

# Sinclair Community College

## Engineering Design

### Electric Guitar Service Manual



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## Recommended Tools:

For routine maintenance only a set of basic hand tools is required. However for jobs such as nut and tuner repair, specialty tools may be required for correct results. If the special tool is required, it will be noted on the page describing the repair process. If you do not feel comfortable attempting any of these repairs, we recommend taking your guitar to a professional luthier in your area to have the work done.

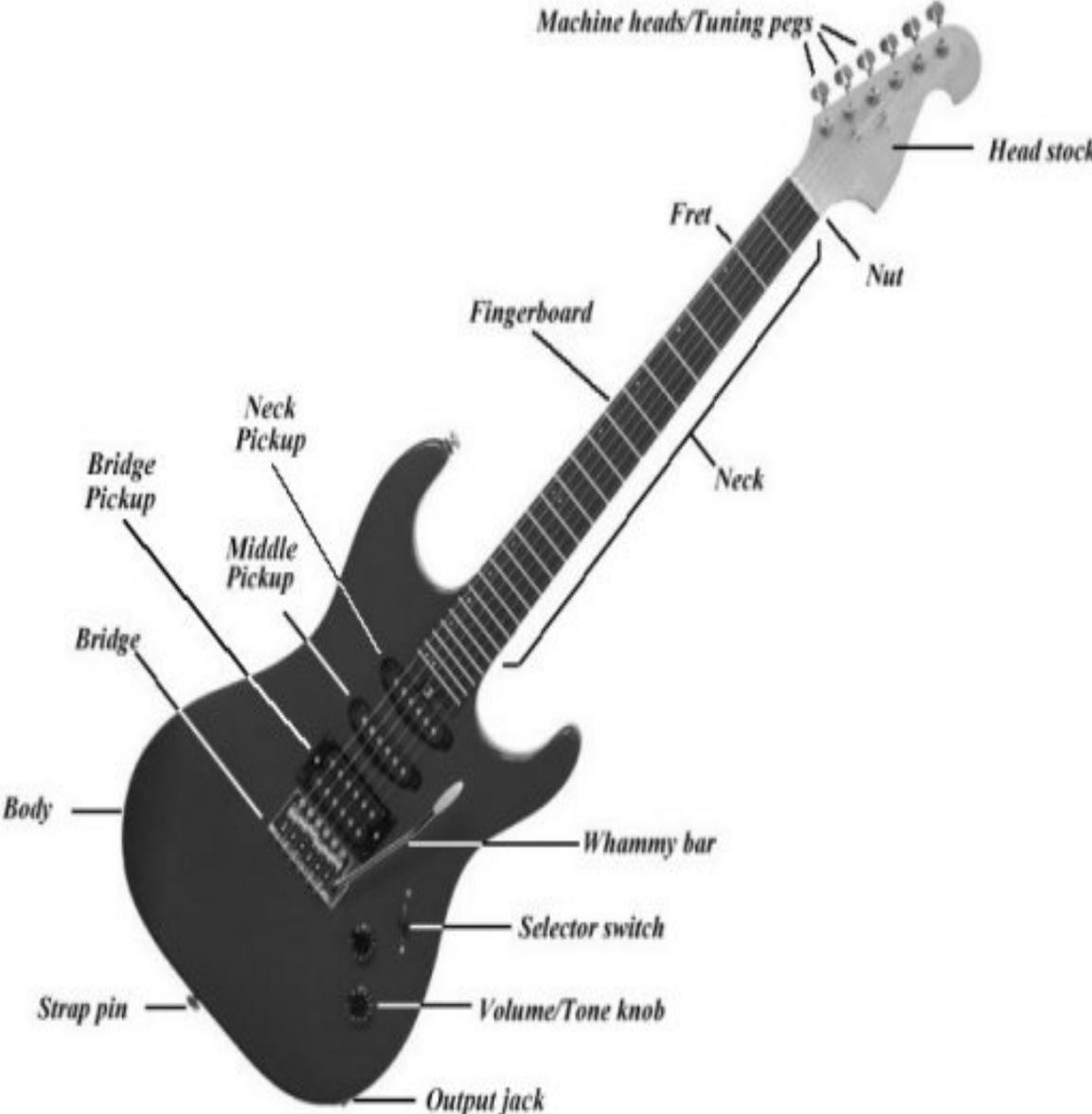
### For Routine Maintenance:

- Small hammer
- Variety of screwdrivers (Regular and mini sizes)
- English and Metric open-end wrenches
- Calipers (dial or digital)
- Long nose pliers
- Wire strippers
- Variety of drill bits
- T-Pins (available at crafts stores)
- Electronic multi-meter
- Wood chisels
- Quick release clamps (12” and 18”)
- Sewing machine oil
- Rubber sanding blocks
- Extra guitar strings
- Guitar tuner
- Fret dots

### Protection:

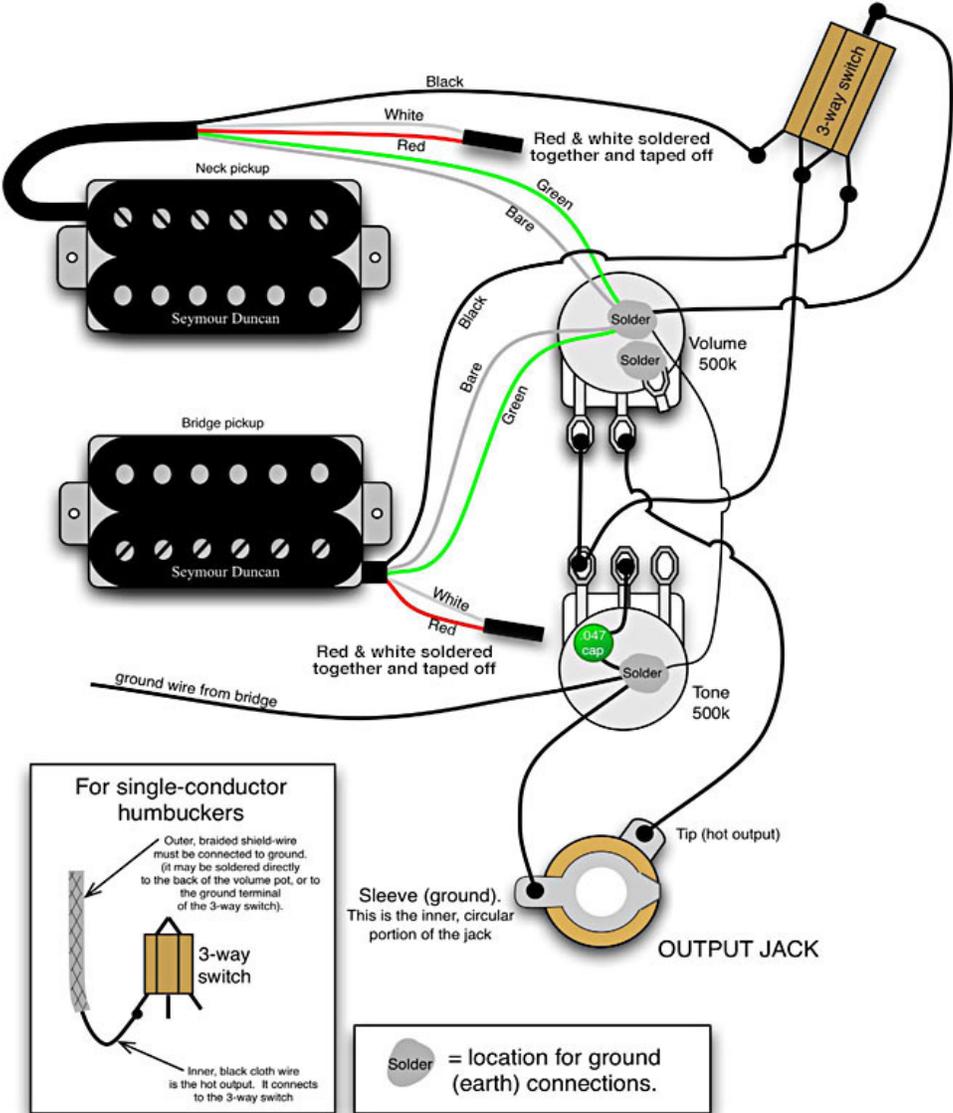
- Gun stock finish oil
- Bona finish and sealer (available through flooring stores)
- Concentrated wood stain

# Overall Assembly:



# Wiring Diagram:

## 2 Humbuckers, 1 Volume, 1 Tone, 3 Way Switch



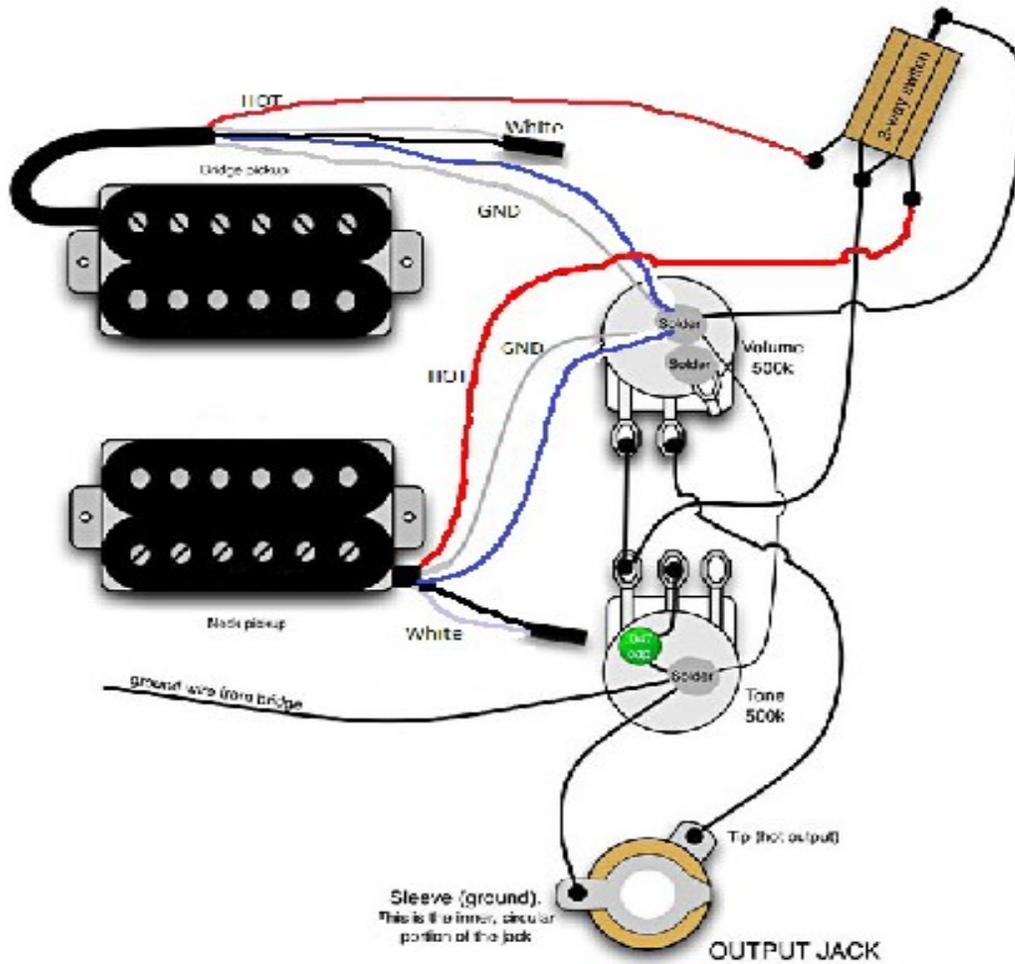
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# Wiring Diagram - Mighty Mite Pickup:



Restringing a guitar is one of the most common repairs you will have to do to keep your guitar in top playing condition. It is very simple to do and should take no more than a half hour to complete.

### ***Tools required:***

- Guitar strings
- Wire cutters
- Powdered graphite (optional)
- Tuner

1.) Loosen the strings by slowly turning each of the tuners on the headstock clock-wise. Only loosen each string, do not remove yet.

2.) Take hold of the middle of each string and cut each with the wire cutters, the strings should be loose enough that they don't snap when cut. Now remove each string half, unwind the top half from each tuner and pull the bottom half out from the underside of the guitar below the saddle.

3.) Take the new strings out of their package, but keep the packaging as it shows what strings go where. Thread the strings up through the saddle as the package shows. Make sure to thread all 6 strings before moving to the next step.

4.) Once all 6 strings have been installed and checked to make sure location is correct, begin threading the strings through the tuners, starting with the 6<sup>th</sup> string (thickest), and thread it through the tuner from the inside out. Once you have pulled the string through, give about 2 inches of slack before you begin tightening. Turn the wing nut while plucking the string until it sounds, then move to the next string. Make sure each string has at least 3 wraps on the tuning post before continuing.

**5.) Continue threading each string from the 5<sup>th</sup> to the 1<sup>st</sup>. Make sure not to over tighten any strings as they will snap.**

**6.) Trim the long ends of the strings above the tuning posts. Tune your guitar and play away!**

## Tuner Repair and Replacement:

### **Tools Required:**

- Philips screwdriver
- Sewing machine oil
- Calipers



There are two ways to easily maintain your tuners to ensure that they will operate properly for the life of your guitar: Keep them tight and keep them oiled. Before you perform any maintenance,

be sure to first remove the strings from the tuners.

### **Tightening Guitar Tuners:**

There are two screws on the tuners that will need to be tightened. The first is a nut that tightens the tuner on to the headstock, simply use a small wrench and tighten it down firmly. The second screw tightens the tuning button, and is located right on the end of the button, simply tighten it with a small screwdriver. Always make sure that this screw is tight, a loose tuning button can strip or even crack.

### **Oiling Guitar Tuners:**

Regularly oiling your tuners gears will ensure that the tuners turn easy, lock correctly and will prevent them from freezing into place. Inadequately oiled tuner gears can cause premature wear that could result in stripped gears. If you notice that the tuners are becoming hard to turn, most likely they need to be oiled. Depending on the frequency and style of your playing, it's recommended to oil your tuners every 6-8 months. To do this, all you need is a bottle light sewing machine oil, put a couple drops around the outside of each string pole and let the oil run down into the gears as you slowly turn

the tuning button. Your gears should turn smoothly now, and last for the life of your guitar.

### **Tuner Replacement:**

Generally there are only 2 parts you'll have to replace tuner-wise, those being the tuner button, or the entire tuner assembly.

#### **Replacing Tuner Button:**

Replacing the tuner button is simple, all you have to do is take out the screw that holds the tuner button in place and the button will slide off its post. Simply slide the new one on and put the screw back in place and you're done.

#### **Replacing Tuner Assembly:**

Before you can replace your tuners you'll have to get a new set, this can be a somewhat overwhelming process as there are many different types and sizes of tuners on the market. The simplest way to make sure everything will work correctly is just to buy the exact same tuners that were on the guitar already.

If you are looking to upgrade however, you will have to take a few measurements to ensure proper fit of the new tuners. Measurements needed are: thickness of the headstock, height of the string post, and size of the hole that the string post sits in. You will also need to decide on a gear ratio. Most tuners have a 14:1 gear ratio, but there are units available from the regular 14:1 to 25:1 for extreme fine tuning, but overboard unless you're a serious guitarist.

Once you have decided on a tuner set, replacing the tuner is simple, just unscrew the nut on top of the headstock and slide the tuner out through the back. Reverse the process for the new one and you're done. Be sure to double check that the new tuners are set tight on the headstock.

## Pickup Adjustment:

### Tools Required:

- Regular or Philips screwdriver

There are literally hundreds of styles and configurations for guitar pickups, the majority of which are called “floating pickups”, named because they do not mount directly to the guitar body but are attached to a pickup ring with springs between the ring and pickup frame holding the pickup in place. The springs allow the pickup to



“float” in place. The height can be adjusted by tightening or loosening the mounting screws, and thus also allows the tone quality to be adjusted.

Almost all electric guitar pickup problems are caused by damage or incorrect pickup height and/or placement. This means that proper setup of the pickup is imperative to the life and performance of the pickups on your guitar.

### Adjusting Pickup Height:

Setting a floating pickup is fairly simple, and you can adjust for any type of playing style. Pickups are basically small microphones picking up sound waves reverberating from the strings, so the closer the pickup is to the string, the more sound it will pick up, and vice versa. The purpose of adjusting is to get all the pickups to have the same volume.

Start by plugging in your guitar and playing the low E string right above the bridge pickup and pay attention to the volume level. Next, do the same thing with the high E string. Raise or lower each side of the pickup until the volume is the same on both sides. Do the same for the neck pickup, then check the volume level between the two, if

there is any difference; adjust until the bridge and neck pickups are the same volume.

Another way to easily check if the pickups are adjusted correctly is to measure the height of the strings on each side of the pickup and adjust till they are the same height on each side. Fine tuning can now be done by testing the volume just like we did before.

## Pickup Selector Repair:

### ***Tools Required:***

- Screwdriver
- Wire clippers/strippers
- Soldering iron and solder

The pickup selector is simply a toggle switch that is used to control which pickups are being used when playing the guitar. Since most guitars have at least 2 separate pickups, the pickup selector switch is crucial to finding the perfect sound to suit your playing style. While there are various types of pickup selectors available, the ones used in our guitar are known as a 3-way selector.



A pickup selector is a simple electronic switch that is hardwired to both the guitar pickups and eventually the guitar jack. When the switch is flipped in a direction, the switch connects the lugs wired to the pickups and the jack completing the circuit. This is how the pickups are selected. While one or a combination of pickups is selected, the other pickups are deselected by the same means.

### *Replacing a Pickup Selector:*

Pickup selectors can wear out over time. The lugs and the rotating switch can lose their tight connection with years of use. Replacing the switch is pretty simple and only requires a few steps.

#### **1. Remove the old selector**

Most pickup selectors are either mounted to the top of the guitar through a cavity routed in the back of the body or mounted to a pick guard. For pickup selectors that are mounted to the top of the body, simply take a screwdriver and unscrew the pickup selector. You will have to remove the knob on the end of the level before you can slide the selector through the channel and out of the cavity. For pick guard mounted selector, like Fender Stratocasters, you will need to remove the entire pick guard to remove the selector. Simply unscrew the pick guard from the body, flip it over, and rest it on the top of the body. The pick guard will still be wired to the body, so you can't go very far with it. Then, unscrew the selector. It is important that you take note of what wires are soldered to what lugs before you remove the selector. Refer to the **wiring diagram** in this manual for assistance. Once you know where everything has been wired, cut the wires close to the lugs and remove the old selector.

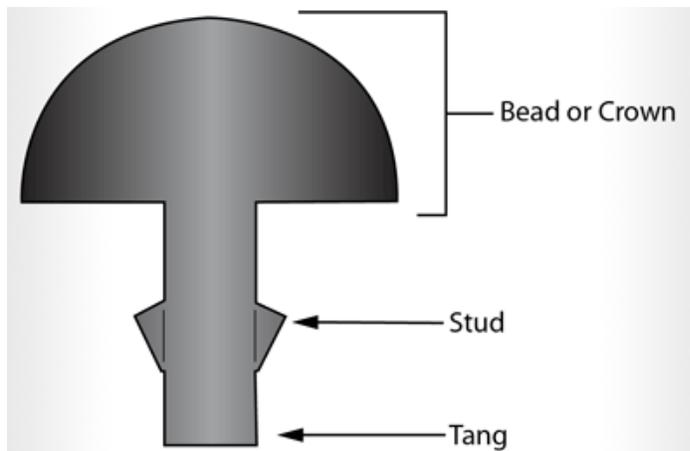
#### **2. Install the new selector**

Once the old selector is removed, screw the new selector in place. Follow your wiring notes from the old pickup selector, strip the wires with a pair of wire strippers, and solder the wires to the correct lugs. After everything is soldered in place and checked for correct layout, reattached the cavity cover or pick guard, plug in the guitar and check operation. For more information about how to solder wiring, see the **How to Solder** section.

## Fret Repair and Replacement:

### Tools Required:

- X-Acto knife
- Calipers
- Feeler gauge
- Radius gauge
- Fret wire bender (optional)
- Fret press
- Fret hammer
- Screwdrivers (various sizes and types)
- Fret bevel
- End nippers
- Chisel
- Guitar Wax



### Fret Wire Diagram:

The **Bead or Crown** is the part of the fret that comes into contact with the strings at the top of the fret.

The **Tang** is the bottom of the fret wire that is set into the fret board.

The **Studs** are the protrusions that stick out of

the fret tang to hold the fret wire in the fret slot.

Not all guitars have the same size fret wire. Different sized in the fret wire will result in different sounds. This leaves it up to the player to decide what kind of sound they would like to get out of their guitar.

## Fret Repair and Replacement cont:

### Fret Wire Materials:



Fret wires are commonly made out of nickel and stainless steel, although they can be made out of several kinds of materials. Stainless steel is much denser than nickel which helps prevent wear. On the other hand stainless steel is much harder to install than nickel due to its density. Nickel is often recommended for the average player.

### Choosing Fret Wire to Install in Your Electric Guitar:

**Measure your existing Fret Wire-**After your frets have been removed from the guitar you need to measure the size of the crown. Using a pair of calipers, you can measure the height and width of the crown.



**Clean the Fret Slot-**If the fret was glued into the slot then will need to clean out the glue that is left in the slot. This will help you get accurate measurements when measuring the fret slot.

**Measure the Fret Slot-**After the fret slot is completely clean, you can take a feeler gauge and insert it into the slot. Frets will range from .023” to .050” in width.

**Choose your Fret Wire-**After you have the measurements of the fret slots, you will then be able to choose the correct fret wire. When selecting a wire, the only thing that needs to be a certain size is the tang. The tang must be .002” smaller than the width of the fret slot. This will let it lay snug in the slot. The bead of crown can either be the same size as the previous wire or different.

## Fret Repair and Replacement cont:

### Measure the Fret board



Fret boards have a slight curve to them known as the radius and this will have to be measured if you want to install new fret wire. To measure the radius, you will have to take the strings off and place a radius gauge against the board. Turn the gauge until you don't see any light coming through when you have the gauge placed on the board.

Radius Gauge

### **Bending a Fret Wire:**



Fret wire will usually come in 1 or 2 foot sections, although they can be bought pre-cut. This fret wire will initially be straight but to fit it on to your guitar, you will have to bend it to the radius of your fret board. You can use a fret wire bender to correctly bend it to fit your fret board

Fret Wire Bender

### **Reason for Removing Frets:**

**Worn Frets-** Over time frets will begin to wear from continued use. Worn frets will have divots where the strings lay. Worn out frets can be leveled out but if the fret is worn down too much than there isn't enough material left to play and they will need to be replaced.

**Damaged Frets-**Frets can become damaged from several different things like dropping your guitar on a hard surface. A damaged fret will most likely need to be replaced.

## Fret Repair and Replacement cont:

**Improperly Seated Frets-**A fret that is improperly seated in the fret board will most likely cause string buzzing. To tell if a fret is seated properly you can look at the base of the crown and the fret board. The crown should lay flat against the fret board so there is no space in between. If the fret is improperly seated then it needs to be removed and resealed properly.

### ***Removing a Guitar Fret:***

Guitar frets are usually glued into the fret slot although there are some manufactures that make the fret slot so tight that friction is what holds the fret in place. It is important to know how the frets on your guitar are kept in the fret slots. There also may be a certain way that the frets need to be taken out.

**Removing Fret from Early Fender Guitars-**Frets in early Fenders were slid in from the side making it very hard, if not impossible to remove them from the top. So the easiest way to remove the frets are by pulling them out from the sides. Here are the steps you should take when removing the frets from an early style fender.

1. Remove the strings from the guitar
2. Unscrew the neck and remove it from its pocket on the body.
3. Clamp the neck down and start to remove the frets. Take a hammer and a nail set to remove each fret. Lightly hammer the nail set into the side of the fret to slowly remove it. Make sure not to chip any of the fret board, but if you do you can glue it back on after the fret has been removed.
4. Clean the slot and replace the fret.

## **Fret Repair and Replacement cont:**

**Removing Frets from Modern Fender Guitars**—Unlike early Fender's, today the frets are directly placed into the slots in Fender guitars. They are also held into place by glue so that they will have to be heated up to be able to remove the fret. Here are the steps for moving this kind of guitar.

1. Remove the strings from the guitar
2. Unscrew the neck and remove it from its pocket on the body.
3. Take a soldering gun and file a notch in the so that it can fit the fret wire in.
4. Run the tip of the gun across the top of the fret. Make sure that you do not heat the fret too much. You just want it hot enough so that the glue is loose enough to allow the fret to come out.
5. Take a pair of end nippers and place them on the fret board. When you clamp on the fret, it should come and without you having to actually pull it out.
6. Clamp the fret in 1/8" increments until it is completely out of the slot.
7. Clean the slot and replace the fret.

## Fret Repair and Replacement cont:

**Removing Frets with Maple and Lacquered Fret Boards** With these types of guitars, the frets are usually installed before the lacquer is put on. This means that if you try to directly remove the frets then you could create cracks in the lacquer. To prevent this, score the edges around the base of the fret with an Xacto-knife. Now when you remove the fret, it won't be attached to the lacquer and cause it to crack or chip. The rest of the steps for removing the fret are the same as above.

### Installing Electric Guitar Frets:



**Wax the Fret Board-**Before you start installing the frets you are going to want to wax the fret board. The wax will prevent the glue from hardening on the board. Try to keep the wax from getting into the slots. If it does manage to get into the slots then you can clean it out with a knife. Note that you do not need to wax finished fret boards.

### Guitar Wax

**Apply the Glue- (*On unfinished boards*)** run a bead of super-glue into the fret slot. Not much glue is needed, just a small bead across the top of the slot. Once you put the glue into the slot, immediately place the fret into the slot. You do not want to let the glue sit for very long, and to prevent this only put glue in one slot at a time.

**(*On finished boards*)** Unlike on an unfinished board, you do not want to use super glue to apply the frets. Super glue will cause problems with the finish on your board. Instead, use common wood glue. Like before, don't let the glue sit for a while and only put glue into one slot at a time.

## Fret Repair and Replacement cont:

**Press the Fret into the Slot-**A fret can be put into a slot with either a fret press or a fret hammer. If you are using a fret press then lightly hammer both ends of the fret when setting it in the slot. You can then press the fret in with the fret press. If you only have a fret hammer then lightly hammer both ends of the fret as before. Then lightly tap

all the way across the fret. Make sure the fret is all the way in the slot and there is no space below the crown. Be sure not hammer too hard or you could damage the fret and it will need to be replaced. Repeat this until all of the frets are in their slots. You can then slightly hammer down the edges that are hanging off the sides of the board. This will allow the frets to be able to stay on the board easier.



Fret Press



Fretting hammer

## Fret Repair and Replacement cont:



**Remove excess glue-**Make sure you remove the excess glue on the fret board before it dries. To do this take a dull chisel and scrape it off, this can be done on both finished, and unfinished fret boards

**Chisel**



**Nip the Fret Ends-**After the glue has dried, you can take a pair of end nippers and cut off the edges of the frets that are hanging off the sides. After they are nipped off, you should take a file and smooth down the edges. Make sure to file downwards on the side of the board. If you file upward then you risk loosening your frets.

**End Nippers**



**Bevel the Edges-**To make your fret rounded on the edges you can use a fret bevel. Use a 35 degree bevel to get a 35 degree angle around the edge of the fret. Beveling will usually leave burrs, so use a three-cornered file to remove the burr. After the burr has been removed, sand the edge with a 320-grit, 600-grit, 800-grit, and 1,000-grit sandpaper.

**Fret Bevel**

## Action Adjustment:

### Tools Required:

- Feeler gauge
- Allen wrench to adjust truss rod
- Radius gauge

**Action-** The action is the height of the strings from the fret board and is usually measured at the 1<sup>st</sup> or 12<sup>th</sup> fret. Strings that are set high



above the fret board are known as “High-action” the opposite goes for strings that are set low. The Action of a guitar is important when determining its playability. If the action is too low, then it can cause string buzzing. If the action is too high then it will start to become uncomfortable and difficult to play. So it’s good to find a median where it is high enough to not cause

string buzzing but also low enough to be comfortable. Picking an action adjustment will also depend on the preference of the player

### Causes of Action Change:

**Temperature and Humidity-**Drastic changes in the temperature will either cause the wood in your guitar to shrink or expand. As a result the neck will start to slightly bow which caused the action of the strings to change.

**String Tension-**If you change the tension of your strings from high to low and vice-versa then it could result in neck bowing and have a similar effect as temperature changes.

**Use and Abuse-**Extended use can cause the nut of your guitar to wear down. When this happens, it could affect the action of your guitar.

## Action Adjustment cont:

Most of the time adjusting the action can be as simple as adjusting the truss rod. For more serious action problems you may have to adjust the nut or bridge of your guitar. Just know that the three main areas to go for adjusting the action is the truss rod, nut and bridge.

**Truss Rod Adjustment:** Adjusting the truss rod will straighten and flatten out the neck which will bring your action back to its normal level. Remember that straightening the neck too far may cause string buzzing so leave a slight amount of action on your strings (for details see truss rod adjustment). If this does not fix the problem then you are going to want to look at the nut and bridge.

**Adjust the Action at the Nut:** To check if the nut is causing the issue, use a feeler gauge to measure the distance between the bottom of the strings and the first fret. The standard distance is .06", if the string is higher than this then you are going to want to file down the nut until it reaches this length.

**Adjust the Action at the Bridge (Fender Style):** Over the years there have been many different styles of Fender guitars. Through all these different styles, the basic design of the bridge has mostly stayed the same. Each string is mounted on top of a saddle piece and is strung through the body or bridge. Each saddle piece can be individually adjusted at the body or fret board. To adjust the action you will have to adjust the height of the saddles at the bridge. Here are the steps for doing that.

1. Tune your guitar to pitch
2. Check the back-bow and relief of the neck
3. Adjust the truss rod to straighten the neck
4. Retune your guitar and check the back-bow and relief again
5. Check and adjust the action at the nut
6. Measure the high and low E string at the 12<sup>th</sup> fret by placing a precision ruler on the 12<sup>th</sup> fret

## Action Adjustment cont:

7. The distance between the bottom of the high E string and the top 12<sup>th</sup> fret should be set to  $2/32$ ". If the string is higher or lower than  $2/32$ " then you will have to adjust the saddle piece with an Allen wrench.
8. Set the low E string to  $3/32$ " at the 12<sup>th</sup> fret by raising or lowering the saddle.
9. Place a radius gauge that corresponds to the radius of the fret board radius on the strings. The gauge should sit on the low and high E strings while touching the middle strings. If the middle strings are higher or lower than the gauge, you will need to adjust the strings' height relative to the outside strings. When the gauge is placed on the outer strings, the rest of the strings should be touching the gauge but not holding it off the outer strings.

Retune the guitar and check the action of the outer strings at the 12<sup>th</sup> fret.

## Bridge and Intonation Repair

### **Tools Required:**

- Small Philips screwdriver or 1.5mm Allen wrench

There are many different styles of bridges. All bridges are made of hard metal; therefore, they are extremely durable and rarely have to be repaired. Most often you can maintain the function of your bridge with just proper set up. In this manual we will discuss the Fender style guitar bridge. The bridge consists of a base plate and six saddles. These saddles can adjust the string height and intonation of your strings.

### **Fender Style Bridges:**

With the Fender style bridge, and with many others, the strings are strung through the body and mounted on top of each saddle. This type of bridge is often referred to as the Tremolo style bridge. This type of bridge is most common not only because of its stylish look, but also because of its adjustability and durability.



### **Adjusting the String Height on Your Bridge:**

The saddle pieces on the bridge can be adjusted closer or farther away from the body, which in turn adjusts the string height or action. Each saddle has a small screw on it that adjusts its height (as seen right). With most Fender style bridges all you will need is a 1.5mm Allen wrench. Tightening the screw will move it closer to the body, while loosening the screw will add to its height.

## Bridge and Intonation cont:

### Adjusting Intonation:

Poor intonation is when your strings sound out of tune as you play up or down fret board. The best way to adjust the intonation of your guitar is to adjust the scale length of each string. Before we talk about adjusting intonation with the bridge, we must first define scale length. Scale length on a guitar refers to the distance between the edge of the nut and the top of each saddle piece. The most common scale length on most Fender is 25.5 inches. Gibson and others are

24.75". You can check the intonation by playing a fretted note on the 12th fret and then a harmonic on the 12th fret. These notes should sound exactly the same. If the note sounds sharp or flat, the intonation will need to be adjusted. At the bottom of each saddle is a screw that adjusts the saddle closer or farther away



from the fret board. No matter what type of bridge you have, the saddles can most often be adjusted the same way. The screw will need to be tightened or turned clockwise if the fretted note sounds sharp. The saddle pieces will move away from the fret board the tighter the screw is turned. If the fretted note sounds flat, you will need to loosen or turn the screw counterclockwise to move the saddle toward the fret board. You may then check the intonation again, but remember to always adjust in small increments.

Another way of checking intonation is through computer software. Here is a link for a free download of a [frequency analyzer](#). You simply plug your guitar into the computer and the software allows you to check the frequency of your strings to determine if your intonation is set up correctly.

## Nut Adjustment and Replacement:

### ***Tools Required:***

- X-Acto knife
- Vice grips or End nippers (optional depending on guitar)
- Super glue



### ***How to Remove a Guitar Nut:***

Nuts can become damaged over time and affect the playability of your guitar. When this happens you are going to want to replace the nut.

**Score the Edges of the Nut-**If the neck of your guitar is finished then you are going to want to score the edges of the nut with an X-acto knife. The reason for doing this is to prevent chipping when removing the nut.



X-acto Knife

### ***Removing a Fender Inlaid Nut:***

**Slide Method-**This is probably the easiest method for removing a guitar nut. After you have scored the edges of the nut, you can slightly tap the nut from the side to cause it to slide out.

## Nut Adjustment and Replacement:

**Pull Method-** The pull method is a little more risky as it can cause chipping in the fret board. To pull the nut out use a pair of fret nippers or vice grips and pull it out slowly and carefully. To prevent chipping of the fret board, put protective tape of both sides of the nut.

**Cut Method-** If you can't manage to get the fret out with the previous two methods then you are going to have to cut it out. Using the cut method will destroy the nut so try to use the other methods if possible. To cut the nut out take a thin saw and cut down the middle of the nut. While you are cutting be sure not to cut down into the fret board. After the middle has been cut out you can break out each side separately.

### ***Nut Installation:***

**Fit the Nut and Clean the Slot-** You are going to want to clean the slot out of any glue that was left behind before you install the new one. You will need a thin file that can fit into the slot. Make sure that you don't file down the sides of the slot as it has to stay straight. After the slot is cleaned out you can lay the nut into the slot. If the nut hangs off the edges at all, you are going to want to file them down until they are smooth.

**Dry Run-** Before you actually glue the nut into place, you are going to want to test putting the not into the slot and seeing how it fits and how you are going to clamp it down while gluing.

**How to Glue the Nut Into Place-** You can use either wood glue or super glue to hold the nut into place. You will only need a small amount of glue. You don't want the glue to seep out the sides and if you have to remove the nut again, a lot of glue will make it difficult. When setting the nut into place, make sure the nut is flat on the fret board and that it doesn't hang off the edges.

**Installing Fender Rolled Nuts-** You will need to clean the slot out just like before. Put the nut into the slot and mark where the screws are going to be. Then remove the nut and drill holes at the marks that are

slightly smaller and shorter than the screw. After you have drilled the holes you can put the nut back in the slot and screw it into place.

## Strap Button Repair

### Tools Required:

- Screwdriver
- Wood glue
- Dowel rods or toothpicks (depending on situation)
- Sandpaper (400 grit+)



One thing that doesn't come up much when talking about guitar maintenance, but is extremely important, is strap button repair. The last thing you want is your guitar to fly off while you are playing. Strap buttons loosen up gradually just from everyday wear and tear. If a strap button loosens or pops out while playing, your guitar will fall to the floor which may severely damage it. Strap buttons can be repaired easily but you must pay attention to detail.

### Strap Button Can Be Pulled Out

First of all if your strap button can easily be pulled out, the only way to fix it is to plug and re-drill. The hole has likely been stripped out which means you must find a dowel or a plug that will snugly fit in the hole. You must first measure the hole left by the screw. You will likely be able to find the correct size dowel at any local hardware store. Use a small amount of wood glue such as Tight-Bond to glue the dowel in the hole and then cut off the excess. Once it has dried you may sand it down flush to the body. **Be careful not to damage the finish on your guitar while sanding the excess dowel!** Once you are done sanding re-drill the hole and now you may screw in your strap button and enjoy the new, snug fit. Remember, always be careful not to scratch or chip your guitar.

### **Strap Button is Slightly Loose**

If your strap button is just slightly loose, there are a couple of ways you can go about fixing it. The golden rule when repairing your strap button is **NEVER GLUE THE SCREW IN THE HOLE**, as this can cause major damage down the road. One way of fixing it is simply by using a toothpick. Unscrew the strap button and place a thin toothpick in the hole. When you screw the button back in the toothpick will give the threads something to hold on to and this may fix the problem.

Another method that works really well is building up the hole or making it smaller. Unscrew the strap button and carefully brush a small amount of superglue around the walls of the hole. Remember to allow this to dry completely before screwing in the strap button. A few coats may be needed to build the hole up enough, but it is very effective. This simple fix should keep your strap button from wiggling around or coming loose.

## String Buzzing:

One of the most annoying problems to have when playing your guitar is string buzzing. It is not a very difficult problem to solve, but locating the cause may be easier said than done. Before you start doing any major work on your guitar, inspect it thoroughly to



determine the exact location where the buzzing is coming from. String buzzing may occur when the neck is warped, the frets are uneven, the slots in the nut are too low, the action is too low, or it is just set up poorly. Either way this problem can likely be fixed in no time at all, or you'll be back to hearing that clean sound that you love.

### **Determine the Source**

First try to play each open string to see if it buzzes. Make sure not to fret any of the strings. If string buzzing does occur the problem is likely coming from your nut. The slots may be too low or just worn down. The string action will be too low at this point which will cause the buzzing. If you hear the buzzing you will need to repair the nut or just replace it all together (see Nut Replacement for details).

If no buzzing occurs on the open strings, try to fret them at various points along the neck. If buzzing occurs at only a few frets and not others, your frets may be uneven. You will need to replace the frets on your guitar to fix the buzzing. If the buzzing occurs at all frets, your action is likely too low. This can be solved with a simple action adjustment (see Action Adjustment).

## String Buzzing:

### Other Possible Problems and Remedies

Most other problems are not as serious and do not require any repair work. These problems can likely be solved with proper setup. The following is a chart that may help with any other buzzing problems that might occur.

| <u>Symptom</u>  | <u>Possible Cause(s)</u>   | <u>Remedy</u>   |
|---|--|---|
| Open String Buzz<br><br>Buzzes when played open, stops when string is fretted.  | <b>Nut</b><br><br>Worn or poorly cut nut slot is placing the strings too close to the frets near the nut.  | Replace nut or shim to add height. Set up instrument properly.  |
| One Spot Buzz<br><br>Buzzes on one note, or one area but stops when moving away from that spot.   | <b>Frets</b><br><br>Frets are not level, one or more is too high/low. Loose or sprung fret is rising out of the fingerboard. Hump in fingerboard. Wear or deep grooves in frets. | Secure all loose frets, level and dress. Fret leveling and/or replacement of worn frets.  |
| Buzzes When I Strum Hard<br><br>Buzzing occurs when strumming or picking aggressively but can be silenced when playing lightly.   | <b>Set Up</b><br><br>Insufficient relief in the neck.<br><br>Poor set up.<br><br>String gauge too light.   | Adjust truss rod.<br><br>Set up instrument properly.<br><br>Use heavier strings.  |
| Buzzes Everywhere<br><br>Buzzes nearly everywhere even though it is set up properly, will often disappear if string is fretted hard or closer to the fret and plucked softly. | <b>Frets</b><br><br>Frets may be worn out or too low.<br><br>Very small fret wire used.  | Replace frets.  |
| Frets Out<br><br>Buzzes nearly everywhere all the time, strings are literally touching the frets in the center or other area of the fingerboard.                              | <b>Neck</b><br><br>Truss rod may be way too tight back bowing the neck.<br><br>Neck could be a warped, or have excess back bow even after truss rod is loosened.                 | Set up instrument properly.<br><br>Adjust truss rod for more relief.<br><br>Use heavier strings if relief cannot be created thru truss rod adjustment |

*\*courtesy of fretnotguitarrepair.com*

## Pot Repair and Replacement:

### **Tools Required:**

- Screwdriver
- Wire cutters
- Guitar pick (optional)
- Soldering iron and solder



One of the parts commonly mentioned on electric guitars are the pots, but what exactly is a pot? Pot is actually short for potentiometer, a small device that controls the flow of electric current making it basically a glorified resistor. A guitar will usually have 2 pots; one is for volume and the other for tone. On the bottom of each pot

there are three lugs; the 2 outer lugs carry electric current to and from the pickups, while the middle lug resists the voltage. When the knob on the pot gets turned, the middle lug will resist more or less voltage which causes the volume to either decrease or increase. The only difference between the 2 pots is that the tone pot has a capacitor installed that prevents high frequencies from reaching the output jack and the amplifier.

### **Replacing a pot:**

Just like any other electronic component on a guitar, pots will eventually wear out or break, and will need to be replaced. Replacing a pot is simple, and very similar to replacing a pickup selector.

1. Remove the knob

## Pot Repair and Replacement:

First, you need to remove the knob for the pot/s that you want to replace. Some knobs are held on by set screws so look for one before you attempt to remove it. If there is no set screw, the knob is on a split shaft, meaning that it is held on by friction and pressure and can usually be removed by pulling up on the knob. If it's stuck, try prying it up with a thick guitar pick. Once removed be careful not to drop it on your guitar.

### 2. Unscrew retaining nut

Once the knob is removed, you will see a nut on the pot's shaft, simply unscrew that to allow the pot to drop out the bottom of the guitar.

### 3. Replace the pot

To access the pot you will need to remove the electronics cover on the back of the guitar. Once inside, you'll be able to remove the old pot. Before you cut any wires take note of which wires are soldered to which lugs (refer to the wiring diagram). Once you have the wiring checked, cut the wires close to the lugs and remove the pot. Bolt the new pot in place, solder the wires to the correct lugs, place the electronics cover on the back of the guitar body and put the knob back on.

If you are unsure about the soldering process, refer the **How To Solder** page.

## Common Electronics Problems and Repairs:

### Wiring Problems:

**Guitar cuts out:** If your guitar is constantly cutting out, it's a very common symptom of a simple wiring issue, usually caused by a faulty solder joint in the electronics. The most common reason for this is the output jack becoming loose in its socket and rotating, causing the connections inside to break off. This is why it's very important to make sure your output jack is always tight. Fortunately, loose wiring connections are simple to fix, the trouble is finding them.

### **Repairing a loose connection:**

1. Plug your guitar in and toggle all the switches and knobs. If your guitar still plays fine, the connection problem is internal.
2. For non-Stratocaster style guitars, remove the cavity covers on the back of the guitar. Strum the strings and move the wires that are soldered to the switches, pots, and output jack. You will probably find your loose connection when the guitar cuts out again. For Stratocaster style guitars, you will need to remove the pickguard and manually check each connection point to make sure the solders are solid.
3. Re-solder the loose wire and screw the cavity covers or pickguard back on.

### Pot Problems:

**Guitar crackles when turning volume or tone knobs:** Guitar crackling is a very common issue but rarely has to do with wiring. Typically, if your guitar crackles when adjusting the volume and/or tone knobs, it's because the pots are dirty. To clean the pots, simply remove the knob and spray some electronic contact cleaner into the pot around the shaft and wipe off excess before replacing the knob. If crackling persists, you may have to replace your pots.

## Truss Rod Adjustment:

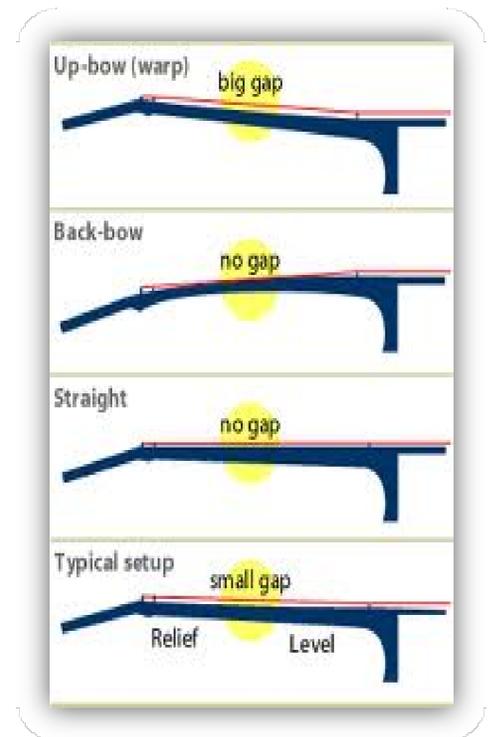
One thing every guitar owner should know how to do is adjust the truss rod. The truss rod is a metal rod that is inserted into a channel in the neck of the guitar. Its main purpose is to counteract the pull of the strings on the neck. Over time the tension from the strings tend to warp the neck of the guitar. The neck can warp due to temperature and humidity changes as well. The truss rod, which is also adjusted on the neck of the guitar, can easily be adjusted with an Allen wrench or screw driver. Many guitar owners are afraid of adjusting the truss rod but it is actually very simple and can make a world of difference with your guitar.

### Types of Truss Rods

There are two types of truss rods used today. Single action truss rods will bend the neck backwards when tightened. When loosened, this truss rod will not actually bend the neck forward; it just relieves its pressure and allows the strings to bend the neck. A dual action truss rod will actually bend the neck backwards when tightened and forward when loosed.

### Determine Adjustment Needed

The first step is to decide which way you actually need to adjust the truss rod. It is extremely important to understand that the truss rod will only adjust the straightness of the guitar and nothing else. Checking the concaveness of the neck is quite simple. You start by holding the Bass E string down at the first fret. At the same time hold the string down at the 12<sup>th</sup> fret as well. While holding the string down, look at the 6<sup>th</sup> fret and use the string as a straight edge to read the curve on the neck. The ideal gap between the string



and the fret will be about a tenth of an inch or the thickness of a business card. If the gap is less than this, the strings may buzz when played due to the neck being back bowed or too straight. A straight neck will be easier to play but a slight bow is ideal to get the perfect tone out of your guitar. Remember you can always adjust to your specific playing style.

### **Adjustment**

As mentioned, the truss rod can easily be adjusted with an Allen wrench or a screw driver. First you must locate the nut for the truss rod.



The location varies on different guitars but is usually located at the end of the neck or behind a plate on the head. If your neck is bowed forward, you will want to tighten the nut to bend the neck backwards. If your neck is back-bowed, you will want to loosen the nut which will allow the neck to straighten or bow forward. As a rule of thumb, never adjust the truss rod more than 1/8<sup>th</sup> turn at a time. Over

tightening may break the truss rod which can be very expensive to replace. Also remember that it may take a few minutes for you to see the results of your adjustments, so just adjust a small amount at a certain time.

### **Precautions**

There are some precautions you must take when adjusting the truss rod. Remember to always use the correct tool to avoid stripping or damaging the nut. Check with the manufacturer to verify that you are using the right side wrench. Some nuts are welded to the truss rod, so as you can imagine, repair work can be costly. Also, if your truss rod makes strange noises or extreme resistance occurs while adjusting, take your guitar to your local shop to avoid any damage.

Over the years, your guitars finish can experience many different problems. This is mainly due to the use and abuse on your guitar. You can re-finish your guitar but it tends to be a hard thing to, so you want to be careful.

**Lacquer Cracks:** Drastic changes in temperature will usually be the cause of cracks in the lacquer. When the temperature is changing, the wood will want to expand and contract. The lacquer will want to stay stiff, so when the wood is changing shape, the lacquer will crack. Lacquer cracks from the inside, so they will feel smooth if you run your finger across them if they haven't cracked all the way through.



**Scratches in the Finish:** Guitar scratches are very common and hard to avoid. These scratches can be both shallow and deep and there are different ways to deal with both.

The best way to get rid of shallow scratches is to wet sand, buff, and then polish. Wet a piece of 1000-grit sand paper with soap and water. Lightly sand down the area of scratches and make sure you only remove a slight portion of the lacquer. Then take a buffer or rag and rub in some buffing compound. After you have buffed the area, polish it down to make it shine.

Deep scratches are much harder to remove and are usually best just left alone. If you try to sand out the scratch then you will have to go deep and may even sand off the paint. At this point it would have to be refinished.

**De-Laminated Finish:** This is caused by an improper finish where the top coat does not stick to the sealer coat. When this occurs, you will need to strip the finish off and refinish the guitar. Simply spraying more lacquer on the guitar will just make this problem come up again later.

## How to Solder:

Being able to solder your own electronics is something every guitarist should know how to do. You never know when you may have to repair a broken wire, replace your pickups, pots, or whatever else may break or wear out over the life of your guitar. Soldering is very easy and only requires a little practice to become good at.

Soldering is the joining of two metals by using a third metal, such as attaching a wire to a pot using the third metal which is the solder. The solder itself is a metal alloy with a very low melting point, when melted it will flow quickly over the piece you are working on and solidify quickly once the soldering iron is removed, and will fuse the two pieces together.

### **Tools Required:**

#### 1. Soldering Iron

Soldering irons are fairly simple devices and relatively inexpensive. Basically it's just a device that uses electric current to heat a metal

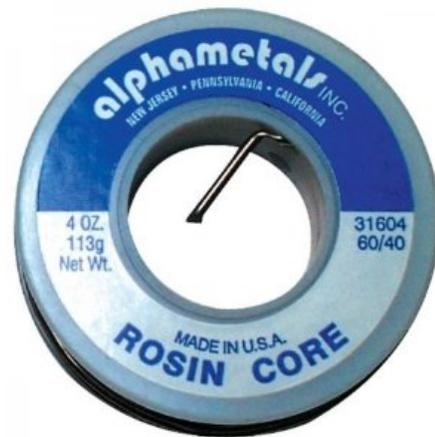


tip. They come in a wide variety of wattage levels, some being adjustable. For a basic soldering iron, I recommend getting one between 30 and 60 watts so that it will have enough to melt the solder quickly, but not too hot to damage the components you're working

with. Some will come with interchangeable tips, which is nice for different types of soldering.

## 2. Solder

Choosing solder is very important since it is what will hold your wiring together. For this type of work, you will want to get a 60-40 rosin core tin/lead solder. It's the industry standard for electronics soldering and will melt quickly and produce a solid joint. This type does give off toxic lead fumes when used, so many companies produce a rosin core solder that is lead free. Either of the two types will work fine for your guitar.



## 3. Damp sponge or paper towel

You will need something to clean the tip of the soldering iron and wipe up any excess solder afterwards. You can use either a wet sponge, rag, or a folded paper towel wetted down to do this. It's also handy for keeping the iron from overheating.

## 4. Wire strippers

Wire strippers are used to remove the rubber insulation from wiring before we solder it. Because of the small size of the wires we are dealing with, you should get a pair of small gauge wire strippers. Most will cover a range of wire from around 10 gauge all the way down to 22 or 24 gauge wire.



## How to Solder Electronics:

Soldering is very simple and easy to learn, however it will take some practice to fully grasp. I recommend that you gain some practice before you dig into your guitar if this is your first time soldering. You may realize it will be nice to have an extra set of hands in some cases, if that's not available just take your time and go steady. This is a step by step, how-to on making a clean solder joint.

### 1. Strip the wire

As mentioned before, stripping the wire refers to removing the protective rubber insulation from the actual wire underneath. Start by taking your wire strippers and inserting the wire into the slot marked for the size wire you're using. Squeeze the handles to cut through the insulation, and then slide strippers away from you to remove the insulation. Usually it works best to remove about  $\frac{1}{4}$  inch of the insulation, just enough to solder the wire to the lug without leaving any extra exposed.

### 2. Tin the tip of the soldering iron

Tinning the tip of the soldering iron means to coat it with a thin layer of solder. Having the tip tinned helps to transfer heat to the workpiece more efficiently. Start by plugging in your soldering iron and letting it heat up for about 10 minutes. Once hot, wipe the tip with a wet paper towel or sponge to clean off any old, oxidized solder. Now take your solder spool, and melt a thin coat of solder on the tip, not too much, just enough to cover the tip. Immediately wipe the tip again with the wet towel before the solder and flux can become solid. You're now ready to start soldering the wire.

### 3. Tin the end of the wire

Tinning the wire helps to hold all the small wire strands together and will make it easier to make the final solder joint. Simply heat the exposed wire end with the iron, melt some solder on to the wire and wipe off the excess.

#### 4. Soldering the joint

Now take the piece that you will be soldering to, such as the back of a pot. Take the soldering iron and move it slowly around on the pot until it is heated just enough to melt the solder. Now take your tinned wire and hold it on the pot until the solder melts. This is where another hand comes in handy. While holding the wire on the pot, don't remove the iron, take your spool of solder and melt a little on top of the wire until it flows evenly across the wire. When you have enough solder applied, remove the spool of solder, and then the iron. The solder joint will solidify quickly, once it has become solid give the wire a small tug to ensure it has bonded well. If it checks good, you're done.

When soldering the back of a pot, or any other electronic device, make sure not to get them too hot as it will cause damage to the components inside.

This is a link to a soldering tutorial video that clearly shows the process involved and some good tips for making a clean joint:

<http://www.guitarbuilding.org/#!/video-series-page-4>

