Electrical Level 2

Circuit Breakers and Fuses 26210-14

Objectives

When trainees have completed this lesson, they should be able to do the following:

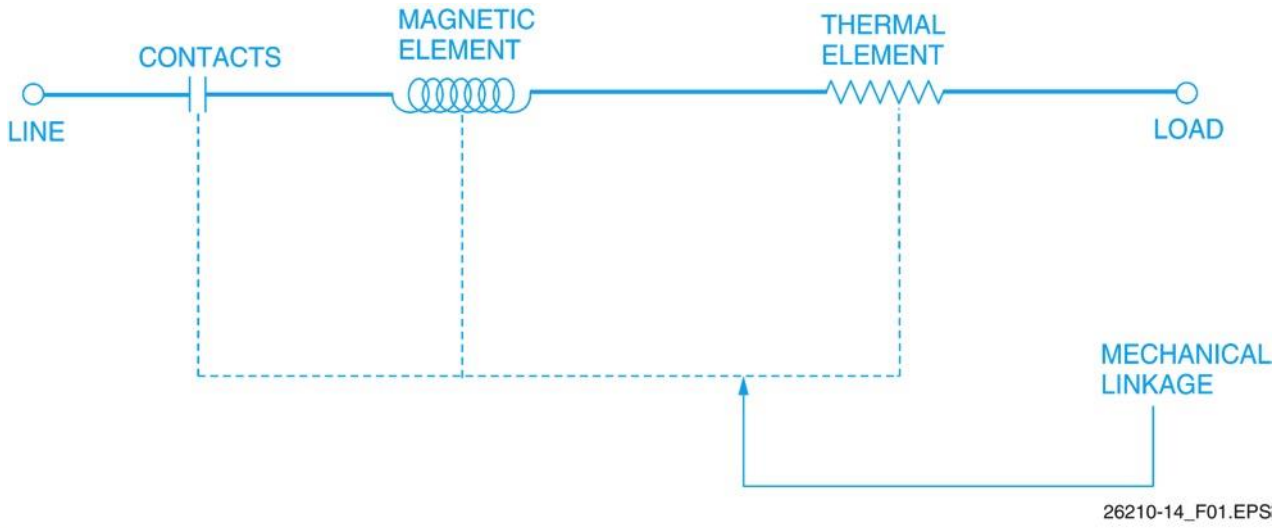
1. Explain the necessity of overcurrent protection devices in electrical circuits.
2. Define the terms associated with fuses and circuit breakers.
3. Describe the operation of a circuit breaker.
4. Apply the *National Electrical Code*® (*NEC*®) requirements for overcurrent devices.
5. Describe the operation of single-element and time delay fuses.

Performance Task

1. Identify the following on one or more circuit breaker(s) and fuse(s):
   - Number of poles
   - Load rating
   - Voltage rating
   - Amperage interrupting rating

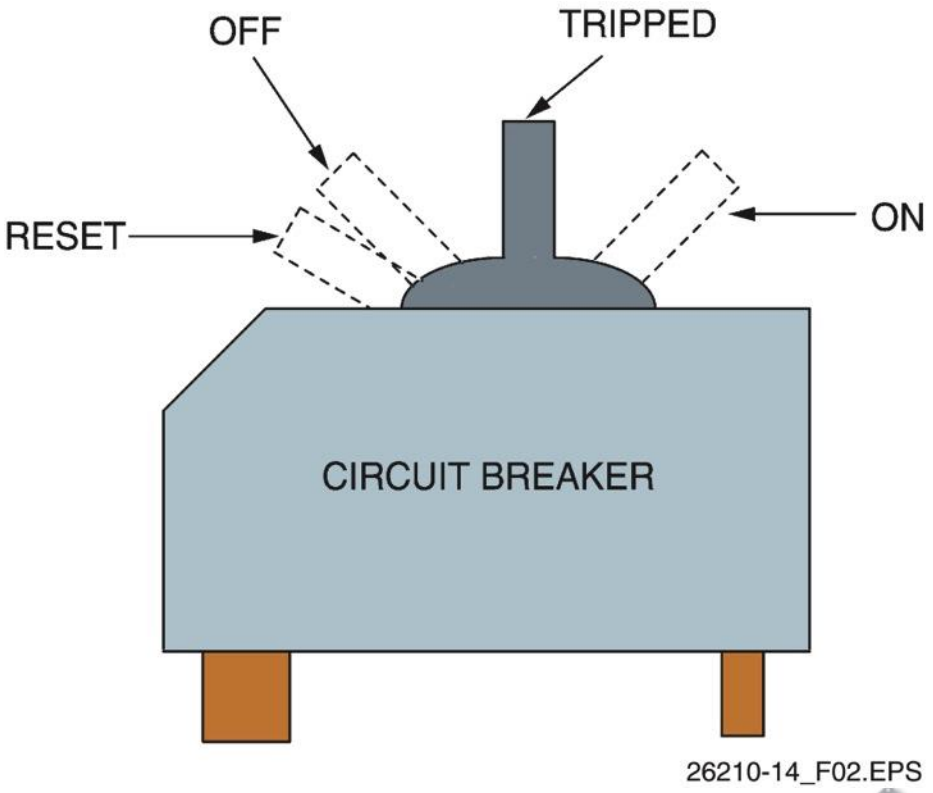
Introduction

- A circuit breaker is used to close and interrupt a circuit under both normal conditions (for service) and abnormal conditions.
- A circuit breaker is designed to automatically open the circuit when it senses a predetermined overload or fault current.



Operating Characteristics of a Circuit Breaker

- When a breaker trips, it moves from the On position to the middle (Tripped) position. To reset the breaker, it is pushed beyond Off to the Reset position and then back to the On position.
- Circuit breakers are available in five frame classifications based on the largest ampere rating of the range (100A, 225A, 400A, 1,000A, and 2,000A).



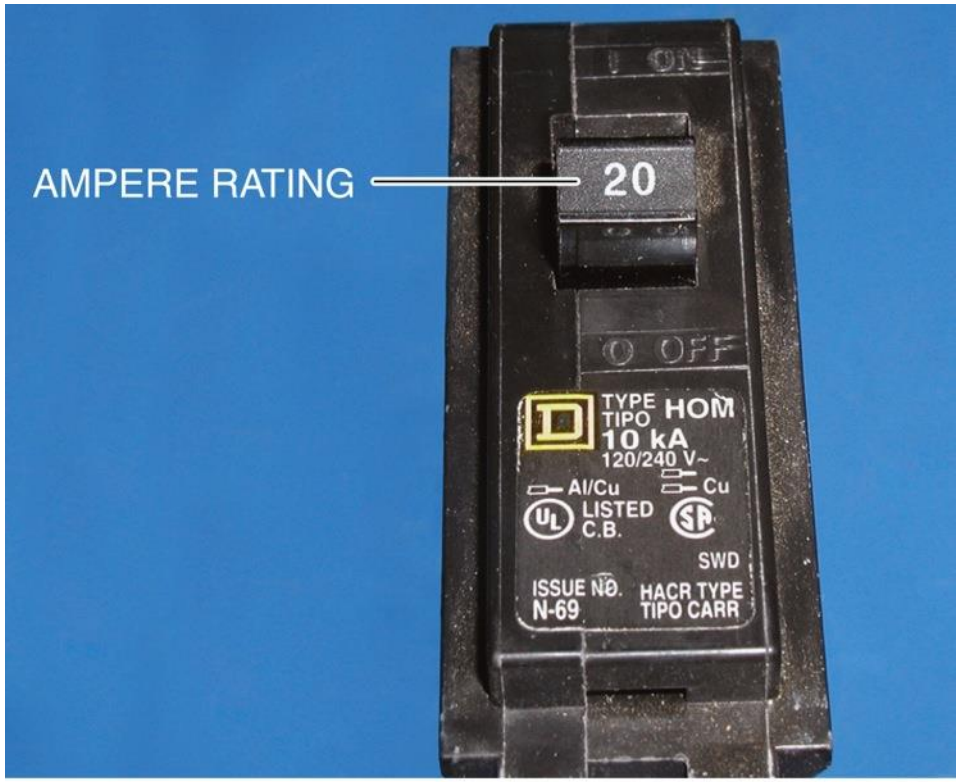
Circuit Breaker Ratings

- Circuit breakers can be rated for either AC or DC or both.
- Circuit breaker voltage ratings must be equal to or greater than the voltage of the associated electrical system.
- Circuit breakers have two current ratings: the continuous current rating and the fault current interrupting capacity.

For Alternating Current	For Direct Current
120V	125V
120/240V	—
240V	250V
277V	600V
277/480V	—
480V	—
600V	—

Circuit Breaker Current Rating

- The continuous current rating of a circuit breaker is the maximum current that it can carry continuously without exceeding the allowable temperature rise.
- Continuous current ratings range from 15A to 6,000A. The ampere rating of a breaker is located on the handle of the device.



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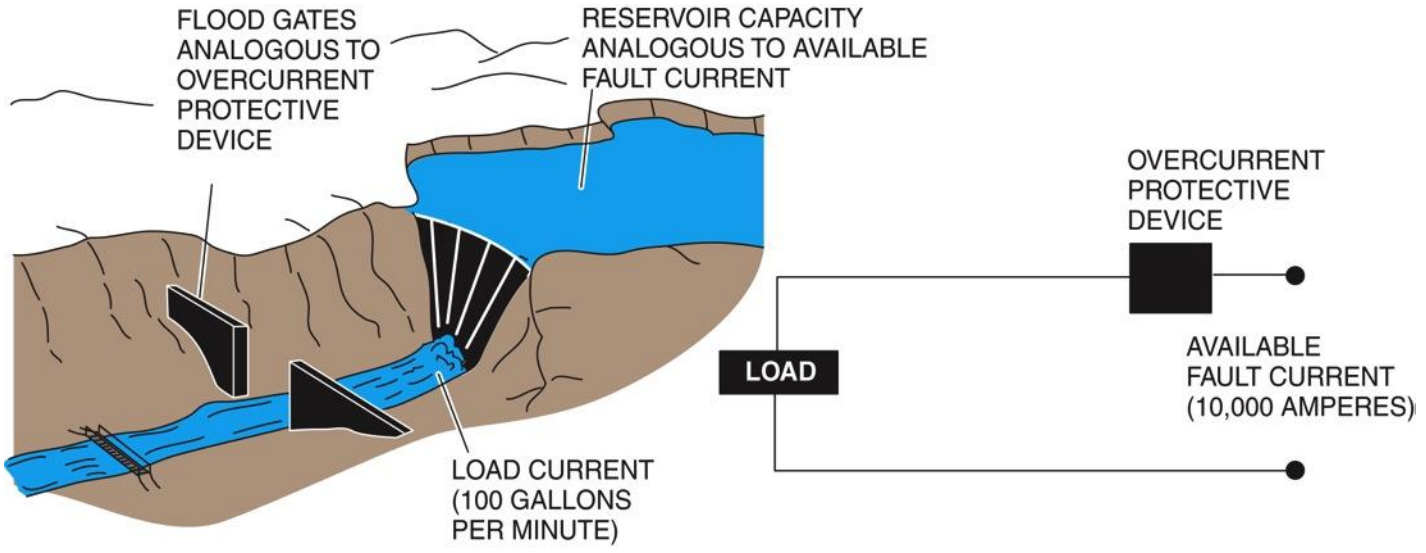
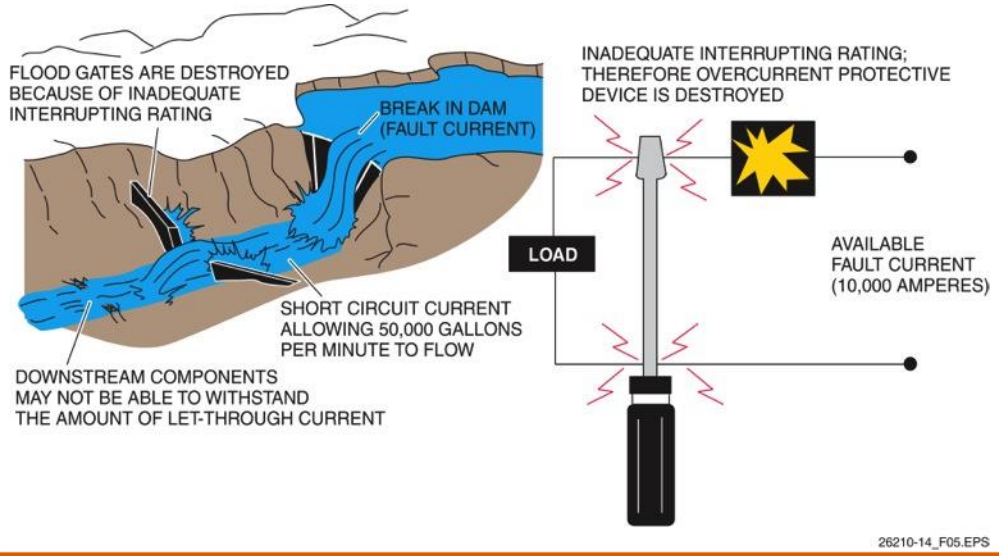
Normal Current Operation

- The amperage interrupting capacity (AIC) is the maximum short circuit current at which the breaker will safely interrupt the circuit at the rated voltage and frequency.
- Under normal operation, the load current is consistent and the protective device will not trip.



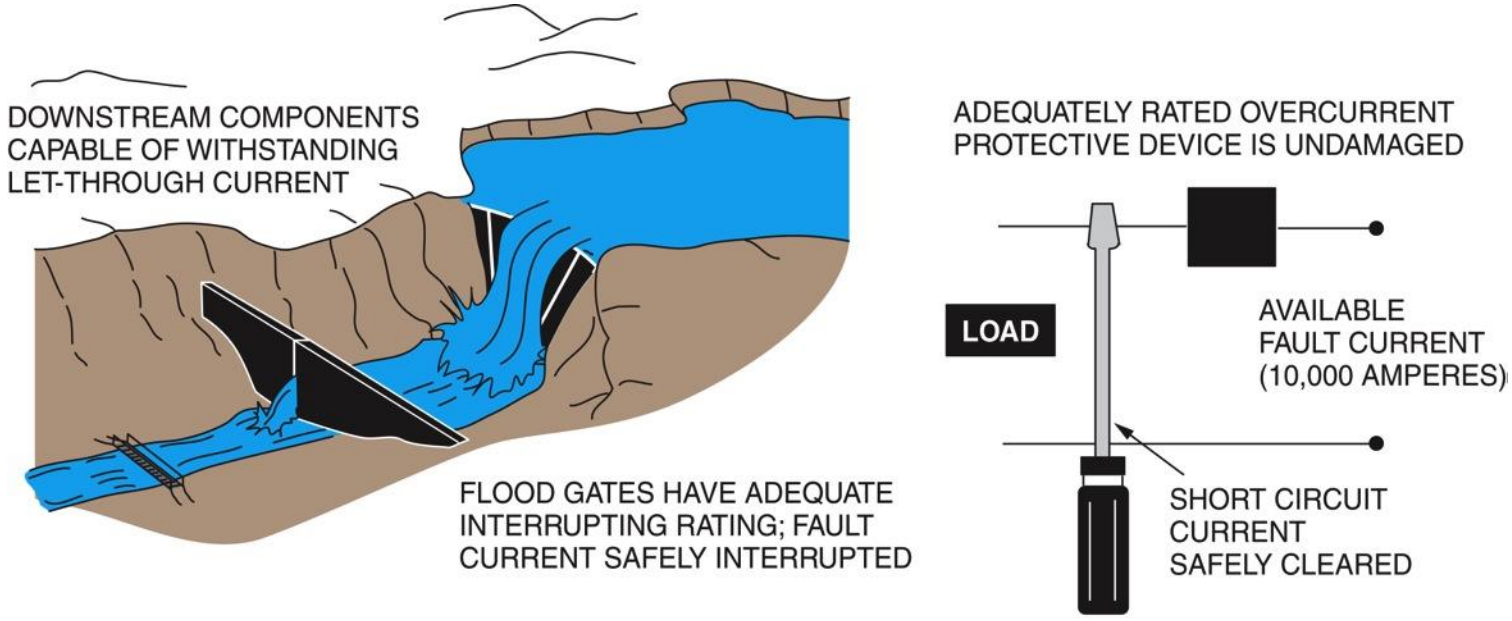
Short Circuit Operation with Inadequate Interrupting Rating

- If the fault current exceeds the AIC, it may result in personnel injury and equipment damage, and the protective device can be damaged or destroyed.
- Downstream devices may also be damaged or destroyed by the let-through current.



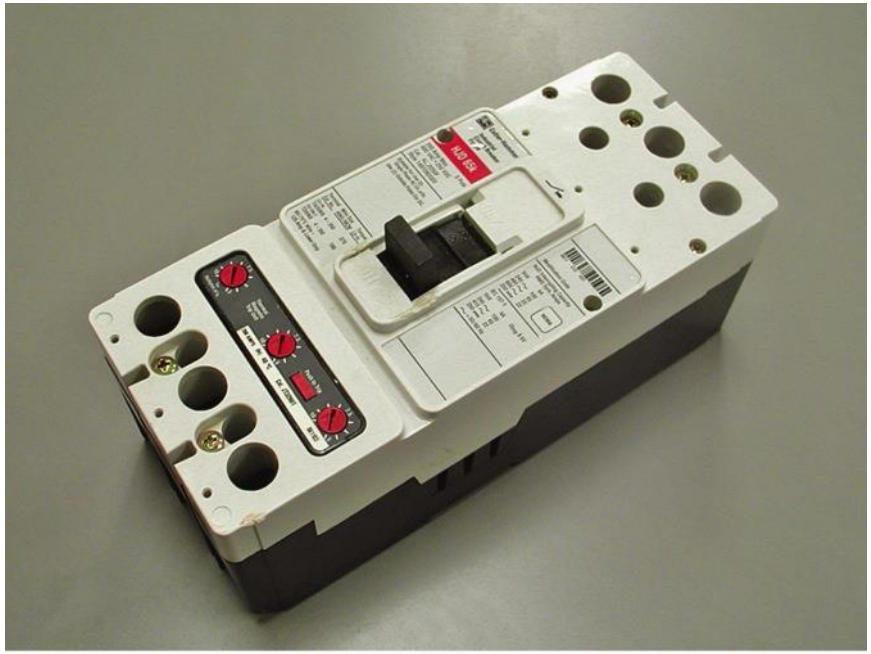
Short Circuit Operation with Adequate Interrupting Rating

When the overcurrent device is sized correctly, it operates to protect the circuit and downstream components.



High Interrupting Capacity Circuit Breaker

- Standard interrupting capacity breakers have black handles and an AIC of 10,000A.
- High interrupting capacity breakers have an AIC of up to 65,000A or more. These heavy-duty breakers are built to withstand the higher shocks from heat and interrupting forces.
- Current-limiting breakers operate very quickly to provide downstream protection on systems with high available fault currents.



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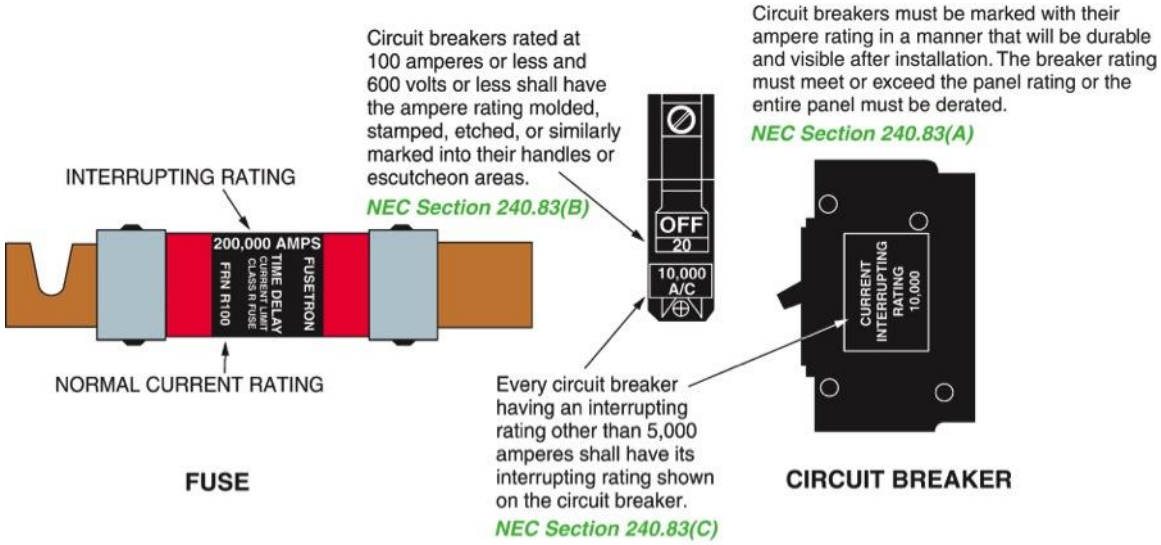
Most Overcurrent Protective Devices are Labeled with Two Current Ratings

- The overcurrent device will be labeled with both the current rating and the AIC.
- ***NEC Article 240*** covers overcurrent protective devices, while ***NEC Article 110*** covers marking requirements.



Next Session…

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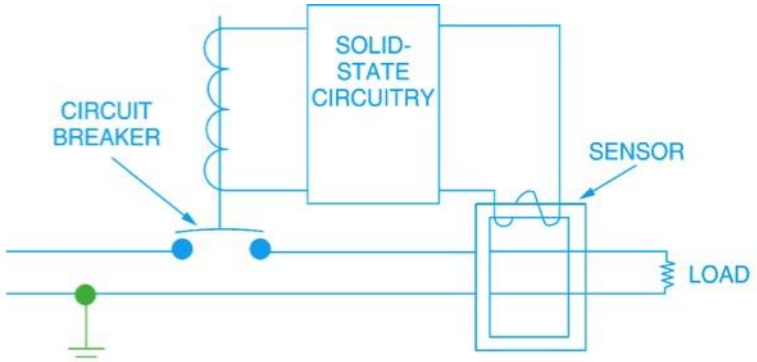
Think About It – Installing Circuit Breakers

In addition to using the correct size circuit breaker (trip current and interrupt current), what are some other factors that should be taken into consideration when selecting and installing a circuit breaker in a panel?

Ground Fault Current Circuit Protection

Ground Fault Current Circuit Protection

- Standard circuit breakers cannot protect personnel from damaged or faulty equipment because the current levels, while enough to harm or even kill a person, are too low to trip a standard breaker.
- Ground fault circuit interrupters (GFCIs) are used to interrupt fault currents of 6mA or more.



(A) DIAGRAM OF A GFCI CIRCUIT MONITORING A TWO-WIRE CIRCUIT

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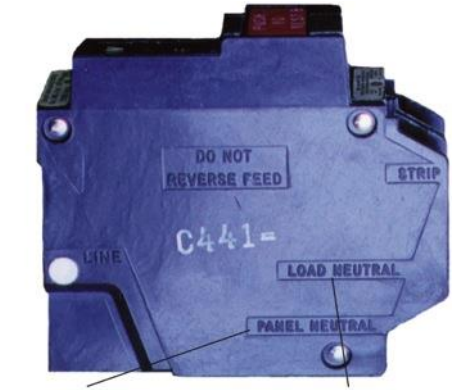

(B) GFCI CIRCUIT BREAKER

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Fuses

- A fuse is the simplest type of overcurrent protective device and consists of a fusible link encapsulated in a tube or plug body.
- Some fuses incorporate a time-delay feature to prevent nuisance tripping due to high inrush currents on equipment startup.
- Plug fuses are commonly used to protect appliances.

EDISON-BASE FUSE
(MAXIMUM RATING 30 AMPERES)

TYPE S
FUSE ADAPTER

TYPE S FUSE
(MAXIMUM RATING 30 AMPERES)

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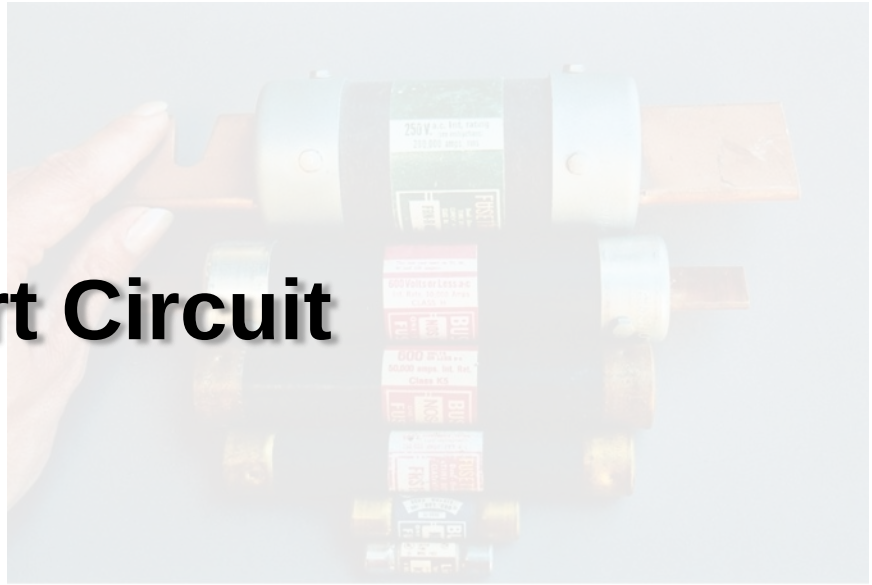
Next Session…

Cartridge Fuses

- Cartridge fuses are used in a wide variety of applications and are available in single-element and dual-element types.
- Dual-element fuses can be applied in circuits subject to temporary overloads and surge currents to provide both overload and short circuit protection.
- Like circuit breakers, fuses must also be marked with the current rating and the AIC.



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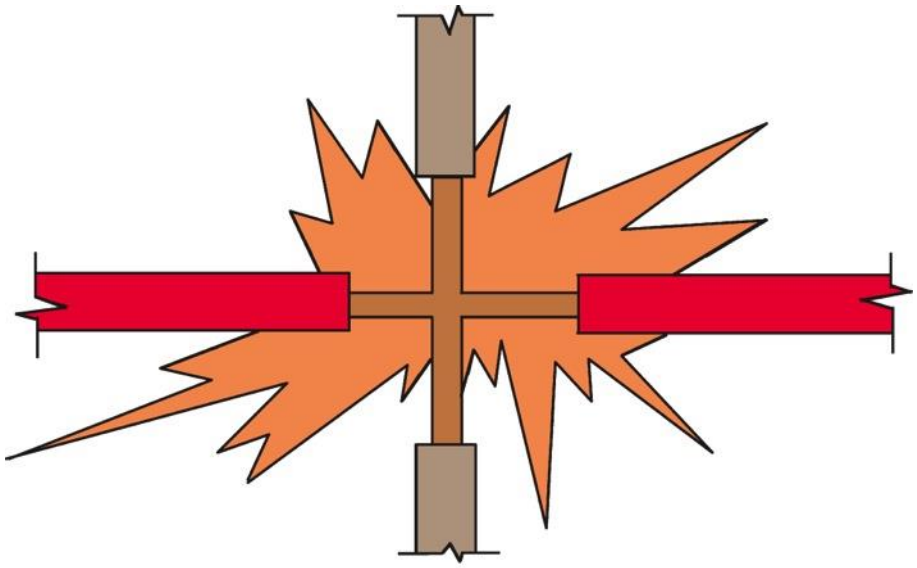
Short Circuit

Performance Task

This session will conclude with trainees identifying various characteristics on fuses and circuit breakers.

Short Circuit

- An overcurrent condition can be caused by a short circuit or an overload.
- Short circuits can occur between two wires or between a wire and a grounded object, such as the metal frame of a motor.
- Continuous overloads can result from motor defects, an overloaded circuit, or overloaded equipment.



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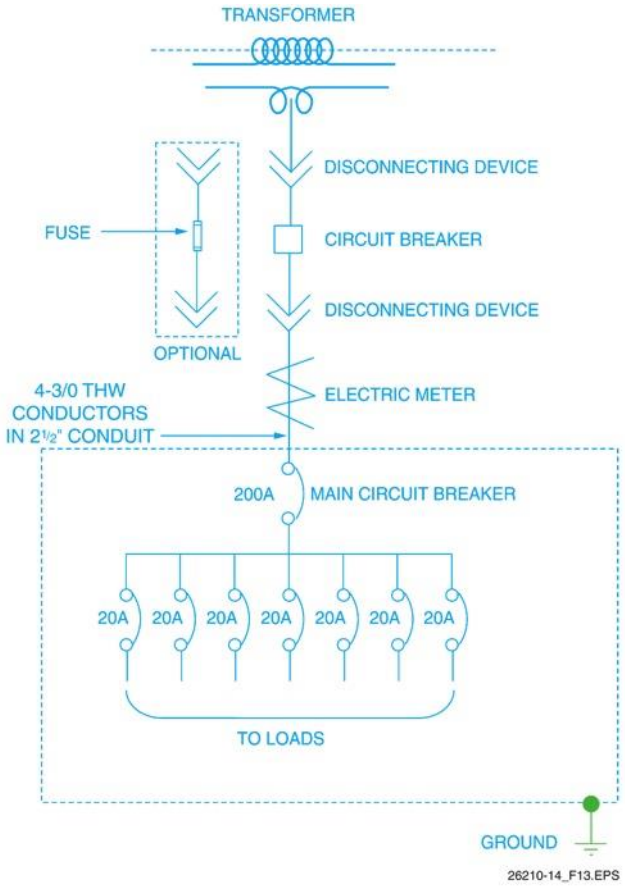
Guide For Sizing Fuses; Safety; Coordination



- Overcurrent selection must consider the application as well as all downstream devices and *NEC*® requirements.
- Selective coordination is the selection of overcurrent devices with time/current characteristics that ensure a fault is cleared by the nearest device on the line side of the fault.

Wrap Up

3-2-1

3 – Write 3 important things learned during class

2 – Write 2 questions you have about the material

1 – Write 1 thought you had about the material

Next Session…

MODULE EXAM

Review the complete module to prepare for the module exam. Complete the Module Review as a study aid.