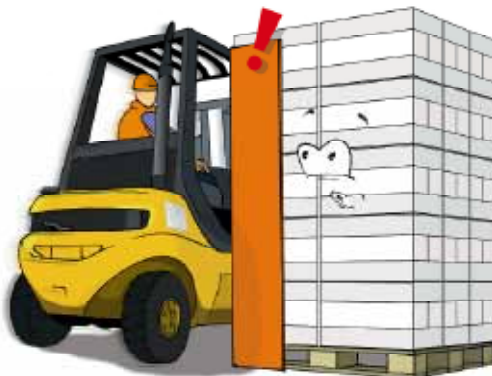
⚠ Caution when storing rolls on pallets on the floor because broken pallets can damage rolls. It is not recommended to stack rolls on pallets (to avoid floor water damage) because weak pallets can collapse, creating a serious safety issue from stacked rolls falling over.

Pallet size m3	Temperature difference paper/room			
	10°C	15°C	20°C	30°C
0,50	13h	19h	28h	60h
0,75	14h	20h	30h	65h
1,00	15h	22h	33h	70h



Use roll guards correctly in storage. Source: Stora Enso.

NEW DRAWING



Use pallet guards in storage. Source: Stora Enso.