

INSTALLATION AND MAINTENANCE INSTRUCTIONS

# Entellisys™ Low Voltage Switchgear

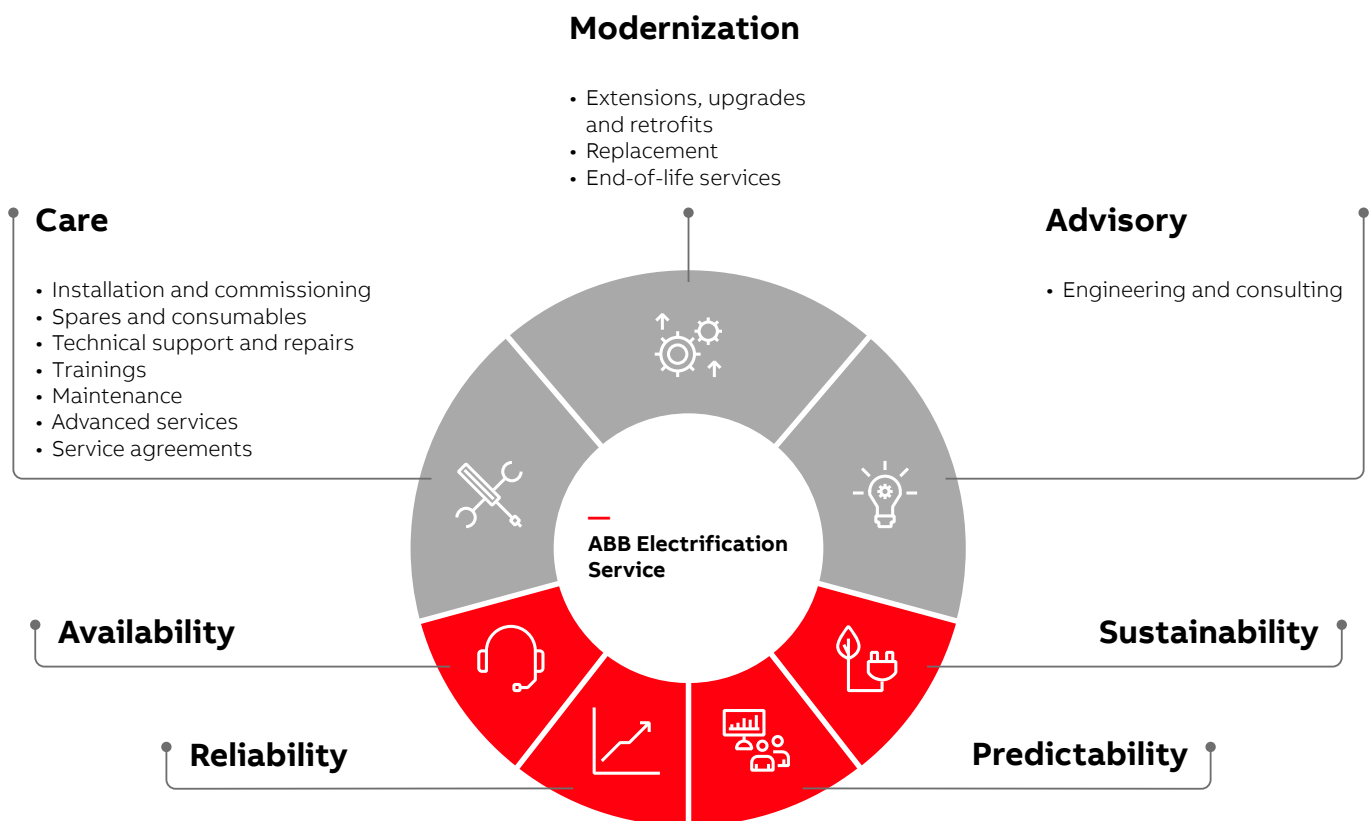
GE legacy product  
documentation



In 2018 ABB acquired GE Industrial Solutions. Entellisys switchgear is now serviced and maintained by ABB. If you need spare parts or your installed equipment has aged and requires modernization or replacement – ABB is your first point of contact (look for contact details on the last page).

ABB provides comprehensive maintenance, diagnostics, and repair services for medium voltage and low voltage electrical apparatus.

The ABB Electrification Service offering is comprised of services that will help you to take care of the equipment, modernize it, and recommend the most appropriate business decisions to guarantee the availability, reliability and sustainability of critical assets and meet your evolving needs.



## DEH237

### ***WARNINGS, CAUTIONS, AND NOTES AS USED IN THIS PUBLICATION***

#### ***WARNINGS***

Warning notices are used in this publication to emphasize that hazardous voltages, currents, or other conditions that could cause personal injury are present in this equipment or may be associated with its use.

Warning notices are also used for situations in which inattention or lack of equipment knowledge could cause either personal injury or damage to equipment.

#### ***CAUTIONS***

Caution notices are used for situations in which equipment might be damaged if care is not taken.

#### ***NOTES***

Notes call attention to information that is especially significant to understanding and operating the equipment.

This document is based on information available at the time of its publication. While efforts have been made to ensure accuracy, the information contained herein does not cover all details or variations in hardware and software, nor does it provide for every possible contingency in connection with installation, operation, and maintenance. Features may be described herein that are not present in all hardware and software systems. We assume no obligation of notice to holders of this document with respect to changes subsequently made.

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These instructions do not purport to cover all details or variations in equipment or to provide for every possible contingency to be met in connection with installation, operation or maintenance. These instructions are intended for use by qualified personnel only.



### 1-1 General Information

This manual contains procedures for receiving, handling, storage, equipment installation, operation, maintenance, and service of Entellisys Low Voltage Switchgear.

**NOTE:** The personnel responsible for installing, operating, and servicing this equipment should be thoroughly familiar with the contents of this manual.

**NOTE:** La ou les personnes responsables de l'installation, l'opération et du service d'entretien de cet équipement devraient être pleinement familiers en ce qui concerne le contenu de ce manuel.

Before any installation work is performed, thoroughly read and understand the material in this instruction manual and the drawings furnished with the equipment. The documentation shipped with the equipment includes the Summary, Front View, Elementary Diagram, Connection Diagram and Instruction Book. This material is located in a forward compartment tagged "INSTRUCTIONS IN THIS COMPARTMENT." The documentation provides all of the information necessary for installation of the switchgear. When requesting information, include the complete data appearing on the equipment nameplate, requisition number, summary number, and elementary diagram number. The nameplate is located in the lower left, front corner of the lineup.

When requesting information concerning any specific item furnished with the switchgear, refer to that item by description, part number, its location within this manual, and any applicable drawing number.

### 1-2 Instruction Book Arrangement

Information and procedures in this instruction book are divided into Chapters as follows:

- **Chapter 1, Introduction**, gives a brief account of the equipment's function and provides for general information, and applicable data for the equipment and its components.
- **Chapter 2, Receiving, Handling and Storage**, describes procedures required for receiving and handling the equipment and how to prepare it for short- or long-term storage.
- **Chapter 3, Description**, describes the Entellisys Low Voltage Switchgear and its various components. Included are the section enclosure, breaker compartment, circuit breakers, instrument panels and instrument compartments, bus bar arrangement, incoming cable and busway, ground and neutral bus, and auxiliary section. This section also explains how the electrical and mechanical components perform their assigned functions.
- **Chapter 4, Equipment Installation**, provides the information needed prior to installation, site location and foundation requirements, and how to anchor the equipment properly and safely. It also covers installation of peripheral equipment and includes information on electrical connections and mechanical construction.
- **Chapter 5, Installing and Removing Circuit Breakers**, gives a step-by-step procedure for lifting the breaker from the floor, installing it on drawout rails, and moving it into the connected position. A further procedure is given to withdraw a breaker, remove it from the drawout rails, and lower it to the floor. Also included is a description of the rejection system provided to avoid the inadvertent use of an incorrect breaker in a breaker compartment.
- **Chapter 6, Testing and Inspection**, reviews items that should be tested or inspected prior to energizing and operating the switchgear.
- **Chapter 7, Operating the Switchgear**, covers how to operate the breakers, and contains information concerning draw-out provisions, doors, and various accessories.
- **Chapter 8, Energizing the Switchgear**, outlines the steps to be taken before and during the electrical energization of the equipment.
- **Chapter 9, Maintaining the Switchgear**, provides instructions for all preventive maintenance, servicing, and lubrication information for the switchgear equipment. Included is service and maintenance data for the circuit breakers, instrument compartments, instruments, bus bar joints, and cable and busway connections. This section also includes paint refinishing requirements.
- **Appendices A through F**, contain information concerning screw and bolt torque values, circuit breaker ratings, rejection features, accessory device ratings, repetitive duty data, and fuse data.

# **Entellisys Low Voltage Switchgear**

## **Chapter 1. Introduction**

### **1-3 Related Publications**

Service and maintenance publications are supplied separately for circuit breakers and Entellisys instrumentation not described in this instruction book.

In addition to instruction books, the following drawings will be supplied as required for each order of Entellisys switchgear equipment:

1. General arrangement drawings, including front view and floor plan.

2. Elementary and connection drawings (or wiring routing tables) which identify test and connection points including terminal blocks, device studs, switch contact developments, and remote connections.

3. Summary of all the components furnished with the switchgear, including the breakers, identified by catalog number.

These are all documents necessary to install, operate, and maintain the equipment. One complete set of drawings and select instruction books are shipped with the equipment.



*Fig. 1-1. Entellisys Low Voltage Switchgear*

## **2-1 Receiving**

### **Equipment Packages**

Every package leaving the factory is plainly marked with the shop order number, requisition number, and customer's order number. If the equipment has been split for shipment, the section numbers of the equipment enclosed in each shipping package are identified.

**NOTE:** To avoid the loss of any parts when unpacking, the contents of each container should be carefully checked against the packing list before discarding the packing material.

**NOTE:** Le contenu de chaque conteneur devrait être soigneusement vérifié avec la liste d'emballage avant de décharger le matériel emballé, ceci dans le but d'éviter la perte de pièces lors du déballage.

The contents of each shipping package are listed on the Master Packing List. In addition, this list includes the number of the shipping crate in which miscellaneous parts needed to install and operate the equipment (such as hardware, contact lubricant, touch-up paint, breaker closing devices, etc.) are located. Normally, such devices are packed in a cardboard carton and the carton secured in an empty switchgear compartment. See Fig. 2-1. If such items are packed in a switchgear section instead of a separate crate, the list will indicate the appropriate section number in which they are stored. Large items (such as hoist dollies and hoist carriages used with indoor equipment) will always be shipped in separate crates or cartons. See Fig. 2-2.

### **Inspecting for Damage**

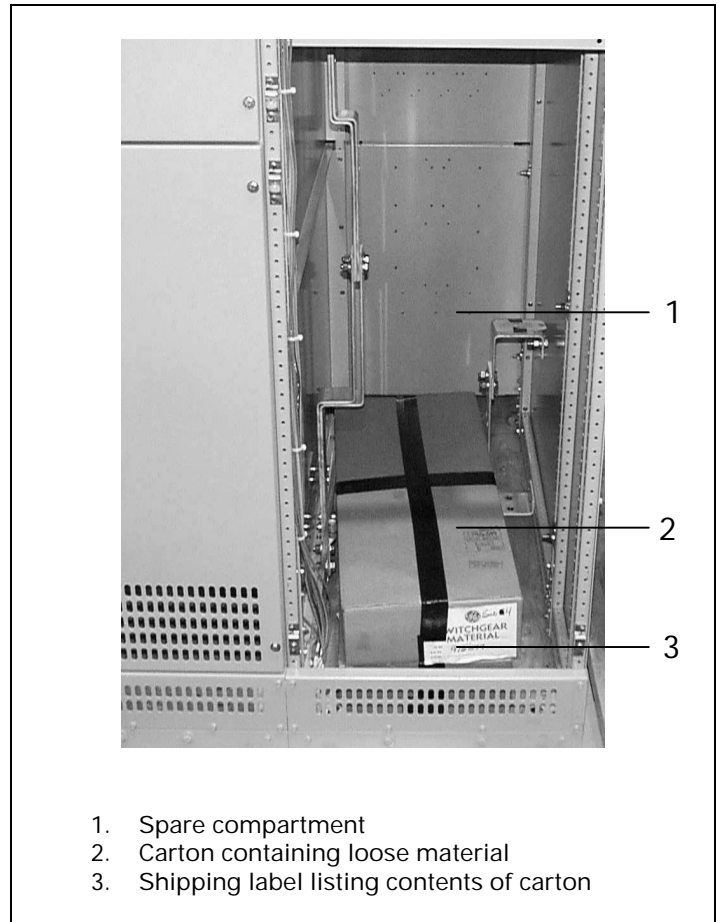
All equipment leaving the factory is carefully inspected and packed by personnel experienced in the proper handling and packing of electrical equipment. Upon receipt of any equipment, immediately perform a visual inspection to ascertain if any damage has been sustained in shipping or if there are any loose parts.

Circuit breakers may be shipped separately in individual containers with the breaker in the open position. Circuit breakers should be unpacked and visually inspected for damage or loose parts as soon as possible after they have been received.

Be sure to inspect all devices mounted or packed inside compartments of each section to see if any have been dislodged or damaged.

### **Filing a Claim**

If any damage is evident, or indication of rough handling is visible, file a claim for damage at once with the transportation company immediately. Information on damaged parts, part number, case number, requisition number, etc., should accompany the claim.



*Fig. 2-1. Packaging of loose material for shipment*



*Fig. 2-2. Carton containing breaker lifting device*

# Entellisys Low Voltage Switchgear

## Chapter 2. Receiving, Handling, and Storage

### 2-2 Handling

**NOTE:** It is preferable to leave the shipping skids in place under the switchgear until it reaches its final location. The equipment should be installed in its final location prior to installing the circuit breakers.

**NOTE:** Il est préférable de laisser l'emballage d'expédition en place sous le dispositif de commutation jusqu'à ce qu'il atteigne son emplacement final. L'équipement devrait être installé à son emplacement final avant que ne soient installés les disjoncteurs.

#### Lifting

The switchgear sections are best handled by lifting with a crane as shown in Fig. 2-3. Removable lifting plates are provided, as standard equipment, on the top of each switchgear shipping section. To preserve the external appearance of the equipment, it is suggested that the lifting plates be left in place except where adjacent equipments must be bolted together, i.e. shipping splits, etc.

Utilize four equal length cables and an overhead crane, each with a minimum load rating of twice the weight of the

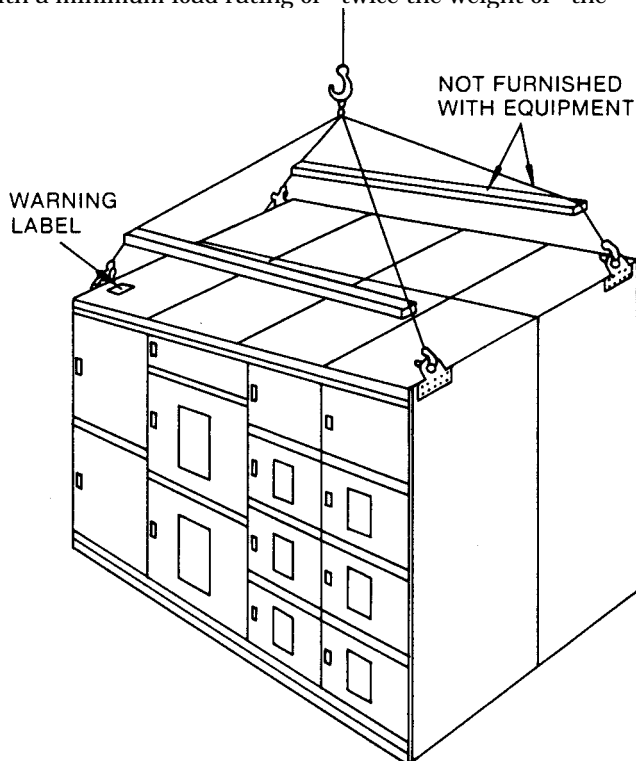
switchgear. Estimated weights for shipping splits appear on the Front View drawings.

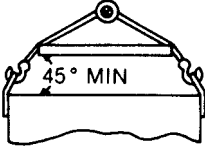
**Example:** Switchgear Section Weight = 5,000 pounds. The crane and the four lift cables must have a minimum load lifting capacity of 10,000 pounds.

**NOTE:** The angle between the cables and the top of the equipment must be at least 45 degrees. If this is not possible because of lack of headspace, spreader bars must be used. Also, lift cables with greater load capability may be necessary, depending upon the angle between the cables and the crane hook.

**NOTE:** Il faut que l'angle entre les câbles et le haut de l'équipement soit d'au moins 45 degrés. Si cela est impossible à cause d'une insuffisance d'espace de dégagement, il faut utiliser des barres d'extension. Il se peut aussi que des câbles de levage ayant une capacité de poids supérieure soient nécessaires dépendant de l'angle entre les câbles et le crochet de la grue.

Connect a cable from the crane to the four lifting plates located on the top-front and rear of the switchgear (Fig. 2-3).



WARNING	ADVERTISSEMENT
WHEN LIFTING THIS EQUIPMENT, USE LIFTING HOLES PROVIDED. ANGLE OF SLING MUST NOT BE LESS THAN 45 DEGREES. IF HEAD SPACE IS INSUFFICIENT, USE A SPREADER BAR.	Lorsque cet équipement est levé, il faut utiliser les trous de levage qui sont fournis. Il ne faut pas que l'angle d'élinguage soit de moins de 45 degrés. Si l'espace de dégagement est insuffisant utiliser une barre d'écartement.
	

THIS LABEL IS LOCATED ON EACH CORNER BY THE LIFTING HOLE

Fig. 2-3. Recommended method of lifting Entellisys enclosure

## Entellisys Low Voltage Switchgear

### Chapter 2. Receiving, Handling, and Storage

Take up the slack in the lifting device very carefully and manually stabilize the switchgear to prevent it from rotating.

**WARNING:** Do not stand under switchgear while it is being moved. Serious injury may occur if the cables or lifting device fail.

**AVERTISSEMENT:** Ne vous tenez pas sous le dispositif de commutation lorsqu'il est bougé. Des blessures graves peuvent survenir si les câbles ou l'appareil de levage tombent en panne.

**CAUTION:** Gently lower the switchgear section onto the level site location. If the switchgear is roughly handled or jarred, it is possible to damage or misalign internal components.

**ATTENTION:** Abaisser doucement la section du dispositif de commutation sur l'endroit d'installation nivelé. Une détérioration ou un désalignement des composantes internes sont possibles si le dispositif de commutation est manipulé grossièrement ou soumis à des vibrations.

#### Rollers

If crane facilities are not available, the equipment may be moved into position by means of construction rollers placed under the shipping skids. The switchgear may be raised enough for the placement of rollers by means of a forklift or jack.

There should never be less than four rollers under the equipment unless the line-up is less than five feet long. Use one roller for each 18 inches of equipment length.

#### Forklifts

When using a forklift to raise the line-up to position rollers underneath, proceed as follows:

1. Expand forklift tines to their maximum (widest) extension.
2. Carefully insert tines of forklift below one side of the switchgear line-up at the approximate center of the panel as shown in Fig. 2-4.

**NOTE:** Do not attempt to lift or move the equipment with a forklift positioned in the front or rear of the equipment.

**NOTE:** Ne pas essayer de lever ou bouger cette pièce d'équipement à l'aide d'un chariot élévateur placé à l'avant ou à l'arrière de celle-ci.

3. Raise equipment and position one roller under the skids close to the raised end of the line-up.
4. Carefully lower the gear until it rests on the roller as shown in Fig. 2-5.

5. Repeat the lifting process at the other end and place the appropriate number of rollers under the skids spacing them evenly across the width of the line-up.



Fig. 2-4. Placing forklift tines under Entellisys equipment shipping skid



Fig. 2-5. Placement of rollers under shipping skid

6. Carefully lower the gear until it rests on the rollers (Fig. 2-6).

**NOTE:** If shipping skids are removed prior to final placement of equipment, rollers may only be used to move the equipment in a direction parallel to the front.

**NOTE:** Si l'emballage d'expédition a été enlevé avant que l'équipement ne soit rendu à son emplacement final, l'utilisation de rouleaux pour bouger l'équipement n'est permise qu'en direction parallèle à l'avant.

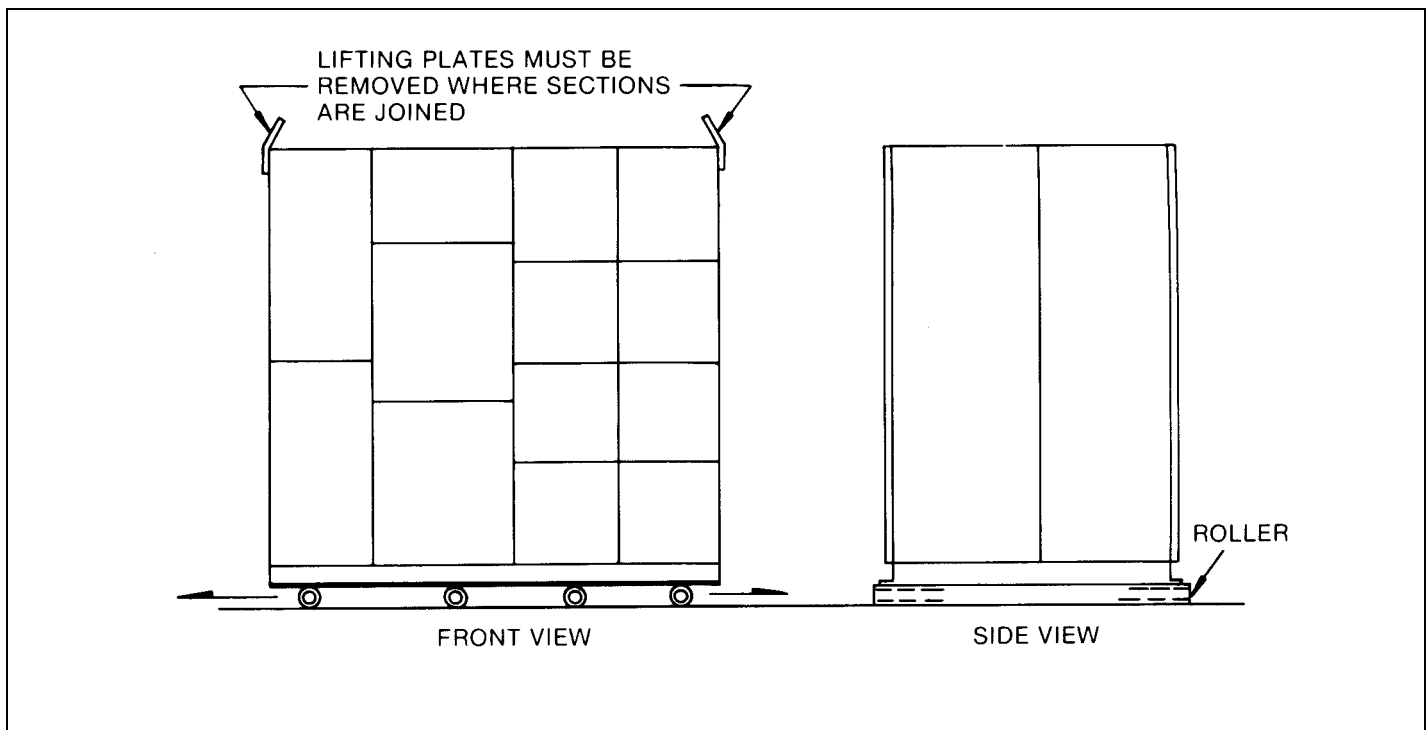


Fig. 2-6. Method of rolling equipment into place

7. While carefully pushing the switchgear to its final site position, the rollers that are freed from the rear of the switchgear are then repositioned at the forward end. This procedure should be continued until the switchgear is in its final location. See Fig. 2-6.
8. When the switchgear is in its final position, remove all lag bolts holding the shipping skids to the switchgear line-up.
9. Insert the tines of the forklift at one end of the line-up, raise slightly, and remove the loose rollers.
10. Lower the end of the gear carefully to the floor.
11. Raise the other end of the line-up slightly and remove the remaining roller at that end.

#### Jacks

Jacks may be used in place of forklifts to raise and lower switchgear.

1. Place a jack under the front and rear corners of one end of the line-up.

**CAUTION:** Do not place jacks in any other location other than the front and rear corners of the switchgear. Doing so may result in serious damage to the switchgear equipment.

**ATTENTION:** Il ne faut pas placer de vérins en aucun endroit autre que les coins avant et arrière du dispositif de commutation. L'équipement peut être sérieusement endommagé si l'on ne respecte pas cette directive.

2. Raise the switchgear evenly and just enough to position a roller beneath the equipment. Gently lower the switchgear onto the roller. Repeat the procedure at the opposite end of the switchgear, raising the gear far enough to place the appropriate number of rollers under the skids, spacing them evenly across the width of the line-up. Gently lower the gear onto the rollers.
3. While carefully pushing the switchgear to its final site position, the rollers that are freed from the rear of the switchgear are then repositioned at the forward end. This procedure should be continued until the switchgear is in its final location.
4. When the switchgear is in its final position, remove all lag bolts holding the shipping skids to the switchgear line-up.
5. Place one jack at each corner, front and rear, of the switchgear. Carefully raise the line-up evenly and remove the rollers and the shipping skids. Evenly lower the line-up to the floor and remove the jacks.



## 2-3 Storage Switchgear

If it is necessary to store the switchgear equipment for any length of time, the following precautions should be taken to prevent corrosion or deterioration.

1. Remove protective covering. Check thoroughly for damage.
2. Store in a clean, dry, rodent-free location with moderate temperature and provide protective coverings to prevent dirt, water, or other foreign substances from entering the switchgear.

**CAUTION:** Remove all cartons, containers and any other miscellaneous packaging and packing material from inside the switchgear sections before energizing any internal heaters. To prevent fire, remove any plastic or polyethylene shrouding from the switchgear sections before energizing any internal heaters.

**ATTENTION:** Enlever tous les cartons, contenants et tout autre objet varié servant à l'emballage et au matériel d'emballage de l'intérieur des sections du dispositif de commutation avant de procéder à la mise sous tension de tout radiateur interne. Pour éviter un incendie, enlever tout résidu de plastique ou de polyéthylène des sections du dispositif de commutation avant de procéder à la mise sous tension de tous les radiateurs internes.

3. If dampness or condensation may be encountered in the storage location, heaters must be placed inside the switchgear sections to prevent moisture damage. Approximately 250 watts of heat in each section is

required. Incandescent lamps may be used for this purpose. These lamps should be located in the bottom breaker compartment of each section and supported so the bulbs will not touch adjacent materials.

**CAUTION:** If the space heaters are to be temporarily energized from an external source, it is important to remove the fuses on the secondary side of the control power transformer. This precaution is to prevent a feed back of higher voltage to other portions of the equipment through the CPT primary.

**ATTENTION:** Il est important de retirer les fusibles du côté secondaire du contrôle du pouvoir du transformateur si les espaces des radiateurs doivent être temporairement mis sous tension par une source externe. Cette précaution prévient une rétroaction d'un voltage supérieur à d'autres portions de l'équipement par le contrôle de pouvoir du transformateur primaire.

### Circuit Breakers

If circuit breakers are not to be placed into service at once, remove them from their shipping cartons and thoroughly inspect them for damage. If the breakers are in satisfactory condition, replace the breakers in their shipping cartons for storage. Do not remove the circuit breaker shipping members at this time.

Store the circuit breakers in a clean, dry location in an upright position. They must be properly supported to prevent bending of the studs or damage to any of the breaker parts. Do not remove any protective grease until the circuit breakers are ready to be installed. A plastic or canvas-type cover should be provided to reduce the possibility of damage to the breakers due to dust and water.

# Entellisys Low Voltage Switchgear

## Chapter 3. Description

### 3-1 General

This section contains a description of Entellisys Low Voltage Switchgear. It also describes the functions of the electrical and mechanical systems.

Fig. 3-1 is a side view of a typical section showing compartmentalization.

### 3-2 Summary Description

Entellisys Low Voltage Switchgear is a freestanding assembly of metal-enclosed sections containing low-voltage power circuit breakers, bus bars, cable termination provisions, and Entellisys instrumentation. It may also be an integral part of a load center unit substation, either single-ended or double-ended.

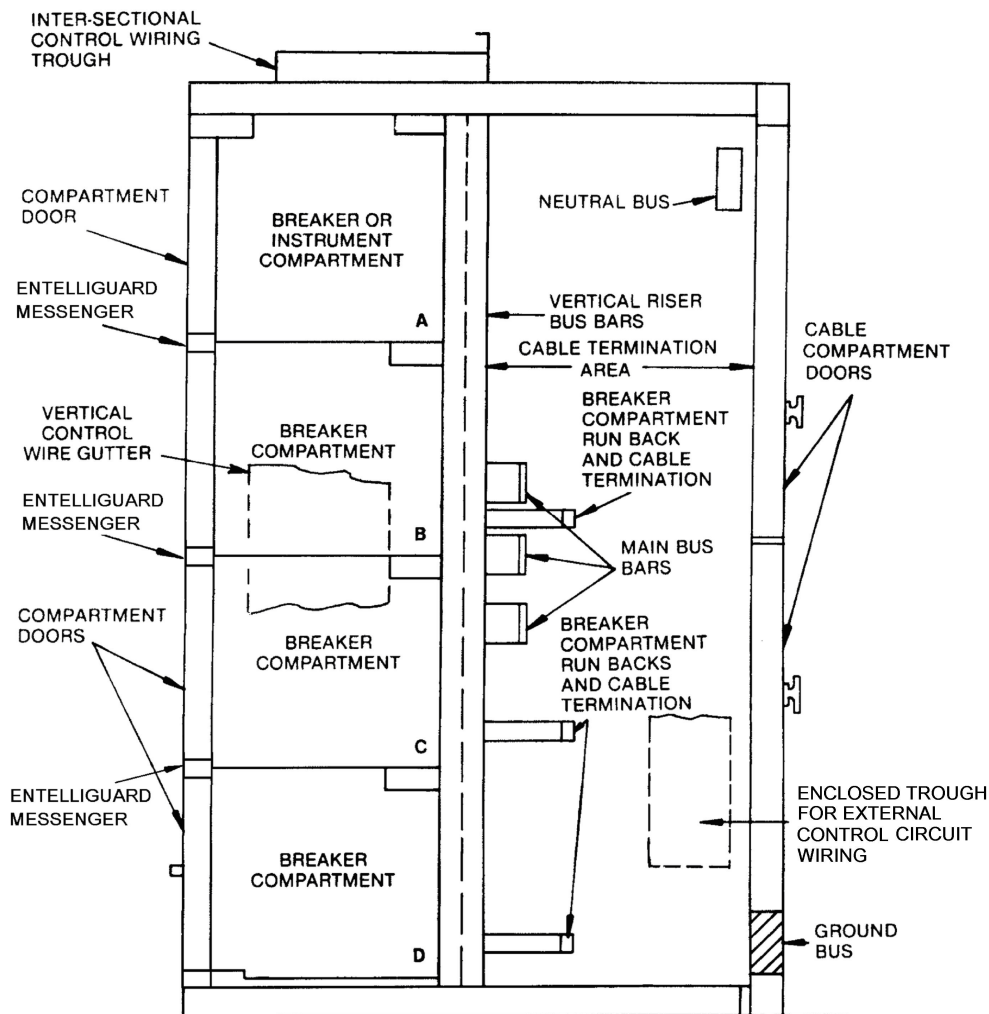


Fig. 3-1. Side-view of Entellisys Switchgear

All of the primary circuit switching and protective devices, Entellisys instrumentation, control fuses, and instrument transformers are mounted in the enclosure. The breaker compartments include drawout rails, stationary breaker contacts, interlocks, and EntelliGuard Messengers. The breakers are provided with self-aligning primary and secondary disconnect contacts and a breaker mechanism

locking unit. The individual sections, compartments, and devices are described in the following paragraphs.

Fig. 3-2 is an outline of a typical single-ended load center unit substation illustrating the nomenclature used for all equipment.

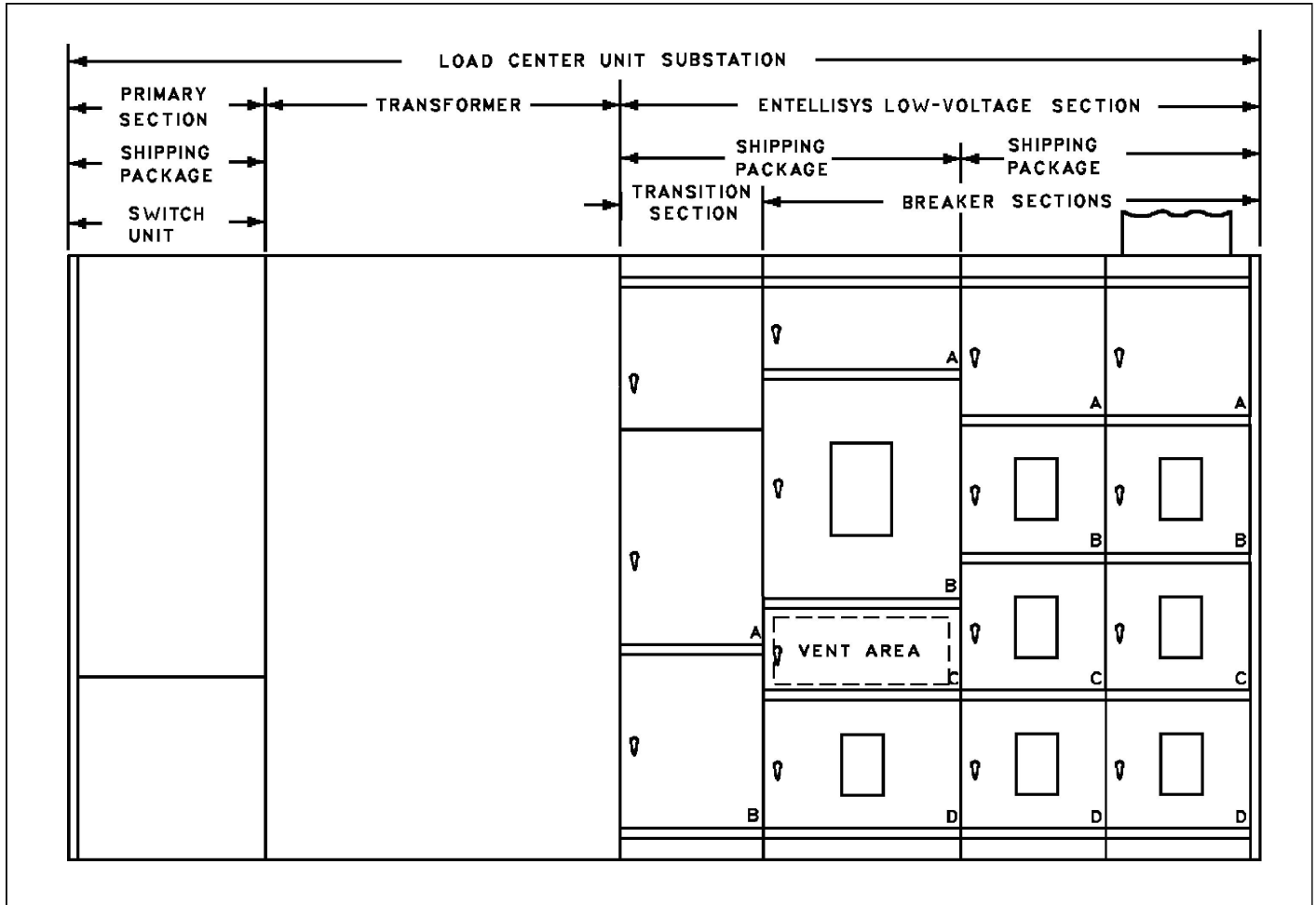


Fig. 3-2. Outline of a typical Entellisys Load Center Unit Substation

#### ***3-3 Front Compartment Area***

The front enclosure of each section is divided into individual compartments. These compartments typically house EntelliGuard low voltage power circuit breakers or Entellisys instrumentation.

#### ***3-4 EntelliGuard Messenger***

An EntelliGuard Messenger is mounted above each EntelliGuard breaker. The Messenger provides an interface between the breaker, the compartment, and the central Entellisys system. See DEH-231 (Entellisys Low Voltage Switchgear System User's Manual) for further instructions.

Each Entellisys low voltage switchgear lineup contains standard devices housed within the instrument compartments. Two CPUs (Central Processing Units) provide the processing capability to support all switchgear functions. At least one HMI (Human-Machine Interface) provides user access to the Entellisys system. Network switches provide communication links between the CPU, the HMI, the EntelliGuard Messengers, and the external world. A pair of uninterruptible power supplies (UPSs) and control power throwover relays supply highly reliable control power to these system devices.



*Fig. 3-3. EntelliGuard Messenger*

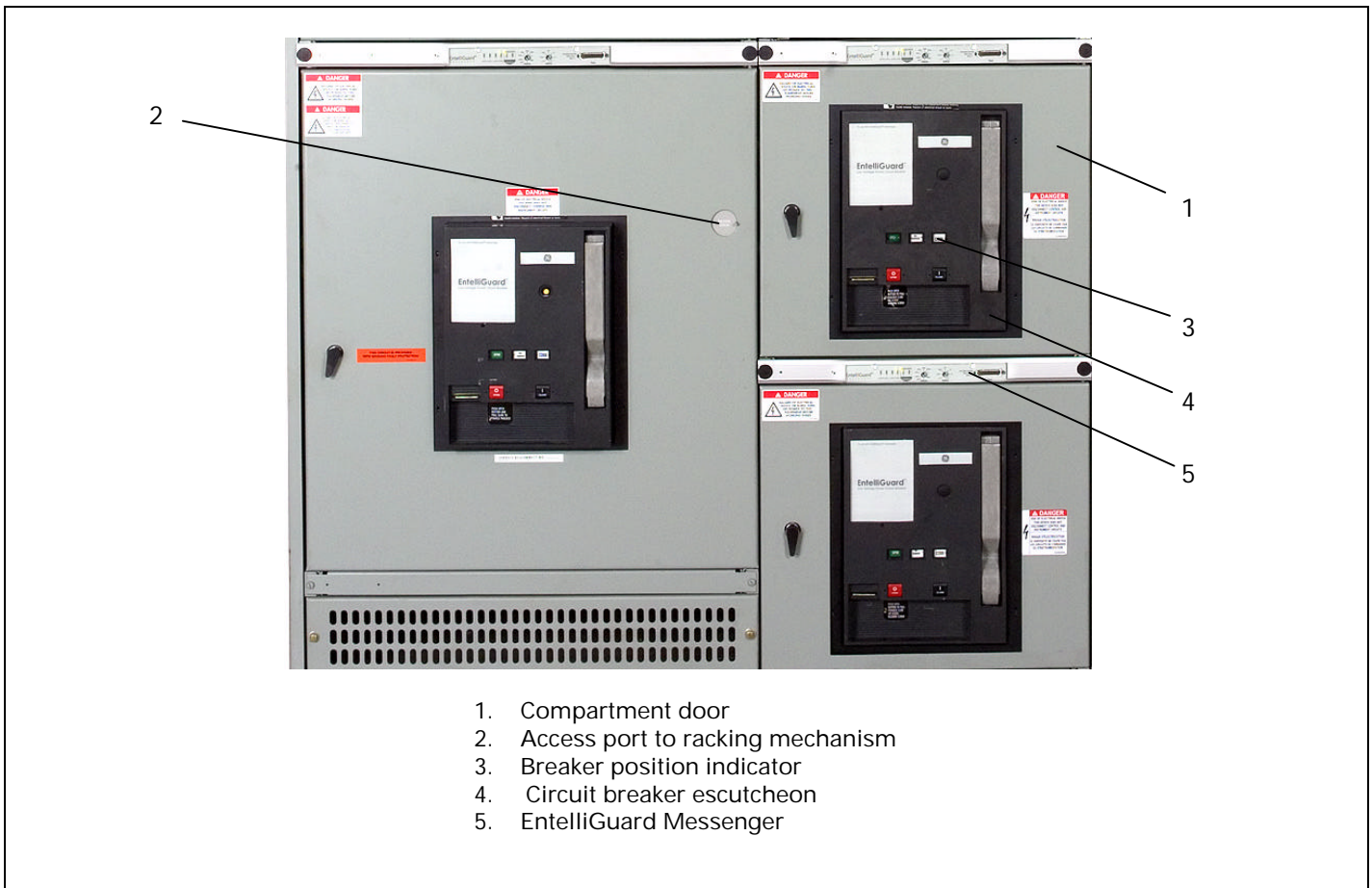
### 3-5 Breaker Compartment

Closed-door drawout circuit breaker compartments, Fig. 3-4, are standard construction with all Entellisys switchgear equipment. The circuit breaker compartment doors remain closed and latched while the breaker is racked out from the connected position, through test, to the disconnected position.

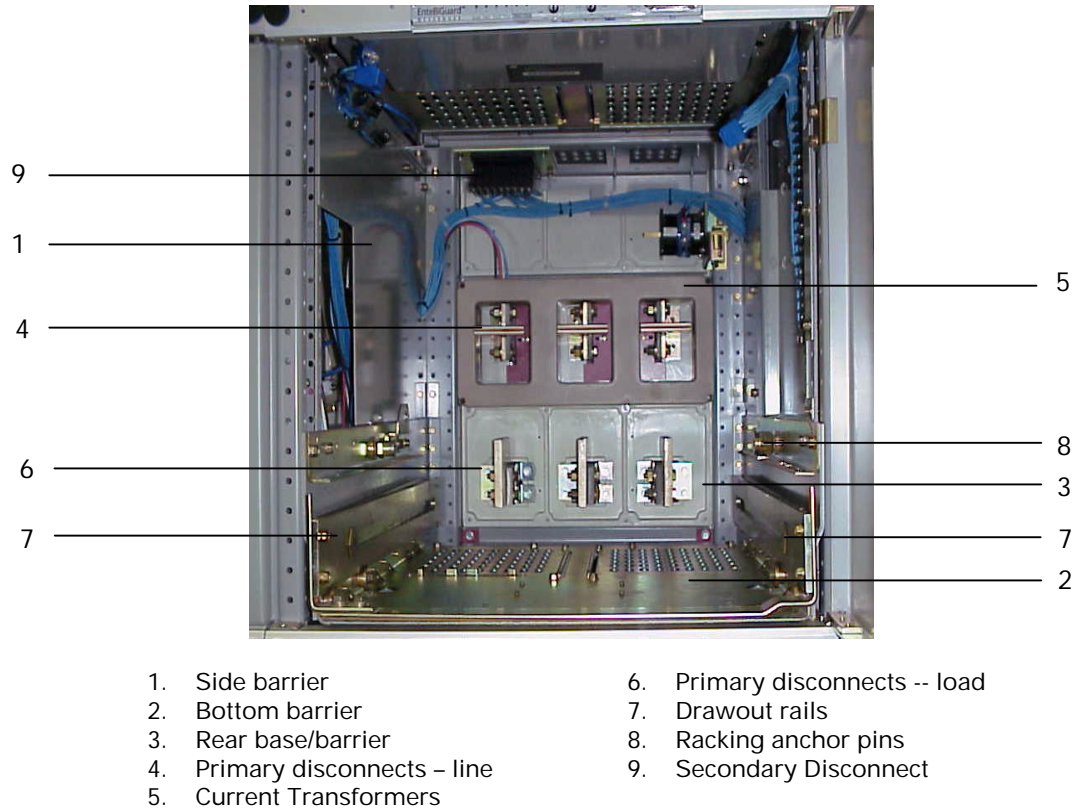
Breaker compartment doors do not have any ventilation slots, thus protecting operators from hot ionized gases

that may be vented by the breaker during circuit interruption.

Additionally, the breaker compartment, Fig. 3-5, is enclosed by grounded steel barriers on the top, sides, bottom, and front. In the back, a flame-retardant, track resistant, glass-filled polyester base minimizes the possibility of fault communication between compartments or to the bus.



*Fig. 3-4. EntelliGuard circuit breaker compartments*



*Fig. 3-5 Circuit breaker compartment (22-inch)*

Fuses for the charge, close, and trip circuits of electrically operated breakers are mounted in the upper left corner of the breaker compartment behind the door. Fuses for the set and reset coils of the optional Network Interlock breaker accessory are mounted in the upper right corner of the compartment.

Primary disconnect shutters are available as options to provide protection against contact with the energized stationary primary disconnects when the breaker is removed from its compartment. Shutters are supplied as standard components in the source (main, generator) and tie breaker compartments of multi-source lineups. The shutters are constructed from glass-reinforced polyester insulating material.

**NOTE:** If a fuse rollout (FRE) carriage is used with an EGF-32/40/50 circuit breaker whose compartment is equipped with shutters, the FRE compartment will also be equipped with shutters.

**NOTE:** Si on utilise un chariot porte-fusibles à roulettes avec un disjoncteur EGS-32/40/50 dont les compartiments sont munis de volets, le compartiment du porte-fusible à roulettes sera aussi muni de volets.

The combination of the stationary and movable portions of the shutters prevent frontal access to the primary disconnect line and load power stabs.

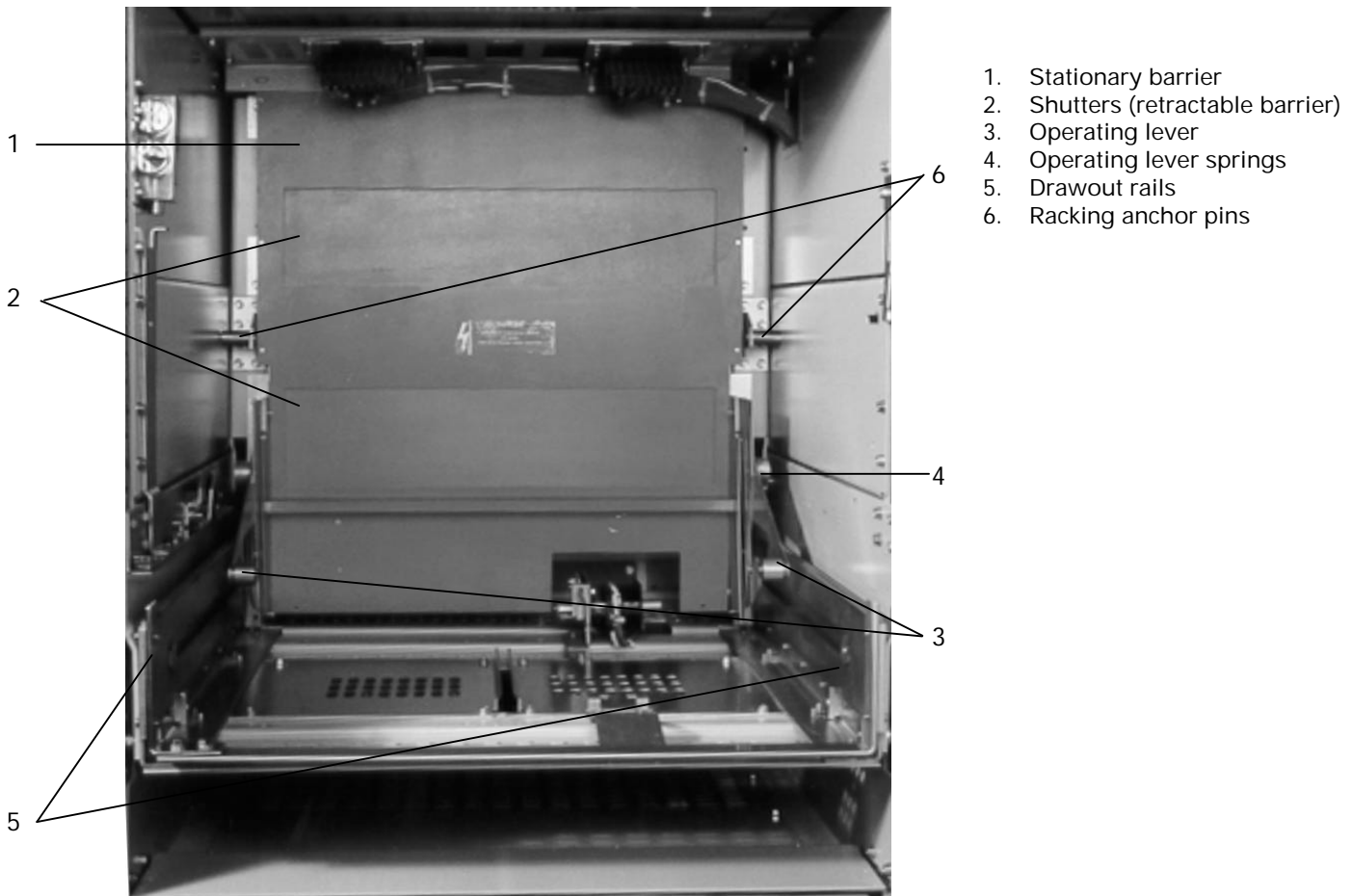


Fig. 3-6. Circuit breaker compartment (30-inch wide) with shutters

# Entellisys Low Voltage Switchgear

## Chapter 3. Description

The shutters are partially retracted when the breaker is in the Disconnect Position. As the circuit breaker is racked from the Disconnect Position to the Test Position, the rear of the circuit breaker frame depresses the shutter operating lever (3) to cause the shutters to fully retract. The operating lever springs (4) cause the operating lever (3) to remain in contact with the circuit breaker frame during operation. As the breaker is racked from the Test Position to the Connected Position, the shutters remain fully retracted.

Fig. 3-7 also shows the shutter assembly with the shutters manually retracted to show the location of the primary disconnect stabs (5) behind the shutter assembly.

Circuit breakers mounted in 22-inch wide compartments (EG-08, EG-16, EG-20) are supported on drawout rails (7), Fig. 3-5. Larger EG-32 and EG-40 circuit breakers and fuse rollout carriages are installed in 30-inch wide compartments and are supported on drawout rails (5), Fig. 3-6. The EG-50 circuit breaker is installed in a 38-inch wide compartment and is supported on drawout rails (similar to Item 5, Fig. 3-6).

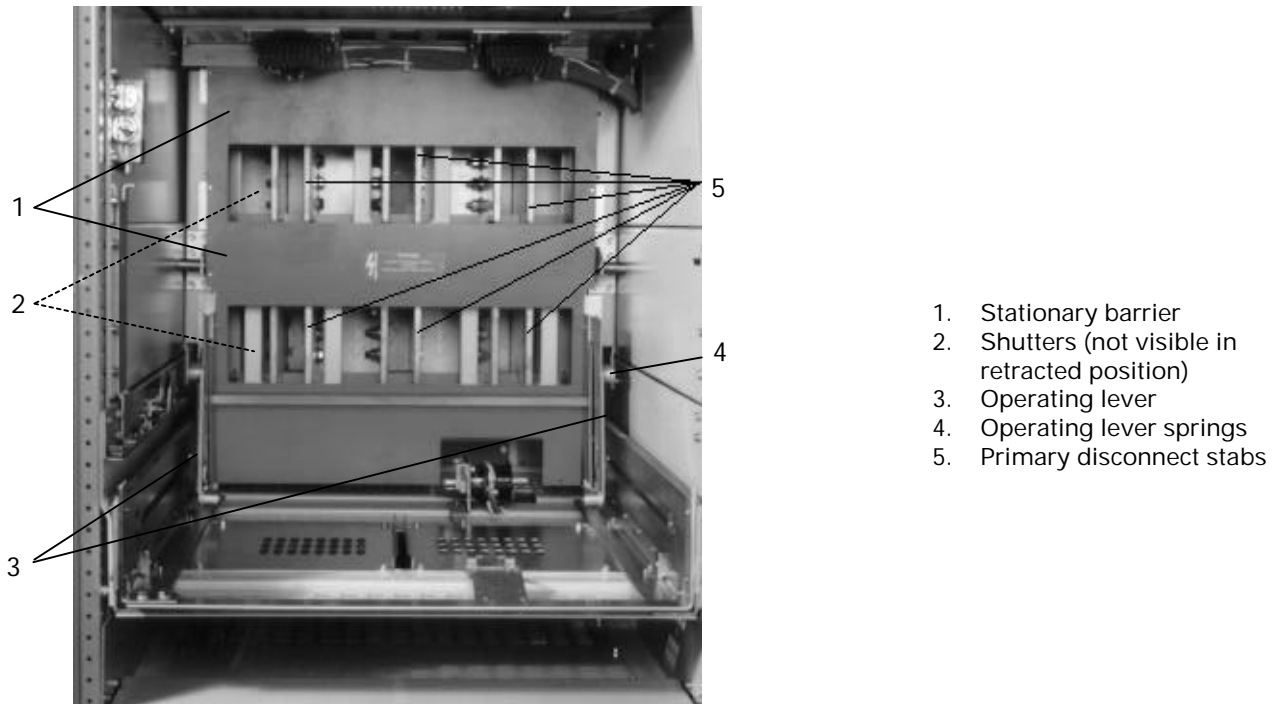
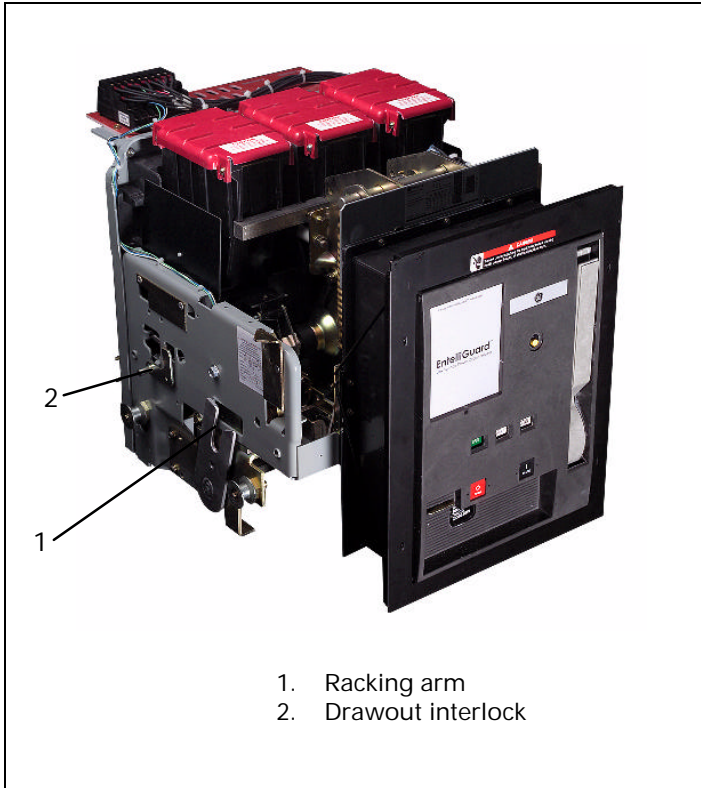


Fig. 3-7. Entellisys primary disconnect shutter assembly (30-inch wide compartment).  
Shutters manually retracted





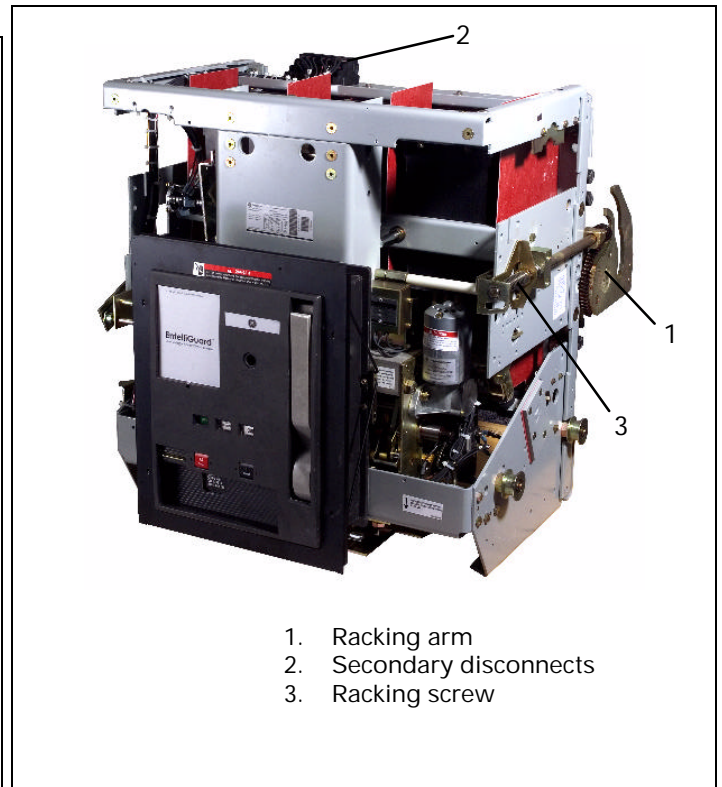
*Fig. 3-8. EGX-08 circuit breaker*

EntelliGuard breakers do not contain current transformers. Instead, current transformers are mounted over the primary disconnect stabs of all Entellisys breaker compartments. Primary disconnects are equipped with short-circuit braces when breakers are fused or when extra-deep breaker compartments are used.

The breaker racking arm slots engage fixed racking anchor pins (6), Fig. 3-6, mounted in the breaker compartment. As the racking arms are rotated by operation of the breaker racking crank, the breaker is pulled into the compartment, and locked in its final connected position.

A breaker should always be OPEN when it is moved into or out of the CONNECTED position. As a safeguard, the drawout interlock (2), Fig. 3-8, will cause the breaker to open before the primary disconnects lose contact if a closed breaker is moved out of the CONNECTED position.

EntelliGuard circuit breakers having higher continuous or interrupting current ratings may be substituted for those having lesser ratings. The compartment, however, retains the factory-configured ratings and protection settings. Substitution of manual for electric or electric for manual EntelliGuard breakers is not recommended.



*Fig. 3-9. EGS-40 circuit breaker*

Each breaker compartment has four positions as described below:

1. **CONNECTED POSITION**-The breaker is in operating position, both primary and secondary contacts made, and the door closed.
2. **TEST POSITION**-The secondary contacts are made, but the primary contacts are not made. Any breaker test that requires control power may be made in this position.
3. **DISCONNECTED POSITION**-All primary power and secondary control electrical circuits between the breaker and the equipment are disconnected. The door may be closed. The breaker may be stored in this position with the door closed.
4. **WITHDRAWN POSITION**-The breaker is completely out of its compartment ready for removal from the equipment. The door must be open. The optional primary disconnect shutters, positioned in front of the primary stabs, would be closed with the breaker in the WITHDRAWN position.

# Entellisys Low Voltage Switchgear

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Movement of the breaker between the CONNECTED, TEST, and DISCONNECTED positions is performed by the use of a racking crank that engages the racking mechanism mounted on the breaker. Movement to the WITHDRAWN position is manually performed after opening the compartment door. These positions are illustrated and described more fully in Chapter 5 of this instruction book.

**CAUTION:** The door should not be opened when the circuit breaker is closed and in the CONNECTED position. Although the breaker compartment door may be opened in any position, it is recommended that the door only be opened when the breaker is in the DISCONNECTED or WITHDRAWN position.

**ATTENTION:** Il ne faut pas que la porte soit ouverte lorsque le disjoncteur est fermé et branché. Bien que la porte du compartiment du disjoncteur puisse être ouverte lorsque le disjoncteur est en n'importe quelle position, il est préférable que la porte ne soit ouverte que lorsque le disjoncteur est en position débranchée ou retirée.

### 3-6 Circuit Breakers

EntelliGuard™ Low Voltage Power Circuit Breaker includes spring-operated, stored energy, close and trip mechanisms for either manual or electrical operation.

Six EntelliGuard™ Circuit Breakers form the complete family of breakers used in the Entellisys switchgear. These circuit breakers range from 800 to 5000 ampere frame sizes and are built with the following ratings and characteristics:

#### EGS/EGH/EGX-08 Circuit Breaker

- 800-ampere frame size
- Standard 30,000-ampere interrupting and short-time capability (480 volts)
- Four-high stacking, 22-inch wide sections
- Increased IC and short-time rating 42,000 amperes (EGH-08) or 65,000 amperes (EGX-08) at 480 volts

#### EGF-08 Fused Circuit Breaker

- 800-ampere frame size
- 300- through 1600-ampere integral fusing
- 200,000-ampere interrupting rating
- Four-high stacking, 22-inch wide sections

#### EGS/EGH-16 Circuit Breaker

- 1600-ampere frame size
- Standard 50,000-ampere interrupting and short-time capability at 480 volts
- Four-high stacking, 22-inch wide sections
- Increased IC and short time rating 65,000-ampere at 480 volts (EGH-16)



Fig. 3-10. EGX-08 circuit breaker (electrically operated)

#### EGF-16 Fused Circuit Breaker

- 1600-ampere frame size
- 450- through 2500-ampere integral fusing
- 200,000-ampere interrupting rating
- Four-high stacking, 22-inch wide sections

#### EGS/EGF-20 Circuit Breaker

- 2000-ampere frame size
- Standard 65,000-ampere interrupting and short-time capability at 480 volts
- 200,000-ampere interrupting rating
- Three-high stacking, 22-inch wide sections (See DET-447)

**EGS/EGH/EGX/EGF -32 Circuit Breaker**

- 3200-ampere frame size
- Standard 65,000-ampere interrupting and short-time capability at 480 volts
- 30-inch wide sections, Two-high stacking in 38-inch wide sections
- Increased IC and short-time rating 85,000 amperes (EGH-32) or 100,000 amperes (EGX-32) at 480 volts.

**EGS/EGX/EGF -40 Circuit Breaker**

- 4000-ampere frame size
- Standard 85,000-ampere interrupting and short-time capability at 480 volts
- 30-inch wide sections, Two-high stacking in 38-inch wide sections
- Increased IC and short-time rating 100,000 amperes (EGX-40) at 480 volts.

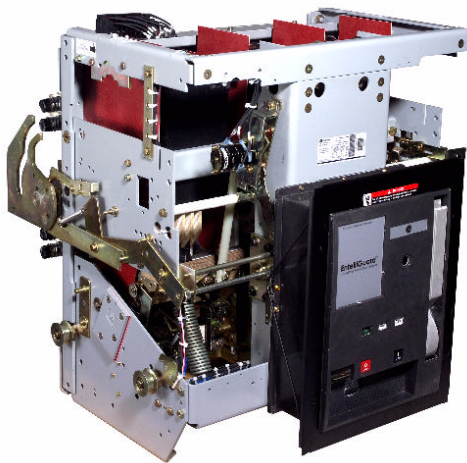


Fig. 3-11. EGS-32 circuit breaker (electrically operated)

**EGS/EGX/EGF -50 Circuit Breaker**

- 5000-ampere frame size, fan cooled
- Standard 85,000-ampere interrupting and short-time capability at 480 volts
- One-high stacking, 38-inch wide sections
- Increased IC and short-time rating 100,000 amperes (EGX-50) at 480 volts."

**3-7 Fuse Rollout Elements**

When the system available short-circuit current exceeds the unfused breaker ratings, current-limiting fuses can be used in series with EGF-20, EGF-32, EGF-40, and EGF-50 breakers to increase the short-circuit rating of the combination to 200,000 amps. When used, such fuses are housed in a separate drawout compartment located adjacent to the breaker compartment; they are mounted on a drawout carriage similar to a breaker frame and referred to as a fuse rollout element (FRE).

**EGF-32 Rollout Carriage**

- 3200-ampere rating
- 200,000-ampere interrupting rating
- Accepts 2000- through 4000-ampere fusing
- Also used for EGF-20 breaker

**EGF-40 Rollout Carriage**

- 4000-ampere frame size
- 200,000-ampere interrupting rating
- Accepts 2000- through 5000-ampere fusing

**EGF-50 Rollout Carriage**

- 5000-ampere frame size
- 200,000-ampere interrupting rating
- Accepts 2000- through 5000-ampere fusing

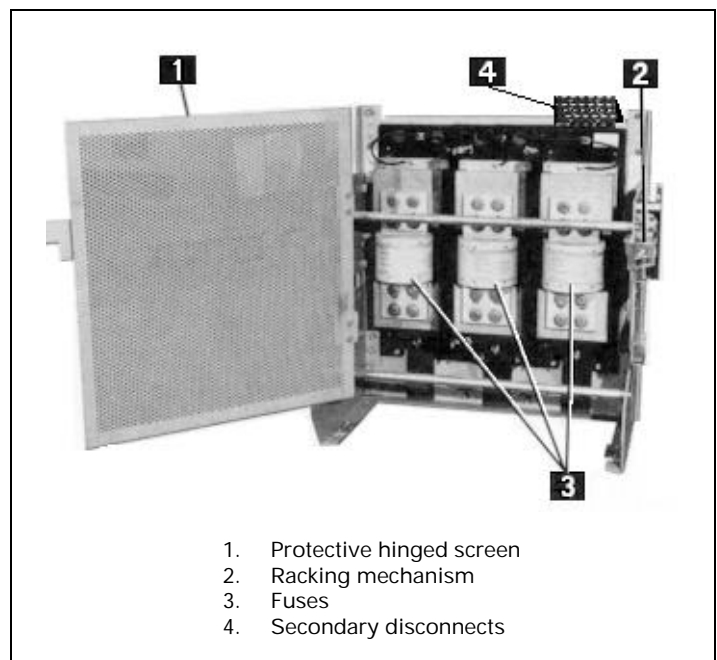
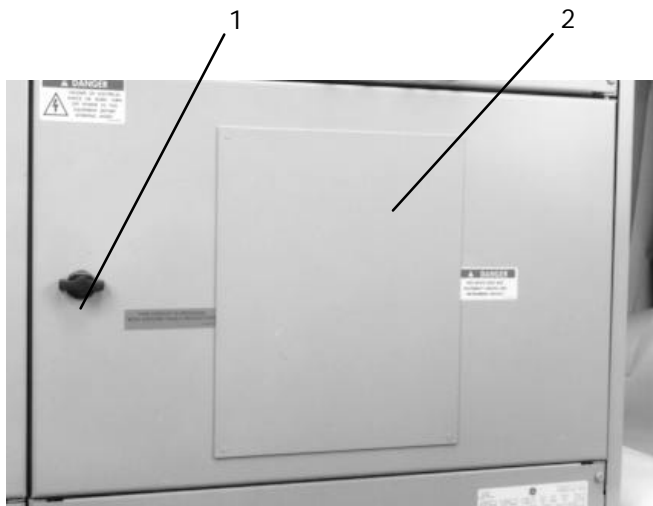
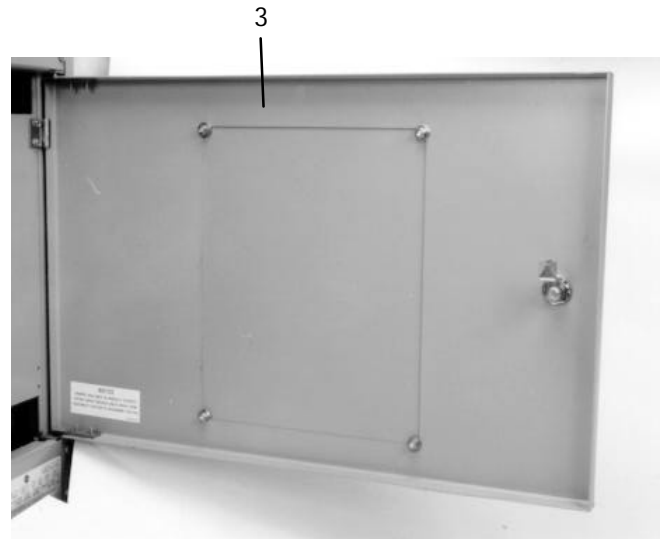


Fig. 3-12. Fuse roll-out carriage



1. Quarter-turn latch
2. Steel plate (future breaker cubicle)



3. Compartment door

Fig. 3-13. Future breaker compartment

### 3-8 Compartments for Future Breakers

When specified, compartments may be supplied for future addition of circuit breaker elements. These compartments are fully equipped with drawout rails, primary disconnects, and ancillary devices as required (i.e. secondary disconnects, accessory devices, etc.) The opening in the breaker compartment door (3), Fig. 3-13, is closed with a bolted-on steel plate (2) to deter accidental contact with energized electrical circuits. (I.e. primary disconnect stabs).

### 3-9 Auxiliary/Transition Sections

Sections may be provided for any one or more of several reasons including:

- Transition to a close-coupled transformer
- Incoming cable or busway when a main breaker section is not provided

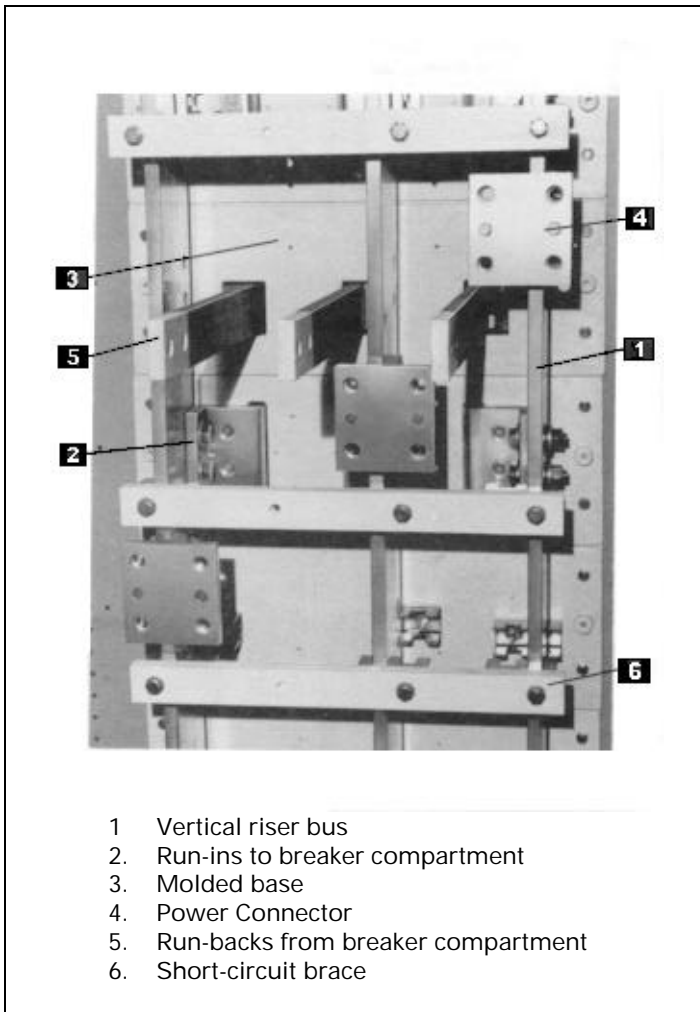
Auxiliary sections may be 22-inch, 30-inch, or 38-inch wide as required to accommodate the space requirements. The compartment doors on the front of the sections are hinged and latched in the same manner as breaker compartment doors.

Generally, transition sections will be 22-inches wide for close-coupling to transformers.

Power company metering requirements generally require either a 38-inch or 49-inch wide auxiliary section to accommodate the current transformers, meters, test switches, etc. as required by their individual practices, tariff schedules, and/or regulatory commissions.

### 3-10 Bus Area

The bus area, Fig. 3-14, contains the main horizontal bus and vertical riser bus bars (1) for the particular section. The vertical bus bars are supported at the breaker run-ins (2) that are bolted to the molded bases (3) that form the rear wall of the breaker compartment. The horizontal bus bars are supported by the power connectors (4), which are bolted to the vertical bus bars. All bolted supports and connections are accessible from the rear for maintenance. The bus area is fully isolated from the breaker, instrument and auxiliary compartments by the molded bases or glass polyester sheet.



*Fig. 3-14. Bus construction*

### Busing System

Bus bars are fully tin-plated copper with bolted joints. The standard construction is open bus. A barrier system (Bus compartmentalization) that isolates the main and vertical bus bars from the cable area is available as an option. All run-backs (load-side power conductors) from the breaker compartment to the cable termination area are covered with non-PVC insulated tubing.

The typical arrangement is shown in Fig. 3-15.

The standard bracing is 65,000 amperes, RMS symmetrical. Bracing for 100,000, 150,000 and 200,000 amperes, RMS symmetrical is available as an option.

In general, when the switchgear equipment has no more than four sections or does not exceed 10 feet in length, it will be shipped as one complete lineup. In such cases, the only field assembly would be to a close-coupled transformer if, the switchgear were part of a Load Center Unit Substation. If, because of shipping and/or handling considerations, the equipment cannot be handled in one piece, it can be split into two or more shipping sections at the factory. The individual shipping splits require both mechanical and electrical connections between sections to be made in the field. At these shipping splits, provisions are made for bolting all buses and making the necessary electrical and mechanical connections. These are described in Chapter 4 of this publication.

On main and tie breakers, the bus area, Fig. 3-15, is divided into an upper (1) and lower (2) section by a glass reinforced polyester isolation barrier (3). For typical unit substation main circuit breakers, the upper section contains the incoming line bus (4). The lower section of the bus area contains the load side main bus (5) (protected by the main breaker) that feeds all sections of the switchgear equipment. Similarly, barriers at tie breakers isolate the two main bus sections from each other.



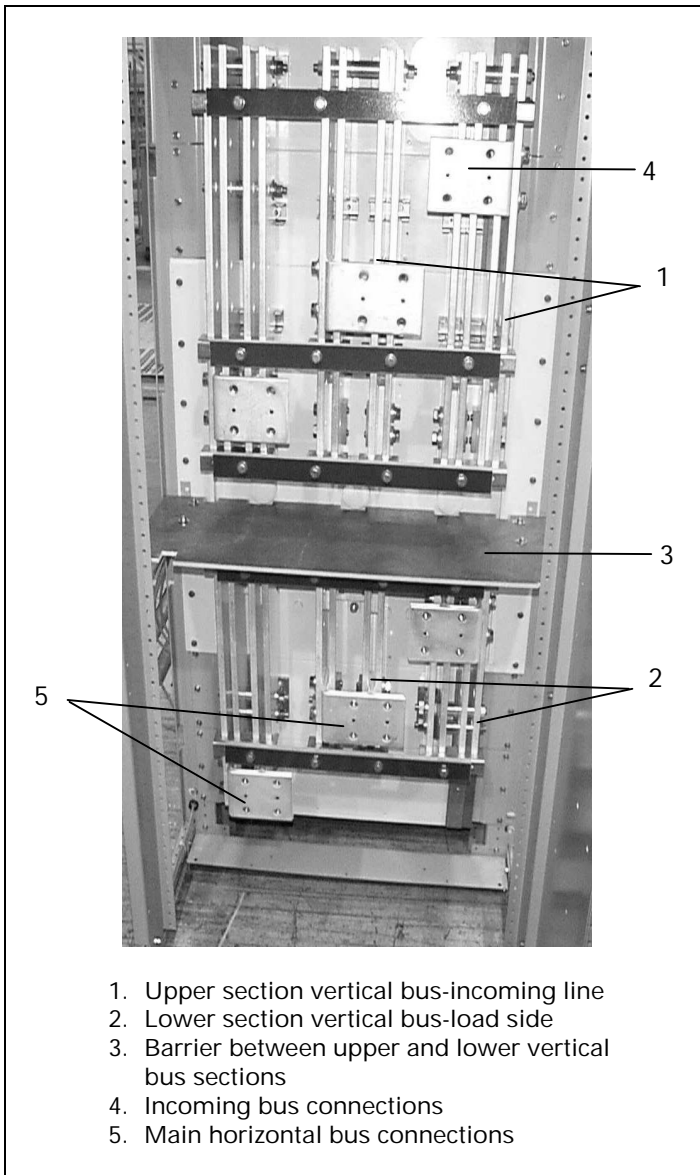


Fig. 3-15. Main breaker bus arrangement

### Insulated/Isolated Bus System

A bus insulation system, Fig. 3-16, that fully insulates each phase of the horizontal main bus and isolates each phase of the vertical bus, is optionally available for Entellisys switchgear when specified. With the INSULATED/-ISOLATED BUS system, there are no live connections accessible in the rear of each section except the cable lugs.

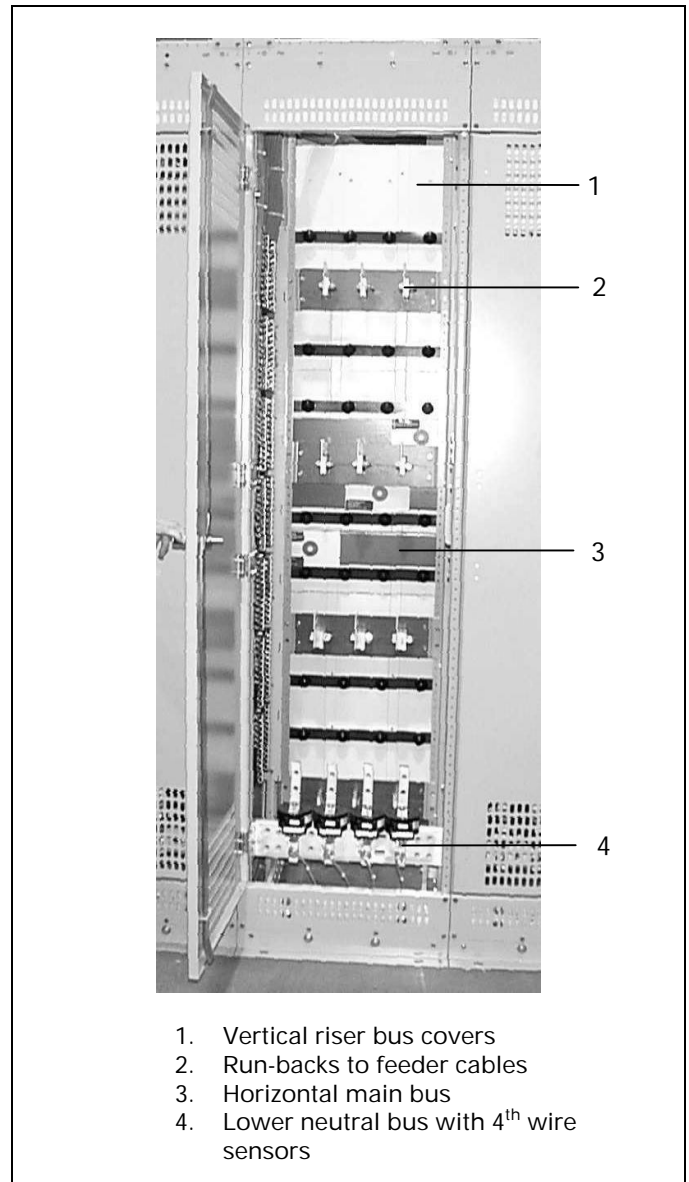
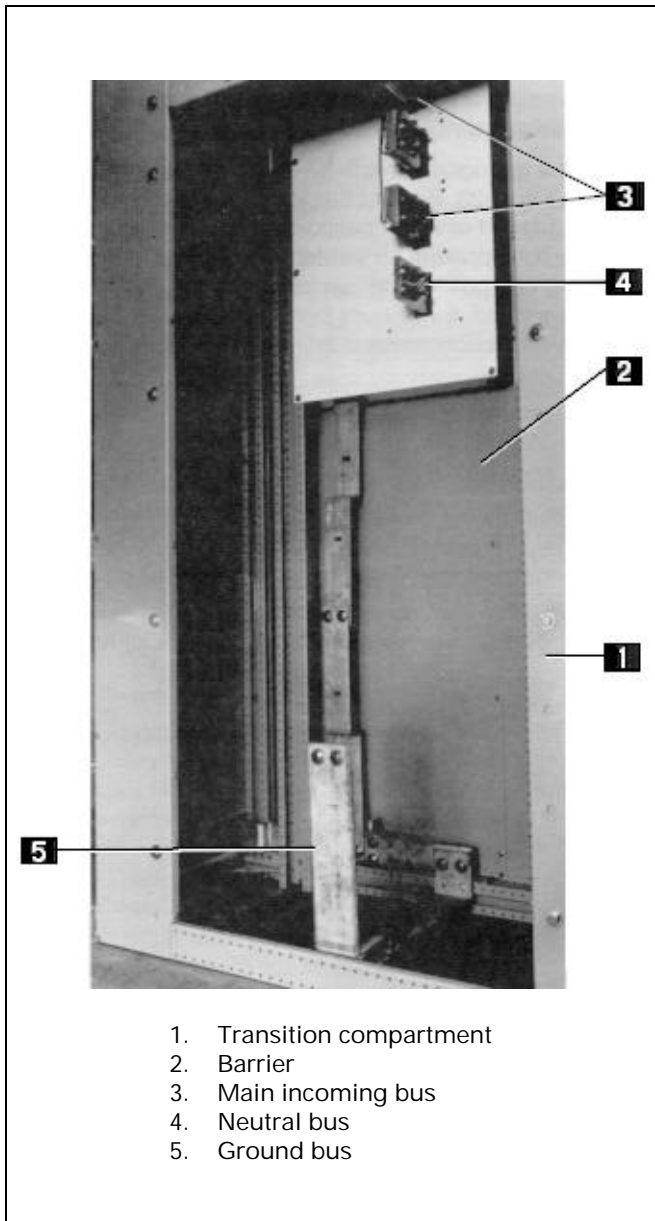


Fig. 3-16. Insulated/Isolated-Bus system

A vertical barrier (2), Fig. 3-17, between the transition section (1) and the first breaker section is always furnished.

The buswork in the device/auxiliary/transition sections is not insulated at the termination points to the other connected equipments such as transformers, busway, or existing equipments.

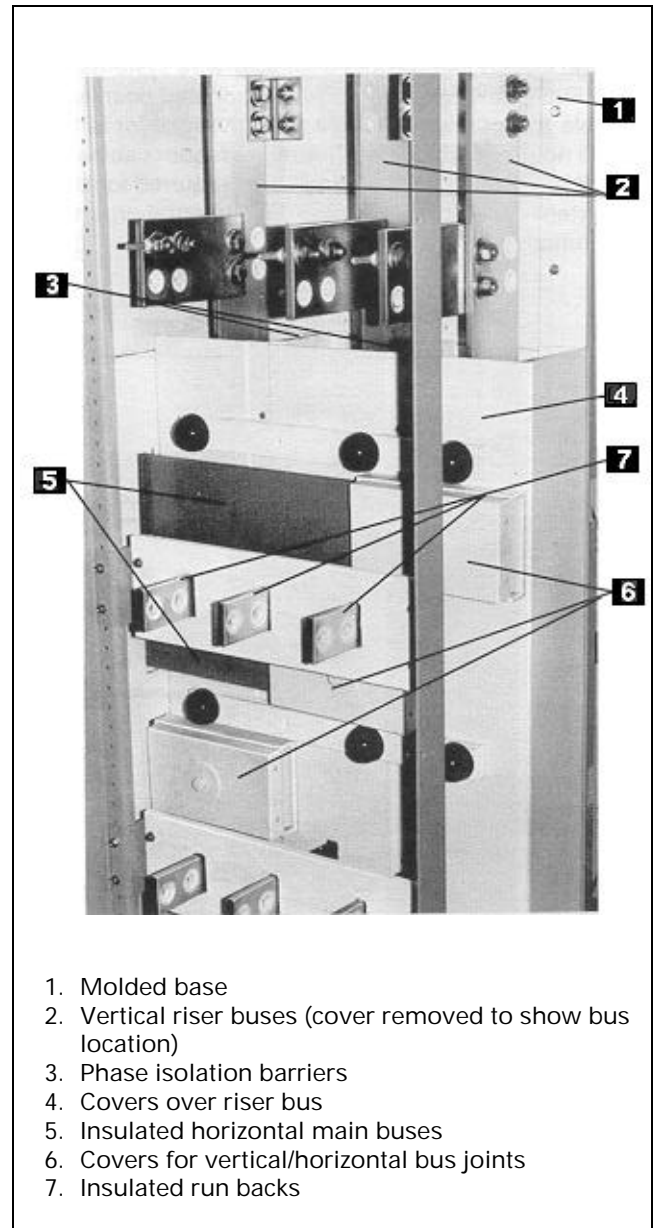


*Fig. 3-17. Transition section*

Insulation and isolation of the vertical riser bus bars (2), Fig. 3-18, is provided by installing phase isolation barriers (3) between the bus bars and by mounting covers (4) over

the bus bars. (The top portion of the vertical bus is shown with the cover removed.)

The phase isolation barriers and riser bus covers are constructed from insulating material. Insulation of the horizontal main bus bars (5) is achieved by an oven cured coating of epoxy.



*Fig. 3-18. Bus insulation system*

Fig. 3-19 illustrates the various components comprising the insulation/isolation system for the horizontal main bus bars. The horizontal bus bars (2) are insulated with an epoxy coating applied by a fluidized bed process. The vertical/horizontal bus bar joints are covered with collars (3) and caps (4) held in place with nylon thumb screws (5). The collars and caps are constructed from insulating material.

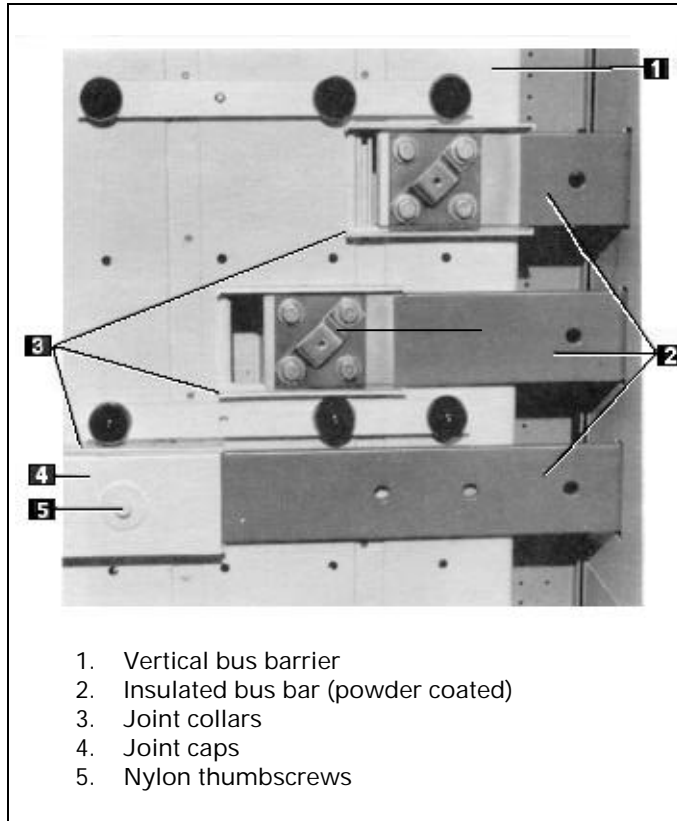


Fig. 3-19. Horizontal bus insulation system

### 3-11 Feeder Cable and Busway Compartment

The rear cable and terminal compartment, Fig. 3-20, provides for cable installation and terminations. The cable bending space meets the requirements of the 2005 National Electric Code. Various arrangements of single or double cable terminals are provided, depending upon the purchaser's requirements.

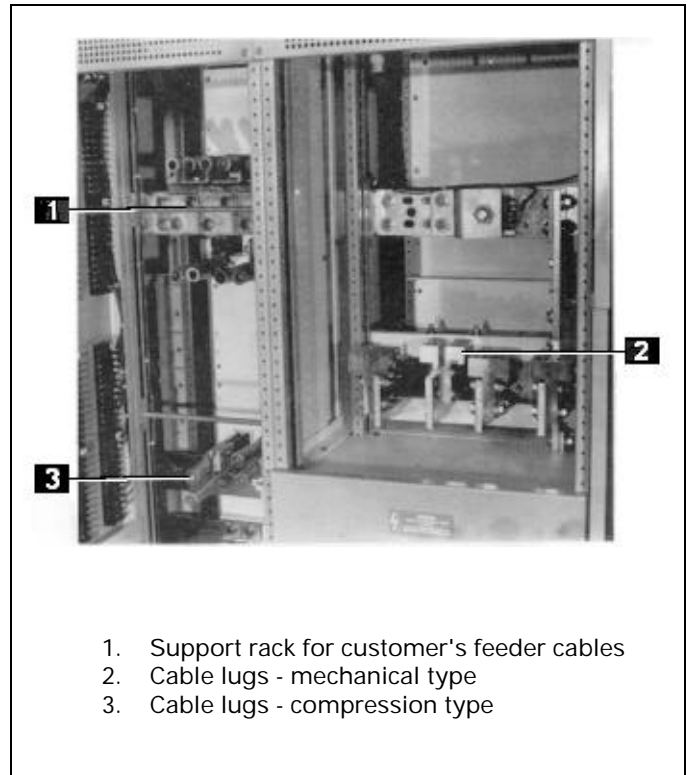


Fig. 3-20. Cable termination provisions

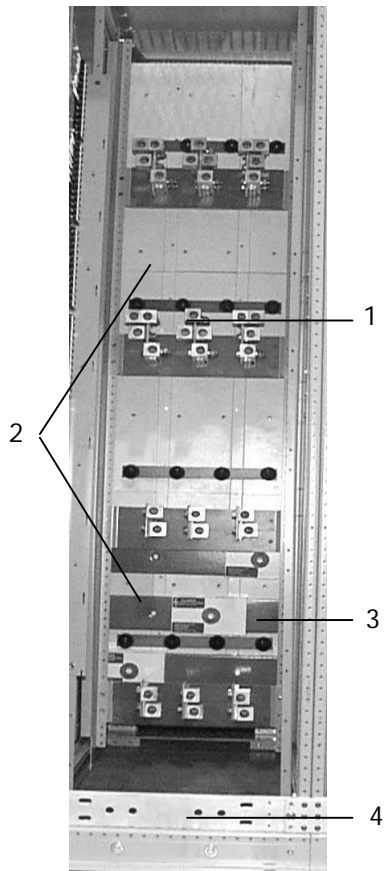
When specified, racks (1), Fig. 3-20, for the support of feeder cables are located in the cable compartment. The actual support of the cables is provided by lashing them to these racks.

A neutral bus, insulated from ground, is provided in the bus area on switchgear designed for four-wire systems. The neutral bus is located near the top of the cable compartment. It includes provisions for terminating the neutral conductor of four-wire feeder cables and also direct mounting of the neutral CT as required for those feeder system circuit breakers having an integral ground fault trip function.



### 3-12 Ground Bus

All Entellisys switchgear sections are grounded to the internal equipment ground bus (4), Fig. 3-21, located at the bottom of the cable compartment.



1. Feeder runbacks
2. Vertical riser bus covers
3. Horizontal main bus
4. Ground bus

*Fig. 3-21. Cable termination compartment*

# Entellisys Low Voltage Switchgear

## Chapter 4. Equipment Installation

### 4-1 General

This chapter contains complete instructions for installing Entellisys Low-Voltage Switchgear.

**CAUTION:** Personnel installing this equipment must be thoroughly familiar with this instruction manual and all articles of the National Electrical Code applicable to the installation of this switchgear. In addition, all drawings, both mechanical installation and electrical, must be understood and strictly followed to prevent damage to the switchgear or equipment being protected by the switchgear.

**ATTENTION:** La ou les personnes procédant à l'installation de cet équipement doivent être tout à fait familier avec ce livre d'instruction ainsi que tous les articles du Code national d'électricité s'appliquant à l'installation de ce dispositif de commutation. De plus, tous les dessins se rapportant tant à l'installation mécanique qu'électrique doivent être compris et suivis à la lettre afin de prévenir des dommages au dispositif de commutation ou à l'équipement protégé par celui-ci.

**NOTE:** Before installation work is started, it is important to review all of the drawings provided, including the equipment arrangement drawings, site installation drawings, elementary and remote connection drawings, mechanical connection drawings, and the summary of equipment list.

**NOTE:** Il est important de reviser tous les dessins fournis, incluant les dessins de disposition de l'équipement, les dessins d'installation du site, les dessins de raccords élémentaires et à distance, les dessins de raccords mécaniques et le sommaire de la liste d'équipement avant que ne débutent les travaux d'installation.

All expendable hardware for shipping purposes only, is painted yellow or tagged with yellow adhesive and may be discarded at completion of the installation phase.

### Site Location

In general, the location of the switchgear equipment will have been predetermined during the specification and/or procurement of equipment phases. Indoor locations within buildings impose certain requirements that must be met so that the switchgear may operate efficiently with a minimum of maintenance.

In locating the Entellisys Switchgear, adequate aisle space must be provided at the front and rear of the equipment to ensure proper ventilation of the equipment and to allow service and maintenance of the equipment with the front and rear doors open. The recommended aisle space is shown on the floor plan supplied with the equipment drawings.

The switchgear equipment should be placed in an area where clean, dry air is free to circulate around and above it. Since air is taken into the equipment at the bottom of each section

and exhausted at the top, a location with good airflow must be provided for efficient operation. A minimum of 30 inches of clear space above the equipment is recommended.

### Foundation Requirements

For optimum performance of your switchgear equipment, the foundation requirements expressed in this chapter should be strictly adhered to.

**NOTE:** The foundation for the outdoor switchgear must provide proper drainage of ground and/or surface water accumulations away from the equipment.

**NOTE:** La fondation du dispositif de commutation situé à l'intérieur doit être en mesure de drainer correctement les accumulations d'eau du sol et de surface loin de l'équipement.

The foundation must be strong enough to prevent sagging due to the weight of the switchgear structure and to withstand the shock stress caused by the opening of the breakers under fault conditions. The shock loading is approximately 1-1/2 times the static load.

The foundation must be flat and level in all planes. Refer to Fig. 4-1 for definition of flat and level.

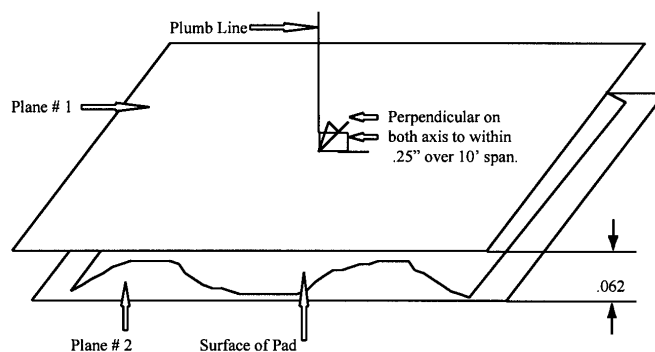


Fig. 4-1. Definition of flat and level

### Foundation Preparation

Refer to Fig. 4-2 along with the owner's foundation construction drawings, and the supplemental installation drawings. Although the indoor switchgear equipment can be mounted directly on a smooth, level floor, it is recommended that recessed steel channels be installed for supporting the equipment. Anchor bolts and channels are to be provided by the purchaser.

**NOTE:** When the equipment is installed on a surface subject to impact (shock) loads due to operating conditions or environmental seismic (earthquake) conditions, the anchor bolts should be fabricated of medium carbon steel (grade 5 load rating).

**NOTE:** Lorsque l'équipement est installé sur une surface sujette à des charges d'impact (choc) causées par les conditions d'opération ou des séismes environnementaux (tremblements de terre), les boulons d'ancrage devraient être fabriqués d'acier à moyenne teneur en carbone (spécification de charge classe 5).

anchor points (see Fig. 4-2) should be embedded in a level concrete slab with their top surfaces flush with the finished floor. It is essential that these steel channels be level and aligned with each other prior to final anchoring, to prevent distortion of the switchgear structure, to assure proper mechanical and electrical connections between shipping splits, and to assure proper interfacing to other close-coupled equipments.

Entellisys Switchgear and Load Center Substations are frequently mounted on steel floors and/or structural steel in industrial installations (such as a mezzanine) to minimize usage of production floor space. Regardless of the type of mounting surface, the requirements for a smooth level surface remain.

The floor channels under the front and rear switchgear

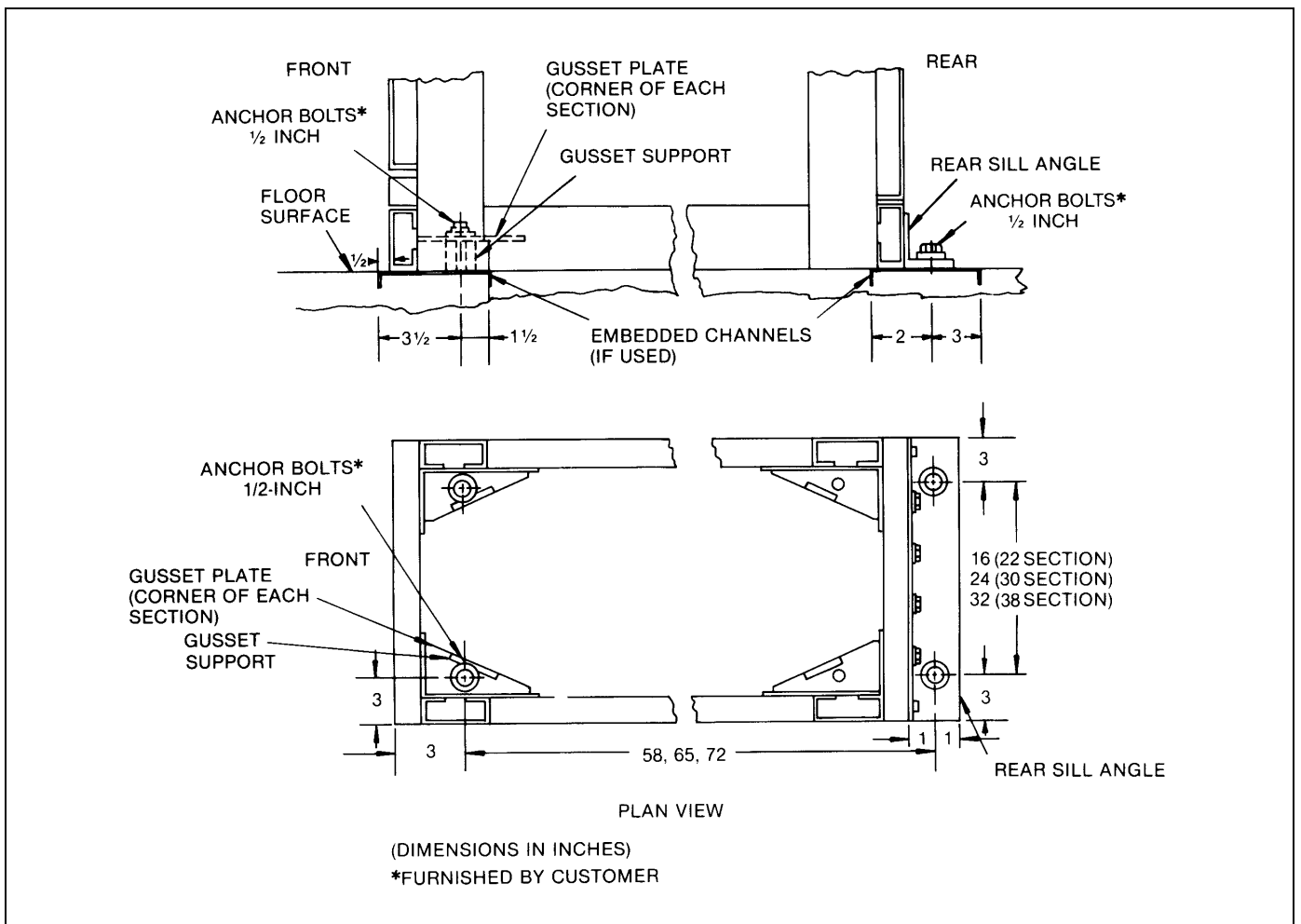
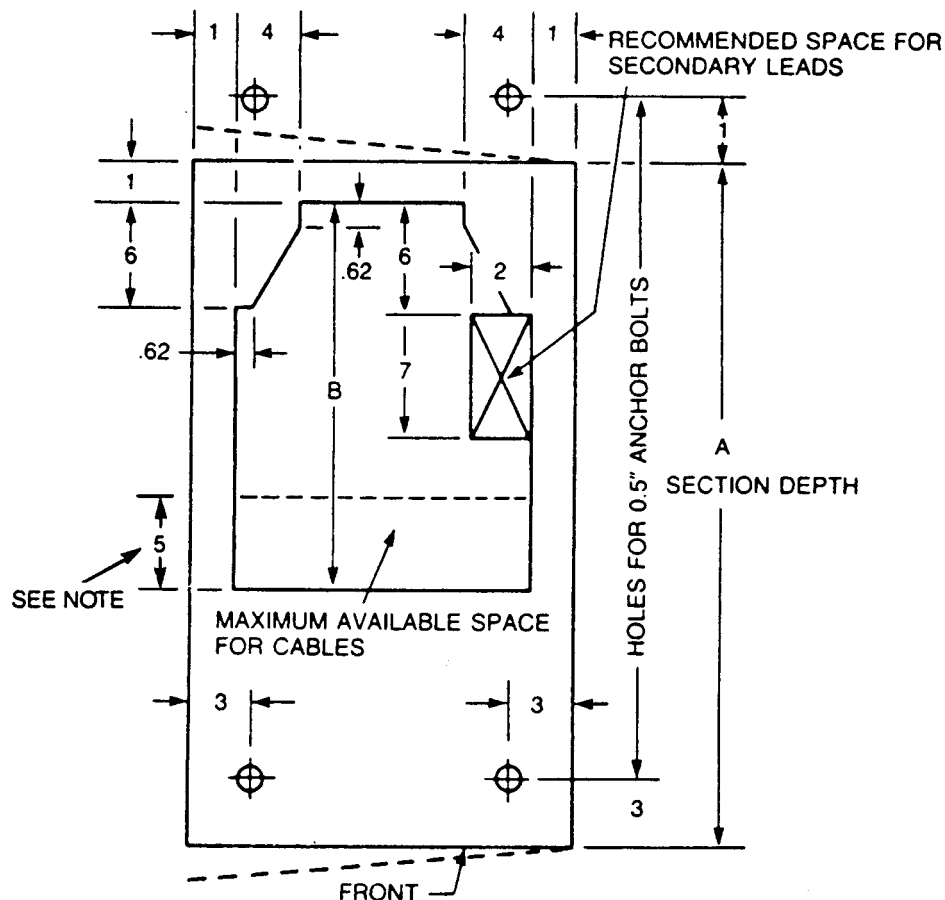


Fig 4-2. Location of equipment anchor points

## Chapter 4. Equipment Installation

cover all of the standard enclosures available for Entellisys Switchgear.

Fig. 4-3 illustrates the space available for conduit and/or cable entrance through the bottom or top of each equipment section. The space required for control wiring entry to the optional wiring trough is also shown.



Equipment Depth "A"	Direction of Leads	B
60" non-fused or 67" with fused EGF-08/16	Below	19
	Above	24
67" non-fused or 74" with fused EGF-08/16	Below	26
	Above	31
74" non-fused or 81" with fused EGF-08/16	Below	33
	Above	38

*Fig 4-3. Floor plan and cable entry space*

## 4-2 Assembly and Installation of Switchgear Equipment

### General Requirements

Before assembling or installing the switchgear equipment, all components should be available at the site location. This will facilitate switchgear component identification as well as installation. The foundation should be prepared in accordance with the instructions in Sections 4-1 and 4-2, and all embedded conduits installed and capped.

**NOTE:** If rollers are to be used for movement of the equipment to its permanent installation, it is recommended that the shipping skid not be removed until the equipment is placed in position over the anchor bolts.

**NOTE:** Au cas où l'utilisation de rouleaux s'avérerait nécessaire afin d'apporter l'équipement à son emplacement permanent, nous recommandons que l'emballage d'expédition ne soit pas enlevé tant que l'équipement n'est pas positionné au dessus des boulons d'ancrage.

If a transformer is not part of the installation, and/or the equipment has been split for shipment, place the center section on the foundation first. Assemble the remaining sections outward from the center section, in each direction.

If the switchgear equipment is part of a Load Center Unit Substation, the transformer section should be set on its pad first in accordance with the instructions furnished with the transformer. All remaining sections of the switchgear should then be installed.

**NOTE:** Before assembling and installing the switchgear equipment, the foundation must be absolutely level and clear of debris to prevent damage and possible misoperation of the switchgear equipment.

**NOTE:** Il faut avant de procéder à l'assemblage et à l'installation s'assurer que la fondation soit absolument au niveau et exempte de débris afin de prévenir des dommages à l'équipement du dispositif de commutation.

### Detailed Assembly and Installation Instructions

The recommended procedure for installation of a switchgear or Load Center Unit Substation is as follows:

1. **POSITION THE EQUIPMENT**-Position the equipment or sections of the complete equipment in their final location.

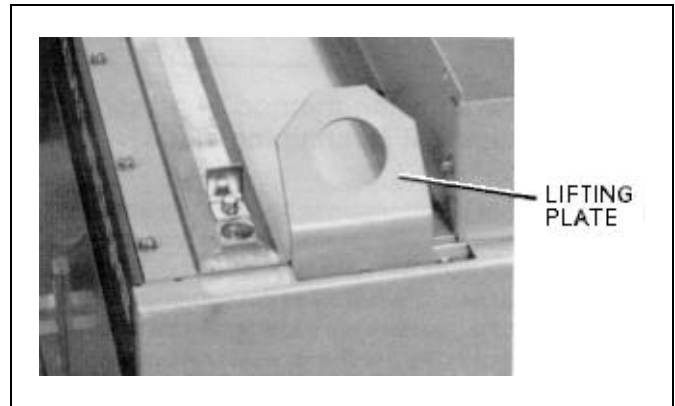


Fig. 4-4. Lifting plate location

**NOTE:** If the equipment line-up was split into shipping sections, the lifting plates on corners of adjacent sections shown in Fig. 4-4 must be removed. Failure to remove these plates will interfere with mating adjacent sections and prevent installation of bus splice plates, structure tie plates, etc.

**NOTE:** Si l'ensemble de l'équipement a été séparé en sections pour l'expédition, il faut que les plaques de soulèvement aux coins des sections adjacentes montrées à la Fig. 4-4 soient enlevées. L'omission d'enlever ces plaques viendra en interférence avec les sections barres omnibus, de l'attache de la structure des plaques, etc.

Once the lifting plates have been removed, they may be discarded.

**NOTE:** In the event the lifting plates must be reassembled on the equipment for lifting purposes, they must be moved to locations where unused screw holes are available, generally achieved by shifting the plate horizontally on the mounting surface one bolt hole from its previous location. When remounting the lifting plates, torque the mounting bolts to 7-9 ft-lbs.

**NOTE:** Dans l'éventualité où les plaques de levage doivent être réassemblées sur l'équipement à des fins de levage, elles doivent être démenagées aux endroits où il y a des trous de boulons inutilisés, on y arrive habituellement en décalant la plaque horizontalement sur la surface de montage d'un trou de boulon de son emplacement précédent. Lors du remontage des plaques de levage, serrer les boulons d'assemblage à un couple de 7-9 livres-pied.

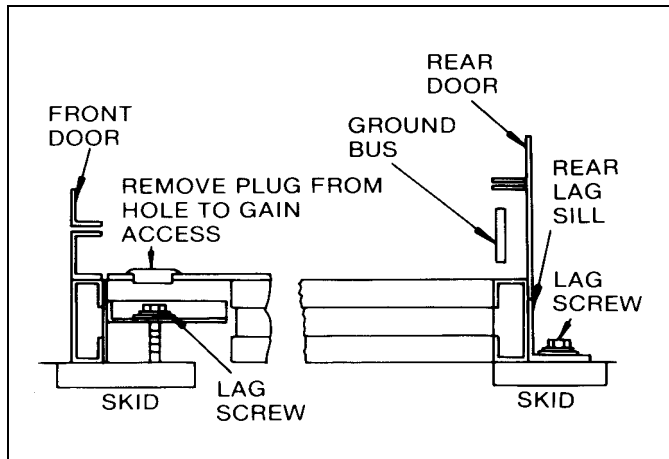


Fig. 4-5. View showing method of attaching equipment to shipping skids

**NOTE:** All mating sections of the equipment line-up (including transformer, if applicable) must be securely fastened together prior to tightening anchor bolts fastening the equipment to the mounting surface.

**NOTE:** Toutes les sections se rapportant à la disposition de l'équipement (incluant le transformateur si tel est le cas) doivent être retenues ensemble solidement avant de resserrer les boulons d'ancrage qui retiennent l'équipement à la surface de montage.

2. REMOVE THE SHIPPING SKIDS-The equipment is fastened to the shipping skids with 3/8-3 lag screws through the equipment anchoring holes. See Fig. 4-5.

Equipment shipping sections up to 10 feet long will be fastened to the skids with four lag screws, one in each corner. Longer sections will have two additional lag screws which are located near the middle of the equipment. The shipping skid and lag screws are expendable material and may be disposed of at the purchaser's discretion.

3. FASTEN SECTIONS TOGETHER-After placement of the equipment and installing the anchor bolts loosely, the various shipping sections must be rigidly fastened together. Through-bolts fasten each section of the switchgear equipment to the adjacent section. Fig. 4-6 shows the location of the through-bolts.

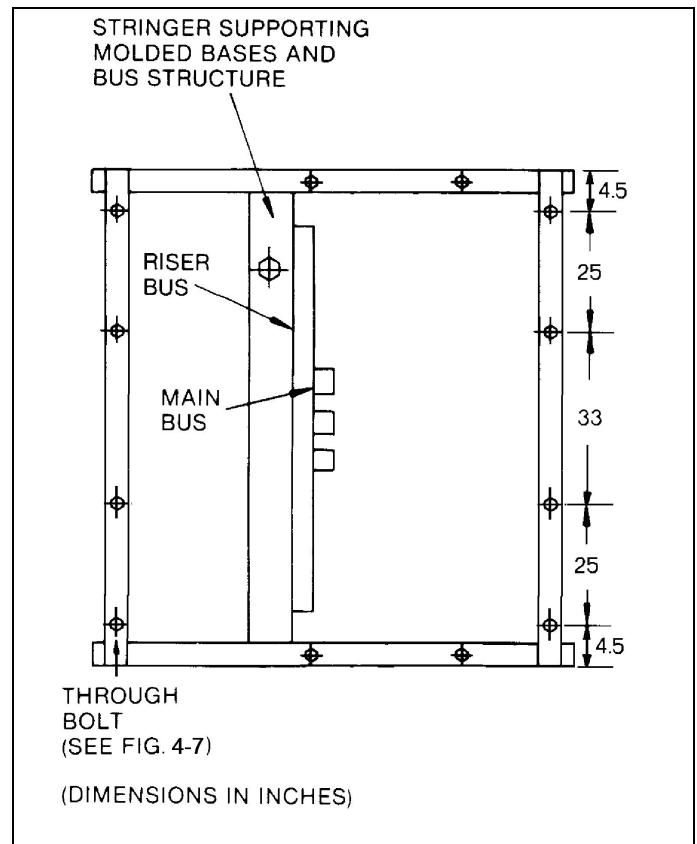


Fig. 4-6 Location of through-bolts

Fig. 4-7 illustrates the installation of the through-bolts. The through-bolts are in the front and rear compartments. The nut and bolt assembly should be tightened with a torque of 25-30 ft-lbs.

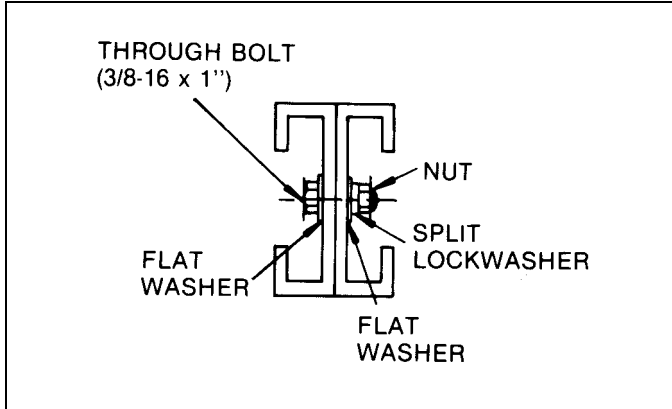


Fig. 4-7. Through-bolt installation

All of the hardware required for assembling the equipment across the shipping splits is furnished with the equipment. If a transformer is included in the line-up of equipment, the transformer flange should be aligned with the opening in the side of the transition compartment and fastened together using the 3/8-16 bolts, nuts and washers supplied with switchgear. The fastener assembly should be tightened with a torque of 25-30 ft-lbs.

**4. COMPLETE THE ELECTRICAL INTERCONNECTIONS** - After completing the mechanical connections between the several sections of equipment, the electrical interconnections should be completed. This includes the installation of splice plates for the main bus bars, the neutral bus, and the ground bus in addition to the Entellisys control and communication circuitry.

**WARNING:** All switchgear equipment must be adequately grounded for safety. Failure to ground equipment properly may result in serious injury.

**ADVERTISSEMENT:** Tout l'équipement du dispositif de commutation doit être mis à la terre adéquatement de manière sécuritaire. Des blessures sérieuses peuvent

survenir si l'on omet de mettre l'équipement à la terre correctement.

Fig. 4-8 illustrates the general location of the buses that must be spliced across the shipping splits.

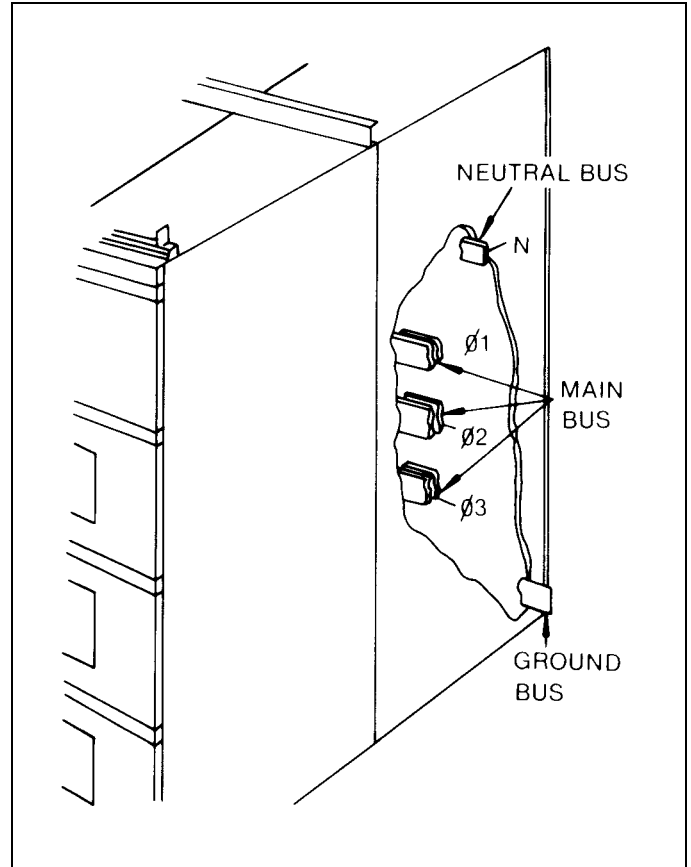


Fig. 4-8. Typical location of buses at shipping split

# Entellisys Low Voltage Switchgear

## Chapter 4. Equipment Installation

The ground bus is mounted directly on the rear upright channels.

**NOTE:** It is particularly important that the ground bus be connected first since it provides an integral ground for all the equipment. It must also be connected to the station ground prior to proceeding with the installation.

**NOTE:** Il est particulièrement important que la barre omnibus de mise à la terre soit branchée en premier, étant donné qu'elle fournit une mise à la terre intégrale à tout l'équipement. Elle doit aussi être branchée à la mise à la terre du poste avant de procéder à la installation.

A 4/0 AWG cable connector is located in the bottom of the transition section (or in the incoming line compartment if a transition section is not included) for terminating the purchaser's cable connection to ground. The specific location of the station ground connection is shown on the site floor plan drawing and in the frontview drawings supplied with the equipment. All grounding of the switchgear should be in accordance with National Electrical Code.

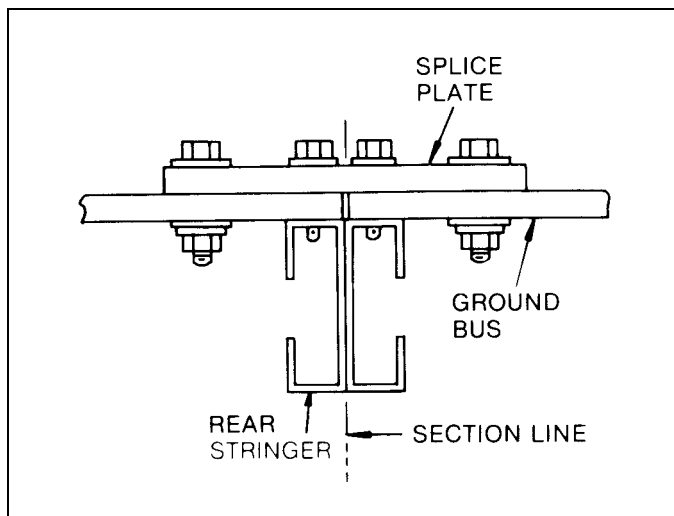


Fig. 4-9. Plan view of ground bus splice installation

Fig. 4-9 illustrates the installation of the ground bus splice plate across a shipping split. In addition to the bolted fastening of the splice plate to the two ends of the ground bus, self-tapping 1/4-20 bolts pass through the splice plate and ground bus stubs, and thread into the equipment frame. These bolts should be fastened with a torque of 7-9 ft-lbs.

If a transformer (rated above 750 kVA) is present in the line-up, a ground bar located in the transition compartment, Fig. 4-10, is provided for connection of the transformer ground pad to the equipment ground termination point.

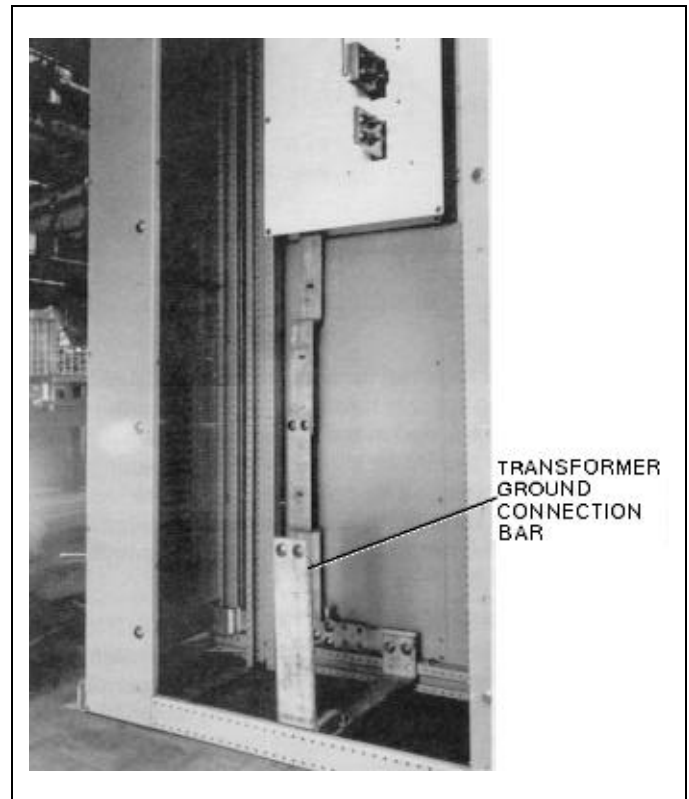


Fig. 4-10. Flange opening on a transition section to a transformer (above 750 kVA)

As shipped, the ground bar is mounted so it does not protrude beyond the outer surface of the equipment. When the equipment is installed in its final location, the ground bar must be reassembled using the outer bolt holes in the horizontal ground bus spanning the width of the transition compartment. In this mounting location, the offset portion of the ground bar will permit connection to the transformer ground pad with the 1/2-13 bolt assembly supplied with the switchgear equipment. If an optional floor plate is supplied for the transition compartment, it will be necessary to remove the floor plate to permit relocation of the ground connection bar.



All bolted bus joints should be made using the proper torque as shown in Table A-1 in Appendix A of this manual.

Transformers not manufactured by General Electric may require special mounting and bus connection hardware.

The neutral bus may be insulated from the grounded frame of the switchgear equipment; thus, it is mounted on insulators throughout the equipment. Installation of the neutral bus splice plate across a shipping split is similar to the ground bar splice except that the splice plate is not bolted to the equipment frame. Fig. 4-11 illustrates the installation of the neutral splice plate.

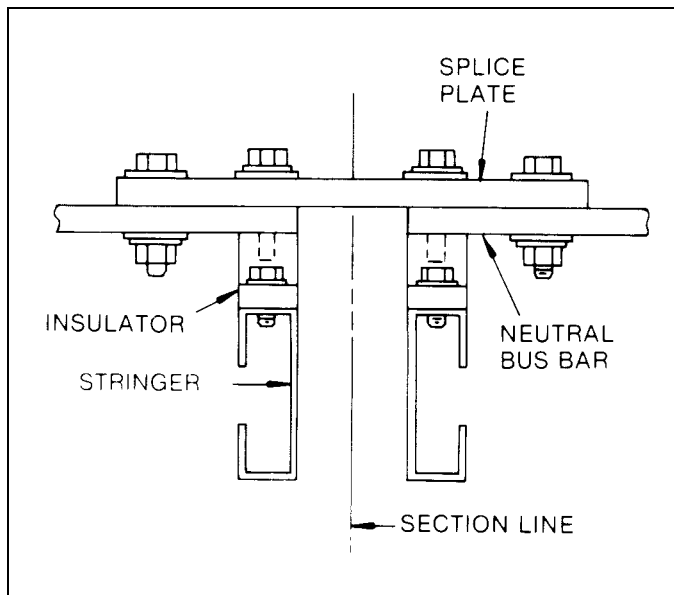


Fig. 4-11. Plan view of neutral bus splice installation

The installation of the horizontal bus splice bars is with bolted joints.

Figs. 4-12 and 4-13 illustrate the assembly of the main bus splice plates on the bolted bus system. Copper bus systems are normally supplied with flat washers and lock washers.

Fig. 4-12 shows the rear view of the main bus area with the installed splice bus indicated with cross-hatching.

Fig. 4-13 shows that a spacer is used both between the busbars when more than one bar is used per phase (normally the 2500 ampere and larger main bus ratings) and over the outer bars of a single or multiple bar joint.

After assembly of the splice plates and spacers, the 1/2-13 bolts should be tightened to a torque of 35-40 ft-lbs.

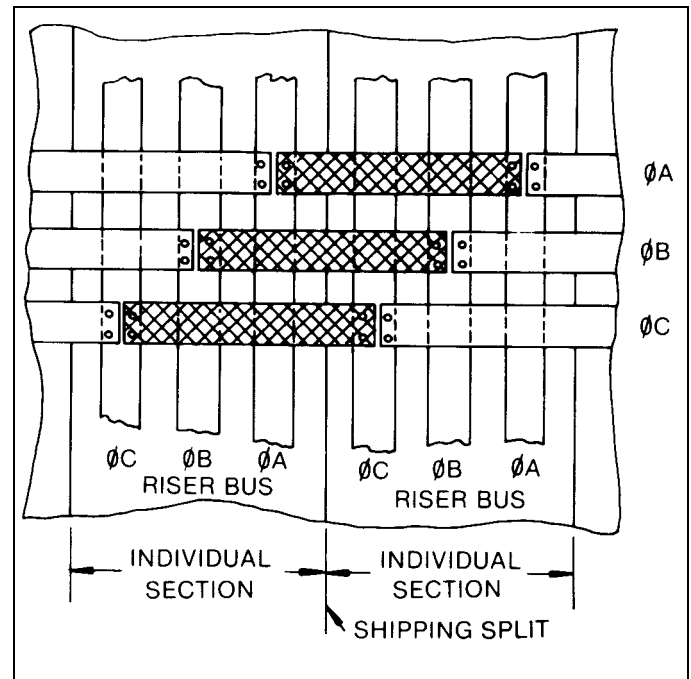


Fig. 4-12. Rear view of main bus at a shipping split

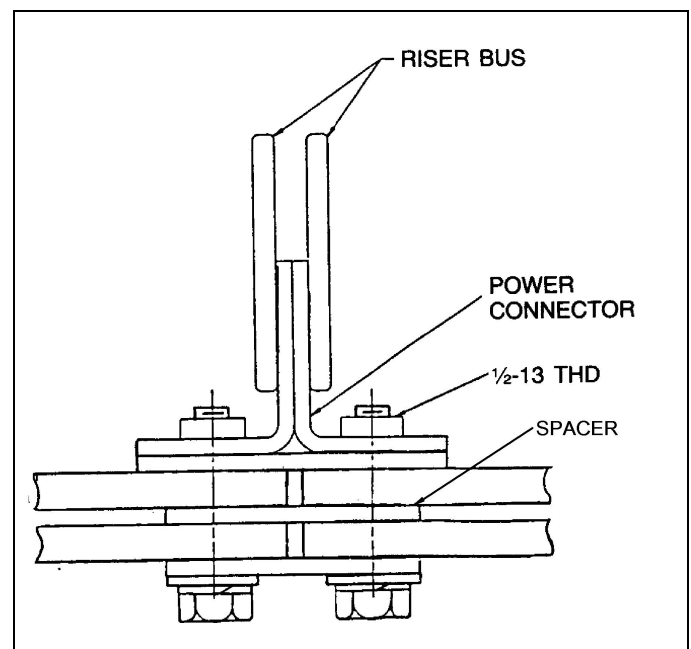


Fig. 4-13. Plan view of a two bar main bus connection

# ***Entellisys Low Voltage Switchgear***

## ***Chapter 4. Equipment Installation***

After completing the installation of the main bus splice bars, the joint covers may be mounted and secured by a 3/8-16 nylon bolt and polyester flat washer if the bus insulation option has been supplied with the equipment.

- 5. CONNECT THE TRANSFORMER SECONDARY** - The connection of the transformer secondary to the incoming bus bars in the transition is made using the flexible connection straps supplied with the transformer. These connections are always bolted joints.

The recommended torque for tightening the ½-13 bolts fastening the transformer connection straps to the incoming bus bars is 35-40 ft-lbs.

- 6. INTERCONNECT ENTELLISYS CONTROL AND COMMUNICATION WIRING** - Interconnection of control wiring across shipping splits is accomplished by connecting to terminal blocks located in the cross-section wiring trough on top of the equipment shown in Fig. 4-14. Ethernet cables are connected by similarly routing them across the top of the equipment and down the gear, between the compartment side sheets.

If terminal blocks are provided, each wire must be attached to the correct point on the terminal block, following the circuit identification number attached to each wire.



*Fig. 4-14. Interconnect control wiring and Ethernet cables in the wiring trough on top of the equipment*

### **Anchoring Switchgear Equipment**

Correct anchoring of the switchgear equipment to the foundation is very important. After completion of re-assembly of the equipment at the shipping splits, the equipment anchoring procedure should be completed.

- 1. ANCHORING BY ANCHOR BOLTS** – Equipment is normally secured to its final mounting surface by anchor bolts threaded into the embedded channel sills. The bolts were loosely threaded into place before reassembling the equipment shipping splits and connecting to the close-coupled transformer, if appropriate.

The anchor bolts should now be tightened with a torque of 35-40 ft-lbs.

- 2. ANCHORING BY WELD** - An alternate method of anchoring the equipment to its foundation is to weld the equipment to floor sills (or the floor itself if constructed of steel). Several methods, shown on Fig. 4-15, are available to the purchaser for welding the equipment to the channel sills.

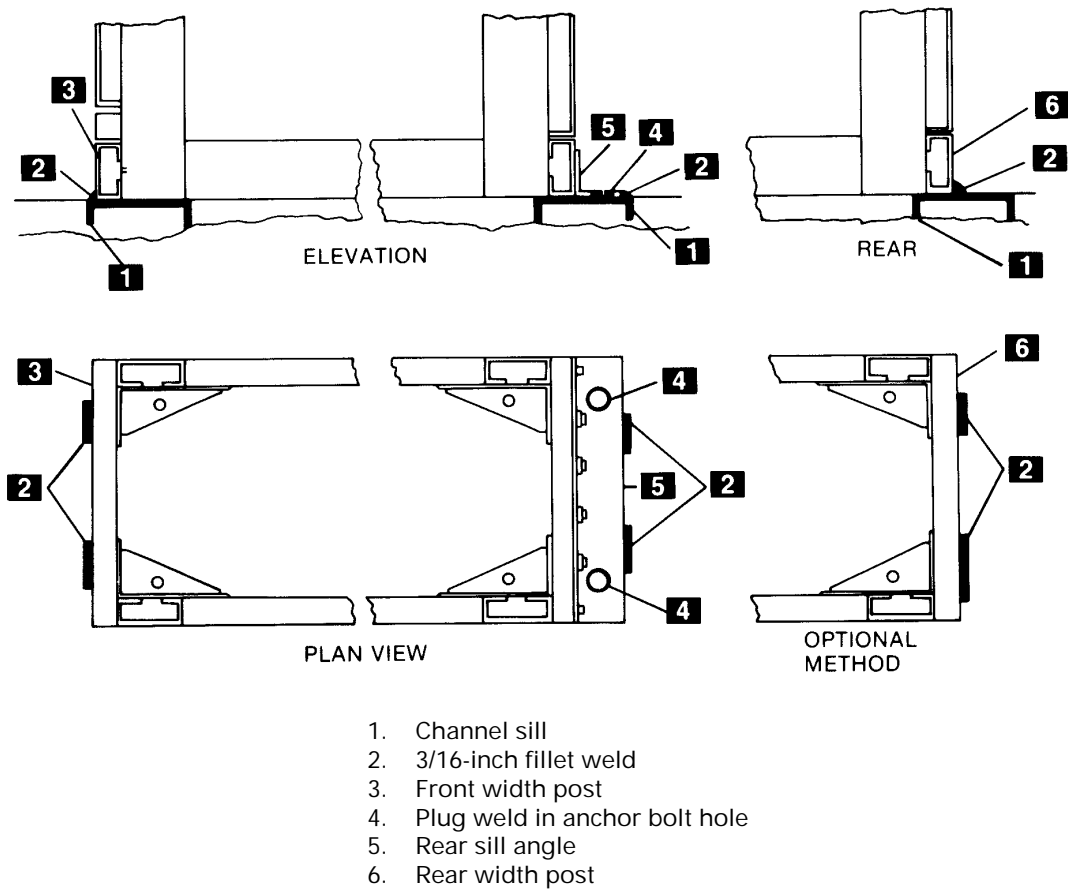
- a.** *The front of the equipment* is attached to the embedded channel sills (1), Fig. 4-15, by two 3/16-inch fillet welds (2). It is recommended that two welds, each 2-1/2 inches long (min.), be used for each section to firmly tie the bottom width post (3) to the channel sill.

- b.** *The rear of the equipment* may be anchored by one of three procedures:

- The first method is by plug welds (4), Fig. 4-15, using the anchor bolt holes in the rear sill angle (5). The plug weld should receive a minimum 1/2-inch bead around the entire circumference of the anchor bolt hole.
- A second method of securing the rear sill angle (5) to the channel sill (1) is the use of two linear fillet welds (2) for each section. It is recommended that each weld be 2-1/2 inches long (min.) with a 3/16-inch fillet (min.).
- A third method for anchoring the rear of the equipment is to remove the rear sill angle (5) from the switchgear and weld the rear bottom width post (6) to the channel sill (1). These welds (2) should, like the front welds, have a 3/16-inch (min.) fillet and each have a minimum length of 2-1/2 inches.

<b>CAUTION:</b> If the equipment is to be subjected to operational or environmental (seismic) shock loading, the factory must be consulted for anchoring recommendations.
---

<b>ATTENTION:</b> Si l'équipement doit être assujéti à une charge de choc opérationnelle ou environnementale (sismique), il faut consulter le manufacturier afin d'obtenir des recommandations d'ancrage.
---



*Fig. 4-15. Equipment weld anchoring*

## Busway Connections

Busway runs must be aligned with openings in the equipment and connected to the mating components electrically and mechanically. A collar is mounted on the top of the equipment cable compartment to which is bolted the busway housing. See Fig. 4-16. The 1/4-20 NC bolts, washers, and nuts for this mechanical connection are supplied with the busway stub. The bolts should be tightened with a torque of 7-9 ft-lbs.

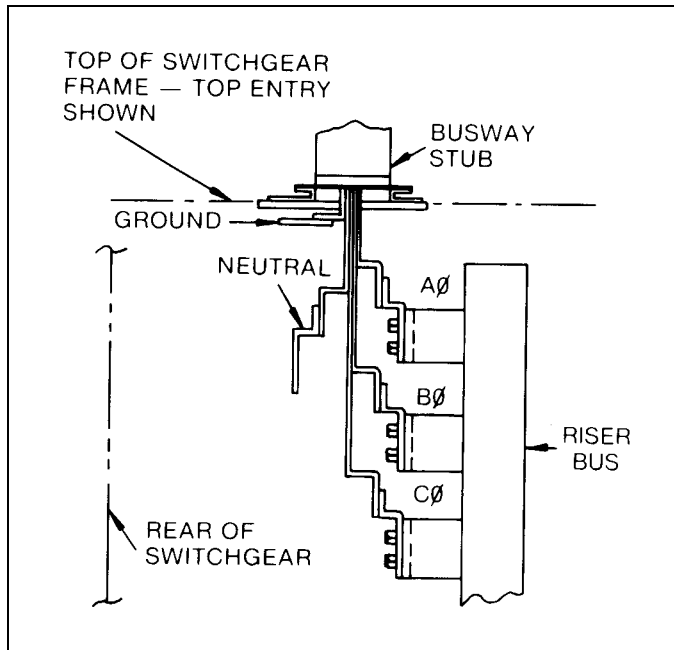


Fig. 4-16. Spectra Series™ Busway mounting (front-entry)

The power conductors in the busway stub are designed to bolt directly to power connector blocks mounted on the switchgear riser bus bars. These connections are made with 1/2-13 NC bolts supplied with the switchgear equipment.

**NOTE:** To maintain the minimum contact resistance across bolted bus joints, it is recommended that the joint contact surfaces be coated with a film of lubricating grease D6A15A2. A can of this grease is supplied with the equipment. Do not put grease on the bolt threads, as this will affect the clamping force exerted by the bolt.

**NOTE:** Afin de maintenir une résistance de contact minimale à travers les joints vissés des barres omnibus, nous recommandons que les surfaces du joint de contact soient enduites d'une pellicule de graisse lubrifiante D6A15A2. L'équipement est fourni avec une boîte de cette graisse. Il ne faut pas graisser les fils des boulons car la force de serrage exercée par le boulon en sera affectée.

The recommended torque for tightening the 1/2-13 NC bolts connecting the busway stub conductions to the riser bus power connectors is 35-40 ft-lbs.

## Control Wire Connections

For external control wiring, refer to Fig. 4-17 for switchgear cable area dimensions, and connect the control wires to the switchgear section as follows:

1. When control conduits enter the switchgear from below, they should not extend more than one inch above the floor. The control wires may be pulled through the conduits before or after the switchgear is installed.

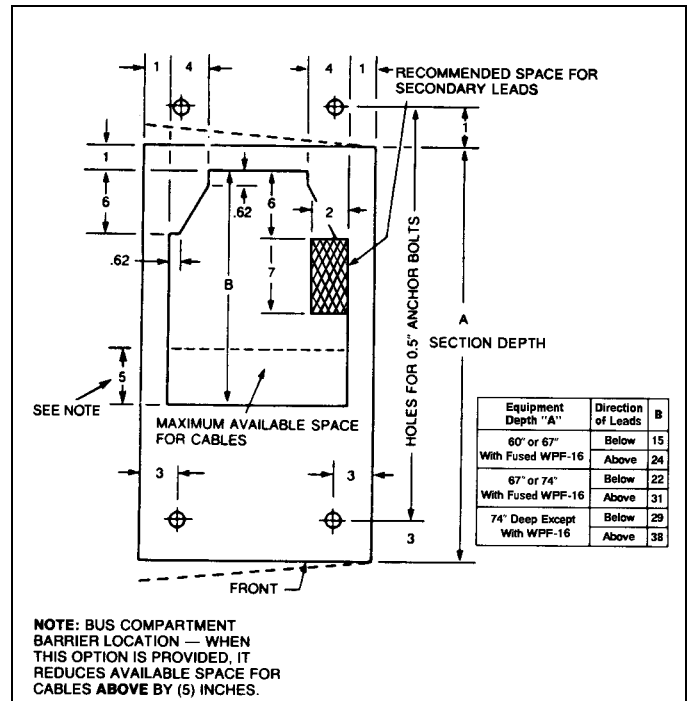


Fig. 4-17. Floor plan and cable entry space

2. Route the control wires from the conduits through the wiring trough (cross-hatched area- 2" x 7"-shown on Fig. 4-17) at the side of the cable compartment. Connect the cables to the terminal blocks in accordance with the connection diagrams for the equipment. Refer to the equipment frontview / floorplan drawings for location of terminal blocks for external control wiring.
3. If the control conduits enter from above, remove the top plate from the switchgear and drill the top cover within the available space indicated. See Fig. 4-17. Control wires should be routed to the wiring trough and connected to the terminal blocks as described previously.

# Entellisys Low Voltage Switchgear

## Chapter 4. Equipment Installation

### Power Cable Connections

Connect the main cables to the main lugs. Before any main cable connections are made, the cables should be identified to indicate their phase relationship with the equipment. Adequate electrical and mechanical clearances must be provided between conduit, cables, and bus. Where the cables enter the section, they can be lashed to optional cable supports at the rear of the cable compartment as required. (See Fig. 3-20.)

Mechanical cable terminals are normally included with the switchgear (compression terminals are supplied when ordered) and are mounted at the ends of the breaker runbacks in the cable compartment. Carefully follow the cable manufacturer's recommendations for installation of cable.

Install the cables in the proper path to the terminals, using temporary lashing if required. Cut the cables to the proper length. Strip the insulation to the desired dimension, being careful not to damage any strands.

For copper cables, coat the wires with lubricating grease D6A15A2, insert the cables into the terminals, and tighten the set screws in accordance with torque values shown in the torque value table for cable terminals in the addendum of this manual. See Appendix A, Table A-2.

For aluminum cables, wire brush the wire strands thoroughly. Immediately after wire brushing, coat the cable strands with a quality oxide inhibiting compound such as Penetrox A. Insert exposed wires into the

terminals and tighten the set screws in accordance with values shown in the torque Table A-2 in Appendix A of this Instruction Book.

**CAUTION:** The torque values shown in the table are for dry threads only. Do not grease or otherwise lubricate the threads on the cable terminals, as this will permit over-tightening of the screw and possible damage to the terminal or cable.

**ATTENTION:** Les valeurs de couple indiquées dans le tableau ne sont valables que pour des filets secs uniquement. Il ne faut pas graisser ou lubrifier autrement les filets des câbles terminaux, car cela produira un serrage excessif de la vis et possiblement des dommages au terminal ou au câble.

This should result in the oozing of compound material from between individual strands. Wipe off any excess compound.

Bolt the cable terminal connectors to the ends of the bars in the cable compartment. Non-oxidizing grease, such as lubricating grease D6A15A2 furnished with each lineup, should be used at these connection surfaces. The bolts should be tightened with a torque of 35-40 ft-lbs.

Lash the cables securely to the cable support, if present, to take their weight off the runbacks and to brace them against short circuit forces in the event of a fault.

Fig. 4-18 shows the breaker hoist assembled on a switchgear lineup. The hoist is shipped in a separate carton completely assembled, Fig. 4-19.

dispose of this guide since it must be reinstalled after mounting the hoist on the equipment.

**NOTE:** La capacité maximale recommandée de soulèvement est de 700 livres.



# Entellisys Low Voltage Switchgear

## Chapter 4. Equipment Installation

The hoist should be lifted into position on top of the switchgear so that the end with two rollers is toward the rear of the equipment, Fig. 4-21.



Fig. 4-21. Location of hoist rear rollers

The rear wheels can then be hooked under the channel and the front wheels can be positioned on the front track. See Fig. 4-22. The runner guide at the rear should then be reassembled, Fig. 4-23. Stop clips are provided at each end of the front track to prevent the hoist from rolling off the ends of the track.



Fig. 4-22. Front rollers positioned on front track



Fig. 4-23. Replacing the runner guide after completion of hoist installation



Fig. 4-24. Removing the bracket locking the hoist dolly

If the equipment has been shipped in sections, run the hoist carriage over the assembled shipping split to check the alignment of the hoist rail and runner. If necessary, adjust the rail and/or runner for smooth operation of the rollers on the hoist carriage.

On seismic rated equipment, it is necessary to remove the bracket locking the hoist dolly on the carriage before the hoist can be used, Fig. 4-24. Replace the bracket after breaker installation or removal is complete.

### Final Inspection

Make a final inspection to see that no tools, construction materials, or other foreign matter have been left in the switchgear equipment.



### 4-3 Installation of Wall-Mount HMI

#### General Requirements

Before installation, ensure the surface to which the enclosure will be mounted is capable of safely supporting 85 lb.

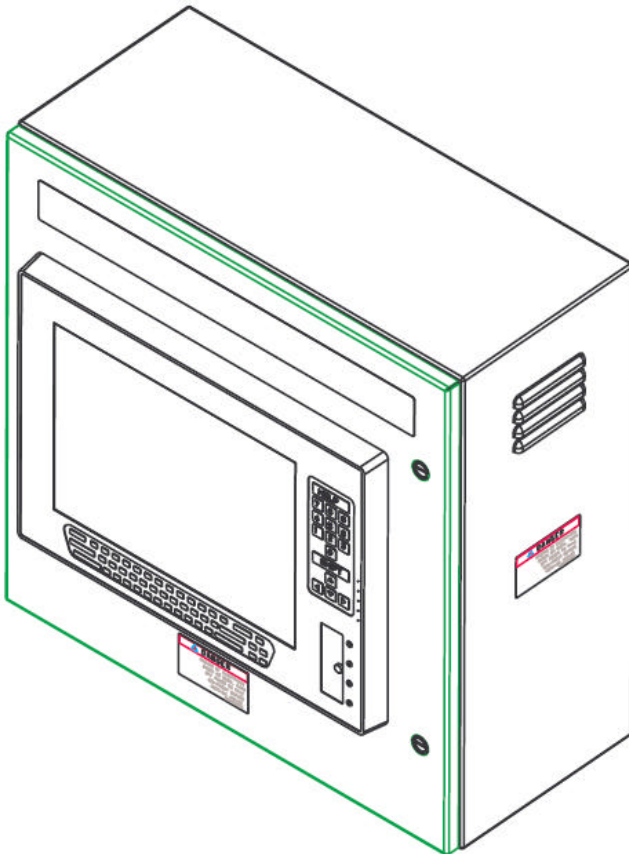


Fig. 4-25. Wall-mount HMI enclosure

#### Enclosure Installation

The recommended procedure for installation of a wall-mount HMI is as follows:

1. Add a conduit connection hole in either the top or bottom wall of the enclosure. Do not position the hole less than 1.5 inches from the edges of the enclosure. See Fig. 4-28 for area suitable for conduit hole.
2. Four mounting holes are provided in the back of the enclosure. Drill an identically spaced pattern of holes in the surface to which the enclosure will be mounted according to the drawing supplied with the enclosure.
3. Attach the enclosure to the wall or other structure using 3/8 inch bolts, flat washers, and, if the bolts are not self-threading, lock washers and nuts. To ensure

proper sealing and enclosure protection rating, use the provided sealing washers. Install the sealing washers inside the enclosure with the tapered cone against the enclosure and then add the flat washers as shown in Figs. 4-26 and 4-27.

4. Attach a suitable conduit fitting to the hole from Step 1. Run conduit to the enclosure as necessary.

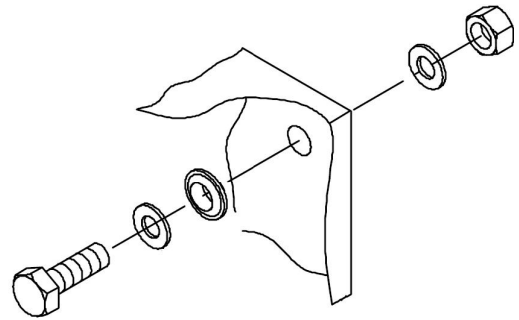


Fig. 4-26. Mounting the enclosure with bolts and nuts

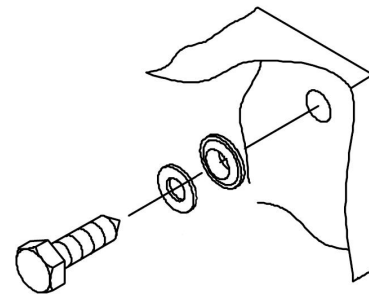


Fig. 4-27. Mounting the enclosure with self-threading bolts

#### Device Wiring

The recommended procedure for connecting the HMI power and communication cables is as follows:

1. Connect 120VAC line, neutral, and ground wires to terminal block as shown in the wiring diagram included with the assembly.
2. Connect incoming Ethernet cable to the port on the side of the HMI. Secure the wires to HMI and enclosure with cable ties.
3. If the enclosure is equipped with a power supply and RS232/RS485 converter, connect the incoming RS485 cable to converter terminals RX+ and RX-.

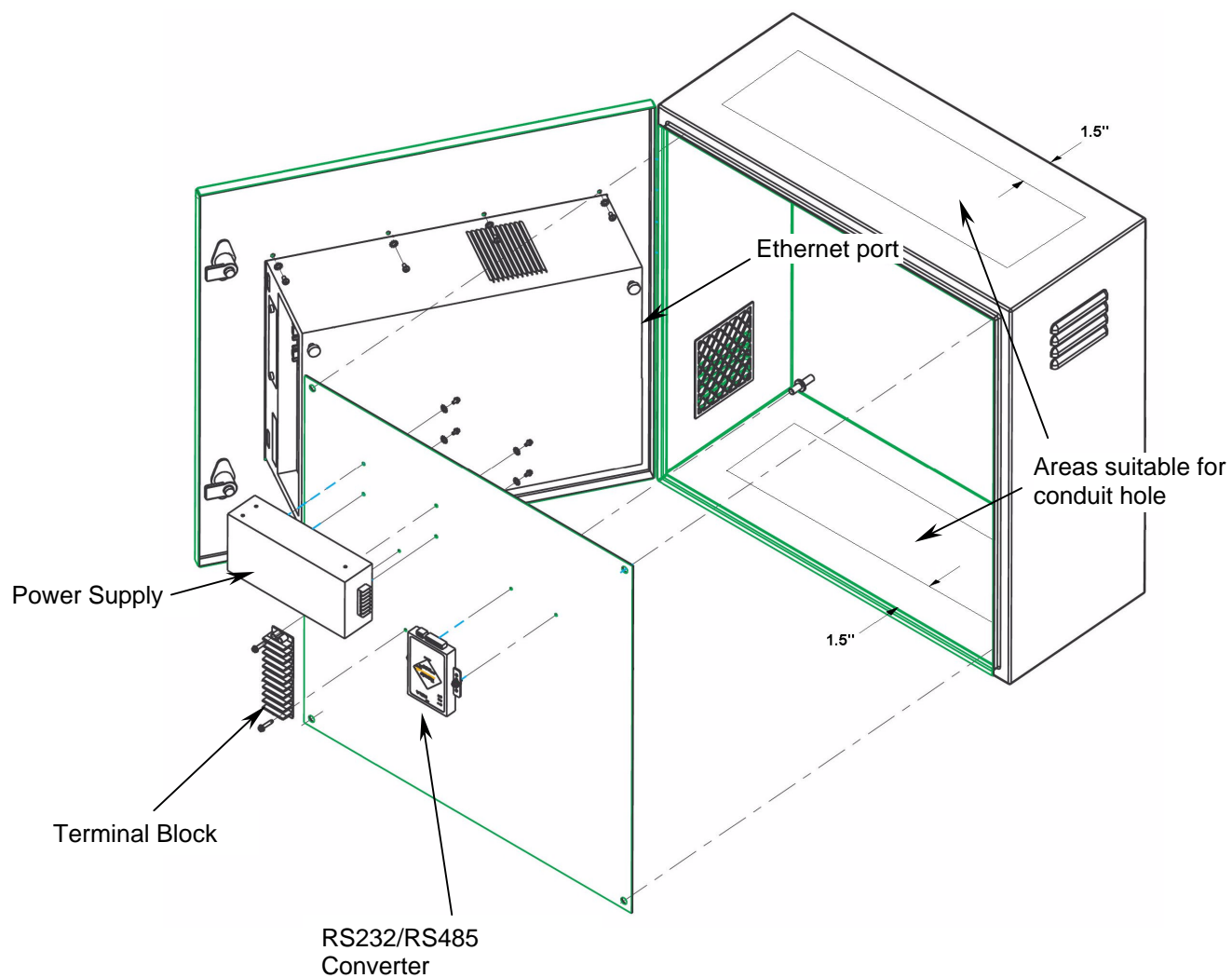


Fig. 4-28. HMI enclosure and devices

## 5-1 General

### Inspection and Preparation of Circuit Breakers

Before installing, operating, or removing a circuit breaker, refer to the breaker instruction manual for preparation, inspection, and test. Check thoroughly for damaged or loose parts and for any dirt or foreign matter that may be in the breaker. Be sure that a thin film of lubricating grease D6A15A2 is present on primary disconnects of the switchgear before installing the breaker.

### Circuit Breaker Installation

To install a circuit breaker, proceed as follows:

1. Before installing a breaker, check the tightness of the bolted joints in the primary disconnect bars. Refer to torque value table, Appendix A, Table A-1, in this manual for the proper torque values. Also check the contact areas on each primary disconnect bar or cluster of fingers for foreign matter that may have accumulated. Clean these areas if necessary. Be sure that a thin film of lubricating grease D6A15A2 covers the contact areas before putting a breaker in the compartment.
2. Check to see that the breakers match their respective compartments. Each breaker is assigned a part or mark number. This number is shown on the breaker sheets of the summary, the front view drawings, the breaker nameplate, and on the identification card on the breaker shipping carton. The breaker may also be identified using the 8 digit catalog number.
3. To locate the breaker in the proper compartment, refer to the breaker location list on the front view drawing. Find the proper breaker by the identification card on the breaker carton or the mark number on the breaker nameplate. All identical breakers will have the same mark and catalog number.

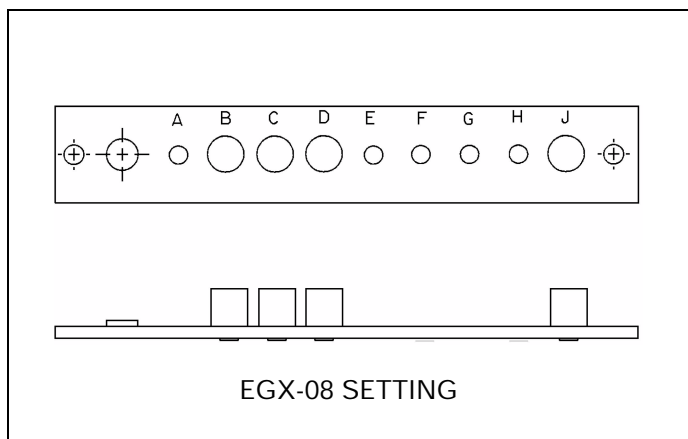


Fig. 5-1. Rejection pin mounting used in EG-08/16/20 compartments

Drawout breakers of the same type and rating are interchangeable in their equipment compartments. Drawout breakers of different frame size, type, or short-circuit rating are intentionally made non-interchangeable to prevent inserting the wrong type breaker into a drawout compartment; unique "rejection hardware" is affixed to each breaker and its compartment. When the wrong type breaker is inserted into a cell, the pins on the breaker and the pins in the cell interfere, thus preventing the wrong breaker from being racked onto the primary stabs.

**EXCEPTION:** A breaker with a higher short-circuit rating will fit into a compartment keyed for a lower short-circuit rating. For example, an EGH-08 breaker can be inserted into an EGS-08 compartment. An EGH-08 compartment, however, will reject an EGS-08 breaker.

**EXCEPTION:** Un disjoncteur ayant un calibrage élève de court-circuit accommodera un compartiment classifié d'un calibrage moindre de court-circuit. Par exemple, un disjoncteur EGH-08 peut être inséré dans un compartiment EGS-08. Cependant un disjoncteur EGS-08 sera rejeté d'un compartiment EGH-08.

Figs. 5-1 and 5-2 illustrate the rejection pin mounting used in EGS-08, EGH-08, EGF-08, EGX-08, EGS-16, EGH-16, EGF-16, EGS-20, and EGF-20 compartments.

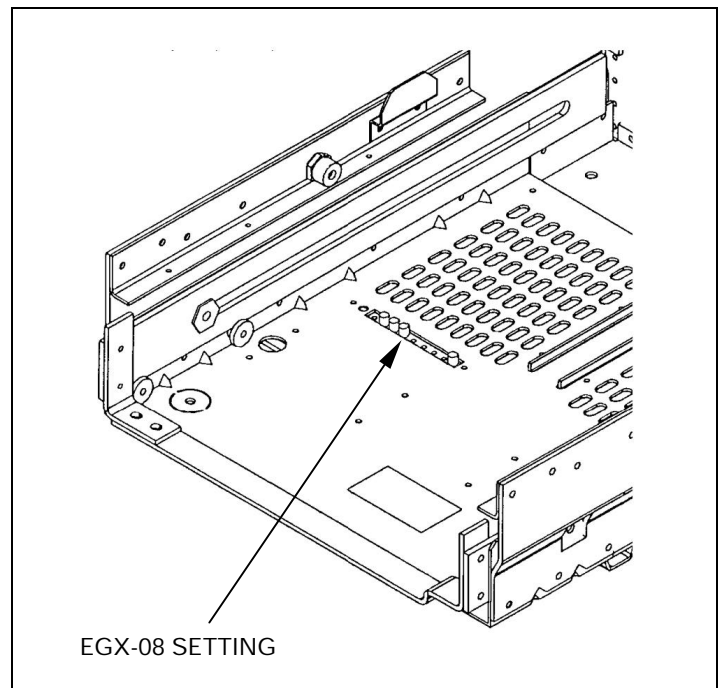


Fig. 5-2. Rejection pins used in EG-08/16/20 compartments

### Rejection Feature

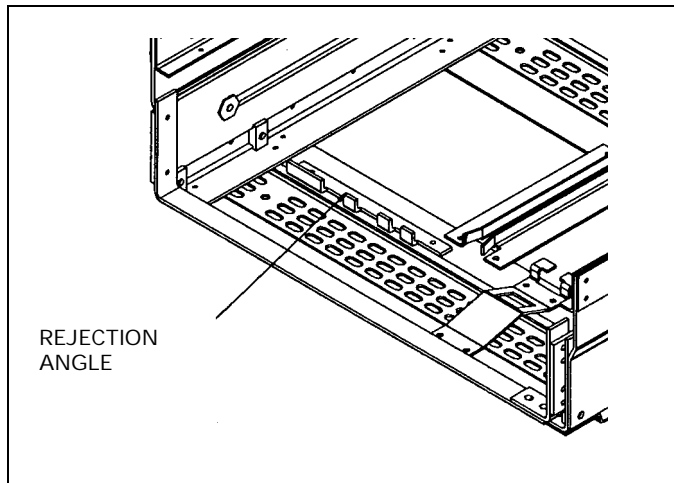


Fig. 5-3. Isometric view of rejection angle used in EG-32/40/50 compartments

**NOTE:** If a breaker is rejected by the rejection pins, check the breaker type and rating against the job drawing.

**NOTE:** Si un disjoncteur est rejeté par les pins coulissants, vérifier de quel type est le disjoncteur ainsi que le calibrage en rapport avec le plan de la tâche.

The complete rejection pin pattern code is included in Appendix B.

### 5-2 Installing EG-08/16/20 Circuit Breakers

#### Prior to Installation

Prior to lifting a breaker to its intended compartment location, observe the following precautions:

##### Precautions:

1. Check the compartment to ensure that it is free of foreign objects.
2. Verify that the breaker is the correct type for that compartment.
3. Ensure that the breaker is OPEN.
4. Apply a thin fresh coat of lubricating grease D6A15A2 to the breakers primary disconnects.
5. Ensure that the racking forks on the breaker are correctly positioned for initial engagement with the pins in the compartment. To do this, insert the racking handle and rotate it fully counterclockwise.

##### Précautions:

- Vérifier le compartiment afin de s'assurer qu'il est libre d'objets étrangers.
- Vérifier que le disjoncteur est du genre correct pour ce compartiment.
- Assurez-vous que le disjoncteur est en position OPEN.
- Appliquer une mince couche fraîche de graisse lubrifiante D6A15A2 aux débranchements primaires du disjoncteur.
- Assurez-vous que les comes de montage du disjoncteur soient positionnées correctement en vue de l'engagement initial avec les goujons du compartiment. Pour ce faire, insérer la poignée de montage et lui faire effectuer une rotation complète dans le sens des aiguilles d'une montre.

### Installation Procedures

To install the EntelliGuard circuit breaker, proceed as follows:

1. Carefully place the breaker in front of the section in which it is to be installed. See Fig. 5-4.
2. Open the breaker compartment door by rotating the door latch assembly  $\frac{1}{4}$  turn clockwise.
3. Using the switchgear hoist or a suitable lifting mechanism and the appropriate spreader, raise the breaker above the elevation of the rails. See Fig. 5-5. The lifting spreader for 800A, 1600A & 2000A AKR breakers cannot be used with 800A, 1600A & 2000A EntelliGuard breakers.

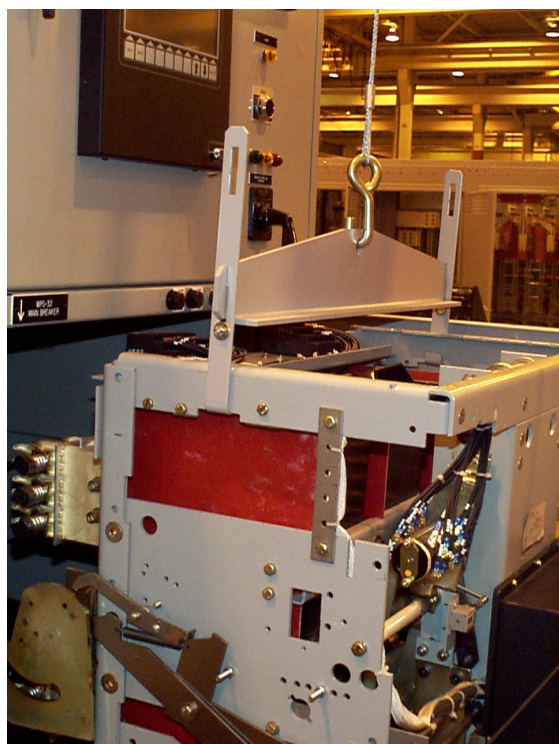
**WARNING:** Do not stand under the circuit breaker during the hoisting operation.

**ADVERTISSEMENT:** Il est interdit de se tenir sous le disjoncteur durant l'opération de levage.



## *Entellisys Low Voltage Switchgear*

### *Chapter 5. Installing and Removing Circuit Breakers*



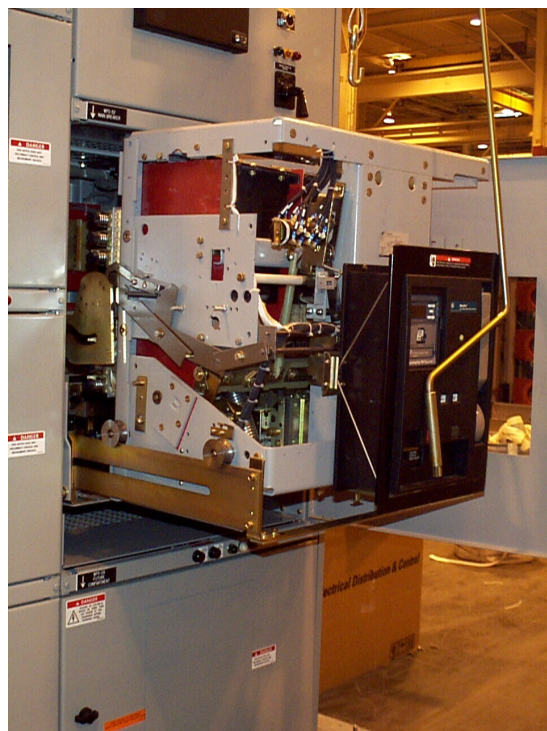
*Fig. 5-4. Reel out hoist cable. Attach spreader bar assembly to circuit breaker*



*Fig. 5-5. Hoist breaker above rails*



*Fig. 5-6. Pull rails out completely from the circuit breaker compartment*



*Fig. 5-7. Lower the breaker onto the rails of the cell. Remove the spreader bar assembly*

## Entellisys Low Voltage Switchgear

### Chapter 5. Installing and Removing Circuit Breakers

**CAUTION:** When using the switchgear hoist, do not unwind the cable completely from the drum. To lift the breaker, turn the hoist operating crank clockwise. To lower the breaker, turn the hoist operating crank counter-clockwise.

**ATTENTION:** Il ne faut pas dérouler complètement le câble du cylindre lorsque l'on utilise le treuil du dispositif de commutation. Tourner la manivelle opérant le treuil dans le sens des aiguilles d'une montre pour soulever le disjoncteur. Tourner la manivelle opérant le treuil dans le sens contraire des aiguilles d'une montre pour abaisser le disjoncteur.

4. Fully withdraw rails to stops.
5. Slowly lower and guide the breaker to allow the 4 breaker wheels to align with the rails. See Fig. 5-7. Remove the lifting device. The breaker is now positioned on the drawout rails.
6. Roll the breaker into the compartment until the racking forks meet the racking pin, this is the DISCONNECT position. If an incorrect breaker has been installed, the interference pins on the breaker will interfere with the rejection pins in the compartment prior to reaching the DISCONNECT position. See Fig. 5-8. At this point, the racking forks are contacting the fixed racking pins in the compartment.
7. Slide rails back into compartment. Close the compartment door and rotate latch  $\frac{1}{4}$  turn counter-clockwise.
8. Engage the racking handle by pushing and holding the trip button in the breaker escutcheon, sliding the cover just below it to the right, releasing the trip button, and inserting the handle on the jackshaft. See Fig. 5-9.
9. Rotate the handle clockwise as far as it will go. As you rotate the handle clockwise, the breaker will travel from the DISCONNECT, through the TEST position (you will notice an audible click), and then into the CONNECT position. The breaker position can be seen on the indicator, located on the breaker escutcheon.



Fig. 5-8. Push the breaker in completely. Close the door.



Fig. 5-9. Engage the racking screw with the racking handle

### 5-3 Installing EG-32/40/50 Circuit Breakers

**WARNING:** Do not stand under the circuit breaker during the hoisting operation.

**ADVERTISSEMENT:** Il est interdit de se tenir sous le disjoncteur durant l'opération de levage.

**CAUTION:** When using the switchgear hoist, do not unwind the cable completely from the drum. To lift the breaker, turn the hoist operating crank clockwise. To lower the breaker, turn the hoist operating crank counter-clockwise.

**ATTENTION:** Il ne faut pas dérouler complètement le câble du cylindre lorsque l'on utilise le treuil du dispositif de commutation. Tourner la manivelle opérant le treuil dans le sens des aiguilles d'une montre pour soulever le disjoncteur. Tourner la manivelle opérant le treuil dans le sens contraire des aiguilles d'une montre pour abaisser le disjoncteur.

#### Installation Procedure

To position the EGS-32/40/50 circuit breaker on the drawout rails, proceed as follows:

1. Carefully place the breaker in front of the section in which it is to be installed, See fig. 5-4.
2. Open the breaker compartment door by rotating the door latch assembly  $\frac{1}{4}$  turn clockwise.
3. Using the switchgear hoist or a suitable lifting mechanism and the appropriate spreader for EG-32/40/50, raise the breaker above the elevation of the rails. See Fig. 5-5.
4. Pull the drawout rails all the way out to its WITHDRAWN limit. The rail pin will be positioned at the back of the rail slot.
5. Slowly lower and guide the breaker to allow the 4 breaker wheels to align with the rails. See Fig. 5-7. Remove the lifting device. The breaker is now positioned on the drawout rails.
6. Roll the breaker into the compartment until the racking cams touch the racking pin and the spring discharge stop engages. This is the DISCONNECT position. At this point, the racking cams are positioned to engage the fixed racking pins in the compartment, ready to begin the racking motion. If the incorrect breaker has been installed, the interference pins on the breaker will interfere with the rejection teeth in the compartment prior to reaching the disconnect position (Fig. 5-10).

7. Slide rails back into compartment. Close the compartment door and rotate latch  $\frac{1}{4}$  turn counter-clockwise.
8. With the EG-32/40/50 breakers rotate the racking access cover in the door and engage the racking handle
9. Rotate the handle clockwise as far as it will go. As you rotate the handle clockwise, the breaker will travel from the disconnect, through the test position (you will notice an audible click as the secondary disconnects engage), and then into the connect position. The breaker position can be seen on the indicator, located on the breaker escutcheon.

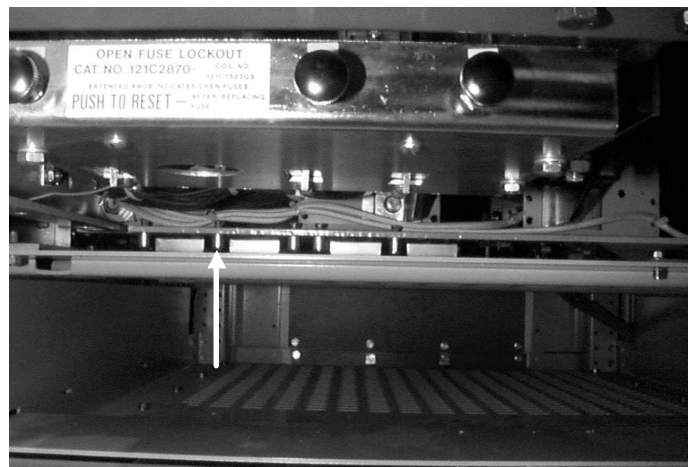


Fig. 5-10. Rating rejection bracket on EG-32/40/50

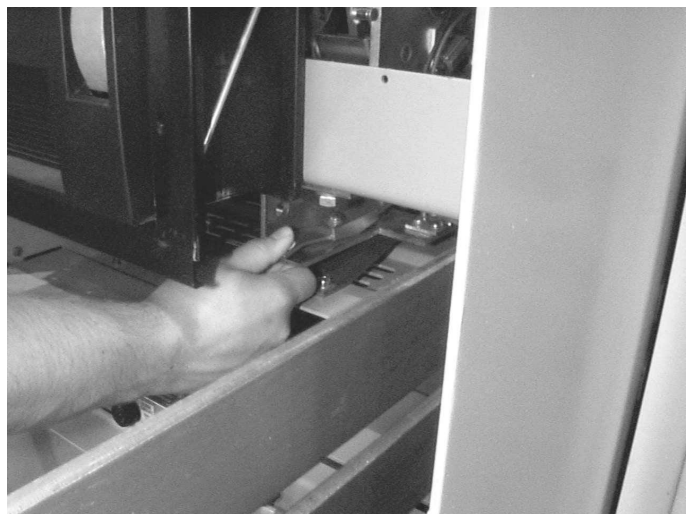


Fig. 5-11. Spring discharge interlock used on manually and electrically operated breakers

### 5-4 Removing the EG-08/16/20 Circuit Breakers

**WARNING:** Do not stand under the circuit breaker during the lowering operation.

**ADVERTISSEMENT:** Il est interdit de se tenir sous le disjoncteur durant l'opération de levage.

**CAUTION:** When using the switchgear hoist, do not unwind the cable completely from the drum. To lift the breaker, turn the hoist operating crank clockwise. To lower the breaker, turn the hoist operating crank counter-clockwise.

**ATTENTION:** Il ne faut pas dérouler complètement le câble du cylindre lorsque l'on utilise le treuil du dispositif de commutation. Tourner la manivelle opérant le treuil dans le sens des aiguilles d'une montre pour soulever le disjoncteur. Tourner la manivelle opérant le treuil dans le sens contraire des aiguilles d'une montre pour abaisser le disjoncteur.

To remove the EG-08/16/20 circuit breaker, proceed as follows:

1. With the door closed and latched, press and hold the trip button while sliding the racking cover open. Now release the trip button.
2. Insert the racking handle and rotate it counterclockwise until the breaker travels from CONNECT through TEST to the DISCONNECT position, as shown by the position indicator. This operation should be performed with the door closed. If the breaker closing spring is fully charged, it will be automatically discharged a few turns before the end of racking action.
3. Open the compartment door and fully extend the draw-out rails. Roll breaker out to rail stops. This is the WITHDRAWN position.
4. Before proceeding, visually check the breaker's spring charge and close indicators to verify that breaker is open and the springs are discharged.
5. Attach the lifting device and raise breaker off drawout rails.
6. Push the drawout rails back into the compartment.
7. Pull the breaker forward until the primary disconnects clear the compartment.
8. Lower the breaker onto a flat surface free of protrusions that could damage the breaker's internal parts. The back of breaker will be resting on the interference pins and guide.

### 5-5 Removing the EGS-32/40/50 Circuit Breakers

**WARNING:** Do not stand under the circuit breaker during the lowering operation.

**ADVERTISSEMENT:** Il est interdit de se tenir sous le disjoncteur durant l'opération de levage.

**CAUTION:** When using the switchgear hoist, do not unwind cable completely from the drum. To lift the breaker, turn the hoist operating crank clockwise. To lower the breaker, turn the hoist operating crank counter-clockwise.

**ATTENTION:** Il ne faut pas dérouler complètement le câble du cylindre lorsque l'on utilise le treuil du dispositif de commutation. Tourner la manivelle opérant le treuil dans le sens des aiguilles d'une montre pour soulever le disjoncteur. Tourner la manivelle opérant le treuil dans le sens contraire des aiguilles d'une montre pour abaisser le disjoncteur.

To remove EGS-32/40/50 breakers, proceed as follows:

1. With the door closed and latched, trip the breaker.
2. Rotate the racking access cover in the door, insert the racking handle and rotate it counterclockwise until the breaker travels from CONNECT through TEST to the DISCONNECT position, as shown by the position indicator. This operation should be performed with the door closed.
3. Open the door, depress the spring discharge lever (Fig. 5-11) to discharge breaker's closing springs and then fully extend the rails. While holding this lever depressed, pull the breaker all the way out to its WITHDRAWN position.
4. Before proceeding, visually check the breaker's spring charge and close indicators to verify that the breaker is open and the springs are discharged.
5. Attach lifting device to cutout notches in top wrap-around frame of the breaker, using care to prevent damage to the wiring.
6. Lift the breaker off the rails. Push the rails back into the compartment.
7. Pull breaker forward until primary disconnects clear the compartment. Lower breaker onto a flat surface free of protrusions that could damage the breaker's internal parts.



## 5-6 Installing and Removing EGF-08/16 Fused Circuit Breakers

Except for the open fuse lockout device and the integrally mounted fuses on the upper studs, the EGF-08 and -16 breakers are identical to the non-fused EGS-08 and -16 models. The procedural steps for installing and removing the EGF-08/16 breakers from the Entellisys switchgear equipment are the same as that described in paragraph 5-2 and 5-4 for non-fused EGS-08/16 breakers.

## 5-7. Installing Fuses on EGF-08/16 Circuit Breakers

The fuses on EGF-08/16 breakers are mounted on the line side primary disconnect conductors. The Class L fuses are mounted as shown in Fig. 5-12. Other than the 800A size, which has a single mounting hole per tang, each Class L fuse tang has two holes sized for one-half inch bolts.

Appendix G includes a tabulation of the range of fuse sizes available for these breakers including catalog numbers of Ferraz-Shawmut Fuses.

Class J fuses rated 300 through 600A have one mounting hole per tang. The 300, 350 and 400A sizes require copper adapter bars as shown in Fig. 5-13.

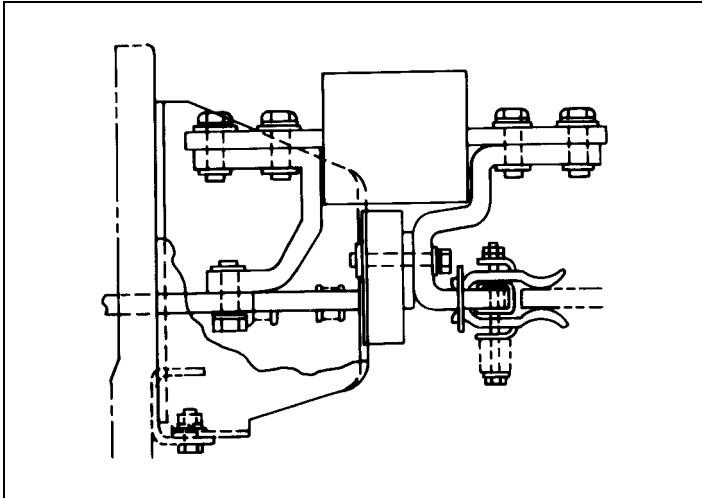


Fig. 5-12. Typical mounting for Class "L" fuse on EGF-08/16 breakers

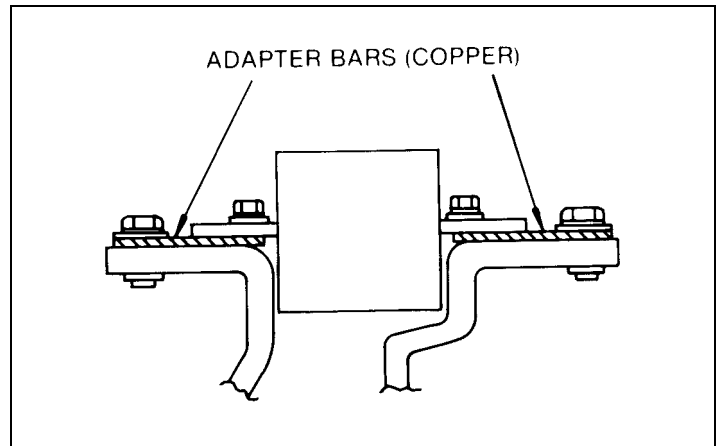


Fig. 5-13. Mounting for 300, 350, and 400-ampere Class "J" fuses on EGF-08 breakers

A special fuse is available for use with EGF-16 breakers. This fuse provides a melting time-current characteristic that coordinates with 1600A trip electronics. Compared physically with a 2500A, NEMA Class L fuse, the special fuse is more compact (shorter) and its tangs are specially configured and offset to achieve the required pole-to-pole fuse spacing. A special primary disconnect assembly mounts directly on the outboard tang of the fuse. Because of their unique mounting provisions, the following procedure should be adhered to when replacing these fuses (Fig. 5-14):

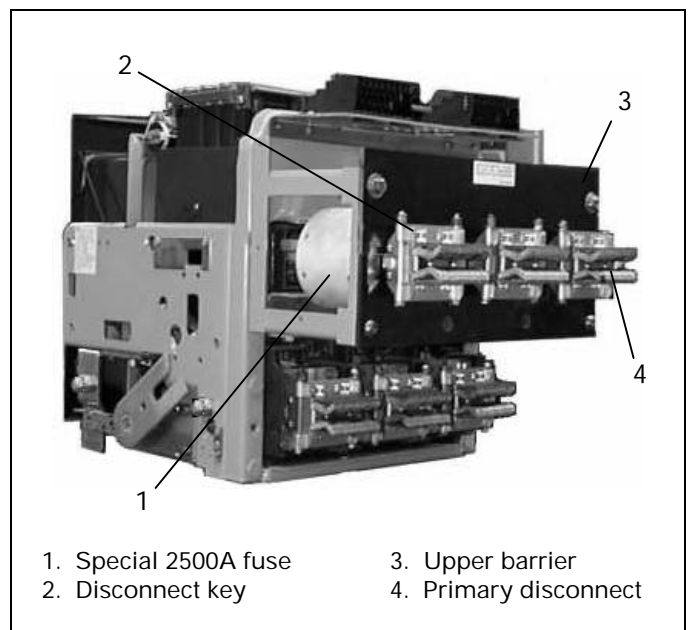


Fig. 5-14. EGF-16 breaker with special 2500-ampere fuse

# Entellisys Low-voltage Switchgear

## Chapter 5. Installing and Removing Circuit Breakers

1. Remove the primary disconnect assembly from the fuse tang. This is accomplished by first loosening the two keys (2), Fig. 5-14, via their holding screw and pulling them upward and out. After the keys are removed, pull the disconnect assembly off the end of the fuse tang.

**NOTE:** This removal does not disturb the disconnect's clamping force adjustment.

**NOTE:** Ce retrait n'affecte pas l'ajustement de la force de serrage du sectionneur.

2. Remove the upper barrier (3).
3. Detach the inboard end of the fuse by removing the two ½-13 NC bolts. A ratchet and socket with a short extension will be required.
4. Remove the fuse.
5. Install the new fuse by reversing the disassembly procedure. Ensure that the mating face of the fuse is clean.

**CAUTION:** When replacing the fuse in the right pole (plan view) of the breaker, note particularly that this fuse is mounted differently from the other two fuses. As shown in Fig. 5-15, for this phase the fuse is rotated 180 degrees about its axis so that its inboard tang is positioned beneath the breaker stud. This tang is offset with respect to the opposite end, (Fig. 5-16), so that rotating the fuse does not alter the position of the primary disconnect.

**ATTENTION:** Lorsqu'on procède au remplacement d'un fusible dans le pôle droit (vue de plan) du disjoncteur, prendre note que ce fusible en particulier est monté différemment des deux autres fusibles. Tel que montré à la Fig. 5-15 pour cette phase le fusible est tourné de 180° autour de son axe de façon à ce que son axe intérieur soit positionné sous le plot du disjoncteur. Cette queue est déplacée en tenant compte du bout opposé (Fig. 5-16), pour que le fusible en rotation n'altère pas la position du débranchement primaire.

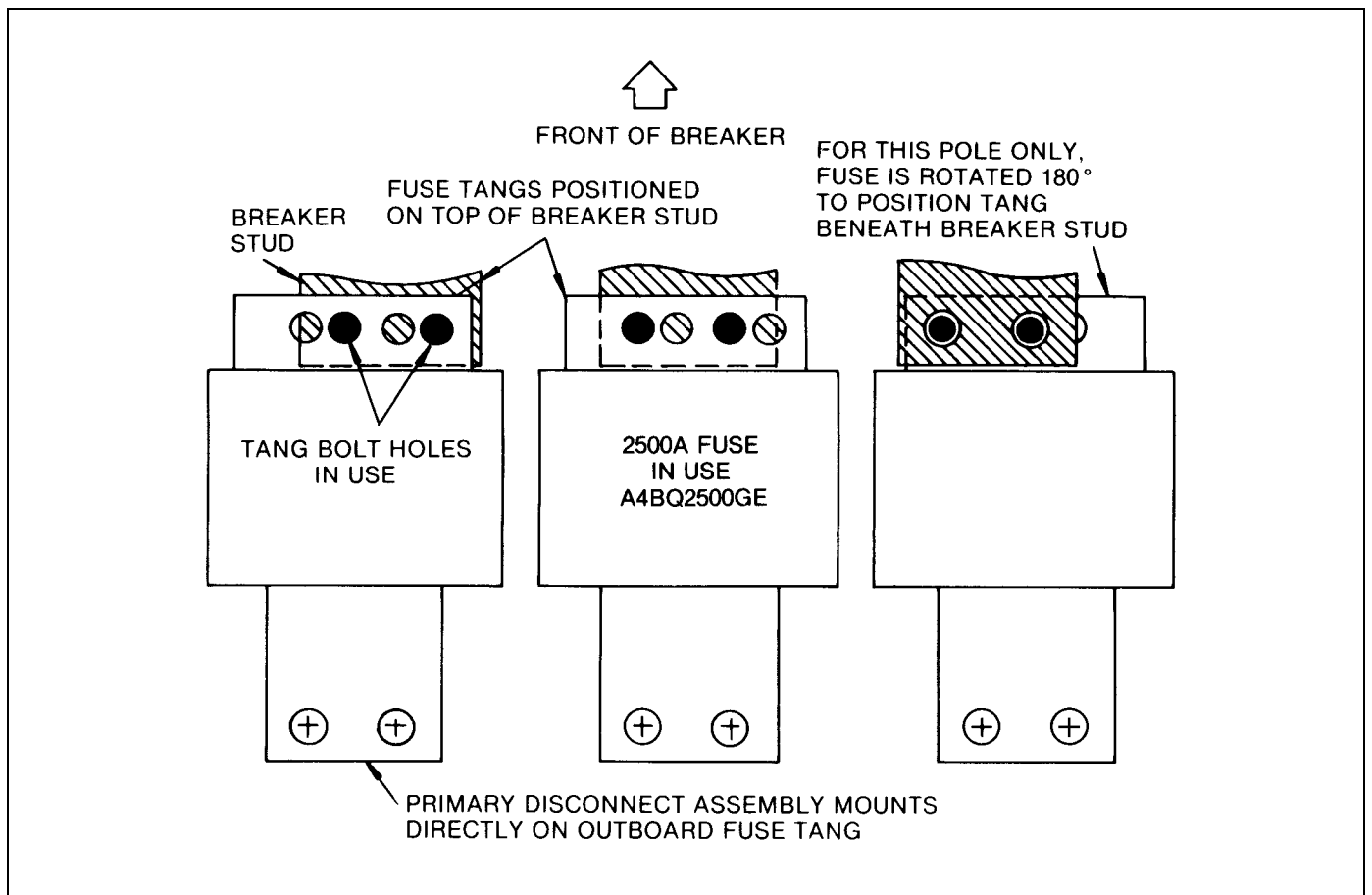


Fig. 5-15. Plan view of EGF-16 breaker showing 2500-ampere fuse tang positions

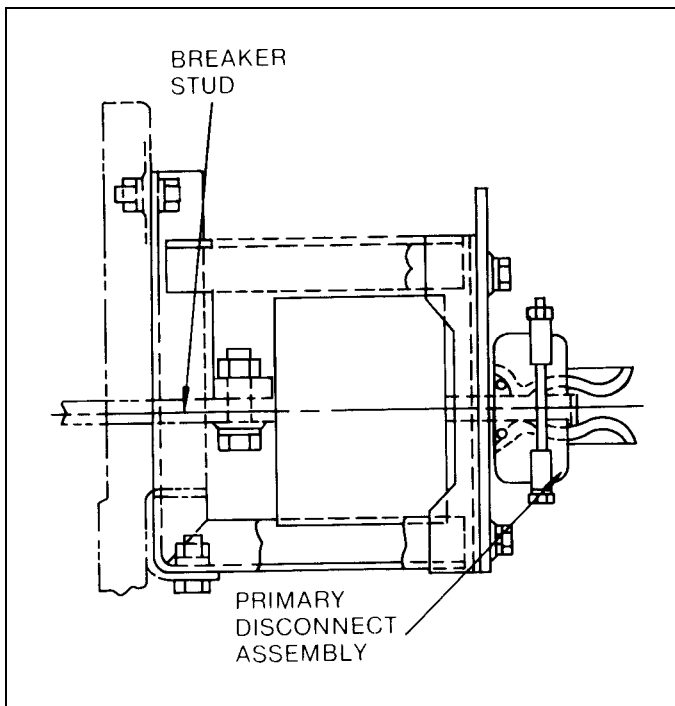


Fig. 5-16. Mounting for special 2500-ampere fuse on EGF-16 breaker

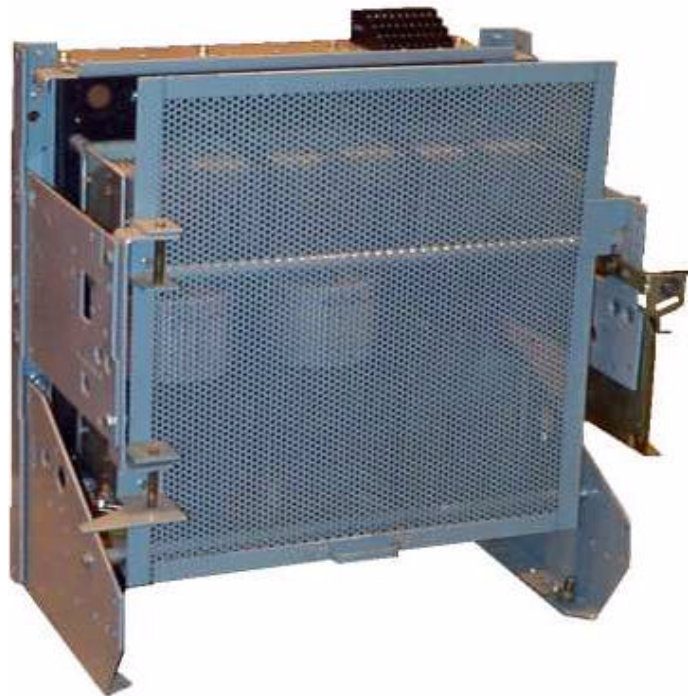


Fig. 5-17. Fuse rollout carriage (FRE) showing hinged, perforated steel screen panel

### **5-8 Installing and Removing Fuse Rollout Elements (FRE)-30-38-inch Wide Compartments**

The FRE is racked into and out of its compartment just like a breaker. However, the fuse and breaker compartments each are equipped with keylocks to prevent racking the FRE when its associated breaker is closed. The FRE also utilizes a rejection pin scheme similar to that used on EGS-32/40/50 breakers, to prevent installation of an incorrect FRE.

All FRE models feature a hinged, perforated steel screen panel in front of the fuses as shown in Fig. 5-17. This panel can be opened to allow access to the fuses, Fig. 5-18, only when the FRE is in the WITHDRAWN position. In all other positions, an interference plate attached to the right side of the panel prevents it from being opened. Operation of the breaker compartment keylock is the same for all models. With the breaker open, the key can be removed; this extends the lock bolt, thereby maintaining the breaker in a trip-free state while in the CONNECT position Fig. 5-20. The breaker can be racked at will regardless of the keylock position.

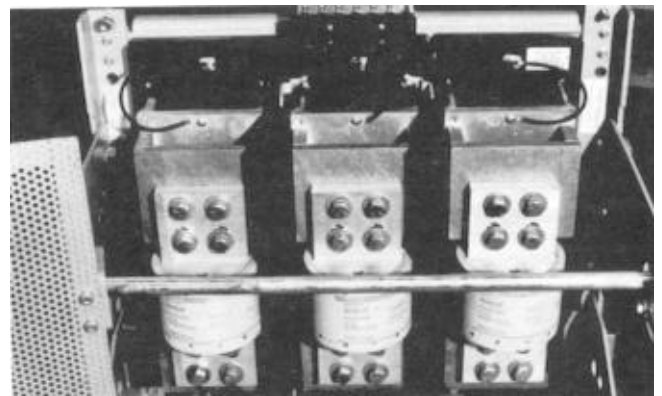


Fig. 5-18. View showing perforated panel open to allow easy access to fuses

The FRE compartment is **KEY INTERLOCKED** with the associated breaker. The FRE is locked in the connect position until a key is inserted in the FRE key interlock, Fig. 5-19, at this time the FRE can be racked out.

## ***Entellisys Low-voltage Switchgear***

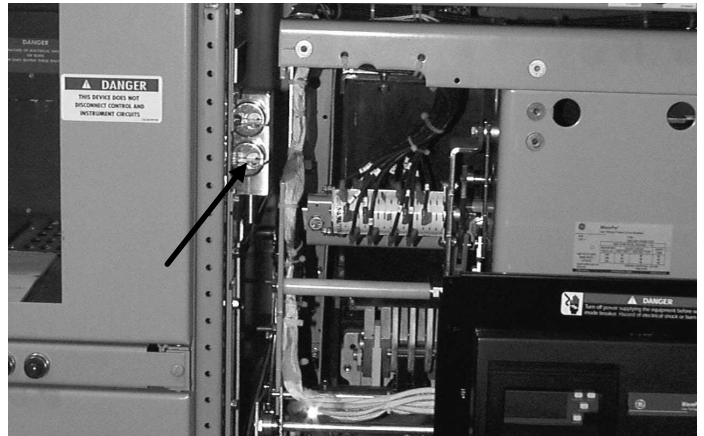
### ***Chapter 5. Installing and Removing Circuit Breakers***

The breaker is prevented from being closed until the key is reinserted and captured in the breaker compartment key interlock mechanism.

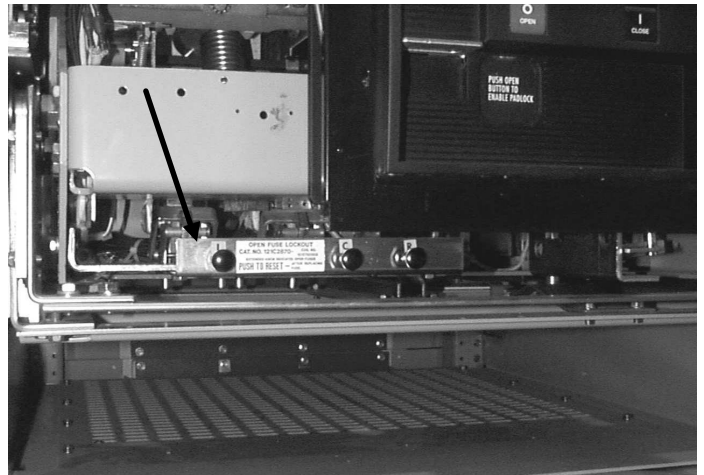
Secondary disconnects on the FRE provide the voltage signals across each fuse to the OPEN FUSE LOCKOUT DEVICE on the associated circuit breaker, Fig. 5-21.



*Fig. 5-19. View showing FRE key interlock locking FRE in connect position*



*Fig. 5-20. Key is captured in key interlock until breaker is opened*



*Fig. 5-21. View showing Open Fuse Lockout Device on the associated breaker*

## 6-1 General

After the equipment has been installed and all connections made, it must be tested and inspected before it is put in service. Although the equipment and devices have been tested at the factory, a final field test must be made to be sure that the equipment has been properly installed and that all connections are correct.

**WARNING:** The equipment must be completely de-energized while the tests are in progress.

**ADVERTISSEMENT:** L'équipement doit être complètement désamorcé lorsque l'on procède à des tests.

Directions for testing Entellisys instrumentation is provided in DEH-231 (Entellisys System User's Manual) and DEH-233 (Entellisys System Test Kit User's Manual.) The proper settings of Entellisys instrumentation are normally determined from a complete power system coordination study performed by the purchaser or their consultant; therefore, the settings of these devices must be made by the purchaser.

**NOTE:** The trip setting adjustment of the EntelliGuard Messenger for each circuit breaker may be in any position when shipped from the factory and must be correctly positioned prior to energization of the equipment.

**NOTE:** Les ajustements des réglages du disjoncteur peuvent être en n'importe quelle position lorsque celui-ci est expédié de l'usine et ils doivent être positionnés correctement avant que l'équipement ne soit mis sous tension.

The extent of the tests on the equipment as a whole will depend on the type and function of the equipment. Tests that should be performed, however, include circuit breaker operation, and switchgear meggering, phasing, and grounding checks.

High-potential tests to check the integrity of the insulation are not necessary if the installation instructions are carefully followed. If local codes demand this test, or the purchaser wishes to make high-potential tests, the voltage should not exceed 75 percent of the IEEE factory test voltage.

For the power circuit, the IEEE factory test voltage is two times switchgear rating plus 1,000 volts. See Table 6-1. Potential and control power transformers must be disconnected during high-voltage testing.

Switchgear Voltage Rating	ANSI Test Voltage, AC RMS	Field Test Voltage, AC RMS
600V	2200V	1650V
480V	1960V	1470V
240V	1480V	1110V

Table 6-1

## 6-2 Key Interlocks

After initial installation of the switchgear equipment, all necessary interlock keys should be inserted into the appropriate locks and all spare keys should be stored in a location in accordance with the owner's established procedures.

**CAUTION:** Refer to the key interlock schematic included in the summary furnished with the equipment to determine the sequence of operation and the correct number of operating keys required. This precaution is necessary since the improper use of spare keys will defeat the interlocking scheme.

**ATTENTION:** Référez-vous au schéma des clés de verrouillage inclus au sommaire fourni avec l'équipement pour déterminer les séquences d'opération et le nombre correct de clés d'opération requises. Cette précaution est nécessaire étant donné qu'un mauvais usage des clés de réserve rendra inopérant le programme de verrouillage.

## 6-3 Breaker Operation Test

All compartments housing EntelliGuard circuit breakers have a TEST position in which the breaker primary contacts are disconnected while the secondary contacts are still engaged. This TEST position permits complete testing of the electrical control circuit without energizing the primary power circuit. When the breaker is first put into service, its control circuit must be thoroughly tested while in this position to make sure that all closing and tripping circuits are complete and functioning properly.

The TEST position is not suitable for inspection and maintenance of the breaker and should therefore be used only for testing breaker operation.

Refer to the appropriate breaker instruction manual for other pre-operational checks on the breakers. See DEH-201 or DEH-202.

## 6-4 Entellisys System Test Kit

An Entellisys System Test Kit is required for testing Entellisys Low Voltage Switchgear functionality. The system test kit user manual is DEH-233.

#### ***6-5 Final Steps to Be Taken Before Energizing Equipment***

The following steps should be taken before energizing the equipment:

- 1.** Manually exercise all switches, circuit breakers, and other operating mechanisms to make certain they are properly aligned and operate freely.
- 2.** Conduct an electrical insulation resistance test to make sure the switchgear is free from short circuits and grounds. This should be done both phase-to-ground and phase-to-phase with the switches or circuit breakers both opened and closed. This test should be performed with a 1000-volt megger. Disconnect all control circuits before checking resistance.
- 3.** Check for secure mounting and wiring connections at Entellisys instrumentation.
- 4.** Using the Entellisys HMI, exercise all EntelliGuard breakers to determine all devices work correctly. See DEH-231 for instructions on using the Entellisys HMI.
- 5.** Test all protection functions using the Entellisys System Test Kit. See DEH-233 for instructions.
- 6.** Make certain that field wiring is clear of live bus and, where necessary, physically secured to withstand the effects of fault currents.
- 7.** Check to determine that all grounding connections are made properly.
- 8.** Remove all debris, scrap wire, etc., from the switchgear interior before closing the enclosure.
- 9.** Install covers, close doors, and make certain that no wires are pinched and that all enclosure parts are properly aligned and tightened.

## **7-1 Circuit Breaker Operation**

### **General**

Included below are abbreviated operating instructions for EntelliGuard circuit breakers. Before activation of the circuit breakers or operation of the switchgear equipment, thoroughly read, and be familiar with, the circuit breaker manuals that will be supplied as supplementary information to this manual. Publication numbers are: DEH-201 and DEH-202.

### **Manually Operated Breakers**

#### **Closing Manually Operated EntelliGuard Circuit Breakers**

Manually operated EntelliGuard breakers are equipped with an integral charging handle and a push button marked CLOSE on the front of the escutcheon. The spring must be charged first.

1. FOR EG-08/16/20 BREAKERS - A complete charge is accomplished by pulling the handle down about 90° (until it stops) five-six times to fully charge the closing springs. *This will not close the breaker contacts.* The charge indicator will show CHARGED on a yellow background.
2. FOR EG-32/40/50 BREAKERS - These breakers require the handle to be pulled down eight times to fully charge the springs. The charge indicator will show CHARGED on a yellow background.

#### **Opening Manually Operated EntelliGuard Breakers**

A mechanically operated, double insulated open button, mounted on the breaker escutcheon, operates the trip shaft to open the breaker. The breaker may also be opened by the Entellisys HMI.

### **Electrically Operated Breakers**

The breakers may be closed by a mechanically operated, double insulated push-button switch on the breaker escutcheon or by the Entellisys HMI. Fuses are located in the breaker compartment, just behind the door.

#### **Electrically Opening EntelliGuard Breakers**

Electrically operated EntelliGuard breakers are equipped with both a shunt trip and a flux shifter for opening the breaker. A normally open auxiliary switch "A" contact opens the shunt trip control circuit after the breaker opens, preventing damage to the device. The shunt trip and flux shifter operate in response to OPEN and TRIP commands, respectively, from the HMI breaker control screen.

## **7-2 Circuit Breaker Drawout Operation**

### **Breaker Positions**

Refer to Fig. 7-1. The drawout operation features four positions:

1. CONNECT - In the CONNECT position, the primary and secondary disconnects are fully engaged. The breaker must be opened before it can be racked out of this position.
2. TEST - When in the TEST position, the primary contacts are disconnected, but the secondary contacts remain engaged. This allows complete breaker operation without energizing the primary circuit.
3. DISCONNECT - In the DISCONNECT position, neither primary or secondary contacts are made. Breakers may be racked between these three positions with the compartment door closed and latched.
4. WITHDRAWN - With the door open, the breaker can be rolled out manually from the DISCONNECT to the WITHDRAWN position. Here, the breaker is completely out of its compartment, ready for removal.



*Fig. 7-1. EntelliGuard circuit breaker  
Shown in DISCONNECT position*



# Entellisys Low Voltage Switchgear

## Chapter 7. Operating the Switchgear

### Drawout Operation

All breakers are supported on the drawout rails mounted on the sidewalls of the breaker compartments. On EntelliGuard breakers, two wheels on each side of the breaker rest on each drawout rail.

Motion is provided by a mechanism mounted on the breaker. This mechanism drives racking cams that engage pins anchored to each side of the compartment.

The cams are driven by a removable racking handle that engages the mechanism. On small frame breakers, the handle is inserted through an opening in the breaker escutcheon; on large frame breakers, the handle is inserted in an opening in the upper right side of the door.

Turning the handle in a clockwise direction drives the breaker into the compartment. As the breaker disconnect fingers engage the stationary studs, a high force will be felt. Turn the racking handle as far as it will go to be sure the disconnect fingers are completely engaged.

The position indicator in the breaker escutcheon gives the position of the breaker as it moves through the door cutout.

### 7-3 Front Doors

#### Operation

The front access doors on all standard Entellisys Switchgear are hinged and equipped with a ¼-turn latch, Fig. 7-3. To open the door, rotate the knob clockwise ¼ turn.

#### Removal and Installation

Refer to Fig. 7-3 and remove/install switchgear front doors.

#### Door Removal

To remove the Entellisys Switchgear door, proceed as follows:

1. Open door.
2. Loosen the two screws holding the top hinge pin plate and allow the pin to drop out of the hinge block. See Fig. 7-3.
3. Move the top of the door away from the switchgear, avoiding the door stop and lift the door out of the lower hinge pin socket. Retain the washer from the bottom hinge pin.

#### Door Installation

To install the Entellisys Switchgear door, proceed as follows:

1. Insert washer, then place lower hinge pin into hinge pin socket on switchgear. See Fig. 7-3.
2. Swing door open, position behind door stop and align hinge pin socket.
3. Insert the hinge pin into the upper hinge block and tighten the two screws.

4. Close the door.



Fig. 7-2. Entellisys switchgear front access doors are hinged with a rotary-type latch

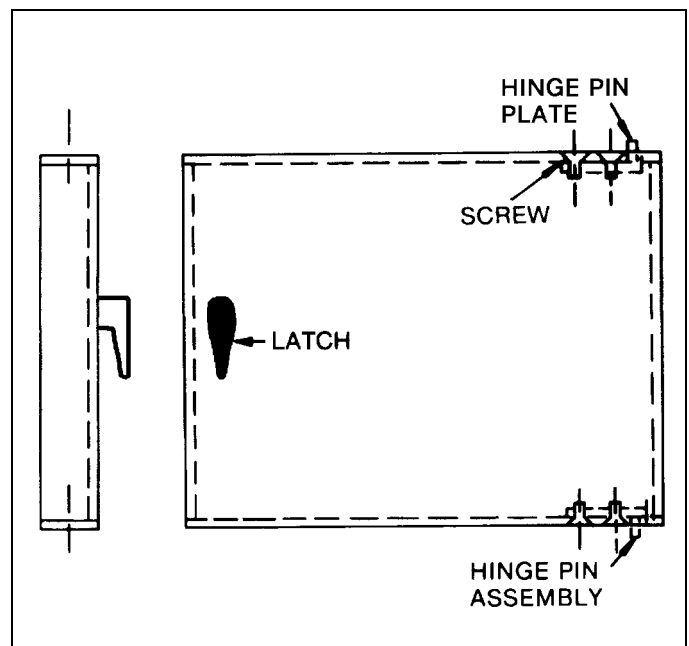


Fig. 7-3. Drawing showing front access details



## 7-4 Entellisys Switchgear Accessories

### Future Circuit Breaker Compartments

Breaker compartments designed for future use are complete and ready to use. These breaker compartments have a steel panel to cover the door cutout, Fig. 7-4. To prepare the circuit breaker compartment for use, remove the steel outer cover.

**WARNING:** Terminals behind the steel barrier may be energized.

**AVERTISSEMENT:** Il se peut que les bornes à l'arrière de la barrière d'acier soient sous haute tension.



Fig. 7-4. Future-use breaker compartments

### Circuit Breaker Key Interlock

#### General

A circuit breaker key interlock is available to provide protection against unauthorized operation. See Fig. 7-5. The key interlock is mounted with two one-way screws and lockwashers on the left side of the breaker compartment.

The interlock system is designed so that the key may be removed from the lock only when the breaker is tripped and the lock bolt is extended. With the bolt extended, the breaker is rendered trip free only in the CONNECT position in this compartment.

The breaker may be operated (open, trip, charge, close) in the TEST position even when the lock bolt is extended and the key removed.

#### Key Interlock Operation Check

The operation of the key interlock should be checked as follows:

1. With the breaker in the CONNECT position, manually trip the breaker. This then allows the interlock trip slide to be pushed in. When the trip slide is in, the lock

bolt may be extended and the key removed. The breaker will remain trip free in the CONNECT position until the key is returned and the lock bolt is retracted.



Fig. 7-5. View showing circuit breaker key interlock to provide protection against unauthorized operation

2. If desired, the breaker may be moved to either the TEST position while the key is removed from the lock. In these positions, the breaker can be operated for checking or maintenance.

### Test and Disconnect Padlock Device

#### General

**WARNING:** This padlock lockout does not provide equipment de-energization, isolation and grounding required for maintenance personnel safety. See instruction book DEH-203 or DEH-204 for details.

**AVERTISSEMENT:** Le mécanisme de verrouillage à cadenas ne fournit pas la mise hors tension adéquate de l'équipement, l'isolation et la mise à la terre requis pour assurer la sécurité du personnel de maintenance. Voir les instructions DEH-203 ou DEH-204 pour les détails.

A test and disconnect rackout mechanism padlock device is available to prevent unauthorized racking of the breaker. The rackout mechanism for circuit breakers and FRE may be locked in either the DISCONNECT or TEST position.



Fig. 7-6. Test & disconnect position padlock device (EG-08/16/20 breakers)

#### **Padlocking the EG-08/16/20 Breakers. (See Fig. 7-6.)**

To padlock these breakers, proceed as follows:

1. The circuit breaker compartment door must be opened to put the padlock on; however, there is no interference with the door after the padlock has been placed in position.
2. With breaker moved to the appropriate position, push down on the sliding lock plate until its holes are aligned with those in the stationary plate. Insert and lock the padlocks.



Fig. 7-7. Racking mechanism padlock device (EGS-32/40/50 breakers)

#### **Padlocking the EG-32/40/50 Breakers & EG-32/40/50 FRE Fuse Rollout Element (See Fig. 7-7.)**

1. The circuit breaker compartment door must be opened to put the padlock on; however, there is no interference with the door after the padlock has been placed in position.

2. The device will permit locking the breaker in the DISCONNECT or TEST position. Hasps, which pivot on the corner post in combination with the circuit breaker crank interlock, prevent movement of the breaker from its locked position.
3. Align the appropriate hasp (front hasp for DISCONNECT position or rear hasp for the TEST position), insert, and lock the padlock.



Fig. 7-8. Compartment padlock device (EG-08/16/20, EG-32/40/50 EG-32/40/50 FRE compartments)

#### **Padlocking the EG-08/16/20, EG-32/40/50, EG-32/40/50 FRE Compartments (See Fig. 7-8.)**

1. The circuit breaker compartment door must be opened to put the padlock on; however, there is no interference with the door after the padlock has been placed in position.
2. Padlocks will prevent the acceptance of breakers or FRE in the compartment

### **Installing and Removing Current Transformers**

**WARNING:** Do not operate any current transformer with secondaries open-circuited. Be sure to short-circuit secondary before moving a current transformer.

**AVERTISSEMENT:** Tout transformateur de courant ne doit pas être opéré avec les secondaires dans un état de circuits ouverts. Assurez-vous de court-circuiter les secondaires avant de bouger un transformateur de courant.

Phase current transformers (CT's) in Entellisys Low Voltage Switchgear are mounted on the stationary primary disconnect studs in the breaker compartment and are readily accessible for inspection and replacement. Neutral current transformers, if present, are located in the bus compartment or in the transition section.

Care must be exercised when installing or removing phase current transformer mounting screws so as not to strip the holes in the plastic base. Do not torque screws over five in/lbs.

### Removing Shutter Units

Visual inspection of primary disconnects and CT's can be made by first removing the breaker and opening the shutters manually. This is done by pressing the left and right hand actuating rollers toward the rear of the compartment simultaneously. This is a two-handed operation.

If it is necessary to perform work on the primary disconnects or CT's, it will be necessary to remove the entire shutter unit.

**WARNING:** Unless the proper precautions are taken, the removal of a shutter unit presents the hazard of electrical shock and burn. Do not remove the shutter unit unless the equipment has been de-energized. Failure to do this can result in serious injury.

**ADVERTISSEMENT:** A moins que les précautions nécessaires ne soient prises, l'installation d'une unité à volet présente des risques de choc électrique ou de brûlure. Il ne faut pas installer l'unité à volet à moins que l'équipement ait été désamorcé. L'omission de ce faire peut résulter en blessures sérieuses.

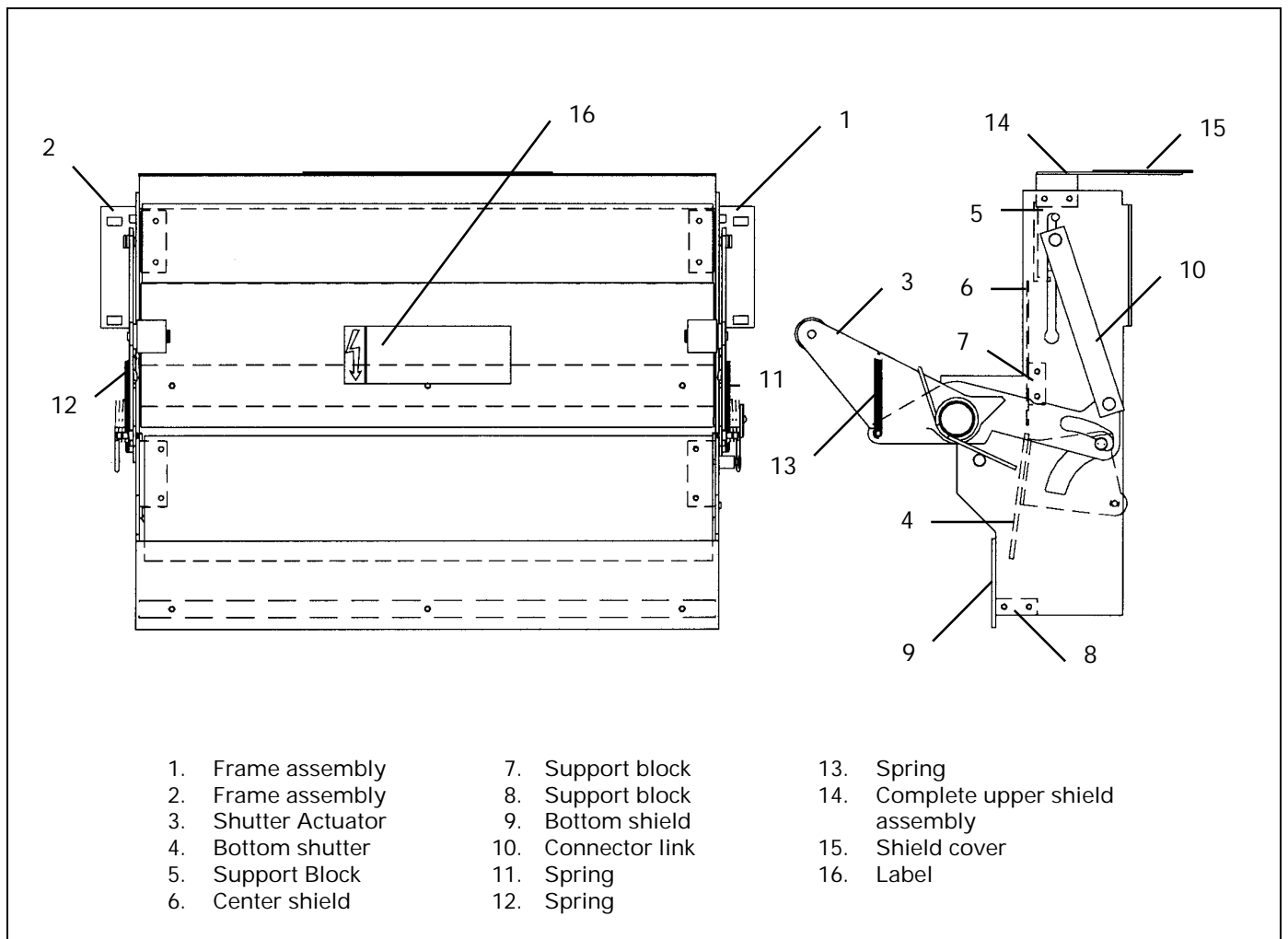


Fig. 7-9. Entellisys circuit breaker shutter unit (EGS-08/16 breakers)

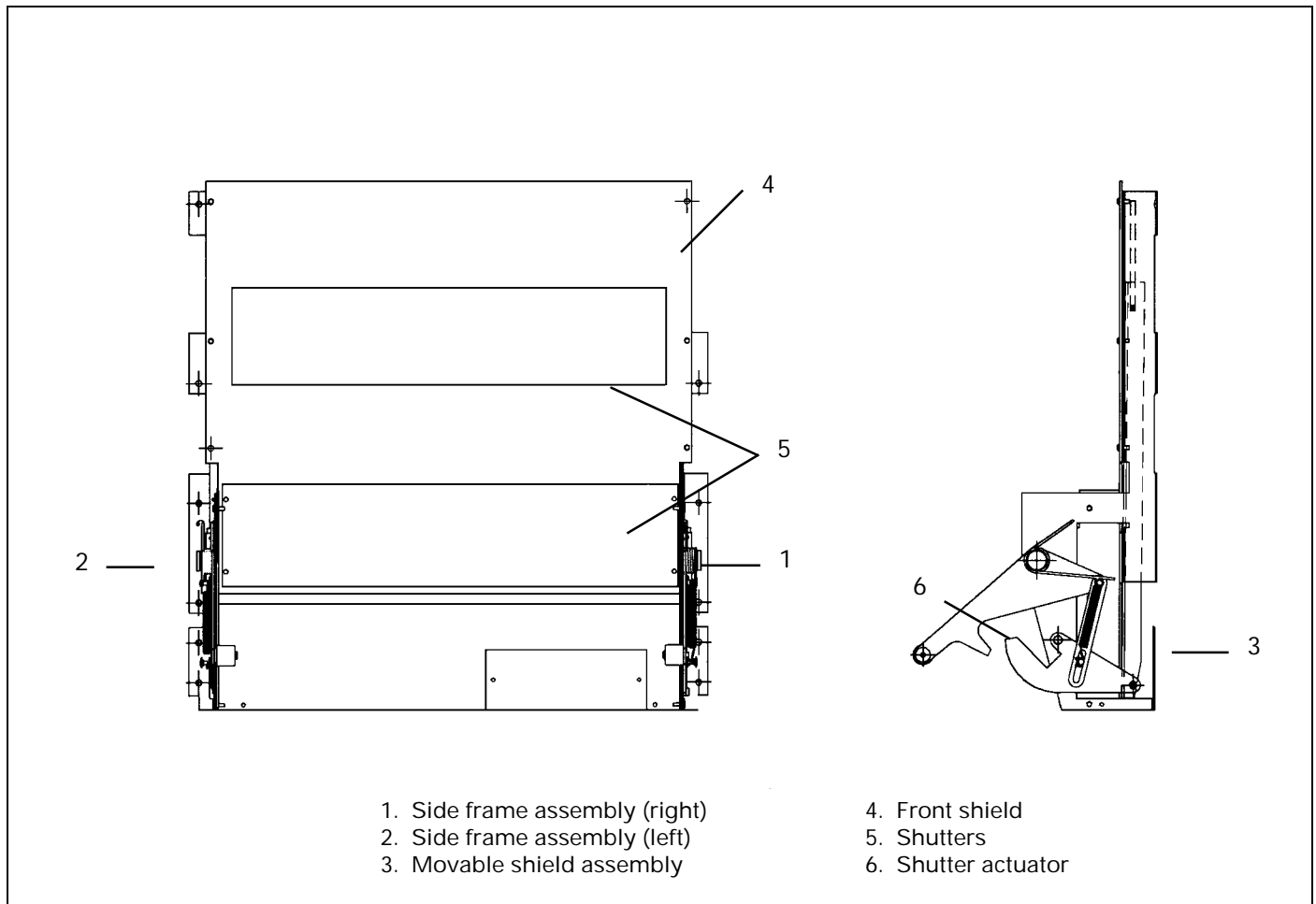


Fig. 7-10. Entellisys circuit breaker shutter unit (EG-32/40/50 breakers)

#### Removing an EG-08/16/20-Shutter Unit

To remove these shutter units, proceed as follows:

1. The shutter unit frame is mounted on the vertical stringers located at each side of the rear of the breaker compartment. See Fig. 7-9. In extended compartments, the shutter is mounted to extension brackets.
2. If it is present, remove the Clamp Circuit, mounted on the left hand side sheet. Remove the twelve wires from the two terminal blocks, and then remove the ¼-inch hex head screws from the enclosure.
3. Take out two 1/4-inch hex head screws on each side of the frame. A socket wrench with a 3/8-inch driving head with 4-inch extension will be needed.
4. Carefully remove the entire shutter frame.

5. The frame is then maneuvered forward past the cam plates on each side, then upward and forward over the cam pins.

#### Removing an EG-32/40/50 or Fuse Roll Out Shutter Unit

To remove these shutter units, proceed as follows:

1. The shutter unit frame is mounted to the vertical stringers located at each side of the rear of the breaker compartment. See Fig. 7-10.
2. Take out 11 ¼-inch hex head screws from the frame. A socket wrench with a 3/8-inch driving head with an 8-inch extension will be needed. See Fig. 7-10.
3. Carefully remove the entire shutter frame.

#### Installing a Shutter Unit

**WARNING:** Unless the proper precautions are taken, the installation of a shutter unit presents the hazard of electrical shock and burn. Do not install the shutter unit unless the equipment has been de-energized. Failure to do this can result in serious injury.

**ADVERTISSEMENT:** A moins que les précautions nécessaires ne soient prises, l'installation d'une unité à volet présente des risques de choc électrique ou de brûlure. Il ne faut pas installer l'unité à volet à moins que l'équipement ait été désamorcé. L'omission de ce faire peut résulter en blessures sérieuses.

#### Installing an EG-08/16/20 Shutter Unit

To install these shutter units, proceed as follows:

1. Carefully maneuver the shutter frame into the compartment, first lifting it over the cam pins on each sidewall and past the cam plates.
2. Position the rear flanges of the shutter frame against the vertical stringers at the rear corners of the compartment.
3. Align the holes in the flange and drive in four 1/4-inch hex head screws using a 3/8-inch driver and a socket wrench with a 4-inch extension.

4. If it was present, reinstall the Clamp Circuit. Reconnect the 12 wires in the same positions as they were before. Reattach the enclosure to the side sheet using 1/4"-inch hex head screws
5. Check the operation of the moveable shutters by pressing the left and right hand actuating rollers toward the rear of the compartment.

#### Installing an EG-32/40/50 or Fuse Rollout Shutter Unit

To install these shutter units, proceed as follows:

1. Carefully maneuver the shutter frame into the compartment.
2. Position the rear flanges of the shutter frame against the vertical stringers at the rear corners of the compartment.
3. Align the holes in the flange and drive in eleven 1/4-inch hex head screws using a 3/8-inch driver and a socket wrench with 8-inch extension.
4. Check the operation of the moveable shutters by pressing the left and right hand actuating rollers toward the rear of the compartment.

### **8-1 Before Energizing**

Before switchgear is energized, a thorough final check should be made using the following checklist: Refer to section 6-5 for additional information.

- Breakers and other operating mechanisms exercised
- Electrical insulation resistance tested phase-to- phase and phase-to-ground
- Entellisys instrumentation properly connected
- Electrically operated breakers and operating mechanisms tested
- Ground fault protection system tested
- Protection settings properly set and tested.
- Field wiring secured and free of live bus
- Grounding connections made
- All debris, scrap wire, etc. removed
- All covers installed, doors closed and latched

### **8-2 Energizing Procedures**

**CAUTION:** Energizing switchgear for the first time is potentially dangerous. Therefore, qualified electrical personnel should be present when the equipment is energized. If problems caused by damage or poor installation practices have not been detected in the checkout procedure described previously, serious damage can result when power is turned on.

**ATTENTION:** La mise sous tension pour la première fois d'un dispositif de commutation est un acte potentiellement dangereux. Il faut donc que du personnel qualifié en électricité soit présent lorsque l'équipement est mis sous tension. Si lors de la procédure de vérification décrite précédemment des problèmes causés par des dommages ou de mauvaises pratiques d'installation n'ont pas été détectés, il peut en résulter des dommages sérieux lorsque le contact est établi.

1. There should be no load on the switchgear when it is energized.
2. Turn off all of the downstream loads, including those such as motor control centers and other devices that are remote from the switchgear.
3. The equipment should be energized in sequence by starting at the source end of the system and working toward the load end. In other words, energize the main devices, then the feeder devices, and then the branch-circuit devices.
4. Turn the devices on using the Entellisys HMI.

## 9-1 Maintenance Requirements

### General

A periodic maintenance schedule must be established to obtain the best service from the switchgear. Under the conditions of a clean and dry environment, a check of the switchgear devices and all connections should be made once every two years. Equipment subject to highly repetitive operation or to a dusty or humid environment may require more frequent maintenance.

A permanent record of all maintenance work should be kept. The record should include a list of periodic checks and tests made, the date they were made, the condition of the equipment, and any repairs or adjustments that were performed. Maintenance employees must follow all recognized safety practices, such as those contained in the National Electric Safety Code, ANSI C2-1981 and in company or other safety regulations.

**WARNING:** Solid insulation surrounding an energized conductor and power apparatus must never be relied upon to provide protection to personnel.

**ADVERTISSEMENT:** Il ne faut pas se fier à une isolation solide entourant un conducteur mis sous tension et à la puissance de l'appareillage pour fournir une protection aux membres du personnel.

For specific information regarding the maintenance of circuit breakers and Entellisys instrumentation, refer to the instruction book furnished with each device.

## 9-2 Breaker and Instrument Compartments

Periodic inspection of the circuit breaker is recommended at least once a year. More frequent inspections are recommended where severe load conditions, dust, moisture or other unfavorable conditions exist, or if the vital nature of the load warrants it. Always inspect the breaker after a short-circuit current has been interrupted.

### Breakers

#### Test for Proper Operation

Test and inspect all circuit breakers for proper operation as follows:

1. Operate each breaker while in the TEST position and check all functions. This is particularly important for breakers that normally remain in either the opened or closed positions for long periods of time.

**WARNING:** Primary equipment must be completely de-energized while tests on control circuits, etc. are being conducted. Be sure that all areas of feedback from secondary circuits, as well as outside sources, are disconnected.

**ADVERTISSEMENT:** Il faut que l'équipement primaire soit complètement désamorçé lorsque des tests sont

effectués sur des circuits de contrôle, etc. Assurez-vous que toutes les aires de rétroaction des circuits secondaires de même que les sources extérieures soient débranchées.

2. Remove the breakers from their compartments to a clean maintenance area. Close compartment door and cover the breaker cutout to prevent access to live parts.

**WARNING:** De-energize equipment completely before doing maintenance work on any devices, connections, bus work, breaker or feeder cable compartments. This includes de-energizing any connections to outside primary or secondary sources, such as transformers, tie lines, etc.

**ADVERTISSEMENT:** Désamorcer complètement l'équipement avant d'effectuer du travail de maintenance dans les compartiments. Cela inclut le désamorçage de toute connexion aux sources primaires et secondaires, telles que les transformateurs et les interconnexions.

### Checks After Breaker Is De-energized

At the time of inspection, the following checks should be made after the breaker has been de-energized.

1. Manually operate the breaker several times, checking for obstructions or excessive friction. Manual closing of an electrically operated breaker may be performed by the following two steps:
  - a. For the EG-32/40/50 frame breakers, raise the breaker frame off the work surface to ensure the spring discharge interlock is not depressed. To charge the mechanism springs, pull the operating handle down until it stops (about 90°) five-six times for the EG-08/16/20 and eight times for the EG-32/40/50 frame. The charge indicator will show CHARGED on a yellow background.
  - b. Depress the CLOSE button on the front of the breaker. The springs should discharge and, if the latch is properly reset, the breaker will close.
2. Electrically operate the breaker several times to check performance of the electrical accessories.
3. Visually check for loose hardware on the breaker. Also, check the bottom of the compartment for any hardware that has fallen from the breaker.
4. Remove and inspect the arc quenchers and contacts for breakage or excessive burning.
5. Check insulating parts for evidence of overheating and for cracks that indicate excessive thermal aging.

Refer to circuit breaker instruction manuals for detailed maintenance instructions and information for replacement of parts. See DEH-203, DEH-204, DEF-004 or DEF-005.

### Lubrication

In general, the circuit breaker requires moderate lubrication. Bearing points and sliding surfaces should be lubricated at the regular inspection periods with a thin film of lubricant D6A15A2. Before lubricating, remove any hardened grease and dirt from latch and bearing surfaces with mineral spirits then wipe with a clean rag.

**CAUTION:** All excess lubricant should be removed with a clean cloth to avoid accumulation of dirt or dust.

**ATTENTION:** Il faut enlever complètement tout excès de lubrifiant avec un linge propre afin d'éviter l'accumulation de saletés ou de poussières.

On drawout breakers, the contact surface of the disconnect fingers should be cleaned and greased with lubricant D6A15A2 as well.

### Entellisys Instrumentation and Instrument Transformers

Check and inspect all devices to see that they are functioning properly. Check that all electrical connections are tight. Check mounting of the device.

### Breaker Compartment Interiors

**WARNING:** De-energize equipment completely before doing maintenance work in compartments. This includes de-energizing any connections to outside primary or secondary sources, such as transformers, tie lines, etc.

**ADVERTISSEMENT:** Mettre l'équipement complètement hors tension avant d'entreprendre tout travail de maintenance sur tout dispositif, raccordement, barres omnibus ou les compartiments des câbles d'alimentation. Cela inclut la mise hors tension des raccordements aux sources primaires et secondaires tels que les transformateurs et les interconnexions.

1. Thoroughly clean the interior of the breaker and instrument compartments. Use a vacuum cleaner and clean rags only. Do not use steel wool or oxide papers. Blowing with compressed air is not recommended.
2. Check indicating devices, mechanical and key interlocks.
3. Check primary disconnecting device contacts for signs of abnormal wear or overheating. Discoloration of the silvered surfaces is not ordinarily harmful. These contacts should be cleaned only by wiping with a lint-free cloth.
4. Clean the racking mechanism and lubricate with lubricant D6A15A1.
5. Before replacing the breaker, wipe off the primary disconnecting device contacts. Apply a thin coat of lubricant D6A15A1 to the stationary studs and to the primary disconnects on the breaker.

### 9-3 Bus Area

**WARNING:** De-energize equipment completely before doing maintenance work on any devices, connections, bus work, breaker or feeder cable compartments. This includes de-energizing any connections to outside primary or secondary sources, such as transformers, tie lines, etc.

**ADVERTISSEMENT:** Désamorcer complètement l'équipement avant d'effectuer du travail de maintenance dans les compartiments. Cela inclut le désamorçage de toute connexion aux sources primaires et secondaires, telles que les transformateurs et les interconnexions.

Inspect and check the bus area as follows:

1. Inspect the buses and connections carefully for evidence of overheating or weakening of the insulating supports. If bus insulation is present, remove the molded covers over the main bus connection to expose joints for inspection.
2. Check all connection bolts in the bus compartment and all bracing bolts for tightness. See the Torque Table A-1 in Appendix A.
3. Vacuum and, with a clean rag, wipe the buses and supports.
4. Visually inspect the insulation on the bars that run from the breaker studs through the bus structure to the cable area.
5. After cleaning, megger and record the resistance to ground and between phases of all insulated bars and all buses and connections. Disconnect all control circuits before checking resistance. Do not apply greater than 1500 volts with the megger. Since definite limits cannot be given for satisfactory insulation resistance values, a record must be kept of the readings.

Weakening of the insulation from one maintenance period to the next can be recognized from the recorded readings. The readings should be taken under similar conditions each time, if possible, and the record should include the ambient temperature and humidity.

### 9-4 Cable and Busway Compartment

Inspect and check the cable and busway compartment as follows:

1. Inspect all power cable connections for signs of overheating and tighten all connections. If severe discoloration or if damage is apparent, remove the damaged portion of the cable.

**CAUTION:** Be sure the condition that caused the overheating has been corrected before energizing.



**ATTENTION:** Assurez-vous que la condition ayant causé le surchauffement a été corrigée avant de mettre sous tension.

2. Check all bolts that hold cable terminals to the connection bars for tightness.
3. Check the neutral bus and ground bus connection and mounting bolts for tightness.
4. Check that all secondary control wiring connections are tight and that all control cabling is intact.

## 9-5 Overall Switchgear

Make the following checks on the complete switchgear equipment.

1. Clean and inspect all painted surfaces and retouch where necessary.
2. Check to see that all anchor bolts and other structural bolts are tight.
3. Check that all breaker and instrument compartment door latches operate properly.
4. If the switchgear is equipped with heaters, check to see that all heaters are energized and operating.
5. For exterior vent openings in equipment furnished with air filters, the foam filter elements should be removed and washed in warm soapy water, rinsed, and reassembled at least annually. Elements should be inspected before re-assembly and replaced if any signs of deterioration are evident.

## 9-6 Paint Refinishing

Indoor switchgear is finished with ANSI-61 gray acrylic enamel paint. To refinish damaged areas, remove all loose paint, rust, scale, oil or grease. Sand any scratches smooth using 220 grit paper or finer.

—Apply a coat of acrylic enamel primer with a viscosity of approximately 24-32 seconds using a #2 Zahn cup. Reduce with thinner if needed. Air-dry the primer for a minimum of 30 minutes, and then apply the finish color coat of acrylic enamel. The topcoat should be applied within 24 hours for best adhesion.

—If the area is to be spray-coated, thin the acrylic enamel. This thinning should only be necessary if the paint was received in a five-gallon drum or more. The recommended viscosity for the enamel topcoat should be 24-32 seconds with a #2 Zahn cup. Both the primer and paint should be applied only when temperature is above 55 degrees Fahrenheit.

—Application of special paint will be per the manufacturer's Product Data Sheet that includes instructions on thinning and application.

## 9-7 Circuit Breaker Lifting Mechanism

Under normal conditions, no special maintenance procedures or lubrication is required for this device. If the cable is abraded under any condition, it should be inspected for broken strands or other damage and replaced if necessary.

## Entellisys Low Voltage Switchgear

### Appendix A. Torque Values

**Table A-1—Torque Values for Low-voltage Equipment Electrical Joint Hardware other than Cable Terminals (Copper, Tin or Silver Plated)**

Hardware Size	Torque* (ft/lbs) Standard Nut with Conical Spring Washer or Lock washer
¼-20	7-10
3/8-16	25-30
½-13	35-40
5/8-11	45-55

\*These torque values are for non-lubricated threads

Caution should be exercised when installing parts or components to the compartment molded base. Torque 1/4-inch screws slowly and do not exceed nine ft/lbs.

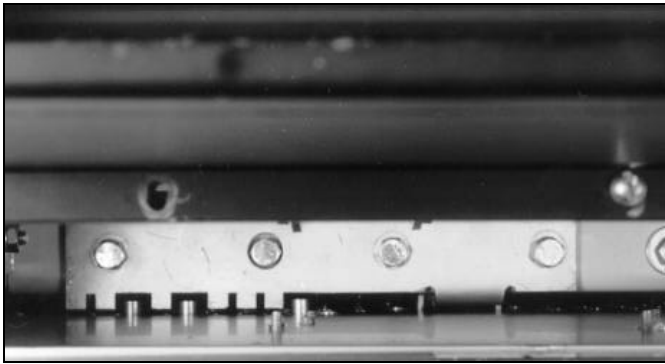
**Table A-2—Torque Values for Self-threading Screws in Plastic**

Wire Size	Torque* (in/lbs)
6 5 4 3	100
3 2 1	125
0 00	150
000 0000 200,000	200
250,000 300,000 350,000 400,000	250
500,000 600,000 700,000 750,000	300
800,000 900,000 1,000,000	400
1,250,000 1,500,000 1,750,000 2,000,000	500

\*These torque values are for non-lubricated threads.

### **General**

In general, EntelliGuard breakers of the same type and rating are interchangeable in their equipment compartments. Similarly, breakers may be installed into equipment compartments designed for breakers having lower ratings. Breakers are intentionally made uninstallable into compartments for breakers with higher ratings.. To prevent inserting the wrong type breaker into a drawout compartment, unique "rejection hardware" is affixed to each breaker and its compartment. The rejection is accomplished by tabs or pins on the bottom of the breaker backframe and tabs or pins on the top of the pan in the equipment compartment.



*Fig. B-1. Breaker-mounted rejection plate*

### **22-inch Wide Compartment**

Figure B-1 (EG-08/16/20 breaker family) shows the breaker-mounted rejection tabs located on the bottom left side of the backframe.

When a wrong type breaker is inserted into a compartment, the breaker tabs and equipment pins interfere, preventing the breaker from rolling into the DISCONNECT position.

Breakers may be interchanged in one direction only. Specifically:

1. Any EG-08/16/20 breaker can be inserted into an EGS-08 compartment.
2. An EGX-08, EGH-16, EGS-20 or EGF-20 can be inserted into an EGH-08 compartment.
3. An EGS-20 or EGF-20 may be inserted into an EGX-08 or EGH-16 compartment
4. An EGH-16, EGS-20, or EGF-20 may be inserted into an EGS-16 compartment
5. An EGF-20 may be inserted in an EGS-20 compartment

The rejection hardware prevents the converse of the above.

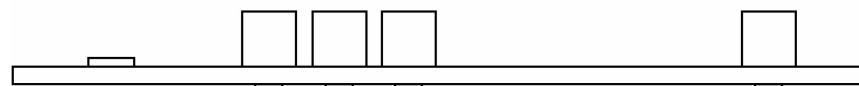
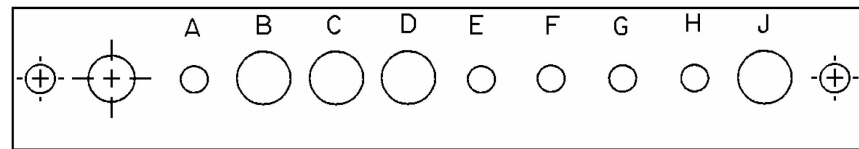
Figure B-2 shows the rejection pin combinations employed for the various breaker models and frame sizes.

# Entellisys Low Voltage Switchgear

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## Appendix B. Circuit Breaker Rejection Features

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EGX-08 shown

Circuit Breaker	Rejection Pin Position								
Type	A	B	C	D	E	F	G	H	J
EGS-08	○	○	○	●	○	○	○	○	●
EGH-08	○	●	○	●	○	○	○	○	●
EGX-08	○	●	●	●	○	○	○	○	●
EGF-08	○	●	●	●	○	○	○	●	●
EGS-16	●	○	○	●	○	○	○	○	●
EGH-16	●	●	○	●	○	○	○	○	●
EGF-16 <2500A	●	●	○	●	○	○	○	●	●
EGF-16 2500A	●	●	○	●	○	○	○	○	●
EGS-20	●	●	●	●	○	○	○	○	●
EGF-20	●	●	●	●	○	○	○	●	●

- Pin
- No Pin

Fig. B-2. Rejection pin pattern code for EG-08/16/20 breakers

The rejection tabs logic shown above is for EntelliGuard™ breakers only. Rejection pin patterns on the breakers prevent their installation into AKD-10™ equipment compartments. Likewise, rejection pins in Entellisys equipment compartments prevent installation of WavePro™ breakers.

### 30 & 38-inch Wide Compartment

EG-32/40/50 breakers and fuse rollouts for Entellisys switchgear include means to prevent improper interchange of these 3200-, 4000-, and 5000-ampere sizes. Interference hardware on each breaker and in its compartment, cause the compartment to accept the correct breaker type and reject breakers with lower ratings.

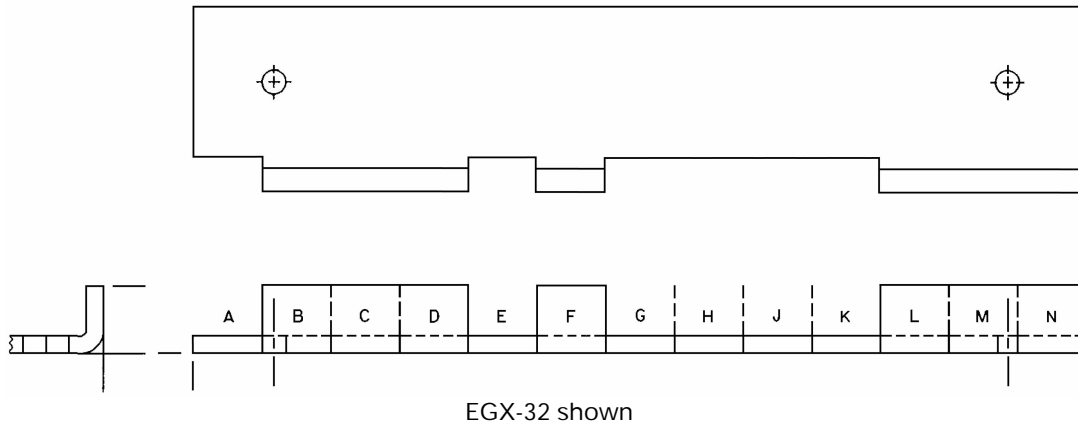
Interchangeability within and between frame sizes is prevented by the rejection system of Fig. B-3. When the wrong type breaker is inserted into a compartment, the breaker pins and the equipment tabs interfere. Breakers may be interchanged in one direction only.

Specifically:

1. Any EG-32 or EG-40 can be inserted into an EGS-32 compartment.

2. An EGX-32 or EGX-40 can be inserted into an EGH-32 compartment.
3. An EGX-40 can be inserted into an EGX-32 compartment.
4. An EGF-40 can be inserted into an EGF-32 compartment.
5. An EGX-40 or EGF-40 may be inserted into an EGS-40 compartment.
6. An EGX-50 or EGF-50 can be inserted into an EGS-50 compartment.

Figure B-3 shows the rejection pin combinations for 3200A, 4000A, and 5000A breakers and fuse rollout elements.



Circuit Breaker			Rejection Tab Position													
Type	OFLO	Volts	A	B	C	D	E	F	G	H	J	K	L	M	N	
EGS-32	N	600Vac	○	○	○	●	○	●	○	○	○	○	○	●	●	●
EGH-32	N	600Vac	○	●	○	●	○	●	○	○	○	○	○	●	●	●
EGX-32	N	600Vac	○	●	●	●	○	●	○	○	○	○	○	●	●	●
EGF-32	Y	600Vac	●	○	●	●	○	●	○	○	○	○	○	●	●	●
EGS-40	N	600Vac	○	○	○	●	○	●	○	●	○	○	○	●	●	●
EGX-40	N	600Vac	○	●	●	●	○	●	○	●	○	○	○	●	●	●
EGF-40	Y	600Vac	●	○	●	●	○	●	○	●	○	○	○	●	●	●
EGS-50	N	600Vac	○	○	○	●	○	●	○	●	○	●	○	●	●	●
EGX-50	N	600Vac	○	●	●	●	○	●	○	●	○	●	○	●	●	●
EGF-50	Y	600Vac	●	○	●	●	○	●	○	●	○	●	○	●	●	●
EG-32 FRE	-	600Vac	●	○	○	●	○	○	○	○	○	●	○	○	○	●
EG-40 FRE	-	600Vac	○	●	●	○	○	○	○	○	○	●	○	○	○	●
EG-50 FRE	-	600Vac	○	●	●	○	○	○	○	○	○	●	○	○	○	●

● = Tab  
○ = No Tab

Fig. B-3. Rejection tab pattern code for EG-32/40/50 breakers and FRE

## ***Entellisys Low Voltage Switchgear***

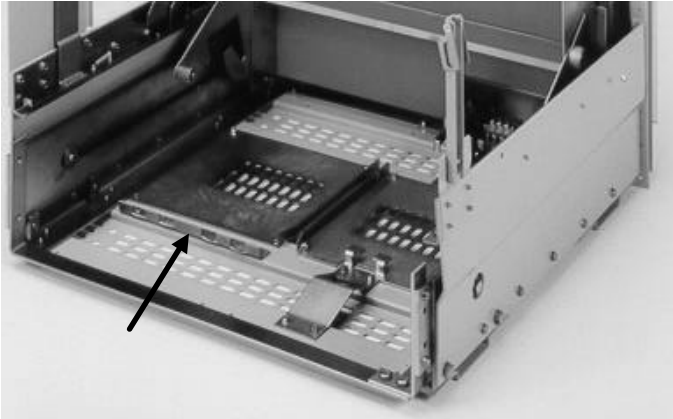
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### ***Appendix B. Circuit Breaker Rejection Features***

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The rejection tab logic shown in Fig. B-3 is for EntelliGuard breakers only. Rejection pin patterns on the breakers prevent their installation into AKD-10™ equipment compartments. Likewise, rejection pins in Entellisys equipment compartments prevent installation of WavePro™ breakers

Figure B-4 shows the EG-32/40/50 rejection system.



*Fig. B-4. View showing EG-32/40/50 rejection angles*

#### ***Fuse Rollout Elements***

Fuse rollout (FRE) elements used in conjunction with the EGF-32 (3200 ampere), EGF-40 (4000 ampere), or EGF-50 (5000 ampere) breakers employ the same type drawout mechanism as their companion breakers and utilize the same type of rejection system. Only a 3200-ampere fuse rollout element may be installed in a 3200-ampere fuse rollout compartment; only a 4000-ampere fuse rollout element may be installed in a 4000-ampere fuse rollout compartment; only a 5000-ampere fuse rollout element may be installed in a 5000-ampere fuse rollout compartment. The rejection pin pattern is shown on Fig. B-3.

# Entellisys Low Voltage Switchgear

## Appendix C. Circuit Breaker Ratings

Frame Size (Amperes)	Breaker Type	System Nominal Voltage (60 HZ AC)	Three-phase Short Circuit Rating RMS Symmetrical kA		
			Short Time Withstand	With Instantaneous Trip	Without Instantaneous Trip
800	EGS-08	600	30	30	30
		480	30	30	30
		240	30	42	30
800	EGH-08	600	42	42	42
		480	42	42	42
		240	42	50	42
800	EGX-08	600	50	50	50
		480	65	65	65
		240	65	65	65
1600	EGS-16	600	42	42	42
		480	50	50	50
		240	50	65	50
1600	EGH-16	600	65	65	65
		480	65	65	65
		240	65	65	65
2000	EGS-20 / EGF-20	600	65	65	65
		480	65	65	65
		240	65	65	65
3200	EGS-32 / EGF-32	600	65	65	65
		480	65	65	65
		240	65	85	65
3200	EGH-32	600	85	85	85
		480	85	85	85
		240	85	130	85
3200	EGX-32	600	85	85	85
		480	100	100	100
		240	100	130	100
4000	EGS-40 / EGF-40	600	85	85	85
		480	85	85	85
		240	85	130	85
4000	EGX-40	600	85	85	85
		480	100	100	100
		240	100	130	100
5000	EGS-50 / EGF-50	600	85	85	85
		480	85	85	85
		240	85	130	85
5000	EGX-50	600	85	85	85
		480	100	100	100
		240	100	130	100

Table C-1-General Circuit Breaker Ratings

Frame Size (Amperes)	Breaker Type	Rated Maximum Voltage AC (60 Hz)	CLF Fuse Rating (Amperes)		Interrupting Rating RMS Symmetrical kA
			Min	Max	
800	EGF-08	600	300	1600	200
1600	EGF-16	600	450	2500	200

Table C-2—Integrally Fused Circuit Breaker Ratings

## Entellisys Low Voltage Switchgear

### Appendix D. Circuit Breaker Accessory Devices

#### Shunt Trip

The Shunt Trip allows the breaker to be opened remotely by the EntelliGuard Messenger™. It is always provided on electrically operated breakers. The catalog number and operating voltage for the Shunt Trip are listed in Table D-1. For installation instructions see DEH168 or DEH169.

Breaker Rating	Catalog Number	Voltage Rating
800A – 2,000A	WPS1SF60120	120 Vac, 60 Hz
3,200A – 5,000A	WPS1LF60120	120 Vac, 60 Hz

Table D-1. Catalog number and electrical rating for the Shunt Trip accessory.

The Shunt Trip causes the circuit breaker to trip when its coil is energized. An “A” auxiliary switch, which is closed when the breaker is closed, is in series with the Shunt Trip coil, as illustrated in Figure D-1. The external tripping source is connected to positions 5 and 7 on the secondary disconnect.

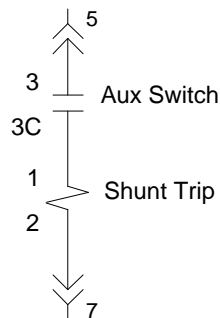


Figure D-1. Shunt Trip connections to the Secondary Disconnect.

#### Charging Motor

The Charging Motor provides a means of electrically charging the springs that close the breaker. The Charging Motor is available only as a factory-installed option. It is always provided on electrically operated breakers.

The circuit breaker closing springs are charged automatically when 120Vac is applied to terminals 8 and 17 of the secondary disconnect. When the springs are fully charged, a cutoff switch automatically de-energizes the motor. The closing springs will recharge automatically after the breaker closes.

Breaker Rating	Catalog Number	Voltage Range, Vac
800A – 2,000A	568B596G5	104–127
3,200A – 5,000A	568B596G2	104–127

#### Remote Close

The Remote Close accessory provides a means of remotely closing the circuit breaker after the closing springs have been charged. It is always provided on electrically operated breakers. The catalog number and operating voltage for the Remote Close accessory are listed in Table D-2. For installation instructions see DEH-172 or DEH-173.

Breaker Rating	Catalog Number	Voltage Rating
800A – 2,000A	WPRCSF60120	120 Vac, 60 Hz
3,200A – 5,000A	WPRCLF60120	120 Vac, 60 Hz

Table D-2. Catalog number and operating voltage for the Remote Close accessory.

A circuit breaker equipped with the Remote Close accessory can be closed remotely by applying control voltage to terminals 9 and 18 of the secondary disconnect.

The Remote Close accessory is continuously rated and has an antipump feature that prevents a motor-operated breaker from repeatedly closing if the closing signal is maintained. The closing control voltage must be removed for 1–2.5 seconds and then reapplied for each breaker closure.

#### Open-Fuse Lockout

The Open-Fuse Lockout is supplied on integrally fused breakers or when the breaker is used in combination with a Fuse Rollout Element. When any fuse blows, the Open-Fuse Lockout trips the breaker to prevent single-phasing. This accessory is available only as a factory-installed option.

The Open-Fuse Lockout contains an individual trip solenoid for each pole, connected directly across the fuse in that phase. When any fuse blows, its solenoid is energized and trips the breaker. An indicator shows which fuse has blown. The breaker is mechanically trip-free and cannot be reclosed until the Open-Fuse Lockout is reset.

The Open-Fuse Lockout is internally wired to the fuses on 800- and 1,600-ampere frame breakers. On 2,000-, 3,200-, 4,000-, and 5,000-ampere frame breakers, the Open-Fuse Lockout is wired to the secondary disconnect as illustrated in Figure D-3. The Open-Fuse Lockout connects to the fuses in a Fuse Rollout Element through the secondary disconnect.



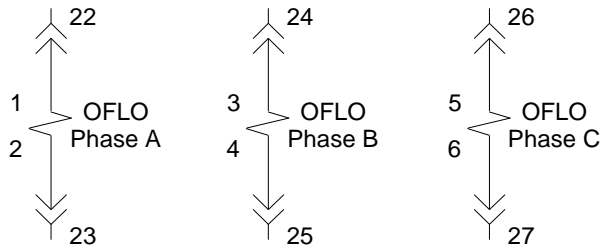


Figure D-3. Open-Fuse Lockout (OFLO) connections to the Secondary Disconnect for EGS-20, -32, -40, and -50 breakers.

### Bell Alarm with Lockout

The Bell Alarm with Lockout prevents closing of the breaker after a protection trip until the Bell Alarm with Lockout is reset. It contains a set of switch contacts to remotely indicate that the circuit breaker has tripped because of a protection trip. Catalog numbers for the Bell Alarm with Lockout module and kit are given in Table D-3. For installation instructions and trouble-shooting, see DEH-238 or DEH-239.

Breaker Rating	Kit Catalog Number	Module Catalog Number
800A – 2,000A	EGBLALMSFKIT	EGBLALMRPLC
3,200A – 5,000A	EGBLALMLFKIT	

Table D-3. Catalog numbers for the Bell Alarm with Lockout module and kit.

The accessory is activated and its status circuit changes state whenever the breaker is tripped by an overcurrent, ground fault, or protective relay function via the EntelliGuard Messenger™. The EntelliGuard Messenger continuously monitors the state of the status circuit. The connections of the Bell Alarm with Lockout to the secondary disconnect are illustrated in Figure D-4. A trip caused by the manual OPEN button or by the Shunt Trip does not activate the Bell Alarm with Lockout.

The Bell Alarm with Lockout must be reset by manually depressing the target on the breaker escutcheon. This will return the Bell Alarm with Lockout status contact to its normal configuration and allow the breaker to be closed.

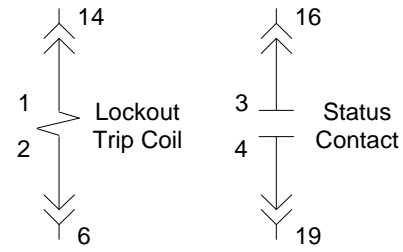


Figure D-4. Bell Alarm with Lockout connections to the Secondary Disconnect. The contact is shown in the reset state.

### Network Interlock

The Network Interlock provides a means of locking out a breaker to coordinate its operation with other breakers in the distribution network. When activated by the EntelliGuard Messenger™, the Network Interlock prevents the breaker from closing. When the EntelliGuard Messenger issues a reset signal, the breaker is able to close either remotely or locally. The Network Interlock contains a set of switch contacts to remotely indicate the state of the lockout and, thus, whether or not the breaker can be closed. Catalog numbers and the operating voltage for the Network Interlock are listed in Table D-4. For installation instructions and trouble-shooting, see DEH-41119

Breaker Rating	Kit Catalog Number	Module Catalog Number
800A – 2,000A	EGNTWKSFKIT	EGNTWKSFRPLC
3,200A – 5,000A	EGNTWKLFKIT	EGNTWKLFRPLC

Table D-4. Catalog numbers and control voltage for the Network Interlock accessory.

The Network Interlock consists of a trip circuit, a reset circuit, and a status circuit. The device connections to the secondary disconnect are shown in Figure D-5. Note that a Bell Alarm with Lockout and a Network Interlock cannot be installed concurrently in a breaker.

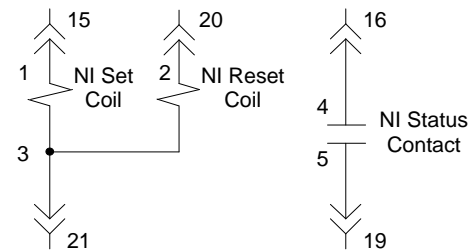


Figure D-5. Network Interlock connections to the Secondary Disconnect

## Entellisys Low Voltage Switchgear

### Appendix E. Circuit Breaker Weights

Device	Net Weight, lb. (kg)	
	Manual	Electrical
EGS/EGH/EGX-08	188 (86)	193 (88)
EGF-08	233 (106)	238 (108)
EGS/EGH-16	198 (90)	203 (92)
EGF-16	243 (111)	248 (113)
EGS-20	203 (92)	208 (95)
EG-32	455 (207)	470 (214)
EG-40	560 (255)	575 (261)
EG-50	600 (273)	615 (280)
2000 Ampere Fuse Rollout	250 (114)	-
3200-Ampere Fuse Rollout	350 (159)	-
4000-Ampere Fuse Rollout	400 (182)	-
5000-Ampere Fuse Rollout	450 (205)	-

Table E-1. Circuit Breaker/Fuse Rollout Element Weights

### Appendix F. Circuit Breaker Repetitive Duty Data

#### General

Circuit breakers are designed primarily to perform the function of circuit interruption under short-circuit conditions. Nevertheless modern circuit breaker mechanisms are capable of many operations under full-load operation and in-rush

conditions such as encountered in motor starting applications. Industry standards have been established for the minimum performance that is indicated in Table F-1. With adequate maintenance, breakers can be expected to exceed the standards.

Circuit Breaker Frame Size (Amperes)	Number of Operations Between Servicing	Number of Operations Rated Continuous Current Switching* (1) (2) (3) (4) (5) (6) (7) (8) and (10)	Number of Operations No-Load Closing and Opening* (1) (2) (3) (4) (5) (6) and (7)	Number of Operations In-Rush Current Switching* (3) (4) (5) (6) (7) (9) and (10)
800	1750	2800	9700	1400
1600	500	800	3200	400
2000	500	800	3200	400
3000	250	400	1100	—
4000	250	400	1100	—
5000	250	400	1100	—

\*Refer to lettered paragraphs under NOTES.

Table F-1. Repetitive Duty and Normal Maintenance

#### Notes

Power operated circuit breakers, when operating under usual service conditions, shall be capable of operating the number of times specified in Table F-1. The operating conditions and

the permissible effect of such operations upon the breaker are given in the following lettered paragraphs. For each column, all paragraphs listed in the column heading must be given consideration.

## Entellisys Low Voltage Switchgear

### Appendix F. Circuit Breaker Repetitive Duty Data

This standard applies to all parts of a circuit breaker that function during normal operation. It does not apply to other parts, such as overcurrent tripping devices, that function only during infrequent abnormal circuit conditions.

1. Servicing consists of adjusting, cleaning, lubricating, tightening, etc., as recommended by the manufacturer. When current is interrupted, dressing of contacts may be required as well. The operations listed are on the basis of servicing at intervals of 6 months or less.
2. When closing and opening no-load.
3. With rated control voltage applied.
4. Frequency of operation not to exceed 20 in 10 minutes or 30 in an hour. Rectifiers or other auxiliary devices may further limit the frequency of operation.
5. Servicing at no greater intervals than shown in Column 2 of Table F-1.
6. No functional parts should have been replaced during the listed operations.
7. The circuit breaker should be in a condition to carry its rated continuous current at rated maximum voltage and

perform at least one opening operation at rated short-circuit current. After completion of this series of operations, functional part replacement and general servicing may be necessary.

8. When closing and opening current up to the continuous current rating of the circuit breaker at voltages up to the rated maximum voltage and at 85% power factor or higher.
9. When closing currents up to 600% and opening currents up to 100% (80% power factor or higher) of the continuous current rating of the circuit breaker at voltages up to the rated maximum voltage.

When closing currents up to 600% and opening currents up to 600% (50% power factor or less) of the continuous current rating of the circuit breaker at voltages up to rated maximum voltage, the number of operations shown shall be reduced to 10% of the number listed.

10. If a fault operation occurs before the completion of the listed operations, servicing is recommended and possible functional part replacements may be necessary, depending on previous accumulated duty, fault magnitude, and expected future operations.

### Appendix G. Fuses for EGF-08/16 and FRE Elements

NEMA Fuse Class 600V, 60 Hz	Breaker Type EGF		Ampere Rating	Gould Shawmut Fuse Cat. No.
	08	16		
"J"	X	—	300*	A4J300
	X	---	350*	A4J350
	X	X	400*	A4J400
	X	X	450	A4J450
	X	X	500	A4J500
	X	X	600	A4J600
"L"	X	X	800	A4BY800
	X	X	1000	A4BY1000BG
	X	X	1200	A4BY1200BG
	X	X	1600	A4BY1600BG
	—	X	2000	A4BY2000
Welder Limiter	X	X	800	A4BX800
	X	X	1600	A4BX1600BG
	---	X	2000	A4BX2000
Special	—	X	2500	A4BQ2500GE

\*Mounting adapter required.

Table G-1. Fuses for Integrally Fused EntelliGuard Breakers

Ampere Rating	Fuse Size		Fuse Cat. No's Gould Shawmut
	Min.	Max.	
3200	2000A	4000A	A4BY2000-55BA
4000	2000A	5000A	A4BQ2500-55BA
5000	2000A	5000A	A4BY3000-55BA
			A4BY4000-55BA
			A4BY5000-55BA

Table G-2. Fuses for Roll-out Fuse Carriages

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**ABB Inc.**

Electrification Services  
305 Gregson Dr.  
Cary, NC 27511 USA

For further information, please visit:

**[www.electrification.us.abb.com/services](http://www.electrification.us.abb.com/services)**

For service, call:

1-888-434-7378 (US)

1-540-387-8617 (International)

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