LEAN & GREEN BEST PRACTICES

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EDITION 2

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Optimised Paper Handling & Logistics

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ERA Idealliance nopa icmPrint WAN IFRA

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Optimised Paper Handling & Logistics

Best Practice Guide

A cross-industry collaborative project published by

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Provides a comprehensive packing materials management service for converters, paper and board manufacturers that includes supply of pallets, packaging materials and logistics. Its e-Pac service combines advanced production process, high quality raw materials and expert staff with efficient logistics to distribute several million industrial logistics packages each year.

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www.era.eu.org

Founded in 1956, and is the international organisation of the gravure industry, with members from the publication, packaging and decorative printing sectors, along with associated industries such as paper, ink, printing and finishing equipment manufacturers, cylinder engravers and some major print buyers.

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HOLMEN
www.holmen.com

Manufactures paperboard, printing paper and sawn timber, along with forestry and energy production. Its paper manufacturing is based on using fresh fibre to deliver sustainable and Holmen's experience and knowledge in sustainable development allows it to create smart paper products that make a difference.

icmPrint
www.icmPrint.com

(International Centre for Manufacture by Printing) Brings together several printing organisations into a single not-for-profit resource centre for best practices, technical advice, underlying science, training and innovation development for products where printing plays an essential role in their manufacture. icmPrint combines WOCG, APN, and the Welsh Centre for Printing and Coating within Swansea University.

Idealliance®
www.idealliance.org

A not-for-profit global association of over 3000 brand owners, agencies, publishers, premedia, print, mail and marketing service providers, along with their suppliers and technology partners. It provides opportunities for creative and technology communities to collaborate on best practices, standards and certification to optimise creation, production and delivery of graphic communications.

If P&C Insurance
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www.INTAKT-Consulting.de

An officially accredited independent surveyor that takes care of the entire transport chain — loading and securing, damage free transport in containers and all transport modes from the paper mill to the customer. INTAKT provides training in the supply chain and is specialised in paper, forest product and containers.

Intergraf
www.intergraf.eu
The European Federation for Print and Digital Communication, representing 21 national printing associations in 19 countries. Based in Brussels, Intergraf works with the European Union to promote and protect the interests of the printing industry, and to enhance the sector's competitiveness through advocacy, information sharing and networking.

Koenig & Bauer Group
www.kba.com
The second largest printing press manufacturer in the world and the oldest (established 1817). KBA is a technology leader with a broad product range of sheetfed, web offset, flexo and digital presses that are used for commercial and publication printing, packaging, banknotes, marking, metal and glass decorating.

Malayala Manorama
www.manoramanews.com
A daily Malayalam language morning newspaper published in the Indian state of Kerala by Malayala Manorama Company Limited. It was first published in 1890. The title translates to "The Entertainer" and it is the third largest circulating newspaper in India with over 20 million readers.

Mondi Extrusion Coatings
www.mondigroup.com
A business segment of the international packaging and paper Group Mondi, providing high barrier packaging solutions. The Company's technical expertise and customer focus makes it one of the leading experts in mill wrapping and industrial paper packaging.

The Nordic Offset Printing Association
www.nopa.nu
The Scandinavian and Baltics meeting place for offset printers and their suppliers who wish to keep updated on trends in markets, product development and technology. NOPA is a forum for exchanging experiences with colleagues to better manage their development.

Paperdam Foundation
www.paperdam.org
Brings together paper companies in Europe and Asia to make contributions to international standardisation in paper and printing. The aim is to allow equitable evaluation of paper products and to take full advantage of their properties. It functions as a working group with ISO governance rules.

Sappi
www.sappi.com
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www.publicationpapers.sca.com
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www.tesa.com/industry/paper print
One of the world's leading producers of self-adhesive solutions for industry, trades and consumers with more than 125 years of experience in coating technology, adhesive development and innovative product solutions.

The Times Group
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www.timesgroup.com
A multimedia conglomerate with its worldwide activities served from India. Multimedia Innovation and quality are the cornerstones of the group's global brands and 'The Times of India' is the world's largest English language daily newspaper.

TRANSWAGGON Group
www.transwaggon.com
Provides wagons throughout Europe for transporting all kinds of dry goods and deploys around 13 500 modern wagons, 90% of which are covered with hoods or sliding walls. Wagons can be hired long-term for customised wagons or travel charter for short-term hire with flat rates or on a daily basis.

UPM
www.upmpaper.com
Integrates bio and forest industries and builds a sustainable future across six business areas. It offers magazine and fine papers as well as newsprint and speciality papers. The clever combination of a comprehensive product range, excellent services and a high environmental performance form the heart of its operations.

WAN-IFRA
www.wan-ifra.org
The World Association of Newspapers and News Publishers and is the global organisation of the world's press. It derives its authority from a global network representing 18 000 publications in 120 countries. The global platform allows the exchange of ideas, information and experiences on editorial, publishing, marketing and printing efficiency.

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Holmen: 'Paper Roll and Clamp Handling Recommendations'

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Foreword

Over 400 million tonnes of paper are produced every year. From the paper mill to the printer/converter a paper roll or pallet is handled 10-20 times, and each time there is a risk of accident and/or damage. This best practice guide is dedicated to assisting every organisation and individual involved in this process in identifying and minimising these risks. In addition to addressing essential health and safety issues, the benefit is a reduction in economic and environmental degradation across the entire papermaking value chain. The guide covers paper and board in rolls and sheets used for publishing and packaging applications for major printing processes.

Collaborative working

This is a unique cross-industry collaborative project that brings together expertise from across the entire paper supply chain from the mill, through transport, storage, and handling, to converting and printing. This guide offers a comprehensive view across a value chain that is both complex and global: which no single company, organisation, or region can adequately address. Its goal is to provide an efficiency-building best practice tool and global reference for suppliers, transporters, converters and printers.

The project was initiated by the International Centre for Manufacture by Print and WAN-IFRA and developed with the support of the European Rotogravure Association, Idealliance, and the Nordic Offset Printers Association with over 30 organisations and companies. The project team has collated, refined and structured best practices into a generic industry guide. This collective approach delivers cost effective international synergies to answer needs in both developing countries and mature markets at no cost to users.

This is a free e-book

The cover price of this book is 250 €/ $280 but it is available as a FREE e-book to everyone because project members believe that cost should not be a barrier to making best practices widely available. To obtain your own free copy, simply register on www.ophal.info. Everyone who registers will also be informed of updates and new editions as they become available.

You can also contribute to this guide

A guide is a snapshot of the best practices at the time of publication. This guide may not have addressed all best practices in every area, and the paper chain is a complex and changing subject. For these reasons, OPHAL will continue as an open industry platform to update and expand future editions.

If you know of something that should be added, updated or deleted, then please let us know. Become a contributor or sponsor by contacting *www.ophal.info.*

Caution

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MODULES

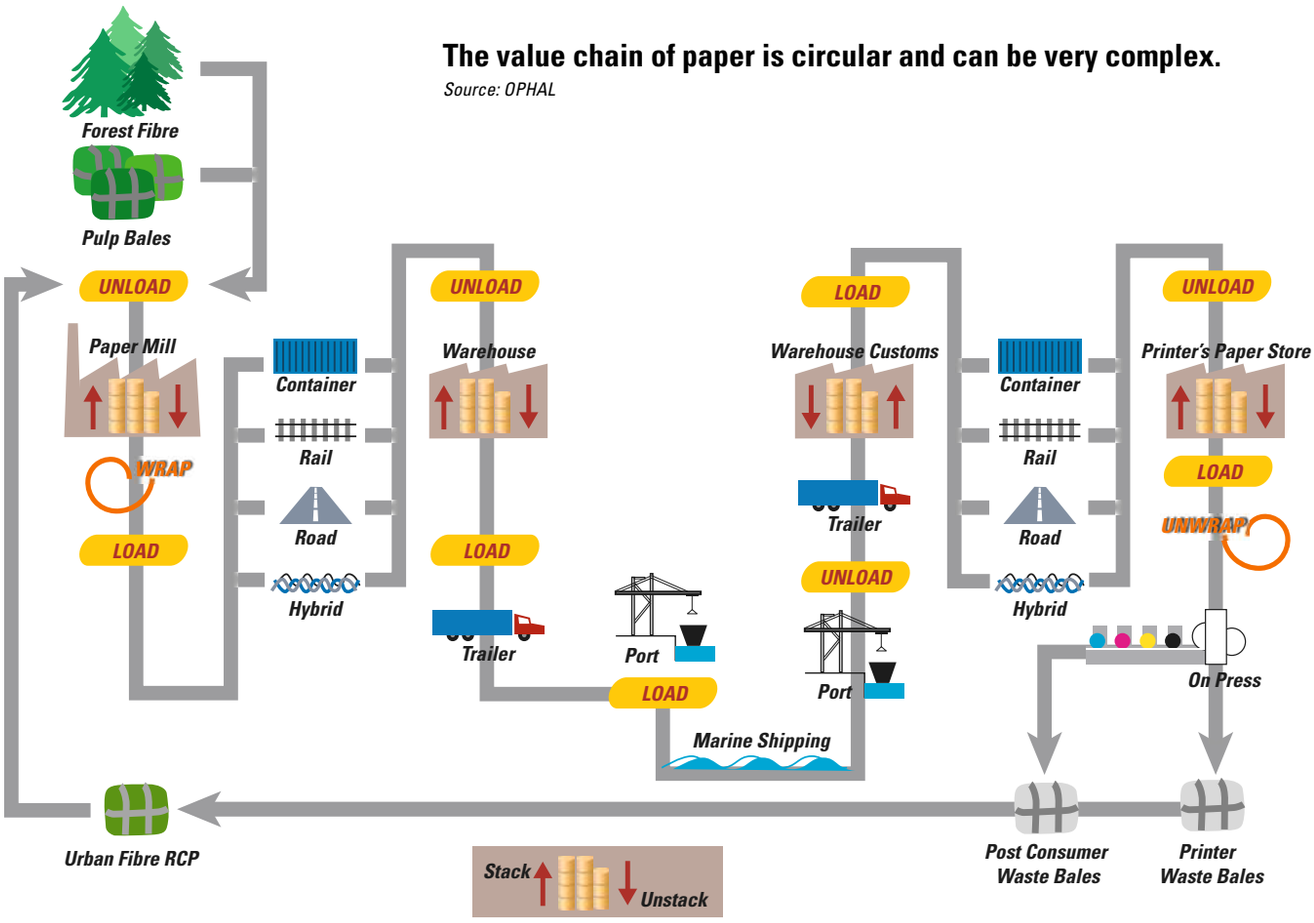
This guide structures best practices into 11 modules across the value chain.

0. Introduction
Using The Guide & Contents
Glossary
1. Paper & Cores — Wrapping & Pallets
2. Inspect, Report, Evaluate & Repair
3. Warehouse and Paper Store
4. Paper Handling Equipment
5. Roll and Pallet Handling
6. Transport — Securing & Lashing
7. Road Transport
8. Rail Transport
9. Transport... Containers
10. Transport... Maritime Shipping
11. At the Printer — Paper onto Press
Index

Introduction

The value chain of paper is circular and can be very complex.

Source: OPHAL



The paper transport chain is often long with 10-20 handling stages (loading, transport, unloading, storage) before the paper is fed into the printing/converting machine. Paper is a delicate high-value product that is susceptible to damage and degradation, including changes in humidity and absorbing residual odours. It is also heavy and difficult to handle, making it essential to use best practice techniques with appropriate equipment. These factors also contribute to the risk of accidents that may include serious injury or death.

There are thousands of specific paper products that have different characteristics that can impact on their handling and transport. Paper is cut into rolls or sheets and then wrapped to protect it from damage, dirt and moisture, and to prevent rolls from unwinding. Sheets are usually palletised and wrapped, while cut-size paper is usually packed in cardboard boxes.

Paper damage claims remain relatively high even in developed regions like North America and Europe.

Paper is often damaged in-transit from causes that frequently include: incorrect protective measures and loading procedures, equipment defects, excessive stress during shipment, and handling issues. In addition, damage claims are often made late and/or are incomplete.

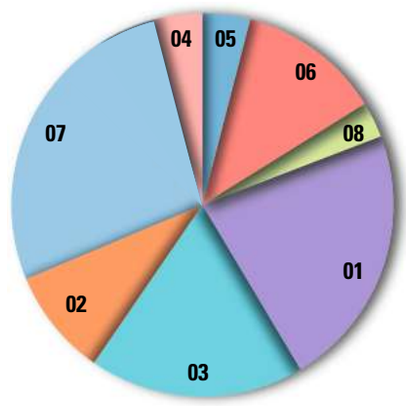
Objectives of the Guide

The content is written to give information relevant for different users — supervisors, managers, administrative and production staff. It provides them with a better understand in the supply chain and how to optimise their part in it.

1. Reduce risks of accidents
2. Improve economic and environmental performance
3. Optimise working practices.

1: Working Safety

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. This guide is intended to be a presentation of the subject matter. 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.



01	Edge damage	13-29%
02	Side damage	6-12%
03	End damage	15-22%
04	Wrapper damage	2-6%
05	Core damage	3-4%
06	Deformation/Out-of-round	6-16%
07	Water damage	15-39%
08	Dirt/Contamination	1-5%

This chart shows the different types of paper damage caused during logistics and handling — these are defined in Module 2. Source: Three large European paper companies/OPHAL.

Avoid risks of accidents and damage caused by carelessness

- Avoid stress, do not skip breaks
- Be alert and concentrate on the task
- Follow established work procedures
- Respect working environment factors
- Do not neglect to take care of equipment
- Always check machine is in its safe position before working on any component
- Only trained personnel should perform maintenance work.

Working environment factors

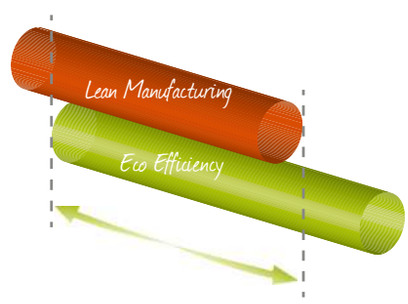
- Good ergonomics for working positions and movements
- Control of light, sound and climate (temperature, humidity, ventilation)
- Manage chemical health risks (gases, liquids, powder etc.)
- Adjust operations to individual site conditions.

Effective working requires

- Competent, trained and adequate personnel
- Appropriate working conditions
- Well thought-out work procedures that are followed
- Appropriate and maintained equipment
- Feedback-motivation on performed work.

2: Economic and Environmental Performance

Substrates are the highest single cost for all printing and packaging applications. Paper generally represents 50-70% of both printing costs and the climate footprint of a printed job. Therefore, any reduction in their waste and damage improves both economic and environmental performance.



A 'Lean & Green' operation is built on the identical first principle to avoid waste to benefit both environmental improvement and lean production. Source : icmPrint

3: Performance enhancement

Integrated cross-industry best practice improves operating performance by reducing economic and environmental losses from avoidable damage and waste, improves safety and communication while simplifying training and supervision. It also gives a better overview across the entire value chain.

Using this Guide & Contents

Each module defines the characteristics of an operation and highlights key issues with these symbols.

- Best practices to optimise operations
- Prevention of poor practices
- Safety Issues
- Environmental & economic performance

This guide structures best practices into 11 modules that are applicable at different points across the value chain. Several modules can be combined to address the needs of an individual site or company. Modules 1 to 5 apply to most users irrespective of their position in the supply chain. The guide will help all participants better understand the whole supply chain, while giving information relevant to different users.

It provides **supervisors** with a tool to assist them manage their tasks; helps **production staff** with clear information on best practices to reduce accidents and paper damage; gives **managers** a better understanding of key factors to optimise work place efficiency; while providing **administration, purchase, insurance and finance staff** with a global view of the supply chain with elements pertinent to some of their responsibilities.

Module 1 provides a short description of paper and board characteristics that can impact on logistics, along with cores, packaging and labels. Paper is cut into rolls or sheets and then wrapped to protect it from damage, dirt and moisture, and to prevent rolls from unwinding. Sheets are usually palletised and wrapped, while cut-size paper is usually packed in cardboard boxes.


OPTIMISED PAPER HANDLING & LOGISTICS

1 Paper & Cores – Wrapping & Pallets

CONTENTS

2 PAPER & BOARD CHARACTERISTICS
2 Impact on Handling & Transport
4 Climate and Fibre-based Products
5 TYPES OF PAPER & BOARD
8 THE PAPER ROLL
9 Jumbo & Super Jumbo Rolls
10 ROLL CORES AS PROCESS COMPONENTS
14 WRAPPING
18 PALLETISED SHEET PAPER WRAPPING
19 Rolls on Pallets
20 LABELS & BAR CODES

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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

2 PAPER & BOARD CHARACTERISTICS
2 Impact on Handling & Transport
4 Climate and Fibre-based Products
5 TYPES OF PAPER & BOARD
8 THE PAPER ROLL
9 Jumbo & Super Jumbo Rolls
10 ROLL CORES AS PROCESS COMPONENTS
14 WRAPPING
18 PALLETISED SHEET PAPER WRAPPING
19 Rolls on Pallets
20 LABELS & BAR CODES

Module 2 describes delivery responsibility, inspection and reporting procedures. It explains and illustrates causes of damage and codes to describe them and what remedial actions are possible. Any visible damage needs to be reported at every transit point. When faults occur it is essential to make clear information available to define the problem and its cause to help prevent its repetition, and determine who has responsibility.


OPTIMISED PAPER HANDLING & LOGISTICS

2 Inspect, Report, Evaluate & Repair

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Best Practice
Poor Practice
Safety Issues
Environmental & Economic Impact

2 TAKING DELIVERY
4 INCOTERMS® FOR DELIVERY
6 DAMAGE REASONS AND CODES
6 Report — Repair or Reject?
7 Evaluation
8 TYPE OF ROLL DAMAGE
14 TYPES OF SHEET DAMAGE

Module 3 focuses on preventing paper degradation in storage to reduce damage including humidity, temperature and stacking issues. Good storage requires a well-designed area, with documented best practice procedures.


OPTIMISED PAPER HANDLING & LOGISTICS

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STACKING
13 Paper Delivery Procedures
13 Roll Storage Patterns
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2	Printers' Paper Store
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3	Materials Storage & Handling Layout
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11	Hot Work
11	Battery Charging
13	STACKING
13	Paper Delivery Procedures
13	Roll Storage Patterns
14	Part Rolls
15	Paper Pallets

Module 4 looks at how to select the right handling equipment to suit the properties for different paper grades, weights, densities and dimensions, either as rolls or palletised sheets. Lift trucks are the most common handling method for paper rolls, palletised paper, pulp and waste paper bales. This flexible load handling tool is extremely efficient when correctly equipped and operated.


OPTIMISED PAPER HANDLING & LOGISTICS

4 Paper Handling Equipment

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2	MATERIALS HANDLING EQUIPMENT
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3	Operational Checklist
4	Lift Truck Specifications
6	Lift Mast and Tilt
8	ROLL CLAMPS
8	Selecting Roll Clamps
12	Clamp Contact Pads
13	Methods to Adjust Clamping Force
14	CLAMPING
14	Clamping Principles and Terms
16	Clamping Force & Clamping Factor
18	FORKLIFT TRUCKS

Module 5 explains best practice handling techniques. Heavy paper on lift trucks has very high safety and damage risks when being moved, stacked and manoeuvred. Lift trucks and equipment require routine inspection, maintenance and set-up with correct clamp forces.


OPTIMISED PAPER HANDLING & LOGISTICS

5 Roll & Pallet Handling Techniques

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2 WORKING SAFETY
2 Avoiding Risks
4 Lift Truck Stability
4 Overloading
6 BEFORE STARTING YOUR SHIFT
6 Pre-lift Checks
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9 Measuring Clamping Force
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12 Clamping Techniques
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31 Common Pallet Handling Errors

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20	Rail Wagons
22	Tower Clamp
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26	Troubleshooting Roll Handling
26	PALLET HANDLING
31	Common Pallet Handling Errors

Module 6 is the first of five transport modules. Cargo is subject to various stresses across the transport chain and it must be prevented from sliding and tipping in any direction by blocking or lashing, or a combination of the two. Establishing stable cargo units is a key requirement to successfully secure loads. This module addresses load securing lashing that are used by all transport modes — Road, Rail, Containers and Maritime. This is a complex area using a variety of techniques, along with differing procedures and regulations.

Module 7 addresses road transport where the relevant international or national rules and regulations must be followed for loading, securing, transportation and handling. The vehicle must be suitable for the intended load. The transport company is normally responsible for the condition and cleanliness of the truck with cargo spaces that are clean, dry, free of smell, tidy, and in adequate condition. Lashing and securing should ensure that the whole load remains safe and in the same position during normal traffic situations, including emergency braking and sharp turns.

Module 8 reviews rail transport where international or national rules and regulations must be followed during transportation and handling, as well as the instructions from railroad companies. The person in charge of loading operations must check that the wagons are in good condition and that the cargo is properly stowed, secured and lashed. The condition of the railway line and wagons may generate high levels of vibration over long distances that may cause abrasion on the rolls and may even lead to the packaging being completely worn through.


OPTIMISED PAPER HANDLING & LOGISTICS

6 Securing & lashing

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2 RISK FACTORS
2 Transport forces acting on a load
2 Friction
4 SECURING CARGO UNITS
5 Securing devices
6 Lashing points
8 CARGO LASHING
9 Equipment
10 Safety first
12 Operation of lashing belts
14 Tensioning elements

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OPTIMISED PAPER HANDLING & LOGISTICS

7 Road Transport

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Pallets, Pulp & RCP
18 LOADING & UNLOADING

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OPTIMISED PAPER HANDLING & LOGISTICS

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20 RAIL TRANSPORT SOURCES OF DAMAGE

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11 Securing Standing Rolls Against Tipping Risk
12 Securing Lying Reels
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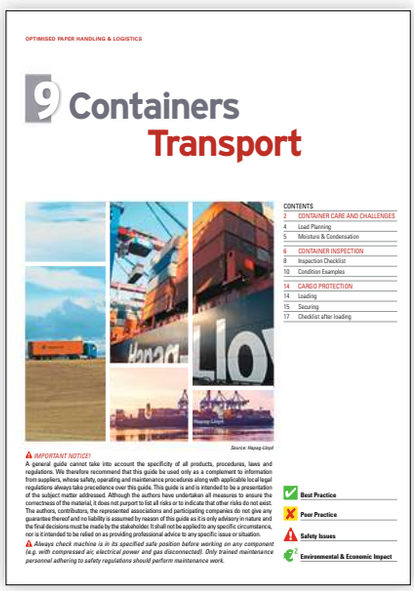
20 RAIL TRANSPORT SOURCES OF DAMAGE

Module 9 considers containers that are widely used for transporting paper. Cargo unit sizes are highly variable and paper rolls rarely coincide with container dimensions. It can therefore be difficult to organise homogeneous cargos as a simple basis for form and friction-locking stowage. Containers may be subject to harsh treatment both when handled at the shipping terminal and also by all types of transport from braking, sharp turns, and uneven ground. The stresses of sea transport pose a particular challenge to the safety of the cargo units and their securing. Transport by a container vessel, truck or train begins with ordering the correct container and continues with their inspection, correct loading and securing of the cargo.


OPTIMISED PAPER HANDLING & LOGISTICS

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14 Loading
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17 Checklist after loading

Source: Hapag-Lloyd

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Best Practice
Poor Practice
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2	CONTAINER CARE AND CHALLENGES
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5	Moisture & Condensation
6	CONTAINER INSPECTION
8	Inspection Checklist
10	Condition Examples
14	CARGO PROTECTION
14	Loading
15	Securing
17	Checklist after loading

Module 10 addresses marine transport by different types of vessels — container vessels, general cargo, roll-on roll-off ships and barges. The stresses of sea transport pose a particular challenge to the safety of the cargo units and cargo securing measures. Bad conditions at sea mean that cargo can be subjected to brief peak loads and repetitive stresses from the rolling motion of the vessel that can impact on the cargo for days. Condensation on cargo occurs frequently in the winter when paper rolls are stored and loaded in a cold climate and then transported to countries with a warmer and more humid climate.


OPTIMISED PAPER HANDLING & LOGISTICS

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11 Side Port Vessel
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12 Loading, Stowing, Lashing and Securing
13 Checklist for LoLo loading
14 Lo Lo Handling Equipment

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Module 11 advises on how to prepare paper for sheet and roll fed presses to minimise waste from all causes. Paper temperature and humidity imbalance can lead to static charge and dimension variations, along with set-off, tensile weakness and folding resistance.


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11 At the Printer – Paper onto Press

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6 Splice Faults and Web Breaks
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35 Sheet Paper Problems
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Glossary

A

Air shaft expanding shaft passing through paper core to support roll on the press

AGV Automatic Guided Vehicle driverless transport to move loads

Antwerp clamp a scissor action lifting equipment

B

Baggy roll/reel a winding fault

Bale a quantity of sheets of paper, or a unit of recycled paper or pulp

Basis weight (or substance) paper weight in grams per square metre; or in US lbs per ream of paper cut to its basic size

Belly the outside of roll/reel parallel to core

Bilge a paper roll/reel lying on the ground

Bulk the specific volume of a material

Burst splice when the new roll bursts open prior to splicing

Butt roll/reel the core and remaining paper after a splice

C

Calendering process to improve paper surface finish or smoothness

Calliper (Caliper) paper thickness

Carbon footprint an indicator of the total set of greenhouse gas (GHG) emissions caused by an organisation, event or product

Cargo Transport Unit (CTU) trailer, cassette, container, railcar

Cassette a loading platform without wheels for Ro-Ro ships

Cellulose main chemical component of paper fibres (cell walls or woody structure of plants)

CEN European Committee for Standardization

CEPI Confederation of European Paper Industries www.cepi.org

Chain of Custody (CoC) An unbroken trail of documentation to guarantee the identity and integrity of the data used to show the origin of wood or paper

Chemical pulp wood-based fibres separated from each other using a chemical solution

Chucks expand into the ends of the core to support the paper roll/reel in the splicer

Clamps attached to a lift truck used to hold and manipulate rolls/reels of paper

Coated paper coating with a mix of clay or carbonates and latex to create a high quality printing surface

Cockling (waviness) warping along the edges of paper, particularly across the grain, due to packing too tightly while it is immature, or too rapid drying

Code of Practice for Packing of Cargo Transport Units (CTU Code) international code for handling and packing cargo transport units

Combi transport (hybrid) a road trailer loaded on to a rail wagon

Conditioning time it takes for paper to regain suitable temperature humidity for printing

Container standard size metal boxes used in transport

Core cardboard tube on to which paper is wound into a roll/reel

Core plug (cone, bung) inserted into the ends of the roll/reel core to protect it from damage

Corrugation (fold, wrinkle) rope or chain marks, not to be confused with moisture welts

Crimped edge (elephant toes) crushed core deformation making roll/reel difficult to run on a printing press

CTU Cargo Transport Unit

CT Combined Traffic is a road vehicle that may be transported via rail, or ship.

Curl paper deformation from faulty manufacture; or to changes in atmospheric conditions

D

daN: dekaNewton (1 daN ≈ 1 kg)

De-inked pulp (DIP) recovered paper after ink and impurities have been removed

Dew point of air is the temperature at which dew forms and is a measure of atmospheric moisture

Density is the specific weight of a material

Dunnage materials used to pack around paper units to prevent them from moving

Doorpost rolls in railcars may be damaged because of poor doorpost protection or handling

Edge damage (edge crack) a cut, imprint or tear in the edge of the paper

End damage (head damage) damage through or under roll end cap

Edge protection avoids corner damage to rolls and pallets.

OEM Original Equipment Manufacturer

Failed splice when the new roll does not paste to the expiring web

Feeder the mechanism of a sheetfed press that separates and lifts sheets into the printing machine

Festoon long loops of paper in the splicer that enables zero speed roll splicing

Fibre (fiber) basic paper structural unit mainly sourced from softwood and hardwood trees

Fine paper (free sheet or woodfree) chemical pulp paper, coated or uncoated, for printing and office papers

Flying splicer (flying paster, rollstand) machine to join new roll/reel to expiring roll at full speed

Forest certification independent certification of forest management schemes e.g. FSC and PEFC

Forks attached to a lift truck used to lift and manipulate pallets

Furnish mixture of various materials from which paper and board is made

Glazed paper highly calendered paper with a smoother surface and a higher gloss than MF paper

Grain direction of the fibres on a sheet of paper, determines paper properties such as increased size change with relative humidity across the grain, and better folding qualities along the grain

Grammage metric weight of paper abbreviated as gsm or g/m^2

Groundwood-free paper does not contain mechanical wood pulp

H/B/L: Height/Breadth/Length

Head clamp a scissor action lifting equipment

Heavy Weight Coated (HWC) paper

Hole in a paper web from various causes (slime, stock lumps, coating splashes and wire holes)

Hot work like welding and steel cutting in the warehouse always requires a permit with special safety measures

Hybrid transport (combi) a road trailer loaded onto a rail wagon

Hygroscopicity property where paper gains or loses moisture according to surrounding atmospheric conditions

Incoterms® International Chamber of Commerce (ICC) defined delivery terms

Joloda a proprietary truck bed loading systems for paper and other products

Jumbo & Super Jumbo Rolls: Very large rolls of paper used only for gravure printing

Kissing roll/reel caused by rolls "kissing" (touching) during transit

Kraft paper high strength packaging paper

Labels on rolls/reels and pallets contain important information about the article inside the packed unit

Laminate bond layers of materials together with adhesives

LC Lashing Capacity

Lift truck powered vehicle equipped with clamps or forks to handle paper

L

Light Weight Coated (LWC) paper

Liner paper used to cover another paper or board for extra strength, thickness or finish

Lipping overlapping edges that are impacted

LoLo (Lift-on, Lift-off) ships that require cranes to load cargo

Loosely wound roll/reel, poor winding of paper reduces integrity of roll/reel

Lying roll/reel (horizontal/bilge) roll core parallel to ground

M

Machine Finished (MF) paper

Machine Finished Speciality (MFS) paper

Machine Glazed (MG) paper/board made smooth and glossy on one side

Medium Weight Coated (MWC) paper

Mill join/splice made at the paper mill during rewinding or after a paper break.

Mis-splice any failure of the splice during the cycle

Moisture content percentage of water in pulp, paper, or paperboard

N

Nested stacking roll/reel stored vertically in a staggered pattern

O

Out-of-round roll/reel with deformed circumference

P

Paper/Paperboard in Europe is defined with a maximum weight of approx. 165 gsm; paperboard is more than 0,3 mm thick

papiNet a global e-business set of standard electronic documents for collaborative electronic business within the paper industry www.papinet.org

Pallet (skid or stillage) a wooden or plastic base on which sheets or paper or board are placed for transport

Part roll/reel partly used roll that can be re-run

Pivot arm clamps on lift trucks allow roll clamping arms to make a swinging motion around fixed pivot shafts

Pulp wood or plant-based fibre used as a raw material in paper making

R

Ream pack of 500 identical sheets of paper

Recycled fibre extracted from recovered paper for secondary use

Roll/reel paper/board wound on to a core

Roll-to-Sheet Feeder allows paper rolls to be run on sheetfed presses

RoRo (Roll-on Roll-off) ships where cargo is loaded on wheeled units that are driven on board

Rotating clamps allow lift truck to handle standing and lying rolls

Relative humidity actual amount of moisture in the atmosphere expressed as a percentage of the total amount needed to saturate it at the same temperature

S

Scuffing (chafe/flat spots) marks from rolls/reels rubbing against each other or transport unit

Sheeter rotary unit to cut web into individual sheets

Sheetfed a printing machine that is fed with individual sheets of paper

Shrinkage decrease in paper dimensions from loss of moisture and poor dimensional stability

Side damage (belly) both the wrapper and the paper product are damaged on the side of the roll

Side Port are StoRo ships where cargo is loaded through a side port with elevators

Skinned roll the wrapper cracks and "skins" (peels) off the roll

Slabbing off removal of outer spires of paper that are not suitable for printing (dirt, damage)

Slack edges web edges that are not wound less tightly than the centre

Slack reel/roll loosely wound paper

Sliding arm clamps on lift trucks where roll clamping force uses a pulling motion

S

Slipping core loose paper near the core allows the roll/reel to move; or core rotates on the supporting chucks/shaft

Splice (paste) crossways join between new paper roll/reel and running web

Splice cycle time from when the splicer begins the process to make a splice and then return to normal unwinding state

Splice break from a faulty splice joint in a paper web

Splicing tapes use double-sided adhesives to paste webs together

Split arm clamp allows multiple rolls to be individually clamped or secure clamping of wide (jumbo) rolls

Soldier stacking roll/reel stored vertically in a parallel pattern

Stack a pile of sheets of paper

Standing roll/reel (vertical) with core 'eye' to sky

Starred reel/roll extreme disruption in the pattern of winding as a result of excessive handling impact

Static electricity excessive electrical charge in a sheet of paper that causes it to be attracted to other sheets or other materials

STF pre-tension force

StoRo (Stowable RoRo) ships where cargo is brought onto the vessel on wheels and then stowed on the decks

Stripping removing the wrapper and damaged spires (outer layers) from a paper roll/reel

Super Calendered (SC) paper

T

Tambour / machine / jumbo or mother reels are made on the paper machine

Telescoped roll/reel edge alignment runs out, starting at the core as the reel/roll rotates. It may telescope during handling leaving reel/roll ends concave and convex

Tight edged dried out paper edges resulting in a web that is slack in the middle

Transit wrinkles occur on top and bottom of wide rolls in rail shipments

U

Unwinder an expanding shaft supports the roll/reel by its core as it is unwound

V

Verified Gross Mass (VGM) an IMO regulation requiring the shipper to supply the weight of packed containers

Virgin fibre (fresh/prime) fibre that has not yet been used for papermaking

W

Water damaged paper exposed to water or condensation, with the wrapper showing water stains.

Waviness see cockling

Web a continuous length of paper

Web break parting of the paper running on a rotary machine

Web press (webfed) printing machine in which the paper is fed from a roll/reel

Web width (roll/reel width) dimension of a web of paper or board measured in the direction across the machine

Winder Machine that winds paper into a roll/reel around a core

WISA-Fix tarpaulin cargo securing tarpaulin

Woodfree Coated (WFC) paper

Woodfree (free sheet, fine, ground) coated or uncoated graphic papers

Wrapper external protection of paper roll/reel or sheets

Wrapper damage typically looks like side damage but only the wrapper is damaged

Wrapper wrinkles poor wrapping create multiple straightline wrinkles around the roll/reel

Wrinkles creases in paper produced during manufacture

Z

Zero speed splicer joins new roll to expiring roll/reel at zero speed

1 Paper & Cores – Wrapping & Pallets

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19 Rolls on Pallets
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Best Practice

Poor Practice

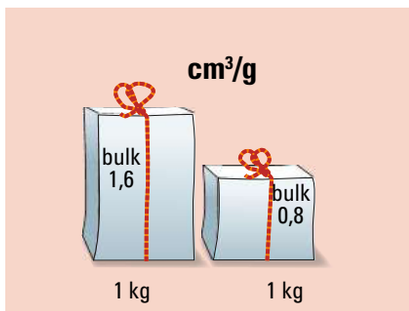
Safety Issues

Environmental & Economic Impact

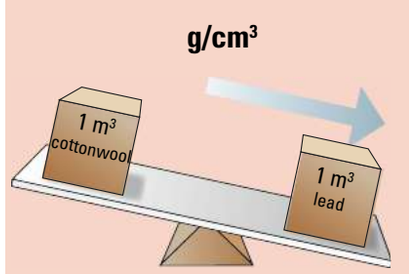
Paper & Board Characteristics

		Paper weight		Moisture	Density			
	Graphic Papers	gsm	Basis # lbs	% absolute	Very soft	Soft	Medium	Hard
NP	Newsprint	40-52	27-35	7-9%		x		
UMI	Uncoated Mechanical Improved	42-60	28-40	7-10%		x		
UMO	Uncoated Mechanical Others	28-60	19-40	~ 8%		x		
LWU	Light Weight Uncoated /	34-70	23-47	5-8%		x	x	
SC-A	Super Calendered	39-65	26-44	5-6%			x	x
SC-B	Soft Calendered	40-60	27-40	4,5-6%			x	x
LWC	Light Weight Coated	39-70	26-47	4-6%			x	x
MWC	Medium Weight Coated	75-115	50-77	4-6%			x	x
WFU	Woodfree Uncoated	50-300	33-200			x		
WFC	Woodfree Coated	60-400	40-270				x	x
	Cartonboard							
SBS	Coated Solid Bleached Board	220-500	150-340	6-7%			x	
FBB	Cast Coated Folding Boxboard	220-500	150-340	6-7%			x	
SBS	Solid Bleached Board	180-380	120-260	6-7%			x	
SUB	Solid Unbleached Board	180-400	120-270	6-7%			x	
CUK	Coated Unbleached Kraft Board	175-380	118-260	7-10%			x	
FBB	Folding Boxed Board	180-400	120-270	5,5-9,5%			x	
WLC	White Lined Chipboard	250-450	170-310	6-9%			x	
	Other Packaging							
	Kraftliner Containerboard	115-430	75-290	7-9%			x	
	Testliner Containerboard	95-220	65-150	7-9%			x	
	Fluted/corrugated Containerboard	90-170	90-115	7-10%			x	
	Sack paper	90-120	60-80	6-9%			x	
	Hygiene paper	16-35	10-24	5-7%	x	x		

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



Bulk. Source: UPM/OPHAL.



Density. Source: UPM/OPHAL

Impact on Handling & Transport

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

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

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

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

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

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

Characteristics with high impact on rolls

Core: While the primary function of the core is to support the paper roll, it must also be of sufficient strength and stiffness to prevent crushing during normal handling. *See page 10.*

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

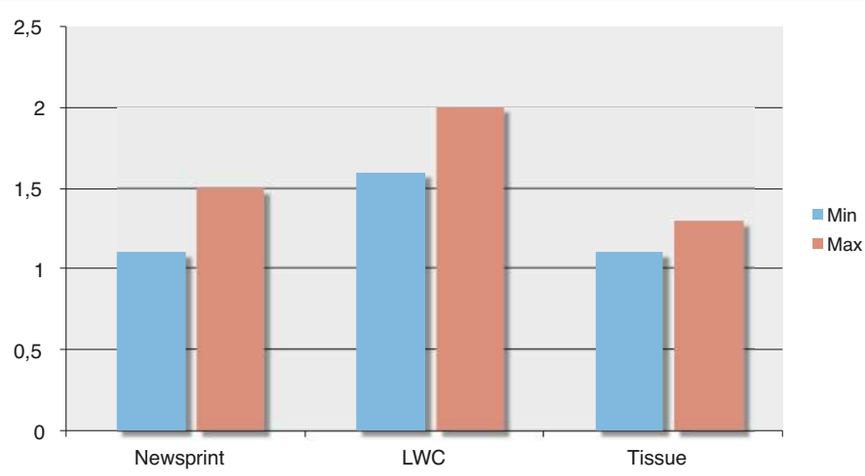
Friction properties: The friction between the wrapper and paper roll is influenced by how "slippery" the paper is. Some coated gloss rolls with lack of friction can lead to increased clamp pressure that can distort the roll. Fillers also influence smoothness of the surface and its friction property.

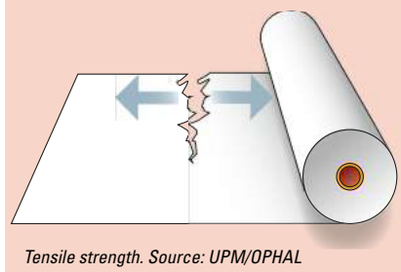
Wrapper Type: The wrapper protects the paper roll from damage, dirt and moisture. It prevents rolls from unwinding. The type of wrapping can vary; the most common wrappers are made of kraft paper. Plastic wrappers are also used and require different handling techniques. Fibre-based wrapping may be covered with a plastic layer for moisture protection. *See also page 14*. During clamp handling the paper rolls are carried with the friction force generated between the wrapper and clamp pads. The wrapping carries approx. 30% of roll weight when optimal clamping force is used.

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

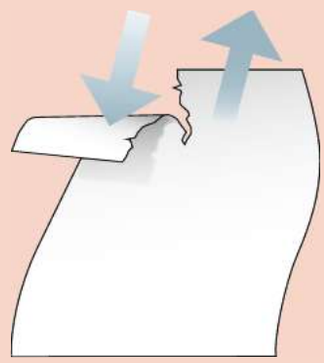
Clamping force: Any paper roll can be destroyed by clamping it too hard or too softly. Different paper grades tolerate different amounts of clamping force and this is influenced by the paper's raw materials, winder type, wrapping and the bulk. Softer, uncoated papers require a reduced clamping force compared to harder coated papers, otherwise there is a high risk of roll and core deformation out-of-round. Insufficient clamping force may allow the paper roll to slide, drop or telescope from the clamp's grip. *See Module 4 page 14.*

Clamping factor





Tensile strength. Source: UPM/OPHAL



Tearing strength. Source: UPM/OPHAL

The clamping force formula in metric units:

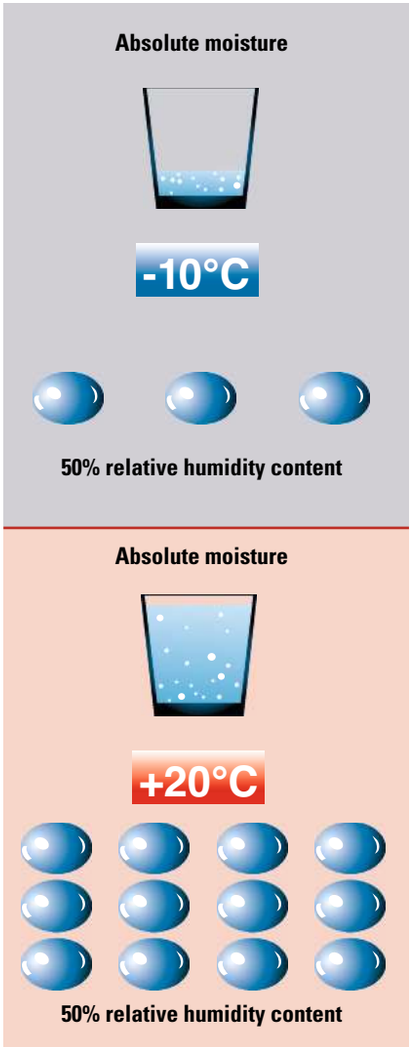
Fc = k = W*g/1000

Where

Fc = Clamping force in kilo Newtons (kN)
k = Clamping factor
w : Weight of roll in kg
g = Acceleration of earth's gravitational pull (9,81=10 m/s^2)

The metric equation includes acceleration due to gravity is 9,8 m/s^2 — this gravitational constant is incorporated in the definition of Lbf and is therefore not required in the imperial equation.

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



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

Climate & Fibre-based Products

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

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

Relative Humidity (RH)

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

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

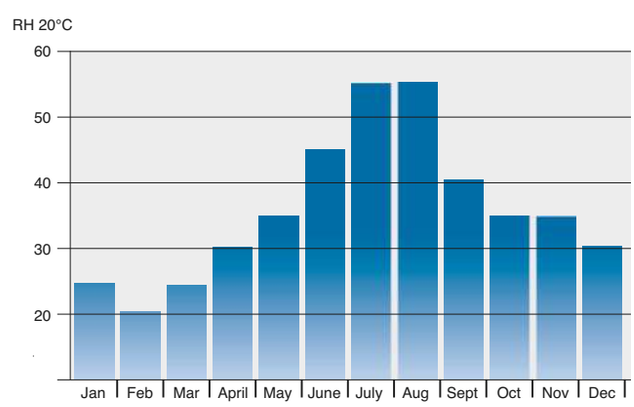
Depending on RH paper fibres will either absorb or exude moisture, causing them to swell or to shrink, particularly in the cross direction of the paper rather than in the machine direction.

Static Charge

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

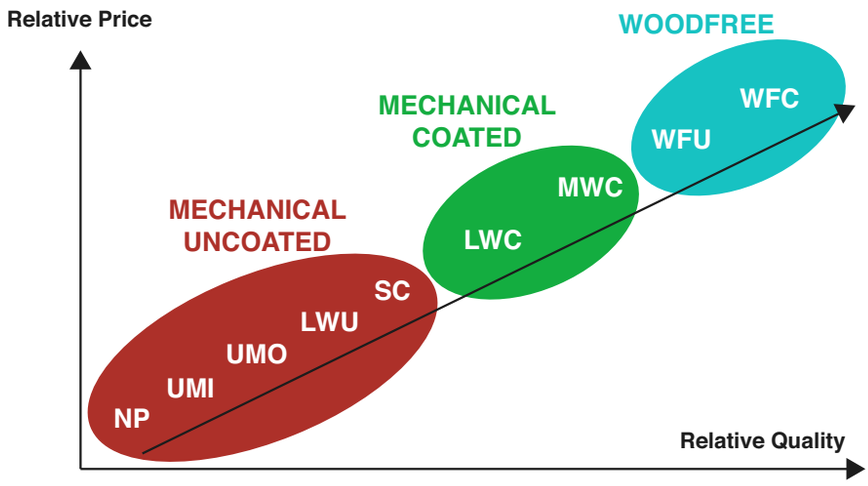
✅ Paper should remain wrapped in its damp-proof packaging throughout the logistics and storage chain. It should not be unwrapped until any difference in its temperature and RH has been balanced out with the ambient pressroom conditions. Paper stability for optimised printing is achieved at 20-25°C (68-77°F)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

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



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

Types of Paper & Board



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

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

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

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

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

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

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

Graphic Papers & Boards

Paper is a general term with two divisions of paper and paperboard. In Europe, paper has a maximum weight of 165 gsm (110 lbs) while paperboard is defined as being more than 0,3 mm (0,12 in) thick. Some of the more important paper grades include

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

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

Newsprint (NP): Uncoated paper manufactured from recycled fibre (up to 100% RCF) and/or mechanical pulp. Newsprint weight ranges from 40 to 52 gsm, it is white or slightly coloured (e.g. Financial Times salmon), and supplied in rolls for offset (CSWO and HSWO), flexo printing and rotogravure. Widths vary from 315 mm to 3600 mm (12,4-142 in).

Uncoated Mechanical Improved (UMI): Contains different grades of Machine Finished (MF) paper to give a higher brightness than Newsprint. It is split into two sub-categories — high-bright and super-bright. Its basic furnish is the same as Newsprint and the basis weight starts at 45 gsm.

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

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

Light Weight Uncoated (LWU): Manufactured from fresh fibre mechanical pulp. Typical properties are high bulk, smooth surface and high brightness. Used in heatset and rotogravure to print magazines, catalogues and advertising leaflets.

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

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

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

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

Special Paper Applications

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

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

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

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

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

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

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

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

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

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

Packaging Papers & Boards

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

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

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

Containerboard is supplied in rolls to corrugating machines as

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

Wood pulp

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

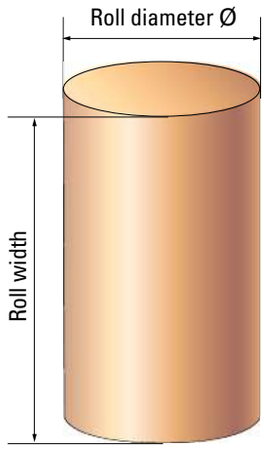
Recycled Paper

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

RCP bales. Source: Ecograf

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

The Paper Roll



Standing (vertical) roll core 'eye' to sky.
Source: icmPrint

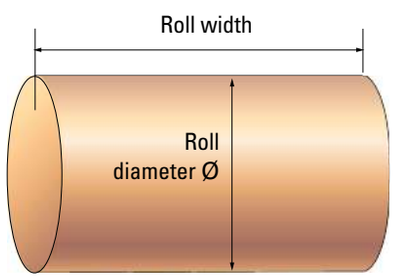
Paper machines manufacture very large tambours (also known as machine, jumbo or mother reels) that are converted into multiple smaller rolls on a winder around a cardboard core. The web is split into narrower widths, parallel to the winding direction, and winds sets of rolls of a smaller diameter and shorter length. Each one of these rolls has a number that represents its position across the width of the machine roll and is recorded on the roll and roll package label under 'Set & Deckle position'. *See page 21* for more information on labels.

Dimensions

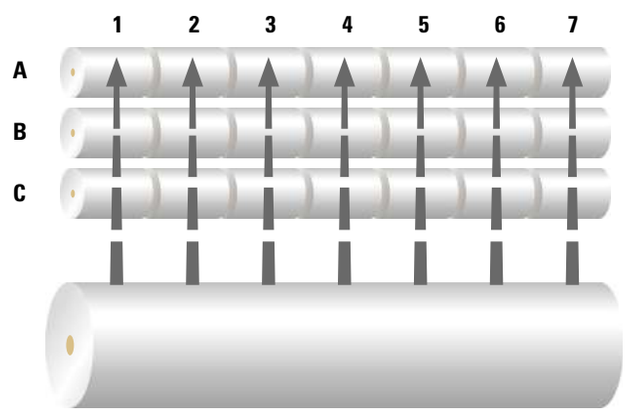
Paper rolls come in a wide variety of sizes, weights and grades that influence handling and transport.

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

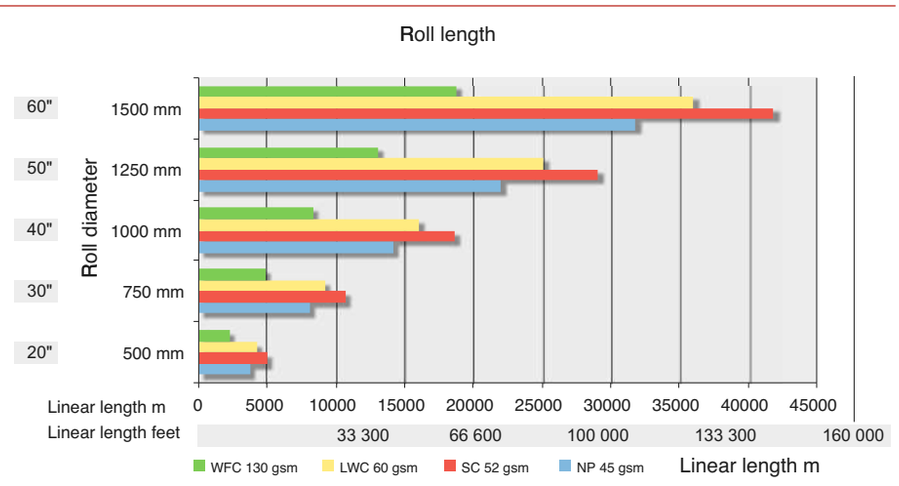
The trend for printing and converting machines is to use the largest roll diameters possible in order to decrease the number of splices and related waste. However, availability depends upon the supplier mill's trimming capacity and market demand. Moving to larger roll diameters can have a significant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



Lying (horizontal) roll core parallel to ground.
Source: icmPrint



The diagram shows a tambour rewound into three sets of seven rolls each. The set and deckle position of rolls are generally found in the paper label *see page 22**. Source: icmPrint*



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

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

Roll widths: Range from 250 mm (10 in) for envelopes to 4320 mm (171 in) for rotogravure. Rolls with widths under 500 mm are generally packed together in a multi-pack (2, 3 or 4 rolls).

Roll weights: Are determined by roll diameter and paper grade. For example, a 1250 mm (50 in) Ø x 1000 mm (40 in) wide roll weighs about 1000 kg (2205 lbs) in uncoated newsprint, and 1400 kg (3087 lbs) as a coated paper. Coated magazine papers generally range from 2000-4000 kg (4410-8818 lbs) up to 6800 kg (14 990 lbs), while tissue papers with large diameter weights 1500 – 3000 kg (330-660 lbs) with < 6000 kg (13 300 lbs).

Jumbo & Super Jumbo Rolls

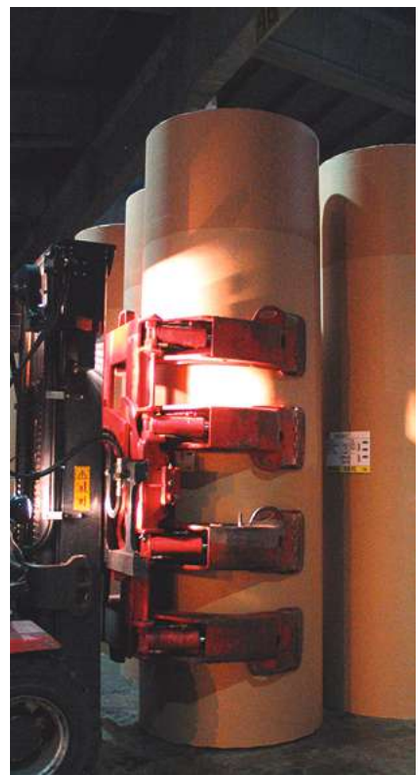
Jumbo Rolls: Widths of 2650 and 3800 mm (104-150 in) wide. Super Jumbo: Widths over 3800 mm (150 in) up to 4320 mm (169 in), weighing up to 6,5 tonnes.

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

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

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

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



Jumbo roll held in a multiple clamp.
Source: UPM

Multi roll packs

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

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

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

1. Multiple rolls are joined with an internal core.

2. Core plugs secure the assembled roll.

3. Marking to indicate multi-pack.

Source Holmen

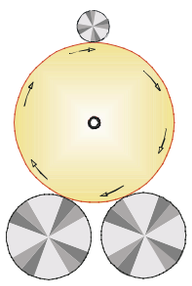
Roll Cores as Process Components

Vari Top. Source: Stora-Enso

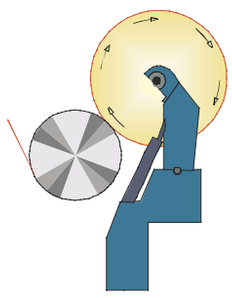
Cores should be considered as an integrated renewable component, to both paper machine winder and printing press splicer, to achieve high efficiency and reduce waste across the delivery and process chain. The function of the core is to support the paper roll. It must be of sufficient strength and stiffness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

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

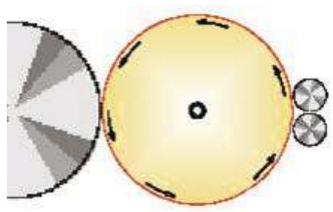
1. **Dynamic strength** (maximum roll weight a core can support with chucks): Loading conditions in paper machine winders vary depending on their type — double drum, supported centre drum, or unsupported centre drum.



Double drum winder
Source: Valmet



Supported centre winder



Unsupported centre winder

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

Centre drum winders have cyclic loading, which can affect both the chuck area of the winder and the press paster. The core lifetime calculation (number of revolutions the core needs to carry the roll weight load without failure) depends partially on the chuck type and the support load. The dynamic strength test estimates core lifetime by loading the core in a similar way to a centre winder or press paster. The achieved loading results determine the maximum roll weight. Different paper parameters, adhesives or winding technologies influence results.

35% lifetime used.

98% lifetime used.

End of life.

Core lifecycle. Source: Sonoco-Alcore

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

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

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

Minimum requirement cores 3" for Pastomat CL

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

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

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

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

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

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

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

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

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

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

Source: Sonoco-Alcore

Core Specifications

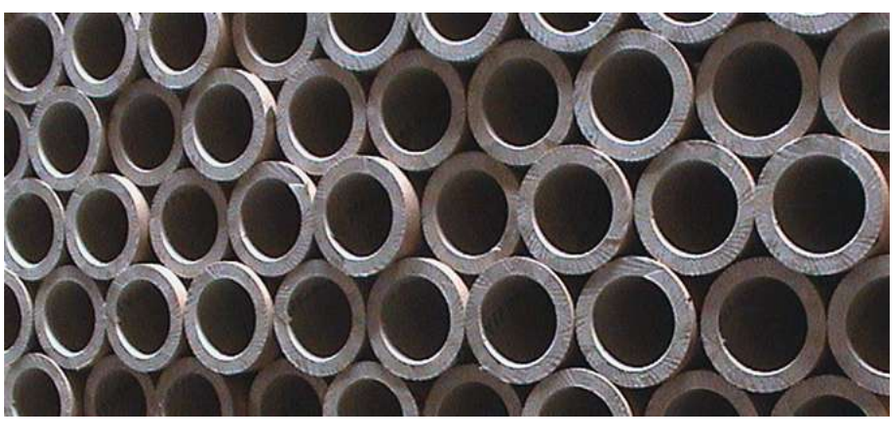
Normally, it is the paper supplier's responsibility to ensure that the cores on which paper is supplied conform to the printer's needs. These are determined by the web width, roll diameter and weight, and production speed. Appropriate core properties are important to safely run the winder and printing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

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

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

Source: Sonoco-Alcore

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



Source: Sonoco-Alcore

Packaging and converting — Typical core requirements

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

Corrugated: Boxes made from liner and fluting rolls run at up to 450 m/min (1500 fps); most run at 100-300 m/min (333-1000 fps). Standard roll widths are 2400, 2800 and 3350 mm (95, 110, 132 in) usually with 1450 mm (57 in) Ø and max weights commonly around 4500 kg (19 920 lbs) inside core diameter is generally 100-102 mm (3,94-4,02 in) with a recommended wall thickness of 10 mm (0,39 in) for good runability in the winder; wall thickness can vary between 5-13 mm (0,2-0,5 in). Design criteria include torque transmission and roll weight capacity, especially for grades below 100 gsm.

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

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

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

For core troubleshooting see Module 11 page 28.

Source: Sonoco-Alcore

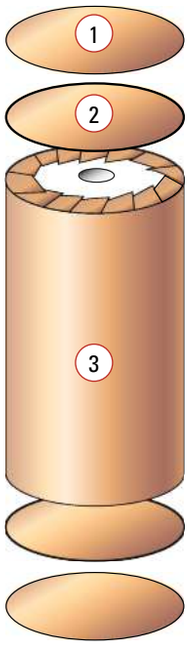
Source: Sonoco-Alcore

Technical Details

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

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

Wrapping



Conventional wrapping components:
1. Outer end shields (cap, head covers, headers or inner discs) with moisture barrier;
2. Inner end shields (cap, head covers, headers);
3. Belly wrapper with moisture barrier.
Source: icmPrint

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

Roll Wrapping

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

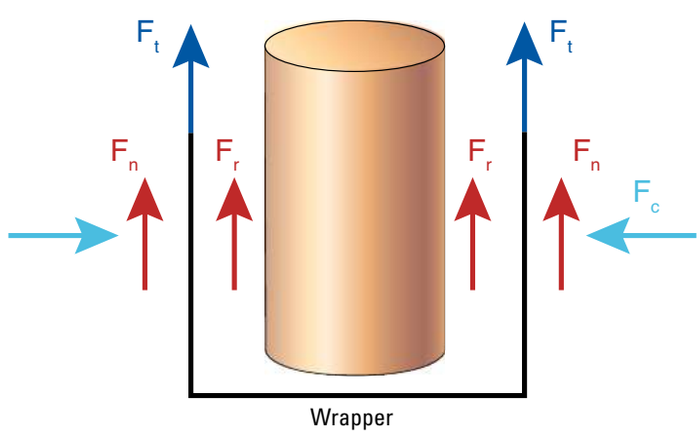
1. **Mechanical protection:** To prevent indentations from roll handling systems, and transport damages on truck, train and ship. The level of protection is influenced by the weight, quality and turns of wrapping. The wrapper also has a load-carrying function as it carries approx. 30% of roll weight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

Correct wrapping criteria

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

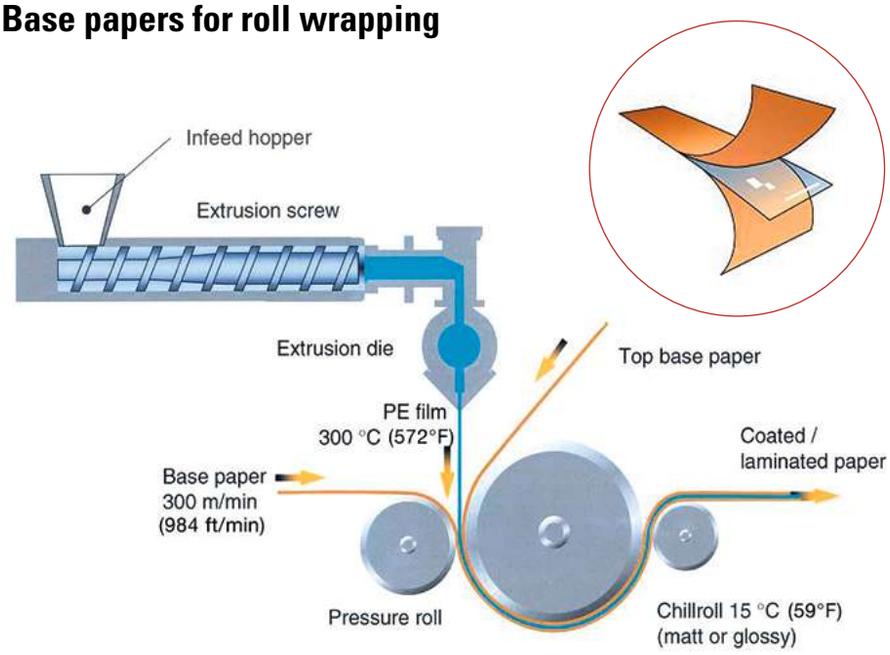
Stretch film wrapping

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

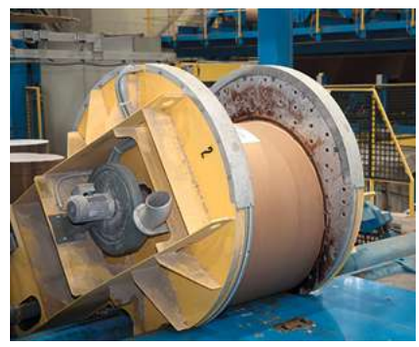


Wrapper handling properties are of vital importance to clamp handling because the rolls are carried with the friction force generated between the wrapper and clamp pads. The wrapping carries approx. 30% of roll weight when correct clamping force is used. Drawings source: icmPrint

Base papers for roll wrapping



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



Source: UPM

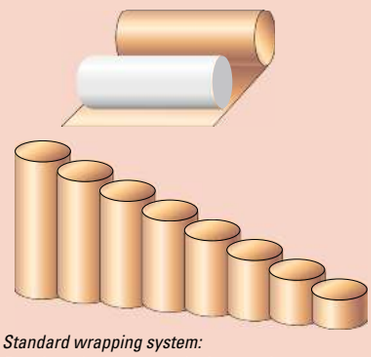
Base papers used for making roll wrappers will vary depending on the application features required. These paper grades are combined and laminated on extrusion lines to provide a final combination to meet specific transport needs and climate conditions. As a general comment, the higher the virgin fibre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

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

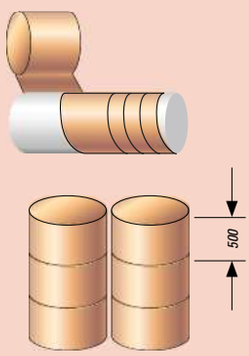
	Test Liner 3	Test Liner 2	Kraft Top Test Liner	Kraft Liner	Virgin Kraft Liner	Kraft Paper
Top layer	100% SWP	100% SWP	100% VF	100% VF	100% VF	100% VF
Bottom layer	100%MWP	100% SWP	100% SWP	60% VF/40% SWP	100% VF	
Definition						
Weight (gsm)	125	125	125	125	125	125
Burst (kPa)	260-280	320-350	370+400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

Source: Mondi

Wrapping paper requirements



Standard wrapping system:
Requires significant stock of paper sizes

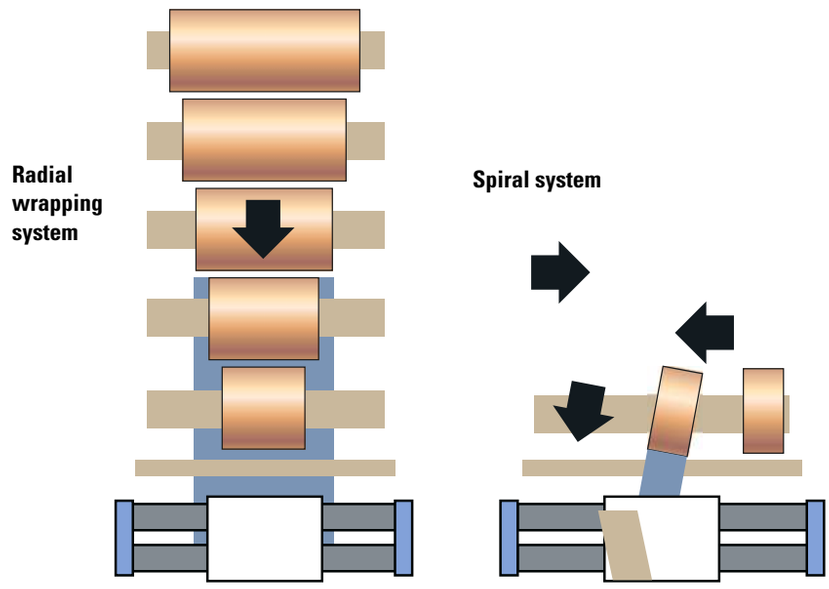


Twister:
Only one paper dimension required.
Source: Mondi/OPHAL

Wrapping Materials

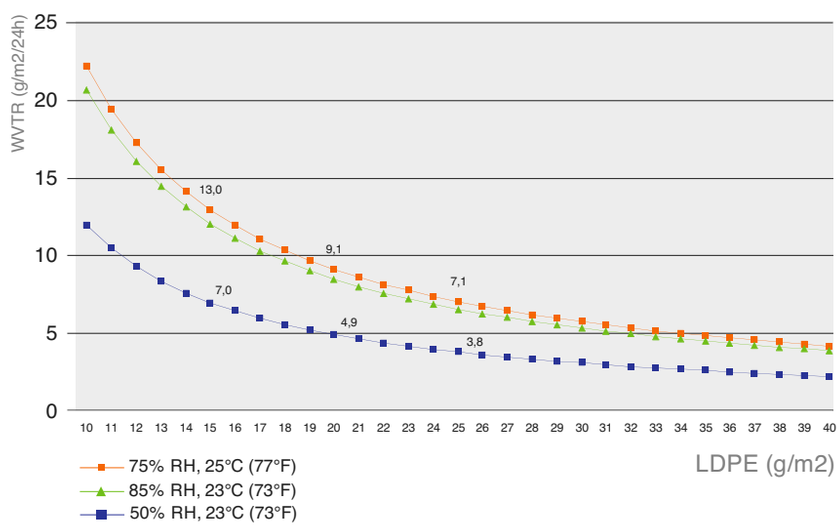
The main purpose of the wrapper and the paper roll end cover is to protect the paper roll during its transport from the paper factory to the end-customer. The layers may vary from single wrap with little overlap, up to three wraps for demanding deliveries. The wrapper can be applied in small strips ('Twister'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

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



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

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



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

Wrapping operation.
Source UPM

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

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

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

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

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

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

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

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

Troubleshooting Wrapping Faults

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

Palletised Paper

Pallet jut. Source: FMS 'Use No Hooks'

Pallet Construction

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

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

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

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

Packed paper reams on pallet. Source: Stora Enso

Sheet Wrapping

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

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

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

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

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

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

Dimensions

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

Wrapping and Securing

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

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

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

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

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

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

XXXL Sheets

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

Rolls on Pallets

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

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

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

Handling

Transporting palletised paper does not differ from normal pallet handling — except that these loads are highly vulnerable to external damage. Due to the high variety of pallet sizes and high volumes involved, fork positioners and double pallet handlers are commonly used for handling palletised paper goods. Some companies prefer load turning clamps because of their better load support. *(see also Module 4.*

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

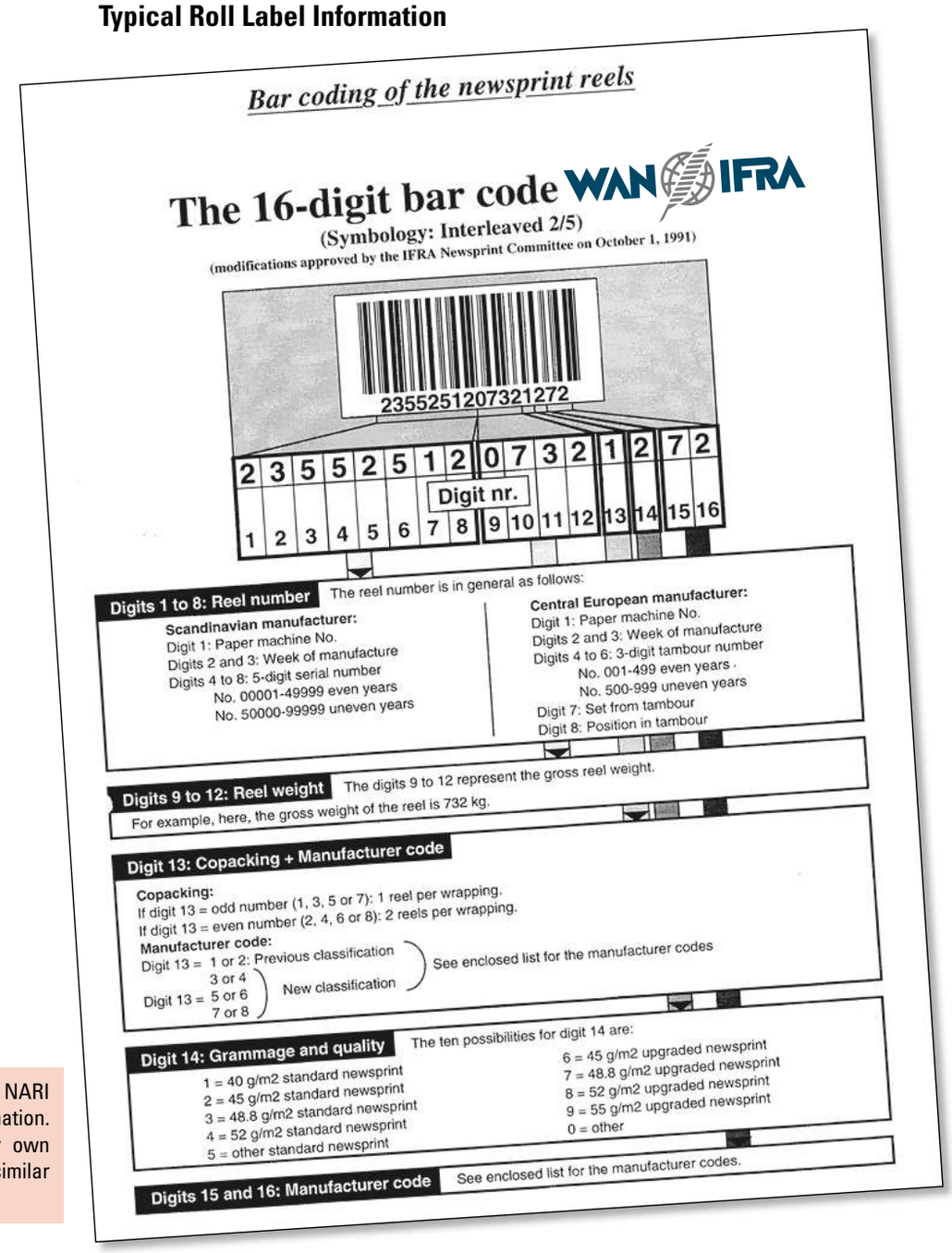
Small rolls for digital printing standing on a pallet. Source: UPM

Rolls on loaded on pallets for transport. Source: Stora Enso

Labels & Barcodes

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

Typical Roll Label Information



Bar coding of the newsprint reels

The 16-digit bar code WAN IFRA

(Symbology: Interleaved 2/5)

(modifications approved by the IFRA Newsprint Committee on October 1, 1991)

2355251207321272

2	3	5	5	2	5	1	2	0	7	3	2	1	2	7	2
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Digit nr.

Digits 1 to 8: Reel number The reel number is in general as follows:

Scandinavian manufacturer:
Digit 1: Paper machine No.
Digits 2 and 3: Week of manufacture
Digits 4 to 8: 5-digit serial number
No. 00001-49999 even years
No. 50000-99999 uneven years

Central European manufacturer:
Digit 1: Paper machine No.
Digits 2 and 3: Week of manufacture
Digits 4 to 6: 3-digit tambour number
No. 001-499 even years
No. 500-999 uneven years
Digit 7: Set from tambour
Digit 8: Position in tambour

Digits 9 to 12: Reel weight The digits 9 to 12 represent the gross reel weight.
For example, here, the gross weight of the reel is 732 kg.

Digit 13: Copacking + Manufacturer code

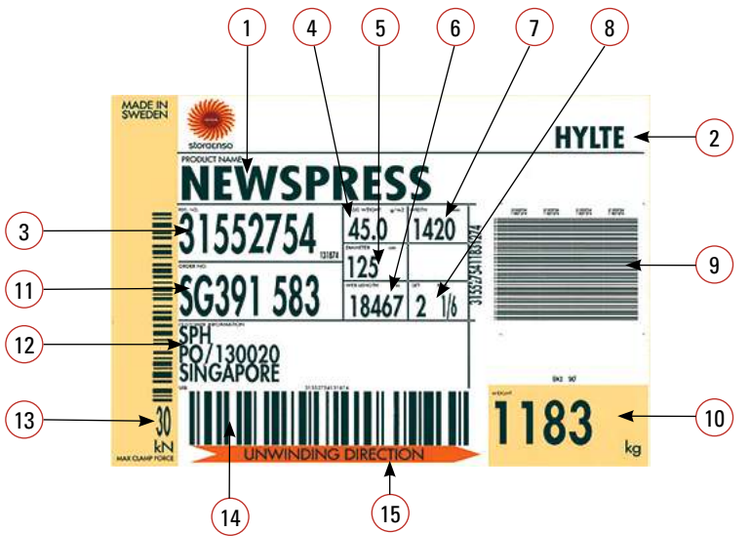
Copacking:
If digit 13 = odd number (1, 3, 5 or 7): 1 reel per wrapping.
If digit 13 = even number (2, 4, 6 or 8): 2 reels per wrapping.
Manufacturer code:
Digit 13 = 1 or 2: Previous classification
Digit 13 = 3 or 4, 5 or 6, 7 or 8: New classification
See enclosed list for the manufacturer codes

Digit 14: Grammage and quality The ten possibilities for digit 14 are:

1 = 40 g/m2 standard newsprint
2 = 45 g/m2 standard newsprint
3 = 48.8 g/m2 standard newsprint
4 = 52 g/m2 standard newsprint
5 = other standard newsprint
6 = 45 g/m2 upgraded newsprint
7 = 48.8 g/m2 upgraded newsprint
8 = 52 g/m2 upgraded newsprint
9 = 55 g/m2 upgraded newsprint
0 = other

Digits 15 and 16: Manufacturer code See enclosed list for the manufacturer codes.

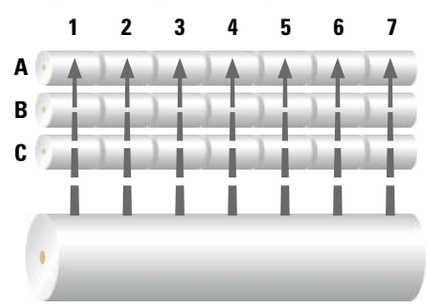
Organisations like WAN-IFRA and NARI provide guidelines for label information. All paper suppliers design their own labels, but most contain a very similar set of information.



Typical Roll Label Information

1	**Product name**
2	**Paper mill** Not all suppliers show mill, only company name
3	**Roll number (IFRA)** The first 8 numbers (WAN-IFRA has 16 digits) Not all mills use IFRA numbering system
4	**Basis weight** Metric or Imperial
5	**Outer diameter** Metric or Imperial
6	**Length of paper in metres** Metric or Imperial
7	**Roll width (pallet size)** Metric or Imperial
8	**Set and/or Deckle position** See diagram below
9	**Bar-codes (WAN-IFRA and CEPI)** Partly as peel-off labels
10	**Gross weight in kgs**
11	**Supplier's order number**
12	**Customer order number/reference**
13	**Recommended clamp force in kN** Important for correct handling
14	**Unit Identifier Barcode (UIB)** Main barcode for supply chain
15	**Unwinding direction** Arrow shows direction for unwinding
16	**Mill joints**

Additional information, for example UPM prints on label the core diameter, signs for weight warning and multi-packs.



The diagram shows a tambour rewound into three sets of seven rolls each. The set and deckle position of rolls are generally found in the paper label.
Source: OPHAL

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

Inkjet marking and labels

Inkjet marking on belly. This example shows:

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

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

Peel-off labels

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

Peel-off label example. Source: Holmen

Roll end labels

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

Label examples. Camera. Source: Holmen.

Label examples. Laser scanner. Source: Holmen

Sheet Pallet Packages

Sheet paper label example. Source: Holmen

Standard Electronic Documents — papiNet

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

papiNet simplifies the paper supply chain

The papiNet standard offers the following benefits:

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

papiNet is free to use!

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

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

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

North American Member Companies

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

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

European Member Companies

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

Members includes:

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

2 Inspect, Report, Evaluate & Repair

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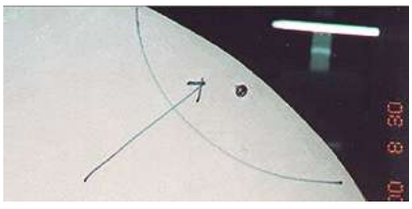
IMPORTANT NOTICE!

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.

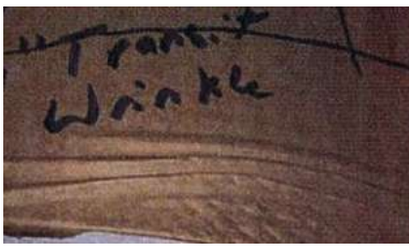
Taking Delivery

If when opening the doors of the delivery vehicle the load is in poor condition then immediately take photographs before unloading. Source: Idealliance



Foreign object in roll end. Source: Bolzoni Auramo

Damaged pallet. Source: Stora Enso



Write damage information on roll (preferably with chalk) then take photo. Source: Idealliance

Burst airbags. Source: Idealliance

Paper Arrival

The commercial invoice confirms the value of the goods, shows the delivery terms and who has the risk during the transport and consequently the right to compensation under the transport (cargo) insurance.

The way bill proves that the transport has been made and includes the name of the carrier. A remark must be made on it to prove the condition of the goods at the time of delivery into the custody of the buyer/receiver. If there is no remark on the way bill, it is considered that the goods were delivered in sound condition. The remark has to be made for visible damage or damage that should have been visible if a control had been carried out.

✅ Paper should be inspected upon arrival and any visible defects noted on the delivery documents (both the carrier's and receiver's copy). Any damage should also be digitally photographed while the paper is still on the loading floor of the vehicle and/or carrying equipment (trailer, container, rail wagon). The location of the damage should be noted — top, bottom or side.

€² Failure to note damage on the delivery documents could result in a claim for damaged paper being rejected. Neither does it allow a fault analysis to be made to identify and resolve the cause of damage.

Take Digital Photos of Damage

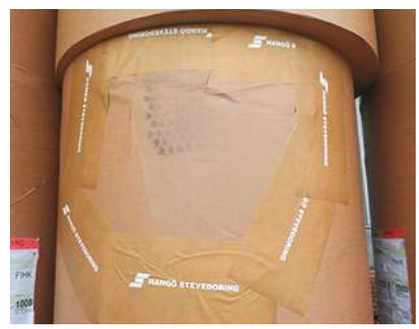
Any damaged products not notified on the transport document should be digitally photographed before handling them and while they are still on the loading floor of the vehicle and/or carrying equipment. Photograph also the identity number of the trailer, SECU, container, rail wagon.

✅ Writing useful damage information on the rolls before taking the photo is a great help.

End damage from poor handling. Source: UPM

Stacked sheet paper tends to tilt or move within the smallest cargo gap when subjected to maximum impacts (sharp braking of a truck, railway shunting, or bad weather at sea). Stora Enso

Rolls toppled in transit. Source: IGP



Rolls shifted from continuous brief impacts during rail or sea transport. Source: Mëtsa Board

Defining Delivery Responsability

Incoterms®

After damage or loss has been identified and reported, the next step is to determine responsibility. This depends upon where the loss or damage occurred in the transport chain and who has the risk for the goods at that point.

Goods are not always inspected at the different points where their risk is transferred. To avoid disputes over where the loss or damage has incurred, it is recommended to use agreed terms of delivery where one party bears the risk for the goods during the entire transport. The possible insurance liability is also defined by these terms.

Incoterms® has been developed by the International Chamber of Commerce (ICC) to provide clarity of delivery terms. When making an agreement based on Incoterms®, it is advisable to state the agreed terms of delivery in the contract of sale and commercial invoices, e.g. "FOB Gothenburg, Incoterms® 2010". This avoids problems with interpretation that may arise in countries having their own definitions of delivery terms. The use of Incoterms® 2010 for international shipments is strongly recommended in preference to creating own delivery terms. It is always advisable to state the version, e.g. Incoterms® 2010, because there are some differences over previous versions.

Monitoring devices

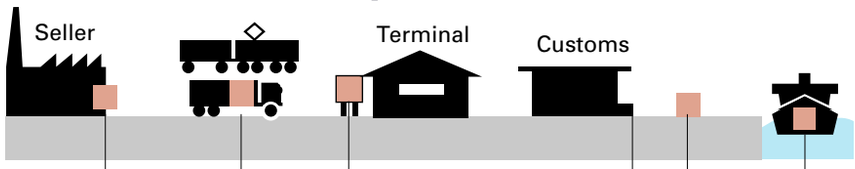
Unknown source(s) of repetitive paper damage across the logistics chain can be diagnosed by inserting a small monitoring device into the roll core. This determines the time, date and possible cause of handling damage due to excessive accelerations from dropping, hitting or other accidents.

Notice of Loss and Periods of Limitation

	Notice of loss		
Applicable rules	**Apparent loss or damage**	**Non-apparent loss or damage**	**Limitation**
1. Carriage by sea: Haag-Visby Rules	Upon receipt of goods	3 days	1 year
2. Carriage by air: Montreal Convention	Upon receipt of goods	14 days	2 years
3. Carriage by rail: CIM Convention	Upon receipt of goods	7 days	1 year
4. Carriage by road: CMR/TKSL	Upon receipt of goods	7 days	1 year

For each of these types of carriage there is a limitation of liability in international transports, usually expressed as price per kilogram. Source: IF P&C

Incoterms® 2010 for Delivery



EXW - Ex-Works
(named place; ex-factory ex-mill, ex-warehouse etc)

Risk
Cost
Documents

The buyer is at risk when the goods have been placed at his disposal at agreed time and place.

FCA - Free Carrier
(named place)

Risk
Cost
Documents

Specify named point

The buyer is at risk when the goods have been delivered to the first carrier or terminal at agreed time and place.

Sea and waterway transport only

FAS - Free Alongside Ship
(named port of shipment)

Risk
Cost
Documents

The buyer is at risk when the goods have been delivered alongside the ship at the port of shipment.

FOB - Free On Board
(named port of shipment)

Risk
Cost
Documents

The buyer is at risk when the goods have been delivered on board the vessel nominated by the buyer at the loading point, at the named port of shipment.

CFR - Cost and Freight
(named port of destination)

Risk
Cost
Documents

The buyer is at risk when the goods have been delivered on board the vessel nominated by the seller at the loading point, at the named port of shipment.

CIF - Cost, Insurance and Freight
(named port of destination)

Risk
Cost
Documents

The buyer is at risk when the goods have been delivered on board the vessel nominated by the seller at the loading point, at the named port of shipment.

CIP - Carriage & Insurance Paid to
(named place of destination)

Risk
Cost
Documents

The buyer is at risk when the goods have been delivered to the first carrier or terminal.

CPT - Carriage Paid To
(named place of destination)

Risk
Cost
Documents

The buyer is at risk when the goods have been delivered to the first carrier.

DAP - Delivered At Place
(named place of destination)

Risk
Cost
Documents

The buyer is at risk when the goods have been placed at his disposal at agreed place of destination ready for unloading.

DAT 1) - Delivered At Terminal
(named terminal at port or place of destination)

Risk
Cost
Documents

The buyer is at risk when the goods have been placed at his disposal at agreed terminal unloaded.

DDP - Delivered Duty Paid
(named place of destination)

Risk
Cost
Documents

The buyer is at risk when the goods have been placed at his disposal at agreed place of destination cleared for import and with duties paid ready for unloading.

Source: IF P&C

1) "Named terminal" includes locations such as quay, warehouse, container yard, road-, rail- or air cargo terminal at named port or place of destination.


Customs
Terminal
Buyer
The buyer may insure the transportation if the buyer so desires. The Buyer bears the risk during the whole transportation.
Both the buyer and the seller may insure their respective legs of the transportation, if they so desire.
Both the buyer and the seller may insure their respective legs of the transportation, if they so desire.
Insurance must be covered by the seller (in favour of the buyer) to the port of destination complying with at least Institute Cargo Clauses (C) or similar clauses (further transports by the buyer if the buyer so desires).
Insurance must be covered by the seller (in favour of the buyer) to the place of destination complying with at least Institute Cargo Clauses (C) or similar clauses (further transports by the buyer if the buyer so desires).
The buyer may insure the transportation if the buyer so desires.
Both the buyer and the seller may insure their respective legs of the transportation, if they so desire.
The seller may insure the transportation to the terminal, if the seller so desires (further trans portations by the buyer, if the buyer so desires).
The seller may insure the transportation if the seller so desires. The seller bears the risk during the whole transportation.
Seller's duties
As agreed
Buyer's duties
= The Goods

Damage Reasons & Codes

"Any change in the presentation of a unit after leaving the production site that requires remedial actions is recorded as damage." These codes and instructions are based on 'Inspection Instructions for Defining Damage of Forest Products' developed by Finnlines, Finnsteve, Hangö Stevedoring, LHG, Metsä, Herman Andersson, Pohjola, Rauma Stevedoring, P&C, Steveco, Stora Enso, Transfennica, UPM.

When faults occur it is essential to make a Damage Report to define the problem and its cause in order to prevent its repetition. The report, including a description of the fault, where it occurred, and the damage illustrated with photos, should be sent to the paper supplier as soon as possible. The same approach is used both for rolls of paper and sheet products on pallets:

1. Any visible damage needs to be reported at every transit point.
2. Paper is then sent for evaluation, repair if possible, or re-pulping if written off.
3. It is important to know who has responsibility for the paper at each transit point.

Where	What	How
Place of damage — mandatory		
● At place of inspection		
● Before place of inspection		
Notice point of damage — mandatory	**Type of damage — mandatory**	**Cause of damage — if clearly identified**
● 00 Mill	● 01 Edge damage	● Handling
● 01 Pre transport	● 02 Side damage	● Transportation
● 02 Port of loading (storage & handling)	● 03 End damage	● Warehousing
● 03 Port of loading (stowage & unitising)	● 04 Wrapper damage/broken pallet base	● Deficiencies of handling equipment
● 04 In vessel	● 05 Core damage	● Deficiencies of transport facilities
● 05 Discharge port (discharge, storage)	● 06 Deformation / Out-of-roundness	● Deficiencies of warehouse
● 06 Discharge port (loading & delivery unitising)	● 07 Water damage	● Insufficient packing
● 07 Terminal or Inland warehouse	● 08 Dirt and contamination	● Insufficient lashing
● 08 Delivery transport	● 09 Shortage, non-delivery	● Condensation
● 09 Printer	● 00 Other, spoiling, mould, rust, etc	● Other

Wrapper damage 30 cm (12 in) wide can be patched with tape. Source: UPM

Report — Repair or Reject?

Damaged paper should be placed in a dedicated and marked holding area for evaluation and reporting:

1. Any and all damaged product and packaging is reported (total or partial).
2. Collect data defined in the Damage Report and digital photos of damage.
3. Use standardised codes where possible.
4. Send Damage Report, transport document and digital photos to the paper supplier.

After inspection, the damaged roll will be either reconditioned or rejected according to the instructions received. If unclear, then contact the paper supplier. Paper may be reconditioned at any qualified point in the supply chain.

Each mill has its own specific rejection and reconditioning guidelines. Normally these are the same across the supply chain (mills, terminals, warehouses, etc).

Roll Evaluation

Paper that has visible damage should be placed into a specific area for evaluation (in a printing site this will include rolls rejected from the press). This area should be properly protected to avoid possible further damage. A report should then be sent to the paper supplier or, for reconditioned or sheeted rolls, to the converter. If the printer has contracted to collect their paper, then they should contact their transport company.

Criteria for Rejecting a Roll:

1. Oval or crushed core that cannot be straightened.
2. Oil stained, wet, or otherwise contaminated.
3. Foreign smell with the product.
4. End, side or edge damage

Place a damage sticker on any rejected goods.

Criteria for reconditioning a roll: If damage is less extensive than above —

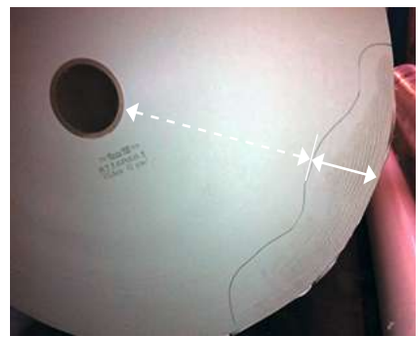
1. White showing — if the paper can be seen, then tape the roll. Taping is not allowed if there is any damage to the product itself. Tape used must have the identification of the operator.
2. Multi-packed rolls (more than one roll in same package, no pallet) should be considered as an individual roll with normal reconditioning limits. If only one of the rolls inside a packet is rejected, then the others can be delivered after repackaging.

✅ **Before repacking ensure:** package is free of dirt, dust, or particles; packaging material is clean and suitable with correct tightness; put the label on the unit; check and update stock control and Damage Report to ensure traceability.

Staff in the reconditioning area must ensure that it is clean, hand hygiene routines for food and liquid packaging products are followed, and working clothes are clean and in good condition.

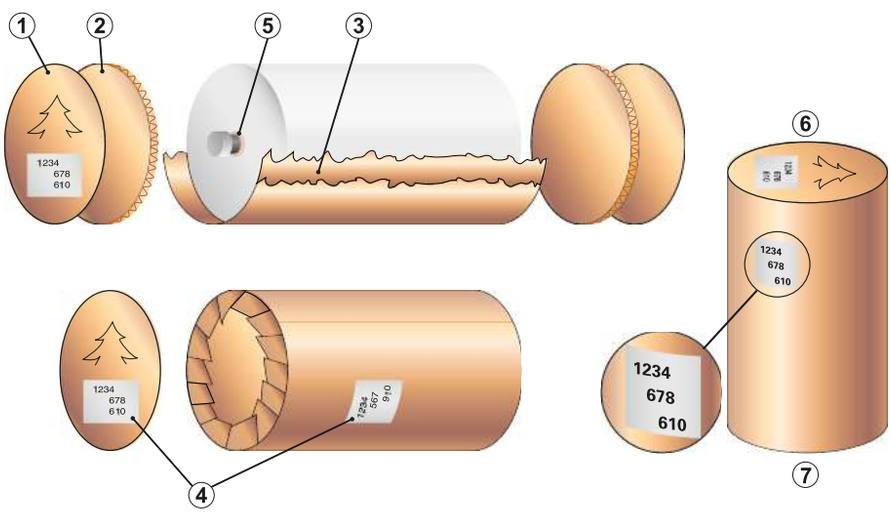
Rolls that have had damaged paper removed need to be reweighed and a new label placed over the old one. For paper roll repair information *see Module 7 page 30.*

Device used to test core deformation. Source: UPM



The extent of damage is expressed in depth (mm/inches) measured from the roll edge towards the core. Alternatively, the number of damaged paper layers should be counted. Source: FMS 'Use No Hooks'

Damage Location



1 - Outer end shields (cap, head covers, headers)
2 - Inner end shields (cap, head covers, headers)
3 - Belly wrapper or side
4 - Label & Barcode
5 - Core
6 - Top
7 - Bottom
Source: icmPrint

Note if damage is on the top or the bottom of the roll. **The top is when the label is in a horizontal readable position when the roll is standing on its end** (roll core pointing to the sky). The top usually has a small label.

Types of Roll Damage

Edge damage.
Source: Stora Enso

Edge damage.
Source: WOCG/icmPrint

Crimped edge/elephant toes.
Source: Stora Enso

Dropped roll.
Source: Mëtsa Board

01 Edge Damage (edge crack)

Damage: A cut, imprint or tear in the edge of the roll. A crimped edge may cause shockwaves in the roll. Out-of-roundness can negatively affect splice operation.

Causes: Multiple causes include —

Incorrect clamping: This is shown by side-to-side tearing of the roll wrap and white paper. Damage risk increases if the roll is not high enough before rotating, lowering it non-parallel to floor, pushing it on the floor, or incorrect mast tilt angle. Slack lifting chains increase damage risk when the roll is released from clamping.

Crimped edge/elephant toes: Typically happens when the roll is lowered edge first causing crimping damage seen as a wave formation on the edge. Alternatively, too low clamp force allows the roll to slide inside the wrapper and the bottom then carries more weight, which rounds the lower corners of the wrapper and crimped edges appear. The roll may be used after checking edges for cuts and there is no risk to running behaviour.

Impact: Roll pushed against a hard object. Clipped roll shows a tear in an upward direction at the bottom of a roll or downward on the top of the roll (not side-to-side as it would appear with clamp damage). Clamp truck impact can be seen when paint from the clamp truck is obvious on the rolls.

Lipping: Overlapping edges that are impacted, particularly when unloading stacks. This can occur at both the top and bottom of rolls.

Skinned roll: The wrapper cracks and "skins" (peels) off the roll due to insufficient clamp weight capacity or loose wrapping of the roll. Frequently happens when handling combines large rolls with small clamp trucks. The amount of damage to the white paper varies and will be extensive if the roll is dropped.

Dropped roll: Seen as an accordion pleat in a semi-circle area on the bottom edge, or on top if another roll is dropped on it during loading. Damage extends into the white paper as deeply as the height of the pleating on the outside of the roll. The uniform size "ridges" do not intersect (transit wrinkles are similar but the wrinkles are much smaller in width and tend to overlap one another).

Cuts and dents: Cut edge damage from contact with a sharp edge in the truck trailer, hold or railway wagon. Corrugated panel or side indentation damaged edges occur when the roll is pressed against corrugated trailer panels.

Loading and stacking: Oblique stacking; inadequate space between roll stacks; stacking with too low lift height. Mixed diameter loads may lead to a variety of damage — always report "multiple diameters in the load" if there is significant damage. Rolls on pallets may suffer edge damage if they overhang the pallet or are on a damaged pallet.

Packing materials: Dunnage* packing may cause a flat spot, straight line or wrinkling on the bottom edge of a roll; it can also transfer a pattern to the roll wrapper. A piece of flattened dunnage might creep under the roll to damage it. (*Dunnage is an inexpensive or waste material used to load and secure cargo during transportation.)

Deflated or burst air bag: A gap can be created in the load when an air bag fails. Rolls then shift into each other causing a variety of damage. A properly inflated air bag is very hard; a deflated air bag retains some air but is soft to touch; a burst air bag with a definite rip in the outer layer is an indication of mishandling and usually results in rolls shifting and edge damage.

Improper blocking or bracing: A common cause of edge damage. Can be overcome by using friction mats under the rolls, and to load rolls tightly against a wall.

ACTIONS

Send to evaluation area.

- ✅ Slab down a maximum 4 cm (1,5 in) of roll diameter.
- ✅ Use fine-grain abrasive paper to sand smooth the visible damage.

Prevention: Ensure correct roll clamp truck handling techniques and maintenance.

02 Side Damage (belly)

Damage: Both the wrapper and the product are damaged on the side of the roll.

Causes: Clamping arms insufficiently opened when clamping the roll; incorrect or poor contact pad condition; clamping force too low; incorrect clamp size for the roll dimensions; clamping too deep; lifting mast overly tilted during clamping; roll not lifted high enough and collides with another roll; roll dropped too hard or towed; rolls dropped or are ejected when braking; pivot arm clamps — smaller rolls with contact pads only – have no contact against the frame; sliding arm clamps roll against the push plates; clamping the roll at the bottom exposes the roll wrapper to stress; using the clamp to push the roll; roll in contact with a dirty floor.

ACTIONS

Send to evaluation area.

- ✅ Slab down affected layers.
- ✅ Before use, check core roundness and inner core wall for broken areas; if damaged, reject the roll.

Prevention: Ensure correct roll clamp truck handling techniques and maintenance. Variables are the wrapper type, the condition of the contact pads, and their friction surface. Some types of wrapper are more sensitive to handling damage, particularly if incorrect contact pad friction surfaces are used.

Side damage (belly) caused by a clamp truck's counter weight. Source: UPM

03 End Damage (head damage)

Damage: Damage through or under roll end cap.

Causes: A loose end shield (cap), or impact and tears, or cut at the end of the roll; dent on roll end side from hard object; water damage on ends; debris embedded into bottom of the roll visible on the outside; debris under the header or by mill handling before the roll is wrapped.

Poor handling, including roll lowered onto an uneven or unclean surface; bottom of roll dragged across an object or gouged on top by a clamp truck removing a roll sitting on top of it; roll end sliding on the floor that abrades the header and usually marks the white paper; rolls handled by forklift instead of clamp truck. Roll walking out of end shield (header) is rare and mostly occurs with tall rolls caused by loose wrapping or loose loading (not due to transport vibration if there is no excessive scuffing on wrapper).

ACTIONS

Send to evaluation area. Note if damage is on the top or bottom of the roll.

- ✅ Deep side damage can be removed with a grinder; if flat, use abrasive paper
- ✅ Slab off damage if it is less than 4 cm (1,5 in) inside roll diameter, otherwise reject.

Prevention: Ensure correct roll clamp truck handling techniques and clean floors.

End damage. Source: Stora Enso

End damaged through wrapper. Source: Stora Enso

End damage due to debris. Source: Stora Enso

Reel end damage top. Source: Stora Enso

Belly wrapper damage. Source: Stora Enso

04 Wrapper Damage

Damage: Typically looks like side damage (03) but only the wrapper is damaged.

Causes: Roll not tightly wrapped, or air trapped during packaging — when the wrapper is poorly glued, or not glued at all; or when the roll slips inside the clamping pads due to insufficient grip or clamping force.

ACTIONS

✅ If damage is less than two hands wide, patch with tape; if damage area is over two hands wide then send roll to evaluation area.

If the roll wrapper and shields are frequently damaged in many rolls from one supplier, then the cause may be that the wrapper and its materials are inadequate.

Core damaged beyond repair. Source: UPM

05 Core Damage

Damage: Crushed or out-of-round core.

Causes: Roll dropped hard, or too high clamp pressure.

ACTIONS

⚠ **Safety risk:** Do not use damaged cores because there is a danger to life and equipment.

✅ At press, remove dust from inside cores before loading onto paster. Cut off paper inside core wall if chuck does not penetrate.

✅ Send to evaluation area if core is too distorted or damaged to use on press.

Prevention: Ensure correct roll clamp truck handling techniques and maintenance.

Deformed roll. Source: UPM

06 Deformation/Out-of-Roundness

Damage: Excessive out-of-roundness may only be noticed when printing. In extreme cases the whole roll can be deformed and the core may be crushed. Depending on the clamping force, paper quality and general roll properties it may be seen as a total deformation or, alternatively, more locally concentrated under the clamp contact pads.

⚠ Modern high-speed presses are more sensitive to out-of-roundness than older machines which may lead to problems on the paster, web breaks, poor printing quality and reduced speed. *See page 16*

Causes: Roll clamps overlap two rolls, or have too high clamp pressure; or if roll is pushed against a fixed object.

ACTIONS

✅ Reduce press speed one minute before the splice and during splice cycle.

✅ Reject roll and send to evaluation area.

Prevention: Use clamp force recommended on roll label. Ensure clamp plates are clean, undamaged and correctly positioned on roll. Check clamp pressure; use larger clamp plates and/or high friction clamp coverage.

See pages 16-17 for more information on tolerances for roll shape.

07 Water Damage

Damage: Roll exposed to water or condensation, with the wrapper showing water stains.

Causes: Roll was placed in a wet area; or if water penetrates the wrapping during transport inside trucks or containers with damaged walls. Condensation in ships and containers may occur in autumn and winter during rainy weather or with snowmelt.

Water damage might be difficult to see on a roll that is still wet, as there is no stain/discoloration and the layers don't show gaps. If gaps are visible in the roll winding (when looking at the roll ends) then the water damage has dried out.

ACTIONS

- ✅ If roll end shows layer gaps and feels dry, then slightly wet the side with a water spray.
- ✅ Cut off the wet area to a maximum 3 cm (1,25 in) deep.
- ✅ Reject and send to evaluation area.
- ✅ Condensation on 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 (50°F) or more.

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

Water damaged roll. Source: Stora Enso

Contamination damage visible on wrapper. Source: Stora Enso

Rolls showing condensation. Source: Stora Enso

Roll with about 20% water damage. Source: Stora Enso

08 Dirt & Contamination

Damage: Contamination or staining of the roll.

Cause: Contact with oil or chemicals, etc. Possibly a mechanical problem on the clamp or lift truck.

ACTIONS

- ✅ Send to evaluation area.
- ✅ Cut off the contaminated part.

Transit wrinkle lines intersect.
Source: Idealliance

A transit wrinkle can occur even with wall dunnage. This "wear strip" is caused by the wall dunnage that protected this roll otherwise there would be paint on the roll. Source: Idealliance

Wall chafe. Source: Idealliance

Other Handling Damage Issues

Telescoping: Can occur when the paper roll is loosely wound or with an unwrapped roll of slippery paper, and when clamping force is too low. Typically, the only way to prevent a roll from telescoping is to increase the clamping force so that the friction between the paper layers inside the roll increases to prevent the problem (check the clamp capacity does not exceed the maximum hydraulic pressure).

Transit wrinkles: Occur on top and bottom of rolls over 1500 mm (60 in) in rail shipments, particularly if rail wagon walls are bowed and there is swaying movement. Rolls with transit wrinkles are normally the bottom tier, at the bottom of the roll where it touches the railcar wall (look for paint on the roll from the wall — if there is paint on the rolls it means no dunnage was used). They look similar to a dropped roll, but the wrinkled area is much smaller and the ridges tend to intersect with one another.

Wrapper wrinkles: Poor wrapping can create multiple straightline wrinkles around the roll that appear as hard creases or folds in the wrapper. Typically, there is no paint, chafing, or handling marks on the wrapper near wrinkles. Normally, there will be no transit damage in the white paper beneath the wrinkles.

Dunnage transit wrinkle: If the wall dunnage is too hard (not compressible) the rolls can be imprinted with its honeycomb pattern. The white paper will be marked and must be slabbed off.

Incomplete layer pinch wrinkle: A single tier blocking roll creates a pinch wrinkle at the bottom of the second tier roll and/or the top of the blocking roll.

Chafe (Rubbing) & Flat Spots

Roll-to-roll chafe: The wear strips show no paint; the ink marks show where rolls rubbed against the label of another roll. Roll-to-roll chafe may appear like white paint but it is only wear on the kraft wrapper.

Wall chafe: Shown by the white paint on the roll. It is hard to tell the difference between wall and door chafe from pictures alone. Label chafe can create a white mark like wall chafe.

Door chafe: Rolls not loaded on centre line or one side, or loaded too close to the door, causes chafing.

Flat spots: The area will be indented and flat as though it was hit hard by another roll or pushed against a wall. They do not exhibit any pinched areas.

Rail Transport Edge Damage

Doorpost rolls: Doorposts can lead to a variety of damage caused by poor doorpost protection or unloading difficulties. It is important to report if the damaged rolls were located at the doorpost and write "doorpost" on the roll before photographing.

Doorpost risers: In some load configurations, the doorpost roll cannot be clamped without dragging/pushing it to the centre of the rail wagon. If this roll is on a floor riser it can sustain edge damage when moved.

Kissing roll: Caused by rolls "kissing" or jumping at some point during transit. Look for impact damage on the top edge of a first tier roll that matches with bottom edge damage on the second tier roll. The damage may not be perfectly aligned because the rolls can rotate during transit.

Wrong type of railcar: Excessive edge damage can occur when fine paper rolls are shipped in a Rigid Under Frame (RUF) car. Only a Cushioned Under Frame (CUF) car should be used — these have a coupler that allows movement to facilitate the cushioning device (a rigid car has a fixed or immovable coupler). An issue in North America.

Indicate on photo report if origin is wear against another roll (left) or paint from wall (right). Source: Idealliance

Toppled rolls. Source: IGP

Other Rail Handling Damage

Rail handling – humped/hit rail wagon: Excessive rail wagon handling can result in significant damage. Wood chocks or unusual material on or in a wagon usually indicates the car has had a problem in transit.

Rail handling/toppled rolls: Toppled rolls are a safety hazard that should be thoroughly investigated. Photos of toppled rolls are critical in dealing with rail handling or mill loading mistakes.

Rail handling vibration loads — minor chafe damage: Occurs on rail or inter-modal shipments. Rolls will show chafe damage around the entire circumference. Wrapper shows evidence of spinning. There may be shavings on the floor. Usually the result of a mechanical problem with the wagon; other causes are cores too long or rolls loaded very loosely against each other. White paper is usually undamaged but roll appearance is poor. Report rail wagon for vibration problems.

Rail handling vibration loads — major chafe damage: Vibration can lead to severe damage if rolls can spin so violently that the wrap is removed and the white paper exposed. Shavings from the rolls are left behind as evidence. Note the light brown dusting and the white shreds of paper on the railcar floor. Spinning of the roll can also cause rolls to "walk" out of their end shield (header). Report rail wagon for vibration problems.

Rail handling vibration loads. Source: Idealliance

Types of Sheet Damage

01 Edge Damage

Damage: A cut, imprint or tear in the edge of the package.

ACTIONS

- ✔ Send to evaluation area.


Source: Mëtsa Board

02 Side Damage

Damage: Wrapper and product damaged.

ACTIONS

- ✔ Send to evaluation area.


Source: UPM

03 End/Top Damage

Damage: Impact dents in the top of the pallet that damage the product inside.

ACTIONS

- ✔ Send to evaluation area.

Source: Stora Enso

04 Broken Pallet Base, Lid or Straps

Damage: Pallet blocks, bottom or edge of the pallet are damaged or missing.

ACTIONS

- ✔ Replace with new elements.


Source: Stora Enso

Damage: Flat band/strap damaged, broken, loose or missing.

ACTIONS

- ✔ Must be replaced with new one(s).


Source: Mëtsa Board

06 Deformation

Damage: The package is out of its original shape.

ACTIONS

- ✔ Send to evaluation area.


Source: Mëtsa Board


Source: Stora Enso


Source: UPM

07 Moisture Water Damage

Damage: The pallet is exposed to water or condensation. The wrapper is water stained.

ACTIONS

- ✅ Send to evaluation area.

08 Stains & Contamination

Damage: The wrapper is contaminated by oil, chemicals, etc.

ACTIONS

- ✅ Send to evaluation area.

✅ Pallets Rejection/Reconditioning Criteria

Pallet bases must be intact — repair the pallet or its leg if damaged.

All broken bands must be replaced.

Bands must be tight.

Wrapping — if torn it must be taped immediately (place plastic under the tape); a new plastic foil must be provided for large exposed areas. The product must be intact.

Stack must be straight.

Any dirt on the packaging must be cleaned — paper should not be dirty or have scratches.

Loose sheets and ream wrapped sheets on pallets (bulk packed):

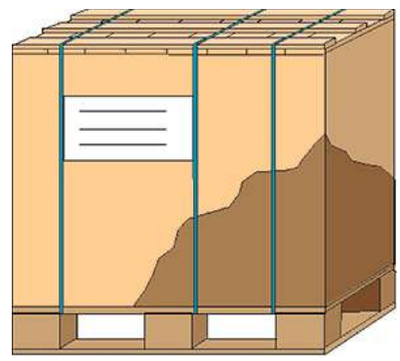
Reject —

- All product damage caused by forks.
- Shifted sheets or moved sheets from pallets (no restacking).
- Capsized pallets.
- Paper in boxes in addition to loose sheets.
- Damaged boxes (if more than one damaged pallet, similar boxes can be replaced from another pallet).

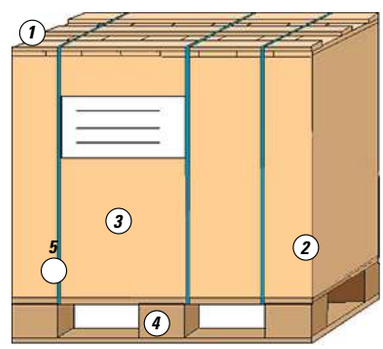
Narrow rolls on pallet — Core and cupboard pallets

With damage on individual rolls up to 50 mm (2 in) of the radius, each roll can be individually reconditioned by removing the damaged layers. If more than half of the rolls on a pallet are damaged in this way, then all of the rolls on the pallet are to be slabbed-off to a uniform diameter.

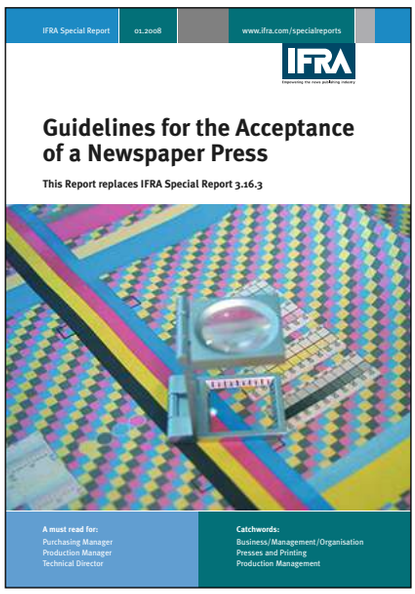
Rolls must be centred on the pallet.



Palletised paper in reams, sheets, rolls or customer packages is normally packed in a waterproof wrapper on a pallet.



1. Lid,
2. Corner protection,
3. Wrapping,
4. Pallet base,
5. Straps.
Source: OPHAL



Special Report 3.16.3 includes quality parameters for newsprint paper rolls to be meet when performing press acceptance tests. Source: WAN-IFRA

Tolerance Guidelines for Deformation/Out-of-Roundness (06)

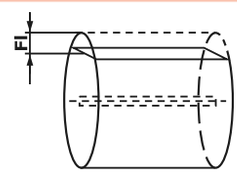
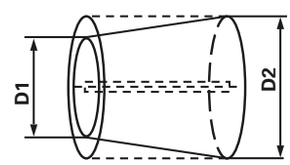
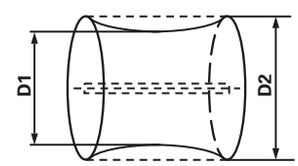
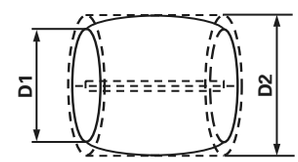
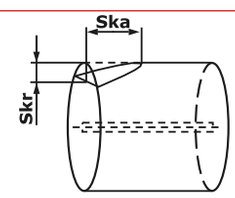
These tolerances were established by a WAN-IFRA cross industry working group for the Special Report 'The Guidelines for the Acceptance of a Newspaper Press' published in 2008.

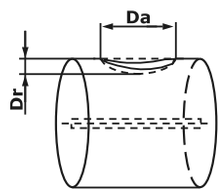
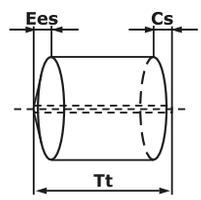
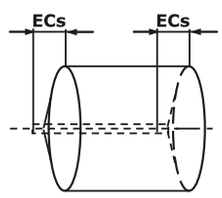
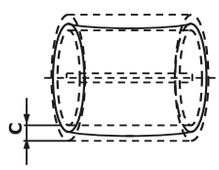
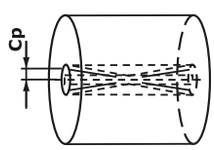
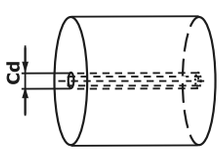
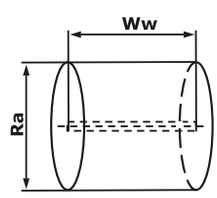
The tolerances are guidelines but are not contractually binding without a detailed written agreement between the paper supplier and printer. They are appropriate only to bulky paper grades like newsprint, WFU, book papers and some packaging grades for all printing processes. Dense papers like SC, LWC, WFC do not normally change shape drastically.

WAN-IFRA 'The Guidelines for the Acceptance of a Newspaper Press'
Appendix 2: Newsprint quality requirements

The following quality parameters for newsprint rolls must be meet when performing any of the described tests:

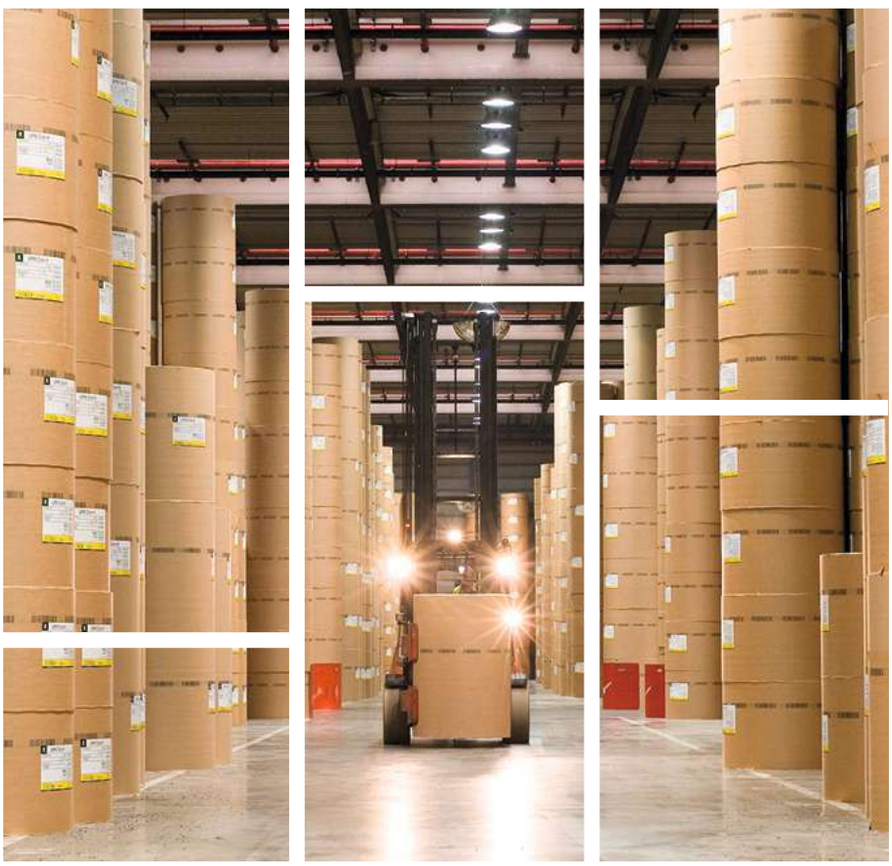
- Core specifications according to → WAN-IFRA Special Report 1.8
- Winding hardness → amphoric resonance
- Conditioning of roll(s) within climate of press hall → > 24 h
- Storing of splice prepared roll → < 12 h
- Paper properties → according DIN 19306-4 (2005)
- No mill splices in test rolls

Roll deformations:	Acronym	Tolerance	Illustrations
Flattening	Fl	< 5 mm (0,20 in)	
Cone deformation	Cn = D2 - D1	< 10 mm (0,40 in)	
Concave deformation	Cc = D2 - D1	< 10 mm (0,40 in)	
Convex deformation	Cv = D2 - D1	< 10mm (0,40 in)	
Skewness (axial) Ska		< 300 mm (11,81 in)	
(radial) Skr		< 2 mm (0,08 in)	

Roll deformations:	Acronym	Tolerance	Illustrations
Dent (axial)	Da	< 300 mm (11,81 in)	
(radial)	Dr	< 2 mm (0,08 in)	
Evenness, end surface	Ees	< 5 mm (0,20 in)	
Core shift	Cs	< 5 mm (0,20 in)	
Total tolerance	Tt	+ 13 mm / - 3 mm	
Evenness + core shift	ECs	< 5 mm (0,20 in)	
Concentrity	C	± 5 mm (0,20 in)	
Core position	Cp	< 5 mm (0,20 in)	
Core diameter	Cd	+ 0.4 mm (0,16 in)	
Roll (width)	Ww	± 3 mm (0,12 in)	
(diameter)	Ra -	30 mm (1,18 in)	

An out-of-round measuring device. Ultrasonic technology can be used to quickly and accurately measure roll roundness without disturbing its wrapping. The results can be viewed on an LCD display and exported to a data management system.
Note, this photo shows bad practice of a person in a work area not wearing safety equipment.
Source: Bolzoni Auramo

3 Warehouse & Paper Store



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IMPORTANT NOTICE!

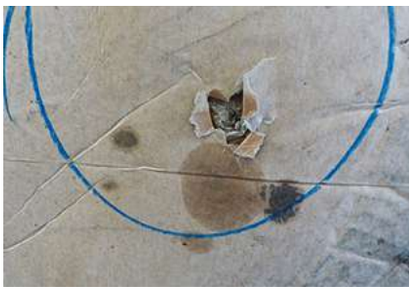
A general guide cannot take into account the specificity of all products, procedures, laws and regulations. We therefore recommend that this guide be used only as a complement to information from suppliers, whose safety, operating and maintenance procedures along with applicable local legal regulations 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.

Paper Storage

Side damage from poor clamping. Source: UPM

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



End damage from debris in floor. Source: UPM

Paper damaged by water leaks. Source: UPM

Poor storage.

- *Damaged rolls require excessive stripping and paper waste before running.*
- *Deformed rolls reduce press running speed and splicing efficiency.*
- *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. The roll should be clamped in the middle, not at the bottom. Source: 'FMS Use No Hooks'

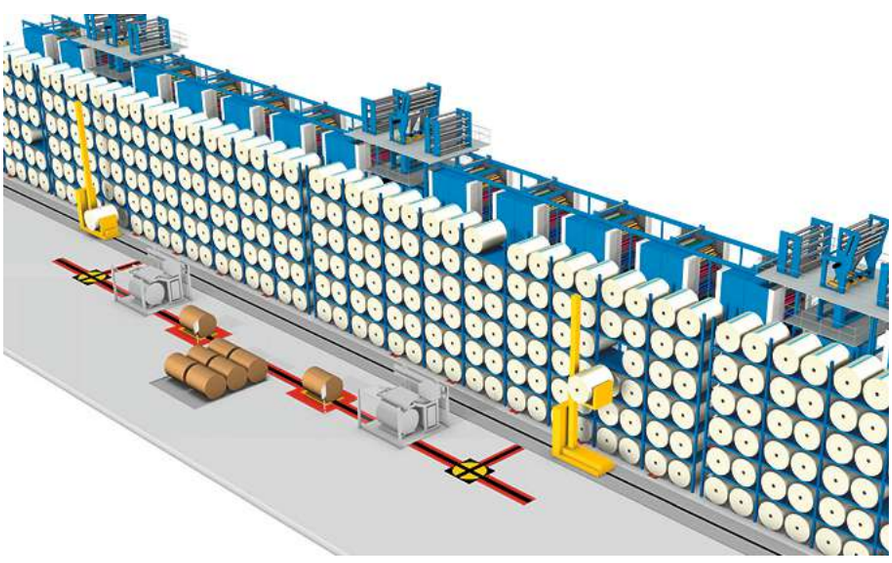
Source: UPM

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 (14°F). 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 offline 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.

✘ 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, 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*.

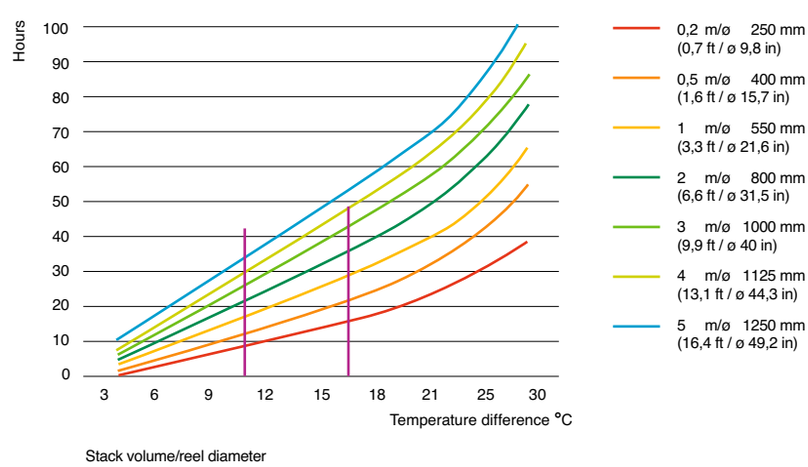
Paper stability is achieved at 20°C to 23°C (68 - 74°F) and 50 - 55% relative humidity and these conditions will improve press productivity.

✔ **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 below).
- 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 end 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.

See also Module 1 page 4 for more information on temperature and humidity.



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 in) 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 — *see photo page 6*.

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 weigh varies with grade e.g. a 1000 wide x 1000 mm Ø roll (40 in x 40 in) in newsprint weighs about 500 kg (1100 lbs) while coated paper is 1000 kg (2200 lbs).

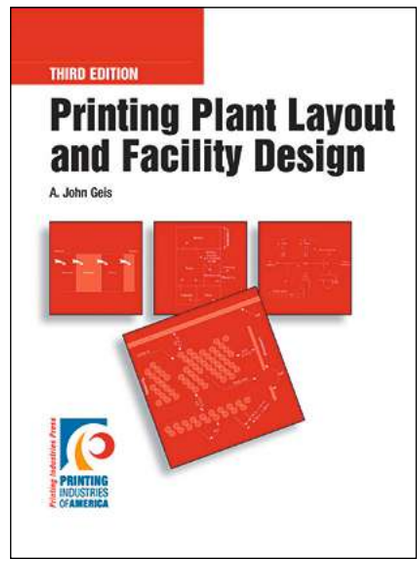
Preferred floor covering materials are polished concrete or bitumen (although less wear resistant). Concrete floors need to be sealed to prevent dusting, usually with an epoxy and urethane coating that is chemical, stain and skid resistant and easy to clean. A reflective light colour floor surface increases 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.

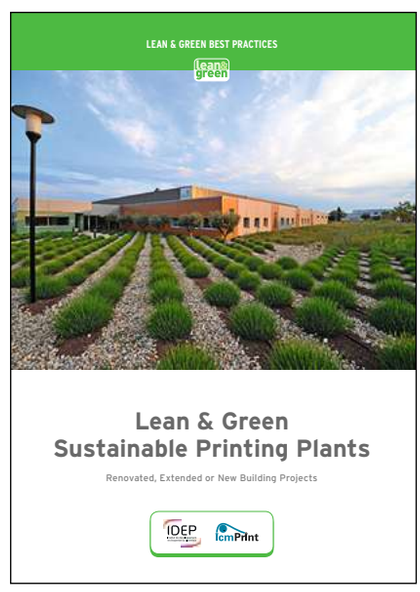
✅ Cracks and damages to the floor must be repaired as soon as possible. Uneven areas should be painted as hazards to prevent from loading on these areas.

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

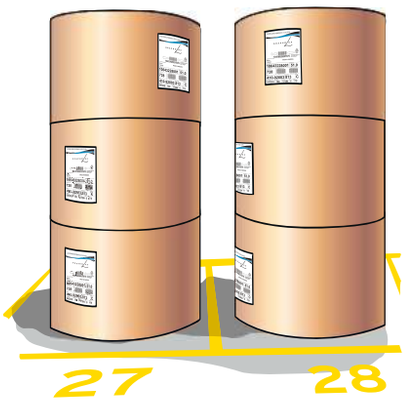
For more information on materials storage and handling layout for printing plants:



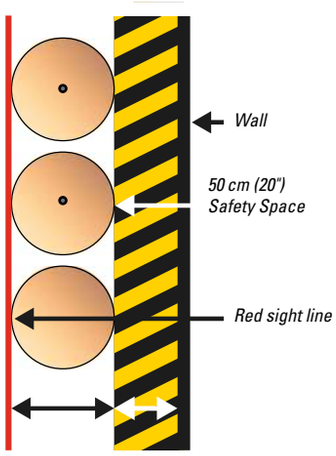
"Printing Plant Layout and Facility Design", 3rd ed. A. John Geis, PIA 2010, which describes best practices to help printers develop optimum facility designs.
www.printing.org



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



✔ *Storage bays should be numbered to facilitate placement and retrieval. Source: OPHAL*



Red sight line
= Roll Diameter + Safety space

✔ *Reduce collision damage when positioning rolls alongside walls by providing lift truck drivers with a red aiming line that provides better guidance. Source: OPHAL*

✘ *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 lift 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 that are 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 lift 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 in) 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.

A doorway cleaning system can remove up to 90 % of dirt from wheels, casters, tires and feet to prevent contamination of storage and production areas. Source ProfilGate

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.

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

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.

❌ *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*

Lighting

Adequate lighting with minimum illumination of 200 lux is required. LED lamps are increasingly preferred because of their low energy consumption. Other 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.

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

Loading Ramps

Ramps must have sufficient space for movement of lift 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.

Poor storage practices increase fire risk from unnecessary fire load. Source IF P&C

Fire detection systems must be in good condition and not obstructed. 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 m^2 (43 000 sq ft) separated by fire doors, others to over 6000 m^2 (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 firefighting 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.

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 m^2 (528 ft^2) 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.

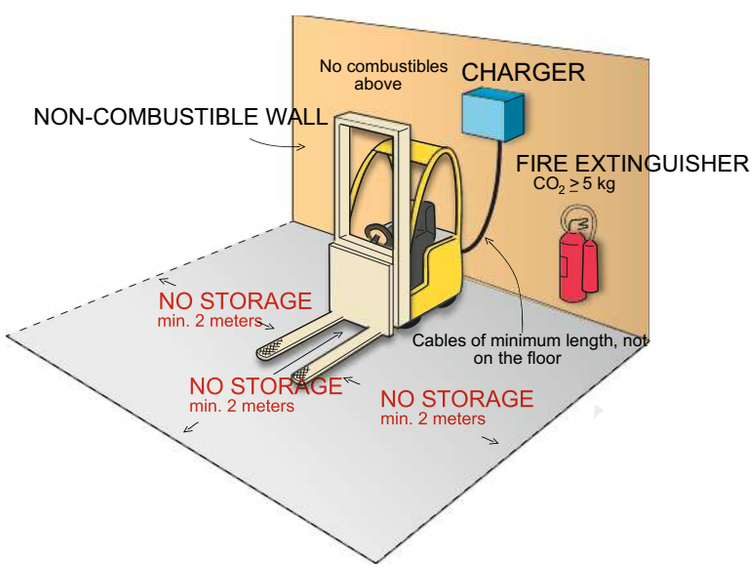
Safety equipment: Install automatic fire detection together with hand-held fire extinguisher (min. 5 kg / 11 lbs carbon dioxide). Chargers should be fixed to a secure wall — never on combustible walls — and protected from collision. Cables should be of minimum length and held off the floor to prevent 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 cm^2 per 50 m^3 (4,3 ft^2 per 38 ft^3) of room volume. Hydrogen detectors in the ceiling should be interlocked with the chargers to isolate them if hydrogen is detected.

⚠ 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 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.

Charging station for lift trucks. Source Ecograf.



Ensure a minimum 2 m (6,5 ft) 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: INTAKT

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

Mobile telephones can be a safety risk. Source: PW-Trigg

Safety & Security

- Staff equipped and wearing specified personal protective 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*.
- Lift trucks should have headlights and warning lights on when operating in a warehouse. Bluespot safety light is recommended.
- 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
- First aid kits should be easily available and maintained

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 8 m (26 ft) and in temporary parking 4 m (13 ft).

It is recommended that overnight parking of lift 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 firefighting 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.

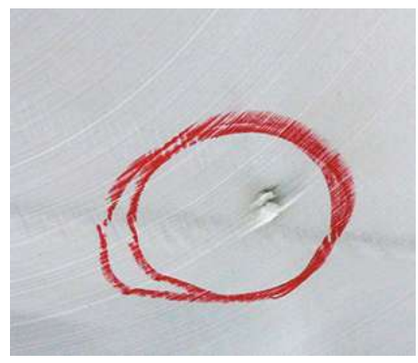
Good Housekeeping

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

Rolls should be:

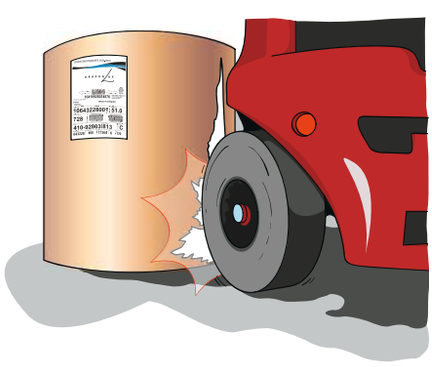
- Stacked on their ends, evenly in straight lines, with the same unwind direction.
- Place additional roll end covers on bottom roll (wrapping material).
- No overlapping — leave a safety gap between the roll columns.
- Space between rolls for clamp access.
- Space in gangways for lifter turns.
- Outer and corner rolls protected with roll guards.
- Normally 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.

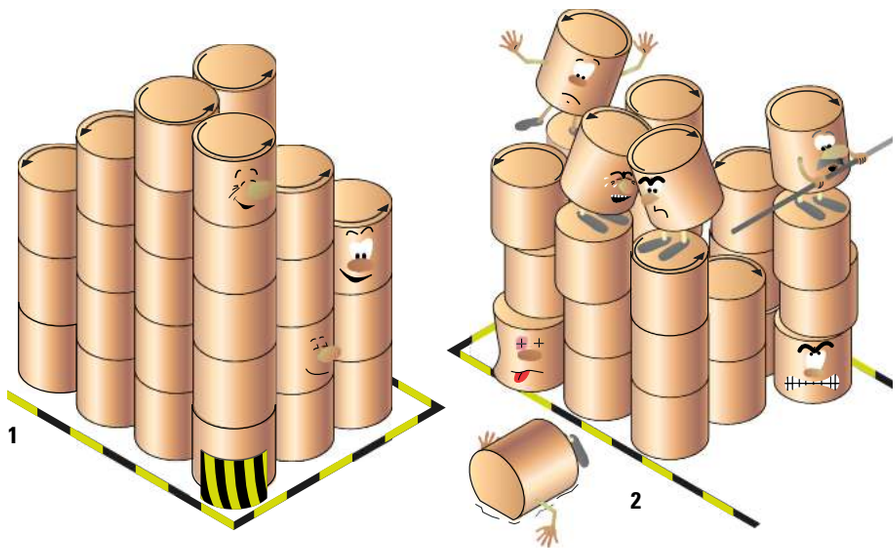
See Module 5 for complete information on handling equipment and techniques.

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.



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

Paper Rolls



1 Straight and stable stacks.
2 Poor stacking increases damage risk, especially edge damage.
Source: icmPrint

Paper Delivery Procedures

Unloading: Use optimised techniques for unloading the specific delivery vehicle. This can be a frequent source of damage.

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 page 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 (14°F) 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 space between rolls for lift 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 of space required to hose down rolls.

Nested

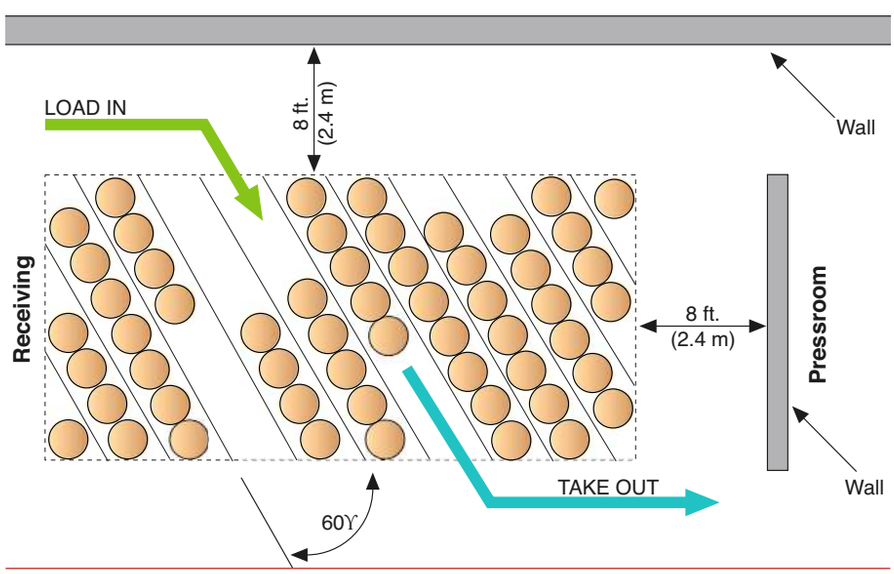
Soldier

⚠ Caution, actual roll diameter within same production batch may vary several centimetres that will require extra care when stacking, however, the roll label will only show the roll diameter ordered.

There are two ways to stack rolls:

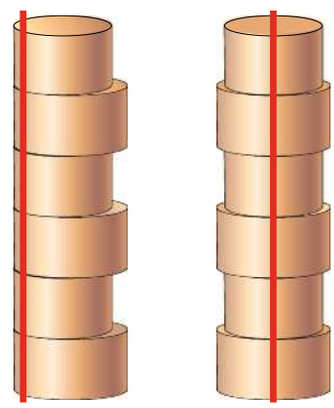
1. **Asymmetrical:** Rolls aligned on one side of the pile — with about a small hands-width of space (5-10 cm /2-4 in) between piles. This reduces the risk of overlapping edges being damaged when the pile is unstacked. It is best suited for roll diameter tolerances of ± 2 cm (0,8 in).
2. **Symmetrical:**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

Access aisles for lift trucks are determined by roll width — add 25 cm (10 in) 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 lift 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. 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. Source: PIA 'Printing Plant Layout and Facility Design'

✘ *Overlapping stacks creates high risk for edge damages. The edge is the weakest part of the roll. Source UPM*



Asymmetric *Symmetric*

Rolls can be stacked either asymmetrically aligned on one side of the pile, or symmetrical with rolls centred on top of each other — this provides better balance for high stacks. Source: icmPrint

Edge damage from overlapping rolls. Source: UPM

Always re-wrap partly used rolls in a suitable protective material. 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 reused 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).

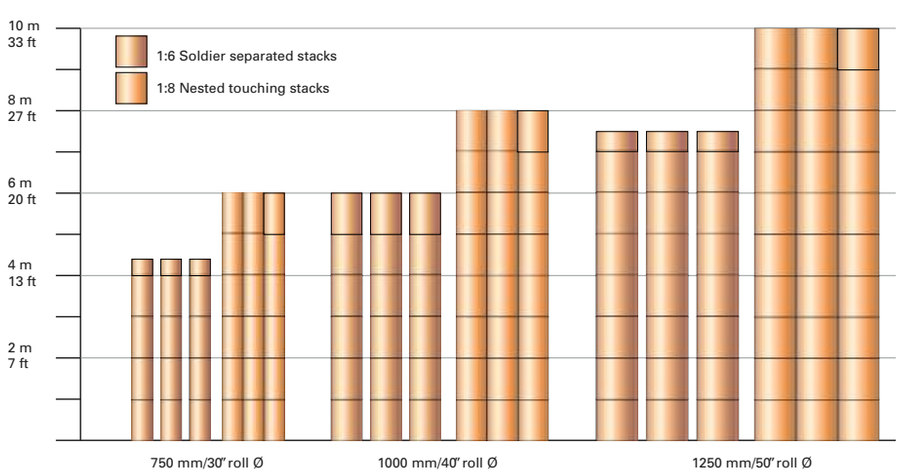
The paper store should calculate its maximum stacking heights based on the variables of its installation, type of paper and any particular issues like seismic risks.

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.

A standard 7 m (23 ft) high ceiling should be able to stack around 6,5 m (21,3 ft) 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 / 12 ft) is too high to unload road trailers or railway wagons, which means another lift truck with a lower mast will be required.

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

⚠ 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.*



Stacking heights for publishing paper with different roll diameter in 1:6 soldier and 1:8 Touching stacks (nested/block) block patterns. Source: INTAKT/OPHAL

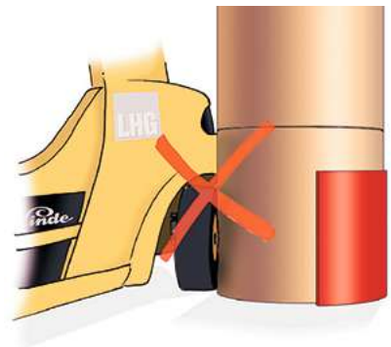
Paper Pallets

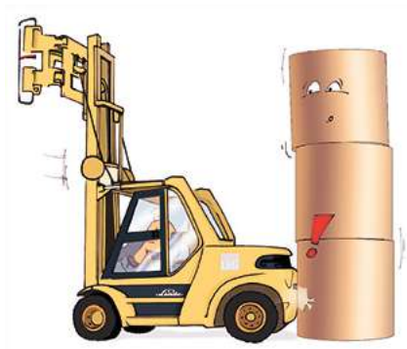
Pallets can be stacked three-high, a maximum of four layers of pallets can be stacked if plywood sheets are used between layers to reduce stress to the lower pallets and to increase stability of the stack.

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.





Source: Stora Enso

✅ Roll and corner guards

Curved plastic protectors shield corner rolls from lift truck damage on intersecting truck aisles. This freestanding protector should be as high as the widest portion of any lift 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 (50°F)	15°C (59°F)	20°C (68°F)	30°C (86°F)
0,50 m^3 / 18 ft^3	13h	19h	28h	60h
0,75 m^3 / 27 ft^3	14h	20h	30h	65h
1,00 m^3 / 35 ft^3	15h	22h	33h	70h

Use roll guards correctly in storage.
Source INTAKT

Use pallet guards in storage.
Source: Stora Enso/LHG

4 Paper Handling Equipment

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3 Choosing Truck and Clamps
3 Operational Checklist
4 Lift Truck Specifications
6 Lift Mast and Tilt

ROLL CLAMPS
8 Selecting Roll Clamps
12 Clamp Contact Pads
13 Methods to Adjust Clamping Force

CLAMPING
14 Clamping Principles and Terms
16 Clamping Force & Clamping Factor

FORKLIFT TRUCKS

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

Choosing Handling Equipment

Throughout its long logistics chain paper may be handled up to 16 times. It is heavy, difficult to handle, prone to damage and has a high unit value: making the correct selection and maintenance of handling equipment essential.

Lift trucks are the most common handling method for paper rolls, palletised paper, pulp, and waste paper bales.
When correctly equipped and operated they provide flexible, efficient and damage-free handling. Lift trucks and their clamping attachments need to be selected collectively to meet specific handling requirements.

Typical tasks	Paper mills	Harbour	Transporter	Warehouse	Printer
Vertical roll pickup from the conveyor line	✔				
Horizontal roll pickup from the floor	✔	✔		✔	✔
Container unloading/loading	✔	✔		✔	✔
Truck trailer unloading/loading	✔	✔	✔	✔	✔
Train wagon unloading/loading	✔	✔	✔	✔	✔
Printing/converting machine loading					✔
Stacking/unstacking in warehouse	✔	✔	—	✔	✔
Ship unloading/loading		✔	—		
- StoRo - sideport loading / unloading / stacking in berth		✔	—		
- RoRo trailer loading / unloading / stacking in ship's berth		✔	—		
- scissor lift loading, sling loading		✔			
Typical types of clamp trucks					
Rotating clamps	1-4 rolls	✔	1-4 rolls	1-4 rolls	1-4 rolls
	1-2 rolls	✔	1-2 rolls	1-2 rolls	1 roll
Tilting & Rotating clamps	1-4 rolls		1-4 rolls	1-4 rolls	1-2 rolls
	1-2 rolls	✔	1-2 rolls	1-2 rolls	1-2 rolls
Non-rotating clamps	1-4 rolls	✔	✔	✔	—
Non-rotating sliding arms clamps	✔	✔	✔	✔	—
Rotating sliding arms clamps	✔	✔	✔	✔	—

Summary of different handling needs in the logistics chain that help define the most appropriate clamp type for each operation.

Operational Checklist

The information is required to help determine the right equipment selection. Many of these points are elaborated in the following pages.

Paper Properties: Units ❑ Metric, ❑ US/imperial

Single roll dimensions	Weight	Minimum Ø	Maximum Ø	Height/Width	Wrapped
Largest roll					yes/no
Smallest roll					yes/no
Average roll					yes/no
Heaviest roll					yes/no
Other important roll size					yes/no

Note: Roll height is roll standing on its end with core vertical (eye-to-sky) — this is the same dimension as roll width.

Paper type: ❑ Newsprint, ❑ LWC, ❑ SC, ❑ Carton board, ❑ Liner ❑ Kraft, ❑ Recycled Kraft > 70%, ❑ Tissue-Facial, ❑ Tissue-Soft Towelling, ❑ Tissue-Hard Towelling, ❑ Wax, ❑ Other

Wrapper type: ❑ Kraft paper, ❑ Plastic, ❑ Stretched Wrap, ❑ Banded, ❑ Unwrapped, ❑ Other (define)

Multiple rolls wrapped together: ❑ None, ❑ 2, ❑ 3, ❑ 4, ❑ 5 or more (define) _____

Flat spot on horizontal position (tissue only): ❑ Yes, ❑ No, or define _____

❑ Heavy rolls (near maximum weight) with diameters significantly below the maximum diameter. Is there enough clamping force for this application and paper type?

❑ Difficult to handle rolls (very soft/narrow/wide, etc.)?

❑ Any previous problems with out-of-roundness, telescoping, overloading or other damages?

Roll Handling

❏ Twin-pack double rolls, ❏ Single wrap single roll, ❏ Single wrap multiple rolls different Ø, ❏ Multiple rolls same Ø, ❏ Two rolls clamped together, ❏ Three or more rolls stacked singly, ❏ Four rolls clamped together

Stacking Pattern: ❏ Nested, ❏ Soldier

Maximum stacking height _____ Any operating height restriction on mast height ❏ no, ❏ yes

How many rolls with a single lift _____

Lying (Bilge/horizontal) handling

Operating Location

Construction: ❏ New, ❏ Existing

Operation type: ❏ Warehouse, ❏ Harbour, ❏ Stevedoring, ❏ Container, ❏ Railcars, ❏ Trucks, ❏ Printer/Converter, ❏ Feed machines, ❏ Unload machines

Environment: ❏ Indoors, ❏ Outdoors, ❏ Rough surfaces, ❏ Dusty, ❏ High temperature, ❏ Low temperature, ❏ High humidity, ❏ Low humidity, ❏ Ocean site

Clamping

Type: ❏ Revolving, ❏ Non-revolving, ❏ Single roll handling, ❏ Multiple roll handling, ❏ Lying (Bilge/horizontal) handling? If yes, then 5° forward tilt is required.

❏ Tilting, upending or extending

Clamp functions: Roll rotation ❏ no, ❏ yes — Rotation ❏ 90º, ❏ 180º, ❏ 190º, ❏ 360º

Mast functions: ❏ Forward tilt, ❏ Side shift, ❏ Tilt indicator, ❏ Mast chain slack prevention valve

Clamp pad preference: ❏ Bolt-on bonded rubber, ❏ Bonded urethane, ❏ Hinged pad, ❏ Ribbed cast/herringbone, ❏ Unribbed cast/herringbone, ❏ Spray metal, ❏ Standard cast; Tissue — ❏ Single radius, ❏ Double radius, ❏ Convex, ❏ Other _____; Contact pad size w_____ x h _____

Total loaded axle weight (roll truck + attachment +load): _____ Any weight limits for containers, trucks, rail wagon? The lift truck supplier has the complete responsibility to calculate capacity for application.

Twin-pack double rolls

Single wrap single roll

Single wrap multiple rolls different Ø

Multiple rolls same Ø

Two rolls clamped together

Three or more rolls stacked singly

Four rolls clamped together

Drawings source: OPHAL

Lift truck equipped for correct handling of two rolls with different diameters. The biggest roll should be on bottom to avoid any risk of roll dropping out.
Source: Cascade

Variable Paper Handling Tools

Paper is manufactured in many grades, weights, densities and dimensions; handling equipment needs to suit the properties of the paper to be handled either as rolls or palletised sheets of paper. There are different ways to handle the same paper rolls. The most efficient and suitable tools should be used at each point in the logistics chain. For example, high volume stevedoring operations require different lift trucks and attachments than those used at a printer's warehouse.

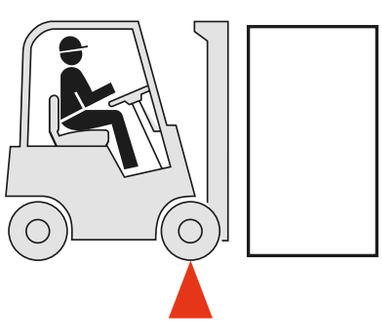
✘ Do not oversize or undersize the attachments in relation to the actual needs.

✘ Any paper roll can be damaged by over-, or under-, clamping them.

✔ Set the clamping force to the requirements of the paper roll — this is often indicated on the roll label. Use pressure selection valves or intelligent clamps to prevent damage to sensitive paper grades. Test the clamping force regularly.

During clamp handling, the paper rolls are held by the friction force generated between the wrapper and clamp pads.

✔ Know the wrapper type and its handling properties. Select the contact pad friction surfaces to match the wrapper's requirements.



Lift Truck Specifications

Motorisation: ❑ electric, ❑ diesel, ❑ LPG

Required load capacity (clamp attachment + maximum roll weight) _____

Height of stowage _____

Lift mast max height _____

Lift mast forward tilt ❑

Hydraulic functions, pressure and flows adequate to the attachment(s) _____

Accumulator to reduce dynamic forces ❑

Cabin features

❑ Overhead guard to protect driver from falling rolls

❑ Signal lights and sound for reverse driving

❑ Bluespot safety light

❑ Rotating seat for reverse driving

❑ Headlights for top loading and driving

❑ Camera for top loading

❑ Signal lamps on roof for pressure valve adjustment

Pressure valves: ❑ manual (3 or 4 different level adjustments), ❑ intelligent system, ❑ scanner device

Motorisation

The engine should be selected to meet national regulations and intended use. Electrical drive, with no noise or air pollution, is preferred for working inside buildings and ship holds. Diesel engines should use reduced sulphur fuel and be equipped with particle or KAT filtering systems. Lift trucks must be regularly maintained to the manufacturer's recommendation.

Generally, clamp and forklift trucks should be as small as possible to save space in the aisles. Large clamp trucks used for multiple roll handling or Super Jumbo rolls should have twin wheels for stability and better weight distribution.

Operator Ergonomics and Safety

Good driver visibility is very important — appropriate mast construction helps. Transporting large rolls or two parallel stacks of rolls requires additional solutions. A rotating seat is recommended when driving backwards, or a camera with a video screen for the driver is an alternative but must comply with safety regulations. Each truck must be equipped with portable fire extinguishers.

Capacity

Lift truck basic capacity tables assume that the truck is operated with forks only. The rated capacity is given for a load with a centre of gravity at a given distance from the vertical face of the forks — this is the load centre. Loads with a centre of gravity further out reduce the truck's rated capacity. An attachment combined with the truck requires it to be re-rated. Attachments, like clamps, can reduce the lift truck's rated capacity if they push the load centre outward; load extenders and tilting attachments may move the load centre further.

The common rest capacity calculation used by attachment manufacturers is based on calculating the overall lift truck stability at low lifting heights. This does not take into account that several lift truck and attachment components may be overloaded — lift mast rollers, the lift mast and fork carriage all carry a heavier than normal burden when overloaded.

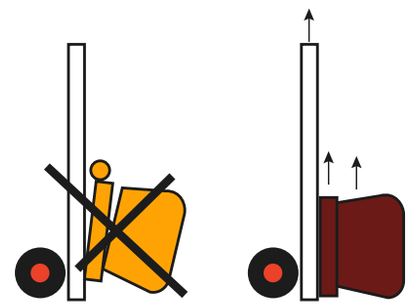
⚠ Only the lift truck manufacturer should calculate the actual axle load including the specific attachment, paper load and lift height combination.

Standard mountings: ISO 2328 defines the main dimensions of fork arm mounting hooks and lift truck fork carriages. The standard divides fork mountings into five capacity classes, but classes 1 and 5 are rarely used on lift truck attachments. ISO 2328/ITA mounting hooks are available with a quick-change option. The lower mounting hooks can be opened without tools to enable fast mounting/demounting of attachments to the lift truck. Dual hook mounting allows the same hooks to be used with two different mounting classes — this requires that the clamp back plate has pre-positioned fastening holes for the different mounting sizes.

Mounting angle: Some rotating paper roll clamps can be built with forward tilted mounting. Typically all non-rotating clamps are built with 0° mounting angle. If a rotating paper roll clamp has a forward tilted mounting, the clamp can pick up lying paper rolls with less lift mast forward tilt. Alternatively, if the full mast tilt can be used, then clamp arms can be designed to be slightly shorter while retaining the same lying roll lifting ability

✅ Paper roll clamps for high stacking should have a 0° mounting to avoid damage (a forward tilted mounting has a severe negative effect when stacking). Correct operation with lying (horizontal paper) rolls requires the lift truck to have at least 5° forward tilt.

Integral mountings: These replace the original fork carriage and wheel brackets to reduce weight to increase capacity while giving better visibility. However, mounting is more difficult and the lift truck attachment cannot be easily detached.



Forward tilted mounting. 0-degree mounting

Hydraulic Requirements

A correct hydraulic connection between the lift truck and its attachment is a key to high productivity.

❌ Inadequate or restricted oil supply from the truck to the attachment is responsible for about half of attachment service problems.

Hydraulic functions: Generally, lift trucks have two hydraulic functions available for attachment use — enough for fork positioners and paper roll clamps. Special attachments, and combinations, may require three or more hydraulic functions that have to be built onto the lift truck.

Hydraulic pressure: The hydraulic pressure available from the lift truck determines the operational force of the attachment. The attachment structure, seals/gaskets, hoses and other hydraulic components define the maximum hydraulic pressure. Hydraulic pressure is important for attachments generating clamping force because low pressure will reduce clamp lifting capacity. If the lift truck hydraulic pressure is too high, separate pressure relief valves must be installed into the hydraulic system of the lift truck or attachment.

Oil flow to the attachment: This defines the operational speed of the attachment's forks or arms. Generally, the higher the oil flow, the faster the forks or arms will move. However, too high oil flow may lead to excessive oil heating, decreased component life and operation malfunctions. Too low oil flow may slow operation, cause problems with simultaneous arm movement with multiple arm clamps, and malfunctions. The attachment's oil flow and its operating speed may be affected by hydraulic hoses going over the lift mast, hose reels, swivel blocks and hose connectors.

Oil grade and quality: Normally, all attachments are compatible with standard, good quality petroleum-based hydraulic oils. Some seal and gasket types are not compatible with water-based or bio oils. Correct installation of the attachment onto the truck requires hose sizes and fittings that match hydraulic flow requirements — undersized fittings or hoses can cause reduced oil flow and heat build-up, reducing seal life and fuel economy.

✅ Oil purity has major influence on operation uptime. Frequent oil and oil filter changes are highly recommended.

⚠ Reduce Dynamic Force

Different floor surfaces can create dynamic forces if the clamp and roll bounce during lift truck travel. These can momentarily double the effective weight of the paper roll with a risk of it dropping out of the clamps, which can cause serious injury and damage. Dynamic forces can be reduced by equipping trucks with pneumatic tyres and/or an accumulator — *see page 15.*

An attachment combination requires four hydraulic functions:
1. clamping, 2. rotation, 3. tilting, 4. extension.
Source: Bolzoni Auramo

Drawings source: OPHAL based on references from Cascade and Bolzoni Auramo.

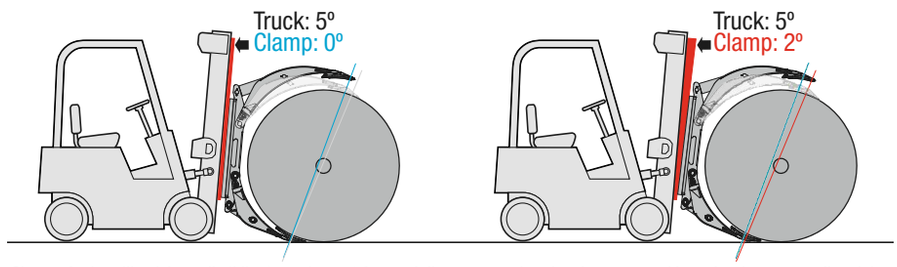
A 5° forward tilt ensures that the short arm pad is under the paper roll and the long arm pad is over the top. Source: Cascade

Lift Mast Height and Tilt

Lift mast height: The lifting height, mast type and need for free-lift depend on the user's requirements. When selecting the mast for attachment use, its lifting height requirements may differ considerably from those of a standard lift truck equipped with forks only. Check that the lifting height is sufficient in relation to the desired stacking height; and that the height of the mast does not restrict driving through doors or into a container or rail wagon.

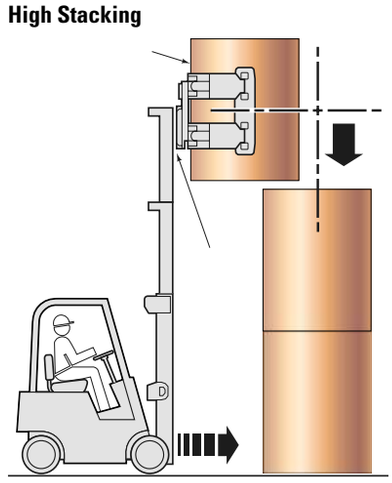
Lift mast tilt: Most rotating paper roll clamps are built to use the lift mast forward tilt when lifting a lying roll to minimise overall clamp dimensions and arm length. Generally, lift masts have a standard 5° forward tilt. Clamps are also available for lift trucks without forward tilt — they are equipped with 0° roll arms, longer long arms and shorter short arms.

The mast is tilted backward for stability over longer distance travel. However, the mast must be in a vertical position to avoid paper damage paper when the roll is put down. If it is tilted too far backward during clamping it can cause local deformations on the roll surface under the pad corners and there is a risk of dropping the roll from incorrect clamping. A tilt indicator helps reduce these risks.

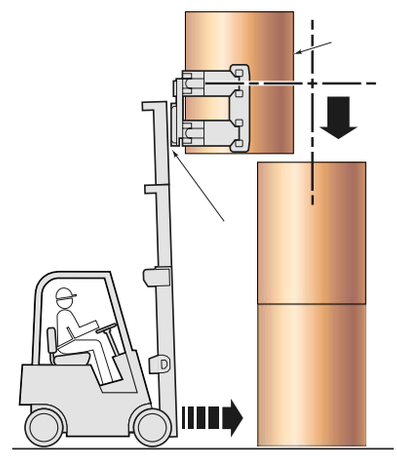


Clamps for handling lying rolls (bilge) require a 5° forward tilt to ensure that the short arm pad is under the paper roll and the long arm pad is over the top. This can be accomplished with 5° tilt on the truck and 0° on the attachment. Some users prefer 7° tilt for easier bilge handling, particularly with rubber pads on short arm. Source: Cascade

High Stacking



Square truck to stack, drive forward slowly, stop
- *Set vertical roll down squarely*
- *0° clamp shown*



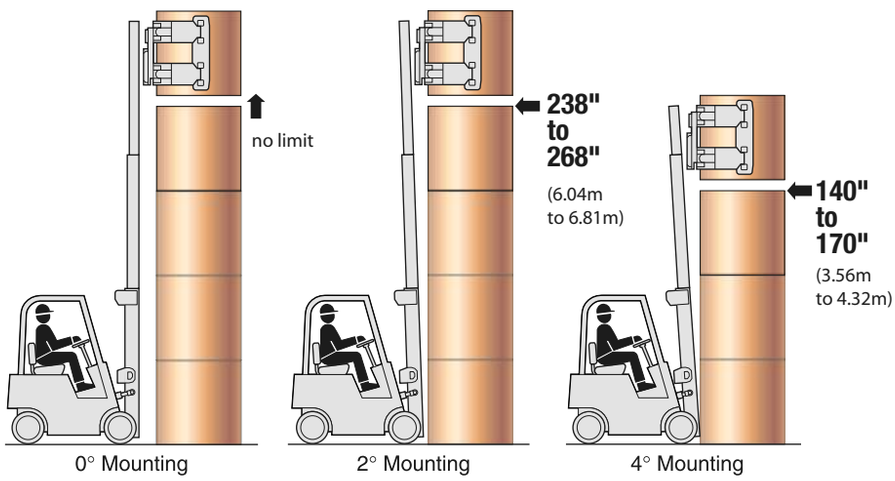
Clamp pads at bottom of roll
- *Contact truck supplier to check stability*
- *Make a rotation drift test*
- *Do not rotate when roll clamped at bottom*
- *Back tilt required if angle clamp is used.*

Source: Cascade

⚠ If rubber pads are used (to improve friction) with a 0° mounting (driver uses the mast to check the pads are parallel to the roll) then maintaining friction is assisted by using a non-rubber short arm pad and a rubber pad on the long arm.

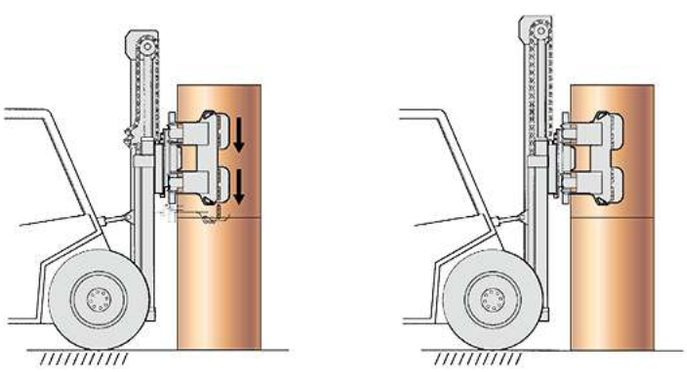
High Stacking and Mast Tilt

A forward tilted mounting has a severe negative effect when stacking paper rolls. When the mast is tilted backwards during stacking, the lift truck cannot reach the correct position on the side of the roll stack and in some situations will prevent stacking altogether. For this reason, all paper roll clamps used for high stacking should be delivered with 0° degree, or near, mounting.



Several types of mast position indicators are available to ensure operators clamp at 0°.
Sources: (left) Cascade, (right) Bolzoni Auramo

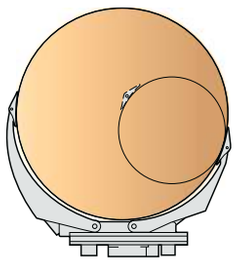
Mast chain slack prevention valve: If the mast lifting chains are slack when the roll is released there is a risk of damage to the paper roll, the truck's steering axle, mast and chains. A chain slack prevention valve inhibits chain slack by stopping the mast's downward movement immediately after the load is taken off the lift cylinder.



A mast chain slack prevention valve is recommended when stacking rolls. Drawings source: OPHAL based on references from Cascade and Bolzoni Auramo

Paper roll clamps for high stacking should have 0° mounting because a forward tilted mounting has a severe negative effect when stacking.
Source: Cascade

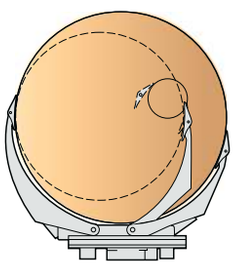
Roll Clamps



Fixed Frame - Fixed Short Arm

Double hydraulic function

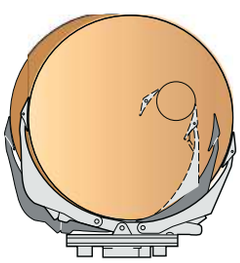
- *Good arm profile when handling rolls near maximum diameter*
- *Continuous 360° rotation*



Fixed Frame - Positioned Short Arm

Double hydraulic function

- *Positioned Short Arm permits improved long arm profile over wide range of roll diameters*
- *Continuous 360° rotation*



Swing Frame - Positioned Short Arm

Triple hydraulic function

- *Improves handling in tight stacking locations*
- *Allows easy lateral positioning*
- *Continuous 360° rotation*

Drawings source: OPHAL based on references from Cascade

Selecting the correct clamp type is a key factor in operating efficiency and avoiding damage.

Pivot arm clamps: The dominant paper handling attachment allows the clamping arms to make a swinging motion around fixed pivot shafts. They can combine several paper handling needs into a single attachment. Clamps may be non-rotating, rotating or tilting and may be equipped with several pairs of arms to handle multiple rolls. The clamping arms can be short and long, or of equal length, and slim pivot arm clamps permit tight roll stacking. These clamps have a simple design, low weight, narrow frame, a wide roll range, good visibility, and self-limiting clamping force when the paper roll diameter decreases.

Different pivot arm clamp models. Sources: (left) Bolzoni-Auramo, (right) Cascade

Non-rotating single paper roll clamps: Typically used in warehouses and port terminals for Sto-Ro ships where the rolls are taken on board on trailers and stowed in the ship's hold by clamp trucks.

Non-rotating multiple paper roll clamps: A good solution for paper transport in terminals and to load side port vessels. Multi-roll clamps can be configured as single or double width stack, with or without extendable upper arms.

Non-rotating multiple paper roll clamps: Sources: (left) Bolzoni Auramo, (right) Cascade.

The extendable upper arm optimises the position of the upper pads to stabilise the top rolls. In addition, clamps can be equipped with positionable centre arms to increase the range of roll diameters that can be handled. Hydraulically adjustable centre arms prevent the long arm from pushing rolls on the ground.

Rotating roll clamps for general handling: Sources: (left) Bolzoni Auramo, (right) Cascade

Rotating clamps: Allow the placement and handling of a roll in both standing and lying positions in a wide range of applications at paper mills, warehouses, ports, printers and paper converters. A rotation system assists tight stacking in confined spaces as the short arm can be turned against the wall, or nearest paper roll, to save space and allow side-by-side roll stacking. Clamps with 180° rotation facilitate returning the roll automatically to the 90° position, they can also provide a hydraulic cushion at the end of rotation. A 360° system allows rotation in either direction; it can have a 90° lying roll (bilge) position stop, and allows for easy placement of the roll on a surface that is not aligned with the lift truck (such as when operating on a railcar bridge or uneven surface).

Rotating clamps for handling either jumbo rolls or up to three rolls for loading and unloading ships, rail wagons or trucks. Sources: (left) Bolzoni Auramo, (right) Cascade

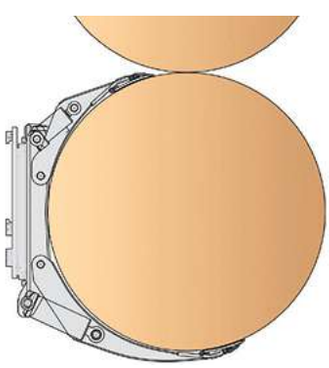
Roll upender clamp tilts the roll forward from vertical to horizontal position to load vehicles from one side. Clamping the roll close to the bottom avoids it hitting the mast when upending or rotating. Source: Cascade

⚠ Paper roll clamps with automatic 180° rotation stop or 360° with 90° option reduce the risk of roll damage.

Swing frame clamp: This is a standard rotating pivot arm clamp with a secondary pivoting frame that allows the roll to be 'swung' or side-shifted in tight stacking spaces, enabling the driver to precisely position the roll without the need to reposition the lift truck. The swing frame also allows the clamp to be operated as an equal arm clamp.

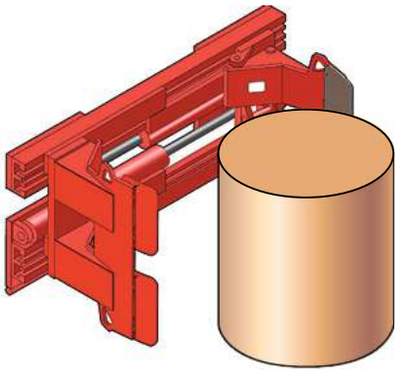
Swing frame. Source: Cascade

Short and long arms: Rotating roll clamps normally have short and long clamping arms to enable lying roll handling. This design also makes standing roll handling faster and safer in confined spaces such as containers and rail wagons. Tighter stacking with less lift truck manoeuvering is possible if the short arm side is turned towards the wall with the long arm making the clamping movement. The short arm can be either fixed or positioned to increase the roll range in the low end, and to centre rolls to the clamp. Non-rotating clamps normally have equal length arms to reduce its dimensions.



Short arm makes handling in tight spaces easier and minimises the roll damage risk. Source: Bolzoni Auramo/OPHAL

Short arm should be against the floor when lifting a roll from the ground. Source: Bolzoni Auramo



Sliding arm paper roll clamps.

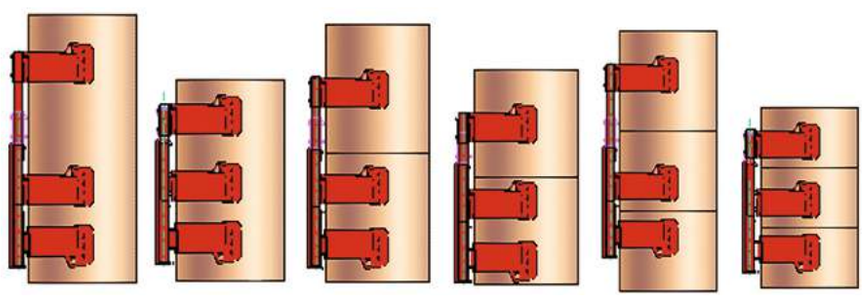
Sliding arm clamps: A slide system in the frame allows the arms to make a horizontal movement. They are mainly used in paper terminals and ports. They are heavier, wider and have a more limited roll range than pivot arm clamps.

There are two types: with or without a centre arm. Both can be used for side-by-side roll handling but only the non-centre arm type is suitable for carrying one roll on the centre line of the truck. Each type has advantages and disadvantages. The centre arm model allows for reduced pad pressure on the inside of the rolls, while the non-centre arm model can handle 2 rolls wide while retaining the ability to handle one roll with a narrow frame to work in a narrow aisle. The model without the centre arm has relatively high surface pressure when the rolls touch each other with only line contact of roll-to-roll — this is the compromise for being able to handle 1 or 2 rolls with a narrow frame.

⚠ Each roll being lifted must be clamped —"free riders" or "floaters" are very dangerous.

✔ Middle arms should be used when handling rolls side-by-side.

Fixed or split arms: Clamps handling more than one roll at time should always have a split clamping arm. This enables safe and damage-free handling of two (or more) paper rolls as well as a single roll. Split arms reduce roll edge damage and the risk of rolls dropping from incorrect clamping.



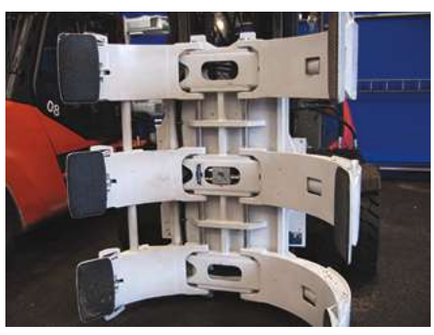
Drawings source: OPHAL based on references from Bolzoni Auramo.

Dual roll, double arm paper roll clamp.
Source: Cascade

Split arm clamps benefit from dividing the clamping force on each paper roll to provide a safer grip with less risk for out-of-roundness. Correct clamps are extremely important to avoid damage. The number of clamp pads determines the possible number of rolls that can be handled — each roll must be clamped by a minimum of one pair of pads.

Jumbo rolls (> 3 m wide) and/or super jumbo rolls (> 3,88 m wide) are best handled with a clamp of 3 or 4 arms with pads of an adequate surface area. Each type has advantages and disadvantages. The two-clamp arm design reduces weight and cost, while 3 and 4 arm models improve clamp force distribution across the roll surface. The material and surface of the pads must be chosen to meet safe transportation requirements.

Multiple split arms: 2, 3 or 4 arms enable safe and damage-free handling of rolls of unequal diameters. Each roll is carried by its own clamping force and clamped in the optimal position. Clamping force is divided between all rolls.



Multiple split arms reduce roll edge damage and the risk of dropping rolls from incorrect clamping. Damage will occur if rolls are clamped over their edges.
Sources: (left) Bolzoni-Auramo, (right) Cascade

Tissue paper clamps: These are designed to handle a wide variety of tissue papers that generally have large diameters and widths, requiring correspondingly larger clamp pads. Many paper types are used for different types of tissue, ranging from relatively dense service paper to very low density TAD (through air dried) tissue. Each requires a different pad to correctly handle each density. Ultra low density TAD paper is particularly sensitive. One system uses re-clamping to avoid over-clamping at the beginning of the clamp cycle to allow for the relaxation of the roll — a patented technology to preserve the original tissue fibre structure to improve runability.

Recycled paper (RCP) & pulp bales: RCP is loaded in wired units similar to pulp and handled with the same bale clamps. Special arms with compact dimensions are used to minimise contact with adjacent bales.

Bale clamp. Source: KAUP

Special clamps are used to handle large diameter tissue rolls. Sources: Cascade

Special clamps are used to handle large diameter tissue rolls. Sources: Bolzoni Auramo

Recycling bale clamp. Source: Cascade

Clamps can be equipped with load extenders to facilitate loading. Source: Cascade

Clamp contact pad. Source: UPM

Clamp Contact Pads

Pads are the only parts of the clamp in contact with the paper roll and are a key to safe and damage-free handling. The material and surface of the pads must be chosen to meet the requirements for safe transportation. Desirable characteristics include: pad radius suitable for the roll diameter and a protected hinge system; a thin pad with good contact properties when handling tightly stacked rolls; smooth rounded profile without protruding parts or edges to damage the paper; front edge steering that guides the pads around the roll; smooth wear strips on short arm side to provide a margin against wear from floor contact; and positioning features that align pads to the roll and stop them from turning to avoid paper damage.

Contact pads are available with a wide variety of friction surfaces that are defined by the paper and wrapper type and other application requirements. Certain types of paper may require increased friction to be handled with an appropriate sized roll clamp. However, the increase of clamp size and force is not always the best option due to potential roll damage risk. High friction pads using rubber are not always suitable in applications where there is a risk of tearing the paper.

			Paper type				
	Contact pads	**All round**	**Soft paper**	**Medium-Hard**	**Tissue**	**Durability**	**Maintenance**
1	Cast or ribbed	✔	✔	✗		High	Low
2	Rubber faced	✔	✔	✔		Moderate	Low
3	Steel-sprayed	✔	✔	✔		Moderate	Low-Moderate
4	Polyurethane faced	✔	✔	✗		Moderate	Low-Moderate
5	Grooved rubber faced	✔	✔	✔	✔	Moderate	Low-Moderate
6	Flexible pads with rubber band		✔				
7	Oversized rubber faced for tissue				✔		

Using the right contact pad is a key to safe and damage-free handling. Sources: (upper) Bolzoni Auramo, (lower) Cascade

An adapted pad is available for carbonless paper, and a pad covered with granulated material for outdoor handling at ports during extreme weather conditions.

1: Cast or ribbed pad is a high friction option often used for handling kraft because it adds 5-10% inner layer friction.

2: High friction pads using rubber are not always suitable in applications where there is a risk of tearing the paper.

3: Steel sprayed pads have very high friction and are good for icy environments but are not recommended for plastic wrappers.

4: Polyurethane faced pads with a non-marking surface have relatively good friction properties.

5: Rubber faced pads with a grooved pattern "stick" less to the wrapper.

6: Flexible pads with a rubber band that adjusts to different roll diameters help minimise surface pressure and are primarily used for newsprint.

7: Tissue paper uses oversized rubber faced pad.

✗ Worn pads may require a clamping force up to three times higher than those in good condition.

Methods to Adjust Clamping Force

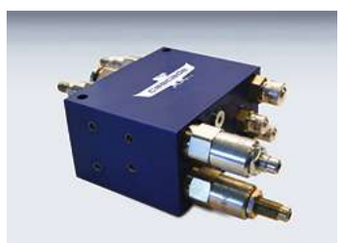
Coloured indicator lights on the top of the truck signal if the roll is clamped with the correct pressure. Clamping force can be adjusted by valve in the lift truck or paper roll clamp. The three types of system to adjust clamping are:

1. Manually

Manually with a four-stage pressure relief valve.
Source: Bolzoni Auramo.

2. Hydraulically

Hydraulically controlled clamp force system that changes clamp force in proportion to load weight.



HFC –
Source: Cascade

Force-Matic
Source: Bolzoni Auramo

3: Automatically

Automatically with an intelligent paper roll clamp.
Source: Bolzoni Auramo

AFC a computer controlled clamping system. Source: Cascade

'Intelligent' paper roll clamps:

Automates clamping force control of the variables of paper grades, roll widths, weights and diameters. The system uses the lowest possible clamping force to prevent the roll from slipping from the clamp's grip while providing optimal handling performance. Automation can drastically reduce out-of-roundness damage. Some systems can also collect data handling in a history file. Automatic hydraulic valves that adjust the clamping force to a preset clamping factor multiplied by paper roll weight are also available. As a result, even the most difficult to handle paper rolls remain perfectly round in all handling conditions and situations. Some paper companies are using AGVs or other driverless systems to minimise costs and damage.

Electronic slip sensors are mounted on the long arm contact pads to measure the paper roll movement in relation to the contact pads.
Source: Bolzoni-Auramo

Clamping Principles & Terms

Six interrelated factors affect how a clamp picks up a roll:

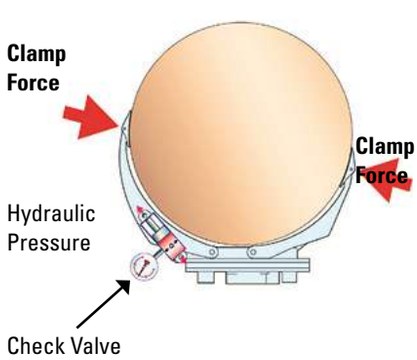
1: Hydraulic pressure
2: Clamp force
3: Contact pad surface pressure
4: Friction Handling and clamp set-up
5: Dynamic forces
6: Clamping Factor

These elements work together to operate a roll clamp. The **hydraulic pressure** from the lift truck to the roll clamp cylinder closes the clamp arms around the roll. This creates **clamp force** that is applied to the roll by the contact pads — a larger pad decreases **contact pad surface pressure** while a smaller pad increases pressure. The **friction** between the pad and the roll surface allows the roll to be lifted — the friction force must be greater than the roll weight or the roll will drop. These factors determine the **Clamping Factor** to securely hold the roll. An estimate of how much clamp force is needed to securely handle the roll can be determined from the roll weight, paper type, pad type and environmental conditions. The operator can then set the hydraulic pressure on the lift truck to ensure that the clamp applies the correct amount of clamp force.

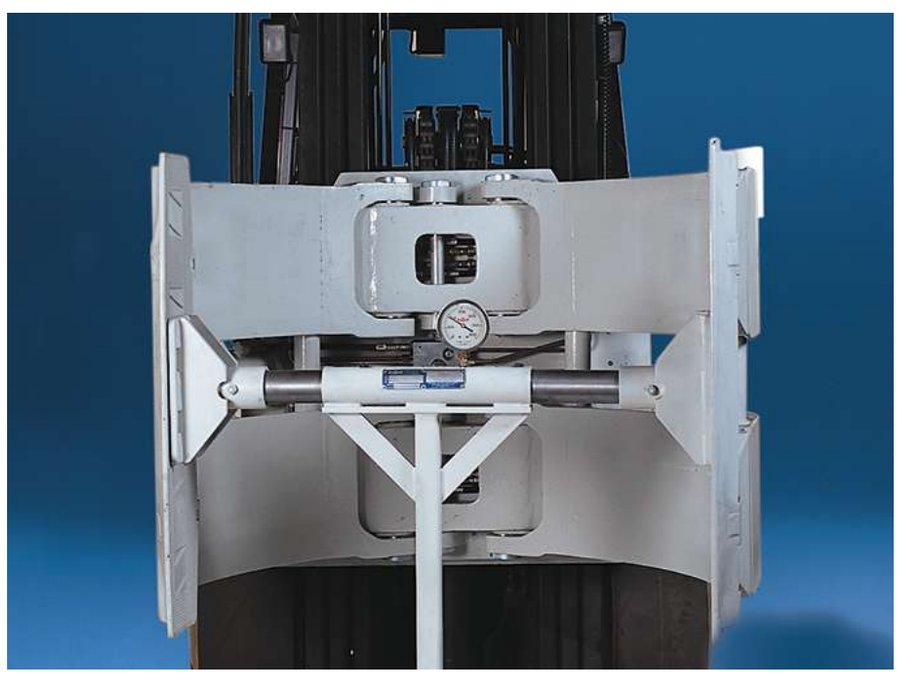
The fundamental steps are:

1. Establish the initial hydraulic pressure
2. Verify that the hydraulic pressure is adequate. Fine tune the amount of pressure
3. Perform daily checks.

Hydraulic pressure: Is the amount of internal hose and cylinder pressure supplied by the lift truck to the clamp. It is measured as psi or bar (1 psi = 0,06895 bar; 1 bar = 14,5 psi). Hydraulic pressure causes the cylinders to move the clamp arms and pads against the paper roll — this is termed clamp force. (Note: It is incorrect to use the term pressure when referring to clamp force. In this guide pressure is divided into two types: hydraulic pressure, as described here, and contact pad surface pressure.)



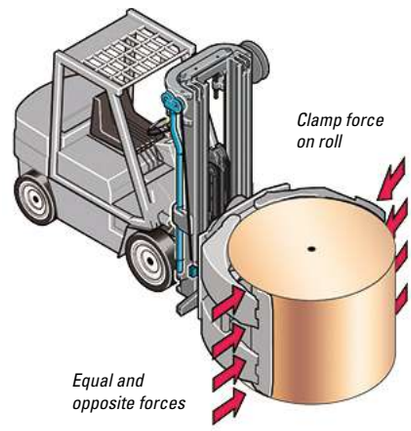
Clamp force is the result of hydraulic pressure moving the clamp arms and pads against the paper roll. Source: Cascade/OPHAL



Clamp Force Indicator. Source: Cascade

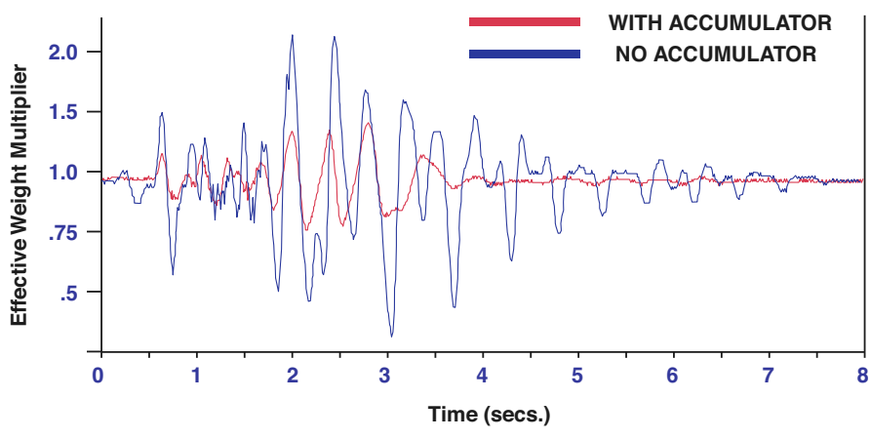
Clamp Force: The total amount of lateral force applied by the clamp pads to the paper roll. Measured as kN or Lbf and (1 kN = 224,81 Lbf; 1 Lbf = 0,004448 kN). Clamp force is generated mechanically and transmitted from the cylinder to the arms and then the pads that squeeze against the paper roll. The amount of clamp force applied to the roll depends on:

- The size of the hydraulic cylinders
- The amount of hydraulic pressure being applied to the cylinders
- The configuration of the arms and frame
- The diameter of the roll being handled. An exception is a Sliding Arm Clamp, where the clamp force is fairly consistent through the range of the clamp, but decreases as the arms extend past the frame.



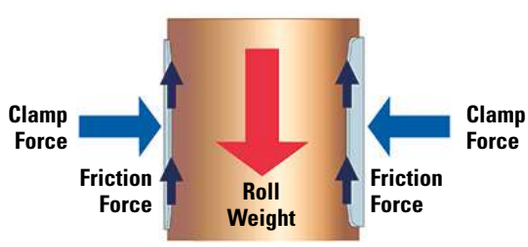
Source: Cascade/OPHAL

Dynamic Forces: Lift trucks operate on different floor surfaces that can create dynamic forces as the clamp and roll bounce during lift truck travel. Commonly known as G-Force (because of its association with gravity force), dynamic force momentarily increases the effective weight of the paper roll by as much as 100% and may lead to a risk of it dropping out of the clamps with a consequent high risk of serious injury and damage. These forces are caused by the simple travel of the lift truck through a warehouse, or by more severe conditions such as driving over rough surfaces or dock boards. Dynamic forces need to be managed and methods include an increase of clamping force, or reducing the dynamic forces by using trucks with pneumatic tires or using an accumulator to reduce the dynamic forces and the required clamp force and risk of over-clamping.



This chart shows roll clamp bounce with and without accumulator. The hoist system fitted with an accumulator significantly reduces the number and magnitude of dynamic forces and its dampening reaction time when compared to a truck without an accumulator. Source: Cascade

Friction: The resistance to movement of one surface against another. One of the most important factors in paper handling is the amount of friction between the paper roll and the contact pad. Friction force is the primary force used to lift the roll. Understanding friction and its effect on roll slippage is important in determining the right amount of clamp force and selecting the correct contact pads. The formula is Friction Force = μ x Weight where μ is the coefficient of friction. Measured as Coefficient of Friction - no units.



Friction force must equal or exceed the roll weight or the roll will drop. The greater the clamp force, the greater the friction force. Drawings source: OPHAL based on references from Cascade

The clamping force formula in metric units:

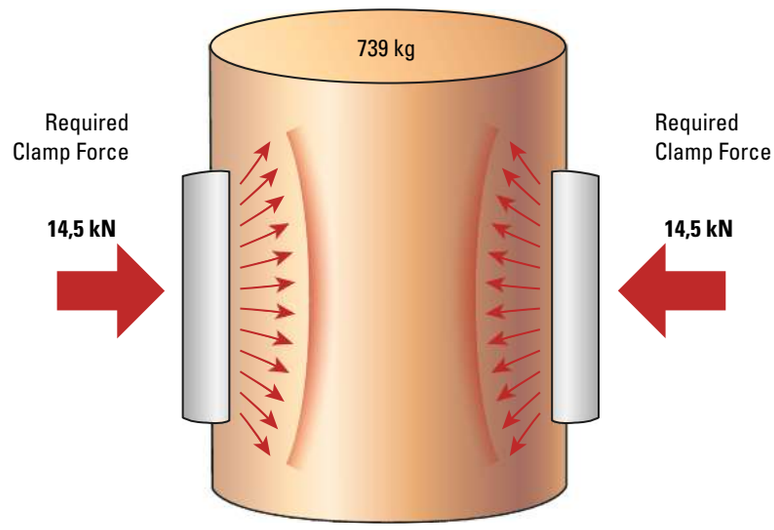
Fc = k = W*g/1000

Where

Fc = Clamping force in kilo Newtons (kN)
k = Clamping factor
w : Weight of roll in kg
g = Acceleration of earth's gravitational pull (9,81=10 m/s^2)

The metric equation includes acceleration due to gravity is 9,8 m/s^2 — this gravitational constant is incorporated in the definition of Lbf and is therefore not required in the imperial equation.

Clamping Force



Example with a clamp factor of 2,0 and roll mass of 739 kg. Drawings source: OPHAL based on references from Cascade

- Clamping force can be adjusted manually, electrically or by hydraulically operated pressure selection valves.
- Clamping force measurement is kN (kiloNewton); 100 kP (kiloPascals) = 1 kN

Pivot arm clamps. Source: Bolzoni Auramo

Pivot arm clamps: Force is generated with hydraulic cylinders directed to the paper roll with a pushing motion through a linkage mechanism formed by the arms and frame. Clamping force normally increases in a non-linear manner when the arm opens. Changing the short arm position changes the dimensions of the mechanism and the clamp will produce different clamping forces.

Sliding arm clamps: The hydraulic clamping force is directed to the arms with a pulling motion. The force is relatively constant regardless of the arm opening position.

No single clamping method

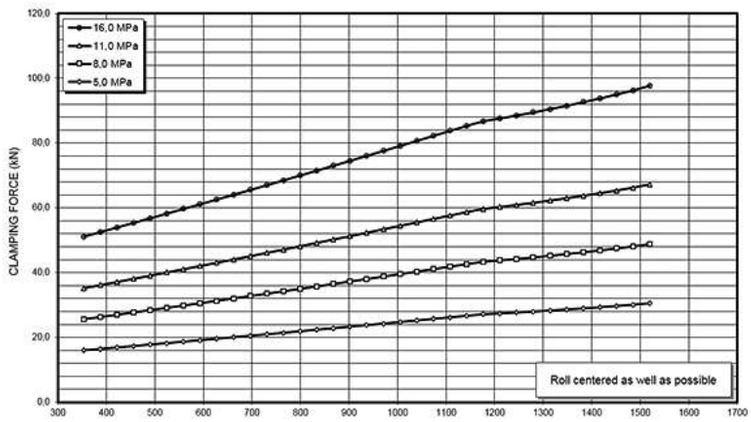
Manufacturers use different methods to set clamp pressure and their setting instructions need to be referred to for each model. This is particularly important for pivot arm clamps where manufacturers provide a unique clamping force diagram/table for each model. If the roll range or lifting capacity changes, so does the form of the diagram/table; the clamping force curve is different with different short arm positions.

The diagram/table is valid only for the hydraulic pressure indicated — if the hydraulic pressure changes, then the curve changes position. This clamping force data is needed for a fixed length clamping force testing device to know the actual clamping force with some other opening range (= test cylinder or test stand). Check the test device reading and use the diagram to determine the clamping force for the actual roll diameter. Sliding arm clamps have a relatively constant clamping force with all arm opening positions and a clamping force diagram/table is not needed.

For setting Clamping Force and Testing *see Module 5 page 8.*

Dual roll, double arm paper roll clamp. Source: Cascade

Clamping force diagram



Source: Bolzoni Auramo

The clamping force diagram is unique for each clamp model. It shows how the clamping force of a pivot arm clamp changes when the arm opening changes. If the roll range or lifting capacity changes, so does the form of the diagram.

The clamping force curve changes with different short arm positions. The main diagram shows separate curves for clamping force with short arm in closed and open positions. Some diagrams may show a third curve for a short arm position optimised to the roll diameter. Clamping force diagrams are not necessary for sliding arm clamps because their force is relatively constant with all arm opening positions.

Use the diagram if you have a fixed length clamping force testing device and need to know the actual clamping force with some other opening range (= test cylinder or test stand). Check the test device reading and use the diagram to determine the clamping force for the actual paper roll diameter. You need the diagram if you do not have a pressure gauge and you want to check that your four-stage pressure relief valve is working properly and is correctly adjusted.

Clamping Factor

(also known as Clamp Force Factor)

The clamping factor is a relation between clamping force and load force (gravity force). It is used to compensate the changes in friction and roll properties and the dynamic changes during handling. It combines the static and dynamic clamping force needed in all possible handling situations and with all paper rolls. The clamping factor can be used to define a rough initial value for the clamping force with varying paper grades and roll weight, e.g. paper weight 2000 kg x 1,3 clamp factor = 26kN total pressure.

Cfc	=	**Freal / G** which is the same as Freal = Cfc x G
Freal	=	Clamping force in the clamp
Cfc	=	Clamping factor
G	=	Theoretical smallest possible clamping force, in practise = the load force (weight x gravity). For example, for a 2000 kg paper roll, the G = 20 kN

Example: A newspaper roll, assumed clamping factor 1,5; paper roll weight 1500 kg.

The clamp can be adjusted to produce a 1,5 x 15 kN = 22,5 kN clamping force for this roll and roll diameter. Clamping force is usually measured in kN (kiloNewton)

1 kN (1000 N) = **100 kp** (kilo Pascals) and corresponds to a weight of 100 kg on the paper roll.

Paper Grade	Clamping factor
Newsprint	1,5 - 1,6
Directory	1,3 - 1,7
Kraftliner	1,5 - 2,3
SC paper	1,6 - 2,4
LWC paper	1,7 - 2,4
Tissue/Fluff	1,4 - 1,6
Fine paper	1,9 - 2,3

The table shows some values for the clamping factor with different paper grades. They should be considered as a guideline only and may not be appropriate for all paper grades and handling situations. The clamping values are based on normal handling conditions using rubber-faced pads in good condition. Out-of-round measurements can be used to verify that clamping force settings are correct.

Forklift Trucks

Printing and office papers are often transported as sheets stacked on pallets. Non-standard pallet sizes are common as paper sheet sizes vary a lot. Paper rolls are sometimes also transported on pallets. The cargo units are picked up and transported with lift trucks equipped with forks. One or more cargo units can be transported depending on the type of construction.

From the handling perspective, transporting palletised paper does not differ from normal pallet handling. The only major difference with these loads is their high vulnerability to external damage.

Depending on customer requirements and packing machine, the pallet loads are often wrapped with plastic or paper cover. Plastic or steel straps are used to keep the load tied securely to the pallet. Sometimes a strong wooden top lid is used to protect the upper side of the pallet, especially when several pallets are to be stacked on top of each other.

The fork used should always take into account its prescribed use and loading capacity limits. Hand-drawn pallet trucks are often used in printing plants.

Pallets should be handled with adjustable width forks or purpose built pallet forks. The length of the forks should be less than the width of the pallets/packs to be lifted. Operators must ensure that the length of the forks used does not lead to impact or damage to adjoining pallets.

Several pallets arranged one behind the other can be transported with long forks (e.g. truck unloading from the side). The 4-fork arm lift truck can pick up two side-by-side pallets. Multiple pallet handler systems are combined with telescopic forks.

✘ Overlength forks and careless handling are the most common reasons for pallet damage.

✔ It is recommended to paint markings on the forks to help the driver determine the correct distance and avoid penetrating and damaging adjoining pallets. The thickness of forks must not exceed the free space in the pallet base where the forks enter.

Some Forklift Configurations

Fork positioners and double pallet handlers are commonly used for handling palletised paper goods due to the high variety of pallet sizes and high volumes involved in this particular transport. Some users prefer load-turning clamps because of the good load support they offer.

Fork positioners are the most suitable solution to handle pallets of sheet paper because they can be adapted easily to different pallet sizes. Source: KAUP

Single-Double used to handle corrugated sheets.

Load turning clamp.

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5 Roll & Pallet Handling Techniques

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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

Working Safety

Avoid Risk of Death, Injury & Damage

Paper is heavy, difficult to handle, has safety risks, is prone to damage and has a high unit value. Best practice operation and well-maintained equipment is, therefore essential.

! Lift trucks laden with heavy paper that is being moved, stacked and manoeuvred represents a very high safety risk to the driver and anyone in the vicinity. There is a risk of death or serious injury from many different causes:

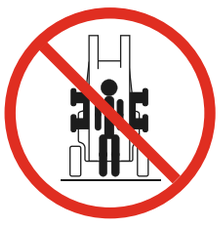
- ✘ Do not operate equipment unless you are a trained and authorised lift truck driver.
- ✔ Be sure you know and understand all operating procedures and safety precautions. If you have any questions, or do not understand a procedure, ask your supervisor.

Do not stand under the load

Do not stand on top of the load

Do not stand in front of the load

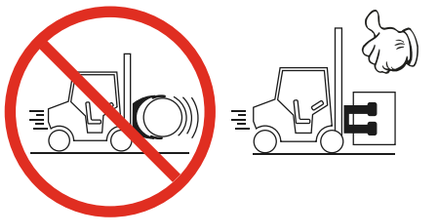
Do not stand to the side of the load



Do not stand between clamping arms

No loose unclamped (free riding) rolls

Do not open clamp while driving

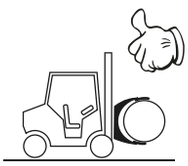


Do not drive with lying roll

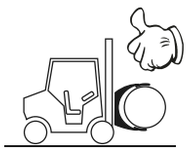
Source: Bolzoni Auramo.

No riders

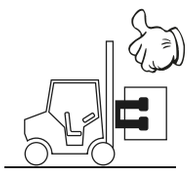
No reaching through mast



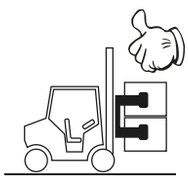
Do not clamp too deep



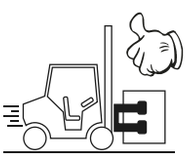
No tip clamping



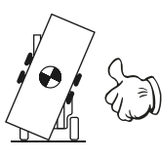
Keep mast vertical when clamping standing rolls



Multiple rolls with split arm clamp only



Do not drive with load lifted high



Do not rotate if roll is off centre

No overloading

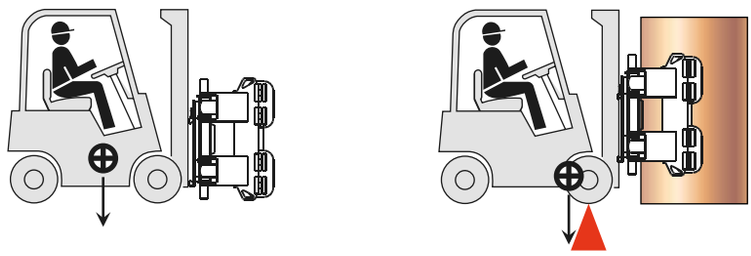
Do not lift unsuitable loads

Source: Bolzoni Auramo.

Lift Truck Stability

Centre of Gravity

Drawings source: OPHAL based on references from Cascade and Bolzoni Auramo.



An unloaded lift truck has a fixed centre of gravity. The lift truck, attachment(s) and load have a combined centre of gravity point that moves forward as the load becomes heavier and/or the more forward the load is situated. The goal is to maintain stable handling with a defined safety margin.

- ✔ Never exceed the rated capacity of the attachment & lift truck combination!
- ✔ Check the actual position of the load centre of gravity and its effect on the lift truck's lifting capacity

Lifting capacity reduces when the load centre moves forward, for example when using a load extender. Source: Bolzoni Auramo

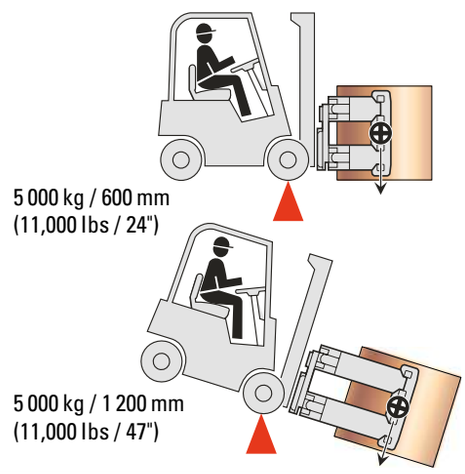
Moving Load Centre of Gravity

When the load's centre of gravity moves forward, the lift truck's lifting capacity decreases.

Example:

5000 kg (11 000 lbs) at 600 mm (24 in) load centre is the same as 2 500 kg (5,500 lbs) at 1200 mm (47 n) load centre.

This means that a 5 000 kg (11 000 lbs) at 600 mm (24 in) specified lift truck cannot lift a 5 000 kg (11 000 lbs) at 1 200 mm (47 in) load!

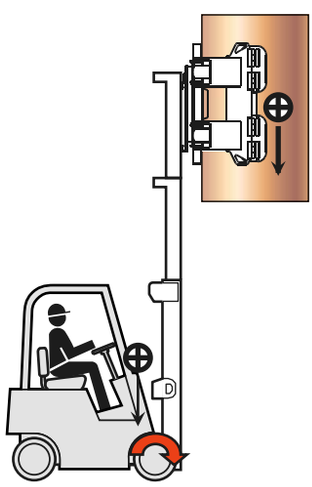


Load centre moves upwards.

- ⚠ The lift truck's stability is reduced when the lift mast is raised.

Lift truck's specifications define the maximum loads for different loading heights.

- ⚠ Dangerous risk arising from reduced lift truck's stability increases when tilting, side-shifting, accelerating.



Stability is reduced when the lift mast is raised.

Drawings source: OPHAL based on references from Cascade and Bolzoni Auramo

⚠ Overloading

✘ Never use the lift truck and attachment combination to lift more than its rated capacity as stability factors will be changed. The lift truck may become unsafe and the wear of its components will increase.

Incorrect handling is often combined with overloading when —

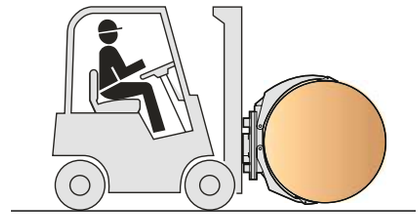
- ✘ Lifting more rolls than the safety capacity of the clamp allows.
- ⚠ Never move free-riding (unclamped) paper roll(s) that may fall off, particularly when braking or cornering — a high risk of injury and damage. There is an increased risk of out-of-roundness damage because the extra weight of the free-riding roll is compensated by clamping the lower paper rolls with < 2 times higher clamping force.

Lifting a paper roll from a lying (horizontal or bilge) position

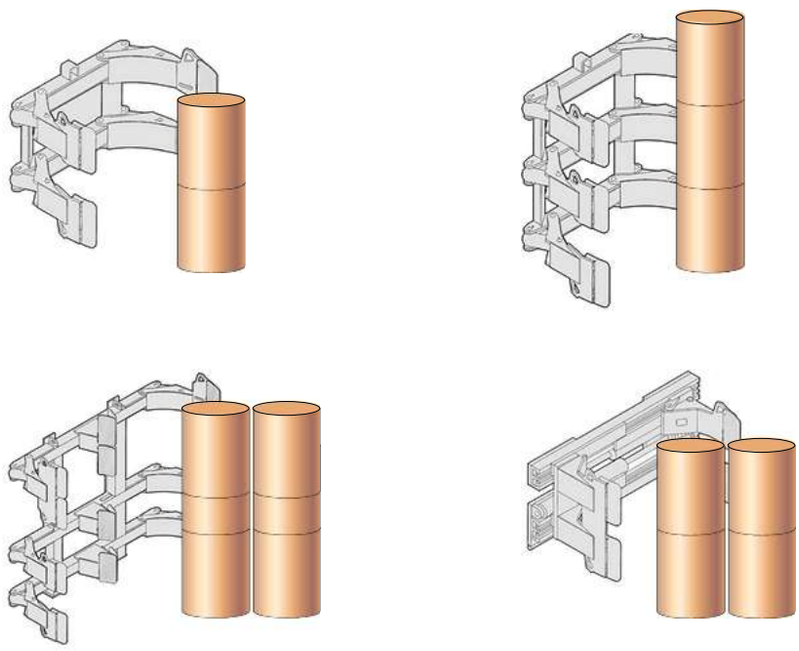
✘ Do not drive with roll in a horizontal position!
High safety risk in the event that the paper roll becomes loose.

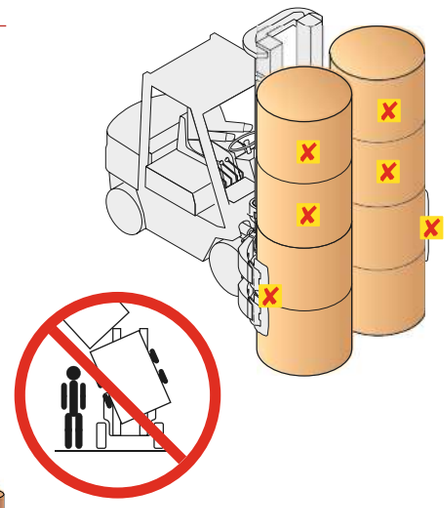
Can place high stress on clamp arms, rotation system, lift mast and carriage.

✔ Rotate the roll to vertical position as soon as possible



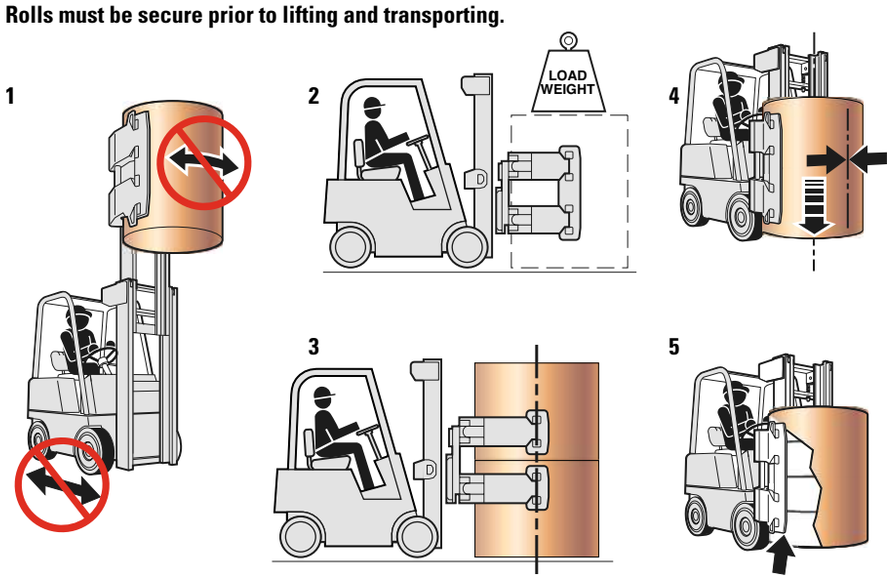
✔ Always use the correct clamp





✘ *Incorrect handling combined with overloading is dangerous. The four upper rolls are unsecured (free riders), and the clamp pads are positioned too close to the roll edges. Source: Cascade*

Rolls must be secure prior to lifting and transporting.



Swing arm clamps or rotate

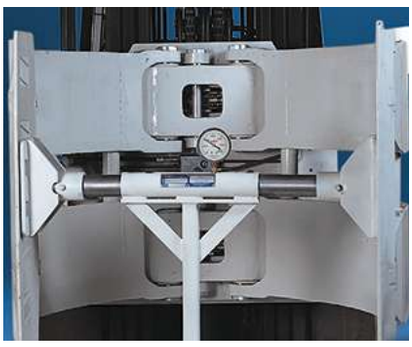
✔ *Position the paper roll centre of gravity as close as possible to the centre of rotation to minimise lateral offset.*

1. *Limit swinging clamp with raised load; limit truck movement with raised load.*
2. *Load weight must not exceed combined truck/ attachment capacity (see truck data plate).*
3. *Split arm clamp is recommended to handle two rolls. Handling two rolls with a single arm clamp may be dangerous and lead to serious injury.*
4. *Make sure load is centred and secure prior to lifting and travelling; check for load slippage.*
5. *Use caution when handling wrapped unitised multiple stacked rolls with single arm clamp; ensure bottom roll is secure.*

Source: Cascade

Drawings source: OPHAL based on references from Cascade and Bolzoni Auramo

Before Starting Your Shift



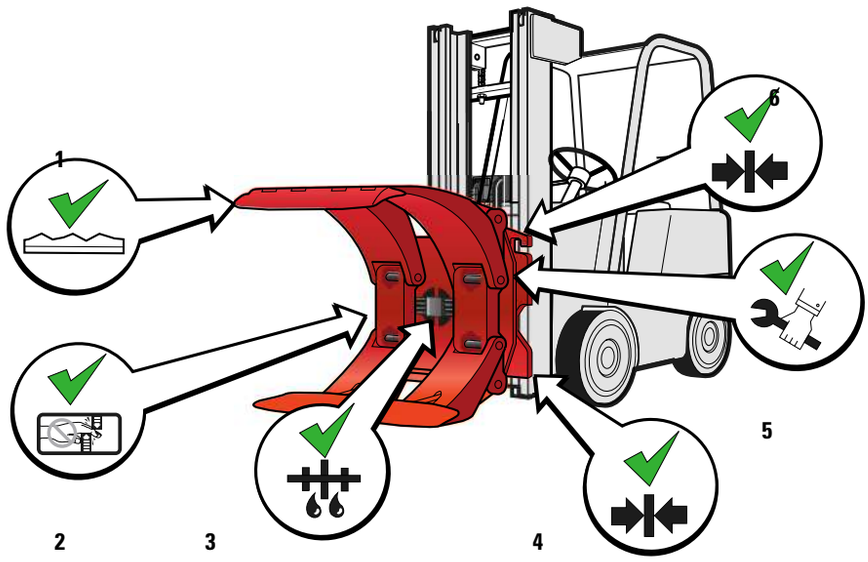
Check the clamping force is correct.
Upper Source: Cascade
Lower Source Bolzoni Auramo

Oil leaks on floor are a high accident risk that need to be cleaned immediately and source repaired.
Source: UPM

Worn friction surface. Source: Bolzoni Auramo

Pre-lift Checks

- ⚠ Contribute to everyone's safety; never use defective or damaged equipment.
- ✔ If you find anything wrong with the lift truck or the attachment, notify the service staff at once!



1. Pad conditions
2. Safety stickers and nameplate
3. Cylinders and hoses for leaks
4. Lower hook engagement
5. Fasteners
6. Upper hook engagement

Drawings source: OPHAL based on references from Cascade.

Daily Checks at Each Shift Change

- ❑ Look for oil leaks, and listen for air leaks.
- ❑ Check equipment condition — that it is clean, no loose or broken fittings, and no sharp edges that can damage paper rolls
- ❑ Clamping arms
- ❑ Contact pads and pad surfaces
- ❑ Frame
- ❑ Hydraulics and hoses
- ❑ Mounting
- ❑ Check the clamping force — paper rolls are easily damaged by over-, or under-, clamping them. It is recommended to check and note the clamp pressure prior to each shift.

✔ Warm up: If the clamp truck has a cold start it is good practice to warm up oil and distribution and check system operation by rotating the clamp and raising and lowering it on the mast. If the system is cold there is a risk that correct forces are not immediately attained and the load may be dropped.

⚠ Do not use a damaged or defective clamp

Contact pads

Contact pads are the only part of the clamp in contact with the paper roll.

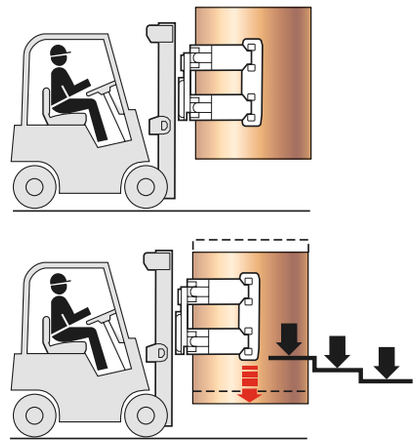
- ❑ Clean the friction surface regularly.
- ❑ Re-surface or replace pads whenever the friction surfaces are too worn out.

✘ Sharp edges on the contact pads can easily cut the roll wrapper.

- ❑ Remove all sharp edges from pads with a suitable tool such as a file or an angle grinder.
- ❑ Ensure pad protector loops on the arms have enough material left to protect the pads from wearing out.
- ❑ Ensure that the wear plates on the short arm pads are not too worn.

✘ Worn pad friction surfaces can require 3 - 5 times more clamping force than a clamp with good pads and will create significant roll out-of-roundness.

✔ Paper rolls are held by the friction force generated between the wrapper and clamp pads. Wrapper handling properties are, therefore, of vital importance — different materials with variable handling properties are used. Ensure the contact pad friction surface matches the wrapper's requirements.



Make a bounce test with the roll in the clamp.
Lift slowly; if slipping occurs maintenance staff should increase pressure in increments of 7 bar (100 psi) until slipping stops.
Lift roll to 1 metre (3 ft) above floor, start to lower and stop quickly — if slipping occurs adjust as above.
Drauwings source: Cascade/OPHAL

Troubleshooting Clamps

Possible reasons for dropping rolls

1: Check roll weight is within capacity range of clamp (see data plate).

Is there enough clamping force in relation to the roll and wrapper properties?

Is the clamp model correct for the way to handle the rolls?

Are clamping procedures correct?

2: Re-clamp load ensuring contact pads are centred on and parallel to roll, with roll against bumper (if equipped). Is there still a problem?

3: Check maintenance issues —

Hydraulic problem?

- ❑ Leak in the long arm check valves
- ❑ Leaking hose
- ❑ Cylinder seal leaking
- ❑ Cylinder ballooned
- ❑ Wrong clamp pressure setting
- ❑ Not enough lift truck pressure
- ❑ Too much back pressure
- ❑ Defective hydraulic quick connectors

Mechanical problem?

- ❑ Worn contact pad friction surfaces
- ❑ Bent or defective contact pads
- ❑ Arms or clamp frame bent or defective

Damage due to sharp clamp pad edge. Source: UPM

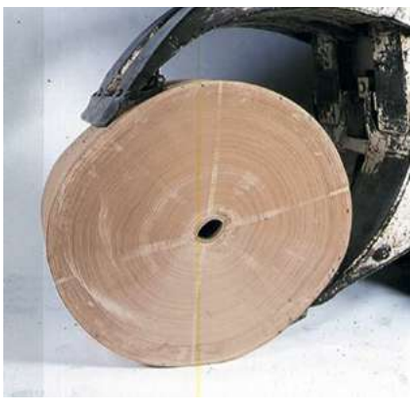
Flushing hydraulic hoses: Most attachments use check valves to ensure correct operation. Contaminates from the hoses can lodge in these valves causing them, and the clamps, to malfunction.

✔ Before connecting an attachment to the lift truck, connect the truck hoses to each other and run oil through them for a few minutes to wash contaminates into the system filter rather than the attachment's components.

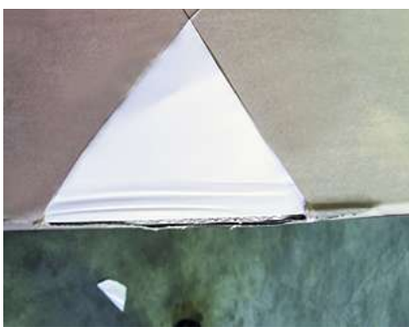
Check back pressure: This is the amount of pressure needed to overcome resistance in the supply circuit. Excessive back pressure can reduce oil supply to the attachment, causing slow operation or loss of torque. Common causes are blocked hydraulic oil filter, restrictions in return portion of the supply circuit, excessive oil flow, or supply from the truck.

Variable clamping force applications often use pressure regulators that ensure the required minimum hydraulic pressure to clamp the load correctly. If there is excessive back pressure, the regulator's relief valve will open and operation speeds become slower.

Ensure Correct Clamping Force



Too high clamping pressure may deform roll and core. The maximum out-of-roundness tolerance for efficient printing is 2 mm (0,08 in).
Source: Cascade

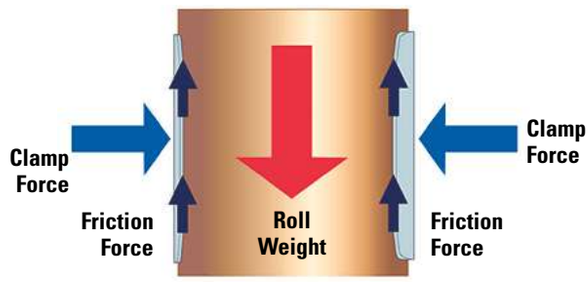


Too low clamping pressure can allow roll to slide to bottom of the wrapper causing crimped edges.
Source: Bolzoni Auramo

Correct clamping force is the prerequisite for efficient roll handling. It comes from applying hydraulic pressure to the clamping cylinders of the roll clamp.

Excessive force can cause roll deformation, out-of-roundness and may damage the core.

Insufficient force can lead to rolls being dropped with serious risk of injury and damage, along with sliding or telescoping.



Friction force must equal or exceed the roll weight or it will drop. The greater the clamp force, the greater the friction force.
Source: Cascade/OPHA

Clamping force is usually measured in kN

1 kN (1000 N) = **100 kp** and corresponds to a weight of 100 kg on the paper roll.

For example **20 kN (=2000 kp)** clamping force corresponds to a weight of **2000 kg** on the paper roll.

Clamping force must be adjusted to suit the requirements of handling, paper grade and size.

Clamping Set-up

Select and adjust the initial clamping pressure to suit the properties of the rolls and conditions:

1. Paper roll diameter, weight, grade, type of wrapper — in some cases winding quality.
2. How many rolls in one lift.
3. Preliminary choice of the clamping factor / clamping force.
4. Type of clamp and contact pads and their condition.
5. Floor surface — rough or smooth.

The key is to ascertain the amount of clamp force to securely handle the roll in all normal situations while not causing the roll to become out-of-round. Verify that the hydraulic pressure is adequate and fine tune. Keep a record of clamp pressure.

After the initial set-up, ensure that the settings are correct and verify pressure daily. It is recommended to check and note the clamp pressure prior to each shift. Further checks are necessary if the attachment is used on other trucks. Drivers should immediately report any handling problems like roll slippage or out-of-roundness.

Excessive truck hydraulic pressure causes excessive clamping force that can damage the paper roll.

Paper Grade	Clamping factor
Newsprint	1,5 - 1,6
Directory	1,3 - 1,7
Kraftliner	1,5 - 2,3
SC paper	1,6 - 2,4
LWC paper	1.7 - 2,4
Tissue/Fluff	1,4 - 1,6

The table shows some values for the clamping factor with different paper grades. They should be considered as a guideline only and may not be appropriate for all paper grades and handling situations. The clamping values are based on normal handling conditions using rubber-faced pads in good condition. Out-of-round measurements can be used to verify that clamping force settings are correct.

There are two principal methods to set clamping force: Clamping factor calculation or using the clamping force printed on the roll label to manually or automatically adjust pressure.

1: Clamping factor: Used to compensate for the changes in friction and roll properties, and the dynamic changes during handling. The clamping factor is a relation between clamping force and load force (gravity force); it can be used to define a rough initial value for the clamping force using the formula **Fc = Cf x w/100**

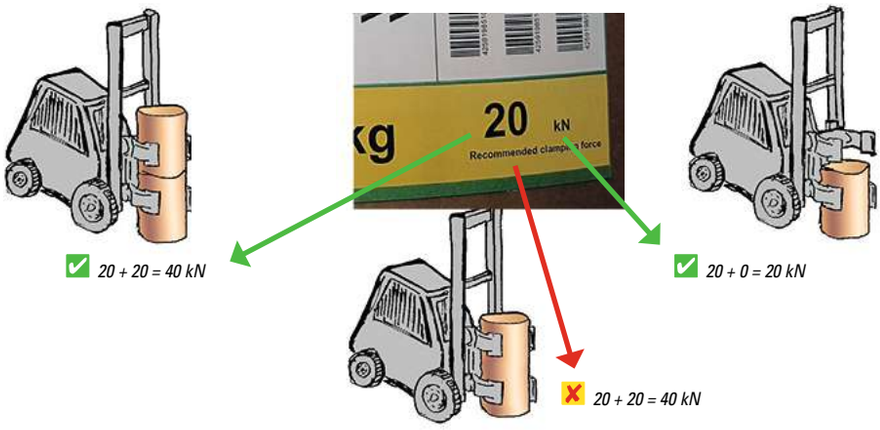
Fc = Clamping force (kN)

Cf = Clamping factor (see table below)

W = Roll weight (kg)

Example: Total paper weight 2000 kg x factor 1,3 = total pressure = 2600 kp = 26 kN

2: Recommended clamping force on roll label: Use these when they are available



✅ *Set clamping force to the recommendation printed on the paper roll. Remember to adjust the total clamping pressure when handling a single roll in multiple arm clamps. Source: Bolzoni Auramo*

Verify correct pressure for operating conditions

Use the clamp for a day in a variety of conditions. Adjust pressure if there is slippage. Make a bounce test. Check if pressure can be minimised while providing secure clamping.

See Module 4 pages 8 - 17 for related information on Clamping.

✅ Verify pressure daily — driver to report any roll slippage immediately.

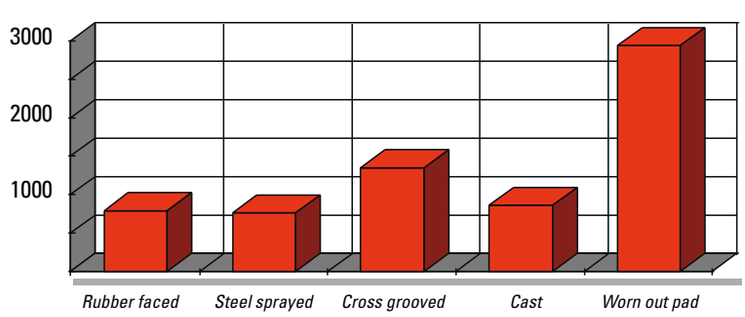
Measuring Clamping Force

A clamping force test will indicate the force used for clamp opening (the clamping force changes with different openings on pivot arm clamps) and correct operation of pressure selection valves and the paper roll clamp hydraulic system. Normally, the clamping force should not change very much. Make regular clamping force testing to check that: the hydraulic pressure has not been changed from its original setting; valves are working properly (pressure relief, multi-stage pressure selection); there is enough pressure to the clamp system from the lift truck; and the cylinder seals/gaskets are working properly (a minor internal leak on the piston seals is difficult to notice without clamping force testing).

✅ To get reliable results always measure the same way: hydraulic oil is at operating temperature; check that pressure is constant for 10 minutes; use normal operation engine revs when clamping the test device; do not pump the operation lever, close or open the short arm completely, and always use the same short arm position.

Clamp pressure reducing valves on the truck facilitate clamp pressure adjustment for handling paper rolls with different weights.

Test stand measurement devices are available for warehouse and paper terminal installations to enable fast and easy clamping force monitoring.



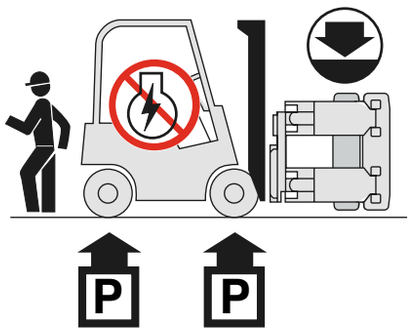
Theoretical clamping force in kP with 1000 kg (2200 lbs) roll for different types of pads. Source: Bolzoni Auramo

***1:** A clamping force indicator that displays the clamping force with a calibrated or digital display. Source: Cascade*

***2:** A cylinder clamping force indicator uses a hydraulic cylinder to measure the pressure that is then converted by a formula to give the clamping force. Source: Cascade*

***3:** Test pad electronic measurement device uses highly accurate weighing cells mounted on a portable aluminium frame. The pad is put between the contact pad and the paper roll and when the clamping arm is closed, the test pad display shows the clamping force. For a split arm clamp, multiply the result with the quantity of split arm sections. This device is suited for quality control supervisors and service staff. Source: Cascade*

Handling Fundamentals



Park, lower load, motor off.

Transport & Traffic

Parking & Dismounting

Before the operator dismounts, the load should be fully lowered, controls placed in neutral, and brakes set — wheel chocks should be used if the truck is parked on an incline. Turn diesel/LPG motor off when parking.

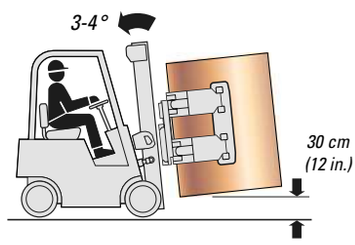
Driving

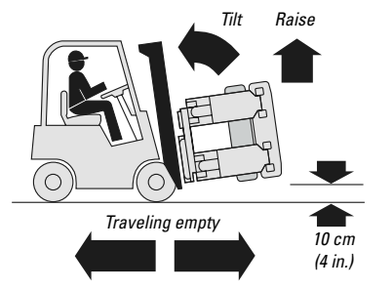
Drivers must slow down and sound the horn at cross-aisles and other locations where vision is obstructed. If the load being carried obstructs the forward view, the driver is required to travel with the load trailing.

When travelling empty tilt mast backwards and raise clamp 10 cm (4 in) above floor.

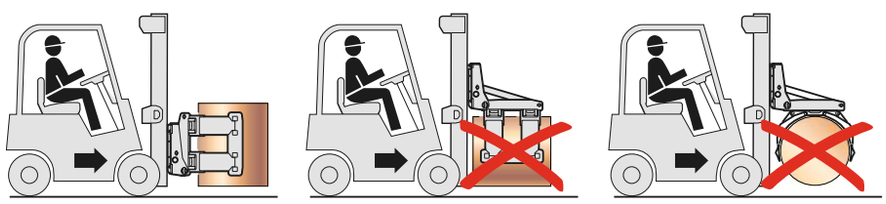
Maintain a safe distance from the edge of ramps or platforms while on any elevated dock or platform or freight car. Trucks must not be used for opening or closing freight doors.

Roll should be standing (vertical) and tilted back. Roll should be about 20-30 cm (8-12 in) from floor when driving. Do not drive with load lifted high.





Do not drive with horizontal roll to avoid any risk of roll dropping out of clamps and running loose. Transporting in any position other than vertical is not acceptable unless attachment is specifically designed for that application.



Drawings: Cascade/OPHAL

Stopping & Unloading

Stop before releasing the roll — do not use the paper roll as a brake.

Mast must be vertical at 0°. Lower with care to avoid core and out-of-round damage.

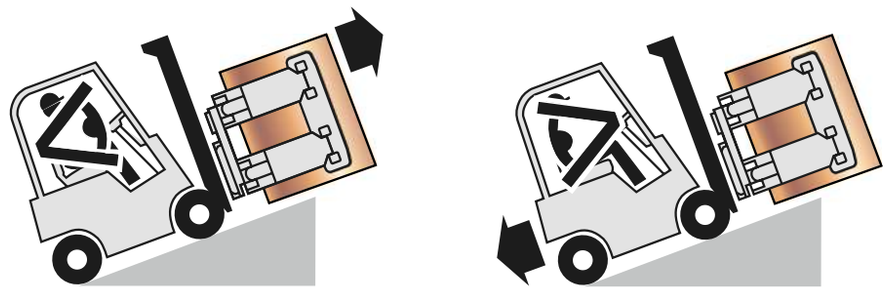
Lowering a roll with a tilted mast will damage its rear edge. A tilt indicator helps prevent this. Source: FMS 'Use No Hooks'

Ramps & Slopes

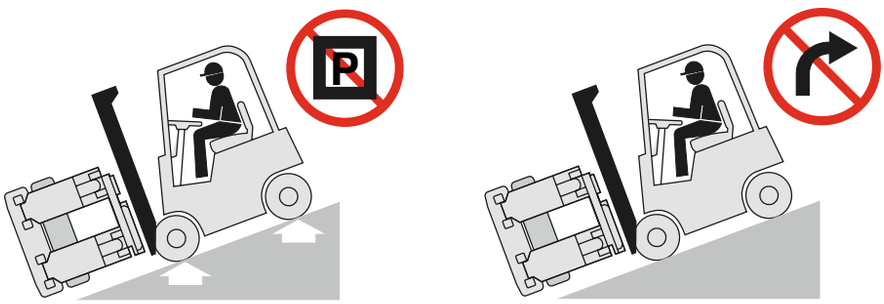
Tilt back the load on all grades and raise only as high as necessary to clear the road surface.

Slopes or ramps in excess of 10% require loaded trucks to be driven going up and down with the load upgrade to avoid any risk of the roll dropping out of clamps and running loose.

⚠ No turning or parking on ramps.



Load is always upgrade when both driven up and down.



⚠ *No parking on ramp.*

⚠ *No turning on ramp.*

Drawings: Cascade/OPHAL

Energy and Environmental Issues Lift Trucks

Many best practices for LPG and diesel powered units are the same.

✔ Maintaining exhaust filtration in an optimal state is a particularly important health issue if the unit is used inside buildings.

Review physical workflows to minimise distances travelled and introduce best practice procedures:

1. Shut down the unit if it is not used for more than three minutes or if the operator is more than 6 m (25 ft) from it.
2. Effective maintenance programmes for LPG units will significantly improve their overall performance: lower running costs; doubling of average service life (from 10-15 000 to 20-30 000 hours); lower fuel consumption; and less air pollution. Service intervals can be almost doubled by using high quality consumable products (oils, lubrication, filters, etc.). There is also less waste to dispose. Regular adjustment of valves and timing helps reduce fuel consumption and air pollution. Use infrared monitoring to check LPG exhaust emissions at every service.
3. Record preventive maintenance, damage and repairs to ascertain when equipment should be reallocated to a lower use application to fully depreciate the unit. Allocate new units to the most severe applications to fully utilise the warranty.

⚠ SAFE DRIVING

✔ **Observe**

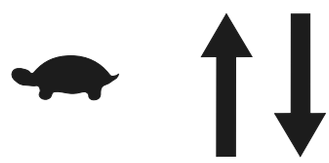
Workers

Stops

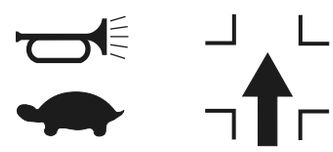
Wet floors

Bumps

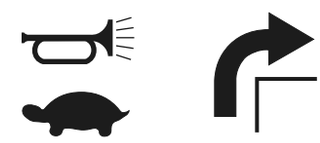
Dips



✔ **Slow for two-way traffic**



✔ **Sound horn, slow at intersection**

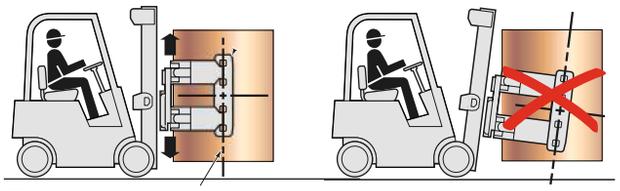


✔ **Sound horn, slow at corners**

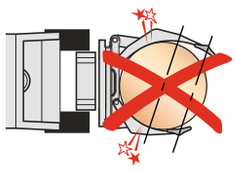
Clamping Techniques

✘ *Clamps insufficiently opened will damage the roll.*
Source: FMS 'Use No Hooks'

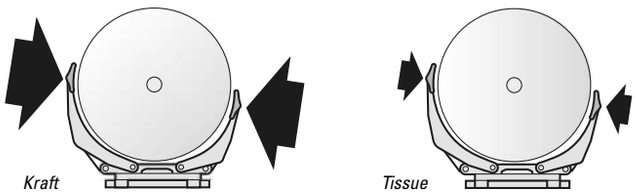
Stop in front of roll to be moved, avoid hectic handling that can cause collision. Open clamps to ensure that the outer edges of contact plates do not damage roll body.



✔ *Centre clamp pads on roll and clamp through the roll centrelines, vertical and horizontal. Roll mast must be vertical when clamping; if not, clamp pads do not grip correctly with a risk of roll being dropped or deformed.*



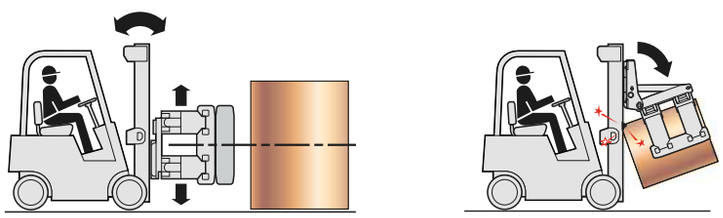
✘ *8 Avoid centreline clamping. Position pads on centreline of the roll.*



Use correct clamping force for load being handled.

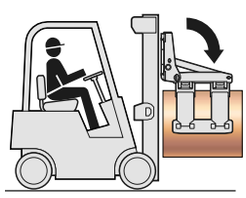
✘ *Avoid off-centre clamping if arms are positioned too far in front of the imaginary centreline of roll.*
Source: FMS 'Use No Hooks'

Upending



⚠ *Centre clamp pads vertically on roll, if possible clamp through roll centreline.*
Prior to tilting the roll forward check the clearance between the bottom of the roll and mast.

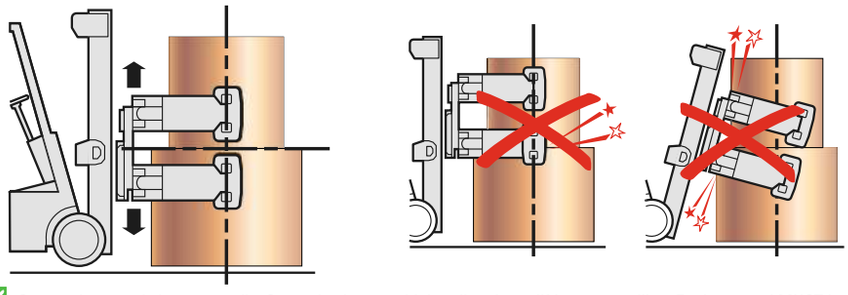
✔ *Raise roll to clear ground when tilted.*



Tilt roll forward. Caution: verify the centre of gravity for the load does not exceed the capacity of the truck. Consult OEM as required.

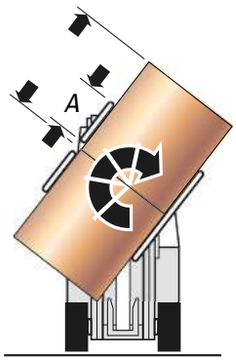
Drawings: Cascade/OPHAL

Handling Two Rolls with a Split Arm Clamp

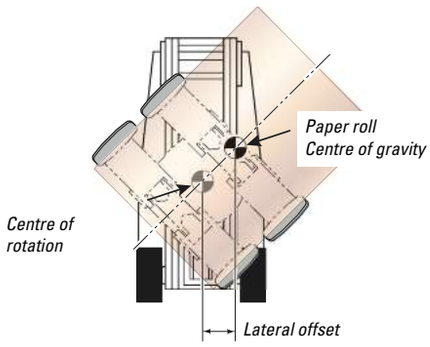


✅ *Centre clamp pads between rolls. Securely clamp multiple rolls prior to lifting or travelling. Engine speed MUST be increased when clamping or releasing rolls with split arm clamps.*

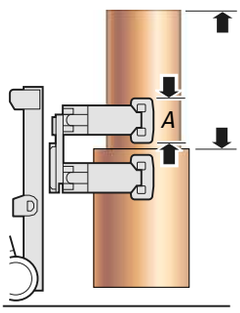
Gripping over roll edges to an adjacent roll can be dangerous and cause damage. Possible cause is driver's vision restricted by truck mast.
Source: FMS 'Use No Hooks'



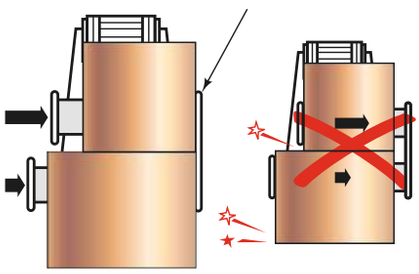
Recommended roll width 2 x pad height 'A' if rotating, maximum 3 x pad height..



Position the paper roll centre of gravity as close as possible to the centre of rotation to minimise lateral offset. This will reduce torque requirements and increase truck stability.



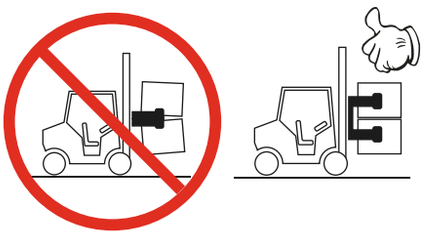
Maximum roll width 3 x pad height 'A' if not rotating.



Position short arm on rolls before clamping.

Gap between contact plate and roll. Possibly caused by incorrect position of clamp arms or too small clamp arms. Source: FMS 'Use No Hooks'

Drawings: Cascade/OPHAL

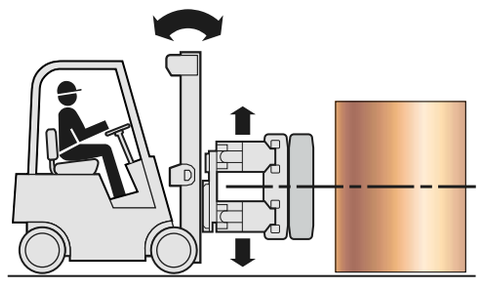


✅ *Only use split arm clamp for handling multiple rolls.*
Source: Bolzoni Auramo

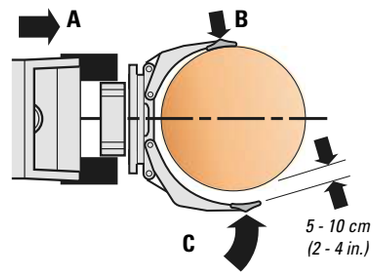
Standing (Vertical) Rolls

Picking up

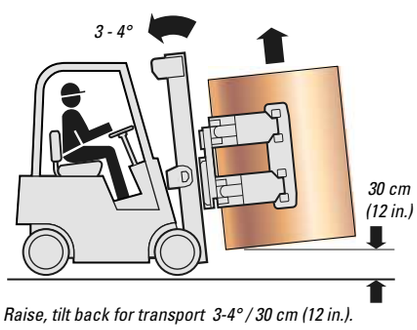
✅ Stop in front of roll to be moved, ensure the mast is vertical when clamping standing rolls. Check the clamp pressure is correct for the rating on roll label. Position clamps correctly — the clamp pad should be in the middle of the roll otherwise it can easily cause side (belly) damage. If only part of the clamp grips the roll, then the roll edge is clamped with a too high pressure causing edge damage (the weakest part of the roll).



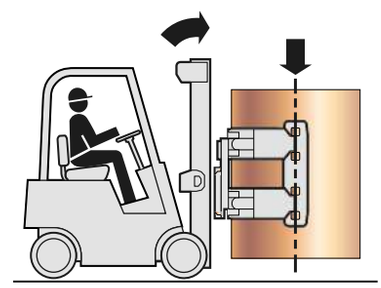
✅ *Position clamp parallel to and centred on roll; ensure lift mast is not tilted.*



A) Adjust short arm for roll diameter
B) Drive forward, touch short arm to roll
C) Clamp with long arm.



Raise, tilt back for transport 3-4° / 30 cm (12 in.).



Ensure mast is vertical before lowering roll to floor.

Drawings: Cascade/OPHAL

✅ *Lift the roll clear before moving. Source: Bolzoni Auramo*

❌ *Avoid edge damage when handling two rolls together by clamping them correctly — do not use single paddle clamps or clamp on the joint between rolls. Source: Cascade*

Lift the roll sufficiently before lowering onto the top of a stack Source UPM

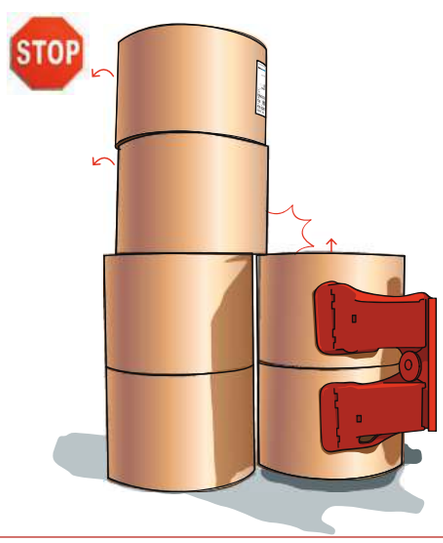
When lowering the roll

- Make sure the floor is dry and clean.
- Make sure that the clamp is parallel with the roll and the mast vertical.
- Lift the roll sufficiently before lowering onto the top of a stack or above the vehicle loading platform. **DO NOT overlap edges when stacking rolls.**
- Stop completely before releasing the roll.
- Lower the roll smoothly — do not drop it.
- Do not damage surrounding rolls when stacking/unstacking.

Lowering with the mast tilted too far forwards, or backwards, causes roll edge damage.

For more information on stacking rolls *see Module 3 Warehouse & Paper Store.*

Do not overlap edges when stacking rolls as this often leads to roll edge damage. Source UPM

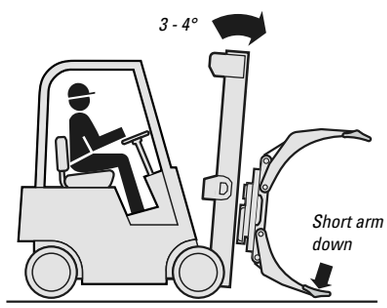


Uneven stacking and overlapping edges can lead to serious accidents from rolls falling from the top of the stack. In addition, it is a common cause of roll edge damage. Source: SCA/OPHAL

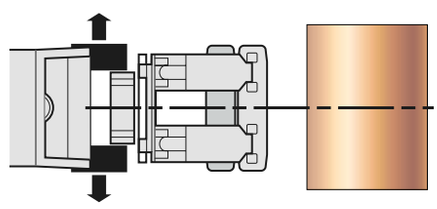
Lying (Horizontal/Bilge) Rolls

Stop in front of roll to be moved. Position clamps correctly — the clamp pad should be in the middle of the roll otherwise it can easily cause side (belly) damage. If only part of the clamp grips the roll then the roll edge is clamped with a too high pressure resulting in edge damage.

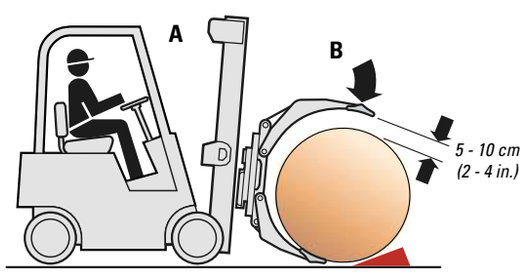
✅ *Clamp the roll in the middle. Short arm should be against the floor while lifting a roll from the ground.*
Source: Cascade



Tilt mast 3-4° forward with short arm down, lower clamp to ground; short arm down 5-10 cm (2-4 in.).

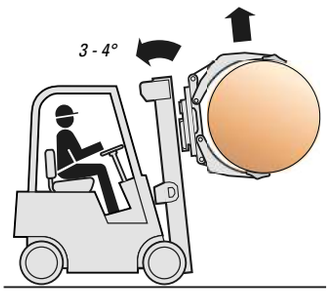


Square truck to the roll, position clamp parallel to roll.

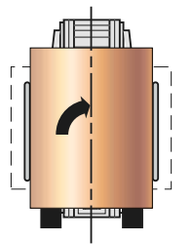


A) Drive forward, touch short arm to roll
B) Clamp with long arm 5-10 cm (2-4 in.).

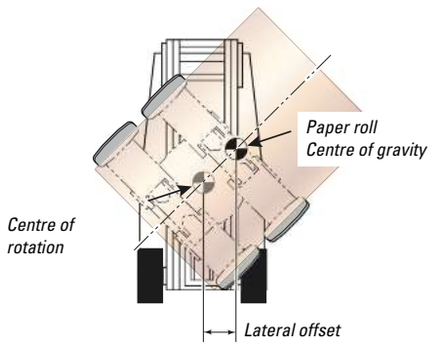
Drawings: Cascade/OPHAL



A. Tilt 3-4°, raise roll



B. Rotate to vertical for transport.



Drawings: Cascade/OPHAL

⚠ Never drive with roll in a lying (horizontal) position.

✅ Position the paper roll centre of gravity as close as possible to the centre of rotation to minimise lateral offset to reduce torque needed and increase truck stability.

✅ Ensure sufficient ground clearance before rotating roll. Source: Cascade

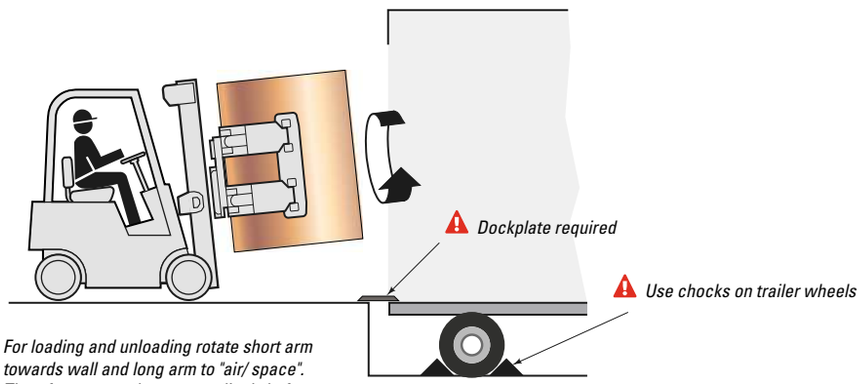
Horizontal paper rolls can also be handled with tine clamps. Source: Bolzoni Auramo

Truck Trailers & Containers

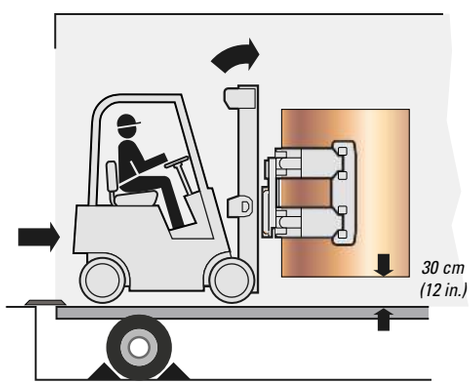
Truck Trailers

Loading

✅ The person responsible for loading operations must inspect the cargo spaces to ensure they are clean, dry, free of smell, tidy and in adequate condition. For more information, *see Module 7 Road Transport*.



For loading and unloading rotate short arm towards wall and long arm to "air/ space". Therefore rotate clamp accordingly before clamping the next roll



Drive down centre of trailer, tilt vertical, brake slowly.

Safe procedures

⚠ Drivers must ensure that trailer, truck or any other transportation unit will remain in its safe loading/unloading position during the entire loading/ unloading operation. Before loading and unloading from the rear end of truck or trailer, chocks (straps) should be placed at the wheels on both sides. Remove vehicle key from ignition.

✅ Normally the truck driver should be either in the cabin or other secure area during loading/unloading.

✅ Authorised pedestrians must stay exclusively in the marked pedestrian areas. A safety distance of 7 m (22 ft) at the back of the trailer is recommended during unloading.

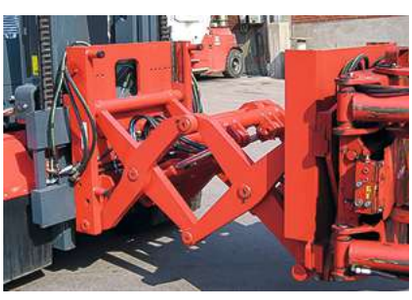
✅ Only trained and authorised staff can use handling equipment.

✅ During loading and unloading, wedges should be used to secure lying rolls.

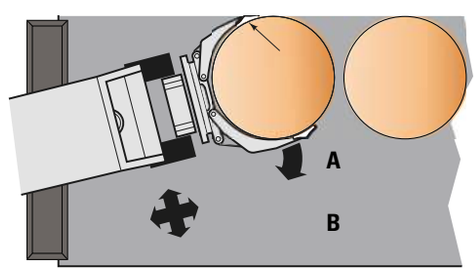
✅ In damp weather protective paper should be placed under the rolls to avoid water damage. Protective paper and anti-slip material should not be used at the same time.

✅ Be cautious of protruding lashing points

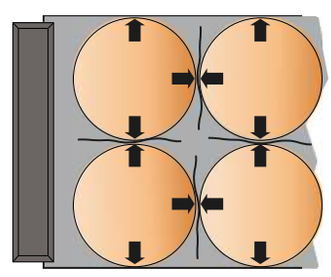
❌ Never push or pull rolls on the floor of the vehicle — or anywhere else.



Use clamp extenders when loading standing rolls from one side — rolls must not be pushed. Source: Bolzoni Auramo



A) Reposition truck to place rolls against wall - short arm; B) Release long arm



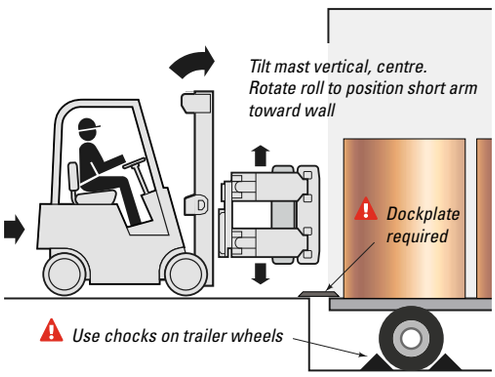
Position rolls together; use spacers to prevent load shifting.

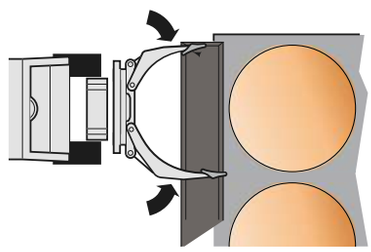
Drawings: Cascade/OPHAL

Rolls can be loaded in a standing (vertical) or lying (horizontal) position. Follow the loading plan. For more information on loading, *see Road Transport Module 7 page 17*.

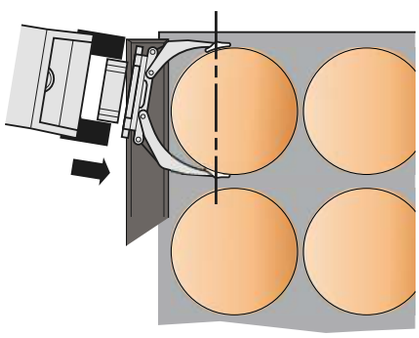
Unloading (Breakout)

✅ **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 more information, see Module 2 page 2.*

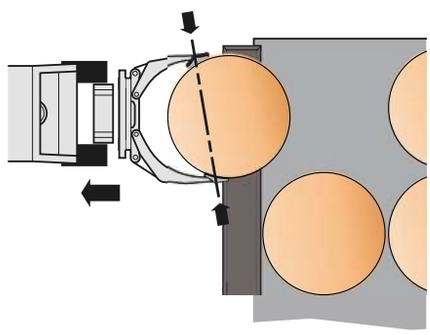




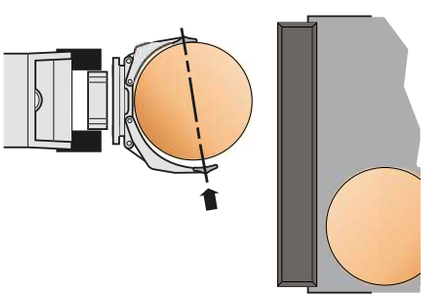
Position arms to roll diameter, short arm towards wall.



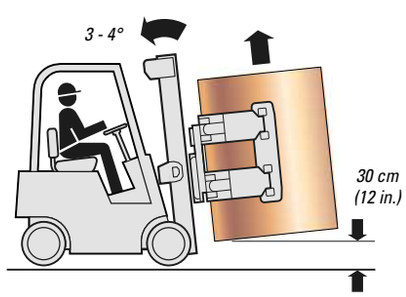
Drive forward, angle truck to grip first roll behind centreline.



Clamp first roll, move back for clearance to re-clamp



Re-clamp through roll centreline with long arm, withdraw roll.



Raise, tilt back for transport.

Drawings: Cascade/OPHAL

Containers

Loading and unloading containers uses very similar techniques to truck trailer loading from the rear.

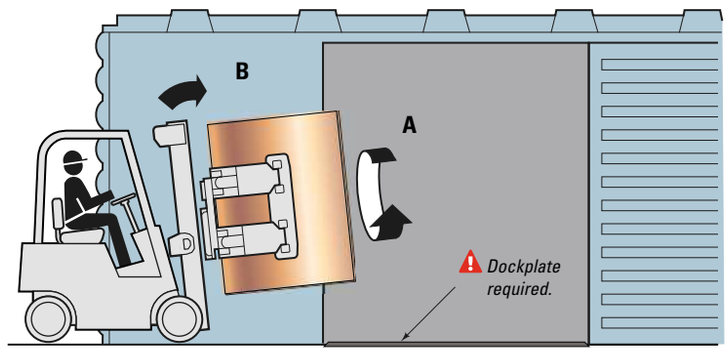
Containers impose height and weight limits on lift trucks.

Ramp for container access.
Source: INTAKT

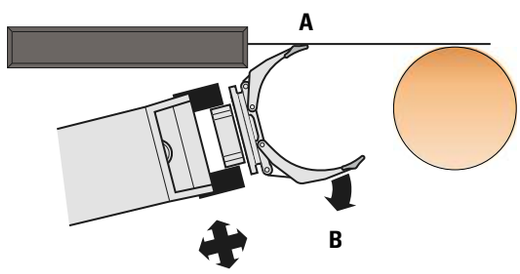
Rail Wagons

Loading

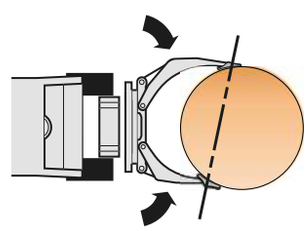
✅ The person responsible for loading operations must inspect the cargo spaces to ensure they are clean, dry, free of smell, tidy and in adequate condition.



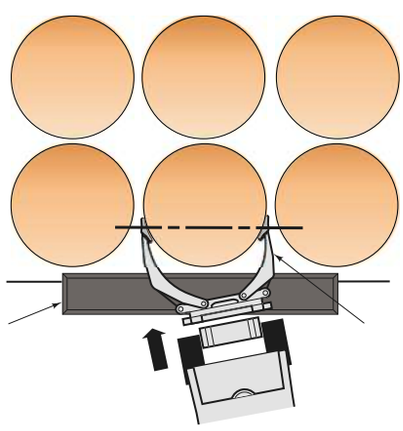
B) Tilt mast to vertical
A) Rotate roll to position short arm towards wall



A) Reposition truck to place rolls against wall
B) Lower to floor, release long arm



Position arms to roll diameter, grip last rolls behind centreline.



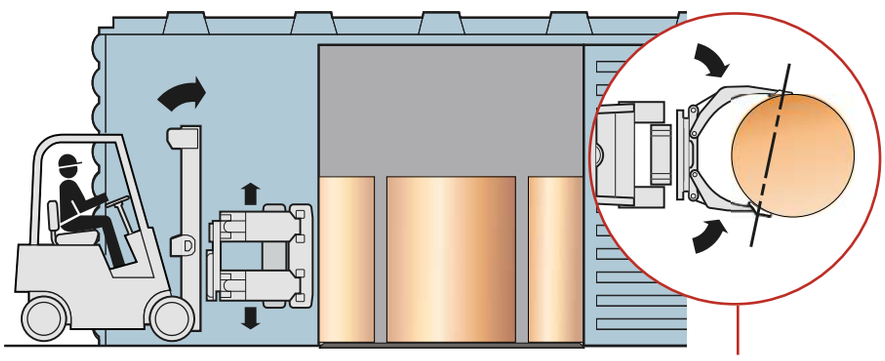
Angle truck to place interior and last rolls; arms not wedged

Drawings: Cascade/OPHAL.

Rolls can be loaded in a standing (vertical) or lying (horizontal) position. Follow the loading plan. For more information on loading, *see Rail Transport Module 8 page 14.*

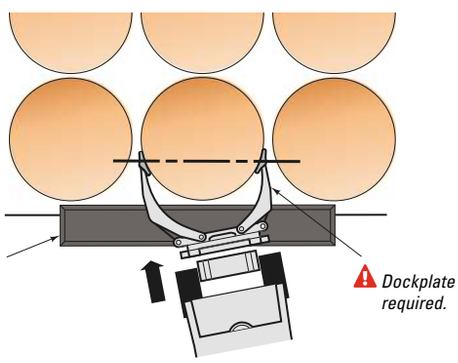
Unloading

✅ 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 more information, *see Module 2 page 2.*

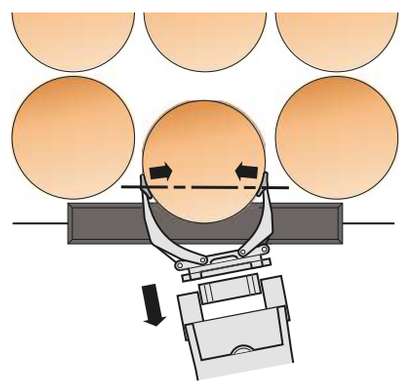


Tilt mast to vertical, centre clamp to first roll.

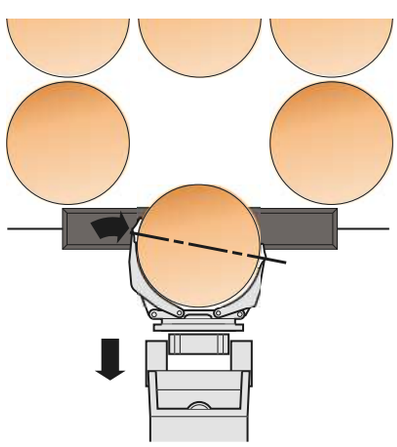
Position arms to roll diameter



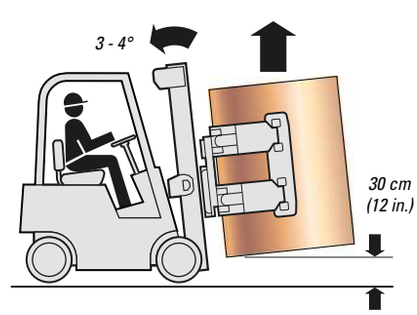
Drive forward, angle truck to grip roll behind centreline; arms not wedged.



Clamp first roll, move back for clearance to re-clamp.



Reclamp through roll centreline with long arm, withdraw roll.

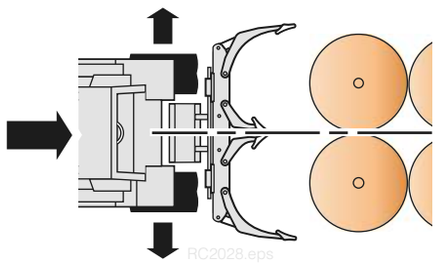


Raise, tilt mast back for transport.

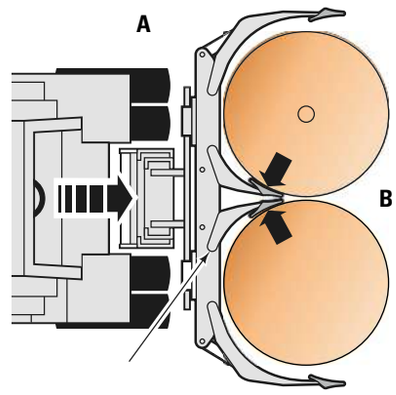
Drawings: Cascade/OPHAL

Tower Clamp

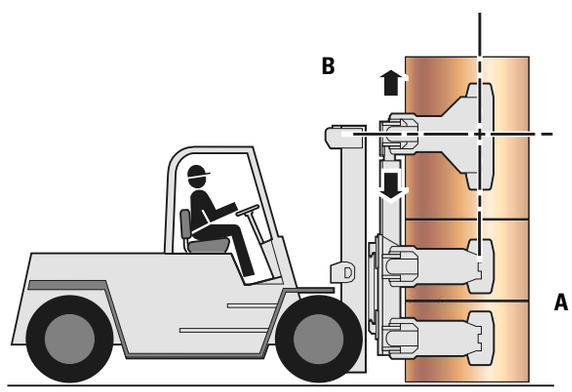
Loading, Transport, Unloading, Stacking



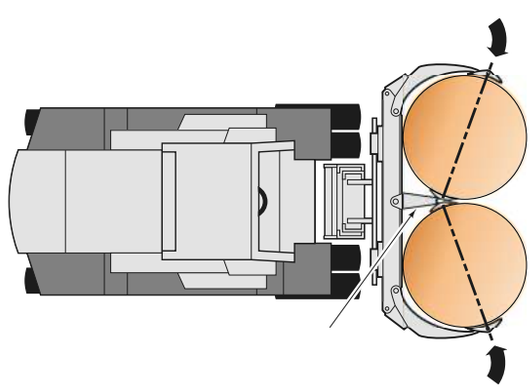
A) Align truck with rolls.
B) Fully open arms -



A) Approach rolls slowly
B) Fully open arms - powered centre arms



B) Adjust telescoping upper clamp arms to centre on upper rolls
A) Centre lower clamp arms on lower rolls.

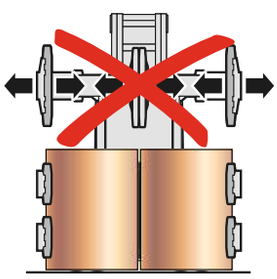


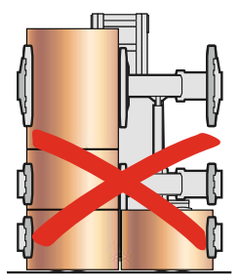
Clamp through roll centrelines - unpowered centre arms

Drawings: Cascade/OPHAL

Double tower clamp. Source: Bolzoni Auramo

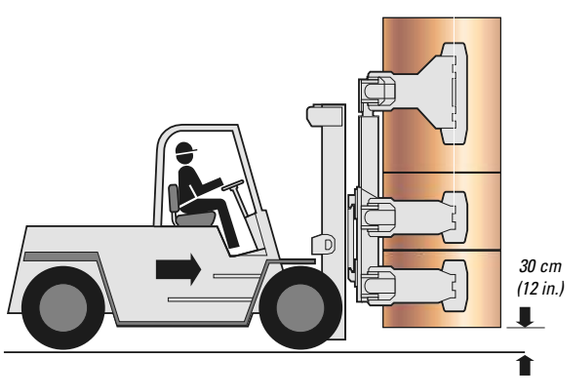
Source: Bolzoni Auramo



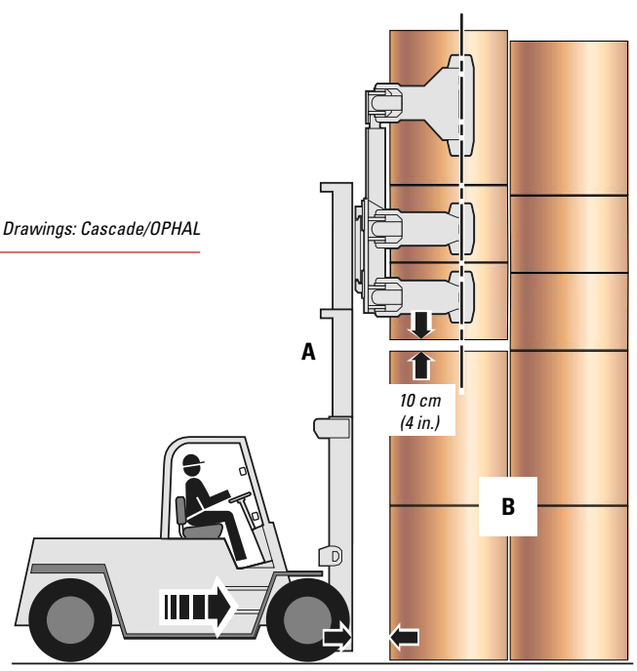


Shut off unused arms; no L-shaped loads.

Drawings: Cascade/OPHAL



Lift load, proceed slowly; Caution: truck balance may be critical when turning with full loads



A) Check clamp pads are vertical
B) Check clearances – • Roll-to-roll • Truck-to-stack

Pulp & Recycled Units

Handling is usually 1-4, 6 or 8 pulp bale units at a time. During handling:

1. Do not push or pull units against the ground.
2. Use only clamps designed for pulp — NO other type of clamps or forks can be used.
3. When handling four or more units, a middle clamp pad is required.
4. Do not clamp on the lifting wire side.
5. Clamps must be clean and in good condition.
6. Do not place units directly on the ground outside warehouse; platforms must be used to protect units from dirt and moisture contamination, use only steel plates (not wood).
7. During wet conditions place protective paper under the units in warehouses and transport positions.
8. To avoid contamination risk ensure that warehouses, quays and other handling areas are completely free of plastic, rubber and wooden residues. One piece of plastic can destroy a pulp load and/or impact on paper manufacturing.

Fluff pulp

Fluff pulp is used in the hygiene industry, so the rolls must always be kept clean. They must be handled to ensure that wrapping is not damaged — otherwise the whole package or roll cannot be used. Rolls packed in recyclable PE plastic should never be pushed on the floor as this damages the wrapping on the roll end.

✘ Packages cannot be rewrapped at any point in the transport chain.

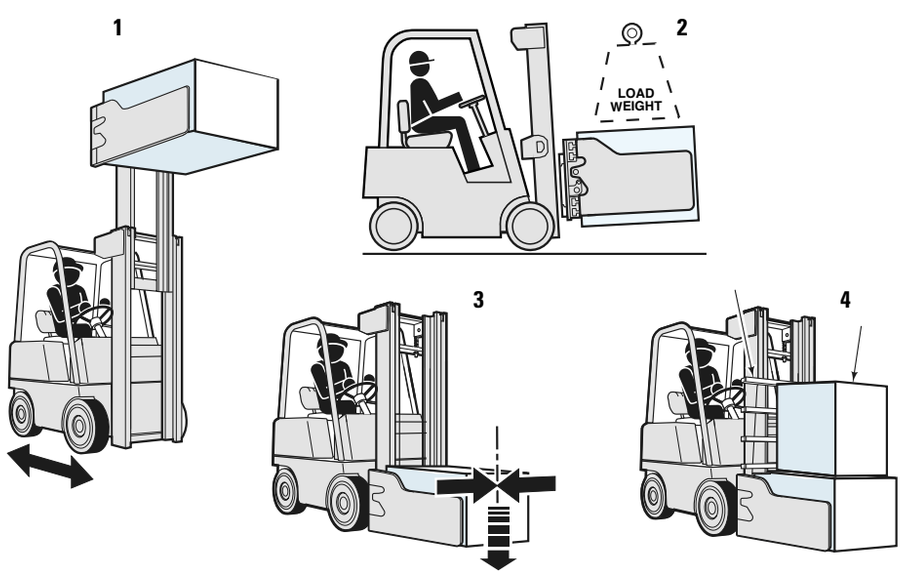
Handling of Recycled Paper

Recycled paper bales should be packed to facilitate transportation. Bales must be handled with care to maintain their shape and uniformity.

Safe Handling

✔ Loads must be secured before lifting and transporting.

1. Limit side shifting with raised load. Limit truck movement with raised load.
2. Load weight must not exceed capacity of truck/attachment (see truck plate).
3. Centre load prior to lifting. Check for slipping loads.
4. Backrest. Before lifting check that load is stable and safely stowed.

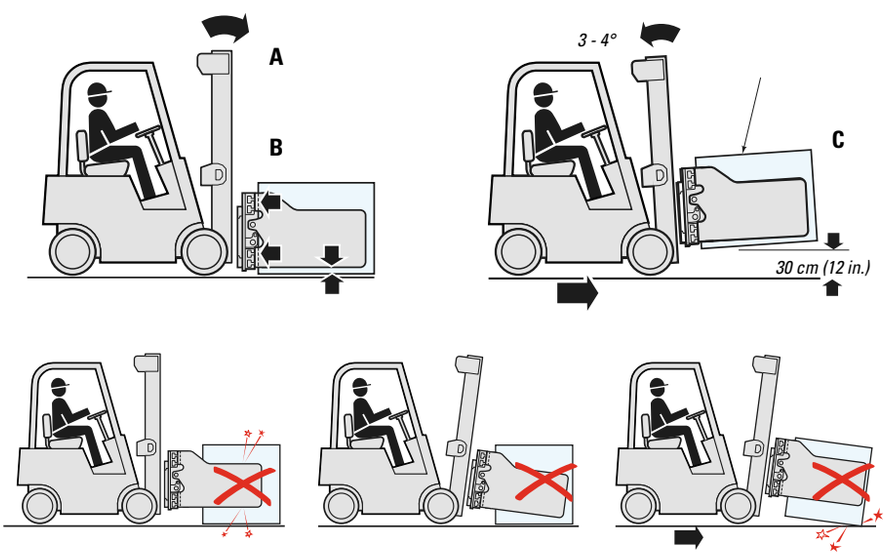


Drawings: Cascade/OPHAL

Source: Bolzoni Auramo

Load Handling with Bale & Multi-Purpose Clamps

- ✅ A — Mast vertical with arms parallel to floor.
- ✅ B — Move forward to position load against backrest.
- ✅ C — Align bottom of load with bottom of pad edges.
  Tilt mast back 3-4° for transport.
  Transport load centred (not side shifted) raised 30 cm (12 in)
- ❌ Bales will be damaged if not handled correctly.

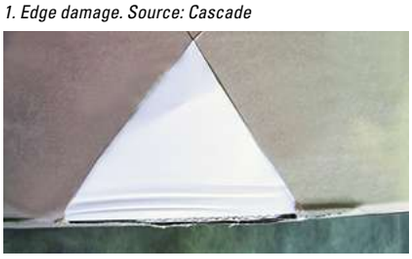


Drawings: Cascade/OPHAL

Troubleshooting Roll Handling

	Damage classification							
Handling sources of damage	**01 Edge / Crimping**	**02 Side**	**03 End/ Telescoping**	**04 Wrapper side**	**05 Core**	**06 Deformed Out-of-round**	**07 Water**	**08 Dirt/ Contaminated**
Maintenance								
Slack lifting chains	●							
Worn/Dirty contact pads		●		●		●		
Oil leak clamp or truck								●
Equipment used								
Larger clamp plates/coverage						●		
Incorrect contact pad		●		●				
Correct clamp arm model				●				
Clamps too small	●	●		●		●		
No split arm clamps fitted	●							
No mast tilt control fitted	●							
Forklift used instead of roll clamp			●					
Handling								
Incorrect clamp position	●	●		●		●		
Clamp overlaps 2 rolls	●					●		
Split arm positioned too low			●					
Roll clamped at an angle to roll	●			●		●		
Too high clamp pressure					●	●		
Too low clamp pressure —dropped roll	●			●				
Wrong mast tilt angle	●	●						
Inadequate rotation clearance	●							
Roll lowered too hard		●			●			
Collision damage		●	●	●				
Lowering unparallel to floor	●							
Pushed/Towed roll across floor	●	●	●					
Lift height too low when stacking	●	●						
Contact with dirty floor		●	●					●
Roll placed in wet area							●	
Inadequate space in stacking pattern	●							

1. Edge damage. Source: Cascade



2. Crimped edge damage. Source: Bolzoni Auramo

See Module 2 for full explanation of roll handling damage. Summarised content here refers only to damage caused by handling.

1 Edge damage (edge crack): A cut, imprint or tear in the edge of the roll. Typical causes: poor clamping, rotation, incorrect mast tilt position (roll lowered with topped in mast = rear edge damage; topped out mast = front edge damage).

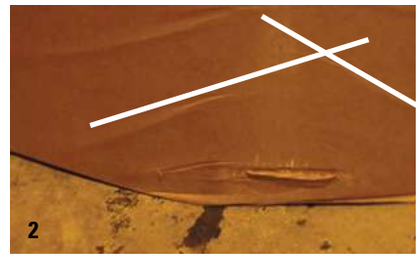
Prevention: Use split arm clamps with 180° rotation and mast tilt control. Use correct stacking practices with enough space between roll stacks. Driver training.

2 Crimped edge damage: Occurs when roll is lowered edge first causing damage seen as a wave shape on the edge; or if the roll slides inside a loose wrapper (paper bag effect) damaging the paper roll corner. Typical causes: wrong position of mast tilt or rotation; inadequate clamping force; dropped roll.

Prevention: Use 180° rotation, mast tilt control, correct clamping force procedure. Driver training.

2. Side damage (belly): Both the wrapper and the product are damaged on the side of the roll. Typical causes: clamping arms insufficiently opened when clamping the roll; incorrect or poor contact pad condition; clamping force too low; incorrect clamp size for the roll dimensions; clamping too deep; lifting mast overly tilted during clamping; roll not lifted high enough and collides with another roll; roll dropped too hard or towed; roll dropped or ejected when braking; pivot arm clamps (smaller rolls with contact pads only) have no contact against the frame; sliding arm clamps roll against the push plates; clamping the roll at the bottom exposes the roll wrapper to stress; using the clamp to push the roll; roll in contact with a dirty floor.

Prevention: Ensure correct clamp truck handling techniques and maintenance. Variables are the wrapper type, the condition of the contact pads and their friction surface. Driver training.



3. End damage: Damage through or under roll end cap. Typical poor handling causes include: roll lowered onto an uneven or unclean surface; bottom of roll dragged across an object or gouged on top by a clamp truck; roll end sliding on the floor that abrades the shield and usually marks the white paper; rolls handled by forklift instead of clamp truck.

Prevention: Regular cleaning and driver training.

4. Wrapper belly damage: May look like side damage (03) but only the wrapper is damaged. Caused by roll slipping inside the clamping pads from insufficient grip, or hitting the roll with the clamp, or pushing it against an object.

Prevention: Ensure correct clamping force; clamp arm and pad for the roll diameter; and contact pad surface condition.

5. Core damage / 6. Out-of-roundness: Typical causes are excessive clamping force, wrong clamping position, or deformation from being pushed hard against an object.

Prevention: Ensure correct clamping force settings and use of the pressure selection valve; correct contact pad friction surface; automated paper roll clamps.

7. Wrapper contamination: Clamp handling marks left on the wrapper; possible oil or grease contamination from clamp or lift truck. Typical causes: incorrect contact pad friction surface for the wrapper type; poor clamp/lift truck condition; roll was placed in a wet/contaminated area.

Prevention: Select correct contact pad friction surface; regular clamp and lift truck maintenance. Place rolls only on dry and clean surfaces.

8. Telescoping: Normally only occurs with unwrapped rolls, when the paper roll is loosely wound, with slippery paper. Typical causes: paper roll properties; or too low clamping force.

Prevention: Increase the clamping force so that the friction between the paper layers inside the roll increases and prevents the problem — check the clamp capacity, do not exceed the maximum hydraulic pressure.

2. Side damage. Source: Cascade
3. End damage. Source: Cascade
4. Wrapper belly damage. Source: UPM
5/6. Core damage. Source: Cascade
7. Wrapper contamination. Source: Cascade
8. Telescoping. Source: Cascade

Pallet Handling

Photo Source: Cascade

Pallet Transport

Cut paper sheets come in many different sizes, they are stacked on pallets and packed.

Generally, pallets are always slightly larger than the stacked sheets of paper (called pallet jut or projection), which prevents friction lock loading between pallets (pallets smaller than the paper size would ensure that pallets are locked, but are rarely used because the paper stack edges are easily damaged).

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

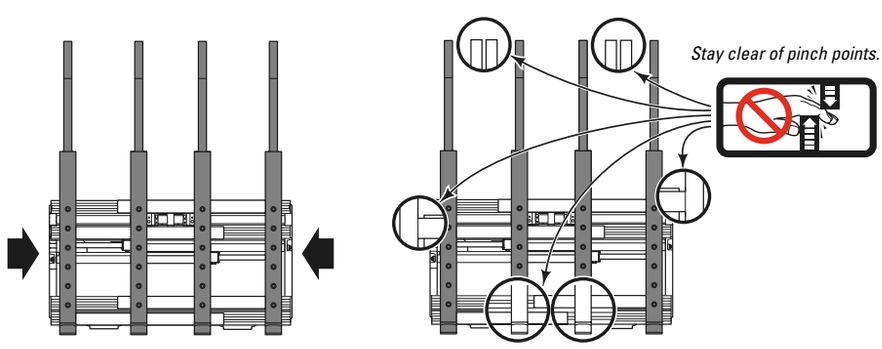
Transport pallets generally are made mainly of wood. Pressboard pallets have feet that are difficult to repair when damaged. Plastic pallets are only economical if an inexpensive return delivery is ensured. The type of construction determines the strength of the pallet.

Sheet Handling Equipment

The cargo units are picked up and transported with lift trucks equipped with forks. Depending on the type of construction, one or more cargo units can be transported.

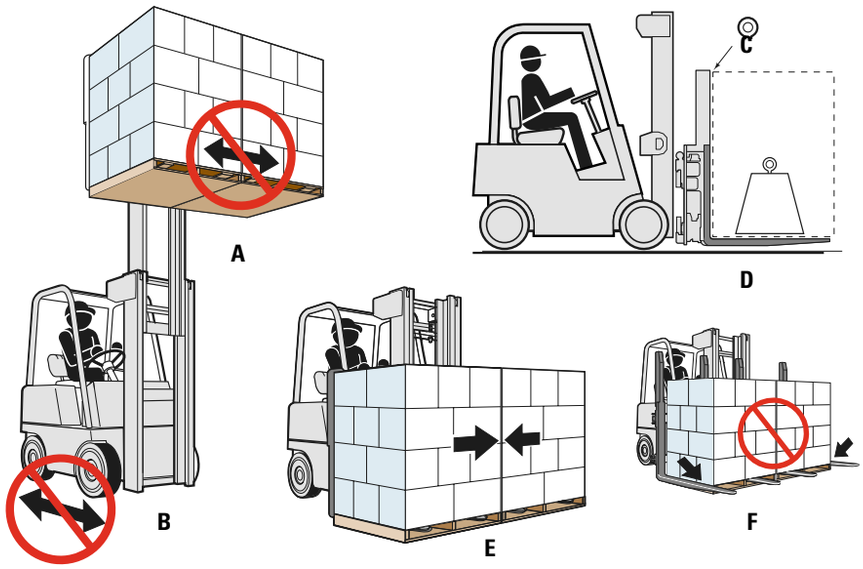
Several pallets arranged one behind the other can be transported with long forks (e.g. truck unloading from the side). The four-fork arm lift truck is able to pick up two pallets arranged side-by-side.

The fork should always be used taking into account the prescribed use and loading capacity limits. For manual transport by truck locally, hand pallet trucks are often used.



Keep forks inside frame when:
- *Travelling empty*
- *Going into trailers empty*
- *Backing out of trailers empty.*

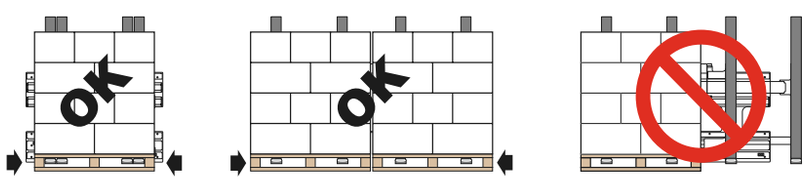
Drawings: Cascade/OPHAL



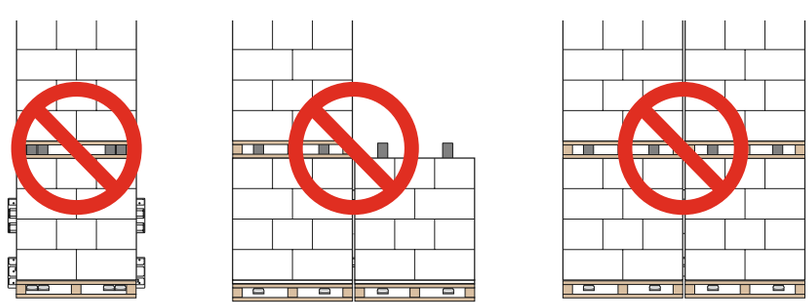
A. Limit sideshift operation with raised load.
B. Limit truck movement with raised load.
C. Top of load should not extend above backrest.
D. Load weight must not exceed attachment capacity (see attachment nameplate).
E. Centre load prior to lifting.
F. Do not clamp on loads or pallets.

Drawings: Cascade/OPHAL

Safety Rules — Handling Loads

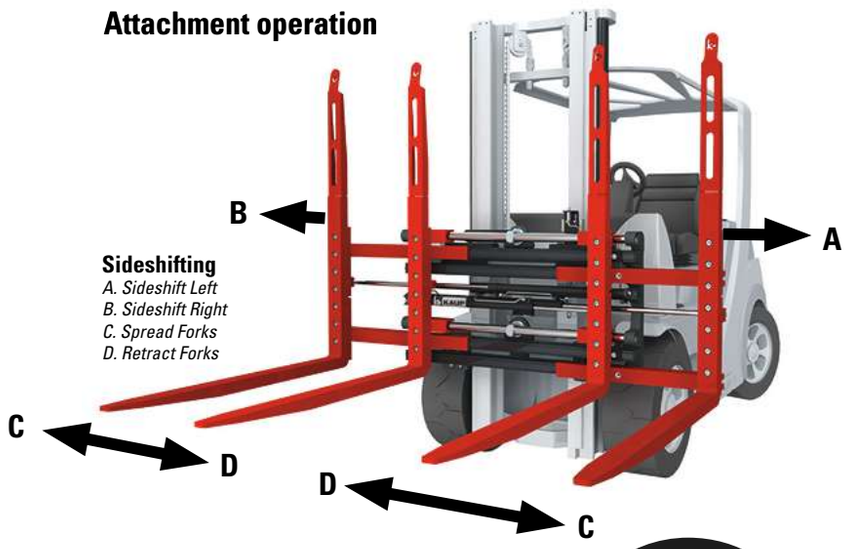


✅ *Forks spread for single pallet load.*
✅ *Forks centred under multiple pallet loads.*
Hoist up/Tilt back.



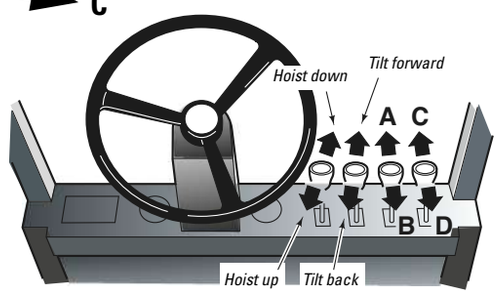
Drawings: Cascade/OPHAL

Attachment operation



Sideshifting
A. Sideshift Left
B. Sideshift Right
C. Spread Forks
D. Retract Forks

Source: Kaup

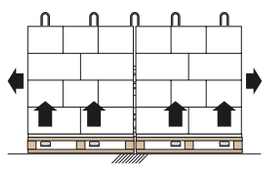


Auxiliary valve
Functions

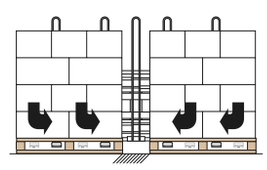
Drawings: Cascade/OPHAL

Picking up Loads

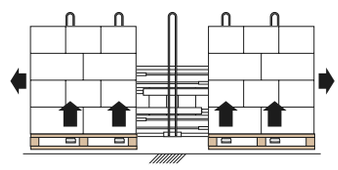
Spreading loads



- *Position forks under load*
- *Raise forks to engage load*
- *Spread load*

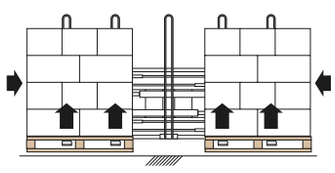


- *Lower forks to release load*
- *Move forks outward*

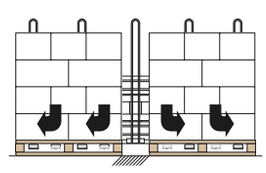


- *Raise forks to engage load*
- *Spread load*

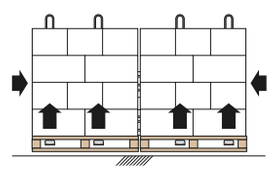
Narrowing Loads (Snapping)



- *Position forks under load*
- *Raise forks to engage load*
- *Move forks inward*



- *Lower forks to release load*
- *Move forks outward*



- *Raise forks to engage load*
- *Move forks inward*

Drawings: Cascade/OPHAL

Common Pallet Handling Errors

A basic precondition for processing paper in sheets without problems is that the cargo unit is delivered undamaged. Internal transport in the pallet rack warehouse or manipulation with the pallet turner places high demands on the quality of handling. Damaged, moist paper with swollen edges or excessively dry paper sheets can result in the customer justifiably refusing to take delivery. Any changes to the cargo unit that would be made, e.g. due to a repair measure, must be agreed upon with the seller of the product in advance.

Pierced Cargo Units

Description: Protruding fork tip damages adjacent pallet during stowage.

Possible cause: pallet not placed correctly on fork prior to stowage.

Prevention: Trained and attentive handling. Source: FMS 'Use No Hooks'

Parallel lifting of pallets

Description: Lifting two pallets each supported by only one fork is unstable and can lead to damage.

Possible cause: incorrect equipment.

Prevention: Use a four-fork arm lift truck when necessary. Source: FMS 'Use No Hooks'

Unsecured pallets transported one above the other

Description: Unsecured pallet on top of another cargo unit is extremely dangerous, particularly if truck changes direction or brakes suddenly.

Cause: non-compliance with accident prevention procedures.

Prevention: Follow safe handling procedures. Source: FMS 'Use No Hooks'

Pallets transported one behind the other

Description: Fork does not hold all cargo units completely and pallet feet threaten to break off during transport; high risk of accident and damage.

Possible cause: forks unsuitable and too short.

Prevention: Use correct equipment and do not overload. Source: FMS 'Use No Hooks'

Fork tip too high

Description: The fork tip damages the pallet board and/or paper stack.

Possible cause: truck mast restricts driver's view.

Prevention: More careful operation, third party assistance. Source: FMS 'Use No Hooks'

Cargo units transported on fork tip

Description: Cargo unit does not sit close to the fork back and can tilt forwards creating a risk of accident and damage.

Possible causes: pallets difficult to reach on truck, driver did not rearrange the cargo after lifting.

Prevention: Ensure that driver fully engages forks. Source: FMS 'Use No Hooks'

Pallet feet damaged by fork.


Description: Fork damages or distorts pallet feet — the nails of the pallet foot can tear out.

Possible causes: fork not positioned correctly under pallet, restricted view due to mast.

Prevention: Ensure forks are correctly positioned. Source: FMS 'Use No Hooks'

Back of fork presses against paper stack


Description: Back of fork perforates packaging and damages paper stack.

Possible cause: fork moved briskly under the pallet with topped out mast and perforates the wrapping.

Prevention: Handle with more care. Source: FMS 'Use No Hooks'

Pushing pallet into position


Description: The cargo unit is pushed on one side by the fork and damages the pallet foot.

Possible causes: lack of suitable equipment, confined space conditions for stowage.

Prevention: Use a fork with lateral arms. Source: FMS 'Use No Hooks'

Other Damage

Holes in shrink wrapping

Description: One or more 'hand size' holes in shrink wrapping, which allows easy entry of dirt and moisture into the paper stack. Possible causes: problems in the wrapping unit, shrink temperature too high, or too tight stowing of wrapped units. Source: Mëtsa Board

Tears in shrink wrapping.

Description: Foil partially compressed like a concertina and torn wrapping. Possible cause: contact to protruding objects during stowage, metal strapping often jams during stowage and tears the wrapping.

Prevention: More careful wrapping and handling. Source: Mëtsa Board

Pallet boards broken

Description: Pallet boards are broken with the grain. Possible cause: strapping pulls the boards upwards through a combination of highly pre-stressed strapping and the jut of the pallet boards.

Prevention: More attention to correct strapping. Source: FMS 'Use No Hooks'

Splintered pallet boards.

Description: Pallet boards knocked off. Possible cause: hard contact with fork tip.
Prevention: More careful handling. Source: FMS 'Use No Hooks'

Description: Pallets tipped over.
Prevention: More careful handling. Source: Stora Enso

Description: Paper tipped off pallet. Possible cause: Imbalanced load, incorrect placement.
Prevention: More careful handling. Source: Source: Stora Enso

6 Securing & lashing

CONTENTS

2 RISK FACTORS
2 Transport forces acting on a load
2 Friction
4 SECURING CARGO UNITS
5 Securing devices
6 Lashing points
8 CARGO LASHING
9 Equipment
10 Safety first
12 Operation of lashing belts
14 Tensioning elements

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.

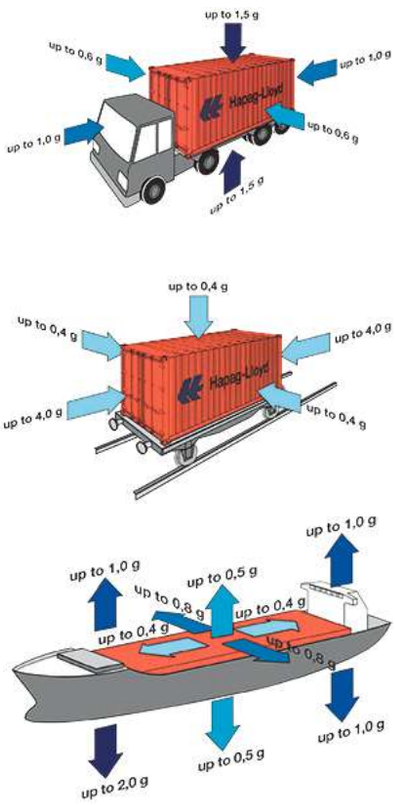
Best Practice

Poor Practice

Safety Issues

Environmental & Economic Impact

Risk Factors



Different transport methods are subject to multiple and sometimes combined forces.
Source: Hapag-Lloyd, values CTU Code

Transport forces acting on a load

Cargo securing is a difficult subject because there are multiple methods to achieve this, along with variable procedures and regulations in different countries. Therefore the aim of this guide is to consider some of the underlying cargo securing issues. National and international specifications take precedence and technical literature covers a large number of issues.

How much force can a cargo unit absorb?

The cargo is subject to various stresses across the transport chain:

- Single, very heavy impact e.g. a cargo pile-up in rail wagon
- Repeated, heavy impacts e.g. container handling
- Continuous, brief impacts e.g. rail transport

Normally, cargo is subjected to a combination of forces — horizontal forward/back (shunting impact), or side-to-side, or vertical up/down forces (hard setting down of a container) or a combination of them (sea transport). Most cargo units are better at absorbing vertical impacts than horizontal ones.

While the cargo unit may give the impression of being intact, the paper may be damaged and this may only become apparent at the printer. Incorrect cargo securing can give the false impression that the paper product is of poor quality. However, the printer may refuse to take delivery of the whole consignment to avoid taking any risk. Effective cargo securing measures do not always coincide with commercial considerations but these do not abrogate responsibility to secure the load efficiently.

	Forces acting on load		
Transport mode	**Forward**	**Backward**	**Sideways**
Road	1,0 g	0,5 g	0,5 g
Rail wagon — subject to shunting*	4,0 g	4,0 g	0,5 g (a)
Combined transport**	1,0 g	0,5 g	0,5 g (a)
Ship — Baltic Sea	0,3 g (b)	0,5 g (b)	0,5 g
Ship — North Sea	0,3 g (c)	0,3 g (c)	0,7 g
Ship — Unrestricted	0,4 g (d)	0,4 g (d)	0,8 g

Source CTU Guideline.

The impact force is expressed in g — 1 g corresponds to the force of gravity of 9,81 m/s2. These values should be combined with static gravity force of 1,0 g acting downwards and a dynamic variation of: (a) = ± 0,3 g (b) = ± 0,5 g (c) = ± 0,7 g (d) = ± 0,8 g.

* It is recommended to use specifically equipped rolling stock (e.g. high-performance shock absorbers, instructions for shunting and switching restrictions).

** Combined transport includes rail wagons with containers, swap-bodies, semi trailers and trucks, and block trains (UIC and RIV).

The force to which a cargo is subjected to an assumed g-value of e.g. 0,8 g (sharp braking of truck) is not always evident. An impact force of 1,0 g (= gravity) corresponds to an angle of 90°.
Source: FMS 'Use No Hooks'

Cargo unit at 90° angle = 1 g *Cargo unit at 53° angle = 0.8 g* *Cargo unit at 30° angle = 0.5 g*

Friction

Movement of unsecured cargo is prevented by friction which is a force that opposes the relative motion of two surfaces in contact. Friction force is related to the roughness of the surfaces and is expressed in μ.

Coefficients of sliding friction	Paper, wrapped in paper	Paper, unwrapped
Paper on paper	—	0,40 μ
Paper on serigraph coated plywood	0,30 μ	0,25 μ
Paper on serigraph & rail-skate Joloda trailer	0,25 μ	0,35 μ
Paper on wood	0,40 μ	0,45 μ
Paper on metal	0,30 μ	0,30 μ
Paper on plastic	0,25 μ	0,15 μ

Source: VDI 2700/Part 9 2004 / BGL German Employers Liability Association

Insufficient blocking / bracing. Source: FMS 'Use No Hooks'

Paper with a sliding coefficient of 0,3 μ subject to impact forces would start to shift at an inclination angle of only 17°. Source: FMS 'Use No Hooks'

Securing with airbags. Source: FMS 'Use No Hooks'

Combined transport (CT) means that the vehicle or container may be transported by road, rail or ship for a part of its journey.
The carrier should always indicate if the vehicle is to be transported as combined traffic.
The vehicle requirements are defined by:

- An exact specification of required loading dimensions.
- Type and extent of the load.
- Any special loading regulations (lying, standing, second location, saddle position, etc.).
- Joloda rails, vehicle with sliding plane, etc.

Cargo securing needs special care because requirements are considerably higher for CT than those of pure road traffic. It is essential that the persons responsible are informed about CT traffic so that they can correctly secure the cargo.

This photo shows two bad safety practices (1) staff not wearing hard hats, (2) a person under a suspended load. Source: INTAKT

Securing Cargo Units

Form-locked cargo securing.
Source: FMS 'Use No Hooks'

Pallets moved in container.
Source: Stora Enso

Cargo must be prevented from sliding and tipping in any direction by blocking or lashing, or by a combination of these two methods. Establishing stable cargo units is one of the key requirements to successfully securing loads, for example: How stable is the cargo unit if the carrying vehicle brakes sharply? Is there any change to the external geometry? Does the unit remain deformed or is it restored to its original shape?

The cargo unit must be suitable for the designated transportation. This is often an issue for paper in sheets, where there is a risk that packaging stability gives way to commercial considerations. The challenge with paper in sheets is that it is multiple sizes and exact pallet sizes cannot be stocked to meet all requirements. If the dimensions of the pallet are larger than those of the paper sheets, then the protruding pallet makes cargo securing difficult.

Cargo will shift into even the smallest unsecured gaps in the event of impact or tilting. Cargo gaps increase on impact. The use of intermediate securing devices or filling is absolutely necessary.

✅ It is imperative to ensure that all units are stowed in form locked or friction locked.

Form locked cargo supports itself against the force of impact (e.g. sharp braking, railcar shunting) on a sturdy structural member or cargo securing system. This means that the adjacent cargo units are arranged in the opposite direction to the force of impact and this action is transferred to the next units.

✅ For detailed information on securing we recommend CEPI's 'General Cargo Securing Guidelines for Pulp and Paper Products' based on the European standard EN 12195-1:2010 – Load restraining. It is also recommended to acquire this EU standard from the European standardisation body CEN or one of its National Standardisation Bodies.

General Cargo Securing Guidelines for Pulp and Paper Products' available from www.cepi.eu

The Quick Lashing Guide in the Appendix can be used to either design the required number of lashings for a specific cargo securing arrangement, or to decide if the completed cargo securing arrangement is adequate. In all cases, the cargo security shall be checked and verified against required securing methodology for the operating conditions of the CTU.

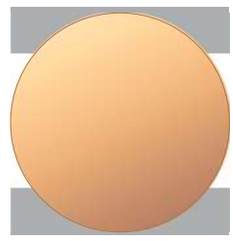
Note that load securing regulations need to fulfil the requirements as referred to in paragraph 1 (Introduction and Preamble) for each individual country, and region within a country, where the load is in transit. It might be necessary to adapt to the maximum required load security level of any country or region for the whole duration of all transit.

Where lashings are used to prevent both sliding and tipping, then;

1. Calculate the number of lashings required to prevent sliding
2. Calculate the number of lashings required to prevent tipping
3. The highest number of these two values gives the minimum required number of lashings

Securing devices

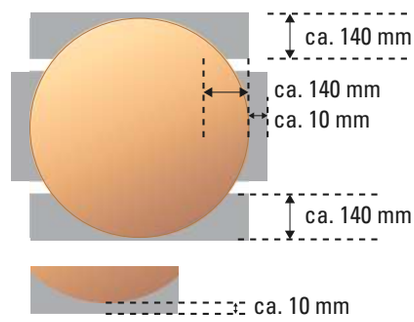
Anti-slip materials: Can be used under rolls or pallets to increase the friction between them and the CTU floor to help maintain their position during transport. The stand-alone use of anti-slip materials for standing rolls is possible subject to the certain conditions: only anti-slip material with a guaranteed coefficient of sliding friction of at least μ = 0.6 is used and the suitability of the material has been demonstrated in field trials; a minimum of two strips should be laid on the platform bed, in the longitudinal direction of the vehicle and both strips should protrude from the rolls to ensure that the friction factor is achieved; loading starts with rolls directly at the front wall of the trailer or wagon, void spaces can be filled with pallets; all rolls must be loaded without any gaps, in straight lines or in groups of rolls tightly together; and trucks/trailers must have air suspension. For safety reasons, these anti-slip materials can be used once only, unless multiple usage is certified.



Anti-slip materials under a standing roll has to be at least 150 mm (6") wide and protrude 1 cm (2/5"). Roll edges must remain fully on the strips. The same method may be used for the rolls on the top tier. Drawing: OPHAL

Airbags: The bags must always be placed between the cargo units — not between the cargo and the container walls because inflated airbags can buckle the wall. Airbags have to be filled carefully as the pallet top covers can break the bag. A gap can be created in the load when an air bag fails and rolls can then shift into each other causing a variety of damage.

✅ A properly inflated air bag is very hard; a deflated air bag retains some air but is soft to touch; a burst air bag with a definite rip in the outer layer is an indication of mishandling and usually results in rolls shifting and edge damage.

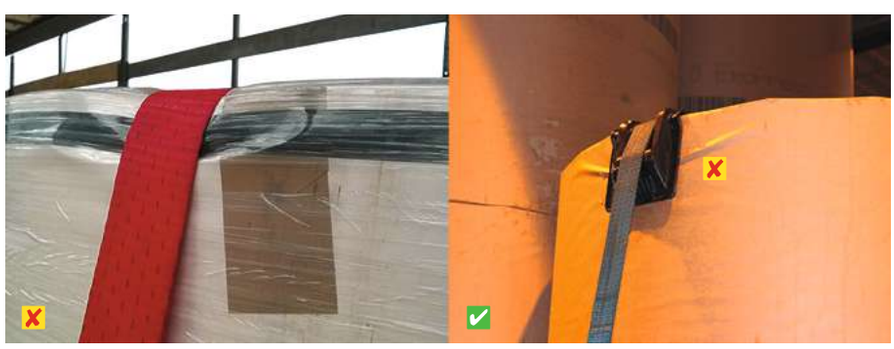


Anti-slip materials required for a single standing roll. Source: DEKRA

Edge protectors: Without suitable edge protectors it is impossible to lash cargo to the required tension without damaging the rolls. Corner protection materials or profiles should be used under the lashing belts at the top edges of cargo to avoid edge damage to rolls and pallets.

❌ Corner protectors for paper rolls should have an internal edge, be stiff, strong, stress resistant with belt guide bars and operate in temperatures -20 to 30°C (-4 to 86°F).

✅ Using the wrong kind of protectors will increase the risk of damage. Soft plastic or cardboard protectors are not adequate to protect rolls against lashing belt tension.

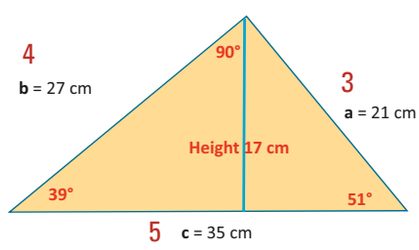


Source: Mëtsa Board *Source: Stora Enso*

The right hand photo shows correct edge protection but the wrinkles on the wrapping shows poor practice caused by the lashing down force being too high.

Correctly placed airbags reduce damage by preventing cargo moving into gaps. Source: INTAKT

Wedges (chocks): May be plastic, metal or wood should have a ratio of 3:4:5. Metal wedges are recommended to keep lying (horizontal) rolls in position. Wedges must be at least 1/8 height of roll diameter but not less than 15 cm (6") to maintain roll position and avoid damage. To avoid marking, the width of wedges should be a minimum 12 cm (5"). During loading and unloading, wedges should be used to secure lying rolls. The size of these wedges is determined according to local requirements. Check if wooden wedges are acceptable. Thinner wooden trailer floors reduced from 40 to 28 mm (1,6 to 1,1 in) make them unsuitable for nailing and nailing is not allowed by many rail wagon owners. Recent VDI Guidelines recommend wedges to be 'fixed' rather than nailed.



Wedge shape for lying rolls with a ratio of 3:4:5. Source: INTAKT

Lashing points on vehicles

The following examples of lashing are based on the provisions in DIN EN 12640 and the BG Verkehr standards that cover the equipment of vehicles with lashing points. For other countries it is essential to refer to relevant regulations.

The DIN EN 12640 standard describes the minimum requirements for lashing points on commercial vehicles used for break bulk cargo with a permissible total weight over 3,5 metric tonnes. The standard does not apply to vehicles designed exclusively for bulk cargo transport, or vehicles designed for transporting special goods with specific load control requirements.

The number of lashing points is largely dependent on the length of the vehicle's loading area:

- Maximum distance from end wall to the first lashing point is 50 cm (20 in).
- Maximum distance between lashing points is 120 cm (48 in).
  Maximum 150 cm (60 in) above the axles).
- The end wall at the front has to be equipped with at least two lashing points.

The tension force of the lashing points is linked to the vehicle's permissible total weight :

• Vehicles with a permissible total weight 3,5-7,5 tonnes (7716-16534lbs)	800 daN (1798 lbs force)
• Vehicles with a permissible total weight 7,5-12 tonnes	1000 daN (2248 lbs force)
• Vehicles with a permissible total weight over 12 tonnes (26455 lbs)	2000 daN (4496 lbs force)
• Lashing points in the end wall	1000 daN (2248 lbs force)

The tension force of lashing points has to be marked on the vehicle.

⚠ Caution! use lashing hooks only in combination with OEM side walls or OEM lashing profile.

Variable lashing point systems

Lashing points may be a lashing rail, or other forms of variable lashing point systems. These systems allow lashings to be anchored at practically any position on the vehicle for securing the cargo. Each hole in the rail is a potential lashing point.

Heavy duty lashing points

Heavy duty lashing points are usually found on special vehicles and have a higher allowable tension force than specified in DIN 12640. These components have been specified as slinging points for specific lifting technology. They are often marked with a number embossed by the manufacturer, and the identification number corresponds to the load capacity when lifting.

For lifting technology, a four-fold safety factor applies and this point may only be loaded with the marked number of tonnes.

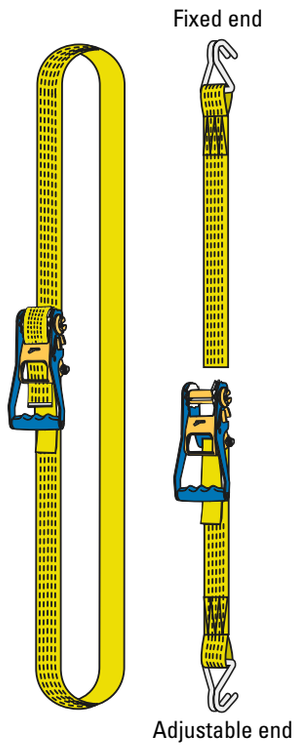
For load securing, a two-fold safety factor applies. When lashing cargo, this point may be loaded with twice the marked force if so specified by the vehicle manufacturer.

Lashing points on vehicles must conform with either DIN 75410-1 or DIN 12640. If possible, distances between the lashing points should be smaller (= 600 mm / 24 in) than the maximum distance specified in these standards to ensure optimum lashing. Source: SpanSet

Lashing point. Source: SpanSet

While the lashing is correct, the floor in this photo is not in a suitable condition to transport paper products. Source: SpanSet

Lashing equipment



One-piece lashing belt. Two-piece lashing belt.

Lashings with partial tears, crosswise tears or V-shaped cuts must be removed from service immediately. Source: SpanSet

Lashings are devices designed to be connected to a lashing point to secure the cargo on road vehicles. Mandatory provisions for lashing means are specified in three European (DIN EN) standards.

- Lashing belts: DIN EN 12195 - Part 2, since February 2001
- Lashing chains: DIN EN 12195 - Part 3, since July 2001
- Lashing wire ropes: DIN EN 12195 - Part 4, since April 2004

Achievable standard tension force (STF) of various lashing methods

Lashing types	STF in straight-line tensioning	
Lashing belt with short levered ratchet (push ratchet)	250 to 350 daN	(562-787 lbs force)
Lashing belt with long levered ratchet (pull ratchet)	350 to 720 daN	(787-1617 lbs force)
Lashing belt with heavy duty ratchet	No specification possible	
Lashing belt on winch mounted on vehicle	500 to 1 000 daN	(1121-2242 lbs force)
Lashing wire rope on winch mounted on vehicle	500 to 1 000 daN	(1121-2242 lbs force)
Lifting tackle for lashing wire rope and lashing chain	750 to 6 000 daN*	(1686-13 489 lbs force)
Lashing chains with turnbuckle	1 500 to 4 200 daN	(3372-9442 lbs force)

** (refer to rating plate)*

Lashing belts

A lashing belt is a woven fabric band made of chemical fibres and equipped with a ratchet, a clamp lock or similar device. Lashing belts can be in one or two pieces.

Generally lashing belts are made of polyester (PES) and have a blue rating label. Some belts are made of polypropylene (PP) and have a brown rating label. The colour of the belt material is the choice of the manufacturer.

Lashing capacity of the tensioning means

The lashing capacity of a lashing belt is specified on the rating label either as Lashing Capacity (LC) or, for older belts, as Fzul (permissible tensioning force). It is specified in daN and the value given applies to straight line lashing. If the lashing is used for banding (e.g. as an end sling) this value may be doubled.

The lashing capacity of a lashing belt must not be exceeded. The minimum breakage force of the lashing is a safety factor that is twice its LC. When the LC is reached, the belt's stretching may not exceed a maximum of 7% of its length.

The belt lashing capacity (LC) must not be confused with the standard tension force of its ratchet (STF) because the tension force of the ratchet designates the pressure or force generated to increase friction and secure the cargo. The normal tensioning force is also known as standard tension force (STF). To avoid overloading, the hand force required to tension the tensioning elements is limited to a maximum of 50 daN (112 lbs force) (DIN EN 12195).

LC (Lashing Capacity): The maximum force of the lashing belt allowed to be loaded with when lashing in a straight line. The LC is an important parameter for direct lashing.

SHF (Standard Hand Force): Normal hand force of the operator — 50 daN (112 lbs force) that has to be exerted to tension the ratchet.

STF (Standard Tension Force): Normal tensioning force of the ratchet is generated by hand force and then acts as pre-tensioning force on the lashing method. The STF is an important parameter for tie-down activities.

Lashing belt marking

Lashing belts must carry a rectangular, long lasting rating label containing all performance specifications for the lashing. Source: SpanSet

The lashing belt label must conform to the standard including a reference to DIN EN 12195 - Part 2, and

STF (Standard Tension Force) of the ratchet in straight line lashing

SHF (Standard Hand Force) to be exerted on the ratchet

LC (Lashing Capacity) of the lashing belt in straight line lashing

⚠ Only use lashing equipped with an approved rating label. Lashings with an illegible or missing label must be removed from service. Lashing belts with a green or blue label are generally recognized as safe for use in temperatures ranging from -40° to 100°C / -40 to 212°F (PES/PA) or -40° to 80°C / -40 to 176°F (PP).

Inspection, checks, repairs and discard

The VDI Guideline 2700 describes the handling of lashing and when they are no longer allowed to be used. When a lashing is found to be unfit for service they have to be immediately removed from service.

✅ Always look for obvious defects when using lashings. Any defects that compromise safety mean the lashing concerned must be removed from service immediately, particularly for

- Partial tears, crosswise tears, V-shaped cuts, breakage or corrosion on the tensioning and connecting elements
- Spreading of more than 5% in the hook recess or any form of general deformation.

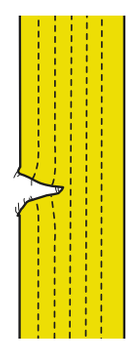
Lashing belts have to be inspected by a qualified technical expert at the intervals specified by the manufacturer or at least once a year. Depending on the conditions of use and the operational environment more frequent inspections may be required.

⚠ Do not use hooks if they have spread more than 5% in the hook recess.

	Discard criteria for lashing belts
Tensioning device	Cuts larger than 10% at the webbing edge and/or excessive wear Damage to the seams Deformation by heat Exposure to aggressive substances
Tensioning elements	Deformation oftensioning element's slotted shaft or its locking slide Wear of the toothed wheels or breakage of the tensioning handle
Connecting elements	Expansion of the hook by more than 5% Cracks, breakage, substantial corrosion, permanent deformation
Identification	Illegible information on the label Missing label

⚠ Repairs may only be carried out by the manufacturer or contractors authorised by the manufacturer. After each repair the original characteristics of a lashing must have been restored.

✅ Record the results of tests and inspections in an inspection file, an inspection book or an MDV table.



⚠ *Do not use belts with partial tears, crosswise tears, or V-Shaped cuts.*
Drawings source: SpanSet

Safety first

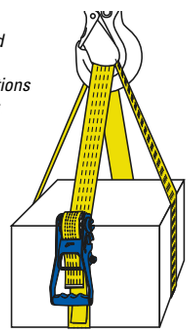
⚠ Warning: Ignoring these important operating procedures will jeopardize the safety of the lashing and may result in accidents causing injury or even death.

✔ Ensure lashing belts are only used by personnel trained in their use.

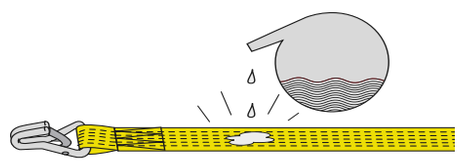
✔ Clean regularly tensioning elements and slightly lubricate the toothed wheels. Ensure lubrication does not touch the webbing because this may cause it to slip and release the load.

• Do not overload the lashing because this may damage or breakage it.

✘ *Lashing belts must not be used for lifting loads or other applications that they are not designed for.*



✘ *Do not allow chemicals to come into contact with the belts.*



• Do not use a lashing for lifting applications because they have not been designed for such use.

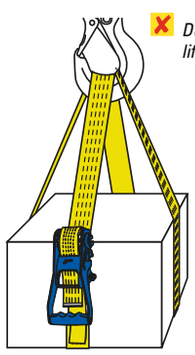
• Never tie knots in the lashing because this will considerably reduce its strength.

• Never drive any vehicle over the lashing otherwise it may be damaged.

• Do not pinch the lashing as this will considerably reduce its strength.

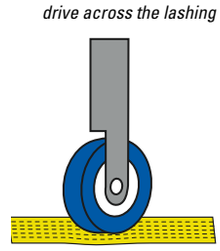
⚠ Immediately remove from service all damaged, overloaded or worn lashings because their nominal strength is no longer ensured.

• Only use lashing without twists.

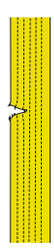


✘ *Do not use lashing for lifting applications*

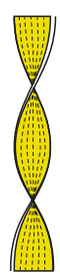
✘ *Never tie knots in the lashing*



✘ *Never allow vehicles to drive across the lashing*



✘ *Do not use damaged, overloaded or worn lashings*



✘ *Do not used twisted lashings*

Drawings source: SpanSet

- Do not load lashing hooks on their tip because this will render the lashing inoperable (unless expressly specified for such purpose). Lashing hooks should be equipped with a retainer lock. Where lashing hooks without a retainer lock are used they should always be installed from the inside outwards to prevent them from being detached from their lashing point.
- Avoid tensioning and connecting elements exposed to bending stress.
- Avoid breakage risk by not allowing lashing to rest on an edge.
- Winch tensioning requires a minimum of 1,5 to a maximum of 3 windings around the webbing tensioning element, otherwise the webbing may slip or become pinched and the belt becomes inoperable. (*For ABS ratchets, see page 13*).
- Lashings may not be used after breakage or deformation of a connecting element, or a tensioning component because this jeopardizes its use.
- Do not be tension or pull lashings across sharp edges that may cut the webbing.
- Lashing belts should not be exposed to chemicals. Lashings that have come into contact with acids, caustic solutions or other aggressive substances should be rinsed and cleaned with water before storing or reuse. If in doubt, consult the belt manufacturer.
- A load will tend to settle during its transport leading to a loss of pre-tensioning force. Check and re-tension as necessary after driving a short distance and then regularly during the entire trip.

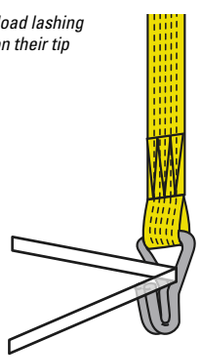
Note reference documents and manufacturer instructions as they contain valuable information that helps to prevent accidents.

Lack of corner protection will damage cargo. Source: Stora Enso

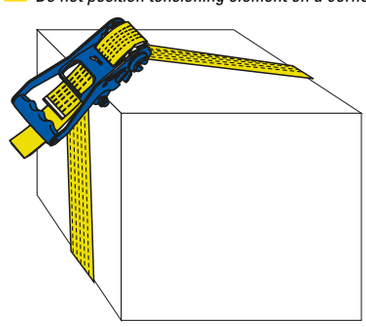
Poor corner protection will damage cargo. Source: Stora Enso

Example of roll edge damage from lack of protection. Source UPM

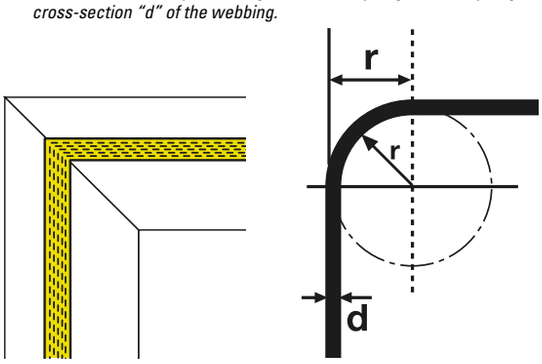
Do not load lashing hooks on their tip



Do not position tensioning element on a corner.



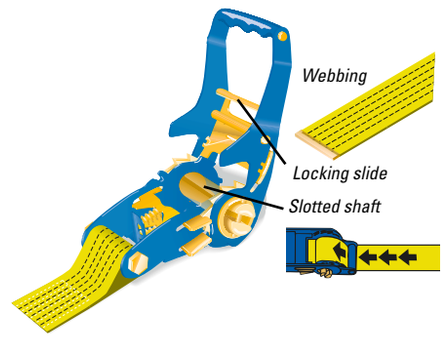
Do not be tension or pull lashings across sharp edges. A sharp edge already if the edge radius "r" is smaller than the cross-section "d" of the webbing.



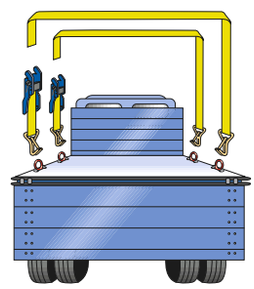
Drawings source: SpanSet

Operation of lashing belts

A Open the ratchet lever and place the slotted shaft in position to insert the webbing.

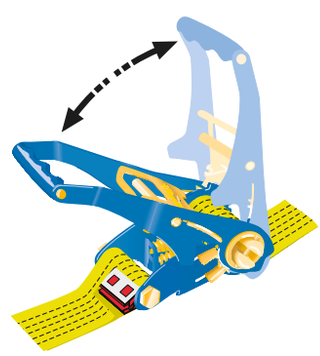


B Place the webbing on the load and securely hook the connecting element in the lashing point.



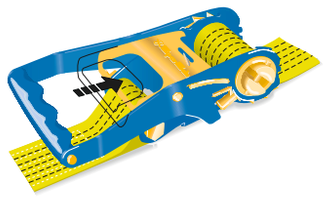
C Adjust the length of the lashing by inserting the lose end of the webbing into the slotted shaft and pull it through until the belt is placed tightly on the load.

D Keep tensioning the lashing until the desired tension is achieved. Ensure a minimum of 1,5 windings (2 windings for an ABS system) and a maximum of 3 windings on the slotted shaft. Tensioning elements with a pre-tension indicator show the force applied and this type of device is recommended for tie down operations. For push ratchets, the webbing is tensioned by pushing the ratchet lever upwards, and for pull ratchets the webbing is tensioned by pulling the ratchet lever downwards.

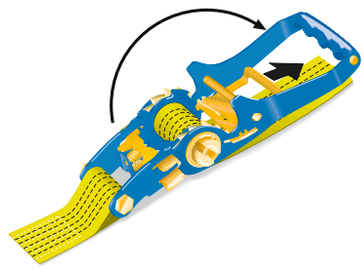


Drawings source: SpanSet

E Lock the tensioning element after lashing the load by pulling out the locking slide and rotating the ratchet lever into its closing position, this allows the locking slide to lock into place in the securing groove. The ratchet is now closed.



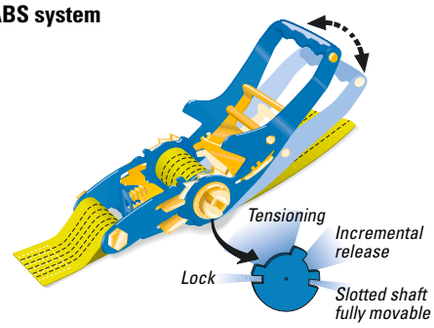
F Release by pulling out the locking slide and rotating the ratchet lever about 180° until it reaches its end position. Then allow the locking slide to lock into the lowest securing groove.



Caution — the pre-tensioning force will be released in one movement

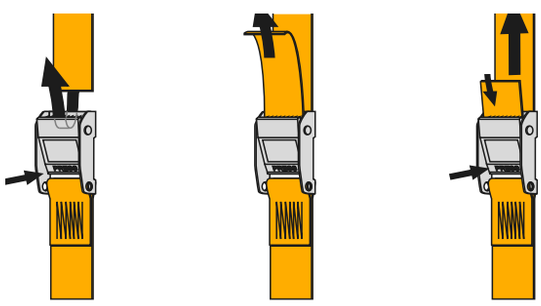
Special characteristics for lashing belts with ABS system

Anti belt slip (ABS) technology allow an incremental release of the pre-tensioning force when reducing the belt tension. The ratchet lever is moved back and forth several times to release the pre-tensioning force in small steps. By moving the ratchet lever to its maximum position the slotted shaft will become fully movable allowing the webbing to be pulled out easily.



ABS lashing belts are equipped with a Tension Force Indicator (TFI) to show their pre-tensioning force at a given moment. The pre-tensioning force can read off either on the left side (250 and 500 daN / 562 and 1124 lbs force) or on the right side (750 daN / 1686 lbs force). Knowing the exact pre-tensioning force helps determine the number of lashing belts required for the specific load and reduces the working time for load securing.

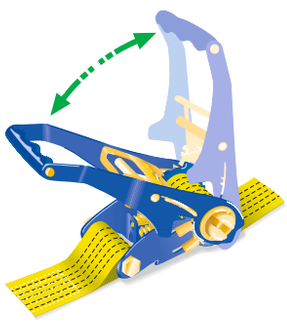
Special characteristics for lashing belts with clamp lock



Insert the webbing from the backside of the clamp lock and tension it with one hand. To release the webbing press on the lock tab of the clamp lock and pull the webbing outward.

1

2



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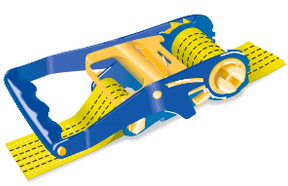


Tensioning elements

A tensioning element is a mechanical device that applies pre-tensioning force to a lashing.

Short-levered ratchets: Also known as standard or push ratchets. The pre-tensioning force of a short-levered ratchet can be read off as STF from the identification label and is about 250 to 350 daN (/ 562 and 787 lbs force) in straight-line lashing. If higher values are needed, they have to be verified by measurement.

1: Inserting the webbing: If the ratchet is closed pull out the locking slide to move the ratchet handle. When the slotted shaft reaches an open position, insert the webbing and pull it through until the belt is tight.

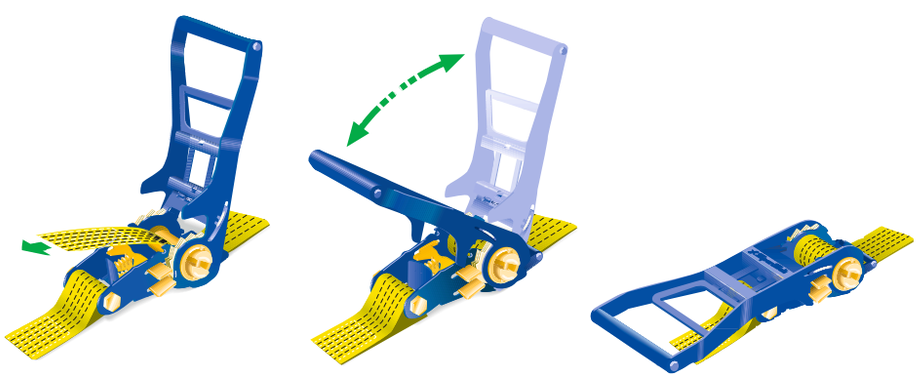
2: Tensioning: Keep ratcheting until the desired tension is achieved. Make 2 to 3 belt windings on the slotted shaft, not more or less.

3: Closing: After ratcheting, pull out the locking slide and rotate the ratchet lever into its closing position for the locking slide to lock into place in the securing groove. The ratchet is now closed and locked and cannot spring open during the journey even when subject to strong vibrations.

Short and long levered ratchets operate in the same way except for tensioning direction of the handle:

- The handle of the short-levered ratchet has to be pushed upwards for tensioning.
- The handle of the long-levered ratchet has to be pulled downwards for tensioning.

Long levered ratchet: Also known as pull ratchets. The pre-tensioning force of a long-levered ratchet can be read off as STF from the identification label and is about 350 to 720 daN (787 to 1619 lbs force) in straight-line lashing. If higher values are required then these have to be verified by measurement, e.g. using a Tension Force Indicator (TFI).



⚠ Ratchet extensions are dangerous and prohibited. They may break the ratchet and the flying broken pieces can inflict serious injuries on operators and bystanders.

Heavy-duty ratchet: The 75 mm (3 in) heavy-duty belt — 50% wider than the standard 50 mm (2 in) belt — are designed for direct lashing and not for tie-down purposes.

Drawings source: SpanSet

Lashing belt winch

A vehicle-mounted lashing belt winch may be operated mechanically or pneumatically. Pneumatic lashing belt winches automatically re-tension the belt during the journey. The pre-tensioning forces of lashing belt winches can differ widely and should be established from the manufacturer.

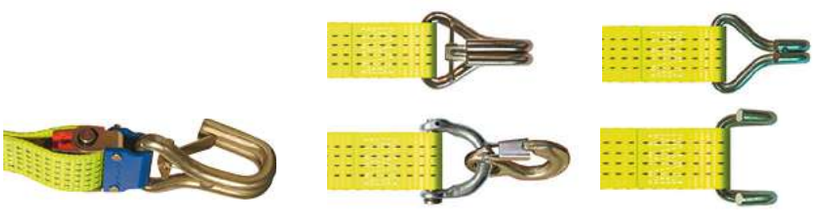
Pre-tensioning force measurement devices

Different pre-tensioning force measurement devices are available to determine the actual pre-tensioning force in the lashing belt rapidly and exactly.

Delog tension force indicators. Source: SpanSet

Connecting elements

Connecting elements are devices used for connecting the lashing to the lashing points on the vehicle or the load.



Photos: SpanSet

Source: SpanSet

✘ Never use connecting elements like this. If connecting elements are loaded the wrong way, they may break. Never load connecting elements on their tip!

Edge damage due to wrong strapping.
Source: Stora Enso

Tivoli tension system. Source: SpanSet

7 Road Transport

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2 ROAD TRANSPORTATION REQUIREMENTS

4 WORKING SAFELY

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8 SECURING THE CARGO

9 Lashing Equipment

10 Cargo Securing Devices

12 LOADING PATTERNS & SECURING

14 Rolls
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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.

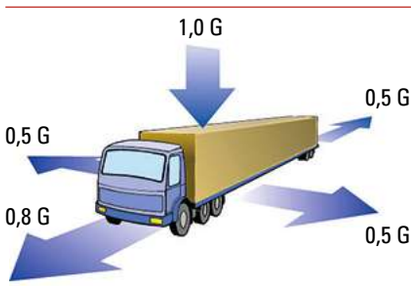
Best Practice

Poor Practice

Safety Issues

Environmental & Economic Impact

Road Transport Requirements



Stresses during road transport
- *Acceleration*
- *Centrifugal forces*
- *Vibration*
- *Retardation/braking*

Source: SpanSet

Rolls lying on truck trailer. Source: INTAKT

Rolls standing on truck trailer. Source: IF P&C

Under all circumstances safety is the priority. Relevant international or national rules and regulations must be followed during the loading, securing, transportation and handling process. National laws and regulations that are more rigid than shown in this guide always prevail.

Load securing must fulfil the requirements for each jurisdiction – country and regional – where the load is in transit. The requirements of one more strict jurisdiction may dictate those for the whole journey.

Load Planning & Responsibilities

No differentiation is made between loading platforms irrespective of whether the cargo is palletised products, paper rolls, pulp, or recycled waste paper. The requirements for the vehicle and the securing material should be clearly specified and recorded in advance; this is essential to allow forwarding agents to adapt to specific requirements in time and avoid possible discrepancies during loading operations.

The transport vehicle must be suitable for the intended load. Weight distribution of the load has to be in accordance with the type of vehicle or trailer and maximum axle load, and the floor strong enough to support a laden forklift when loading and unloading. Load planning should ensure that the legal maximum weight per transportation unit is not exceeded.

The haulier is responsible for the condition of the vehicles, which should be suitably equipped for the damage-free and eco-efficient delivery of paper products. Responsibility for securing the load may vary from country to country. While the driver is generally responsible for securing the load to requirements, in many jurisdictions the company and employees loading the cargo share the responsibility and liability along with the shipper.

Some shippers have few problems with the suitability of the vehicles provided, while others are faced with challenges arising from significant variations in the quality and equipment of vehicles to be loaded. Providing all forwarding agents with a single, consistent requirement profile is not always problem-free, particularly when customers pick up their cargo themselves (incoterm: “ex works”).

Loading has to be carried out in accordance with the load plan using the correct handling procedures for rolls, bales, and pallets described in *Module 5*. Load securing is a prerequisite for safe and secure transportation, and all vehicles must be equipped with the relevant securing materials prior to loading.

Road trailers are also used in multi mode transport on trains and ships. Source: LKW Walter

Cargo Transport Units (CTUs)

There is a range of CTUs, vehicles and swap bodies that should meet the requirements of the appropriate standards (e.g. in Europe EN 12642, EN 12640 and/or EN 283). The type of load securing in these different CTUs depends on the strength of their sidewalls, headboard and rear wall, along with the type of cargo to be carried.

Closed box trailer: Generally, no lashing is possible. Anti-slip materials are used under the rolls — except those with a walking floor where mats may cause unloading problems.

Frigg trailer: These are also closed box trailers where no lashing is possible to secure the load. Most of these trucks have an anti-slip floor coating.

Combi road trailer on rail wagon.
This photo shows two bad safety practices:
(1) staff not wearing hard hats,
(2) a person under a suspended load.
Source: INTAKT

Joloda trailer with rail loading, steel wedges and lashing systems provide optimised securing, transport and handling of paper. Source UPM

Working Safely

Safety Rules

✔ *Observe and follow site safety rules*

✘ *Do not ignore safety notices and signs.*

Symbols source LKW Walter
Photos source: LKW Walter

⚠ No Drinking and Driving

National regulations must be strictly followed. In addition, many companies have a zero tolerance policy related to alcohol and will make random tests on all personnel entering a site, both staff and external workers such as drivers. Ferry disembarkation is a key testing point, where drivers might have residual alcohol levels in excess of legal alcohol limits.

✔ *Stand clear of handling equipment equipment and keep eye contact with the driver.*

✘ *Dangerous position hidden from lift truck driver.*

✔ *Ergonomic and safe working.*

✘ *High risk behaviour.*

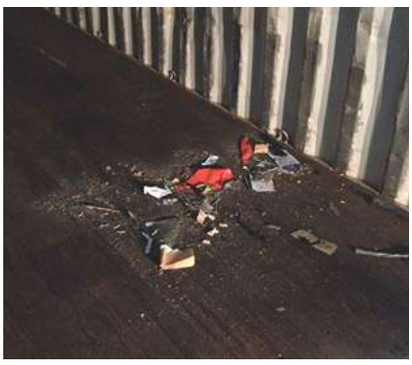
✔ *Correct working position.*

✘ *Cramped working position.*

Photos source: LKW Walter

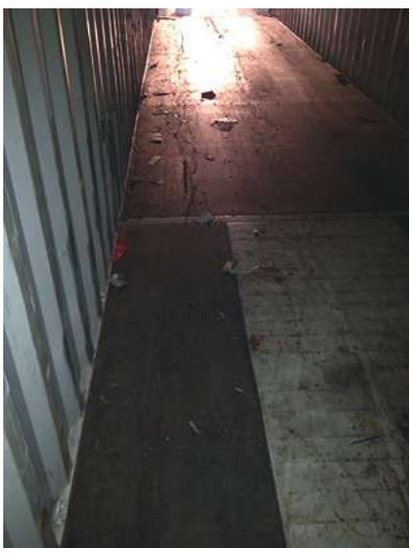
⚠ In addition to normal safe working systems, particular care in accordance with national laws and regulations needs to be taken when equipment and personnel are working together in a confined area and/or at height.

Inspection of Cargo Spaces



✅ *Tool to detect protruding screws is particularly useful in poor light conditiond. Source: UPM*

Protruding screw on trailer floor. Source: UPM



Unacceptable dirty and soiled floor. Source: IF P&C

A clean floor is essential. Source: Holmen

The transport company represented by the driver is normally responsible for the condition and cleanliness of the truck.

✅ The person responsible for loading operations must ensure that cargo spaces are clean, dry, free of smell, tidy, and in adequate condition. The conditions for rail and road transport are virtually the same.

Floor strength: The trailer must be strong enough to carry the loaded cargo — including carrying a loaded lift truck — otherwise the floor could collapse. Any repairs must maintain overall strength.

ACTION: Reject if inadequate repairs or the floor does not look strong enough.

Floor: The floor must be dry and clean, smooth and even, without pits or holes, and with no protruding objects such as nails or bolt heads.

ACTION: Remove protrusions and clean.

Walls: Any deformation beyond normal wear and tear to panels and frames that are bent, dented, or bowed is unacceptable if it reduces the internal dimensions in any direction, particularly width, or if deformation increases the risk of cargo damage.

ACTION: Reject if damaged.

Curtains: The opening and closing mechanism should be in good working order and the general condition acceptable and watertight.

ACTION: Reject if damaged or not watertight.

Customs Seal String (TIR Cord): The TIR Cord should be complete and without any damage.

ACTION: Reject if damaged and the transport is running under Customs control.

Doors: The doors of the truck/trailer should be in good working order, able to be easily closed and locked. The door seals should be in good condition to prevent leakage.

ACTION: Reject if there are any defects.

Clean: The cargo space must be dry and clean, without stones, debris and residues of previous cargoes and unsuitable substances such as oil, or odours that can contaminate paper.

ACTION: Clean if dirty.

Clean: All cargo residues must be removed, including those between the floor plate joints and around recessed lashing rings. If the loading platform is soiled or cargo residues are visible, the loading platform must not be used until cleaned because lift truck or other movements can loosen these foreign bodies and contaminate the cargo. Particular attention should be paid to plastic granulate or similar residual deposits — any contamination of pulp with this material can give rise to significant difficulties during subsequent processing.

If another suitable vehicle is not available, then all responsible persons in the transport chain may agree in writing to its provisional use (photos should also be taken of the vehicle clearly showing the conditions at the time) with appropriate measures to be taken: sweeping and cleaning with compressed air, and/or lining the loading platform. Select suitable lining materials to ensure that the material protects the cargo throughout the entire transport (sufficient thickness and strength); avoid all direct contact with the soiled loading platform; ensure the lining material is suitable for the cargo (e.g. do not place any plastic sheeting below pulp); ensure lining materials are not damaged by the work of the lift truck. If necessary, the customer should remove this lining from the vehicle and dispose of it separately.

Odour: Residual odour can easily adhere to paper. Unacceptable strong odours are those that are either nauseous or caustic. If there is an odour, ask the driver what was the nature of the last load carried.

ACTION: Ventilate if there is a strong odour; if odour persists, reject.

Dry & Watertight: The cargo space must be completely watertight and weather protected (roof, sides, doors and floor).

ACTION: Reject if not watertight.

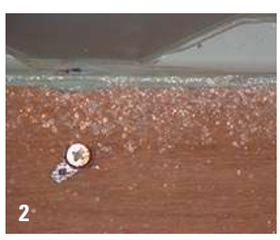
Dry means that the loading platform must not transfer any moisture to the cargo. Paper and pulp react hydroscopically, which means that the cargo will establish a moisture balance with the ambient climate. Also, for this reason, any wet areas on the loading platform will affect the paper quality even if they have no direct contact with the paper. Wet or moist areas on loading platforms are always a cause of complaint among customers or external inspectors during receiving inspections. In general, treat moisture or wetness with scepticism — not everything that is wet has to be water.

⚠ There are countless hazardous liquids that could have contaminated the vehicle floor. Loading personnel often check a spilled liquid by touching it but this should be avoided as it represents a potential safety hazard. If possible, a replacement vehicle should be used.

✘ It is not recommended to attempt to shield damp areas with layers of paper, cardboard or plastic because they slip during loading. In addition, moisture penetration may still occur during transport. Wooden boards are suitable protective layers but can be expensive — beware of old wooden boards that are too soiled to be used as a cargo layer. Even if the cargo does not have direct contact with moist areas, there is still a risk that the cargo indirectly absorbs moisture or smell from the contaminated loading platform.

Warning signs changed in 2017. The new GHS (Globally Harmonized System of Classification, Labelling and Packaging of Chemicals) replaces the previous orange background colour with white.
Source: FMS 'Use No Hooks'

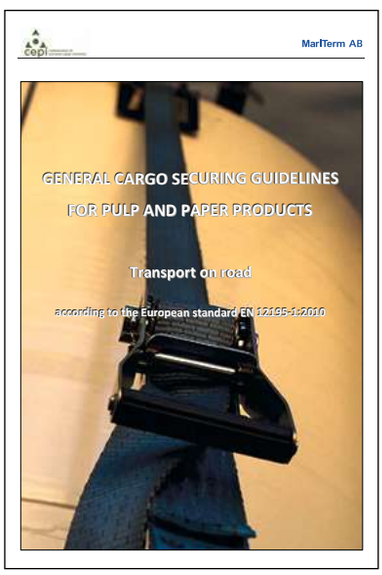
Lined loading platform.
Source: FMS 'Use No Hooks'



1. *Foreign particles found on bales of wood pulp. Source: FMS Use No Hooks*
2. *Plastic granulate on loading platform Source: FMS Use No Hooks*
3. *Wet floor. Source: FMS Use No Hooks*

Securing the Cargo

✅ For detailed information on securing we recommend CEPI's 'General Cargo Securing Guidelines for Pulp and Paper Products' based on the European standard EN 12195-1:2010 – Load restraining. The Quick Lashing Guide can be used to design the required number of lashings for a specific cargo securing arrangement or confirm if completed cargo securing arrangements are sufficient. In all cases, the cargo security shall be checked and verified against required securing methodology for the operating conditions of the CTU. It is also recommended to obtain this EU standard from the European standardisation body CEN or one of its National Standardisation Bodies.



General Cargo Securing Guidelines for Pulp and Paper Products' available from www.cepi.eu

The purpose of lashing and securing of rolls, pallets and units is to prevent products moving in different directions during transportation, avoiding the risk of damage, or of part of the load falling from the vehicle thereby creating external hazards. Lashing and securing should ensure that the whole load remains safe and in the same position during normal traffic situations, including emergency braking and sharp turns. The maximum accelerations are: 0,8 g in driving direction and 0,5 g sideways (centrifugal force).

Stowed rolls can tip during transportation, including those lashed in blocks of three or four standing rolls; the same effect can occur with lying rolls. Standing rolls will tilt if their width is much greater than the diameter.

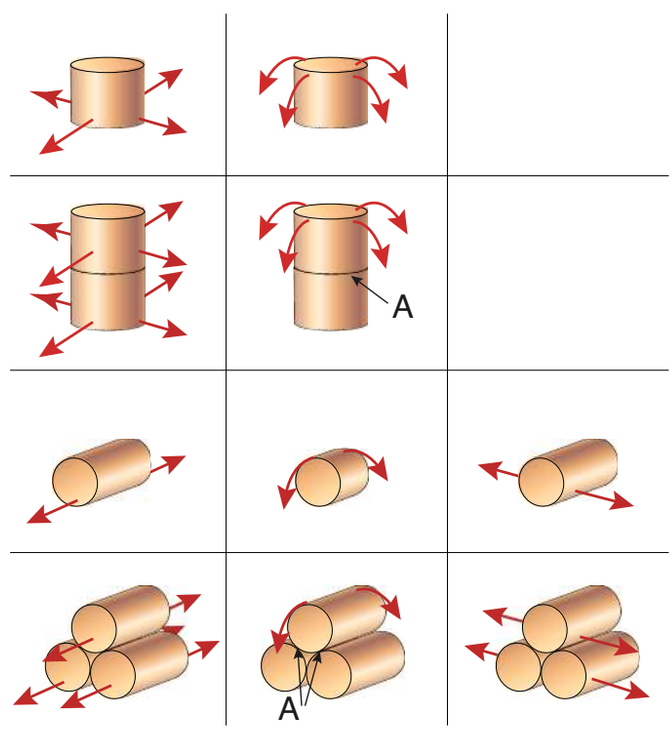
Insufficient friction between load and floor may allow the load to move. This is unacceptable, and action is required using lashing, anti-slip material or chocks. Wedges combined with lashing will prevent lying rolls from rolling. The friction between the load and the loading platform will significantly influence how much one lashing can hold.

⚠ The responsibility for securing the load may vary from country to country. While the driver is responsible for securing the load to the relevant requirements, in many jurisdictions the company and employees loading the cargo share the responsibility and liability.

National laws and regulations that are more rigid than shown in this guide always prevail.

✅ Lashing and securing materials should be in good condition; damaged material must not be used. If the vehicle is not provided with the necessary cargo securing devices such as general purpose ratchet straps and anti-slip mats, the shipper should provide this material for the driver.

See Module 6 for more information on securing & lashing.



Forces and acceleration in road transport. Source: UPM/OPHAL

Heavy-duty ratchet tie-down strap lashing must be used with edge protectors. Source: Holmen

Heavy-duty ratchet for tie-down lashing. Use lashing straps with min. 4000 kg (8818 lbs) breaking strength. The recommended standard minimum to maximum pre-tension force is between 400 to 500 daN (899-1124 lbs). Source: Holmen

⚠ *Staff should wear safety helmets*

Tighten with ratchet to correct force, (max 50 kg (110 lbs) per ratchet.

✘ *Do not use a longer extra lever-arm. Source: Holmen*

Cargo Lashing Equipment

Adequate lashing and securing material must be available, in good condition and used in accordance with the instructions issued by the manufacturer, shipper or terminal.

- The use of eco-efficient recyclable materials is preferred.
- It is recommended to have the technical data printed on the belts

Belts: Sting belts tension winches should be used for securing vertically loaded rolls together. Hook end belts with tension winches should be used for lashing rolls to the transportation unit. The belt classification or rating must be in accordance with the weight of the cargo/load. Different types of hooks can be used depending on the lashing point types of transportation units. The maximum distance between lashing points is 600 mm (24 in); however, a lashing bar is a better solution.

⚠ Inspect belts every time before use. Torn, partly broken or oily belts, or belts unable to meet the rated strength must be rejected.

It is recommended (and may be a compulsory local requirement) to measure the lashing tension force after loading and to check following any extreme event during transportation.

✔ The loading supervisor should make regular spot checks of the lashing tension force.

Typical content of webbing strap label, marked in accordance with EN 12195 2. Source: SpanSet/CEPI

✔ Securing Guidelines

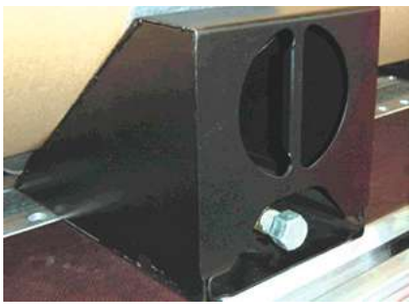
CEPI's 'General Cargo Securing Guidelines for Pulp and Paper Products' recommendations are based on lashings with a lashing capacity (LC) of at least 1600 daN (1 daN ≈ 1 kg / 0,225 lbs force) and a standard pre-tension force (STF) of minimum 400 daN (899 lbs force) during the entire transport. It is better to use as high a pre-tension (STF) as possible but not all lashings will achieve this. Therefore, the pre-tension should always be measured. A pre-tension higher than 500 daN (1124 lbs force) can cause edge damage to some paper grades. The Quick Lashing Guide Appendix gives the required number of lashings to prevent the cargo from sliding and tipping sideways, forward and backward.

Where lashings are used to prevent both sliding and tipping, then;

1. Calculate the number of lashings required to prevent sliding.
2. Calculate the number of lashings required to prevent tipping.
3. The highest number of these two values gives the minimum required number of lashings.

Cargo Securing Devices

Joloda skate system. Source: UPM



Perforated rail with screw wedge.
Source: FMS Use No Hooks

Partition bar.
Source: FMS Use No Hooks

Rails in a Joloda trailer optimise securing and transport of paper rolls. Source: UPM

Cargo securing devices and other equipment fasten cargo units onto vehicles. One type of vehicle (known as a paperliner) is equipped for optimised securing and transport of paper rolls. This may include Joloda trailers with rail loading, steel wedges and lashing systems. Other vehicles require a combination of different cargo securing devices that can contribute to fast and effective securing of cargo.

Lashing points and variable lashing systems: Lashing rings are used for direct fastening of the lashing straps and should have a lashing capacity of at least 2000 daN (4496 lbs force). Vehicles with flexible lashing points are preferred because they allow exact positioning of the lashing straps. Lashing rings in troughs can be rusty and stiff, making it difficult to attach the lashing strap hook. Claw hooks must be used to attach lashing straps to the vehicle (only if the lashing method is "tie down"). Under no circumstances must straps be placed across the yielding loading sideboard.

Perforated rails: These metal profiles have a series of holes that are firmly embedded in the loading platform and connected to the floor. They offer a good base for securing cargo when used in conjunction with screw wedges or clamping blocks.

✅ Ensure wedges are undamaged and move easily.

Partition bars: These telescopic metal profiles can hold only minor loads. They can be used only if they have a certificate showing load-bearing capacity. On their own, they are normally not suitable as cargo securing devices for paper rolls, pallets or pulp. The partition bars are often attached to the tuck plates of the vehicle body. However, if the tuck plates are too thin or damaged, the required clamping force cannot be attained. In this case, the partition bar serves only for visual purposes.

Wedges: Wedges should have a ratio of 3:4:5. Metal wedges (chocks) are recommended to keep lying (horizontal) rolls in position. Check if wooden wedges are acceptable. Wedges must be at least 1/8 height of roll diameter but not less than 15 cm (6 in) to maintain roll position and avoid damage. To avoid marking, the width of wedges should be a minimum 12 cm (5 in). During loading and unloading, wedges should be used to secure lying rolls. The size of these wedges is determined according to local requirements. Thinner wooden trainer floors — reduced from 40 to 28 mm (1,6 to 1,1 in) — make them unsuitable for nailing. Recent VDI Guidelines recommend wedges to be "fixed" rather than nailing them.

✘ *This photo shows correct edge protection but the wrinkles on the wrapping shows poor practice caused by the lashing down force being too high. Source Stora Enso*

Edge protectors: Without suitable edge protectors it is impossible to lash cargo to the required tension without damaging the rolls. Avoids edge damage to rolls and pallets. Corner protection materials or profiles should be used under the lashing belts at the top edges of cargo.

✔ Corner protectors for paper rolls should have an internal edge, be stiff, strong, stress resistant with belt guide bars and operate in temperatures -20° to 30° C (-4 to 89°F).

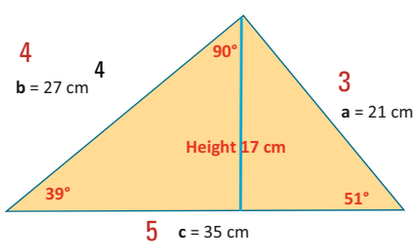
✘ Using the wrong kind of protectors will increase the risk of damage. Soft plastic or cardboard protectors are not adequate to protect rolls against lashing belt tension.

Anti-slip materials: Can be used under the rolls or pallets to increase the friction between them and the CTU unit floor to help maintain their position during transport. The stand-alone use of anti-slip materials for standing rolls is possible subject to the following conditions: only anti-slip material with a guaranteed coefficient of sliding friction of at least μ = 0.6 is used and the suitability of the material has been demonstrated in field trials; a minimum of two strips should be laid on the platform bed, in the longitudinal direction of the vehicle and both strips should protrude from the rolls to ensure that the friction factor is achieved; loading starts with rolls directly at the front wall of the trailer, void spaces can be filled with pallets; all rolls must be loaded without any gaps, in straight lines or in groups of rolls tightly together; and trucks/trailers must have air suspension. For safety reasons, and unless multiple usage is certified, these anti-slip materials can be used once only.

Airbags: The bags must always be placed between the cargo units — not between the cargo and the container walls because the airbags can buckle the wall when inflated. Airbags have to be filled carefully as the pallet top covers can break the bag.

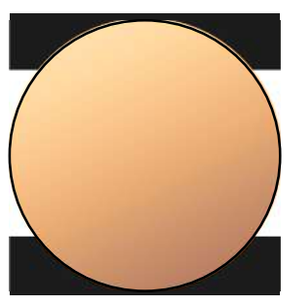
✔ *Correctly placed airbags reduce damage by preventing cargo moving into gaps. Air bags inflated to their specifications are relatively hard. Source: INTAKT*

✘ This photo shows correct edge protection but the wrinkles on the wrapping shows poor practice caused by the lashing down force being too high.

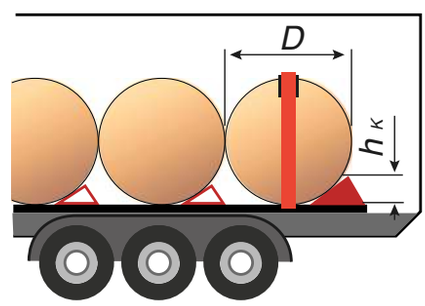


Wedge shape for lying rolls with a ratio of 3:4:5 Drawing: INTAKT

Drawings source: OPHAL



Anti-slip materials under a standing roll must be at least 150 mm (6 in) wide and protrude 1 cm (2/5 in). Roll edges must remain fully on the strips. The same method may be used for the rolls on the top tier. Drawing: OPHAL



Wedges help keep lying rolls in position.

Loading Patterns & Securing

Establishing stable cargo units is a key requirement to successfully secure loads. The cargo shall be prevented from sliding and tipping in all directions by blocking, lashing or a combination of these two methods.

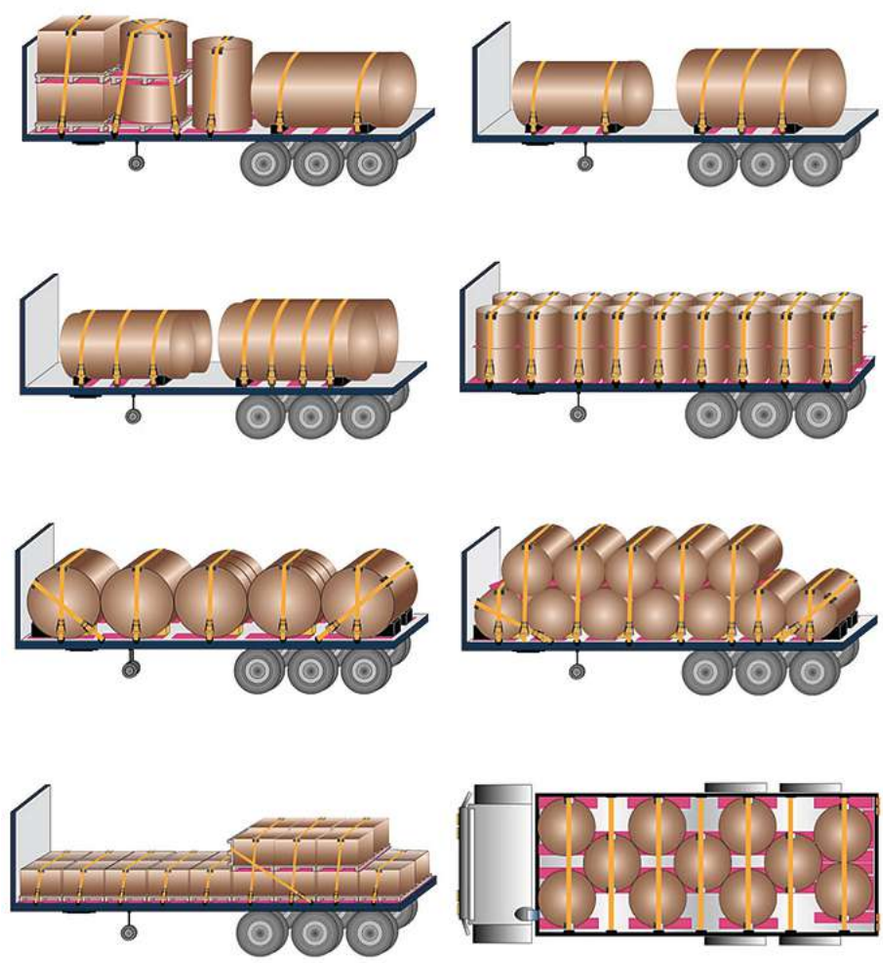
The cargo unit must remain stable if the carrying vehicle brakes sharply. Is there any risk of change to the external geometry? Does the unit remain deformed or is it restored to its original shape? Cargo gaps increase on impact.

Loading patterns are highly variable because of different diameters, widths, weight, and payload constraints of truck (capacity, size, regulations of countries being travelled).

Blocking — the best option for load securing

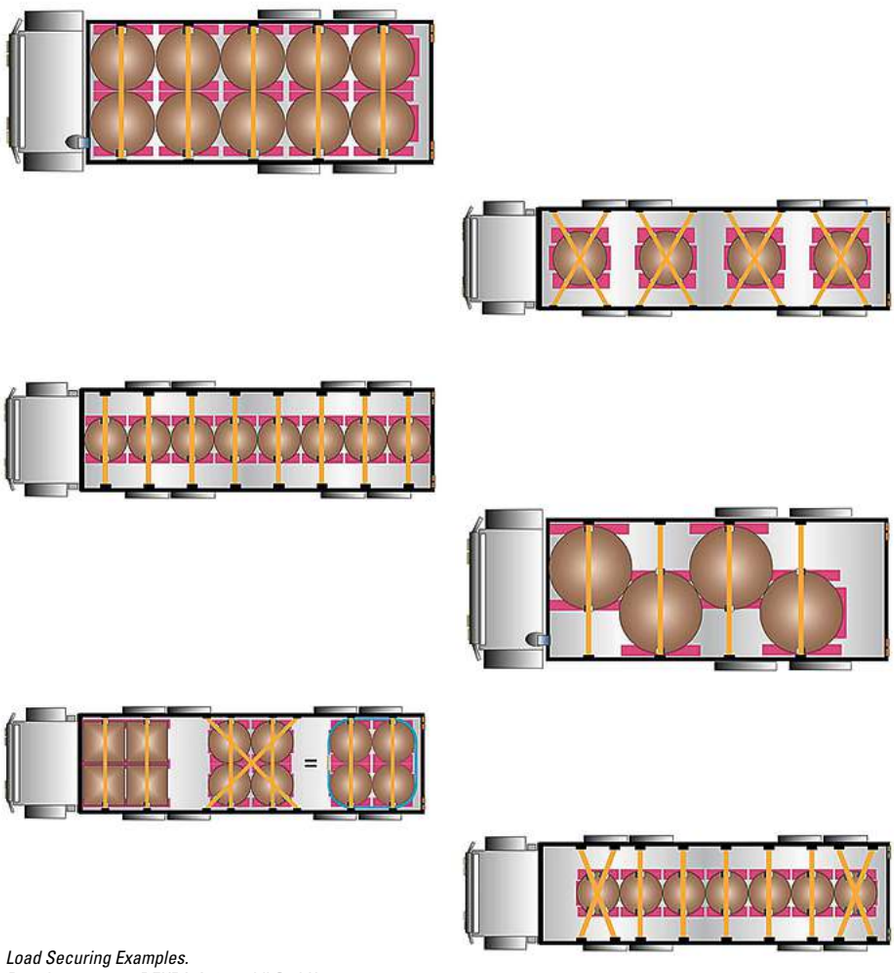
Where possible, blocking should be used to secure the load. This involves positioning the load, or parts of the load directly to the headboard, sideboards, stanchions, supports, walls or parts of the load to stop it from moving. If the load is blocked to a sufficient height, this will effectively stop it from sliding and tipping. If the load is only bottom blocked, lashing may be needed to prevent tipping.

Load Securing Examples



Load Securing Examples. Drawings source: DEKRA Automobil GmbH 'Ladungssicherung von Papierprodukten Version 6'.

Source: IF P&C

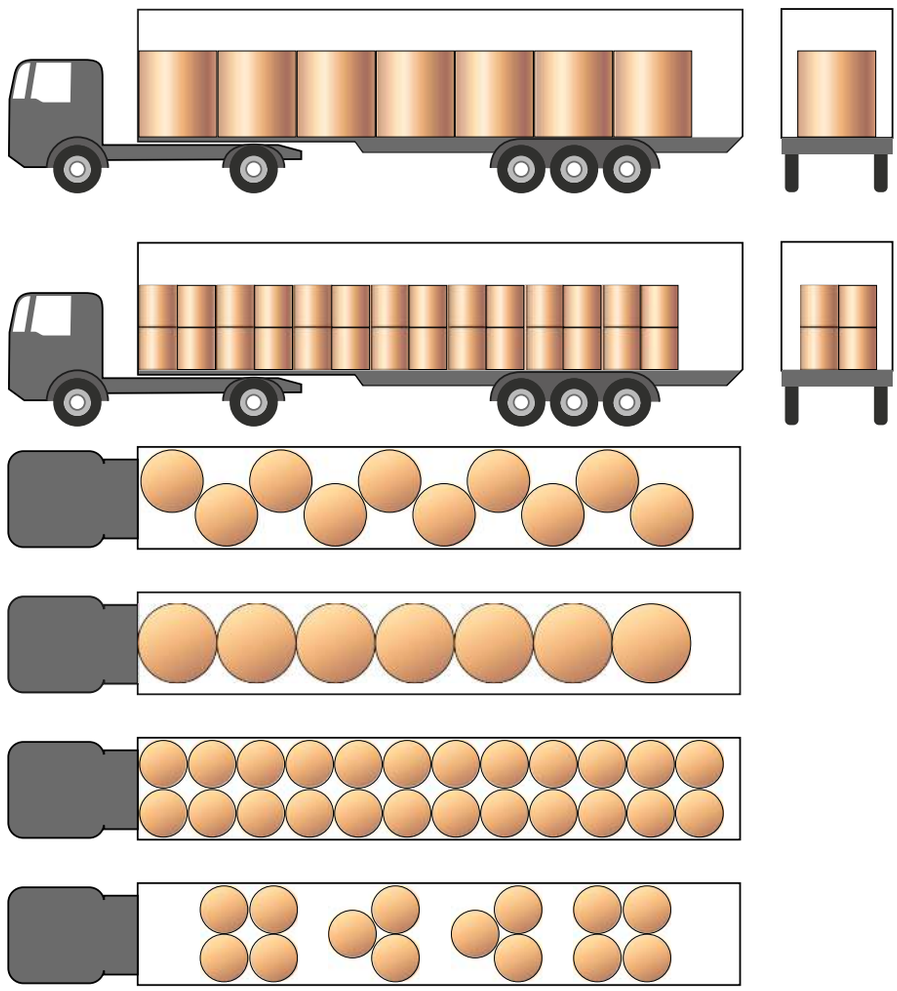


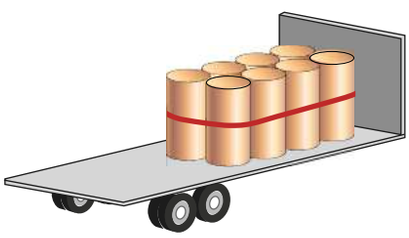
Load Securing Examples.
Drawings source: DEKRA Automobil GmbH
'Ladungssicherung von Papierprodukten Version 6'.

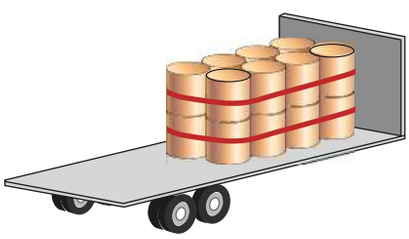
Standing (Vertical) Rolls

Typical loading patterns

The drawings are schematic and do not showing all of the load securing elements needed. Actual loading is determined by the position of axles and weight distribution. Drawings source: UPM/OPHAL







Standing (vertical) load patterns.

Recommended loading is to completely fill the trailer. If possible create blocks to improve stability while respecting weight distribution requirements. Void spaces must be filled with supporting material.

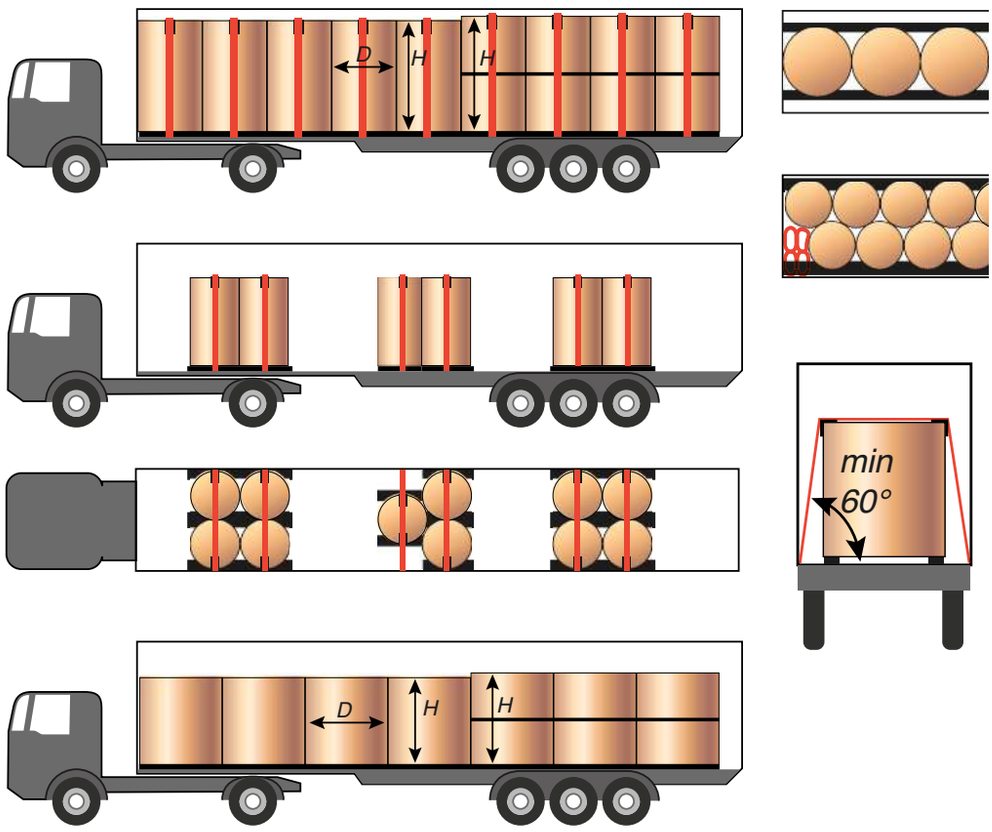
Securing standing rolls

There are several techniques for securing standing rolls:

Downlashing is the most common securing method in Europe because it is both fast and efficient for most road requirements.

✅ Corner protection should be used if belts are placed over rolls.

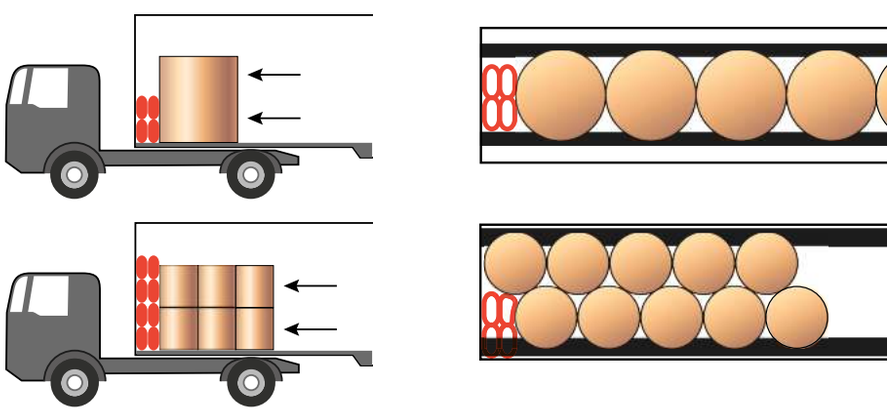
Horizontal (belly) lashing is an alternative securing method but not common for road transport because it is time consuming and that the horizontal belts tend to slide down during transport (even with supporting belts fixed to the rolls with adhesive tape). This kind of securing is more typical in sea transport. Typically horizontal lashing is used in combination with downlashing.



Some examples of different methods of lashing and securing. The use of anti-slip material is recommended under and between roll layers to increase friction.

Standing rolls without lashing requires tight loading to eliminate the need for belts, using only anti-slip material under the rolls (if permitted by national laws and regulations). However, if the load is not blocked appropriately, there is a risk that the unlashed load will move in transit because of vibration, then it must be secured using an alternative means.

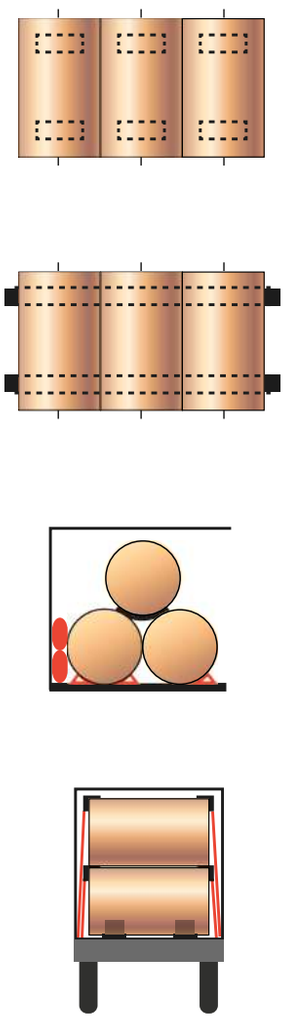
One solution is to fill the gaps with materials such as pallets. However, the disposal of these pallets at the end of the journey may be a problem.

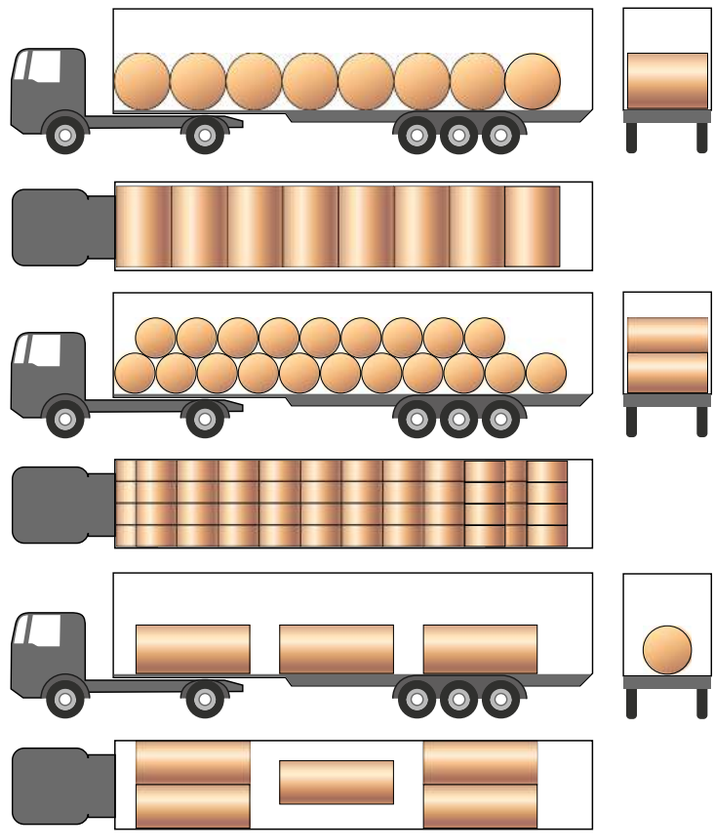


Drawings source: UPM/OPHAL

Lying (Horizontal) Rolls

Typical loading patterns





Drawings source: UPM/OPHAL

Lashing and securing of lying rolls: Small wedges are used for safety during loading and unloading while large chocks are used for load securing. Rolls are secured by metal (preferable) chocks with height 1/8 of roll diameter and lashed with belts over at least the last roll. If a tipping danger exists then all rows of rolls have to be lashed and anti-slip material used under them. Due to higher stress, end chocks should be larger.

Lashing and securing of small horizontal rolls require anti-slip material to be used between the roll layers. All upper rolls and the last of the lowest rolls must be secured to the vehicle by belts over the rolls. The first and last rolls must be secured to the vehicle by belts over the rolls.

Lying rolls longitudinal to the direction of driving: This cargo securing method can be used only if it is possible to combine rolls with smaller and larger diameters in the load. This type of loading is very critical because of the maximum allowed overall vehicle width of 2,55 m (100 in) — 2,50 m (98 in) + stanchion + ratchet. The stanchions cannot always be closed on new trailers.

New trailers may allow positioning the stanchions on the trailer frame at loading gaps. This type of loading should only use steel wedges connected with perforated rails on the loading surface. Wooden wedges are no longer used because waterproof wooden plates cannot guarantee the necessary nail depth of 4 cm (1,6 in). An alternative is to use steel wedges with lateral slings to bind the rolls in pairs; however, this is an expensive and time consuming method.

Pallets & Load Units

A pallet is only the empty pallet platform. A load unit is, for example, paper sheets strapped onto a pallet. These load units must be placed and handled in accordance with defined loading patterns and methods to ensure maximum security, optimal payload and correct lashing material.

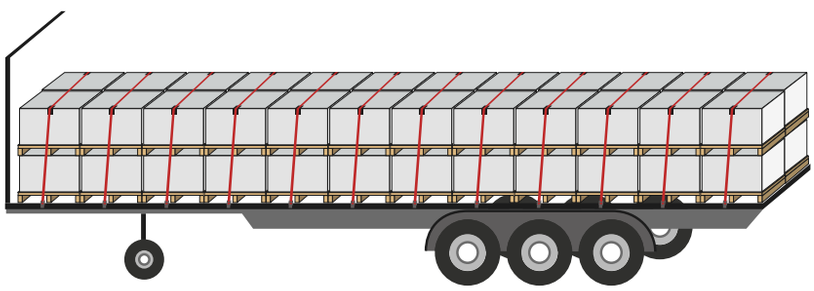
Coming in so many different sizes, sheet paper on pallets poses a particular transport challenge. If the dimensions of the pallet are larger than those of the paper in sheets, the pallet protrudes beyond the paper, making securing of the cargo difficult.

Slipped cargo unit. Source: FMS 'Use No Hooks'

Form Locked / Form-fit

The form locked method offers the advantage that the cargo is able to support itself against the force of impact (e.g. sharp braking, rail wagon shunting) on a sturdy structural member or cargo securing system. This also means that the adjacent cargo unit arranged in the opposite direction to the force of impact is also supported form locked and this action is transferred to the next near unit, etc. The force of impact resistance increases as a whole.

Ideal stowage. Source FMS 'Use No Hooks'



Pallets need to be secured with belts with at least one belt over one tier of pallets. Corner protection profiles should be used on the top corners of the load to avoid edge damages. It is recommended to place anti-slip material on the trailer floor and between the layers of load units. Drawings source: UPM/OPHAL

Pulp and Recycled Paper

Bales should be loaded as close together as possible in block formation, without gaps, starting at the forward part of the vehicle. The use of long corner protectors reduces the number of belts required for lashing. Lashing belts have limited functionality because the units are soft.

Pulp loads do not use ant-slipping materials because particles from them can contaminate the pulp.

Pulp bales loaded on to a trailer. Source IF P&C

Loading & Unloading

Drivers must chock wheels. Source: UPM

Use clamp extenders when loading standing rolls from one side — rolls must not be pushed. Source: Bolzoni Auramo

Source: Bolzoni-Auramo

Safe procedures

⚠ Drivers must ensure that trailer, truck or any other transportation unit will remain in its safe loading/unloading position during the entire loading/unloading operation. Before loading and unloading from the rear end of truck or trailer, chocks (straps) should be placed at the wheels on both sides. Vehicle key is removed from ignition.

✔ Normally the truck driver should be either in the cabin or other secure area during loading/unloading.

✔ Authorised pedestrians must stay exclusively in the marked pedestrian areas. A safety distance of 7 m (23 ft) at the back of the trailer is recommended during unloading.

✔ Only trained and authorised staff are allowed to use handling equipment.

✔ During loading and unloading, wedges must be used to secure lying rolls.

✔ Paper products cannot be loaded on to wet trailer floors.

✔ Be cautious of protruding lashing points

✘ Never push or pull rolls on the floor of the vehicle — or anywhere else.

✔ *See Module 5 pages 18-19* for best practice clamp truck techniques for loading and unloading.

Loading

During loading check:

- ❏ Shipment includes all goods ordered.
- ❏ Do not let rolls lean against sideboards unless they can withstand the force.
- ❏ Ensure that the cover is watertight.
- ❏ Quality, size and packing markings in each unit loaded/to be loaded are correct.
- ❏ Packaging meets requirements.
- ❏ Dispatch markings are correct.

Contact the supervisor if there are any problems.

Rolls and pallets can be loaded from either side, or from the rear by driving clamp truck inside if the floor is strong enough, or using a Joloda or other loading system.

✔ Use the right equipment and proper load securing to prevent damage and accidents.

Loading of Lying Rolls

- Never place the roll so that it is aligned with the other rolls, this avoids end-side damage.

Loading of a trailer IF. Loading a trailer from a dock. Source: IF P&C

Use straps and edge protectors to secure the rolls — edge protectors are missing in this photo. Source: Stora Enso

Check straps are properly secured. Source: INTAKT

Loading Standing Rolls

- Distribute load evenly in accordance with the load plan.
- If possible, fill trailer deck completely.
- Stow tightly.
- Fill any gaps with air bags, empty pallets or use alternative securing methods.
- Load rolls of different diameters alternately.

Check after loading to ensure:

- ❑ All rolls are secured.
- ❑ Do not let rolls lean against sideboards if they cannot sustain it.
- ❑ Cover is watertight.
- ❑ Sideboards and tailboards are closed and locked after loading and clasps are in good condition.

Trailer cover and opening side doors are generally not intended for the securing of load. It may be possible under certain circumstances e.g. load width to 240 cm (94 in) with XL type trailer.

Unloading

⚠ Before unloading from the rear end of truck or trailer, chocks (straps) should be placed at the wheels on both sides. Remove vehicle key from ignition.

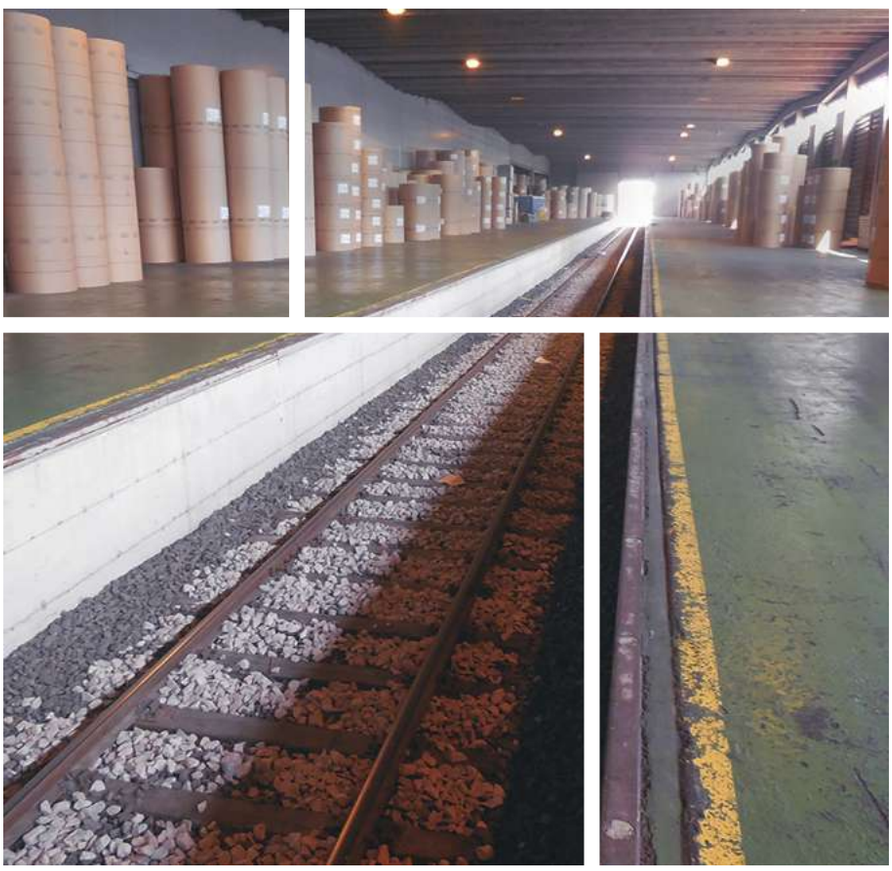
On arrival and before unloading begins, check the paper for damage. Note in writing on the waybill any damage (carriers and receivers). *See Module 2 page 2* for Inspection and *Module 3* for Warehouse procedures.

✅ Use correct equipment and techniques when unloading. See Module 5.

Unloading Lying-Loaded Rolls

- Be very careful when breaking down.
- Use paddlebats
- Do not remove wedges by force.
- Never let a roll in the second tier fall down.

8 Rail Transport



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2 RAIL TRANSPORT REQUIREMENTS
3 TYPES OF GOODS WAGON & GAUGES
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8 PREPARATIONS BEFORE LOADING
9 LOADING/UNLOADING PROCEDURES
10 LASHING & SECURING
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20 RAIL TRANSPORT SOURCES OF DAMAGE

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

Rail Transport Requirements

- *Acceleration*
- *Shunting*
- *Vibration*
- *Centrifugal forces*
- *Retardation/braking*

Acceleration forces during rail transport.
Source: FMS 'Use No Hooks'

Wagons suitable for the transport of roll paper can also be used for the transport of raw materials to the paper works. This is certainly the case with baled recycling paper and also baled pulp. More economical use of rolling stock creates synergies that keep rail-traffic systems competitive.

In Europe, there are usually three organisations involved in rail traffic:

1. Track owner — usually a national government organisation or a private company.
2. Railway Undertaking (RU) provides the traction (engine) and bogies for national and international freight services.
3. The transport unit. This may be a goods wagon or a container that is often leased by the transporting company for one or more national and international journeys.

Pallets that have shifted during rail transport. Source: Stora Enso

⚠ Safety is always the first priority under all circumstances. All international or national rules and regulations must be followed during the transportation and handling process, as well as the instructions issued by railroad companies. All railroad operations should meet these requirements. Independent of 'best practice', the relevant international guidelines take precedence unless subsumed by a more stringent bilateral agreement with the Railway Undertaking (RU). In addition to the loading guidelines, there are loading examples whose limitations are valid only for those countries listed in them.

General information concerning load-stress and conforming capacity utilisation can be found in Volume/Section 2, Information Sheet 0.1 (wagon load-stress) of Loading Guidelines from *http://www.dbschenker.com/ho-en/products_services/start/additonal_services/cargo_securing/loading_guidelines.html*

On many European tracks infrastructure management has installed automatic measuring points capable of checking for correct loading during a journey. Incorrectly loaded wagons will be stopped to regulate the loading, usually leading to increased costs and extended delivery time.

The requirements for securing cargo for rail transport differ considerably to those for road transport.

Wagons may be repeatedly shunted and impacts are unavoidable (except for trains that are designated 'not shunted!'). Rolls should not be subject to more than 1 g of force in combined traffic (e.g. swap trailers and containers) or block trains that run straight from shipper to receiver.

The condition of the railway line and wagons may generate high levels of vibration. Very long distances are covered by rail. These long and continuous movements cause paper rolls to turn on their axes, causing abrasion (chafing) marks on the rolls and resulting in fine paper dust or paint being rubbed off the wagon walls. This may lead to the packaging being completely worn through, as well as barcodes and other labels being damaged or illegible.

The person in charge of loading operations must check that the cargo is properly stowed, secured and lashed.

Types of Goods Wagon & Gauges

There are several different rail gauges. The continental European and North American standard gauge is 1,435 m (56,5 in). Other gauges are used in Finland 1,524 m (60 in), Spain 1,668 m (65,7 in), and the countries on Poland's eastern borders use 1,520 m (59,8 in). The UK has the narrowest gauge of 1,422 m (56 in).

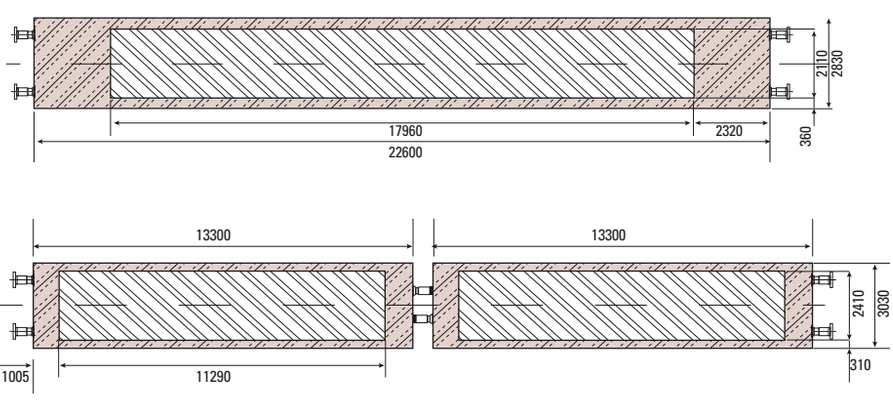
A loading gauge defines the maximum height and width for railway vehicles and their loads to ensure safe passage through bridges, tunnels and other structures. Classification systems vary between different countries and gauges may vary across a network, even if the track gauge remains constant. All wagons with the G1 international profile can be used freely throughout Europe (except in the UK). Large volume G2 profile wagons do not have a permit to be used in France, Italy, Belgium and Switzerland. These high wagons are mainly used for standing rolls.

For paper transport, the wagon options suitable for different roll sizes are G1/G2 gauge bogie wagons or tight coupled G1 gauge wagon units. Bogie wagons have a shorter load length and a narrower load width compared to wagon units. Bogie wagons are better for heavy rolls, wagon units are more suitable for lighter rolls. In North America, Boxcars 15,2 m (50 ft) long are commonly used for paper transport with some railway companies using 18,3 m (60 ft) wagons – often described as railcars.

Wagons without partitions should be used for transporting paper rolls regardless of gauge. Partitions may be suitable for transporting paper on pallets but hinder roll handling irrespective of whether they are loaded standing or lying. These partitions reduce the payload of the wagon.

Habbins rail waggon loaded with standing rolls. Source INTAKT

Loading rolls onto a goods wagon. Source: Bolzoni Auramo



Drawings source: TRANSWAGGON/OPHAL

Habbiins 14

Loading area: 64,0 m² (689 sq ft)

Loading length: 22,6 m (24 ft 2 in)

Loading width on floor: 2,83 m (9 ft 3 in)

Hiirrs 4

Loading area: 2 x 40,3 m² (434 sq ft)

Loading length: 2 x 13,3 m (43 ft 8 in)

Loading width on floor: 3,03 mm (9 ft 11 in)

Rail wagons may have two types of openings a sliding door or a heavy duty sliding wall — this is commonly used in Europe.

Sliding door. Source: INTAKT

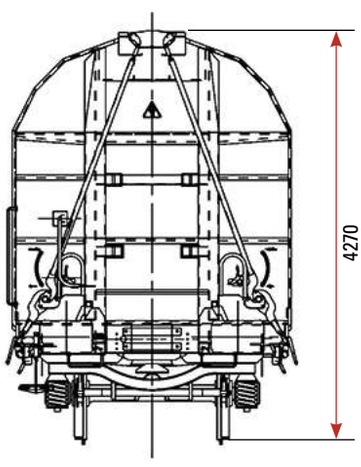
Doors or Walls

Heavy duty sliding wall commonly used in Europe. Source: INTAKT

Load Cross-sections

Load cross-sections provide useful information on the available loading width, particularly the half-load width when loading standing rolls. Make loading easier by marking a white line along the floor from one end wall to the other..

⚠ Ensure the maximum weight-tolerances per axle and per wheel are taken into account.



Drawings source: TRANSWAGGON/OPHAL

Bogie wagon, G1 gauge, e.g. Hbbins 16, Hbbins 17

Height above floor mm	Maximum width	
	wall mm	pillar mm
1887	2840	2840
2000	2840	2727
2042	2840	2668
2100	2800	2628
2150	2750	2578
2200	2685	2528
2250	2634	2478
2300	2586	2428
2350	2536	2378
2399	2486	2329
2444	2442	2240
2500	2331	2130
2550	2232	2031
2600	2133	1932
2650	2034	1834
2686	1964	1763
2700	1936	1686
2749	1838	1418
2800	1564	1142

Bogie wagon, G2 gauge, e.g. Hbbins 12

Height above floor (mm)	Maximum width	
	wall (mm)	pillar (mm)
2055	2780	2780
2100	2780	2763
2150	2780	2744
2200	2780	2726
2250	2780	2707
2298	2780	2689
2350	2718	2635
2400	2655	2573
2450	2593	2511
2500	2531	2449
2550	2470	2380
2600	2403	2299
2650	2318	2200
2700	2233	2102
2750	2147	2004
2800	2062	1906
2850	1977	1808
2900	1891	1710
2914	1867	1682
2950	1806	1498
3000	1722	1243
3050	1542	978
3100	1369	732
3165	1143	400
3190	1057	0

Source: INTAKT

Tight coupled wagon units, e.g. Laaiis (NLD

Height above floor (mm)	Maximum width wall (mm)
1882	3030
1900	3030
1950	3030
2000	3030
2050	3030
H1 2070	W1 3030
2100	2999
2150	2947
2200	2896
2250	2844
2300	2793
2350	2741
2400	2689
2436	2652
2450	2638
H2 2477	W2 2610
2500	2564
2550	2465
2600	2366
2650	2266
2700	2167
2750	2068
H3 2779	W3 2010
2794	1953
2800	1931
2850	1742
2885	1610
2900	1553
2950	1364
3000	1176
H4 3020	W4 1100

Source: INTAKT

Goods Wagon Inspection

Poor repair of a rail wagon. Source IF P&C

Rail waggon cleaned and ready for inspection. Source: INTAKT

The transport company is responsible for the condition and cleanliness of the wagon.

✅ The person responsible for loading and unloading operations must ensure that cargo spaces of CTUs (Cargo Transport Units) are clean, dry, free of smell, tidy, and in suitable condition. This includes ensuring after unloading that the wagon is in good condition for the next journey. The conditions for rail and road transport are virtually the same.

Floor strength: The wagon must be strong enough to carry the loaded cargo — including carrying a loaded clamp truck — otherwise the floor could collapse. Any repairs must maintain overall strength.

ACTION: Reject if inadequate repairs or the floor does not look strong enough.

Floor: The floor must be dry and clean, smooth and even, without pits or holes, and have no protruding objects such as nails or bolt heads.

ACTION: Remove protrusions and clean.

Walls: Any deformation beyond normal wear and tear to panels and frames that are bent, dented, or bowed is unacceptable if it reduces the internal dimensions in any direction, or if deformation increases the risk of cargo damage.

ACTION: Reject if damaged.

Doors: Should be in good working order, capable to be easily closed and locked. The door seals must be in good condition to prevent leakage.

ACTION: Reject if any defects.

Clean: The cargo space is dry and clean, without stones, debris and residues of previous cargoes and unsuitable substances such as oil, or odours that can contaminate paper.

ACTION: Clean if dirty.

All cargo residues must be removed, including those between the floor plate joints and around recessed lashing rings. If the loading platform is soiled or cargo residues are visible, the loading platform must not be used until cleaned because lift truck or other movements can loosen

these foreign bodies and contaminate the cargo. Particular attention should be paid to plastic granulate or similar residual deposits — any contamination of pulp with this material can give rise to significant difficulties during subsequent processing.

If another suitable wagon is not available, then all responsible persons in the transport chain may agree to its provisional use in writing (photos should also be taken of the wagon clearly showing the conditions at the time) with appropriate measures to be taken: sweeping and cleaning with compressed air, and/or lining the loading platform.

- Select suitable lining materials to ensure that the material protects the cargo throughout the entire transport process (sufficient thickness, strength and friction);
- Avoid all direct contact with the soiled loading platform;
- Ensure the lining material is suitable for the cargo (e.g. do not place any plastic sheeting below pulp);
- Ensure lining materials are not damaged by the work of the lift truck.
- If necessary, the customer should remove this lining from the wagon after use and dispose of it separately.

Odour: Residual odour can easily adhere to paper. Unacceptable strong odours are those that are either nauseous or caustic. If there is an odour, check what was the nature of the last load carried.

ACTION: Ventilate if there is a strong odour; if the odour persists, reject.

Dry & watertight: The cargo space must be completely watertight (roof, walls, doors and floor).

ACTION: Reject if not watertight.

Dry and watertight

Dry also means that the loading platform and ramp must not transfer any moisture to the cargo, e.g. on the wheels of a clamp truck. Paper and pulp react hydroscopically, which means that the cargo will establish a moisture balance with the ambient climate. Also, for this reason, any wet areas on the loading platform will affect the paper quality even if they have no direct contact with the paper. Wet or moist areas on loading platforms are always a cause of complaint among customers or external inspectors during receiving inspections. In general, treat moisture or wetness with scepticism — not everything that is wet has to be water. It is not recommended to attempt to shield damp areas with layers of paper, cardboard or plastic because they slip during loading. In addition, moisture penetration may occur during transport. Even if the cargo does not have direct contact with moist areas, there is still a risk that the cargo will absorb moisture or a smell indirectly transferred from a contaminated loading platform.

⚠ There are countless hazardous liquids that could have contaminated the wagon floor. Loading personnel often check a spilled liquid by touching it, but this should be avoided as it presents a potential safety hazard.

Covered rail platform ensures dry conditions for loading and unloading. Source: IF P&C

Preparations Before Loading

Check the Load Plan

Load securing requirements vary with the expected stresses and requirements of the respective means of transport. This may be:

- Single wagon
- Group of wagons/whole train/no shunting
- Multimodal transport (container or truck trailer on a goods wagon)
- Sea transport.

Only use wagons adapted to the type of goods to be transported. Follow loading instructions. Wagons shall be in good condition, the loading surface undamaged and clean and free from foreign objects that could damage the paper or impair friction.

Persons undertaking load planning should ensure that the legal maximum axle weight is not exceeded, both lengthways and crossways. Protective paper should be placed under the rolls in moist weather conditions if there is a moisture risk. Anti-slip material and protective paper should not be used at the same time.

- Rolls, pallets, bales and packages should be loaded so that the load is as low as possible and the maximum floor area of the wagon is used.
- Empty space should be left in the middle of the wagon.
- Units have to be loaded so that it is possible to discharge them from both sides of the wagon. Standing and lying roll loading is possible.
- If it is necessary to load lying rolls, then they must lie lengthways along the wagon. Rolls have to be secured and lashed with wedges, anti-slip material and belts.
- Place all rolls so that the closing and opening of the doors/walls will not damage them. Make sure that the doors/walls are closed and secured.
- Opposite doors/walls shall be closed and locked.
- Necessary load securing equipment shall be available.
- Use best practice procedures for all risky operations in all handling stages (these should be checked at reasonable intervals).
- Use handling equipment (trucks and devices) adjusted to the properties of wagons and loading.
- As far as possible, the intended loading space should provide a good working environment in terms of lighting, exhaust fumes, noise, dirt, flooring etc.
- The surrounding environment should not cause any damage to the goods.

Check the relevant regulations

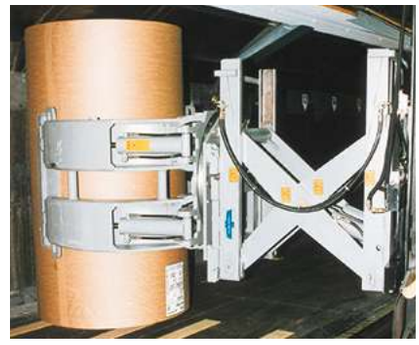
Best practices provide a general indication to actions related to rail logistics. However, the relevant national or contractual regulations will always take precedence. In addition, these may be periodically changed and, therefore, they should always be consulted. These regulations include for example:

- DB Cargo AG (UIC loading guidelines) www.dbcargo.com
- SSB Cargo (UIC loading guidelines) www.sbcargo.com
- UIC (UIC loading guidelines) www.uic.org

Loading/Unloading Procedures

✅ Long reach paper clamps have the advantage that the cargo can be set down at almost any point on the loading platform, e.g. in the centre along the length of the wagon.

❌ Without this type of clamp, the rolls placed in the centre cannot be unloaded from the side of the wagon without a risk of serious damage. If rolls are either pushed against the edge of the wagon from the opposite side using a second roll, or pulled towards the edge using a sling, then the ends of the rolls can be seriously damaged by an uneven floor, protrusions or debris.



Long reach paper clamp. Source: Cascade

Wet Weather Operations

Wagons with sliding walls have large door/wall openings for fast unloading. However, these openings also expose the cargo to weather, resulting in damage in the event of rain or if negligent workers interrupt unloading without closing the door/walls.

The degree of damage increases if these rolls are stowed without further measures being taken. It is often incorrectly assumed that paper rolls have waterproof wrappings. However, paper often needs to be handled in less than dry weather conditions and the decision as to how wet the paper may become lies with the owner of the goods.

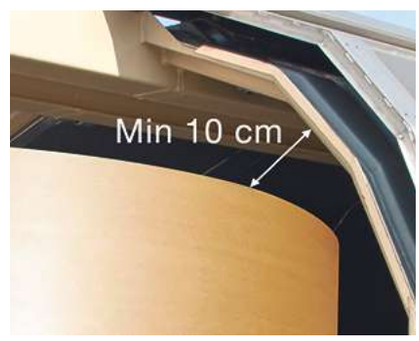
Wet paper rolls. Source: FMS 'Use No Hooks'

Loading Standing Rolls

Rolls must be stowed close to each other to give maximum support. Weight is distributed evenly on both sides of the centre lines, both lengthways and laterally. All roll rows are blocked against the wagon ends. If the entire floor surface is not filled, then the empty space should be in the middle of the wagon.

Free space of minimum 10 cm (4 in) to be left for:

- Rolls that reach the angled part of the sliding doors.
- Wagons without heavy-duty sliding door/walls* when rolls are stowed in zigzag or in uneven rows. (*Contact the railway company for more information on heavy-duty sliding doors.)



Leave space for rolls that reach the angled part of the sliding doors. Source: INTAKT/OPHAL

Load extender placing rolls on anti-slip material. Source: INTAKT

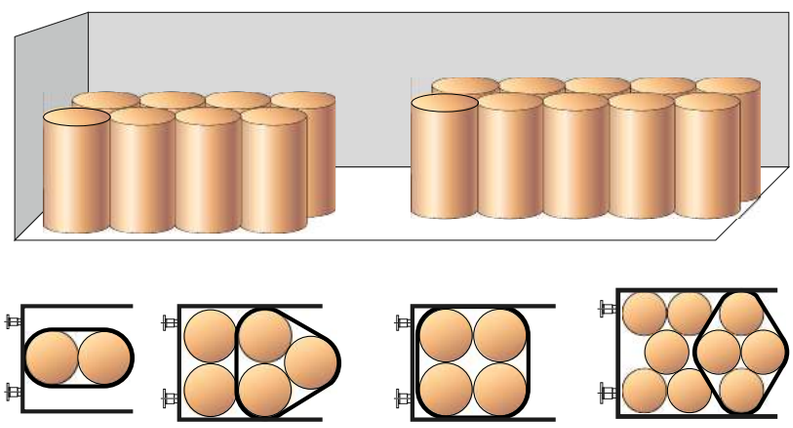
Rolls being secured. Source: IGP

Lashing & Securing

The loading areas for wagons at European paper mills are normally protected against adverse weather conditions. Source: INTAKT

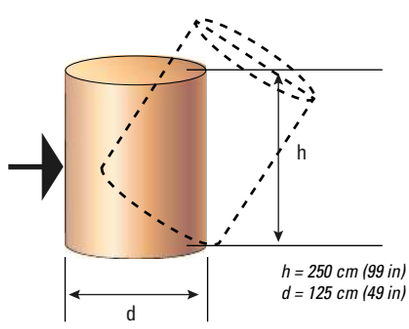
See Module 5 pages 20-21 for best practice clamp truck techniques for loading and unloading.

- Belts are used for securing vertical and horizontal rolls, bales and packages. Horizontal belts must be secured onto the rolls to prevent the belts from slipping down.
- Airbags can be used to fill empty spaces in wagons.
- Risers can be used to secure the second or upper layer of rolls. Risers should be used under the rolls in the middle, fore or aft of the wagon to lift the joint between the roll layers higher to prevent roll movement.
- When lashing and securing horizontal rolls use wedges to prevent lower rolls in the middle of the wagon from moving.
- As a minimum, normally at least two lashing belts for each row of pallets/packages are required for securing the cargo. Corner protection profiles should be used under belts at the top of the load.
- The person in charge of loading operations must check that the cargo is properly secured and lashed.



Lashing and securing of standing rolls. Drawings source: UPM/OPHAL.

Securing Rolls Against Tipping Risk



Drawings source: Cascade/OPHAL

Standing rolls in the lengthways direction of the wagon —

Single wagons: Rolls with a diameter (d) less than 0,7 of the roll height must be secured against tipping.

Wagon groups: Entire trains and multimodal transport: Only wagons that are not shunted! Rolls with a diameter (d) less than 0,6 of the roll height (h) must be secured against tipping.

Rolls less than 0,7 and 0,6 (whole trains without shunting) must always be secured against tipping!

$$\frac{d}{h} = \frac{125}{250} = 0{,}5$$

In the transversal direction of the wagon —

Rolls with a diameter (d) less than 50% of the roll height (h) must be secured to avoid toppling.

$$\frac{125}{125} = \frac{d}{h} = 1{,}0$$

Securing of standing rolls at risk for tipping —

When two or more rolls with the same diameter are placed on top of each other:

- The total height of the stack without lashing may not exceed the roll diameter divided by 0,7 (single wagon) or 0,6 (entire train).
- The bottom layer must be without space for multi-layer loading.

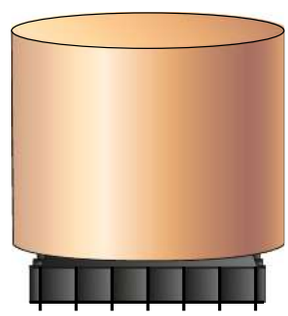
For rolls that must be lashed together:

- A maximum of six rolls lashed together.
- Single roll layer – each roll group is lashed with one strap.
- Double roll layers – each roll group is lashed with two straps, one for each layer.
- Triple layers – each group is lashed with two straps, one each for the two upper layers.
- Rolls in the top layer shall be blocked backwards and forwards against rolls in the lower layer. This can be done by placing them against higher rolls or against the wagon ends.
- Lashings shall be secured so as not to slide down.

Dunnage used between rolls to reduce shifting of standing rolls. Source: INTAKT

Preventing Load Shifting of Standing Rolls

Standing rolls loaded in rows on anti-slip material. Source: INTAKT.



Risers can be used to secure the second layer of rolls. Drawings source: UPM/OPHAL

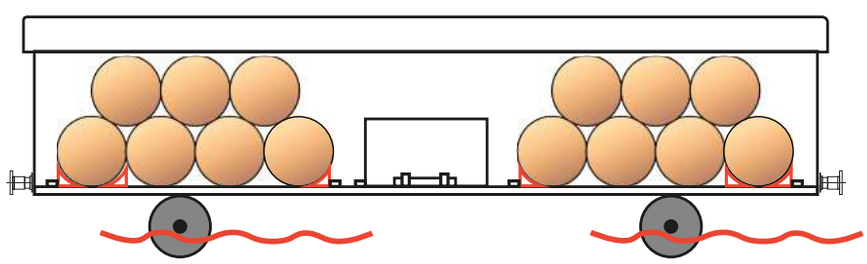
Load standing rolls in rows with support from the wagon ends. Use anti-slip material or approved friction end plates:

- A minimum friction coefficient is required to comply with the norms for using friction enhancing mats and head covers to secure the load — verify what this is at your location (for example 0,7 μ).
- When the stacking height exceeds the height of the doors/walls, friction enhancing mats or head covers are placed under all rolls.

When the stacking height is less than the height of the doors/walls, friction enhancing mats or head covers can be omitted only if the wagon has heavy-duty doors/walls and if rolls are placed in straight rows with a maximum 10 cm (4 in) from the sliding doors/walls.

Loaded standing rolls. Source IF P&C

Securing Lying Rolls



Rolls loaded across the wagon. Drawings source: TRANSWAGGON/OPHAL.

Roll axis across the wagon

Horizontal rolls without a dedicated locking cradle should be placed with the roll axis across the wagon:

- The bottom layer is placed close to the wagon ends or against blocks.
- Roll groups to be limited to 3 - 4 rows of rolls in the bottom layer, around 4 - 7 tonnes.
- Saddled rolls in an upper layer must not have a larger diameter than rolls in the bottom layer.
- Friction enhancing strips are placed under the saddled layer.

Minimum wedge height:

- 15 cm (6 in) for rolls < 80 cm (32 in).
- 20 cm (8 in) for rolls > 80 cm (32 in).
- The rolls shall be placed with a free space of at least 10 cm (4 in) between rolls and doors/walls.
- Wedge angle ca: 35°.
- Wedge width ca: 20 cm (8 in).

Number of wedges:

- 2 wedges for roll widths <1500 mm (59 in)
- 4 wedges for roll widths >1500 mm (59 in)

Roll axis along the wagon

Some wagons have integrated securing devices for this kind of handling, e.g. metal wedges.
Specially designed and approved cradles can also be used for this kind of transport.
Loading and unloading of jumbo rolls is particularly demanding.

⚠ Routines, wagons and devices should be adapted to eliminate hazards.

✘ *Nailing wedges to the floor is no longer practiced in most European countries because this damages the floor and may cause splinters that damage paper. Source: INTAKT*

✔ *Roll axis along the wagon paper secured by adjustable wedges. Source: INTAKT*

Loading Examples

Standing rolls. Source Stora Enso

Standing Rolls (eye-to-sky)

Loading into wagons with sliding walls and fixed end walls:

1. Rolls should be loaded standing in one or more tiers. The first tier should cover the entire loading surface. The rolls in subsequent tiers should be placed exactly on top of each another.
2. When loading without intermediate spacing, the roll diameter must be at least 50% of its height.

Rolls shall be arranged in the wagon:

3. In a single line, one behind the other (roll axis placed lengthways along wagon), or
4. In two staggered lines (evenly distributed lengthways along the wagon, with empty spaces); any transverse offset relative to the roll diameter to be reduced to a minimum, or
5. In two lines, with the rolls one behind another, or
6. In several staggered lines,
   - standing and in contact with the end walls, with space left in the middle of the wagon
   - no contact with the sloping part of the roof.
7. If arranged according to (4) or (6), use either one fastening per group secured crossways in the wagon or a fastening as per (10) and an intermediate space of at least 10 cm (4 in) between the load and the sliding walls, including the sloping roof areas.

Securing

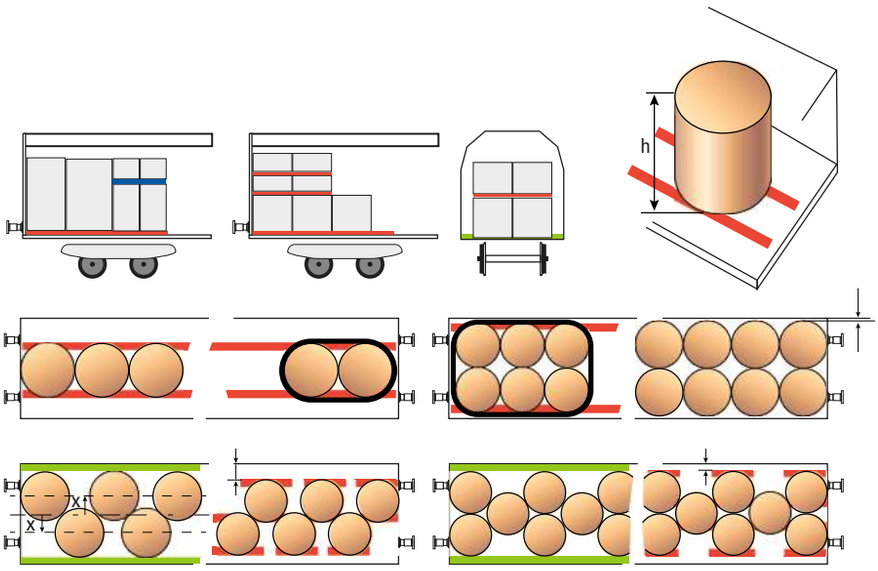
Lengthways in the wagon —

8. Using the end walls, able to slide if appropriate; rolls with diameter less than 60% of their height should be bound together (minimum breaking strength of straps: 1000 daN / 2248 lbs force) and prevented from moving. (The minimum breaking strength (straight pull) corresponds to double the permitted tensile force (LC); this relates only to synthetic straps, woven straps and load securing straps.)

Crossways in the wagon —

9. Using guide rails that are an integral part of the wagon (profiled tubes 5 cm high with the upper edge facing the goods rounded off to avoid causing damage), or fixed using the holes in perforated guide pieces, or with cradles resting against the sliding walls (corrugated cardboard, several layers thick, wooden laths) to fill up the lateral clearance in the wagon.
   - ✘ Nailing wedges to the floor is no longer practiced in most European countries because this damages the floor and may cause splinters that damage paper.
   - cradles resting against the sliding walls (corrugated cardboard, several layers thick, wooden laths) to fill up the lateral clearance in the wagon.
10. Using friction mats with two parallel strips laid lengthways under each roll, with a minimum width of 15 cm (6 in) for rolls with a diameter lower than 50% of their height and a maximum thickness of 5 mm (1/5 in); the friction coefficient, resistance to deformation and average resistance to dirt shall be guaranteed by the manufacturer; or
11. Sliding walls if loaded as shown, then loading without friction mats is possible providing the lateral clearance to the sliding wall is 10 cm (4 in) and the height of the paper rolls is no greater than the vertical part of the sliding wall.
12. If the rolls are stacked, anti slip material shall be placed between each tier.

Data source: http://www.dbcargo.com/rail-deutschland-en/products_services/additional_services/cargo_securing/loading_guidelines.html



Drawings source: DB Cargo/OPHAL.

This is an example and the relevant national or contractual regulations will always take precedence and should be consulted. Drawings source: Fr. Meyer's Sohn/INTAKT/OPHAL

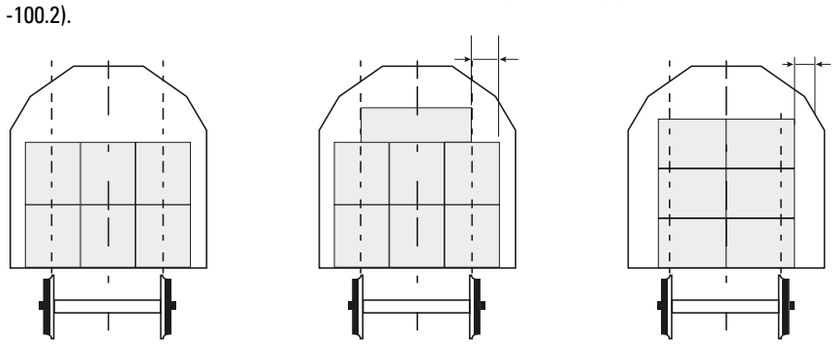
Rail wagon with sliding doors ready for loading.
Source: IF P&C

Wagons with Heavy-Duty Sliding Doors

Covered wagons suitable for paper traffic should have heavy-duty sliding doors recognisable by the type-designation 'ii', e.g. 'Hbbiins or 'Laaiis'. The loading guidelines determine the conditions under which the sliding doors may be used as a securing device for the load. Example:

Standing Rolls (eye-to-sky)

Bogie wagons and permanently coupled wagon units with strengthened sliding walls and fixed end walls, marked with the code letters "ii" or conforming to loading guidelines (Volume/Section 2 -100.2).



a b c

Applicable only to wagons with heavy-duty sliding walls for rolls of paper and wood pulp with a diameter of at least 50% of the height of the rolls or stacks:

a) Rolls loaded in one or more tiers, the total height not exceeding the vertical part of the sliding walls.

b) The total height of rolls loaded in several tiers shall not exceed the vertical part of the sliding walls, with a further tier loaded centrally in the sloping roof area only if the underlying tiers are arranged in aligned rows.

c) Rolls loaded in one or more tiers, their total height exceeding the vertical part of the sliding walls.

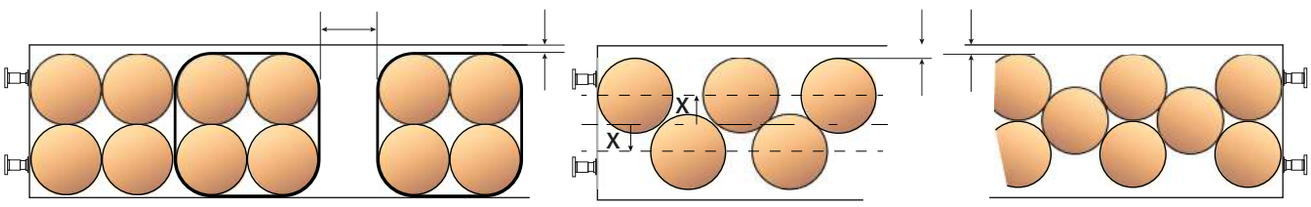
Loading

1. Rolls should be loaded in a continuous pattern, packed tightly against each other, in one or two tiers, with the first rolls against the end walls and using as much of the floor area as possible.
2. Lateral clearance to the sliding walls is 10 cm (4 in) maximum.
3. When loaded as in (b) above, the lateral clearance between the tier and the sliding wall in the sloping roof area must be greater than 10 cm (4 in).
4. When loaded as in (c) above, the distance to the walls should be about the same on each side and be at least 10 cm (4 in) in the sloping roof area.
5. Lengthways, any loading space should be left in the centre of the wagon; when loading in several tiers, a loading space may only be left in the upper tier.

Rolls should be arranged in:

6. Rows packed tightly one behind another (and one next to another as appropriate) when the diameter of the rolls is no more than 50% of the loading width; or
7. Two staggered rows, one next to the other, when the diameter of the rolls is greater than 50% of the loading width (any transverse offset relative to the roll diameter to be reduced to a minimum); or
8. Several staggered rows, one next to the other, when the diameter of the rolls is less than 50% of the loading width.

Rolls on a wagon. Source: IF P&C



Drawings source: DB Cargo/OPHAL

Securing

Lengthways in the wagon —

9. By the end walls.

10. When there is a space of more than 50 cm (20 in) in the centre of the wagon, any freestanding rolls must be bound to the adjacent rolls with self-adhesive fastenings (breaking strength 1000 daN / 2248 lbs force minimum) or secured against sliding.

Crossways in the wagon —

11. Goods as in (a) above, by the sliding walls.

12. Goods as in (b) above, by the sliding walls, with the tier in the sloping roof area secured using friction-enhancing inserts/packaging.

13. Goods as in (c) above, by enclosed lateral securing or lateral guide pieces or friction inserts/packaging; the upper tiers should be secured using friction mats.

Maximum thickness of supporting scotches and friction-enhancing inserts: 5 mm (1/5 in).

✅ Place corrugated board around the bottom of the walls to help protect rolls that turn during transport from coming into contact with wagon wall.

This is an example and the relevant national or contractual regulations will always take precedence and should be consulted.

Source: http://www.dbcargo.com/rail-deutschland-en/products_services/additional_services/cargo_securing/loading_guidelines.html

Transporting a Wellbed cradle. Source: INTAKT

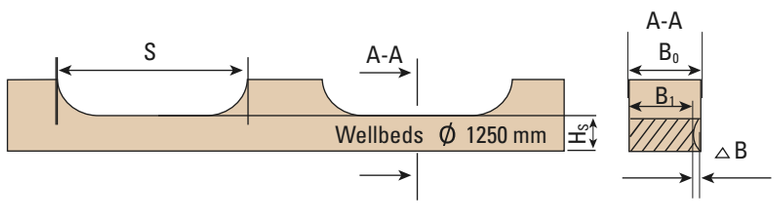
Loading example Wellbeds®

Paper rolls on cardboard saddles (Wellbeds®)

Loaded goods

These may be a single or a twin cradle lying in a lengthways direction. They must be checked for operational fitness prior to transport.

Discard criteria for Wellbeds®



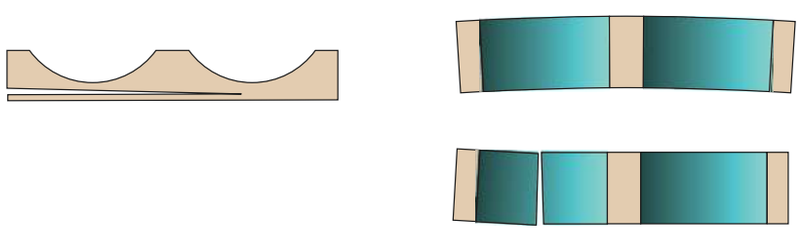
Drawings source: DB Cargo/OPHAL

B0 Saddle width
B1 Minimum width in the area of damage (depression)
ΔB Maximum depression
S Saddle cradle

No vertical depression is allowed inside the saddle area. Outside the saddle area, a maximum vertical depression of 10% is allowable.

HS Minimum saddle height 80 mm (3 in).

The limits for the maximum depression for each relevant area, and diameter variations and maximum loading per cradle are inscribed on the Wellbed®.



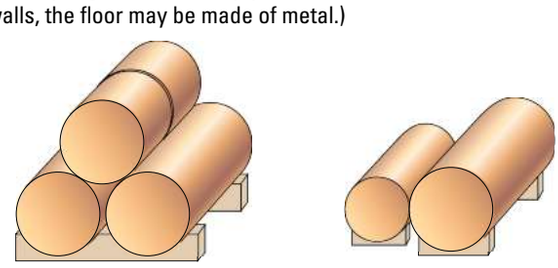
Drawings source: OPHAL

No deformation is allowed from delamination, buckling or curving.

Wagons

Sliding-wall wagons with flat, multilayer glue laminated plywood floor (close to the end walls and along the lengthways sidewalls, the floor may be made of metal.)

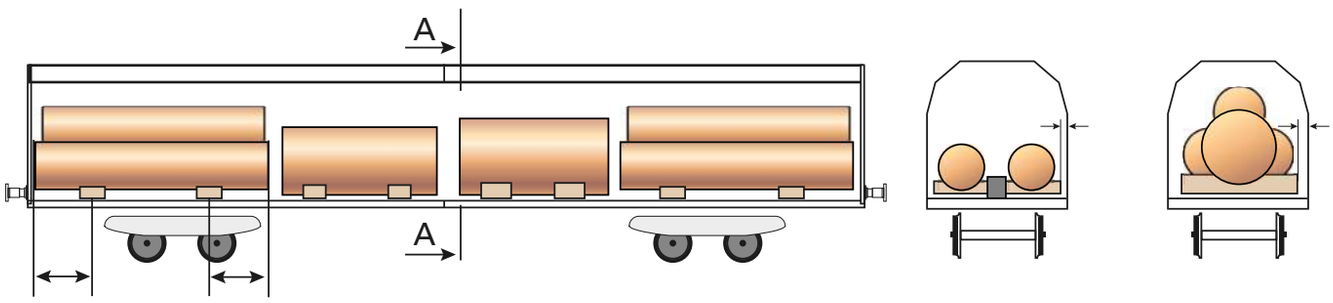
Loading type for rolls



Loaded next to each other on twin-cradle Wellbeds®, provided they have about the same diameter and the same width; a third roll may be saddled on top of them, provided the diameter of the saddled roll does not exceed the diameter of the rolls underneath it. Saddled rolls must not protrude in the lengthways direction beyond the underlying rolls.

Rolls should extend at least 50 cm (20 in) on both sides from the centre of the Wellbed®.

Where rolls are loaded next to each other on single-cradle Wellbeds® it is not permitted to saddle rolls on top of them. If rolls have different diameters, loads must be properly distributed crossways in the wagon. Single rolls have to be loaded in the centre of the wagon, evenly distributed lengthways. No contact with the sliding walls.



Securing of cargo lengthways in the wagon:

Rolls and Wellbeds® have to be secured using a sliding load pattern. The cradles are equipped with friction coating (coloured differently). If the coating is worn, anti-slip material (μmin = 0.6) with a minimum width of 150 mm (6 in) may be inserted to cover the entire length of the cradle.

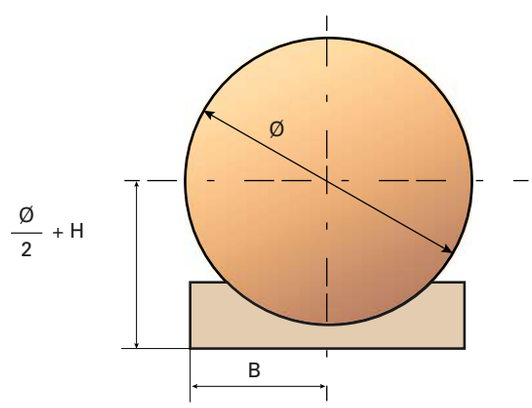
Securing of cargo in crossways in the wagon:

Secured by the Wellbeds®, with a distance of ≥ 10 cm to the sliding walls, or

Where rolls are placed next to each other on single-cradles or when a Wellbed® extends beyond a single roll, the distance between roll and sliding wall must be ≤ 10cm ‘4 in)

Where rolls are loaded on single-cradles, any voids between rolls/cradles have to be filled. The filler must be a one-piece element that extends beyond the cradle by 60cm on each side.

Observe the tipping ratio.



This is an example and the relevant national or contractual regulations will always take precedence and should be consulted.

Data source: *http://www.dbcargo.com/rail-deutschland-de/products_services/additional_services/ladungssicherung/verladebeispiele/papier.html*

Drawings source: DB Cargo/OPHAL

Rail Transport Damage Sources

Pallets that have shifted during rail transport. Source: INTAKT

Rolls damaged from door posts.
Source: Idealliance

Risk of incorrectly secured loads. Source: IGP

Doorpost Rolls: Damage can be the result of a lack of doorpost protection or unloading difficulties. Write "Doorpost" on the roll before photographing.

Kissing Roll: Impact damage on the top edge of a first tier roll marries with bottom edge damage on the second tier roll. This results from rolls "kissing" or jumping at some point during transit. The roll damage may not be perfectly aligned because the rolls can turn during transit.

Kissing damage on the bottom edge of the top roll and top edge of bottom roll.
Source: Idealliance

Excessive Rail Handling: Excessive wagon handling can result in significant damage. Any wood chocks or unusual material on or in a wagon usually indicate it has had a problem in transit.

Toppled Rolls: Causes include loading and rail handling. Toppled rolls are a safety hazard that should be thoroughly investigated.

Excessive wagon handling can result in significant damage. Source: Idealliance

Photographs of toppled rolls help identify rail handling or mill loading errors. Source: Idealliance

Minor Chafe Damage: Occurs on rail or intermodal shipments. Rolls will show chafe damage around the entire circumference. Wrap shows evidence of turning. May see shavings on the floor. Usually the result of a mechanical problem with the wagon unless cores are too long or rolls are loaded very loosely against each other.

White paper is usually undamaged but roll appearance is poor. Report wagons number if vibration problems.

Minor chafe damage is generally caused by vibrations during rail transport Source: Idealliance

Roll to roll scuffing. Source: UPM

Severe chafe damage from excessive rail transport vibration. Source: Idealliance

Major Chafe Damage: Vibration can cause rolls to turn so violently that the wrapping is removed and the white paper exposed. Light brown dusting and shreds of white paper may be left on the wagon floor. Turning of the roll can also cause rolls to "walk" out of their end shields (headers). Report wagons number if vibration problems.

Wrong Type of Wagon: In North America, Excessive edge damage can occur if fine paper rolls are shipped in a Rigid Under Frame (RUF) wagon. Only a Cushioned Under Frame (CUF) wagon should be used — these have a coupler that allows movement to facilitate the cushioning device (a rigid wagon has a fixed or immovable coupler).

9 Containers Transport

Source: Hapag-Lloyd

CONTENTS

2 CONTAINER CARE AND CHALLENGES
4 Load Planning
5 Moisture & Condensation
6 CONTAINER INSPECTION
8 Inspection Checklist
10 Condition Examples
14 CARGO PROTECTION
14 Loading
15 Securing
17 Checklist after loading

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

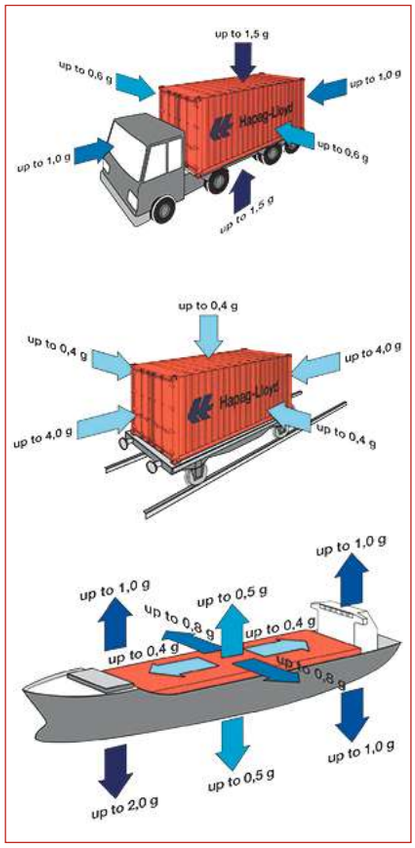
Poor Practice

Safety Issues

Environmental & Economic Impact

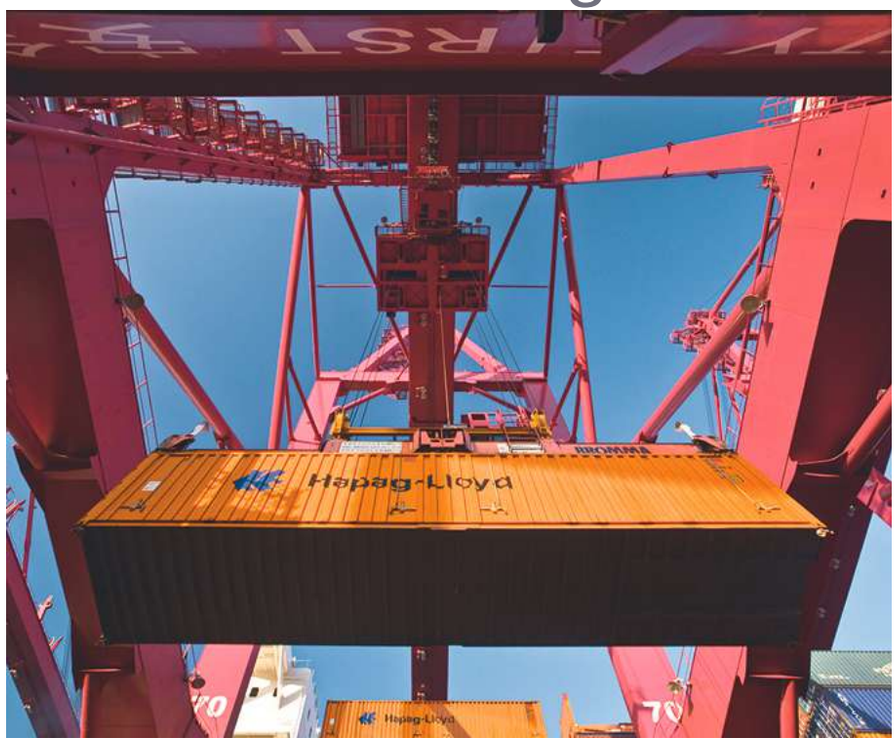
Container Care & Challenges

Transport Stress



Acceleration forces on a container. Cargo in containers must be secured to withstand all stresses resulting from their sea and land transport, as well as handling. Source: Hapag-Lloyd, values CTU Code

Van carrier for container transport around terminal. Source: HHLA



Source: Hapag Lloyd

Dry cargo containers are widely used for transporting paper products. Initially, they seemed to offer unlimited advantages, but it has become increasingly difficult to organise smooth container transport because homogeneous cargos as a simple basis for form and friction-locking stowage are less and less common. Cargo unit sizes are highly variable and the sizes and weights of paper rolls rarely coincide with container dimensions.

There are three types of vessel that carry containers — feeders, Panama and post-Panama. Feeders are the first and last link in the sea transportation chain of containers. These ships are used for transporting containers to and from smaller ports that bigger vessels cannot enter.

Containers may be subject to harsh treatment both when handled at the shipping terminal and also by all types of transport from braking, sharp turns, and uneven ground. The stresses of sea transport pose a particular challenge to the safety of the cargo units and their securing. Bad conditions at sea have an effect similar to a truck braking sharply in normal traffic conditions; in addition, the container may also be subject to brief peak loads and repetitive stresses from a ship's rolling motion over a period of days. In serious cases, with each rolling motion some of the cargo units in the container can slide into the gaps between the cargo.

If the entire cargo "settles", the existing voids can become one large cargo gap. This can cause the cargo to build up high kinetic energy. After a certain time, the container is no longer able to absorb these continuous forces and becomes seriously damaged. The paper (rolls, pallets, pulp) subjected to these conditions can be rendered unusable.

Even before the journey starts, a container could be set down so hard that its load securing method is compromised. After pre-carriage and transport by sea to the port of entry, the container is usually delivered to the receiver, who may or may not have an adequate understanding of suitable handling techniques and might be incorrectly equipped.

As their average service life has increased, along with difficult cargoes like waste metals and plastics that deteriorate containers and repairs that are often inadequate, the condition of containers is declining. For example, some floors may be too weak to support a loaded lift truck.

Standard size *High cube*

A standard container alongside a high cube container that is frequently used for paper rolls. Source Holmen

Container wall damaged by the cargo within. Source: FMS 'Use No Hooks'

Container door damaged by cargo within. Source: FMS 'Use No Hooks'

✅ Transport by a container vessel, truck or train begins with ordering the correct container and continues with their inspection, correct loading and securing of the cargo. Load planning should ensure that the legal maximum weight, per transportation unit is not exceeded.

Standard size containers

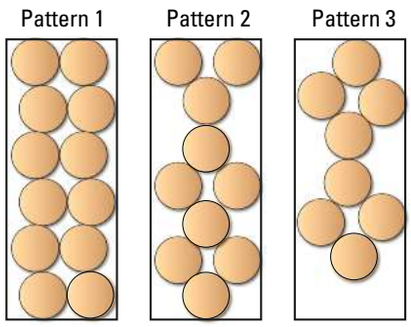
Standard containers sizes according to ISO 668 and ISO1496-1 for their doors. New pallet-wide containers are used in Europe for 40' and cube sizes with a wider internal dimension to allow two standard Euro pallets to be stowed side-by-side. Not all containers are standard sizes so it is important to verify dimensions when ordering. Dimension tolerances from production variations is 10 mm (3/8 in). Source: Hapag-Lloyd.

High-cube containers are mostly 40' long, but are sometimes 45'. Many 40' containers have a recess in the floor at the front end to centre the container on a 'gooseneck' chassis to allow them to lie lower and therefore to be of taller construction.

Internal	20' Standard		40' Standard		40' High cube	
Length	5867 mm	19'3 in	11998 mm	39'4 in	12020 mm	39'5,25 in
Width	2330 mm	7'7-3/4 in	2330 mm	7'7-3/4 in	2342 mm	7'8-1/8 in
Height	2350 mm	7'8-1/2 in	2350 mm	7'8-1/2 in	2693 mm	8'10 in
Door opening						
Width	2286 mm	7'6 in	2286 mm	7'6 in	2416 mm	7,93 ft
Height	2261 mm	7'5'	2261 mm	7'5'	2585 mm	8,48 ft
Weight						
Max. gross*	30480 kg	67200 lbs	30480 kg	67200 lbs	29370 kg	67200 lbs
Tare	2250 kg	4960 lbs	3780 kg	8330 lbs	4630 kg	8860 lbs
Payload	28230 kg	62240 lbs	26700 kg	58870 lbs	26460 kg	58340lbs
Volume	33,2 m^3	1172 cu ft	67,7 m^3	2390 cu ft	79 m^3	2694 cu ft

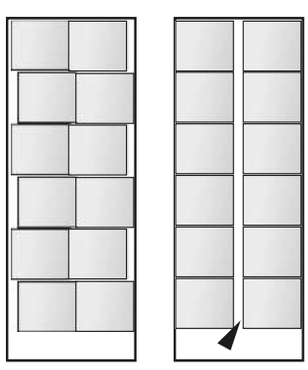
**34000kg maximum for 'heavy weight' containers. Source: Hapag-Lloyd*

'Container Specification' published by Hapag Lloyd has comprehensive information available from www.hapag-lloyd.com



Loading patterns 2 and 3 require additional securing to ensure stability.
Source: OPHAL

Example of a CSC information plate fixed to container door. Source: INTAKT



Pallets loaded in a form locked pattern (left). Load pallets along the container walls if there are large gaps they must be filled (right). Source: OPHAL

Load Planning

✔ Load patterns should be determined for each roll diameter because larger and smaller sizes require different solutions. Actions to optimise container capacity and minimise lashing and securing costs include:

Total weight: Do not exceed the maximum weight limitations of the entire delivery chain and of the container's carrying capacity. This includes the maximum permitted container payload or gross weight, any special customer requirements, and the country (e.g. axle load road transport) or port of destination. A container's maximum weight limit is specified on the CSC plate fixed to the container door. A new IMO regulation requires the shipper to supply the Verified Gross Mass (VGM) of packed containers *(see page 16).*

Maximum payload: Maximum loading volume and mass is stipulated on the CSC plate. A suitable loading pattern should be used to achieve the maximum payload.

Lashing: The loading of the container should be planned effectively and safely so that the minimum amount of lashing is needed for safe cargo securing.

Weight distribution: The horizontal weight distribution should be as even as possible. The vertical centre of gravity should be in the middle by placing cargo units symmetrically. Heavy rolls must be loaded to both ends of container a nd not the centre. See also the 'CTU Code' (Code of Practice for Packing of Cargo Transport Units).

Standing (vertical) roll loading patterns: The effect of the loading pattern to the container payload is shown in the diagrams. The illustrated rolls have a diameter of 100 cm (39 in) loaded in a single layer in a 20' container.

Loading patterns of lying (horizontal) rolls: If rolls are to be manually unloaded, the width of lying loaded rolls must be smaller than the width of the container doorway. A reasonable space must be left between the roll end and the container wall/doorway.

Pallet loading patterns: Minimise the empty space between pallets and container sidewalls. It is preferable to split any remaining void space so that it is equal on both sides of the container. Correct loading techniques require a small handling space across the width of the container — this may vary slightly with handling method. Any larger gaps required for correct handling must be filled.

For larger gaps the pallets should be loaded along the container walls. The empty space in the middle allows access for securing.

✔ It is essential that the cargo cannot move and it is recommended to fill gaps with airbags.

Pallets per container

Pallet size		20' container	40' container
Length x Width		N° pallets	N° pallets
600 x 400 mm	23,6 x 15,7 in	53	108
800 x 600 mm	31,5 x 23,6 in	26	53
1100 x 1100 mm	43,3 x 43,3 in	10	20
1130 x 1130 mm	44,5 x 44,5 in	10	20
1150 x 1150 mm	45,3 x 45,3 in	10	20
1150 x 750 mm	45,3 x 29,5 in	15	31
1200 x 1000 mm	47,2 x 39,4 in	10	20
1200 x 800 mm	47,2 x 31,5 in	11	24
1300 x 1100 mm	51,2 x 43,3 in	8	18
1420 x 1120 mm	55,9 x 44,1 in	8	16
2000 x 1250 mm	78,7 x 49,2 in	4	9
2250 x 1250 mm	85,6 x 49,2 in	4	9

The greatest moisture stresses occur in winter when transporting from a cold to a warmer climate.
Source: Hapag Lloyd

Source: Hapag-Lloyd

Moisture & Condensation

There are several causes to manage. The greatest moisture stresses occur in winter when transporting from a cold to a warmer climate — frost turns to water when the temperature rises, and moisture in the air may condensate on a cold roll. Condensation will form inside the container if the temperature goes up after paper has been loaded and the doors closed. Moisture entering a container during a warm day will condense on the container's internal roof when the temperature falls at night and this moisture drops onto the paper — this effect can be repeated over many days of a voyage, particularly if the container is above deck, or in the container yard, and exposed to the sun with temperature variations of 20-30°C (68-86°F). Incomplete drying after washing is another cause.

- ✅ Minimise condensation by using practices adapted to prevailing climate conditions. Do not expose paper to rain or snow. Moisture absorbing materials can be placed inside the containers, ensure proper ventilation before loading. The container has no ventilation once its doors are closed.

Containers exposed to the sun can have temperature variations of 20-30°C (68-86°F). Any moisture trapped inside will evaporate and when the temperature falls at night condenses and drops onto the paper cargo.
Source: Hapag-Lloyd

Container Inspection

Tool to detect protruding screws is particularly useful in poor light conditions. Source: UPM

Unacceptable dirty and soiled floor. Source: IF P&C

Ensure there is adequate lighting for visual inspection. Source: FMS 'Use No Hooks'

Protruding floor screws may penetrate the end of the paper roll and damage the paper. Source: FMS 'Use No Hooks'

The condition of a container may make it unsuitable for paper use. Containers are subject to different stresses, for example on short voyages they may be loaded and unloaded every two days, whereas those used on longer routes may be handled only every few weeks and are, therefore, subject to less handling stress.

Control begins when the container is ordered by stating precisely the intended cargo. Some companies incorrectly assume that roll packaging (particularly end shields) is resistant to water, oil, dirt and moisture — this assumption may only be valid for palletised paper that does not come into contact with the container floor.

Shippers who pack containers at their own facility on their own responsibility should inspect the containers on receipt. The forwarding agent or the customer ordering the container should verify whether the depot carries out the appropriate inspections and document these in an interchange form.

⚠ / €² The risk of accepting a container without inspection is that it is generally assumed that any damage (not recorded at the time of delivery) was caused at a later date by someone else. This applies to all further transfers of the container to other persons within the transport chain. The lack of traceability makes regress very difficult and leads to disagreement. Most large container terminals inspect incoming and outgoing containers for damage, and increasingly use video technology for this.

✔ The condition of the empty container should be checked at delivery and any damage noted in writing on the interchange form. On transfer, the next responsible person (e.g. truck driver) should check the container is in the same condition and report any damage or sign a clean receipt.

Inspection

✔ The line between usability and unsuitability can be objectively addressed using a container checklist (*see page 9*) combined with photographic examples of different components.

Every container must be inspected for foreign bodies prior to loading. These are not only loose objects such as wood splinters, stones, etc., but also ingrained cargo residues such as plastic granulate, or a screw protruding from the floor that may penetrate the end of a paper roll.

✘ Only inspecting containers externally on taking delivery and/or interior inspection limited to opening the right-hand door and glancing into the container is inadequate because inspection of the floor is particularly important for paper and pulp. Ensure there is adequate lighting for visual inspection.

✔ **Thoroughly check the container before loading starts for:**

Watertight: Check by going inside the container and closing the door — during daylight even the smallest beam of light indicates that the container is not completely watertight.

ACTION: Reject leaking containers.

⚠ Safety requires a second person must be present whenever a person goes inside a container.

Dry: The container should be completely dry inside. If not, there might be a leak in the floor, or small cracks in the structure or welding points etc

ACTION: Reject a leaking container.

Clean & no protrusions: The container must be clean inside. The floor should have no oil stains, and be free of nails, screws, bolt heads or other protrusions like differences in the thickness of the floor plates.

ACTION: Clean and accept, or reject.

Odour: Residual odour can easily adhere to paper. Unacceptable strong odours are those that are either nauseous or caustic.

ACTION: Reject containers with an odour.

General condition

The container must be strong enough to carry the loaded cargo. Hidden defects can be dangerous, e.g. bolted container floor joints may be defective or a repair may have been carried out incorrectly causing the container floor to bend after loading.

ACTION: Reject if in poor condition.

Floor: The floor must be capable of carrying a loaded lift truck otherwise the floor could collapse under the vehicle. ISO 1496-1:2011(draft) stipulates a maximum axle load of 7260 kg (16 006 lbs) if the contact area per wheel is at least 142 cm^2 (22 sq. in.)

ACTION: Reject if inadequate repairs or the floor does not look strong enough.

Walls: Bent, dented, or bowed panels and frames are not acceptable if they reduce the internal dimensions in any direction, for example not being able to load two 1,15 m (45,3 in) pallets side-by-side (container inner size 2,33 m / 91,7 in] or if the shape of the deformation increases the risk of cargo damage. Damaged containers may be stopped by cargo inspectors, or refused by the ship, particularly the newer container ships with a tolerance of only about 2 cm (0,8") per container when loading.

ACTION: Reject if damaged.

Doors: Must be in good condition and can be easily closed and locked. The opening and closing mechanism and door seals must be in good condition. Check for water tightness by going inside the container and closing the door — during daylight even the smallest beam of light indicates that the container is not completely watertight.

⚠ Safety requires a second person must be present whenever a person goes inside a container.

ACTION: Reject container with leaking doors.

External lifting points / upper corner castings!: Check they are complete and in good condition. (no cuts, incorrect repairs or welding etc.).

ACTION: Reject if in poor condition.

Internal lashing points: Normally found in almost all containers. Check they are in good order and complete.

The container must be rejected if it fails on any of the previous items and cannot be repaired. Unacceptable damage is that which is beyond normal wear and tear like dents, minor rust and scratches.

✘ **If container is only partially repaired after the first inspection, it should not be accepted until all required repairs are carried out.**

Examples of container that is not water tight. Source: Mëtsa Board

Is the repaired floor strong enough? Source: UPM

Examples of unacceptable walls. Source: UPM

Examples unacceptable door condition. Source: UPM

Inspection Checklist and Possible Faults

	Designation	Fault	Crack	Hole	Loose	Missing	Broken	Bent	Dent	Scratch	Rust	Dirty
1	Door sill		●	●	●		●	●	●	●	●	
2	Door header		●	●	●		●	●	●	●	●	
3	Door corner post with j-bar		●	●	●		●	●	●	●	●	
4	Door hinges		●	●	●	●	●	●	●	●	●	
5	Door locking bar with cam		●		●	●	●					
6	Door handle/linkage lever		●	●	●	●	●					
7	Door handle retainer with catch		●		●	●	●					
8	Bent door			●	●	●		●			●	
9	Door rubber gasket		●	●	●	●					●	
10	Data sign board				●	●				●	●	
11	Threshold door plate		●	●	●		●	●	●		●	●
12	internal side panel		●	●			●	●	●	●	●	●
13	Internal front panel		●	●			●	●	●	●	●	●
14	Roof internal		●	●			●	●	●	●	●	●
15	Floor		●	●	●		●	●	●	●		●
16	Lashing fittings/rings/shackles/eyes		●		●		●		●		●	
17	Top side rail		●	●	●		●	●	●		●	
18	Bottom side rail		●	●	●		●	●	●		●	
19	Fork lift pockets		●	●			●	●	●	●	●	
20	External side panel		●	●	●		●	●	●		●	
21	Front header		●	●	●		●	●	●		●	
22	Front sill		●	●	●		●	●	●		●	
23	Front corner post		●	●	●		●	●	●		●	
24	External front panel		●	●	●		●	●	●		●	
25	Roof external		●	●	●		●	●	●		●	
26	Cross member/rail		●	●	●	●	●	●	●		●	
27	External lifting points		●		●	●	●	●			●	

The type of faults that may effect the condition of a container and its fitness for use. Source: OPHAL

Source: Hapag Lloyd

CTU Code

The Code of Practice for Packing of Cargo Transport Units (CTU Code) is jointly developed by the International Maritime Organization (IMO), the International Labour Organization (ILO) and the United Nations Economic Commission for Europe (UNECE). It is a non-mandatory global code of practice for the handling and packing of cargo transport units for transportation by sea and land. See International Maritime Organization (IMO), http://www.imo.org/en/OurWork/Safety/Cargoes/CargoSecuring/Pages/CTU-Code.aspx

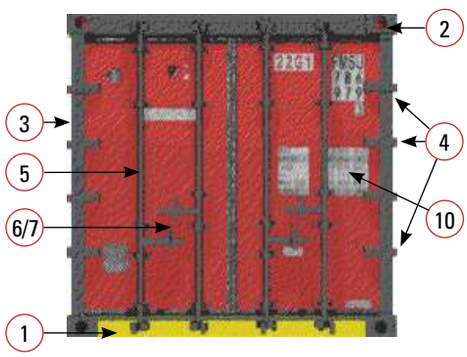
Within the CTU Code, there is comprehensive information and references on all aspects of loading and securing of cargo in containers and other intermodal transport, taking into account the requirements of all sea and land transport modes. The CTU Code applies to transport operations throughout the entire intermodal transport chain and provides guidance not only to those responsible for packing and securing cargo, but also to those who receive and unpack such units. The Code of Practice also addresses issues such as training and the packing of dangerous goods.

The CTU Code is intended to assist the industry, employers' and workers' organizations as well as governments in ensuring the safe stowage of cargo in containers. The CTU Code was recently issued as an MSC circular (MSC.1/Circ.1497) and it can also be downloaded from a dedicated website:

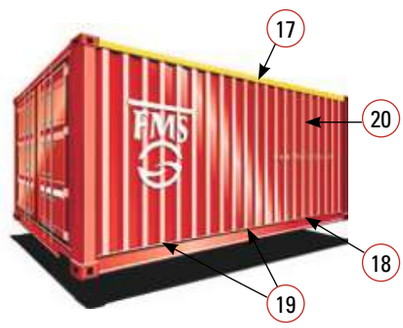
Code https://www.unece.org/fileadmin/DAM/trans/doc/2014/wp24/CTU_Code_January_2014.pdf

Related informative section https://www.unece.org/fileadmin/DAM/trans/doc/2014/wp24/IMO Circular_1498_-_Informative_Material.pdf

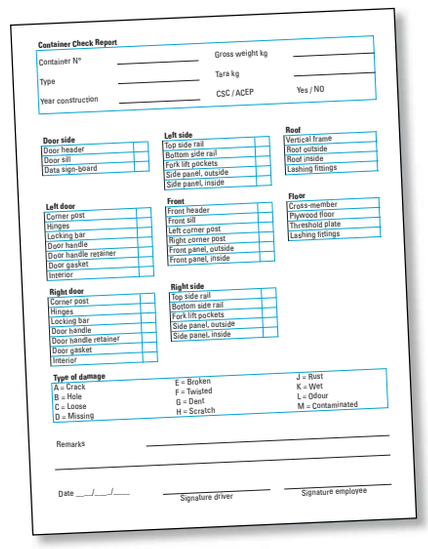
What to inspect



Door p 90



Exterior p 96 A



Container Check Report

Containerr N°		Gross weight kg	
Type		Tara kg	
Year construction		CSC / ACEP	Yes / NO

Door side	
Door header	
Door sill	
Data sign-board	

Left side	
Top side rail	
Bottom side rail	
Fork lift pockets	
Side panel, outside	
Side panel, inside	

Roof	
Vertical frame	
Roof outside	
Roof inside	
Lashing fittings	

Left door	
Corner post	
Hinges	
Locking bar	
Door handle	
Door handle retainer	
Door gasket	
Interior	

Front	
Front header	
Front sill	
Left corner post	
Right corner post	
Front panel, outside	
Front panel, inside	

Floor	
Cross-member	
Plywood floor	
Threshold plate	
Lashing fittings	

Right door	
Corner post	
Hinges	
Locking bar	
Door handle	
Door handle retainer	
Door gasket	
Interior	

Right side	
Top side rail	
Bottom side rail	
Fork lift pockets	
Side panel, outside	
Side panel, inside	

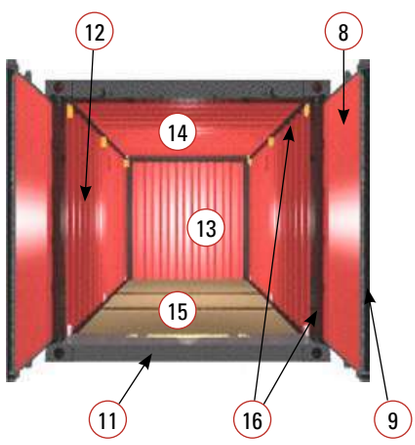
Type of damage

A = Crack	E = Broken	J = Rust
B = Hole	F = Twisted	K = Wet
C = Loose	G = Dent	L = Odour
D = Missing	H = Scratch	M = Contaminated

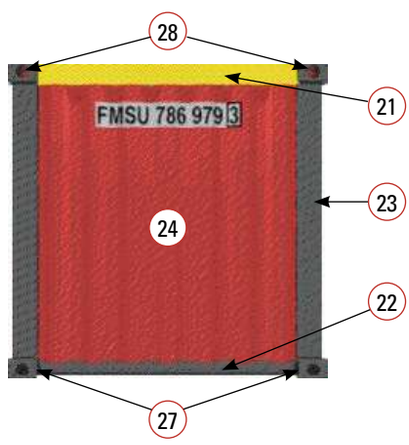
Remarks

Date __/__/__ Signature driver Signature employee

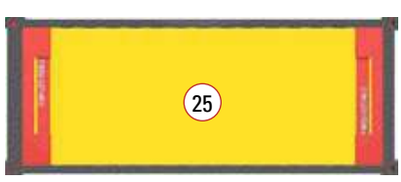
Example of a container check report as a systematic guide to inspection and to help ensure traceability and responsibility. See page 18 for full size form.
Source: OPHAL



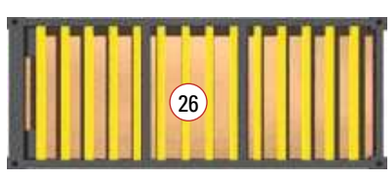
Inside p 108A



Front p 101



Roof p 106 A



Cross Member 109 A

✅ The condition of the empty container should be checked at delivery and any damage noted in writing on the interchange form.

Source all photos: FMS 'Use No Hooks'.

Examples of Container Faults

These photographic examples courtesy of 'Use No Hooks' published 2007 by FR. MEYER'S SOHN (GMBH & CO.) KG, www.fms.de

1 *Cracked door sill.*

2 *Damaged door header.*

3 *Bent door corner post (with j-bar).*

4 *Damaged hinges.*

5 *Bent locking bar.*

6 *Bent door handle/linkage lever.*

7 *Complete door handle retainer and missing handle catch.*

Source all photos: FMS 'Use No Hooks'

8 *Bent door.*

9 *Loose door rubber gasket.*

10 *Data sign board unsatisfactory and/or missing (CSC/Customs/TCT/Owner & manufacturer's plates).*

11 *Rusted threshold door plate.*

12 *Holed internal side panel.*

13 *Dented internal front panel.*

14 *Rusted internal roof.*

15 *Cracked plywood floor. Source: Mëtsa Board*

Source all photos: FMS 'Use No Hooks'

Examples of Container Faults

16 *Sound top lashing point.*

17 *Broken top lashing point.*

18 *Missing bottom lashing fittings.*

19 *Sound bottom lashing poin*

20 *Bent top side rail.*

21 *Bent bottom side rail.*

22 *Cracked forklift pockets.*

23 *Dented external side panel.*

Source all photos: FMS 'Use No Hooks'

24 *Dented front header.*

25 *Broken lower corner casting.*

26 *Bent front corner post.*

27 *Dented external front panel.*

28 *Dented external roof.*

29 *Bent cross-member rail.*

30 *Upper corner castings lifting point.*

31 *Lower corner casting lifting point.*

Source all photos: FMS 'Use No Hooks'

Cargo Protection

Cargo is secured with horizontal belts. The three tiers of rolls are secured with two belts, around the second and third tiers. Source UPM

Plywood or corrugated cardboard is placed as protection around the sides and in front of the door. Source: UPM

✅ Protect cargo along the container sides (according to customer requirements and container condition) by using runners (plywood, corrugated honeycomb board, or hardboard) strong enough to resist transit forces.

• If the container has steel bars on the sides and near the front wall of the floor, they must be covered.

• A container should be rejected if its floor is wet. If the paper owner agrees, the container floor may be covered with protective paper as a prevention measure during winter and in wet weather. However, paper on a wet floor becomes very slippery and facilitates roll movement. Therefore, extra lashing or anti-slip mats may be required. Some companies also line the walls to reduce loading damage; however, this doubles preparation time, adds to cost and creates a waste disposal problem, while having only a limited ability to control moisture.

• All protruding objects, such as lashing points, should be covered to prevent edge/side damages. A roll of several tonnes will generally move during transport and the covering material used needs to be strong enough to prevent force going through it to damage the roll.

Plywood or corrugated cardboard (5 or 10 layers) protection can be placed on all sides. On the bottom it is placed parallel with the wall. The same protection is used in front and around the sides when needed.

Horizontal belts are commonly used to secure the cargo but this may have safety limitations. There are varying recommendations from different shipping agents. Lashing needs to be calculated with criteria that includes: if anti-slip materials are used; resistance of internal lashing points (specified by CTU guidelines as 500 daN (1124 lbs force) for upper, and 1 tonne for lower point — shipping organisations may have their own limits); and the stretch of belts. The result may be that more belts may be required, e.g. after 6 m (20') first set of belts, then another set after each 10 tonnes of cargo. It is recommended to refer to CTU for different securing methods.

Insufficient blocking. Source: UPM

Loading

The container must be loaded in accordance with the loading instructions. Load must be uniform with the container's centre of gravity to ensure its balance. It is important not to damage the paper's wrapping protection when loading.

Lying (horizontal) rolls must be particularly well secured, see CTU guidelines. The bottom layer must start from the back wall. Unloading rolls in a lying position involves rolling them in the container. Therefore, it is very important that the floor of the container is smooth, clean and free of nails, etc.

The top covers of pallets with different heights pose a damage risk to adjacent pallets when loading. If so, secure them with boards, timber or corner profiles.

A container load must be balanced correctly to avoid handling difficulties, accidents, and load instability on a carrier. A rule of thumb is to ensure that cargo weight is distributed within a 60-40 % ratio around the centre of the container. Source: Holmen

Securing

✅ The cargo must be secured so that it does not move in transit. This needs to be particularly effective if the products do not fill the whole of the container space. Good planning of the loading pattern may considerably reduce the need for securing. The securing method depends on the cargo and cargo mix in the container, and must always be considered on an individual basis. Do not secure against doors or container walls if they are not meant for it (punctual, linear loads) let the corners take the forces. Form lock system are ok, the problem is only the linear roll load.

⚠ Caution, belt flexibility of up to 10-13% means that long belts have a high elasticity, which may be insecure.

Step-down securing: Can be used when rolls of equal widths or pallets are loaded in two or more layers in part of the container. Secure them by lifting the adjacent roll/pallet higher by placing timber risers or honeycomb corrugated cardboard underneath them. The adjacent roll/pallet secures the top layer. Step-down securing can take place at both ends of the container, or every other roll/pallet can be lifted. The container must always maintain its balance. The timber used underneath the lifted roll/pallet should be at least 100 mm (4 in), two or three planks should be used to avoid roll end damage. The timber must not overlap the roll diameter otherwise damage is caused to adjacent rolls. The stepping roll height difference should be a minimum 15 cm (6 in) for rolls and 30-40 cm (12-16 in) for pallets. The quality of pallet wrapping is critical, e.g. a strong loading unit has a wooden top secured with four straps; while simple plastic wrapping means the load is vulnerable to movement — in this case vertical plywood barriers should be used as a barrier to movement. Step-down securing only is insufficient and belts must be used to keep the cargo in place.

Lashing belts must be prepared and lashed to the container before loading the last rolls. Source UPM

Depending on the friction factor, it may be necessary to use anti-slip mats. There are some certified systems available.

Rolls will tilt during an emergency stop, but a block of rolls lashed together resists tilting. Taping or special belt holders keep the lashings from slowly sliding down the roll. The problem is that rolls rotate continuously during transport (worst is rail, followed by road), making the taping ineffective for anything other than short distances. The load may look very secure when loaded but it may be in a mess when delivered. Sliding of the load may be prevented by securing the load to the side of the container.

Often rolls are secured to the lashing points in a container. To avoid rolls falling out when the doors are opened they should be secured across the doorway by horizontally placed belts (diagonal fastening is not recommended). The CTU-Code requires cargo be secured to prevent it from falling out when opening the door.

Rolls secured with a horizontal belt with its buckle placed between the rolls. Source: UPM

✅ When tightening a disposable belt to secure a complete load, the buckle should be placed so that there is 30-40 cm (12-16 in) of free belt remaining — this end should be bound around the locking device to prevent it from opening during transport — if in doubt request belt manufacturer for information. Belts should be prepared and lashed to the container's lashing points before loading the last rolls.

Verified Gross Mass of Loaded Container

A new regulation from the International Maritime Organisation (IMO) requires the shipper to supply the Verified Gross Mass (VGM) of packed containers. The reason for this is that discrepancies between notified and actual container weights are a security risk for the vessel and its crew.

The shipper is responsible for determining and documenting the VGM and providing sufficiently in advance to the vessel's master or representative to be used in the preparation of the ship stowage plan. The document has to be signed by the shipper or somebody appointed by the shipper. Without this information containers may not be shipped on vessels any more. These rules are valid for all container types, but not for bulk or out of gauge shipments.

The two methods to determine the VGM are:

1: Weighing the packed and sealed container using calibrated and certified weighing equipment.

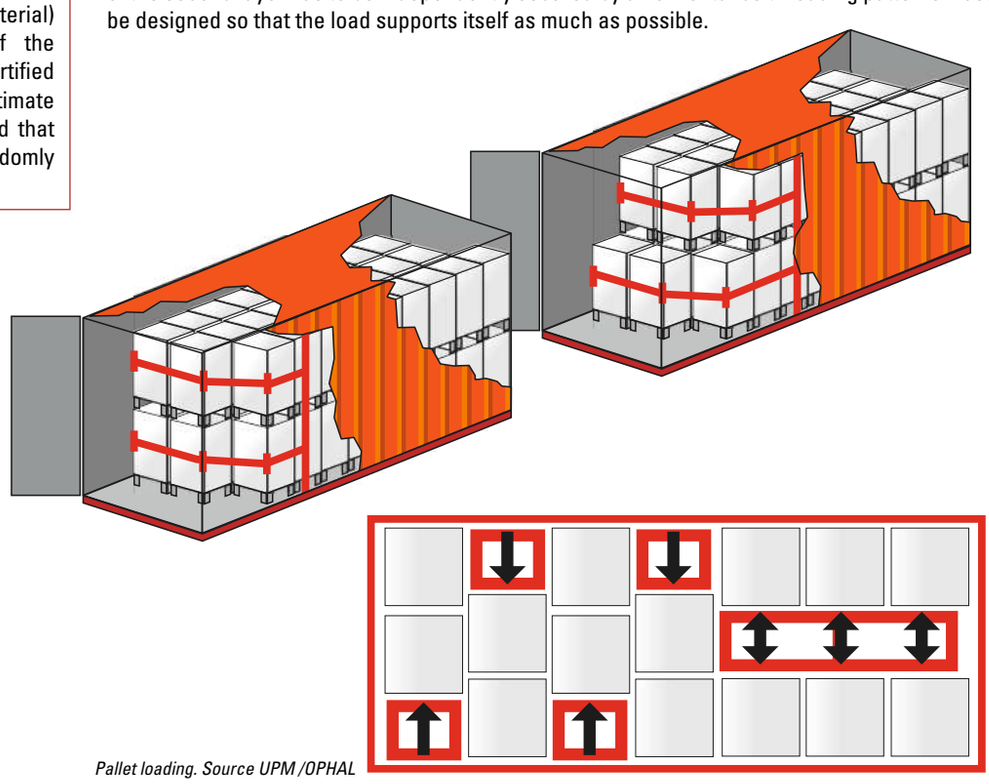
2: Calculation by weighing all packages and cargo items (including pallets, dunnage and other securing material) and adding the tare mass of the container using an approved certified method. It is not allowed to estimate the VGM and it is to be expected that the competent authority will randomly perform spot tests.

Securing lying (horizontal) rolls: There is a high risk that lying loaded rolls move during transport. A securing method is to use chocks in every row on top of which belts are extended over the load. Some companies may extend this to every second or third row after testing. The height of the chocks has to be at least 1/8 of the roll diameter. A plank fixed across the container, is used to prevent the chock from moving during transport. A wooden frame supported by the doorway corners, can be used. The lying rolls should be placed so that the empty space is left to both sides in turn. Wooden structures, airbags, etc., should be used to give support in the cross direction.

Nailing: The CTU code recommends against this technique. It can only be used with specific permission of container owner. This technique requires caution because a container floor is generally only 25 mm (1 in) thick meaning that 75% of a 100 mm (4 in) nail is unattached and has limited resistance. The term "fix" is often used instead of "nail" but without explanation of alternate techniques. (*Nailing is forbidden for trucks because of risk to damage of electrical, pneumatic and hydraulic systems. Nailing is also a problem for rail wagons unless recommended by the railway company.)

Securing pallets: Horizontal belts are fastened to the container's fastening loops and every pallet load unit layer is kept in place with horizontal belts. Corner profiles should be used between the belts and pallet edges. Prevent slippage of horizontal belts by using an additional belt over the load. (If the container has no securing loops the load can be secured by binding the pallets at the rear end of the container in a large block.) If there is a large empty space in the container, timber can also be used for securing the pallets. The empty space should be left in the middle of the container. When pallets are loaded partly in one, and partly in two layers, the uppermost layer should be lashed, if not with belts then fixed with timber or boards. The CTU code states the acceptable total horizontal empty space is 15 cm (6 in) on the condition that the cargo does not move — which is unlikely in a container.

When copy paper pallets are loaded two-high, a board must be used between the layers. The correct size board is slightly smaller than the pallet. Corner profiles must be used. The end of the second layer has to be independently secured by a horizontal belt. Loading patterns must be designed so that the load supports itself as much as possible.



Pallet loading. Source UPM /OPHAL

Securing the load end with timber: A crosswise protection should be placed against the corner posts of the doorway. Securing is carried out with vertical planks fastened to the horizontal ones — nail the planks to the container floor if it is permitted. If there is an empty space between the horizontal planks and the doors, additional timber should be used to prevent the securing from becoming loose.

Airbags for securing: The bags must generally be placed between the cargo units — not between the cargo and the container walls because the airbags can buckle the wall when inflated. Airbags have to be filled carefully as the pallet top covers can break the bag. To prevent this place hardboard sheets against the pallets, this also helps avoid deformation from direct pressure on to sheets.

Checklist after loading (extract 'Container Packing' Hapag Lloyd)

- ❑ The container is packed to meet the requirements of the cargo, to withstand the probable stress during transport and meet the requirements of the container itself.
- ❑ The weight of the cargo must not exceed the maximum load limit of the container.
- ❑ Determining and documenting the Verified Gross Mass (VGM) of the packed container *see page 16.*
- ❑ A copy of the packing list is helpful for customs inspections, etc. must be displayed at an easily visible place in the container.
- ❑ If timber is used as packaging material, it may, under some circumstances, be necessary to comply with the quarantine regulations of the country of destination. A fumigation certificate or certification that the wood has been treated may have to be displayed conspicuously on the container.
- ❑ Doors as well as detachable roofs of containers must be closed carefully.
- ❑ The seal number must be noted. Strong steel cable and container locks can protect the cargo from theft.
- ❑ Old self-adhesive labels must be removed.
- ❑ The entire documentation must be punctually and properly completed.

€² If a container is overloaded or cargo incorrectly secured, the transport can be interrupted and the insurance may not compensate for any possible damage.

Once a container has been closed it is no longer possible to inspect it, or adjust cargo securing. It is therefore essential that containers are packed correctly to avoid the risk of damage.

Cargo shifted into voids. Source: Mëtsa Board

Airbag in a wrong position.
Source: FMS 'Use No Hooks'

'Container Packing' published by Hapag Lloyd provides general packing information and is available from www.hapag-lloyd.com

Container Check Report

Container N°	_____	Gross weight kg	_____
Type	_____	Tara kg	_____
Year construction	_____	CSC / ACEP	Yes / NO

Door side

Door header	
Door sill	
Data sign-board	

Left side

Top side rail	
Bottom side rail	
Fork lift pockets	
Side panel, outside	
Side panel, inside	

Roof

Vertical frame
Roof outside
Roof inside
Lashing fittings

Left door

Corner post	
Hinges	
Locking bar	
Door handle	
Door handle retainer	
Door gasket	
Interior	

Front

Front header	
Front sill	
Left corner post	
Right corner post	
Front panel, outside	
Front panel, inside	

Floor

Cross-member
Plywood floor
Threshold plate
Lashing fittings

Right door

Corner post	
Hinges	
Locking bar	
Door handle	
Door handle retainer	
Door gasket	
Interior	

Right side

Top side rail	
Bottom side rail	
Fork lift pockets	
Side panel, outside	
Side panel, inside	

Type of damage

A = Crack	E = Broken	J = Rust
B = Hole	F = Twisted	K = Wet
C = Loose	G = Dent	L = Odour
D = Missing	H = Scratch	M = Contaminated

Remarks _____

_____

Date ____/____/____ _____ Signature driver _____ Signature employee

Example of a container check report as a systematic guide to inspection and to help ensure traceability and responsibility. Source: OPHAL

10 Marine Transport

CONTENTS

2 TYPES OF VESSELS

4 LOADING & HANDLING
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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

Types of Vessels

The Yantian Express at the container terminal in Hamburg. Source: Hapag-Lloyd

Feeder container vessel. Source: IF P&C

General cargo ship. Source: IF P&C

Paper rolls stowed on deck. Source: INTAKT

Cassettes of paper in cargo hold. Source: INTAKT

Container Ships

There are three types of vessel that carry containers — feeders, Panama and post-Panama. Feeders are the first and last link in the sea transportation chain of containers. These ships are used for transporting containers to and from smaller ports that bigger vessels cannot enter.

Panama and post-Panama vessels transport containers over the oceans between large harbours. Container capacity is measured in TEUs (Twenty-foot Equivalent Units).

Panama vessels are still small enough to pass through the Panama Canal and can carry around 5000 TEUs. The enlargement of the Canal in 2016 increased container ship capacity to 14 000 TEUs. Post-Panama vessels are ships that can carry up to 20 000 containers. These are too big for the Panama Canal.

Containers

Dry cargo containers are widely used for water as well as land transport of paper. Containers initially seemed to offer unlimited advantages for transporting paper products. However, it has become increasingly difficult to organise smooth container transport because homogeneous cargos are becoming less common.

Sizes of cargo units are extremely variable, e.g. sizes and weights of paper rolls rarely coincide with container dimensions. Containers are addressed in detail in *Module 9.*

General Cargo Ships

These ships are built for carriage of a vast variety of goods from forest products to non-standardised project cargoes. The cargo holds of these vessels accommodate both containers and assorted other cargo.

LoLo (Lift-on Lift-off) cargo is moved either with the ship's own cranes or with harbour equipment. The cargo can be lifted straight into its place or with the help of forklifts or clamp trucks in the cargo hold.

A Roll-on Roll-off vessel. Source: INTAKT

Cargo being driven on to a Roll-on Roll-off vessel. Source: INTAKT

Cargo being driven on to a Roll-on Roll-off vessel. Source: IF P&C

River Barge. Source: IF P&C

RoRo (Roll-on Roll-off) Ships

RoRo: Cargo is loaded on wheeled units that are driven or pushed/pulled on board. Paper and pulp is loaded onto roll trailers and cassettes that are towed by a special vehicle driving on/off the ship's stern ramp. Other cargo can be stowed on different types of transport units alongside transport vehicles and containers. This means loading and unloading is rapid. However, the empty space (broken stowage) between cargo units reduces carrying capacity and the ship must use all of its available cargo space for the voyage to be economically viable.

StoRo (Stowable RoRo): Cargo is brought onto the vessel on wheels and is then stowed on the decks. This technique increases the space utilisation rate by increasing the stowage height and reducing broken storage space. The stern ramp or side ports are used to load the cargo with clamp trucks, forklifts, Tugmasters and MAFI trailers/cassettes. Loading may be on any deck from the weather deck down to the tank top. However, loading on the weather deck always requires approval of the shipper and sensitive cargo must always be transported under the deck. StoRo cargo will include paper or board in rolls and pallets, copy paper pallets, pulp bales, plywood or timber packages, and others.

Side port ships (also known as elevator ships) are StoRo vessels that are loaded via side ports with elevators.

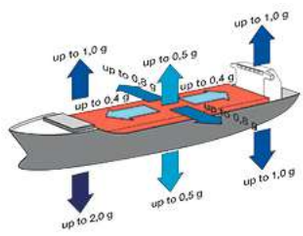
Barges

The term barge covers different floating vessels. They usually have a low draught, minimum clearance above water line and generally have no lifting equipment. Types include:

- Unpowered 'dumb' floating vessel (lighter) that is intended to be pushed or towed.
- Lash barge for sea transport. This vessel is taken by the mother ship to transport cargo in shallow waters to the final port of destination.
- Powered vessels for inland waterways like canals and rivers (such as the Rhine, Rhone, and Seine) with low freeboard (minimum clearance above water line).
- Powered coastal vessel.

The securing of cargo, particularly in the case of lash barges, takes place according to the requirements for seagoing vessels.

Loading

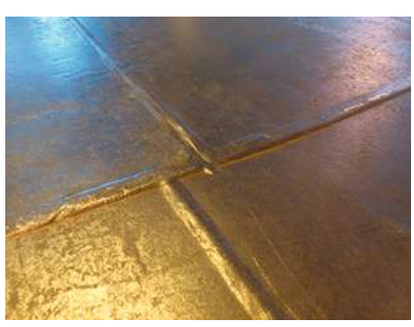


Stresses on seagoing vessel.
- *Rolling*
- *Heaving*
- *Vibration*
- *Pitching*
- *Heeling*
- *Shearing*

Source: FMS 'Use No Hooks'

Wet cargo hold. Source: FMS 'Use No Hooks'

Uneven cargo hold. Source: IF P&C



Welded joints in cargo hold. Source: UPM

The stresses of sea transport pose a particular challenge to the safety of the cargo units and cargo securing measures. Bad conditions at sea mean that cargo can be subjected to brief peak loads and repetitive stresses from the rolling motion of the vessel that can impact on the cargo for days.

Therefore, the goods must be loaded correctly to avoid damage during shipment. The quality of loading operations substantially depends on the experience and knowledge of all those involved. Loading operations can be jeopardised if one of the participants is not at a competent level.

Cargo Handling Procedures

- Inspect vessel before loading begins — see below.
- Cargo is correctly stowed and secured. Minimise condensation by using moisture absorbing materials and ensure the correct functioning of air dryers, ventilation and drainage.
- Correct handling equipment and techniques are used for unloading/loading.
- Clarify in advance under what weather conditions unloading/loading operations must be stopped. Observe the weather conditions during loading/unloading and do not allow rolls and pallets to be exposed to rain, sleet or snow.
- If handling damage occurs, then follow the set procedures — are these communicated?
- Stevedores should follow the loading plan under the supervision of the vessel's officers and personnel. The maximum load capacity of the cargo decks should not be exceeded. Therefore, it is important to stow according to the stowage plan and designed weights. Stow one order at a time according to the diameters. Rolls must be stowed tightly nested together in StoRo and LoLo loading.
- If there are rolls with different diameters in the same pile/tower, the larger diameter rolls must be on the top to prevent smaller diameter rolls moving.

Inspection of Cargo Spaces

The vessel's holds must be inspected before starting every loading operation, including:

- ❑ The cargo space is dry and clean without residues of previous cargoes and unsuitable substances such as oil or odours that can contaminate paper. Hatches and coamings are free from cargo residues.
- ❑ Decks (and any repairs) are sound, smooth and even, without pits or holes, have smooth welding joints, and no protruding objects such as bolt heads. An even floor without any deformations in the deck is particularly important for the horizontal transport of paper rolls.
- ❑ No loose paint or rust particles in the holds and the sides are rust free and clean — this is particularly important for pulp.
- ❑ Manhole hatch cover bolts are below deck level.
- ❑ Timber and board used for covering cargo space walls must be intact and suitable for loading (smooth surfaces without protrusions).
- ❑ The vessel's ventilation and air drying units are in good working order.
- ❑ Lighting inside the holds is adequate.
- ❑ The cargo spaces are watertight.
- ❑ Hatch covers and seals are watertight. The hatch covers may have to be sealed by additional measures.

Loading capacity of cargo decks is the responsibility of the ship's officers.

(For container inspection Module 9)

After inspection, and before starting the loading operations, clear instructions must be given on if and how, protective paper or board will be used in cargo decks, or if other protection is required; instructions to be given by the person in charge of loading.

Extra care is required when loading in wet or snowy conditions. Source INTAKT

Winter/Nordic Conditions

When shipping paper products it is very important to ensure that no wet or snow covered RoRo units (trailers, machinery) are accepted to be loaded next to paper StoRo cargo without careful cleaning and protection barriers between them (foam and sawdust on deck). Melting snow on top of curtain trailers produces large volumes of water that can directly cause massive wetting damage to paper cargo. It is important to take this issue into account when preparing the stowage plan and, where possible, avoid RoRo units and paper to be loaded on the same deck. In addition, it is recommended to use protection paper under the StoRo rolls during wet/winter season due to condensation and to avoid water damage.

Cargo Care While at Sea

Condensation on cargo occurs frequently in the winter when paper rolls are stored and loaded in a cold climate and then transported to countries with a warmer and more humid climate. If the vessel's cargo holds are ventilated with air of a higher dew point than the temperature of the cargo, the airborne water vapour condenses, leading to water droplets on the rolls. Condensation continues until the surface of the rolls reaches the same temperature as the dew point of the air. Vessels used for longer voyages should be equipped with adequate ventilation and dehumidifier units to keep the air dry even when the temperature rises.

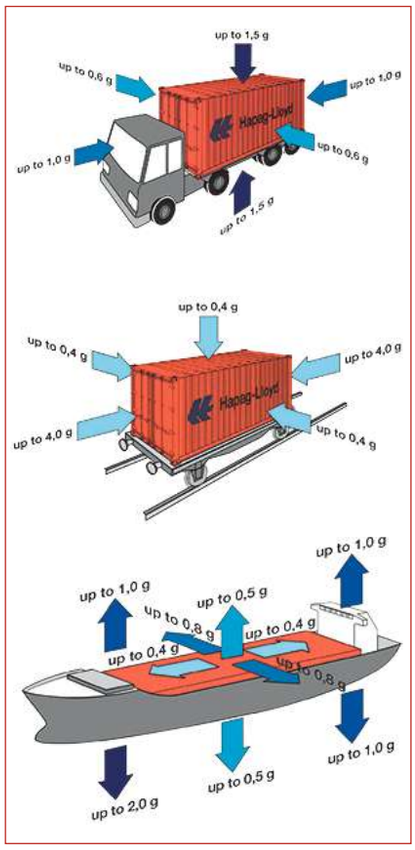
In addition (to using air dryers) it may be necessary to change the air inside the cargo holds to increase the temperature of the cold cargo. The condition in the cargo holds must be closely monitored during this kind of operation. Extra care must be taken when loading extremely cold rolls, as frozen rolls significantly increase the risk of condensation during voyages to warmer climate.

To be checked during voyage:

- Ventilation and air dryer (check with hydrometer and thermometer)
- Lashings and cargo movement
- Leaks of bilge valves and deck hatches.

Roll damage from a wet and rusty vessel floor. Source: UPM

RoRo (Roll-on, Roll-off) Ships



Roll trailer. Source: IF P&C

A fully loaded cassette is being pushed into the ship by a Tugmaster. Source: INTAKT

Loading cassette. Source: Holmen

Cargo Transport Units (CTUs)

Roll Trailers: These unsprung trailers are also called MAFI trailers (after the manufacturer's name of the towing vehicle). Trailers are loaded prior to the arrival of the vessel. The cargo needs to be secured with the utmost care because RoRo vessels navigate all shipping routes.

Cassette: A loading platform without wheels. A wheeled translifter is placed underneath the platform that is then lifted to be transport between the ship and the port warehouse.

Inspection of Roll Trailers and Cassettes

The condition of the roll trailers/cassettes must be checked before loading starts. Their deck must be clean, dry, free of protruding objects such as bolt heads, smooth, free of oil stains and debris and have no holes. The lashing points must be in good condition and the wheels and tyres inspected for damage.

Loading/Unloading Cargo onto CTUs (Cargo Transport Unit)

Do not exceed the payload of the roll trailer/cassette! It is important to take into account the vessel's lifting platform capacity and the deck's maximum mass limitation (kg/sq m) — this is the responsibility of the ship's officers.

The height of the vessel's hold (although not usually a limiting factor) needs to be taken into account in stowing the roll trailers/cassettes.

To maintain stability, the cargo height should not exceed 3,5 m (11,5 ft) except for Super Jumbo rolls. Paper pallets can normally be loaded 2-high, sometimes 3-high.

Rolls with a diameter of less than 900 mm (35,5 in) should be unitised on RoRo or into containers.

⚠ To avoid damage cargo should not overlap the roll trailer/cassette edges. Use warning stickers if the load exceeds the trailer width.

✅ If different types of units are loaded on the roll trailer, the lighter units must always be loaded on top of heavier ones. Stowage must be as tight as possible.

When loading paper pallets in more than one layer, plywood boards must be used between the layers to prevent damage and to stabilise the load.

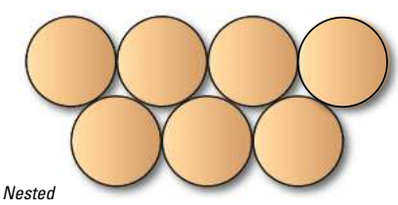
The load must be built as evenly as possible. To avoid lashings damaging the centre unit packages of different sizes must be arranged so that the highest part of the stow is along the centre line.

Plywood boards must be used between layers of pallets. Source: INTAKT

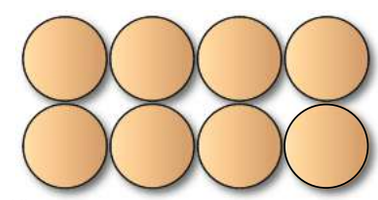
Roll Stowage

Rolls are always stowed in vertical position.

- **< 800 mm (31,5 in) Ø rolls:** Load in a soldier pattern, leaving a gap in the centre of the load to enable horizontal lashing in two blocks. Lashings are identical on both sides. The width of the roll trailers/cassettes permits the loading of 3 rolls across and 15 rolls lengthwise [40 ft trailer].
- **< 1200 mm (47 in) Ø rolls:** Load in soldier pattern in contact with each other. The width of the loaded unit is 2 rolls across and 9 rolls lengthwise. The lashings are identical on both sides.
- **1250 mm (49 in) to 1700 mm (67 in) Ø rolls:** Loaded in nested pattern on the roll trailer/cassette to optimise payload. The lashings are not identical on both sides of the unit. Chains must be placed on the rolls on the supported parts of corner profiles.
- **>1700 mm (67 in) Ø rolls:** Load in the centre of the roll trailer/cassette.
- **Jumbo rolls:** Loaded in two or more blocks on roll trailer/cassette. Do not load them in a row on the centre line as they would start swinging when the vessel rolls.

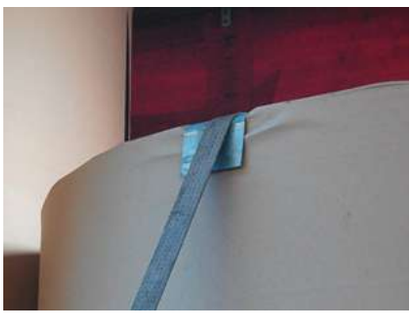


Nested



Soldier

Rolls on a trailer being towed off the ship by a MAFI tug master (tractor). Source INTAKT



Incorrect edge protection. Source: IF P&C

Strips of wood as edge protectors.
Source: FMS 'Use No Hooks'

Cargo securing tarpaulins.
Source: IF P&C

Cargo Lashing and Securing on CTUs

€² Incorrect securing will damage paper in rolls or palletised sheet paper.

Cargo is often only secured by lashing down. Parts of the cargo are secured with textile straps and a ratchet system. Depending on the type of ratchet system used, considerable force is exerted on the cargo, which can cause damage.

✔ Prevent damage by using generously dimensioned edge protectors to distribute the forces evenly over the cargo and protect its edges.

⚠ The use of self-made edge protectors of nailed strips of wood is not recommended as these are unable to withstand the applied forces over long periods of time.

The cargo must be sufficiently secured on roll trailers/cassettes to ensure that it does not move during the sea voyage. Chains, corner profiles, boards and WISA-Fix tarpaulins and cargo belts (web lashings) can be used. Different equipment is required for different cargoes. The basic method of lashing the load is to tie it down onto the platform with belts or chains strapped over the load. The upper corners must always be protected with the corner profiles. The tightening is made from the top of the load.

Horizontal lashing belts are used to prevent packages from falling or moving by tightening the packages together into blocks.

⚠ When paper pallets are stowed in more than one layer, use plywood boards between the layers as a support to protect the tops of the lower pallets from damage. It is extremely important to use boards when stowing copy paper pallets. The boards should not exceed the sides and ends of the trailers/cassettes.

Stanchions are used at the ends of the unit, together with a vertical plywood sheet.

The use of WISA-Fix tarpaulin is recommended for a variety of commodities. These can provide good results for securing cargo; however, incorrect use of tarpaulins can lead to damage to the edges of the cargo.

Cargo securing tarpaulins are expensive and only economic if their return is guaranteed. To secure trailers on seagoing vessels ensure that the sling chains are attached only to the points on the trailer provided for this purpose.

⚠ Under no circumstances must chains be tightened over the cargo.

✔ Corner profiles should always be used to protect the upper corners. Long profiles should be used if possible. When horizontal belts are used in lashing paper pallets, corner profiles must be used at the corners.

When lashing palletised cargo, the lashing chains must be placed in the centre of the package with at least one chain for every pile, particularly when there are two or more layers. Chain lashings must be placed over the roll, not on the unsupported part of the corner profile. This is particularly important if the stow has more than two layers. Chains used in securing the cargo should be placed in such manner that they do not exceed the edges of the RoRo unit.

Pieces of walking board must be used under the tension levers to prevent damage to the tops of the pallets and rolls.

Loads of small rolls should be stowed on the platform so that they can be tied together with horizontal belts to form blocks.

Stability of jumbo rolls is increased by horizontal web lashing.

Lashing and Securing CTUs on Board

After the cargo has been secured on the RoRo unit, it is carefully taken on board and secured to the deck of the vessel. If the securing becomes loose during loading, it must be retightened before departure. RoRo units must be secured firmly enough to the deck to take the forces from the vessel's movements in all directions. Where possible, it is advisable to place units with the same cargo next to each other. RoRo units may be secured either in lanes, or by block stowage (cassettes only).

⚠ MAFI tyres can break and flap around during transport in the terminal and can damage the cargo. Recheck the securing measures to ensure that no settling of the cargo has happened.

Lane stowage: Traditionally, roll trailers are pushed on board in lanes with a small space between them to allow securing to the deck with chains. The lashing is made from the unit to the deck between the lanes. The stability of the roll trailer can be improved by securing the load from the top to the deck above with a top lashing. Attach a small hook to the cargo lashing chain on the RoRo unit, and then crosswise lash the chains (of the top lashing) to suitable fittings of the deck above. Another way to improve stability is to attach extra lashing from the deck above over the load to deck lashing points — use chains as short as possible fitted diagonally to the deck fittings.

Tightening of the securing chains can be done manually, or more efficiently with a pneumatic tool compatible with the tightener. Rubber mats should be used between the units and the vessel deck. The securing should be checked and tightened.

Block stowage: This is normally made using specifically designed cassettes that are stowed next to each other and secured to the deck only from the ends and from the side of the last unit of the row. The building of the blocks begins from the sides of the hold. The first unit is stowed in contact with the side, the next in contact with the first unit and so on. The large block that is formed is tied to the side of the vessel.

Stability can be improved with top lashings. A lashing from the side of the vessel is extended around the corner of the large block to the deck. Another method is to extend the lashing from the cargo lashing chains to the deck above. Containers on cassettes or roll trailers can be used as protection on the other side of the block. To prevent damage to goods special care must be taken with different heights of roll trailers.

Unlashing and Discharging of RoRo Units

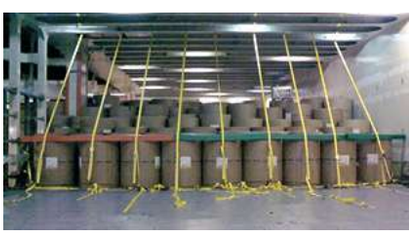
✔ Remove with care all lashings (securing chains, tension levers, etc.) to avoid damaging the cargo on the units. Discharging a RoRo vessel is in the reverse order to loading. The onboard securing is removed; the units are pulled ashore, where they are unlashed. After unlashing, the RoRo units are discharged and the cargo is sorted in the warehouse.

Cassettes must be firmly secured to the deck to resist the forces from all of the vessel's movements.
Source: INTAKT

StoRo (Stowable RoRo)

Securing of timber packages with lashing belts. Source: IF P&C

Correctly use of airbags with a StoRo cargo. Source: IF P&C



Step-down securing of StoRo cargo. Source: Stota-Enso

StoRo cargo secured with Wisa-Fix. Source: Stota-Enso

Cargo is brought onto the vessel on wheels and is then stowed on the decks. The stern ramp or side ports are used to load the cargo with clamp trucks, forklifts, Tugmasters and MAFI trailers/ cassettes. Loading may be on any deck from the weather deck down to the tank top. However, loading on the weather deck always requires approval of the shipper and sensitive cargo must always be transported below deck.

StoRo Loading/Unloading

Before loading the following points should be checked with the ship's officers and stevedores:

- Go through the loading plan so that everybody knows how and where cargo is intended to be loaded.
- Cargo holds are in suitable condition for StoRo loading, i.e. clean, dry and without any unevenness.
- Identify need for protective measures such as paper, walking boards, soft board, sawdust and urethane.
- Define weather conditions when the loading needs to be halted.
- Condition of the handling equipment being used.

Lashing, Securing and Cargo Protection

Lashing and securing materials must be appropriate, in good condition and used correctly to avoid damage or staining the cargo.

Rolls and pallets should stay in their positions during the sea voyage. The rolls should be loaded in a nested pattern to optimise space utilisation and cargo safety. Pallets should be loaded tightly against each other and empty spaces should be filled either by blocking or with the use of airbags.

There are many ways of securing the last tier. WISA-Fix tarpaulins can be used for lashing the rolls. It should be installed at the top of cargo hold and the other end secured to the deck. Every layer of rolls or pallets at the end tier can also be lashed with horizontal lashing belts.

Step-down securing should be used whenever possible. In this method the final tier should be secured with belts and corner protection by securing every single column with a belt fastened to the roof and the deck. When securing the cargo like this, it is important to finish with rolls that can lock the previous tiers.

Unloading rolls from cassette to deck. Source: INTAKT.

Side Port Vessels

Rolls being loaded via a side port. Source: Stora Enso

Rolls are moved from elevator to conveyor. Source: Stora Enso

Precise final roll stowing in StoRo hold. Source: Stora Enso

StoRo cargoes can be loaded or discharged by using either the stern ramp of the vessel, or its side ports with elevators. The side ports have a conveyor system and lifts serving the tween deck and lower hold. Lift trucks position rolls on to the loading platform where a conveyor moves them on to the elevator. When the elevator reaches the desired deck level, the cargo will again be automatically moved to conveyor into the hold allowing lift trucks to pick them up and place them into their final stowage position.

The unloading is conducted in reverse order.

Before Handling Rolls/Pallets Check:

- ❑ Condition of clamps/forks and their safe working load.
- ❑ Clamping force is as specified on the label of the rolls to be handled.
- ❑ Check slats of the conveyor elevator system are not faulty — they can damage roll ends.
- ❑ As rolls are moved ashore by lift trucks, ensure that:
- The trucks can reach the rolls unhindered by surface unevenness (rails, cable ducts, etc.).
- For elevator operation, the vessel is located close enough to the quay wall (check fender dimensions) so that the trucks are able to pick up the rolls unhindered.

Loading/Unloading of Pulp

The maximum loading height is four bales high. Step-down securing is the best method using horizontal belts or WISA-Fix tarpaulins.

✅ Special attention should be paid to prevent contamination, i.e. no plastics, wooden particles, nylon ropes, stones, etc.

Rolls on sideport conveyor. Source: Stora Enso

Stern ramp loading. Source: Holmen

LoLo (Lift-on, Lift-off)

LoLo stowage and dunnage. Rolls being stowed into the hold of a LoLo vessel — the deck has timber dunnage to avoid direct contact with the deck.
Source: Stora Enso

Poor stowage in general cargo vessel.
Source: FMS 'Use No Hooks'

Mobile hydraulic harbour crane loading a LoLo vessel. Source: Stora Enso

Loading Planning

Efficient planning requires the main parties (stevedore, ship´s personnel, quay cargo-handling operator, forwarding agent, etc.) to agree on the type and volume of the load. All issues should be discussed in advance to identify appropriate solutions, from dealing with bad weather conditions through to quantity and unit dimension variations. Overloading, cargo securing and the choice of cargo handling and loading equipment are the main challenges. In order to avoid these problems, the parties can agree on a standard checklist for advance clarification of the most important issues (see checklist example opposite).

Roll Loading, Stowing, Lashing and Securing

Rolls should be stacked in nested formation to optimise space and cargo safety. The nested pattern locks rolls with each other, preventing them from moving during the sea voyage.

It is important that all loading equipment is in good order so that there is no risk of damaging the cargo during the loading operations. Timber can be used under the rolls to minimise the risk of wettage to the roll ends through condensation. Airbags should be used on the top layer for securing the load.

Pallet Loading, Stowing, Lashing and Securing

Ship movements can be quite violent during a sea voyage. This requires special care to the height, stability and integrity of the bottom layer of the cargo: high stacks can easily become unstable or the bottom layer damaged. Plywood walking boards should be used between the layers of pallets. Airbags should be used on the top layer for stabilising and securing the stacks.

✅ When handling pallets, ensure the equipment is clean and that the pallets are not damaged by the lifting forks or other machinery.

Loading/Unloading of Pulp

Special attention should be paid to prevent contamination (from water, plastics, wood particles, nylon ropes, stones, etc.).

- Protective tarpaulins, or papers, must be used to completely cover the tank top/cargo hold walls if they are in a poor condition (rust, loose paint and previous cargo residues, especially in the winter time).
- If sawn timber or plywood is carried in the same hold, pulp must be completely covered with tarpaulins.
- Pulp bales should be loaded and lowered on a platform or steel plate alongside the vessel to prevent contamination from sand and stones.

Checklist for Lo Lo loading *Please complete a checklist for each cargo and each ship*

1. Cargo (to be completed by forwarding agent)
Item No:_____
Contact partner:_____ Telephone: Office: _____ Mobile:_____
The following cargo is ready for shipment
Number: _____ Type: _____ Weight: _____
Sheds: _____ M/S: _____ eta: _____
eta: _____
Photos: ❑ yes, ❑ no Photo report: Photos: ❑ yes, ❑ no
Loading arrangement: ❑ yes, ❑ no
❑ vertical ❑ horizontal ❑ horizontal in sling
Miscellaneous:_____
Delivery conditions:_____
Right of disposal:_____
Peculiarities:_____
Date:_____

2. Terminal (to be completed by quay operators)
Contact partner:_____ Telephone: Office: _____ Mobile:_____
Loading times: from date: _____ Time: _____
to date: _____ Time: _____
Number/Operations:
Peculiarities:_____
Date:_____

3. Ship (to be completed by ship broker)
Contact partner:_____ Telephone: Office: _____ Mobile:_____
Name of ship:_____ Year of manufacture:_____
Is the ship presently suitable without restriction for the aforementioned goods and does it comply with the currently applicable regulations?
❑ yes, ❑ no for the following reason:_____
Is an advance inspection possible? ❑ no, ❑ yes from date: _____ Berth:_____
Contact partner:_____ Telephone: Office: _____ Mobile:_____
May photos be taken? ❑ yes, ❑ no
Hold number(s) and probable slot: _____/_____
Understowage: ❑ yes, ❑ no Cargo:_____
Overstowage: ❑ yes, ❑ no Cargo:_____
Foreign cargo in direct contact with aforementioned goods? ❑ yes, ❑ no
Can a stowage plan be requested for the ship? ❑ yes, ❑ no
If no, size of cargo holds: Length: _____, Width: _____, Height: _____
Peculiarities: _____
Who is responsible for cargo securing?_____
Who provides lashing material?_____
What lashing material is available?_____
Has lashing material already been used? ❑ yes, ❑ no
Are wooden pallets available? ❑ yes, ❑ no
Peculiarities (hatch cover, crane assistance, etc.):_____
Date:_____

4. Stevedores (to be completed by stevedores)
Contact partner:_____ Telephone: Office: _____ Mobile:_____
Does information from parts I and II correspond with information provided?
❑ yes, ❑ no Following variations were noticed:_____
Loading devices suitable for the goods available: ❑ yes, ❑ no
Other remarks:_____
Date:_____

5. Survey (to be completed by inspector)
Item No:_____
Contact partner:_____ Telephone: Office: _____ Mobile:_____
Employee on site:_____ Telephone:_____/_____
Date:_____

6. Special notes _____

When all issues on the checklist have been clarified, loading operations should commence in the presence of a competent representative of each of the companies involved.

Frequent problems are:

- **The cargo has not yet been delivered in full.**
- **The planned stowage locations do not comply with the requirements.**
- **The cargo hold is not swept properly.**
- **Cargo residues are present on the hatch frame(s).**
- **Large amounts of water fall into the hold when the cargo hatches are opened.**
- **The hatches cannot be closed quickly enough when it starts to rain.**
- **Contrary to agreement, work continues in rain or snow.**
- **The cargo is not stowed properly.**
- **Forklift drivers are inexperienced in handling the cargo.**
- **Cargo handling equipment is unsuitable for the product.**
- **Contrary to agreement, the cargo is over-stowed with other cargo.**
- **Contact partners are unavailable or do not have the necessary competence.**

If the conditions vary considerably from those agreed, then loading should be stopped until clarification is provided.

Source: FMS/INTAKT

LoLo
Cargo Handling Equipment

LoLo operation by Mantsinen. A mobile hydraulic crane equipped with clamps for roll loading. Source: Stora Enso

Clamps

Head clamp: A scissor action lifting equipment positioned on the end of a horizontal roll — when it is lifted it grips the load like a pair of scissors. The amount of pressure exerted by the contact plates depends on the roll weight. Different types are available for various roll diameters. These can be varied within their specific operating range to sit individual roll diameters.

Antwerp clamp: Uses a similar scissor lifting action — it presses itself against the roll via guided pull chains. To increase the handling capacity, several clamps are attached in a row to a single girder or in two rows to the frame girder. The girders are provided with holes. The clamps are positioned in the holes with shackles depending on the roll diameter. This clamp is unsuitable for handling jumbo reels.

Antwerp clamp. Source: FMS 'Use No Hooks'

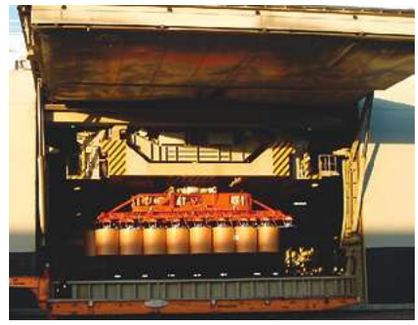
Head clamp. Source: IF P&C.

Antwerp clamp. Source: FMS 'Use No Hooks'

Frame girder. Source: FMS 'Use No Hooks'

Antwerp clamp, off-centre. Source: FMS 'Use No Hooks'

Eccentric load. Source: FMS 'Use No Hooks'



Vacuum clamp. Source: FMS 'Use No Hooks'

✅ Preconditions for smooth cargo handling using head clamps are:

- Roll packaging is undamaged and tightly wrapped.
- Clamp positions in the holes are at an exact distance to the slots for loading and unloading.
- The heavy head clamp is placed slowly on the end of the paper rolls.
- The clamp is centred above the roll core.
- The load is initially lifted after the safety mechanism has been completely released.
- The crane does not lift the cargo abruptly.
- The heavy contact plates of the Antwerp clamp are placed slowly (not thrown) on the ends of the rolls after being released.
- The pull chain guide is centred above the roll core and the rolls are vertically suspended.

Vacuum clamp: Large rubber "cups" are positioned on the ends of vertical rolls and a suction vacuum is created between the cup and roll. To prepare a roll for vacuum clamping its packaging must be open around the roll core and the vacuum cup must be exactly centred above the roll. An optical system tells the crane driver when the appropriate vacuum has built up for all rolls.

Slings

Jensen sling: Rarely used because of increased roll size and volume. The paper rolls are stowed in blocks and a frame-rope winch combination lowered above the rolls. After releasing the locking mechanism, the sling is pulled tight and the rope winch system tightened around the roll block to lift the load.

Endless slings: Used only for horizontal loading. The rolls hang horizontally in the sling and are not placed above the roll edge. Straps must be clean, dry and free of oil, etc. Specify if the straps are to remain attached to the rolls or should be removed prior to shipment.

Transport cage

Often used where no special handling equipment is available. The transport cage must be clean and undamaged. Before lifting loads by crane, the safety chain must be attached to ensure that no reels can fall out of the cage.

Jensen sling. Source: FMS 'Use No Hooks'

Endless slings. Source: FMS 'Use No Hooks'

Transport cage. Source: FMS 'Use No Hooks'

11 At the Printer – Paper onto Press

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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

Fundamental paper conditions for printers

For a printer, substrates are the single largest expense (50-70% of total costs), making it essential to minimise waste from all causes. Paper and associated waste comes from several areas: transport, handling, storage and preparation for use. "Two keys for management of productivity are measurement and people. Measure the right things and communicate the measurements to people in a manner that encourages corrective response." War on Waste II (Roger V. Dickeson GCA).

Optimise Temperature & Humidity

	Temperature			Humidity		
	< Lower	20-25°C (68-74°F)	Higher >	< Lower	50-55% RH	Higher >
Poor sheet feeding & jams	●		●	●		●
Static electricity	●			●		
Brittleness			●	●		
Piping paper rolls*						●
Shrinkage on open rolls			●	●		
Burst splice			●	●		●
Splice failure	●		●	●		●
General web break risk				●		●

**Piping occurs in <10 outer layers and increases risk of creasing.*

'Climate and Paper in the Press Room' Sappi technical brochure. Source: www.ideaexchange.sappi.com

Paper that is not in balance with its storage and operating environment can lead to serious printing problems such as static charge and dimension variations, along with set-off, tensile weakness, folding resistance and surface smoothness.

Paper being a porous material, humidity control becomes crucial; temperature has a significant influence on relative air humidity. Air can contain only a specific amount of moisture vapour at a given temperature — the higher the temperature, the more moisture air can absorb. (Relative humidity (RH) is the proportion of absolute moisture content in relation to the highest possible moisture content at a given temperature.) RH is often variable during the course of a day and by season.

Paper will adapt itself to the humidity of the surrounding air by either absorbing or exuding moisture. This tends to occur:

- During summer periods that are hot and humid in non-conditioned warehouses and pressrooms;
- When damp-proof wrapping is not used during transport or storage in humid conditions;
- In winter, when cold paper is unpacked in the warm air of a pressroom the surrounding air temperature will drop sharply, causing a rapid rise in air humidity. The paper edges then absorb moisture, making them swell in relation to the centre of the sheets.

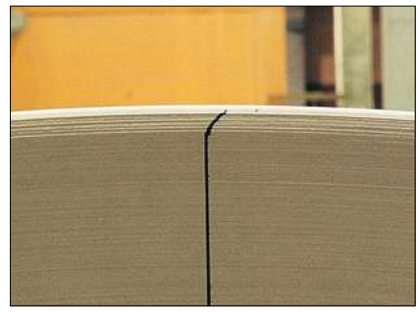
✅ Best practices for optimised paper condition for printing

- Paper stability is achieved at 20°C to 25°C (68-77°F) and 50-55% RH relative humidity.
- Paper should remain wrapped in its packaging until any difference in temperature has been balanced out. The time needed depends on the temperature difference, the size of the stack, and the conductivity of the paper.
- Store the paper in the pressroom for a few days before use if (a) there is a significant difference in temperature and humidity between the pressroom and paper storage area or (b) if paper is delivered directly to the pressroom from the paper supplier.
- 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 also depends upon their diameter because they condition from the edges inwards.
  See conditioning chart Module 3 page 4.

Paper Rolls

- ✔ Keep the protective wrapping on as long as possible to minimise risk of damage and the negative effects of atmospheric humidity and dynamic roll expansion. The open time of prepared rolls is determined by the grade of paper and the ambient pressroom RH.
- ✔ In extremely cold winter conditions the outer layers of paper warm up relatively quickly, but the paper near to the core (splice area contact point) can take two weeks to obtain an ideal minimum splicing temperature of 15°C (59°F). Below this temperature there is a high risk of splice failure. Remedial practices by some printers using cold rolls include using climate-resistant splice tapes; placing heaters in the roll core to warm up the adjacent paper to a temperature high enough for splicing adhesives to work; using a larger area of splice tape or liquid glue over a large area on frozen coated paper; reducing press speed by 30% during splice; avoiding weekend paper delivery cycle (loading Friday - delivery Monday) when weather is cold. A side effect of cold paper is that the inking system cools down and creates flow problems.
- ✘ Preparing splice patterns of several rolls in advance could increase risk of the splice pattern breaking open, as unwrapped rolls take up moisture quickly in the outer spires (layers). This increases the risk of creasing and expansion that can burst the splice pattern. Keep the protective roll wrapping on as long as possible.
- ✘ Taking the end shields off too early can cause roll edges to dry out or absorb moisture, resulting in a visibly skewed profile as the web leaves the roll.
- ✔ Reduce heatset web static by remoistening the paper after the chill rolls with a mixture of water, silicone and liquid fabric softener.

For more information *see Module 1 page 4, and Module 3 page 4.*



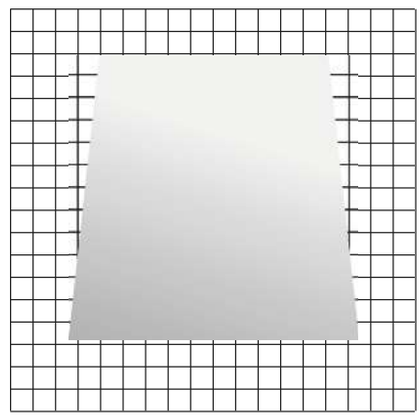
Dynamic roll expansion after wrapper removal. When unwrapped the roll acts like a released spring and will tend to loosen, putting additional tension onto splices prepared in advance. High humidity in the pressroom exacerbates the problem. Cold rolls tend to expand more when warming up. Source: WOCG/icmPrint

Sheetfed Paper Issues

Dimension variations: Paper fibres will either absorb or exude moisture depending on RH, causing them to swell or to shrink, particularly in the cross direction of the paper rather than in the machine direction. A 10% change in RH causes paper to "grow" 0.1% to 0.2% across the width, which will cause printing mis-register.

Humidity and curling: Curling is closely connected to fluctuations in humidity that cause the paper fibres to expand and shrink in the cross direction. If paper is moistened on one side, the fibres expand in one direction, causing the paper to curl toward the dry side. As soon as a balance in humidity within the paper structure has been restored, the effect is cancelled out.

Stack humidity and temperature effects on ink drying: A high humidity balance of the paper stack can significantly extend ink drying times. The effect is pronounced above 60% RH, leading to drying times up to three times longer than normal. Extended drying times can also occur when the stack of printed paper is too cold.

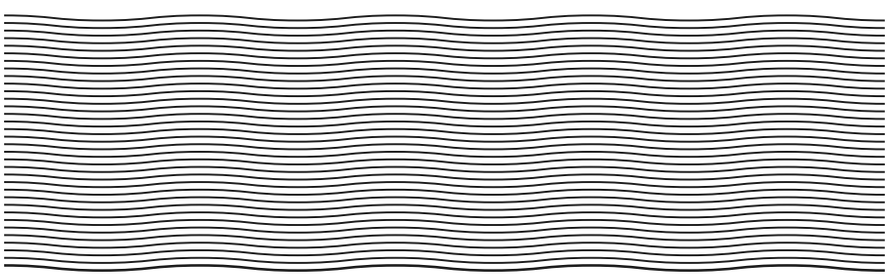


Paper stretch is caused by imbalance of paper RH to that of pressroom. Source: icmPrint

Static Charges

Static commonly occurs when very dry paper is processed in low air humidity conditions. The critical lower limit is 30-40% RH for both the paper and the pressroom. *See also page 37.*

Relative humidity in a paper pile can be measured with a sword gauge. Source: Stora Enso



Sheets failing to feed properly because of paper curl, wavy edges or out of square can be minimised by conditioning paper correctly in pressroom. Source: icmPrint

Internal logistics
for printers

Preventing handling and storage defects will result in less physical damage to the paper, minimising paper losses and production difficulties arising from deformed rolls and local paper weaknesses on the edges and surface.

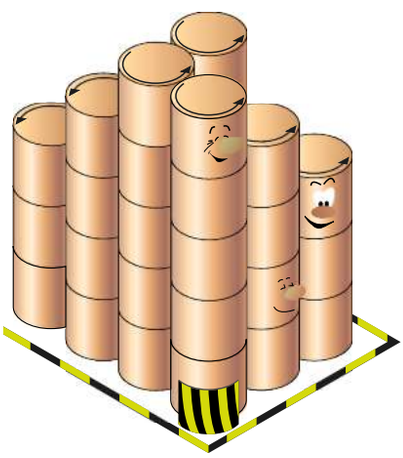
Paper Delivery

Unloading: Use optimised techniques for unloading the specific delivery vehicle — this can be a frequent source of damage. *See Module 5.*

Inspection: Any visible damage needs to be reported at every transit point. Failure to note damage on delivery documents and timely reporting to the supplier can result in a claim for damaged paper being rejected; nor does it allow fault analysis to be made to identify and resolve the cause of damage. For more information *see Module 2 page 2*.

✅ Rolls should be inspected on arrival and any visible defects should be noted on the delivery documents. Additionally, digital cameras can be used to document damage for timely transmission and be sent by e-mail to those needing this information. For insurance purposes any complaint to the supplier must normally be made within 48 hours.

€² **Failure to note damage on the delivery documents could result in any claim for damaged paper being rejected.**



✅ *Correctly stacked rolls*

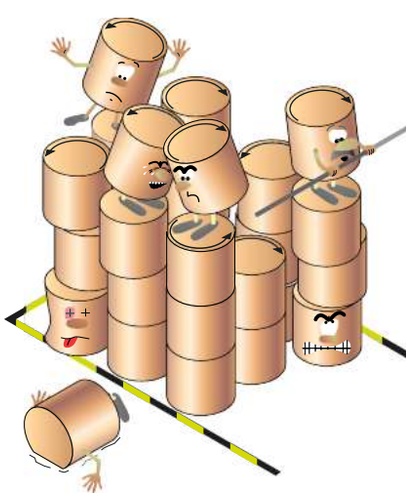
Storage — For full information *see Module 3*

✅ The warehouse should have these attributes:
- Dry
- Clean
- Even/level floor
- Sufficient working space
- Good lighting
- Roll bay markings on the floor
- Storage temperature should be similar to the pressroom.

✅ Rolls should:

- Be stacked on their ends, evenly in straight lines, with same unwind direction
- Not overlap
- Have outer rolls protected with roll guards
- Be used on a "first in, first out" FIFO principle.
- Show a clean, readable label/roll number.

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



✘ *Poorly stacked rolls. Source: WOCG/icmPrint*

Partly used rolls that are returned to storage should be protected from damage and atmospheric changes with a wrapping capable of withstanding minor impacts and acting as a moisture barrier. The ends should be protected by reuseable end caps. They should have the original roll label reattached 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.

Paper Handling — For full information *see Module 5*

- Use correct equipment and handling procedures to maintain rolls in the best possible condition.
- Lift truck capacity must be suitable for the rolls being handled.
- Using the wrong equipment can be a danger to personnel.
- Poor handling and storage will result in more damage to rolls, higher waste levels and increased risk of web breaks during production.

Correct use of lift trucks

- Ensure the mast is vertical.
- Clamp the roll in the middle.
- Lift the roll before moving.
- Ensure sufficient ground clearance before rotating roll.
- Stop before releasing the roll.
- Handle only the number of rolls for which the lift truck is intended.
- Use split arms when handling more than one roll at a time (including multi-packs).

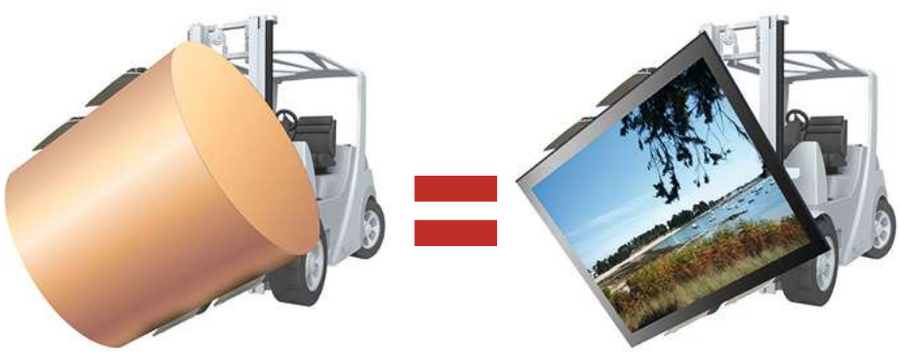
Clamp blades

- Keep the surface clean.
- Inspect clamp blades daily.
- Corners and edges should be well rounded. Grind smooth any damaged edges.
- Some printers attach high density foam pads to the metal clamps to act as a cushion.

Clamp pressure

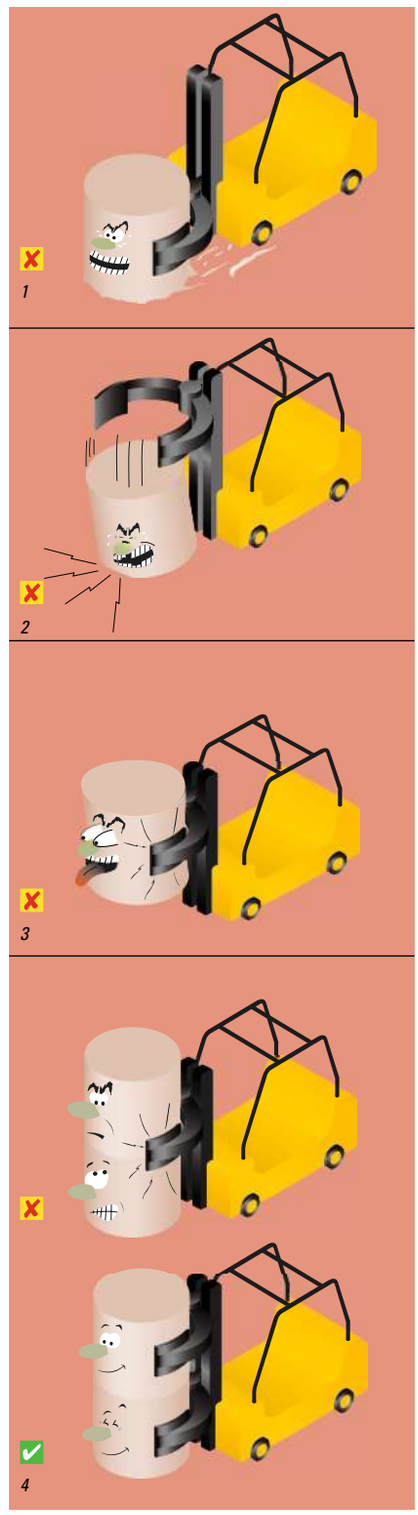
Lifting capacity depends on friction between clamp-wrapper-roll.

- Always adjust clamp pressure to roll weight and paper quality.
- Check clamp pressure regularly, keep a record.
- Too low a pressure may result in dropped rolls.
- Too high a pressure may result in deforming rolls out-of-round.



Depending upon its grade, a paper roll is worth about the same as a large screen HD TV — it is also just as fragile. Source: WOCG/icmPrint

Check clamp pressure regularly. Source: WOCG/icmPrint



1- Lift the roll before moving.
2- Stop before releasing the roll.
3- Adjust clamp pressure to roll weight and paper quality.
4- Use split arms when handling more than one roll at a time.
Source: WOCG/icmPrint

Roll processing efficiency

'Web Break Prevention & Diagnosis' provides a systematic best practice approach. Source www.icmprint.com

Web Break Reporting

To speed up help from paper supplier provide them with following information:

- Order number
- Roll number
- Paper grade
- Roll width
- Fault description (in case of breaks)
- Evidence available — Electronic, Paper printed/ unprinted
- Contact at print plant

Recommendations ERA 'Paper First Aid'

"Often, roll preparation produces such a surprisingly high and unnecessary amount of waste that the productivity of the entire press can be affected. Any mis-splice following careless preparation or any web break due to an inaccurate check of the roll will cause a lengthy production interruption with the corresponding consequences. The successful preparation of the splice greatly depends on the skill and experience of the staff." WAN-IFRA.

To achieve a consistent splice efficiency of over 99% requires (a) correct roll handling and storage, (b) optimum combination of tape and tab qualities, (c) correct splice preparation and (d) an efficiently maintained and operated splicer. Many press and postpress runability problems are also directly related to poor roll storage and handling and/or temperature and humidity variations.

The roll core and the splice pattern on the paper's outer surface are the two key interface points between the paper roll and the press splicer. Both need to provide high functional performance.

Web Breaks

Usually occur when press tension variations become excessive and/or coincide with local area weaknesses in the web. Paper damaged from poor handling can be a significant cause of web breaks.

Causes are typically attributed to (source Goss):

30% Paper

20% Poor operating procedures & equipment faults

50% Unknown reasons, includes poor handling & Storage

Paper quality is generally consistent and excessive web breaks due to paper faults are rare (automated roll handling considerably reduces risk). We recommend web break causes should be treated under two classifications:

- Paper defect (manufacturer's responsibility)
- Roll handling and storage damage (transport and/or printer's responsibility)

Web break frequency varies between printing method, print job, run length, type of printing/ finishing, consumables, experience of operators, maintenance, housekeeping, environmental conditions, etc.

A single defect does not necessarily impair runability; however, the combination of two or more will affect press performance. Many faults are rare and unlikely to be repeated throughout the roll (e.g. holes or cuts).

✅ The standard procedure after a web break is to restart with the same roll. Normally if there are two web breaks in the same roll then change it for a new one that preferably has a different position in the tambour (jumbo roll), or a different manufacturing batch. Contact your paper supplier to help deal with the problem.

What can be done to minimise web breaks?

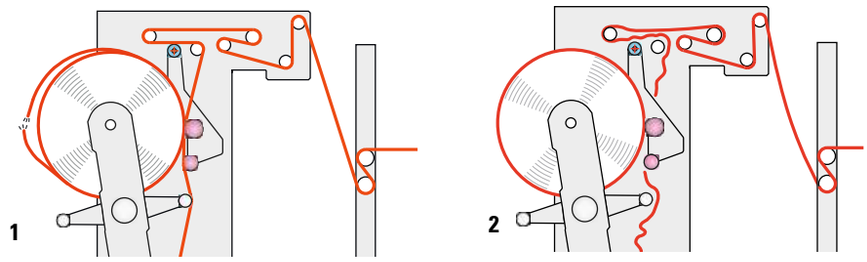
1. Measure and analyse missed splices and web break causes to identify priority areas for improvement.
2. Regularly share with staff data on economic value of paper, waste and web breaks.
3. Introduce best practice to reduce web break probability from both individual and combined causes.
4. Train and motivate staff to apply best practice systematically.

Mis-Splices

Any failure of the splice during the cycle — from when the splice arms start to move (or zero speed festoon begins to fill) to the moment the splice leaves the folder without disturbing the web — causing a press stop or excessive waste. During the splice cycle there will be a change in tension profile and any weak spots in the web or splice will be subjected to extra stress and a web break or splice failure can occur.

Some causes can be defined as:

1. **Burst splice:** When the new roll bursts open prior to splicing.
2. **Failed splice:** When the new roll does not paste to the expiring web.
3. **Mis splice:** Other reasons for a missed splice.



Some Paper and Splicing Problems at the Printer

		Splicing failure reason				Splicer type	
		Burst	Fail	Mis	Break	Flying	Zero
1	Paper delivery — printer inspection failed to identify roll fault		●	●	●	●	●
2	Poor storage at printer				●	●	●
3	Handling damage at printer				●	●	●
4	Rolls unwrapped too early	●	●	●		●	●
5	Excessive roll vibrations	●	●	●	●	●	●
6	Wrong roll unwind direction (flying paster)		●			●	
7	Incorrect splice pattern type		●	●		●	
8	Splice pattern bursts open before splice						
	— Air pockets	●				●	
	— Dynamic roll expansion (see also 2)	●				●	
*	— Rupture tabs applied too tightly	●				●	
	— Open tape in acceleration belt path	●				●	
	— Too fast acceleration tears paper			●			●
	— Splice shields not fully closed or no vacuum		●				●
9	Failed splice						
	— Inadequate splice tape pressure		●			●	
	— Tape protective liner not removed/No tape applied		●	●		●	●
	— Dust, moisture, solvent on open splice tape		●			●	●
	— Glue unsuitable (tack, temperature, humidity)		●			●	●
	— Cold roll (temperature near core below 10°C)		●			●	●
*	— Rupture tabs incorrect or turned over covering detection tab		●	●		●	
	— No splice detection tab, sensor dirty		●	●		●	
10	Tape or glue overlaps edge of roll			●		●	●
* 11	Tabs come loose and stick to expiring web or blanket			●	●	●	
12	Splice detection tab in wrong position		●	●		●	
* 13	Tab in path of folder slitter			●		●	
14	Excessively long paster tail causes folder jam			●		●	
15	New roll not aligned to expiring roll or variable roll widths			●		●	●
16	Cocking roller setting incorrect			●	●	●	●
17	Zero speed splicer incorrect alignment to nipping roller		●	●			●
18	Incorrect setting and/or maintenance issues	●	●	●	●	●	●

** Not applicable to multi function splicing tapes*

A high performance automated unwinder can handle web rolls up to 1370 mm (54 in)Ø weighing 1500 kg at maximum speed up to 300 m/min (1000 fpm) for web widths of 203-762 mm (8 in-30 in). Source: Hunkeler

Roll Changing & Splicing Devices

Two techniques are used: either manual unwinders that require the press to be stopped for five minutes or longer to change the roll or automatic roll changing and splicing at full press speed for continuous production. There are many variations of technologies and functions for both.

Manual Unwinders

An expanding shaft supports the roll by its core as it is unwound. The press has to be stopped to manually changeover the roll and to join the expiring web on to the new roll (with glue or tape). Some models allow a second roll to be mounted for more rapid changeover. This technique has largely disappeared from many web applications except for some narrow width web presses and for digital presses for speeds below 150 m/min (500 fpm) because of their low investment cost. The use of larger diameter rolls can reduce the frequency of roll changes by 30-40% .

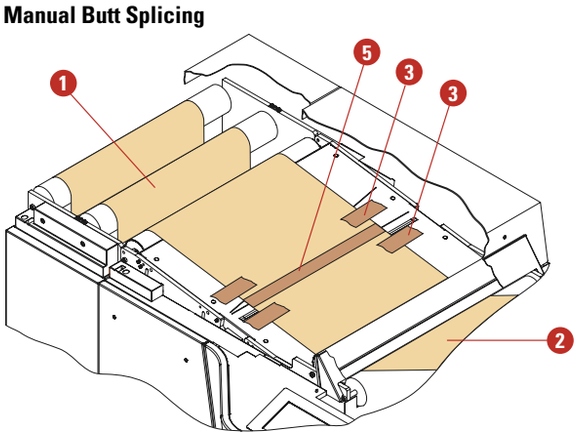
✅ *See page 20 for best practices when using expanding roll shafts.*

Digital Printing & Butt Splicing

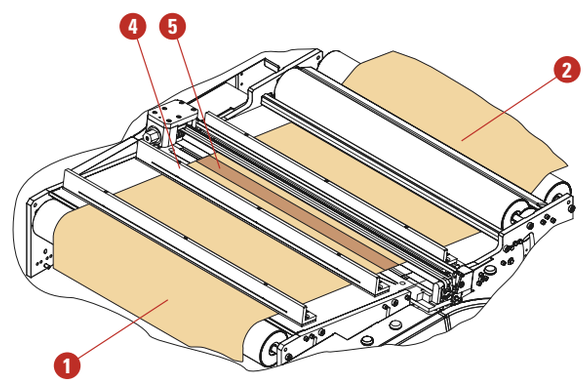
Many digital presses use A4-A3 cut size paper, while high volume presses use rolls ranging in width from 200 to 840 mm. Most inkjet printing systems prefer butt splices to reduce the splice overlap thickness and tail running through the press that could damage an inkjet head.

Manual unwinders take about five minutes to change rolls and prepare a butt splice — this significantly reduces the output of high performance digital presses. Some manufactures offer hybrid unwinder/rewinder systems that by using some automation can reduce roll changeover time by about 50%.

Manual Butt Splicing



Automated Butt Splicing



1 Expiring web
2 New web
3 Manual taped web edges & cutting
4 Automated clamping & cutting carriage
5 Splicing tape
Source: Hunkeler

Manual splicing: When the press is stopped, the outgoing web's edges are lightly taped to the cutting table. The web is then cut, the expired roll removed and a new roll loaded. The new web lead is drawn onto the cutting table and lightly fixed by tape on its edges before being cut. The parallel edges of the two webs are then joined together with a single-sided adhesive tape. The tapes holding down the web edges are then carefully removed and the new roll is ready to be printed.

Semi automatic splicing: Automated clamps hold the web while it is severed by the cutting carriage. A clamp holds the paper in place while the remaining web is rewound on the expired roll. A new roll is loaded and moved into position. Its web lead is drawn under the clamps where it is tensioned and aligned to the outgoing web, and held down while the cutting carriage slices the new paper web. The edges of the expired and new webs are joined with a single-sided adhesive tape. The web is ready to be printed.

Automatic Roll Changing & Splicing

An automatic splicer converts rolls into a continuous web by splicing from roll-to-roll at full press speed, and also assists in loading. Key qualities of the splice and roll change process are:

- Maintain tension and lateral position (in relation to press, infeed, web guide)
- Minimise web breaks, splice failures (press downtime and waste)
- Minimise paper running waste
- Measure running length.

There are two technologies: **Flying splicers** (sometimes called pasters or match speed) and **zero speed splicers**. The main difference between them is that a zero speed splice occurs when the web is stationary (but the press runs at full speed), while a flying splice occurs at the match speed of the running press. There are many variations to these basic designs and this guide must be read in association with the operator's manual(s) for the machines in your plant.

Butt splicing is complicated to automate on zero speed splicers and for this reason the splice tail needs to be short and secured. To minimise risk, some inkjet presses have splice detectors to lift the printing heads from the web.

Technology Options

Shafts or Chucks? Shafts run all of the way through the core and are either mechanically or pneumatically expanded. They provide good adhesion along the length of the core, but cannot be used with damaged cores. They allow the roll to be positioned anywhere along the shaft, which is generally limited to 1450 mm web width or less. Roll shaft systems are simpler than chucks on arms but are more difficult to automate, although can be used with a hoist. Chucks penetrate only the ends of cores, which, therefore, must be of adequate quality and condition to withstand braking torque. Chuck systems are easier to automate and have no width restrictions. Both splicer designs use these technologies.

Core or Belt Acceleration? Core braking and acceleration is now common. Some flying splicers use belt acceleration and/or braking on the outside of the roll to provide good torque control — this is no longer common in web offset but is still used in rotogravure.

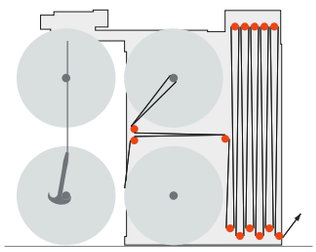
Flying splicer pastes at full production speed. Source: Goss

Zero speed splicer with vertical festoon. Source: Ecograf

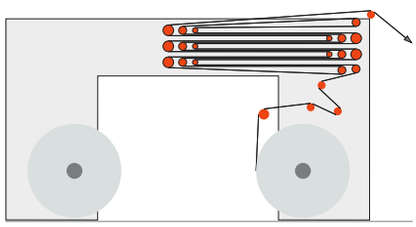
Roll Handling on Pallets

Many printers and converters moving into digital printing do not have roll handling clamp trucks and require their rolls to be supplied on pallets that can be handled manually and with conventional forklift equipment. The preparation and handling of rolls and pallets is often a manual process and leads to limitations in logistics (amounts of pallets on trailers and in containers). Standing rolls need to be handled with care because of the risk of being deformed on the bottom that can lead to unwinding problems at moderate to high speeds.

Standing roll loaded on to a pallet and securely chocked both sides. Source: UPM



Roll-over-roll with vertical festoon.



Horizontal roll and festoon. Source: WOCG/icmPrint

Horizontal zero speed splicer with automated roll loading. Source Goss

Zero Speed Splicer

Splicing occurs when the web is stationary while a festoon of paper provides a temporary stock of paper for the press to run at full speed. Splice preparation is relatively simple and the tape requires only a moderate performance. Advantages of zero speed designs over flying splicers include: their flexibility in unwind direction and choice of the web side to be on top; no restriction on the roll splice diameter, allowing small part rolls to be used up; and changing the web width is simpler.

The two principal zero speed configurations are:

Vertical festoon with roll-over-roll: This provides simple braking, acceleration, control, easy web-up, with minimum floor space required; it uses core shafts and requires a hoist to load upper rolls. Central loading twin webs are common.

Horizontal festoon: Same functional advantages as vertical but splicer is lower in height and floor loading does not require a hoist; commonly equipped with roll arms and chucks instead of core shafts, integrated infeed, web guide and automated webbing-up.

Splice heads using rubber coated rolling nip splice bars are common. Higher performance models have a one-step operation.

The Splice Cycle

All zero speed designs have a similar splice cycle:

A The new roll is loaded and its web is led to the splice head and the splice prepared. An automatic cycle starts about two minutes before the splice, when a klaxon/flashing light informs the press crew; the splice cycle can also be manually started by the operator.

B Just prior to the splice cycle the festoon rises to its highest position to store the maximum length of paper to allow a continuous paper supply to the press during the splice cycle (during normal running the festoon is maintained by a web brake at a low level to minimise web wander).

C The splice cycle starts by braking the running roll to a stop, which then activates:
- the nip to bring the running web into contact with the adhesive tape on the new roll lead
- the knife cuts the web of the expiring roll.

D The splicer head retracts and the roll is accelerated to the press running speed. The expired roll is removed.

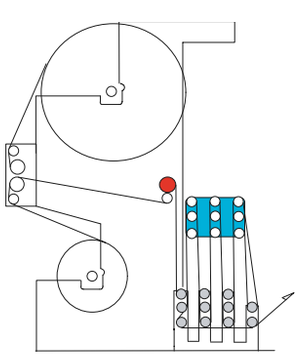


Fig A - Unwinding

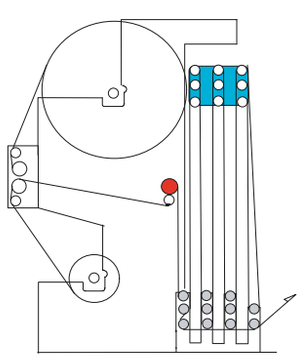


Fig B - Festoon fills

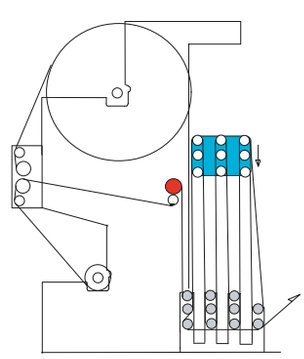


Fig C - Stationery splice

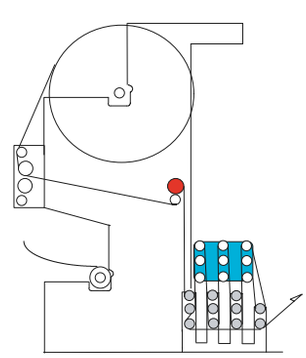
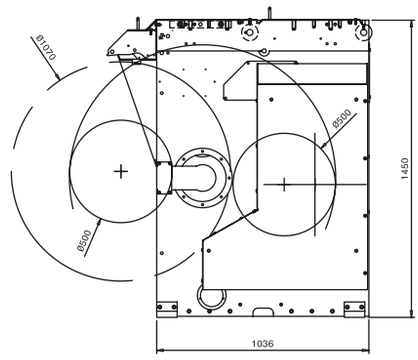


Fig D - New roll acceleration

Flying splicers for heavy and wide rolls are equipped with automatic loading. This can include a core container (left) into which the expired roll can be placed. Source: KBA



There are numerous flying paster designs, however, they all have a similar splice cycle. The main differences are in the way rolls are supported, rotated, accelerated and braked — this is a compact model. Source: B&W MEGTEC

The incoming roll and expiring roll both run at full press speed when the "flying" roll change is made. Splice preparation requires precision, correct tapes and tabs.

The Splice Cycle

A The new roll is loaded and splice pattern prepared while the running roll is being unwound, An automatic cycle starts about two minutes before the splice, when a klaxon/flashing light informs the press crew; the cycle can also be manually started by the operator.

B The arms (turret) are rotated into the splice position, the splice arm carriage pushes the running web to about 10 mm (0,4 in) from the new roll surface. The new roll is accelerated (by either a belt on the roll circumference, or by a core drive) to match the speed of the running roll (± 0,5-1%). The new roll is normally automatically aligned to the running web (± 1 mm/0,04 in).

The PLC synchronises all splice parameters (running web speed, minimum roll Ø at splice, new roll circumference, speed, position of detection tab) and automatically triggers the splice.

The running web is pushed by (roller or brush) against the surface of the new roll about 1,5 m (60 in) before the splice pattern, the roll is pasted on to the running web and the splice opens to release the new web

✅ The knife cuts the web of the expiring roll just after the end of the splice pattern (splice tail).

✅ Tension control brake is transferred to the new running roll.

✅ The expiring roll is braked to a halt and the splicer carriage returns to its home position.

C The arms (turret) are rotated into the running position.

Source: Goss Contiweb

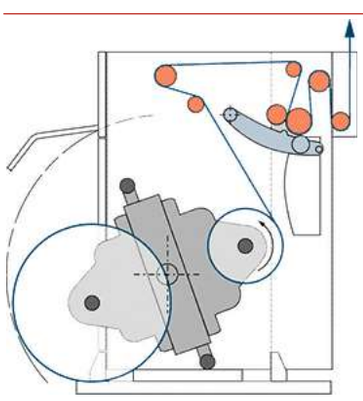


Fig A - Unwinding

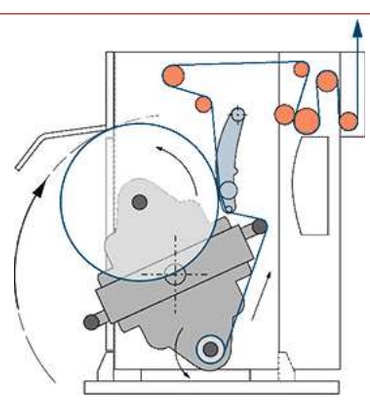


Fig B - Splice cycle

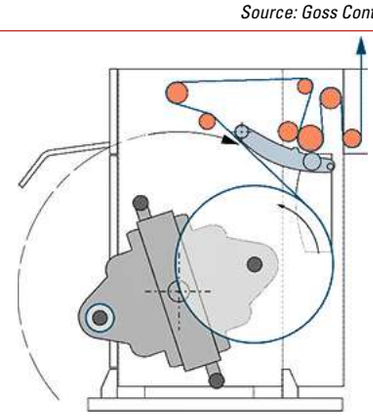
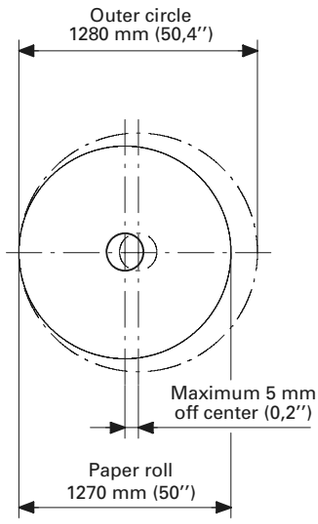
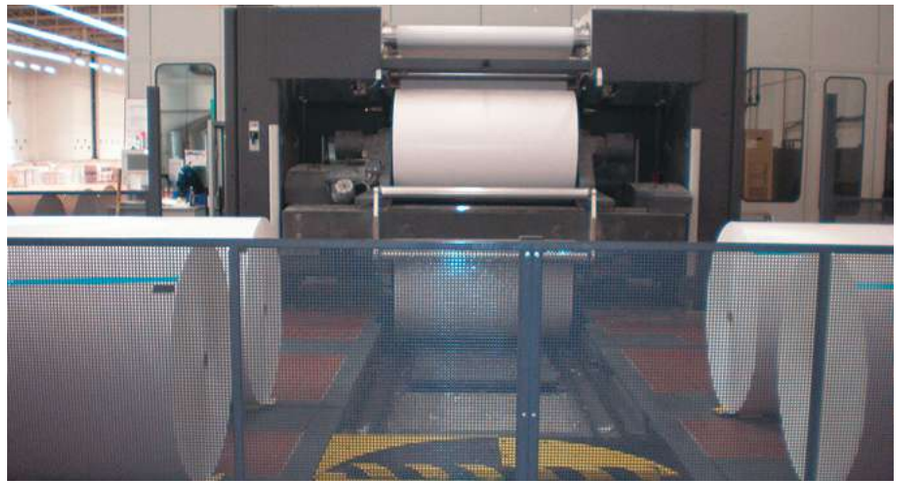


Fig C - Loading



Out-of-round tolerances for automatic handling. Source: KBA

Automation Issues



Roll buffer system in heatset web offset. Source: Goss

Key automation issues for safety and productivity:

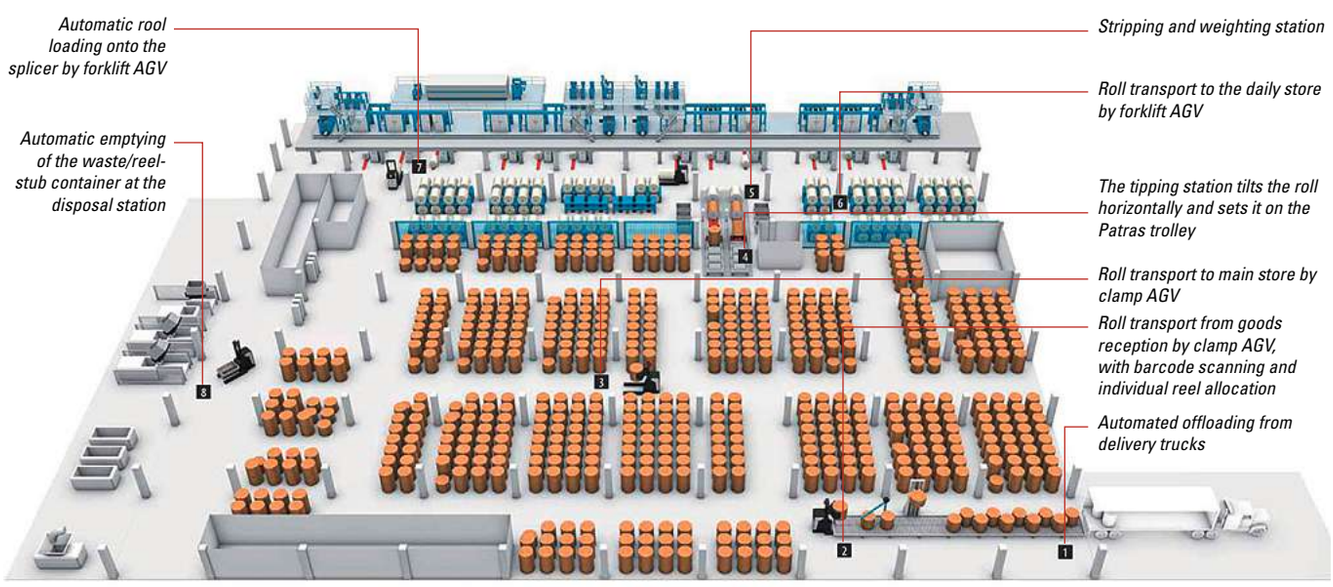
- Auto unwrapping needs standardised roll packaging
- Auto splice preparation needs multi-function splice tape
- Paper needs to be in acceptable temperature RH range.

Most new high speed presses use automated roll handling located in an area secured with safety fencing and access protection around the splicer.

High Press Speeds and Larger Roll Dimensions

Increased offset press speeds up to 20 m/s means reduced intervals between roll changing. Some presses have increased roll diameter from 1250 mm to 1500 mm Ø (50 to 60 in) to reduce roll changes by 31%; however, this increases roll weight by 44%. Offset web widths have also increased to between 2000 to 2860 mm. This means that rolls of up to 7,5 tonnes need to be handled, requiring automatic roll handling and loading. Publication gravure web widths of 2450 to 3680 mm are common and the widest rolls are 4320 mm. Logistics need to be adapted to handle and store rolls at the paper mill, in transit and at the printer. The threshold for roll handling automation is from 2,2 tonnes (it can be lower) using either rail or AGV systems.

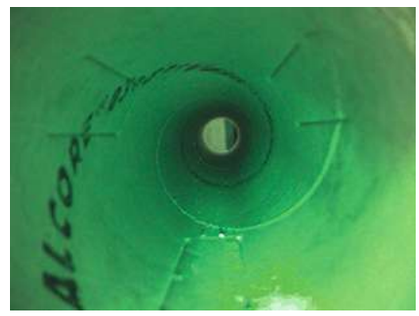
High productivity press installations have increased automation for multiple process steps.
Source: KBA



Roll Cores — an Integrated Renewable Component

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

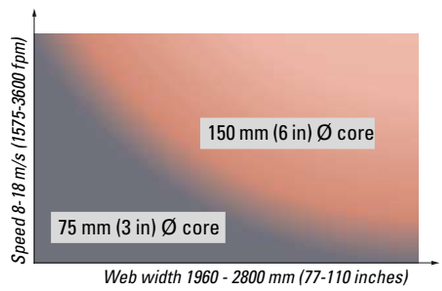
Most offset splicers now use core braking and acceleration, making the quality of the core critical to the transfer of torque. Splicers use shafts or chucks to support the roll by the core and firmly lock it without slippage, including during emergency stops. Shafts run through the core and are either mechanically or pneumatically expanded to provide good adhesion along the length of the core, but they cannot be used with damaged cores. Chucks penetrate only the ends of cores and, therefore, these must be of adequate quality and condition to withstand braking torque.



Source Sonoco- Alcore.

Core Specifications

Normally, it is the paper supplier's responsibility to ensure that the cores on which paper is supplied conform to the printer's requirements. These are determined by the web width, roll diameter and weight, and production speed. Appropriate core properties are important to run the winder and printing press safely. Only the press manufacturer in cooperation with core and paper suppliers can provide information about safe unwinding speed for roll width, weight, speed combinations and core diameter required (76 or 150 mm/3 in or 6 in). *See Module 1 page 10 for more information*.

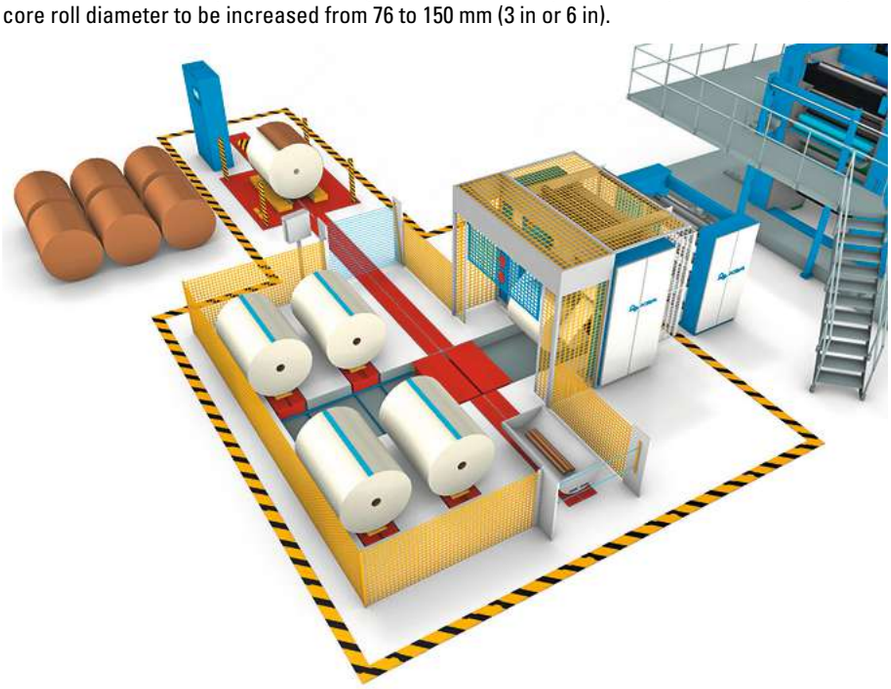


This chart indicates core diameter requirements in relation to printing speed and web speed with a splice diameter of 120 mm (4,7 in). Always check with the press manufacturer and core supplier particularly when in the transition zone from 75 to 150 mm (3-6 in) core diameter — see Module 1 for more details. Source Sonoco- Alcore

Residual Roll Explosion Risk

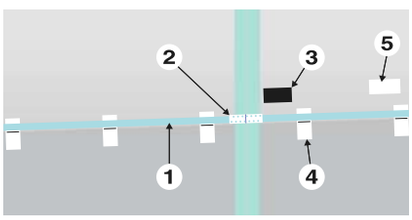
High speed presses with web widths over 2000 mm require a higher critical speed (axial E-modulus of core divided by its density). If this value is incorrect the residual roll can explode and may cause serious injuries. Therefore, these offset splicers should be enclosed within safety cages during operation (these are already used in publication gravure). The planned ISO 12643 standard requires a safety barrier against core fragments when web speed exceeds 15 m/s or webs are wider than 2000 mm.

Dynamic strength is measurement to estimate roll weight. It does not correlate web vibration. Critical speed is determined by core E-modulus divided by its' density — a high value is required to avoid residual roll explosion risk at higher web width and production speeds. This may require core roll diameter to be increased from 76 to 150 mm (3 in or 6 in).



A movable barrier in front of the splicer protects operators in case of a residual roll explosion. The door is automatically closed before and after splicing, and at a given web speed and roll revolutions. Source: KBA

Different characteristics and dimensions are used for different splice conditions. Please check with your supplier to ensure using the correct tape for the conditions in your environment, printing substrates and machinery. Source: tesa SE



1 *Splicing tape*
2 *Belt bridge tab*
3 *Splice detection tabs*
4 *Splice rupture tabs*
5 *Folder exit detection tabs*
Source: WOCG/icmPrint

Splicing Tapes and Tabs

Adhesives (all with high tack)	Coldset	Heatset	Pub. Gravure
Repulpable adhesive	●		●
Repulpable heat-resistant adhesive		●	
Climate resistant adhesive	●	●	●

Tape opening force	Low	Moderate	High
Core driven splicer		●	●
Belt driven splicer	●	●	
Fragile paper quality	●	●	

Modern splicing tapes allow a straight-line splice pattern that has become the market standard for flying splices and has largely replaced complex "V and W" patterns — these are still occasionally used in some gravure plants for certain conditions (gloss paper in winter); and for some specific paster types.

Pressure sensitive adhesive (PSA) tapes must paste the new web to the running web with sufficient adhesion to pass through the press, dryer and exit the folder without failure of the join. High tack adhesive tape functions equally well for zero speed and flying splicer but a low tack zero speed tape cannot be used for a flying splice because it will lead to a mis-splice.

Multi-function splicing tape systems for flying splicers combine several functions (tapes, rupture and detection tabs) into one tape to make splice preparation simpler, faster and more reliable with reduced risks of web breaks. Mono-function splicing tapes and tabs systems are still in (declining) use in some markets and applications.

Tapes are available in a range of widths to suit varying splice characteristics: for flying splice 25 - 50 mm (1-2 in) and 12 - 25 mm (0,5-1 in) for zero speed. Undersize tapes increase the risk of splice failure and oversize tapes add avoidable cost.

Liquid glue for splicing is now rarely used due to the difficulties of application and the risk of splice failure. It is sometimes used in very cold conditions. In a number of countries it is also banned due to employee health risks. If liquid glue is used, avoid drops on surface and roll ends. If solvent thinner is necessary, use breathing mask.

Mono-Function Double-Sided Splicing Tapes and Tabs

These systems are still in use, although they have declined in favour of multi-function tape systems.

Splicing tape: Double-sided coated tapes using high-tack pressure sensitive adhesive (PSA) on an acrylic base.

Belt bridge tab: Splicers with belt drive require bridge tabs positioned over the top of the exposed splicing tape in the path of the acceleration belt(s) to prevent premature opening from air pockets forming during acceleration. Bridge tabs are available in different versions depending on the application and paper grade. For papers with lower coating anchorage more exposed adhesive in the belt path is recommended.

✘ Do not use tape liner as a bridge tab as it will separate during acceleration and may cause a mis-splice.

Splice detection tabs: Different types — (a) printed solid black for photocell recognition — correct density and consistency of printing are essential for reliable detection, (b) reflective for light sensor detectors and (c) inductive.

Splice rupture tabs: Hold down the outer spire during rotation to prevent air pockets being formed that can burst the splice during acceleration. The die-cut/perforated tabs break instantly after the splice has been made to release the new roll for unwinding. Number and type of tabs are determined by splice speed and paper grade.

Folder exit detection tabs: Aluminium tab used for sorting out splice waste during postpress processes. (In Europe they are not normally separated from pressroom waste because they are easily removed by filtration during repulping.)

Multi-Function Splicing Tapes

These tapes combine different features for a simpler and more reliable splice performance:

- Easy-to-use for operators
- Reliable high quality tape with perfect wetting on most paper grades
- Prevention of air pockets and premature opening during roll acceleration
- Easy opening of the splitting strip and high initial tack at the moment of splice-to-web contact
- Shear-resistant bonding of the top sheet, even for rolls prepared in advance, and throughout the press
- Reliable splice recognition when using splicing tapes with integrated detection.

Contact adhesive: Splicing tapes use PSA (pressure sensitive adhesive) with high tack for three functions:

1. Secure attachment of the top spire of new paper roll during storage, transport and acceleration in the paster.
2. Optimum contact between expiring and new web at the moment of splice. The bond intensity is influenced by the pressure and condition of the contact roller or brush in the splicer.

✅ Follow the manufacturer's settings and maintenance.

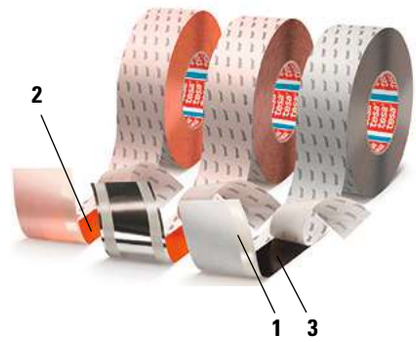
3. Heat-resistant adhesive for high temperatures of heatset press dryer.

Splitting strip: Provides secure closure of the incoming paper roll during storage, transport and acceleration in the splicer. During the splice process the strip precisely opens after pasting contact (from a defined strip width and specified opening force). The splitting strip is like a breaking point independent of the tape's width, positioned 2 mm from the tape's edge for a reliable lifting of the splice. A lower opening force is recommended for belt driven splicers and low quality paper.

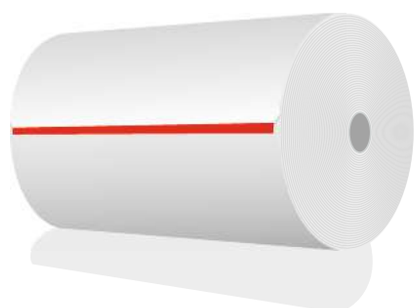
Integrated detection: Reliable splice detection for the correct timing of the contact roller and the knife to cut the expiring web can come from either a mechanical mark on the splicer's axis or automatically, using an optical or inductive sensor. Automatic splice detection reduces the number of mistakes due to wrong tab positioning — the splice will be detected directly on the tape's position. It requires either detection tabs, or splicing tapes with integrated detection:

- A black backing for optical sensors in the splicer.
- Aluminium backing for inductive sensors in the splicer and postpress (to remove printed copies with tape).

✅ Ensure the correct splice tail length when changing from detection tabs to splicing tapes with integrated detection. Request settings from the splicer supplier.



Multi-function splicing tape:
1 *Splitting strip,*
2 *High tack contact adhesive,*
3 *Integrated detection feature.*
Source: tesa SE



Roll ready for splicing. Source: tesa SE

Temperature and Humidity for Tapes

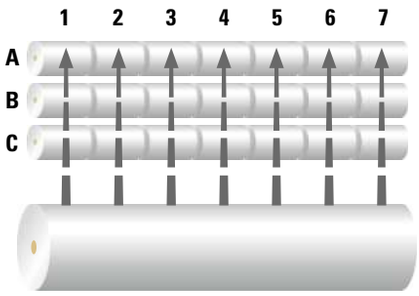
Repulpable adhesives offer very good wetting on paper but also react with the environment and substrate temperature and humidity. Adhesive properties are influenced by temperature and humidity — different adhesive formulations are available to deal with some of these variations. Newer climate-resistant tapes offer an improved adhesive with higher shelf life to provide high stable tack under different environment conditions, such as high humidity or low temperature of the paper rolls or pressroom.

✅ Select tape type in relation to ambient temperature and humidity in your plant. Consult tape supplier.

✅ Store tape in its original packaging at a temperature between 10 - 40°C (50 - 104°F) with 40 - 65% RH and away from direct UV exposure. Respect the specified tape shelf life, as adhesive qualities deteriorate over time. Leave protective liner on tape as long as possible.

✅ Cold conditions: Store the tape in the original packaging at ambient pressroom temperature at least one day before use. Special tapes are available.

✅ High humidity conditions: Keep the tape cool (in a refrigerator) except when being used to prepare a splice. Special tapes are available.



The diagram shows a tambour rewound into three sets of seven rolls each. The set and deckle position of rolls are generally found on the paper label.
Source: icmPrint

Web Tension — Key to Efficiency

Optimum web tension is crucial for colour quality and high productivity. Tension variations come from (a) paper (b) press line and (c) poor working practices. Web break risk increases either when tension variations become excessive and/or there are local area weaknesses in the web. Local papermaking weaknesses that may cause web breaks include poor mill splices, creases and hairline cuts that might not resist the tensions applied to the web.

Paper and Roll Characteristics

Paper is primarily composed of natural cellular materials, which by their nature are locally variable and do not react to a given stress in the same way. There will always be some variation in tension profile in all papers from all suppliers. It is normal that there are variations of tension (1) across the width of the papermaking machine, consequently with a variation from roll-to-roll, (2) between the surface and core layers, and (3) at mill splices near cores.

Modern paper mill winders run at speeds up to 50 m/s (8000 fpm) on webs over 9 m (30 ft) wide. To obtain a good and even winding it is important to have even profiles of moisture, hardness and tension. Mill join splices are made after a web break or to make fillings (joining two tambour reels to fit customer diameters). Mill joins should be coloured to allow photocell detection and physical separation and should not be closer than 70 mm (2,75 in) to the core to avoid any disturbance to the splice cycle and tension.

✅ To minimise roll-to-roll tension variations some printers organise their internal paper storage to print from rolls from the same tambour position. This practice is claimed to provide lower tension variations between rolls during splicing and running, contributing to waste reduction and reduced creasing, particularly on heavier papers. The roll position is contained on the roll label. It is best to use position numbers within an order and not mix orders, as the positions do not always match exactly between orders.

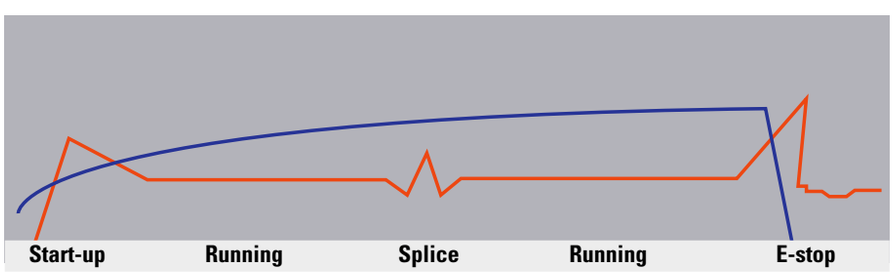
Web Tension Variations from Press Line

Press line tension settings are specified by the press manufacturer and vary from press to press. Generally, they are about five times lower than the breaking tension of the paper. These tensions need to be optimised over time for variables of different papers, blankets, ink and dampening. Web tension control should be smooth and slow.

Equipment influences on tension include: type of splicer and infeed, variation at printing units (cylinder pressure setting, blanket type/packing), automatic blanket washers, dryer, chill rolls and folder. During the splice cycle there will be a change in tension profile. If there are any weak spots in the web or splice they will be subjected to extra stress and a web break or splice failure can occur.

Poor Working Practices

Lack of ongoing training and motivation often results in incorrect setting, operation and maintenance of equipment. Poor roll handling can damage and deform rolls.



Variation in the web tension profile is normal during different running states. Source: WOCG/icmPrint

Preparing the Roll for Splicing

⚠ PASTER OPERATION SAFETY: Different splicer models have their own specific operation. Therefore, this general guide can under no circumstances replace the supplier's instructions. Before operating the splicer, all staff concerned must know the manufacturer's safety regulations, operating instructions and maintenance procedures.

Paster makeready

- ✔ Set roll width (adjust width between splicer arms to roll width + clearance specified).
- ✔ Core waste: This is the preset length of paper to be left on the core at time of splicing. It is determined on the basis of minimum length to avoid web running off roll and consequent press stop. The last wraps around the core may not be suitable for printing due to wrinkles or embossing.
- ✔ Set low start-up tension setting (to minimise risk of web break at low speed).
- ✔ Web-up splicer after roll is loaded following the splicer manufacturer's instructions.
- ✔ Ensure web guide is centred.
- ✔ Ensure web cocking device is in neutral position. Some zero speed and flying pasters can cock either the festoon or outlet roller. This is used to compensate for deformed rolls. It is essential that this device is in a neutral position when not required as otherwise it will create massive instability in the running web.

Paster and Infeed Tension

- ✔ Experience identifies these starting points to develop optimum settings on each press (in conjunction with those of the manufacturer). Values depend on: type of paster, winding hardness, printing cylinder assembly (gummi-steel or rubber-rubber), experience of the printer, virgin fibre, mixed, or recycled paper. The following table is a guideline example only.

Commercial start-up tension settings			Newspaper start-up tension settings	
Paster	40-120 gsm	120-150 N/m (0,68-8,6 pli)	Paster	70-90 N/m 0,4 pli
Infeed	30-60 gsm =	(___gsm x 10 x 90%) = __N/m	Infeed	200 N/m 0,5 pli
	60-90 gsm =	(___gsm x 10 x 80%) = __N/m		
	90-120 gsm =	(___gsm x 10 x 70%) = __N/m *1 N/m = 0,00571 pli (pounds linear inch)*		

1. Always reset tension when changing paper weight.
2. Set low start-up tension level (to minimise risk of web break at low speed).
3. Fine tune tension during makeready and running.
4. Record settings for each paper and web width for faster future set-up with less waste.

€² Too high tension causes wrinkles, increased web break risk and can change print length.

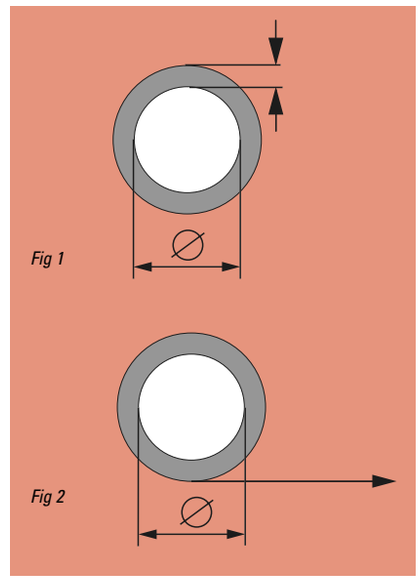
€² Too low tensions causes web wander.

Half and Part Roll Widths

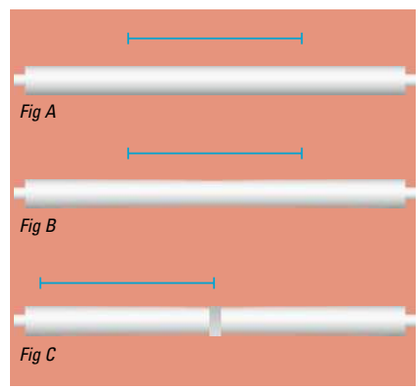
Part roll widths generally run better in the centre (if the folder permits). For twin web in-line configurations the half web should be run in the lower position to print in the second set of units to avoid running a part web over air turns and to minimise tension variations.

Some zero speed splicers use parallel festoon rollers (A). Most splicers use tapered rollers to self-centre the web and provide better tension on web edges (B).

If the roll cannot be run in the centre (for some 2-web productions) the rollers will need to be taped to avoid web wander (C). The dancer rolls can be cocked on some models.



Core waste is set either as
1 *radial thickness or*
2 *linear length.*
To minimise either having too little core waste or too much, these settings can be changed when the press changes from a very thick to a very thin paper or vice versa. Attention, the external diameter of cores are variable. Source: WOCG/icmPrint



A. Parallel festoon rollers
B. Tapered rollers to self-centre the web
C. Off-centre half web requires tapered rollers to be taped. Source: WOCG/icmPrint

Roll to Web Processing Steps

Preparation with the roll on the splicer is recommended because it is ergonomically efficient and minimises damage and waste. An automated central roll preparation station is used at some installations, but requires careful transport of rolls to the splicers. A few very high volume printers use fully automated systems.

- ✔ Roll preparation area needs to be dry, even (free of hard particles), and clean.
- ✔ Best practice roll handling avoids damage that frequently leads to excessive paper waste and web breaks.
- ✔ Close gates and doors near the splicer to control draughts and dust, temperature and RH variations.
- ✘ Premature removal of the wrapping increases the risk of dimensional instability from atmospheric variations, and accidental damage to the white paper.

Manual On-Paster Preparation — roll placed next to splicer

1. Remove end covers and core plugs, inspect, test with Schmidt hammer
2. Record roll number and bar code (if system fitted)
3. Load roll on to splicer
4. Remove brown wrapper, weigh and dispose
5. Slab-off white waste, weigh and dispose
6. Prepare splice
   Rotate roll to avoid dust falling onto tape
   Set cocking roller if needed to compensate uneven rolls
7. Splice cycle
8. Remove core/part roll. Support butt roll as chucks are retracted.

Source: KBA

Automated Roll Handling System

1. Automated roll delivery and truck unloading
2. Scanning roll data and allocation
3. Automated main roll store
4. Roll preparation with weighing station
5. Record roll number and bar code
6. Automated daily store
7. Load roll on to paster/splicer incl. splice cycle
8. Remove core/part roll – waste disposal

Source: ERA

Splice Preparation Tool Kit

- Schmidt hammer to test rolls for soft spots
- Flat-bladed knife for removing roll end covers
- Roll slitter for stripping (available from most paper suppliers)
- Scissors (to cut off splice "ears")
- Sharp knife with undamaged blade for cutting out damage — store in scabbard when not in use
- Sandpaper or powered sanding disc to smooth out damaged areas of the roll
- Tape squeegee/applicator
- Good lighting where rolls are inspected and prepared for splicing
- Roll report sheet for monitoring paper data and splice/web break failures
- Tapes and tabs need to be stored at 10 - 40°C (50 - 104°F) with 40 - 65% RH and protected from sunlight and dust.

Inspect Rolls Before Preparation

- Check wrapped ends for cuts, glue, dirt (dust), dents, water damage.
- Check roundness.
- Note any damage with information about size and depth on delivery list with roll number.
- Take photos of damaged roll parts.
- Check grade, grammage, roll width, core size.

For more information on inspection and reporting *see Module 2*.

Remove end covers with a broad-bladed knife. Source: WOCG/icmPrint

1: Remove End Covers (Shields)

- ✅ If a knife is used, care should be taken not to penetrate the roll end. A broad-bladed knife helps reduce risk.
- ⚠ The cutting action with the knife should always be away from the person using it to minimise the risk of injury if the knife slips. Always return the knife to a scabbard when not in use.
- ✅ Inspect white roll ends for damage (cuts, glue, dents, water damage).
- ✅ Check roll and core for roundness.
- Remove core plugs (if fitted) and inspect core for damage, sweep away any dust.
- For splicers with chucks, the outer 10-15 cm (4-6 in) must be in good condition.
- For splicers with shafts, the core must not be crushed or blocked.
- ✅ A Schmidt hammer can be used to test rolls for soft spots.

Avoid knife damage to roll. Source: ERA

2: Record Information/Read Bar Code and Weigh

Record the roll number and other information either manually (most paper mills provide peel-off labels that can be stuck onto a report sheet) or automatically (using barcode) into a data log or Electronic Data Interchange (EDI). This provides essential data on paper use and allows rolls to be traced in the event of paper problems.

Radio frequency (RF) tags are a roll tracking technique used by some mills and printers. The tag is inserted into the roll core and can be automatically read by detectors in the store, on lift trucks, roll transporting devices and at splicers to give the status of all rolls in the plant at all times.

Read bar code or peel-off label. Source: WOCG/icmPrint

3: Load Roll onto Splicer

Best Practice and Safety First

- ⚠ **Before operating the paster, all staff must know the manufacturer's safety regulations and operating instructions.**
- ⚠ **Arm rotation safety:** Before splicing, and during manual arm rotation, the operator must verify that rotation path is clear of personnel and foreign objects.
- ⚠ **Emergency stop devices:** All staff must know their location and function.

Unwrapped roll ends: Some paper rolls are marked with inkjet on the ends with roll number, weight, unwind direction, mill splice position. These markings help ensure that the roll is loaded onto the splicer with the correct unwind direction, and marks any mill joins to allow detection and sorting.

- ⚠ Roll arms are adjusted to the correct width for the roll being loaded plus supplier's tolerance.

For splicers without any form of assisted loading, it is a good idea to paint reference lines on the floor for common web widths to allow better line-up of rolls before they are moved into the arms. Edge damage is common during loading from collisions with splicer arms or chucks and causes avoidable paper damage.

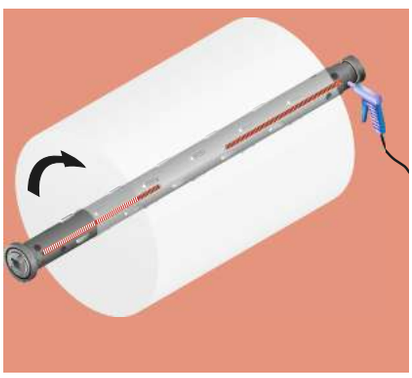
Ink jet printing on roll end shows roll number, weight, unwind direction and mill splice position. Source: WOCG/icmPrint

Ensure chucks are fully retracted and free of debris before loading and roll brake is switched on.
Source: WOCG/icmPrint

Chuck pasters — Roll Loading Safety Check:

- ⚠ Make sure chucks are fully retracted and free of debris before loading and roll brake switched on.
- ⚠ Verify chucks are fully inserted on both sides. Risk is that roll could come free of chucks to create a potentially serious accident, damage to roll and splicer.
- ⚠ Chuck jaws are fully expanded into core. If soft cores are used there is a risk that the chucks will settle into core. If chucks do not provide continuous automatic expansion, then the chucks should be checked for expansion just prior to start of splice cycle.
- ⚠ If manual expansion tools are used (T-wrench, air guns) ensure they are removed and replaced in their storage rack immediately after they have been used. High risk of injury.

- ✔ Make sure that the roll unwind direction (marked on roll end) is correct before loading.
- €² Lost time to unload roll, rotate and reload it creates risk that roll is available too late for splice



Always expand air shaft before roll is loaded.
Source: WOCG/icmPrint

Expanding Shafts

- ⚠ Expand the shaft before the roll is loaded onto the splicer arms/hoist, otherwise the roll will be off-centre.
- €² Off-centre rolls generate vibrations and tension variations during unwinding, causing increased risk of web break, creasing and mis-register.

For splicers with roll-over-roll make splice preparation on the shaft when loaded on to hoist.

- ⚠ Follow supplier's procedures to avoid safety and roll damage risks.
- ⚠ Ensure shaft is locked into position in splicer.

4: Remove Wrapper

When unwrapped, roll acts like a released spring and will tend to loosen. This puts additional tension onto splices prepared in advance. Cold rolls tend to expand more when warming up.

- ✔ Use plastic/wooden roll stripper when removing the belly wrapper (do NOT use a knife). Dispose of wrapper with brown waste.
- €² Removing the belly wrapper with a knife is less controllable and can result in excess stripping.

Use a roll stripper to remove the belly wrapper
Source: WOCG/icmPrint

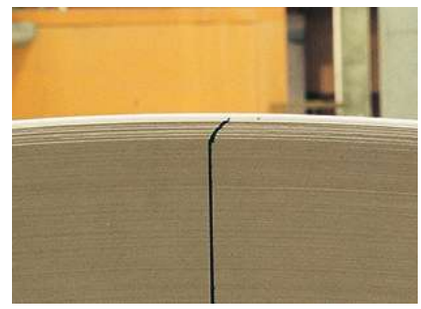
5: Slab-off White Waste, Record & Dispose

- ✅ Pull individual wraps from the roll, inspecting the edges and belly for damage. Roll surface must be free from impression marks made by stones, nails, wooden parts. If OK, prepare the splice.
- ✅ If further stripping is needed, tear the top layers by hand before introducing the stripping tool. Once the roll is damage free, prepare the splice.

Experience shows that some edge and side damage does not always require stripping to the bottom of the damage. This can often be treated by carefully cutting out with a sharp knife and/or sanding of the area. The press operator should be informed of the problem so that he can slow down the press and nurse the damaged web through the press. Applying a lubricant to damaged area may assist passage through the press.

- €² Failure to identify end damage may result in a web break during production.
- €² Risks of accidental damage to the white paper are increased.
- €² Over-zealous use of the stripper will result in unnecessary waste.

Frequently, more layers are stripped off than are really necessary. It is important to remember that much more paper can be saved at the top of a roll compared with near the core, e.g. 5 mm (0,25 in) at the top of a roll is equivalent to 5 cm (2 in) at the core!

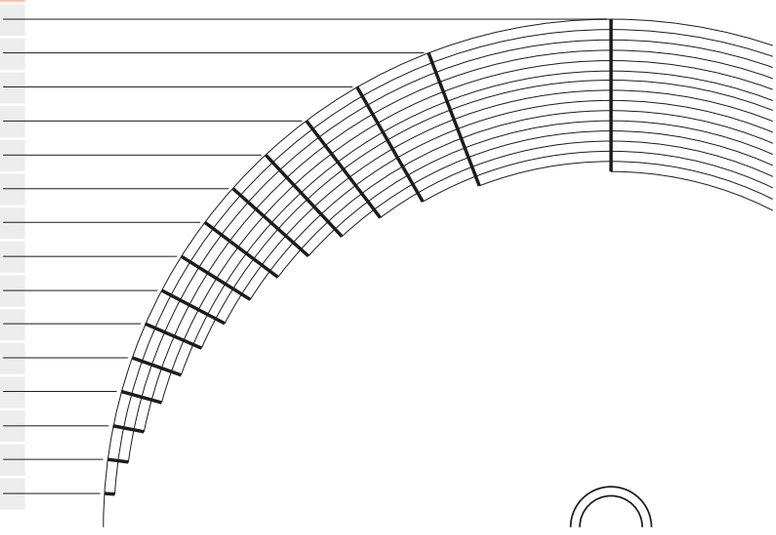


Dynamic roll expansion if wrapper removed too early.
Source: WOCG/icmPrint

STRIPPING WASTE CALCULATION CHART

Stripping waste as % of total paper on roll

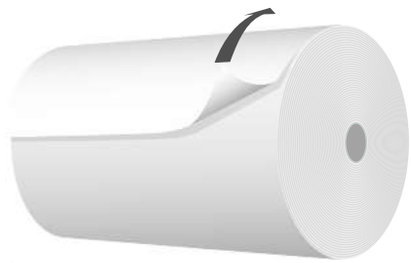
Depth of damage	Roll 1000 mm/40 in	Roll 1250 mm/50 in	Roll 1500 mm/60 in
100 mm 3,94 in	36,4%	29,6%	25,0%
90 mm 3,54 in	33,1%	26,9%	22,7%
80 mm 3,15 in	29,7%	24,1%	20,3%
70 mm 2,76 in	26,3%	21,3%	17,9%
60 mm 2,36 in	22,8%	18,4%	15,4%
50 mm 1,97 in	19,2%	15,5%	13,0%
45 mm 1,77 in	17,4%	14,0%	11,7%
40 mm 1,57 in	15,5%	12,5%	10,4%
35 mm 1,38 in	13,7%	11,0%	9,2%
30 mm 1,18 in	11,8%	9,4%	7,9%
25 mm 0,98 in	9,9%	7,9%	6,6%
20 mm 0,79 in	7,9%	6,3%	5,3%
15 mm 0,59 in	6,0%	4,8%	4,0%
10 mm 0,39 in	4,0%	3,2%	2,7%
5 mm 0,20 in	2,0%	1,6%	1,3%



Separated waste

Environmental best practice and higher value payment for recycling comes from separating waste:

1. Brown waste (end covers, wrapper)
2. Fibre core (strip off white waste)
3. White waste from slab-off, core.
4. Printed waste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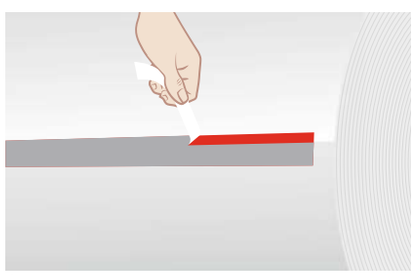
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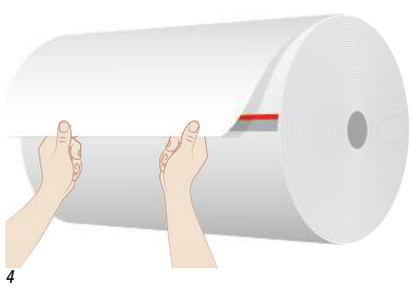
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6.1 Splice Preparation — Single Multi-Function Tape

Apply the brake to stop the roll rotating during preparation.

1. Peel off and fold back the first paper layer (spire) of the new paper roll (figure 1). Do not touch the exposed adhesive area on the reverse of the tape as grease decreases its adhesion.

   Apply the tape from left to right with the narrow part of the liner on top*. Leave a space of about 10 mm (1/2 in) on each side to prevent exposed adhesive outside of the splice (figure 2).

   **Exceptional cases may require preparation to be turned upside down, depending on splice direction and splicer.*

   ✅ Use a squeegee or plastic card to apply high pressure across the total width and length of the tape after positioning to ensure optimum adhesion.

2. Remove the narrow part of the liner. Pull it upwards at a 90° angle to prevent damage to the splitting strip underneath that could cause premature opening during acceleration (figure 3).

3. Pull the top sheet tightly over the exposed adhesive (figure 4). Expel air between the outer and inner spires so that they lie smoothly to prevent wrinkles or tension difference at the moment of contact between the new and expiring webs.

4. Fold back and tear away the excess material of the top paper layer by hand (figure 5).

   ❌ Do not use a knife that can damage the tape or paper.

   ✅ Use a squeegee for higher pressure when pressing the top paper layer on to the tape (Figure 6).

5. Trim both edges of the prepared splice (figure 7). This prevents wrinkles caused by air blowing under the top layer during the acceleration of the new roll.

6. Remove the remaining liner. Pull 90° downwards. The roll is now ready to splice.

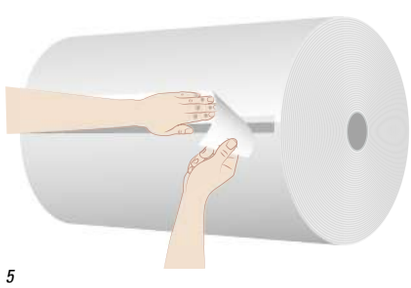
7. If belt acceleration, apply belt bridge tab in path of acceleration belt, make sure tape width is fully covered otherwise splice preparation will be torn off by acceleration belt *(see page 24)*.

8. If splicing tape does not have integrated detection, apply detection label (black or aluminum), correctly position for optimum tail length, apply an aluminum detection label for postpress exit if required.

   ✅ Release splicer brake. Rotate roll to avoid dust and moisture condensation falling onto tape.

   ❌ Dust and condensation on the tape surface reduces its adhesive qualities. If possible, only remove the protection tape liner from the adhesive just prior to the splice cycle.

Set lateral position of new roll to align it with running roll to avoid the high risk of splice failure or web break.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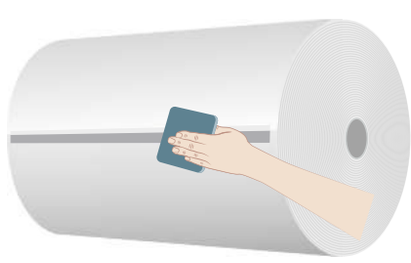
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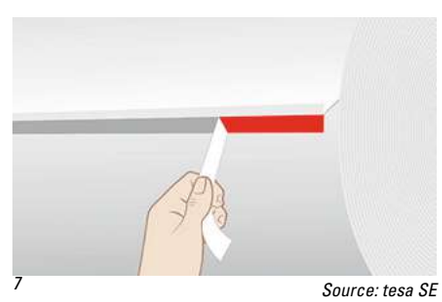
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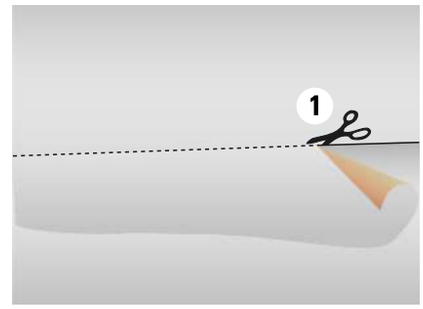
Source: tesa SE

6.2 Splice Preparation — Mono-function Tape and Tabs

Apply the brake to stop the roll rotating during preparation.



1. Fold back the first paper layer (spire) and slit along the folded edge. Expel air between the outer and inner spires so that they lie smoothly.

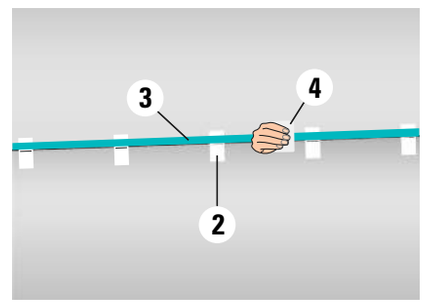
✘ Wrinkles cause tearing and separation of the top layer from the surface during acceleration.

2. Use rupture tabs to close the roll system. The distance between tabs (100-150 mm/4-6 in) is related to paper weight and press speed. Outer tabs should be 25 mm (1 in) from the edges. Use line printed on the tab to position adhesive-free zone under the line pointing to the inner spire of the roll for easy opening at pasting.

✘ Do not apply tabs too tightly or they may break in advance of splice.

✘ Always close the top of the splice pattern to prevent creating air pockets that can cause splice failure.

✘ Incorrect rupture tab position increases breaking strength and may result in a failure to open.

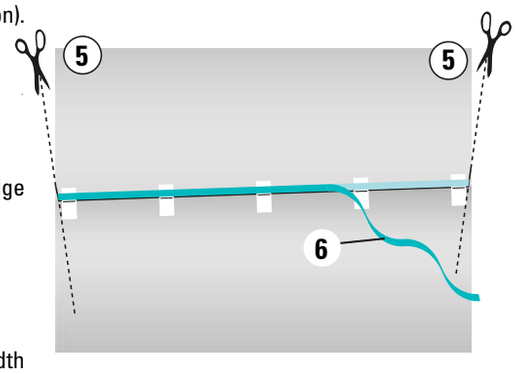


3. Apply the tape along the splice profile 2 mm (0,08 in) from the edges on all three sides. Do not remove protective tape liner.

✘ Do not allow tape to overhang the roll edges.

✘ Do not stretch the tape and avoid pleats.

✘ Do not apply tape/tabs in the path of folder slitter wheel path (possible web break of a ribbon).



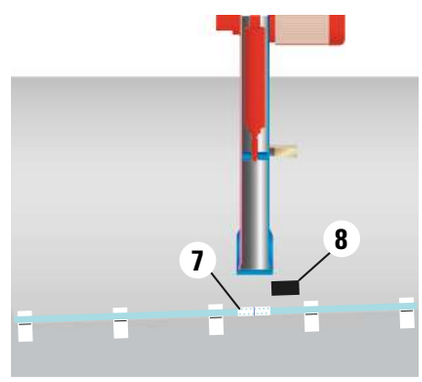
4. Use a squeegee or plastic card to apply high pressure across the total width and lengtl the tape after positioning to ensure optimum adhesion

5. Use scissors to cut off "ears" of leading edge next to the external tabs to improve edge profile.

6. Remove PSA tape protective liner.

7. If belt acceleration, apply belt bridge tab in path of acceleration belt, make sure tape width is fully covered otherwise splice preparation will be torn off by acceleration belt

8. Apply detection label (black or aluminum). Correctly position for optimum tail length. Apply an aluminum detection label for postpress exit if required.



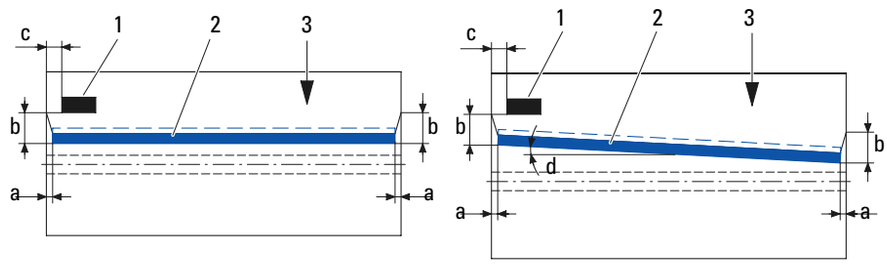
✘ Dust and condensation on the tape surface reduces its adhesive qualities. If possible, only remove the protection tape liner from the adhesive just prior to the splice cycle.

✔ Release splicer brake. Rotate roll to avoid dust and moisture condensation falling onto tape.

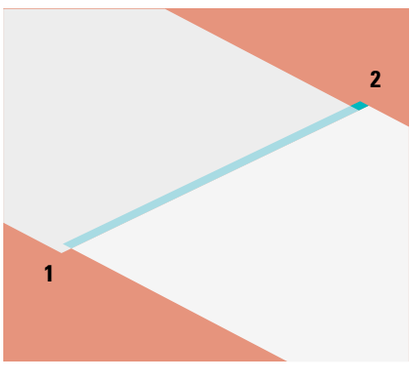
Set lateral position of new roll to align it with running roll to avoid the high risk of splice failure or web break.

Drawings source: tesa SE

Splice Pattern



Straight splice preparation:
1, Reflective tab
2, Splicing tape
Dimensions:
a) 20 mm
b) 100 mm
c) 50 mm
d) 3° maximum angle
3, Direction of rotation
Source: KBA



✘ *1 Overlapped paper edge sticks to ink build-up on blanket edge tearing the web.*

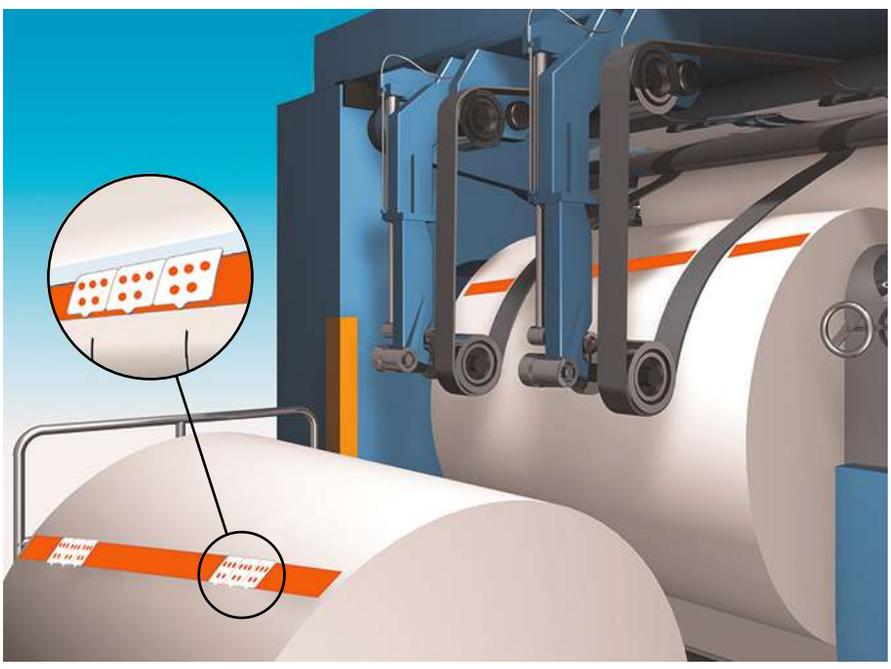
✘ *2 Exposed adhesive will stick on to rollers or blanket causing a break.*
Source: WOCG/icmPrint.

The standard pattern is now a straight splice that can be at 90° or at a 1:10 angle to reduce the impact of the splice thickness as it passes through the press.

The pattern depends on the roll drive (external belt or core drive) and the selection of either (a) multi-functional or (b) mono-functional tab and tape systems.

"V and W" patterns — which are occasionally used in some gravure plants for certain conditions (gloss paper in winter); and for some specific paster types. Recommendations for these patterns are not included in this manual but are available from WOCG Guide 1 on www.imcPrint.org.

Ensure belt bridge covers tape width



Apply belt bridge tab in path of acceleration belt, tab must be 5 mm wider than belt. Holes in belt bridge tab allow correct positioning onto exposed PSA tape, the width of which must be fully covered. A small 'nose' on the leading edge of this bridge tab helps position it correctly. Source: tesa SE

Technique to use with discretion

Applying grease to the edges of the web alongside the splice zone should be done with care. The purpose is to avoid roll edges sticking to blanket at splice point. Consequences are accumulation of grease and paper dust on splice arm and splice roller that may reduce its surface life.

Splice Tails

All zero and flying splicers normally have tails. For zero speed the position changes with every roll. The flying splicer tail is in a constant position that needs to be set to the splice pattern used.

Tail length should be short to minimise the risk of the tail being cut loose by the folder cutting cylinder (which can trigger a jam detector or cause a folder jam). Flying splicer tail length can be as short as 100 mm (4 in). It is influenced by the splice pattern, position of splice detection tab and the accuracy of speed synchronisation between the new and running rolls. Some zero speed splicers can reduce the tail length to the width of the tape (this technique increases preparation time by up to one minute), or make an end-to-end butt splice, but this has more complex preparation.

Secure the Tail

Flying splicers can angle the splice across the web to reduce the impact of the splice running through the press, but this leaves part of the tail longer than the minimum cut length. Many printers reduce this risk by securing the loose tail by:

- ✅ Applying a second narrow strip of PSA (or glue) to hold down the tail, or use an aerosol glue to secure the loose area.

Splice Detection Tab Position = Cutting Point

When preparing rolls there are two simple things to remember for tails:

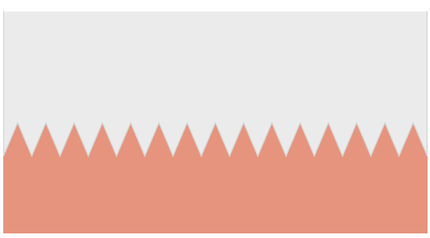
- ✅ The "relative" length of the tail (distance between tab and cut) is determined by the position of the splice detection tab. The same relative tail length is possible for all splice patterns.
- ✅ The "effective" tail length (distance between cut and end of splice pattern) is determined by the type of splice pattern used.

Splice tab position: Irrespective of what splice pattern is used, the distance between the end of the splice pattern and the cut web is always the same providing the splice detection tab is correctly positioned. The tab is always in the same relative position for all splice patterns. The effective tail length is determined by the type of splice pattern.

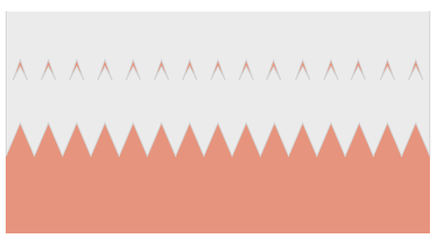
Detector position: A constant tail length error can be caused by a change in the relative position and/or angle of the splice tab detector.

Every Tail Tells a Story

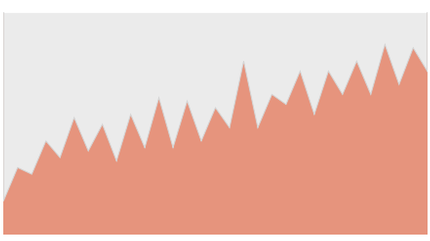
The causes of many splicing problems can be rapidly diagnosed by examining the splice tail. Many are simple and easy to fix by the splicer operator or in-plant technician with the aid of the user manual.



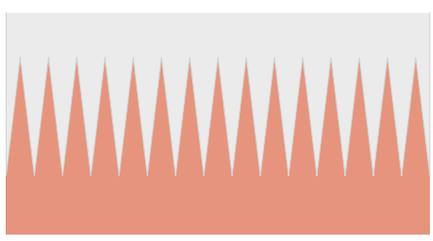
Correct knife cut and short tail length



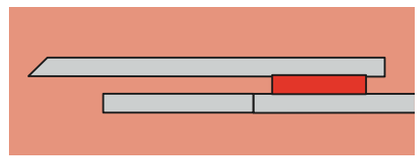
Knife bounce or too high web tension



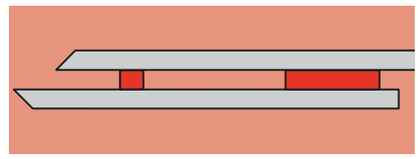
New roll too slow or knife misalignment



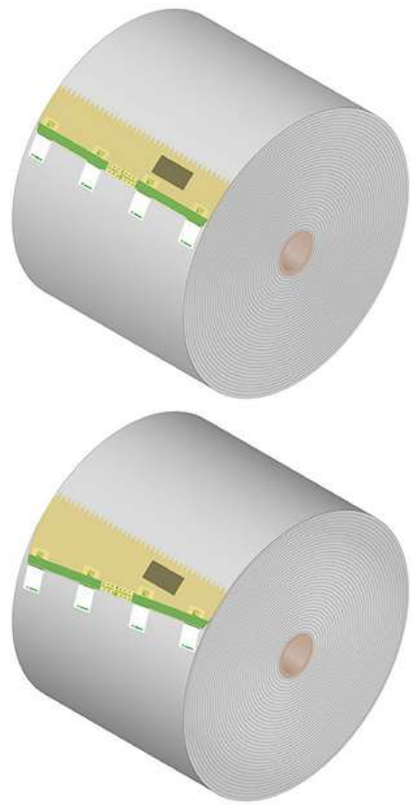
Incorrect speed match



Normal overlap splice with tail. WOCG/icmPrint

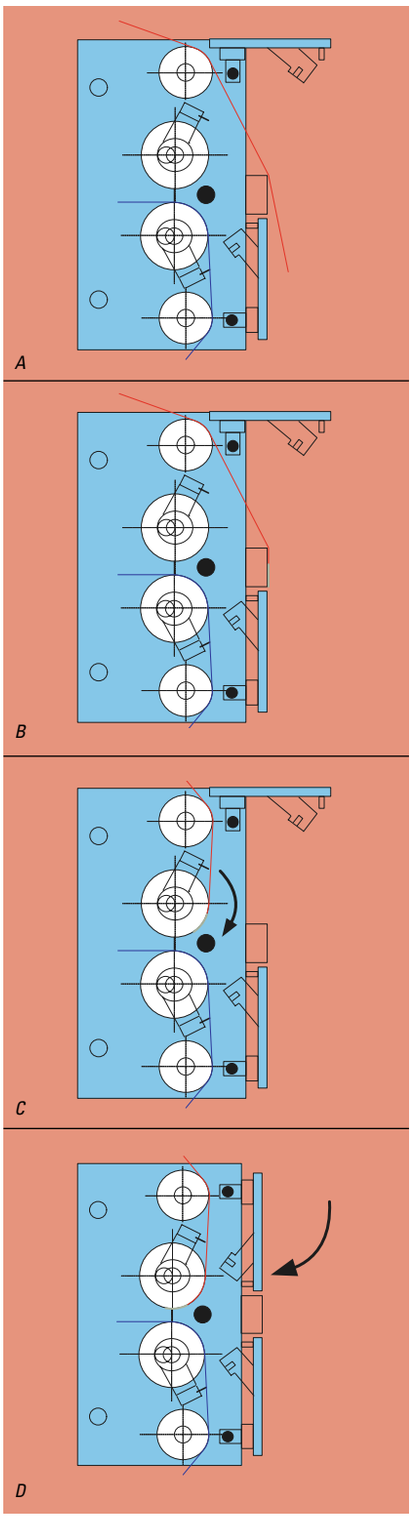


Splice tail secured with a narrow strip of PSA tape. WOCG/icmPrint



✅ *Apply glue to securely hold down the tail during its journey through the press and folder. The effective tail length is determined by the type of splice pattern. WOCG/icmPrint*

Source: WOCG/icmPrint



A. Side view of preparation head
B. Trim off the excess web and apply the splicing tape
C. Transfer to nip roller
D. Close splice head and rotate nip roller in web direction until taut. Source: WOCG/icmPrint

Zero Speed — Rolling Nip Design Type

A) Open appropriate preparation bar

Pull enough paper from new roll to reach past the preparation head and apply holding brake. Place the web against the prep bar where the vacuum will hold it in place.

Align the edge of the web with the running roll. Make sure web is square and uniformly tensioned.

B) Trim off the excess web. Use a sharp knife using the prep bar edge as a guide.

Apply the splicing tape across the full width of the web — 2 mm from the paper edges on all three sides. Do not allow tape to overhang edges. Optimum adhesion requires pressure to be applied across the total width and length of the tape after positioning.

Trim off corners and leading edges to help allow for any small misalignment of webs at splicing.

C) Transfer to nip roller. Re-check alignment of web and ensure it is square and of uniform tension.

- ✘ If the paper is stiff or has a curl away from the nip roll it may be necessary to roll the material so that it conforms to the curvature of the nip roller.
- ✘ It is essential that any uncovered holes in the vacuum bar are sealed off with tape, otherwise a failed splice may occur.
- ✘ Any build-up of tape or paper on nip rolls may prevent a good seal at time of splice.

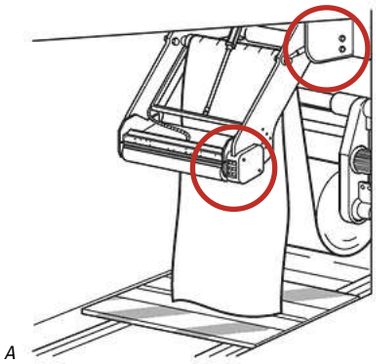
Remove the complete protection liner from the adhesive. Clean off any excess adhesive from the prep bar.

D) Close the splice head. Rotate the nip roller in the direction that the web will be running until it is taut.

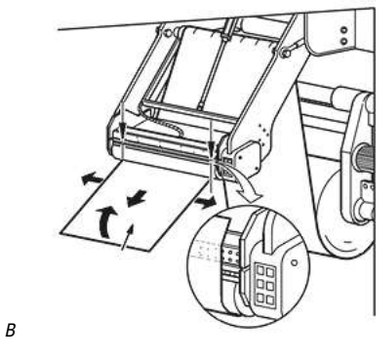
- €² Splice failure, web break, paper waste, press downtime, folder jam.
- €² Splice failure (poor adhesion)

Trouble shooting zero speed dancer operation	Fail	Break
Web break during Deceleration		✔
Dancer cylinder ports closed		✔
Chain sprockets worn		✔
Dancer brake malfunction		✔
Web break during Splice: Insufficient air pressure		✔
Web break during Acceleration:		✔
Dancer rollers out of alignment		✔
Dancer bottoms out:		✔
Inadequate air pressure on dancer		✔
Inadequate acceleration signal (air flow volume or electric)		✔
Leaking dancer cylinders		✔
Dancer not at maximum position before splice, runs-out of paper	✔	✔
Dirty or glazed acceleration roller		✔
Loose, dirty or worn acceleration belt		✔
Dancer does not fill prior to splice		✔
Dancer tension too low		✔
Brakes set too tight		✔
Air leaking from brake interferes with running roll solenoid		✔
If dancer fills out before or after splice		✔
Speed signal incorrect		✔
Incorrect brake transducer adjustment		✔
Incorrect or faulty dancer POT/encoder setting		✔

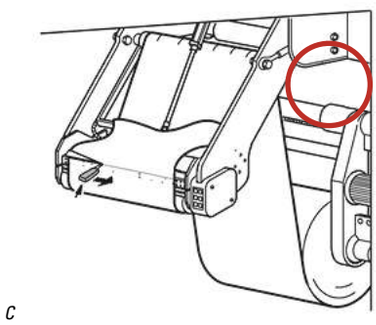
Zero Speed — Vacuum Bar Design With Split Splicer Head



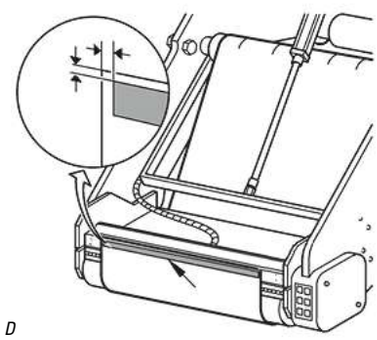
A



B



C



D

Source: Goss

A. Guide the web around the upper guide roller and unwind the paper until it touches the floor.

Push and hold the "Open splice head half" button until the splice head half near the roll (for which the splice has been prepared) is fully open.

Push the "Handbrake" button to brake the roll and extend the chucks to clamp the roll.

B. Push the "Vacuum" button to activate the vacuum pump.

Pull the web taut without creases.

Read out the web position from the ruler and compare it to the web position of the running roll.

Correct the lateral position of the running roll.

Push the web against the vacuum bar. The vacuum holds the web in the correct web position.

C. Place the tip of the knife in the slot over the vacuum strip and cut off the web in a straight line.

Apply tape to the web along the full web width.

D. Pull the backing film off the tape.

Push and hold the "Close splice head half" button until the splice head half has fully closed.

Troubleshooting & Maintenance

It is essential that the manufacturer's preventative maintenance procedures are completely followed to ensure optimum performance, safety and reliability, and to enhance equipment life. Substitution of recommended consumable parts (drive belts, brake pads, foam rollers) should be done with caution to ensure these alternatives have the same specifications and performance.

Core Troubleshooting

When in doubt contact core supplier to access correct parameters. Usually, the printer does not know the core supplier and therefore should contact their paper supplier.

Poor torque transmission:

Core chew-out at winder or printing press

1. Clean chucks.
2. Check if chucks are worn (including internal parts).
3. Check tolerance between core inside diameter and cylindrical part of chucks.

Compressed oval core and roll:

Check roll truck clamp pressure and handling. *See Module 5.*

Roll bounces heavily in unwinding:

Possibly some smoke and a smell of burning.

1. Check if roll is out-of-round before looking for a core issue.
2. Check the chuck length and chuck expansion is working correctly.
3. Compare specified roll weight — is dynamic strength too low?

Residual roll vibrates during unwinding near the splice:

Core and paper has too low critical speed in printing press.

1. Check the press supplier requirement for E-modulus of the core and core density relation.
2. Decrease printing speed.
3. Splice at a larger running roll diameter.
4. Change core diameter from 76mm to 150mm.
5. Contact core supplier to identify correct core type and asses paper roll residual runability characteristics.

Paper web flutters at the edges near the splicing diameter:

Core has probably deformed due to radial pressure.

1. Use stronger core grade.
2. Use higher wall thickness.
3. Contact core supplier for other options and solutions.

Loose cores:

The whole core slides out from the roll at the printing press and it seems there is no paper pressure left between the core and paper.

1. Check the length of core and compare to roll width — has it shrunk?
2. Check the delivered paper moisture.
3. Check the delivered core moisture.
4. Check the core package (wrapped or not).
5. Check the humidity at core warehouse and the way from warehouse to winder.
6. If necessary change the core moisture specification, core packaging and handling during operation.

Paster/Splicer Diagnostics						
Splice preparation	**Burst**	**Fail**	**Mis**	**Break**	**Flying**	**Zero**
1. Failed roll fault inspection prior to loading		✔	✔	✔	●	●
2. Rolls unwrapped too early	✔	✔	✔		●	●
3. Excessive vibrations		✔	✔	✔	●	●
4. Wrong roll unwind direction (flying paster)		✔			●	
5. Incorrect splice pattern type		✔	✔		●	
6. Splice pattern bursts open before splice					●	
Air pockets	✔				●	
Dynamic roll expansion (see also 2)	✔				●	
Rupture tabs applied too tightly	✔				●	
Open tape in acceleration belt path	✔				●	
Too fast acceleration tears paper			✔			●
Splice shields not fully closed or no vacuum		✔				●
7. Failed splice					●	
Inadequate splice tape pressure (see also 21)		✔			●	
Uneven tape profile from overlaps		✔			●	
Tape protective strip not removed/No tape applied		✔			●	●
Dust, moisture, solvent on open splice tape		✔			●	●
Glue unsuitable (tack, temperature, humidity)		✔			●	●
Cold roll (temperature near core below 10°C)		✔			●	●
Rupture tabs incorrect or turned over covering detection tab		✔	✔		●	
No splice detection tab, sensor dirty		✔	✔		●	
8. Tape or glue overlaps edge of roll			✔		●	●
9. Tabs come loose & stick to expiring web or blanket			✔	✔	●	
10. Splice detection tab in wrong position		✔	✔		●	
11. Tab in path of folder slitter			✔		●	
12. Too long paster tail causes folder jam (see also 10, 22, 23)			✔		●	
13. New roll not aligned to expiring roll or variable roll widths			✔		●	●
14. Cocking roller setting incorrect			✔	✔	●	●
15. Zero speed splicer incorrect alignment to nipping roller		✔	✔			●
Setting and maintenance						
16. Debris build up on roller edges				✔	●	●
17. Sensor defective or dirty		✔	✔		●	●
18. Roll not up to speed		✔	✔		●	
19. Roll will not go to splice position (paster status problem)		✔			●	
20. Tension/drive belts: Incorrect tension, burred, worn	✔	✔	✔	✔	●	●
21. Pasting brush/roller dirty, worn, incorrect pressure (see also 7)		✔	✔		●	
22. Knife cut too early (see also 10)		✔	✔		●	
23. Knife cut too late (see also 10)		✔	✔		●	
24. Knife failed (see also 10, 17)		✔			●	
25. Improper adjustment or malfunction of paster carriage		✔	✔		●	
26. Roll runs off core		✔			●	●
27. Incorrect brake load/tension setting			✔	✔	●	●
28. No low tension make ready setting (start-up break)				✔	●	●
29. Press stops in splice cycle (no web break but no splice)		✔			●	●
30. Press speed change during paste cycle		✔	✔	✔	●	
31. Oscilation of compensating roller (pumping)			✔	✔	●	●
32. Erratic tension near end of roll			✔	✔	●	●
33. Excessive tension during splice			✔	✔	●	●
34. Brakes fail to transfer correctly		✔	✔	✔	●	●
35. Air supply failure cause loss of tension				✔	●	●
36. Drops of oil, water, ink falling on to web				✔	●	●
37. Overpacked blanket explodes splice in printing unit			✔		●	●
38. Zero speed splicer head rollers out of alignment						●
39. Faulty zero speed dancer operation (see page 26)				✔		●

Paper Roll Repairs

The recommendations on these pages are from 'Paper First Aid' published by the ERA

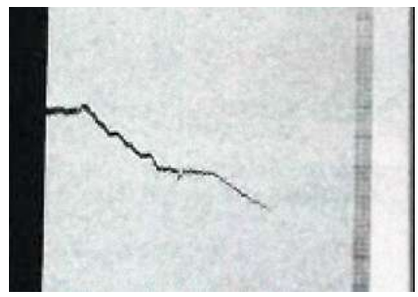
The Splice Thorn device — a pin inserted into the damaged core and spread hydraulically to restore the circular shape of the core to restore crushed cores to their original shape — is now rarely used as it does not conform to high quality production.

Loose and bad winding: *Adjust web tension (tight, less tight). Stick tape around a roller in the paper path at the web edges to increase diameter to centre the web. Separate rolls from the same winding position. Change to another roll winding position or different roll batch.*

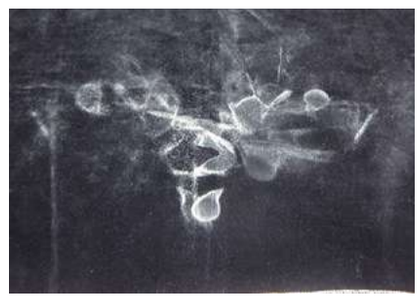
Layers glued together: *Glue spray inbetween layers and roll end causes breaks. Remove hard hotmelt spots with knife or grind them with sand paper. Slab off large areas.*

Out-of-round: *Some of these rolls may be unwound but production speed may be affected. However, the high vibrations from running out-of-round rolls may make splicing very difficult or even impossible. Change to a roll from a different batch.*

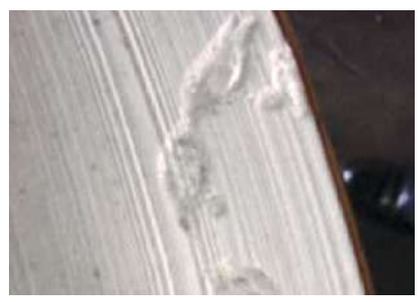
Burst, flagging: *Nail the area between the first paper layer and core, twice each end. Nails should be placed opposite each other. Rolls with burst that have broken twice should be rejected from press. Increase roll change diameter. Save a remaining core with flagging for paper mill.*



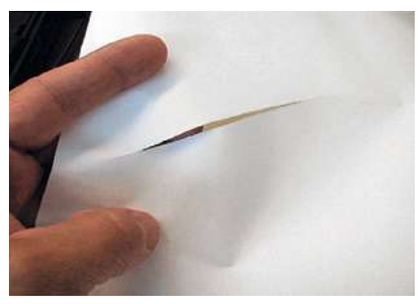
Edge damage: *Slab down the part, maximum 3 cm (1,3 in) of roll diameter. Control roll end surface to edge cuts.*



Bad cutting: *Wipe dust down with smooth tissue or velvet. Clean roll end with slightly oiled cotton cleaning cloth. Do not use water or water spray because paper becomes wavy and changes dimension, and its layers may become glued together after drying.*

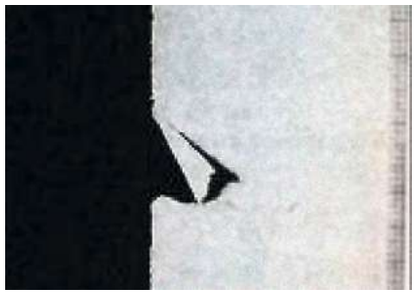


Glued roll ends: *Sand down the affected area using fine grain emery paper. Slab-off if the area is large. Cut off a piece for the defect documentation and note roll number.*



Wrinkles, pleats, calender cuts: *Slab down a part of the diameter. After second break, reject the roll from press and change to a roll from a different batch or winding position.*

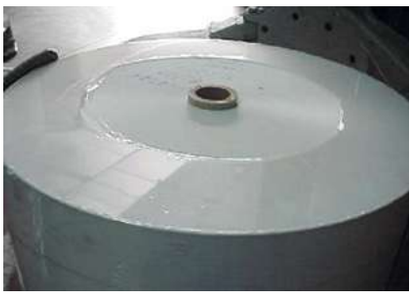
Stickies: *Slab down a part of the diameter. After second break, reject the roll from press and change to a different production batch or winding position. Collect an unprinted piece of paper with defect.*



Edge cuts: *Use emery paper with a fine grain and sand the visible area smooth. Slab down a part of the diameter.*

Core faults: *Remove dust from inside cores before putting roll in press. Cut off paper from wall inside core if the chuck does not penetrate. Reject roll from press if core is out-of-round or damaged!*
Don't use damaged cores!

Side damage: *If side damage is deep use a milling head, if flat use emery paper. Slab-off if damage is less than 7 cm (3 in) inside roll diameter; if higher, change roll. If rejected to stock then replace the correct roll end shield.*



Slipping core/protruded layers: *Nail the core twice each end (see recommendations for burst/flagging). If roll end gets burned reject it from the press. Use a different winding or winder position.*

Wet roll end: *If roll end shows layer gaps and feels dry, then wet the side slightly with a water sprayer. If wet area is maximum 3 cm (1,3 in) thick, cut off the part. After a second break, reject the roll from press.*

Poor mill splice: *Use abrasive paper to remove overlapping. If layer is too thick, slab down the layers to position of mill splice, maximum 3 cm (1,3 in) of diameter — reject roll if protruding layers are deeper.*

Belly damage: *Slab down affected layers. Before use, check core roundness and inner core wall due to broken areas. Check shape if out-of-round or core is damaged reject the roll.*

Sheets & palletised paper

Sheetfed Press Feeder

The feeder and lay system takes sheets of paper or board from a pile to deliver individual sheets in exactly the same position to the press grippers.

A suction head feeds separated sheets from the top of the pile on to the feedboard. A classic feed suction head uses low-pressure air generated by a vacuum pump and it is adjustable for speed, sheet size and weight. Newer suction head nozzle technology generates vacuum and compressed air directly inside the suction head during each process step for smoother sheet control at all speeds (this system eliminates rotary air valve, hoses and air control, is 50% more energy efficient, and has less wear).

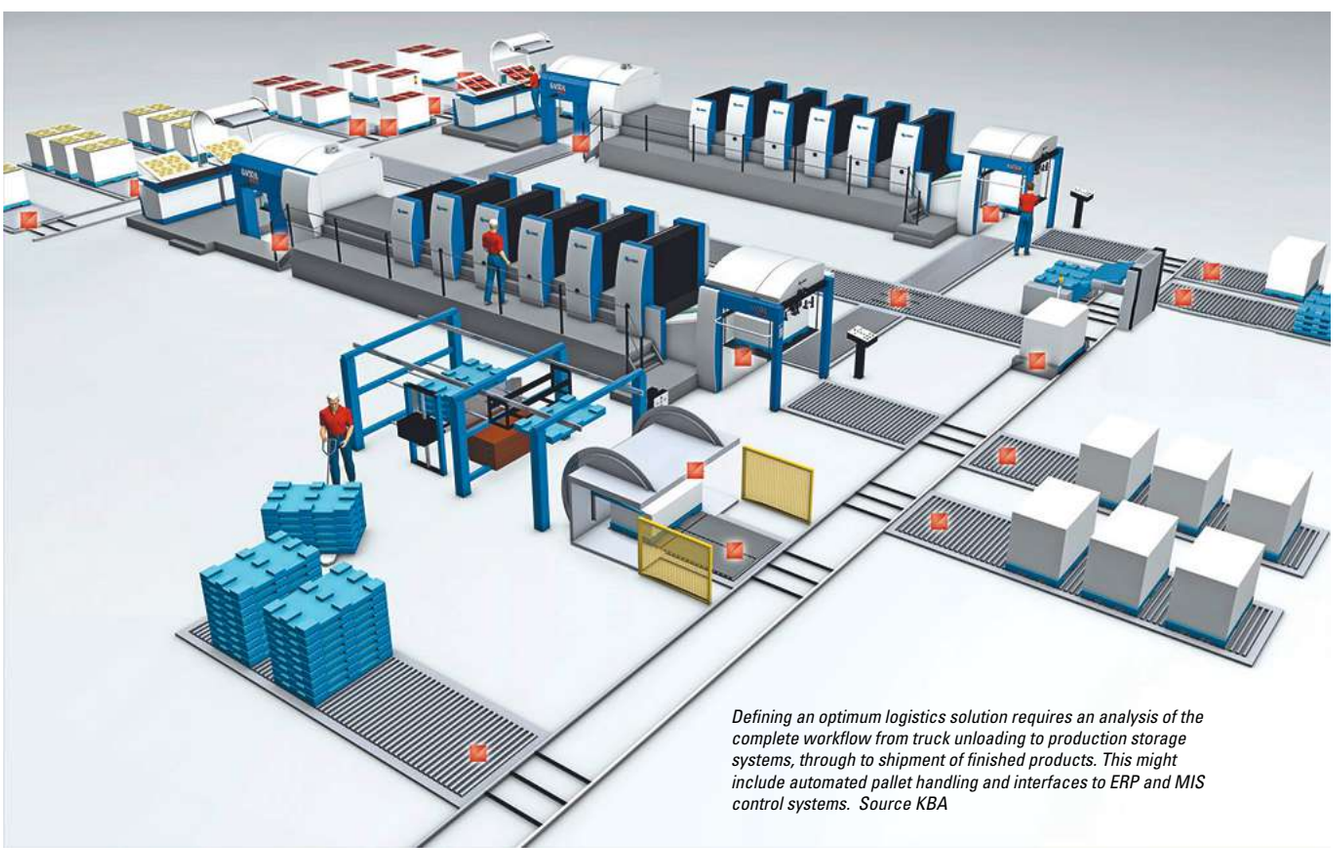
The sheets are then moved down the feedboard by suction belts into the front and side lays to position the sheet accurately before it is taken into the press by the gripper system.

Stream feeders work at a speed slower than that of the press, and the edge of a sheet of paper overlaps the front edge of the successive sheet. This system provides good control of sheet position, to prevent mis-register and paper jams. A double-sheet detector avoids multiple sheets being fed simultaneously.

To ensure continuous press operation on high speed presses and/or those printing on thick substrates, a high pile delivery is available with the option of continuous non-stop pile feeding and automated pile handling.

✅ Optimise paper feeding by keeping paper and board in its protective wrapper until it is required to be used. Condition paper to pressroom climate conditions if these are significantly different to external environment.

Pallet handling with integrated workflow



Defining an optimum logistics solution requires an analysis of the complete workflow from truck unloading to production storage systems, through to shipment of finished products. This might include automated pallet handling and interfaces to ERP and MIS control systems. Source KBA

Source: KBA

Roll-To-Sheet Feeder

This system allows paper rolls to be run on sheetfed presses with improved process performance because there is no sheet separation step. This reduces the number of stops and sheets transported at an angle; it also prevents double sheet feeding as each is cut in-line, transported individually and delivered directly to the feed roller of the press (the suction head is not used during roll-fed operation). This provides uninterrupted printing and higher process speeds, particularly of lightweight papers down to 35 gsm, and processing of materials that are available only on rolls, like plastic film for labels. No pile changing is required. The roll holds up to five times the number of sheets than a comparable pile.

Roll-to-sheet feeding is particularly appropriate for any press using relatively large quantities of a restricted range of paper weights and grades. This makes them suitable for most perfecting publication printing, particularly on double-decker perfecting presses because the second gripper edge is not required, reducing paper use by 2%. Other paper savings are derived from substrate rolls being generally 5 - 25% cheaper than sheets, only using the exact cut-off length needed, and using very light papers efficiently.

Roll-to-sheet feeding reduces the effects of electrostatic charges. The system runs plastics efficiently and an optional Corona treatment ensures ink receptivity on plastics.

- ✅ Use best practice techniques for roll handling described earlier in this Module.
- ✅ Roll on pallets *see Module 1 page 19.*

Two KBA sheetfed presses equipped with roll-to-sheet feeders. The MABEG device is retrofitable to all brands of presses and available for sheet sizes widths up to 1420 mm. Source: MABEG

Printers who do not have roll handling clamp trucks require their rolls to be supplied on pallets that can be handled manually and with conventional forklift equipment.

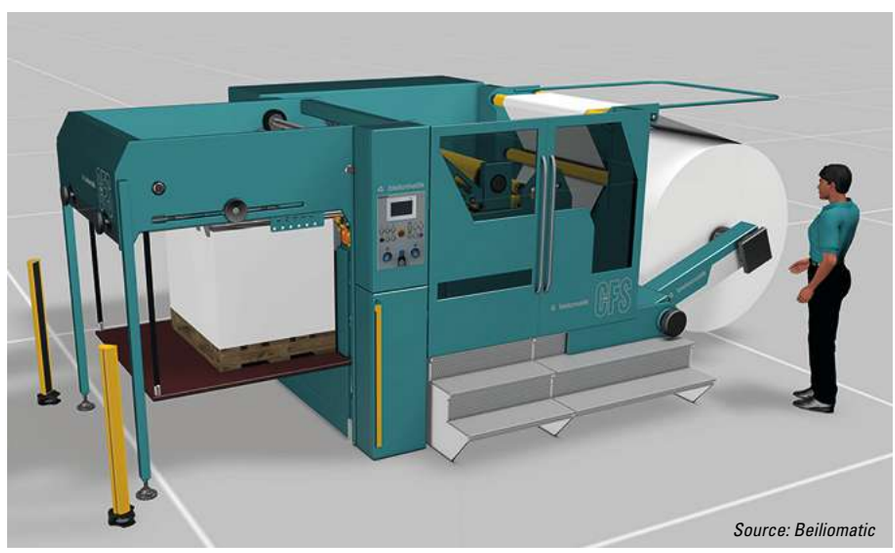
✅ Use forklifts with angled clamps to better handle standing rolls that otherwise may risk being deformed on the bottom that can lead to unwinding problems.

Roll loaded on to an electric truck equipped with angled forks. Source: Mabeg

Source: Mabeg

1. The paper web coming from an unwinder runs through an infeed into the cutting unit
2. A shearing system ensures a clean cut and precise angles. The web tension is controlled automatically.
3. A decurler can be activated to achieve sheet flatness if necessary.
4. Running out of the crosscutter the sheets are overlapped in the stream feeding device and the shingled sheets conveyed on the transport table of the press's sheet feeder. The sheeter can be moved aside when conventional pile feeding is required.

Crosscutter Roll Sheeting Systems



Source: Beiliomatic

Roll-to-sheet systems are also for used in different converting applications to convert rolls of paper, carton and foil into sheets that are delivered into a stacker to create a sheet pile. Some systems allow preprinted rolls to be processed in register and without leaving marks. Crosscutters are used by paper wholesalers, packaging suppliers and printers.

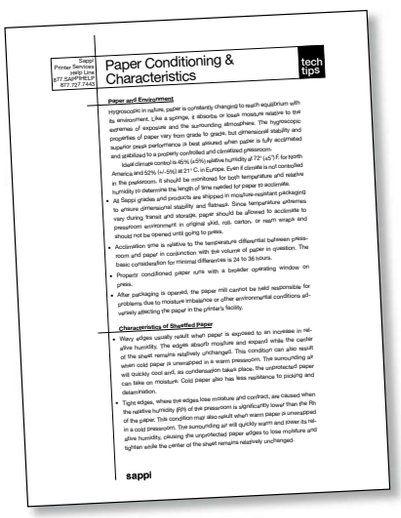
✅ Use best practice techniques for roll handling described earlier in this Module and also in Modules 4 and 5.

SHEET PAPER PROBLEMS ON PRESS RELATED TO STORAGE AND HANDLING

Problem	Causes	Solutions
Feeder Misses or Doubles	Misses — Paper pile too high	Lower feeder pile
	Doubles — Paper pile too low	Raise feeder pile
	Too much separation air blast	Adjust air blast nozzle to correct height and reduce air pressure
	Suckers malfunction	Clean if dirty
		Replace if worn
		Check and adjust suckers if needed*
		Check vacuum timing*
	Sheets are stuck together	Air the paper, flip through to unstick
	Sheets not separating — burred edges	Poor guillotine blade
	Poor sheet separation and feeding	Paper curl, wavy edges, out of square
	Static in paper	Insert ionizing air cartridges in air blast lines
		Maintain RH above 35%, ideally 50%+/-5
Uneven Forwarding	Too much or too little air under top sheet	Use just enough air to float top few sheets
		Or repile and roll the lifts to free sheets
	Dirty rotary valve	Clean any clogged powder, oil and debris
	Air blast nozzles incorrectly aligned	Align nozzles correctly
Stains on Sheets	Compressor overheated or over oiled	Needs preventive maintenance*
Conveyor Cocking/Jamming	Single sheet feeder forwarding wheels	Adjust wheel timing
	Forwarding wheels in poor condition	Put new rubber on wheels and re-set*
	Transfer tapes in poor condition	Replace tapes
	Rust or moisture on feedboard	Clean
	Curling of front edges and sheets fails to enter side guide	Repile, rolling sheets downwards to uncurl
	Static build-up in paper or feed tapes	Install static elimination, or RH too low
Front Register Variation	Not enough clearance under hold-down springs or fingers	Adjust clearance*
	Too much clearance under hold-down	Adjust to stop sheet bounce/buckle
	Tail end wheels too far back or forward	Reset. Use only steel or soft brush wheels
	Sheet gripper edge or tail not straight or sheets vary in length from to back	Replace or retrim the paper
	Sheets slip in impression cylinder grippers	Clean and re-set gripper uniform tension*
		Replace worn gripper pads
	Poor synchronisation with grippers	Check for worn parts
	Incorrect timing of overfeed roll	Adjust timing or front stops*
Push Side Guide Variation	Uneven paper trim or out of square	Re-trim paper
	Pusher plate not parallel to edge of sheet	Adjust pusher plate *
	Incorrect clearance buckle plate to sheet	Re-set*
	Side guide touches sheet before it stops against front guides	Check and adjust timing of side guide and slow down
Pull Side Guide Variation	Incorrect guide setting	Re-set*
	Incorrect spring setting of upper to lower guide rollers	Adjust setting to the paper being printed
	Too little sheet clearance at front guides	Adjust clearance of hold-down springs
		Check sheet timing to front stops
Nicked or Torn Gripper	Too much gripper bite	Re-set front guides to reduce bite
Edges	Front guides do not clear sheet edge	Check and adjust front guide timing
	Incorrect sheet transfer synchronisation	Clean, service and re-set gripper systems
Sheets Pull Out of Gripper	Tension of grippers too weak or uneven	Check grippers for uniform timing
and Stick to Blanket	Excessively high ink tack	Reduce ink tack
	Poor release of blanket	Use a quick release blanket
Wrinkles or Creases	Grippers not closing simultaneously	See manufacturers service instructions*
	Out of line front guides	Re-align guides
	Too tight wheel tension on register table	Adjust wheel to minimum tension
	Paper slips out of some (not all) grippers	Clean and service gripper pads
	Wavy edge paper from unwrapping cold paper, or if press room RH too high	Do not unwrap until at room temperature Consider dehumidifier or air conditioning
	Tight edged paper	Occurs if paper left unwrapped in dry area
		Humidify press room
Poor Fit at Tail Edge	Side edges of sheets pick up moisture between printings & become longer	Place moisture vapour-proof cover over pile after first printing
Poor Multi Colour Fit	Wavy or tight edged paper	Use flat paper to prevent distortion

**Follow manufacturer's instructions*

Air humidification systems improve productivity when humidity is too low. Source PDI



Sappi Printer Services Help Line 877.SAPPHELP 877.727.7443

Paper Conditioning & Characteristics

tech tips

Paper and Environment

Hygroscopic in nature, paper is constantly changing to reach equilibrium with its environment. Like a sponge, it absorbs or loses moisture relative to the extremes of exposure and the surrounding atmosphere. The hygroscopic properties of paper vary from grade to grade, but dimensional stability and superior press performance is best ensured when paper is fully acclimated and stabilized in a properly controlled and classified pressroom.

Most climate control is 45% (±5%) relative humidity at 72° (±5°) F. for North America and 52% (+/-5%) at 21° C. in Europe. Even if climate is not controlled in the pressroom, it should be combined for both temperature and relative humidity to determine the length of time needed for paper to acclimate.

- All Sappi grades and products are shipped in moisture-resistant packaging to ensure dimensional stability and flatness. Since temperature extremes vary during transit and storage, paper should be allowed to acclimate to pressroom environment in original shrink, roll, carton, or reel wrapping and should not be opened until going to press.
- Acclimation time is relative to the temperature differential between pressroom and paper in combination with the nature of paper in question. The basic consideration for minimal differences is 24 to 36 hours.
- Properly conditioned paper runs with a broader operating window on press.
- After packaging is opened, the paper mill cannot be held responsible for problems due to moisture imbalance or other environmental conditions adversely affecting the paper in the printer's facility.

Characteristics of Sheetfed Paper

- Wavy edges usually result when paper is exposed to an increase in relative humidity. The edges absorb moisture and expand while the center of the sheet remains relatively unchanged. This condition can also result when cold paper is unwrapped in a warm pressroom. The surrounding air will quickly cool and, as condensation takes place, the unprotected paper can take on moisture. Cold paper also has less resistance to picking and delamination.
- Tight edges, where the edges lose moisture and contract, are caused when the relative humidity (RH) of the pressroom is significantly lower than the RH of the paper. This condition may also result when warm paper is unwrapped in a cold pressroom. The surrounding air will quickly warm and lower its relative humidity, causing the unprotected paper edges to lose moisture and tighten while the center of the sheet remains relatively unchanged.

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'Paper Conditioning & Characteristics' — Sappi Technical Tip Sheet.
Source: www.ideaexchange.sappi.com

Climate and Sheet Paper/Edge Problems

Dimension variations: Paper fibres will either absorb or exude moisture depending on RH, causing them to swell or to shrink, particularly in the cross direction of the paper rather than in the machine direction. A 10% change in RH causes paper to "grow" 0.1% to 0.2% across the width, which will cause printing mis-register.

Humidity and curling: Curling is closely connected to fluctuations in humidity that cause the paper fibres to expand and shrink in the cross direction. If paper is moistened on one side, the fibres expand in one direction, causing the paper to curl toward the dry side. As soon as a balance in humidity within the paper structure has been restored, the effect is cancelled out.

Stack humidity and temperature on ink drying: A high humidity balance of the paper stack can significantly extend ink drying times. The effect is pronounced above 60% RH, leading to drying times up to three times as long as normal. Extended drying times can also occur when the stack of printed paper is too cold. *See also Module 3 page 4.*

Edge Problems

Wavy edges: Usually caused when paper is exposed to an increase in relative humidity and the edges absorb moisture and expand while the centre of the sheet remains relatively unchanged. Causes include excessively dry paper; extremely high air humidity in the pressroom; damp-proof wrapping not used during transport or storage in humid conditions; cold paper unwrapped in a warm pressroom (cold paper also has less resistance to picking and delamination).

Tight edges: Occurs when sheets of normally humid paper are subjected to exceedingly dry air humidity. In this case, moisture is absorbed from the edges of the sheets, which, as a result, shrink in relation to the centre. This mainly occurs during winter if the RH of air in heated, non-conditioned or non-humidified working spaces drops significantly. When warm paper is unwrapped in a cold pressroom the immediate surrounding air warms quickly and lowers its RH, causing the unprotected paper edges to lose moisture and tighten while the centre of the sheet remains relatively unchanged.

For either problem, it can be helpful to cut out the blanket packing on the outer non-image edges to allow the sheet some relief during impression squeeze.

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

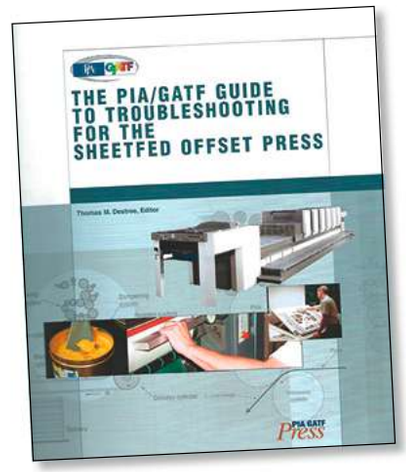
Length of time required for pallet acclimatisation. Source: UPM.

✅ *Optimise press performance by conditioning paper and board to pressroom conditions and keeping it wrapped until it is required to be used. Source: Stora Enso*

✅ Minimise Climate and Paper Problems

Air moistening systems are commonly used in paper processing environments and are particularly helpful when air humidity is very low during winter. To avoid wavy edged paper when pressroom relative humidity is too high, turn pressroom heat up to a maximum of 29°C (85°F). The RH will decrease as the temperature rises.

- 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 dampness.
- Avoid cutting paper sooner than necessary before printing and protect paper with moisture-proof wrapping immediately after cutting.
- Paper is not an efficient heat conductor. Therefore, allow sufficient time to let the paper adapt itself to the temperature in the workshop. Properly conditioned paper runs with a broader operating window on press. *See paper condition times Module 3 page 4*.
- Do not open the paper wrapping until printing is about to begin. The wrapping protects the paper from fluctuations in temperature and humidity. Avoid damaging the paper wrapping and carefully re-wrap remaining pallets.
- IR and UV Mercury dryers can drastically reduce paper RH and should be used cautiously.
- During drying, the paper should not be exposed to extremely low temperatures as this would significantly extend drying times.
- For wavy edged sheets, try conditioning the paper through the press on impression (without moisture) and pre-warm with the IR dryer or strip heaters above the feedboard.



'Guide to Troubleshooting of Sheetfed Press' Printing Industries of America.

Static Electricity in Paper

Static charges commonly occur when very dry paper is processed in low air humidity conditions. The critical lower limit is 30-40% RH for both the paper and the pressroom.

Paper is a non-conductive material that can accumulate static electricity, leading to feeding problems when individual sheets resist separation at the feeder head causing double sheeting and interfering with forwarding and timing into the head stops. A static charge also attracts airborne contaminants onto the paper leading to hickeys or print voids. Paper coating is an insulator that increases the risk of static compared to uncoated paper. Gloss coated papers with large sheet size have the greatest risk because their smooth surface offers a large contact area with low weight. Causes of static:

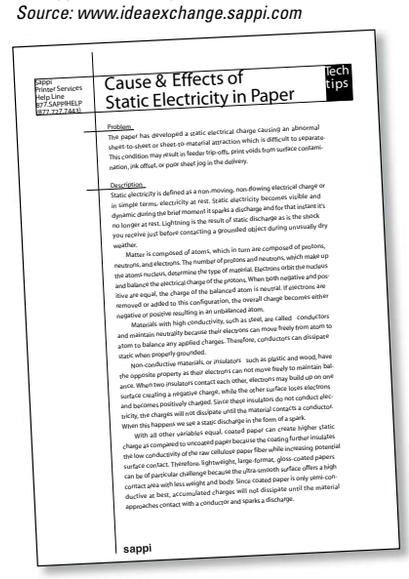
1. Low air humidity aggravates static charge, particularly below 35% RH. Cold winter temperatures and high altitudes tend to lead to dryer conditions and static build-up.
2. Low paper moisture — cold paper is less conductive and more prone to static build-up than warmer paper acclimatised to recommended pressroom temperature.
3. Incorrectly earthed equipment increases static charges. The potential for static build-up also increases with the contact area and pressure between paper and other surfaces, and with heat.

Static electricity in paper can be managed through a combination of:

- Effective earthing of machinery, ionization, and minimised heat for drying.
- Checking that air blower filters and heads are clean with adequate air pressure and distribution to ensure optimum sheet separation.
- Anti-static or silicone sprays increase conductivity and minimise excessive friction contact with paper transport components (feedboard, transport tapes, wheels).
- Adequate pressroom moisture level increases conductivity, helping dissipate static charge. Recommended humidification (source Sappi) is 45% (± 5%) RH at 22°C (72°F) (± 4%) for North America and 52% (± 5%) RH at 21°C (70°F) for Europe. Moisturising systems help create optimal conditions in storage and pressrooms.
- Do not unwrap paper until printing is about to start. Avoid storing paper close to hot or cold heat sources.

To check static, take about 30 sheets from the top of the pile and then slowly slide the next sheet across the surface without lifting it. If significant resistance is felt, then a static charge is present causing a material attraction.

'Cause & Effects of Static Electricity in Paper' — Sappi Technical Tip Sheet
Source: www.ideaexchange.sappi.com



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Cause & Effects of Static Electricity in Paper

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Problem

The paper has developed a static electrical charge causing an abnormal sheet-to-sheet or sheet-to-material attraction which is difficult to separate. This condition may result in feeder trip-offs, print voids from surface contamination, ink offset, or poor sheet jog in the delivery.

Description

Static electricity is defined as a non-moving, non-flowing electrical charge or in simple terms, electricity at rest. Static electricity becomes visible and dynamic during the brief moment it sparks a discharge and for that instant it's no longer at rest. Lightning is the result of static discharge as is the shock you receive just before contacting a grounded object during unusually dry weather.

Matter is composed of atoms, which in turn are composed of protons, neutrons, and electrons. The number of protons and neutrons, which make up the atoms nucleus, determine the type of material. Electrons orbit the nucleus and balance the electrical charge of the protons. When both negative and positive are equal, the charge of the balanced atom is neutral. If electrons are removed or added to this configuration, the overall charge becomes either negative or positive resulting in an unbalanced atom.

Materials with high conductivity, such as steel, are called conductors and maintain neutrality because their electrons can move freely from atom to atom to balance any applied charges. Therefore, conductors can dissipate static when properly grounded.

Non-conductive materials, or insulators such as plastic and wood, have the opposite property as their electrons can not move freely to maintain balance. When two insulators contact each other, electrons may build up on one surface creating a negative charge, while the other surface loses electrons and becomes positively charged. Since these insulators do not conduct electricity, the charges will not dissipate until the material contacts a conductor. When this happens we see a static discharge in the form of a spark.

With all other variables equal, coated paper can create higher static charge as compared to uncoated paper because the coating further insulates the low conductivity of the raw cellulose paper fiber while increasing potential surface contact. Therefore, lightweight, large format, gloss-coated papers can be of particular challenge because the ultra-smooth surface offers a high contact area with less weight and body. Since coated paper is only semi-conductive at best, accumulated charges will not dissipate until the material approaches contact with a conductor and sparks a discharge.

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Separate & Recycle Waste

Collected waste paper for recycled pulp production. Source: UPM

Around 40% of paper is made from collected waste paper and board that is turned into recycled pulp. Waste paper is the "urban forest" and a key resource of the sustainable economy.

By collecting, separating and selling their waste, some printers cover the cost of their monthly ink bills.

To manage this resource effectively:

- Separate waste to measure its volume, maximise its recycled value, minimise both actual waste volume and the cost of any residual disposal by incineration or landfill.
- Dispose of contaminated packaging materials by following the rules for the product that polluted it.
- Discuss with recycling companies, government agencies or others to identify the best recycling options.
- Regularly share recycling results with staff.

Wooden Pallets

Reuse or return to the supplier wherever possible unless sold for reuse.

Damaged wooden pallets can be sent to pallet recyclers who either repair them or use the components to assemble new pallets and shred any remaining waste for landscape mulch, boiler fuel, etc.

Remaining scrap should be disposed of by a wood recycler.

Separate Waste Paper and Board

There are many different grades and prices for recycled papers. Separate them by grade and into printed and unprinted types. To achieve the best value for the recovered paper in the recycling chain, papers should be sorted into the highest grades possible. Sorting requires good internal co-operation, and success factors include the effective separation of incompatible materials and contamination control.

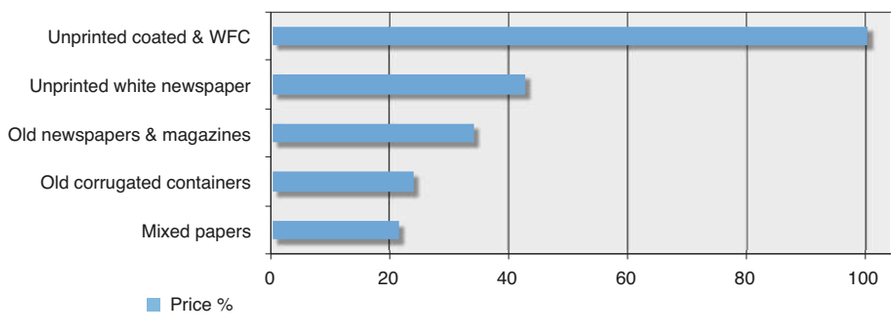
- White waste (no ink, coating or, glue), from roll stripping at splice preparation, at web-up, and core waste, has a significantly higher value than printed waste.
- Separate printed waste and bale it by grade to maximise its value. Keep separate coated and varnished waste and jobs with very high background tint ink coverage (e.g. directories).
- Brown roll and sheet wrapping can be reused to separate layers of printed product; end caps can be reused to cap pallets of outgoing deliveries; any excess can be shredded and sent to a paper mill for recycling.
- Cores can be shredded and either recycled or incinerated for energy.
- Office paper has a comparatively high value for recycling into other products — treat used office paper as a separate recycling grade.
- Paper cartons from suppliers can be reused for packaging printed material or recycled in a similar manner to paper recycling — keep a separate grade.
- Damaged rolls of paper (not returned to the paper mills) can be fixed into smaller usable rolls or converted into wrapping paper.

Paper and board for recycling are classified by EN 643:2013 into 95 grades in five groups: ordinary, medium, high, craft, and special grades. There are specific requirements for deinking grades, and the list includes grades in which non-deinkable papers count as unwanted material.

Plastic Waste

Availability and conditions for plastic recycling are highly variable and should be assessed locally. Separate plastics into different classes for a higher value recycling.

- PETE strapping— bale used strapping (in the same way as recovered paper) or granulate it (cut into small pieces) for sale to either the manufacturer or a certified recycler.
- ABS and PS plastic spools (primarily from postpress stitching operations)— sort spools by grade and sell them to a scrap plastic recycler.
- LDPE plastic stretch film— stretch film can be collected and baled in-house and sent to a recycler or broker.
- Clean plastic containers that are not recyclable should be placed in the general industrial waste stream.



This table shows the relative value of different types of paper collected for recycling. Prices increases with whiteness and paper fibre quality. Source: OPHAL.

Standard EN 643:2013 for Paper and Board for Recycling

The revision of European standard EN 643:2013 coincides with a fundamental change in waste legislation. The Waste Framework Directive introduces a procedure for defining End-of-Waste criteria that a given waste stream need to fulfil in order to cease to be waste. (The End-of-Waste criteria require compliance with EN 643, the provision of information on material that has ceased to be waste, and the implementation of a quality management system.)

EN 643 defines what the 95 different grades of paper for recycling may or may not contain. It facilitates trading, and establishes comparable requirements for a material traded inside and outside of Europe. It defines this material as "natural fibre-based paper and board suitable for recycling; consisting of paper and board in any shape or product made predominantly from paper and board, which may include other constituents that cannot be removed by dry sorting, such as coatings, laminates, spiral bindings, etc."

Recommendations of EN 643 are to use Guidelines for Recovered Paper Quality Control and Responsible Sourcing and the European Recovered Paper Identification System (RPID). This is to identify paper for recycling purchased, received, stored and consumed in paper mills to improve traceability, see *www.recoveredpaper-id.eu*

Quality Issues

Prohibited materials with zero tolerance: these represent a hazard to health, safety and environment, for example medical waste, contaminated products of personal hygiene, hazardous waste, organic waste including foodstuffs, bitumen, toxic powders and similar.

Unwanted material: not suitable for the production of paper and board (with a tolerance level of 1 - 3% depending on grade) that might include: non-paper components (with tolerance levels of 0,25 - 3%) of paper and board not according to grade definition, or detrimental to production, or not suitable for deinking (when intended for deinking). Non-paper components include: metal, plastic, glass, textiles, wood, sand, building and synthetic materials.

Moisture content: recovered paper and board should have the same moisture as the naturally occurring level. If it is over 10% (of air dried weight) the excess weight may be claimed back.

Deinking: paper products not suitable for deinking belong to unwanted material. This currently refers to most flexographic printing, inkjet, liquid toners and to some UV cured printing. (If paper and board for recycling is not suitable for deinking it is usable in other paper recycling processes.)

For more information see "Guidance on the revised EN 643" from CEPI.

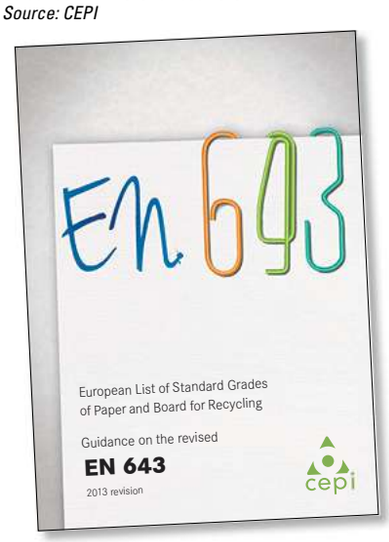
Waste Storage & Shipping

The shipping area is often the best place to position waste.

Paper waste can be collected automatically by suction or conveyors or manually. Conveyors require sufficiently heavy waste to function correctly. They are energy efficient because they do not aspire air from the factory, conserve the internal temperature, and are quieter than other systems. Compaction is the most efficient system to reduce paper volume but needs careful evaluation of space required, noise impact and cost. Horizontal compaction balers can be fed manually or combined with automated trim extraction systems. These systems generate dust and should be located away from manufacturing. In certain special cases (security printing) waste signatures and makeready sheets may need to be shredded.

Ask your waste collector to evaluate your operation, including the level of sorting (white paper, printed, laminated) to develop an adapted waste management concept for the printing company.

European List of Standard Grades of Paper and Board for Recycling. Guidance on EN 643 revised 2013. Source: CEPI



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E.G 11-7 is module 11 page 7

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