



Struck through (left) and surface dyed (right) leather shoelaces.

CREDIT: AUBURN LEATHER

Footwear Fundamentals

SHOELACES

George Davis, the UK retail clothing guru, has been quoted as saying that one of the things that annoyed him the most, was a good pair of shoes spoilt by cheap laces. He had a point. Laces have traditionally been regarded as an incidental item and not worth wasting time on in terms of either design or quality. The general view was 'look for the cheapest and let the customer find a replacement when they break' which, unfortunately, was often all too soon. Fortunately, things have changed and laces are now frequently a key feature of the overall shoe concept, even to the point of carrying the brand logo.

So, what is a shoelace? It was originally a strip of tape or leather put through holes punched in the upper to close the shoe and keep it on the foot. As mechanical weaving and braiding processes became available, woven fibres took over in all but the highest quality mens Goodyear welted shoes or in specialist footwear such as boat shoes. Today, there is a wide variety of laces made from different raw materials and there is no need for any manufacturer to compromise on quality, performance or aesthetic values.

RAW MATERIALS

Cotton yarn – very much the traditional material, cotton remains the favourite for quality footwear. It has good aesthetic appearance, minimal elongation plus excellent tie-ability and so satisfies all the basic requirements for a lace. If extra strength is needed, a small percentage of nylon filament can be added. Round cotton laces can also be waxed and polished in a special process to give them a

similar appearance to the old fashioned rat-tail leather lace and are the first choice for dress shoes.

Acrylic fibre – soft and voluminous, it makes a particularly good substitute for cotton in non-waxed laces. It offers a very similar finished appearance and at the same time provides remarkable improvements in mechanical and abrasion performance.

Polyester – this fibre features high tensile strength and abrasion resistance. It is therefore popular for sports shoes and also with brown shoe manufacturers, where it provides the extra abrasion resistance needed for ski-hook fastenings, which cause a higher wear rate than eyelets. The downside is relatively poor tie-ability and aesthetic appearance, although recent technical developments have improved the latter considerably.

Nylon – this is used for specialist laces where chemical products may be present in wear or as an additive to other lace making materials such as cotton. It has good strength but does have relatively high elongation, plus poor tie-ability.

Other fibrous materials include linen and hemp which are sometimes used to produce laces for 'ethnic' or very casual styles to create a 'raw' look rather than for any mechanical reason. It is therefore clear that there is a wide choice of raw materials or various combinations of them to consider. Many manufacturers and brands go so far as to have laces made to their own specifications in order to guarantee quality and performance in wear. They recognise that premature failure can easily harm their image.

CONSTRUCTIONS

Once the raw materials have been chosen, there are two basic methods of producing a lace.

Braided – the tubular braided lace is by far the most commonly used construction and is able to produce varying sizes of round, tubular or flat laces. The actual braiding machines employ from 16 to 48 spindles, one for each thread, to achieve the size required. The diameter of a lace can also be altered by using a variety of central cores and braiding round them. This can also determine whether the final profile is round or elliptic. Flat laces are obtained by using coreless tubular braid. A further variation is based on the type of braid standard; standard weave for classic shoes and rough or 'Dama' weave for sports and fashion footwear.

Woven – these are always flat and are produced on specialist narrow width looms, where weft (cross) threads are inserted through the warp (length) threads. They are very strong and lack the cross-section malleability of a braided lace and so can twist in the eyelets or when tying, which spoils the general appearance. All laces of both types must have the ends sealed by either a metal or plastic aglet or tag to prevent them from unravelling.

TECHNICAL CONSIDERATIONS

What are the main requirements to look for in a lace?

Mechanical resistance – this prevents it from breaking through repeated stress as the lace is tied and untied.

Abrasion resistance – breaking can be accelerated by excessive wear due to repeated rubbing against the eyelets or through knotting.

Durability – a lace must retain its original structure, profile and aesthetic values in the face of external agents such as light, water and mud, etc.

Resistant end tag – aglet must not break or come off easily to allow thread of fibres to come loose and make insertion through the eyelets more difficult.

To ensure you have the right lace for your purposes, it is advisable to have tensile strength, stretch and abrasion tests made by one of the independent test houses which carry out a material testing service. The alternative for larger companies is to purchase test equipment for use in-house.

SPECIAL LACES

This leaves specialist or technical laces, which are produced against very specific requirements and sometimes for abnormal or hazardous situations. Not all lace manufacturers are able to produce such products and the higher the specification, the correspondingly more expensive the lace becomes.

Anti-static – for industrial boots worn in conditions where methane or other gases are treated or where solvents and other inflammable materials are handled. These laces must not accumulate electrostatic charges or risk accumulating hazardous discharges or sparks.

Waterproof – for sports shoes, military and general purpose work boots or, more simply, shoes with waterproof uppers and soles. In these instances, the laces are treated with

special preparations in order to prevent water penetrating into the lace itself and further filtering into the shoe.

Fire resistant – produced with non-inflammable fibres for footwear worn by people involved in situations where conditions can be carried to extremes, such as airmen, firemen, racing drivers, etc. They can withstand extreme heat as the fibres do not generate gases which might ignite.

Non-stretch – made from high tech fibres such as Kevlar to replace traditional materials which lack sufficient in-extensible properties for the intended purpose. They have been used on a variety of applications, including top of the range boat shoes worn by round-the-world yachtsmen.

Fashion – these often feature complex customised colour combinations in different types of braids and structures. They can also be treated with particular pigments to create special effects such as fluorescent, reflective and even thermosensitive laces which change colour as the air temperature varies.

LEATHER LACES

Leather laces have been a part of the shoe industry since man first had a need to secure pieces of animal hide around his feet. Today, their use is confined to top end mens welted shoes and specialised casual categories of footwear such as hiking, boating, work and slipper moccasins. They are, however, still very much an integral component part of sporting goods and hobby crafts industries, worldwide.

While anyone can make a leather lace from any kind of leather using a strap cutting machine, it will most likely prove unsatisfactory as a quality lace calls for specially processed high quality leather. Thickness, tensile strength, colourfastness, knot slippage and abrasion resistance all have to be addressed. Specialist leather lace producers such as Auburn Leather in the USA, carry out the complete process from retanning from wet blue stock, through colouring to final cutting.

The company's quality control standards indicate the tight parameters needed to produce laces with a maximum performance.

Strength – minimum pull strength 32kg (industry standard 25kg).

Abrasion resistance – 1500 cycles at 0.9kg tension and 0.9kg pressure using the Wyzenbeck Method (wearability through the eyelets).

Shrinkage – the leather must be able to withstand 100°C for 30 minutes with less than 5% shrinkage.

TANNING

Rawhide is the most basic process whereby raw leather is cut into long thin strips and cured. It is more common, however, for the leather to be tanned and oil, vegetable, chrome and alum (aluminium) tannages can all be used.

Chrome, using chromium salts, is the most widely used method. It plumps up the fibre structure and makes it pliable. Properly tanned chrome lacing leather offers excellent tensile strength and wear resistance, plus a mellow feel. A chrome tanned lace is claimed to be 'strong yet tie-able'.

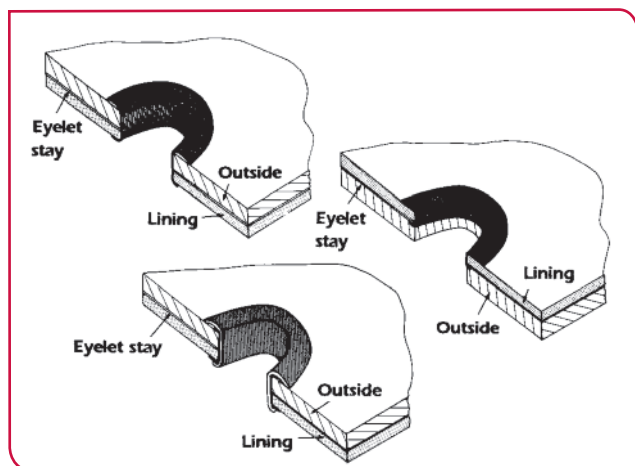


Fig 1 - The three main eyelet types; single (A), blind (B) and double (C).

Alum tannage is a double salt containing aluminum sulfate, which constricts the fibre structure to produce a stiffer lace. While it is mostly used for sporting goods lacing, such as in baseball gloves and lacrosse sticks, some moccasin shoemakers still use alum tanned laces for their whipstitching lace, as it is strong with a firm and rigid feel. At high temperatures, alum will continue to process or 'cook' and become dry and brittle so it is not suitable for shoes that go through any wetting and drying cycles when worn.

COLOURING

The tanned hides are mostly coloured or dyed in large drums or vats, as opposed to top sprayed as is in the case of most upper leather. Because it is drum-dyed, there may be a slight amount of shade variation, between dye-lots. There is, however, no risk of the colour peeling or being scraped off. Auburn, for example has developed three dyeing options.

Surface Dyeing – is where colour is applied to both the grain and flesh sides of the leather and the cross-section or middle portion of the hide is left in its natural tanned state.

Two Tone – is where the surface is one colour and the centre another. The overall effect is one colour on the top and bottom and another on the edges or sides of the square cut lace.

Struck Through – is a method of colouring which involves dyeing the leather twice. First, a penetrating dye is used to colour the interior or middle portion and cover the colour of the tannage. Then, a surface dye is used to colour just the grain and flesh sides. While this produces the best looking leather laces, it also makes them the most expensive.

RETANNING

Thickness is, of course, critically important in leather lace production. The optimum leather thickness is 2.8mm. To achieve this, lightweight hides are cleaned and levelled to an even 2.8mm without removing too much of the flesh side. This splitting process is performed prior to colouring and retanning, so that the integrity of the hide is not compromised.

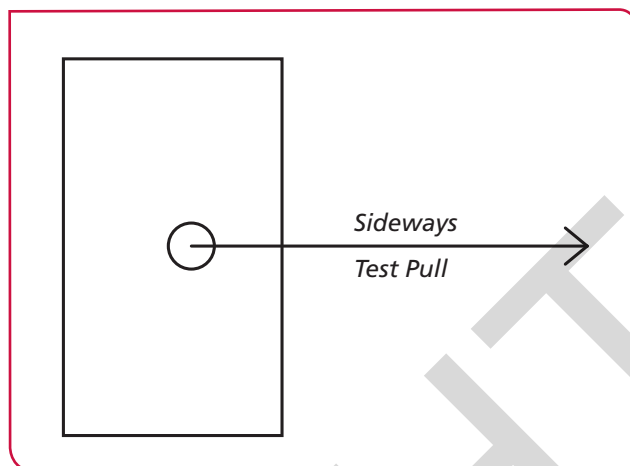


Fig 2 – SATRA TM 149 reproduces the action of the lace as it is tightened.

When the leather is considered to be at 'full weight', it is also at full strength in terms of tensile performance. The amount and type of fatliquor used in retanning and colouring, controls the temper and feel of the finished lace. The fatliquor used not only makes it mellow, but also promotes strength by reinforcing the internal fibres of the hide. A firmer and less mellow lace can be produced by reducing the amount of fatliquor; too little, however, will lead to brittleness and a risk of breakage.

EYELETS

Tightening and tying a lace exerts considerable stress on a shoe upper, especially at the top of the facing where it will be tied. It is for this reason that eyelets of one type or another are used on such a large proportion of laced footwear. A failure to reinforce them properly is also a frequent cause of customer complaints.

The three main types of eyelet are shown in Figure 1. It is not unusual for lace pull to approach 4.5kilogram-force and it all falls on the top pair of eyelets, causing high levels of stress in the surrounding area of the upper. The only time when a suitable reinforcement can be omitted with any degree of safety, is when either visible or double eyelets are used with stiff materials such as heavy outer leathers. If this is not done, several things can happen.

Distortion – the facings distort producing at best an unsightly appearance and, at worst, making it impossible to tighten the laces sufficiently to close the facings.

Eyelets pull out – the clenched edges of the eyelets will fail to grip the upper material as it is stretched and the eyelets will pull out.

Tearing – sooner or later and, usually sooner, the upper material around the eyelet will tear.

The best test of for eyelet strength is Satra TM149 (Figure 2) in which a sideways pull is exerted on the upper using a lace passed through the eyelet. The force required to tear the eyelet out is measured and this provides a good indication of performance in wear. If it is too low, the reinforcement can be upgraded until a satisfactory performance level is reached. 🌀