# Vacuum patched

In search of an exact fit between an instrument and its restoration patch, **Andrew Carruthers** successfully adapted the woodworking technique of vacuum bagging. He demonstrates the method on a 1743 Tecchler cello

Most advances in instrument restoration over the past hundred years have been philosophical rather than technical, and there are few things that restorers do now that could not have been done in the Hill's restoration shop early this century. Then, as now, good restoration depended on a good eye, an engaged mind and a steady hand. What has changed since those days has not been how we do things but rather what we allow ourselves to do.

With increasing value placed on the originality of instruments, conservation and preservation are the restorer's guiding principles and some early restoration practices are now regarded as heavy-handed. There have been technical innovations, however, and although some, like the Hacklinger thickness gauge, allow us to do things that were previously impossible, most, such as plastic films and wraps, are simply conveniences. My own innovation was to adapt vacuum bagging techniques to overcome one technical problem in the process of fitting reinforcing patches to violin tops and backs. Patching is a widely used technique in which a wood reinforcement is closely fitted to a damaged area of the instrument to secure a repair or to stiffen a part of the instrument which is too thin to function properly.

Vacuums have been used by woodworkers for years in various clamping, holding and gluing operations, and they have been found to be particularly useful in veneering work. The job and veneer are assembled, glued and sealed inside a thick plastic bag. When the bag is evacuated by a vacuum pump, the parts are drawn tightly together and held until the glue sets. By using the vacuum bag, instead of the traditional mechanical veneer press, you are less likely to get air pockets beneath the veneer. This is due to the even pressure the vacuum exerts on the work. Another advantage is that curved surfaces can more easily be veneered.

The traditional procedure for applying a patch to strengthen a thin violin top plate, for example, would involve making a plaster mould of the outside of the plate. The plate would then

Photo Deborah Rieders. Cello courtesy of Machold Rare Violins, New York

**Back in shape: the restored 1743 David Tecchler cello**

be held firmly in the mould while a block of wood, the patch, is carefully shaped to fit exactly to the contours of the inside of the plate. This exact fit is achieved through 'chalk fitting', a process whereby chalk is applied to the inside of the plate and the patch is offered up to the chalked area and then examined to see where it has picked up chalk. Any chalk on the patch shows the contact points. These points are carefully cut off and when the patch is offered up to the plate again it will fit a little closer. Many repetitions of this cycle will eventually lead to total contact between the two surfaces and then the patch can be glued into place. Once the glue has dried the new patch is completed by trimming it down to the finished dimensions.

In the later stages of chalk fitting, the new patch is clamped into place and the plaster mould serves as a solid base to hold the plate and to prevent the patch from bending the plate out of shape. This is the point at which problems arise. It is rare for the plate to lie perfectly flat in the mould; often the mould has been reshaped to reform a distorted arching. As the patch is clamped into the plate, the plate bends until it reaches the mould. The chalk reading on the patch becomes difficult to interpret since chalk could be transferred from plate to patch whether the plate is snug in the mould or not. A further problem caused by this 'springing' of the plate in the mould is that cracks which have been repaired often reopen. Attempts to hold the plate firmly down in the mould have mostly been inadequate or elaborate and risky, so patch fitting has had to rely on the judgment of the restorer to compensate for the spring as best they could.

To solve this problem I have been using a vacuum bag to suck the plate down into the mould and hold it there through the patch fitting operation. This method is simple, quick and very effective. Though I was mostly interested in overcoming the 'spring' problem, I have found that vacuum bagging has other useful applications. I used a vacuum bag during the restoration of a 1743 Tecchler cello, in a process shown here.

In this instrument the back was too thin to function tonally and the arching had deformed, sinking along the centre joint. Although a large reinforcing patch had previously been fitted to the back it had started to fail and needed replacing.

The old patch, which was poorly fitted to the back and was making little contact, was removed down to the original wood of the instrument (figure 1). The patch made no contact in the soundpost area. This would severely inhibit sound-wave transmission from the soundpost to the back and would impair the playing qualities of the instrument.

Having removed the large back patch, a plaster cast of the outside of the back was made. The back was propped up to correct the sunken arch and was temporarily glued to a flat backing board. Next, a latex sheet was stretched over the back to protect it from the plaster, retaining walls were placed around the back and plaster was poured in. When the plaster set, the new mould was removed and allowed to dry. Before starting to fit the new back patch, the old back cracks were opened, cleaned and reglued. Then, during the rough fitting stage, the back was clamped into the mould with a series of clamps around the edge of the patch area (figure 2). This is the traditional way to stop the back springing in the mould, and although this had some effect around the edge of the patch area it was still quite springy in the centre. ☛

**Figure 1. The old patch is removed, revealing how poorly it fitted to the back**

**Figure 2. The back and mould set up in the traditional manner for patch fitting. A series of clamps around the edge of the patch area tries to prevent the back from springing up from the mould. This is quite ineffective at holding the back down in the centre of the patch area and only the rough preliminary fitting was done like this**

All workshop photos Andrew Carruthers

**Figure 3.** *(left)* **The vacuum bag set-up, essentially a plastic bag connected to a vacuum pump**

**Figure 4.** *(below)* **A hole slightly larger than the patch is cut into the bag to allow access to the work area. The edges of the hole will be taped down to the cello back before the vacuum pump is turned on**

When the patch had been roughly carved to shape, the back and mould were removed to a vacuum bag. Figure 3 shows the equipment used: a bag is made up of a heavy clear polythene sheet sealed with duct tape. A length of plastic tubing is sealed into one corner of the bag, and the tubing is connected to a small vacuum pump. As there can be small leaks in the bag, causing a lower vacuum, an in-line vacuum gauge is used to monitor how airtight the system is; the strength of vacuum can be regulated with an in-line bleed valve. Although there is a vacuum bagging industry in many countries, supplying more sophisticated materials, the hardware store items that I used are generally available, inexpensive and quite adequate.

Next, the mould and back were sealed into the bag, the patch area was traced onto the bag, and a patch-shaped hole

**If the patch area of the back is not thoroughly glued before the vacuum system is set up, the air is pulled straight through the wood and no vacuum is achieved.**

cut out (figure 4). The edges of the hole were taped down to the plate around the patch area, thereby resealing the vacuum system. After ensuring that the back was seated correctly in the mould, the pump was turned on and the system evacuated. The plate sucked firmly down into the mould and was held there ready for the final patch fitting (figure 5). The vacuum was adjusted to provide only a little more pressure than was needed to hold the plate down. It is necessary to glue-size the patch area of the back thoroughly before setting up the vacuum system otherwise air is pulled straight through the wood and no vacuum is achieved.

With the back now held firmly in place, chalk fitting proceeded with its seemingly endless cycle of chalking the patch area, clamping the patch into it, removing the patch and cutting off the chalked points of contact (figure 6). As the patch gradually fits more closely, the chalk is cut from the patch with smaller and smaller cuts until a smooth, evenly chalked surface is left. Finally, the patch is ready to glue.

After gluing and allowing time for the glue to set and the patch to dry, the back was removed from the vacuum bag and the corrected arching examined (figures 7a & 7b). Once the new patch was trimmed down to size (figure 8) and retouched to blend in with the older wood of the back, the patching process was complete.

**Figure 5.** *(left)* **The vacuum bag in use during chalk fitting. The vacuum holds the back firmly into the mould. The large c-clamp presses the patch into the back to take a chalk reading. A chipboard backer has been lightly glued to the patch to prevent the thin edges of the patch from flexing as the patch is clamped in place. The handle in the centre of the patch makes handling the patch easier during the hundreds of chalking and cutting operations**

**Figure 6. The patch surface in the early stages of chalk fitting is dimpled by repeated gouge cuts. The patch picks up chalk on the ridges between cuts. These ridges are cut off and the surface gradually becomes smoother. Reading the chalk on the patch is an art. Because the chalk applied to the back has some thickness it is picked up both where patch-to-back contact is light and where it is firm. It is necessary to distinguish between these and remove only the spots where firm contact has been made**

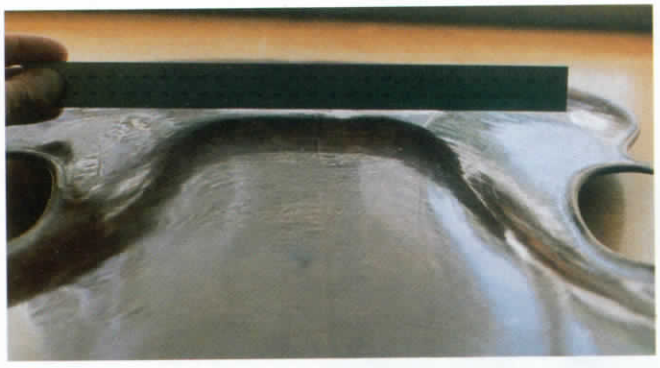

**Figure 7a. The sunken back arching before correction**

**Figure 7b. The back arching after correction.**

**Figure 8. Trimming down the patch**

The vacuum bag offers a simple and effective solution to the perennial problem of spring in patch fitting. It has been suggested, however, that placing wood in a vacuum causes the wood to dry out, possibly even to the extent of causing cracks. So until there is a larger body of experience of using vacuum bags in restoration, I would urge the following cautions:

- Apply only a little more vacuum than is necessary to hold the plate down firmly.
- Only run the vacuum pump while actually working on the job.
- Before finally gluing a patch into place allow the plate to sit with the pump off for a couple of hours so that it can equilibrate to the workshop humidity.
- In sandbagging (described below) only hold the plate in the vacuum until the sand has cooled.
- Be aware that this is a new process and there may be other complications.
- Patch fitting is a potentially destructive technique and should only be attempted by a trained and experienced restorer.

The other restoration jobs for which I believe a vacuum bag may prove useful are 'sandbagging' and 'rib doubling'. Sandbagging is the process by which a plate may be re-shaped to fit a shape-adjusted mould by clamping a bag of warm sand into it. The plate is sucked down into the mould using a vacuum bag. The bag of warm sand can simply be laid on top of the plate as no further clamping is necessary. The advantage of this over the traditional mechanical clamping process is that the clamping pressure is much more even and problems of crushing soft spruce or soft varnish are virtually eliminated.

Rib doubling is the process whereby a second thickness of rib is applied to the inside of a weak original. This is essentially a veneering job, the job for which cabinet makers first developed the vacuum bag. ❑

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