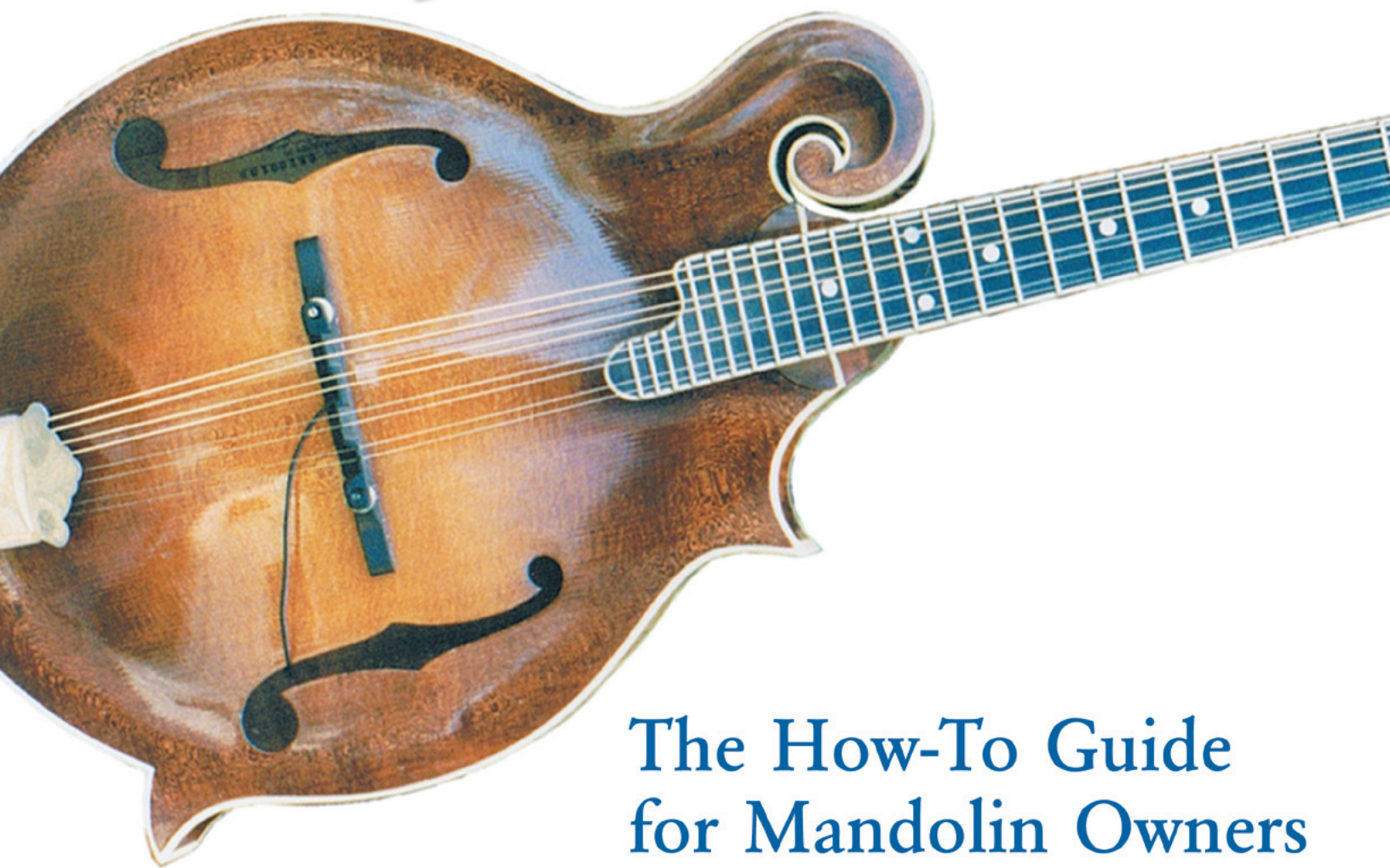


The Mandolin Handbook

An Owner's Manual



The How-To Guide
for Mandolin Owners

Written & Illustrated
by Bradley Laird
with foreword by Bob MacIsaac

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An Owner's Manual



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A Note to the Reader...



Throughout this book you will see two emblems at the start of each "how-to" procedure. The round emblem means that almost any mandolin player should reasonably be able to perform this operation. You should definately learn to do these things. The octagon "stop sign" emblem is a warning to consider having this operation done by an experienced luthier. This doesn't mean that you cannot learn how to do these jobs, but you will need training, experience and specialized tools before you become proficient at them.

FIRST EDITION

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Foreword

I first met Brad in 1983, when he joined the bluegrass band of which I was a member. The ensuing twenty-three years have allowed me to be continually amazed at the depth of his talent and knowledge. An accomplished graphic artist and designer, multi-instrumentalist (mandolin, guitar, banjo, bass, percussion), songwriter, flintknapper, homebrewer and piano technician, he is truly a renaissance man.

He has now added the title of author to that impressive list. This book, the fourth in a series from Brad's MandoUniversity, is chock full of useful information. There is something here for everyone, from the neophyte player to the veteran with 20+ years under his or her belt. Even I, with 25 years as a luthier/repairman behind me, learned a few things.

After reading this book, you will have a much greater understanding of how your mandolin functions and how to keep it safe and secure for years of trouble free playing. The section on tuning is the most comprehensive treatment of this subject that I have seen. It, alone, is worth the price of admission.

So sit back, adjust your reading light, and enter the wonderful world of the mandolin. You won't be disappointed.

Enjoy.

Bob MacIsaac

Bob MacIsaac is a professional luthier with more than twenty-five of experience in repair, restoration and setup of fretted instruments. After beginning his training in the early 1980's at The Apprentice Shop in Springhill, Tennessee, Bob studied the craft under the guidance of master luthier Devon Bogue. Bob now operates his own fretted instrument repair shop and has for many years been an authorized Martin repairperson serving the needs of musicians in the Atlanta area.

Preface to the First Edition

I wish that I found a book like this when I first started playing mandolin back in the 1970's. In those days you had to just ask around or fool around until you figured out something. More recently, after repeatedly answering the same basic questions over and over with my students I decided that I would sit down and compile a basic owner's manual for the mandolin. What I envisioned as a small pamphlet grew into the book you are now holding. My wife Darlene often wondered if I was ever going to come upstairs during my extended writing, illustration, and editing sessions. Her patience and encouragement was vital to the completion of this project. Bob MacIsaac, who I have always trusted with my mandolin when it needs service, helped me a great deal by reading drafts of the book and offering his suggestions and clarifications. Thank you, Wild Bob. Thanks also to Orville Gibson, Lloyd Loar, Guy Hart and the nameless craftsmen who led to the creation of the mandolin as we know it in America. Thank you to Steve Carlson for making Flatiron F-5 Artist #85100109, my loyal, patient and sonorous friend! And of course, thanks to Bill Monroe for showing us the tremendous power and heart-touching soul that could be brought forth from a mandolin. We may have forgotten the mandolin entirely had he not chosen it as his means of instrumental communication. And thank you for buying this book.

B.L.

The Mandolin Handbook

by Bradley Laird

Introduction

By owning and playing a mandolin you develop a close relationship with your instrument. Learning to play the instrument is a challenge that is achieved in small steps over many years of study, practice and experience. Learning how to maintain and care for your mandolin can make the playing experience better for you and for your instrument.

Accomplished piano players rarely, if ever, know how to tune a single string on their own instrument. You could say that the strings of the piano are played by remote control since the player never touches the strings. Yes, the pianist learns the subtle touch of the keys and damper pedals and the sounds that are produced by their manipulation. But what happens inside the piano case remains a mystery to nearly every piano player.

The mandolin player, on the other hand, is in even more intimate contact with his or her instrument. You hold it in your hands, much like a mother holds a child. Fingertips touch the strings to produce sounds. The hand, holding a small pick, delivers the force to the strings without the mechanical advantage or the leverage of keys, hammers and the other workings of a piano action. Short of the tiny pick held between the fingertips, the mandolin player IS the action of a mandolin.

The workings of a piano are so elaborate and complex that one must call upon a seasoned, trained technician for adjustments to tuning and response. Not so with the mandolin player. Every mandolin player in time learns to tune and replace strings. Yes, you may turn to a professional luthier* for refretting, finish work, and repairs to your mandolin, but a great many of the tasks which keep a mandolin performing at its best can easily be understood and learned by the average player.

This book is not designed to turn you into a mandolin repairperson, but it will help you understand how the instrument functions and what you can do yourself to take better care of and enjoy the instrument more. You will also learn about certain intricate tasks that are better left to the most experienced experts. With a better understanding of these topics, you will be in a better position to find qualified experts, judge their work, and have a greater appreciation for the skills they possess.

You will learn how to make adjustments, select accessories, and many other things which will make you more conversant and knowledgeable about mandolins. You will learn how to keep your instrument protected from damage. You will learn ways to bring out the most from your instrument and it is my belief that a deeper understanding and appreciation of the instrument will produce better and more fulfilling music.

**A luthier is a fretted instrument builder or repairman and is based on the word "lute", an early fretted stringed instrument.*

Historical Background of the Mandolin

Determining precisely when and by whom the mandolin was invented is nearly impossible. Logically, it seems to be a descendant of the lute which was played beginning around the 1500's. There are, of course, more ancient stringed instruments that precede the lute.

The lute has many similarities to a mandolin in that they both are wooden bodied instruments, have frets for creating different notes of the musical scale, tuning pegs for adjusting the tension, and thereby pitch, of the strings, and strings arranged in multiples called courses. A course is a group of strings tuned to the same pitch (usually 2 or 3 strings) and played as if it were one string to increase the volume of the instrument. Few modern stringed instruments have courses of strings. The mandolin does with its pairs of strings tuned to the same pitch. The piano does throughout most of its range of notes and the 12-string guitar has them as well. There are other examples found world-wide, but generally most popular stringed instruments today have one string per pitch aside from the ones I mentioned.

In addition to the mentioned lute-like features, the early *Neapolitan* style mandolin possessed a round back much like the shape of a turtle shell or bowl. This construction feature was also present in the lute of antiquity. Mandolins of this old "bowl back" style (and many variations thereof) are still found around the world and were popular in America prior to the 1900's and beyond. The old bowl back mandolins were usually constructed of bent strips of contrasting color wood for the resonating chamber, and became known as "tater bug" mandolins due to their resemblance to the striped shell of that garden insect pest.

Mandolins are often thought to be of Italian origin because there were certain composers in the Classical Period who wrote specifically for the mandolin by name. However, there are mandolin-like instruments found around the globe and it is relatively certain that they all have a common ancestry which is lost in the history of mankind.

Certainly European immigrants to America brought the mandolin with them. Mostly the rounded back, tater bug variety, but some early mandolins were also made with a flat back design more along the lines of the typical 20th century acoustic guitar. Due to the similarity between the mandolin and the violin (they are both tuned the same and roughly the same size) mandolin makers also began to employ carved soundboards (in the Stradivari tradition) in their instruments.

The great revolution in mandolin popularity and construction standardization began with the Gibson mandolin introduced by founder Orville Gibson in 1902. Gibson's mandolin design incorporated an arched, carved soundboard and did away with the bowl shaped back in favor of a flatter design. Gibson mandolins evolved into two basic designs. The first was the pear-shaped "A" style body design. These mandolins of the time had carved tops with an oval soundhole, a similarly carved back with the sides of the sound chamber being made of bent strips of wood perpendicular to the top and back. The necks were similar to the necks on mandolins today except they were a bit shorter in scale length.

As Gibson mandolins evolved their next major design development was the "florentine" or "F" style body. Essentially a fancier version of the pear-shaped "A" style, the "F" had a scroll on the upper side of the body and curves and points on the lower side. In early "F" model Gibsons the sound hole was still in an oval shape.

The pinnacle of mandolin development arrived in 1922 (arguable by few) when Gibson employees Lloyd Loar and Guy Hart created the Master Model line of mandolins and guitars. The new "F-5" mandolin retained the old "F" style body shape, sported a new longer neck, and a raised fingerboard extension which reached out over the body. The oval sound hole was replaced with two "f" holes more like what are found on violins and, internally, the "bracing" was changed to include two "tone bars" glued inside and running lengthwise under each side of the instrument top.

The new F-5 style mandolin was capable of producing sounds never before heard on a mandolin. The clarity and power of the notes it produced set it apart from all mandolins made before. It was expensive in its day and relatively few were produced making them highly sought after by players and collectors today.

The period of roughly 1905 to 1925 saw a tremendous growth in mandolin sales and popularity which can mostly be credited to the marketing skills of the Gibson company and its representatives who travelled the country establishing mandolin ensembles and orchestras and outfitting the groups with Gibson instruments. Gibson even published music written and arranged for such mandolin groups. The Vaudeville stage saw many musicians playing mandolins and in ensembles of various kinds.

As radio and recorded music began to replace live music as a form of entertainment, the mandolin (as well as the banjo—also heavily promoted by Gibson and other companies) began to fade into obscurity in the popular culture of America. As the Great Depression slowed the economy of the country many mandolins were put away under beds or found their way to pawn shop windows.

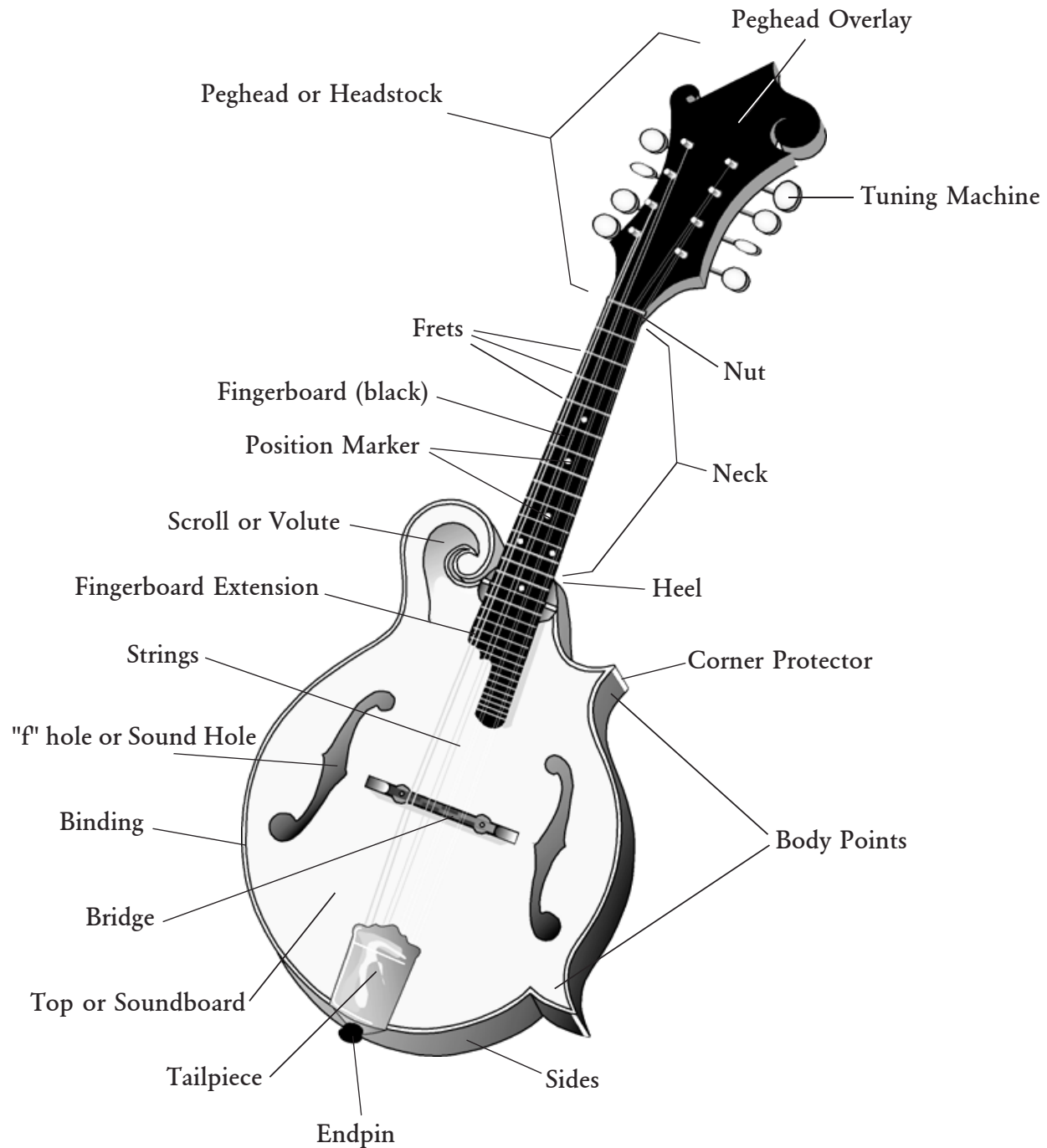
The F-5 mandolin might well have been forgotten had it not been for the musician Bill Monroe who chose this type of mandolin as his own as he developed his "bluegrass" style of American country music in the mid-1940's. He demonstrated new sounds on the mandolin with his fast-paced blues lines and powerful, driving rhythmic "chop" chords. As Monroe's "bluegrass" music gained disciples and imitators, the F-5 mandolin became the standard by which all mandolins are measured. Today, nearly every significant mandolin player in America plays a Gibson F-5 or a high-quality copy of that famous instrument.



Styles of Mandolins: (Left to Right) Bowl-back "tater bug", "A" Style with oval sound hole, "A" Style with "f" holes, F-5 "Loar" style.

Parts of the Mandolin

The illustration below should help you learn the names of the basic parts of a mandolin. The names of other more detailed parts will be covered as the need arises throughout this book.



The Top or Soundboard

The top of a mandolin is usually made of spruce. It could be Sitka, Norway, Engelmann, Adirondack or another species of spruce. Spruce is known for its strength-to-weight ratio and also its sound producing capacity. Nearly all guitars, violins, cellos, and mandolins have tops made of spruce. In finer quality mandolins, the top begins its life as a pair of planks split lengthwise from a large spruce log. The planks are approximately 3/4" thick before they are carved to produce the arched shape of the mandolin top. Usually a single thicker plank is split in two, then glued edge to edge producing the width and grain orientation needed for making a quality top. When a plank is split and glued to itself the boards are called "book-matched" which makes each half of the top appear to be a mirror image of the other.

Here is an end view of a pair of planks glued edge to edge. You can see that the grain lines are oriented perpendicular to the finished curved surface of the top. At first thought you might assume that a glue seam is a sign of a lower quality instrument or that the maker couldn't obtain wood that was wide enough, but this actually assures that the right and left halves of the top have their grain perpendicular to the curvature of the top and you should consider this glue seam to be a sign of quality, not economy in manufacture.



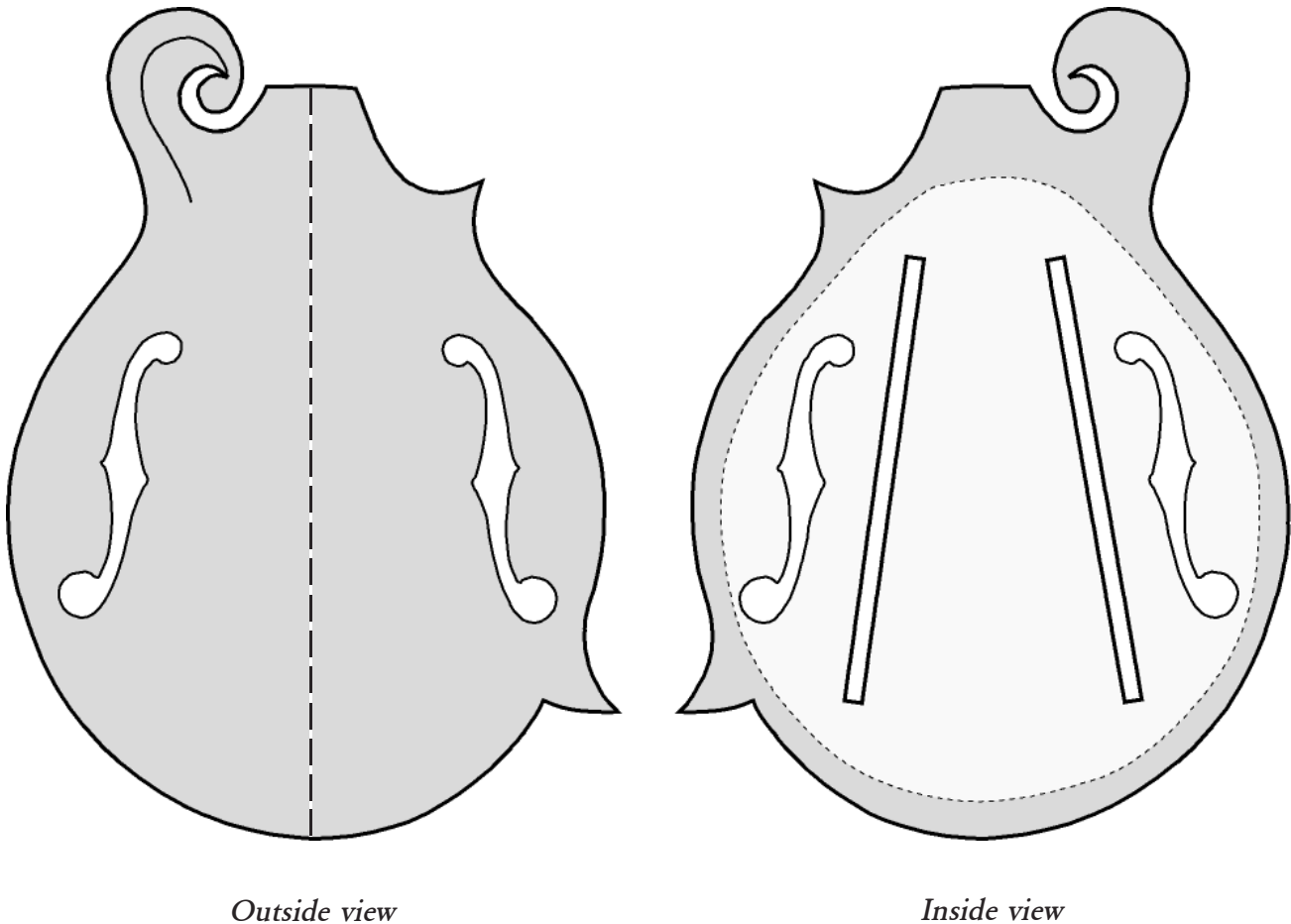
Cross-sectional view of the mandolin soundboard and its parent material showing "Stradivarius arching" and the orientation of the grain perpendicular to the surface. The darker grey area is all removed in the carving process.

This view of the top shows the arched final profile as if one sawed a mandolin across the body at its widest point. If you look closely you will see that the finished profile is not the same thickness throughout. At the edges the top is approximately 3/16" thick. Then the top thins to around an 1/8" and then gradually increases in thickness to about 1/4" at the center of the top. This gradual thinning of the top, from the center to the thin area near the edge is called a "graduated" carved top. Similar to the violin maker's art, this type of carving is called Stradivarius arching.

The gradual thinning of the top assists the transmission of sound vibrations which weaken as they get farther and farther from the bridge. The edge is left slightly thicker to provide more strength for the glue joints around the sides.

The arched shape, as is seen in dome roof construction and bridge design, makes the top very resistant to the downforce from the bridge and strings. If you ever noticed the bottom surface of a beer can or champagne bottle you see the same principle of the arch applied to resist the internal pressure of the carbonated beverage. The curved outer skin of a submarine works the same way to resist the external undersea pressure. Straight, flat sides would be more easily crushed.

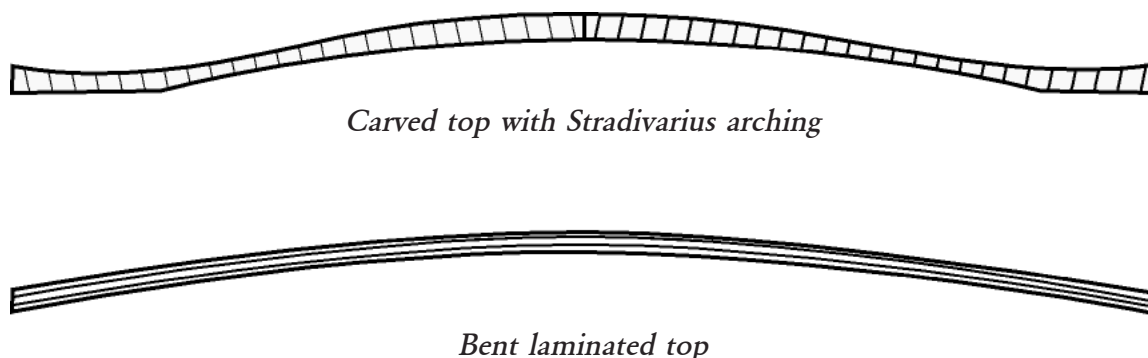
Below is an illustration showing a soundboard for an F-5 style mandolin. A dotted line shows the location of the center glue seam. On the underside of the top you can see a dotted line which shows the approximate area that is carved out in a hollow. The area around the sides is left flat so that the sides and neck can be properly glued in place. The two lengthwise strips are the tone bars.



The tone bars are also made of spruce and taper in thickness toward each end similar to the gradual thinning of the top arching. The tone bars help the entire top function as a single unit by carrying sound vibrations throughout the soundboard. (Note: A few manufacturers use "X bracing" on the underside of the top.) If you ever notice a rattle which you can not trace to its source, along with some distortion of the shape of the top, it is possible that a tone bar has come unglued. While highly unlikely in a quality instrument, I have witnessed this exact failure in two recent imported F-5's made in China. Luckily, the failures happened soon after purchase and in both cases the dealer replaced the instrument. I mention this to remind you that a mandolin is basically a wooden box held together with glue. Glue joints can be damaged or fail for a variety of reasons. You don't have any control over the manufacturing techniques and materials (other than choosing a different maker) but you do have a lot of control over how you care for your instrument. Leave it laying in a hot car or leaned against the couch where it will get kicked over is asking for damage.

Sometimes lower priced mandolins will appear to have a carved spruce top which in reality is made of thin plywood. Honest dealers will refer to this as "laminated spruce construction" or by similar terms. Laminated tops are made of 3 or more thin layers of wood glued together with every other layer's grain oriented at right angles to the layer above. The topmost layer will be a very thin and nice looking piece of spruce and you might be fooled into thinking it is a solid wood top because the upper surface looks so nice.

Here is an illustration showing the difference between a solid carved top and a laminated top. The laminated top will lack the Stradivarius arching and is uniformly the same thickness in all areas of the top. The curvature is obtained by bending the plywood against a mold using steam and pressure.



Laminated plywood mandolins have their pros and cons. A laminated construction instrument is cheaper to produce and if you are a struggling student with a burning desire for a mandolin this might mean the difference between a mandolin or no mandolin. The laminated mandolins are also less likely to crack or be damaged by physical abuse or dropping so they are often a good choice for rowdy children and people who must trust an instrument to an airline baggage handler. On the downside, laminated instruments don't sound as good. I am not saying they sound awful, but any player who has enough experience to choose an instrument based on sound will always choose a solid carved top instrument over a plywood top instrument.

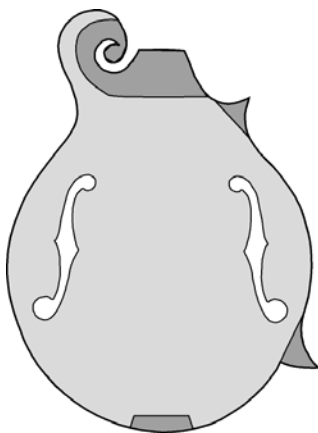
While we are discussing laminated plywood construction, be aware that this sort of construction can also be found in the sides and back of a mandolin as well. Sometimes the entire instrument body is laminated and sometimes the top and/or back is solid and the sides are laminated. There are many possible combinations. The easiest way to tell if an instrument is made of laminated strips of wood is to compare the grain pattern on the outside with the pattern on the inside. If the instrument part in question is made of layers of different wood the two sides will exhibit different grain patterns. Usually the inside of a laminated instrument is made of much lower quality (and often a different species) wood than what is used on the outside. You can get a flashlight and a small mirror and look inside and make the comparison. Another way to detect a laminated top is to examine the edges of the sound holes. If the wood is solid the grain lines should go all the way through the edge. However, some builders do a pretty good job of hiding the visible layers of laminated tops by using paint or binding along the edge to prevent inspection.

Almost all mandolins have binding glued along the outside edge of the top. If this were not present you could easily see if a top was laminated or solid wood presuming the instrument was not finished in some opaque color. But, the edge binding is not there to hide anything. It is there to protect the edge of the soundboard and the glue joint from damage. The rigid binding helps to spread the shock of a blow to the edge so that it will not easily chip, crush, or split the top. It is inevitable that the mandolin will bump into things during its life and the binding is there to avoid major damage. It also has an obvious aesthetic purpose as well.

The Construction of the Body

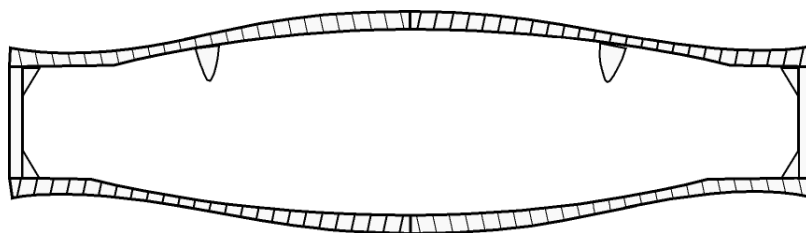
The sides of the mandolin are made from strips of hardwood that are steamed and bent to the shape of the outer profile. An F-5 style mandolin is made of several individual side pieces. One long section runs from the inside of the scroll all the way around to the corner of the first point. Then there is a section alongside the point. Another section reaches from the tip of one point to the tip of the next. And finally there is another piece that joins the point to the neck joint area.

Hardwood blocks are sawed out and are used to reinforce certain key areas of the body and to provide a solid mounting area for the neck and strings. In the drawing below you will see the approximate area where the solid blocks exist inside the mandolin.



Dark areas show location of solid blocks in the body of the mandolin.

After the sides are bent to shape they are glued to the four blocks forming the basic outlines of the instrument. After this, the soundboard is glued to the sides and blocks. All along the joint between the sides and the soundboard and back are triangular strips of wood called "kerfing" that helps provide a good gluing surface between the sides and the top.



Cross-section showing top, back, sides, kerfing strips, and tone bars.

The back is carved from hardwood, usually the same kind of wood as the sides, and is later glued in a similar manner as the soundboard to complete the sound chamber enclosure. Varying amounts of inner air space will alter the resonant frequency of the sound chamber and produce instruments with different sounds.

The air space inside the instrument can be further tuned by the size of the soundholes cut through the top. The soundholes can be either "f" shape holes (as in the F-5) or a centrally located oval sound hole (as in the A style). Sometimes the holes are adjusted in size (enlarged) after the final assembly to finely adjust the resonance of the air chamber.

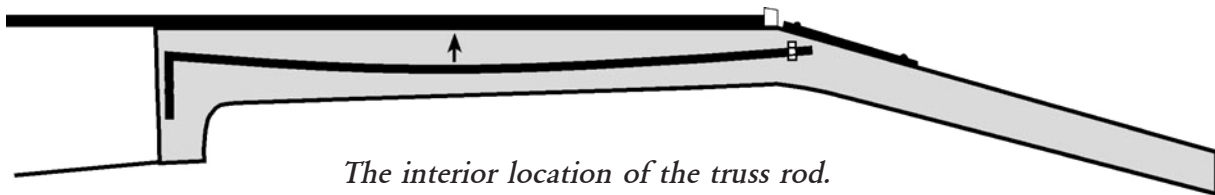
Binding has already been mentioned and it is usually made of celluloid, plastic, or in some cases shell or wood. A small "shelf" is routed around the edges of the instrument where the binding is going to be installed. The binding may be a single layer or multiple layers of contrasting colored material. The binding is bent to shape, glued in place and then scraped flush with the wood surface. As you can imagine, if you examine an F-5 mandolin closely, the exacting work required to neatly install binding is one of the most time-consuming aspects of mandolin construction. For this reason you will see less fancy binding work on lower priced instruments. Some instruments will eliminate it from around the peghead, the sides of the neck, and around the back of the instrument to lower the costs of production. Binding is almost always present around the soundboard edges to protect the relatively soft spruce from impact damage.

The Neck and Attachment to the Body

The neck of the mandolin is constructed separately from the body and is glued in place after careful fitting of the joint where it attaches to the body. The traditional neck joint is a "dovetail" joint which tapers and "locks" the neck to the body. The pitch (angle) of the neck to the body is established at the dovetail joint. In some mandolins the neck may be secured with a straight joint and a bolt which runs through the neck block. Debate over the pros and cons of the two systems rages with purists favoring the dovetail glued joint over the engineered bolt-on neck. A bolt-on neck does have the advantage of a nearly failure-proof solid attachment, but many believe the dovetail design is unsurpassed. Glued on, dovetail joints can and are frequently steamed apart for repair and adjustment of neck angle. Modernized production facilities would most likely cut the joint using computer controlled milling machines in either case to assure a consistent joint from one mandolin to the next. In a hand-cut neck joint the neck and the body are custom fitted to one another and no swapping of parts later in production is possible. Externally, it is impossible to tell the difference between the two neck joint methods.

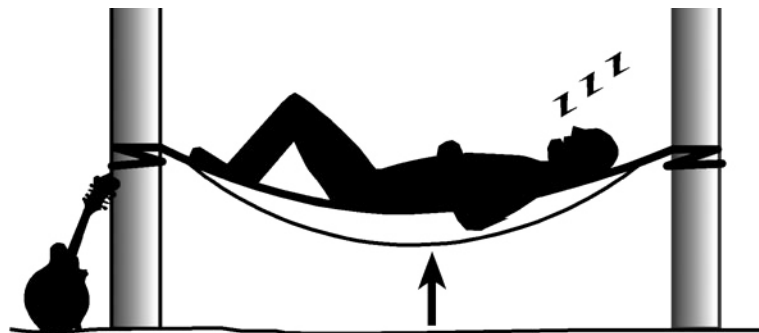
There is considerable variation in how manufacturers construct the neck of a mandolin, but they do all typically follow the same general principles. A block of hardwood, usually mahogany or maple is sawed out to the basic profile of the neck shape. Usually the peghead and neck are of the same piece of wood. A slot is routed in the neck creating a long cavity where a steel reinforcing "truss rod" is installed. Usually the rod is anchored inside the heel of the neck and an adjusting nut is located at the peghead end with a truss rod cover plate screwed to the peghead to provide access to the nut.

The purpose of the truss rod is to stiffen the neck and to counteract the pull of the strings. The tension of the strings tends to pull the neck and fingerboard in an upwards bow and the truss rod, when it is tightened, tends to pull the neck back removing forward bow. Here is a drawing showing the approximate location of a truss rod in a typical mandolin neck installation:



The end of the truss rod is threaded to accept an adjusting nut and when more pressure is applied to the nut the neck can be bent slightly backwards. The truss rod is installed in a curved shape and when the adjusting nut is tightened the rod becomes more straight. As the truss rod straightens, the middle of the rod applies pressure inside its "pocket" against the underside of the fingerboard. This sideways force of the rod (as shown by the arrow) is what bends the neck backwards. The way a truss rod works is similar to the hammock in the following illustration. As the rope is tightened the curved hammock tends to straighten which lifts the sleeping mandolin player by pressing on his lazy backside.

This adjustment is best left to a qualified and experienced mandolin repairperson. It doesn't take much movement of the nut in either direction to affect the curvature of the neck and if you over tighten the rod it is possible to strip the threads or even break the rod. Extensive repair work would then be needed, involving removing the fingerboard, to correct the problem. Another word of caution. If you don't have the correct tool to turn the nut then don't do it! Grabbing the nut with pliers or the wrong type of wrench can make a mess of the nut, which is often made of brass, and then, when you ultimately have to take it in for repairs, you will have to explain what happened to the nut!



I will not go into any more discussion of the truss rod here as I do not consider it an adjustment that one should make without experience or training. One important thing to know about fretted instrument necks in general is that it is normal for them to have a very slight curvature upwards. A neck that is perfectly flat (when under string tension) requires that the strings be raised up too much in order to keep them from buzzing on the frets. The proper curvature (relief) in the fingerboard allows an overall lowering of the action (string height) without buzzes.

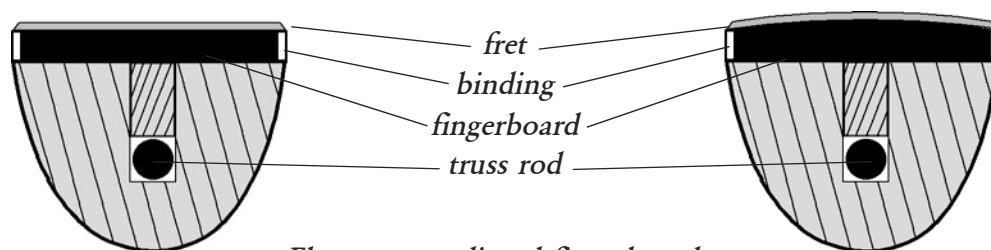
One way to test the mandolin to see how much (if any) neck relief is present is to use the strings as a straight edge. Hold down a string at the first and 15th frets at the same time. I use the little finger of the left hand and the index of the right. With the string in contact with the frets it makes a straight line down the neck. Observe the string near the 7th fret. Is there any clearance? Reach with your left thumb while holding the string as before and see if you can move it down towards fret #7 and by how much. There should be a slight bit of clearance. The amount you are able to move the string represents the amount of "relief" you have in the neck.

Too much relief and the neck is hard to play. Too little and you get fret noise and buzzing. Just like bears and porridge, the amount of relief should be "just right." There are plenty of books, mostly pertaining to guitar set-up, that can educate you more on the subject if you are interested. Just know that proper neck relief is desirable.

Not all mandolins have truss rods. Older mandolins often did not have them but today they are pretty standard on almost all mandolins. Sometimes lower priced models did not have them and the higher priced models did. Obviously, if your mandolin neck does not have a truss rod, the adjustment of neck curvature is more problematic. Most of the time you can determine if a truss rod exists simply by the presence of the truss rod cover plate on the peghead surface. Sometimes there might be no truss rod cover, but the neck might still have some kind of internal strengthening rod or bar inside.

The Fingerboard and Frets

The fingerboard of the mandolin is usually made of rosewood or ebony. Sometimes the fingerboards are dyed black (even if ebony) to make them more even in color. The fingerboard is glued to the upper surface of the neck and this glue joint adds considerably to the overall neck stiffness. Most fingerboards are around 3/16" thick. Traditionally mandolins have flat fingerboard surfaces. Some players prefer slightly curved (side to side) "radiused" fingerboards which are common on guitars.



Flat versus radiused fingerboard

A series of parallel slots are cut into the surface of the fingerboard to accept the frets. Fret wire when viewed in cross section is approximately "T" shaped with a rounded top. If there is no binding along the edges of the fingerboard you can see the slots and the "tang" of the fret (the part below the fingerboard surface) as it goes down into the slot.



Side view of a fret in its slot

A slotted fingerboard blank before it is glued down and fretted is very flexible. When the frets are installed, assuming the fret tang perfectly fits the slot, the neck is then very stiff again. A certain amount of compression is required to hold the frets firmly in place and sometimes glue is used to be certain they stay down where they belong. Tiny little "teeth" are raised on the edge of the fret wire which help it grip the walls of the fret slot and assist in keeping the frets in place. There is considerable debate on the subject of whether glue should be used to install frets. Smart technicians will always assume that frets are glued when they need to be replaced during a "fret job" and they will heat the fret with the tip of a soldering iron to weaken the glue bond. This momentary heating also causes the fingerboard to release oils which lubricate the slot slightly so the fret can be coaxed from the slot without pulling wood chips up in the process.

Frets come in a variety of shapes, sizes and metal alloys and it is beyond the scope of this book to discuss them all. In general, older mandolins were originally fretted with much smaller frets than are in common use today. You should know that fret wire is always made of a material that is slightly softer than the hard steel used for the mandolin strings. This relatively softer material means that the fret is always going to lose the battle and eventually wear away after repeated contact with the strings. This fact means that every fretted instrument eventually needs fret replacement if played enough.

If you notice grooves beginning to appear under the strings you may soon be in need of some fret work. Here are the basic levels of "fret jobs" as I understand them:

1. Fret dressing. This is the least expensive remedy for frets which are beginning to wear yet still have enough material left in them to be reshaped to a proper half-oval top profile. Fret tops are filed to bring them to a uniform height and then they are individually shaped to restore the curved tops.

2. Partial refret. In this more extensive process the most worn frets are removed and replaced and then all the frets are "dressed." The upper frets which are rarely played will usually not be worn very much at all and can remain in place.

3. Full refret. Here the frets are "pulled" and discarded. The fingerboard is trued and dressed and the fret slots are cleaned up. New frets are selected and installed and then filed and dressed. This is the most time consuming and expensive of the three options.

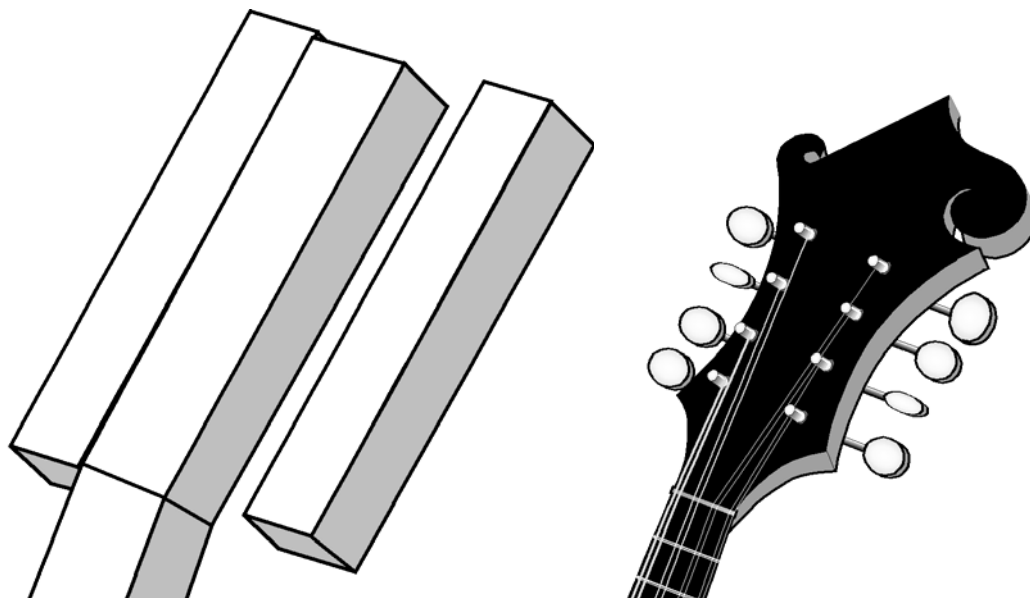
Bear in mind that prices for fret work are higher when you have a radiused or bound fingerboard as the fret job is more complicated. On the subject of repair pricing, remember that you might only have your instrument refretted about every decade or so. If you divide the cost out on a per year basis the cost to have frets in good shape is very small. Frets kept in good shape are easier to play and make better sounding music. Don't neglect them too long. The wear happens incrementally over a long time so you may not notice that the sound and playability is gradually degrading. The next time you change strings take a good look at the condition of your frets.

Before we leave the topic of fingerboards and frets I'd like to make some mention of the inlays that are often found in the fingerboard. Usually made of mother of pearl (the inside surface of a mollusk shell), the inlays have cavities for them cut in the fingerboard and are glued in. With common round "dots" the cavity is created using a round drill. The pearl piece is glued in and sanded flush with the fingerboard surface. More elaborate inlay cavities are created using tiny dental burrs in a router and by hand work with tiny chisels. In the best inlay work you will see very little "filler" around the pearl pieces which means the artist was very good at creating the perfect size cavity for each piece. On the other hand you sometimes see oversized, sloppy looking inlay cavities with lots of filler (epoxy mixed with sawdust) around the edges of the pearl. The creation of elaborate pearl inlay patterns is truly an art form and is very time consuming and highly ornate instruments are priced accordingly.

Many other materials, such as abalone shell, color varieties of shell, precious stones, silver, gold, colored woods, and engraving may be incorporated into the inlay work. If a bit of inlay ever falls out of your instrument try to find the piece and stick it on a piece of masking tape and bag it up so it doesn't get lost. Re-installing inlay parts is easy, but making lost pieces which match is more difficult!

The Peghead

The peghead, as stated earlier, is considered a part of the neck and is usually made of the same piece of wood as the rest of the neck. Sometimes in an effort to conserve wood, the peghead is made sufficiently wide by gluing on "ears" or blocks of wood prior to cutting out the shape of the peghead.



Peghead blank before completion next to a completed mandolin F-5 style peghead.

The above illustration shows the peghead "ears" (one already glued on) in the approximate position as the completed peghead. The presence of glue lines is masked by the addition of an overlay, usually of ebony, on the surface of the peghead. If the back of your peghead has no overlay, or by examining the side, you should be able to detect the joint. This method of building up sufficient width for the peghead should be viewed as intelligent conservation of dwindling materials. I would be more apt to question an instrument maker who wastes large chunks of valuable hardwood by sawing the entire neck from one piece of wood.

Peghead shapes vary considerably among mandolins. The "A-style" tends to have a straight-sided peghead and the "F-style" having a more ornate shape. The peghead tips back at an angle (which varies slightly among mandolin designs) which causes the strings to bear down on the "nut" which is installed at the corner where the fingerboard meets the peghead. We will take a more detailed look at the nut and its function a little later. The peghead, as its name implies, is home to the tuning "pegs". These days friction pegs (like on a violin) are rarely used to secure and adjust the strings. More modern geared tuning "machines" are the current standard.

Mandolin tuning machines are usually mounted four-to-a-plate and are secured with screws to the back of the peghead. The capstan, or string shaft, emerges through a hole in the peghead and the strings are attached on the upper side. Bushings are usually installed which line the hole through the peghead and provide for a neater appearance and smoother turning. The buttons which are turned to adjust the string tension are made of a variety of plastics and may be glued on the shaft or secured with a screw.

The Nut

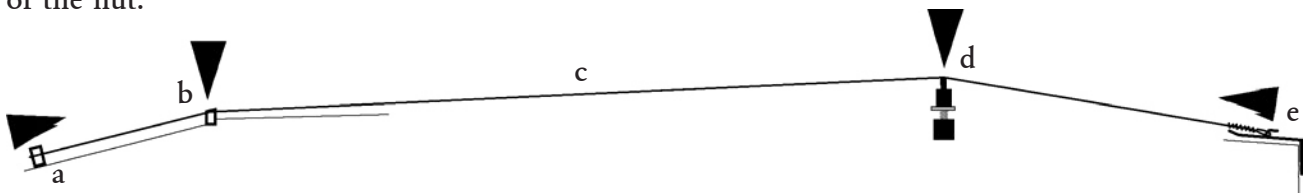
The nut, as previously mentioned, is positioned at the transition point where the fingerboard meets the peghead. The nut performs several vital functions. The first is that its grooves determine the spacing between the individual strings. As you already know, the strings on a mandolin are arranged in pairs, and the spacing of the grooves (or slots) determines the position of the strings.

The second function of the nut is that the depth of its slots or grooves determines the height of the strings above the frets. String slots which are too shallow mean the strings will be high up above the frets and harder to depress with the fingertips. String slots that are too deep may allow the string to rattle and buzz against the frets when played. This implies that there is a depth to the string slots in the nut which is "just right."

Slots, for practical purposes, can only be made deeper by filing and therefore one must exercise great care not to deepen the slots so much that fret buzzing results. It is far better to file a small amount, retune the string and check the sound and feel, and then file a bit more. This is repeated until the proper depth is achieved. Once a nut has been properly adjusted in this way it is rare to ever need any additional work or adjustment in the future.

The slots should be shaped just like the string (round bottom) and be just barely larger than the preferred string diameter so that the nut does not "grab" the string. We want the string to be as frictionless as possible in the slot for more responsive tuning. If you are ever tuning and hear a minute squeak it may indicate that the string is binding in the slot. Proper slot shaping and lubrication with powdered graphite helps allow the string to smoothly move through the slot during tuning.

Nuts are made of a variety of materials, all of which are very hard and durable. Materials include hard plastics, bone, ivory, and mother of pearl. Plastics are sometimes used which can wear out over time because of string abrasion in the slot and any of the materials might crack requiring replacement of the nut.



The string and its bearing and attachment points. (Not to scale) From left to right: (a) attached at the tuning machine, (b) bearing on the nut, (c) "speaking length", (d) bearing on the bridge, (e) attachment at the tailpiece. At the two end points the string exerts lengthwise pulling forces and at the two bearing points it exerts downward forces. (Arrows show direction of forces.)

The Bridge

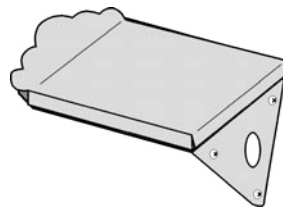
The bridge is usually made of rosewood or ebony though other hardwoods such as maple have also been used with good results. Most mandolins, even economy models, have adjustable height bridges with a pair of threaded rods and thumb wheels which allow you to raise and lower the upper half of the bridge. Some older mandolins had solid, fixed-height bridges and had to be adjusted up and down by trimming the bottom or by adding shims underneath.

The bridge, being the only part of the "string suspension system" which rests on the soundboard, has the important function of transmitting energy from the vibrating string to the resonating body of the instrument. The bridge must be strong enough so it does not collapse under the downward force of the 8 strings and it must be of a mass such that it does not totally absorb the energy of the vibration. An overly heavy bridge will suppress too much energy resulting in lower volume of sound. If it is overly light it may become structurally weak. The bridge on a mandolin is not glued to the soundboard but is held in place by the downward force exerted by the strings. This means that the bridge can be moved. In a later section of the book we will discuss how to move and adjust the bridge for easy playability, maximum sound and correct intonation.

The Tailpiece

The tailpiece serves as an anchor for the end of the strings. Mandolins use strings with a loop twisted at the end and the tailpiece provides a series of "hooks" which accepts the loop end of the string. Traditional tailpieces are usually stamped from steel and the hooks are simply tabs that are bent up from the base. The base then has a metal cover that is held on by friction and can often be quite a challenge to make it fit so it is easy to remove, replace, and be free of rattling.

Traditional stamped metal tailpiece with cover in place.



There are now several options on the market in which the tailpiece is cast as one solid part. Some believe that the greater mass of the tailpiece improves the tone of the instrument. I am still personally using the traditional style tailpiece and have had good service from them. The solid cast tailpiece is probably stronger.

Whether stamped or cast, the metal is normally plated prior to installation for appearance and corrosion resistance. The plating will normally be either nickel, gold, or in some cases chrome. Gold plating is obvious by its yellow color. Nickel and chrome look more alike but there is a slight color difference, chrome having a blue hue and nickel having a more yellow appearance. Normally the tailpiece plating will match the plating of the tuning machines.

Since it resides so close to the tailpiece I should mention the "end pin" which is a wooden "plug" that is press fitted into a tapered hole in the tail block of the mandolin. The end pin protrudes through a hole in the tailpiece and provides an attachment point for a shoulder strap. Some less expensive mandolins might have a plastic end pin but ebony is standard. The end pin tapers and is a tight friction fit. A warning about the end pin: ***Be sure the end pin fits snugly*** as your mandolin could fall to the floor if it pops out while playing! The end pin is not typically glued in but relies on its tapered cylindrical shape to keep it tightly in place. Never hammer or pound an end pin in (in an effort to make it tight) as its wedge shape can split the tail block inside the mandolin. Just lightly tap it in, and if the taper of the hole matches the taper of the pin perfectly, it will stay nice and tight. If it will not stay in I suggest that you take it to a repairperson who can do the job correctly using a tapered reamer that matches the shape of the end pin.

The Strings

Mandolins are strung with steel strings. Four of them (the two E strings, and the two A strings) are plain steel. The other four strings (the two D strings and the two G strings) are made of a plain steel core which is wrapped with tiny spiral covering (the winding or wrap), usually made of bronze. The alloy of the outer wrap can vary in composition with some strings having silver alloys and other copper bearing alloys. The purpose of the winding is to increase the mass of the string causing it to vibrate at a lower frequency or note. We will discuss the particulars of string gauges, replacing strings, and other features later in the book.

Strings on the mandolin, since they are in contact with the fingers, do corrode over time and will require frequent replacement. The life of the strings can be prolonged by wiping them off with a clean, dry cloth after playing but eventually you will need to replace them.

Strings also break, either because of faults in manufacture (rarely), because of faults caused by corrosion, metal fatigue and age, because of damage to the wire brought about by burrs or sharp edges (such as at the tailpiece hooks), or because of an error in over tightening a string beyond its breaking point by accidentally turning the wrong tuning peg. Rest assured that you will break strings from time to time and it is easily remedied by replacing the string.

The Pickguard or Finger Rest

Some mandolins are fitted with a plate, made usually of celluloid or plastic, that is suspended by brackets over the surface of the soundboard. The pickguard prevents accidental damage to the top from errant pick strokes. More importantly, to some players, the pickguard acts as a "rest" for one or more fingers of the right hand which glide on its surface during playing. Some flat top mandolins have a pickguard glued directly on the top surface of the soundboard, but most carved top instruments have the pickguard elevated above the curved surface of the top.



This illustration shows the approximate location of an elevated pickguard on an "F" style mandolin.

Changing Strings



Required tools and supplies:

- Set of mandolin strings
- Needlenose pliers with wire cutter

Caution: Be careful to protect your eyes when handling, uncoiling, or cutting music wire!

When changing strings I like to remove and replace one at a time with the instrument kept under tension and up to pitch. These instructions will show you how to install one string from start to finish. Once you have accomplished this you will repeat the process for the other seven strings.

Begin by arranging your work area (either a towel laid out on a table or in the lap) and by making sure you have sufficient light to see what you are doing. Open the string package and lay out the inner envelopes in order so you can find them easily. At this point do not remove the strings from the envelopes.

Next, remove the tailpiece cover by sliding towards the endpin. (Figure 1) Then, turning the correct tuning machine knob, lower the pitch of one of the G strings until it can be removed from its hook at the tailpiece. Note: For clarity the other strings are not shown in these illustrations.

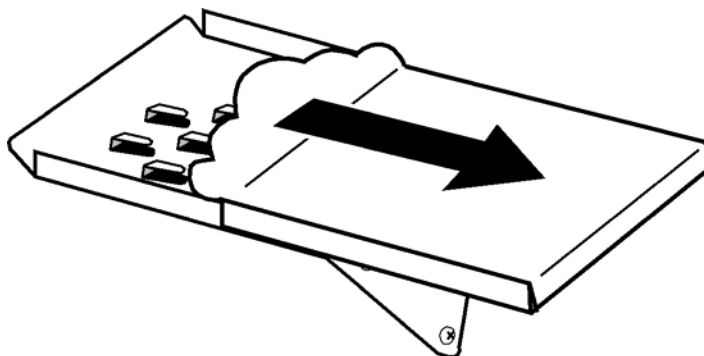


Figure 1

Holding the string in your hand you will next unwind and remove the old string from the tuning machine. Use the needlenose pliers if you need to. Try to avoid scratching the finish on the peghead with the tool or the string ends.

Remove the G strings (they are usually packed two per envelope) from their envelope. Unroll them carefully so the coil doesn't spring open possibly poking you in the eye.

Attach the loop end of one of the strings to its hook on the tailpiece. (Figure 2) Extend the free end of the string up towards the peghead bringing the string over the bridge and the nut.

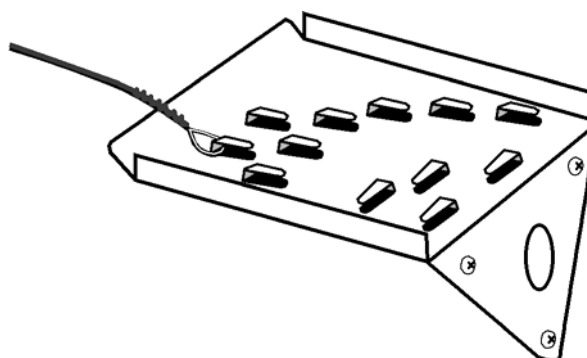


Figure 2

Turn the tuning peg until the hole is crosswise and then insert the free end of the string through the hole. The string should always (on either side) go from the center of the peghead outwards towards the tuning knob. (See Figure 3) The arrow is pointing back towards the tailpiece.

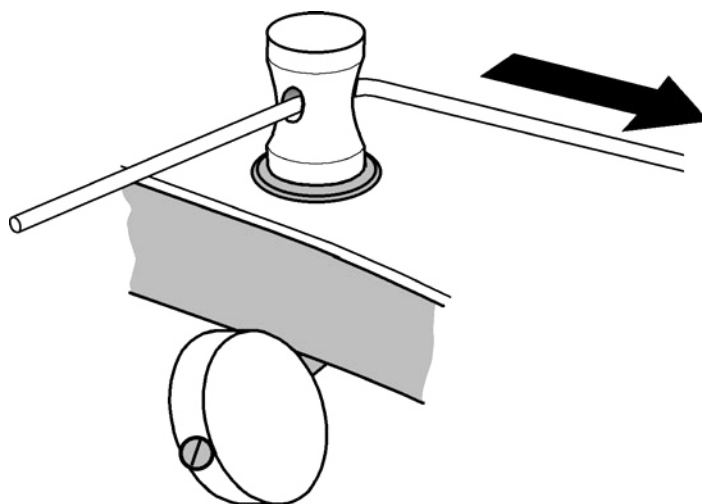


Figure 3

Next you will pull most of the slack out of the string by pulling it through the hole. Leave enough slack in the string that you can raise the center of the string 3" to 4" above the midpoint of the neck. (See Figure 7 on next page.)

Ultimately we would like 2 to 3 complete turns around the peg when the string is tuned to pitch to prevent slippage. With some experience you will be able to judge how much slack you need to end up with about 3 turns around the peg.

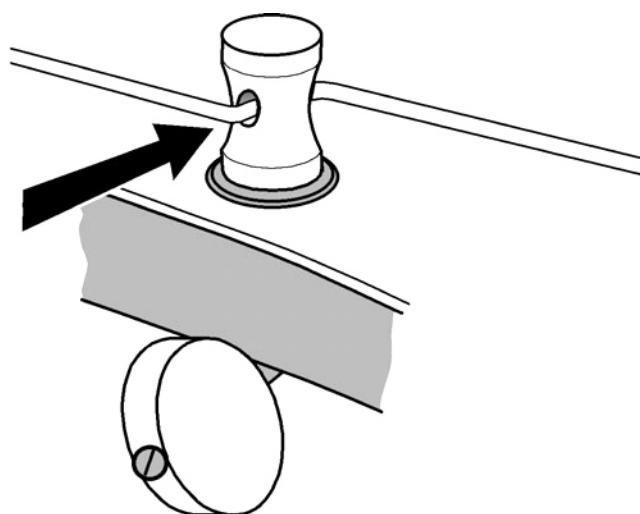


Figure 4

Pull a sharp 90 degree bend where the free end of the string exits the hole. (See Figure 4) The arrow points to this bend. The free end is bent straight towards the tip of the peghead. Once that bend is made you want the bend to stay in that position at the hole throughout the rest of the operation.

Next, take the free end of the string and wrap it 1/2 turn around the peg and pass it under the long part of the string. (See Figure 5) Then, bend the free end of the string straight up. This part of the string will become locked under the long part of the string as the tuning machine is tightened.

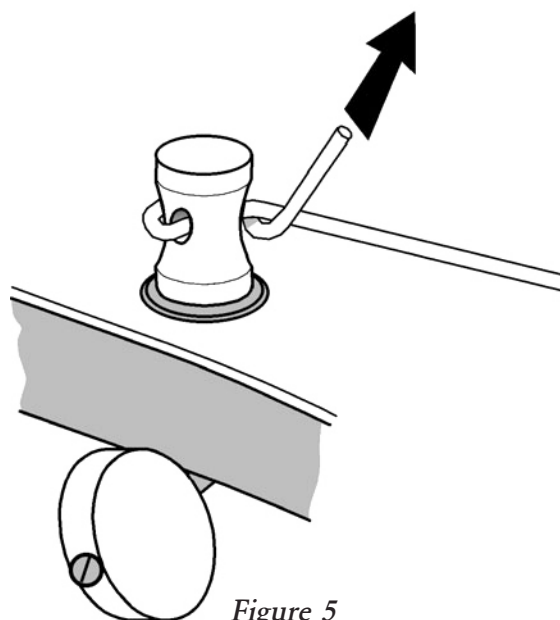


Figure 5

Note: In the illustration the free end is shown shorter than it might be in reality. The length of the free end will vary from string to string and from one manufacturer to another.

Begin turning the knob (See Figure 6), tightening the string, until the free end is trapped under the long part of the string. It is helpful at this point to use the hand position shown in Figure 7 to maintain tension on the string so that it contacts the nut and stays attached to the tailpiece. As you begin winding the string tighter you will gradually lower your right hand down until the string comes into contact with the bridge.

Try to keep from putting any sharp bends or kinks in the string as you hold it during tightening. Any kink could result in premature breakage or unusual overtones in the sound of the string. Just gently maintain tension on the string as it comes down.

I should mention here that on some mandolins the tuning peg knobs turn in the opposite direction when tightening. Regardless of the way the knob turns, the string should always wind around the peg from inside to outside as shown in Figure 6.

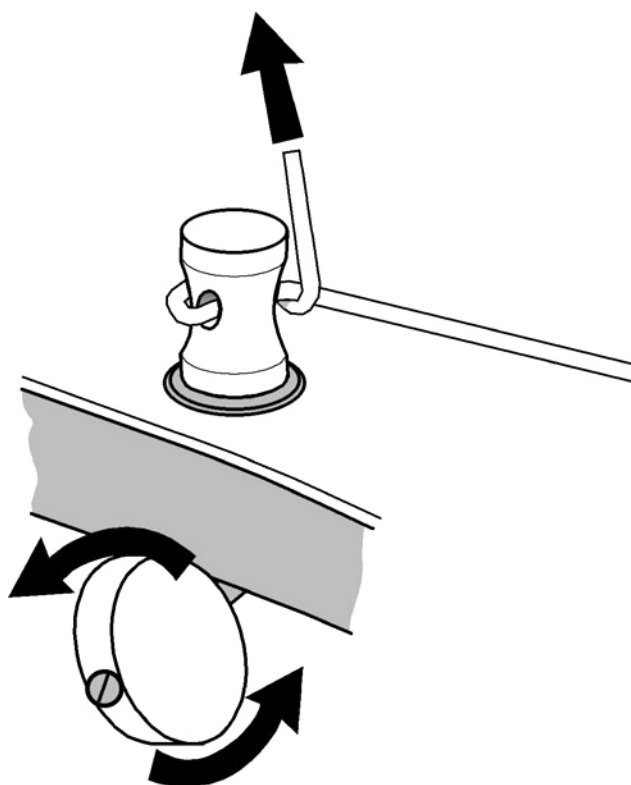


Figure 6

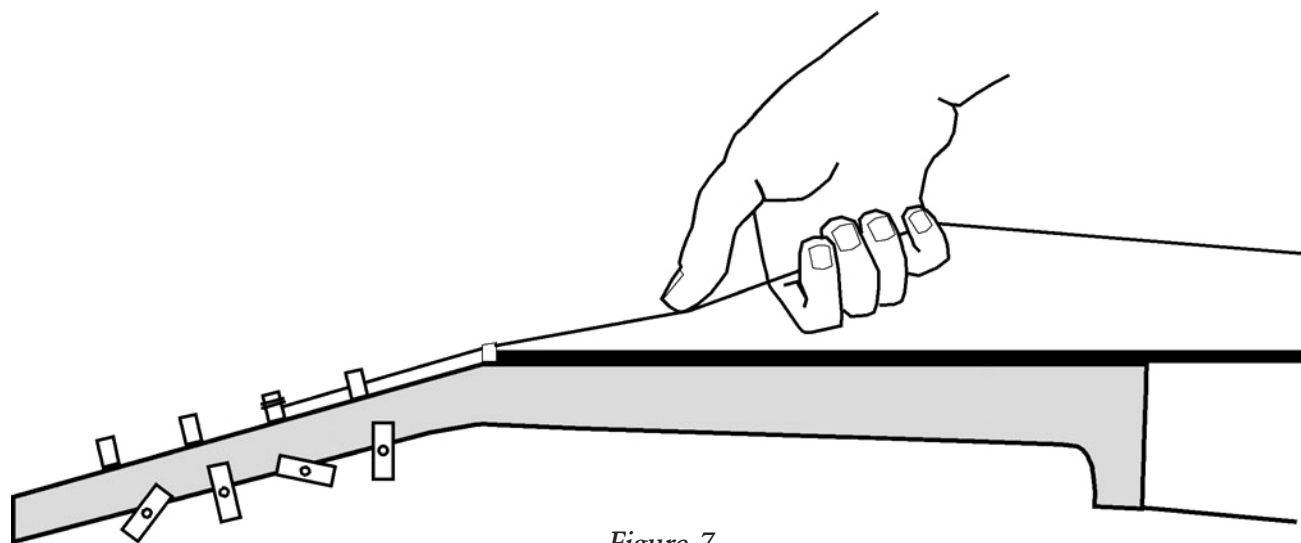


Figure 7

Continue winding the peg and be sure that the coil is spiraling downwards toward the peghead surface. A perfectly installed string will have a neat coil with no loops crossing over each other. Each additional spiral around the peg brings the string farther down the peg increasing the downward force at the nut.

Once the string is on the bridge you can take your right hand and begin to pluck the string. Play it as you tighten the string and bring the string up to match the pitch of the old G string which should still be pretty close to in-tune. The new string will drop in pitch as the new wire stretches and the loop end elongates and forms itself to the hook in the tailpiece. I usually tighten the string just slightly higher in pitch than the old G string and leave it there until I am finished replacing all the other strings.

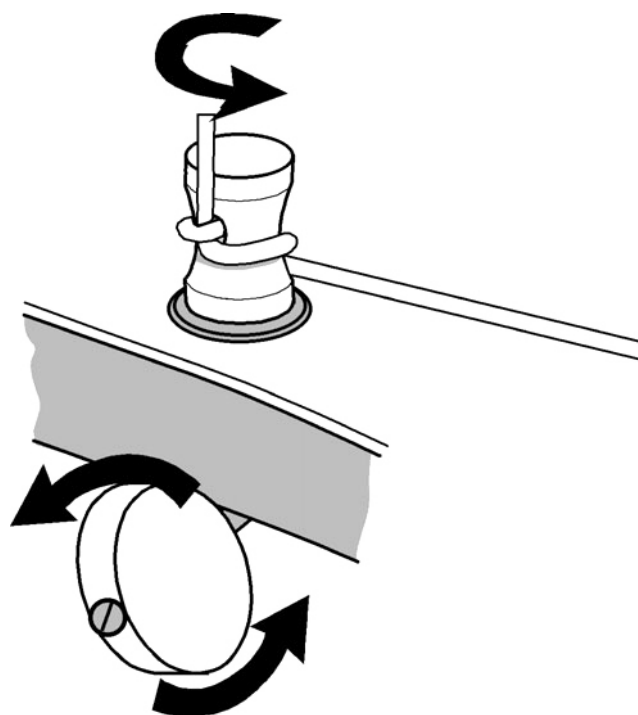


Figure 8

To complete the installation of this string, take your wire cutters and clip the free end off even with the top of the tuning peg. I hold the free end in my fingertips (so it doesn't fly across the room) and I just lay the cutter sideways flat on the top of the peg and chop it off as close as possible.

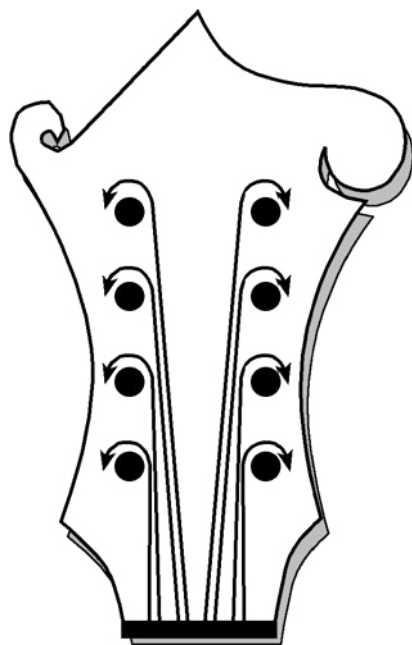


Figure 9

Cut each string off, one at a time, after you finish putting it on so that you don't have all those free ends flailing around and getting in the way as you install the next string. Be careful! Those little free ends are very sharp. Don't jab yourself in the finger. Some people, after cutting the string, will bend the little stub sideways to lessen the chance of sticking someone with it. At this point, I usually wind the old string up, along with the part I cut off, and stuff it into the empty string package for later disposal. Don't leave the old strings laying around where someone can step on them or where a child might pick it up! Safely dispose of them!

Go back and repeat these same steps for the other seven strings. I usually work with the mandolin in my lap, with the neck facing left as I do the G's and D's. Then I flip the instrument around so the neck is pointing right as I work on the A's and E's. Just be sure that you wind the string around the pegs going from inside to outside. (See figure 9.)

In case you are wondering why there are 12 string hooks on the traditional "Gibson style" tailpiece here is the reason. In the past it was common for the loop end of the plain steel strings to come unwound. Gibson designers added 4 additional hooks so that the string would be anchored on one hook and bend around the other before heading up towards the bridge. The sideways pressure of the string as it angled around the additional hook helped to lock the twisted wire together so that it would not unwind.

Some believe that the purpose of the additional hook is to help relieve the stresses and share the load of the string tension over two hooks instead of one. No doubt this is true, but I don't think this was the primary reasoning for the extra hooks.

Figure 10 shows the string attachment pattern as adopted by Gibson. With improvements in modern string manufacturing, this Gibson innovation is no longer really needed. I have been playing for over 30 years and have never had a string loop unwind.

Figure 11 shows the way I (and most mandolin players I know) attach the strings to the tailpiece. It is easier to get the strings on and off with this simpler pattern.

Once or twice, over the last 3 decades, I have had a string hook break off. I believe that the cause was corrosion and metal fatigue. If this happens, you can hook the string onto one of the "extra" hooks and bring it around a neighboring hook to guide it towards the bridge. This will work in a pinch until you can obtain a replacement tailpiece. It is also possible, if one of the hooks breaks off, to share hooks and put two strings on one hook. This will double the strain on that hook and, since they are obviously weakening, you will be asking for another break.

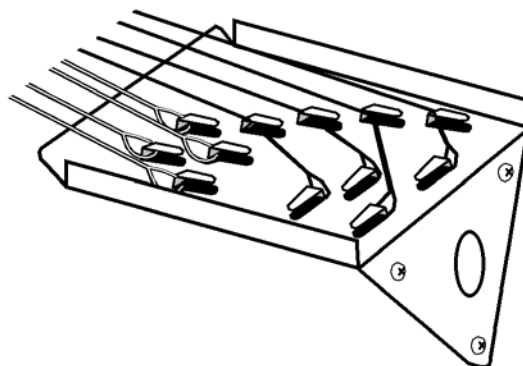


Figure 10 - Gibson stringing pattern as originally intended.

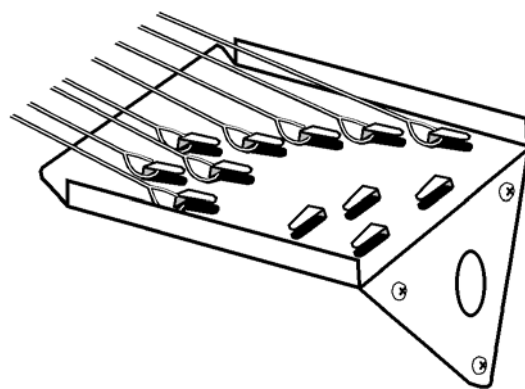


Figure 11 - My usual stringing pattern.



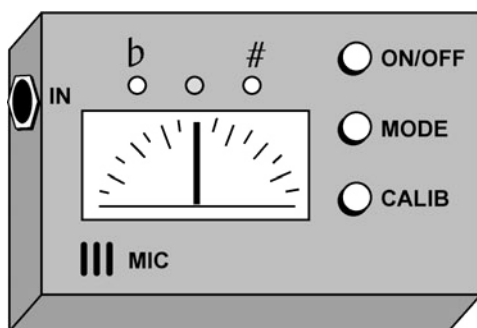
Tuning with an Electronic Tuner

Required items:

- Chromatic Electronic Tuning Meter

Electronic tuning machines come in a huge variety of designs but all of them accomplish the same basic task. They have a microphone (or other sensing device) which "hears" the sound of the string when you pluck it. The meter then displays information about the pitch (the frequency) of the sound it hears.

Note: There is additional information later in this book concerning the science of tuning and I suggest you refer to that after you learn the basic steps of tuning. Here is an illustration of a typical (fictitious) tuning machine and its controls and display:



A typical electronic tuning device.

Most electronic tuning machines incorporate the following features:

- 1) An on/off switch.
- 2) A mode switch which allows you to select the name of the note you wish to tune or have the tuner determine the note you are playing automatically. (Auto mode or Chromatic mode.)
- 3) A built-in microphone. Some tuners have a little clip with a sensor in it so that you can attach the machine directly to your instrument. That type of tuner senses the vibrations by direct contact rather than through a microphone.
- 4) A calibration button. This button allows the user to change the reference frequency of the "A" note within a range from about 435 to 445 cycles per second. The current internationally agreed upon frequency for an "A" is 440 cycles per second (or Hertz) and you should verify that your tuning machine is set to 440.
- 5) An input jack (which we will not use) for connecting an electric guitar or an instrument with a pickup installed.
- 6) Some sort of display which tells you the note name and whether you are too high or too low in pitch.

Some meters have a needle that moves left or right of center to indicate whether you are too high or too low. Most meters today are liquid crystal displays (LCD) which depict the old style analog meter. Our fictitious tuning machine has an LCD display.

In addition, our meter has three light emitting diodes (LEDs, or lights) which illuminate to indicate whether you are too high or too low. The little symbol that looks like a "b" is the flat symbol and means you are too low in pitch. The "#" is the sharp symbol and means you are too high.

Somewhere on your tuner, either using LEDs or a text display, it will display the name of the note you are tuning. If you are in "auto" or "chromatic" mode the tuner will listen to the sound and display the name of the note it hears. If you are in "manual" mode you must select the name of the note you are about to tune. Automatic chromatic tuners are more convenient, but are sometimes fooled by extraneous sounds and harmonics and might display erroneous note designations at times. If you have an "auto" mode select it before continuing.

To be sure the tuning machine can do its job be sure to use the machine in a quiet area with the microphone near the instrument!

To begin the process of tuning you should turn on the machine.

Next, play one of the G strings with your pick. Observe the readout of the machine. It should be reading G and the needle (and LEDs) will indicate how far flat or sharp you are from an "in-tune" G note. If the display reads out anything other than G, say Ab, F#, F or anything other than G you must determine whether you are lower than G or higher than G by looking at the order of the notes of the musical scale.

Here is the order of the notes of the musical scale:

C C# D D# E F F# G G# A A# B C C# D D# E F F# G G# A A#...

As you can see the pattern keeps repeating over and over. To make matters more confusing all those notes marked as sharps can also be called flats. Here are the same musical notes written as flats:

C Db D Eb E F Gb G Ab A Bb B C Db D Eb E F Gb G Ab A Bb...

Your tuning machine could possibly use either (or both) to display the name of the note it is hearing. But, the important thing to remember is this:

If the note that is displayed (in Auto Mode) is to the right of the desired note in the chart above, you are very sharp--so sharp that the tuner "thinks" you are tuning a higher note. If so, lower the pitch until you see G in the display.

If the note that is displayed (in Auto Mode) is to the left of the desired note, you are very flat--so flat that the tuner "thinks" you are tuning a lower note. If so, raise the pitch until you see G in the display.

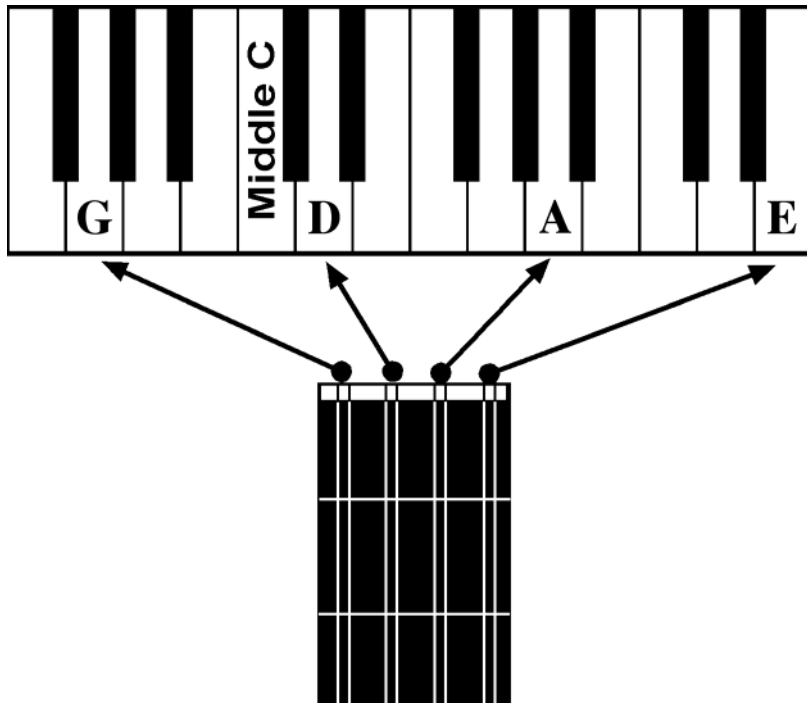
If your display is showing "G" then you are pretty close to the correct pitch for a G note and you can proceed by looking at the "sharp" and "flat" indicators. If the needle is to the left of center it means you are a little flat so tighten the string slightly. If the needle is to the right of center it means you are a little sharp so loosen the string slightly.

Many tuners, including our fictitious model, include green and red LEDs (lights) which come on to show you if you are flat or sharp. These lights are helpful when you are tuning in dark conditions and cannot see the LCD display. Just adjust the string either tighter or looser until the center light glows and you will be pretty close.

Now that you have one of your G strings agreeing with the tuning meter, tune the other strings in the same way. In case you don't already know the notes for each of the mandolin strings are:

1st string	(both strings)	E	(smallest diameter)
2nd string	(both strings)	A	
3rd string	(both strings)	D	
4th string	(both strings)	G	(largest diameter)

Here is a diagram of a piano keyboard showing the notes of the mandolin:



Tuning notes of the mandolin.

Tuning Tips

Tune only one string of each pair using the tuning machine. After centering the needle or display, tune the other string by ear to the machine-tuned string. In most cases, with practice, you can do a better job of getting the two strings exactly on the same pitch if you just listen. You will hear a "beating" or "wavering" pulse which increases in speed as the strings move farther away in pitch from each other. As they become closer in pitch to one another the beating will slow down. Your goal is to eliminate this beating entirely on each unison pair. A unison (it means "one sound") is simply a pair of identical notes. (For more information on beats see the section on the science of tuning near the end of the book.)

The ear can actually hear minute differences in pitch (evident by the beating) that the tuning meter cannot display. The circuitry of the tuning machine may be precise enough to detect these ultra-small pitch deviations but the display is not precise enough to show them! Most tuning meters are marked in "cents". A "cent" is 1/100 of the distance from one note to the next. Say, A to A#. From A to A# is one "semi-tone" or a "half step" therefore a "cent" is 1/100 of a semi-tone or half step. On the face of the tuning meter display you will usually see that it is marked off in "cents". The markings might be minus 5, 10, 15, 20, 25, 30, 35, 40, 45, and 50 cents on the "flat side" and plus 5, 10, 15, 20, 25, 30, 35, 40, 45, and 50 on the "sharp side."

If the needle is pointing to -50 cents and reading "G", then all it takes is a drop of 1 cent and the display will change over to F# reading +50 cents sharp. This all seems very precise, but if you look carefully at the segmentation of the LCD display you will see that the "needle" images are usually something like 2.5 cents apart. So, if a pitch is off by 1 cent the machine will round up or down to the nearest 2.5 cent mark so it can display the needle. The human ear can pretty easily hear a pair of unison strings that are off by 1 cent, so you can actually do a better job touching up your unison pairs by ear.

On the other hand, when comparing two notes which are farther apart than a unison pair the untrained human ear is not as good at deciding if the notes are "in-tune." The bottom line of all this is: If your G's, D's, A's and E's are off by a small amount (like 2 cents) the mandolin will still sound pretty good. But, if the two G's (or any of the other unison pairs) are off by 2 cents they will howl and sound bad! For this reason I always suggest that you tune one string to the machine to get it as close as you can then tune the remaining string by ear by listening to the unison and attempting to make it sound pure and beatless.

When tuning, by any method, play the string pretty forcefully. I like to whack the string harder than I intend to play it during performance and then softly play the note as I check the meter or listen for beats. Tune hard and then listen soft. The idea is to settle the string and equalize the tension throughout all portions of the string *before you perform*. This is better than having them equalize and go out of tune while you are playing!

As you raise the pitch of a string, friction at the nut and bridge can cause uneven tensions to develop in different parts of the string. Playing the string hard will vibrate the string and allow the string to slip through the grooves in the nut and bridge. (Graphite lubrication and properly sized nut slots help too.) If you raise the pitch of a string, and higher tension remains in the section between the nut and the tuner, it will eventually break loose of the bonds of friction and the pitch will change.

If you are lowering a string's tension the same friction points may cause the note to temporarily remain higher than the pitch it will eventually settle to. I hate to put it this crudely, but the basic idea here is that you want to "knock the string out of tune" if you can and then correct it if you need to before you play. Have you ever noticed that most people tend to "fiddle" with their tuning more during the beginning of a session than in the middle or towards the end. This is partly caused by the beating that the instrument takes as it is played. The strings have all settled to a state of equal tension throughout their lengths and, when they do, they will do not go out of tune easily.

While on the subject of tuning, **temperature does have a slight effect on tuning.** Tuning in a cold environment and then walking out under hot performance lights can throw your mandolin out of tune. Try to do your tuning in the environment where you will be playing. If you are forced to tune up in a cold area you can try warming the strings up by rubbing them with your hands before tuning. Sometimes, if the temperature differential is great, you may just have to walk out on stage and do the best you can. But, whatever you do, do your tuning off the microphones! And get on with it quickly. Audiences get very impatient with long or constant on-stage tuning sessions and the musicians look like idiots.

Humidity also has an affect on tuning but the effects are much slower and will not usually be noticed over the course of just a few hours. Humidity causes the wooden parts of the instrument to change in size (ever so slightly) and this will push the overall pitch of the instrument up or down. High humidity swells the body of the instrument and the pitch goes up. Low humidity shrinks the mandolin and the pitch goes down. (There will be more information on humidity later in this book.)

Here is another tip on tuning. If you grab the instrument and habitually tune it before each set, you may find that your instrument sounds out of tune as soon as you start playing. If, as is usually the case, the other musicians have made tuning adjustments or drifted slightly off pitch throughout the set, the overall pitch of the band may have moved slightly off "standard" but you were all in tune with each other. Unless something were seriously sounding out of tune I would not monkey with it. If you "hit the tuner", and the rest of the band does not, you might be the only person "in tune" and yet it will sound like you are not. If everyone, or most everyone, is tuning between sets you should too. That is the best way.

One last thing on tuning. **Remember that new strings take a little while to stretch out and stop dropping in pitch.** Try to avoid changing strings right before a performance unless you have sufficient time to "settle them down" with some vigorous playing. I have seen some people yanking and pulling on strings to try to stretch them out five minutes before going on stage. I suppose that works but a little time and 20 minutes of playing will do the job and you can "warm up" at the same time.

Your skills at tuning will increase over time if you work towards that goal. Strive for good consistent tuning and don't believe that phrase you hear tossed around at jam sessions. The one that says its OK to be out of tune as long as you are "close enough for bluegrass!" On the other hand, don't be a tuning snob. Sometimes you have to just quit fiddling with your tuners and play. I don't like the insinuation that bluegrass sounds fine even if you are out of tune. Bluegrass, like other styles, sounds lots better when everyone is in tune! But, I agree that sometimes "close enough" is "close enough" and you should get on with the show.

Tuning to Yourself (Tuning Checks)



Required items:

- A Mandolin - Roughly in tune

When you have no point of reference to tune to (such as when stranded on an island), or whenever you wish to check the integrity of your tuning, you can use the following checks:

- Play the 7th fret note of the 4th string. This note should sound like the open 3rd string. Adjust the 3rd string(s) until they match that note.
- Play the 7th fret note of the 3rd string. This note should sound like the open 2nd string. Adjust the 2nd string(s) until they match that note.
- Play the 7th fret note of the 2nd string. This note should sound like the open 1st string. Adjust the 1st string(s) until they match that note.

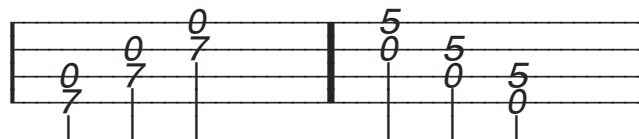
At this point the mandolin should be in "relative" tune with itself even though you may be considerably flat or sharp from standard pitch.

Important Note: If the bridge is not positioned correctly this method of tuning will not work very well. The bridge must be correctly positioned for the frets to function correctly. (See section on Locating the Bridge Correctly.)

Here are some additional checks I use after verifying all my 7th fret notes as shown above:

- Play the 5th fret note of the 1st string. That is an A note. Play it together with the open 2nd string (an A note, one octave lower) and they should sound pure together with no beating.
- Play the 5th fret note of the 2nd string. That is a D note. Play it together with the open 3rd string (a D note, one octave lower) and they should sound pure together with no beating.
- Play the 5th fret note of the 2nd string. That is a G note. Play it together with the open 4th string (a G note, one octave lower) and they should sound pure together with no beating.

Here are the above checks written out in mandolin tablature:



That is my usual "testing" procedure I use after any tuning. If all of that checks out pretty good you can be fairly certain that your bridge is in the right place. Keep in mind that old, cruddy strings will not always "fret out true" and it may be impossible to make them sound "in tune." If your strings are old (the wound strings will look brownish green and the plain steel will start looking black) think about changing them soon.



Tuning the Mandolin to a Piano

Required items:

- An "in-tune" piano or electronic keyboard

Note: Pianos go out of tune, just like all stringed instruments, and the its pitch may not be correct unless it has been recently serviced by a piano technician. Electronic keyboards do not drift in pitch in a normally detected amount but they can be incorrect too! Reed and pipe organs are notorious for constantly being out-of-tune.

Have the pianist play the following notes and match the pitch of your strings to each one.



The notes are the G just below middle C, the D just above middle C, an A and an E. (Refer to illustration on page 28.) In case you were not aware of it, pianos have multiple string unisons throughout most of the instrument. Each note has a three-string "course" similar to the double string courses on the mandolin. If you are listening for the wavering beats as you try to match your strings to the piano you may hear beats which you cannot tune out. These beats can be caused by slightly out-of-tune piano strings. If all three strings on the piano, for that single note, are not perfectly in unison a distinct beat will be heard. This can be very frustrating as you try to decide whether it is your mandolin or the piano that is causing the beats. Sometimes you can listen to the piano note which may be beating and get a mental image of the speed of its beats. Then play the mandolin string which will likely beat at a different rate. Then, perhaps, you can differentiate the two combined beats and successfully tune your string "beatless".

If the piano is in-tune, or at least those 4 notes, and the piano unisons are not beating, just listen as adjust your strings to match. As I stated in the previous section, I suggest you match one string of each pair to the piano notes. Then, ask the piano player to stop playing while you adjust the remaining string of each pair to get your unisons in tune.

The piano player might hold down the "damper pedal" so the notes they play for you ring for a long time. They are trying to be helpful but this is bad idea. If you see that the piano player is depressing the right pedal ask them nicely just to play the note and hold the key down without pressing the pedal. The right pedal on all pianos lifts all the dampers and allows every string in the piano to vibrate freely. If the pedal is down and you play a single note all sorts of other strings and their harmonics are free to vibrate sympathetically and you will hear a jumble of all sorts of beats and tones. If the player strikes one key and holds it down the damper for just that one note is lifted and you will hear a much purer sound from the piano and it will be easier to tune. Some piano players call the damper pedal the "sustain pedal" which is also correct.

If you encounter a situation where you are asked to tune to, or perform with an out-of-tune piano or organ, just do the best you can. Suggesting that their beloved piano or hundred thousand dollar pipe organ is at fault will only make you seem like a snob and a complainer. Remember, they cannot tune their instrument without calling a professional so don't take it out on them. It is up to you to do the best you can and maintain a good attitude.

If you are only using the piano as a reference for pitch and you will not be performing with the piano, just match your A to the piano and then tune the mandolin to itself as previously described.

Tuning the Mandolin Using a Pitch Pipe



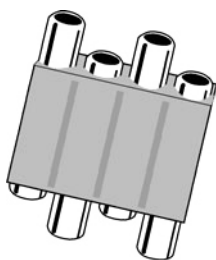
Required items:

- Mandolin or violin pitch pipe

A pitch pipe is a little device, similar to a harmonica, which has 4 tubes mounted together. Each tube has a "pre-tuned" metal reed inside. When you blow into each tube you will hear a sound that is supposed to be a G, a D, an A, and an E. I say "supposed to be" because those metal reeds are often off pitch. You can vary the pitch based on how hard you blow. Dirt and crud on the reeds can make them go out of tune too. To use one, just blow the note and tune as if you were tuning to a piano. Pitch pipes were a good idea in their day and remain fun little reminders of the pre-electronic era.

Pitch pipes can be used to get you "pretty close" but are not a trustworthy reference for accurate tuning. A pitch pipe is handy because you can hold it in your mouth and continuously blow the note while tuning with your hands. I have an old one that I sometimes use when changing strings just to get me in the ball park. Perhaps you can learn to play a song on the pitch pipe (that has just four notes) and work it into your show. Incidentally, since mandolins and violins are tuned the same, a pitch pipe for a violin will work.

The pitch pipe.





Tuning with a Guitar

Required items:

- A Mandolin
- An In-tune Guitar

Tuning to a guitar is pretty easy since the guitar has an E, an A, a D, and a G among its 6 open strings. In fact the guitar has 2 E strings. Here is how I do it:

Have the guitar player play their open 3rd string. This is a G note and you match your 4th string to it as close as you can. Next, ask them to play their open 4th string. This is a D note and will sound like a D which is one octave below your 3rd string. If you can match your high D up to their low D (just like you did with the octave checks in the previous section) then you are halfway there!

Once you have the G note matched you can use the procedure "Tuning to Yourself" and just work your way up through the other strings. However, accumulated small errors may leave you far from "in tune" if you are not careful. My suggestion is to tune your D to the guitar's D (which sounds an octave lower) and then make your 7th fret check.

Once you have G and D, and you are satisfied with them, play the 7th fret of your D string and tune your A to that. Then, have the guitar player play his 5th string which is an A. Your A is 2 octaves higher but should still match up and sound pure when played together.

If you are happy with the A string do the same with the E. Play the 7th fret of your A string and tune your high E to that. Then have the guitar player play his 1st string which is an E one octave below your high E. If that sounds pretty good you have done it.

When tuning up with a guitar player I usually ask them to play a few chords while I tune and verify my tuning. I do this after getting things as close as I can using the above procedures. Here are the chords I ask for:

I ask the guitar player to strum an A minor chord while I play my A and E. If all sounds well I move on and ask for a D minor chord while I play my D and A strings. Minor chords on the guitar seem to make it easier to hear the notes I am tuning.

Finally I get the guitar player to strum a few G major chords. I will check my G and D strings against the sound of the G major chord and if all seems well I will stop bugging them.

Once in a while a clever guitar player will offer to play your *exact* notes, by fretting his strings at his 12th fret, in an effort to help you. I usually decline this offer as I must assume that his guitar is correctly set up and is playing "in tune" halfway up the neck. There is a good chance that his 12th fret notes will sound flat or sharp depending on his bridge, age of strings, etc. I put more faith in the integrity of the guitarist's open strings if he is in tune at all. If he seems to be "out of tune" as you do this you might have to think of a "plan B".

Tuning with a Tuning Fork

Required items:

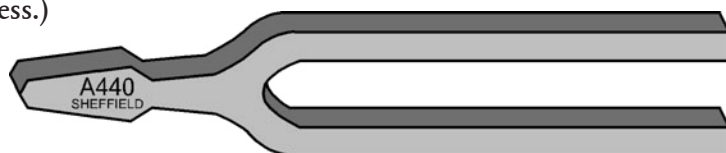
- An "A440" tuning fork



Tuning forks are made for a wide variety of notes but I use an A fork which is calibrated at 440 cycles per second. They are usually stamped A440. They are temperature sensitive so only trust them at approximately average room temperature. When you strike one of the tines of the fork against a solid (yet padded) object it will vibrate and produce an A440 tone which is very pure. I usually rap the fork against my kneecap. Smacking it down on a really hard object like a tabletop or something can damage the fork and render it useless. The tone of the fork is hard to hear unless you amplify it somehow. Here are two methods:

1) Touch the base of the vibrating tuning fork to the top of your bridge. The soundboard will amplify the sound nicely, but you have one hand occupied and need to pluck your string and turn the tuning machines. Because of this lack of a third hand I use the method used by many old-time piano tuners:

2) Strike the fork on your knee (that could account for the hobbling of your ancient piano tuner) and, holding it by the handle, stick it in your mouth and hold it **gently** between your teeth. Don't touch it with your lips or you will dampen the vibrations. The vibrations of the fork will be transmitted internally through the teeth and bones of your head right to your ear and you will find that you can hear the A note for a much longer time this way. Now your hands are free to adjust your A string to match the sound of the fork. (I am sure your dentist would disapprove of this though he might appreciate the business.)



*A steel A440
tuning fork*

Since the fork only produces one note you must then use your 7th fret unison checks (See previous section "Tuning to Yourself") to complete your tuning. With practice you can learn the sound that each of your strings make when compared to the A fork and, eventually, you can actually tune all your strings to the A fork directly. Until that day arrives, here are some checks you can make using the A tuning fork to verify your tuning. (Again, the bridge location must be correct for this to work.)

- Play the 2nd fret of the 4th string. (An A note) This note should make a nice pure octave to the A tuning fork.
- Play the 5th fret of the 1st string. (Also an A note) This note should make a nice pure octave to the A tuning fork.
- Play the 7th fret of the 3rd string. (Also an A note) This note should make a pure unison with the A tuning fork.



Locating the Bridge Correctly (Setting Intonation)

Required items:

- An electronic tuner (or your ear)
- A ruler marked in millimeters

Several times throughout the tuning sections I have mentioned how crucial it is that your bridge be located correctly in order for the frets to perform correctly. Let me state, in more detail, why this is so and how it works.

The bridge is not glued down but is held in place by the downward force of the strings. This means that the bridge can be moved from side to side and lengthwise or even at an angle. The fact that you can move the bridge means that you can set the bridge in a location that allows the frets to produce "in tune" notes!

The frets on the mandolin are arranged in a specific way so that they will produce all of the notes of the chromatic scale as you progress up the fingerboard one fret at a time. (I will skip the discussion of how the locations of the frets are determined for now.) But, as you can imagine, it is impossible for the casual player to rearrange the frets of the mandolin if the notes they produce are not correct. For all practical purposes we can assume that the frets are not adjustable as far as their placement goes. It is important to note that the frets are arranged with a specific bridge location in mind. But, since the bridge may have been moved it is up to the player to be sure it is in the right location.

To begin you should know that the distance from the nut to the 12th fret is theoretically the same as the distance from the 12th fret to the bridge. In other words, the 12th fret is halfway between the nut and the bridge. (By nut, I mean the point at which the string leaves the edge of the nut.)

Take a ruler and carefully measure from the nut to the center of the 12th fret. Then compare this measurement to the distance from the 12th fret to the bridge. If they are approximately the same then you are at a good starting point for making any adjustments.

I say "approximately" since the whole point of adjusting the bridge location is to correct for "reality" not some theoretical ideal. Before we actually do any adjusting of the bridge location take a look at the top of your bridge. (The saddle.) You will most likely have one that is not a straight line but, rather, has each string at a slightly different location from the rest. This type of bridge top is called a "compensated saddle." Nearly every mandolin is "compensated" like that. Why is that?

When a string is pressed down to bring it into contact with a fret the finger tightens the string ever so slightly. This causes the pitch of the string to rise by some small amount. The stiffer the string the more the pitch rises when pressed to a fret. The farther you have to push the string down to reach the frets (a high action) the more the pitch raises. As you can see there is a complex interaction of many factors which determine where the pitch of a note will end up when you play a string at some fret.

The top of a compensated mandolin bridge is made the way it is because the designer has attempted to predict how much each particular string will "stretch sharp" when played. Compare the saddle for the E string with the saddle for the A string. Since the A string is thicker, and therefore stiffer, the contact point for the A string is moved slightly away from the nut making the A string slightly longer than the E string. You see the same thing when you compare the compensation of the D string and the G string. The G string is made longer than the D string since it will likely go more sharp when fretted.

You must keep in mind this important fact about compensated mandolin bridges. The design that was used was a prediction of average types of strings and average action heights. The strings you use, the height of your action, and even the amount of neck relief, and certainly age of strings, can cause the compensation provided to be less than perfect.

At this point we are not going to worry about the possible differences in individual string compensation (since we would have to make a new bridge top) to change things. We are going to be concerned with getting the entire bridge in a location that makes most of the strings play in tune most of the time. In other words, we are going to make the average note play in tune.

Now that I have all that said, let's talk about how to actually get the bridge in the best possible location. First, get ready to do lots of tuning and de-tuning. You cannot move the bridge easily under tension so before we move anything we have to loosen the strings. Don't do that yet. Just be ready to loosen them somewhat before you make any movement. After each move you will have to tune back up to standard pitch to check the results. You may have to do this several times before you get things right so choose a day to do this when you have plenty of time and few distractions.

How to Check if the Bridge is Located Correctly - Method One

Play a harmonic over the 12th fret of the 1st string. A harmonic is produced when you lightly touch the string at its halfway point while you pluck the string. Just touch the 1st string very lightly directly over the 12th fret. Pluck the string and remove your fingertip immediately so your finger doesn't dampen the sound. You should hear a pure, ringing bell-like tone.

Next, fret the 1st string at the 12th fret and play that note as you normally would. Does the fretted note sound higher than the harmonic? If so the bridge is too close to the nut. Does the fretted note sound lower than the harmonic? If so, the bridge is too far away from the nut.

As you can tell, if you tried this, it requires a good ear for pitch and the ability to remember the pitch of a note while you hear another one.

Even if the test makes you believe that you should move the bridge, do not move it yet! What you need to do is test all strings first. Some strings may demand more movement than others and you must "average" the amount required. You cannot favor one string over another. It is a game of splitting the difference so that "most of them" sound as good as they can.

How to Check if the Bridge is Located Correctly - Method Two

Turn on your electronic tuning machine and get the mandolin in tune as precisely as you can. Play the 12th fret note on the E string. It is also an E one octave higher than the open string. What does the tuner display when you play that note? Is it reading sharp or flat? If it is flat, the bridge is too far from the nut. If it is sharp, the bridge is too close to the nut.

Use that procedure on each of the strings. I even like to stop one of the two strings from vibrating at all during the test by touching it with my fingertip from the side. I don't want any mis-tuning of the pair of strings to interfere while checking the intonation. In theory, each of the two strings should act the same so you can test one a single string at a time.

To recap, you make absolutely sure that the open strings are in tune with the machine. Then play the fretted 12th fret notes and check their degree of sharpness or flatness on the machine. As before, you must decide on an "average" direction to move the bridge and by how much. Let's say that one string reads perfectly in tune when played open and at the 12 fret, but the rest of the strings all are sharp when fretted. Three strings need to be longer and one is already fine. What do you do? I would move the bridge away from the nut. Yes, this will cause the string that was "OK" to now fret out slightly flat but on average I will have improved the lot of them.

You get the idea. Without the ability to adjust each string individually you must do the best you can and settle on an average location that works the best.

Before You Move the Bridge Read This!

If you are making this adjustment with old, nasty, rasty strings you will likely need to re-do it all when you install a new, good set of strings.

If you are making this adjustment with your action high enough to slice eggs, you will likely have to re-do it all after you set your string height.

If you are making this adjustment with your strings so low that they are rattling on the frets, you will likely have to re-do it after you raise the strings.

If you are making this adjustment with a giant bow in the neck caused by a loose truss rod, you will likely have to re-do it after you correct the neck relief.

Bottom line: Many setup factors work together. Change one thing and you changed something else. Checking and moving the bridge is fairly easy, once you understand it, so now go ahead and move it and just be aware that if you change brands or gauges of strings, or make any action adjustments, you will need to reset the bridge location.

Now, let's get on with the actual moving of the bridge...

Physically Moving the Bridge

I assume that you have now decided that the bridge is either too close or too far from the nut. (If you haven't decided, back up and re-read and re-test.)

Step One: Loosen the strings. Loosen them but do not let them go completely slack. Just loosen them so that they all make a very low musical note. Not so loose that they just go "thud."

Step Two: Move the entire bridge in the direction you determined. I would move it about a 1/16" to an 1/8" and check it. Don't go wild and move it an inch.

Step Three: Check that the bridge is where you want it side-to-side. Observe the strings as they run down the fingerboard and center the strings on each side if you have moved it sideways by accident.

Step Four: Tune the mandolin. Since you have dropped the pitch so drastically you may need to tune it several times before it finally settles in and stays put.

Step Five: Test for correct location of the bridge using the methods previously explained.

Step Six: If the test proves that you have found the best possible location then congratulate yourself on your success. If the test says you are too close or too far away go back to Step One and start over.

You may find that your tests are telling you that you should angle the bridge. If so, go ahead. Sometimes the bass strings (the G and D) need more adjustment than the treble strings (the A and the E) and you might discover that the bass end of the bridge needs to be moved and the treble side is fine where it is. Put the bridge in whatever location you decide brings the most strings in tune most of the time. (Remember our idea about averaging?)

Forget about marking the location of the bridge on the top somehow. It is better to become good at making the tests and learning how to adjust the location. Don't be afraid to make this adjustment. It is time consuming especially when you are just learning how to do it. But, you will have an instrument that sounds better as a result. And you will be able to make future changes whenever you notice that your notes are not "fretting out" correctly.

You might wonder why, if we used the tuning machine for testing, we did not play any other notes around the fingerboard. Why, for example did we not play a 1st fret F on the 1st string and see what the tuning machine says about that note. You are certainly free to do so if you are curious. But, the height of the string at the nut might be too high and cause the first few fretted notes to be way sharp of the average notes throughout the rest of the fingerboard. I often pick up mandolins which play in tune very nicely everywhere but the 1st fret just because the nut is too high. Lower the nut and all is well. We will deal with those notes close to the nut in the section on adjusting the nut.



Adjusting String Height at the Bridge

Required items:

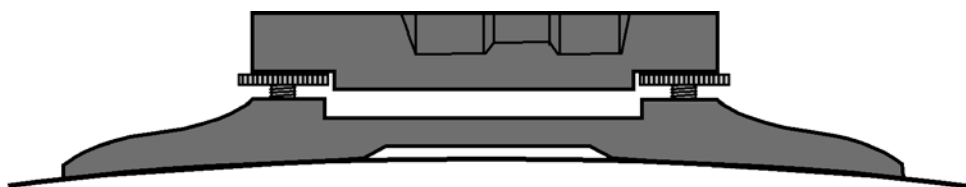
- A small ruler

String height (action) can be a very personal matter. Some people prefer a higher action than others. Some struggling beginners, and a few advanced players, struggle by attempting to play an instrument with that action too high or too low. Too high and it hurts to play. Too low and you get lots of fret buzzing on strongly played notes.

The overall action is a combination of things: height of strings at the nut, height of strings at the bridge, gauge of strings, neck curvature and style of playing. All of these factors are part of what is known as "action". This section explains how to raise and lower the action at the bridge if you have an adjustable height bridge which is the simplest of all these things to adjust.

I like to take a before and after measurement so I can gauge the amount of change I have introduced by moving the bridge. Most luthiers measure the string height at the 12th fret.

Here is an illustration of a typical mandolin bridge:



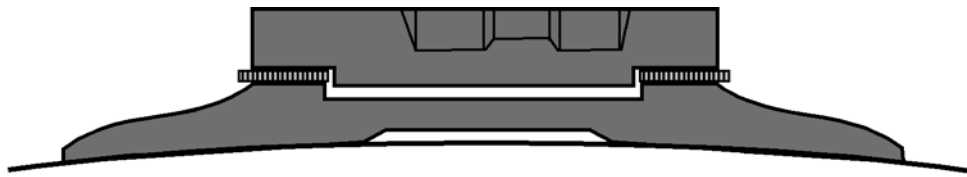
Gibson style adjustable height bridge.

The bridge is very simple to adjust. Simply loosen the strings. Not enough to allow the bridge to move, but enough to release most of the down force on the bridge. Releasing the tension (de-tuning) will prevent the threads of the screw post or thumb-wheel from being ruined as you turn the nut. Loosen the strings partly whether you are lowering or raising the bridge. The pressure of the strings can ruin the threads in either case. The wheels will turn easily if you loosen the strings.

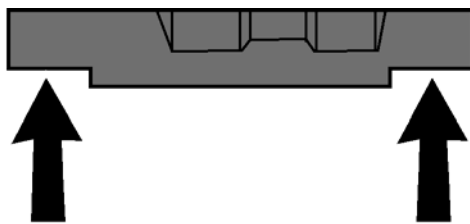
With the tension reduced, simply turn the knurled thumb-wheel to raise or lower the upper part of the bridge as desired. I like to have my bass strings slightly higher than the treble strings so I leave my bridge tilted at a slight crosswise angle. Adjust the wheels to suit you and then tune the strings back up to pitch and you are done.

There are, of course, some mandolins which have solid, non-adjustable bridges. If this is the case with your mandolin the only way to adjust them is to add material (in the form of thin, ebony or rosewood shims) to the bottom of the bridge or to sand away material from the bridge feet or top. Talk to a qualified luthier before you start whittling away the bridge of an old vintage mandolin. It might be a better idea to replace the old bridge with a newer adjustable model and save the original one in a bag in the case.

Once in a while you will find that you cannot lower the bridge as far as you would like to because the upper part comes to rest on the lower part like this:



This bridge is lowered as far as it can go without modification. Although you risk weakening the top part of the bridge, it is possible to sand or file the "notch" a little deeper allowing you to lower the bridge a bit more. The arrows show where material is removed.



It is also possible to completely remove the thumb-wheels and screw posts, file or sand the area they rest on, and bring the top down without altering the upper part.

Sometimes, depending on the bridge dimensions, the upper part will bottom out on the lower part all the way across between the thumb-wheels. In this case, in order to go lower, one must remove some material across the bottom of the saddle or deepen the opening between the wheels on the lower part of the bridge.

Be cautious, and perhaps seek a professional's opinion before hacking away at your bridge. I have made this modification on a few cheap "beginner" mandolins when nothing short of resetting the neck angle would have made them playable. And that would have been insane on an instrument of that price range. The work would have cost more than the mandolins were worth.

There is always the chance that if you remove very much material from the bridge, especially the upper part, it will become too weak to resist the downforce of the strings and will bend, crack or break.

On some bridges, the holes for the screw posts go all the way through the upper part of the bridge. Once in a while you will find bridge tops where the hole only goes part way through leaving the top of the saddle solid with no holes. When you lower the wheels as far as they will go sometimes the top of the screw will "bottom out" in the hole preventing any further downward motion. In this case, it is possible to remove the top section, choose a drill of the correct size and complete the hole so it goes all the way through. Of course, you might knock a big chip out of it when the drill emerges, or ruin it in some other way.

If you lower the bridge so much that the screw posts are sticking out of the top of the saddle you might need to file them off smooth so you don't snag your wrist on them when you are playing. The screw posts are normally "threaded" into the lower portion of the bridge and sometimes they can be turned in a little deeper, but often they are already in as far as they will go.

Warning pertaining to vintage instruments: Think twice before modifying any part of a vintage mandolin. The part you decide to alter may be rare and you might lower the value, both in terms of monetary value and historical value, of the instrument by "hacking" on a fine, old instrument. I am a believer that instruments are meant to be played and not locked up in museum cases or bank vaults, but be aware that the part you modify, remove, or destroy may be unique or at least nearly impossible to replace.

You will notice that I didn't give you any measurements for how high the strings should be. String height is such a personal preference that I would rather you discover your favorite action settings through experience. Play other people's mandolins. Ask them what kind of strings they use. Ask them if you can measure the height of their strings. Take a reading at the 12th fret. Check to see if the bass side and the treble side are the same. Check the amount of neck relief. Check the height of the strings at the nut. Play the instrument and see how it all feels.

If you do some research like this you will learn a great deal about the many different possible setups that are in use by different players. With some accumulated information you will be better able to set your instrument up the way you want it to be. Or be better able to describe what you are seeking if you take it to an experience luthier for action work.

Just for the record, I checked the height of my strings at the 12th fret on my Flatiron F-5. It is about 4/64" on the bass side and 3/64" on the treble side. But, don't use my numbers. Find what you like. Your "perfect setup" will be something that is perfect for you, not for me.



Photo of "Uncle Rudy" by Tara Adcock

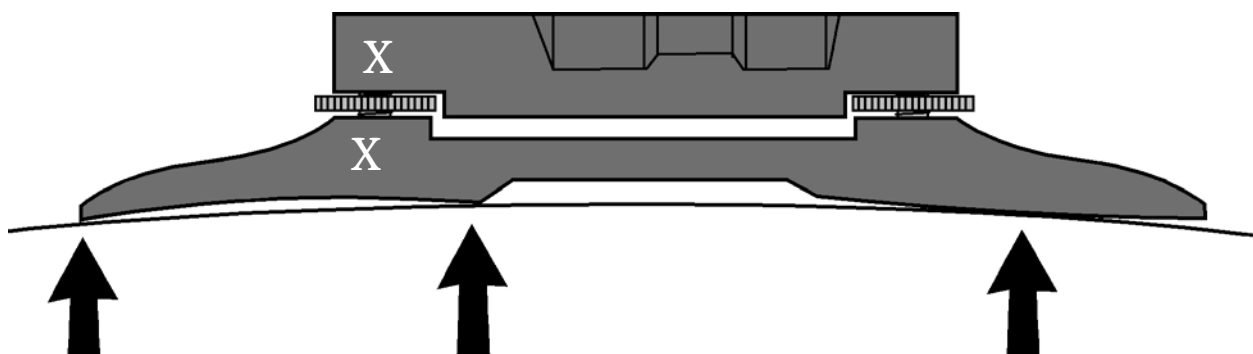
Fitting the Bridge Feet

Required items:

- 6" square of 150 grit sandpaper
- 6" square of 220 grit sandpaper



It is a common and accurate belief that having a "perfect" fit between the bridge feet and the top of the soundboard improves the sound quality. To check the fit of the feet of the bridge to the curvature of the top hold the mandolin up to a bright light and sight with your eye directly in line with the bottom of the bridge feet. Tilt the mandolin at various angles and look for "cracks of light" under the feet which indicate a poor fit with the top.



Arrows indicate locations on the bridge feet which are making contact with soundboard. Drawing is grossly exaggerated for illustration purposes. The actual gaps may be as small as a few thousandths of an inch.

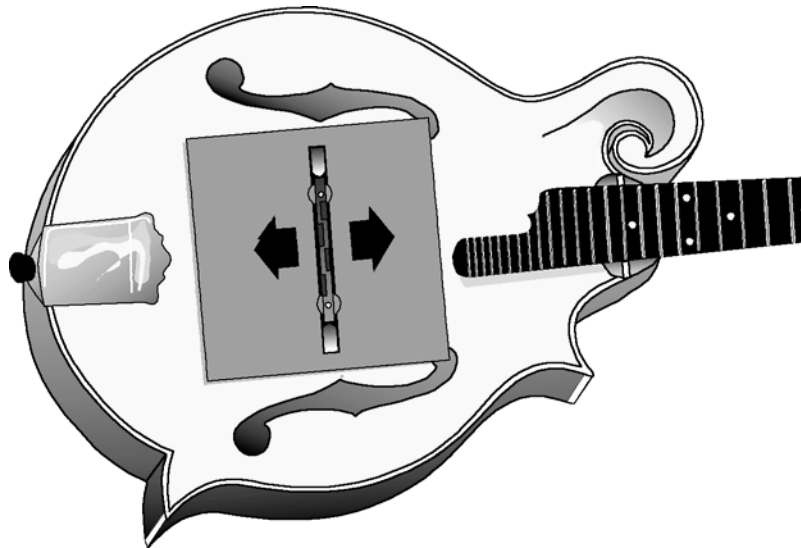
In the illustration above the left side is touching at each edge but it not in contact in the center of the foot. The right side is just the opposite with the center making good contact but the edges are not touching. You may also use a slip of paper (which is about 0.005" thick) and see if you can slip it under the bridge feet anywhere.

In order to eliminate the gaps and create a near-perfect fit we must sand away the "high points" on the bottom of the bridge feet. Before you do anything else you might want to use a pencil and mark which side is the bass and which side is the treble on both the upper and lower parts of the bridge. I usually just put an X on each part on the bass side of both parts. There is a good chance that the top will fall off the screw posts as you handle the bridge and this will assure that you can reassemble it correctly.

Next you must remove the strings. The bridge will then be loose so plan on going through the procedures for setting the bridge in the correct location as previously described in the book. I like to lay the mandolin on its back on a folded bath towel or a piece of carpet. Sometimes I do the job by holding the body of the mandolin on my lap with the neck held between by knees facing away from me.

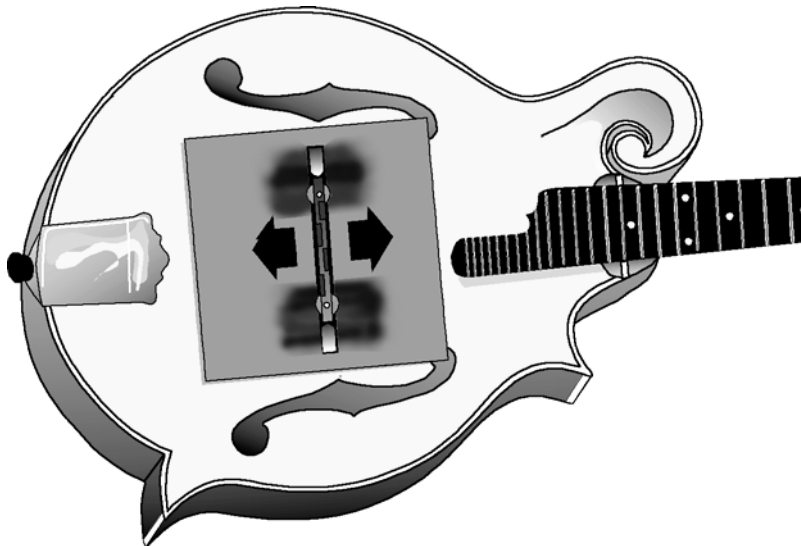
Now you are ready to begin the sanding process. Take the 150 grit paper and lay it on the top of the soundboard with the grit side facing up! You can use some masking tape to stick the corners down to the soundboard if you like.

With the sandpaper face up you should now place the bridge on top of the sandpaper positioned as close as possible to its original location between the f-holes. Instead of moving the sandpaper we are going to grasp the bridge and scoot it back and forth, holding it as securely and squarely as possible, and gradually sand away the contact areas of the bottom of the feet.



Sandpaper is face up! Move the bridge, not the sandpaper.

You will only move the bridge in the direction shown by the arrows (towards the fingerboard and towards the tailpiece) in a back and forth motion. You should only move the bridge an inch or less in either direction as the curvature of the top changes too much as you get very far from the center. Just slowly and carefully move the bridge back and forth and you will begin to see dark stripes of ebony (or rosewood) sawdust appearing on the sandpaper indicating the "high points" you are gradually wearing away. As you work, do everything in your power to maintain the bridge in an upright position, not tilting it side to side at an angle, and try to take as small of a stroke as you can. Back and forth 1/2" will do the job if you are patient.



Dark bars of color appearing on the face up sandpaper as the fit improves.

Periodically blow off the accumulation of sawdust and sand some more. When the stripes of color on the sandpaper are even and dark all across the width of each foot of the bridge you should have a pretty good fit established.

Next, switch to the finer grain sandpaper and place it face up as you did before. Sand a bit more to achieve a smoother finish on the bottom of the bridge. It usually doesn't take much removal of material in order to greatly improve the fit of the feet. If you find you have to remove so much material that you end up removing the gap between the feet you may want to reestablish its shape after you finish sanding. Most mandolins (though not all) have two distinct feet with a gap between them that does not contact the top.

Once you are done with the sanding process just clean up the sawdust and reinstall the strings and locate the bridge. When the strings are at full tension you may find that the top flexes down slightly which causes the ends of the feet to end up with a slight gap. If this is happening the task of correcting it is a bit more complex. When I have noticed this in the past I just do a bit of hand sanding everywhere but the edges that showed the gap. Or you can use 1/2" wide strips of cut sandpaper, face up, and hold the bridge in place as you pull the sandpaper from underneath the high places of the feet. The chance of marring the finish of the top is much greater if you do this so *be very careful*.

Perhaps you will never try this bridge fitting procedure but I hope that by reading this section you will have a better understanding of the process and methods if you ever ask a professional luthier to do the job for you.



Red Light Cafe, Atlanta, Georgia - Left to right: Fred MacIsaac, the author, and David Ellis

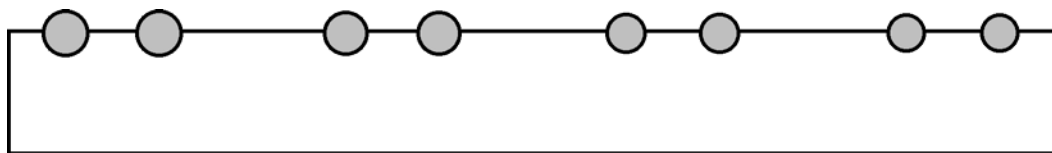


Adjusting String Height at the Nut

Required items:

- Set of "nut files"
- Sandpaper
- Set of feeler gauges
- Small steel ruler marked in 1/64" increments or millimeters

Earlier we learned how to adjust the height of the strings at the bridge. The other contact point for each string is the nut so it too must be adjusted if we want to control the height of the string properly. As with string height at the bridge, personal preference comes into play here, at least a little bit. It has been my experience that every new mandolin arrives with the strings too high at the nut. I think the reason for this obvious. You can lower the strings easily by filing the grooves (or slots) deeper but you cannot easily raise them up! So, by shipping a new mandolin with the nut left relatively high you can lower the strings down to suit you.



Cross-sectional view of mandolin nut showing the strings resting in their grooves.

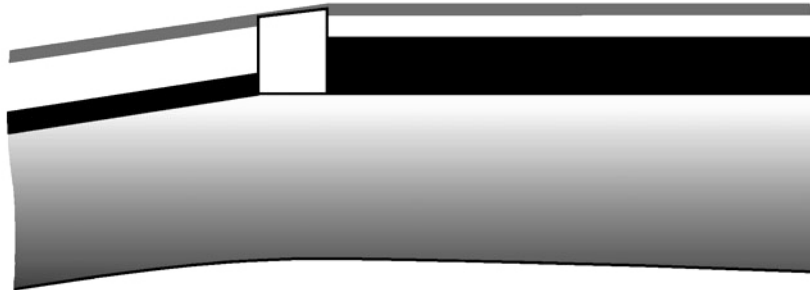
So how high should the string be at the nut? Here is a good way to feel for yourself what a good nut string height should feel like. Get a guitar capo (or a banjo/mandolin capo) and put it on your mandolin at the 1st fret. Now, press the strings down with your fingertips at the 1st fret. (Really the 2nd fret since we have the capo in place.) Get a good feel for the amount of pressure required to bring the string down to the fret. Now, remove the capo and do the test again at the real 1st fret. Does it feel harder to push the string down? It is the same? To me, the string should be no harder to press down to the 1st fret with or without the capo.

As the string leaves the nut it angles gently up and away from the plane of the frets, ending up perhaps 1/4" above the frets at the end of the fingerboard. Near the nut the string is much harder to bend down into contact with the first fret compared with the relative ease with which you can press the string down near the center of the fingerboard. Why work so hard? I like to get those strings down so that the first fret notes are as comfortable as all the other frets on the neck.

You might want to get a feeler gauge and insert the blades under the string with the capo back in place at the first fret and measure the clearance between the strings and the 2nd fret. Just select a gauge that you can barely feel some resistance as you pull it from under the string. Then, remove the capo and insert the same feeler gauge blade between the string and the 1st fret. Does it feel the same or is it a lot looser fit? I like them to be about the same.

The process for bringing the strings down, to whatever point you desire, is simple in concept but tricky in actual practice. All you really have to do is make the grooves deeper. The tricky part of the

operation is a) having the proper tools, b) filing the groove at the proper angle, and c) **making sure you don't get them too deep!** If you get them too deep you will have a nasty buzz caused by the string vibrating against the first fret which can only be corrected by making a new nut!



Side view of string at the nut.

The illustration above shows the geometry of the string "breaking over" the edge of the nut as it goes out over the fingerboard. The grooves (or slots) should be angled back at the same angle as the peghead to assure that the string is in good contact at the very edge of the nut. If the slots are cut with their bottoms parallel with the plane of the fingerboard, or worse yet, if they are angled downwards towards the fingerboard, the strings will often buzz in the slots. If the string contacts the back edge of the nut, and the slot is cut drastically downwards towards the fingerboard, the distance from the "nut" to the first fret has been artificially increased which can cause all 1st fret notes to be out of tune. The end of the fingerboard which butts up against the nut has been carefully measured to be the correct distance from the 1st fret. Never remove the nut and alter the end of the fingerboard unless you know what you are doing.

To deepen the slots properly a set of gauged nut files is used. Luthier supply companies have them in a variety of sizes. It is always best to use a file that is rounded on the bottom, just like the string, and that is the same width as the diameter of the string. This means 4 different sized files are used to do the job right. Yes, it is possible to use just one or two sized files and rock the file from side to side to create the desired slot width, but having the correct files is one of the big secrets of doing the job right. Some people will grab a small triangle "needle file" and dig away at the slots until they have them where they want them. The problem with the triangle file is that the walls of the slots end up flat instead of rounded like the string. This means there will be a tiny v shaped trough under the center of each string and the string itself will only make contact at two microscopic points at each side. All luthiers would agree that the slot should be the same shape as the string.

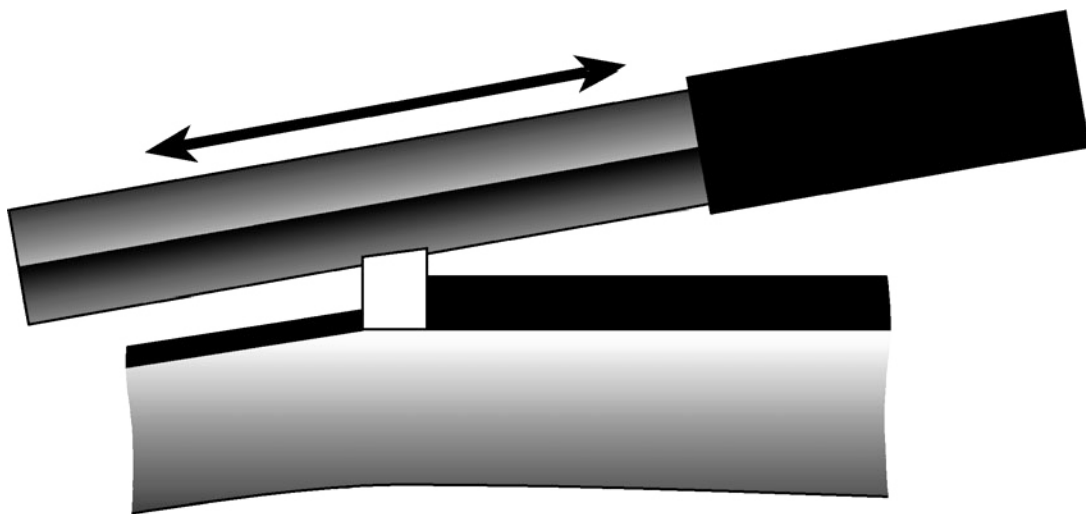
If you have the proper files in hand, here is the procedure for filing the slots deeper. The illustration on the next page shows a fret file held at the proper angle (this is called "ramping the slots") while cutting them deeper.

Filing the nut slots is a very tedious and time consuming process since you must, one at a time, loosen a string, move it out of the slot, file a stroke or two, replace the string, tune it up to pitch, check the progress, and repeat. This is done over and over on each slot until each one is where you want it to be. If you get in a hurry and decide to take 30 strokes of the file you may find that 29 would have been perfect. Now, you went too far and you will have to make a new nut or shim the nut up higher and then cut the slots even deeper.

Making a new nut is as much an art form as it is a science. I have made a few over the years, usually because I accidentally went too far in my filing process, but I prefer to have the luthier make them. I have a lot of patience but not enough for lots of nut-making.

If the strings are really, really high, and you need to lower the overall height of all of them by a great deal, it is possible to remove the nut and sand the bottom squarely thereby reducing the string height of all the strings at once. If you decide to remove the nut you must loosen the strings and get them out of the way. The nut may have some lacquer or varnish over it so you need to score a line around the nut with a sharp exacto blade so that you don't knock out chips in the finish during the removal. After this, the best way to get the nut out (if it hasn't already fallen out on its own) is to tap the nut sideways using a small diameter wooden rod as a punch. Just tap the nut sideways and, if it is glued in with a tiny drop of glue, it will pop free. I always punch them sideways towards the treble side so that any possible chip which might come with it ends up on the non-player side of the neck.

While on the subject of nuts, let me mention that the nut may be made of bleached cow bone, mother-of-pearl, or a super hard synthetic such as Micarta®. This section is really not meant to turn you into a mandolin technician. Like some of the other sections in this book, it is designed to help you understand the process better. File away if you feel like it, but do some research and arm yourself with the proper tools.



Nut file in action at the proper angle.

Here are a few more things you should know about nut work. A luthier who takes pride in his work, and knows what he is doing, will leave your nut in the following condition:

- a) The strings will be in a level line across the nut of you have a flat fingerboard, or in a matching curve if you have a radiused fingerboard.
- b) Each unison pair will be evenly spaced.
- c) The top of the nut will be reduced so that the strings just peek out over the tops of the slots. Some strive to have half the string in the slot and half above. In other words, the slots are not left extremely deep.
- d) All filing marks and sanding scratches are polished away from all nut surfaces.
- e) The nut is glued in place with a very tiny dot of glue. Just a tiny spot to keep it from having any tendency to move sideways in the slot or to keep it from falling out when the strings are removed. It is very lightly glued so that it is simple to remove should that ever be necessary.
- f) The sharp corners of the nut are radiused in an artistic fashion and for playing comfort.
- g) The strings will fit perfectly in the bottom of the slots with the slot just barely larger than the string so that the string can move freely through the slot during tuning.
- h) The slots will be ramped back at the same angle as the peghead so the string leaves the slot, heading towards the bridge, at the highest point in the nut slot.
- i) The visible surface of the nut will be cleaned of all traces of graphite if it was applied as a lubricant in the string slots.
- j) All sanding and filing dust created during the filing process is cleaned away.

It should be said that different players and luthiers have different preferences for the spacing of the strings. As with action differences, it is a good idea to study the spacing patterns at the nut and at the bridge of other mandolins and decide what you like best. Of course, in order to alter the spacing of the nut slots or bridge grooves, they will need to be replaced or filed down to remove the old slots.

Here is one last little story of an emergency nut repair. Once, at a gig, a fellow musician's nut cracked and a chip came away from the corner so the string kept popping off the end of the nut. In other words, the side of the slot broke away. In a "MacGyver moment" I came up with an idea to cut the nut slot a tiny bit deeper with no nut files within 50 miles. (Luckily the old slots were high enough that it was possible to go a bit deeper so the string would again stay put.) I grabbed a wound banjo 4th string and stretching it tightly I ran it back and forth like a file in the slot. It worked. It proved how abrasive a string can be in the nut slot. It made me think that perhaps a person could make a set of nut files by coating little short sections of mandolin strings with super glue and diamond dust and then mounting them in little tensioning handles. (Like a micro-coping saw.) Send me my 25% commission if you decide to make and sell those.



Suppressing String Vibrations Between the Bridge and Tailpiece

- 4 small rubber grommets, or
- A strip of 3/4" wide braided cloth "tape", or
- Some scraps of suede leather

It has become fashionable of late to address the issue of sympathetic vibration of the part of the string between the tailpiece and the bridge. If you pick up your mandolin, and have no dampening devices in place, and pluck the strings between the bridge and the tailpiece you will hear that they are quite capable of producing an easily heard tone. When you play the strings of your mandolin (in the normal manner) the vibrations pass over the bridge (and through the body) and cause those string segments between the bridge and the tailpiece to vibrate too.

Here is where the issue of suppressing those sympathetic vibrations (sounds) comes into play. Based on the length of those string segments, and the tension of the strings, the musical notes that are produced may vigorously clash with the notes you are playing on the main (speaking length) part of the string. Or, on the other hand, they might pleasingly enhance the overall harmonious sound. Pluck the strings between the bridge and tailpiece a few times and listen to the notes they produce. Play your open E string strongly and, while it is still ringing, pick the same strings between the bridge and tailpiece. Do they clash or harmonize? Next, play a few chords and while they are ringing just strum lightly across the strings "behind the bridge". Do those additional notes clash horribly or do they sound good to you?

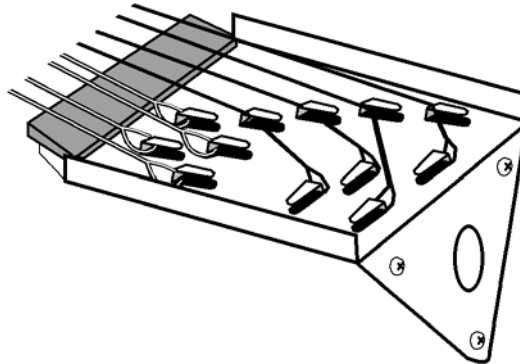
Whether you are aware of it or not, every time you play a note or a chord on your mandolin, these sections of the string begin vibrating and add, in some small way, to the complex overall output of the instrument. The bottom line is this: If your mandolin sounds better to you with the sympathetic string segments free to "color" the tone, then leave them alone. If, on the other hand, you like the sound of your mandolin better with those sympathetic vibrations damped or muted, then by all means damp them by some means.

You can test what it sounds like with complete damping (muting) of this section by taking a length of leather shoelace and weave it back and forth through the strings between the tailpiece and bridge. You could also use a strip of felt or suede or just ask someone to press lightly on the strings with a couple of fingers. Anything to stop them from vibrating freely. Now that the strings are temporarily damped in that section play a little bit and listen. Now, remove the temporary damping "rig". Which sounds better? If you prefer the sound with that section of string muted then here are a couple of ways to do it in a neater and more permanent manner:

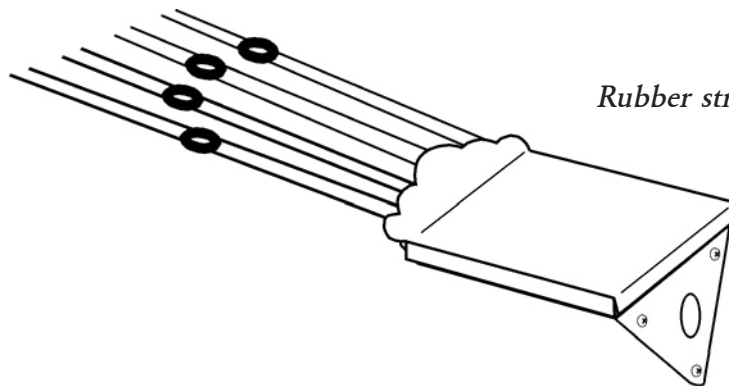
The method used by many players over the years, which I prefer, is to simply glue a small rectangle of suede or soft leather to the tailpiece. In this position, if the leather is the right thickness, the strings will be resting on the leather and will be significantly reduced in their tendency to resonate freely. For my mandolin, and my ears, I prefer this sound. It only partially reduces the sound of the strings in a way that is pleasing to my ear, yet not totally dead sounding. I think that completely muting the strings in that section (on my mandolin) gives the instrument a vacant, empty sound. But, with no muting at all, it has what I call a "clanging jangly" sound which I don't like.

The leather mute installed under the strings can actually be held in place by the down pressure of the strings, but mine is stuck down with a smear of yellow glue. In addition to reducing undesirable string vibration this also "stops cold" any possible metallic buzzes and rattles that can be produced if the strings are barely in contact with the edge of the tailpiece where the strings exit on their way towards the bridge.

Leather "mute" installed under strings



A second method, dreamed up by some mandolinist, is to use a small rubber "grommet" between the strings. These grommets are shaped like a little black rubber donut with a groove around their circumference. These grommets are designed to protect wires as they pass through a hole in a metal object. They are found (much larger) where wiring passes through the firewall of your car under the dash. The "mandolin sized" grommets are simply wedged in between each pair of strings so you would need four of them to mute all eight strings. A couple of my students have purchased these on the internet but I have never sought them out. I have seen them in the "weird hardware" drawers at the local home fix-it center. I have not experimented much with these but they seem to do an excellent job of completely muting that section of the strings. The grommets do fall out when a string breaks or when you remove a string for any reason so I suspect it would be wise to have a few extras on hand.



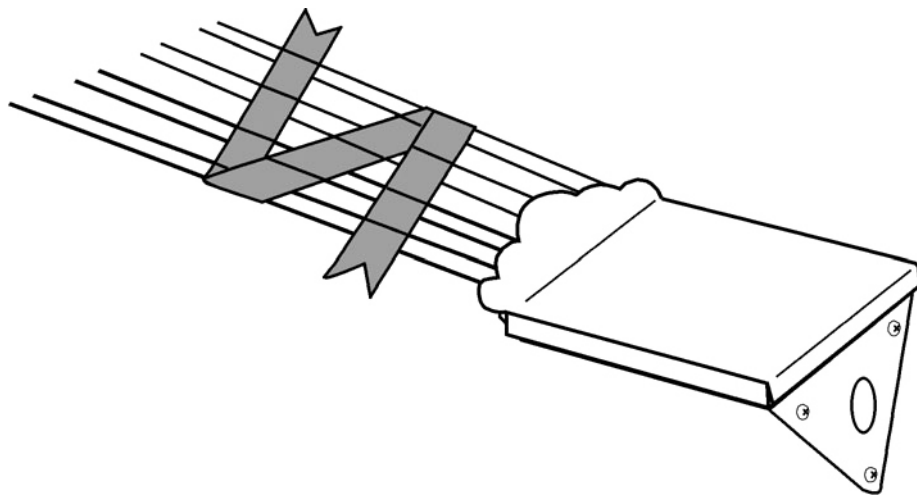
Rubber string grommets installed

I think it would be interesting to experiment with their placement at different points along the string segment to see if that alters the sound in any way. I work as a piano technician and, in the world of pianos, this part of the string is treated in two different ways. Sometimes a strip of bright red, and quite handsome, cloth tape is woven through the strings between the bridge and the "hitch pin" (which is like the tailpiece) in order to mute this section of the strings. It also looks pretty and I am sure helps sell pianos in the showroom. Sometimes, primarily on pricey grand pianos, that part of the string is "tuned" by means of something called an "aliquot" which, in effect, is another tiny bridge wedged under the "non-speaking" part of the string. Some piano designers have fixed the location of the aliquots in

the form of a casting which cannot be adjusted individually and other makers use tiny moveable aliquots. These, in theory, can be positioned so that the "non-speaking" part of the string will vibrate so as to enhance the sound of the main part of the string rather than clash with it.

In thinking about moveable piano aliquots (piano makers call this the "duplex scale") and how they are "tunable" got me thinking that perhaps a similar idea could be employed on a mandolin. By attaching little metal clips (with sufficient mass) at various node points in that section of the string I suspect that one might be able to "tune" and enhance the sounds. Perhaps lead split shot fishing sinkers could be clipped on the string to test the idea. It is an idea that I have not experimented with but it sounds plausible. Instead of damping the entire complex group of sympathetic vibrations it might be possible to select a set of harmonious ones. That is getting a bit deep for this text so I will move on to a third way to mute or dampen the strings.

A really classy looking way of suppressing the string vibrations between bridge and tailpiece is to borrow the method used in grand pianos. In this method a strip of scarlet "stringing braid" (which is a cloth tape about 3/4" wide) is woven back and forth between the strings. It looks beautiful when woven artfully, does a fine job of muting the strings, and won't fall out even if a string breaks.



Scarlet "stringing braid" woven through strings in the style of a grand piano

You should definitely experiment with these ideas. I have heard some mandolins that sounded really "incoherent" and "jumbled" until some measure of muting was applied to the strings. I don't think I have ever heard a mandolin that was hindered by it. As I said before, I am not a believer that the "non-speaking" portion of the string should be deadened completely. But, I also can't tolerate the sound of a lot of discordant "twanging" which interferes with a nice pure mandolin tone.

As with so many things in the music world, this sort of judgement is highly subjective in nature and I respect your right to favor whatever type of sound pleases you. These muting devices are easy enough to put in and take out so you can experiment with a variety of materials (felt, leather, cloth, rubber, even wood) until you find a sound you like best.

Attaching a Shoulder Strap



Required items:

- Commercially made mandolin strap, or
- Leather strip long enough for strap, or
- Length of rawhide lacing

As long as mandolin players have been standing to play they have been devising various ways to hang the instrument from the body. All straps are meant to help hold the instrument in a stable position so that you are free to play with your two hands and not concern yourself with holding onto the instrument.

Before we go any further I should issue this warning. **NEVER** trust your strap completely. They break, they can pop off the endpin, rot, crack, soften, or fail in some other way which can cause your mandolin to come crashing down in the grips of gravity.

If you stroll around a bluegrass festival parking lot and study the various instrument straps you will find a huge variety of clever and not-so-clever straps in use. I have seen fancy tooled leather creations, nylon webbing with holes burned through with a hot nail, rawhide lacing tied around the endpin and scroll, string, shoelaces... you name it! You will see mandolin players with the instrument "hiked up" nearly to their chin with a single rawhide lace over the right shoulder. You will see day-glo yellow nylon straps imprinted with the words "Crime Scene" with the mandolin hanging nearly to the player's knees in true heavy-metal guitarist fashion. You'll see just about everything eventually.

I am a "practical conservative" when it comes to mandolin straps. I want the strap to function well and hardly be noticed visually and I want the instrument stable. I want the strap to easily fit in the case alongside my mandolin without removing it every time I pack up. I want the strap to be comfortable. My choice, after trying a variety of straps over the years, is about the most simple thing you could imagine. The strap is a 5/8" wide strip of brown, chrome-tanned leather that is pretty soft, yet not stretchy. I punched a hole in one end, enlarge the hole by adding a slit with a razor blade, then passed the strap back through the hole forming a loop which goes around the scroll of my F-5. The end which attaches to the endpin has three 1/4" diameter holes, each lengthened with a razor blade slit, and this gives me a couple of choices as to overall length. That's it. No sewing, no tying, nothing fancy at all.

Holes for endpin



Loop for scroll

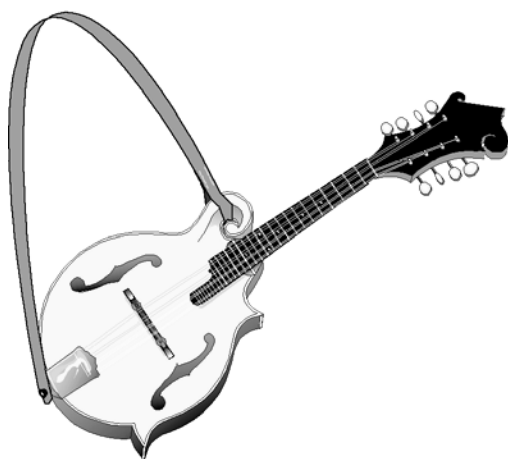


If you are the "arts and crafts" type person you can pretty easily make a strap like that. Attaching it to an F-style mandolin is always easier because the scroll is a good, well-balanced location for carrying the weight of the instrument. An A-style mandolin requires a bit more ingenuity. You will have to either tie the strap somewhere at the peghead or have a "strap button" installed at the neck heel. Strap buttons are little "knobs" that look a lot like your endpin. They are held in place with a screw. Strap buttons are very common on guitars of all kinds, but are frowned upon in the mandolin world.

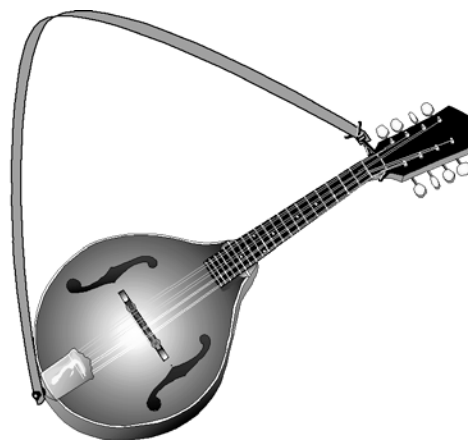
I dislike using a strap button for a couple of reasons. I put one on the heel (in the same way as they are usually installed on an acoustic guitar) of an A-style mandolin I built. I found that my hand hit the button whenever I played up the neck and that was annoying. It also seemed like the instrument wanted to tip and lean forward because the strap comes up around the back of the heel. Some folks dislike the idea of running a screw into the neck heel and, for mandolins, I think I am in that camp. My suggestion is, if you decide upon the installation of a strap button, have it installed by a competent luthier unless you have some experience and know-how about doing it or you might crack the heel.



A student of mine has an A-style with an elevated fingerboard and managed to tie the end of his strap around the body/heel and under the fingerboard. It seems well balanced and works good for him. The other option, of course, is to tie the strap to the peghead somehow with lacing or cord. This works fine if you can get used to the cramped feeling of your left hand sometimes touching the strap as you play. When attached at the peghead (either somewhere among the tuners or down near the nut) the instrument has a tendency to move towards your right side as you play it.



Attached at the scroll of an F-style



Tied to the peghead on an A-style

Some people wear the strap over the right shoulder only. Some wear it across the back and hanging from the left shoulder. That is the way I do it because it just feels better to me. Do what suits you.

Legend has it that many old-time performers (in the days of live radio shows and playing around a single microphone) would hang the instrument really high so that it was nearer the microphone during solos. The legend also claims that hanging the strap over the right shoulder was preferred so that the

instrument could be taken on and off without having to remove their Stetson hats. I think there is some truth to that idea because I wore a ten-gallon hat to a gig once and had a devil of a time getting my strap over my hat without knocking it off. I eventually figured out that I could take the hat off and hang it on my peghead, strap up, and replace it on my noggin. But, it would have been easier to just hang the strap over my right shoulder. I guess if you wear big hats and need to get on and off the stage quickly, in Grand Ol' Opry fashion, the right shoulder would work best.

If you study old photographs of mandolin players from the past, like Bill Monroe, you will see that the legend has some truth to it. Since it is common these days for each instrument and singer to have their own microphones, the instruments have come down from that "playing under the chin" style.

I use my strap even when seated. To me it stabilizes the instrument somewhat and keeps it from jumping all over the place. I play better and enjoy playing more when I am seated while playing. This might be because I do most of my practicing while seated. I suppose it would be a good idea to spend more time on my feet while practicing.

General Comments on Picks

I am reluctant to get into the subject of picks because there are so many different kinds of them and everyone seems to have their own favorites. Before I say anything about my ideas about picks let me state that I think you should use the type of pick that you like. You will anyway. Someone once asked Bill Monroe what kind of pick he used and his not-so-elaborate reply was "This one here."

Picks come in a multitude of shapes, thicknesses and materials. Here is a short rundown of the types of picks which are common:

Celluloid or Plastic Picks - These are made in a dizzying array of colors, shapes, and thicknesses. You can have your picture printed on them. Plastic picks, in general, wear out pretty quick but are cheap to replace. Picks might be made from Delrin, celluloid, nylon, or other mysterious compounds. I generally don't like picks which have a "mold line" or "seam" around the edges like many nylon picks have. I like a really slick smooth edge. For me I use either a Fender brand medium or heavy. I use the rounded corners of the standard teardrop shape for tonal reasons.

The rounded corners of a teardrop shaped pick are slightly stiffer than the point so you get a slightly darker tone and a "heavier feel" which I like. The round corners of a "medium" pick feel like the stiffness of something half-way between a "medium" and a "heavy."

Tortoise Shell Picks - Made from the outer covering of the Hawksbill sea turtle. Incidentally, the Hawksbill is not a "tortoise" but a "turtle". These picks were popular in the early days but now *the importation of tortoise shell is illegal*. Tortoise shell picks are revered for their tonal qualities and long life. They tend to stay smooth longer than plastic and can be reshaped and polished when they become worn or nicked.

Rather than go through some long, drawn out discussion of the ever changing variety of picks that are available, and knowing how pick preference is a highly personal subject, I will veer away and tell you about how, in my quest for the ultimate string-whacking device, I made some picks.



Poor Man's Tortoise Shell

(Reprinted from my MandoUniversity Newsletter)

The importation of genuine tortoise shell is illegal because the sea turtle which is the source of the raw material is an endangered species. Tortoise shell picks are becoming almost impossible to find and when a stash is located it can cost a small fortune just to acquire a few picks. The unlucky Hawksbill sea turtles who are staked to the beach with piles of dry grass burned on their backs rarely, if ever, survive the horrendous ordeal of the shell removal process.

The properties that have made tortoise shell so desirable are: 1) long pick life, 2) even wear with minimal roughness, 3) superior tone, 4) stiffer than plastic picks of the same thickness, and 5) easy to re-polish and restore as wear occurs.

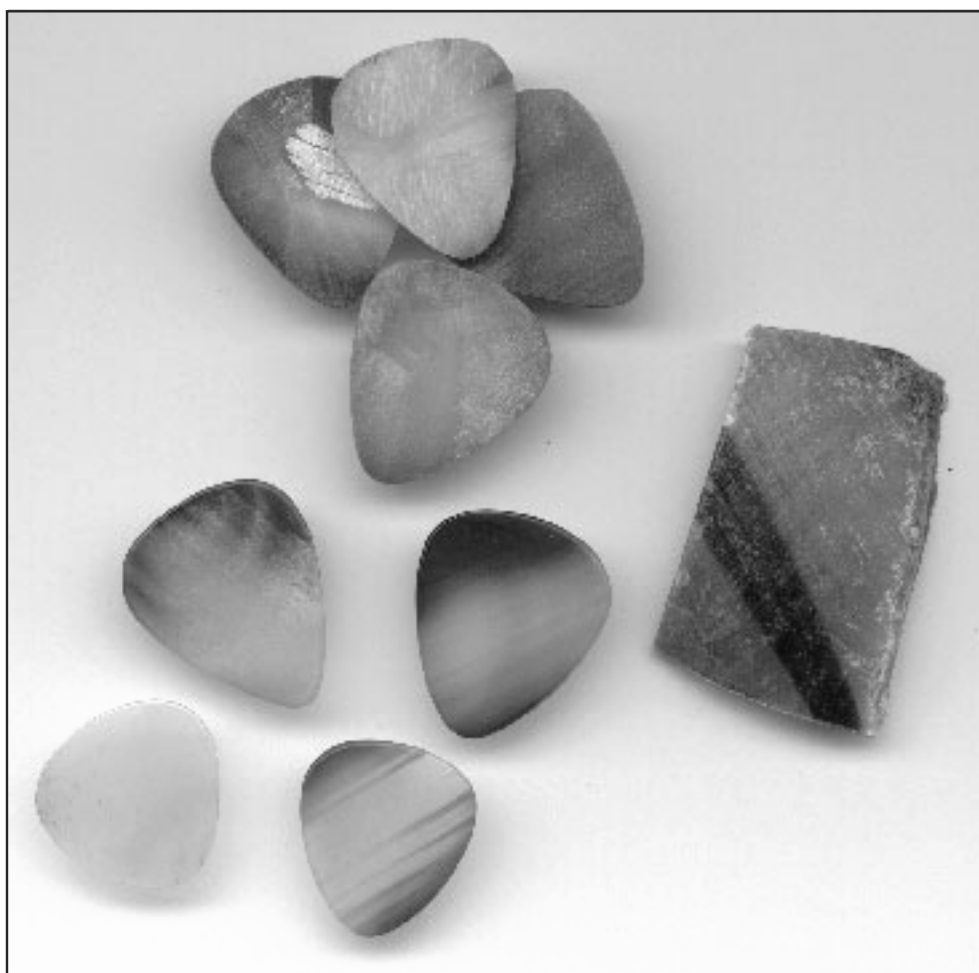
There have been numerous attempts at duplicating the look, feel and performance of genuine shell plectrums. However, all seem to fall short in one aspect or another. Some plastics used in the quest for a suitable alternative include nylon, cellulose nitrate, acetate and various plastics. Some of these tend to soften from the heat which is generated by the friction of picking the strings. Others refuse to stay flat. Others develop rough spots or wear rapidly. On the good side, these alternatives are cheap and do not leave one with a guilt complex over anguished turtles. With plastic picks you may feel guilty over some long-gone dinosaurs if you feel so inclined.

After experimenting with bone, horn, and other natural materials, I found what I believe to be a good alternative to tortoise shell. And the hapless animal donor is going to end up as part of a Happy Meal anyway! The material is cow hoof. Cows are not in danger of extinction and far more humanely dispatched as they march towards the meat locker.

I ran across a bin full of dried cow hooves offered for sale at a pet shop for use as dog chews. I guess the marketing idea is that it is better for Rover to chew on a cow hoof than your new wingtips. At seventy-nine cents each, I picked up four of the them and decided to give them a try as raw material for picks.

After looking the hoof material over for the best areas, I ground flat spots on the sides using a belt sander. Then I traced the outline of some picks onto the flat sides using a pencil.

The hooves are hollow and rather “pithy” on the inside, but the material is nice and solid for a thickness of about 1/4” on the outer surfaces. A few cuts with a coping saw and I had a flat “blank” about 1” x 1.5” with my pick outline drawn on the side.



Cow hoof picks: lower left, finished picks; top, roughed out blanks; right, raw material.

By the way, don't breathe the dust when sanding the hoof. I don't know for sure, but my guess is that the finer particles would do your lungs absolutely no good. I know that dust of mother of pearl and bone are known to cause lung problems so take the safe route and do your sanding with a respirator mask on to filter out the dust. I would suggest that your sanding be done outdoors as well.

Carefully, to avoid sanding my fingertips to the bone, I sanded the inside surface of the flat blanks until they were about 1/16" thick. Then, using the same coarse belt on the sander I roughed out the outlines of the pick perimeters.

From this point, the handwork becomes a bit more of a chore but it still rises far above watching television as a character building experience. Using a sanding block with 100 grit paper I continued to sand both sides of the blank until the pick approached a thickness I thought suitable. Testing the "flex" of the hoof pick at this point revealed that the material is quite a bit stiffer than plastic picks of the same thickness. So, find a pick that feels the way you like and sand the blank down until the "flex" is the way you prefer. It will end up being thinner than you expect.

As I approached the correct thickness (which may vary some from hoof to hoof) I used finer and finer grades of paper on the block. I used some 600 grit paper to remove all traces of sanding marks left by the coarser grades.

At this point I rounded the edges using 300 grit paper, polished them smooth with 600 grit and then buffed the entire pick using a drill press mounted cloth buffing wheel and jeweler's rouge polishing compound. If buffing reveals scratches, back up and re-sand with 600 grit and buff again.

Start to finish, I spent about two hours to complete three picks. That may seem like a long time but it is far less than spending 10 years in the slammer for messing with tortoise shell!

The hoof material polishes to a nice gloss and is a translucent light brown to dark brown color when completed. Various colors, streaks, and patterns are found as you search through the hoofs and different colorations may alter the performance of the pick as well. It will require more experimentation to determine this.

In actual use, the picks feel really good both on guitar and mandolin. The tone is darker than a similarly flexible plastic pick. I doubt that cow hoof picks will ever approach the hallowed status of tortoise shell, especially in light of the organic substances the hoof has stepped in over the years, and due to the fact that it is so easy to obtain, but given a fair try it may prove to be a good alternative. Make some and see for yourself. Worn edges are easy to re-polish with a small square of 600 grit paper and fingertip rubbing with auto polishing compound.

One thing is certain. If you put two hours into making a pick you are going to be far less likely to lose the thing.

(End of article as it appeared in the newsletter)

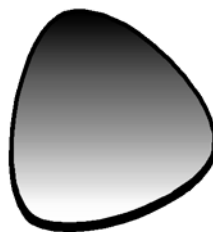
So much for picks. Picks are fun to talk about, compare, and trade. They make for good conversation when they fall out on the counter at the grocery store as you dig for change. They accumulate in the belly of your washing machine. They will be discovered by archeologists of the future, still perfectly intact, buried along with the rubble of what once was your home. Collectors of the future will proudly mount them on magnetic ion wavefield "boards" and levitate them in their living rooms next to their display of stone age flint arrowheads. It is completely up to you what you use, how you treat them, and what lengths you go to in order to find the perfect pick.



*Standard
teardrop*



*Round, or
well-worn triangle*

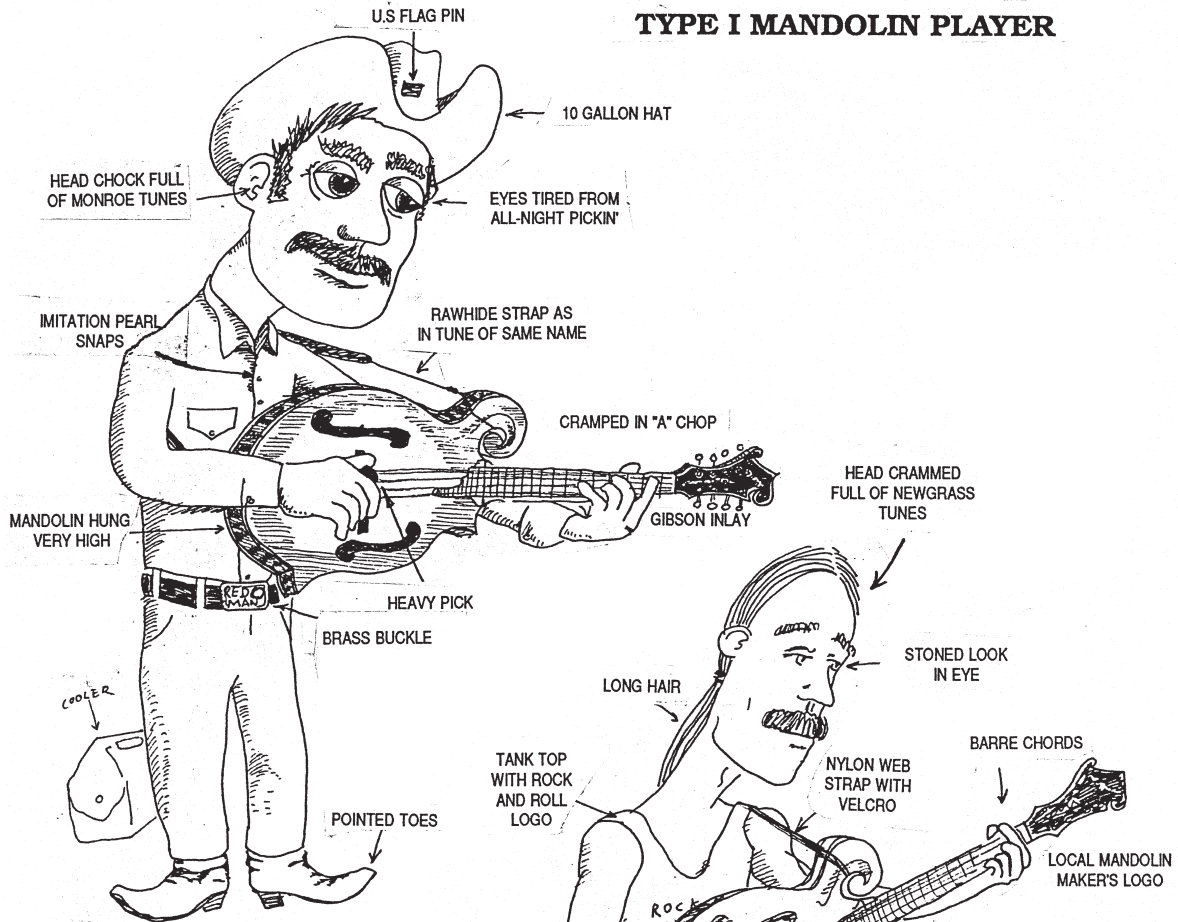


*Triangle
shaped*

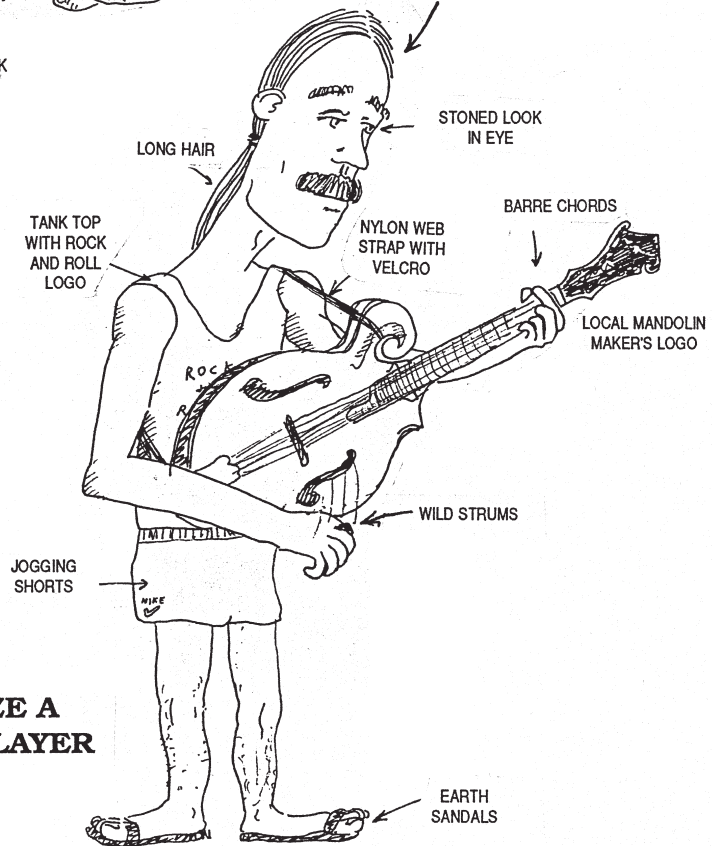


*High-tech pick
of the future?*

HOW TO RECOGNIZE A TYPE I MANDOLIN PLAYER



HOW TO RECOGNIZE A TYPE II MANDOLIN PLAYER



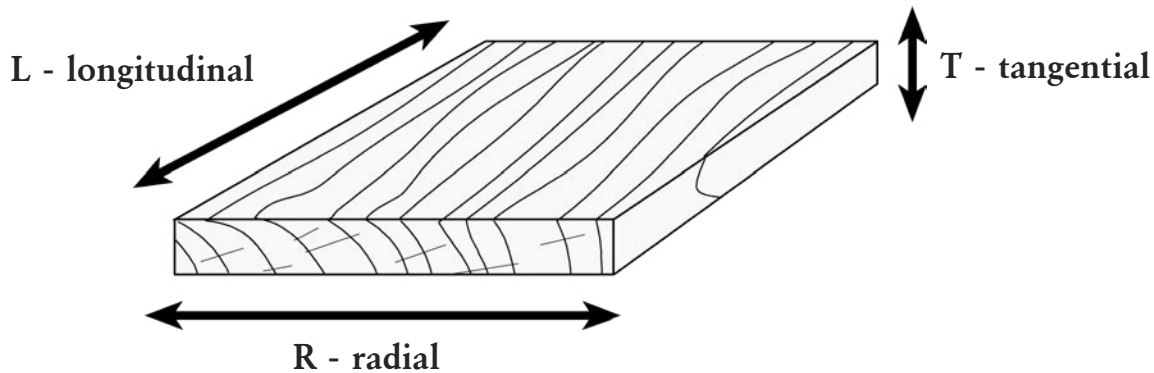
Brad Laird

Cartoon drawn by the author from his 1988 mandolin workshop "handout"

Humidity and Your Mandolin

Mandolins, and all things made of wood, can be damaged by rapid or extreme humidity changes. Even though there is a protective finish on the outer surfaces of the wood of the instrument, changes in the humidity of the environment affect the wood itself. As wood is exposed to higher levels of humidity it takes on water and expands. As wood is exposed to lower humidity it shrinks. These dimensional changes, actual physical change in size, can cause cracks in the wood and glue joints to pull apart.

Wood changes in size in response to humidity changes more in certain grain orientations than in others. The illustration below shows the three basic grain directions in a piece of wood.



The arrow marked "L" is the **longitudinal** direction parallel with the lengthwise grain. Wood shrinks and swells very little in this direction in response to humidity changes. The arrow marked "T" is in the **tangential** direction which is parallel to the annual rings. Wood shrinks and swells the most in this plane. The arrow marked "R" is the **radial** direction which is across the annual rings. Wood shrinks and swells a moderate amount in this direction—not quite as much as "T" and a lot more than "L".

An important fact about all of this is that wood does not change in dimensions equally in all directions as humidity changes. When different pieces of wood in the mandolin are glued together they may have edges joined which do not swell and shrink at the same rates. For example, where the sides meet the edges of the soundboard. Glue joint failures along this area are fairly common. The glue joint down the centerline of the soundboard rarely ever fails because the two halves of the soundboard are oriented similarly and thus they shrink and swell as if they were one piece of wood. The soundboard will shrink and swell a lot more across its surface, and in thickness, than it does lengthwise.

Consider how hardwood floors tend to shrink in the dryness of winter and gaps open up between each plank. In the summer, when humidity is high again, the boards swell and the gaps close. This is fine for your oak floor, but not so good for a musical instrument. The bottom line is this: Minimize humidity changes and the instrument will remain in good condition longer. Huge or fast swings in the humidity around an instrument can swell or shrink the wooden parts beyond their breaking point and cracking and other damage can appear.

When wood is freshly cut it is very high in moisture content and as it "cures" and dries out it shrinks. Instrument makers go to great lengths to assure that the wood they use for construction has reached equilibrium with the surrounding humidity before it is used. The standard for average humidity in their

workshops is 42% relative humidity. (This is pretty close to the national indoor humidity average for the continental U.S.A.) Instrument factories are maintained fairly close to this 42% humidity range. Once the mandolin is living outside the protective walls of the manufacturing facility it is at the mercy of the surrounding air. If the humidity rises it swells. If the humidity falls it shrinks. Unevenly. So, the closer you can maintain the relative humidity to 42% the better for your instrument. Now, this doesn't mean that a mandolin will fall apart if the humidity goes to 30%. Nor will it explode if it rises to 65%. But, it is changing in size. The finish (and keeping it in its case) slows down the reaction to humidity in the surrounding air. Simply keeping your mandolin in its case, out of direct sunlight, and away from heating and air conditioning vents can go a long way towards protecting it from damage.

In the winter, here in Georgia, the humidity will sometimes drop to 20-30% for days at a time. These are usually cold, clear days when you get shocked whenever you touch a doorknob. Those are the times to take extra precautions with the instrument. Remember that the mandolin was made at around 42%. So, the longer you keep it exposed to the low humidity conditions the riskier it is for the instrument. It might tolerate it for a while and then suddenly crack or split. The swings in humidity indoors is much less than outdoors. Relative humidity may change by more than 50% in a 24 hour period outdoors but indoors the rate of change is slower. So, indoors is a better place for the instrument to rest.

I keep a digital humidity meter in my music studio and check it pretty often. When things begin to get in the dry range I put instruments in their cases and will sometimes stick *instrument humidifiers** in the cases. I also have a room humidifier that I run which is set to come on when the relative humidity drops below 35%. There is less concern with high humidity but long exposure to high humidity can make the mandolin sound tubby and if the drying, which inevitably will come, is sudden, serious damage can occur. High humidity levels for extended periods of time will encourage mildew and mold growth, corrode metal parts, and weaken some types of glue.

Another thing to remember is that the finish on your mandolin, while it looks like a hard coating, is flexible and can stretch with the changes in wood dimensions—within limits. If the wood of the instrument changes in size faster or more than the finish can physically bear, the finish can develop hairline cracks or flake off. The same applies to the strips of binding which don't change in size, except gradual shrinkage due to age, and so can pop loose when the wood changes size.

Here is the simplest way I know of to explain how to care for your mandolin: Treat your mandolin as you would a newborn baby. Don't leave the baby in the trunk of the car during a blizzard or a heatwave. No extremes of heat or cold. No burning sunlight. Don't set the baby down where someone will step on it. Don't balance the baby on a bar stool or a rocking chair where some clumsy oaf will knock it to the floor. Even though we don't usually think about humidity when caring for a baby, our skin is much healthier if not exposed to overdrying or constant moisture. So, include humidity in your thinking too. (It is OK to close the mandolin up in a dark case and leave it in your closet for months at a time which you should definitely not do with a baby! My analogy fails if carried too far.)

**There are several manufacturers of instrument humidifier devices which hold water and are placed inside the instrument body or in the case to combat low humidity. With any of these devices it is imperative that no liquid water ever comes in contact with the wood, only water vapor as it evaporates. Read the manufacturers instructions and follow them. Old timers used a cut apple or potato in the case.*

Cases, Instrument Stands and Horror Stories

In over three decades of performing, I have seen a number of fine instruments damaged in a variety of entertaining ways. I saw a friend of mine eating a plate of bar-b-cue with his brand new Martin HD-28 guitar slung across his back a la Johnny Cash. I saw the strap pop off the endpin and the guitar dropped straight down, peghead first, onto the hard Georgia clay. Luckily for him the guitar did not break but bounced and got a little scratched up.

I watched a guy take a step backward on stage and put his heel right through the front of a fiddle that was leaned against the back wall. It flew apart upon impact with the boot heel. I witnessed one of Doc Watson's guitars get smashed by a lighting technician working on a ladder. Once I saw a nice old Martin get the headstock broken completely off when some drunk bumped into it and knocked it to the floor. It was, foolishly, leaning against a bar stool. I was returning late at night from a festival with the whole band in a station wagon as "bungies" broke and the bass fiddle flew off the roof to be demolished by a pickup truck in the dark of night. No case would have saved that old bass.

I saw our banjo player's 1930's Gibson hit the floor and break off its peghead because it was resting in a flimsy instrument stand on a bouncy stage. He merely walked in front of it and the stand tipped over, face first, and boom. He never even touched it. To make matters worse, at a gig a few months later, the same banjo fell off the same flimsy stand again and this time the neck broke completely off at the heel. (I was proud that the repair job I did on the peghead held!) We had a little fun with that banjo after it broke the second time. Our fiddle player was off somewhere in the food line or something when it fell and broke the second time so we stuck it back together and put it back in the stand as if nothing had happened. When he returned and was standing with his back to the already broken banjo I pushed it over and we all yelled "Jeff, you idiot! You broke Jimmy's banjo again!" For a few minutes he really believed that he knocked it over. Our stupid grins and restrained chuckling eventually forced us to spill the beans and let him off the hook.

I could go on and on with more horror stories, but I will end with one that I remember very well. Some guy, during a break at a backyard bluegrass gig, foolishly rested his banjo on the seat of a rocking chair. While standing in line for a beer, he heard what sounded like a .22 rifle go off on the back porch. Rushing out to see who had been shot, the guy saw his banjo laying on the concrete where it had slipped out of the seat of the chair when someone brushed against the rockers of the chair. Gravity is a powerful force. The reason that incident sticks in my mind so clearly is that *I was the idiot* who left his banjo laying in a rocking chair. Luckily the damage was relatively minor and I still play that banjo. Learn from other people's mistakes. It is better if you never have any "good stories" like this to tell.

Cases come in a variety of styles and price ranges. Here is a brief description of the major types of bags and cases.

Gig Bags - These are sewn cloth bags with zipper closures. They are usually padded somewhat and offer a bit of temperature insulation. However, they are useless when it comes to preventing breakage. The instrument will survive gentle knocking about but it won't do much in the event of more catastrophic collisions. My friend, fellow bandmember, and professional luthier, Bob MacIsaac, jokingly calls them "The Luthier's Best Friend" because their use leads to more business in the repair trade.

Chipboard Cases - The cases are made of cardboard. The outside is covered with "leatherette" embossed paper and the inside is usually "flocked" which makes it feel like thin velvet. The interior fit is always very loose and the instrument can bounce around inside the case while carrying. They protect against gentle bumps but nothing serious. They are fine for keeping an instrument in your closet, or just to keep the dust off. Don't ever let a chipboard case be exposed to even a light mist of rain as it will cause the chipboard to fall apart. Chipboard cases are better than nothing—barely.

Fabric Covered Foam Cases - These are the latest innovation in "cheap cases" and they are actually pretty good. They are made of a block of molded polystyrene foam, are lined with foam and velvet, and are covered with a synthetic fabric sewn outer shell. They usually have zippers and Velcro closures of some kind. The cases are inexpensive, offer pretty good protection from hard blows or dropping, and are extremely good temperature insulators.

Plywood "Hardshell" Cases - This type of case is basically a plywood box, covered in vinyl or fabric, lined with velvet covered foam rubber inserts. They vary in strength depending on the thickness of the plywood used. The heavier they feel the stronger they are. They offer good protection from damage and have good insulative and padding qualities. If the latches and hinges are strong they are hard to beat.

Thermo-Molded Plastic Hardshell Cases - These cases have an outer shell of molded plastic which is lined with foam covered in velvet. The cases are pretty strong and don't get ugly as fast as the standard plywood cases. They are lighter than the plywood variety.

Reinforced Fiberglass Cases - This type of case has an outer shell of molded fiberglass with the usual foam/velvet interior. These ultra-protective cases have plywood strengthening inside, rubber seals around the lid edges, and sometimes even an interior humidity gauge. They are pretty expensive but protect the instrument incredibly well. However, even the strongest case made is useless up against the destructive powers of the average airline baggage handler!

Most cases are black in color which will heat up rapidly if left exposed to direct sunlight. If you have a black case keep it out of the sun! If I am forced to stand around in the sun for even a few minutes I orient the case so the smallest possible surface is facing the sun. There are insulative, reflective outer bags (a case for the case) that will slow down heating by the sun. I have never owned one but I have seen them.

I can't tell you how many times I have seen guys at gigs lay their cases flat on the floor, and then during breaks, instead of putting the instrument in the case, they will lay their instrument on top of the case. This is a good way to have it kicked, stepped on, a beer dumped on it, or the strap hung on someone's shoe as you watch your mandolin being dragged off the stage. Put the instrument in the case and close the latches. It only takes 10 seconds and can save you hundreds in repair bills. I usually go one step further, which adds an additional 2 seconds. I like to stand the case upright the way it is carried. I would prefer that it be kicked over instead of stepped on by some 350 pound roadie. On latch closing, I have, more than once, seen someone quickly grab up a case and the instrument fall out on the floor because they assumed the latches were snapped. If the case is closed, latch it!

I don't trust instrument stands. Let me rephrase that. Stands work fine so long as people never come

near them. Would you use an instrument stand in a cattle feedlot? Eventually the cattle will knock it over and trample your mandolin. The same can be said of people. It just might take a little longer.

Here are a couple of other true tales from my collection of instrument horror stories and close calls. One night, in the mid 80's, our band was playing for a party thrown by a bunch of real estate "people". The gig was winding down and folks were getting thrown into the pool so we decided to get our check and get out of there. We hauled out the P.A. and were leaving with our instruments but we had to pass by the swimming pool. Some (expletive deleted) grabbed me from behind and tried to shove me into the pool. I resisted as best I could and, as I began to realize I was losing my balance in the scuffle, I hollered "Catch!" to our bass player who was helplessly standing there watching the scene with his bass fiddle in his arms. I tossed my mandolin, in its case, about 10 feet towards him and he miraculously caught it as I was plunged into the pool against my will. I was hot as I swam for the ladder, not sure if the mandolin survived the toss, wallet soaked, drenched from head to toe and I was ready to find the (even better expletive deleted) who shoved me in the pool. As I steamed (literally) the guys in the band wisely dragged me away to prevent any further incident. I didn't even know the fool who pushed me in. I guess that guy thought he was pretty funny, but in fairness, he probably didn't realize I was carrying an expensive instrument. Later, Fred (our bass player and champion mandolin catcher) told me it was actually two people who grabbed me from behind. I never really got a good look at them.

Let me tell you about a close call I had with my Flatiron F-5 Artist. I was arriving, after dark, for a gig at someone's home in downtown Atlanta. I crossed the street, mando case in hand, and stepped in what I thought was a shallow puddle of water in the grass strip between the curb and the sidewalk. It was not a shallow puddle at all. It was a water meter box with the lid gone. My right leg plunged straight down into the muddy, frigid water to a point where my knee was 4" under water. This happened in less than a tenth of a second and my forward walking momentum nearly broke my leg on the iron meter box. As I subconsciously reacted to maintain my balance my right arm swung the mandolin case overhead (like a major league pitcher) and slammed it flat down on the concrete sidewalk. The subconscious slamming of the case forward slowed my torso enough to keep my leg from breaking. I heard "the death chord" from inside the case as it hit. (Similar to the sound when a Macintosh computer dies.)

After climbing out of the hole, I opened the case expecting to find the smashed remnants of what was once a great mandolin! To heck with my leg. I can check for protruding bones later. How's the Flatiron? What? Not a scratch! Not even out of tune! Fate intervened! It is the first and only time I ever fell in a hole and nearly broke my leg and thought how lucky I was! I had to do the gig with one leg soaked and a shoe full of water (an odd feeling) and I eventually became thankful my leg survived the incident. If I had been using a "gig bag" that mandolin would have been reduced to kindling. My wife was a witness to this and, to her credit, was more concerned about my leg than my mandolin.

Here is one last thing about cases. I have my name plastered across the case in giant stenciled lettering. One night I left a jam session early, grabbed my mandolin case and made it all the way to the car before I realized I had absconded with someone else's mandolin! Sheepishly, I went back in and made the swap. We had identical cases so, in the morning, I painted my name on my case and added a collection of stickers so I wouldn't repeat that incident. If I could walk off with the wrong case someone else could walk off with mine!

General Cleaning and Finish Care

Most mandolins today are finished using lacquer or varnish. If the manufacturer of your instrument included any finish care instructions you should follow them. The information included here is for general knowledge and, if you have any doubts concerning how to clean or care for your mandolin's finish, by all means consult with an experienced luthier.

I discourage people from using furniture polish, or whatever happens to be stashed underneath their kitchen sink, on a mandolin. I suggest for general cleaning that you wipe the instrument gently using a soft flannel rag with a little bit of good quality instrument polish. I use Martin Guitar Polish (on my lacquer finished F-5) with good results. Since violins are almost always finished using varnish, I would use a high quality violin polish if I had a varnish finished instrument. Avoid any polish or cleaning agent which contains, or may contain, silicone! Silicone traces are nearly impossible to remove from the instrument and will present a nightmare for the repairman if you ever need refinishing work or touch-up finish work.

Be aware that if you have a satin finish, the finish may change its sheen and develop glossy patches if you polish it with any kind of "paste polish" or simply by repeated rubbing with a cloth.

Avoid contamination of the underlying wood if your instrument has any cracks or places where the finish is broken or missing. Allowing any polish to seep into a crack may prevent good glue bonding when an attempt is made to repair the crack.

Avoid extremes of cold and heat. Keep your instrument away from heat vents, sunny windows, fireplaces, wood burning stoves, etc. "Cold checking" (fine hairline cracks) can appear if you subject an instrument to extreme cold and then allow to warm up too rapidly. If you are forced to leave an instrument in a very cold environment (such as in a car trunk in the winter) be sure to keep the mandolin in its case for a few hours after you bring it into the house so that it warms up very slowly.

Keep vinyl and plastics away from the finish of your mandolin. Unknown reactions can occur as various plastic objects are in contact with the finish and can make a real mess. Every guitar repairman has seen an old guitar brought in with the cheap, vinyl strap "melted down" and welded to the face of a guitar where it laid for 30 years under someone's bed.

Fingerboards can be cleaned by using 0000 (ultra-fine) steel wool followed by an application of a drop or two of lemon oil or boiled linseed oil. If the fingerboard is extremely nasty from a build-up of "crud" it may require some careful scraping with a single-edge razor blade prior to the steel wool cleanup. Again, seek the advice of a luthier if you have any doubts about what you are doing. Obviously the strings must come off to do a decent job of cleaning the fingerboard. A partial dusting and cleaning of the fingerboard can be accomplished by threading the cloth between the strings and the fingerboard and using a little "shoeshining" back and forth motion.



Tuning Machine Lubrication

The tuning machines on most mandolins are of the "open gear" type which means the gears are exposed on the back of the peghead. This makes it very easy to lubricate periodically. I believe that you should apply a tiny droplet of oil between the worm gear and the round gear with the string off the post. Next, turn the tuning knob enough turns to completely rotate the round gear a couple of times. This will distribute the oil throughout the surface of the gears. It does very little good to apply the lubricant after you have changed strings and are all tuned up. You need to rotate the tuning machines for the oil to be distributed.

Use less oil than you think you need. If you apply too much oil, or oil too frequently, you can inadvertently saturate the wood around the tuners and make a real mess. Some people use a tiny touch of Vaseline rather than oil. I use the venerated 3-in-1 oil. I only oil my tuning machines perhaps once a year. Maybe every other year. I have never had a gear wear out. I think it goes without saying that spray lubricants should not be used as they are impossible to control and may contain silicone which will contaminate the finish.

If you suspect that a tuner is binding in the bushing do not oil the bushing! It is possible that corrosion of the post or bushing is adding friction and could be making the post tight in the hole. The best way to handle this is to remove all the strings, take off the tuning machines completely and then clean the bushing out with a pipe cleaner and some naphtha. Sometimes it is possible to pry the bushing out of the hole, or they may just fall out, from the top. However, if the bushing needs to come out be aware that they are often very tight where they have been jammed into the hole and you might knock a big chip out of the edge of the tuner hole if you try to get it out. My advice would be to consult a competent luthier if your problems seem to be coming from the bushings. A bent tuning post or knob shaft can cause a tight spot in the tuner rotation.

Tuner Button Problems

The tuner buttons are held on in one of two ways. They are either held on with a screw or they are glued on. About the only thing you need to know about the screw-secured type is that the screw should be snug so it doesn't rattle and that you should not over tighten the screw and crack the button.

If a glued-on tuner button comes loose it can usually be stuck back on using super glue. If the tuner button cracks (which they eventually might do) sometimes they can be repaired and sometimes they must be replaced. Modern plastic tuner buttons are easier to replace than repair. Old plastic or ivory buttons are worth taking to a luthier to see if they can be salvaged and made usable again.

Major Repairs

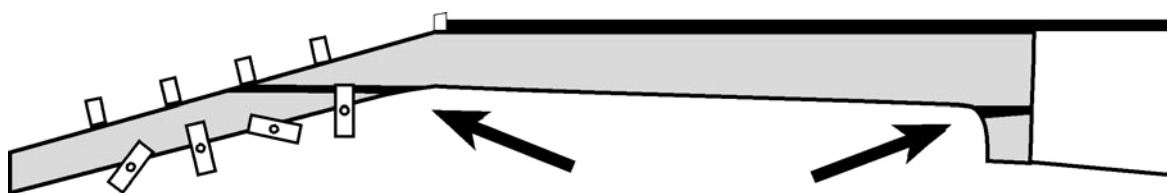
The day may come when, despite your best care, you must visit the repairman for some major work. In this section I will list some of the types of repairs that you might encounter with your mandolin. Some of them are inevitable with time, such as fret replacement, and others will only be needed in the event of some damage to the instrument. Most likely you will need to find a good luthier with mandolin repair experience to handle all of these issues.



Broken Peghead Scroll- The little rounded scroll on the F-style peghead is the most fragile part of the entire instrument. Even Bill Monroe broke the scroll off of his peghead. It was missing for years and eventually Gibson repaired it for him. The scroll area is usually reinforced inside the peghead with a piece of cross-grained hardwood which is hidden under the peghead overlay. But, don't worry. If you break the scroll it can be reglued and the finish touched up. If this happens to you save every tiny bit of wood, even if it looks like a splinter, as the repairman will need them to put it back together properly.

Broken Peghead - In this mini-disaster the entire peghead is broken off. Usually caused by the mandolin being dropped. Save every splinter and a qualified repairman can put it back together. There will be finish touchup required and, unless you have a very dark shaded sunburst to hide it, the repair will not be completely invisible. The cleaner the break, and the few missing pieces of wood, the less visible the finished repair will be.

Broken Neck at the Heel - If the mandolin neck cracks or breaks it is usually at the heel. If the break was clean it can be repaired just like the peghead. Even ghastly breaks that you might think would doom the instrument can usually be repaired, though not as invisibly. The break usually follows the grain direction in the location shown in the illustration below. If the neck cracks at the heel it may not completely break off so lower all the string tension so the crack does not open more than necessary. This is to prevent possible additional damage to the dovetail neck joint.



The two most common failure locations in a mandolin neck

Neck Joint Pulling Apart - If the neck joint fails, remove all string tension and have it examined by a good repairman. The repair may require major disassembly of the instrument, but it can be done successfully. Always consult the repairman before you decide to junk an instrument. Sometimes an instrument is not worth the cost of repairs and sometimes the job might cost less than you think.

Cracks in the Soundboard - These are almost always caused by dryness so prevention is the best cure! But, if a crack appears take heart in the fact that they can be repaired. Usually the instrument is "humidified" for a period of time to re-establish a proper stability and then the cracks are glued. In the case of gross cracks, or cracks with missing wood, the repairer may have to fit shims in the cracks to replace missing wood. The degree of invisibility of the repair varies with the location of the crack, the complexity of the crack shape, the finish of the instrument, and the skill of the repairer.

Top or Back Unglued From Sides - This type of repair is usually not too difficult with the proper clamps and know-how. Take the tension off the strings if you get a seam separation and get it taken care of promptly. A failed glue seam that is ignored will lead to warping of the wooden parts and make the repair more difficult and more expensive.

Splits in the Back or Sides - Like cracks in the soundboard, just about any crack can be made stable again through proper repair technique.

Split at the Tail Block - The tail block (inside the body) can be split if the mandolin receives as hard blow to the endpin. Since the endpin is wedge-shaped it will split the block if driven in too deep. Dropping a mandolin on its endpin is the usual cause here. Many mandolin companies remove the endpin during shipment so that rough handling will not split the tail block. If the tail block splits the endpin will usually get loose and you will probably see some separation of the back or soundboard in the area. This can be repaired but the back of the mandolin will have to come off to do the job right.

Tone Bars Unglued - If the tone bars come unglued you may notice some distortion of the shape of the top over time or a rattle or buzz coming from the soundboard. Unglued tone bars are pretty rare, but they do happen. It is more likely in cheap instruments. I suppose a hard "shot" to the soundboard surface could pop one loose even on an otherwise high-quality instrument, but I don't plan on testing that theory. If you suspect a loose tone bar you might be able to see something with a small flashlight and a dental mirror, but don't count on it. It's pretty hard to see what's going on inside there. I would consult a good mandolin repairman. If in fact the tone bar has come loose it will require the back to be removed to reglue it properly. I suppose there might be a rare case that could be corrected somehow from the outside but I am unaware of it. Of course, if the back must come off, then there is going to be degree of finish touchup work needed too.

Loose Fingerboard - This is pretty rare, but heat could soften the glue and cause it to slip or pop up. This would be a fairly simple repair and nothing too serious. Do let the string tension off until you can have the repair done as the fingerboard plays a role in the overall stiffness of the neck.

Loose Binding, Missing Binding - Again, a fairly simple repair for an experienced luthier. If any binding falls off take pains to find it and keep it. It is easier to glue the old binding back on than to try to match with new binding.

Tuning Machine Repair or Replacement - Replacement of an entire set of tuning machines is pretty easy for even the average player, but I still suggest you consult a repairman. Many times he can get a better price on the machines and has better knowledge of which brand fits nicely, which exact one to order, and how to put them on. Since the tuners are mounted "four to a plate" the spacing of the holes

is critical. In addition, tuners are made with "standard cut" and "reverse cut" gears which turn in opposite directions. Also, the F and A style tuners are different because of the shape of the peghead. A little friendly help from a good mandolin repairman can save you a lot of trouble.

Fret Work - Earlier in the book I described the basics of fret work. This is certainly something you will want to take to the repair shop to have done. If you can find someone who is really familiar with mandolins that is even better.

Truss Rod Adjustment - I briefly described the truss rod and its function earlier in the book. I consider the truss rod to be an adjustment that is easy to do right and easy to do wrong! If you suspect that you need adjustment to the truss rod take it to the shop or seek proper training it making the adjustment. You certainly don't want to break a truss rod or strip the threads. Mandolin necks are considerably stiffer than long, limber electric guitar necks so, as I have said so many times, try to find someone familiar with mandolins.

Nut Replacement or Adjustments - This has been adequately discussed earlier in the book. The luthier has the right tools so I would take it to the shop for this.

Finding a Good Repairperson

I have used the term luthier, repairperson, and repairman interchangeably throughout this text. For the record, and you all know this, repair "men" come in both sexes. The term luthier originally meant "someone who makes lutes" but has come to mean someone who builds fretted instruments. Instrument repairmen (and women) technically are not luthiers unless they also build instruments. Luthiers sometimes do repair work. Repair people sometimes build instruments. It is all rather confusing. Ask your luthier/repairman what he or she prefers to be called and don't ever bounce a check on them.

Over and over I have suggested that you rely on a competent luthier with mandolin experience for certain repair and maintenance jobs. Finding one can be difficult sometimes. Remember this: Just because you are in front of the counter and the other guy is on the other side does not mean that he knows what he is doing! I have seen some real "hack jobs", especially lowering of the action at the nut slots, done by part-timers behind the counter at the local music store. The "kid" means well in most cases, but if you want the job done right, it is up to you to find a good person you can trust.

The goal is not to find someone who knows more than you do. Nor is the goal to find someone who looks like a qualified repairer because he owns a fret file and a couple of nut files and is standing behind a glass counter. Your goal is to find someone who actually knows their craft, doesn't do shoddy work, and won't lie to you. The way to find a good person is by asking around among the other mandolin players in your area. Rely more upon the better players with better instruments and better reputations that you would upon the advice of a beginner who "had good luck with a kid at XYZ music store." Talk to people. Ask questions. This is the way to get a referral and introduction to a good repair person.

Keep this in mind when dealing with your repair person. Believe it or not they were not sitting around just waiting on you to show up with your mandolin needing a crack glued up because your aunt sat on it at Thanksgiving dinner. Good luthiers are usually backlogged with work and you will need to

be patient. Some repairs take time and rushing the repairman (especially if you barely know him) will not do you any good. The only way a good luthier can stay in business is by having enough work to stay busy all week, every week. At least some backlog of work allows the repairman to stay busy and move from one instrument to another throughout the day. Sometimes an instrument must sit overnight as glue dries before the next step can take place. Having more than one job in the shop going at one time is normal.

The luthier usually puts working musicians ahead of amateurs and hobby players, not out of disrespect, but because the working musicians in the area, or when passing through, are usually long-term customers who are frequent repeat customers and much tighter schedule demands. Don't lie to the luthier about the "big gig" you have on Friday if you come in on Thursday. Every repairman can tell you of the dozens of times they have stayed up late at night installing a set of humbuckers on some guy's electric guitar, or doing a refret, because "the dude" said he was going "on the road" and absolutely had to have it in the morning—only to have the guy finally wander into the shop 2 months later to pick up his instrument.

It's fine to ask for an estimated completion date and to expect it to be met barring any unforeseen problems. Be aware that unexpected or hidden issues may reveal themselves as the repair progresses. The repairman may contact you to discuss things before the work is done. Stay in contact but try not to be a pest either. Expect to put a deposit down towards the bill when you drop off the instrument. This is normal.



Array of tools, supplies, emergency items and other oddities found during a recent exploration of the author's mandolin case contents. Next to snapshot of the author and his wife is a laminated photograph of Bill Monroe, an essential item.

Mandolin String Sizes and Sets

Mandolin strings are made in a variety of materials and gauges. String diameters are usually measured in 1/1000ths of an inch in decimal form such as:

0.010" = 10/1000ths of an inch

0.014" = 14/1000ths of an inch

It is common among players to simply refer to these strings diameters as "a ten" or a "fourteen", a "twenty-four", etc.

The E and A strings are usually plain steel. The D and G strings are wound with an outer wrap of a very small diameter wire, usually a bronze alloy of some kind. Strings sets vary in how they are designed by different manufacturers but here are the diameters of a typical "light", "medium", and "heavy" mandolin set:

Light Gauge

1st	E	0.009" (plain)
2nd	A	0.013" (plain)
3rd	D	0.022" (wound)
4th	G	0.034" (wound)

Medium Gauge

1st	E	0.010" (plain)
2nd	A	0.014" (plain)
3rd	D	0.024" (wound)
4th	G	0.036" (wound)

Heavy Gauge

1st	E	0.011" (plain)
2nd	A	0.015" (plain)
3rd	D	0.026" (wound)
4th	G	0.040" (wound)

Please note that the sizes I have just listed are fictitious average sets. You will see lots of different names for sets such as "Light-Medium" and "Medium-Heavy" and all sorts of combinations of strings diameters. You will even see some sets with "half-size" diameters such as "0.0115" and the like. The only sure way to know what you are buying is to read the actual string diameters for each individual string since one maker's "medium" may be another maker's "light".

Sometimes sets are listed as "10-34" or "11-38" and so forth. That is a shorthand way of stating the diameters of the 1st and 4th strings but it leaves you guessing as to the diameters of the 2nd and 3rd strings.

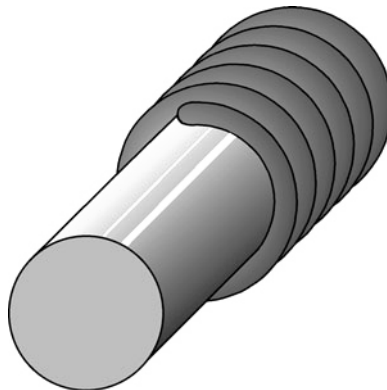
Varieties of Wound Strings

Wound strings confuse matters even more since they vary in metallic composition and in size combinations. It is possible to have two wound strings, each listed as 0.038" diameter, of the same exact metal alloys, that feel different when played. You see, the wound strings are wound on a core of plain steel, just like the plain 1st and 2nd strings. But the core diameter from one maker to the next might be different. Take a look at this table of component sizes, both of which add up to a 0.038" string:

	Diameter of Core	Diameter of Wrap x 2	Total Diameter
(a)	0.018"	0.010" =	0.038"
(b)	0.020"	0.009" =	0.038"

These theoretical string sizes may not exist in the real world but you can see that by changing the core wire size and the wrap size you can still end up with a finished diameter that is the same. In the example above the string with the 0.020" core would feel stiffer even though it is the same diameter. (The wrap diameter is multiplied by 2 because it wraps around the top and the bottom of the string and thus counts twice.) I didn't explain this in an effort to confuse you or to convince you to measure your string cores with a micrometer. I just want you to know why some brands of strings may have a different feel to them than others that are supposedly "exactly the same" size. Plain steel strings are all pretty much the same.

The small wire used as the outer wrap is normally round in shape. These strings are called *round-wound*. A *flat-wound* string is wrapped with a flat wire and has a smoother feel which causes less finger noise as it is played. Their tone is usually mellower than the brighter round-wound strings. You typically see flat-wound strings on violins and other bowed instruments, but they are sometimes used by jazz guitarists and are available for mandolin as well.



Closeup illustration of the end of a typical round-wound mandolin string showing the core wire and the spiral-wrapped outer winding

The alloy used in the outer wrap wire of a wound string does alter the sound and life of a string. Here is a brief rundown of some of the more common wound string varieties:

80/20 Bronze - This is probably the most common string on the market. They are yellow in color when new and develop a darker sound and color over time as they oxidize and tarnish.

Phosphor Bronze - These strings have a slight reddish tint to the wrap, to me they are brighter in tone, but do not last quite as long as 80/20.

Nickel Wrapped or Nickel/Steel - These are silver colored strings that are used on electric mandolins with wound magnetic pickups. Identical to typical electric guitar strings.

Flat Wounds - Instead of the common round wire used to wrap the string, a "tape" of flat wire is wrapped around the core giving a smoother feel to the string.

Ground Tops - This variety is made like a typical round-wound string, but the outer surface is ground flat after winding to give the string the feel of a flatwound string.

Coated Strings - There are several varieties of strings on the market today in which the wound strings are coated with a thin protective layer of plastic or other material. One brand coats the entire string after it is wrapped and another coats the winding wire before it is wrapped around the core. Both varieties extend the life of the string but they cost more.

String choice is a very personal matter. Try lots of different kinds of strings and you will eventually settle on a type of string that you like best in terms of sound, feel, string life, and price. All strings degrade over time as they oxidize and become damaged from contact with the frets. Flat spots will develop on the wound strings where they contact the fret which can cause them to sound poor. Finger oils and dirt clog the spaces between the windings, slowly choking the brilliance from the string. Strings stretch and get uneven in diameter and become more stiff as they are hardened through repeated playing.

You can increase the life span of your strings by wiping them clean at the end of each playing session. Old timers used to boil strings in an attempt to revive them but that was in the day when you might have to ride a mule forty miles to find a set of mandolin strings. Keep plenty of fresh strings on hand and you will never have to resort to boiling, tying together a broken string, or saving your old, rusty strings.

When your strings die you should give them a nice funeral by pitching them in the trash and please do not leave them laying around where someone might step on them. I frequently play stages where last-night's musicians left broken and changed strings laying all over the place. Not to mention all the string packaging, wadded up set lists, cracked guitar picks, cigarette butts, damp napkins that say "Free Bird, Man!" and empty drink cups and bottles. **Do your part and clean up after yourself at a gig** and we'll all be more welcome when we play there. It only takes a minute or two to police up the area when you pack up. The management, waitresses, and sound and light technicians will see you doing this and appreciate it. And trust me, you want to be on their good side.

Some Comments on the Science of Tuning

The science of tuning is complex but here are some basics. A musical string vibrating at a certain number of cycles per second is perceived by the ear as a musical pitch. Since about 1925, the recognized standard reference pitch for an A note is 440 cycles per second (c.p.s.) or Hertz. All other A notes are theoretically multiples or divisions of 440 c.p.s. Go down an octave and that A is 220 c.p.s. Go down another octave and we find an A that vibrates at 110 c.p.s. Go up from our starting point and we find an A at 880 c.p.s. An octave is one of the purest sounding intervals because of this 1:2 frequency ratio. A string vibrating at 220 smoothly and seamlessly blends with a string vibrating at 440 because one is evenly divided by the other. But, this is where the harmonious math seems to end.

Mandolins are tuned in intervals of open 5ths. A 5th is the distance from *do* to *sol* in the major scale. (Remember singing *do, re, me, fa, sol, la, ti, do* in school?) The 4th string on the mandolin is a G so let's allow that to be *do* then play up the major scale to *sol*. This is a D note and the 3rd string is tuned to this note. D is the 5th note of the G major scale. This tuning pattern of ascending fifths continues until we reach the high E string.

String	Note	Interval
4 th	G	starting note
3 rd	D	up a 5 th from G
2 nd	A	up a 5 th from D
1 st	E	up a 5 th from A

You may have heard the term “beat” in reference to tuning. Beats are best demonstrated using a pair of strings tuned to the same pitch though they also occur in varying degrees in intervals of other pitches. Mandolins have 4 pairs of strings tuned to the same notes so they are the perfect demonstration example.

Let's say that we have tuned both A strings to exactly 440 c.p.s. The strings seem to vibrate as one since their vibrational patterns superimpose on each other and we call this being “in phase”. Now let's raise the pitch of just one of the A strings to 441 c.p.s. When struck together the pair begins vibrating “in phase” but soon is “out of phase” because 441 cannot be evenly divided by 440 and there is a small fraction of time left over. Each second that passes will exhibit a strong moment when the two strings are completely in phase and a weak moment when the strings are out of phase and cancel each other's sound energy. This pulsing in intensity is called a beat. A beat is heard once per second since the two strings are tuned exactly one cycle per second apart. To “zero-beat” the two strings is to adjust them so that they are 100% in phase and produce no fluctuations in intensity.

If we tune one of the A strings to 440 cps and one to 442 cps we will hear 2 beats per second. The difference of the two frequencies equals the beat rate produced when vibrating together.

Here are some possible examples of other beat rates:

String 1	String 2	Difference	=	Beat Rate
440	441	1		1 per sec
439	440	1		1 per sec
439	443	4		4 per sec
440	446	6		6 per sec

In general, the faster the beating, the less pleasant the sound is to the ear. Eventually, if we get the strings far enough apart, the beat rate becomes too fast to perceive by the ear and we begin to accept the combination as pleasing again. In fact, if we get “out of tune” far enough we stop thinking of it as the same note. We just perceive it as a different note. In tuning mandolin unison pairs the goal is to eliminate the beats and get the two strings 100% in phase.

If you have an electronic tuner of sufficient display accuracy, such as a strobe tuner, you can make a “clock” that beats exactly 1 beat per second. Set your tuner to 440 and tune the first A string. Now, change the calibration of the tuner to 441 and tune the second A string to that reference pitch. Play them together and you should hear a beat rate of exactly 1 beat per second. If you sit around all day counting those beats you can determine when Seinfeld comes on TV.

You could do a similar experiment in reverse. You could tune a pair of strings so that the beat rate matches the ticking of a metronome set to click at 60 beats per minute. Your one second beat rate would tell you that the strings are exactly 1 cycle per second apart in frequency.

Unisons, with their 1:1 ratio, don’t produce beats. The octave with its 1:2 ratio doesn’t beat either. But, other intervals do! And some intervals beat more than others do.

The modern musical scale is devised of a series of tones based on something called equal temperament. Equal temperament, in an oversimplified nutshell, is the equal division of each octave into 12 parts. Fretboards and electronic tuners are arranged according to the system of equal temperament. Equal temperament has not always been the standard of musical “perfection” and its use has been hotly contested for centuries. But, this is the system we currently use and are accustomed to so we will discuss things “as they are” rather than debate other systems of dividing the octave.

In equal temperament all intervals are not beatless. Unisons and octaves are beatless but 3rds, 4ths and 5ths all beat! (So do most other intervals such as the minor 3rd, the 6th, etc.) In the middle of the musical range, the approximate beat rates for a few common intervals are:

Interval	Approx. Beat Rate*
Unison	0 beats
Octaves	0 beats
3 rd (<i>do</i> to <i>mi</i>)	10 beats/sec
4 th (<i>do</i> to <i>fa</i>)	1 beat/sec
5 th (<i>do</i> to <i>sol</i>)	0.8 beats/sec

**Beat rates are only approximate since beat rates double with each octave we go up and are halved with each octave we go down.*

It is clear that 3rds beat a lot faster than 4ths and 5ths when tuned in equal temperament. Not so fast that they sound really bad, but not so slow and pure as the 4ths and 5ths. The natural tendency when we tune is to make our 4ths and 5ths as pure and beatless as possible. Don't feel bad. The Greeks insisted that it be done that way too! To tune otherwise was an affront to the gods. But, to be in equal temperament, which allows us to play in all keys without sounding "too bad", we *must* narrow the 5ths and make the 4ths wider so they beat slightly. And we must make the 3rd very wide with a fast beat. We cannot fit the other intervals of the scale into an octave, and produce chords that sound equally pleasing in all keys, if we do not adjust (or temper) most intervals. In other words, to be in tune means, in fact, that certain intervals are really out of tune (not pure and beatless) by just the right amounts.

Fiddle players, fretless or upright bass players, resonator guitar players, and singers are not bound by the limitations of equal temperament in this way. They can and do temporarily adjust their pitch to produce closer to pure and beatless intervals. This is naturally done at times because it simply sounds better at the moment. But fretted instrument players are locked into the compromised system of the equal tempered scale.

You might wonder why certain intervals must be tuned so they beat? Couldn't you just tune it so it was pure and beatless. Yes, you could. But if you do that you will not be following the system of equal temperament. Let's say you have tuned your mandolin to an electronic tuner (which are almost always arranged in equal temperament) and then you play an interval of a 3rd. You can produce a nice third on the mandolin by playing an F on the 3rd string (3rd fret) along with the open A string. If you listen closely, and if your unisons are absolutely pure and beatless, you will hear the fairly rapid beating of a third as it sounds in equal temperament.

Now, let's say you begin to lower the A string until the beating of the F-A 3rd slows and then disappears. You will have tuned a pure and beatless third. That new A note will sound rich and pure when played with the F note. Now that you have done that, play the A on the 3rd string (7th fret) along with the A which you retuned. The fretted A note and the open A notes will clash horribly! Since we are stuck with frets which are arranged according to equal temperament we must tune the same way. (If this experiment is difficult you may wish to try muting or removing one of each of the pairs of strings so that any out-of-tuneness in the unison pairs does not interfere with your ability to hear the beating of the F-A interval. Or try the experiment one string lower or higher.) If your bridge is not correctly located, or if your strings are completely shot, this experiment will likely fail. If you don't hear beating at all don't be especially concerned. It takes some practice to learn to hear it, but trust me, even if you cannot isolate the sound of the beats in your mind, your ears and brain are sensing them. The varying speed is what tells you if a note sounds "in tune" or "flat" or "sharp." (Or casual terms like "sour", etc.)

The interval of a 5th beats relatively slowly so you may not even realize that they are beating at all as you tune your mandolin. And if you insist on making them absolutely pure (by instinct) you may find that the electronic machine and your ear will not agree.

If any of this is interesting to you I suggest that you read the book "Temperament" by Stuart Isacoff (Random House Publishing) which is a fascinating and very readable history of the musical scale as we know it and how it came to be. You will learn about the scientific, theological and philosophical battles that have raged for centuries over the subject. This topic is a lot more complex and interesting than my little discussion here. There are a number of good books on the subject of piano tuning which can provide more technical information on the science of tuning if you are inclined to seek them out.

Devices for Amplification

There are a number of options for amplifying the sound produced by a mandolin and the options mirror those which are available for guitars. Here is a description of the devices which can be employed to deliver your music to audiences beyond the living room:

Microphones - All microphones sense audio vibrations in the air and convert them into a weak electrical signal. The signal is passed along a cable to an amplifier which boosts the voltage sufficiently to drive a loudspeaker. The loudspeaker then reverses the process and converts the electrical signal back into sound waves through the air.

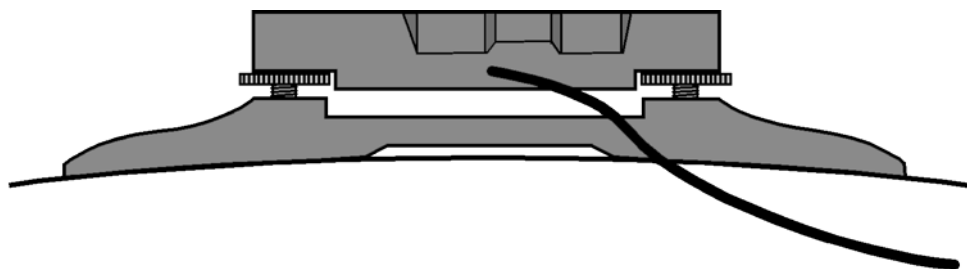
Dynamic microphones create an electrical signal by moving a coil through the field of a permanent magnet. A diaphragm senses the vibrations and moves the coil. In essence, the dynamic microphone is a tiny electric generating station and they are essentially a loudspeaker working in reverse. Dynamic microphones do not require a power supply or batteries and are usually quite rugged. The famed Shure SM58 and SM57 are examples of dynamic microphones.



The author attempting to pay the bills. Note the dynamic vocal mic, the condenser instrument mic, the wire visible from the (unused) bridge mounted transducer, and the mixing board in the background.

Condenser microphones have a diaphragm which acts as one plate of a device called a *capacitor*. The capacitor (also called a *condenser*) is made of two plates separated by air. Sound causes the diaphragm to move in and out relative to the other plate which varies the distance between the plates. A voltage is applied (from an external source) to the plates and the *capacitance* changes are converted to an electrical signal which is fed to the amplifier. These microphones, known for their more accurate sound reproduction, require an electrical power source either supplied by a battery or directly through the mic cables (called *phantom power*) from the mixing board. Condenser mics are usually favored for amplifying and recording acoustic instruments but are more fragile than dynamic mics. There are tiny versions of condenser mics which can be mounted *inside* your mandolin! My favorite condenser mic which I use most frequently (though I am not using one in the photo) is the AKG C-1000S.

Piezo-electric Transducers - These are small devices which are made of a crystal which is either embedded in the bridge or housed in a capsule which is adhered directly to the instrument. The direct vibrations of the instrument compress the crystal which produces an electric signal. The weak signal usually must be amplified, sometimes by an on-board battery operated *preamp*, before being sent to the main amplifiers and the speakers. I sometimes use a Fishman piezo-electric transducer which is built into the top of my bridge. The wire from the crystal goes down into the F-hole and then arrives at an endpin jack which accepts a 1/4" standard electric guitar cable. Because the vibrations are sensed through direct contact with the instrument it is sometimes difficult to reproduce the natural sounds we are used to hearing produced by moving air.



A transducer mounted in the bridge

Magnetic Wound Pickups - These type of pickups are just like what is normally installed on an electric guitar. Magnetic pickups rely upon the motion of the string within a magnetic field to produce an electric signal which is sent to the amplifier. They are rarely seen on acoustic mandolins (unless they were screwed to the top by some clown who, back in the sixties, tried to become the Jimi Hendrix of mandolin players) but are common on solid body electric mandolins. Nickel wound strings are used since bronze wound strings do not affect the magnetic field sufficiently.

The Fender FM-60E five-string electric mandolin I sometimes play has magnetic wound pickups. I briefly owned a Godin eight-string electric mandolin which had piezo transducers instead of magnetic wound pickups. Either type of mandolin can be played through a standard guitar amplifier or by feeding the signal directly to the mixing board.

Closing Thoughts

I hope that you have learned a few things about your mandolin and that the knowledge increases your enjoyment of the instrument. Mandolins are making a tremendous comeback these days in terms of popularity. When I started playing bluegrass in the 1970's it seemed everyone wanted to be a banjo player. Me included! Back then I thought a mandolin was "pretty cool" but didn't really have much desire to play one until I put a band called Pony Express together in college and was "forced" to play mandolin because there was already a banjo player, guitar player and bass player handy. None of them knew how to play a mandolin, and since I could make three chords on my \$49 J.C. Penney mail-order mandolin, I was roped into it.

Going to a "cow college" meant we didn't have to hit the books too hard and those three guys and I picked bluegrass nearly every day for hours and hours. We used to perform every Thursday night at Branch's Saloon in trade for free beer. We picked constantly it seemed. There was an almost constant pickin' happening on the stoop outside our dorm room. We played at all the local festivals including the Great Hahira Pick-In, Fletcher's Lake, Twin Oaks, and some others I can't recall. We used to drive over and jam with fiddlers Bud Rhodes, Red Lindsey and Henry Rutland just to learn tunes.

When we were out of class for the summer we travelled around the five-state area doing a bluegrass festival every weekend. I remember driving, four of us sitting on the bench seat of a pickup truck, all the way to Cullman, Alabama for a festival that paid us a grand total of \$37. And believe it or not, that was enough for the gas, food and one motel room! We were so "eat up with bluegrass" that Pony Express did a 6 nights-a-week gig, for 3 hours a night, at a place called Gus Fletcher's in Marietta, Georgia for \$300. Not \$300 a night. \$300 a week. Split four ways that comes out to \$12.50 per night per guy. We did that for months! I remember we were followed each night by Buck Peacock and the amazing Rosebud who played into the wee hours after we finished.

I had a turntable and a puny collection of bluegrass records. Less than ten I think. (No money!) The first "New Grass Revival" album, Tony Rice's "Manzanita", Monroe's "Beanblossom" double record album, and a couple of Flatt and Scruggs and Reno and Smiley records I got at the Ben Franklin dime store. The more I played those records the more fascinated and obsessed with bluegrass I became.

I signed up as a deejay for the college station and did a three-hour Sunday night show called "Bluegrass, Etc." that was beamed out across the campus and perhaps the nearby town of Tifton, Georgia with an incredible 5 watts of power! I used to call the dorm pay phone just to be sure they could hear the signal on the other side of the campus. The station (WABR) eventually was swallowed up by Public Radio and is now a high power station playing classical all day long and they booted the student deejays and their wacky programming out of the station. All for the sake of big fat grant checks I guess.

We eventually passed all of our classes including such actual courses as "Fishing", "Forest Recreation", "Aerial Photo Interpretation," and "Archery" and they made us leave with our Forestry Technician degrees in hand. Nearly thirty years have passed since those wonderful days and I still love the mandolin. I hope the next thirty years brings you as much music and fun as I've had in the last thirty. I'll still be out there pickin', knock on curly maple, so keep your eye out and let's pick a little one of these days! – *B. Laird*

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*Bob MacIsaac, Luthier
Atlanta, Georgia*

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