

# UNIT 26

## GFCIs, GFPEs, AFCIs, AND SPDs

### 26.1 Introduction

In addition to overcurrent protection of electrical circuits, electronic devices with the technology to protect against electric shock and fire are used in the electrical system. In this unit you will learn:

- ▶ what a ground-fault circuit interrupter is
- ▶ what an arc-fault circuit interrupter is
- ▶ what ground-fault protection of equipment is
- ▶ what a surge protective device is

### 26.2 Ground-Fault Circuit Interrupters (GFCIs)

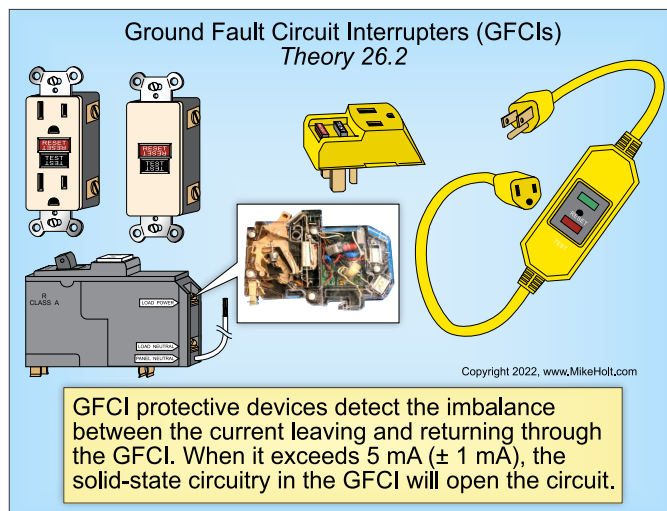
Ground-fault circuit interrupter (GFCI) protective devices detect the imbalance of current between circuit wires. During normal operation, the current returning to the power source through the GFCI is equal to the current leaving the power source. When the difference between the current leaving and returning through the GFCI exceeds 5 mA ( $\pm 1$  mA), the solid-state circuitry in the GFCI will open the circuit. ▶Figure 26-1

#### Author's Comment:

- ▶ The abbreviation “mA” stands for one one-thousandth (1/1,000) of an ampere, so 5 mA is equal to 5/1,000 of an ampere or 0.005A. ▶Figure 26-2

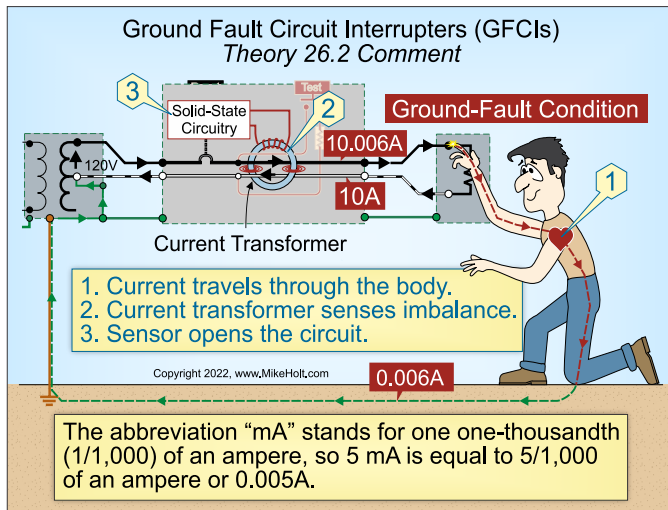
**(A) Equipment Grounding Wire Not Required.** An equipment grounding wire is not necessary for the proper function of a GFCI device.

▶Figure 26-3

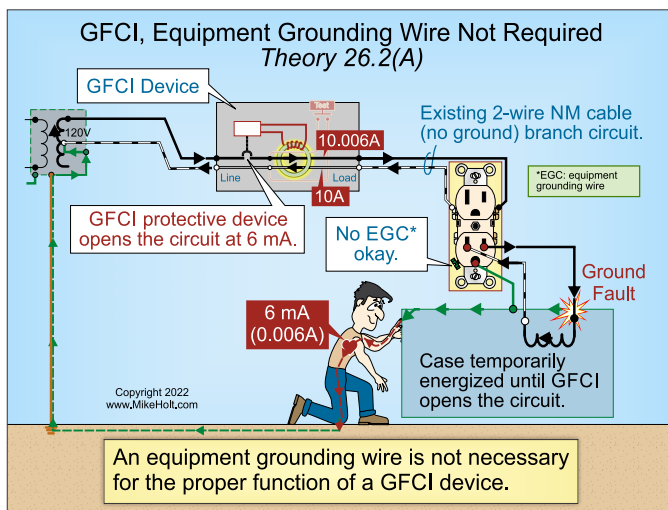


▶Figure 26-1

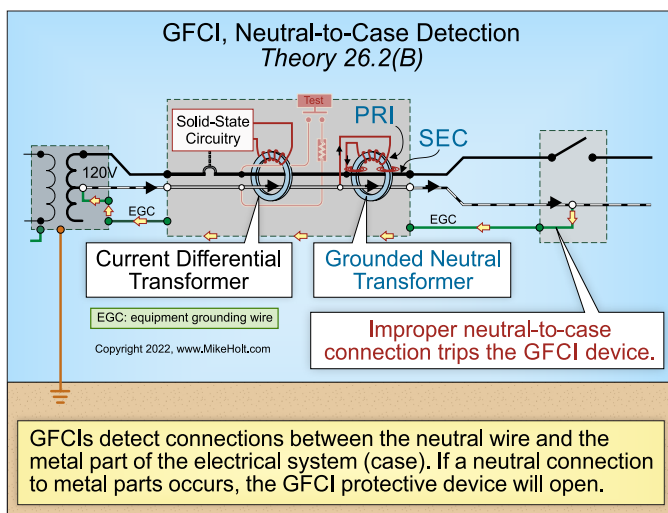
**(B) Neutral-to-Case Detection.** GFCIs detect connections between the neutral wire and the metal part(s) of the electrical system (case). If a neutral connection to a metal part(s) occurs, the GFCI protective device will open. ▶Figure 26-4



►Figure 26-2



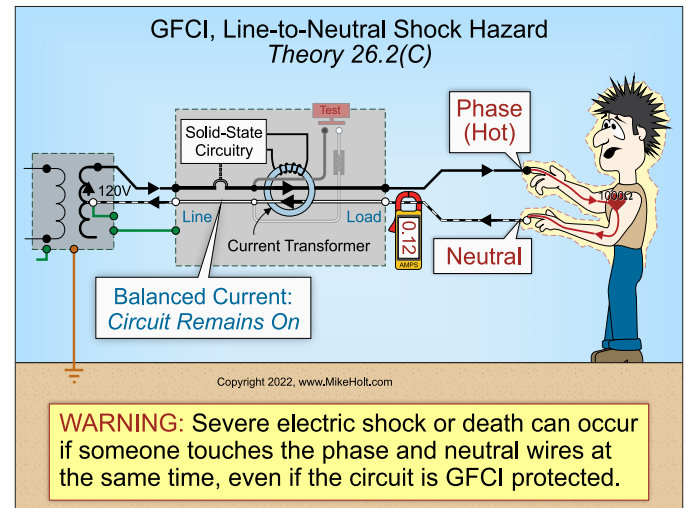
►Figure 26-3



►Figure 26-4

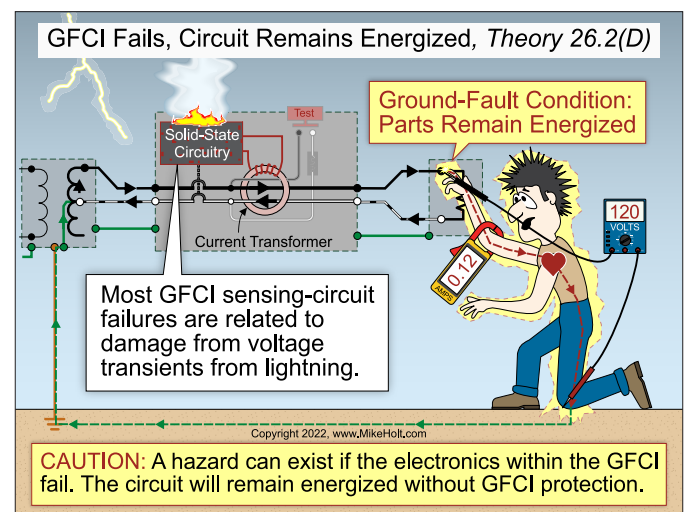
**(C) Line-to-Neutral Shock Hazard.** Severe electric shock or death can occur if someone touches the phase and neutral wires at the same time, even if the circuit is GFCI protected. This is because the GFCI does not sense an imbalance between the departing and returning current.

►Figure 26-5



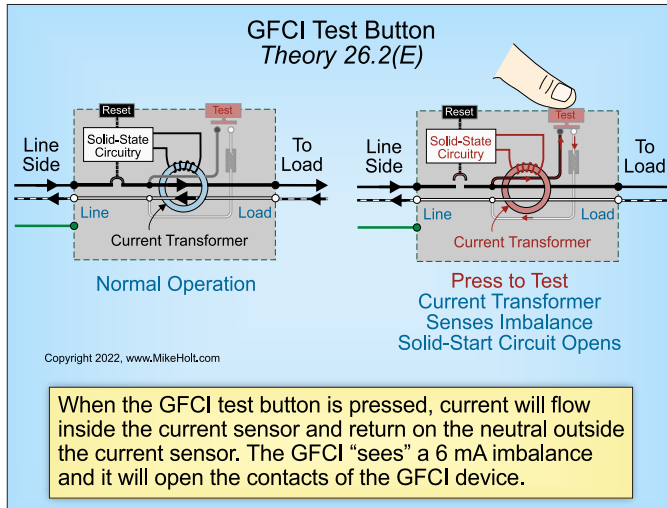
►Figure 26-5

**(D) GFCI Failure—Circuit Remains Energized.** A hazard can exist if the electronics within the GFCI fail. The circuit will remain energized without GFCI protection.



►Figure 26-6

**(E) GFCI Test Button.** GFCIs can only be properly tested by pressing the GFCI test button. When the GFCI test button on a 120V circuit is pressed, current will flow inside the current sensor of the GFCI to the test button at a value of 6 mA or more and return the neutral outside the current sensor. Since the GFCI “sees” a 6-mA imbalance, it will open the contacts of the GFCI device. ▶Figure 26-7



▶Figure 26-7