

UNITED STATES MARINE CORPS
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STUDENT HANDOUT

REPAIR INTERIOR ELECTRICAL WIRING SYSTEMS

LEARNING OBJECTIVES:

a. Terminal Learning Objective:

(1) Provided a building with an installed electrical system with a malfunction, a building construction plan, a multimeter, an amprobe, and references, repair the interior electrical wiring system such that all faulty components are operational per the references. (1141.03.11)

b. Enabling Learning Objectives:

(1) Provided a branch circuit containing a short circuit, a multimeter, and tools, with the aid of references, repair the circuit in accordance with Wiring Skills Unit 1. (1141.03.3a)

(2) Provided a branch circuit containing an open circuit, a multimeter, and tools, with the aid of references, repair the circuit in accordance with Wiring Skills Unit 1. (1141.03.3b)

(3) Provided a branch circuit containing a faulty electrical component, a multimeter, and tools, with the aid of references, identify the faulty component in accordance with Wiring Skills Unit 1. (1141.03.3c)

BODY

1. Short Circuit:

a. The definition of a short circuit is two bare conductors of different potential coming in contact with each other. The two conductors of different potential can be hot to ground, hot to neutral or hot to hot.

(1) Hot to ground is when the hot wire comes in contact with anything grounded. It is sometimes referred to as grounded or having a ground fault instead of shorted. Grounded is when the hot wire comes in contact with a conductive part that is grounded. It could be a motor frame, conduit, or the equipment grounding conductor.

(2) Hot to neutral is when a hot conductor comes in contact with the grounded or neutral conductor. This usually happens in a box where a device is installed or a splice is made. It can also happen when someone mounting Romex with staples, hammers the staple in so far that it cuts through the insulation right into the conductors.

(3) Hot to hot is when two hot conductors come in contact with each other. In single phase systems, the two hot conductors have to be from different circuits. In three phase systems, contact has to be made between phases.

b. Troubleshooting time can be reduced by giving prime consideration to the portable equipment. Most of the short circuits that occur in interior wiring systems happen inside electrical motors or the flexible cords supplying the fixtures or electrical devices. In many cases a physical check of the flexible cord will indicate the troubled area. However short circuit malfunctions are almost always due to abuse of the electrical system itself. Look for signs of damage to the wire, boxes, or other parts, such as receptacle boxes knocked loose or off the wall.

c. The characteristics of a short circuit are:

- (1) Increased current flow.
- (2) Decreased resistance.
- (3) Voltage drop across components will be zero.

d. The best indication of a short circuit is for the circuit breaker to trip or fuse to blow.

e. When repairing a short circuit perform the following steps:

(1) Perform a visual check. Look for the obvious signs, conductors and components that are burned or melted.

(2) Turn the main off and test the voltage to ensure that the branch circuits are not energized.

(3) Ring the system out at the panel to locate the branch circuit that contains the short.

(4) Trace the circuit. Start at the panel and follow the path of the circuit. It is important to know where the circuit goes and what components are installed on the circuit.

(5) Systematically locate the short. As you trace the circuit examine the conductors to ensure that they are not making contact with each other or any metallic parts. Open up and

inspect the connections and conductors in every box. Sometimes conductors will come loose from the terminals on the devices they are connected to.

(6) Repair the short. To repair a short or ground fault in the system, either reinsulate the bare spot(s) of the conductor(s) with electrical tape or replace the conductors and or faulty equipment. Ensure that all splices and connections are properly tightened and do not come loose when the boxes are closed.

(7) Reenergize circuit and test for proper operation.

Open Circuit:

a. An open circuit occurs in a wiring system when one or more conductors in the circuit are broken, burned out, or otherwise separated. Since current needs a complete path in order to flow an open in either the hot or neutral conductors would effect the circuit. During operation, an open circuit is determined by the failure to operate part or all of an electrical circuit even though the overcurrent device is not tripped or blown.

b. The characteristics of an open circuit are:

(1) Decreased current flow.

(2) Increased resistance.

(3) Voltage drop across components before the open will be source.

(4) Voltage drop across components after the open will be zero.

c. When repairing a short circuit perform the following steps:

(1) Perform a visual check. Sometimes this will allow you to quickly find the problem. Look for obvious signs such as recently performed construction near any part of the electrical system.

(2) Test the incoming power at the panel. It is possible that the problem is on the supply side.

(3) Ensure that all circuits are energized. Inspect all branch, circuit breakers and or fuses, to make sure that they are not off or tripped or blown.

(4) Test components for voltage. A test lamp or a multimeter should be used to check voltage to see what part(s) of the circuit are not operating.

(5) Locate the open. The best way to find an open in a circuit is to find the midpoint of the circuit and take a voltage measurement. If source voltage is present, the open is somewhere between that point and the end of the circuit. If source voltage is not present, the open is between that point and the power source. This of course is assuming that there is only one open present in the circuit and that is normally the case. If after the first measurement is taken the open is not located, find the midpoint of the half where the open is and take another measurement for voltage. Repeat this step until the open is found. Another way to find an open in a circuit is to ring out the circuit with the power off.

(6) Deenergize and test the circuit to ensure that the power is off.

(7) Repair open. Once the defective connection is found, the connection should be tightened or repaired. If necessary a junction box may be installed and a new conductor may be spliced into the circuit at the defective point.

(8) Reenergize circuit and test for proper operation.

Faulty Electrical Components:

a. For the purpose of troubleshooting an electrical circuit a component is defined as any part within an electrical system other the conductors themselves. Some examples of components are switches, receptacles, plugs, and lights just to name a few. There are really only two problems in an electrical circuit. If a component is bad it is due to an open or short inside the component.

c. When repairing a faulty component perform the following steps:

(1) Perform a visual check. Cracked or broken components are obvious and can be easily identified.

(2) Check component for voltage and or operation.

(3) Turn power off and test. After the suspected faulty component is located a further inspection is required.

(4) Inspect component and locate problem. Broken components can be identified by taking apart the suspected component and visually inspecting for any damage. Some signs of damage would be burned or melted housings on switches or outlets. Another sign would be burned or melted circuit cards, conductors, or components inside the actual component. It is also important to find out what caused the problem so when the new component is

installed the problem does not reoccur. For example, a light fixture that was burned because the lightbulb that was installed had a larger wattage rating than the fixture could handle.

- (5) Replace the faulty component with a new one.
- (6) Reenergize the circuit.
- (7) Test the new component for proper operation.

REFERENCES: NATIONAL ELECTRICAL CODE
WIRING SKILLS UNIT 1