

# THE SCIENCE OF **STRAP SELECTION**

A Handbook by Samuel Strapping Systems



## Executive Summary

Shipping is an essential part of any product-based business, but it comes with an assortment of risks. Of these, product damage is one of the most common and costly. Freight can shift while in transit or handling, or be jolted out of position by shocks or sudden movements.

Strapping helps alleviate this problem by providing a cost-efficient, readily available means of securing packages and pallet loads. There are many types of strapping available, such as steel, polyester, and polypropylene, each of them with their own gauges and recommended applications.

This handbook will explain the most common types of strapping, their advantages and disadvantages, and help you determine which strap is the right one for your needs.



## What Is Strapping?

Strapping is a flat, flexible material that helps minimize product damage by keeping the load under tension. This tension prevents the load from shifting or slipping out of place. Additional edge protection can be added to protect corners and further stabilize the load.

Strapping fulfills five primary functions in the packaging process:

### 1. Unitizing

Bundles of product are assembled into an orderly stack or block. Strapping is then applied as needed to compress the stack together and therefore package it as one “unit” of product.  
Sample Industries: Metals, Forestry

### 2. Palletizing

Large numbers of product are stacked onto a pallet for easy transportation and handling. Strapping is used both to retain stack integrity and secure the stack to the pallet.  
Sample Industries: Bottle & Can, Consumer Product

### 3. Baling

Large amounts of loose material are gathered together into one bundle, which is compressed into a “bale” by multiple straps.  
Sample Industries: Cotton, Hay, Corrugated

### 4. Reinforcing

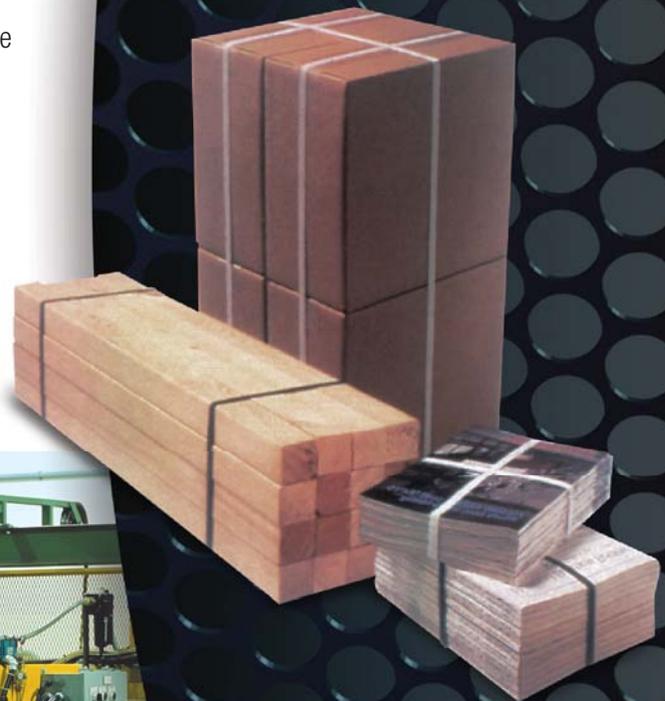
Strapping reinforces pallets or units already secured by other means. Often used in conjunction with stretch wrapping.  
Sample Industries: Bottle & Can, Consumer Product

### 5. Closing

Strapping is used to help close and seal product containers, such as boxes and crates.  
Sample Industries: Meat Packers, Photocopy Paper

## Fast Fact

The North American Transportation Statistics Database reports that in 2009, over 460 million tons of freight was shipped over Canadian roadways, and over 1.7 billion tons of freight shipped over US railways.



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## How Strapping Works

### Strapping Terms

#### Break load

The amount of force required to break a strap. An applied tension's working range is normally far below this limit.

#### Creep

The ability of the strap to contain an expanding load.

#### Elongation

How much a strap will stretch when under tension.

#### Elongation recovery

How much tension the strap will recover after being stretched.

#### Retained tension

How much tension a strap can consistently apply after over an extended amount of time.

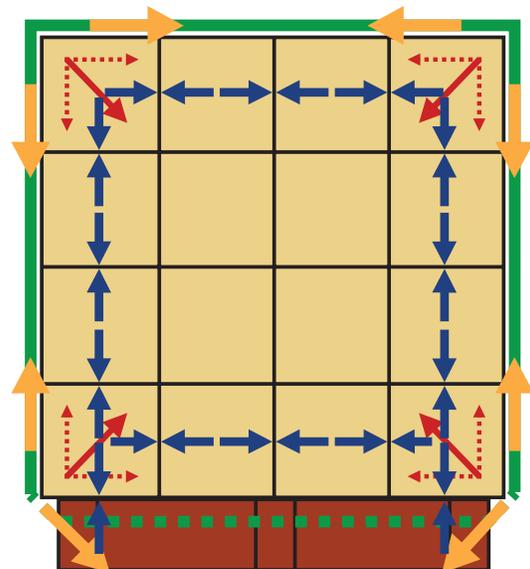
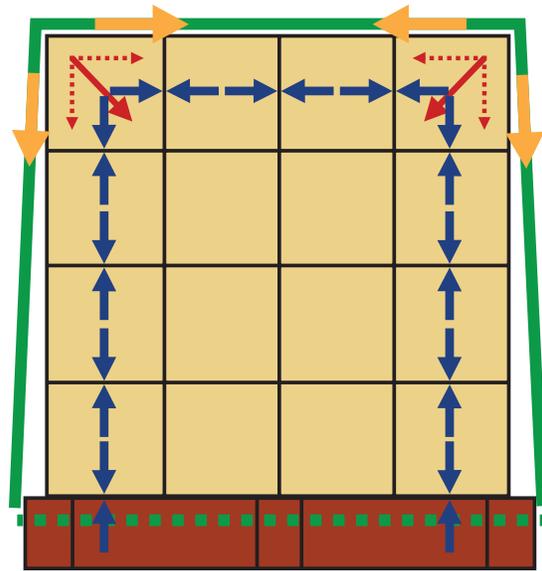
#### Shear

Amount of stress applied to a surface in a tangential direction.

#### Stress relaxation

How much straps under constant strain stretch to accommodate stress.

All strapping is applied under tension. This tension imposes compressive forces on a stack of items or packages. The compressive force pushes the individual items together and increases the frictional forces between adjacent surfaces. This reduces shear and helps prevent items from shifting relative to both other items and the pallet. The tension has to be properly balanced so that it keeps the load secure, but does not damage the product. Edge protection is useful in this regard.



# Steel Strapping

The workhorse of the packaging industry, steel is the most commonly used strapping material in the world. Its high tension rating, temperature resistance, and column strength make it ideal for medium to heavy loads. This includes industries with rigid product types such as the steel and paver industries, as well as expanding products such as cotton. Steel strapping is often sheathed in wax or similar substances for smooth machine feeding and operator safety, and there are rust-resistant varieties of steel strapping available.

## Advantages:

- High tensile strength
- Retains tension over time
- Resistant to temperature changes, moisture, and UV

## Disadvantages:

- Heavier weight
- Low stretch rating
- Untreated steel can rust and stain product



## Seals

Seals are used to secure straps after tensioning. Most seals have a minimum 75% seal joint efficiency. This means that the seal will break at 75% of the straps' overall load capacity.

Strapping seals come in multiple varieties, each according to an operator's preference or work process.

### Open

Fast and easy to use. Open seals can be placed over the strap either before or after tensioning.



### Push-type

Straps are pre-threaded through the seal prior to tensioning. Some push-type seals feature an overlapping flange to provide the required strength as the tensioner pushes against the seal's edge.



### Thread-on / Closed seal

Straps are pre-threaded through the seal prior to tensioning.



### Open Flange

Used for heavy-duty or high tensile applications. Open flange allows placement over the strap either before or after tensioning.



### Magazine-fed

Stacked seals are loaded into combination strapping tools or powered strapping machines.



## Polyester Strapping

### How To Seal Plastic

#### Friction Seal

This method involves a machine rubbing two sections of strap together at high speed. The heat generated forms a molten weld pool. Straps are then pressed together and held until the pool cools and solidifies into a secure friction seal.

#### Heat Seal

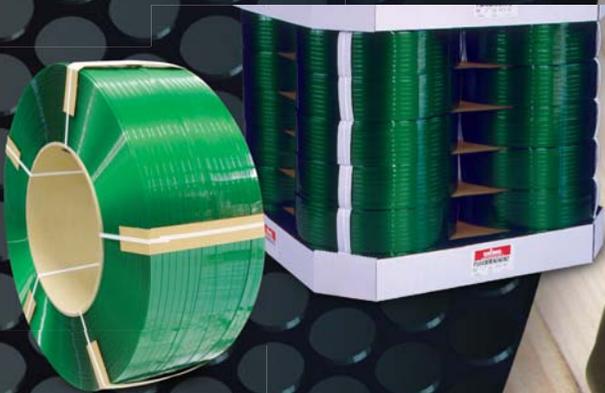
An electrically heated blade is inserted between two straps to create a molten weld pool. The two straps are then pressed together and held, creating a solid and secure heat seal.

#### Metal Seals

Metal seals can also be used to secure polyester straps, in all the varieties mentioned in the previous section. Metal seals can be sealed in multiple ways, ranging from manual tools to automated machinery.

Polyester strapping is an emerging product in the packaging industry, and is fast becoming a popular all-around alternative to steel. It has good tensile strength, excellent retained tension, and responds well to shocks during transit. Ideal applications for polyester include palletized or unitized loads in the timber, can and bottle, and container industries.

Polyester strapping has excellent elasticity, resulting in constant package integrity in the event the package settles and shrinks in size. The polyester strap's performance is susceptible to extreme heat and cold, and tends to deform over time if kept under tension for extended periods.



# Polypropylene Strapping

Polypropylene is the most economical of all strapping material. It is ideally suited for light to medium loads, and for packages with odd or irregular configurations. Newspaper bundles and individual product boxes are commonly strapped using polypropylene.

Polypropylene has a high elongation rating, which means it can resist shocks in transit. It is also highly resistant to corrosion and moisture. As with all types of plastic, however, polypropylene tends to yield and deform when under tension for extensive periods of time. It also tends to degrade under extreme temperatures and temperature changes.

## Advantages:

- Low cost and light weight
- Resistant to moisture and corrosives
- Flexible

## Disadvantages:

- Low tensile strength
- Stretches out over time
- Degrades under intense temperature changes and UV

## Polypropylene strapping methods

Wire Buckle

Plastic Buckle

Metal Seal

Heat Seal

Friction Weld



# APPENDIX

## A. Comparison of Strap Properties

PROPERTY	STEEL	POLYPROPYLENE	POLYESTER
UV	good	poor/fair	poor/fair
Moisture	good	good	good
High temp.	good	poor	fair
Low temp.	good	poor	fair
Corrosives	poor	good	good
Tensile strength	good	poor	fair
Elongation	poor	good	fair
Elastic range	good	poor	fair
Elongation recovery	poor	good	fair
Creep resistance	good	poor	fair
Retained tension	good	poor	fair
Corner strength	fair	poor	good
Energy to break	poor	poor	good
Notch sensitivity	poor	poor	fair

## B. Comparison of Package Types and Strap Selection

PROPERTY	STEEL	POLYPROPYLENE	POLYESTER
Rigid	good	good	good
Moderate expanding	good	poor	good
Severe expanding	good	poor	fair
Moderate settling (<2%)	poor	good	good
Severe settling (>2%)	poor	fair	poor

## C. Break Strength

Break strength is the amount of stress a strap can take before it reaches critical failure. This number should always be one of your primary considerations when evaluating your strap requirements. In order to get your ideal break strength, you first have to get the load weight of your product. Once you have your ideal break strength, it is always a good idea to select a strap with a slightly higher break strength rating. This gives you an additional safety buffer.

## D. Strap Assessment Questions

It is always best to be prepared when shopping for something as important as strap. Before you start calling vendors though, it might be a good idea for you to assemble all of the relevant information ahead of time. This will help make the buying process simple and efficient.

Below are a few questions that a strapping sales representative will likely ask:

1. What is the product?
2. What is the load weight?
3. What are the load dimensions?
4. What is the shipping method?
5. What is the product's value per load?
6. Where will it be stored? Inside or outside?

