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.

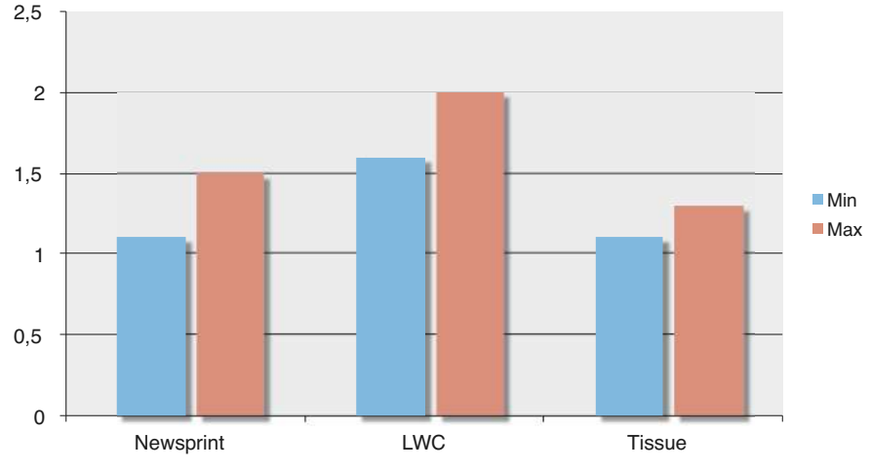
Friction properties: The friction between the wrapper and paper roll is influenced by how "slippery" the paper is. Some coated gloss rolls with lack of friction can lead to increased clamp pressure that can distort the roll. Fillers also influence smoothness of the surface and its friction property.

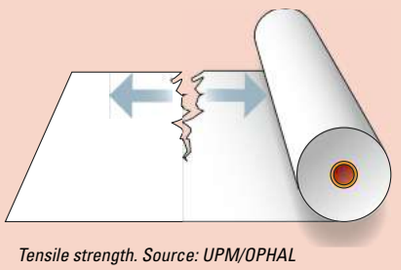
Wrapper Type: The wrapper protects the paper roll from damage, dirt and moisture. It prevents rolls from unwinding. The type of wrapping can vary; the most common wrappers are made of kraft paper. Plastic wrappers are also used and require different handling techniques. Fibre-based wrapping may be covered 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.

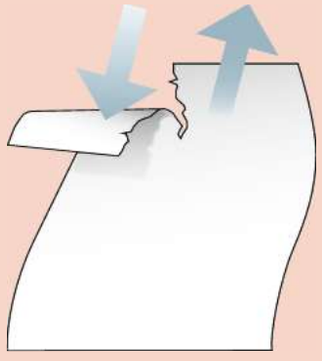
Clamping force: Any paper roll can be destroyed by clamping it too hard or too softly. Different paper grades tolerate different amounts of clamping force and this is influenced by the paper's raw materials, winder type, wrapping and the bulk. Softer, uncoated papers require a reduced clamping force 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