Fundamentals of Bassoon Padding

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Presented at NAPBIRT's Technical Spirit '97, Williamsburg, Virginia

Introduction to Bassoon Padding

Every type of woodwind instrument has unique qualities for padding. To begin with, consider the variety of different pads we contend with, made of leather, skin or cork, in different thickness', some with holes in them and others with hardware attached. Metal bodied instruments, such as flutes and saxophones have raised metal tone hole holes with nice thin level rims. Wood bodied instruments such as clarinets and oboes have conical facings surrounding the tone hole providing nice thin level rims. Despite these diverse qualities, bassoons still remain unique in a way that none of the other woodwinds share.

With the exception of bassoons, all modern woodwinds have tone holes that are perpendicular to the bore axis and emerge through a section of the instrument body that is radially symmetrical around the bore axis. This provides the simplest geometry for making the instrument and subsequently padding the resulting tone holes. Bassoons, on the other hand, are made with asymmetric body parts and with tone holes drilled at an angle to the bore that resulting in tone holes that are geometrically complex. The techniques of padding such tone holes require a different approach than is used on other woodwinds.

Normal padding techniques involve installing a pad in the form of a flat disk so that it is seated on a tone hole rim that is itself within a plane. Padding skills are required to accommodate the inevitable errors that cause both the pad and the tone hole rim to be less than perfectly flat and to match the two planes to each other to achieve a seal. Note the emphasis on flatness. Also keep in mind both the variety of tone hole leveling devices we use to reduce the errors in tone hole rims as well as the constant search for the mythical source of perfect pads.

These techniques are not sufficient for bassoon padding. When a tone hole is drilled at an angle through a facing that may be either conical or oval in section the resulting rim of the tone hole cannot be within a plane. Single facings with two or three holes venting through them bring further complications. Of the twenty-one to twenty-seven tone holes needing pads that occur on various models of bassoons, only the six simple holes of the bass and bell, the three vent holes of the wing joint, and the whisper key vent on the bocal have facings and holes on axis with each other. The remaining eleven to seventeen tone holes are drilled at an angle to their facings. Flat pads simply cannot cover tone hole rims that are not flat!

To properly cover bassoon tone holes it is necessary to use pads that are able to conform to the contours of a bassoon tone hole facing, and it is necessary to install those pads in a way that takes advantage of that ability to conform. To accomplish this it is necessary to alter the construction of normal pads to suit the special needs of bassoon tone holes and it is necessary to make special tools that assist in the alterations and proper installation of those pads.

Evaluating the results

It is appropriate to talk about the results before we begin. It is important to know where you want to go before you can decide how you want to get there. It is also important to be able to evaluate existing conditions before you can properly decide how you want to change them.

There are a number of aspects which need to be examined in determining the effectiveness of pads. This would certainly include the tightness of the seal but must also include other more tactile qualities.

The padding of any woodwind must certainly be tight. However, some instruments are more demanding in this than others. Certainly, oboes are absolute in their utterly non-negotiable demands for perfection. Bassoons, by contrast are more tolerant. A good bassoon will keep working with a surprising amount of leakage. It will work better if it is tight.

I test wings and boots primarily by vacuum but also with pressure. This is all done orally, only rarely using any kind of a leak testing machine. I expect to feel a vacuum "grab" and hold without immediate decay. I do not time the vacuum to demonstrate that the joint will hang on my lip for the next two minutes! A tight joint will grab and hold with a moderate level of vacuum. (Watch out for leaky fingers before you declare a joint leaking.) Pressure is also used, and evaluated by ear, to check for pads that will blow open too easily.

The two bores of the boot joint must be considered as separate joints. With the u-tube off, check vacuum and pressure of each side. Pay particular attention to the B♭ pad. Air must not leak under the B♭ pad from one bore to the other. Under pressure, the sound of air leaking under the pad will be audible in the open bore. When each side is satisfactory, replace the u-tube and check the complete boot joint.

The bass joint (and bell joint) is checked by ear. Close off the small end and hold the bell tenon by your ear. Closing the keys should give a ringing sound in the bore. Any leak or misadjustment will kill the ring.

The quality of the pad seating requires evaluation beyond the consideration of air tightness. Pads must do their job efficiently. This requires that they seal the hole will the least amount of effort from the finger. A well seated pad will give a firm feel to the finger with absolutely no sensation of mushiness. Good padding can be heard in the way the pads close on their holes. This sound will be too hard to hear on a wing joint but a boot joint should do it nicely. The greater the bore volume and the larger the pad, the easier this sound will be to hear.

Types of pad alterations

Standard commercial pads are not made with flexible backings. Usually the backing is in the form of a piece of cardboard that stiffens the pad to achieve flatness. Since bassoons

need a to be flexible it is necessary to change the backing of the pad.

The simplest procedure to make the back flexible is to simply wrinkle it. Bend it, twist it and otherwise mutilate the back to destroy its strength. This is quick, expedient and often adequate.

Taking a knife and slicing through the backing is another quick and simple way to make the pad more flexible. Simply make several cuts across the back of the pad. Avoid cutting into the felt.

Completely backless pads certainly provide the ultimate in flexibility. Pad makers usually don't want to make pads this way. The backing cardboard provides a surface on which to glue the pad together and helps to give the pad shape. A compromise is to use a backing in the form of an open centered ring to help give shape and provide a glue surface while keeping the center of the pad flexible.

Backless and ring backed pads both suffer from another kind of problem. The felt can soak up the pad cement and become hard. This is particularly problemsome with pad cements that can become very fluid.

My favorite type of pad uses a cork back. The cork backing gives excellent flexibility while preventing pad cement from soaking into the felt. These pads seem softer and may, in fact, be quieter in use. In addition, it is possible to build the pad to any necessary thickness by means of using different thickness of cork. No pad maker is manufacturing cork backed pads. You must alter existing pads yourself to get them.

Sizing the Pad

Contrary to popular opinion, bassoon padding can, in fact, be very easy. When a pad is correctly chosen for diameter, thickness and flexibility, its installation is almost an afterthought.

Pad diameter is the most obvious consideration. Certainly you will want to select a pad that fills the pad cup as completely as possible without needing to be forced into the cup. Heckel style cast pad cups are a little more challenging as they don't precisely define the required pad diameter. With Heckel pad cups the diameter of the pad can directly affect the effective pad thickness.

Thickness is the most important consideration. Using the correct pad thickness will result in a pad that is evenly seated on a tone hole with the pad showing a uniform exposure out of the cup. If the pad thickness is incorrect extra effort will be expended trying to skew the pad in the cup to force it to cover the hole.

I always dry fit a pad to a key. With no pad cement in the cup, I place the selected pad in place and check how it seats on the tone hole with a feeler gage. When the pad thickness is correct the dry fitted pad will be very nearly perfect. If the pad is obviously not covering the hole you will need to change the pad to get the correct thickness.

Note whether you will need a thicker or thinner pad. When the pad is taken apart to be remade you will know that the new backing should be thicker or thinner than the old backing.

Pad flexibility affects the effective pad thickness under certain conditions. A tone hole which is relatively small for the diameter of the pad used on it will make the pad effectively thinner than its actual thickness. It does this because the rim of the tone hole is near the center of the arching of the pad when it is installed. A tone hole which seats near the rim of the pad will have little effect on the pad thickness.

Making the Pad

Making a pad from an existing pad is not particularly difficult. The existing pad provides you with most of the materials. You provide those materials that make the new pad what you need.

You will need to have some kind of pad die to assist in assembling the new pad. At best, this would be a die made for the purpose for a specific pad diameter. An alternative might be a draftsman's circle template that provides a number of graduated diameters. Some pad cups may be usable for the purpose but pad cups will generally be too shallow and will always be clumsy for this purpose.

Begin by opening up the back of the pad. Carefully lift up the edges to separate the leather cleanly from the backing cardboard. Stretching the perimeter of the leather will help to remove any remaining cardboard and glue stuck to the leather. Remove the backing cardboard from the felt and save it.

The old backing cardboard will serve as a template to cut out a new backing. Place it against a piece of cork of the desired thickness and cut around it with scissors. Set the new backing aside for the moment.

Making certain that there is no debris under the leather, press the leather and felt together face down into the die. The leather should be reasonably centered around the felt but does not need to be perfect. Spread the extra leather outward from the felt so that glue can be spread onto the inside of the leather.

I use Aleene's Tacky Glue for making pads. This is a widely used craft glue that is readily available wherever craft supplies are sold. I like it because it remains flexible when it dries.

Spread the glue onto the inside surface of the leather that will be folded over onto the back of the pad. Place your new backing onto the felt and begin folding the leather in. Don't try to do it all at once. Continuously go around the pad first raising up the leather all around and then folding it in before finally flattening it down. Use a clean cloth to absorb any extra glue and to press the leather into place.

The pad is ready to stitch and use at once.

Stitching pads

Stitching bassoon pads is needed to control excess leather. As a pad is distorted from flat to concave the diameter of the disk is actually reduced. This reduced diameter generates a surplus of material that can end up in the wrong place. It is undesirable to have any part of the pad intrude into the tone hole itself. Keep in mind that your objective is to cover the hole with a pad; not to plug the hole with a stopper. Stitching the pad center will tie the leather to the felt and preserve the pad shape.

Stitched pads also improve the response of notes. As a pad is opened the note will not respond unless and until the pad fully separates from the tone hole facing. The stitch insures that the pad will move with the key and not leave any part of itself behind to delay response.

Generally, any single hole pads of 16mm or larger are candidates for stitching. It is certainly possible to stitch smaller pads and I regularly stitch certain pads as small as 14mm. Certainly, none of the pads used on the wing joint require stitching.

Stitching the multi-hole pads of the A and B♭ tone holes is open for debate. It is certain that stitching these pads will benefit the performance of the instrument. However, stitching these pads does make seating them more difficult. In addition, while stitches are normally placed in the center of the pads, these two pads must have the stitches displaced off center in order to be inside the largest hole of the facing. Do not allow the stitch to contact the facing—it must be fully within a hole. To locate the positions of the stitches, press the pad onto the facing to impress the tone holes into the leather, mark the leather with two dots indicating where you want the needle holes, and mark the leather to position it in the pad cup.

Stitching is done with a needle and thread. The gage of the needle and the size of the thread is not too important. Use whatever sizes you are comfortable with. The color of the thread is not important either. I prefer to use white thread but colored stitching is not unusual. A pair of very slim extra long nose pliers is needed for tying the knot in the back of the pad. Any alterations to the pad should already be done before stitching.

The stitch should normally be centered in the middle of the pad. To center the stitch the two needle holes need to be very slightly off center. From the back side of the pad push the needle through the pad at a point just off center. On the front side of the pad pull the needle and thread through without pulling the free end of the thread through. Reverse the action so that the needle starts on the front side a couple millimeters away across the center of the pad from the first needle hole. Pull the needle through from the back side so that about an inch of the free end remains on the back side.

The knot is tied on the back side with the aid of the long nose pliers. With the needle end of the thread, wrap a single loop of thread around the jaws of the pliers about an inch or so back from the tip. With the pliers grab the free end of the thread in the back of the pad near the tip of the pliers. Holding the free end of the thread firmly, pull the needle end of the thread so that it comes over the tip of the pliers and becomes the first part of a square knot. Now repeat the same procedure except loop the thread two or three times around the tip of the pliers in the opposite direction so that you get a square knot and not a granny knot and fail your scout merit badge for knots.

When I tighten the second part of the square knot I grip the free end of the thread closer to the pad. This gives me a small loop that looks nice. It doesn't really serve any other purpose and is certainly never going to be seen again after the pad is installed. But it looks nice. The knot doesn't really require it but I do it anyway.

Installing the Pad

If the pad is correct, installing it is easy.

This will be pretty much straightforward and familiar….up to a point. Pad cement is put into the pad cup, and the pad is placed into the cup and leveled in the cup. Before the key is put back onto the instrument, however, press your thumb into the center of the pad to depress the center of the pad into the cup. This is the first step in conforming the pad to the shape of the tone hole facing.

With the key back on the instrument and hot enough for the pad cement to move place a domed pad slick between the pad and facing and press the key down with moderate pressure. The pad cement will move to accommodate the pad adjusts its level to the facing with the help of the domed slick. The amount of time and heat required depend mostly on the type of pad cement used. You might want to repeat this a time or two. I usually continue this until the pad is warm. I take the pad's temperature by removing the domed slick and immediately touching it to my chin.

The domed pad slick is the key to getting the pad coordinated with the facing; be sure to use a domed slick that nearly fills the diameter of the tone hole facing. The objective is to form the pad into a dome that fits the conicity of the tone hole facing. These will not become precisely mating surfaces, but rather surfaces that work well with each other.

Check with a feeler gage to ensure a good seat and make any adjustments that might be needed. While the leather is still warm a few taps with a mallet will put a seat into the leather. Note that the pad as a whole has been coordinated with the tone hole facing; the visible impression in the pad is in the leather, not in the felt.

For everything to work optimally, the facing, the domed pad slick, the pad, and the pad cup need to be in line with each other. There is a central axis that rises straight up from the tone hole facing that goes right through the pad and through the center of the pad cup. If the pad cup is askew these axes are not aligned and the pad will not seat properly. If the pad is too thick or too thin it will keep the axis of the pad cup from aligning properly. When everything is in line the whole system works sweetly.

For the last couple years I have used George Jameson's pad cement. I particularly like the slow movement of this cement. Other cements I have used tend to get too fluid and gushy when they are hot. George's cement stays thick and slow.

Finishing the installed pad

Leather pads are not always airtight. By nature, animal skins are a respiratory organ. The process of tanning skins to for pads intends to make the leather airtight. It's not dependable, however. Pads, themselves, do leak. It is easier to anticipate this than to search later for a ghost leak. In addition, we have poked holes in the pad ourselves in the process of stitching the centers. These holes also need to be sealed.

The preferred method of sealing leather bassoon pads is to seal them with Carnauba Cream. This is a leather treatment marketed by Tandy Leather Company. Tandy is a nationwide chain of stores catering to leather crafts workers. They also do mail order business and have some overseas outlets.

Carnauba cream comes as a white liquid which appears to be an emulsion of carnauba wax in a water base. When applied to the leather the wax provides an air tight seal and increases the moisture resistance of the leather. The cream is applied to all of the exposed leather surface of the pad; don't try to confine the cream to the center of the pad.

I usually apply the carnauba cream with a finger tip leaving a thin sheen of moisture on the pad. At this first stage I can also use a clean cloth with the cream to clean off any dirt or stains that may have gotten on the white leather, but leaving the pad in the end with a thin sheen of moisture. After the pad has dried for about ten minutes a second application of the cream is applied.

After the second coat of carnauba cream has dried two final steps are taken. First, a thin stylus is heated and touched to a cake of paraffin. The melted paraffin is applied with the stylus to the stitches to seal them. When the paraffin has hardened a clean, soft and dry cloth is used to lightly buff the face of the pad to a gloss. The gloss looks nice and I believe it may help the leather to resist dirt and moisture.

Carnauba cream can be applied to the pad at any time. Pads can be pre-treated before they are used, however, I suspect that the heat of seating the pad may degrade the wax's effectiveness. It can also be applied to old pads in an instrument. Not only might it restore a seal in the old pads but it will also aid in cleaning them.

An older method of sealing bassoon pads, which is largely out of use today, is to use paraffin to seal the center of the pad. This is done by heating a screwdriver tip, touching it to a cake of paraffin and "painting" the center of the pad with the paraffin. The paraffin must be kept in the part of the pad inside the tone hole and must not touch the facing. Paraffining the pads is no longer as highly regarded as it once was. The paraffin stiffens the pad, reducing its ability to conform to the tone hole facing. In addition, it tends to shrink as it cools and can distort the pad and actually create leaks!

Using Feeler Gages

The feeler gage is one of the most commonly used tools in woodwind padding. Most technicians, however, are unaware that there is more than one method for using this tool.

The normal use of the feeler gage tests whether or not contact is being made at various points around the perimeter of the tone hole rim. I refer to this as the **"perimeter feel"**. At its simplest level, it only determines that contact is being made at each test point. With experience the technician soon learns to recognize different degrees of contact pressure.

Another technique of using the feeler gage determines relative degrees of contact on opposite sides of the tone hole rim. I refer to this as the **"comparative feel"**. This technique requires a longer strip of material in the feeler gage holder. The strip is positioned completely across the tone hole rim and pulled back under the closed pad until the end of the strip is in the hole. The feel of release as the end of the strip passes over the further rim of the tone hole gives an indication of which side of the pad is more strongly in contact with the tone hole rim. A strong release suggests that the far side of the pad is too heavy. No feel of release suggests that the near side of the pad is too heavy. By reversing the test and checking the same diameter from the opposite side a clear indication of even pad seating can be determined. When the pad is optimally level a small feel of release can often (but not always) be felt from both sides.

The perimeter feel answers the question *"is the pad in contact at this point?"* The comparative feel answers the question *"is the pad evenly contacting both sides of the tone hole rim?"* A pad may contact the rim all of the way around the tone hole but may not be optimal. Such a pad might require more finger or spring pressure to seal and might present a mushy feel to the finger. A pad which is <u>evenly</u> in contact all the way around the tone hole rim presents a firm precise feel to the finger and requires less finger or spring pressure to seal.

Desirable Error

The concept of desirable error is a subtlety of padding that can be easily overdone. In short, it can be preferable for pads to be less than perfectly leveled on a tone hole.

Open standing pads benefit from a slightly toe heavy seating. This gives a firmer feel to the finger when the key is closed. On the other hand, closed standing pads will close quieter if the pad is slightly heel heavy.

In both cases, the amount of error must be kept small. The light side of the pad must still close effectively when the heavy side stops the pad movement. Excessive error is no longer desirable but a mistake that creates a leak.

Pressure shifting

Pressure shifting is a phenomenon that is often observed while seating a pad. When understood, it can be controlled and used as a tool.

The observed result of pressure shifting is that a pad which has been leveled carefully and held closed (by spring pressure, finger pressure, a wedge, or whatever) is later noted to have changed. Where once both heel and toe of the pad were even, now the heel is heavy and the toe is light. This is not a result of any changes in the felt but rather an actual movement of the pad while the pad cement is still plastic.

Basically, when pressure is put on a pad cup there is a physical distance through which the cup moves. This distance is not equal at the closest and furthest points from the hinge axis on the cup. As the cup moves through an arc with the hinge axis as the center the two points describe chord lengths through the arc. The chord length of the furthest point is greater than the chord length of the nearer point. Therefore, when closing pressure is applied to a pad cup the resulting movement is not equal.

On large pad diameters, such as many on the bassoon boot joint, these radial movement differentials can be significant. For instance, the strongly sprung Bb pad key is quite capable of changing the level of its pad until the pad cement cools and hardens. Added finger pressure can move other pads.

Knowing about pressure shifting can change this phenomenon from a mystery to a tool. Where once you may have been confused about pads that moved from where you seated them, you can now set their level slightly toe heavy and press them into position.

Pressure shifting is at its best when the pad thickness is close to correct and a moderate amount of pad cement is behind the pad. If a pad is too thick or thin pressure will tend to move it away from the correction you have been trying to give the pad's level. It also benefits from the standard conical backed pad cup and may not work properly on the flat backed pad cups of recent Heckels.

Tone hole conditions

The best pad work will be useless if the body of the instrument refuses your efforts. The surface of tone hole facings deteriorate over time leaving the surface too rough to seal. Maple bodies dry out and can leak through the wood if it is not maintained.

Always inspect tone hole facings for roughness. The surface of the wood tends to degrade and a pad may not seal against it. Use sandpaper or scrape the facing with a knife to get a smooth surface. Seal the surface with polyurethane. Inspect the tone hole itself for condition; it should be smooth and sealed also.

Maple is very capable of leaking air through the body. If the wood appears dry it should be oiled. If the surface of the bore is rough the instrument will benefit from sanding the bore. I suggest about 150 grit paper on a shaft in a Foredom tool. Don't use too much paper; a looser fit does a better job. Oil the body after sealing the tone holes and sanding the bore.

While you're at it, check the bore for moisture damage. The prime area for this problem is in the unlined boot bore at the u-tube. Check for discoloration of the wood. Poke a sharp pointed knife into the wood to check its hardness. Also check the little finger G♯ tone hole which is the first hole on the unlined side of the boot bore. Mishandling of the instrument often causes moisture to damage this area of the bore, up to and including the G♯ tone hole. The pad on this hole is always the tattletale that will tell you that the player has never been instructed in the proper way to hold a bassoon.

The other pads

Not every key on a bassoon should be padded with a leather pad. In particular, the high A, high C and high D keys should not use leather pads. In addition, most but not all bassoons should not use leather pads for the high G ring key.

Leather pads have a tendency to stick to nickel silver tone hole liners. As a result, it is not unusual to see leather pads on the wing vent keys that are otherwise in good condition but have had their centers torn out leaving felt to close the hole. These keys should be padded with cork.

The high G vent of the boot joint is most often made with a metal liner. These should also be padded with cork rather than leather. Some instruments do not use a liner but rather drill the hole in the wood with a conventional facing. These should be padded with leather pads.

An improvement on cork pads is to use Valentino cork style clarinet pads. These seal better, are more consistent, and most importantly are much quieter.

Making Pad Dies

I make my pad dies from 2 ½" plastic rod stock. I cut 3/8" thick pieces off of the stock with a parting tool in the lathe. Each of these disks will make two diameters of pad dies. I normally make one disk for each full millimeter diameter plus the half millimeter diameter, such as 23mm and 23.5mm.

The dies are turned in the lathe using a boring bar. The disks can be held in a three jaw chuck. If the faces of the raw disks are rough, cut one side flat and reverse it in the chuck before cutting the other side of the die.

Begin by drill a 5/32" hole through the center of the disk. This hole is very important but its diameter is not critical. You may want to vary the size from about 1/8" for small pad sizes to 3/16" for very large sizes. This hole may be needed for poking the finished pad out of the die and can also help in centering the stitching.

Begin cutting the die by facing the disk smooth. Bore the die to the pad diameter, to a depth of .140"-.156". Bassoon pads are typically about .140" thick. I prefer my dies to be slightly deeper than the thickness of the finished pad. Be sure to get a smooth finish on the die. There is a tendency to get glue on the die while making the pads. A smooth finish is much easier to keep clean.

Be sure to label the diameter of the die on the face of the disk. It is an unnecessary nuisance to have to measure a bunch of dies just to find the correct one.

Another way to get a set of pad dies is to use a draftsman's circle template. You will need to glue together three or four identical templates to provide sufficient thickness. If you get templates with an appropriate set of sizes this can be quite satisfactory. Having used both, I find individual dies much better.

Making domed pad slicks

Domed pad slicks are made from Saxophone Pad Ironers. These are catalog number EB1 from Ferree's. They were originally the Erick Brand no. RT202. I never did find them very useful for ironing saxophone pads and they otherwise sat uselessly idle. These are very simple stamped pieces of .012" steel. Their original purpose was probably to get a flat pad surface. My alteration to them achieves a concave pad surface that conforms to the contours of the bassoon pad facing.

Several sizes are required in order to match the diameter of the domed slick to the diameter of the tone hole facing. Since the EB1 set comes in seven sizes you already have a start on the needed sizes. Of course, the sizes that come in the set aren't really the sizes you need, and some of the sizes are hugely too big for anything on a bassoon, so the first step is to grind down a too large pad ironer to the size you need.

Where the handle joins the disk, it is necessary to cut down the width of the handle to a narrower width. The full width of the handle will not fit properly into the facing of the tone hole without damaging the sides of the facing perimeter.

Doming is accomplished by hammering the center of the disk until the dome raises to a satisfactory degree. This takes some time to accomplish. Be patient and watch what you are doing so that the dome is even all the way around the disk. Stay mostly but not exclusively in the center of the disk. Avoid the very edge as this will reduce the effect of the work you are doing in the center. As you hammer be sure to check the diameter of the disk as it may become larger or out of round. Get the dome to rise to roughly 5% of the disk diameter.

The most recent copy of the Ferree's catalog no longer lists the EB1 Pad Ironers. 0.012" steel shim stock can be used to make domed slicks. It is a better quality of steel and comes at a

higher temper. You will need to anneal the steel and work a bit harder with the hammer.