January 2009

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Howdy!

When my friend Bill asked me recently to go with him to a big box guitar store to help him pick out a new strat I was reminded of my own strat shopping experience almost 20 years ago. Back then I "auditioned" at least seven virtually identical USA made instruments. In this "audition" I used the same amp and cable and only changed guitars. All seven instruments had the same pickup configuration, volume and tone controls, body and neck woods and found I could hear a significant difference in tone between these instruments. All of these instruments were new, and made in the same year and even had the same finish! I now believe that part of the reason for the difference in tone I heard was in the setup of these instruments, specifically in the pickup height adjustment which leads me to the topic for this newsletter.

In its most basic form, a passive magnetic pickup designed for electric guitar or bass has three components:

1. One or more permanent magnets
2. One or more coils
3. Output cables that provide a means to electrically connect the coil to the controls circuit of an instrument

The magnetic field which extends invisibly from a pickup to the strings of an electric guitar plays a crucial role in the tone and output of a pickup. This field can be strong or weak depending on the type of magnet, number of magnets, and the size, geometry and orientation of the magnet(s).

When the guitar strings (which contain material which is attracted to a magnet such as iron or nickel) vibrate, the magnetic field of the permanent magnet fluctuates at the same frequency and it is this fluctuating magnetic field which induces electrical current in the coil of the pickup. This low voltage electric current is the signal which the pickup generates that travels through the guitar's volume and tone controls circuit, through the guitar cable (or wireless system) and ultimately to the input of an amplifier.

Proper height adjustment of a magnetic pickup relative to the strings is crucial in obtaining great tone.

Most pickups are secured to an instrument with a means of adjusting the distance between the magnets of the pickup and the strings. In guitars which have a pickguard or a pickup mounting ring, the same screws that hold the pickup to the pickguard also allow the pickup to be raised and lowered.

Very small adjustments (¼ to ½ of a full rotation) of the pickup height adjustment screws can make a dramatic change in the tone and volume of a magnetic pickup. Some pickups such as a P-90 style soapbar and PAF style humbuckers also have adjustable pole pieces that allow an additional degree of adjustment.

It has been my observation that single coil pickups are more sensitive to small changes in height than are humbucking pickups with side by side coils. Also, in general as one increases the distance between the pickup and strings the volume decreases, the attack of notes becomes softer and the overall tone is warmer.

To examine the magnetic field of pickups I built a test measurement frame which held the probe of my gauss meter directly above a pickup and allowed me to measure the change in magnetic field strength as a function of the number of turns of the pickup height adjustment screws. Using this test fixture I made careful measurements of two pickups: a PAF style humbucker with an AlNiCo-III bar magnet and a strat style single coil pickup with AlNiCo-V rod magnets. The height adjustment screws for the PAF style humbucker were 3-48, while the height adjustment screws for the strat style single coil pickup were 6-32. Each full (360 degree) rotation of a 3-48 machine screw will raise a pickup approximately 21 thousandths of an inch (0.021"). Each full (360 degree) rotation of a 6-32 machine screw will raise a pickup approximately 31 thousandths of an inch (0.031"). In both measurements the probe of the gauss meter was centered directly over a pole piece or AlNiCo rod magnet.

Here graphs which contain the results:

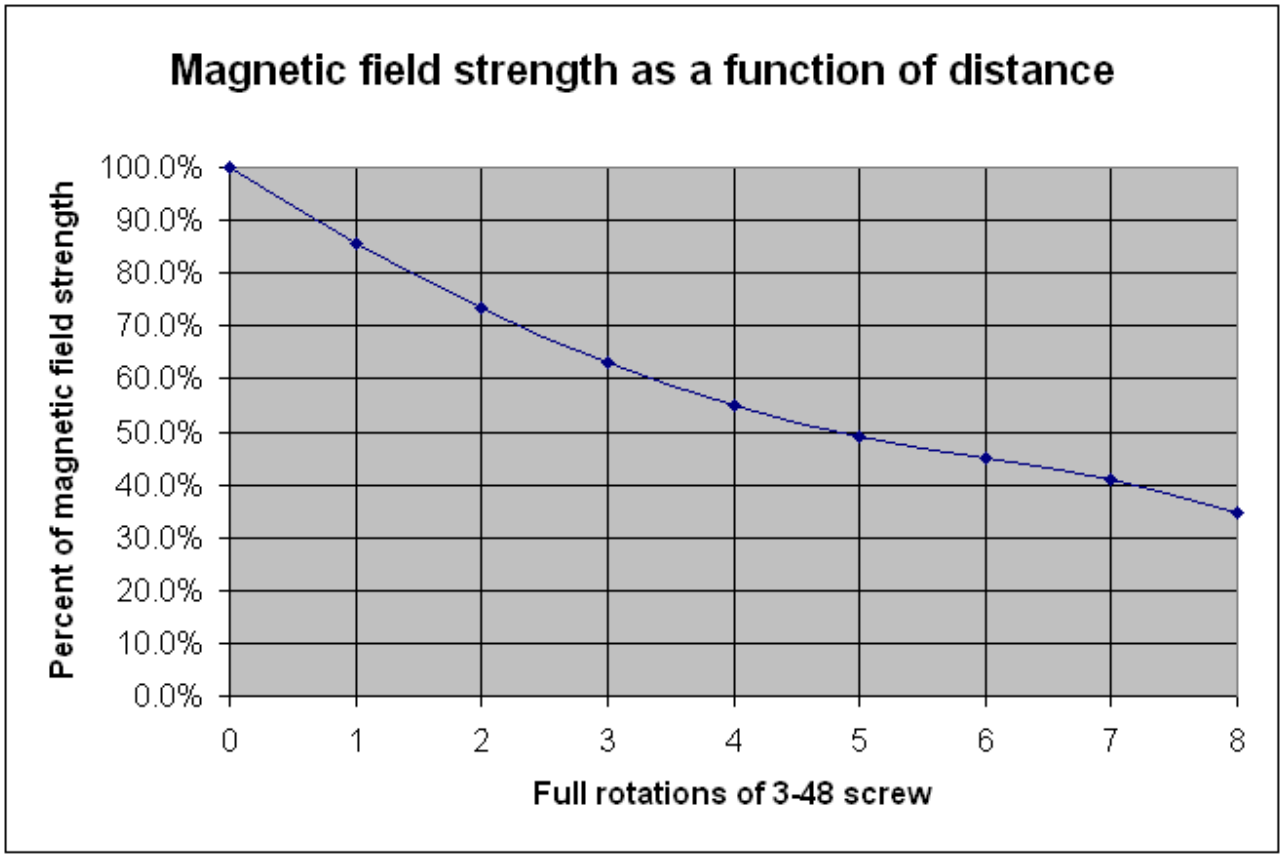

Figure 1. Magnetic field strength of a PAF style humbucker as a function of height adjustment via 3-48 machine screws.

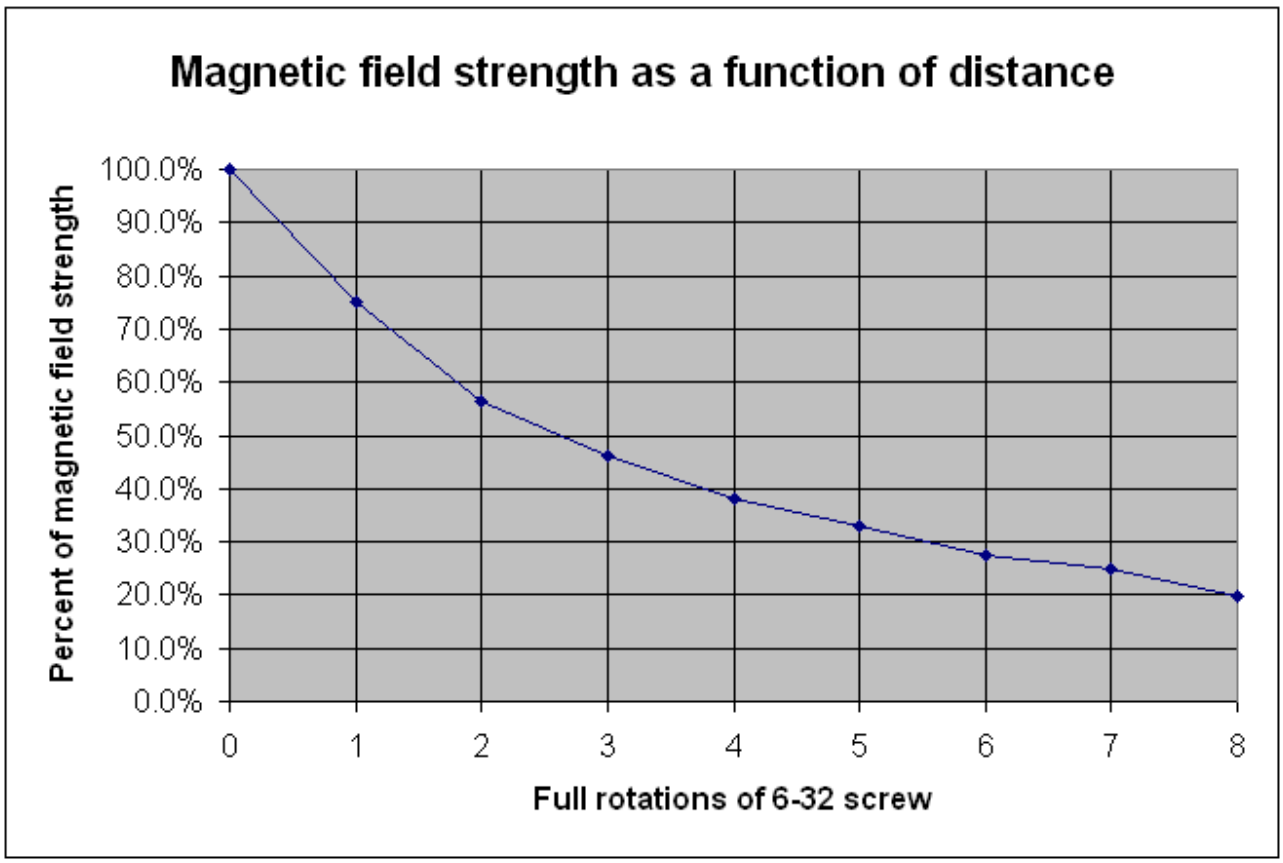

Figure 2. Magnetic field strength of a strat style single coil as a function of height adjustment via 6-32 machine screws.

In both Figure 1 and Figure 2 the strength of the magnetic fields observed has been normalized to 100% (all magnetic field strength data is therefore relative to the strongest observed field close to the polepiece or AlNiCo rod magnet).

Note that in Figure 1 the magnetic field strength for the PAF style humbucker drops to approximately 85% of the maximum with one full rotation of the adjustment screws and after 5 full rotations, the magnetic field strength is reduce to 50% of the maximum.

In Figure 2 the magnetic field strength for the strat style single coil drops to 75% of the maximum with one full rotation of the adjustment screws and after 5 full rotations, the magnetic field strength is reduce to approximately 35% of the maximum.

OK, so what does one do with this information?

First, it is important to realize that as with many things, “more is not better”. A strong magnetic field from a pickup can dampen the vibration of the strings and reduce sustain.

I suggest starting with the neck & middle position pickups about 3/16 inch from the strings. I usually have the bass side of the pickup slightly closer to the strings than the treble side.

The bridge pickup can be closer to the strings than the middle & neck PUPs. Again, bass side closer.

The best way to get the exact right height adjustment for your guitar is to plug into your amp & have a screwdriver handy. Play a little, adjust the height of the pickup & repeat as required to get the right tone & balance.

If the pickups are too close to the strings you will experience odd sounding "Wolf tones", poor sustain and an electronic tuner will work erratically.

I hope this information is helpful to you.

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Best Wishes.