



Back to Basics: A Framework for Leather Manufacture

Richard Daniels and Walter Landmann

The splitting machine and its tools in operation

The splitting machine needs to handle a range of leathers and produce controllable and predictable results with a fairly high degree of accuracy. Accordingly, it has numerous controls and settings. Nevertheless, the condition of the leather, its water content, its temperature, hardness/softness and its elastic/plastic behaviour affect splitting results. The design and construction of splitting machines does not vary fundamentally between processing limed, tanned or dry-crust leather.

KEY OBJECTIVE

The key objective of machine splitting is to produce a substance controlled grain split normally leaving a less precise but usable flesh split.

The splitting action

The fibre weave within the skin structure is at an angle to the horizontal (See: Essay 8, Panels E8/7a & E8/7b) and the splitting operation severs these fibres by means of a slicing action. This causes

both a reduction in the tensile strength of the hide or skin, and a general relaxation.

This is most noticeable when splitting limed skins. Here, the pressure between gauge and ring rollers onto the malleable skin and the fibre structure slicing can lead to area gains to the order of 7% to 9%. In contrast, the collagen fibre structure after tannage is more rigid and will not move.

Increased precision of the machine, and above all the ability to bring the material through the gauge and section rollers very close to the knife-edge, aids substance precision. Tanned splitting can be within 0.1mm and better, but lime splitting presents special problems because of the elastic nature of the limed skin.

As the limed skin passes between the rollers it is compressed instantly. As soon as it leaves the nip it springs back and as well as becoming irregular in substance, it puts extra load onto the knife. For this reason final splitting accuracy tends to be as low as 0.2mm and that is only in the main body of the skin. Flanks and shanks vary considerably more.

The mechanism of splitting

Splitting performance, more than in any other machine process, involves interaction between the components of the cutting mechanism. With reference to Panel E15/1 the components of the central cutting mechanism are:

THE GAUGE ROLLER (a)

The gauge roller, also acting as the transport roller driving the leather to the cutting edge, is set to determine the substance of the upper split (*normally the grain split*). Smooth-faced for splitting tanned leather, and knurled or grooved for lime splitting, it can be profiled to be slightly concave or convex or canted left and right. This is needed, for example, when splitting bovine sides.

Because of the relationship between gauge and ring rollers (b) the uniform and accurate substance split in the classic machine is always the upper one. The lower split suffers the irregularities occurring in the full substance piece.

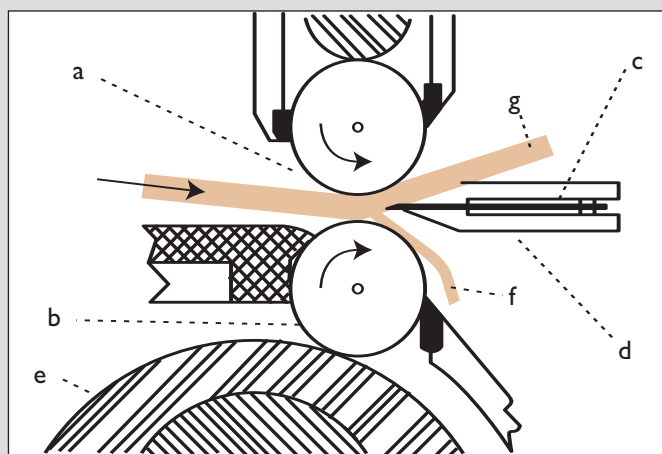
THE RING OR (SECTION ROLLER) (b)

The ring rollers revolve on a fixed axle and are free to move radially. A rubber roller (e) supports them so that they can move to absorb substance irregularities in the piece. In addition, they freely rotate for splitting tanned pieces, but are driven for lime splitting. The section rollers for lime splitting are frequently grooved, sometimes in an asymmetric pattern, which assists transport of the skin.

THE BANDKNIFE (c)

The bandknife is an endless band manufactured from hardened alloys 1.2mm thick and between 85mm and 100mm wide. The cutting edge is continuously ground in the machine to bevels arrived at by practical experience.

Panel E15/1: Classic splitting machine configuration



- a. Gauge roller
- b. Ring roller
- c. Bandknife
- d. Jaw plate assembly
- e. Ring roller support roller
- f. Flesh
- g. Grain



Panel E15/3

Interactions and effects: The splitting operation

Differences in outcome due to the influence of temperature and moisture content of the piece are presented in *Essay 10*, where the role of elastic and plastic behaviour in machine operations is discussed. The shifts in properties described should be taken into account within the following table.

The effects of the splitting operations are generalised. The type of skin and its condition (temperature, water content and softness/hardness) play a major part in machine settings and the effects on the piece after splitting. Some of the effects may not arise, be diminished or be accentuated.

LIME SPLITTING

The full substance piece is split into two separate layers:

- The flesh layer carries the remainder of the total skin thickness and will reflect all the natural thickness variations
- Spring back is considerable and is only partly mitigated by reducing pressure exerted by gauge roller setting
- Some spreading action
- Hide relaxation
- Thinner flesh layer (compared with wet blue splitting). This is because the grain layer is split more thickly to allow for variations in plumping of a hide and between individual hides

- Recognition of grain defects is difficult
- Fat wrinkles are normally less pronounced
- Good grain character and generally even leather colour evident
- Eventual feel not as good as with wet blue splitting
- There is area gain due to tension, pressure, and fibre slicing during the process
- Better, faster and more uniform penetration of chemicals in subsequent processing
- The untanned flesh split is a marketable product

WET BLUE SPLITTING

The full substance leather is split into two separate layers:

- The grain layer is split to a set substance (best accuracy ± 0.1 mm). The flesh layer (the flesh split) will carry the remainder of the total skin thickness and will reflect the variations in the thickness of the unsplit material
- Surface defects of grain split are readily

recognisable (compared with lime splitting)

- Flesh splits are thicker because grain split accuracy can be more precisely set with the gauge roller
- There is little, if any, area gain. (The fibre structure after tanning is robust and the pulling component in the machine is not great)

DRY SPLITTING

The objective is to adjust the grain split substance accurately to a final thickness on shaved, dyed and dried material:

- The best accuracy can be ± 0.05 mm
- There is not sufficient substance for a flesh split
- Appearance and properties suffer
- Feel becomes less satisfactory
- Loss of tensile strength (Usually disproportionate to substance change)
- There may be more pronounced grain draw and wrinkling with soft or spongy leathers

The classic bevel configuration is at an angle of 8° , equal top and bottom faces. This puts the cutting edge at the centre of the knife with the disadvantage that knife flutter may occur. This is influenced by the hardness and water content of the leather and affects splitting accuracy. More frequent is off-centre grinding with a longer bevel at the top (*Panel E15/2*).

Experience and theory indicates that the latter results in more uniform and precise splitting. This is because the knife is being pushed against the bottom of its guides (*the jaw plates (d)*) with the leather pressed firmly against the gauge roller.

The cutting speed of the knife is generally designed to be a relatively low 5m/second. This represents a compromise between throughput capacity, excessive knife and knife guide heating, keeping the wear of the cutting and running faces of the bandknife at an acceptable level, and arriving at a suitable grinding

speed. (*Keeping the edge sharp without over grinding*).

THE KNIFE GUIDE (d)

Commonly known as the jaw plates, these guide the knife travel to retain the

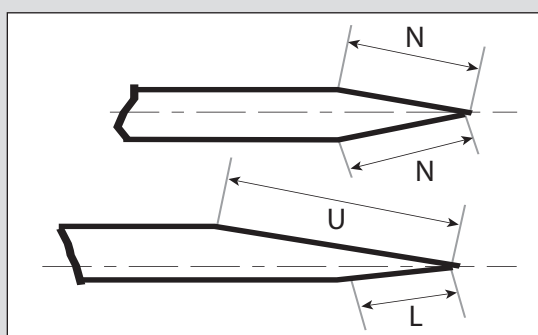
geometry in relation to the leather as presented to it by the gauge and ring rollers. It also carries the automatic knife advance mechanism. This is part of a pusher arrangement which ensures that the knife is kept at a constant pressure and position against the leather edge being cut, thus compensating for knife wear.

Classic splitting systems have no provision for presenting pieces to the gauge and section rollers flat, spread out and pleat free. To avoid cutting damage, reliance is placed upon the skill and dexterity of the operator feeding the machine. More recently devices have been developed feeding the material by means of spreader belts to a point close the gauge/section roller nip. To a large extent this overcomes the problem and de-skills the feeding operation. 🌐

Additional Information:

"The Machines in the Tannery" – Walter Landmann; *Splitting Machines and Extractors*, pages 170 - 187.

Panel E15/2: Bandknife bevels



- N** = Normal bevel length (approx. 5mm)
U = Asymmetrical upper bevel length (approx. 6mm to 7mm)
L = Asymmetrical lower bevel length (approx. 3mm to 4mm)