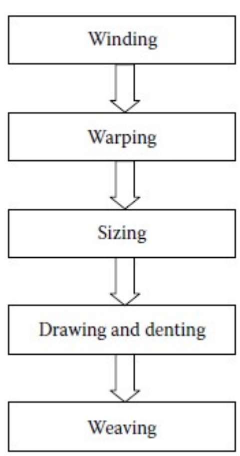
Winding

Yarn preparation processes for weaving

Actual weaving process is preceded by yarn preparation processes, namely **winding, warping, sizing, drawing and denting.**

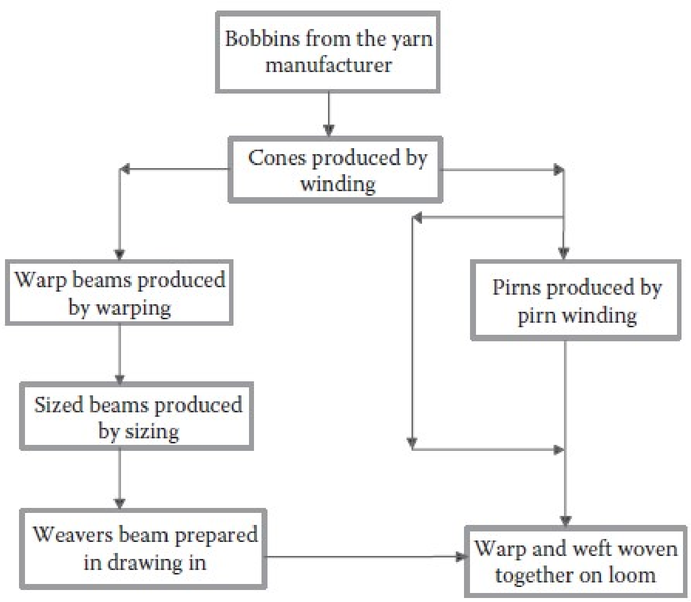


Yarn preparation processes for weaving

Winding converts smaller ringframe packages to bigger cheeses or cones while removing the objectionable yarn faults.

Pirn winding is performed to supply the weft yarns in shuttle looms.

Yarn preparatory stages for weaving

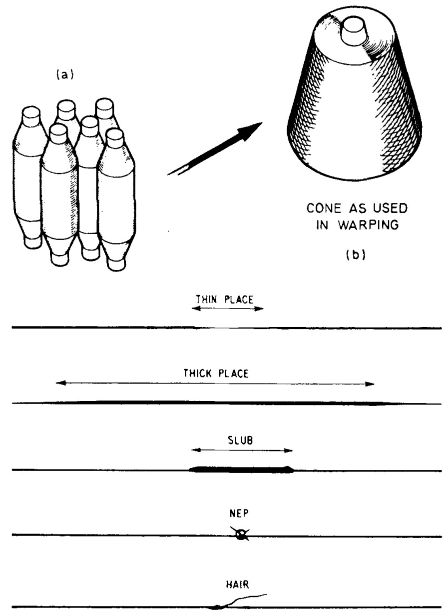


Objectives of winding

To **wrap** the yarn on a package

To **transfer** yarn from one supply package to another compact package.

To remove the **objectionable faults** present in original yarns.



Basic motions required for winding

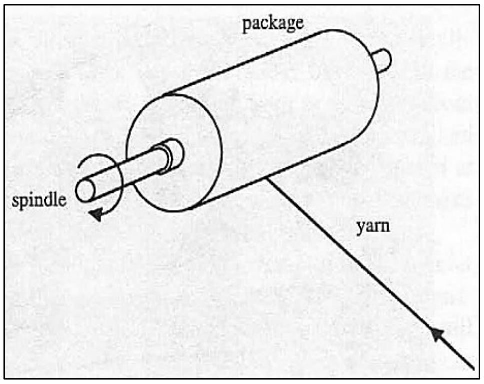
Two basic motions are required for effective winding

- **Rotational motion** of the package, on which the yarn is being wound.

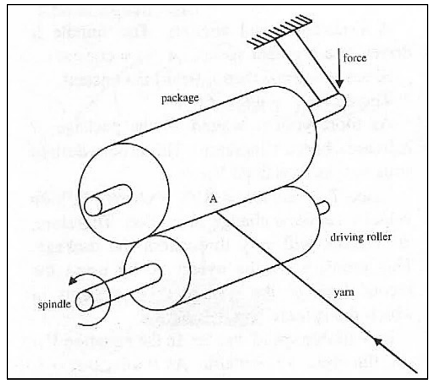
- **Traverse motion** so that the entire width of the package is used for winding the yarn.

Basic motions required for winding

Rotational motion



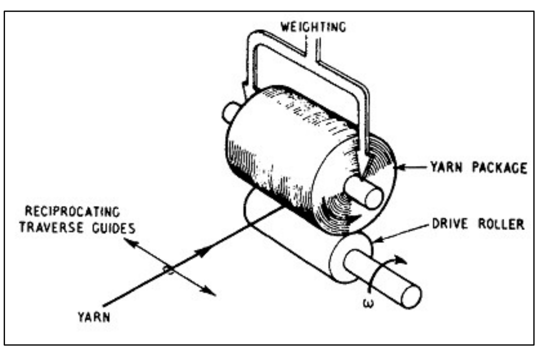
Positive Drive
(Varying surface Speed)



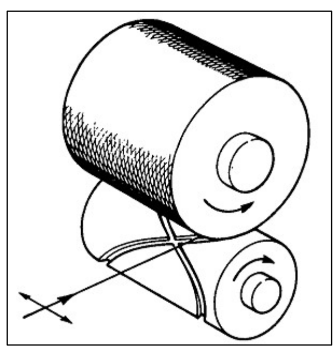
Negative Drive
(Constant Surface Speed)

Basic motions required for winding

Traverse motion



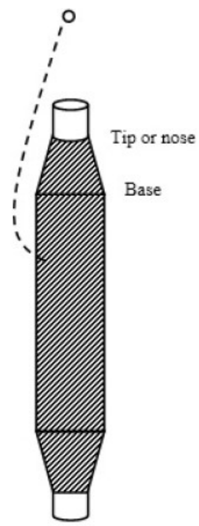
Traversing Guide
(Reciprocating)



Grooved Drum
(Rotating)

Yarn withdrawal from supply packages

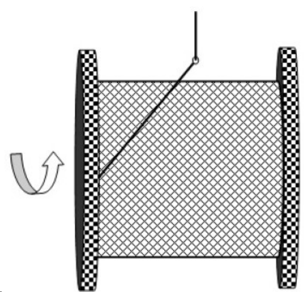
1. Over-end withdrawal



- **Benefits**
  - Quick withdrawal
  - No rotation is required i.e. Package can be stationary
  - Supports Flangeless Packages
- **Drawbacks**
  - Twist may be effected
  - Balloon formation
  - Flanged Packages are not supported
  - Only feasible for single yarn packages

Yarn withdrawal from supply packages

2. Side withdrawal



- **Benefits**
  - Supports Flanged Packages
  - Twist will not be effected
  - No balloon formation
  - Can be for single and multi yarn packages
- **Drawbacks**
  - Rotation is required (Energy and equipment)
  - Relatively Slow withdrawal
  - Flangeless Packages are not supported

Types of Wound Packages

1. Parallel wound package

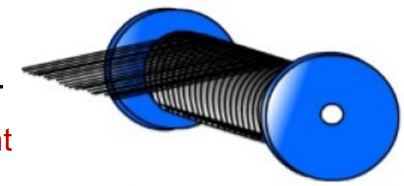
Yarns are laid parallel to each other.

Helps to maximize the yarn content in the package.

However, problem of stability as layers of coils collapse specially from the two sides of the package.

Therefore, double flanged packages are sometimes used

Example: Weaver's beam, warper's beam

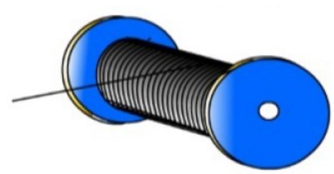


Parallel wound packages

Types of Wound Packages

2. Nearly parallel wound package

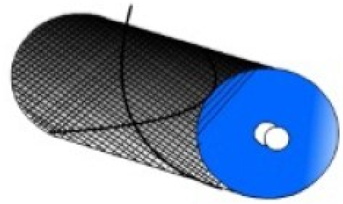
Successive coils of yarn are laid with a very nominal angle at very slow rate of traverse



Nearly parallel wound packages

Types of Wound Packages

3. Cross wound package



Yarns are laid on the package at considerable angle.

Lower package content than that of parallel wound package.

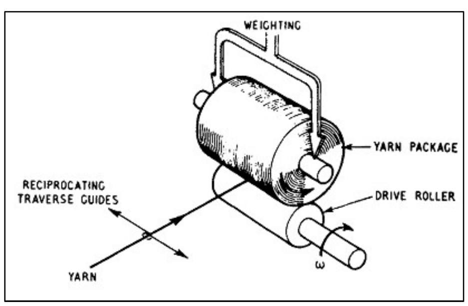
However, provides very good package stability as the coils often change their direction at the edges of the package.

Example: Cones, Cheeses.

Important Definitions in Winding

1. Wind

It is the number of revolutions made by the package (i.e. number of coils wound on the package) during the time taken by the yarn guide to make a traverse in one direction across the package.

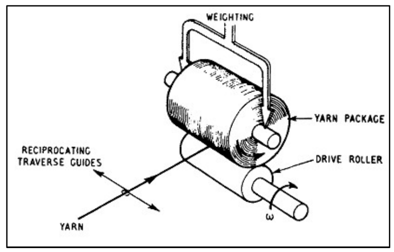


Important Definitions in Winding

2. Traverse ratio or wind ratio or wind per double traverse

It is the number of revolutions made by the package (i.e. number of coils wound on the package) during the time taken by the yarn guide to make a to and fro traverse.

Traverse ratio= 2× Wind



Important Definitions in Winding

Angle of wind (θ)

It is the angle made by the yarn with the sides of the package.

If surface and traverse speeds are V_s and V_t respectively, then

$$\tan\theta = \frac{V_t}{V_s}$$

Larger the angle, lower the density & hence greater softness of the package

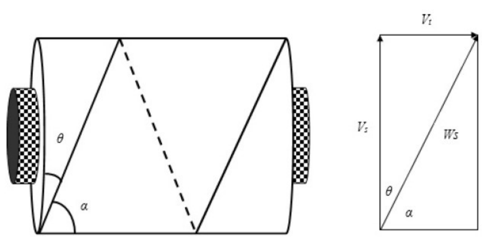


Figure 2.3: Angle of wind and coil angle

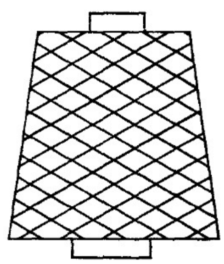


Fig. 1.2– Open wind

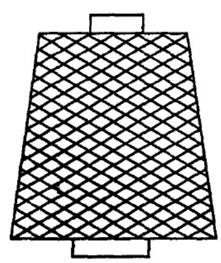
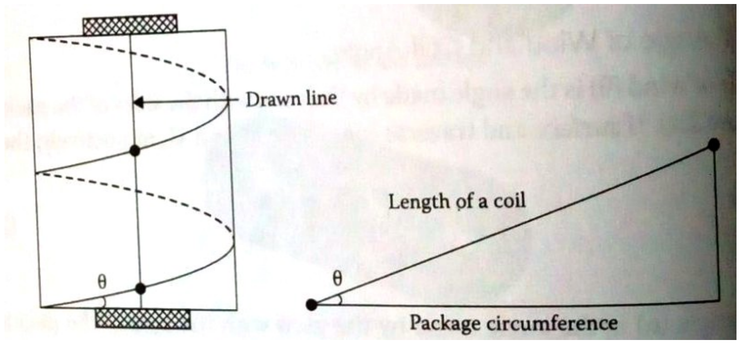


Figure 1.3 – Closed wind

Important Definitions in Winding

Measurement of angle of wind (θ)



$$Cos(\theta) = \frac{Package\ circumference}{Length\ of\ coil}$$

Important Definitions in Winding

Coil angle (α)

It is the angle made by the yarn with the axis of the package.

The coil angle and angle of wind are complementary angles as they add up to 90°.

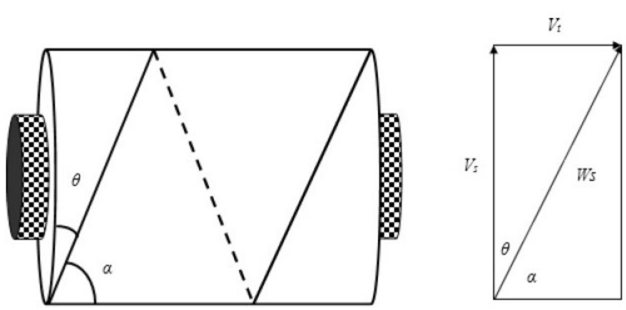


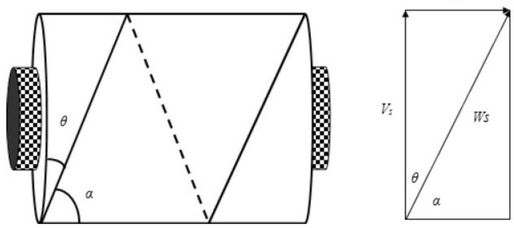
Figure 2.3: Angle of wind and coil angle

Important Definitions in Winding

Winding speed

The winding speed obtained by the resultant vector of surface speed (V_s) *and traverse speed* (V_t).

$$\text{Winding speed} = W = \sqrt{\text{Surface speed}^2 + \text{Traverse speed}^2} = \sqrt{V_s^2 + V_t^2}$$



Important Definitions in Winding

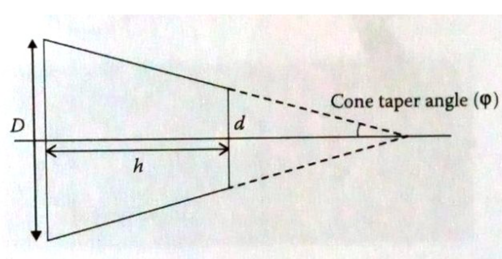
Scroll (S)

It is number of revolutions made by grooved drum in one double traverse

Cone taper angle

It is half of the angle at the cone top

$$\boxed{\tan\varphi = \frac{D-d}{2h}}$$



Cone taper angle.

The winding machine

1. Unwinding zone

Yarns are unwound from the supply package (ringframe bobbin)

Yarn balloon is formed

Unwinding tension varies continuously as the winding point shifts from tip to base of a ringframe bobbin.

Besides, the height of the balloon also increases as the supply package becomes empty.

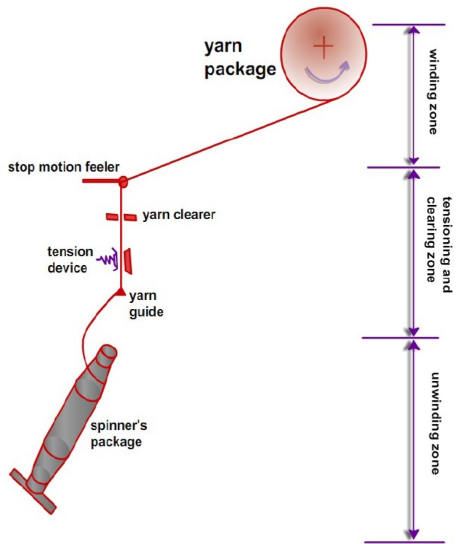


Figure 2.4: Zones of winding machine

The winding machine

2. Yarn tensioning and clearing zone

Tensions are applied on the yarns by using tensioners so that yarns are wound on the package with proper compactness.

The objectionable yarn faults as well as other contaminants (colored and foreign fibres) are also removed by using optical or capacitance based yarn clearer.

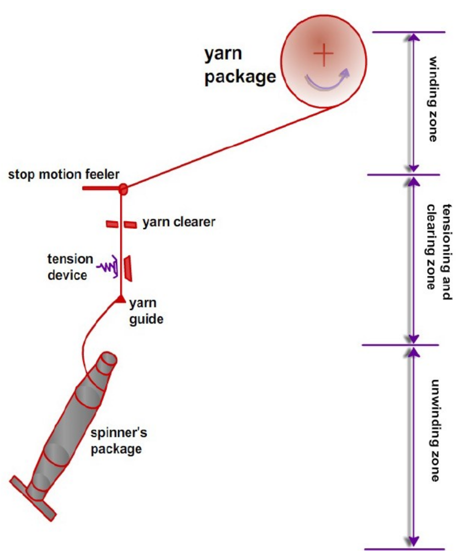


Figure 2.4: Zones of winding machine

The winding machine

3. Winding zone

Yarns are wound on the package by means of rotational motion of the package and traverse motion of the yarn guide.

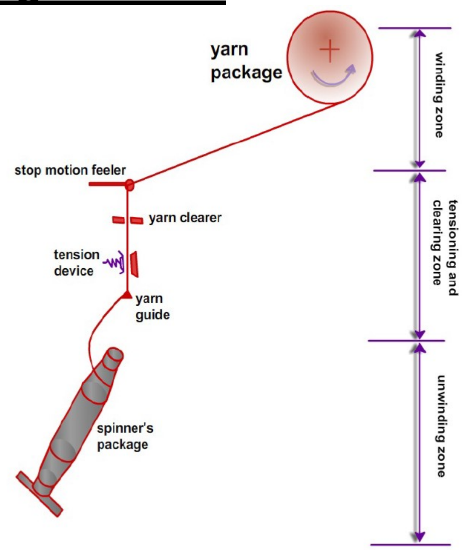


Figure 2.4: Zones of winding machine

Classification of Winding Principles

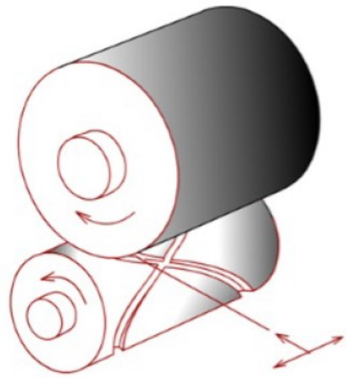
1. Drum-driven or random winders
2. Spindle-driven or precision winders

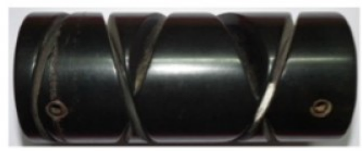
Winding
- Warp winding (cone/cheese)
  - Drum → Slow speed
  - Precision → High speed & super speed
- Weft winding (pirn/quill/filler)
  - Automatic (Autoconer)

1. Drum-driven or random winders

Package is driven by a cylinder by surface or frictional contact.

Traverse of yarn is given either by the grooves cut on the drum or by a reciprocating guide.





1. Drum-driven or random winders

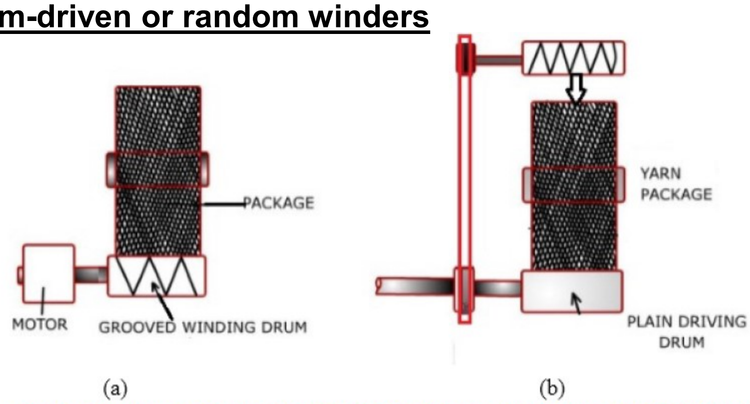


Figure 2.6: Types of drum-driven winder (a: grooved drum, b: plain drum)

In case of grooved drum, the drum performs the dual functions of rotating the package by surface contact and performing the traverse.

However, when plain drums are used, it just rotates the package and traverse is performed by reciprocating guide

2. Spindle-driven or precision winders

➢Package is mounted on a spindle which is driven positively by a gear system

➢If the r.p.m. of the spindle is constant then the surface speed of the package will increase with the increase in package diameter

✓Constant r.p.m. spindle winders

✓Variable r.p.m. spindle winders- winding speed remains constant

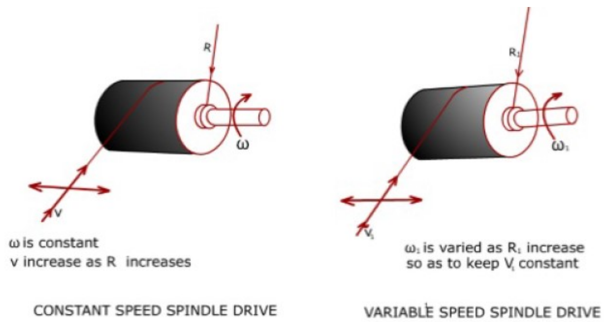


Figure 2.7: Spindle-driven winders

2. Spindle-driven or precision winders

➢Spindle-driven winders are also known as precision winders as a precise ratio is maintained between the r.p.m. of spindle and r.p.m. of traversing mechanism.

➢This leads to maintaining a precise distance between adjacent coils, termed **Gain of Wind**.

➢Precision winders ensure a constant value of traverse ratio during package building.

➢Precision winders are preferred for winding delicate yarns as the package is not rotated by the surface contact and therefore the possibility of yarn damage due to abrasion is lower as compacted to that of surface driven winders