

PREPARATION 9

General introduction 10

Parts of an electric guitar 10

String frequencies 11

Guitar classics 13

Wood 14

Wood for solid-body guitars 14

Sound characteristics 16

Buying wood 16

Drying wood 18

Hardware 20

Tuners 20

Nuts 22

Bolt-on neck hardware 23

Pickguards 23

Fretwire 23

Bridges 24

Tremolos 25

Other hardware parts needed 27

Strings 28

Guitar electronics 29

Pickups 29

Making your own pickups 38

Magnets 38

Pickup bobbins 39

Wire 39

Strat-style singlecoil bobbin flanges 40

Dimensions of a typical Humbucker 40

Pickup covers 41

Winding pickups 42

Potting pickups 45

Passive circuits 46

Classic circuits 56

Active electronics 58

Shielding 64

Designing the Guitar 66

Scale length 66

Fret distances tables 68

Calculating fret distances 70

Laying out the guitar 71

Design options 72

Truss rods 80

Non-adjustable truss rods 80

Adjustable truss rods 81

Some effects on sound 84

Sustain 85

Design examples 86

Making templates 91

Workshop 92

Tools 93

Power tools 94

Plunge router 94

Router bits 96

Planes 98

Scrapers 99

Sawing tools 100

Sanding tools 100

Japanese Tools 101

Sharpening 102

Alternatives for sharpening 103

Safety 104

BUILDING 105

Making the body 106

Making a solid body 106

Preparing the body blank 106

Gluing up the body blank 109

Cutting out the body 111

Smoothing the body side 112

Sanding the body 114

Rounding off the edges 115

Making a hollow body 116

Hollowing out the body 116

Making the top 117

Gluing on the top 118

Binding 118

Making a semi-acoustic body 120

Bending the sides 121

Gluing the sides to the block 123

Making the lining 123

Gluing on the lining 124

Gluing on the top and back 125

Routing the binding rabbet 126

Making f-holes 127

Making the neck pocket 127

Making the neck 128

Preparing the neck blank 128

Options for making an angled-back head 129

Making a glued-on peghead 130

- Making Trussrods 134**
 - Making a one-way twin-rod system 134
 - Making a compression truss rod 136
- Making the trussrod channel 136**
 - Cutting a straight truss rod channel 137
 - Making a curved truss rod channel 138
- Making the access cavity 139**
- Gluing up a heel 139**
- Fitting the truss rod 140**
 - Fitting a truss rod into a one-piece neck 140
 - Fitting a two-way twin truss rod 141
 - Fitting the truss rod cover strip 142
- Making the peghead 142**
 - Gluing on the peghead veneer 142
 - Sawing out the peghead shape 143
 - Fitting a peghead inlay 144
- Making the fingerboard 145**
 - Marking the fret positions 145
 - Making the fret slots 146
- Gluing on the fingerboard 148**
- Routing the neck shape 150**
- Drilling the tuner holes 151**
- Shaping a Fender-style peghead 151**
- Fitting fingerboard dots 153**
 - Fitting side dot markers 154
- Radiusing the fingerboard 155**
- Installing the frets 159**
 - Bending fretwire 159
 - Fretting 160
- Shaping the neck 163**
- Fitting the neck 166**
 - Routing the neck pocket 166
 - Mounting an angled-back neck 168
 - Bolting on the neck 170
 - Positioning the bridge 171
 - Fitting a tremolo 172
 - Making the body cavities 175
 - Routing the pickup cavities 175
 - Routing the control cavity 177
- Assembling the guitar 178**
 - Mounting the hardware 178
 - Wiring the electronics 181
 - Shielding the electronics 183
- Preparing for finishing 184**
 - Repairing dents 185
 - Finish-sanding 185
 - Staining 186
 - Filling the grain 187
- Finishing 188**
 - Applying oil 188
 - Applying wax 189
 - Shellac 190
 - Synthetic finishing materials 191
 - Coloring clear finishes 191
 - Using a brush 192
 - Varnish 194
 - Wiped-on varnish 194
 - My favorite finishing choice 194
 - Spray finishing 195
 - Using spray cans 195
 - Using a spray gun 197
 - Sanding the finish 198
 - Several weeks later 199
 - Polishing the finish 200
- Fret dressing 202**
- Set-up 206**
 - Stringing the guitar 206
 - Tuning 207
 - Adjusting the neck relief 208
 - Setting the string height at the nut 209
 - Setting the action 210
 - Adjusting the pickup height 211
 - Setting the intonation 212
 - Your self-made guitar 213
- Straight-through neck 214**
 - Making a neck-through headless bass 215
- A VISIT TO ... 219**
 - Steve Jarman guitars 220
 - Sadowsky guitars 224
 - PRS guitars 226
- Literature 231**
- Suppliers 233**
 - Suppliers mentioned in the book 233
- Additional instruction materials 234**
- Acknowledgements 235**

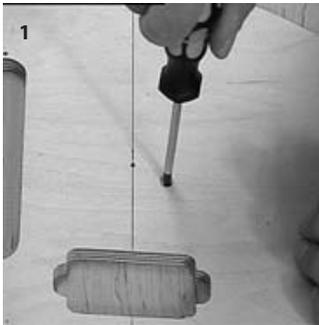
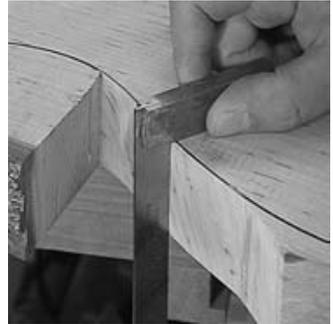
Cutting out the body with a jigsaw

When I started building guitars, I used a jigsaw instead of a bandsaw. If your jigsaw has an orbital blade action mode you had better switch it off. You will also have to put a longer sawblade into the tool.

In order to follow tight curves with a jigsaw it is important that you make several relief cuts towards the body shape line (see page 98). These cuts, which are needed to allow changing the direction of sawing should be stopped a jigsawblade-thickness before the body line. Cut v-e-e-r-y slowly and calmly along the outside of the drawn line, making sure that the line remains visible at all times. Never force the sawblade into a curve as this can easily lead to a strong lateral deformation of the shape of the blade and can result in an oblique cut as the blade is no longer cutting perpendicular to the

body surface. You should therefore check the right-angle between the body surface and the body side at regular intervals. Bear in mind that sawing 45mm ($1\frac{3}{4}$ "-thick hardwood is a great strain on a jigsaw and that no high sawing speed should therefore be expected. The body shown is made of alder, which is relatively soft and was easy to cut with the jigsaw. It is also better to move or turn the workpiece than to turn the saw. Patience and caution will pay off and reduce the time needed for cleaning up the body edges later.

It is also possible to use a more expensive, high-quality jigsaw with an attachment for additionally guiding the sawblade on the base to make it more stable. Workmen often have to cut holes into 40mm ($1\frac{5}{8}$ "-thick hardwood boards, for instance when working in a kitchen.



Smoothing the body side

Routing the body shape is common practice in guitarbuilding. Often overarm pin routers are used for this purpose in place of table-mounted routers or shapers. Mount the body on a board and fix the body template on its underside. A guide pin protruding over the table serves to guide the template. The pin is of exactly the same diameter as the router bit and exactly under it.

I use a table-mounted router and a 50mm (2")-long flush-trimming bit with end-mounted ball bearing for routing the body shape (3). Such router bits come only with 12mm or $1\frac{1}{2}$ " shank and a larger, more expensive router is therefore needed.

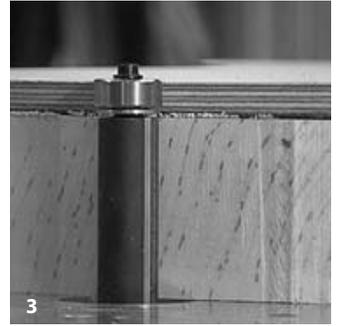
Fasten the body template so that the holes of the mounting screws can later be hidden under the bridge (1) or are removed by routing the pickup cavity or neck pocket. Two screws will do the job perfectly well, unless you use a split template, in which case four screws will be required.

It is important that you remove any wood that protrudes more than 2mm ($\frac{3}{32}$ " over the template. Do so with a rasp and very carefully, especially at the tips of the body horns (2); the router bit can tear out big chunks of wood if there is too much material. Work the body horn tips almost flush with the template.

Set the bit so that the cutting edge is high enough for cutting the whole height of the body while still allowing the ball bearing to be guided safely along the template edge (3).

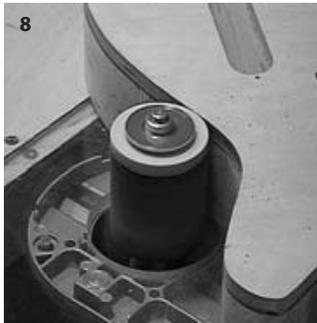
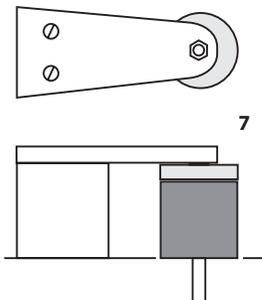
This is quite dangerous work: the router bit can easily get caught in the wood and pull the fingers dangerously close towards it. For this reason I urgently recommend the use of a protective shield. Such a protection consisting of a threaded rod (fastened at the table with two nuts) and a small clear plastic plate that can be adjusted for height and fastened with two further nuts will do the job (4).

Not more than 2mm ($3/32''$) of wood should need to be routed off as otherwise the risk of tearing out chunks of wood would be too great. This danger exists in particular when routing against the wood fibers, which is unfortunately inevitable as the the body is of a curved shape and you will have to rout with the wood grain in some places and against the grain in others. The routing direction has to remain the same all the time: always move the wood counterclockwise. Getting rough spots and having small chunks torn out is therefore almost inevitable. Most body side areas, however, will be extremely smooth and not require much further attention. Because of its vibration-free shearing action a spiral-fluted router bit would be ideal. Instead of the ball bearing you could use an index pin above the router bit.



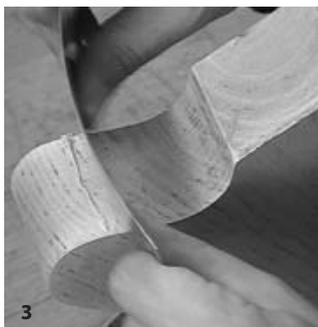
Spindle-sanding of the body side

The best tool for smoothing the sides would be an oscillating spindle sander as it has an additional up/down movement; build your own "poor man's" spindle sander (6) with a vertically-mounted electric drill, a sanding drum and a board (5). Areas that are more difficult to get to, such as the cutaways, can be sanded using small-diameter sanding drums.



Wheel-guided sanding drums

Sanding drums with end-mounted guide wheel are very useful as you can leave the routing template on the body. Such guided drums can be home-made (7) or are available from Woodcraft (RoboSander) (8). Because I found the diameter of the RoboSander-wheel too large, I replaced it with a slightly smaller wooden wheel. You can also use sanding drums in a drill press.



Sanding the body

Fine-sanding and smoothing of the surfaces is very time-consuming. A random-orbit sander can be an invaluable tool for this. Mount a hard sanding pad for flat (1) and a soft one for domed or curved surfaces (2). For difficult-to-get-at areas such as the cutaways a scraper is extremely useful (3,4). Start with 80-grit sanding discs and then move on to 120. Final sanding should be done by hand with 180-grit paper and only in the direction of the grain.

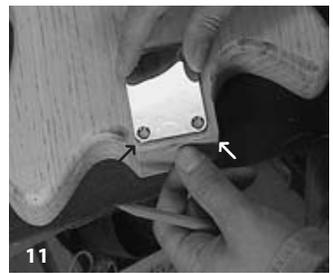
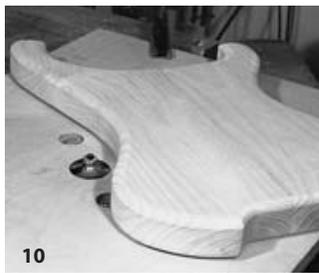
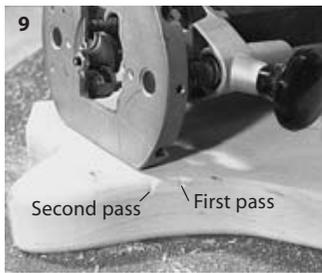
Sanding can of course also be done entirely by hand, without power tools, but this demands a good deal of patience. Use either 80- or 100-grit sandpaper for sanding the body (5) - which one to choose depends on the initial smoothness. If you start with 80-grit paper, sand at an angle across the whole surface. Then switch to 100-grit paper and sand in the opposite direction. This way it is easy to see when the traces of the rougher paper have been removed. Finish off with 120-grit sandpaper, sanding in the direction of the grain (6) and removing any traces of the rougher paper used before. For hand-sanding convex parts wrap sandpaper around a short bar. As a lot of work still needs to be done on the body, there is little point in using finer sandpaper than 150- or 180-grit at this stage.



Domed-body top

To make a domed surface you can use a special violin-makers' plane with convex sole (8) or a rasp (7). Finish with sandpaper of successively finer grits.

When you sand properly you will inevitably be exposed to wood dust for quite a long time. Use a dust bag or vacuum hose with power tools and a protective mask when sanding by hand.



Rounding off the edges

Rounding off the edges is best done with a rounding-over bit with end-mounted ball bearing. These come in different radii. The edge radius of a standard-size body which will be fitted with a standard pickguard is to be fitted must not be too large and must not on account exceed 6mm ($1/4$ ") as otherwise the rounded edge will extend under the pickguard and the edge of the rounded edge of the pickguard will not lie flat on the body. If no pickguard is fitted, any radius is possible. There are even router bits which are elliptically rounded (twice as wide as high, for instance).

Setting the right cutting depth on the router to get an evenly-rounded edge is not easy. I do it by sighting along the baseplate of the router - the curve of the bit should flow nicely and evenly into the router base. Then I set the depth stop and check the result on a piece of well-fastened scrap wood; if necessary, adjust it differently until you get just the right curve.

I always round off such edges in two passes: on the first one I do not lower the router bit fully, and on the second pass I rout off what is left after the first. This gives a clean curve and the bit isn't overstrained and doesn't leave burns on hardwood surfaces. Picture 9 shows both stages of routing in a small area. Two passes are also advisable when using a table-mounted router (10).

If the neck is bolted on with an attachment plate or attachment ferrules, the edge radius has to end before the neck attachment area (on the back of the body). The area under the neck pocket on the back of the body has to remain flat as otherwise the radiused edge would extend under the plate or ferrules (11). To make sure I stop and start in the right places I mark these points on the back of the body (12). The remaining edge sections are rounded off by hand, the edge radius turning into a sharp edge at the points marked with arrows in picture 11.

Making the body more comfortable. The areas on which the hand rests are contoured with a small plane (13), and the back of the body is rounded with a spokeshave, rasp, scraper and sandpaper (14). When after careful inspection from different angles and against the light no more scratches or uneven areas are found on the body, the neck can be mounted.

