

# Guitar Setup and Intonation

By: Gary Allen

I thought I might take a break from the effects articles this week and talk about guitar intonation. Lets face it. Most players either don't know what intonation is or they are to afraid to try to do it themselves. If you are a player that is going to try adjusting your intonation for the first time I suggest that you use a guitar that you do not play on a regular basis until you get the hang of it. If you use your regular playing guitar and do not get the intonation right you will have a guitar that will not play in tune no matter how many times you tune it. If this happens, do not worry. You have not damaged the guitar and you can take it into a professional to reset the intonation. Intonation setting gives you no chance of doing any permanent damage to your guitar unless you try to do it blindfolded sitting in the middle lane of a busy interstate. Of course this will probably void your warranty anyway.

Now lets define intonation. Intonation is the ability of the guitar to stay in tune for the entire length of the scale. This basically means that any note that you fret from the first fret to the last fret will be perfectly in tune. Intonation has to do with the total length of the string from its contact points at the nut and the bridge. If the string is to long or short it will cause you to be out of tune when you fret notes of chords. This is because the string stretches as you fret notes. If the guitar is not set up to compensate for this stretching you will pull the strings pitch either flat or sharp. There are a few ways to check this, but I will get into that later. There are other adjustments that need to be made before you can adjust your intonation.

First off, lets look at what can cause your intonation to be off. Here are a few examples of things that can cause intonation problems.

**String Height:** If the action on your strings is set to high then you have to push them further to make contact with the fingerboard or frets. This will cause to much stretching of the string resulting in the pitch of the fretted note being too sharp.

**A Loose Saddle:** The saddle is the part of the bridge that the string makes contact with. Saddles are the adjustable part of the bridge that you use in setting the intonation. If any saddle is loose the string will change length every time the saddle moves. This will cause notes to be to sharp or flat depending on the movement of the saddle. Once the intonation is set the saddles should be stationary.

**A Change of String Gauge:** If you change the gauge of strings that you use this can have an adverse effect on your intonation. A heavier gauge of string will put more pressure on the neck of the guitar while a lighter gauge will put less stress on the neck. This can change the natural bow of the neck causing a change in string length. The adjustment for this lies with the truss rod, which leads us to the adjustments that must be made before to adjust the intonation.

## Guitar Setup Before Intonation Adjustment

This section will deal with the setup of the guitar you will need to do before you adjust the intonation. If you do any of these steps after the intonation is adjusted it will ruin all the work you did to the intonation and you will have to do it all over again. Adjusting your intonation takes quit a bit of time so you will probably only want to do it once and be done with it.

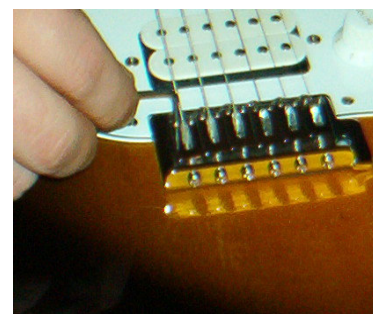
**Change Your Strings:** The first thing you want to do is to change your strings. Put on a fresh set of strings in the gauge you will use on a regular basis.

**Set Your String Height:** The first adjustment you will want to make is your string height. On most guitar you can set each string height separately using the height adjustment screws on each individual saddle. You will need a six inch ruler with 1/32" and 1/64" increment and a small phillips screw driver.

First tune the guitar. Now measure the distance between the bottom of the string and the top of the 17<sup>th</sup> fret. Check with your guitar manufacture for the specifications for your particular guitar. Use the saddle height adjustment screws to adjust each string. If your saddles are pre set you may have to adjust the whole bridge to the closest spec.



**Left Picture:** Tunomatic Style Bridge. (On Most Les Paul Style Guitars) Use a flat head screwdriver.



**Right Picture:** Strat Style Tremolo. (Most Strat & Tele Style Guitars) Use a very small allen wrench for height adjustment.

Here are some basic specifications that will work with most electric guitars.

<b>Neck Radius:</b>	<b>17<sup>th</sup> Fret String Height</b>
7.25"	5/64" - 4/64"
9.5" to 12"	4/64"
15" to 17"	4/64" - 3/64"

**Adjust The Truss Rod:** The second adjustment you will want to make is to the "truss rod". The truss rod is a metal rod that goes down the length the neck. The purpose of this rod is to counteract the pressure put on the neck by the strings. Without a truss rod the wood from the neck would snap in half from the pressure of the strings. This adjustment unlike intonation setting can cause serious and often unreparable damage to the guitar if done improperly. If the truss rod is tightened to much it can cause the fretboard to separate from the neck of the guitar. It is advisable to do small adjustments at a time.

To adjust the truss rod you will need a capo and an automotive feeler gauge set. Tune the guitar and then put the capo on the first fret. With the capo on the first fret depress the string at the last fret. Using the automotive feeler gauge set check the gap between the bottom of the string and the top of the eighth fret. The distance should be approximately .010". The truss rod adjustment is found at the top of the neck usually just above the nut.



*Put Capo on the First Fret*



*Use Feeler Gauge to measure the gap between the string and eighth fret while fretting the string at last fret. Gap should be approximately .010".*



*Adjust Truss Rod accordingly*

Make the adjustment by looking up the neck of the guitar toward the tuning keys.

**Neck too concave** - Adjust truss rod nut counter-clockwise

**Neck too convex**- Adjust truss rod nut clockwise

**Note:** Do not turn the truss rod more than a ¼ turn at a time. After you make an adjustment, take the capo off and re tune the guitar. Put the capo back on the first fret and go through the same steps until you reach the goal of .010" between the bottom of the low E string and the top of the eight fret. Do not forget to retune the guitar between each adjustment.

If you feel uncomfortable adjusting the truss rod you should take your guitar to an authorized service technician. I actually recommend this because of the damage you can cause to your guitar if you do this wrong.

### ***Setting the Intonation***

Now that the string height is adjusted and the neck is straight we can start adjusting the intonation. Remember that intonation is the ability of the guitar to stay in tune down the entire length of the scale. You can tune your guitar with an electric tuner and get all the open notes in tune, but that does not mean that any note that you fret at any other fret location will be in tune.

**Special Note:** If you play in an alternate tuning you will want to set the intonation in this tuning. For instance if you regularly play in a “Drop D” tuning you will want to tune the guitar to “Drop D” before you set the intonation. Have you ever been to a concert where the guitar player changed guitars during the show. This more often than not is because that guitar player plays some songs in alternate tunings. He has different guitars with the intonation set at different tunings for this. If you set a guitars intonation for standard tuning it will not be completely in tune for a “Drop D” tuning because of the reduced stress on the neck in “Drop D”.

If you only have one guitar and play in multiple tunings, tune to the tuning you use the most then intonate the guitar. The other tunings will not be perfect, but they will be close. Ultimately you should have different guitars intoned to the different tunings, but many people can not afford this, or they do not use an alternate tuning enough to justify the cost of another guitar.

Now lets set the intonation. You will need a tuner, and a guitar cable. You will also want a small screwdriver. For a Fender style bridge you will need a small Phillips screwdriver. For a Gibson style bridge you will need a small flat head screwdriver. If you have a different style bridge you will want to check and see what kind of adjustment screws you have. I have even encountered allen wrench style adjustment screws a few times, but mostly on Floyd Rose style tremolo bridges.



**Left picture:** Tuneomatic style bridge. Use a small flat head screwdriver to make saddle adjustment.



**Right Picture:** Vintage tremolo system bridge. Use a phillips screwdriver to make saddle adjustments.

The first thing you are going to want to do is to tune the guitar with the electric tuner. Make sure and get it as close to perfect as possible. Remember to tune to the tuning you use the most predominately.

Now that you are in tune you will want to fret the first string at the 12<sup>th</sup> fret. While fretting this note pick the string and check the pitch on the electronic tuner. It should be identical to the open string tuning of that same string.

If the pitch is “sharp” you will need to move the saddle away from the neck by using the saddle adjustment screws at the bottom of the bridge. Turn the screw clock-wise. This will pull the saddle away from the neck and lengthen the string. Only turn the screw a quarter turn at a time. Retune the guitar to the open tuning and go through these steps again until you have a perfect octave. Once you achieve the intonation on this string you will move on to the next string and repeat this procedure all over again until all strings are intonated.

If the pitch is "flat" you will need to move the saddle toward the neck using the saddle adjustment screw on the bottom of the bridge. Turn the screw counter clock-wise. This will push the saddle toward the neck and shorten the string. Once again only turn the screw a quarter turn at a time. Retune the guitar to the open note and go through these steps again until you have a perfect octave on the open string and twelfth fret. Now repeat this procedure with each string until finished. Once you have finished each string you have completed a basic intonation of your guitar.

**Note:** Always remember to retune the guitar to the open tuning every time you adjust a saddle in either direction. Anytime you shorten or lengthen a string by moving the saddle it will ruin the tuning of that string. Trying to set the intonation while the string is out of tune in the open position will get you nowhere fast.

Some players and guitar techs will even go a step further and check the pitch of every fretted note in the entire guitar scale length. The scale length is the entire distance of the string from the point of contact on the nut to the point of contact on the bridge saddles. While this is a truer intonation it is very time consuming and can be very frustrating. I suggest just intonating at the twelfth fret until you get the hang of it. If you feel the need to have your guitar intonated at every fret I suggest having it done by a professional luthier, or your favorite local guitar tech. I believe that the average cost of a standard intonation is about \$65.00 USD. This cost may vary depending on your location.

So how often and when should you set your intonation? If your guitar has not been intonated in over a year I would suggest doing it. After you have it set up you can quickly do it every time you change your strings. If you do this you should only need to make a few very minor adjustments that can probably be done in just a few moments.

If you change the string gauge you are using you will need to reset the intonation. Heavier gauge strings put more stress on the neck while lighter strings cause a reduced stress on the neck.

Any time you adjust your truss rod you will need to adjust your intonation. Any changes in the neck will cause a shortening or lengthening of the string causing the intonation to go crazy on you.

There is always the chance that your guitar is left out and your 5 year old child sees these shiny things that this really cool looking screwdriver thingy fits into and turns really neat like. You will need to reset your intonation!!!!

I hope you have found this article to be informative. Please feel free to E-mail any questions or comments.

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