

## Combing

The rectilinear comb was developed to remove vegetable matter and short fibres from wool and form a sliver with fibres parallel along the sliver length. The rectilinear comb is a technical improvement on the previously used noble comb as it is capable of processing much shorter fibres and does not waste as much wool.

### 1 Combing Principles

Wool is fed into the feed rollers of the comb from either balls or cans. Studies have shown that the impact of feeding from cans is normally 2mmH shorter and about 0.5% more romaine than feeding from balls. The other major disadvantage of feeding via cans is the floor area it requires. However, from an operator perspective, it is generally easier to feed from cans than from balls. Japanese combers form a lap using special equipment to feed an even web of fibres to the comb rather than slivers; this process is used in only a few mills around the world.

Modern reciprocating combs (see <http://www.finlane.com/>, or <http://www.nsc.fr/us/accueil/index.asp>) can run up to 280 cycles per minute. Each cycle is described below.

- The shovel plate feeds a predetermined amount of fibre past the nipper jaws.
- The nipper jaws clamp the fibres and the nipper brush pushes the fibres into the circular comb.
- The circular comb removes short fibres, neps and VM from the projecting fringe.
- The top comb enters the fibre mass behind the nipper jaws.
- When the top comb is at the bottom of the stroke, the nipper jaws release the wool mass,
- The drawing-off-rollers move to pick up the combed fringe and pull the fibres through the top comb.
- The vegetable matter, neps and short fibres (*see gauges*) are held behind the top comb and are removed by the segment on the next cycle as this now forms the fringe.
- The material removed by the circular comb (or segment) is doffed by the noil brush and forms the noil component.
- When the drawing off roller grasps the fringe, the front carriage moves forward whilst the rollers rotate, drawing the fibres onto the apron.
- Air suction is used to control the trailing fibres so they are not caught on the segment. This timing is vital as in high speed combs the forward carriage movement is restricted to approx. 28 cm.

- The next draw of fibres is laid on top of the previous draw by an amount called the overlap. As this provides the only strength the sliver has at this point of the process, by fibre to fibre friction, the resultant sliver is crimped in the crimping box at the front of the comb so that the sliver has the strength to be worked in the subsequent gilling passages.

A rule of thumb for determining the loading of a comb is 24 slivers, the input sliver weight equal to the micron of the fibre. The amount of fibre feed forward at each cycle is determined by the feed cog which drives the pinned feed grid. Typical comb settings are between 13 tooth cog (fastest) and 19 tooth cog (slowest). The pinned feed grid controls the fibres and as its forward movement coincides with the drawing off rollers it helps prevent sudden fibre acceleration which could cause fibre breakage.

The top comb is composed of a strip of very fine pins. These are variable in their pinning density, with fine wool being combed on 30 ppcm and coarser wool being combed on 25 ppcm. The segment or circular comb is normally pinned with removable vario bars. These enable a range of opening pins to be used starting with coarse pinning followed by successively finer pinning which helps reduce the fibre breakage which would occur if fine pinning was used at the start of the segment.

As seen above, the process of combing wool is complex and prone to a number of setting errors. Although new generation combs are designed to remove some of these issues, enough older combs are in use that require an experienced operator to set and maintain them at a high level of productivity and quality. Obviously, the selection of pinning for the top comb and the segment is highly dependant on the micron and contamination level of the input wool.

- The finer the wool the greater the pinning density. Pinning density is also increased if the wool contains a lot of vegetable matter. The amount of wool combed at any cycle will depend upon the cleaning ability of both the top comb and the segment. The top comb pins must fully penetrate the wool mat and allow sufficient free space so that when the fibres are drawn between the pins the wool does not drop below the bottom of the pins. If this occurs then that wool is not combed and the wastes are contained in the sliver. This becomes apparent if the combed sliver is opened after the crimping box and debris can be seen on one side of the sliver.

- If the pinning density of the segment is incorrect, there is excessive wear or grease build up on the pins, and then the sliver will have random patches of “noil” through-out the sliver. Similarly, if the noil brush is not set to clean the circular comb correctly, noil will be deposited back into the sliver causing contamination.
- If the overlap is not correct then the draw will not maintain its shape and there will be turn backs on the apron.
- Long fibres in the noil normally indicate a poor nipper brush setting, overfeeding or poor creel tension. Long fibres in the Back dust (if separated from the noil) indicate poor brush settings as well as all of the above.
- Noil being returned to the sliver can also be caused by noil brush wear. This brush removes the wastes from the circular comb and is an item of high wear. The brush must be periodically checked, rotated to restore the bristle effectiveness and reset closer to the circular comb. The new generation machines make this job simple and quick. They also have a motorised drive on the brush which automatically indexes the brush as it wears.

There are two components to noil generated from the rectilinear comb. The longer fibre, nep and vegetable matter particles are removed by the noil brush and doffer cleaning the circular comb. These wastes are transferred to the front of the machine and in most cases collected via a suction system. At the transfer point, circular comb to brush and brush to doffer, there is a chute that collects the airborne dust and broken fibres that are floating in the transfer spaces. This is called the back dust or 2<sup>nd</sup> noil. In most mills the 1<sup>st</sup> and 2<sup>nd</sup> noil are combined, cleaned through a duster system and sold as a by-product.

Romaine is the calculated value of noil expressed as a percentage of total fibres. Thus if we put 100 kgs into the comb and removed 19 kgs of noil and 90 kgs of top then the noilage would be 10% ( 10/(90+10)). Back dust, if kept separate would be approximately 10-20% of the noilage value.

## 2 Gauge setting

The setting of the gauge is one of the most important settings on the comb. The gauge, or noil setting, determines the amount of fibre lost in the combing process, it also affects the cleanliness of the final product, the production rate of the machine and the Hauteur and CVH of the final top.

The smaller the gauge setting the less fibre will be lost in the combing process as noil. This results in lower production rates, for a given cleanliness aim, and more short fibres in the top. (i.e. Higher CVH and lower Hauteur results.)

A wide gauge setting has the opposite effect; cleaner top, higher production rates, lower CVHa and longer Hauteur. However, there can be a significant increase in noil percentage as a result. Normally gauge settings of 34-36 are required for fine long tops to enable the CVHa parameters of less than 45% to be achieved. Shorter gauge settings are possible (down to 28) for open top blends. As in all factors affecting the processing of wool, the exact requirements will depend upon the totality of processing factors starting with wool choice through scouring conditions, carding settings and gilling practices.

It is not possible to optimise a single factor but all of the settings need to be taken into consideration in order to calculate the most economical and effective settings for a given production process.