Photograph by **Dave Hutton**

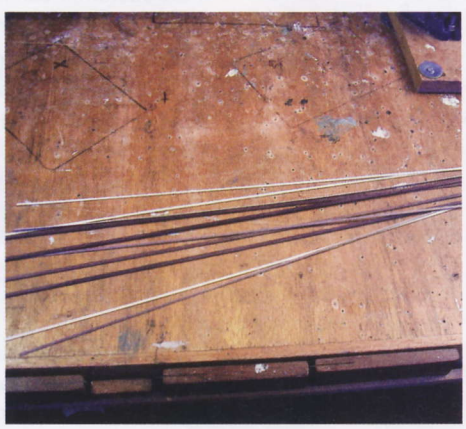
STRIKE A CHORD

In the final instalment of this three-part series, **Shaun Newman** takes us through the final steps of making an early Viennese guitar

In part 2, I described how the soundboard and its rosette are made and fitted before moving on to show how the back of the instrument is constructed. When fitted, the guitar is then ready to receive the bindings and purflings.

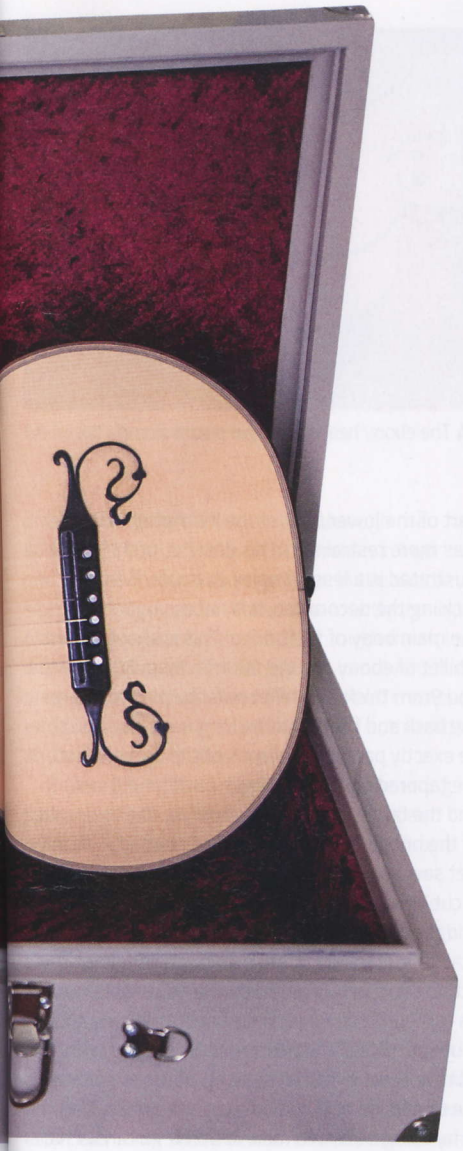
Bindings & purflings

The bindings on a guitar are there to protect the edges of the instrument from damage; the purflings are decorative and on this guitar only fitted around the soundboard. Both are let into the edges of the guitar by cutting a channel around the outside edges of the instrument. The bindings are made from strips of rosewood just 2mm thick and 6mm high. They should exceed the length of half the perimeter of the guitar by around 60mm and be trimmed to the exact length after they have been bent to shape on the hot iron. The purflings for the front are made from strips of walnut and sycamore in an alternating pattern (**photo 58**). Each veneer is 0.5mm thick and 2mm deep, so if three sycamore and three walnut pieces are used the channel should be 3mm wide for them and a further 2mm for the bindings. There are no purflings for the back, so the channel is just 2mm wide and 6mm deep (**photo 59**). The front of the instrument requires two channels – one each for the binding and purfling (**photo 60**). For both the back and the front of the guitar, it is as well to start gluing the



58 Examples of bindings and purflings

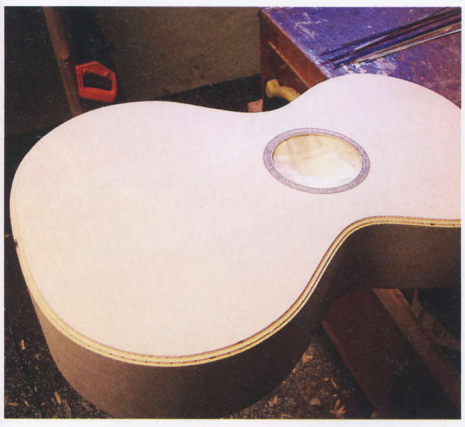
59 Binding channels in the back



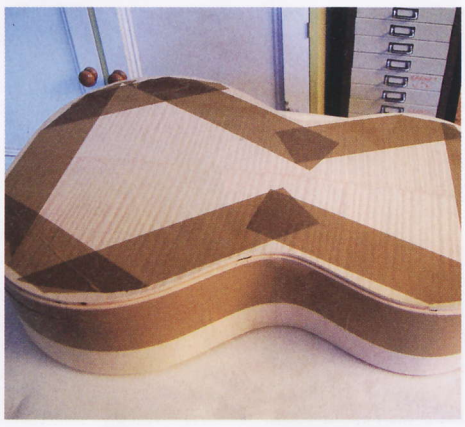
Photograph by Dave Hutton

bindings and purflings into place at the centre of the tailblock. As they arrive at the heel the front ones are inlaid into a channel, which will be hidden by the fingerboard. For the back they must be cut exactly to length, as it is not easy to hide the join. Before attaching the bindings and purflings, I use parcel tape to help the binding tape to adhere more securely (**photo 61**). Strong masking tape is used to hold everything in place as the glue dries (**photo 62**), and once the tape has been removed the bindings and purflings can be levelled and cleaned up with a thumb plane and/or sanding stick (**photo 63**). Just before that operation the parcel tape needs to be removed and care is required here while dealing with the soundboard as the soft spruce grain can easily tear.

When the back has been cleaned up a small heel cap can then be fitted. Sometimes 19th century guitars would have a bone heel cap, but in most cases, the maker would use a scrap of ebony or rosewood left over from a previous project. On this occasion, I decided to fit a heel cap of ebony, which would contrast nicely with the maple (**photo 64**).



60 Binding and purfling channels in the front



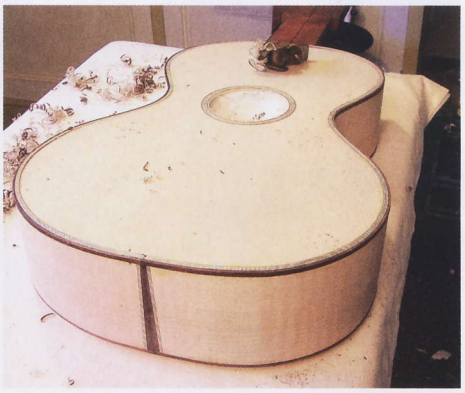
61 Parcel tape helps the binding tapes hold firm

The fingerboard

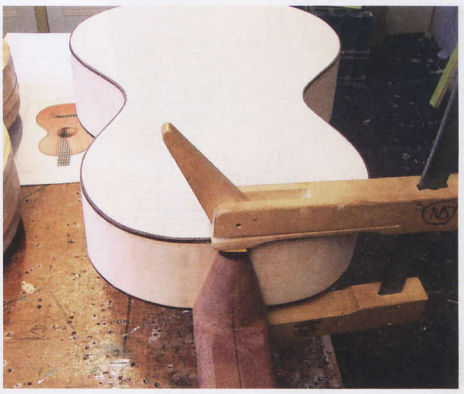
The fingerboard on a Staufer guitar is rather different in its design than most fitted to classical guitars. For one thing it has 22 frets where most classicals have 19 or 20. It is also reduced in width from fret 12 (i.e. at half the string length) to fret 22. Then, it is not attached to the soundboard from fret 12 but sits a couple of millimetres above the surface to help give the instrument a larger vibrating surface. This means that the underside of the fingerboard from the nut to fret 12 is raised from the top face of the neck by around 2mm. This can be achieved by attaching a 2mm ebony veneer on the underside of the fingerboard from the nut end to fret 12, or by some careful plane and chisel work. From the end of the 'step' that is created, the fingerboard is tapered just enough to ensure that when the strings are pressed against frets lower than No.12, the underside of the fingerboard does not come into contact with the soundboard. It is as well to dry-fit the fingerboard with cramps to test this as it is difficult to work on the underside of the lower part of the fingerboard once it has been glued into place.

The fingerboard itself is made from a billet of ebony 500mm long, 65mm wide and 7-7.5mm thick. When finished, the part that is glued to the neck should be no thinner than 7mm. At the nut

62 The bindings held in place on the back with strong masking tape



63 Cleaning up the bindings and purflings



64 The ebony heel cap held in a cam clamp

the fingerboard is 48mm wide and 58mm at fret 12. The bottom corner of the fingerboard is tapered to the centreline of the guitar (**photo 65**).

The fret slots can be cut with a dovetail saw, using the right-angle slot of a mitre block, or a specialist slot cutting tool provided by luthiers' suppliers (**photo 66**). It is important to test the depth of cut frequently as too shallow and the fret will sit proud causing buzzes; cut too deep and the tensile strength of the combined neck and fingerboard can be compromised. A small piece of thin metal with a masking tape line set to the depth of the fret tang works well as a depth gauge and is easy to make (**photo 67**).

The frets are cut from lengths that can be bought from luthiers' suppliers such as Stewart-MacDonald. I used standard classical fret wire made from nickel silver (**photo 68**) and each one is cut to around 6mm over length, which helps to give an overlap that can be held between the finger and thumb while the fret is tapped into place. A hammer with a rubber, nylon or brass head should be used to get the frets tightly seated, and the best is the 'dead blow' hammer, which has a nylon-faced head that is filled with lead shot. This helps to prevent the hammer from bouncing back at each blow, ensuring the fret does not bounce back either.

Once the frets have been safely located, the ends can be snipped flush, filed to exactly 90° and then angled to around 60° for comfortable playing. This can be achieved using a couple of simple, home-made tools. Lengths taken from two files are attached to hardwood blocks, which have a 90° and 60° angle respectively planed along them. The lower edge of the file protrudes around 5mm and when the block is run along the top of the fingerboard the fret ends are nicely trimmed (**photo 69**). From time to time, small jagged parts are felt at the fret ends, and these should be carefully removed with a safe edged file.

Finally, the tops of the frets should be tested for evenness. Any standing proud should be levelled with a file until they are the same height as the others and the top of the fret 'crowned', which requires care to recreate the domed profile. Some makers run a flat whetstone over the frets until all have been touched and then each one is carefully re-crowned. This should not be necessary if the fingerboard was truly flat after it had been fitted and all of the frets are properly seated, however.

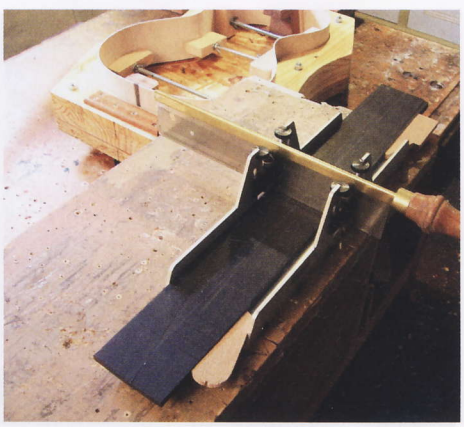
The fret spacings are as follows: nut to fret 1 – 34mm; to fret 2 – 66mm; to 3 – 95.5mm; to 4 – 124.5mm; to 5 – 151mm; to 6 – 177mm; to 7 – 201mm; to 8 – 223mm; to 9 – 244mm; to 10 – 265mm; to 11 – 284mm; to 12 – 302mm; to 13 – 318.5mm; to 14 – 334.5mm; to 15 – 349.5mm; to 16 – 364mm; to 17 – 377mm; to 18 – 390mm; to 19 – 402mm; to 20 – 413.5mm; to 21 – 424mm; to 22 – 434mm. For the instrument to play in tune the spacings should be carefully observed, and each fret slot should be exactly parallel with the inner face of the nut, i.e. the top edge of the fingerboard.

The bridge & decorative 'mustachios'

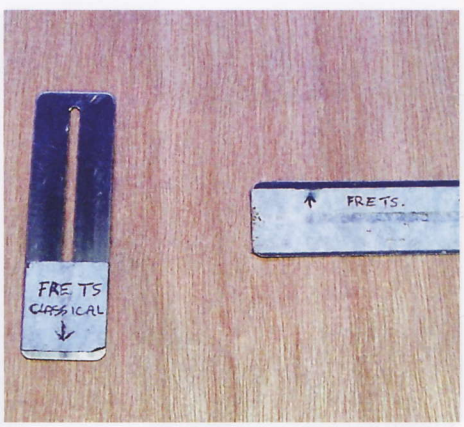
It is very common to see highly decorative 'mustachios', as they were called, fitted to the bridge of early 19th century guitars. Some Italian guitars (e.g. those made by Gennaro Fabricatore) from a similar period had them covering the larger part of the lower bout of the instrument. Staufer was more restrained in his designs, and the one illustrated is a less complex example. Before tackling the decoration, it is necessary to make the main body of the bridge. This is shaped from a billet of ebony around 180mm long, 30mm wide and 9mm thick. The billet must be planed flat on the back and front and the longer edges should be exactly parallel. The ends of the bridge billet are tapered down from 9mm to around 3mm and the taper is on a gradual curve. The top parts of the bridge decoration are first shaped with a fret saw and then with warding files. A housing is cut 2mm wide and 5mm deep to accept a bridge saddle made from ebony (**photo 70**). Some Staufer guitars did not use a bridge saddle as the action could be regulated by the adjustable neck. As this guitar does not have that facility, a saddle is useful so that the action can be altered with relative ease, either by shaving a little away from the underside of the saddle to lower the action, or by using a shim to raise it. Some guitarists have several saddles tucked away in their instrument case so that they are able to raise or lower the action at short notice.

The next task is to locate the correct position for the bridge. First two 2mm holes are drilled down through the saddle housing each around 4mm from either end of the slot. This will be used to help locate the bridge accurately. The inside edge of the saddle housing should be 604mm from the top edge of the fingerboard, and the centreline of the bridge should sit directly over the centreline of the guitar. The position of the two 2mm holes needs to be marked through onto the soundboard and two further 2mm holes

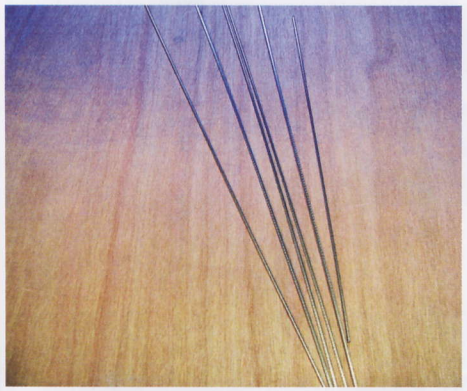
65 The ebony fingerboard under preparation



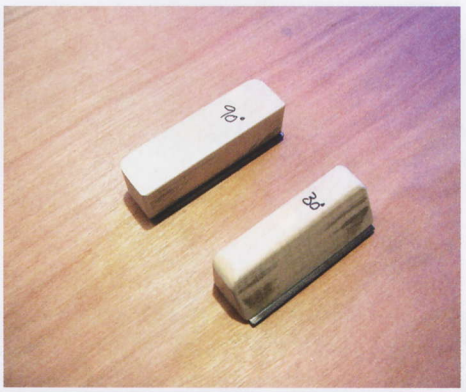
66 Cutting the fret slots



67 Home-made fret depth gauges



68 Nickel silver fret wire before cutting



69 Home-made fret edge trimming tools

70 The bridge roughly made showing the saddle slot

drilled exactly on each spot right through the spruce. If a cocktail stick is then broken in two and passed through the two holes in the saddle slot, the bridge can be placed into exactly the right place by also passing the sticks through the holes in the soundboard. The sticks help to prevent the bridge from moving when it is glued and cramped into place and are simply snapped off both inside and out when the glue has dried.

Before gluing the bridge into place, the string spacings must be determined and a set of six holes drilled to accept the bridge pins. Such pins are normally around 30-32mm long and 5 or 6mm thick at the widest part of the taper. The angle of the taper is normally 5° but can also be 3° depending on the manufacturer. They can be turned on a small lathe, but this takes a lot of time, and they are not expensive to buy. The ones illustrated are rather special. Staufer used quite large mother-of-pearl dots in the ends of his bridge pins, and these are difficult to locate now, especially since the restrictions on the movement of some types of shell from, for example, the USA. The ones I used came from Graph Tech in Canada and are known as 'Presentation' bridge pins as they have the larger mother-of-pearl dots – see supplier list at end of this article (**photo 71**).

It should further be noted that bridge pins can be slotted or unslotted. The slots are to allow the strings to be gripped tightly on the bridge so if unslotted ones are used, it is necessary to cut small grooves in each hole to allow the string to pass through. I used slotted ones here.

Once everything is in order with the upper part of the bridge and it has been cramped into place, the 'mustachios' can be tackled. These are made from four pieces of ebony each 1mm thick and measuring 60 × 60mm. Two are laminated with epoxy with the grain running at right angles between each piece. The other two are similarly treated and when the epoxy has cured all four are stuck together with a piece of newspaper between them and fish glue. The grain on the top piece of the four must run in the same direction as the bottom piece. When the fish glue has dried a piece of white paper can be glued onto the top of the stack, and with the grain running horizontally, the mustachio design is drawn onto the white paper. A white address label will serve well for this purpose.

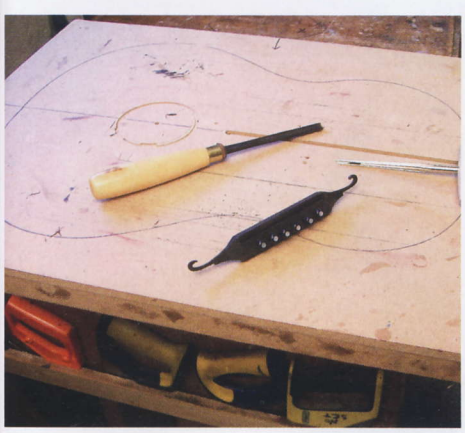
The design is then carefully cut out with a fine blade fitted to a small fretsaw (**photo 72**). Once the design has been cut out and satisfactorily cleaned up with needle files, the assembly is dropped into hot water, which, after a while, will dissolve the fish glue and the two halves can be separated. The good thing about this approach is that any slight error will look intended when the two halves are laid out like butterfly wings, so there is no need to worry about the blade going slightly off track! The mustachios are then coated on the back with a fine layer of Titebond and held in place on the soundboard with weights. Using as little glue as possible will make the clean-up much easier. At this point a small strap button may be fitted into the tail end as these 19th century guitars were sometimes played while standing (**photo 73**).

The top nut & bridge saddle

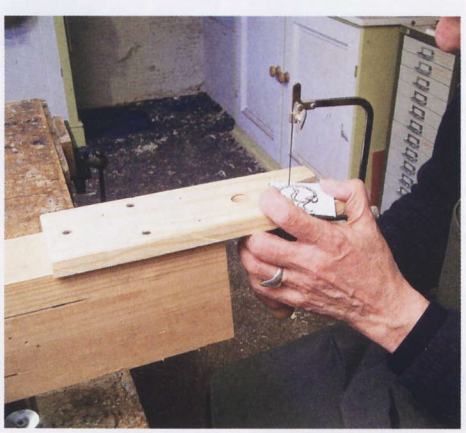
On modern guitars these are usually made from bone but on this instrument, ebony is used in keeping with the tradition. The saddle is made to fit the slot in the bridge and sits around 4mm above the top surface of the bridge on the bass side, and 3mm on the treble. These measurements are a rough guide to begin with, and when the strings go on may be adjusted according to the type of action required. Some guitarists who enjoy playing fast runs and scales will often look for a low action, as is the case, for example, with Flamenco players. Others look to a high action to be able to get more tone colour from each note. This is very much a matter of personal taste. The edge of the saddle nearest the tailblock is sloped downwards to allow the string to sit comfortably on its way to the bridge pin. At the other end of the fingerboard the nut is also made from ebony but is thicker at around 5mm (**photo 74**). The height of the nut should allow the strings to sit just 2mm above the height of the fingerboard and requires six grooves so the strings can be held in place as they are struck. The grooves that hold the strings in place in the nut may be lowered if the player wants a low action at fret 1. The top 'E' string (also called No.1) is usually no more than 3mm from the edge of the fingerboard on 19th century guitars, whereas today on a full-sized classical guitar, it can be as much as 6mm. The bass 'E' (No.6) string sits at around 2.5mm from the edge. As with the saddle, the back of the nut should be sloped down towards the headstock (**photo 75**).

Finishing

There are many ways to finish a guitar, from French polish to oil, from urea formaldehyde resin to nitrocellulose lacquer. Over the years

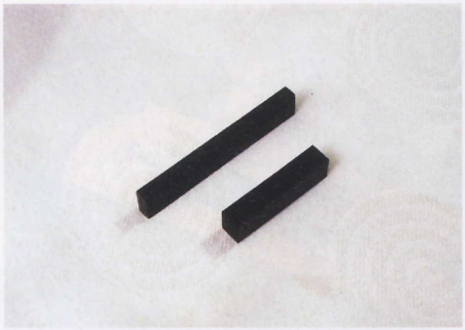


71 The bridge pins in place



72 Fretting out the 'mustachios'

73 The mustachios and strap button in place



74 The ebony nut and saddle before finishing

75 The nut in place ready to accept the string grooves

76 General Finishes acrylic resin

77 A simple support to hold the guitar steady during finishing

78 The guitar in its custom-built case

I have come to appreciate the water-based, low VOC and therefore environmentally friendly acrylic resins produced by General Finishes in the USA (**photo 76**). As the finish is water-based it can be imported without restrictions and happily does a very good job. While applying the finish it is helpful to support the instrument for at least part of the operation, particularly as the weight alone can make your arm ache (**photo 77**). No more than three or four coats are required, rubbed down with 400 grit abrasive between applications and then buffed with polishing compound. Both gloss and satin are available from Stewart-MacDonald, and also from various suppliers in the UK.

Stringing up & tuning

Good quality strings are vital for any classical guitar, and although original Staufers may well have been strung with gut, modern strings are far superior. If the maker wants to stay with tradition, then gut strings are still available from, for example, the Early Music Shop in Saltaire or London. Some makers use 'nylgut' strings, which are halfway between nylon and gut. For me, however, the best are D'Addario EJ45 nylon ones in normal tension.

The strings must have a 'stop knot' at one end to pass through the hole in the bridge and be held in place by the bridge pin. At the other end they are simply threaded through the hole in each roller and brought up to tension with the usual 'EADgbe' regimen.

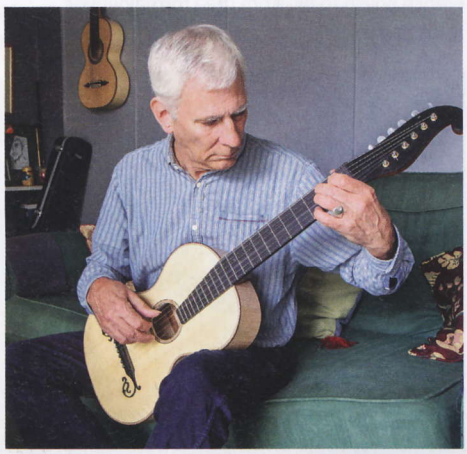
A suitable case

The final task is to make a case, although cases for smaller guitars are available from good music shops. The case is really just a box lined with foam rubber covered in crushed velvet. A neck support should be put in place and a method of keeping the instrument firmly located is necessary. Hook-and-loop strips hold the neck nicely (**photo 78**). It is a good idea to fit 90° hinges to the lid as guitars are often damaged by lids falling on them while they are taken out of, or put into, the case.

SUPPLIERS

- **Alpenholz Pahler** – fine quality maple and spruce in keeping with the Staufer tradition – **www.alpentonholz.de**
- **Stewart-MacDonald** – timber, tools and accessories (including drawings). USA based, therefore 20% tax needs to be added to most purchases – **www.stewmac.com**
  David Dyke – timber, tools and accessories. UK based – **www.luthierssupplies.co.uk**
- **Tonetech** – as with David Dyke – **www.tonetechluthiersupplies.co.uk**
- **Touchstone Tonewoods** – as with Tonetech and David Dyke – **www.touchstonetonewoods.co.uk**
- **Tonewoods4luthiers** – timbers, particularly exotic - **www.guitartonewoods4luthiers.co.uk**
- **Graph Tech** – 'presentation' grade bridge pins – **www.graphtech.com**
- **Strings Direct** – strings for all types of guitar – **www.stringsdirect.co.uk**
- **Rubner Tuners** – via 'Rosette Guitar Products'. USA based – **www.rubnertuners.com**
- **The Early Music Shop** – a source of authentic strings for 19th century guitars – **www.earlymusicshop.com**

The body depth, bracing, quality of the Alpine spruce and the excellent strings will bring the Staufer to life and be able to hold a concert audience spellbound, creating an instrument that is ideal for the 19th century classical guitar repertoire. Great composers such as Sor, Regondi, Aguado and many more have all written gems for instruments such as the one made here.



79 The Staufer is ideal for the 19th century guitar repertoire