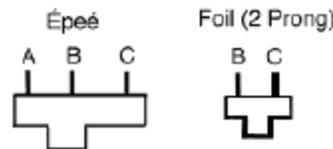

Armory Guide by Frank Pratt

Introduction

This is a guide to troubleshooting, repairing, and wiring foils and épées. My knowledge of sabre is extremely limited, and thus sabre is not included in this guide. The only edited part of this document is the syntactic content, so anything that seems to be wrong might very well be. E-Mail me at fpratt@fencing.net if you have any questions or corrections.

How the basic fencing circuit works

One should understand how the foil and épée circuits work before trying to figure out why the equipment is misbehaving. The scoring machine uses input from three lines from each fencer to determine what's going on, who hit whom and when, etc. These lines are known as A, B, and C. On the three prong connector, B is the center prong, A is the one closest to B, and C is the one that is furthest from B (see diagram below.) In the foil and épée, the electrical current goes from the box, through the B line, to the tip (via a wire) and back to the box somehow through the A or C line. Which route it takes depends on the weapon and a variety of other circumstances. For both foil and épée, the C line is the ground circuit. This includes all metal portions of both weapons (excluding the A and B sockets and the metal on top of the tips) and the metal strip if one is present.



Troubleshooting

Foil

The foil circuit is *normally closed*, and is a bit more complex than the épée. Normally, electricity is flowing from the box, through the B line (through the wire in the blade's groove,) up to the tip, back through the metal portion of the weapon, and back to the box via the C line. On the weapon end of the 2-prong body cord, the smaller prong is the B line, and the larger prong is the C line. On the bayonet connector, the B line goes to the tip and the C line goes to the surrounding metal portion if the connector. The A line goes to the lamé via the alligator clip.

If you depress the tip anywhere except for your opponent's lamé, you break the circuit, and the white light goes off. In other words, *if there is a break in the connection between the B and C lines, and the circuit does not return to the box within about 200 milliseconds, your white "off-target" light will go off.* The weird thing about foil is that your A line is on *your opponent's* side, not yours. If your B line (the tip of your weapon) is in contact with your A line (your opponent's lamé) when the tip is depressed, then the circuit will return to the box through your opponent's lamé and body cord, which will cause your colored "on-target" light to go off.

Common Problems

White light goes off when tip is not depressed

This is by far the most common problem with foils. It happens because there is a break in the B and C lines for some reason. The break might be continuous, or might only happen intermittently. Remember, *anything* that breaks the connection between the B and C line for more than a fraction of a second will cause the white light to go off. The problem is usually caused by a loose connection, loose tip or a loose grip.

- First, take the body cord out of the socket and firmly short the two lines on your *disconnected* weapon. If the light goes out when you short the B and C line and stays out when you wiggle the connection to the plug, then the weapon is bad. If the lights do not go out, then the problem is probably with the body cord. If the latter seems to be the case, hook up the weapon to the other side (assuming that that guy does not have the constant white light problem.) If there is no white light over there when your weapon is plugged into the other reel, then you need a new body cord.

- If the weapon is suspect, first be sure the grip and tip are tight. If they are not, then there will not be a solid connection between the B and C lines. This is often the cause of intermittent white lights. It is difficult to tell if the tip is loose since it is secured in place with tape. Go ahead and twist it hard counterclockwise (but only 1/4 turn) just to make sure. Also be sure that the connection between the blade wire and the body cord socket is secure. Intermittent white lights can also be caused by a loose connection at either plug on the body cord.

- If the weapon is tight and the problem persists, then hook it up to the ohmmeter and see if you can reproduce the break in the connection. The needle should get no more than 2 ohms resistance when it's connected. If the resistance is very high, then you need to re-wire the blade. Shake the weapon and hit the tip against something hard. A break can be seen as a jump in the needle. If there is a break and you cannot figure out where it is, it may be time to re-wire the blade.

Off-target when I hit him square in the lamé

For some reason, the B line (the tip of your weapon) is not connecting to the A line (your opponent's lamé.) The problem probably lies in the opponent's lamé, the A line on his body cord or his reel. First check to see that his alligator clip is secure on his lame. If it is, take it off and depress your directly on his alligator clip. If it works now, then the circuit is not making it through the lamé. This is probably because of corrosion in the lamé, which is caused by salt deposits from sweat. If the on-target light does not come on when the lamé is bypassed, then the A line in the opponent's body cord is probably the problem. To check this, partially unplug the opponent's body cord and depress the tip directly on the exposed part of the opponent's A line. If this works, then the A line on *his* body cord is bad. Get him to replace the cord so you can start scoring touches on him. If this still does not produce a colored light, then the reel might be bad. To check the reel, unplug the floor cord from the reel and short out the B and C lines with a screwdriver or a blade that is *not* connected to the box to stop the white light. Then hit your weapon directly to the A line. If this works, then the reel is bad. If not, then the floor cord is bad. It could also be the box, but that is very unlikely.

Miswiring a body cord is probably more likely than a bad reel or floor cord, so check this before testing the floor cord or reel. If you have your B line connected to the large prong and the C line connected to the little prong, then the weapon will seem to work okay, except that you never be able to get a valid touch (kinda of a strategic disadvantage, isn't it?) This happens because your C line (rather than your B line) connects to your A line when you hit, which grounds out the touch (the box thinks you hit your opponent's bell or the metal strip.) To see if this is the problem, place a uninsulated metal portion of your weapon firmly on your opponent's lamé and depress your tip. If you get a valid light, then the B

and C lines are reversed. Re-wire the body cord if this is the case.

Another possible cause of the no-colored-light-syndrome is corrosion or something similar on your tip. If this is the case, then there will be no electrical connection between your tip and the other guy's lamé. Rub it with some sandpaper or replace the tip if this is the case. If you are sure that your body cord is wired correctly and your opponent's lame and body cord are okay, then the reel or floor cord is probably the source of the problem.

The box indicates on-target when the touch is not on the lamé

This usually only shows up in the finals at big tournaments. Why? because those guys are sweating a lot after fencing five or six 15-touch bouts. Human sweat has salt in it, and salt water is a good conductor of electricity. If an off-target area (i.e. the bib on the mask) is soaked with sweat and is in contact with the lame, the circuit might go from the attacker's tip, through the sweaty clothing, and to the lame. The circuit return to the box via the lame, and thus the box thinks that the touch was on the lame. This phenomena usually happens on the bib or the mesh of the mask. It can also happen at the shoulders and even down weapon arm. The only solution is to dry off the affected clothing or have the fencer change into dry clothing. I once heard of a kid in the finals at the National Championships who was getting on-target touches on his arm. His coach striped him completely from the waist up and replaced all his clothing with dry replacements.

Sweaty gloves are also a potential problem in foil. All electrical equipment is checked thoroughly at National tournaments, so weapon problems are relatively rare. Wet gloves are a big problem, however (especially in the finals.) Foilists should *always* have two gloves on hand so the dry one can be used if there are any problems. Anyway, one of two things can happen. If there is sweat all up the arm, then a touch on the wet glove can register as on-target. However, if the glove is touching an uninsulated portion of the weapon and there is sweat all the way up to the lamé, then the lamé might ground out, and nothing will happen when he hits the sweaty fencer. This happens because the B line of the attacker is going through the lamé, down the arm of the attackee, through his glove, and to the *C line* of the attackee's weapon. The box thinks the attacker has hit the strip or the attackee's weapon, and thus no touch is registered (no lights on the box.) This is analogous to the attackee placing his bell in contact with his lamé (see below.) If the box has yellow lights, you might see the light on the side of the sweaty fencer go on (dimly, perhaps.) This is why it is a good idea to insulate the entire handle on foils if the handle is made of metal.

There is also one other possible cause of grounding touches. If the defender has a metal portion of his weapon in contact with his lame, then the current will go from the attacker's B line, through the lamé, and to the C line via the defender's weapon. The box thinks that the attacker has hit the defender's weapon, and no lights come on. This is why it is a 1st Group (yellow card) offense to touch your weapon to your lamé. This is another good reason to insulate the entire handle if it's made of metal (or at least the portions of the grip that are not covered by the hand.) If the box has yellow lights on it, the yellow light on the defender's side will light up when he touches his weapon to his lamé. I think newer boxes will actually register the touch, since they are controlled by a microprocessor rather than the principles of electricity.

Dry gloves and an insulated grip are a foil fencer's friend. Wet gloves and uninsulated grips are not.

No lights at all when I depress the tip

This is kinda rare in foil. The most likely cause is that the B and C lines are connected as they should be, but there is no way to break them by depressing the tip. There is probably a short circuit between the B

and C lines somewhere.

First make sure the box is set to "foil" (not "épeé".) Then unplug the body cord. If this causes the white light to go off, the weapon is to blame. If not, then the B and C lines on the body cord are shorting out.

If the weapon appears to be the culprit, check and make sure that no part of the blade wire is in contact with any metal portion of the weapon except for the "B" terminal on the socket. If there is a loose end where the wire wraps around the terminal, it might be in contact with the metal portion of the socket and/or the bell, which makes it impossible to break the B/C connection. Snip of any loose ends of the blade wire and make sure that the B socket is completely insulated from the C socket. If all else fails, disconnect the blade wire completely and see if this breaks the circuit. If not, then the short might be in the tip.

If the blade wire is not shorting out at the socket, then remove the tip screws, tip, and spring, and plug the weapon into the text box. If this circuit is open now (no lights on the text box or white light on the scoring box,) the tip and/or spring is probably shorting out the two lines. This can happen if the spring gets unseated from the cup. Re-assemble the tip and see if all is well now. If the light goes on again after replacing the tip, try a new tip and spring.

If you cannot correct the problem at the tip, then there is probably a short between the blade wire and the weapon. Check where the wire leaves the bell. The insulation can get chafed here, which may cause a short. If this seems to be the case, insulating the exposed wire with spaghetti might solve the problem. The short might also be somewhere between the bell and the tip, or in the tip itself. If the short is beyond the bell, it's probably time to strip it down and re-wire the blade.

If none of the above solves the problem, check the floor cords and reel for a short between the B and C lines (use the ohm meter.)

Épeé

In the épeé is a simpler normally open circuit, meaning that the circuit is open when the tip is not depressed. the A and B lines go to the tip and the C line is connected to the ground (i.e. the metal portion of the weapon.) When you depress the tip, you complete the circuit between the A and B lines, and the light goes off (there is no way to make the white lights go off in épeé, unless the box is set to "foil" or something has gone horribly wrong inside the box.) Due to the nature of electricity, *the circuit will go to ground if at all possible*. So if you hit a grounded surface with your tip (i.e. your opponent's bell or the metal strip,) the A and B lines will connect as they should, but the circuit goes through the C line of your opponent (or through the strip,) and the box does nothing (if the box has yellow lights on it, these will light up when there is a grounding connection.)

Common Problems

Box does not make any noise when I hit my opponent.

This is the most common problem in épeé, and like the off target light in foil, there are a number of things that can cause it.

Be sure that you check the body cord before blaming the weapon. Take out the body cord and short the A and B lines on the bell of the *disconnected* weapon. If the box goes off, then the problem is probably in the weapon. If not, then it's probably the body cord. Have your opponent try your weapon (assuming

his body cord is okay.) If it works, get another cord.

If you determine that the problem is in the weapon, there are two underlying reasons for this problem: (a) the A and B lines and not connecting when you press the tip and/or (b) The A and/or B line(s) is/are connecting to the C line and grounding out the weapon (in this case, the box thinks you hit your opponent's guard or the metal strip.) If the problem is (a), then the test box will not produce any lights when the tip is depressed. If it is (b), then the red (foil) light on the test box will light up (sometimes along with the green light, sometimes not.) Here's what you need to do in each condition:

No light: If there are no lights on the test box at all, check and make sure that both blade wires are connected to the socket securely. You can do this by visually checking for a broken wire at the socket or by pressing in the tip and checking for continuity between the depressed tip and the A and B terminals on the socket. You should get very low resistance in both cases. Also check that the barrel is tight. Sometimes simply tightening it will solve the problem. Do not turn the barrel more than about 1/4 turn; any more rotation will break the wires at the cup, and this will mandate a re-wiring job.

If the problem is not solved by any of these measures, check and make sure that neither wire has broken off between the socket and top of the tang (where the wire exits the bell.) If one or both wire is/are broken and there is not enough left to get the wire to the socket, then you will probably need to re-wire the blade. Splicing the wire with a scrap piece is temporary at best and may not last for more than a few bouts. If all is well inside the bell, then there is probably a broken wire somewhere in the blade or tip. To find out, unscrew the tip screws and remove the tip and pressure spring. Test for continuity between each terminal on the cup and the A and B lines in the bell. If one or both does not cause the needle to jump, a wire is broken, and you need to re-wire the weapon. You probably won't be able to find the break if it is under a big glob of glue or in the barrel.

Another place to check is inside the tip. If connecting the two terminals inside the tip with a small screwdriver causes the green light on the test box to come on, then the contact spring might not be hitting both contacts on the cup simultaneously. This happens because [a] the spring cannot reach the contacts because it is too short, [b] the spring is not flat at the end or is slightly bent, or [c] the cup is not properly set. If you can get the light to go off using a small screwdriver directly on the contacts, then gently unscrew the contact spring on the tip counterclockwise a bit and try again. Also check to see that the spring is straight and the bottom of the contact spring is flat (never cut the spring, as this cut off the flat surface.) When in doubt, try another tip. When you get it to work, be sure to check it with the .5mm shim to make sure you did not unscrew the spring too much (the tip must travel at least .5mm before the box goes off.) If the cup appears to be improperly set, you can try to firmly re-seat it with the point setting tool, but chances are you will have to re-wire the blade (this is why you want to properly set the cup in the first place.)

The grounding light is coming on: If the box has no yellow grounding lights, then no touch will be registered; the weapon will seem to be dead. If the box does not have yellow lights, you can check for a grounding problem on the strip by disconnecting the body cord, turning it around, and plugging it in with the C prong hanging disconnected in space (be sure it's not touching the bell.) If the *épee* works under this condition, there is a grounding problem. You can also use the test box to see if there is a grounding problem.

For some reason, the A and/or B line(s) are connecting to the ground circuit (i.e. the C line and/or the metal operation of the weapon.) If the grounding light is coming on, then check inside the bell and make sure that neither blade wire is touching the metal part of the weapon or the C terminal on the socket. If a loose end is touching any metal parts, snip it off.

Another area to look in is inside the barrel. If the little contact spring on the tip is bent (even slightly,) then it might touch the pressure spring, which is in contact with the metal portion of the barrel. Thus, the weapon grounds out when you depress the tip, or even when the tip is not depressed. Try a new tip/spring combination to see if you have better luck.

Also check the groove in the bell where the wires leave the bell. It is common for the insulation to wear off here, causing one or both wires to ground out via the blade. If this is the case, cover the exposed wires with the "spaghetti" insulation. If none of this solves the grounding problem, one of the wires is touching the blade at some point between the bell and the tip. If you cannot find a break in the blade wire, the break is probably in the barrel. At any rate, you're gonna have to re-wire the blade.

Another *theoretical* cause is the circuit grounding out through a wet glove if the touch is on the wrist, though I have never seen this happen. If the glove is wet, then the circuit might go through the sweat in the glove, and to the metal part of the weapon (if the grip is metal and uninsulated.) The B line returns to the box through the sweat on the glove, the grip, and then to the C line (the weapon.) Thus the box thinks the attacker has hit his opponent's guard. This is obviously easy to check; if the box goes off when you manually depress the tip but not when you hit your opponent's wrist, then the glove is grounding out the touch. If this seems to be the problem, replace the glove with a dry one. See the last foil troubleshooting section for more details about sweaty clothing and insulated grips.

The box goes off when the opponent's bell (or the strip) is hit

For some reason, the B line in the attacker's weapon is not connecting to the C line on his opponent's side.

First, unplug the opponent's body cord at his weapon and depress the tip directly on the C line on the body cord. If the box goes off, then the opponent's body cord and/or the floor cord is bad. Unplug the floor cord from the reel and hit the weapon directly on the C line. If this causes the box to go off, you need to repair the floor cord. You might also want to check the tip for corrosion or anything else that might inhibit the completion of the circuit.

If depressing the tip on the body cord's (floor cord's) C line works, then the problem is probably corrosion on the opponent's bell. If you can get the touch to ground out on some places of the bell, but not others, corrosion or might be inhibiting the touch. Rub the suspected area with sandpaper and see if it gets any better.

If hitting the grounded strip causes the box to go off, make sure a metal portion of the strip is connected to the box's strip socket, and make sure the connection to the strip is secure. Check for resistance from the strip (where the wire is connected) and the end of the wire that goes to the box; it should be very low. Also check for and remedy any corrosion or holes on the strip itself.

Weapon Re-Wiring 101

Sometimes the only way to get a weapon to work is to put a new wire in it. The good news is that everything on the blade except for the old wire and cup can usually be re-used. You just need a new wire with a cup attached. However, *be sure not to mix different types or brands of tips and wires*. They might fit together, and may even work, but they will fail quickly if they do. We have always used **French parts** from Tripplette Competition Arms (the "**High Precision Components HPC**" brand.) Most of our current weapons use these parts, and the majority of the spare parts are also HPC. These parts are interchangeable with the Purier parts from Tripplette, but **not** with German (i.e. Uhlmann/Allstar) or any

other kinds of parts! Even French parts from another supplier might not work just right, so it's best to stick with the same type of parts from the same supplier.

Anyway, back to re-wiring. Start by taking everything off the tang (i.e. the pommel [or pommel nut,] grip, body cord socket, wire insulation, and bell.) Then remove the tiny tip screws and take off the tip. Unscrew the barrel with a wrench to remove it. Wipe some alcohol all over the glue to weaken it a bit. Let it soak for a while.

Removing the wire

Grab the old wire at the tang and slowly pull it out of the groove. If you are lucky, much of the glue will come off with the wire. Use a screwdriver or the Dremel tool to remove any pieces of the wire that are really stuck (some more alcohol, or even acetone might help here too. If you use alcohol or (especially) acetone, remember that this stuff is extremely flammable, so *be careful with sparks from the Dremel tool!!*. **Always wear safety goggles when using the Dremel tool!** The disks on the have a tendency to throw tiny red-hot pieces of metal all over the place, which is bad for you eyes' health. The disks also shatter on a regular basis when you're using them, and the pieces go everywhere. Trust me on this; one such piece came within a few centimeters of blinding me in my right eye a few years back. I have never used the Dremel tool without safety goggles since then. You should avoid using acetone and the Dremel tool together. Doing so produces a horrible smell that is almost unbearable. You shouldn't need to use acetone if you use the Dremel tool anyway.

Despite the hazards, the Dremel tool works well for this task. Use the small grinding wheel for foils and a large heavy-duty one (and a grinding head, if necessary) for épées. The Dremel tool also scores the groove, which will help the new glue bond to the wire. It is important to get all the old glue out. Any old crud that is left in the groove will cause the wire to pop out (especially towards the tip on épées since the groove is so small up there.) After using the Dremel tool, take a small screwdriver and get out the tiny pieces of glue that are left. Do not proceed until you've carefully examined the blade to ensure that there is no more glue left. Every minute you spend cleaning out the blade is well worth it!

Initial Tip Assembly

Collect all the stuff you will need to re-wire the blade:

- blade wire
- barrel
- tip/contact spring
- pressure spring
- tip screws
- blade insulation ("spaghetti")
- bell, pad, socket, pad, grip, and pommel (or pommel nut.)

N.B.: you can usually re-use all these parts except for the blade wire and cup.

You will only need the barrel and blade wire for now. Put the small parts in a film canister and set it aside with the bell and other parts.

Take the blade wire and *carefully* unwrap it, removing all the twists and kinks. This is 20 gauge wire, and it will snap very easily. Be especially careful towards the cup; it is not hard to pull a wire right out of the cup. Get the wire(s) straight, and for épées, make sure the wires are parallel to one another.

Thread the wire through the barrel. Stop when the cup is about 0.5" from the end of the barrel (*do not*

put the cup in the barrel yet.) Screw the barrel on the blade one or two turns and ensure that the wire is not caught in the threads (i.e. make sure it moves freely in the groove. Then tighten the barrel as tight as you can get it using a wrench or pliers on the tip and some vice grip pliers to hold the blade (keep the wire away from the vice grips!) Be sure not to crack the barrel or twist the blade, though. You should not be able to loosen the barrel by hand when it's tightened. This is really the only chance you're gonna get to make sure it is tight; after the wire is glued, you cannot turn the barrel more than 1/4 turn or so without breaking the wires. Next, place the cup just inside the barrel. Use the point setter to push the cup into the barrel. The point setter is designed to push the cup straight into the barrel and to set it evenly at the bottom. There is a small line on the point setter. The cup is at the proper depth when this line is at the top of the barrel. If you cannot get the cup in far enough, you can try removing the cup (carefully!) and removing the plastic washer. When the cup hits the bottom, push the cup in there firmly to make sure the cup is set evenly. As you push the cup into the barrel, gently take up the slack of in the wire, pulling it through the bottom of the barrel to make sure it does not bunch up in the barrel. Again, be careful not to snap the wire as you pull it through.

Preparing the Blade for Gluing

Now it's time to wire the blade. The best glue to use is the Devco stuff (in the green tube.) This will turn into a gel in about 5 minutes and will be dry after several hours. If you must get it going quickly, super glue works well, but you really have to be really careful not to get it in the tip or past the tang (see "Types of Glue" below for more on this topic.) Start by straightening the wire(s). Then bend the blade and hold it there (against a wall or using the PVC cups and chain.) Put the wire in the groove and wrap the end around the tang. Put a piece of tape at the very top of the tang (where the top of the bell will be) to stop the glue from going too far down.

Gluing

Bend the blade in the normal way and secure it there somehow (i.e. with the chain and PVC cup gizmo or with the vent next to the punching bag in the gym.) The bend it to make sure the wire does not snap when the blade is bent in a bout. However, don't bend the blade any further than it would bend in a bout. If you do, then the blade wire will eventually pop out after you take the bend out of the blade. Bending the blade so the tip is pointing 45 degrees relative to the ground is a good rule of thumb. Check one last time that the blade is in the groove, then apply the glue. Go back and fill in the gaps you missed, and check it again. Once the entire blade is covered, let it set overnight before taking the bend out of the blade.

- **Types of Glue:** The Duco® "Household Cement" (in the green tube) gives the best results, in my experience. You can get this stuff at Wal Mart for \$1-\$2 per tube. Cyanoacrylate (super glue) also works well, but is much harder to clean up (not that big a deal if you have a Dremel tool.) The best brand to get is "Jet" or Hobbico "Bullet." These brands are available at hobby stores that sell Radio Controlled airplanes. These brands come in big bottles, and are *much* cheaper per ounce than the "super glue" you get at Wal Mart. If you choose to use cyanoacrylate, be careful and make sure not to get any of it below the tang or in the tip. The cyanoacrylate that hobby stores sell comes in three thickness. The thinnest is like water, and dries instantly. The thickest is easier to handle, and dries in only a few minutes. Go with the thickest version. It will be easier to keep this stuff out of the tip and easier to stop the glue at the tang (you're pretty much screwed if too much of this stuff gets on the wires below where the bell is supposed to go. If you mess up, acetone does a good job of dissolving super glue, and it will not attack the cotton insulation or the wire.

Overall, super glue may be best since you can have the weapon working within 30 minutes (as opposed to 12 hours minimum with the household cement.

Reassembly

After the glue is dry, slowly take the bend out of the blade. Then test the tip. Do this by stripping the insulation off the wire(s.) For *épées*, get a tip and place it in the barrel (don't worry about the pressure spring or screws. Take a body cord, and plug one end into the weapons tester. Connect the two wires to the A and B lines, and touch the C line to the tang. The tester should act normally (no lights when tip is not depressed; green light only when tip is depressed.) If something else happens, see the *épée* section to determine what's wrong.

For foils, assemble the tip completely. You must do this because the circuit travels from the B line to the C line (the weapon) via. the screws that hold the tip in place. Then connect the B line to the wire and touch the C line to the weapon (don't worry about the A line; it goes to the lamé.) With the assembled tip and pressure screw secured in the barrel, the red light should be on. Depressing the tip should cause the red light to go out.

If all is well, re-assemble the rest of the weapon. Be careful when stripping the wires, and be sure to leave some extra length on them in case the wire breaks near the socket later on. USFA rules mandate that all wire(s) be insulated all the way up to the terminal(s) on the socket (the wires must be individually insulated on *épées*.) Also check and double check that the wire(s) go straight up after they come into the bell, and that they are going through the groove in the grip. If a wire is being pinched, it will snap when you tighten the pommel nut. Then you get to re-wire the newly re-wired blade! When the blade is completely assembled, test it once again to make sure the socket is wired correctly and that there are no wires grounding out at the socket.

After you finish assembling a foil, be sure to put tape on the tip and six inches from the tip. The tape must cover the entire tip, right up to the top of the barrel. This is vital because if any uninsulated portion of the weapon hits the opponent's lamé before or at the same time as the tip, the circuit will go from the attacker's B line to his own C line rather than through the opponent's lamé. As a result, the box doesn't make any noise.

Note that it is illegal to put tape on *any* portion of the *épée* (the only exception is that you may use *clear* tape under the thumb pad to secure one or both wires, provided that the wires are secured separately with different pieces of tape.)

Body Cords

Body cords go bad at least as often as the weapons do. The good news is that they can almost always be repaired easily. If the cord is dead (i.e. no lights in *épée* or constant white light in foil,) chances are one or more wires has come out of one of the plugs. After you determine that the body cord is the source of the problem (see the above troubleshooting guidelines to determine if the weapon or the cord is defective,) use an ohm meter to see which line is not working. Also be sure that the prongs on one end goes the correct prong on the other end, and that no line is in contact with any other line. In foil, be sure that the A line goes to the alligator clip, the B line goes to the *small* prong, and C line goes to the *big* prong (the B to the tip and C to the surrounding portion on the bayonet connectors.) When you find the wire that has pulled out, just cut off the old end (only about a centimeter or so,) strip off some insulation, and put the fresh wire into the hole. Secure it with the screw and make sure you cannot pull it out. You might need to curl the end of the wire over itself to get it to stay in the prong securely. Lastly, make sure all lines have resistance of less than 2 ohms. If the resistance is any higher, the box might not register the touch.

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