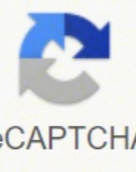


Electrical wiring 101 pdf

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Home House & Components Systems Electrical System Every editorial product is independently selected, though we may be compensated or receive an affiliate commission if you buy something through our links. Ratings and prices are accurate and items are in stock as of time of publication. 2 / 11 Family Handyman People often use these terms interchangeably, but there's a difference: Cable is an assembly of two or more wires in a single jacket. Wires are the individual insulated or bare conductors inside the jacket. 3 / 11 Wires come in different sizes/gauges to work with the amperage of the circuit in which they're used. It's counterintuitive, but the larger the number, the smaller the wire. The most common sizes you'll find in residential work are 14-gauge and 12-gauge. Larger appliances such as electric stoves, electric water heaters, electric dryers and central air units will often use 10-, 8- or even 6-gauge wire. If you're adding an outlet, you need to use wire the same gauge as the existing wiring. How do you tell your old wiring gauge? Here's a simple visual. 4 / 11 Family Handyman An electrical cable is classified by two numbers separated by a hyphen, such as 14-2. The first number denotes the conductor's gauge; the second denotes the number of conductors inside the cable. For instance, 14-2 has two 14-gauge conductors: a hot and a neutral. This cable also contains a bare copper wire as the ground. Individual conductors are also color-coded, which tells you their purpose in the circuit. 5 / 11 The color of a cable's outer sheath tells you the gauge of the wire inside the sheath as well as the amperage rating for the circuit. WHITE = 14-gauge wire, 15-amp circuit YELLOW = 12-gauge wire, 20-amp circuit ORANGE = 10-gauge wire, 30-amp circuit BLACK = 8- or 6-gauge wire, 45- or 60-amp circuits. Check sheath labeling for gauge and circuit specifics. GRAY = Underground cable. Since all UF (underground feeder) cable is gray, check the sheath labeling for gauge and circuit specifics. 6 / 11 April Cat/Shutterstock Cable-sheath color coding started in 2001 and is still voluntary. If you have older wiring, don't assume it complies with the current color coding. However, most manufacturers now follow the standard color code. Wiring problems and mistakes are all too common, and if left uncorrected have the potential to cause short circuits, shocks and even fires. 7 / 11 This code is standard for all conductors. The colors you're most likely to find in your home are the following: BLACK (OR RED) = HOT. Hot wires carry current from the panel to the device, which could be a switch, receptacle, light fixture or appliance. There are other colors for hot wires, but they're much less common. WHITE = NEUTRAL. Neutral wires carry the current back to the panel, completing the circuit. BARE (OR GREEN) = GROUND. In the event of a ground fault, the ground wire provides a path for the fault current to return to the panel, opening the breaker or blowing the fuse and cutting off the flow of electricity. 8 / 11 This is the most common type of electrical cable in homes built since the mid-'60s. "Nonmetallic" simply means that the outer jacket is not metal. It's often referred to as Romex, which is a brand name. Typically, NM-B cable has either two conductors and a ground, or three conductors and a ground. The conductors are individually insulated, wrapped in paper and sheathed in plastic. Ground wires are either bare copper or insulated in green. 14-2 Used for general lighting and receptacle circuits. 15-amp circuit maximum. 14-3 Used for three-way switches and split receptacle circuits. 15-amp circuit maximum. 12-2 Used for 20-amp kitchen, bathroom, laundry and garage receptacles; 230-volt heating circuits up to 3,700 watts; and 115-volt circuits up to 1,800 watts. Can be used anywhere in place of 14-2. 12-3 Same uses as 12-2, with the addition of three-way switches and split receptacle circuits. 9 / 11 Family Handyman UF is used primarily to bring power to detached garages, outbuildings or outdoor lighting. The insulated conductors are molded into the sheathing. Depending on the situation, UF is either direct-buried or run in conduit. It must be protected from physical damage by conduit where it exits the ground and is exposed. 10 / 11 Family Handyman MC cable is common in unfinished areas where the cable would otherwise be exposed and subject to physical damage. It's also sometimes used inside walls. A bare aluminum wire is in continuous contact with the metal sheathing. The combination of aluminum wire, sheathing and metal boxes grounds the circuit. 11 / 11 Stranded wire is more flexible than solid. If you're pulling wire through conduit, stranded wire makes it easier to get around corners and bends in the conduit. However, if the situation requires pushing wires through conduit, you'll want to use solid wire. Originally Published: February 04, 2021 3-way switches are used to control lights with two switches. Multiple light switch wiring using NM cable. Includes wiring diagrams. Voltage, current, resistance, and power can be calculated using ohm's law. Your home's wiring consists of a few different types of wiring, including non-metallic cable (commonly called Romex), Bx cable, and wiring concealed in conduit. NM cable is the most common type of circuit wiring. It is suitable for use in dry, protected areas (inside stud walls, on the sides of joists, etc.) that are not subject to mechanical damage or excessive heat. Bx cable, also known as armored cable, consists of wires running inside a flexible aluminum or steel sheath that is somewhat resistant to damage. It is commonly used where wiring for appliances, such as dishwashers and garbage disposals, is exposed. Conduit is a rigid metal or plastic tubing that protects individual insulated wires. It is used in garages, sheds, and outdoor applications where the wiring must be protected from exposure. Wires running inside NM cable, Bx cable, or conduit are sized according to each circuit's amperage. Wire size is given in its gauge number. The lower the gauge, the larger the wire, and the more current it can handle. For example, wiring for 20-amp circuits is 12-gauge, which is heavier than the 14-gauge wiring used for 15-amp circuits. Skip to main content Home House & Components Systems Electrical System Wiring Time Complexity Cost You can save a lot of money by doing your own wiring. Here we'll show you to wire an entire room. Even if you've never picked up an electrical tool in your life, you can safely rough-in wiring by following the directions in this article. You'll learn all of the pro techniques for a wiring job, including choosing the right size receptacle boxes, running cable throughout the room, and making the electrical connections. Plastic boxes and flexible nonmetallic cable (commonly called Romex) put electrical wiring projects within the skill range of every dedicated DIYer. In this article, we'll show you some house wiring basics—how to position outlet and switch boxes and run the electrical cable between them. We won't cover many other house wiring details. For help with circuit design and making connections to your main electrical panel, we recommend you consult a licensed electrician. Besides standard hand tools, you'll need a special-purpose tool to cut and strip electric wire. We like the Klein No. 1412 (\$18 at hardware stores and home centers). To drill a few holes, use a 3/4-inch spade bit in your electric drill. For larger jobs, rent a heavy-duty right angle drill (\$25 per day) and equip it with a 3/4-inch x 6-inch auger bit (\$7). Electrical house wiring mistakes can be deadly, so make sure you obtain a permit from your local building department and have an electrical rough-in inspection scheduled with a building official when you're finished. Draw a sketch of your room that shows lighting, switch and outlet locations. Review your plan with the inspector and ask whether there are any special requirements. Be safe! Here are the top electrical mistakes to avoid: Measure and mark the center of each box. Mark the height from the floor to the center of the boxes (usually 48 in. for switches and 12 in. for outlets) or line them up with existing boxes to determine electrical outlet height. Use letters and symbols to identify boxes. Add 2x4 blocks to position boxes away from wide window and door trim. Mark Box Location with These Symbols Mark the box locations on the studs using symbols to indicate outlets, switches and lights. Complete DIY projects like a pro! Sign up for our newsletter! Do It Right. Do It Yourself! Place the Box on the Framing Member Position the box so its face will be flush with the wall covering material. Nail the box to the framing. Pro tip: Double-check that the face of the box is parallel with the framing member. The electrical code limits how many wires you can safely put in an electrical box. To figure the minimum box size required by the National Electrical Code, add: 1 – for each hot and neutral wire entering the box 1 – for all the ground wires combined 1 – for all the cable clamps combined (if any) 2 – for each device (switch or outlet-but not light fixtures) Multiply the total by 2 for 14-gauge wire and 2.25 for 12-gauge wire to get the minimum box size required in cubic inches. Plastic boxes have their volume stamped inside. Steel box capacities are listed in the electrical code. Most boxes have nibs or marks to help you align the box for use with standard 1/2-in. thick drywall. If you're not sure how thick the final wall material will be, use a special adjustable depth box. Drill Holes in the Framing Bore 3/4-inch holes through the framing members about 8 inches above the boxes. Pro tip: Center the bit on the stud, brace the drill and apply pressure with your thigh for easier drilling of wall studs. Drill into Corners at an Angle Angle the bit into tight spots. Make sure there's at least 1-1/4 inches between the back face of the stud and the cable. Cover the face of the stud with a metal nail plate to protect the cable where the hole is closer than 1-1/4 inches to the face of the stud. Thread the Cable Through the Holes Straighten about 12 feet of cable and thread it through the holes from one box to the next. When you reach each new box, follow the stripping procedure shown below, and push the conductors and about 1/4 inch of sheathed cable into the box. Staple the cable. Cut the end still connected to the coil and repeat the process at the other box. Run the Cable Around Corners Fish the cable around corners by bending a sharp hook in it. Stick your little finger into the hole to feel for the cable and guide it through as you apply pressure with the other hand. Cut the Cable at the Box Grab the cable at the point you estimate it will enter the box. Cut the cable about 12 inches beyond this spot and strip off all but about 1 inch of sheathing. Knock Out a Hole in the Box Punch a hole (or two for two cables) through the knockout area of the box with a screwdriver or the point on your stripping tool. Push the conductors and about 1/4 inch of sheathed cable into the box and staple the cable within 8 inches of the box. Note: The cable must be at least 1-1/4 inch from the face of the framing. Push the first cable aside while you staple the second cable. Run Cables to the Main Service Panel Run cable(s) from your completed circuits to the service panel. Pro tip: Leave 4 extra feet of cable for the electrician to work with. Label the cables with the location of the circuit. Call in the electrician to connect the circuits. Cut and Strip the Wires Cut all the wires to leave at least 6 inches protruding past the face of the box. Leave one bare copper ground wire an extra 6 inches long. Thread the long ground wire through the hole in the top of the special green wire connector and splice all the ground wires by holding them together and twisting the connector clockwise until it's tight. Strip the ends of the white and black wires and one end of each 6-inch-long pigtail. Splice them with wire connectors. Cover the unstripped end of the black (hot) pigtail with a wire connector for safety. Group the Wires Together Group and label the wires in the switch boxes so you'll know how to connect them after the drywall is complete. Push the Wires into the Box Fold and pack the wires neatly into the box to conserve space and reduce pressure on connections. Label wires with scraps of cable sheathing. Originally Published: September 22, 2020

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