

Schatten Design

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Coil Winding Machine Models ECWN and ECWE

Thank you for purchasing one of our fourth generation coil winding machines. This particular machine is the result of nearly eleven years worth of testing and trials. While the concept of the winder is simple, the execution is not. Despite its small size, the Schatten Coil Winding Machine is robustly built and will offer you years of service with little or no attention.

The coil winding machine comes in two iterations: the ECWN model which comes with a 110 volt power supply for North American use and the ECWE model which has a 220 volt power supply for overseas markets; otherwise the machines are identical, operating with a supplied 9 volts d.c. and 500 milliamps.

All machines are fully assembled and tested before having the winding tower and the cross feed limiter laid down for shipping simplicity. The only tool that you will need to reassemble the machine is a Phillips head screw driver.

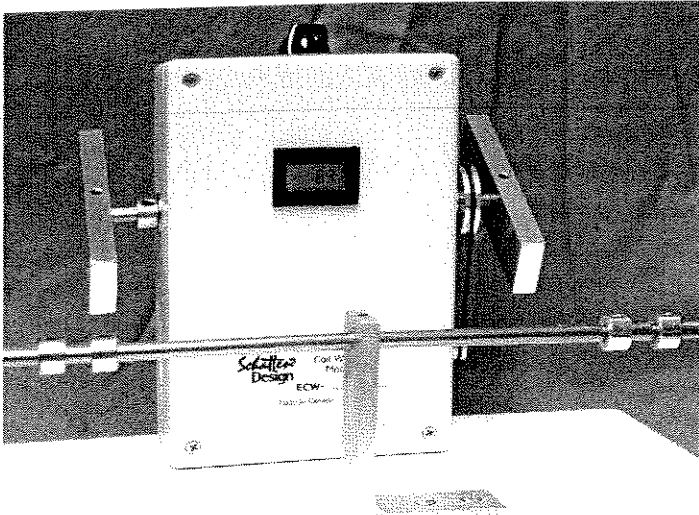


Figure 1

List of Contents:

- 1) One composite winder base, pre-drilled for correct placement of components.
- 2) One winding tower with motor drive and digital resettable rev counter.
- 3) One cross feed limit mechanism.
- 4) Four Phillips head screws, two for mounting the winding tower and two for mounting the cross feed mechanism.
- 5) Three allen wrenches: 3/32", 5/64", 1/16"
- 6) One 9 volt 500 milliamp power supply of either 110 volts or 220 volts depending upon model.

Assembly of the Machine

- 1) After unpacking all of the items supplied, the cross feed mechanism should now be mounted in the centre pre-drilled holes using the two small self tapping Phillips head screws.
- 2) Stand the winding tower up on the composite base with the 9 volt power plug side facing away from the limiter. Line up the tower at the back edge of the board. Note that the two holes on the underside of the composite base correspond to two pre-tapped holes located at the back edge of the winding tower. Secure the winding tower to the base using two of the supplied Phillips head screws.
- 3) The plug from the power supply can also now be plugged in to its jack on the motor control unit.

Please understand that a little bit of 'chatter' or noise can be common from the machine as all of the rotating bits and pieces are mounted in what is essentially a hollow box and this tends to amplify the noise.

Speed Control and Digital Counter

All of the electronics are now built into the winding tower. The pointer knob will allow you to control the speed of the wind from about 40 rpm up to maximum. Note that there is a click detent to the speed control to turn the machine off.

A small blue push button provides the reset for the digital counter. Please note that once the power supply is plugged in, turning off the machine does not reset the counter.

Changing the Drive Belt

The drive belt may now be changed from the outside of the machine. Simply line up the belt so that it runs in the recesses of the motor and main shaft pulleys.

Winding Tower Main Shaft

A flat is ground onto the length of the main shaft. Please note that all Allen screws are positioned so that they contact only the flat and not the round of the shaft. If it is ever necessary to readjust the collars on the shaft or to remove or reposition the winding arms for custom work, make sure that the Allen screws contact only the flat portion of the shaft. If they contact the round portion and imprint or deform its surface, the main shaft may become very difficult to slide through its bearings without damaging them.

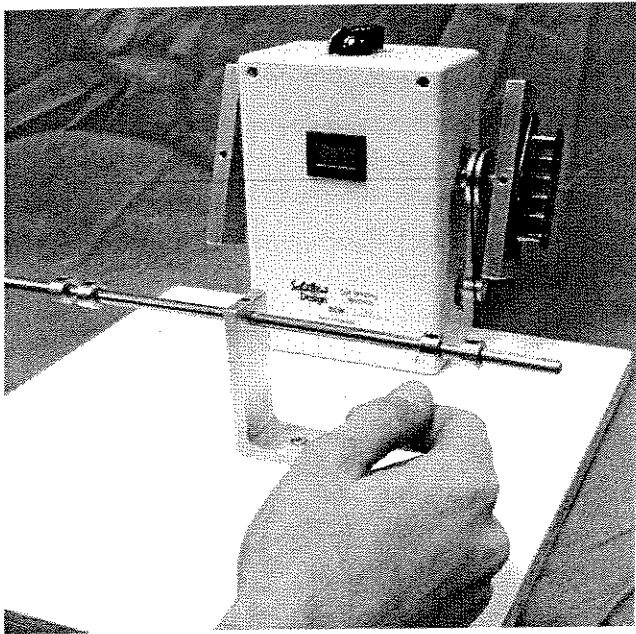


Figure 2

Cross Feed Mechanism

As on the main shaft, there is a flat ground onto the top surface of the limit bar. The two limit collars each have an Allen key set screw located on the top surface of the collar. Make sure that the set screws are always vertical and that they only come into contact with the ground flat surface of the limit bar. Since the coil wire will pass under and against the lower surface of the limit bar it is imperative that the lower surface of the bar remain unmarked and smooth.

Attaching a Bobbin to the Winder Arm

We have found that the simplest and usually the best method for securing a bobbin to a winding arm is by using a double sided tape. Supplied is a sample of the type that we use in our shop. It can be a cloth or fibre glass woven double sided tape (usually marketed as a carpet tape) and can be found in most hardware or 'home depot' type of stores. Notice

from the sample that we generally fold the tape in two to provide the best conformity. The same piece of tape can normally be used numerous times.

Before pressing the bobbin into place, visually make sure that the bobbin is centred on the arm so that it winds evenly.

Starting a Wind

- 1) Place your spool of coil wire about 3 or 4 feet behind you and about on the level of the winder base so that it may unspool end on. It may help if the end of the spool is tipped up a few degrees.
- 2) Stick the end of the coil wire against a bit of the exposed double sided tape on the winder arm. Rotate the opposite winder arm by hand to run the coil wire around the bobbin about 6 turns.
- 3) The coil wire is grasped lightly between thumb and first finger so that it may be controlled and moved between the limits set. The pressure that you exert in holding the wire between your fingers also provides the winding tension.

- 4) Run the wire under the limit arm and adjust the inner limit collar so that the coil wire winds inside of the inner bobbin edge. Make sure that the wire does not quite come into contact with that bobbin lip. You should be rotating the winder by hand to make this adjustment.
- 5) Repeat the same procedure to set the outer limit collar.
- 6) When you are satisfied that the limits are properly set, turn the machine on at low speed and moving the coil wire slowly from one limit to the other, check to see that the coil wire is being evenly wound.
- 7) When you have wound the number of rotations that you require turn the speed control off and break the coil wire from the supply spool. A very small piece of masking tape can secure it to the bobbin.
- 8) Make sure that you remove the other end of the coil wire from where you stuck it onto the winder arm at the beginning of the of the procedure.

Optical/Digital Counter Adjustment

The electronics of the digital counter is triggered by the rotation of the hole in the optical disc running within the walls of the optical sensor.

- 1) The optical disc should run equidistant between the walls of the optical sensor. Adjustment for it to run centered is made by moving the optical disc along the main shaft. The optical disc is held in position by the set screw in its collar.
- 2) The outside edge of the optical disc should have approximately 1/8" to 3/16" of clearance between it and the inside of the bottom of the optical sensor.
- 2) Adjustment for this clearance may be made by loosening the allen bolt that holds the optical sensor assembly in place and sliding the assembly into proper position and then retightening the allen.

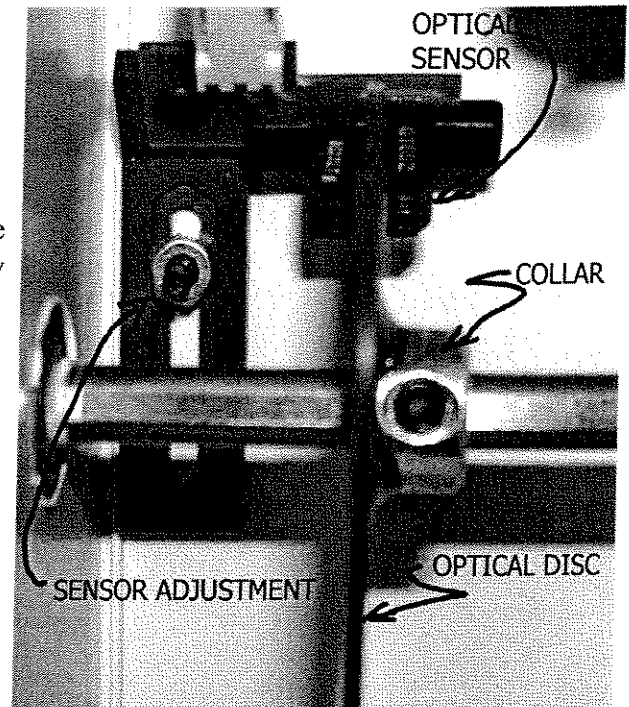


Figure 3

Controls and Electronics:

All components connecting to the circuit board of the machine are attached with snap connectors. Note that the wire groups are colour coded.

- 1) Red banded wire group connects to the optical counter.
- 2) Green banded wire group connects to the motor and power supply jack.
- 3) Yellow banded wire group connects to the digital counter. Please note that the yellow band has a black bottom to the band. This black band is to be positioned so that it is at the bottom of the wire group when the connector is attached to the back of the digital counter.

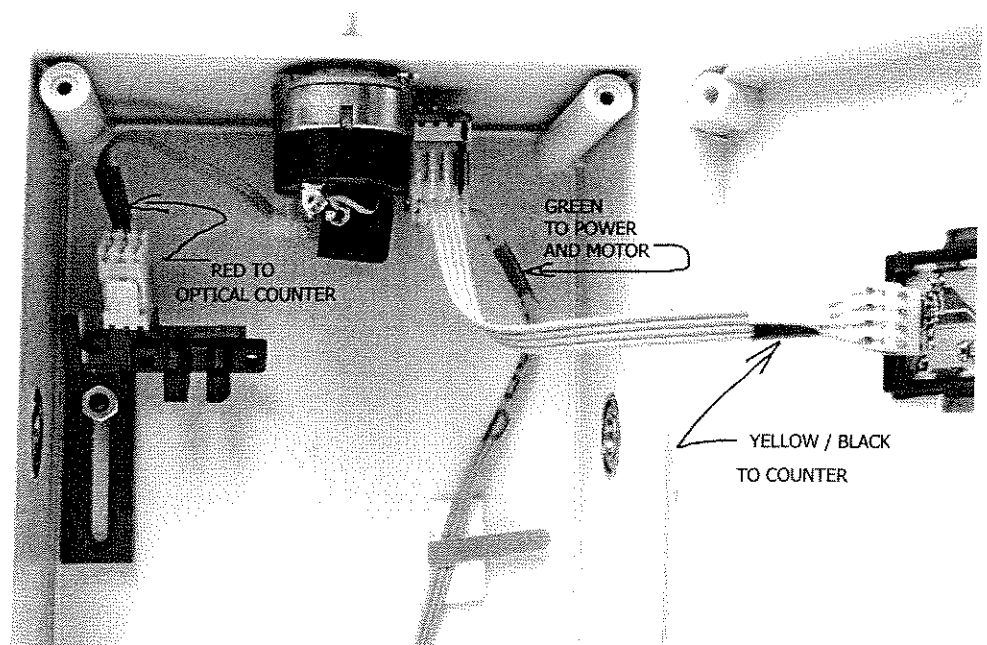


Figure 4

Figure 5 shows a close up of the wires connected to the motor and 9 volt power supply jack.

- 1) The red coloured wire from the green banded wire group is soldered to the positive (+) lug of the 9 volt jack.
- 2) The middle wire from the green banded wire group is soldered to the ground (-) lug of the 9 volt jack.
- 3) A white jumper wire then connects the ground (-) lug on the 9 volt jack with the ground (-) terminal on the motor.
- 4) The outside wire of the three wires in the green banded wire group is soldered to the positive (+) terminal on the motor.

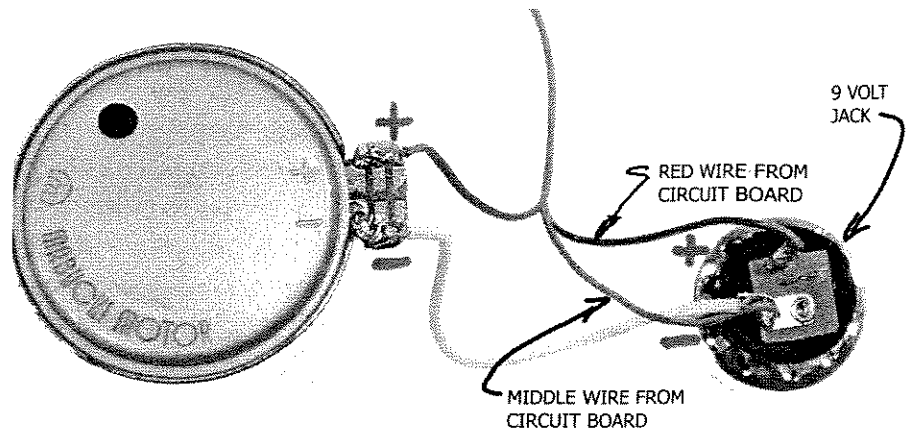


Figure 5

Winder Components

Part No.	Qty	Description
1	1	ABS Box, light grey, Hammond 1594EGY
2	1	Cross-feed limit assembly: 1/4" dia shaft x 11", 3x2x 1/4" angle with set screw,
3	1	Main shaft, 1/4" dia x 6.5"
4	1	Optical disc with integral 1/4" mounting collar
5	5	1/4" collars with set screw for limiter (4) and box (1)
6	1	Main shaft pulley, 1/4" id with set screw
7	1	Optical disc trigger and mounting assembly with nut and allen cap screw
8	1	Main circuit board with speed control and reset
9	1	Motor, 9V, EG 520AD, 2400 rpm, CW rotation
10	1	Motor pulley
11	1	O ring, buna, 2 1/8" id, 2 1/4" od, 1/16" thick
12	2	Flanged Bearings, 1/4" id, FR4 ZZ
13	1	Composite base 11 1/2" x 11 1/2" x 5/8"
14	2	Winder Arms aluminum, 1" x 4"x 3/8" with set screw
15	1	Kit: allen wrenches 1/16, 5/64, 3/32, 2 screws 1/4-20x1" flat head phillips, 2 screws #6 x 3/4" oval phillips head, 1 pc sample double sided tape
16	1	Digital counter, KE minical-1
17	1	9V jack assembly, Mode 2.1 mm
18	1	Pointer Knob, 1/4" id with set screw
19	1	Power supply 9V, Sooma, tip negative. Either 110v or 220v depending upon model

Pickup Winding

with the Schatten Pickup Winder

A pickup winder is a great way to make money in your shop. If you can fix a stock pickup there is no better way to maintain an instrument's vintage value. Use the pickup winder for these repair and customizing jobs:

Rewinding dead pickups

- Rewind an entire pickup to original specs.
- Peel a pickup to find the problem, then rewind from the problem out.
- Rewind a pickup to custom specs (overwound, underwound, tapped output, etc.).

Modifying pickups

- Make higher output pickups out of standard pickups.
- Make a "tapped" single-coil.
- Add wire to an existing coil.

- Reduce the output of overwound pickups by peeling, tapping the coil and rewinding. This gives the customer more tone options from one pickup.
- Add wire to one coil of a humbucker to get slightly mismatched coils (credited for some players' unique tone).

Make pickups for custom/specialty instruments

- Make replacement components to replace damaged pieces of an existing pickup.
- Design and build your own pickups.

Pickup rewinding requires patience and study. Don't dive into rewinding vintage pickups until you've repaired and wound some el Cheapo pickups. Most repair shops have collected a pile of dead pickups over the years—they're perfect for practicing. (Remember the luthier's golden rule: *Practice On Scrap!*)

Troubleshooting

Here are some common pickup ailments. To isolate a problem, unsolder the pickup from the guitar so that other electronic components don't affect your tests.

Output is weak

What is the DC resistance of the pickup?

- Normal DC resistance for a single-coil pickup is 6-8K Ohms; humbuckers are normally around 8-13K. If the pickup's DC resistance seems normal but the output is low, the magnets could be weak. See "Remagnetizing a pickup" later in these instructions.
- A low DC resistance could indicate shorts within the coil windings. A typical cause is corrosion of the coating on the magnet wire, causing the coil wraps to short out against each other. This can drastically reduce output, making the pickup a candidate for rewinding.

No output

Is there DC resistance between hot and ground, or is there a dead short?

- If there is a reading for DC resistance, and it appears to be normal or close to normal, the magnets may be dead, or there could be a poor solder joint, which has oxidized where the ends of the coil wire connect to the output wires.
- If there is a dead short, then inner coil corrosion could be shorting out to ground, or there is a break in the coil wire. Before you do anything drastic like completely peeling or cutting the coil wire off of the pickup, make sure that the output wire solder connections to the coil wire are not corroded or broken.

Techniques

Peeling

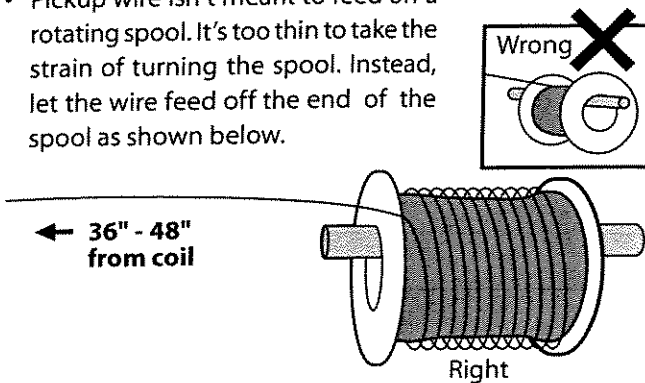
How a pickup has been manufactured and potted (coated with wax, lacquer, or epoxy) will effect how easily a coil can be peeled. Often, no matter how careful you are, a coil cannot be removed wind-by-wind. Age also can make the

wire difficult to remove in one continuous piece. If you're not trying to retain the original wire or determine the number of winds on a specific coil, the quickest and easiest way to remove the coil windings is to cut through them with a sharp hobby knife.

Winding

Here are some tips and a general outline for winding a pickup.

- When you disassemble and peel a pickup be sure to make notes on how the coil attaches to the lead wires.
- Quick sketches or a photo are very helpful in recording how a pickup comes apart, and more importantly, how it will go back together!
- File or sand any dings or nicks in the coil's flatwork. They should be smooth so they can't catch the coil wire.
- Make sure that there are no nicks in the edge of the wire spool or the traverse bar to snag the coil wire, so it comes off the spool cleanly.
- Pickup wire isn't meant to feed off a rotating spool. It's too thin to take the strain of turning the spool. Instead, let the wire feed off the end of the spool as shown below.



Position the spool horizontally, at the same height as the coil being wound, and about three or four feet away from it.

- Be sure the pickup coil is well attached to the winding arm and that it runs true. Before attaching the coil wire, start the winder and see if there is a wobble or if the flatwork isn't spinning true and straight.
- Start the first 6-10 wraps by hand, turning the opposite arm of the winder. This insures that coil wire won't be pulled off of the bobbin when you start the motor.
- Set the traverse end-stops so they're just inside the inner faces of the flats.
- Set the counter to zero. Determine the number of turns you would like to put on the coil and log that as the "end" counter number on your log sheet (see last page of these instructions).

Potting

Potting a pickup is a technique used to help eliminate unwanted microphonics. Some pickups are not potted from the factory. While it's not necessary, potting is generally a good idea. Here are the common pickup potting materials.

- Start the winder slowly, then increase the speed. Use your fingers or a doubled-over piece of felt to pinch and guide the wire along the traverse.

Variations in tension, and how the wraps align with each other are just two of the ways to affect a pickup's tone and response, so be sure to experiment to see what works for your needs.

The term "scatterwound" refers to pickups wound by hand rather than by a machine. Machine wound pickups have a very even winding pattern, and a "distributed capacitance" (the capacitance between each successive turn and layer of a coil). Scatterwinding lets you control the space between your winds and layers, therefore changing the distributed capacitance. Many feel the reason hand-wound pickups sound better and have more harmonic content than their machine-wound counterparts is because there is less capacitance within the coil.

Don't wind a pickup too loose, but don't wind it too tight either!

- If a coil is too loose it will be microphonic and sloppy.
- If a coil is too tight you can actually deform the bobbin and it's even possible to cause the pickup to implode.

Wind until you reach the desired number of turns, the mass of wire you want on the coil, or until you reach the desired DC resistance.

You can check the DC resistance during the winding process by gently scraping off some of the protective coating on the coil wire with a hobby knife. Touch the "start" of the coil with one probe from your volt-ohm meter and touch the other probe to a portion of scraped coil wire just off of the coil (don't cut the coil wire!). When holding the VOM's probes on the wire, don't let your body's resistance affect the readings—there are VOM probes that have delicate little clips for clamping onto thin wire, and they are ideal for guitar electronics. If you need more wraps, put a drop of lacquer or nail polish on a paper towel and wipe a thin coating onto the bare portion of coil wire, let it cure for a few minutes, and continue winding.

Carefully cut the wire and solder it to either the solder lugs (single-coil) or lead wires (humbucker).

Wax

Pros: Works for most pickups, it's non-toxic, easy to deal with, cheap, and you can undo it if something goes wrong. Wax has a traditional appearance, and it works great for humbuckers with metal covers.

Cons: If the wax is too hot you can warp or melt plastic bobbins. If the wax is way too hot you have a potential fire on your hands! Make sure that the wax never smokes—that's an indicator that it's getting too hot. Never try heating your wax on the kitchen stove or in a microwave oven because hot paraffin, and especially paraffin vapors, can ignite. It's best to wax pot outdoors until you have your methods refined and have eliminated any fire hazards.

Application: After a pickup has been wound, and the output wires are attached and assembled, suspend the pickup in canning paraffin mixed with 20% beeswax, heated to 145-150° Fahrenheit. After ten or fifteen minutes all of the bubbles should have risen out of the pickup, and all of the voids within the pickup should be filled with a coating of wax.

Pull the pickup out of the wax and suspend it over the wax pot letting the excess wax drip back into the pot. Then lay the pickup on a paper towel and allow it to cool to touch. Carefully remove any excess with a paper towel before the pickup completely cools to room temperature.

Stewart-MacDonald's Hot Glue Pot (#0668) has a thermostat designed to heat hide glue to about 145°. Keep the pot at

least 2/3 or 3/4 full. It can operate with less liquid, but the wax may get too hot.

Lacquer

Pros: Good for plastic bobbins that may melt during wax potting.

Cons: Can react with some plastic bobbin materials. Doesn't stop microphonics caused by metal covers on humbuckers. It's difficult to peel a lacquer potted pickup. Lacquer has to be applied while winding, which slows down the process.

Application: Use a small brush and add a thin coating of lacquer every minute or so. You must wait a few minutes before you start the winder, or you'll fling lacquer all over the place.

Epoxy

Pros: Virtually bulletproof and won't degrade in damp or harsh conditions.

Cons: It's difficult to get epoxy to penetrate deep into a pickup's windings, and practically impossible to repair an epoxy-potted pickup.

Application: Because thin epoxies are difficult to obtain, and permanent, it's best to avoid epoxy potting.

Remagnetizing a pickup

If a pickup has a good DC resistance, but is still weak, the magnet(s) may have lost their strength. If you don't have a Gauss meter or magnetometer it's difficult to know how strong a magnet is. However, if you have similar pickups in your shop, and one seems to pull on the tip of a screwdriver harder than the other, you can guess that the magnet is weak. A polarity checker (Stewart-MacDonald #5127) is a must for deciphering polarities.

Another reason for remagnetizing a pickup is to swap the magnetic polarity of a single-coil, so it will act as a humbucker when combined with another single-coil. Note: the coil must also be "reverse-wound" for this pickup to have the proper phase relationship and noise canceling humbucking properties.

To recharge a dead or weak magnet, use two strong Neodymium Boride magnets (Stewart-MacDonald #4643) held just far enough apart for the pickup to be held and guided between them. The magnets should be aligned so the attracting flat surfaces are facing each other (the magnets are pulling toward each other). You may wish to make a simple holding fixture in the shape of a "C" to hold the magnets. Then you can hold the pickup steady with both hands as you move it through the magnetic field. Make note of which side is North and South polarity in your magnet-holding fixture, and what the top polarity of the pickup should be.

To swap a pickup's polarity, simply run the pickup between the two magnets a few times with the top aligned with the new desired polarity.

Recommended tools and supplies

Where applicable, item numbers for ordering from Stewart-MacDonald are included.

- Volt-Ohm meter (VOM)
- Soldering iron and solder (60/40 rosin core)
- Polarity tester #5127
- Gauss meter/Magnetometer
- Glue pot #0668—for wax potting pickups

- Paraffin and beeswax—available at many grocery stores.
- Cooking thermometer for monitoring the wax's temperature
- Pickups and Guitar Electronics Video, by Lindy Fralin #4335
- Basic Pickup Winding, by Jason Lollar #5106
- There is a great deal of information on pickup winding and specifications on the Internet. Have fun learning, and share with others!

Pickup specifications

Gibson	PAF Humbucker	P-90
Turns	5000-5050 per coil	10,000
Wire gauge	42 plain enamel	42 plain enamel
Wind direction/arm	Counterclockwise/left winding arm	Counterclockwise/left winding arm
Magnet/polarity	Alnico II/south on adjustable coil	Alnico V/north
Adjustable coil	Start Finish	Black ground White hot
'Slug' coil	Start Finish	N/A N/A
Notes	N/A	Two bar magnets are used per pickup. Both north polarity edges are towards the adjustable polepieces.

Fender	50s & early 60s Strat	Late 60s & 70s Strat	50s Tele Bridge	50s Tele Neck
Turns	7900-8350	7600 - 7700	8000-9200	7800-8000
Wire gauge	42 Formvar or plain enamel	42 plain enamel or poly-nylon	42 plain enamel	43 plain enamel
Wind direction/arm	Clockwise/ left winding arm	Clockwise/ left winding arm	Counterclockwise/ right winding arm	Counterclockwise/ right winding arm
Magnet/polarity	Alnico V/south	Alnico V/south	Alnico V/south	Alnico V/south
Start Finish	Black ground White hot	Black ground White hot	Black ground White (or yellow) hot	Black ground White hot
Notes	Hand wound with staggered pole-pieces, wax potted. 1954-1957 were typically north polarity.	Machine wound with staggered pole-pieces eventually went to flat pole-pieces sometime in the 70s, wax or lacquer potted, and some may not be potted at all.	Hand wound, early 50s had flush pole-pieces, late 50s had raised D and A poles, and 60s have staggered pole-pieces, wax potted. Copper plated steel baseplate. 1950-1951 were typically north polarity.	Machine wound with staggered pole-pieces. Eventually went to flat pole-pieces sometime in the 70s. Wax or lacquer potted, and some may not be potted at all.



21 N. Shafer St. Athens, OH, 45701
800-848-2273 Fax: 740-593-7922

Pickup winding log sheet

Customer _____

Date _____

Address _____

Notes _____

Phone _____

e-mail _____

Pickup type

- Single coil
 - Clockwise
 - Counterclockwise
 - RW/RP (Reverse Wind/Reverse Polarity)

Coil

Wire type _____ gauge _____

Polarity North South

Total turns _____

Notes

- Humbucker
 - Clockwise
 - Counterclockwise
- Custom/other _____

Notes

Humbucker Pickup Kit

Assembly Instructions

Gibson's Seth Lover invented the "humbucker" in the mid-fifties to solve the inherent problem of single-coil pickups — 60-cycle hum. In 1955 Gibson filed for a patent for his humbucking invention and the Gibson "PAF" (Patent Applied For) Humbucker was born! The PAF has acquired holy grail status among guitarists of all types, and has inspired many to replicate or add their own spin to this pickup design. The original humbuckers had two black coils (double-black) under the pickup cover, however, in early 1959 Gibson manufactured some pickups with mixed white and black bobbins, known as a "zebra" pickup. This kit has all the parts to wind and build your own PAF inspired humbucker.

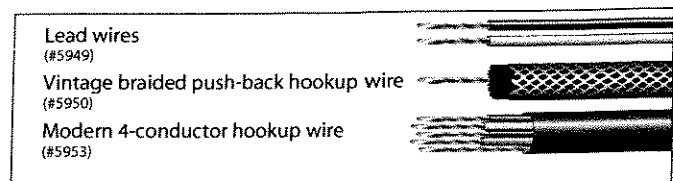
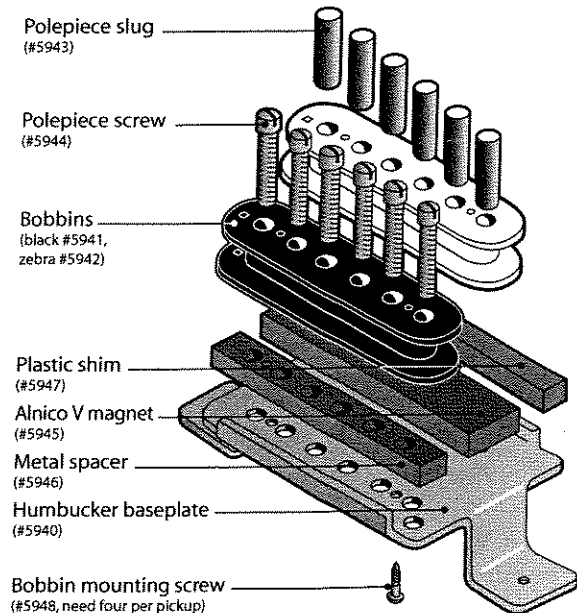
Number of turns and winding techniques

Gibson wound their humbuckers on machines, which means the traverse and layers of the windings are very consistent. You can experiment with winding very methodically to replicate "machine-wound", or "scatter-wind" your coils. The number of turns will affect the pickup's tone and response. More wraps will give you higher output, and more midrange punch. Fewer wraps will give you a more open sound with greater high-end clarity, but less output.

Another way to affect a pickup's tone and response is to experiment with mismatched coils. You can mix different number of turns/DC resistances and styles of winding to produce some very interesting and great sounding pickups.

Assembly instructions

1. Carefully inspect the bobbins to make sure there are no rough edges, nicks, or molding lines that may snag the coil wire. Smooth any possible snags with 600-grit sandpaper or a fine emery board.
2. Cut the 4" long white and black 28AWG lead wires into two 2" long pieces (one black and one white per coil).
3. Original PAFs used black lead wires for the starts and finishes, but that can get confusing when hooking up the coils and hookup wires (especially if you plan using the 4-conductor hookup wire). We recommend using black for the starts, and white for the finishes of your humbucker. Strip back 3/16" off of each end of the hookup wires.
4. Wrap the end of your 42AWG coil wire (#1462) around the exposed end of one of the black lead wires. Solder the coil wire to the lead wire — the heat of the solder should melt the poly-coating off of the copper for a good solder joint. Poke approximately 1" of the black wire through the "square in a



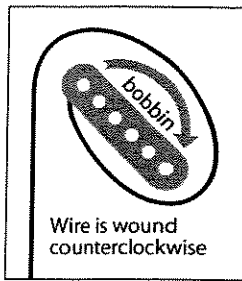
Recommended tools, supplies and reference

- | | |
|-------------------------------|--|
| #5127 Magnet Polarity Tester | #5951 Pickup Tape, 1/4" |
| #1465 Schatten Pickup Winder | #5952 Pickup Tape, 3/8" |
| #1462 Pickup Coil Wire, 42AWG | www.stewmac.com/pickups |
| | www.stewmac.com/freeinfo |

circle hole" on the bottom of the bobbin — from the inside of the bobbin out through the bottom (the bottom of the bobbin has four round mold marks). Kink the black wire so that it lays against the bottom of the inside of the bobbin.

5. Attach the bobbin to your winder — be sure the pickup coil is well attached to the winding arm and that it runs true. Start the winder to see if there is a wobble or if the flatwork isn't spinning true and straight.

6. Traditionally PAF wire is wound counterclockwise (looking at the face of the bobbin). Reset your pickup winder's counter, and with your end-stops set on the winder's traverse, hand wind a few wraps of coil wire onto the bobbin to seat the black lead wire. Slowly start your winder and wind to 5000 turns, which is common for a PAF.



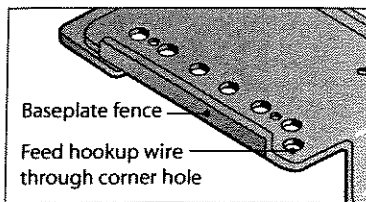
7. Once you've achieved the desired number of windings, carefully cut the coil wire and solder it to the white lead wire so that it extends from the same end of the coil as the start "black" lead wire. Wrap the coil several times with 1/4" wide Pickup Tape (#5951) to secure the lead wire and protect the coil wire. Repeat the winding procedure for the other coil (same winding direction, same number of turns).

8. Press the "slugs" into the slug bobbin one at a time. They can be pressed in one at a time by pressing them against a bench top until they are flush with the face of the bobbin. Then, thread the six adjustable polepieces into the adjustable coil.

9. Before you assemble the pickup, you must decide if you want to use the braided "push-back" hookup wire, or the 4-conductor hookup wire.

The original PAF used a braided, cloth-covered hookup wire — known as "push-back" because the covering can be simply pushed back to reveal the wire, and does not require stripping. For more tonal flexibility you may want to opt for the 4-conductor hookup wire — allowing coil cuts, combining the coils in series or parallel, or wire the coils in-phase or out-of-phase.

10. Feed 3" of the hookup wire up through the hole in the corner of the baseplate (see illustration). If you're using the braided push-back wire, push-back approximately 1/4" of the braid and black cloth insulation to expose the inner conductor. If you're using the 4-conductor wire, remove 3/4" of the black covering exposing



the four inner wires and the bare ground wire. Then strip back 3/16" of the covering off of the 4 conductors.

11. Connect the wires using the Humbucker Wiring Chart (below). Cover each solder connection with a piece of the black, flatback tape. If you're using the pushback wire, after you solder and tape the two white lead wires together, tuck them between the two coils.

12. Solder a small portion of the outer braid (push-back wire) or the plain "ground wire" (4-conductor wire) to the baseplate fence.

13. With the hookup wire running flush along the baseplate fence, place the metal spacer and magnet on the baseplate (south polarity facing the metal spacer). Locate the slug coil (north polarity) on top of the magnet and start two of the brass bobbin mounting screws (don't tighten them completely). Next, attach the adjustable coil loosely to the baseplate. Then insert the plastic spacer between the slugs and the baseplate fence.

14. After you've soldered and taped all the connections, carefully tighten the two bobbins down. Neatly tuck the solder wires into the various crevices at the end of the pickup and then wrap flatback tape around the bobbins.

15. Wax potting: the original PAFs were not potted. Our i-1465 Pickup Winding instruction sheet covers pickup potting.

Humbucker Wiring Chart

Wire type	Adjustable coil "start" BLACK	Adjustable coil "finish" WHITE	Slug coil "start" BLACK	Slug coil "finish" WHITE
Vintage push-back hookup wire	Solder to outer braid "ground"	Solder to slug coil finish (white)	Solder to inner wire "hot"	Solder to adjustable coil finish (white)
4-conductor hookup wire	Solder to black	Solder to green	Solder to red	Solder to white

Single-coil Pickup Kits

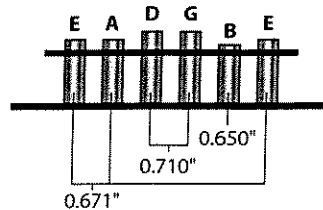
Assembly instructions for Strat and Tele-style pickups

Smooth the flatwork edges

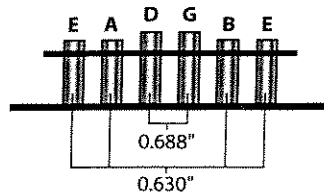
Smooth, and slightly round the edges of the fiber flatwork with very fine sandpaper to remove any roughness that might catch the thin wire during winding. The bottom piece has two metal eyelets. On one side, the eyelets are slightly larger — this side is the underside of the pickup.

Install the polepieces

Strat: The polepieces are in three lengths. The two longest pieces are for the D and G strings, and the shortest is for the B string. The remaining three are the same length, and they are for the E, A, E strings.



Tele bridge: The polepieces are in two lengths. The two longest pieces are for the D and G strings, and the remaining four are the same length, and they are for the E, A, B, and E strings.



Tele neck: The polepieces are the same length.

To hold the polepieces upright while installing them, make a small jig with a hole just larger than the polepieces. Drill a 19/64" hole through a short length of hardwood or acrylic, 1/4" thick x 3/8" wide. An accurately drilled hole will hold the polepieces squarely and keep your fingers out of the way when pressing or tapping the pieces into the flatwork.

Option 1: Using a small hammer (one with a plastic or brass head is the most gentle), firmly tap in the magnets while the flatwork rests on a support block placed on a very solid, flat surface.

Option 2: Press the polepieces into the flatwork using a drill press. Close the jaws in the drill press chuck and use the flat underside of the chuck as an overhead press.

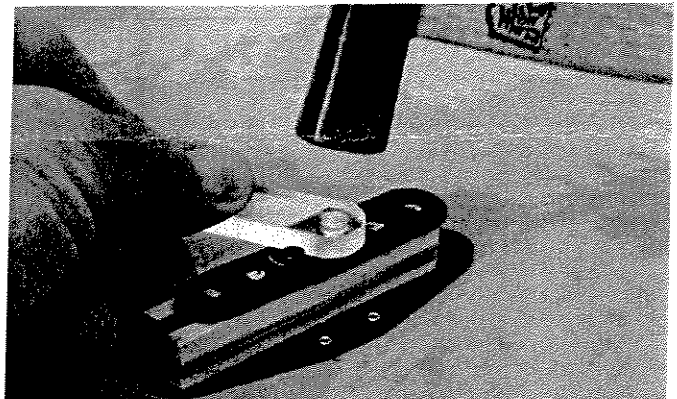
The thickness of the eyelets in the bottom flatwork will keep it from laying flush to the work surface, so let them hang over the edge of a support block during installation. For Strat and Tele bridge pickups, install the shorter polepieces first and the longer pair last, so that you're not trying to ham-

mer a shorter piece while hitting a taller one that's already installed.

Once they're installed, make sure the polepieces are square to the flatwork and parallel with each other. If they're not, or if the flatwork is warping, manipulate the pieces until the poles are squarely seated and the fiber pieces are flat.

Install the top flatwork

Pieces of hardwood placed on each side of the polepieces will serve as spacers to make sure the top flatwork is at the right height, leaving a gap of 7/16"-15/32" for the wire. Cut two pieces measuring 2-1/2" x 7/16" x 1/8". For Tele pickups, cut two pieces measuring 2-1/2" x 15/32" x 1/8". Use a rubber band to hold them in place beside the polepieces (photo).

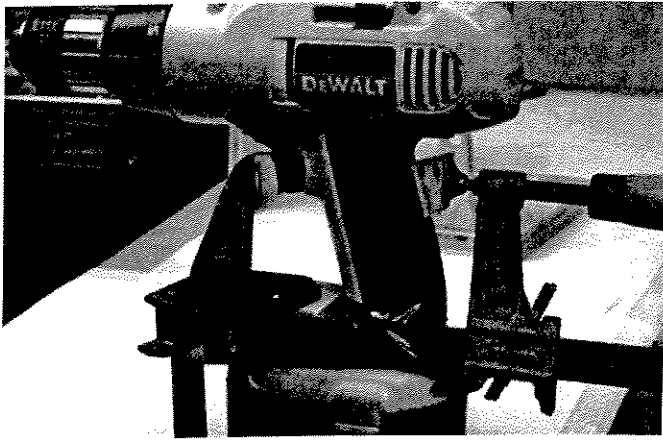


The holes in the top piece are tighter than the bottom holes. The fiber will press over the magnets, but not as easily — the sharp edges of the magnets will punch out a small amount of fiber as the top flatwork is pressed on.

Option 1: Tap the top piece on with your hammer, using the polepiece-holder you made as a caul to protect the flatwork as shown in the photo.

Option 2: The drill press can be used again to provide downward pressure. A small socket wrench or similar shape held in the drill press chuck can provide a caul to press the flatwork onto the polepieces.

Start on the two tallest polepieces first (D-G). Alternate between them, applying pressure (or tapping) until the flatwork is started over both pieces. Again, the flatwork may warp out of shape slightly — keep this to a minimum by frequently alternating, pressing or tapping each hole equally.



As the D-G poles start to come through the top of the flatwork, your polepiece-holder will become helpful in tapping the flatwork down.

When all the magnets have started through the holes, be sure to have your two wooden spacers in place. The top flatwork is installed when it is flush against these two spacers. The spacers should be snug when you're finished, but will pull out with little trouble.

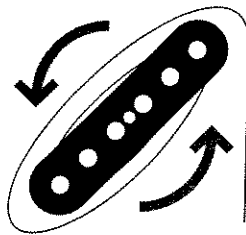
Choose your wire

Fender used both 42AWG (American Wire Gauge) and 43AWG coil wire for their pickups. Stratocaster pickups were all wound with 42AWG, while Tele neck pickups were all wound with 43AWG. The very earliest Broadcaster and Telecaster bridge pickups used 43AWG, but switched to 42AWG sometime in the early fifties.

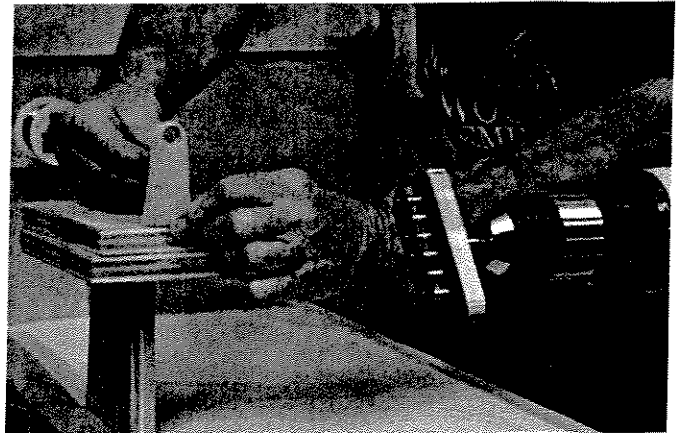
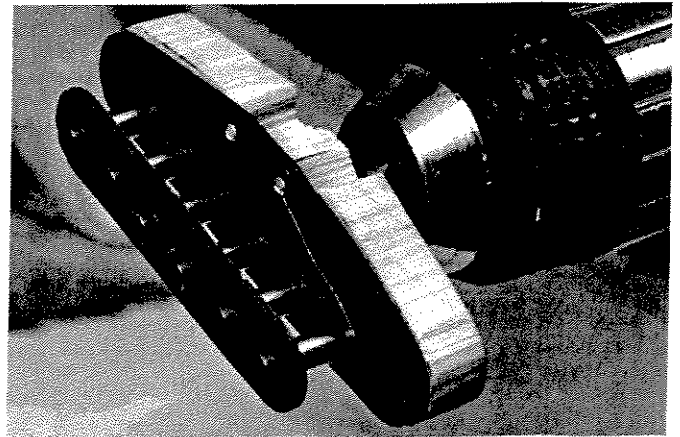
Wind the coil

There are lots of ways to wind a pickup. Virtually anything that spins with a controllable speed could be rigged to do the job. Your winder could be built from a simple hand drill (although it would have no way to count the number of winds) or you could use the more advanced #1465 Schatten Pickup Winder, with its digital counter and speed control.

The number of winds, the coil wire tension, and the way in which you build up the layers of wire all affect the tone of your pickup. Don't make the winds too tight, or you could cause the pickup to deform from the pressure. If your winds are too loose, you could have problems with excessive feedback. Pickups from the '50s and early '60s were wound clockwise (when viewed from the top of the pickup) with approximately 8000 turns of wire. If you don't have a counter, you can start by looking at another pickup and visually matching the size of its coil.



For **clockwise winding**, the pickup turns counterclockwise (viewed from above).



Attach the pickup to your winder. Depending on the winder, this might mean using double-stick tape (carpet installation tape is strong) or another fastener. You want the pickup carefully centered on — and square to — the winding shaft. If your winder has a flat pickup mounting plate, the metal eyelets on the underside of the pickup will keep the flatwork from sitting flat on the surface. Multiple layers of double-stick tape can shim it up while holding it, or you may want to file a groove into the mounting plate to accommodate the thickness of the eyelets.

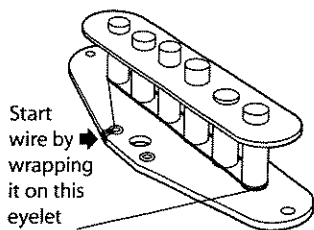
In our example photos, we've used a homemade winder: an electric drill clamped to a workbench. The speed control is simply a second clamp which is tightened onto the drill trigger: screwing it down tighter presses the trigger and speeds up the drill. It's easier and more accurate to use the Schatten Pickup Winder, but we wanted to demonstrate that your first pickups can be wound with very simple gear.

We fashioned a mounting plate in the shape of the pickup (with a recess for the eyelets), and mounted that onto a metal shaft that's held in the drill chuck. Whatever your method, see that the pickup is spinning true and straight.

You'll be moving the wire back and forth as it feeds onto the coil, and you'll want to create a "traverse limiter" to keep it between the two flatwork pieces. On the Schatten Winder, this is a polished metal rod with adjustable right and left limiters. For our simple winder, the limiter is a hole drilled

in a piece of wood that pivots right and left. The hole must be sanded very smooth.

Attach the wire to the pickup. Pickup coil wire has a thin clear coating that acts as an electrical insulator. Use very fine sandpaper to gently sand off this covering from an inch or so at the end of the wire. Wrap this uncoated bit of wire around the metal eyelet on the bass side of the pickup (see illustration). Don't sand the wire running from the eyelet to the polepieces — that part should still be insulated.



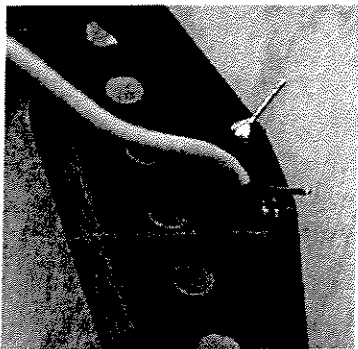
If you have a winder with a counter, set it to zero. Start the first 6-10 wraps turning the drill winder by hand to insure that the coil wire won't be pulled off of the bobbin when you start the winding. Watch out for the metal eyelets: they can snag coil wire and break it. A little bit of cellophane tape along the edge with the eyelets can help guide the wire up and over the eyelets.

Coil wire is thin and easy to break! Control your winding pressure, and the drag on the wire, by folding a piece of felt over the wire as you hold it. Talcum powder on your hand is another way to keep a light hold on the wire without sticking. If you break the wire you can choose to start over or you can sand the insulation off the wire ends and solder them back together.

When you're done winding, cut the coil wire leaving enough to reach the eyelets with at least 2" to spare. Sand the coating from the end of the wire and wrap it through the treble-side eyelet. The start and finish ends leading to the eyelets should be snug and flat against the bottom flatwork.

Soldering the lead wires

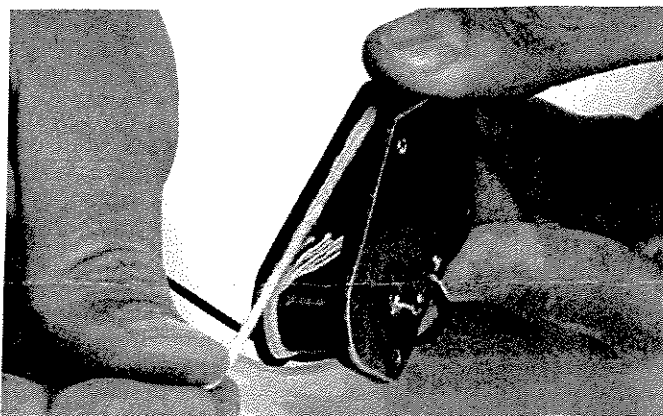
Strat pickups: From the underside of the pickup, feed the black and white hookup wires through the center hole between the eyelets. The black wire will be soldered to the start of the coil wire and the white is for the finish. Expose (push-back the covering) approximately 3/16" of the lead wires and carefully feed them down into the eyelets on the bottom of the pickup, solder each wire to its eyelet and coil wire.



Tele bridge pickups: From the underside of the pickup, feed the black and white hookup wires through the center hole between the eyelets. Expose (push-back the covering)

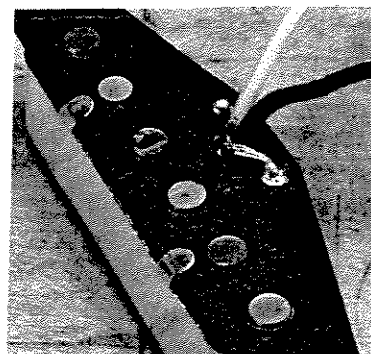
3/16" of the white wire and 1/2" of the black wire (you may need to use wire strippers rather than simply pushing back the black wire's covering to expose 1/2" of wire), then carefully feed them down into the eyelets on the bottom of the pickup. Solder each wire to its eyelet and coil wire — the black wire will be soldered to the start of the coil wire and the white is for the finish. The extra length of exposed black should extend below the pickup and is used to solder to the bridge pickup's baseplate. Once the leads are soldered to the eyelets, solder the extra length of black wire to the bottom of the copper plate.

Traditionally the copper-plated steel plate isn't attached to the bottom flatwork other than by the magnets and in the pickup potting process where the wax will hold it in place. To reduce the chance of microphonic feedback, the plate can be glued to the bottom flatwork using silicone caulking — run a small bead of caulk along the bottom of the polepieces and clamp the plate to the pickup. After the caulk cures, the pickup is ready to be wrapped with string.



The white string is wrapped around the coil to protect the delicate windings. You may want to test the pickup with your volt/ohm meter before wrapping the pickup (see "Test the DC resistance"). To wrap the pickup, lay about 1/2" of the end of the string on the side of the coil. Carefully wind the string around the coil so that the windings completely cover the coil wire. The end of the string can be tucked beside the last few windings of string and the flatwork. This will hold the string in place until the pickup gets potted.

Tele neck pickups: From the underside of the pickup, feed the black and white hookup wires through the center hole between the eyelets. Expose (push-back the covering) 3/16" of the white wire and 1/2" of the black wire (you may need to use wire strippers rather than



simply pushing back the black wire's covering to expose 1/2" of wire), then carefully feed them down into the eyelets on the bottom of the pickup. Solder each wire to its eyelet and coil wire — the black wire will be soldered to the start of the coil wire and the white is for the finish. The extra length of exposed black should extend below the pickup and is used to solder to the neck pickup's cover.

You may wish to test your pickup prior to soldering the cover in place (see "Test the DC resistance"). To install the cover, first use a file or sandpaper to remove the plating on the center tab — this will allow it to take the solder better. Carefully slide the cover over the top of the pickup, making sure that the center tab slides in the hole where the two lead wires come up through the bottom flatwork. Press the cover down flush with the flatwork — be careful not to damage the two fine coil wires leading from the eyelets to the coil. With the cover in place, use a flat tool such as a blade screwdriver to bend the two outside tabs under the flatwork. The center tab isn't bent down, instead, solder the extra length of black lead wire to the center tab.

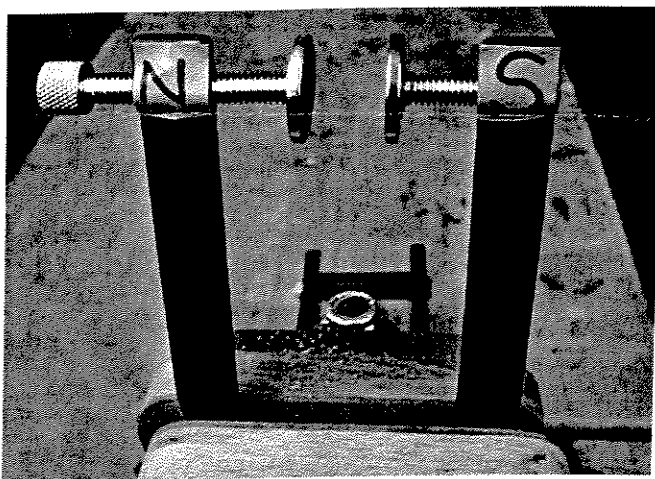
Test the DC resistance

Test with a volt/ohm meter set to the 20K range. A Strat pickup should be about 5.75K-6.75K. If you get an open circuit: are your connections to the coil wire good? Did you solder a break inside the coil which is now causing a short?

Charge the magnets

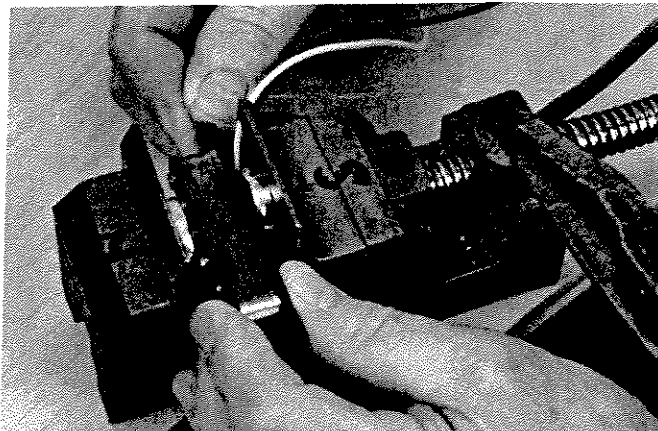
The polepieces are now ready to be magnetized by passing them between two strong magnets held apart with just enough room to pass the pickup between.

Option 1: Make a simple fixture using a 5" soundhole clamp. Remove the feet with a screwdriver and attach two of our 1" diameter Guitar Repair Magnets with #20 Super Glue. Orient the magnets so that they pull toward each other, and adjust the magnets so they are 1" apart. Identify and mark the north/south polarity for reference.



Fender Strat pickups were always "north up" until 1960 when they became south up. Use our #5127 Magnet Polarity Tester to determine a magnet's polarity.

Option 2: For an adjustable-width magnetizing fixture, our Nut and Saddle Vise #1816 works well. Since the jaws are steel, the Guitar Repair Magnets hold themselves in place without glue. This lets you adjust for different pickups and different proximity by simply opening and closing the vise.



The Guitar Repair Magnets will charge the Alnico V magnets to their full capacity of 20-25 Gauss. Several passes through the magnets does the job; move the pickup as slowly as you can while keeping it free of the magnets. To determine a magnet's strength, we recommend the analog Model 25 Magnetometer (50-0-50 gauss range) available from the R.B. Annis Company. It works well and is reasonably priced.

Pickup potting

Potting a pickup (dipping it in melted wax or other material) helps eliminate unwanted microphonics and feedback. Although early Fender pickups weren't potted, potting's generally a good idea. Refer to our instruction sheet #i-1465, "Winding Pickups with the Schatten Pickup Winder" for information on potting materials and techniques. It's free, and you can download it from our website at www.stewmac.com/freeinfo.

Tools, supplies, and resources

#5127 Magnet Polarity Tester
#4638 Guitar Repair Magnets
#1465 Schatten Pickup Winder
#1462 42AWG Pickup Coil Wire
#1463 43AWG Pickup Coil Wire
www.stewmac.com/pickups
www.stewmac.com/freeinfo

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