# UNIT **28**

# **MULTIWIRE CIRCUITS**

# **28.1 Introduction**

Understanding series, parallel, and series-parallel circuits is the foundation for understanding multiwire branch circuits. A multiwire circuit is a circuit consisting of two or more phase wires that have a voltage between them, and an equal voltage between each phase wire and the neutral wire. A typical 3-wire, 120/240V, single-phase circuit is an example. ▶Figure 28–1



## 28.6 Dangers of Multiwire Circuits

Multiwire branch circuits offer fewer wires, and reduced raceway size and voltage drop. However, improper wiring or mishandling of multiwire circuits can cause a fire hazard and/or equipment failure.

(A) Fire Hazard. Failure to terminate the phase wires to separate phases may cause the neutral wire to become overloaded from excessive neutral current, and the insulation may be damaged or destroyed. Overheating is known to decrease insulating material service life, potentially resulting in a fire from arcing faults in hidden locations. It is difficult to predict just how long wire insulation will last under normal operating conditions, but heat does decrease its life span.
Figure 28–13

**(B) Equipment Failure.** If the continuity of the neutral wire of a multiwire circuit is interrupted (opened), there could be a fire and/ or destruction of electrical equipment resulting from overvoltage or undervoltage.



Figure 28-13

### **Example**

**Example:** A 3-wire, 120/240V circuit supplies a 1,200W, 120V hair dryer and a 600W, 120V television. If the neutral wire is interrupted, it will cause the 120V television to operate at 160V and consume 1,067W of power (instead of 600W) for only a few seconds before it burns up. ▶ Figure 28–14



### Figure 28-14

Solution:

Step 1: Determine the resistance of each appliance:

### $R = E^2/P$

Hair Dryer

 $R = 120V^2/1,200W$ 

 $R=12\Omega$ 

Television

 $R = 120V^2/600W$ 

 $R = 24\Omega$ 

*Step 2:* Determine the current of the circuit:

### I = E/R

 $I = 240V/(12\Omega + 24\Omega)$ I = 6.70A

*Step 3:* Determine the operating voltage for each appliance:

### $E = I \times R$

Hair Dryer Operates  $at = 6.70A \times 12\Omega$ Hair Dryer Operates at = 80VTelevision Operates  $at = 6.70A \times 24\Omega$ Television Operates at = 160V