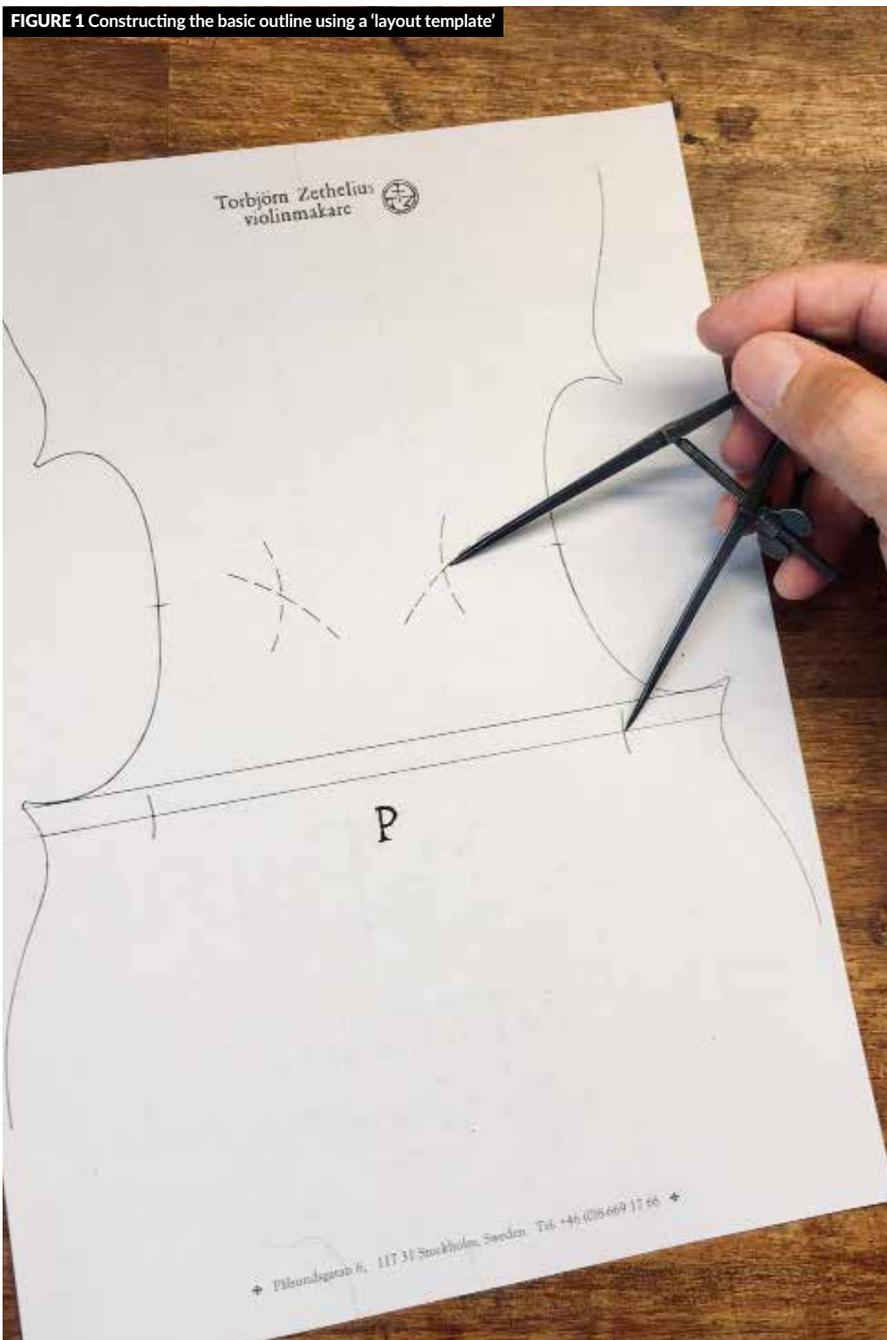


All laid out in black and white

Stradivari's method for laying out f-holes has long been a mystery. **Torbjörn Zethelius** reveals the method he believes the Cremonese master may have used, and how it can still be useful today

FIGURE 1 Constructing the basic outline using a 'layout template'



Antonio Stradivari's busy workshop produced instruments that were fairly consistent, yet there was no exact replication between instruments, as became the norm during the Industrial Revolution a few decades after Stradivari's death. The workshop contained at least two of his sons, and possibly assistants who either helped him or were making instruments entirely on their own under the guidance of the master. Stradivari's method for laying out f-holes allowed the worker to minimise the errors that numbers and calculations inevitably produce. Thanks to the well-preserved state of many Strads, as well as the tools and templates in the Museo del Violino, we can deduce this method with great certainty.

Stradivari began by transferring the measurements from a pre-made template (here referred to as the 'layout template') on to the top plate (**figure 1**), and see Trade Secrets, April 2016). He then scribed lines on the inside of the front plate, drilled the upper and lower eyes, and then sketched the stems according to two paper models. These scribe marks and pencil lines are still visible inside some of his instruments. The following is my interpretation of how he worked out the arrangement of the f-holes.

The first task is to transfer the markings from the layout template on to the internal arch. To do this, I trace the outline of the rib garland on to the plate. This outline is the base for transferring the scribe lines to the internal arch.

Using a straightedge and a sharp object (such as the tip of a knife) I scribe a line tangent to the bottom part of the

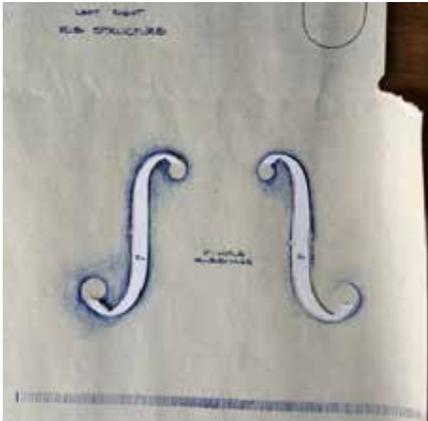


FIGURE 2 Two f-hole templates are made from paper



FIGURE 3a

FIGURE 3 Above Fixing the f-hole templates in place with pins gives a visual idea of the final result
Below Stradivari may have deliberately expanded the distance between the lower eyes to make the bridge area wider



FIGURE 3b



FIGURE 3c

DID STRADIVARI
SOMETIMES MAKE
THE F-HOLES
MORE SLANTED
FOR AESTHETIC OR
ACOUSTIC PURPOSES?

C-bout outline. This line runs across the lower flat part of the C-bouts. A second parallel line is then transcribed on to the plate from the layout template. The centres of the lower eyes will lie on this line. I only scribe this line on the flat part of the plate; there's no need to mark it as the arch drops away from the flat surface.

On the second line, using the layout template, I transfer the distance from the rib to the centre of the lower eye. The lower eye's position is established temporarily; it may be adjusted further, as I will show.

Using a compass I then scribe the arcs

for the placement of the upper eyes following my layout template. I start by establishing the distance from the lower eye to the point on the C-bout rib. From there I can draw arcs from the C-bout edge as well as the lower eye's position, establishing the centre of the upper eye. When all the lines have been transferred from the layout template to the inside of the belly, I prod the points for the upper eyes with an awl. I then drill the upper eyes.

For the stems, I create a pair of paper templates (figure 2). The templates are narrower than the actual f-hole stems, but get thicker towards the tip of the

upper and lower wings to prevent them from separating in two. I then fasten them with needles to keep them in place, and to get a visual idea of the final result (figure 3).

Stradivari, as I understand it, sometimes diverted from the layout template by extending the distance between the lower eyes, thereby making the f-holes more slanted. This is still a bit of a mystery. Was it for an aesthetic idea or did he deliberately extend the bridge area for an enhanced acoustic effect?

By arranging the paper f-stem templates around the upper eyes, on the inside as well as the outside, >

FIGURE 4 My adjustable f-hole drill

I can check and decide to follow the original layout, or if I should divert from it by extending the distance between the lower eyes. Once I'm fully satisfied, I drill the lower eyes.

Stradivari didn't bother to remove the residual pencil lines, which can still be seen in well-preserved Strads. Incidentally, for this particular belly we chose as a model the f-holes from a technical drawing by Kate MacLeod of the 1704 'Betts'. I was part of the team that helped Kate in making the drawing in the Library of Congress, Washington DC.

As stated by Sacconi, Stradivari drilled the holes for the upper and lower eyes. It is uncertain what kind of tool he used for this. My drill is capable of making holes that covers both violin and viola sizes (**figure 4**). It has a span from c.5.5mm up to 15mm or more. I begin by drilling the upper eyes following the tracings from the layout template on the inside of the belly.

For the diameter of the eyes I prefer to use ratios rather than copying a pre-existing instrument. A possible ratio for Stradivari's upper and lower eyes is 2:3, which for a violin could convert to 6.33mm and 9.5mm. These

STRADIVARI TENDED TO CUT THE STEMS AT AN ANGLE, GIVING THE F-HOLES A THREE-DIMENSIONAL EFFECT

measurements correspond well with some existing Stradivari violins.

When it comes to cutting the stems, Stradivari tended to cut them, and the upper eyes, at an angle following the curve of the arch. This gives the f-holes a three-dimensional effect (**figure 5**). The lower eyes lie quite flat, so can be drilled vertically. Placing the compass at the tip of the wings, I trace two arcs of equal radius to establish the notches. The inner notch on the treble side gives the mensur. It may vary up to 3mm, owing to the nature of the handiwork despite working on the same model.

Once the f-holes have been cut, there remains a few finishing touches to be completed on the outside, such as creating the fluting in the lower wing with a gouge and scraper, as described by Sacconi. The belly shown here (**figure 6**) was made by my student Gunnar Iggendal, under my supervision. ●

FIGURE 5 Cutting the stems at an angle gives a 3D effect**FIGURE 6** The finished f-holes seen from the inside