

# Siemens STEP 2000 Course



## Load Centers

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# Introduction

Welcome to another course in the STEP 2000 series, **Siemens Technical Education Program**, designed to prepare our distributors to sell Siemens Energy & Automation products more effectively. This course covers **Load Centers** and related products.

Upon completion of **Load Centers** you should be able to:

- Explain the role of a load center in residential distribution
- Distinguish between the terms panelboard and load center
- Define a load center (panelboard)
- Explain the need for circuit protection
- Identify various components of a Siemens load center
- Distinguish between a main breaker and main lug only load center
- Identify various power supply systems used in residential applications
- Explain the use of load centers used as service-entrance equipment
- Describe the proper grounding techniques of service entrance and downstream panelboards
- Describe the proper use of GFCI and AFCI circuit breakers in a load center
- Describe the proper use of the circuit breaker surge arrester in a load center
- Identify various ratings of Siemens load centers

This knowledge will help you better understand customer applications. In addition, you will be able to describe products to customers and determine important differences between products. You should complete **Basics of Electricity** and **Molded Case Circuit Breakers** before attempting **Load Centers**. An understanding of many of the concepts covered in **Basics of Electricity** and **Molded Case Circuit Breakers** is required for **Load Centers**.

If you are an employee of a Siemens Energy & Automation authorized distributor, fill out the final exam tear-out card and mail in the card. We will mail you a certificate of completion if you score a passing grade. Good luck with your efforts.

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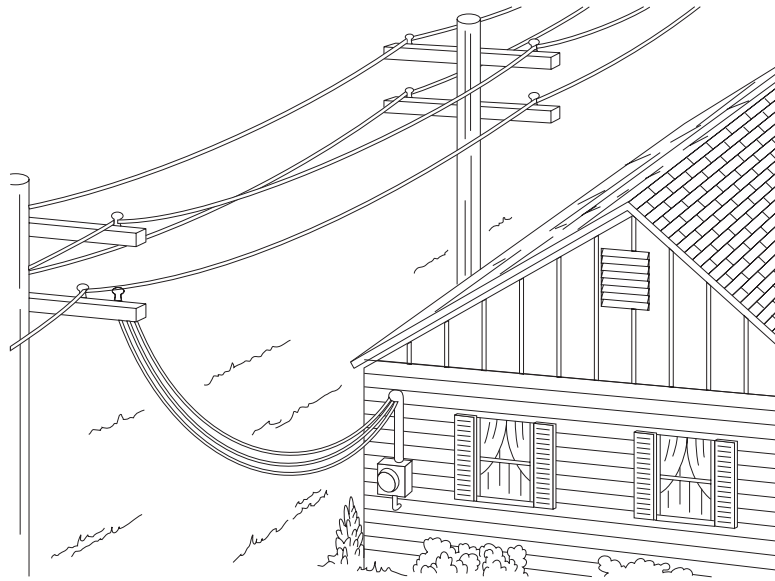
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# Residential Distribution

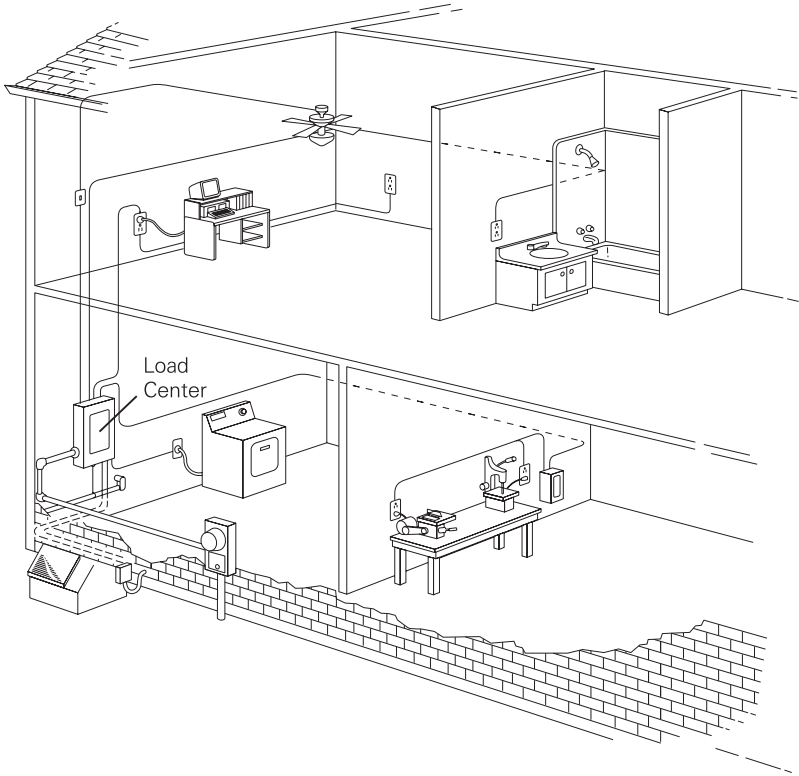
A distribution system is a system that distributes electrical power throughout a building. Distribution systems are used in every residential, commercial, and industrial building.

## **Residential Distribution**

Most of us are familiar with the distribution system found in the average home. Power, purchased from a utility company, enters the house through a metering device.

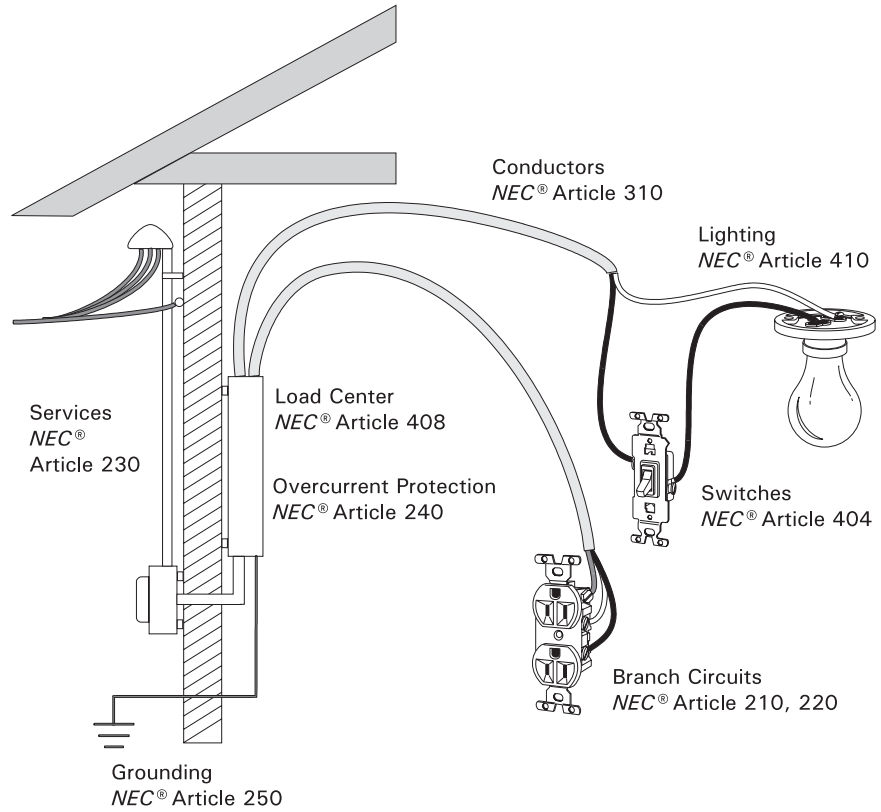


The incoming power then goes to a load center which provides circuit control and overcurrent protection. The power is distributed from the load center to various branch circuits for lighting, appliances and electrical outlets. Careful planning is required so that the distribution system safely and efficiently supplies adequate electric service for present and possible future needs.



## The National Electrical Code®

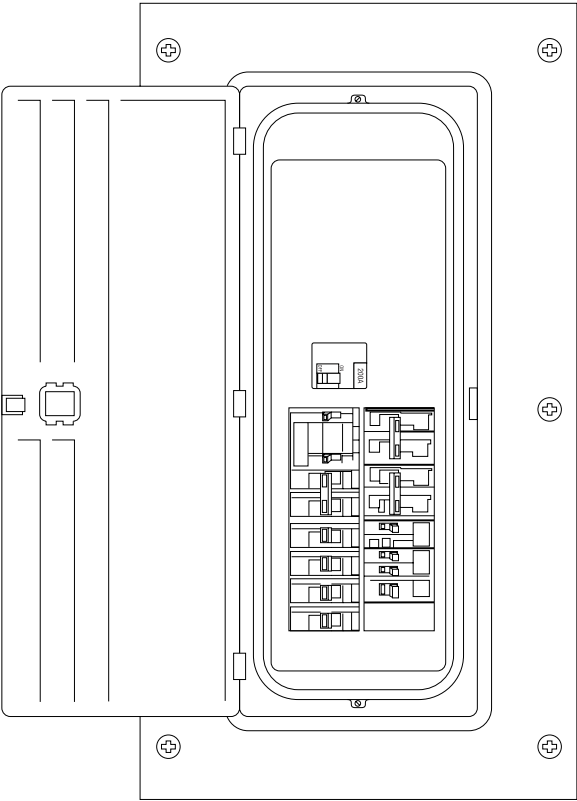
The *National Electrical Code*® (*NEC*®) is used extensively in the electrical industry. Throughout this course various articles of the *NEC*® will be referred to. You are encouraged to become familiar with this material as well as local building codes which are often more stringent than the *NEC*®.



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# Load Centers

The term “load center” is an industry term used to identify a panelboard used in certain applications. Load centers are typically rated 225 amps or less and 240 volts maximum and are intended for use in residential applications. *NEC*<sup>®</sup> and UL, however, make no distinction between a panelboard and a load center. Rules and definitions that apply to panelboards also apply to load centers.



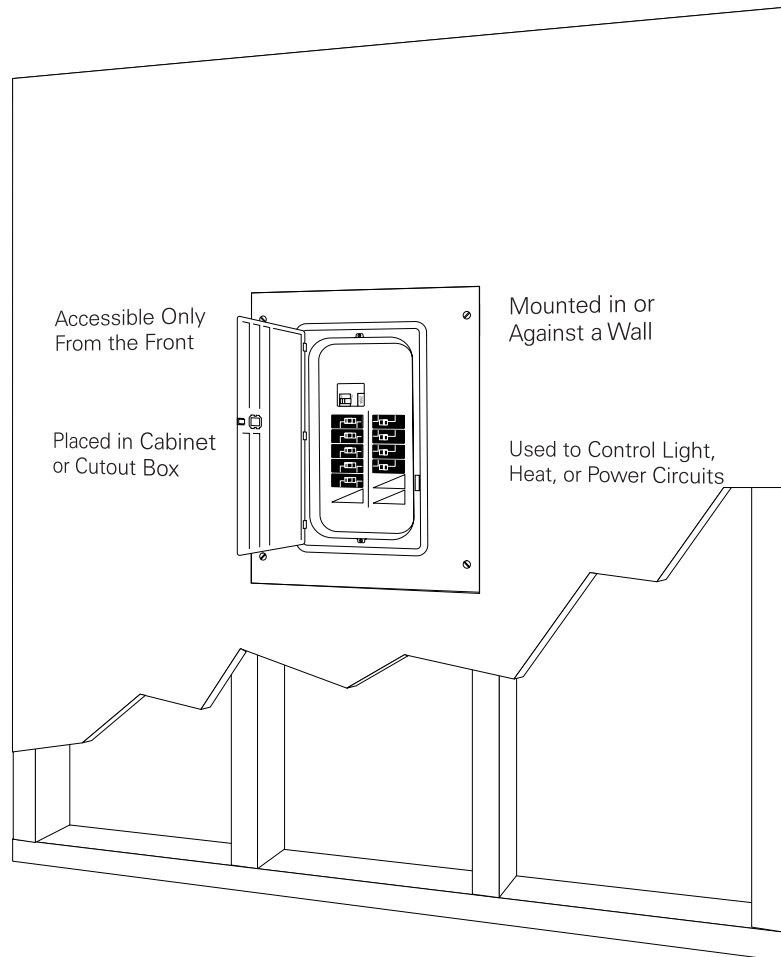


## Load Center Definition

The *National Electrical Code*® defines a load center (panelboard) as a single panel or group of panel units designed for assembly in the form of a single panel; including buses, automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front (Article 100-definitions).

According to the *NEC*® definition, load centers (panelboards) are:

- Used to control light, heat, or power circuits
- Placed in a cabinet or cutout box
- Mounted in or against a wall
- Accessible only from the front



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## Review 1

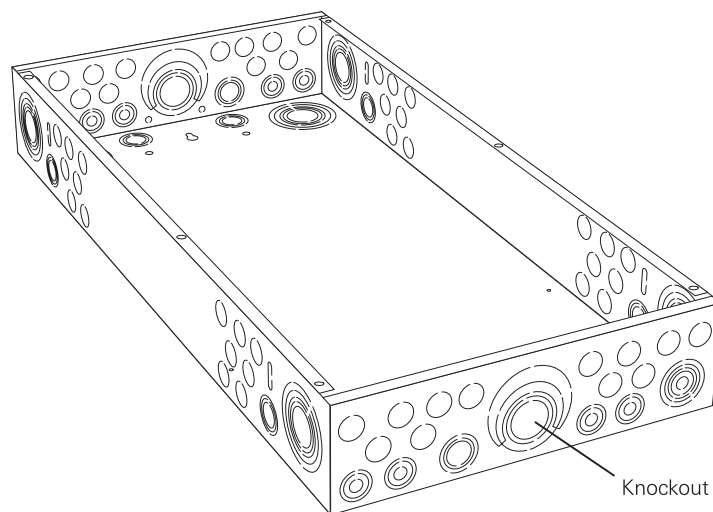
1. A \_\_\_\_\_ system distributes electrical power throughout a building.
2. Load centers are covered by *NEC*<sup>®</sup> Article \_\_\_\_\_ .
3. Overcurrent protection is covered by *NEC*<sup>®</sup> Article \_\_\_\_\_ .
4. The *National Electrical Code*<sup>®</sup> makes no distinction between a panelboard and a load center.
  - a. true
  - b. false
5. Which of the following does not meet the *NEC*<sup>®</sup> definition of a load center (panelboard).
  - a. Used to control light, heat, or power circuits
  - b. Placed in a cabinet or cutout box
  - c. Accessible from the front or back
  - d. Mounted in or against a wall

# Load Center Construction

There are several components that make up a load center. Load centers consist of an enclosure, interior, and trim.

## Enclosure

The enclosure is typically constructed of cold rolled (for indoor use) or galvanized steel (for outdoor use) and houses the other components. It is designed to provide component and personnel protection. Knockouts are provided to allow the user to install conduit or cabling as required. Approved cable clamps or conduit hubs are used in the holes to secure and protect the cable and conductors.

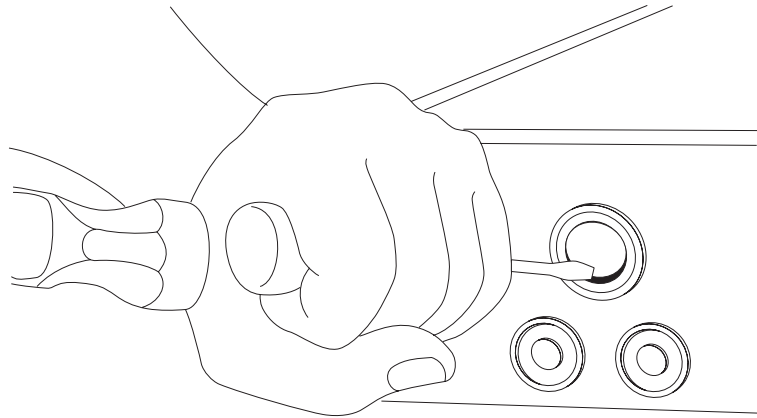


## NEMA Enclosures

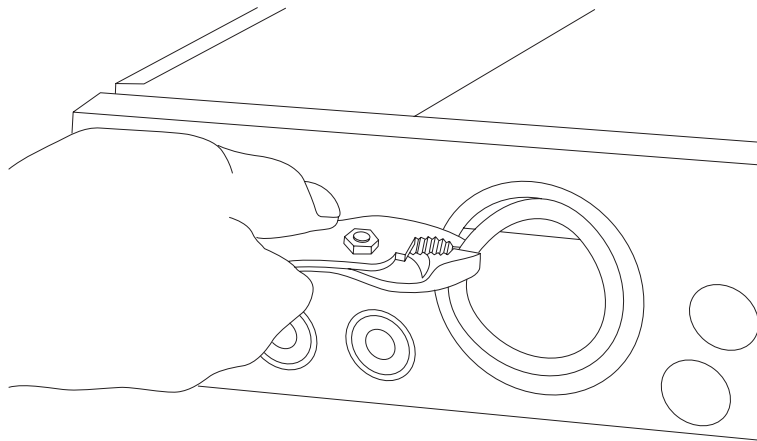
The National Electrical Manufacturers Association (NEMA) and UL have established guidelines for electrical equipment enclosures. NEMA Type 1 enclosures are intended for indoor use. NEMA Type 3R enclosures are intended for outdoor use primarily to provide a degree of protection against rain, sleet and damage from external ice formation.

## Removing Knockouts

Required knockouts may be removed prior to mounting the enclosure. On multiple ring knockouts remove the center section by striking at the point furthest from the tie. Bend the knockout back and forth to break the tie.

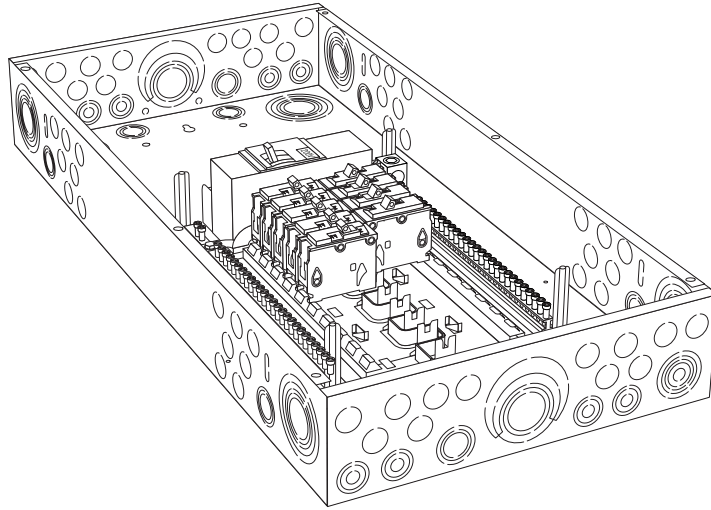


If a larger opening is required, remove each additional ring one at a time by prying with a screwdriver and bending back and forth with pliers as shown in the following figure.



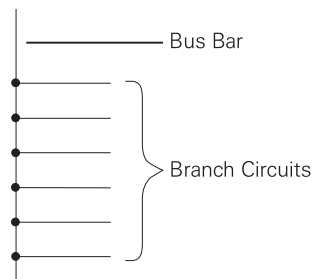
## Interior

The interior consists of several components, including bus bars and neutral bars. Branch circuit breakers are field added at the time of installation.



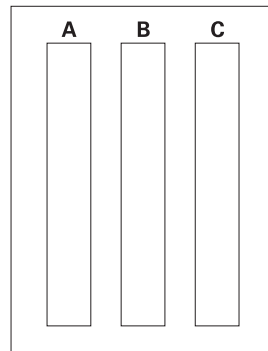
## Bus Bars

A bus bar serves as a common connection for two or more circuits. It is represented schematically by a straight line with a number of connections made to it. Siemens load center bus bars are made with tin plated aluminum or copper.

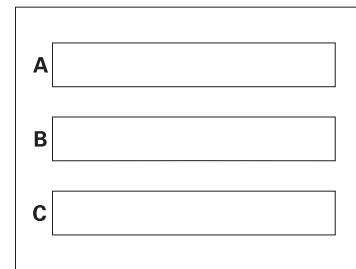


## Circuit Identification

Bus bars are required to have phases in sequence so that an installer can have the same fixed phase arrangement in each termination point in any panelboard or switchboard. This is established by NEMA and UL. It is assumed that bus bars are arranged according to NEMA and UL standards unless otherwise marked. The following diagram illustrates accepted NEMA and UL phase arrangements.



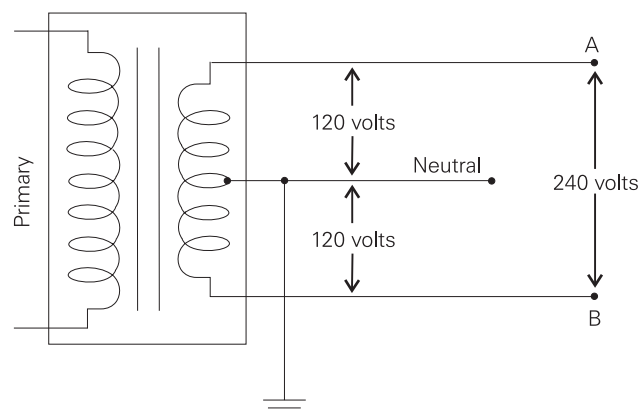
Vertical



Horizontal

## Neutral Bus\*

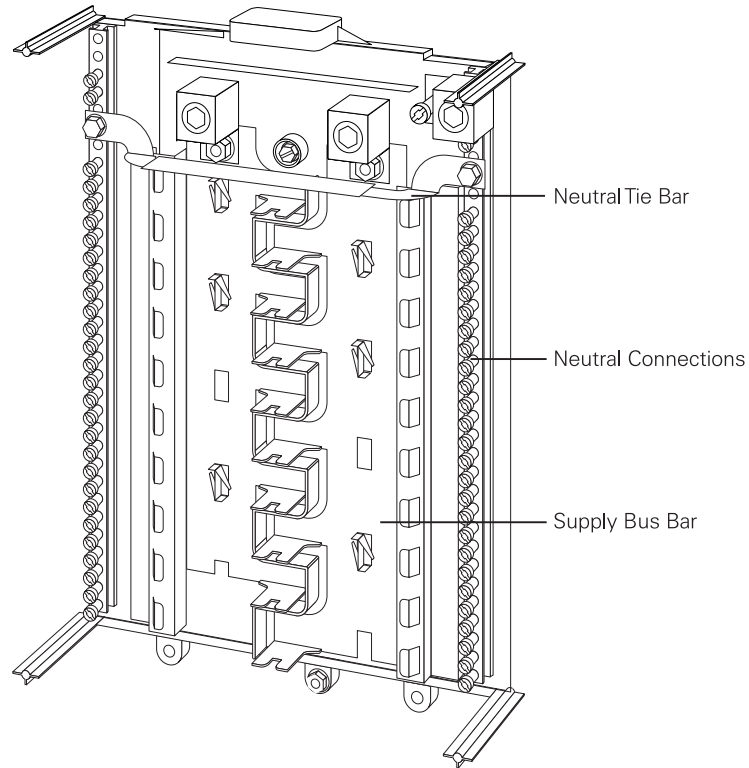
An insulated neutral bus (which may be grounded/bonded) is provided in the load center. The neutral is a current-carrying component that is connected to the third wire of a single-phase, three-wire system or the fourth wire of a three-phase, four-wire system. For example, the following illustration shows the secondary of a 240 volt, single-phase transformer with a center tap. There are 240 volts between phases and 120 volts between phases and neutral (N).



\*Technically the "grounded circuit conductor."

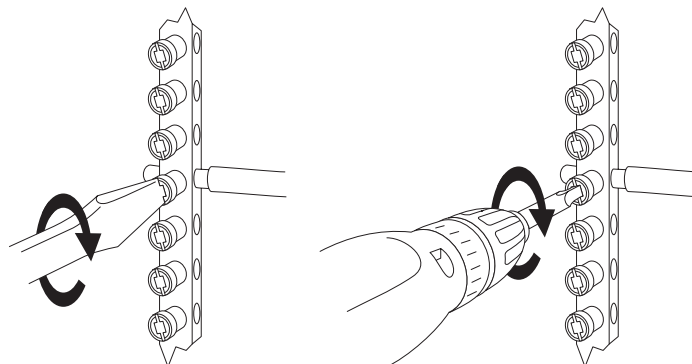
## Split Neutral

In most instances the neutral bus is a split neutral, meaning that neutral connections are available on both sides of the load center. Split neutrals are connected together through a neutral tie bar.



## INSTA-WIRE™

INSTA-WIRE is a feature found in Siemens load centers and circuit breakers up to 50 amps. The INSTA-WIRE screw is a backed-out screw retained in place by a special feature on the screw thread. This feature prevents the screw from falling out during shipment. The INSTA-WIRE screw head will accept either a standard screwdriver or a square tool bit. The INSTA-WIRE feature saves an installer time by eliminating the need to back out every screw and by allowing the installer to use a power tool to tighten screws.

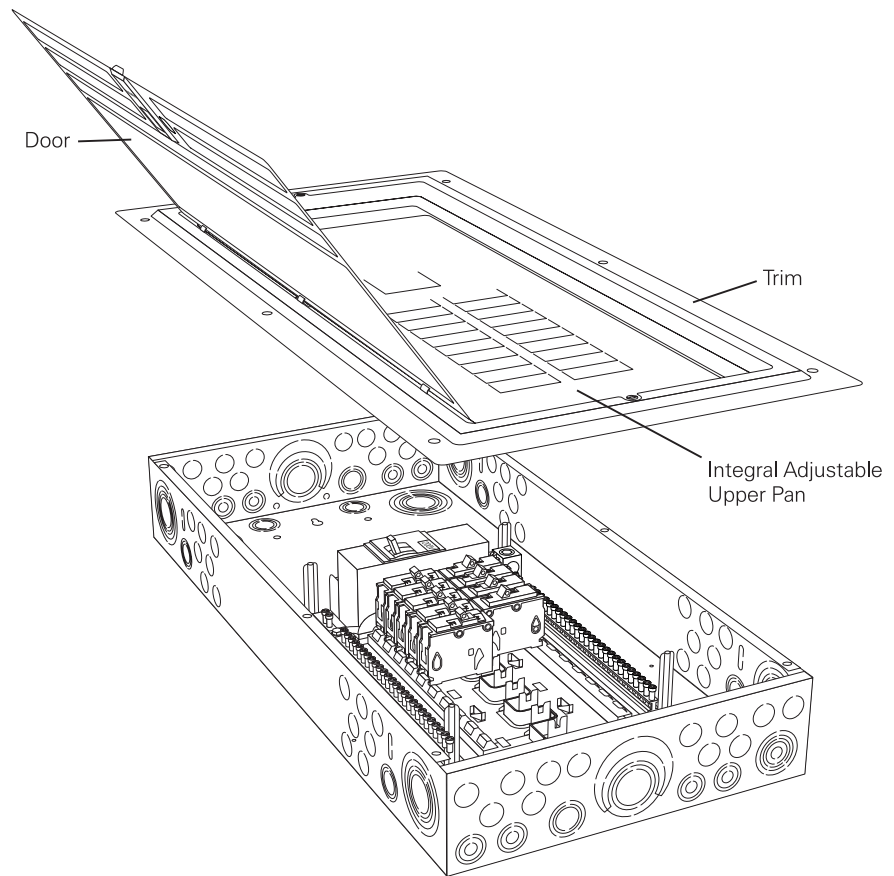






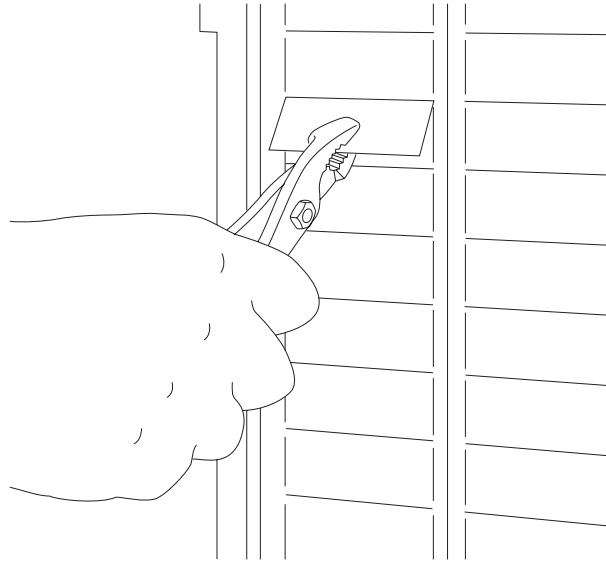
## Trim Assembly

The trim assembly (dead front) is the front portion of the load center that covers the interior. The trim includes an access door and an adjustable upper pan. The trim/door provides access to the overcurrent devices while sealing off live parts and internal wiring from contact.



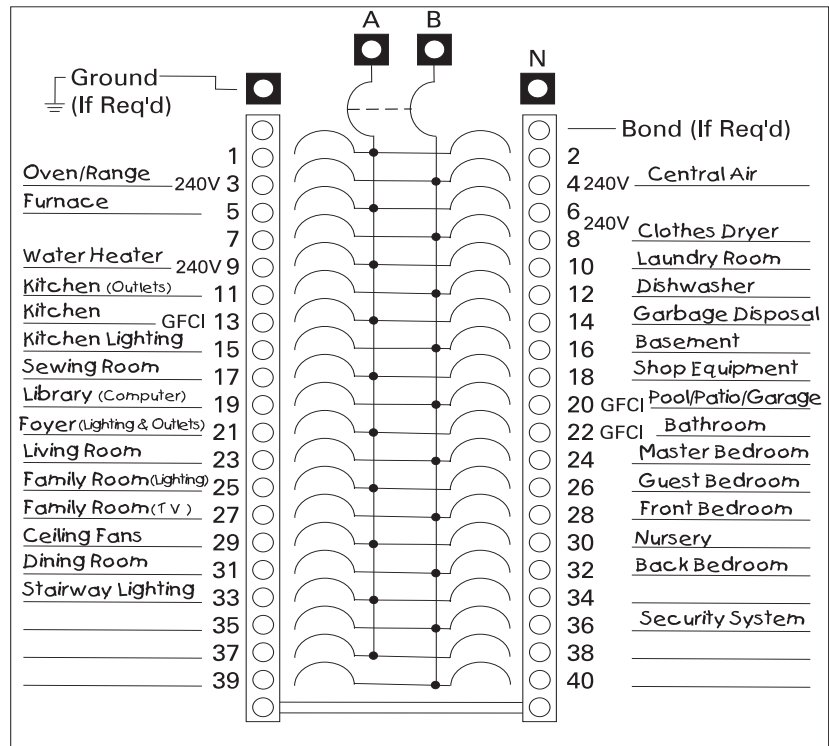
## Twistouts

Part of the upper pan contains twistouts. These are used to cover any unused pole spaces not filled by a circuit breaker. Twistouts are removed by an up and down twisting motion with pliers. All unused openings in the upper pan must be filled with a filler plate.



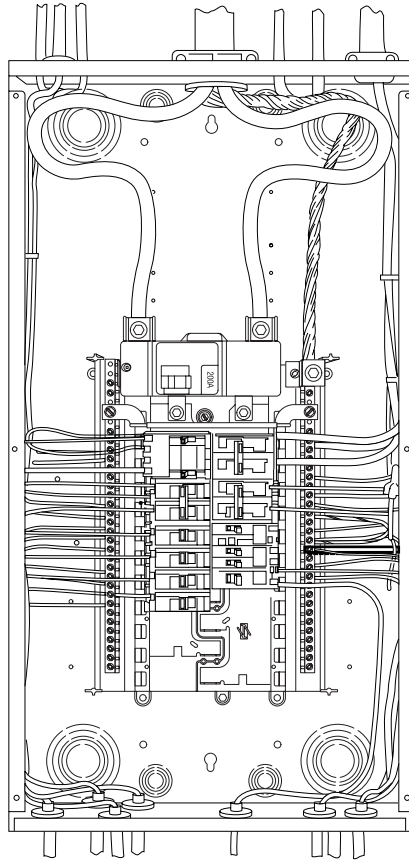
## Circuit Directory

A circuit directory (on the door), similar to one shown below, provides space for listing which breaker provides service for each room or large appliance.

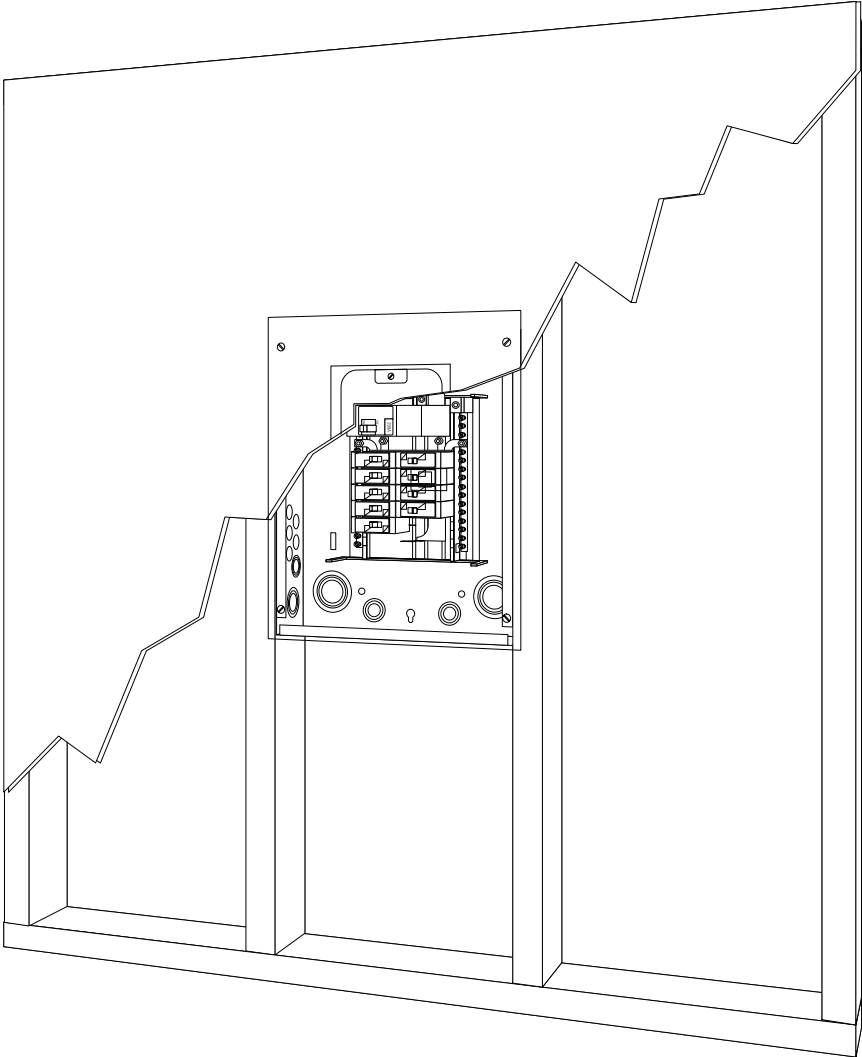


## Installation

The enclosure, with the interior, is mounted to a wall. All incoming and outgoing conductors are connected to the load center.

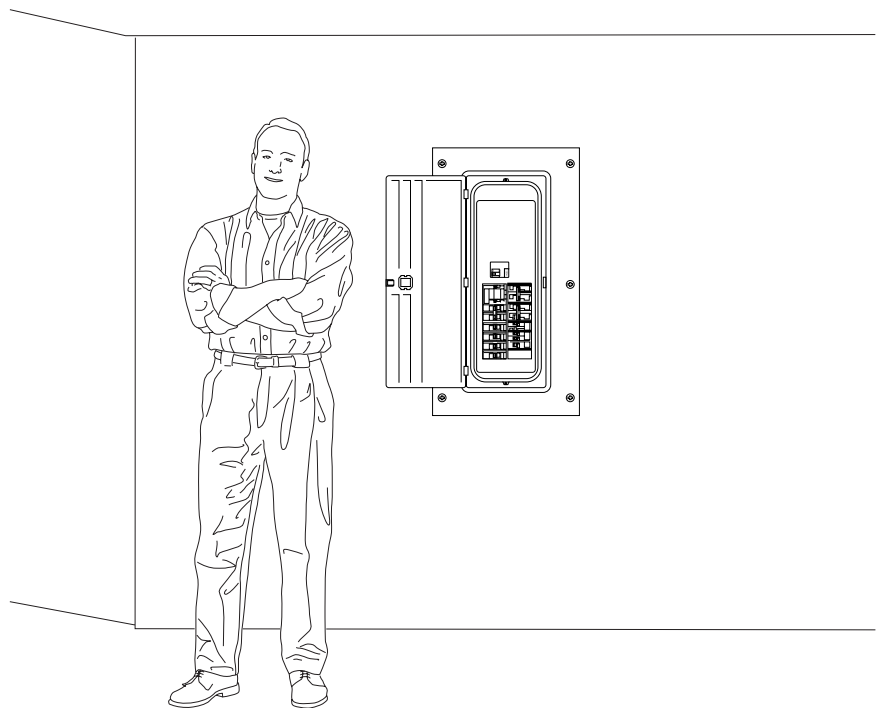


Siemens load centers can be surface or flush mounted. For flush mounted devices, the load center is positioned so that the front edge of the enclosure is flush with the finished wall. The trim assembly is installed after the wall is finished. All covers are combination covers unless surface or flush is specified.



## **NEC® Article 110.26**

Load center installation requires careful planning to ensure a safe environment for personnel and equipment. Article 110.26 of the *National Electrical Code*® covers spaces about electrical equipment, such as load centers (panelboards). The intent of Article 110.26 is to provide enough working space for personnel to examine, adjust, service, and maintain energized equipment. Article 110.26 divides the three parts of a safe working space environment into depth, width, and height. In addition, Article 110.26 discusses entrance requirements to the working space as well as requirements for dedicated equipment space for indoor and outdoor applications. It is beyond the scope of this course to discuss in detail the requirements of Article 110.26. You are, however, encouraged to become familiar with it.



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## Review 2

1. The two types of NEMA enclosures available for Siemens load centers are NEMA Type \_\_\_\_\_ and NEMA Type \_\_\_\_\_ .
2. A \_\_\_\_\_ \_\_\_\_\_ serves as a common connection for two or more circuits.
3. \_\_\_\_\_ circuit breakers are field added at the time of installation.
4. A \_\_\_\_\_ \_\_\_\_\_ is a neutral connection that provides neutral connections on either side of the load center.
5. \_\_\_\_\_ is an installation feature where screws are backed out and retained in place to prevent the screws from falling out.
6. The \_\_\_\_\_ assembly provides access to the overcurrent devices while sealing off the bus bars and internal wiring from contact.
7. A \_\_\_\_\_ \_\_\_\_\_ provides space for listing which breaker provides service for each room or large appliance.