

BASIC ELECTRICAL INFORMATION

I became a journeyman electrician, category 2, as they called it then and some states still use the category 1, 2, 3, 4, 5 electrical certifications, by force. The company I was working for in Austin Texas told me if I wanted to be a superintendant I would be required to go to classes and OJT (On the job training) to get an electrical/plumbing/welder/drywall/hvac and a couple of other certifications they issued in the early 70's in Texas. All of that has changed in 40 years but that is the way it was then. They paid me to go to the classes which didn't actually teach me the trade but taught me how to pass the test. I still learned a lot in those classes and today I am proud I went to them.

Reason for this they said is that you will be responsible for all construction on the job and if you don't know the basics of the different trades you won't last two weeks as a super. This proved to be true the first week I worked as a superintendant.

A know it all electrical contractor was going to cover some utility supply conduit without installing red tape 12" above the 6" conduit he had installed. I called the inspector and the electricians immediately went and got the tape and installed it as to specs.

Now to the article, I am going to show you how I wire some boxes. A lot of electricians are going to ridicule me for some of these techniques and say it takes too much time and is not needed and many other statements. After 12 years I am use to it.

I'll tell you this; most of the electricians I know can't do this. I can go back years later from wiring a recep (receptacle box) and tell you what every wire in it is and where it is going and where it came from. I know very few electricians that can do that, they just go to knocking holes in the wall and doing continuity testing to find the wires. I see them running test when they go to trim a recep box and spend more time doing that than it takes to trim the box and install the switch or recep

(plug) as most people call it. I don't have to do that, I already know the wires and very few times in 40 years have I had a problem recognizing the source or the other box that it goes to.



These are only a few of the tools you will need but they will be sufficient for wiring a house or small building you may be doing.

On the left is a multi-tester (read the directions for using it) same as the second one, voltage tester, read. Third is a current tester, read the directions, this little tool could save your life, it tells you if there is power in the wires you are about to work on. Fourth is a recep tester, it tells you if you wired the recep correctly and also tells you what's wrong with the wiring.



These are the hand tools you will need. First is a cable cutter, 2nd is lineman pliers, 3rd is side cutters (dykes) 4th is needle nose pliers, 5th is 6½" channel lock pliers and you will need about 3 sizes of these, 6th is wire strippers and they will also cut a 10-3 cable with ease. They will strip from 18 to 10 gage.

Electricians have probably three times this many tools. Most of them carry about 3-4 thousand dollars worth of tools, minimum.



These are T-stat scissors, called T-stat scissors, T-stat stands for (telephone and thermostats, door bells).



Also on the Tstat scissors are two notches that have beveled edges for stripping the 22, 24, and 28 gage Thermostat and telephone wire. Great tool. 22 gage is the thickest wire and it's the one I use.



Here is just a few of the screwdrivers you will need, 1st is a #1 wobble, mainly used for installing the small 6-32 plate screws. 2nd is a #1 slotted, 3rd is a #2 slotted, 4th is a #2 Phillips, 5th is a combination screwdriver fully insulated except for the tip.

Others include, drills, bits, self feed bit, sawsall and many more that most of you already

have. I have seen electricians with probably over 25,000 dollars worth of tools. What I have shown you here will cost about \$400. You can buy cheap tools but your money is far better spent to stay with Ideal, Klein or Greenlee that electrical suppliers carry.



I saved this one for the last tool to show as it is absolutely the best utility knife I have ever used. Stanley doesn't even have it on their website page of utility knives. I have of 8 or 10 of these knives and I have one I have been carrying in my tool bag for over 5 years. It has a pocket for 5 extra blades and is a snap to change a blade. I have never broken one nor has one ever failed to operate as it is suppose to. It weighs only 1½ oz with 5 blades in it, some of the big curved knives weigh up to 12-15 oz. The tool bags I wear when all the tools are in them weigh about 15 lbs, so every ounce counts with me, but I have Stiletto hammers and that's a plus. But to carry a utility knife that weighs almost a pound is not to smart when you can get one of these that weighs about 1½ oz. Any tool store can get them; they come in 6 packs to the store. The Stanley order and model number is 10-065. Stanley calls this a light utility knife for homeowners. This veteran master carpenter calls it the best knife he has ever owned.

Now about some wire you will be using:

I have had many electricians tell me they don't make a 14-4 wire. Proof is right here off of an electrical supply house copy.

MC Cable 14/4 is an electrical wire used indoors, outdoors and in conduit. MC Cable 14/4 is an electrical wire that has 3 hot wires, neutral and a ground wire.

Nes Bell Electronics, Inc. PO Box 1690 Merrimack, NH 03054

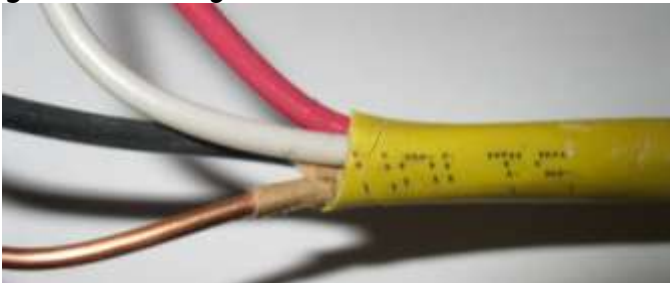
You can get online and find almost any wire size and configuration you will need. You can be UF-B wire in almost all sizes and configurations; it is for direct underground burial.



This picture above shows the end of a 14-3 with ground, 2 hots, white neutral and bare ground.



This is 14-2 with ground, the most common one you will use, 1 hot, neutral and bare ground. White jacket.



This is 12-3 with ground, 2 hots, neutral and ground. Yellow jacket



This is 10-2 with ground, 1 hot, neutral and bare ground. Orange jacket.

You can get all of these wires in one hot, two hots or 3 hots. If you can't find them just pull an extra single wire with your installation and use it for your extra wire, but they are available. I had a journeyman electrician tell me on a job one time you can't install but two four way switches on one circuit. I have seen 5 or more installed and it's legal.

I was told by an electrical engineer for NASA in Alamogordo NM that I had better not write this article because I was going to be eaten alive by nasty emails. He reviewed this article and fully agreed with every word or I would have changed it immediately. He is absolutely a genius when it comes to electrical construction and is a good carpenter.

He even teaches my recep box wire identification in his classes he holds at New Mexico State University, mainly because it only makes sense and it works.

Most electricians use wire nuts for connecting sometimes up to 5 wires in one nut. I do also but mainly I use Ideals **push-in connectors** (brand name of company that makes excellent tools and supplies).



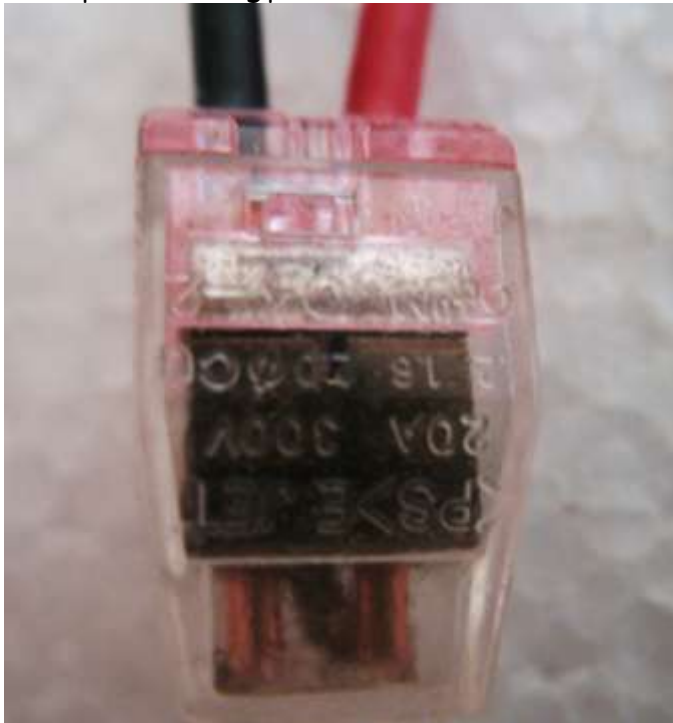
Many electricians won't use them, they say they won't hold and can short out. They are

full of bull, I've been using them for years and have never had one single problem with them.



These are the three I use, (top view and end view) 2 ports, 3 ports and 4 ports, they will take 18, 16, 14 or 12 gage wire, solid or stranded. Ideal offers many others.

They are absolutely a wonderful time saving and space saving product.

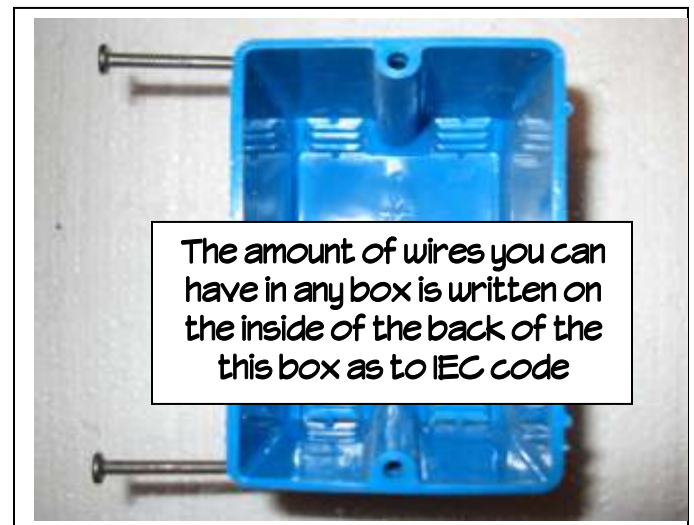


This is a two port connector with the wire installed properly. Look at the bottom and you can see the stripped wire ends. A lot of electricians don't strip the 9/16" that you are suppose to and don't get the wire into the connector far enough, then to cover their ignorance of construction they blame Ideal for a bad product. If you don't see the wire at the end of the clear plastic cover, of which is why Ideal made it clear so you could, you need to cut the wire and try it again, the wire you insert needs to be straight, exactly straight.

The electricians that won't use these are usually more concerned about the 70 or 80 dollars an hour they are charging you and don't want to spend the money it takes to stock them.

I almost always install a two gang deep box at the switch in a room. I do this for many reasons, one is I have a lot of space, another is I always run my homeruns to the switch box and the inspectors don't gripe, the other is I have had many call back and say they want a fan installed and a dimmer and rheostat like I installed at so and so's house. I absolutely always run a 14-3 to any room ceiling light, doesn't matter if it is only one switch, I still run a 14-3 to it. That way I always have the wire I need if the owners decide they want the dimmer and rheostat.

By the way, and I have seen this many times done by electricians, never use a dimmer to control the speed of the fan, it just won't work, use a rheostat because that is what it



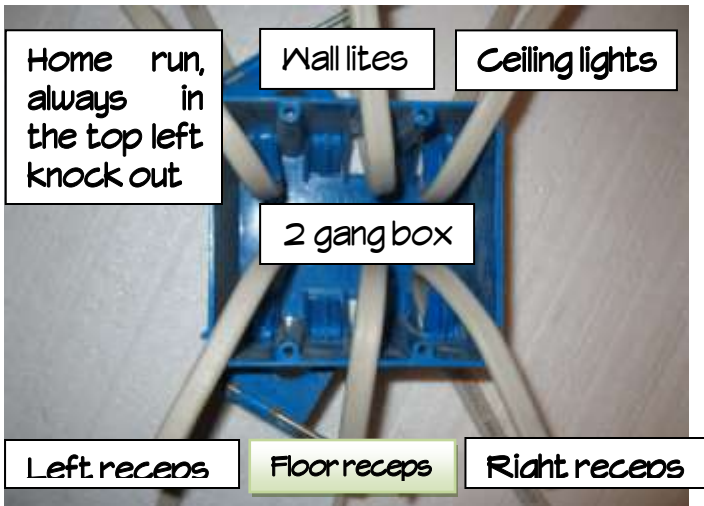
The amount of wires you can have in any box is written on the inside of the back of the this box as to IEC code

was made for, a dimmer is for lights only.

This box above is a single gang nail box, one recep or one switch or you can get a switch/recep combo switch for it. I only use these deep boxes, the extra cost is nothing and the inspectors require so many cubic inches per wire into the box.

For the extra 15 cents I will use the deep ones.

Now for the one thing that will show you how to know your wires years after a job.

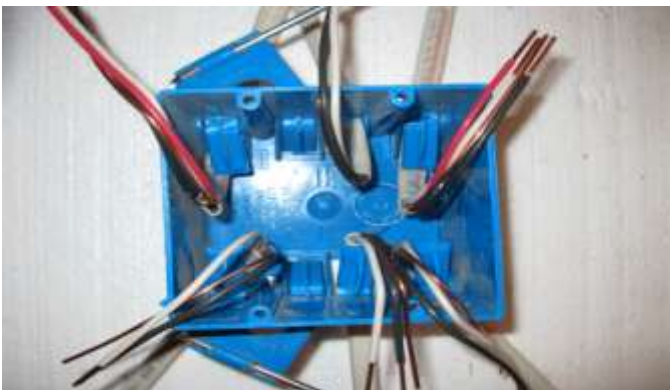


I use the same sequence in a single gang box or 3 or 4 gang switch boxes. Another advantage to taking your home runs (wires that go straight to the panel breaker box). I usually run a 14-3 (2-15 amp breakers) for the home run and then I have two circuits to work with instead of a single 15 amp circuit.

In bathroom I run a 12-3 (2-20 amp breakers) home run to accommodate hair dryers, curling iron, electric heaters, coffee pots and whatever else women come up with that uses a lot of electricity.



4-5" pigtails



Here we have 20 wires that all have to be in the exact line of travel and go to the load that they are described in the label picture above. One small mistake here could burn your house down or kill someone working on this box.



The easiest and simplest way to deal with this conglomeration of wires is elimination. It's the only way I can keep this many wires and circuits in my head at one time.

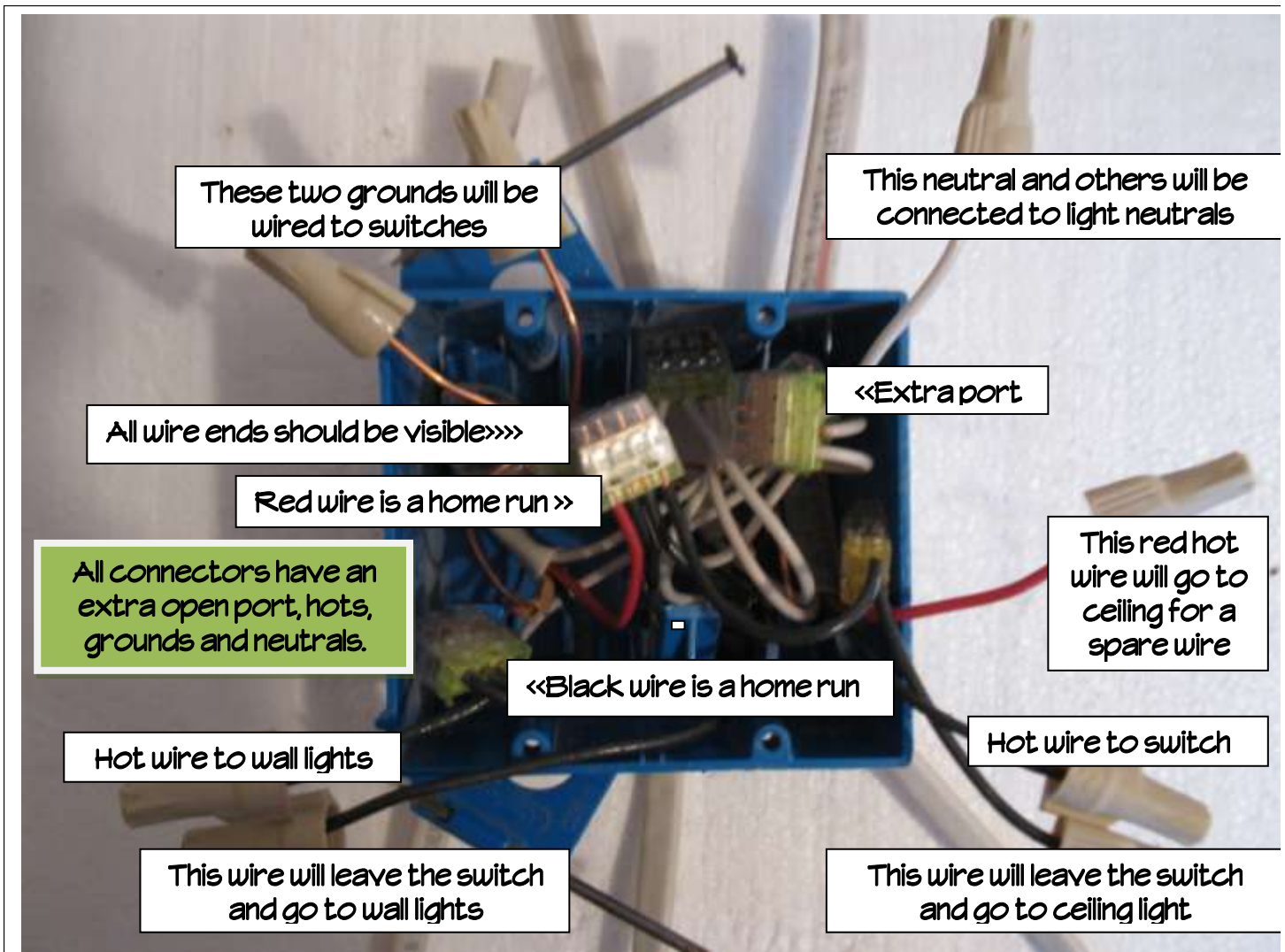
First thing I did was connect all the grounds together, as shown above, leaving two ground pigtails for the two switches and also leaving a open port for some unseen thing that someone would want done as if there is not enough in here already.

I have written 5 articles about construction colors, just finished one this week about gear wrenches. White, green, yellow, red, blue and black.

In electrical white, green and yellow are all neutrals and sometimes yellow is used as hot or neutral but the electrician will mark as to what he is doing with it.

Red, blue, brown and black are all hot.

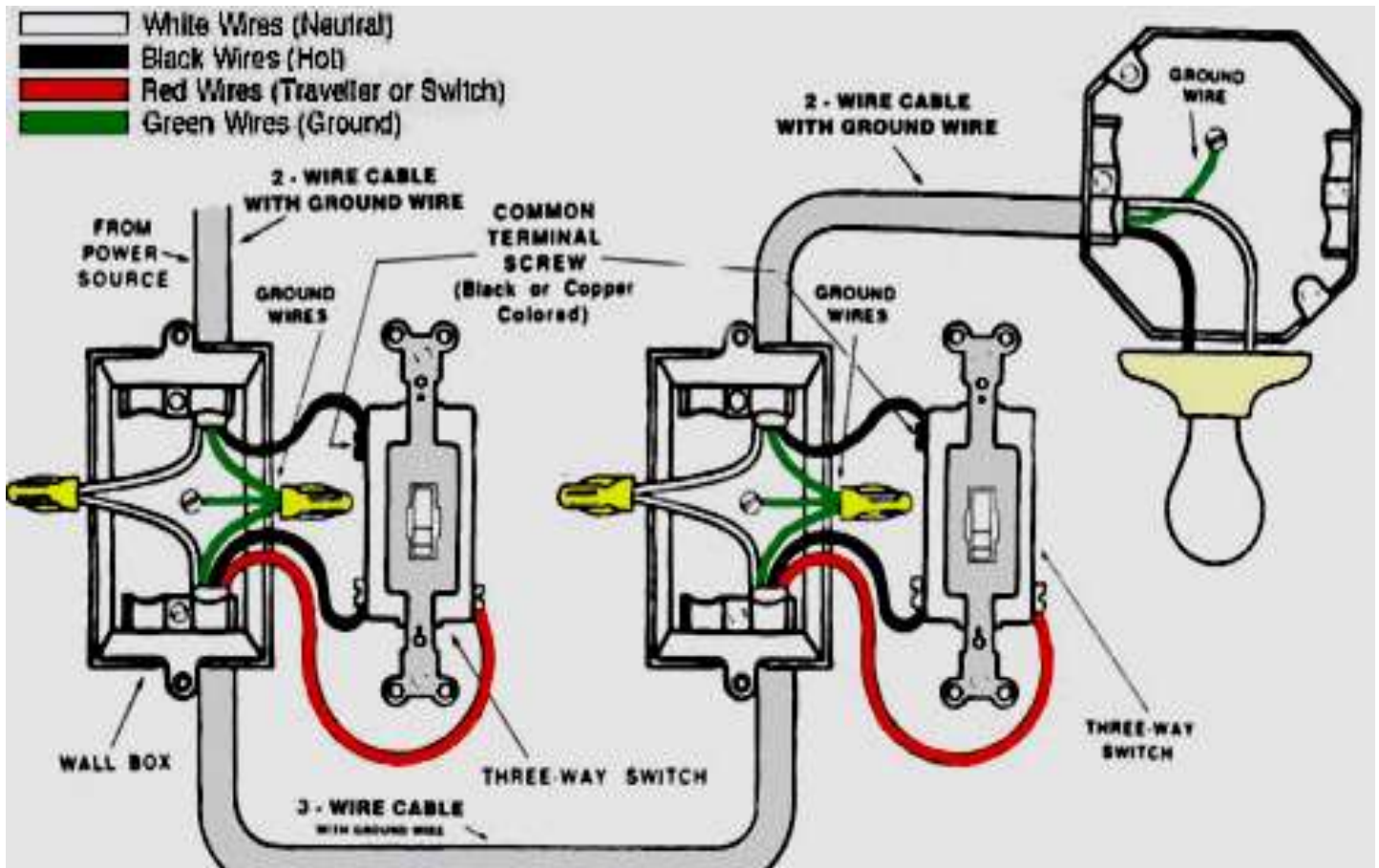
We had an electrician at Lordsburg NM I was working on hook the light switch to the white wire. The light worked fine, up was on and down was off. No problem. A carpenter friend of mine came to me and said he had something he wanted me to look at and took me and showed me the switch (the painters had taken the cover off to touch up the drywall and paint. I called the electrical foreman and he had a fit and had them fix it. Problem was the light worked fine but the black wire at the light box was hot all the time and someone working on it could have got shocked or killed because of one little wire.



This looks very complicated, it's not. The secret, of which is no part of a secret, is elimination, do it in sequence exactly as I say and concentrate on what you are doing and not on what you are going to do or what the guy next to you is doing.

Connect all of your grounds to the push-in connectors and then leave extra ports and two pigtails for connecting to the switches, push these connections into the back of the box with your lineman pliers. Do the same with the white neutrals and leave extra open ports and a white neutral pigtail and about 4 extra open ports to connect to the neutrals coming from the lights and recepts. Now all you have left is the hots, look at the picture in the preceding page and label or know all your hots, the only two you have to pigtail is the ceiling lights and the wall light wire, they go into the top of the switch, load wire goes in the bottom of the switch, all the rest go into the connector with the home run wire in the connector first. Walk in the park after you have done a few.

The following page is a very good schematic of wiring a 3 way switch. I use this method all the time because it saves wire, time and money. Some electricians run the power to the ceiling then spend 30 minutes working on a 10' ladder wiring the base box which is the one the power comes in to. I had rather stand on the floor and do this. To each his own. As I have said before always spend a little more money and always run 14-3 to ceiling lights and you can always 3 way or 4 way a light or many light fixtures. A four way switch is nothing but a interrupted switch with the wires you are running from the base box to the other 3 way switch. You can install 3, 4, 5, or 6 four ways in a circuit. Look on line and they have some great schematics of these wiring procedures.



This concludes this article, but if you know me, I have some advice that might just save your life and let you see your children grow up.

When you are working on a breaker panel, always get a 2'x2' piece of 2" Styrofoam and stand on it, you may get tingled a little if you touch a hot part of the panel but you'll live over it. Concrete is a very good conductor of electricity and your body is even a better one.

When you go to change a light fixture always use your current tester and make sure some knothed has not used the white neutral wire as a switch wire and the black wire at the light is hot, all the time.

When you have a problem with a circuit, say in a bathroom and you are going to work on the wires, go to the panel and pull the breaker out and take the wire off and screw a wire nut to it and set it aside with the breaker. If you simply turn the breaker off someone could come by that has trip his breaker and turn yours on and get you shocked or killed.

If you are trimming a panel box and arranging the wire to look nice and neat, wrap some tape around the ends of your needle nose or lineman pliers. The sharp edges of the pliers will cut through the rubber coating on the hot wires and if you touch a ground with them you will have a blowup. They make plastic pliers for arranging wire in a panel, good investment.

Always ground your panel as to code.

Always use a fiberglass ladder when working on an upper fixture or box.

Some so-called electricians say a neutral won't shock you. Wrong. Take the neutral off returning from a light and then turn the light on and it will be hot or better than that let the electrician hold the neutral and then turn the light on.

Bob Johnston, carpenter
www.carpenterbooks.com

