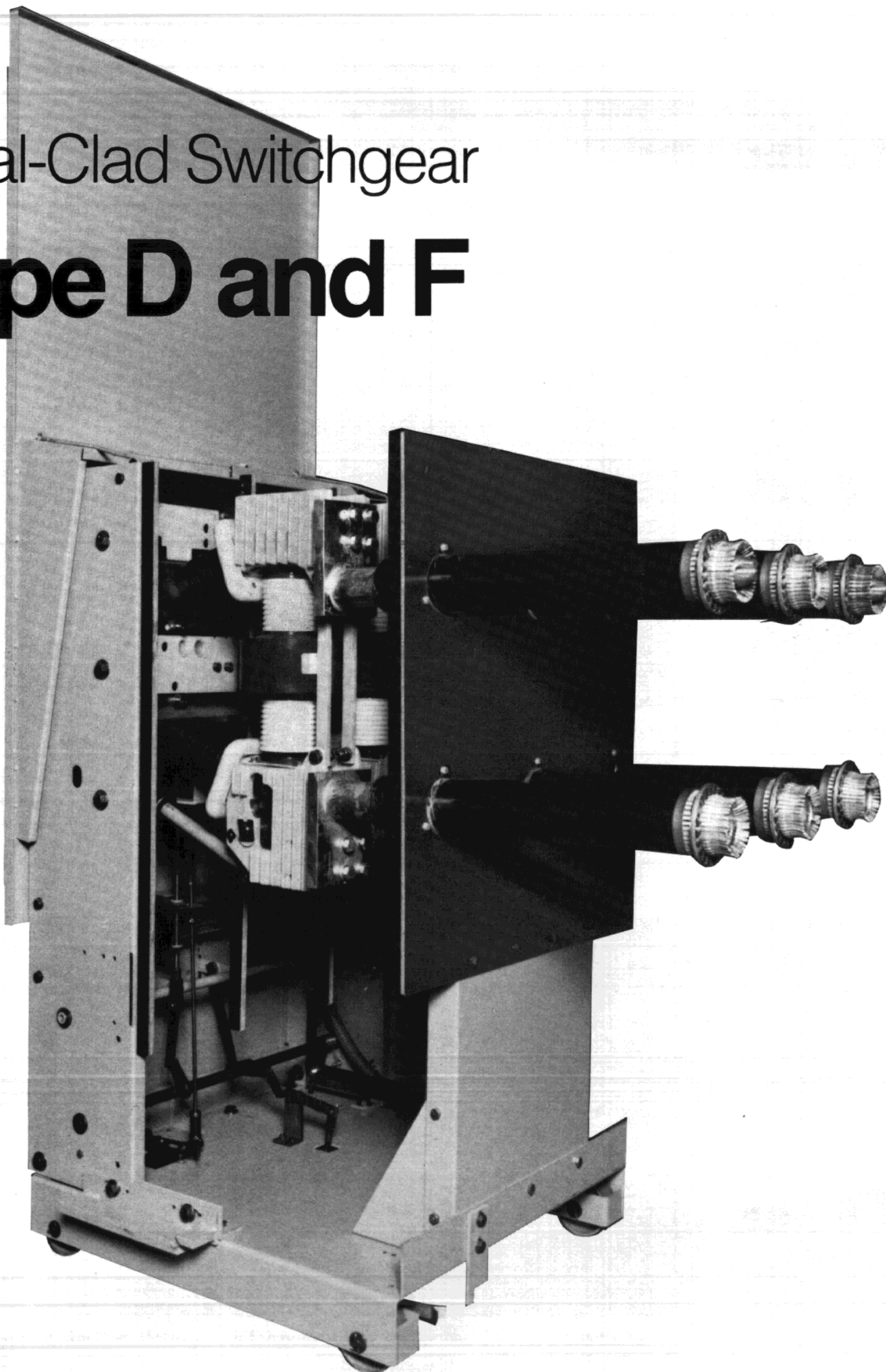


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Metal-Clad Switchgear

Type D and F



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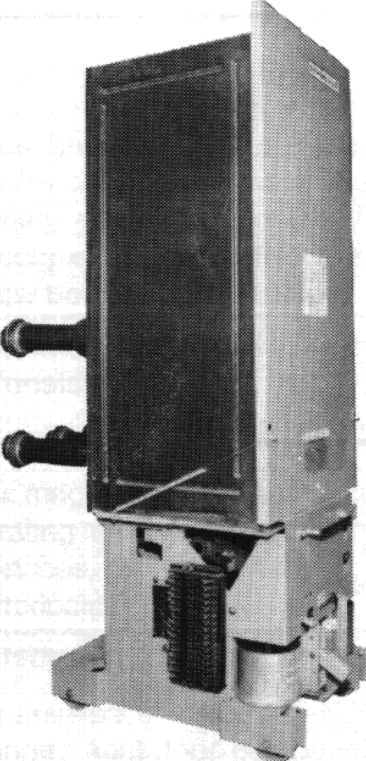
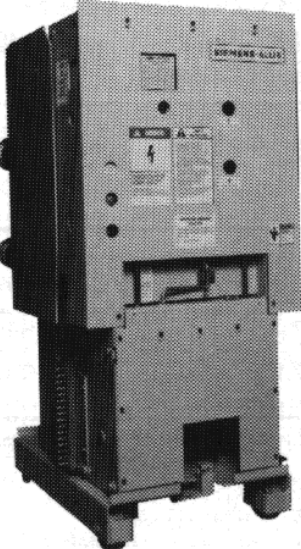
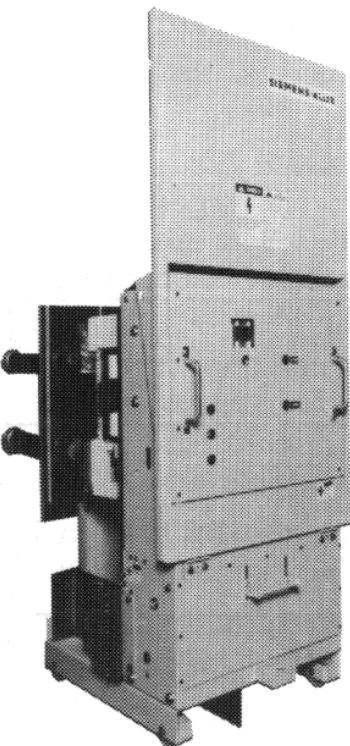
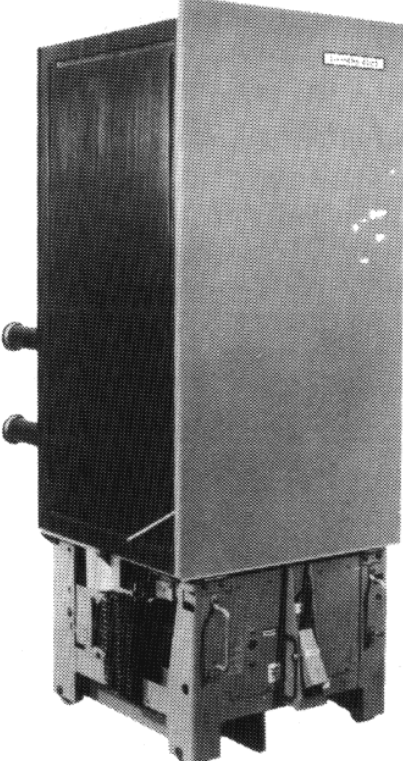
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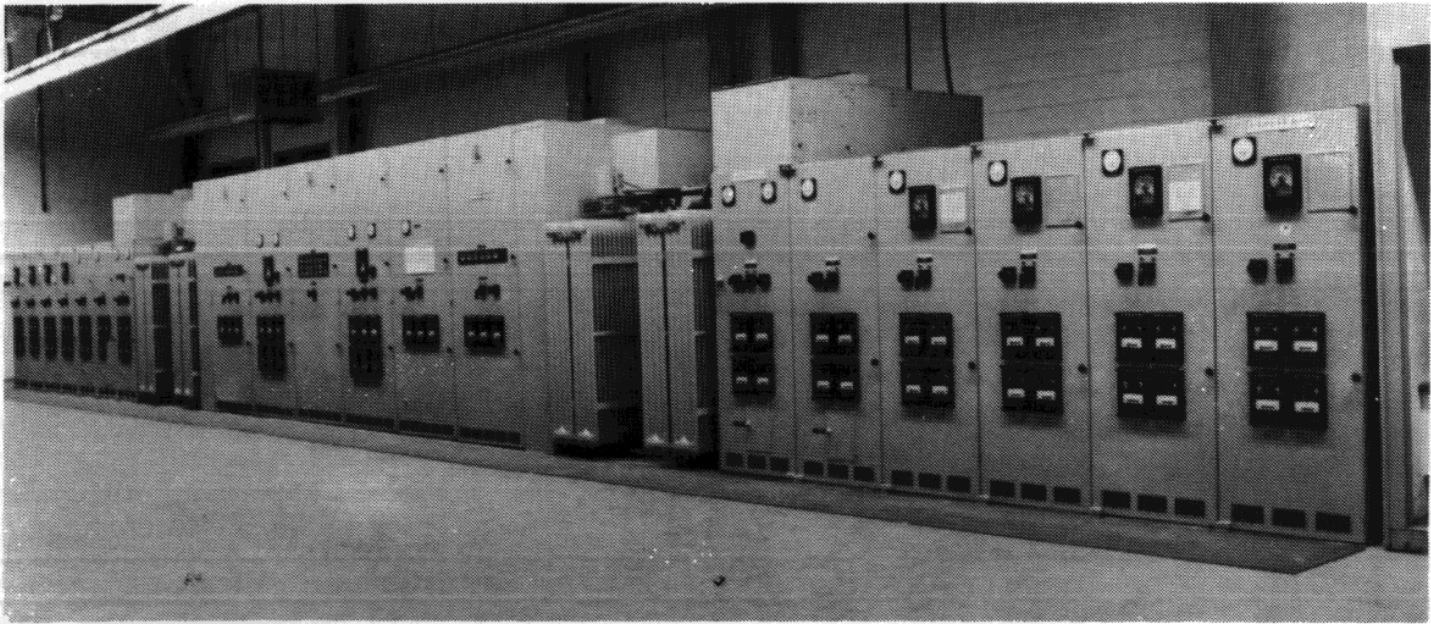
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5 kV Air Magnetic Circuit Breaker	5 kV Vacuum Circuit Breaker	15 kV Vacuum Circuit Breaker	15 kV Air Magnetic Circuit Breaker



Typical Medium Voltage Switchgear 15 kV in Center, 5 kV at Both Ends

Type D&F
Metal-Clad Switchgear

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Medium Voltage Horizontal Drawout Metal-Clad Switchgear
5 and 15 kV Air Magnetic and Vacuum Circuit Breakers Description

Siemens 5, 7.2 and 15 kV, horizontal drawout, metal-clad switchgear meets or exceeds the latest IEEE, ANSI and NEMA standards.

This advanced switchgear line is completely factory-built, wired and assembled. Each cubicle may contain the circuit breaker, bus bars, primary and secondary disconnecting devices, instrument transformers, instruments and relays, secondary wiring and other necessary components. The switchgear is designed so that additional circuit breaker or auxiliary cubicles may be added in the future.

Standard Metal-Clad Switchgear
Consists Of:

Removable Element (The Circuit Breaker)

Air magnetic or vacuum circuit breaker with stored energy operating mechanism, primary and secondary disconnecting devices, auxiliary switches, ground contacts, control wiring, interlocks.

Stationary Element (The Cubicle)

Framework of welded steel, sheet steel enclosure, including a hinged front door, compartment and inter-unit barriers, three-phase insulated bus and connections, bus supports, stationary primary and secondary disconnecting devices, circuit breaker racking-in device, circuit breaker interlocking device, instruments and relays, control wiring, terminal blocks, instrument transformers, provision for connecting main cable, guide rail on floor of structure, wiring channels, control circuit cut-outs.

Air Magnetic or Vacuum Circuit Breakers

Units are available in all standard ratings with either air magnetic or vacuum circuit breakers. In most cases, vacuum circuit breakers will fit into cubicles designed originally for air magnetic circuit breakers, so that existing systems can utilize the advantages of vacuum technology in replacement programs. Air magnetic and vacuum circuit breaker availability is summarized in table 1.

Horizontal drawout circuit breakers allow ease of maintenance and positive operator safety in disconnect, test and operating position. Disconnect contacts are readily accessible for inspection with breaker withdrawn from cubicle.

Stored energy operator used on all circuit breakers is designed for positive action, long life and ease of maintenance. All components are readily accessible for inspection when circuit breaker is withdrawn from cubicle.

Dead-front construction is supplemented by a hinged steel barrier on the front of the breaker (except on MSV-250). This barrier locks to the cubicle, preventing any direct path for gases to escape (towards the operator). For the MSV-250 vacuum circuit breaker, an equivalent barrier system (without hinges) is used.

Positive-acting shutters close the opening to the stationary primary disconnects when the breaker is withdrawn. These shutters also isolate the high-voltage disconnects from the breaker compartment of the cubicle including the front access current transformers.

Front-access current transformers permit testing, replacing or servicing with complete operator safety. These transformers are fully isolated from high-voltage areas by the positive-acting shutters when the circuit breaker is withdrawn from the unit.

Eye-level instrumentation speeds accurate reading of instruments.

Trunnion mounted voltage transformers withdraw easily from the switchgear. After tilting out, transformers and fuses are readily accessible.

Air Magnetic Circuit Breakers
5, 7.2 and 15kV Class

The power circuit breaker includes new materials and improved design techniques for fast-acting and highly dependable interruption.

The breaker consists of three principal parts: (1) the interrupting device; (2) the contact structure; (3) the operating and control mechanism.

The air magnetic circuit breaker is available in 250 to 750 MVA nominal interrupting capacity up through 3000 amperes continuous current . . . with exclusive features such as ground potential dual puffer mechanism, self-locking front protective barrier, four-bar trip-free mechanism, multicompression spring backing of contacts and auxiliary switch. Extended continuous ratings thru 2500 amperes are available with a forced air cooling option.

Vacuum Circuit Breakers
5, 7.2 and 15kV Class

The vacuum circuit breaker utilizes the advantages of arc-interruption in a vacuum and the 3AF operator.

The vacuum circuit breaker is available in 250 to 1000 MVA nominal interrupting capacity up through 3000 ampere continuous current. Extended continuous ratings thru 3750 amperes are available with a forced air cooling option.

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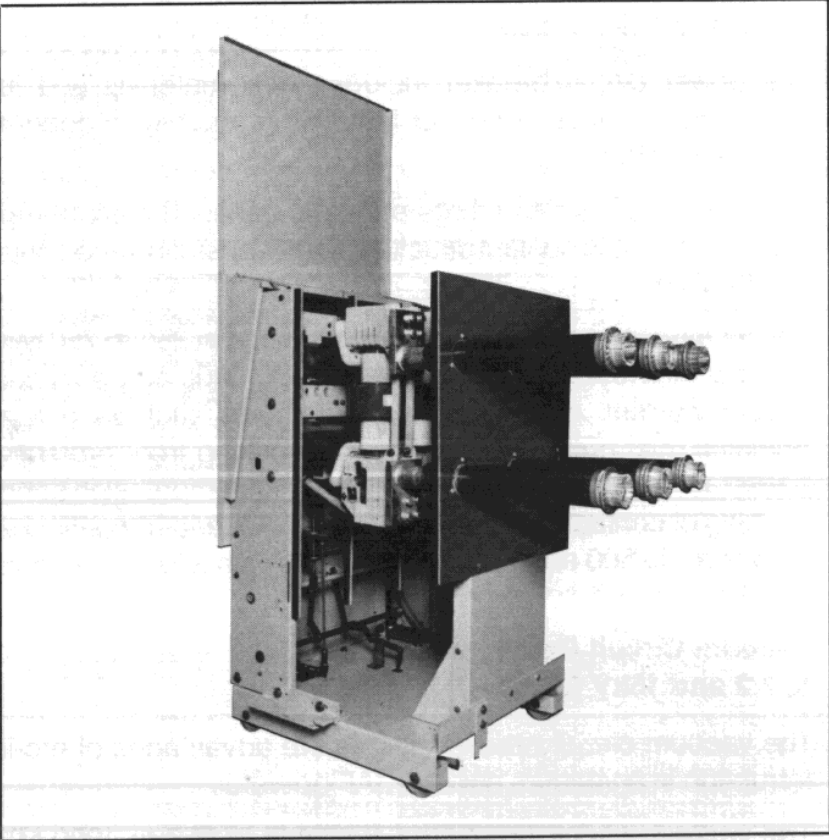
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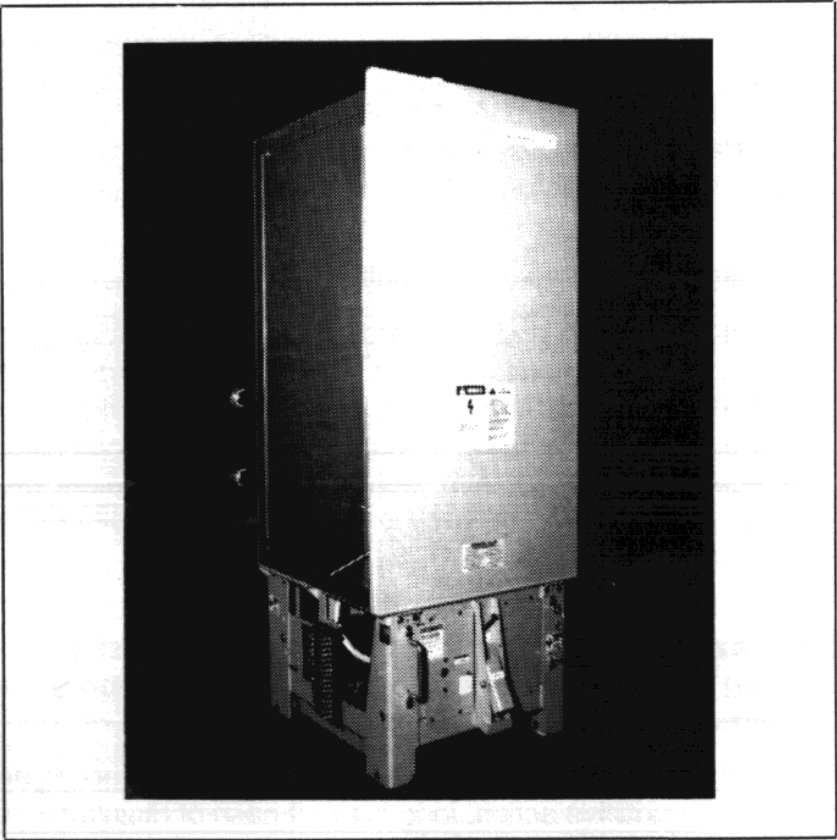
Air Magnetic/Vacuum Circuit Breaker Availability Table 1

Nominal Voltage Class	Nominal 3 Phase MVA Class	Air Magnetic Breaker Type	Vacuum Breaker Type	Cubicle Width
4.16 kV	250 MVA	MA-250/1200A-2000A	5-MSV-250/1200A-2000A ^①	26"
	350 MVA	MA-350/1200A-2000A	—	
7.2 kV 13.8 kV	500 MVA	FB-500 1200A-2000A-3000A	5-FSV-350 1200A-2000A-3000A ^②	36"
		FC-500/1200A-2000A	7-FSV-500 1200A-2000A-3000A ^③	
	750 MVA	FC-750 1200A-2000A	15-FSV-500/1200A-2000A ^③	
			15-FSV-750 1200A-2000A-3000A ^③	
	1000 MVA		15-FSV-1000 1200A-2000A-3000A ^③	

¹ 5-MSV-250 vacuum breaker requires minor cubicle modifications and is not interchangeable with MA-250 air magnetic breaker.
² 5-FSV-350 3000A vacuum circuit breaker will fit into cubicle originally designed for FA-350 3000A air magnetic circuit breaker.
³ Vacuum circuit breaker will fit into cubicle originally designed for air magnetic circuit breaker.



5 kV Air Magnetic Circuit Breaker



15 kV Air Magnetic Circuit Breaker

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Metal-Clad Switchgear

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**Medium Voltage Horizontal Drawout Metal-Clad Switchgear
5 and 15 kV Air Magnetic and Vacuum Circuit Breakers**

Description

Advantages of Vacuum Circuit Breakers

- High Speed Interruption
- Fast Closing
- Quiet Operation
- Ideal Dielectric
- No Arc Products Vented to Atmosphere
- Reduced Impact Forces
- Light Weight
- Low Center of Gravity
- Positive Test of Interrupter Integrity
- Reduced Maintenance
- Easy Access to Components
- Fewer Components
- Longer Interrupting Life
- Interrupter Not Affected by Ambient Temperature, Humidity or Dust
- High Repetitive Switching Capability

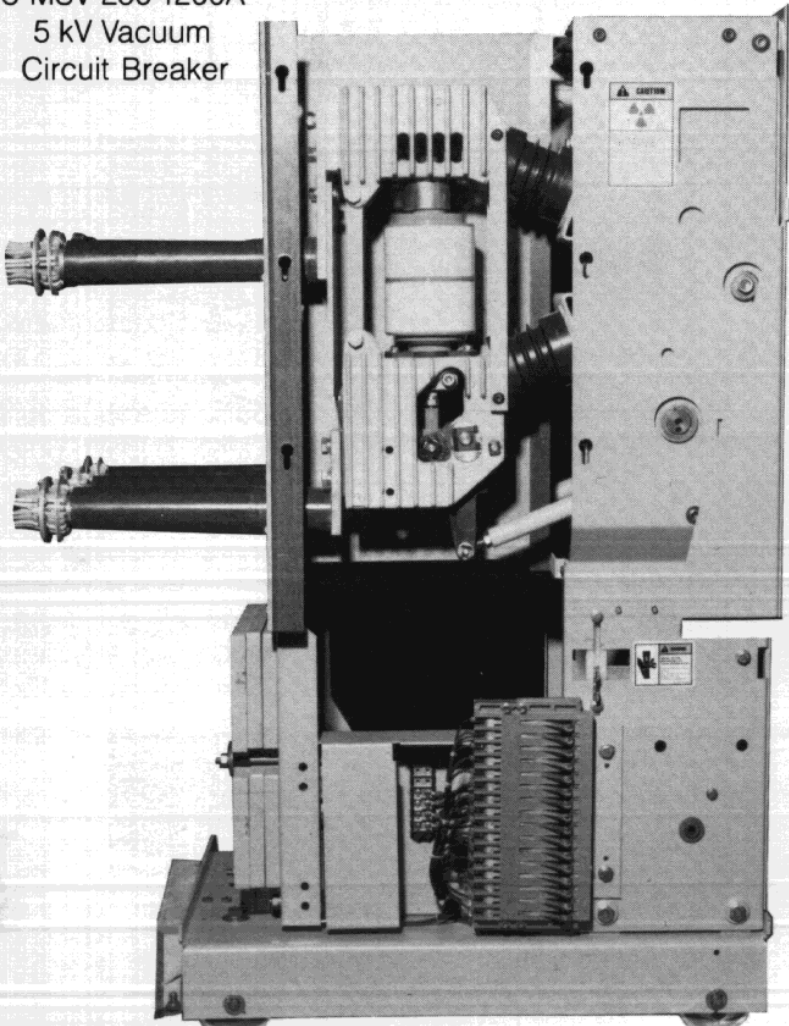
Method Of ARC Interruption Air Magnetic Circuit Breakers

Interruption in an air magnetic circuit breaker is accomplished in air at atmospheric pressure with the aid of a self-induced magnetic blowout field and air draft.

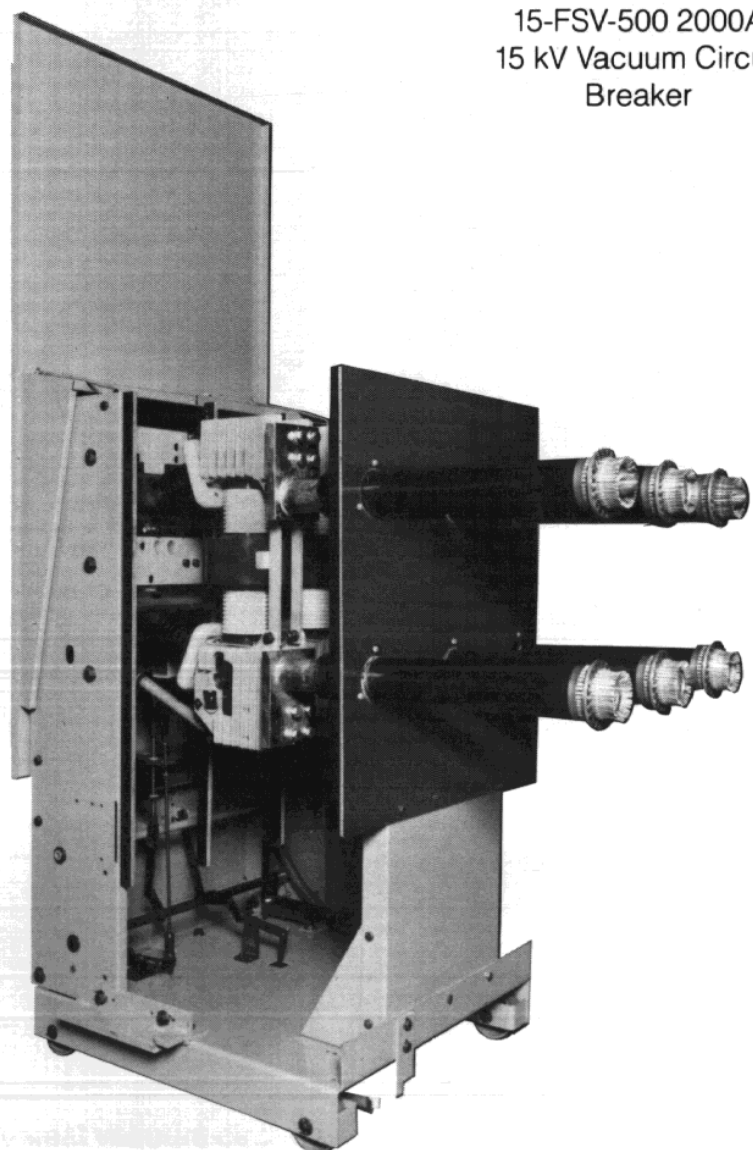
At the time the trip coil is energized, current is being carried through the main contacts (1). As the moving contact arm (7) separates from the stationary main contact, the current is transferred to the arcing contacts (2).

As the arcing contacts part, the current is transferred to the arc runners (3), establishing full current flow through the blow-out coils (5) and setting up a magnetic field. The magnetic field, together with the natural effects of the heated arc and configuration of the current carrying circuit, forces the arc upward into the barrier stacks (4).

5-MSV-250 1200A
5 kV Vacuum
Circuit Breaker



15-FSV-500 2000A
15 kV Vacuum Circuit
Breaker



Type D&F Metal-Clad Switchgear

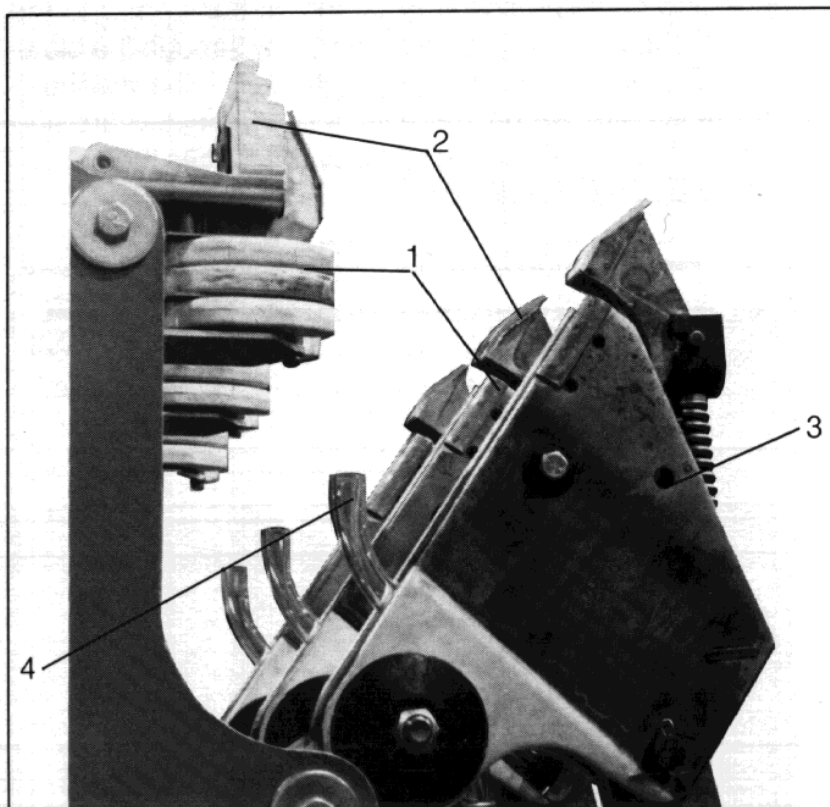
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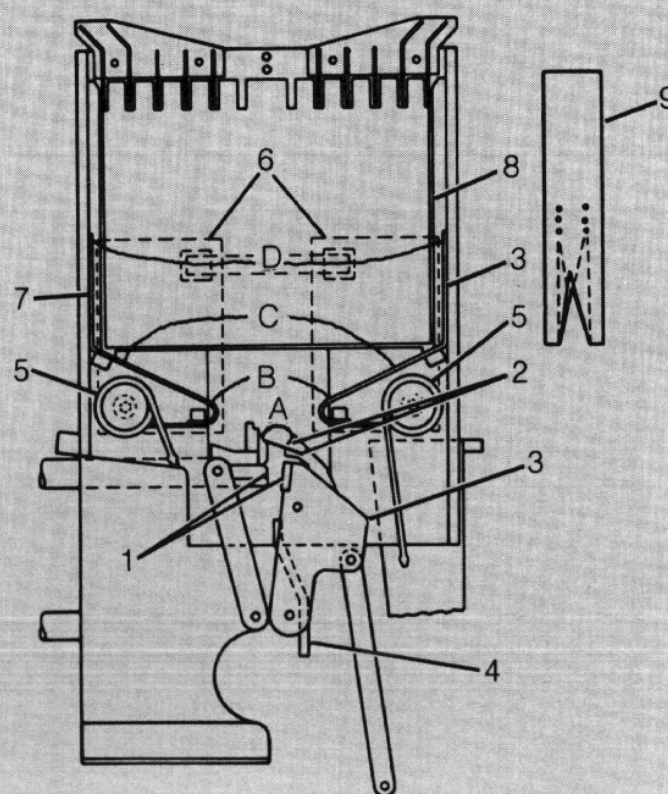
The surfaces of the barrier stack cool and deionize the arc while the slots in the stack reduce its cross sectional area and elongate it. The arc runners are made of wide, heavy material for maximum heat dissipation and help to minimize metal vaporization. To facilitate interruption of low currents, a puffer assembly provides a movement of air upward through the contact area to aid the magnetic field in moving the arc into the barrier stack. All these effects collaborate to increase the resistance of the arc and enable it to be extinguished at an early current zero.



1. Main Contacts
2. Arcing Contacts
3. Moving Contact Arm
4. Puffer Tube

Section View of a Single Breaker Pole

1. Main Contacts
2. Arcing Contacts
3. Moving Contact Arm
4. Puffer Tube
5. Blowout Coils
6. Pole Extension
7. Arc Runners
8. Barrier Stack
9. End View of Barrier Stack



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**Medium Voltage Horizontal Drawout Metal-Clad Switchgear
5 and 15 kV Air Magnetic and Vacuum Circuit Breakers**

Description

Method Of ARC Interruption Vacuum Circuit Breaker

Interruption with a vacuum circuit breaker is accomplished with more ease than air magnetic. The superiority of vacuum as an interrupting medium has long been recognized. For example, with a gap spacing of 1/2 inch, the breakdown voltage in vacuum is approximately seven times higher than in air.

Ionized gas is not present under vacuum interruption, consequently recovery is rapid, arc energy is low, and interruption less explosive.

Interruption times are three cycles or less. No arc products are expelled, thus there is no need for arc cooling and quenching devices, such as arc chutes. The arc plasma, which is metal vaporized from the interrupter contacts, rapidly condenses on the contacts and shield surfaces provided within the interrupter.

The bottles are hermetically sealed making the device impervious to conditions of moisture and other contaminants that might affect the contact surface and the interrupting capability.

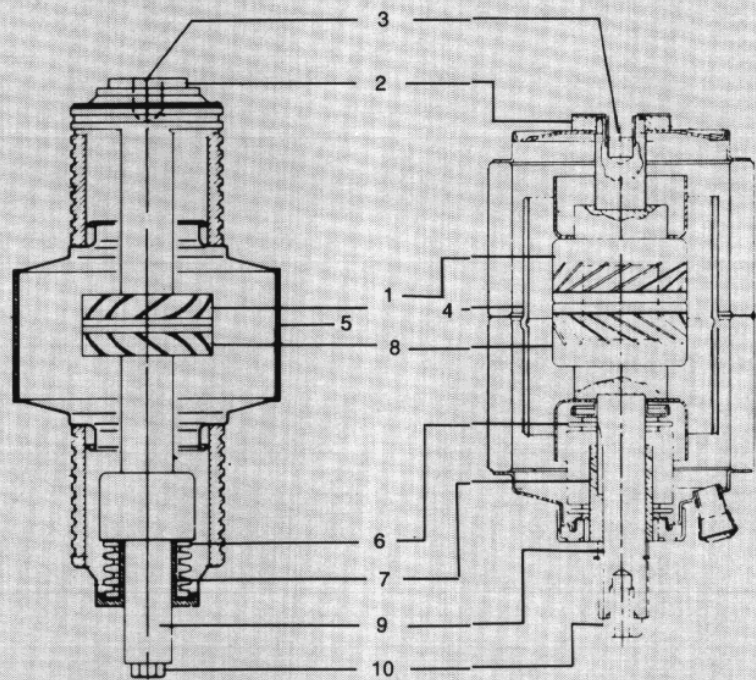
The interrupting capability is excellent for low current levels, fault current levels, and switching currents—particularly capacitor switching.

Vacuum interrupters were not generally accepted early due to the phenomenon known as "chopping." The interruption was so fast in early interrupters that the current went from a high value to zero in micro-seconds. This is no problem in capacitive circuits, but in inductive circuits a voltage can be induced which can cause severe transient overvoltages.

In new interrupters, sintered chrome-copper arcing ring and cup shaped slotted contacts are used to minimize the chopping effect since a slight amount of the contact vaporizes (arc plasma) as the contacts part.

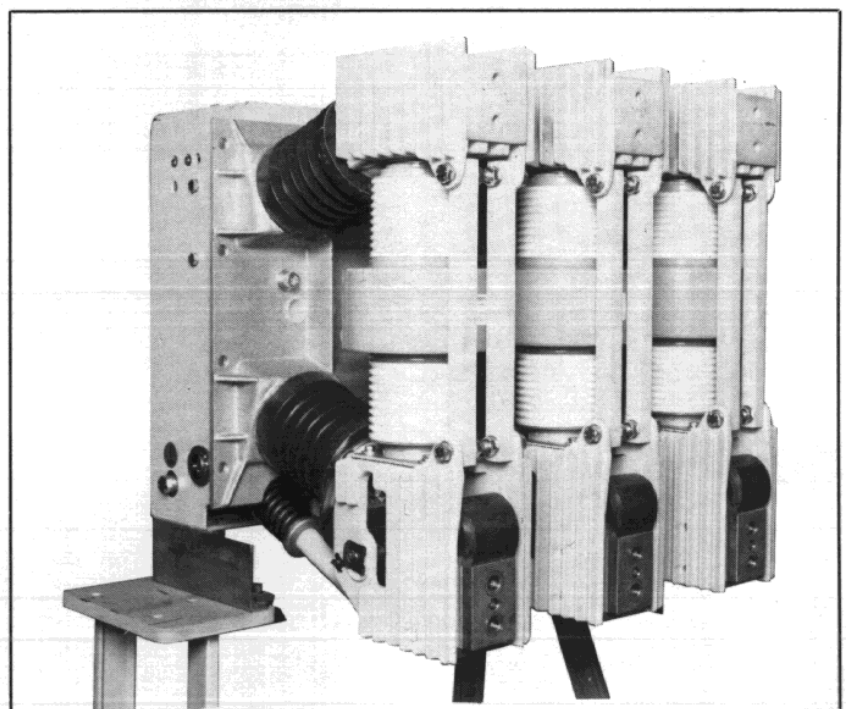
The vaporized metal furnishes enough ions to conduct the normal load current until a natural current zero is achieved. Sintered chrome-copper arcing ring and cup shaped slotted contacts allow only extremely low chopping currents, 5 amperes or less.

- | | |
|----------------------------|-------------------------|
| 1. Stationary contact | 6. Bellows |
| 2. Washer | 7. Guide |
| 3. Stationary Contact Stem | 8. Moving contact |
| 4. Insulator | 9. Movable contact stem |
| 5. Arcing chamber | 10. Mechanical coupling |



Typical for other ratings

Typical for 5 MSV-250



Typical vacuum circuit breaker operator showing vacuum interrupters.

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Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

Description

Circuit Breaker To Cubicle Disconnects Are Self-Aligning, Multi-Contact Devices For Positive Connection

The primary circuit between the breaker and the cubicle is made of sets of silver-plated finger contacts which engage with silverplated, cylindrical contacts. The contacts, mounted on the ends of the breaker bushings, have multiple-fingers and are compression-spring loaded (one spring per pair of fingers). This arrangement offers a large number of contact points to ensure proper alignment. The breaker finger assemblies (movable portion) are withdrawn with the breaker . . . and are available for inspection without de-energizing the main switchgear bus.

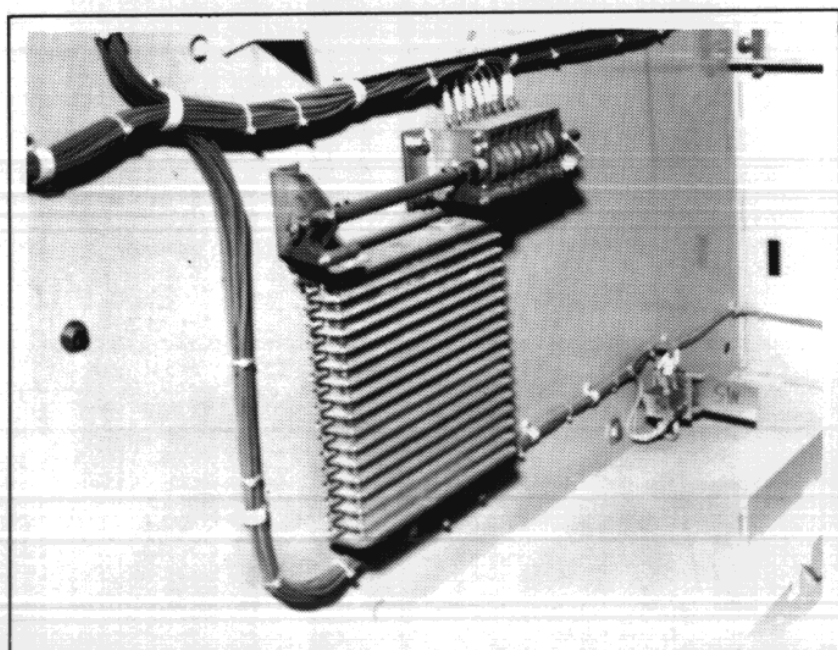
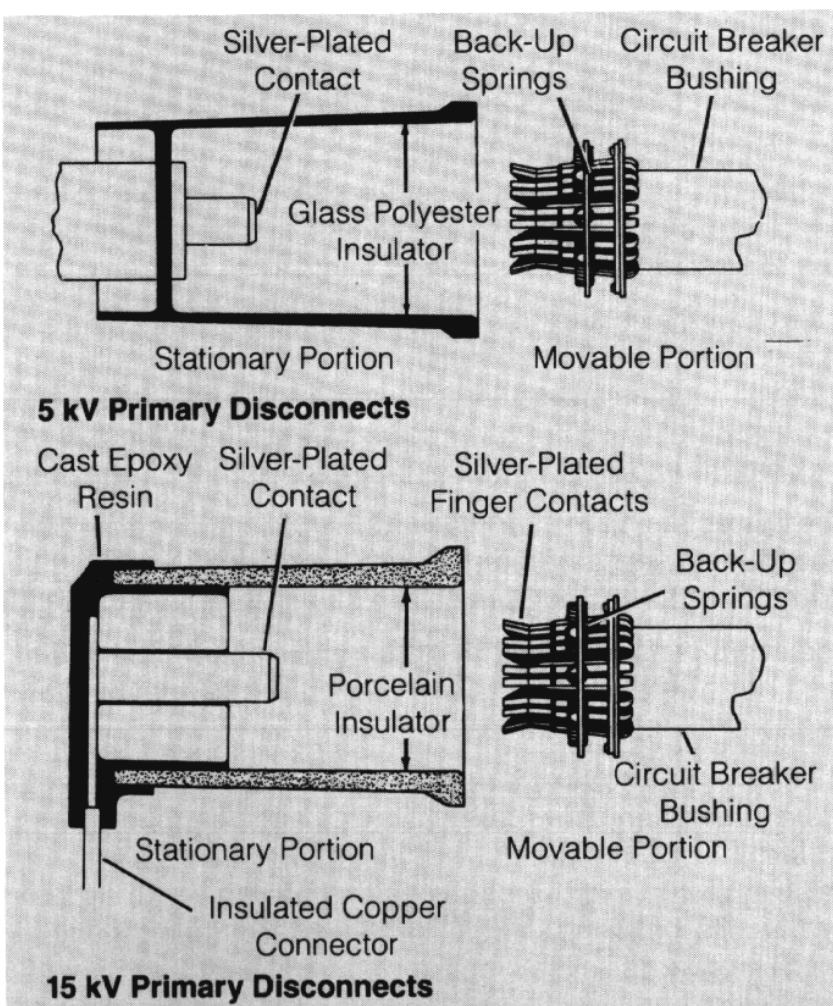
The cubicle contact members (stationary portion) inside the insulator assemblies are recessed and shielded to prevent accidental contact when the breaker is withdrawn.

Circuit Breaker-To-Cubicle Secondary Disconnects Are Easily Adjusted . . . Make in Both the Operating and Test Positions

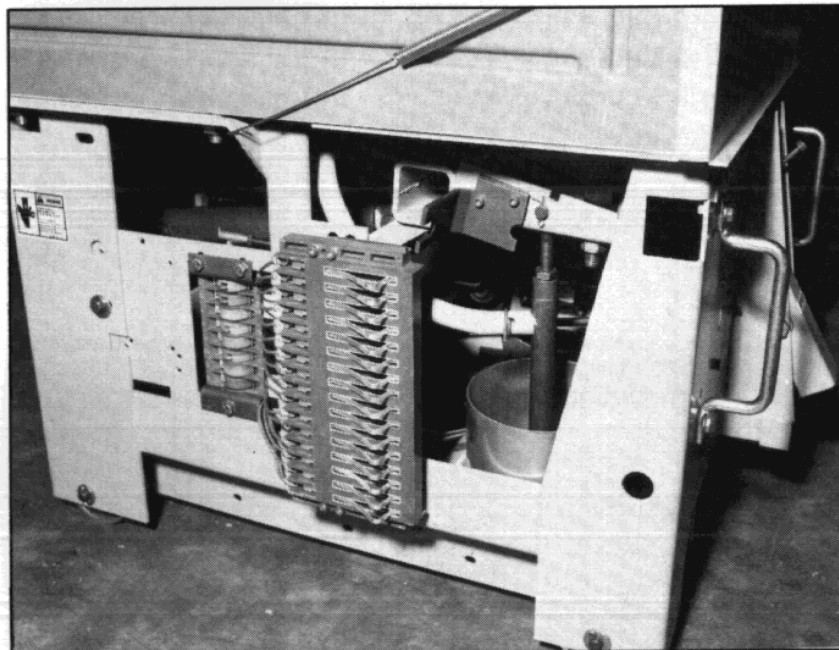
The movable secondary control contacts mounted on the breaker are self-aligning, line-contact, slip-type connectors. The multiple-finger arrangement on the breaker makes contact with a stationary-mounted element. The contact surfaces on the stationary element are recessed to prevent accidental short-circuiting of the control circuits.

These secondary disconnects mate in both the operating and test positions. No special jumper is required . . . no hand setting of secondary disconnects for testing.

Mechanical stops prevent overtravel and avoid damage to the disconnecting devices when the circuit breaker is levered into the operating position.



Stationary Secondary Contacts Mounted in the Cubicle



Movable Secondary Contacts Mounted on the Breaker

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**Medium Voltage Horizontal Drawout Metal-Clad Switchgear
5 and 15 kV Air Magnetic and Vacuum Circuit Breakers**

Description

Air Magnetic Circuit Breaker Features

Manual Controls and Indicators

All breaker manual controls and indicators are conveniently located on the lower front portion of the breaker. Standard features include breaker release pedal, manual trip button, manual close pullrod, open-close indicator, stored energy spring charge-discharge indicator, operation counter, and handles to assist when moving the breaker.

Stored Energy Operator

The stored energy operator used on all Siemens 5, 7.2 and 15 kV air magnetic circuit breakers has been developed to provide extremely fast closing and high reliability. The operator is located at the base of the circuit breaker and is accessible for inspection without removal of arc chutes or the necessity to tip the circuit breaker. All moving parts can be examined and lubricated. The method of operation easily expedites maintenance training.

Dual Puffers

Ground potential puffer mechanism with dual cylinders on air-magnetic breakers accelerates low-current arc to insure short arcing times throughout the entire breaker interrupting range. Puffers are at ground potential—not line—and are mounted on the breaker frame—not on the moving contact arm.

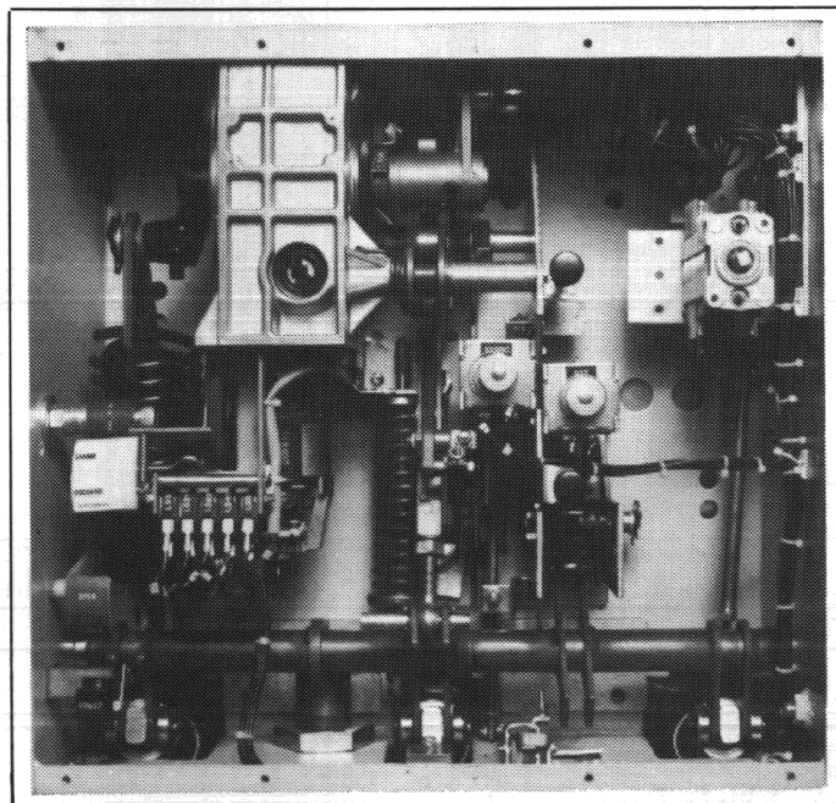
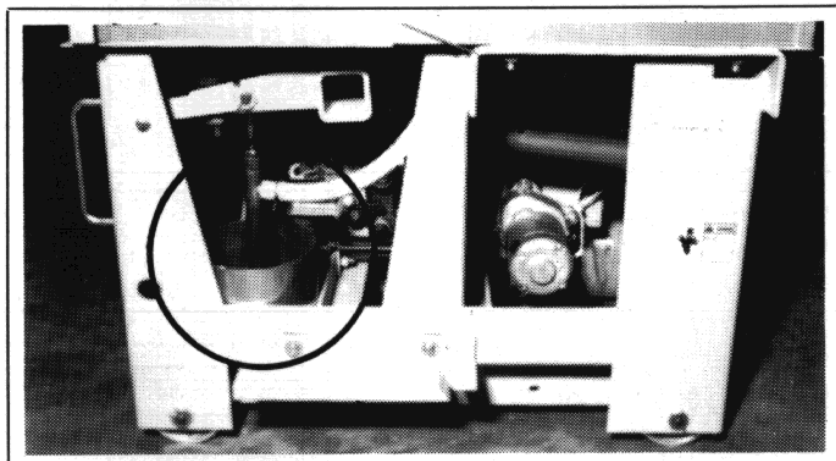
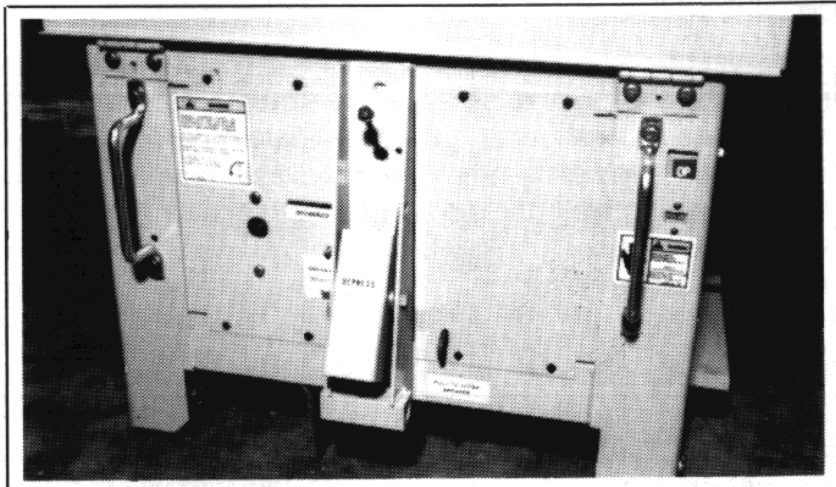
Vacuum Circuit Breaker Features

Manual Controls and Indicators

All breaker drawout controls are located on the lower front portions of the breaker and operator controls are located on the middle front portion of the breaker. Standard features include breaker release handle, red manual trip button, black manual trip button, open-closed indicator, stored energy spring charged-discharged indicator, and operation counter.

Stored Energy Operator

The type 3AF stored energy operator as used on Siemens 5, 7.2 and 15 kV MSV and FSV vacuum circuit breakers has been developed to provide extremely fast closing and higher reliability than previous operators. The operator is located at the middle front of the circuit breaker and affords easiest maintenance accessibility without the necessity to overturn the breaker element. All moving parts can be examined and lubricated. Under normal conditions, lubrication is required every 10,000 operations (3,000 for 5-FSV-350 or 15-FSV-1000) or 10 years, whichever occurs first. Maintenance training is easy with the method of operation.



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Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

Description

Metal-Clad Cubicle Features

The stationary element of the switchgear cubicle and the removable element (circuit breaker) are built to master fixtures so that circuit breakers of the same type and rating are interchangeable with each other. All removable elements of like type and rating are checked with a master stationary element fixture. Each stationary element is checked with a master removable element fixture . . . to insure complete interchangeability between elements of like type and rating.

Maximum compartmentation for safety is an integral part of Siemens advanced design. This means complete enclosure of all live parts and segregation of circuits. Removable plates permit easy access to all compartments. Side plates, top plates, bus compartment barriers and front panels are all 11 gauge steel. Rear plates are 14 gauge.

Major Compartments

- Instrument and Control Compartment
- Intercompartment Wiring Trough
- Circuit Breaker Compartment
- Current Transformer Compartment
- Auxiliary Equipment Compartment
- Cable Entrance Compartment
- Voltage Transformer Compartment
- Bus Compartment

All-Steel Barriers

All metal barriers are completely grounded. Sheet steel inter-unit barriers extend the full height and depth of cubicle for isolating each cubicle from adjacent cubicles. The stationary elements are equipped with a ground bus which extends through the complete switchgear lineup.

Clean Design

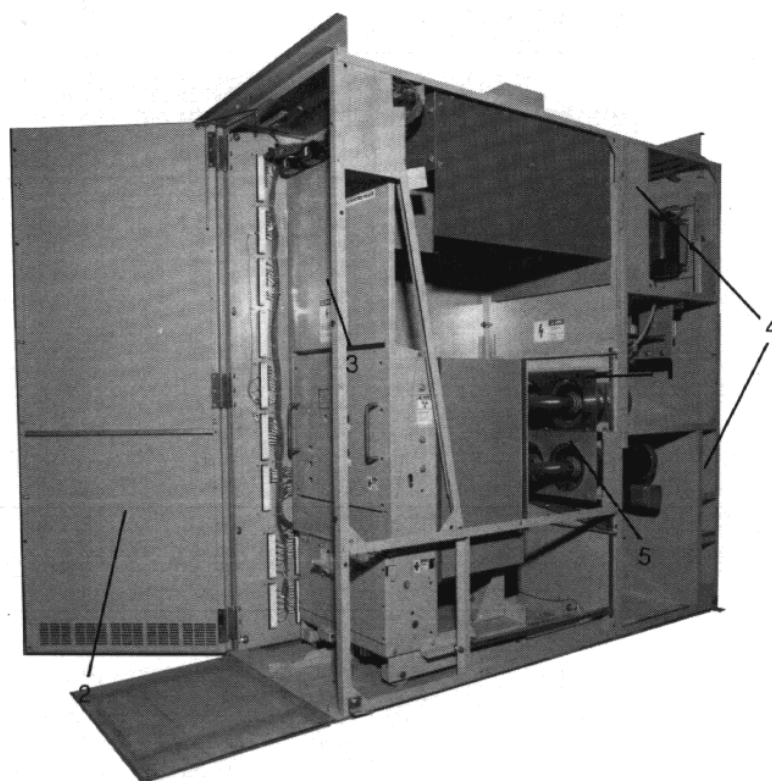
The switchgear is designed and built to minimize entry of dust and other foreign matter. Carefully placed louvers give controlled unit ventilation.

Rigid, Reinforced Framework

The framework is constructed of steel angles and formed plates accurately welded together in a master fixture and reinforced to form a rigid, self-supporting structure. Where welded joints are made, angles are spot welded (gusset construction) and arc welded (offset) for maximum strength and accurate alignment.

Easy Compartment Access

Siemens switchgear compartments retard spread of faults to other compartments. Maintenance is safe and easy. Each compartment is accessible by easy-to-handle steel plates. The rear panel is removable for access to down-feed cables, while access to up-feed cables is available through a removable panel in the circuit breaker compartment.



1. Separate Compartments for Current Transformers
2. Full Panel for Meters and Relays
3. Double-Lock Panel for Operator Safety

4. Separate Up-Feed and Down-Feed Cable Compartments
5. Grounded Metal Shutters Behind Current Transformers Protect Personnel

Side View of Cubicle with Breaker in Disconnect Position

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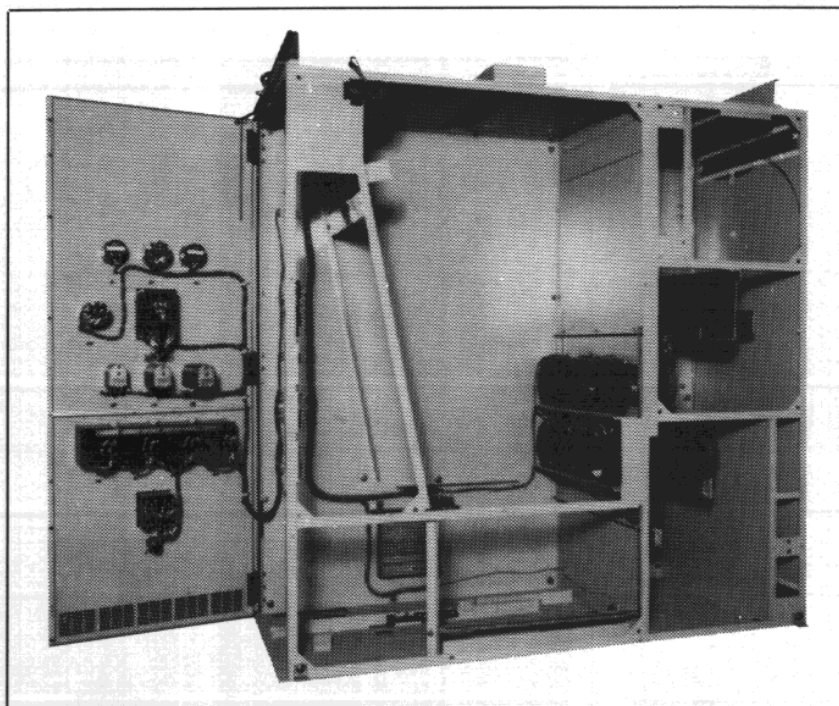
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5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

Description



Side View of Cubicle Without Breaker and with CT Covers Removed

Stationary Element (Cubicle)

Plumb and Square Through Fixture Welding

Floor plate assembly, side sheets, secondary contact supports, rear bushing support plates and other components are fixture welded to insure correct location and provide plumb and square switchgear units. Fixture welding insures interchangeability of standard cubicles and circuit breakers. The use of welding and checking fixtures give perfect alignment of component equipment. Cubicles also are aligned on perfectly flat steel bed plates in the factory before shipment of multiple interconnected assemblies. This results in minimum installation time of switchgear at the job site.

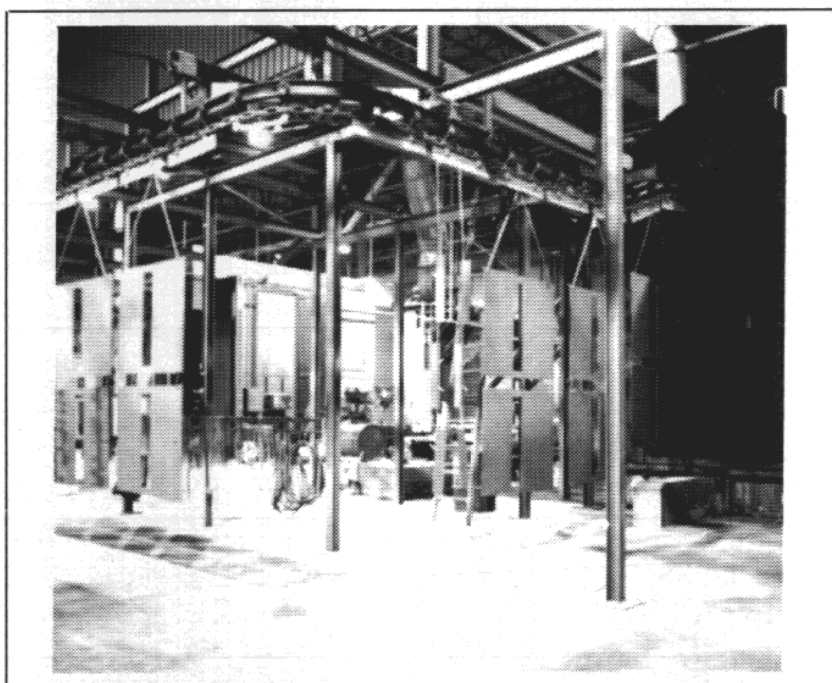
High Durability Finish

The framework and panels are conveyed through a spray tunnel. Here they are cleaned and degreased using a three stage process. The three stages are (1) alkaline cleaning, degreasing, and iron phosphate wash, (2) water rinse, and (3) non-chromic acid sealer.

The hot phosphate bath effects a chemical conversion of the metallic surface to a nonmetallic phosphate coating. Insoluble in water, this coating is effective in retarding corrosion, and is an excellent undercoating for paint.

After cleaning and stabilization, the framework and panels receive a combination primer-finish coat of vinyl paint. The framework, panels and other detail parts are conveyed through

a convection oven to insure adequate curing. All exterior surfaces of outdoor gear are given an additional finish coat of air dry vinyl paint. Standard indoor finish is light gray ANSI-61; for outdoor dark gray ANSI-24, or sky gray ANSI-70.



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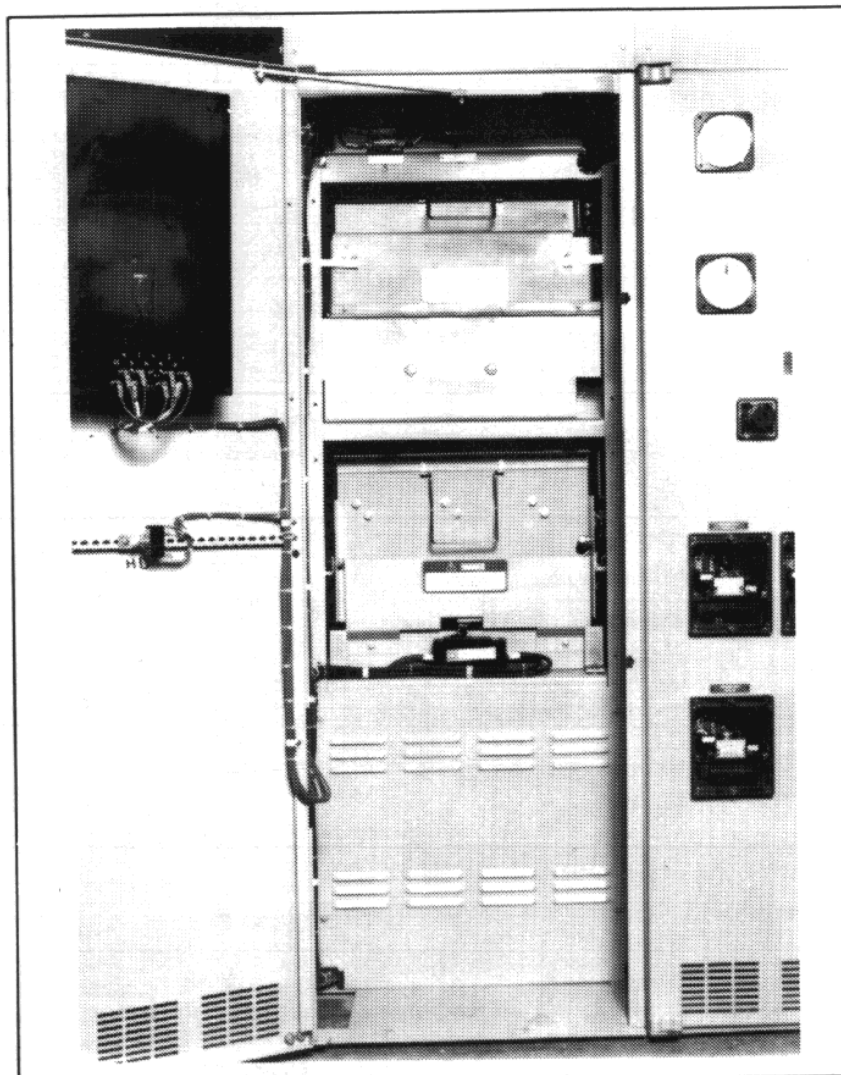
Description



Auxiliary Cubicles

Auxiliary cubicles are constructed in the same general manner as the circuit breaker cubicle except that no provision is made for either present or future mounting of a circuit breaker removable element. Auxiliary cubicles are used to house such equipment as voltage transformers, control power transformer fuses, control transformers, generator or synchronous motor field control, rectifiers, reactors, batteries, chargers, voltage regulators, etc.

Compartments for housing bus, control wiring, voltage transformers, etc., are separated by tightly fitted sheet steel barriers. Removable plates allow access to these compartments. The front of the cubicle is enclosed with a hinged steel panel equipped with knurled fasteners. These panels offer a convenient location for mounting instruments, meters and relays when the panels of adjacent units are crowded.



Auxiliary Cubicle with Trunnion-Mounted Voltage Transformers and CPT Fuse Trunnion in Fully Connected Position. CPT Barrier is Bolted into Place, Completely Shielding Operator from High Voltage Compartment.

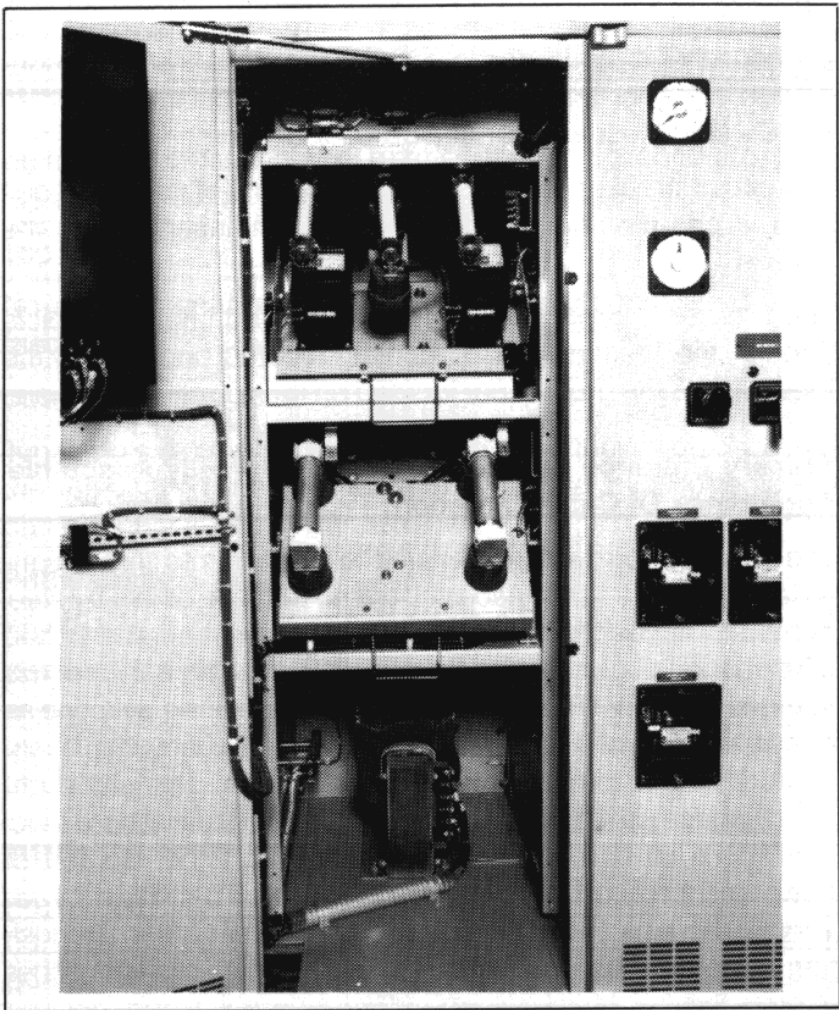
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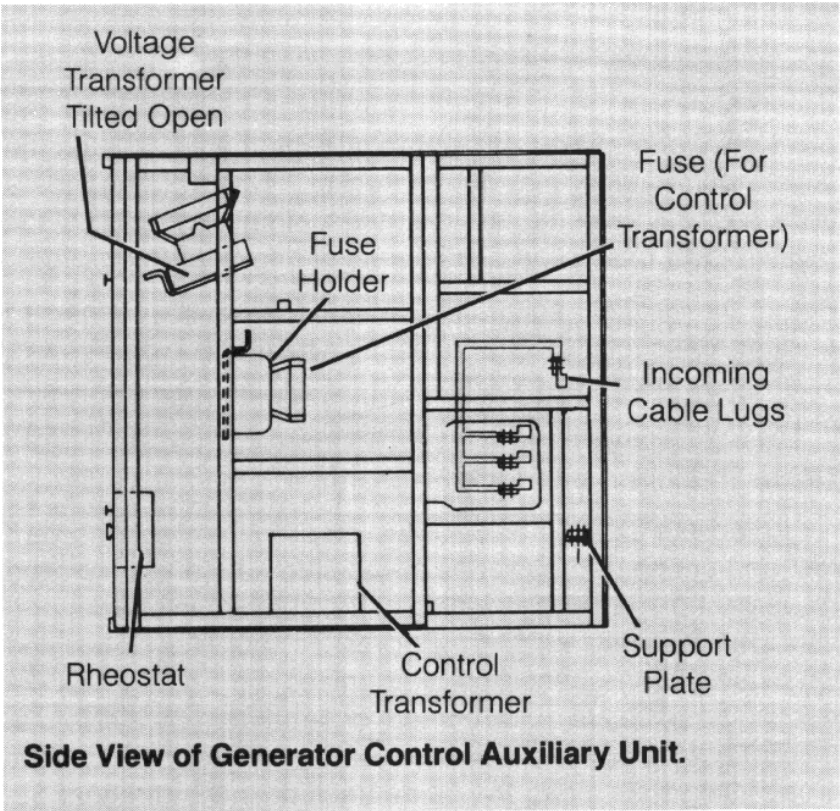
Auxiliary Cubicle with Meter Panel Door Open Showing Voltage Transformer and Fuse Carriage in the Top Compartment, Control Power Transformer Fuse Carriage in the Center Compartment and the Control Power Transformer in the Bottom Compartment.

Installation Of Circuit Breakers

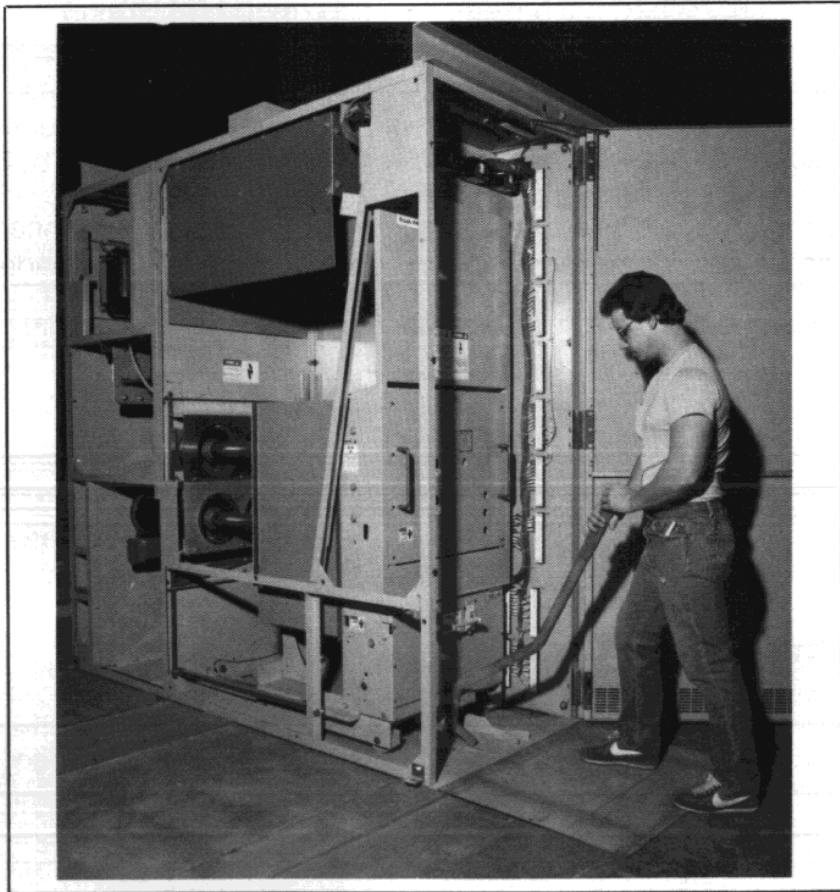
5 kV Circuit Breaker— Safe and quick racking in of the circuit breaker to connected position is achieved by one stroke of a lever crank.

The pivot point of the lever crank is inserted into its mating hole in the fulcrum angle mounted on the compartment floor. A short upward stroke of the crank levers the breaker into the full operating position. The circuit breaker can be closed only when in the full connected position or test position.

To withdraw the circuit breaker, the fulcrum pin is inserted into its mating hole in the bearing block of the circuit breaker carriage. Pivoting about the fulcrum angle with a short downward stroke quickly withdraws the circuit breaker. The circuit breaker release pedal must be depressed, raising the interlock and



Side View of Generator Control Auxiliary Unit.



Using Racking Lever Along with Floor Track to Insert Breaker into 15 kV Cubicle.

Type D&F Metal-Clad Switchgear

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Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

Description

tripping the circuit breaker before the circuit breaker can be moved from the connected position.

To use the racking lever, the pivot point of the lever is inserted into the mating hole on the lower front edge of the circuit breaker. The pawl engages a track on the floor of the cubicle, and a simple pumping of the racking lever moves the circuit breaker into desired position.

Before the circuit breaker can be moved from the connected position, the circuit breaker release pedal must be depressed. This raises the interlock and trips the circuit breaker for safe removal.

Guide Track and Interlock Mechanism

A rugged interlock bar has positive stops in the disconnected, test and connected positions to regulate safe and controlled movement of the circuit breaker in the cubicle. Interlocks prevent (1) movement of the circuit breaker when it is closed and (2) closing of the circuit breaker unless the primary disconnecting devices are in full contact or separated by a safe distance. Located on the circuit breaker, this interlock bar engages close-fitting slots along the guide track on the switchgear cubicle floor for the disconnect (or storage), test and connected positions. The circuit breaker cannot be moved while the interlock is engaged. The breaker release pedal on the circuit breaker must be manually depressed to release the interlock, permitting the circuit breaker to be moved. During transition from one position to another, the interlock rides on the guide track between slots holding the breaker in the "trip-free" position.

Positive straight-line, in-and-out movement of the circuit breaker is assured by the guide track. Failure of the guide follower to enter the guide track prohibits entry of the circuit breaker into the cubicle.

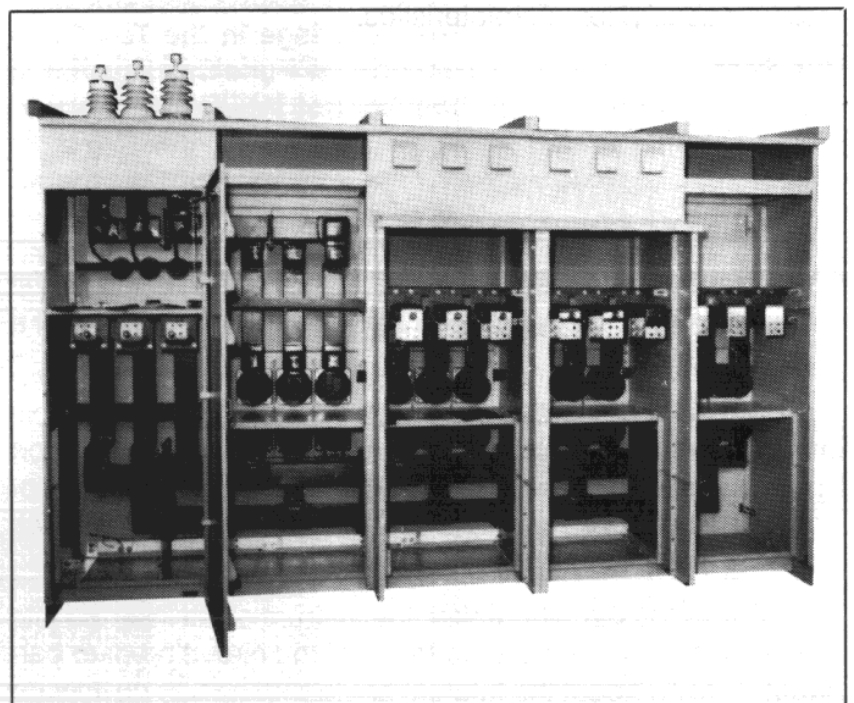
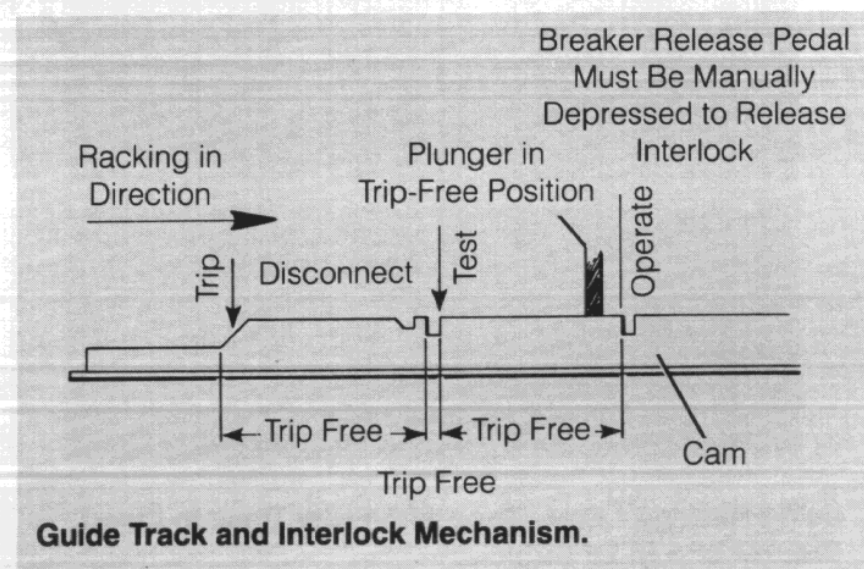
When the breaker is inserted, it is rolled into the cubicle and pushed until it stops and automatically locks in the disconnected position. The manual release must be depressed to move it to the test and connected position.

The circuit breaker can be padlocked in any of its three positions. It can also be padlocked to prevent insertion into the cubicle.

The breaker is grounded when it is inserted into the cubicle through the breaker ground contact located underneath the breaker and the ground bar located on the floor of the cubicle.

Primary Entrance Compartment Is Universally Adaptable Regardless Of Cable Direction, Type Or Termination

The rear of a circuit breaker unit is divided into three high-voltage compartments, each separated from the others by steel barriers. The rear frame is of combination welded and bolted construction to give overall rigidity while allowing easy access to the equipment. The main bus location is placed as close as possible to main disconnects to eliminate unnecessary connectors and to provide maximum insulation. The cable entrance space provides complete flexibility of termination without any structural or conductor modifications. Either upfeed or downfeed pothead or lug connections may be made by reversing the lugs or mounting the pothead in its alternate position for upfeed. Adequate space for the building of stress cones is provided.



Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers	Description
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Bottom Feed

This design is used in standard indoor metal-clad switchgear units. Steel floor does not extend to rear of unit. Absence of a bottom rear cross-member permits stubbing of conduit or pulling of cable before receiving the switchgear.

Top Feed

No major structure changes are normally necessary for top feed.

Cable Type and Size

Type and size of incoming cable are important when choosing the terminating method. A complete description of entering cable is necessary.

Potheads

Maximum of one three-conductor or three single-conductor potheads can be mounted in a standard cubicle. Connection of cable to potheads can be by wiping sleeves, stuffing box gland, cable clamp or conduit adapter—depending on type of cable used.

Insulation System—General

Preformed Pyro-Shield track-resistant insulation of flame-retardant glass polyester insures a uniformly high level of insulation quality throughout the switchgear. All bus bar supports and primary disconnect bushings are made of high impact strength Pyro-Shield insulation with high dielectric strength and low moisture absorption characteristics.

Bus Bars

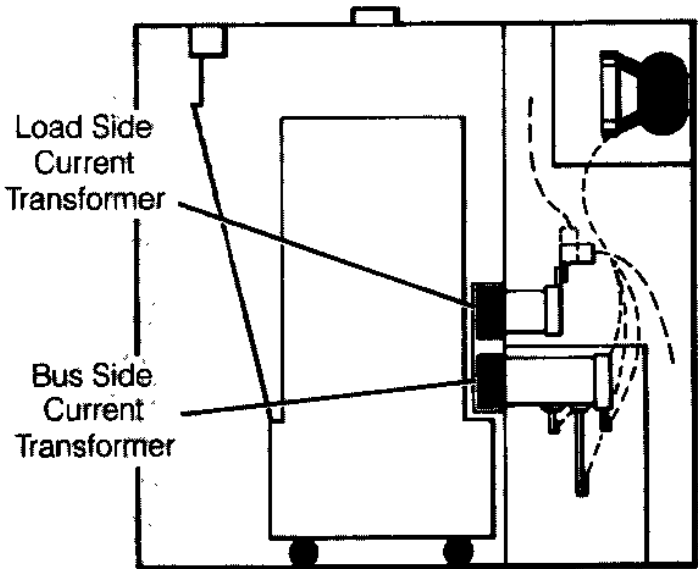
Full rounded-edge tin-plated aluminum bus bars are provided as standard. Copper bus bars with silver plated joints are an available option.

A combination of high strength steel bolts, flat washers and conical washers assure constant pressure to bolted connections to ensure proper contact.

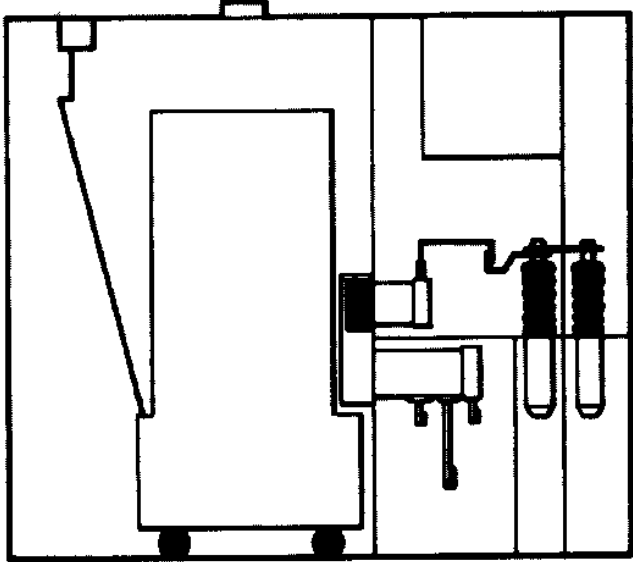
Bus bars are insulated by means of a tight fitting extruded sleeving of "Noryl" phenylene-oxide based resin. The material is flame retardant class 94V-1 per UL94. Insulation is at bus potential.

Ground Bus

A common ground bus is incorporated in all cubicles to properly ground the equipment after installation. The ground bus extending through the switchgear is accessible in the primary cable area of the left-hand end of the group and in each feeder cubicle. Standard ground bus is 1/4" x 2" aluminum bar with copper optionally available.



Circuit Breaker Unit Cubicle Downfeed or Upfeed.



Circuit Breaker Cubicle with Extension to Accommodate Multiple Potheads.

Preformed Pyro-Shield™ Insulated Joint Caps—5 kV

The overlapping design of the Siemens cap creates a long path for an arc to travel, thus maintaining high impulse strength in a minimum of space. Extensive testing on the bus joint showed that audible corona was not detected on a joint with cap under 21 kV—well above nominal operating voltage.

These glass polyester parts are outstanding in electrical and mechanical properties and in ease of molding . . . making Pyro-Shield ideal for application as electrical insulation.

Type D&F Metal-Clad Switchgear

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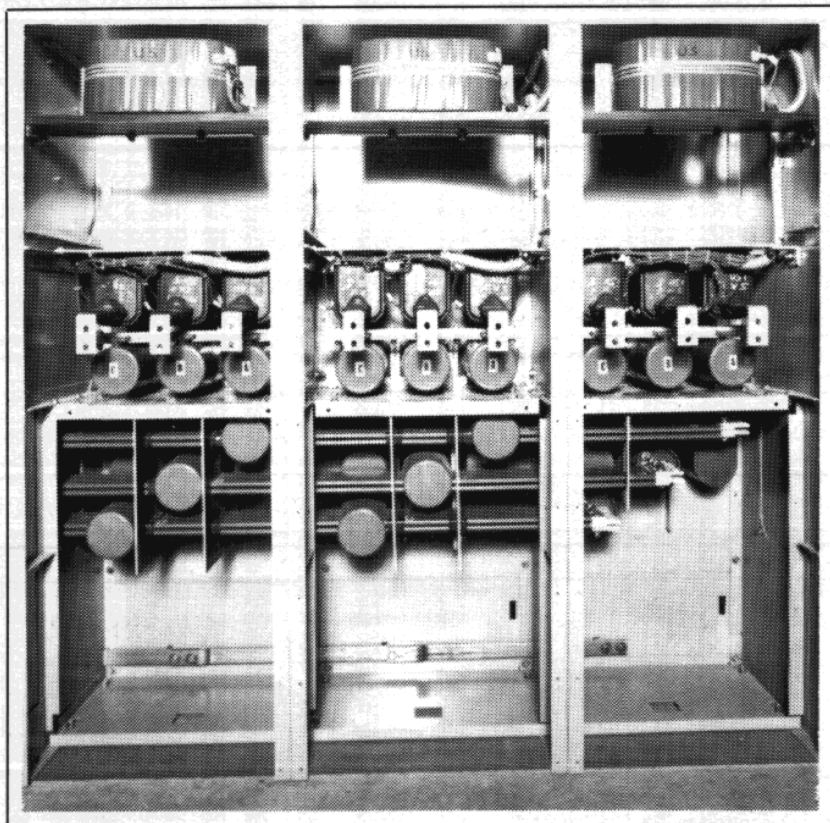
Switchgear Division

Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

Description

Specially insulated parts include bus insulation, bus bar supports, primary disconnect bushings, phase barriers on breaker, contact support structure, bushing tubes, operating rods and arc chute parts.

All buses are mechanically braced to withstand repeated shocks and stresses imposed by high currents of a magnitude corresponding to the close and latch rating of the power circuit breaker connected to the bus.



Rear View of 5 kV Switchgear Showing Use of Glass Polyester Insulation.

Insulation System—5 kV Switchgear

For service under extreme conditions of contamination and humidity or where high voltages create destructive carbon tracking, "Pyro-Shield" flame-retardant glass polyester materials form the basis for a modern, coordinated switchgear insulation system.

The important characteristics of Pyro-Shield insulation are:

- Ability to Resist Tracking
- Low Water Absorption Rate
- Low Time-Temperature Deterioration Rate
- Excellent Flame Retardance
- High Resistance to Chemical Fumes
- High Impact Strength



Molded Glass Polyester Case is Placed Over the Bus Joint and Fastened with a Reusable Nylon Pin.

Years of experience have shown that when the absorption of moisture is held below one percent, as measured by the ASTM 24-hour test, the reliability of the insulation is not noticeably impaired. Pyro-Shield insulation measures less than one-half percent absorption.

Preformed insulating materials eliminate the need for molding and taping joints when connecting shipping groups in the field. This method reduces installation time and resultant costs. The same preformed, high dielectric strength joints used in factory assembly are also used in field assembly. After bolting the main bus to the primary disconnect bushing assembly, a molded Pyro-Shield cap is placed over the joint and fastened to the main bushing with a reusable nylon pin. Field assembly time is reduced by as much as 30 minutes per joint.

The main bus consists of tin-plated aluminum bars with bolted joints using conical washers. As an alternate copper bus with silver-plated joints can be furnished.

SIEMENS

Type D&F
Metal-Clad Switchgear

SG 3011

Switchgear Division

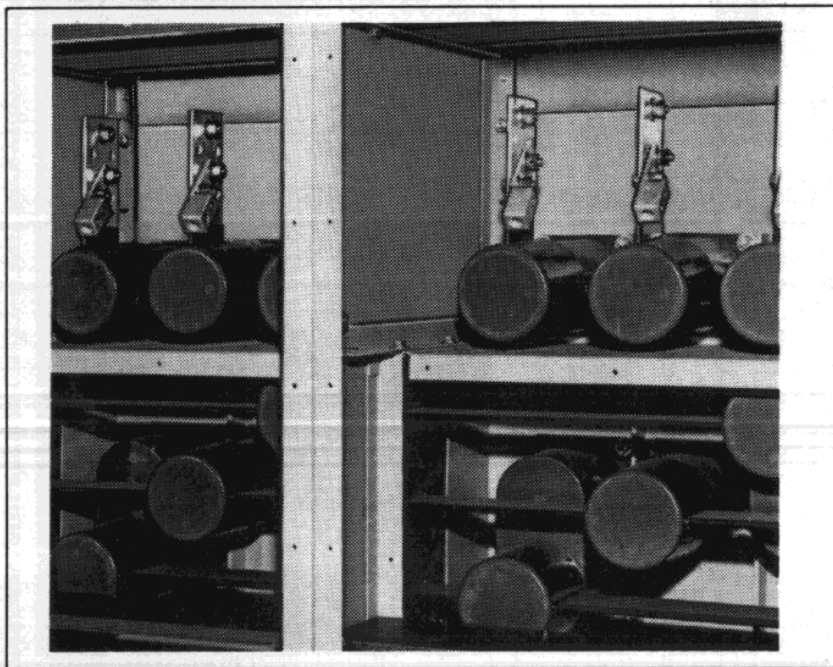
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Medium Voltage Horizontal Drawout Metal-Clad Switchgear
5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

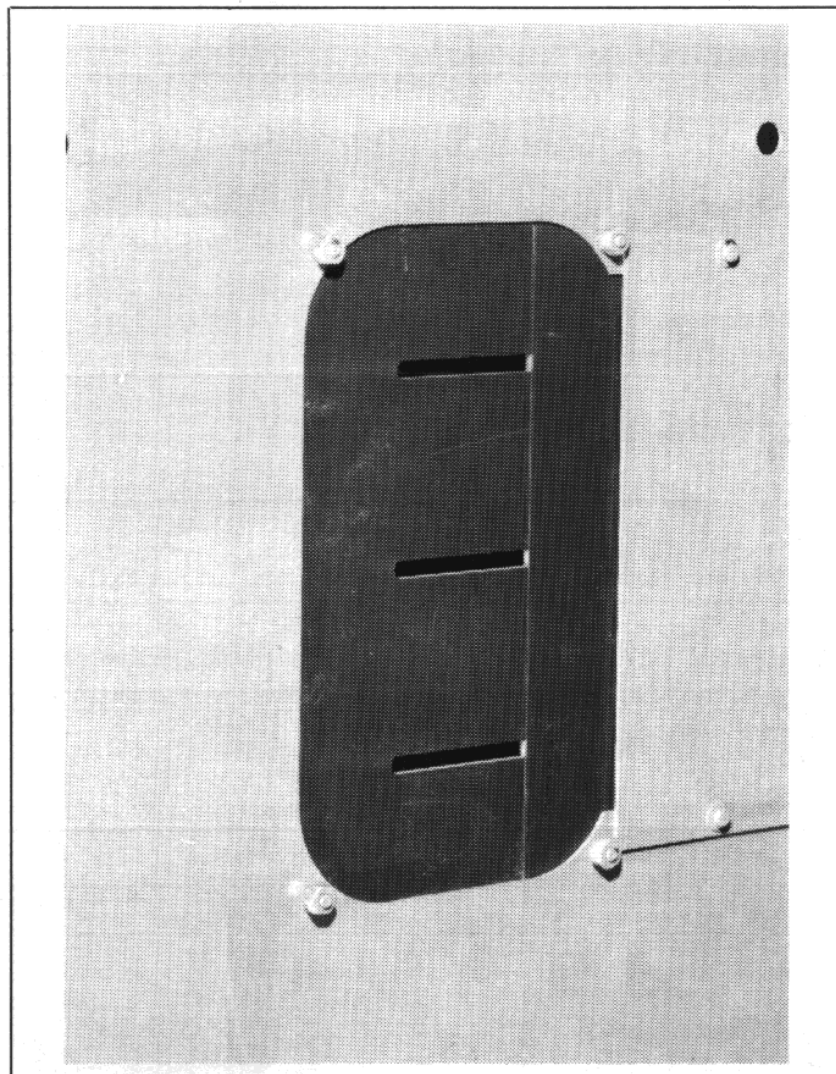
Description



Placing Polyester Cap Over Bolted Joint of 5 kV Cubicle



Rear View of 5 kV Cubicle



Pyro-Shield in 5 kV Interunit Bus Bar Supports Results in a Rigid, Well Supported Main Bus, Resistant to Arc Tracking and Moisture.

Insulation System—7.2 And 15 kV Switchgear

Porcelain Insulators

Electrical grade porcelain is used exclusively for all 7.2 and 15 kV main bus primary insulation. The low power factor, high dielectric strength, flame retardancy and resistance to tracking make porcelain an excellent material for these critical applications.

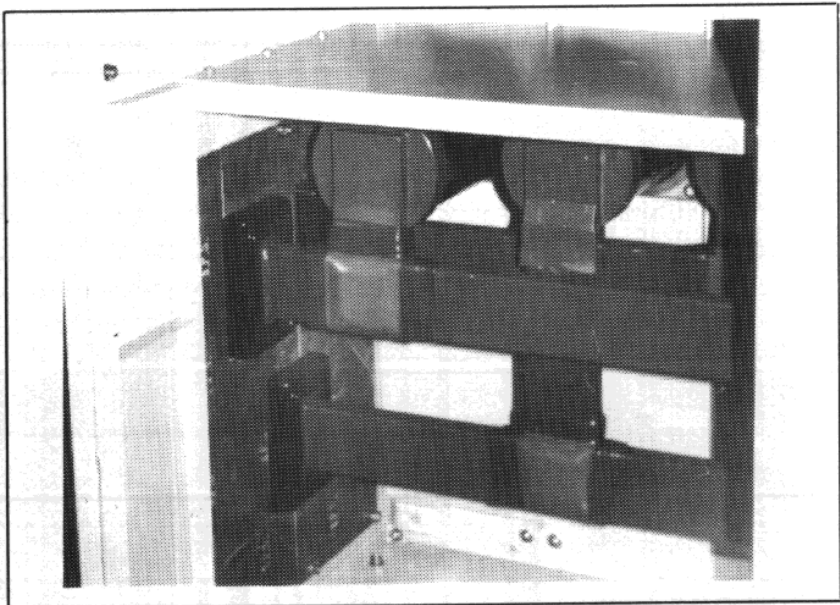
Bus bars are insulated by means of a tight fitting extruded sleeving of "Noryl" phenylene-oxide based resin. The material is flame retardant class 94V-1 per UL94. Insulation is at bus potential.

**Type D&F
Metal-Clad Switchgear**

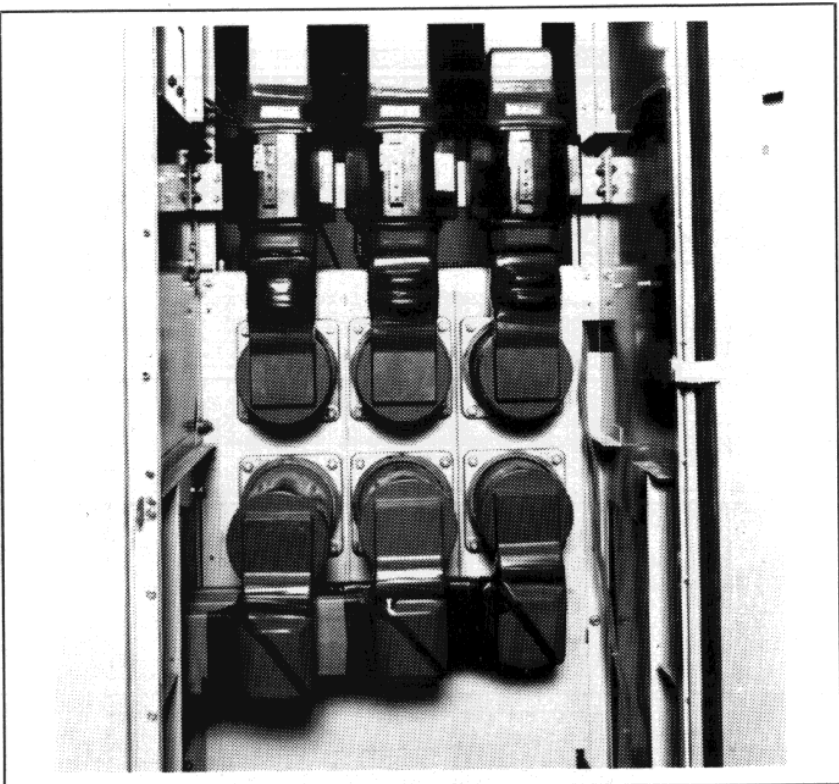
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Switchgear Division

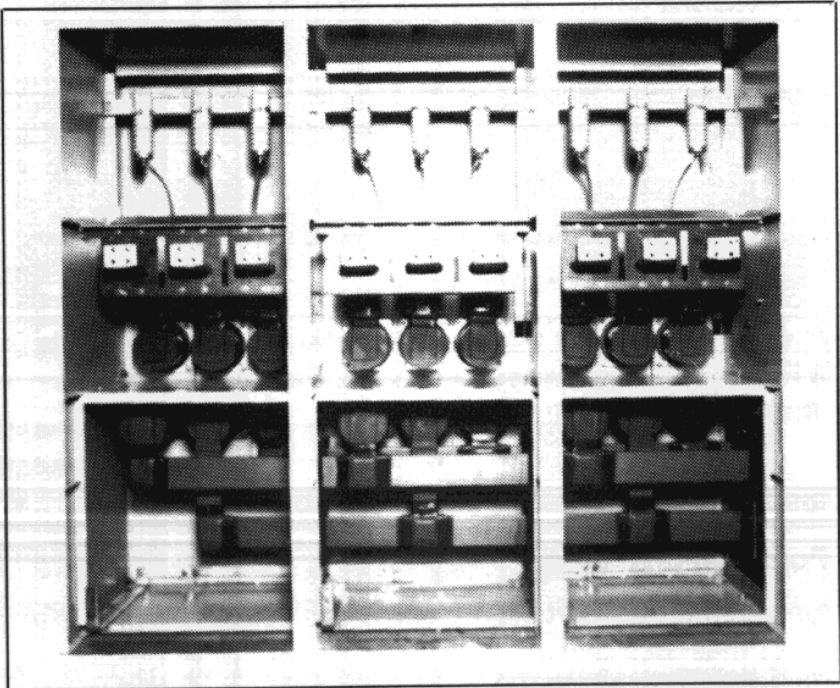
Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers	Description
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Contoured Porcelain Interunit Bus Supports, Mounted in Pyro-Shield Supporting Barrier, Are Used in 7.2 and 15 kV Class Switchgear.



Molded Polyvinyl Boots Are Used to Insulate Current Transformers Mounted in the Bus Compartment.



Rear View of 15 kV Switchgear.



Molded Polyvinyl Boots Are Used to Insulate Bus Joints in 7.2 and 15 kV Switchgear. Molded Boot is Placed over Bus Joint and Then Secured over Bolted Bus with Vinyl Tape.

SIEMENS

Type D&F
Metal-Clad Switchgear

SG 3011

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Medium Voltage Horizontal Drawout Metal-Clad Switchgear
5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

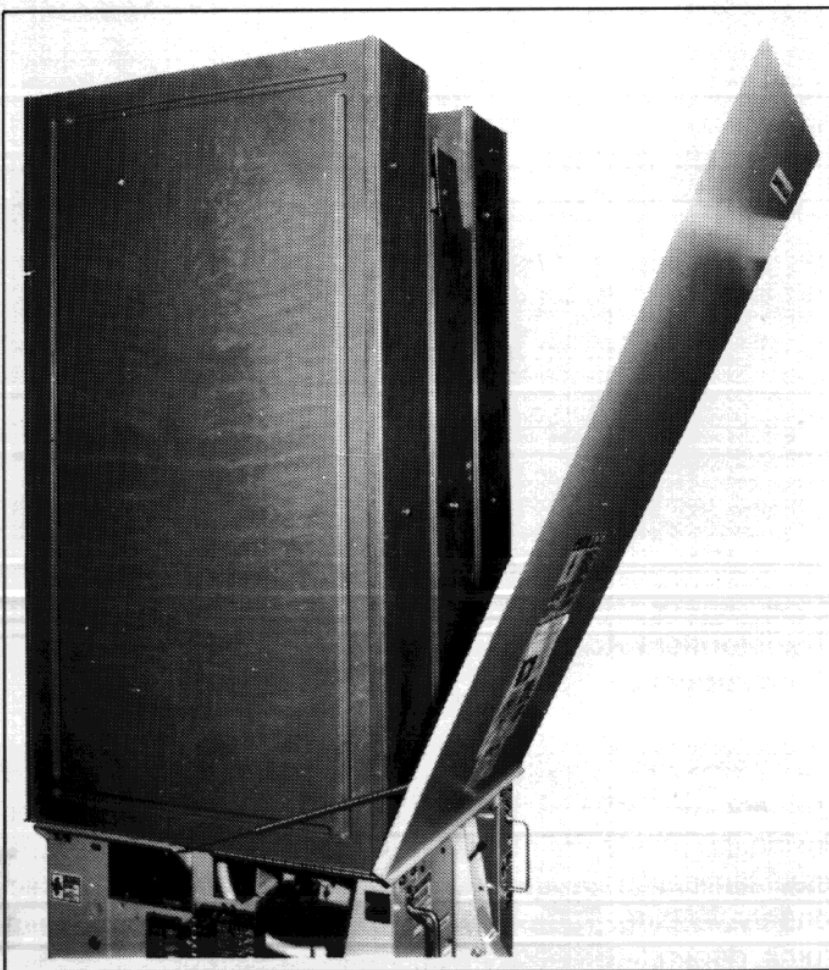
Description

Operator Protection

Counterbalanced Automatic Shutters

The grounded aluminum shutters automatically close the openings to the cubicle primary disconnects when the circuit breaker is withdrawn from its connected position. The protective shutters guard against accidental human contact with the cubicle primary disconnect members. They also keep foreign matter from entering the disconnect chambers. Shutters are designed to remain closed until the movable primary disconnects on the breaker are in position to enter the cubicle disconnect chambers.

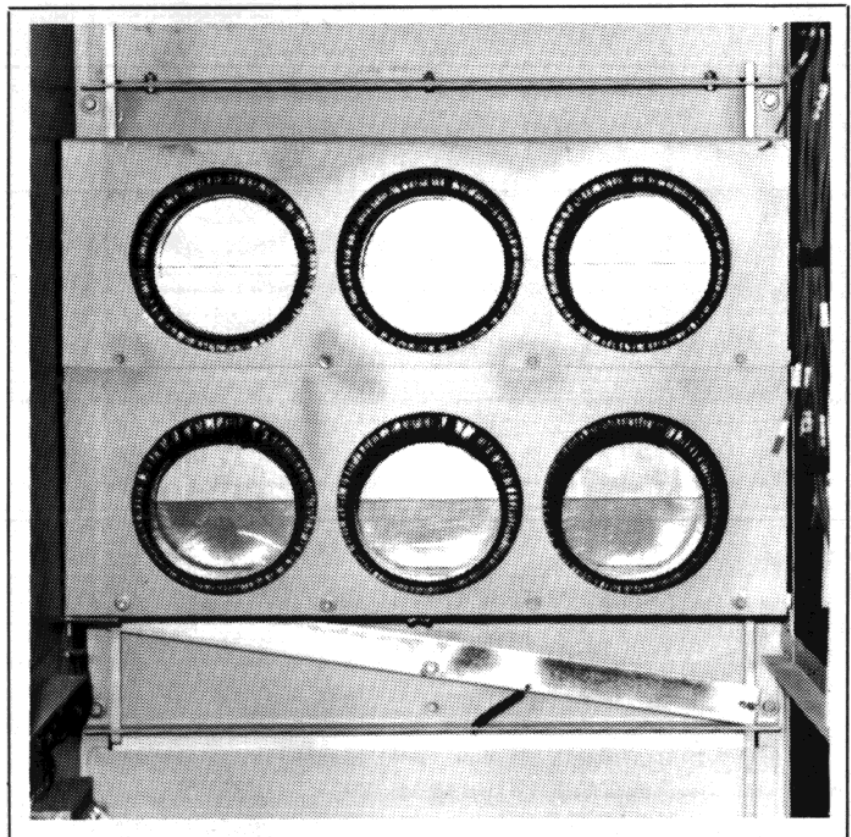
The two shutter blades operate with a counterbalanced action. One blade moves up while the other moves down. This design requires a minimum of operating forces with smooth shutter operation. Blades are actuated through a common link bar from a cam mounted on the circuit breaker frame.



Locked-On Protective Barrier

Breaker Protective Barrier

A Siemens exclusive. The tilt-front steel panel on the circuit breaker automatically locks to the cubicle as the breaker is inserted into the operating position. This design means a steel barrier is between the operator and the high-voltage conductors—even when the door is open. An equivalent, fixed panel is used on the 5-MSV-250 vacuum circuit breaker.



Shutters Closed

Shutters Operate by Positive Action when Opening or Closing as the Breaker is Racked Into or Out of the Cubicle.

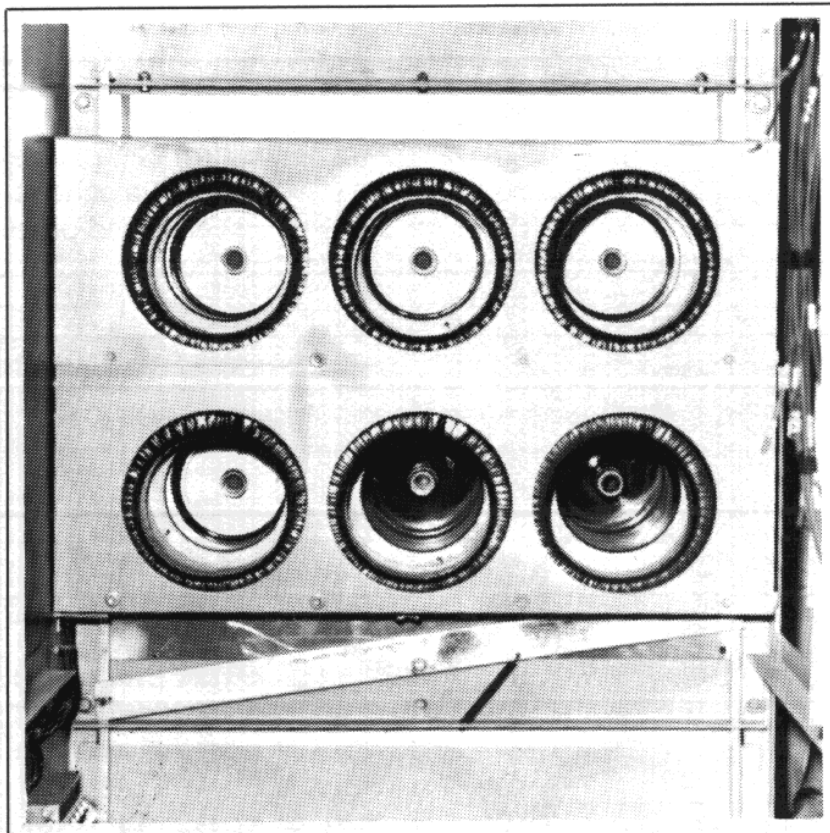
Type D&F Metal-Clad Switchgear

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Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

Description



Shutters Open

Instrument Transformers

Current Transformers—Readily Accessible

Current transformers used in switchgear are of Siemens manufacture, insulated and built to NEMA and ANSI standards.

Unless otherwise specified, the mechanical rating of the current transformers in RMS amperes is at least equal to the close and latch rating of the breaker in RMS amperes at circuit voltage. The one-second thermal rating in RMS amperes is at least equal to the symmetrical interrupting current rating of the circuit breaker in RMS amperes at circuit voltage.

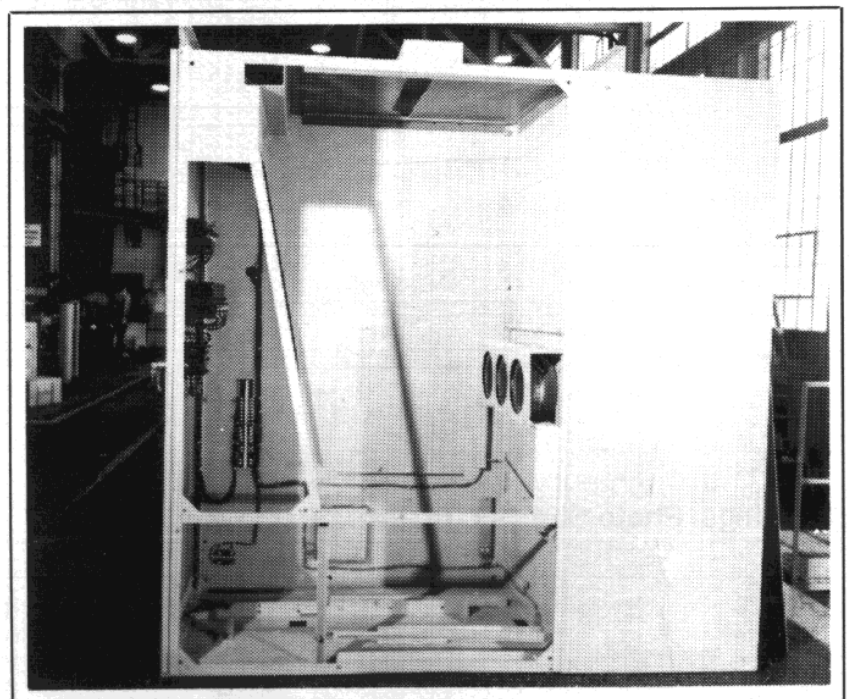
Adequate protection of the transformers from possible damage due to circuit breaker interruption is offered by enclosing them in an easily removable grounded metal barrier.

Toroidal Type DD and FD current transformers are used for ratios above 200:5. Metering accuracies at low ratios are obtained by using high-quality core steel wound on a circular mold until the desired cross-sectional area is obtained. To further improve the accuracies, each transformer has a fully distributed secondary winding.

Mounted in the circuit breaker compartment, it is possible to test the transformers without removing them from the unit. Maximum operator safety is maintained since removal of the circuit breaker automatically removes the primary bar and closes off the high-voltage bus compartment.

The current transformers may be mounted either on the bus, load, or bus- and load side of the circuit breaker, depending on the requirements of the application.

Wound Type MKS current transformers are used for applications where ratios below 200:5 are required. They are mounted in a rear compartment that is isolated from the bus compartment by a steel barrier. Isolation from the cable compartment is provided by the cable support block or pothead support plate and pothead.



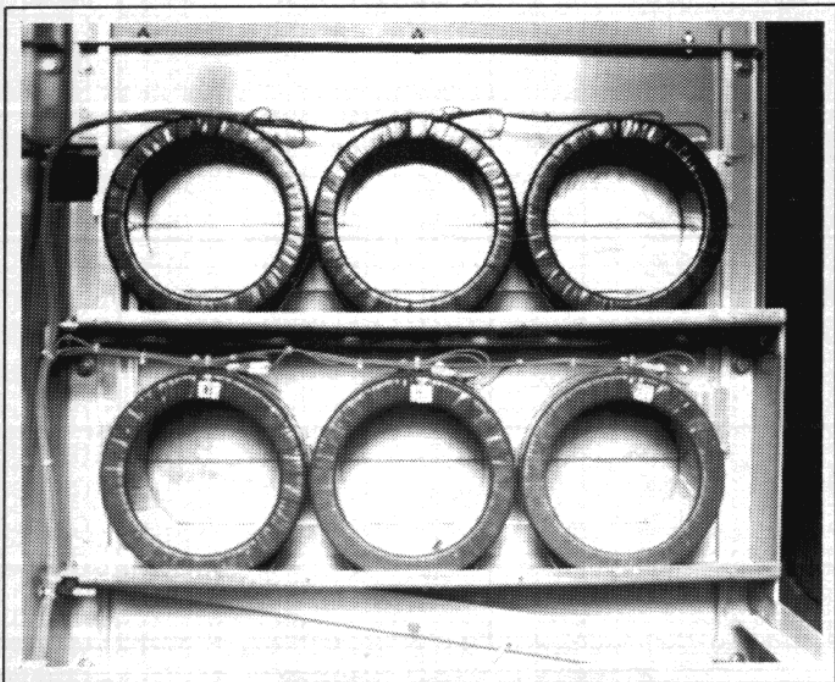
Side View of 15 kV Metal-Clad Switchgear Shows Current Transformers Accessible from Circuit Breaker Compartment

This type of current transformer consists of several turns of primary conductor and a cylindrical secondary coil inserted inside the primary winding. One leg of the precut rectangular steel laminations is stacked through the opening of the secondary winding. The primary winding may consist of several turns, depending on accuracy and ratio desired.

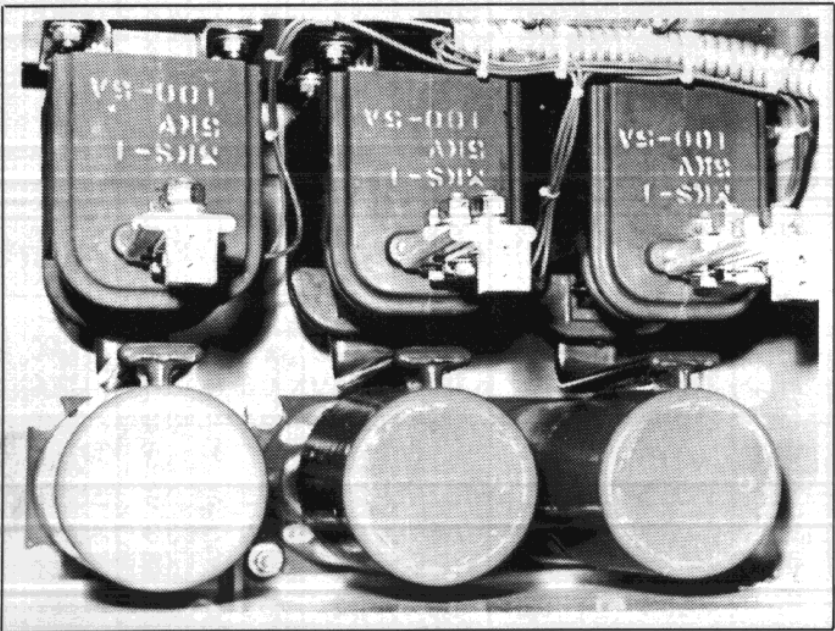
Medium Voltage Horizontal Drawout Metal-Clad Switchgear
5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

Description

Bar Type FB and DB current transformers are used for applications which require higher ratios than can be achieved with the wound type MKS current transformer. The FB and DB current transformers are mounted in the rear compartment of the equipment, and are isolated from other equipment in a manner similar to the type MKS current transformer.



Current Transformers Are Mounted in Separate Enclosure Against the Circuit Breaker Compartment Rear Plate Which Supports the Stationary High-Voltage Bushings. Photo Shows CT Covers Removed.



Wound Type Current Transformers Mounted in Rear of 5 kV Unit

Standard Current Transformer Ratings

Toroidal Type
5 kV

Type	Ratio	Current		Accuracy @ 60 Hz				Re-laying Class
		One Second Thru	Momentary	Metering Burden (ohms)				
				B-0.1	B-0.5	B-1.0	B-2.0	
DD	200/5	Breaker Rating		0.6	2.4	4.8	—	C20
DD	300/5	Breaker Rating		0.3	0.6	2.4	4.8	C30
DD	400/5	Breaker Rating		0.3	0.6	1.2	2.4	C50
DD	600/5	Breaker Rating		0.3	0.3	0.6	1.2	C70
DD	800/5	Breaker Rating		0.3	0.3	0.3	0.6	C100
DD	1200/5	Breaker Rating		0.3	0.3	0.3	0.3	C110
DD	1500/5	Breaker Rating		0.3	0.3	0.3	0.3	C140
DD	2000/5	Breaker Rating		0.3	0.3	0.3	0.3	C100
DD	3000/5	Breaker Rating		0.3	0.3	0.3	0.3	C100

7.2 and 15 kV

Type	Ratio	Current		Accuracy @ 60 Hz				Re-laying Class
		One Second Thru	Momen- tary	Metering Burden (ohms)				
				B-0.1	B-0.5	B-1.0	B-2.0	
FD	200/5	Breaker Rating		1.2	1.2	4.8	4.8	C40
FD	300/5	Breaker Rating		0.6	0.6	1.2	4.8	C60
FD	400/5	Breaker Rating		0.3	0.6	1.2	2.4	C80
FD	600/5	Breaker Rating		0.3	0.3	0.6	1.2	C130
FD	800/5	Breaker Rating		0.3	0.3	0.3	0.6	C180
FD	1200/5	Breaker Rating		0.3	0.3	0.3	0.3	C250
FD	1500/5	Breaker Rating		0.3	0.3	0.3	0.3	C240
FD	2000/5	Breaker Rating		0.3	0.3	0.3	0.3	C380
FD	3000/5	Breaker Rating		0.3	0.3	0.3	0.3	C260
FD	4000/5	Breaker Rating		0.3	0.3	0.3	0.3	C350

Type D&F
Metal-Clad Switchgear

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Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers	Description
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Standard Current Transformer Ratings

Wound Type

Type	Ratio	Current		Accuracy @ 60 Hz			Re-laying Class
		One Second Thru	Momentary	Metering Burden (ohms)			
				B-0.1	B-0.5	B-2.0	
MKS-1	25/5	*37500	60000	1.2	2.4	—	T10
MKS-1	30/5	*37500	60000	1.2	2.4	—	T10
MKS-1	40/5	*37500	60000	0.6	1.2	4.8	T15
MKS-1	50/5	*37500	60000	0.6	0.6	2.4	T25
MKS-1	75/5	*37500	60000	0.6	0.6	1.2	T35
MKS-1	100/5	*50000	80000	0.3	0.3	0.6	T65
MKS-1	150/5	*50000	80000	0.3	0.3	0.6	T70
MKS-1	200/5	*50000	80000	0.3	0.3	0.6	T80
MKS-1	300/5	*50000	100000	0.3	0.3	0.6	T90
MKS-1	400/5	*50000	100000	0.3	0.3	0.6	T80
MKS-1	600/5	57000	141000	0.3	0.3	0.6	T100
MKS-1	800/5	68000	141600	0.3	0.3	0.6	T80

Type	Ratio	Current		Accuracy @ 60 Hz			Re-laying Class
		One Second Thru	Momentary	Metering Burden (ohms)			
				B-0.1	B-0.5	B-2.0	
MKS-3	25/5	*37500	60000	2.4	2.4	—	T10
MKS-3	30/5	*37500	60000	2.4	2.4	—	T10
MKS-3	40/5	*37500	60000	1.2	2.4	—	T15
MKS-3	50/5	*37500	60000	1.2	1.2	—	T25
MKS-3	75/5	*37500	60000	0.6	0.6	2.4	T35
MKS-3	100/5	*50000	80000	0.6	0.6	1.2	T65
MKS-3	150/5	*50000	80000	0.3	0.3	1.2	T70
MKS-3	200/5	*50000	80000	0.3	0.3	1.2	T80
MKS-3	300/5	*50000	100000	0.3	0.3	0.6	T90
MKS-3	400/5	*50000	100000	0.3	0.3	0.6	T80
MKS-3	600/5	57000	141000	0.3	0.3	0.6	T100
MKS-3	800/5	68000	141600	0.3	0.3	0.6	T80

* With B-0.2 burden or greater on secondary.

Note: One second and momentary ratings are same as breaker rating for bar type FB and DB current transformers

Note: Continuous thermal rating at rated primary current and 40°C of switchgear room ambient . . . 1.0

Note: Other CT ratios as well as multi-ratio CT's are available.

Standard Current Transformer Ratings

Bar Type

Type	Ratio	Accuracy @ 60 Hz					Re-laying Class
		Metering Burden (ohms)					
		B-0.1	B-0.2	B-0.5	B-1.0	B-2.0	
DB	200/5	0.3	0.6	1.2	2.4	4.8	C40
DB	250/5	0.3	0.3	0.6	1.2	2.4	C50
DB	300/5	0.3	0.3	0.6	0.6	1.2	C60
DB	400/5	0.3	0.3	0.3	0.6	1.2	C90
DB	500/5	0.3	0.3	0.3	0.3	0.6	C110
DB	600/5	0.3	0.3	0.3	0.3	0.6	C130
DB	800/5	0.3	0.3	0.3	0.3	0.3	C120
DB	1000/5	0.3	0.3	0.3	0.3	0.3	C150
DB	1200/5	0.3	0.3	0.3	0.3	0.3	C190
DB	1500/5	0.3	0.3	0.3	0.3	0.3	C210
DB	2000/5	0.3	0.3	0.3	0.3	0.3	C210
DB	2500/5	0.3	0.3	0.3	0.3	0.3	C260
DB	3000/5	0.3	0.3	0.3	0.3	0.3	C320
DB	3000/3.75	0.3	0.3	0.3	0.3	0.3	C300
DB	3000/3	0.3	0.3	0.3	0.3	0.3	C400

Type	Ratio	Accuracy @ 60 Hz					Re-laying Class
		Metering Burden (ohms)					
		B-0.1	B-0.2	B-0.5	B-1.0	B-2.0	
FB	200/5	0.6	0.6	1.2	2.4	4.8	C40
FB	250/5	0.6	0.6	1.2	2.4	2.4	C50
FB	300/5	0.3	0.3	0.6	1.2	2.4	C60
FB	400/5	0.3	0.3	0.3	0.6	1.2	C90
FB	500/5	0.3	0.3	0.3	0.6	1.2	C110
FB	600/5	0.3	0.3	0.3	0.3	0.6	C140
FB	800/5	0.3	0.3	0.3	0.3	0.3	C150
FB	1000/5	0.3	0.3	0.3	0.3	0.3	C190
FB	1200/5	0.3	0.3	0.3	0.3	0.3	C230
FB	1500/5	0.3	0.3	0.3	0.3	0.3	C290
FB	2000/5	0.3	0.3	0.3	0.3	0.3	C200
FB	2500/5	0.3	0.3	0.3	0.3	0.3	C240
FB	3000/5	0.3	0.3	0.3	0.3	0.3	C290
FB	3000/3 75	0.3	0.3	0.3	0.3	0.3	C250
FB	3000/3	0.3	0.3	0.3	0.3	0.3	C250
FB	4000/5	0.3	0.3	0.3	0.3	0.3	C320
FB	4000/4	0.3	0.3	0.3	0.3	0.3	C400

Medium Voltage Horizontal Drawout Metal-Clad Switchgear
5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

Description

Instrument Transformers

Trunnion-Mounted Voltage Transformers—Automatic
Disconnection, Easy Withdrawal for Test or Inspection

Voltage transformers used in the switchgear are built and tested in accordance with the latest NEMA and IEEE standards.

The use of epoxy resin as the insulation between primary and secondary windings permits corona control with less space between coils. Smaller in size than conventional dry-type transformers, three VT's can be mounted on one tilt-out carriage.

The drawout compartment for voltage transformers is located in the top rear of the circuit breaker cubicle at convenient shoulder height, or the compartment can be mounted in an auxiliary cubicle. The transformers are mounted on a separate base which pivots in a pair of trunnions. The pivoted base is easily rotated 135 degrees to disconnect position. Three voltage transformers may be mounted on one tilt-out carriage.

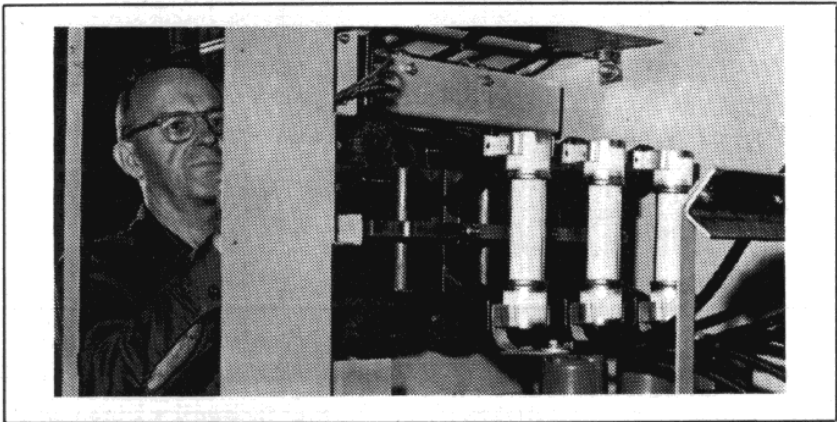
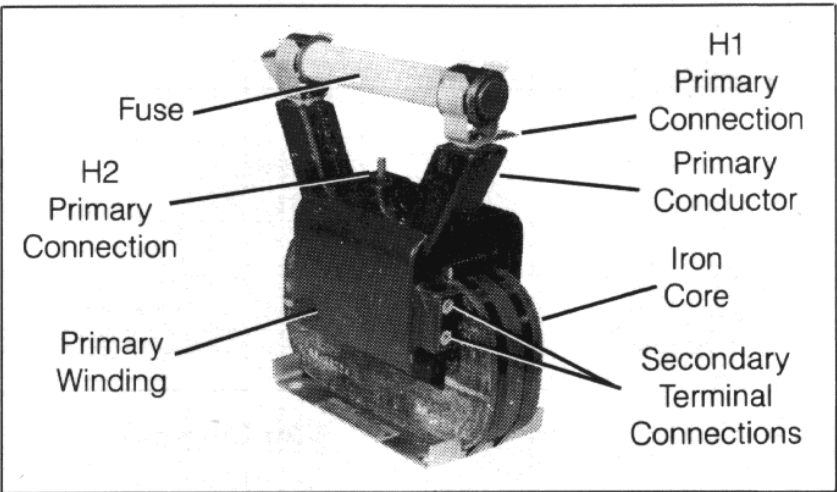
While pivoting from the connected to the disconnected position, the transformer primary windings and transformer-mounted current-limiting fuses are automatically and safely grounded to remove any charge from the windings. When the transformers are in the disconnect position, the base acts as a barrier between the primary studs and the operator. The weight is distributed so that minimum effort is needed to revolve the carriage.

Type DP (5 kV) Voltage Transformers

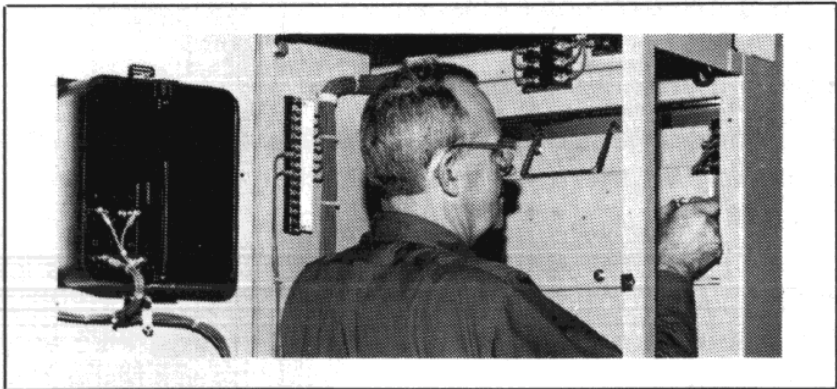
Ratio	Accuracy Class				Volt-Amp Thermal Rating	Hertz
	W	X	Y	Z		
4800/120	0.3	0.3	0.3	1.2	400	50/60
4200/120	0.3	0.3	0.3	1.2	400	50/60
2400/120	0.3	0.3	0.3	1.2	400	50/60

Type FP (15 kV) Voltage Transformers

Ratio	Accuracy Class				Volt-Amp Thermal Rating	Hertz
	W	X	Y	Z		
14,400/120	0.3	0.3	0.3	0.6	1000	50/60
12,000/120	0.3	0.3	0.3	0.6	1000	50/60
8400/120	0.3	0.3	0.3	0.6	1000	50/60
7200/120	0.3	0.3	0.3	0.6	1000	50/60
4800/120	0.3	0.3	0.3	0.6	1000	50/60
4200/120	0.3	0.3	0.3	0.6	1000	50/60



1. Voltage Transformers in Connected Position.



2. Latches Are Turned to Release Trunnion Mounted Carriage.

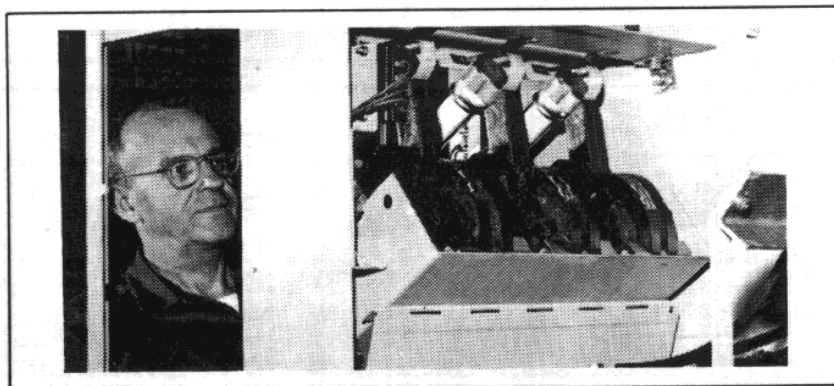
Type D&F Metal-Clad Switchgear

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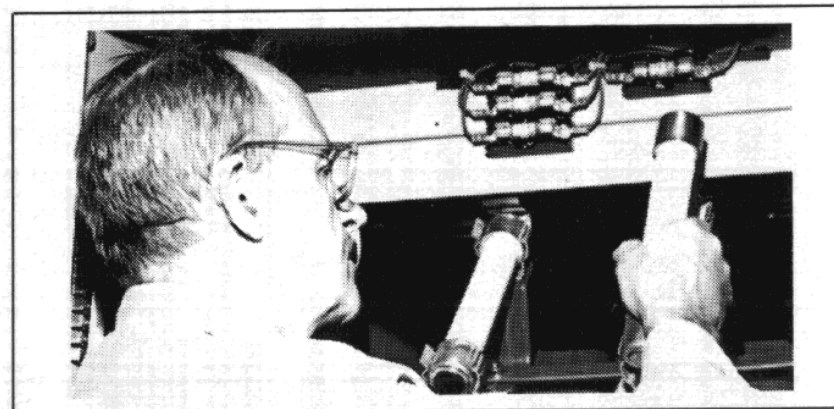
Switchgear Division

Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

Description



3. Carriage Is Rotated to Disconnect Transformers. Fuse Strikes Grounding Strap to Remove Static Charge.



4. Transformer Carriage Rotation Is Completed, Placing Grounded Fuses Outside of Unit for Safe and Convenient Removal and Replacement.

Control Power Transformers

Performance-Tested Control-Power Transformers for Operating Breakers, Compartment Lights, Outlets, Heaters

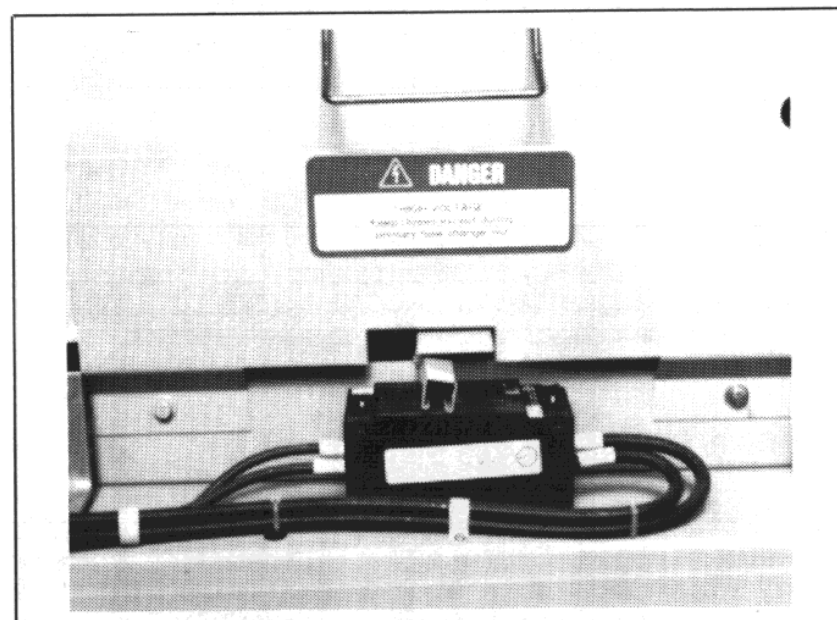
Control-power transformers are furnished when specified to supply power for the functions of the switchgear lineup. They are built and tested in accordance with the latest IEEE and NEMA standards. They meet these standards with respect to temperature in metal-clad switchgear and are designed with a uniformly low reactance to assure good regulation. Primary fuses are current limiting.

Control transformers are stationary mounted with tilt-out fuses. The fuses are mounted on a tilt-out carriage which operates in the same manner as the voltage transformer carriage.

A thermal circuit breaker on the secondary side of the transformer is interlocked with the carriage. It cannot be rotated unless the circuit breaker is open. This prevents accidental circuit interruption with the main primary contacts.

The drawout mechanism is trunnion operated with the transformer fuses mounted on a separate base which revolves 135 degrees from the connected position to the disconnected or test position. The weight of the revolving carriage is distributed so that it swings out easily. During the half-revolution required to fully disconnect, the current-limiting fuses are automatically grounded to remove any charge. When the disconnect position is reached, the stationary disconnect studs are behind a steel barrier. No accidental contact with the high voltage circuit is possible.

7.2 kV and 15 kV control power transformers are available as a combination Fuse/CPT trunnion mounted device in single phase ratings thru 15 kVA. This allows additional compartmentation space in the same vertical section for auxiliary devices such as batteries.



Trunnion-Mounted Fuses for the Stationary-Mounted Control Power Transformer Are Mechanically Interlocked with Secondary Thermal Breaker to Prevent Load Break. When the Secondary Breaker Is Closed, Rotation of Carriage is Prevented as Interlock Engages Breaker Toggle.

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Metal-Clad Switchgear

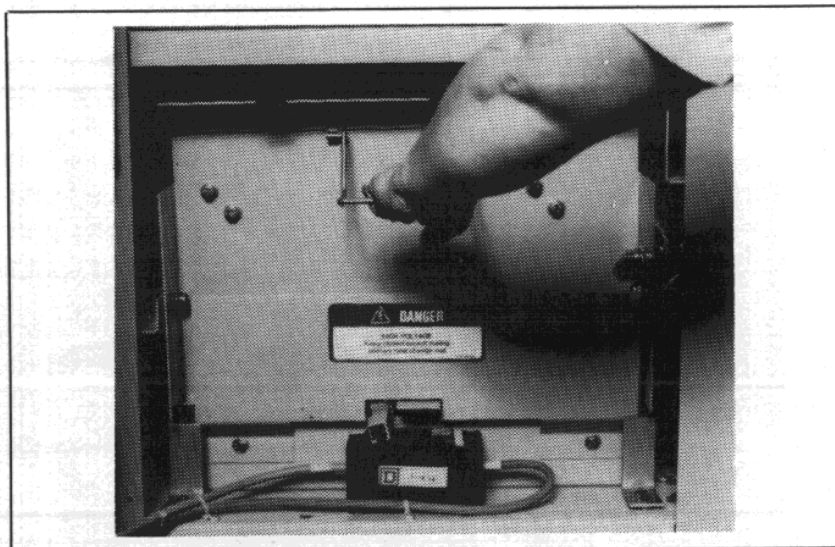
SG 3011

Switchgear Division

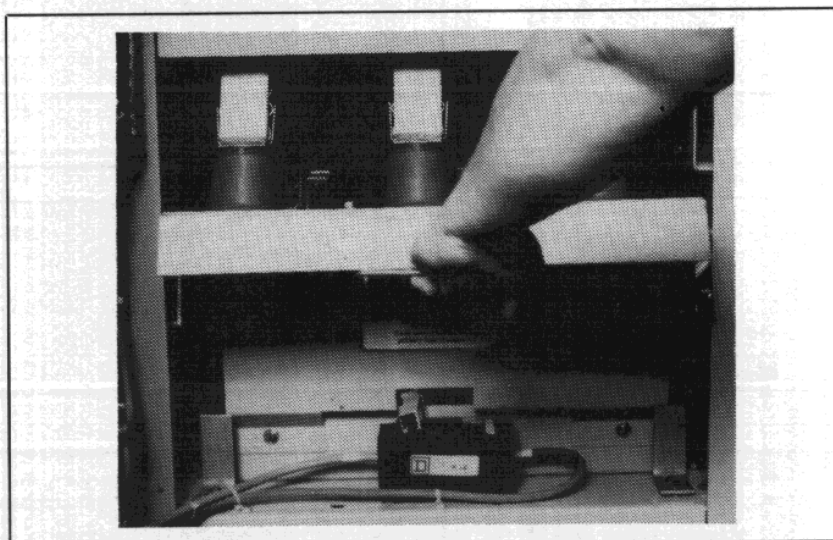
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Medium Voltage Horizontal Drawout Metal-Clad Switchgear
5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

Description



When the Secondary Breaker Is Open (Top), Rotation of Carriage Is Possible (Bottom).



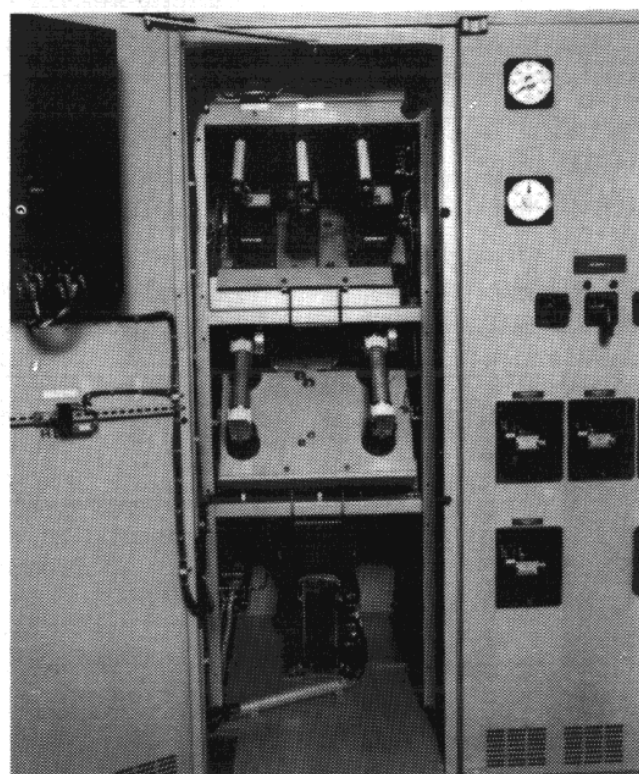
Auxiliary Switches And Wiring

Auxiliary Switches (Breaker Mounted)

On Vacuum Circuit Breakers, Type MSV and FSV, up to four pre-selected auxiliary contact stages may be wired out for customer use. As standard, these fixed contact stages are 2-Normally Open and 2-Normally Closed.

Cubicle Mounted Auxiliary Switches (Mechanism Operated—MOC)

On Air-Magnetic Circuit Breakers, Type MA, FA, FB, and FC, the Type Q-10 auxiliary switch is used. It has 8 individually adjustable contact stages with 4 normally being used in the



Control Power Transformer Mounted in Bottom Compartment of 5 kV Auxiliary Unit with Its Trunnion-Mounted Fuses in Center Compartment.

circuit breaker control circuit. The balance may be wired out for customer use.

When specified, extra type Q-10 auxiliary switches can be mounted on the left-hand side of the cubicle. Switches are operated by a notched lug attached directly to the circuit breaker mechanism main crank and are available in 8, 12, and 16 stages. The making point of each stage can be adjusted completely individually in 15-degree steps. The rotor is adjusted by pressing the contact to the sides and rotating it within its insulated housing until it snaps into desired position. The switches can be converted from NC to NO and vice versa in the field.

Truck Operated (TOC) Cell Switch

The truck operated switch is mounted at the rear of the circuit breaker compartment and is actuated by the circuit breaker when it is in the connected position. These are push button type switches and they are available in stackable elements with a maximum of eight contacts. (4 N.O. and 4 N.C.)

Wiring

The secondary and control wiring is brought to terminal blocks which have numbered points for identification. Separate ter-

Type D&F
Metal-Clad Switchgear

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Switchgear Division

Medium Voltage Horizontal Drawout Metal-Clad Switchgear
5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

Description

terminal blocks are supplied for all secondary and control connections leaving the metal-clad cubicle with one side reserved for external connections.

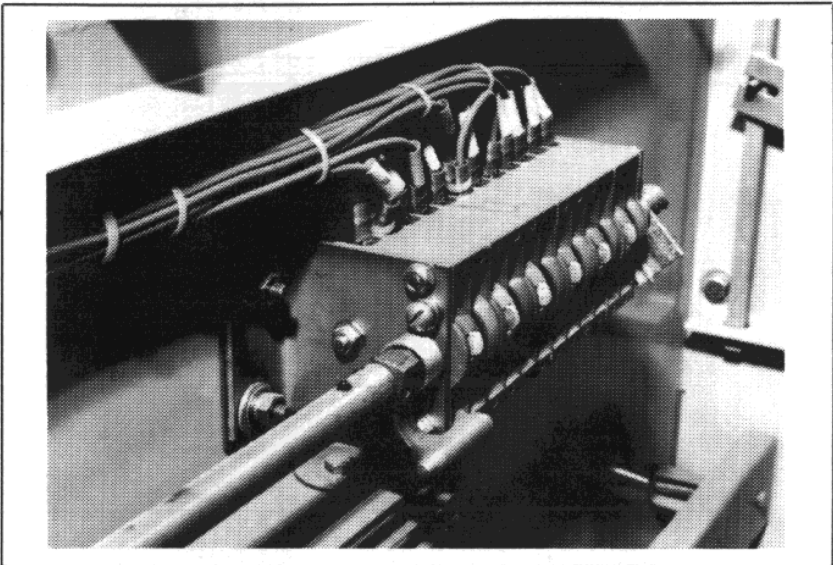
Standard secondary and control wiring is NEC Type SIS insulated for 600 volts and no smaller than No. 14 AWG. Wiring between cubicles is carried in an accessible wiring trough.

Auxiliary Switch Ratings (Vacuum Breaker Mounted)

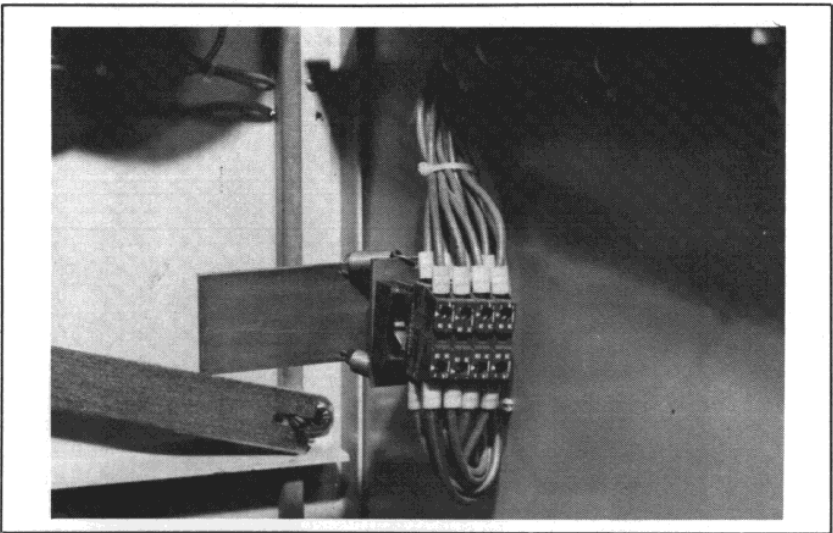
Characteristic	Rating
Maximum Operating Voltage	500 V
Continuous Current, Max.	10 A
Making Current, Max.	30 A
Breaking Capacity	
Resistive Load DC or AC	1200 VA
Inductive Load at 220VDC (L/R = 20ms)	750 VA

Q-10 Auxiliary Switch Ratings
(Air Magnetic Breaker Mounted or MOC)

Voltage	Interrupting Ratings	
	Non-Inductive Current	Inductive Current
24 VDC	40	30
48 VDC	30	20
125 VDC	15	10
250 VDC	8	5
110 VAC	75	30
220 VAC	50	25
440 VAC	25	—



Panel Door Is Shown Open to Reveal Cubicle Mounted Auxiliary Switches. (MOC)



Truck Operated Switch (TOC)

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**Medium Voltage Horizontal Drawout Metal-Clad Switchgear
5 and 15 kV Air Magnetic and Vacuum Circuit Breakers**

Description

Control and Instrument Switches

All switches furnished are switchboard type. They are of rotary-type construction, with two contacts per stage.

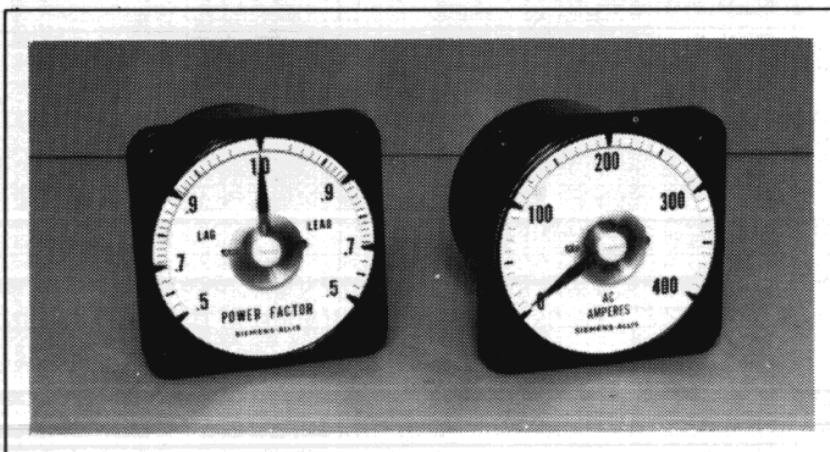
Circuit breaker control switches have pistol-grip handles, instrument switches have round notched handles, and transfer or auxiliary switches have oval handles. Standard switches have black handles.

All circuit breaker control switches have a mechanical flag indicator which shows a red or green marker to indicate the last manual operation of the switch.

Convenient Full-Panel Metering And Relay

All instruments, meters and relays are standard switchboard type for mounting on cold rolled steel panels. Conventional semiflush mounted cases with dull black finish are normally used. All meters and protective relays, if available as standard, are of the draw-out type with built-in test devices.

Indicating and recording instruments, meters and relays are of the rectangular type, semiflush mounted. Special instruments will be furnished upon request. All scales have a suitable range and are designed with black letters on a white background.



Siemens Standard Instruments Have Taut-Band Suspension and 250° Scales.

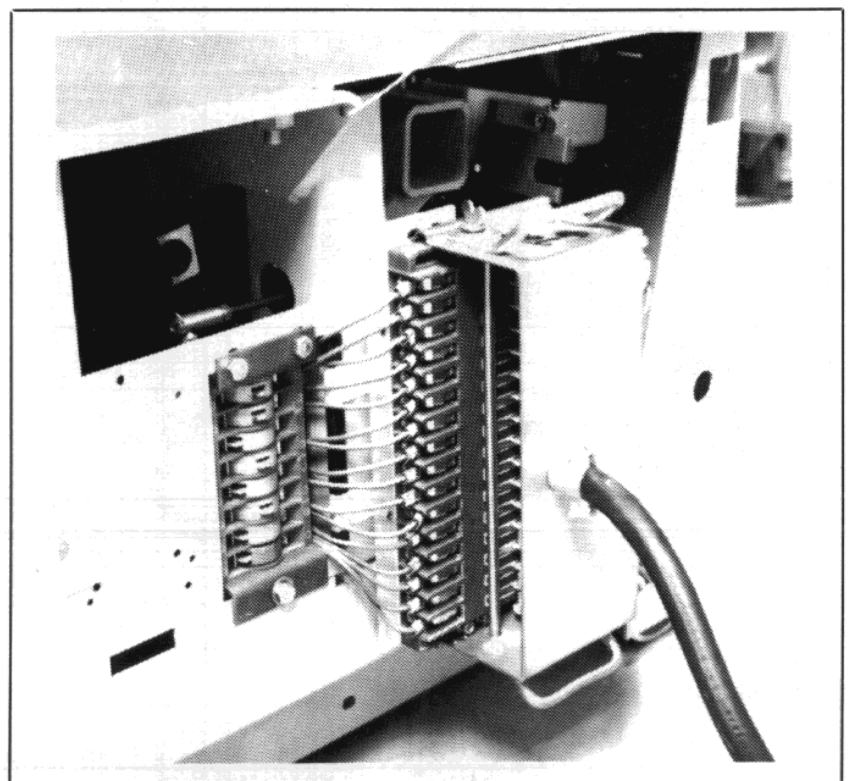
Accessories

The following accessories will be supplied, but not housed:

- 1—Racking lever.
- 1—Maintenance closing spring blocking device (to permit slow closing air magnetic circuit breakers).
- 1—Manual spring charging crank.
- 1—Fifth wheel.
- 1—Test plug, less cable, for drawout relays and watt-hour meters. (optional)
- 1—Plug jumper (optional) or 1-test cabinet (optional).
- 1—Floor plate racking extension (for type F indoor units).
- 1—Transfer truck (for conventional outdoor switchgear only).
- 1—Arc chute support stand (air magnetic circuit breakers).

Optional test devices—either a plug jumper or test cabinet—are available for testing the circuit breaker outside of its cubicle.

The plug jumper is used to bridge—with a flexible cable—the secondary disconnects so that the circuit breaker can be electrically closed and tripped with the control switch on the instrument panel.



Plug Jumper (Optional)

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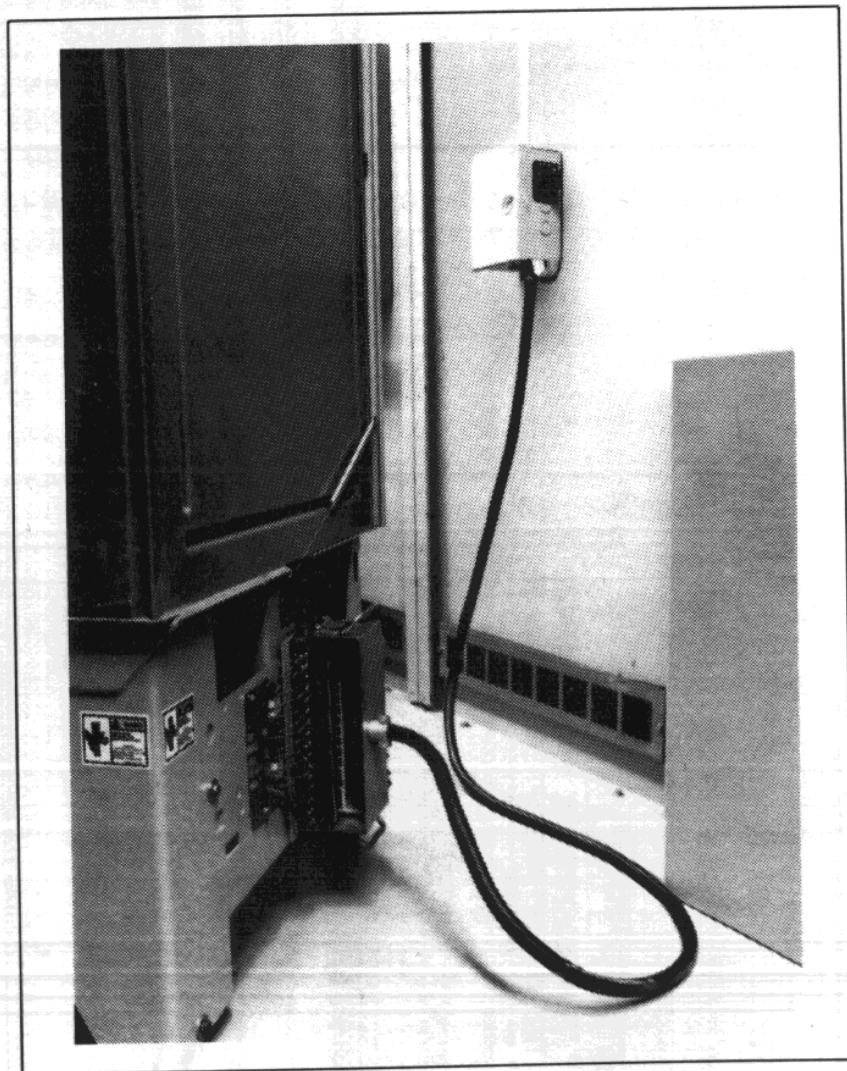
Switchgear Division

Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

Description

The test cabinet is connected to a plugging device by a flexible cable. It can be either bench- or wall-mounted remotely from the switchgear, near a suitable power source that must be wired into the cabinet by the user.

The plug jumper should be specified when normal maintenance is to be done in front of the switchgear. When circuit breakers are to be tested in a separate maintenance area, the test cabinet is recommended.



**Test Cabinet with Flexible Cable and Plugging Device
(Optional)**



Fifth Wheel Facilitates Breaker Handling

Outdoor Housings

General

Two types of outdoor housings—shelter-clad™ single aisle and Shelter-Clad™ common aisle—are available to meet any application. Both types can be furnished with all classes of high voltage metal-clad switchgear.

Steel plates are supplied for covering the space between the ends of the "I" beams to prevent entrance of debris. The underside of the enclosure and beams are undercoated with asphaltic material. The switchgear is shipped in convenient groups for erection in the field. Shipping groups do not exceed fifteen (15) feet in length. Necessary erection hardware is furnished.

Shelter-Clad™ Housing—Single Aisle

The Shelter-Clad switchgear consists of indoor type circuit breaker and auxiliary cubicles located in a weatherproof steel housing having an operating aisle space of sufficient size to permit withdrawal of the circuit breakers for inspection, test or maintenance. An access door is located at each end of the aisle, with provision for padlocking on the outside, but also arranged so that the door can be opened from the inside regardless of whether or not it has been padlocked on the outside. The aisle space has adequate incandescent lighting which

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Switchgear Division

Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers

Description

is controlled by means of a three-way switch at each access door.

Included in the switchgear are the following:

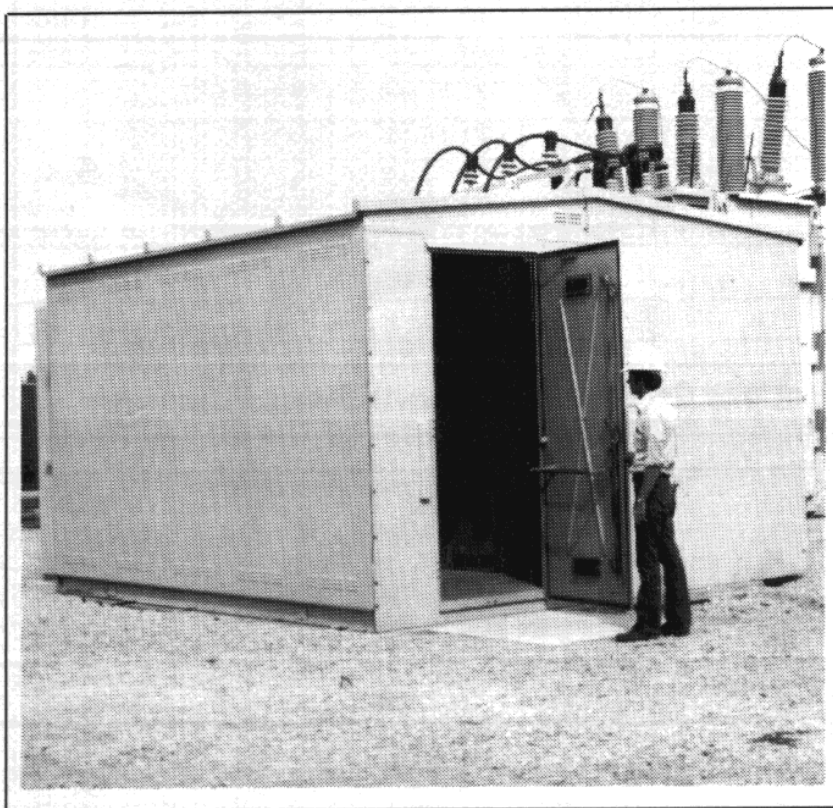
- a. One (1) space heater, 500 watts, 240 volts, A.C. in each unit.
- b. Two (2) utility duplex receptacles, one at each access door for electric tools, extension cords, etc.

The complete assembly rests on four (4)—6 inch high "I" beams running parallel to the length of the switchgear.

The weatherproof enclosure for the aisleway is shipped disassembled for ready erection in the field.

Included in the switchgear are the following items:

- a. One (1) space heater, 500 watts, 240 volts, A.C. in each cubicle.
- b. Two (2) utility duplex receptacles, one at each access door, for electric tools, extension cords, etc.



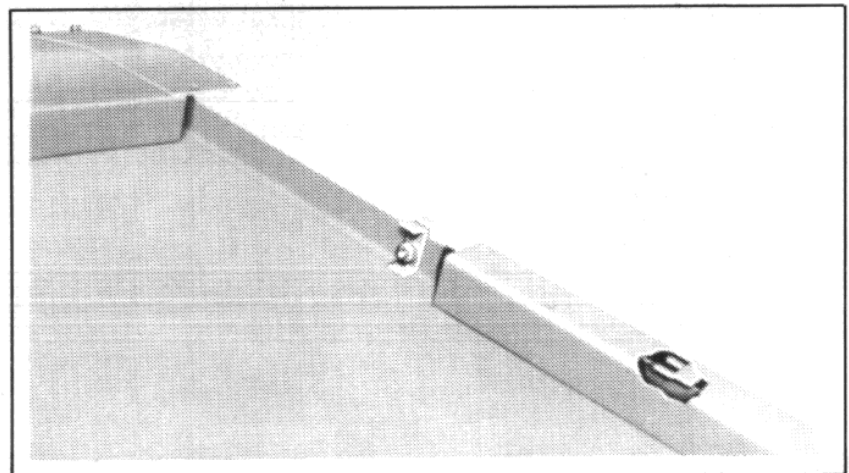
Shelter-Clad™ Housing

Shelter-Clad™ Housing—Common Aisle

The Shelter-Clad switchgear consists of two (2) lineups of indoor type circuit breaker and auxiliary units located in a weatherproof steel housing having a common operating aisle space of sufficient size to permit withdrawal of the circuit breakers for inspection, test or maintenance. An access door is located at each end of the aisle, with provision for padlocking on the outside, but also arranged so that the door can be opened from the inside regardless of whether or not it has been padlocked on the outside. The aisle space will have adequate incandescent lighting which will be controlled by means of a three-way switch at each access door.



Door Assembly is Packed in Shipping Box with Floor Plates, Roof Decks, and Associated Hardware.



Roof Decks Are Fastened Together Using Channel Washers. The Joint Channels Are Placed so that Inside Clips Engage Channel Washers. Channel Is Then Slid Toward Peak. Gasketing Is not Required.

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Metal-Clad Switchgear**

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Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers	Description
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The complete assembly rests on five (5)—6 inch high "I" beams running parallel to the length of the switchgear.

The weatherproof enclosure for the aisleway is shipped in sections for ready erection in the field.

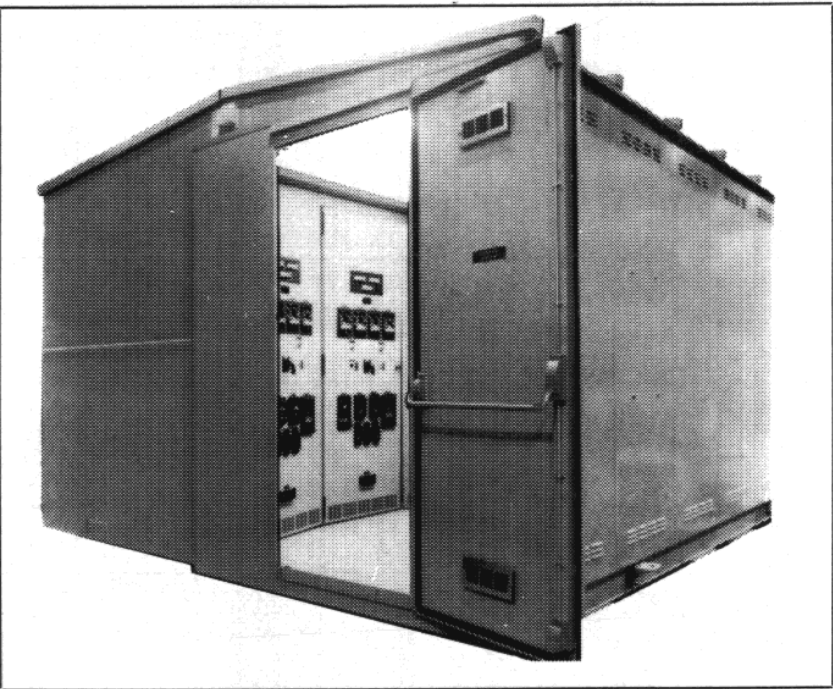
Shipment and Assembly

Shelter-Clad switchgear is shipped in two portions, one factory assembled and one boxed. The factory assembled portion contains the metal-clad switchgear, one-half the housing, and the wall from the sheltered aisle opposite the unit panel doors. The boxed portion contains the knocked-down shelter-aisle including floor plates, roof deck, roof channels, and door braced for shipment. Every precaution is taken to insure its safe arrival.

In assembly the switchgear lineup is supported by six-inch base "I" beams and rests on preset concrete foundation piers or a poured slab—the only foundation preparation needed prior to receiving the outdoor equipment. After the factory assembled portion of the outdoor group is in position, the aisleway portion is easily constructed. The front wall, which covers the meter panels during shipment, is removed and placed in position to form the front wall of the aisle. The aisle beam is set into position and the wedge plates, door assemblies, roof decks, and floor plates are then bolted into place.

Adjacent roof plates are bolted together, forming a joint between plates that runs parallel to the slope. Each bolt holds U-shaped brackets in place, one leg extending above the joint. A cover channel slides into place towards the gable, covering the joint. The channel engages the bracket extensions with welded clips inside the channel as it slides toward the peak. The channel is then secured at the peak by interlocking with pre-cut notches in the gable. This results in a rigid joint that is free of hardware.

The completely assembled unit is firmly secured to the piers and the cable or bus connections are attached. Insert breakers and the lineup is ready for service.



Front Wall Covering Meter Panels During Shipment Is Removed and Placed in Position to Form the Front Wall of the Aisleway.

Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers	Description
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5 kV Circuit Breaker Data

Siemens Type	MA-250	5-MSV-250	MA-350	5-FSV-350
Interrupter Type	Air Magnetic	Vacuum	Air Magnetic	Vacuum
Description Nominal Voltage Class—kV, RMS Nominal 3 Phase MVA Class	4.16 250	4.16 250	4.16 350	4.16 350
Voltage Rating Rated Maximum Voltage—kV, RMS—V Rated Voltage Range Factor—K	4.76 1.24	4.76 1.24	4.76 1.19	4.76 1.19
Current Ratings Rated Continuous Current at 60 Hz—AMP, RMS Rated Short Circuit Current at Rated Maximum Voltage (Symmetrical)—kA, RMS—I	1200 2000 2500* 29	1200 2000 2500* 29	1200 2000 2500* 41	1200 2000 2500* 3000 3750* 41
Rated Interrupting Time Cycles Maximum Permissible Tripping Delay (Y) Sec	5 2	5 2	5 2	5 2

S = Ratio of required asymmetrical interrupting capability to symmetrical interrupting capability.

* The 2500 and 3750 ampere ratings are achieved with fan cooling.

K is the ratio of rated maximum voltage to the lower limit of the range of operating voltage in which the required symmetrical and asymmetrical interrupting capabilities vary in inverse proportion to the operating voltage.

To obtain the required symmetrical interrupting capability of a circuit breaker at an operating voltage between 1/K times rated maximum voltage and rated maximum voltage, the following formula shall be used

Required Symmetrical Interrupting Capability = Rated Short-Circuit Current Times the Ratio of (Rated Max. Voltage)
(Operating Voltage)

For operating voltages below 1/K times rated maximum voltage, the required symmetrical interrupting capability of the circuit breaker shall be equal to K times rated short-circuit current.

Switchgear Division

Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers	Description
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5 kV Circuit Breaker Data

Siemens Type	MA-250	5-MSV-250	MA-350	5-FSV-350
Interrupter Type	Air Magnetic	Vacuum	Air Magnetic	Vacuum
Insulation Level				
Rated Withstand Test Voltage				
Low Frequency—kV, RMS	19	19	19	19
Impulse Crest—kV	60	60	60	60
Related Required Capabilities				
Minimum Voltage (V/K)—kV, RMS	3.85	3.85	4.0	4.0
Maximum Symmetrical Interrupting Capability— kA, RMS (KI)	36	36	49	49
Short-Time (3 Sec.) Current Carrying Capability— kA, RMS (KI)	36	36	49	49
Closing and Latching Capability—kA, RMS Std. (1.6 KI)	58	58	78	78
Available (Special Order)	78	—	—	—
S Factor	1.21	1.20	1.21	1.20
Operating Time				
From Energizing Trip Coil Until Contacts Part, Milliseconds (avg)	30	33	30	33
From Energizing Close Coil Until Contacts Touch, Milliseconds (avg)	65	75	65	75
Spring Charging Time, Stored Energy, Seconds (max)	3	8-10	3	8-10

S = Ratio of required asymmetrical interrupting capability to symmetrical interrupting capability

* The 2500 and 3750 ampere ratings are achieved with fan cooling

K is the ratio of rated maximum voltage to the lower limit of the range of operating voltage in which the required symmetrical and asymmetrical interrupting capabilities vary in inverse proportion to the operating voltage

To obtain the required symmetrical interrupting capability of a circuit breaker at an operating voltage between 1/K times rated maximum voltage and rated maximum voltage, the following formula shall be used

Required Symmetrical Interrupting Capability = Rated Short-Circuit Current Times the Ratio of (Rated Max. Voltage)
(Operating Voltage)

For operating voltages below 1/K times rated maximum voltage, the required symmetrical interrupting capability of the circuit breaker shall be equal to K times rated short-circuit current.

Medium Voltage Horizontal Drawout Metal-Clad Switchgear 5 and 15 kV Air Magnetic and Vacuum Circuit Breakers	Description
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7.2 and 15 kV Circuit Breaker Data

Siemens Type	FB-500	7-FSV-500	FC-500	15-FSV-500	FC-750	15-FSV-750	15-FSV-1000
Interrupter Type	Air Magnetic	Vacuum	Air Magnetic	Vacuum	Air Magnetic	Vacuum	Vacuum
Description							
Nominal Voltage Class—kV, RMS	7.2	7.2	13.8	13.8	13.8	13.8	13.8
Nominal 3 Phase MVA Class	500	500	500	500	750	750	1000
Voltage Rating							
Rated Maximum Voltage—kV, RMS—V	8.25	8.25	15	15	15	15	15
Rated Voltage Range Factor—K	1.25	1.25	1.30	1.30	1.30	1.30	1.30
Current Ratings							
Rated Continuous Current at 60 Hz—AMP, RMS	1200	1200	1200	1200	1200	1200	1200
.....	2000	2000	2000	2000	2000	2000	2000
.....	2500*	2500*	2500*	2500*	2500*	2500*	2500*
.....	3000	3000				3000	3000
.....	3750	3750*				3750*	3750*
Rated Short Circuit Current at Rated Maximum Voltage (Symmetrical)—kA, RMS—I	33	33	18	18	28	28	37
Rated Interrupting Time							
Cycles	5	5	5	5	5	5	5
Maximum Permissible Tripping Delay (Y) Sec. ...	2	2	2	2	2	2	2

K = Rated voltage range factor.

S = Ratio of required asymmetrical interrupting capability to symmetrical interrupting capability.

* The 2500 and 3750 ampere ratings are achieved with fan cooling.

K is the ratio of rated maximum voltage to the lower limit of the range of operating voltage in which the required symmetrical and asymmetrical interrupting capabilities vary in inverse proportion to the operating voltage.

To obtain the required symmetrical interrupting capability of a circuit breaker at an operating voltage between 1/K times rated maximum voltage and rated maximum voltage, the following formula shall be used.

Required Symmetrical Interrupting Capability = Rated Short-Circuit Current Times the Ratio of (Rated Max. Voltage)
(Operating Voltage)

For operating voltages below 1/K times rated maximum voltage, the required symmetrical interrupting capability of the circuit breaker shall be equal to K times rated short-circuit current.

Type D&F
Metal-Clad Switchgear

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General Arrangements 5 kV Indoor	Dimensions
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7.2 and 15 kV Circuit Breaker Data

Siemens Type	FB-500	7-FSV-500	FC-500	15-FSV-500	FC-750	15-FSV-750	15-FSV-1000
Interrupter Type	Air Magnetic	Vacuum	Air Magnetic	Vacuum	Air Magnetic	Vacuum	Vacuum
Insulation Level							
Rated Withstand Test Voltage							
Low Frequency—kV, RMS	36	36	36	36	36	36	36
Impulse Crest—kV	95	95	95	95	95	95	95
Rated Required Capabilities							
Minimum Voltage (V/K)—kV, RMS	6.6	6.6	11.5	11.5	11.5	11.5	11.5
Maximum Symmetrical Interrupting Capability— kA, RMS (KI)	41	41	23	23	36	36	48
Short-Time (3 Sec.) Current Carrying Capability—kA, RMS (KI)	41	41	23	23	36	36	48
Closing and Latching Capability—kA, RMS Std. (1.6 KI)	66	66	37	37	58	58	77
Available (Special Order)	77	77	58	58	77	77	—
S Factor	1.21	1.20	1.21	1.20	1.21	1.20	1.20
Operating Time							
From Energizing Trip Coil Until Contacts Part, Milliseconds (avg)	31	33	31	33	31	33	33
From Energizing Close Coil Until Contacts Touch Milliseconds (avg)	71	75	71	75	71	75	75
Spring Charging Time—Seconds (max)	3	8-10	3	8-10	3	8-10	8-10

K = Rated voltage range factor.

S = Ratio of required asymmetrical interrupting capability to symmetrical interrupting capability.

* The 2500 and 3750 ampere ratings are achieved with fan cooling.

K is the ratio of rated maximum voltage to the lower limit of the range of operating voltage in which the required symmetrical and asymmetrical interrupting capabilities vary in inverse proportion to the operating voltage.

To obtain the required symmetrical interrupting capability of a circuit breaker at an operating voltage between 1/K times rated maximum voltage and rated maximum voltage, the following formula shall be used.

Required Symmetrical Interrupting Capability = Rated Short-Circuit Current Times the Ratio of $\frac{\text{Rated Max. Voltage}}{\text{Operating Voltage}}$

For operating voltages below 1/K times rated maximum voltage, the required symmetrical interrupting capability of the circuit breaker shall be equal to K times rated short-circuit current.

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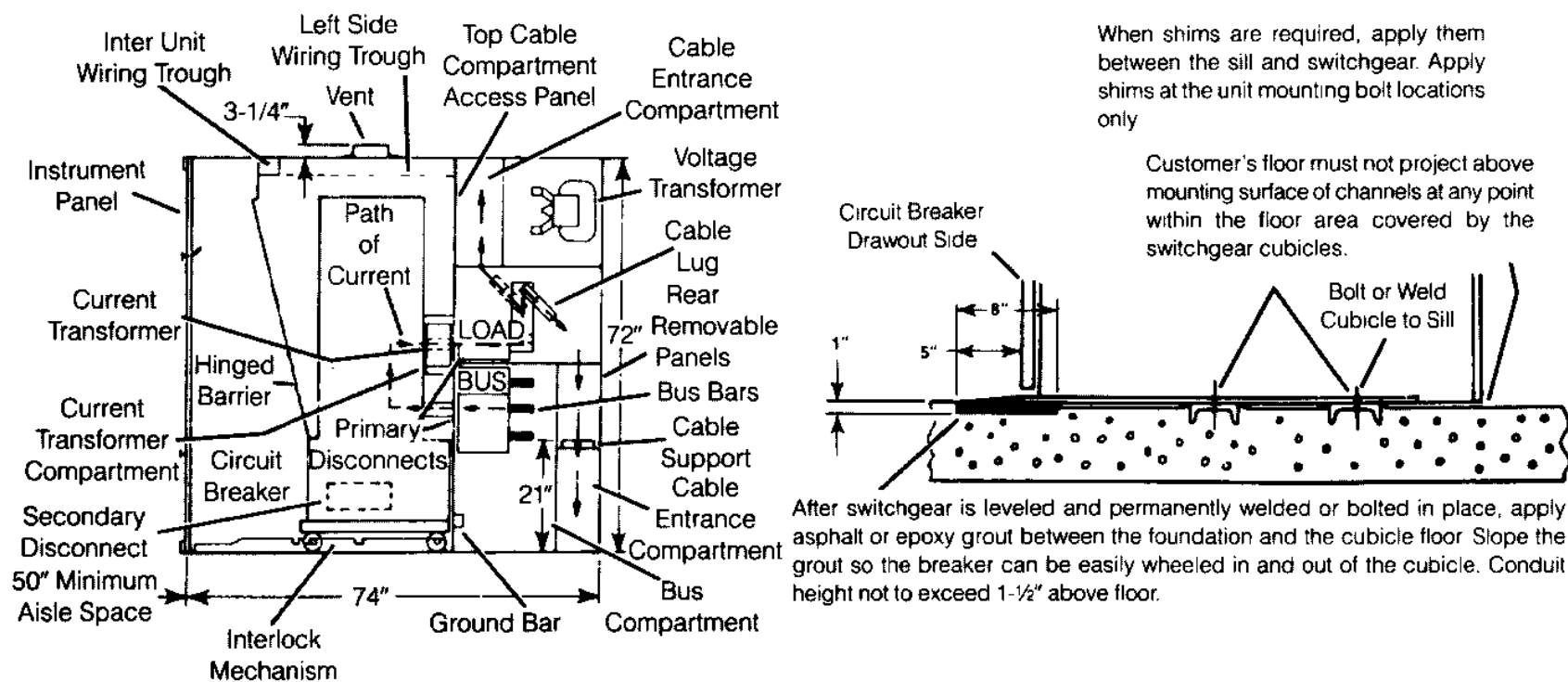
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Dimensions And Installation Data 5 kV Indoor	Dimensions
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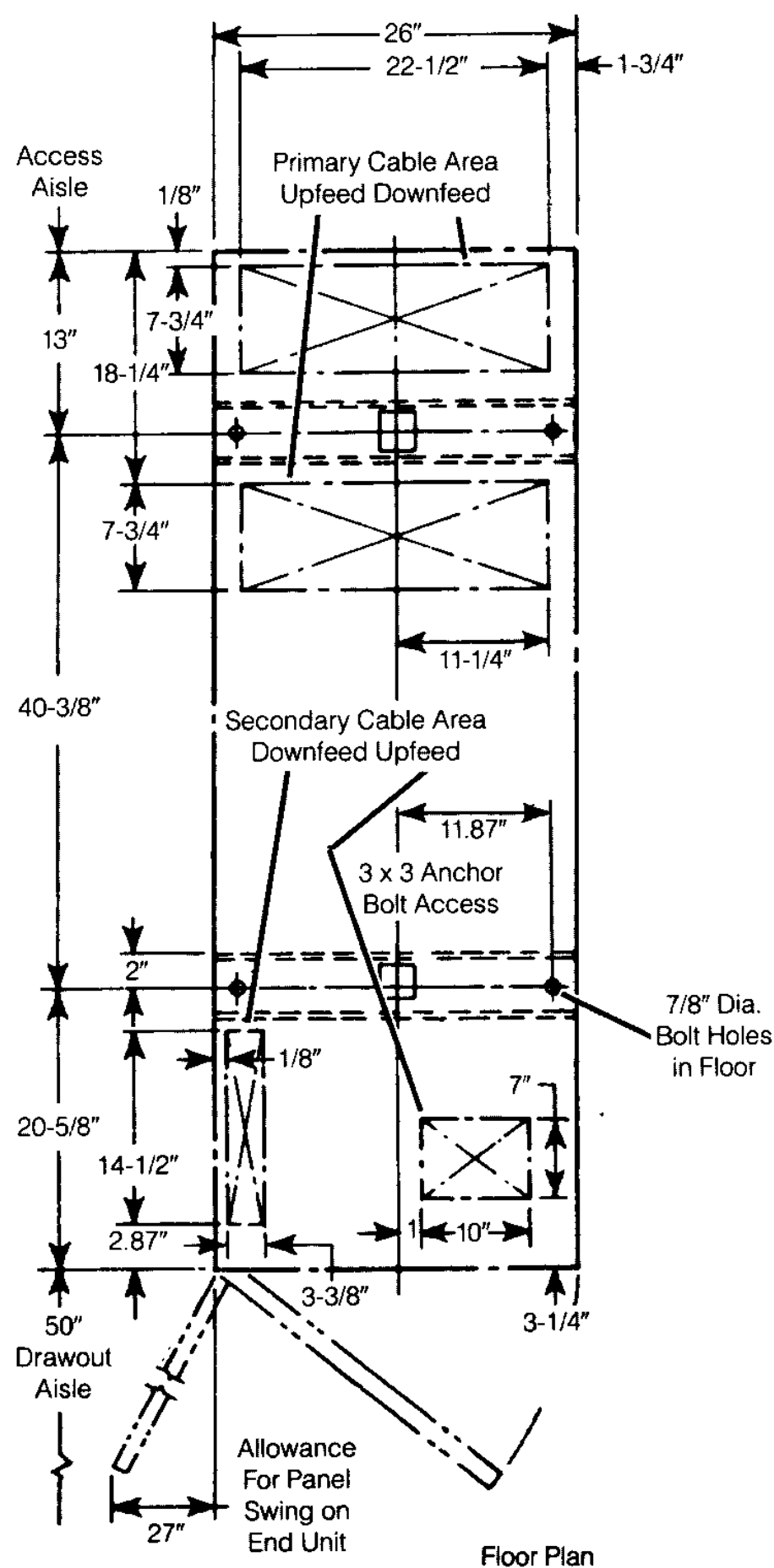
Breaker Ratings		Air Magnetic		Vacuum		Structural Data				
Rated kV	Cont. Current (Amps)	Type	Weight (lbs)	Type	Weight (lbs)	Type	Dimensions (in) W X D X H	Drawout Aisle	Weight (lbs)	Side Views and Floor Plans
4.16	1200	MA-250	734	5-MSV-250	600	DM	26 X 74* X 72	50	1200	Pages 36 & 37
4.16	2000	MA-250	834	5-MSV-250	625	DM	26 X 74* X 72	50	1200	Pages 36 & 37
4.16	1200	MA-350	834	—	—	DN	26 X 74* X 72	50	1200	Pages 36 & 37
4.16	2000	MA-350	884	—	—	DN	26 X 74* X 72	50	1200	Pages 36 & 37
4.16	1200	—	—	5-FSV-350	1200	FN	36 X 94 X 92	66	1800	Pages 38 & 39
4.16	2000	—	—	5-FSV-350	1200	FN	36 X 94 X 92	66	1800	Pages 38 & 39
4.16	3000	—	—	5-FSV-350	1200	FN	36 X 94 X 92	66	1800	Pages 38 & 39

* Units with 1200A or 2000A main bus. Units with 3000A main bus are 76" deep.
Maximum shipping group is 15'-2" or 7 26" units.
Additional weight for impact loading is equal to the sum of the weights of the circuit breakers involved.



Carefully check that switchgear not furnished with supporting beams is in firm contact with the sills. DO NOT FORCE CUBICLE INTO FIRM CONTACT BY DRAWING DOWN MOUNTING BOLTS. THIS MAY DISTORT CUBICLE. Place 4"x4" shims, if necessary, in the area of the mounting points to get firm contact. Still channels and anchor bolts are normally furnished by the purchaser.

Dimensions And Installation Data 5 kV Indoor	Dimensions
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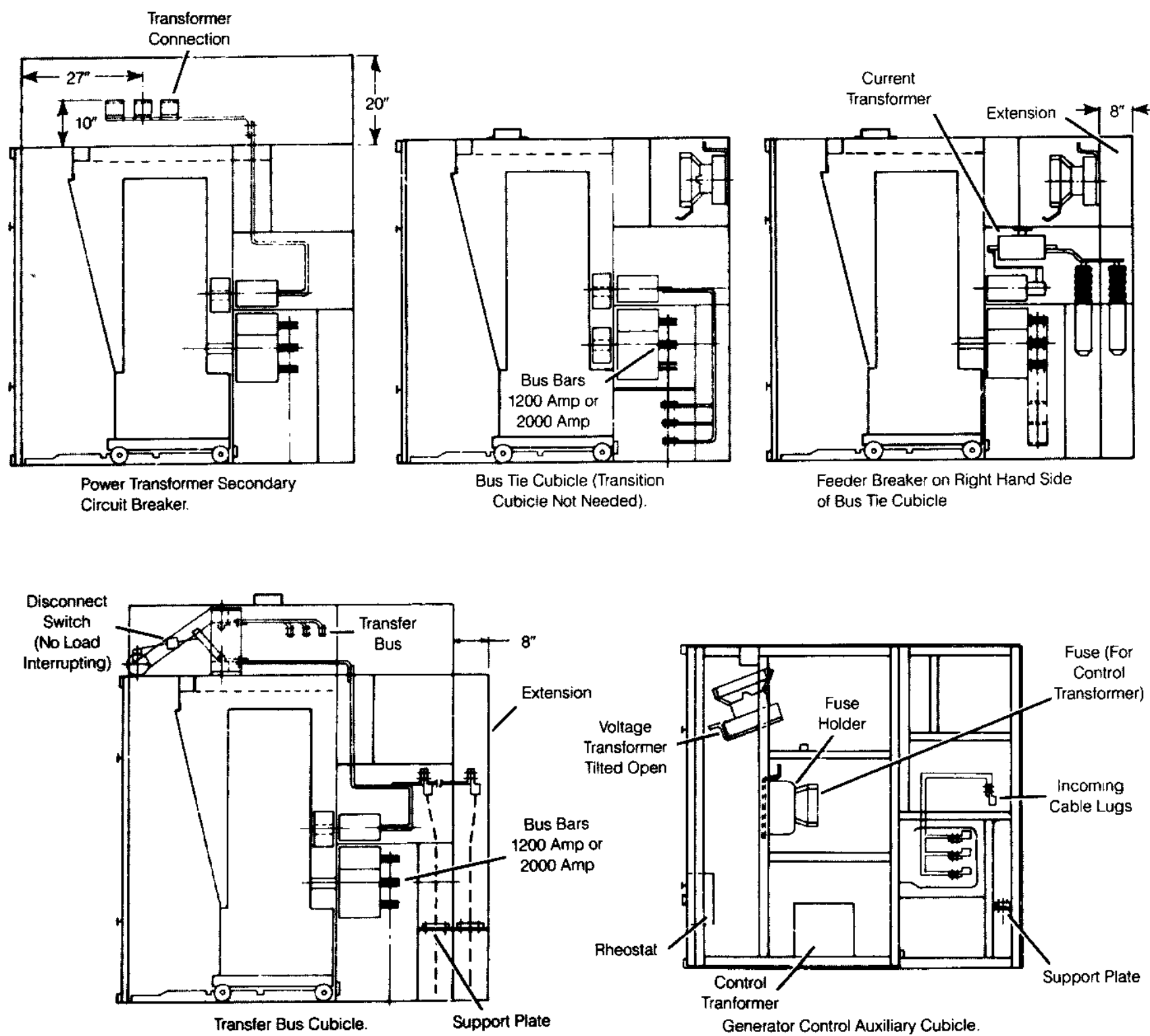


**Type D&F
Metal-Clad Switchgear**

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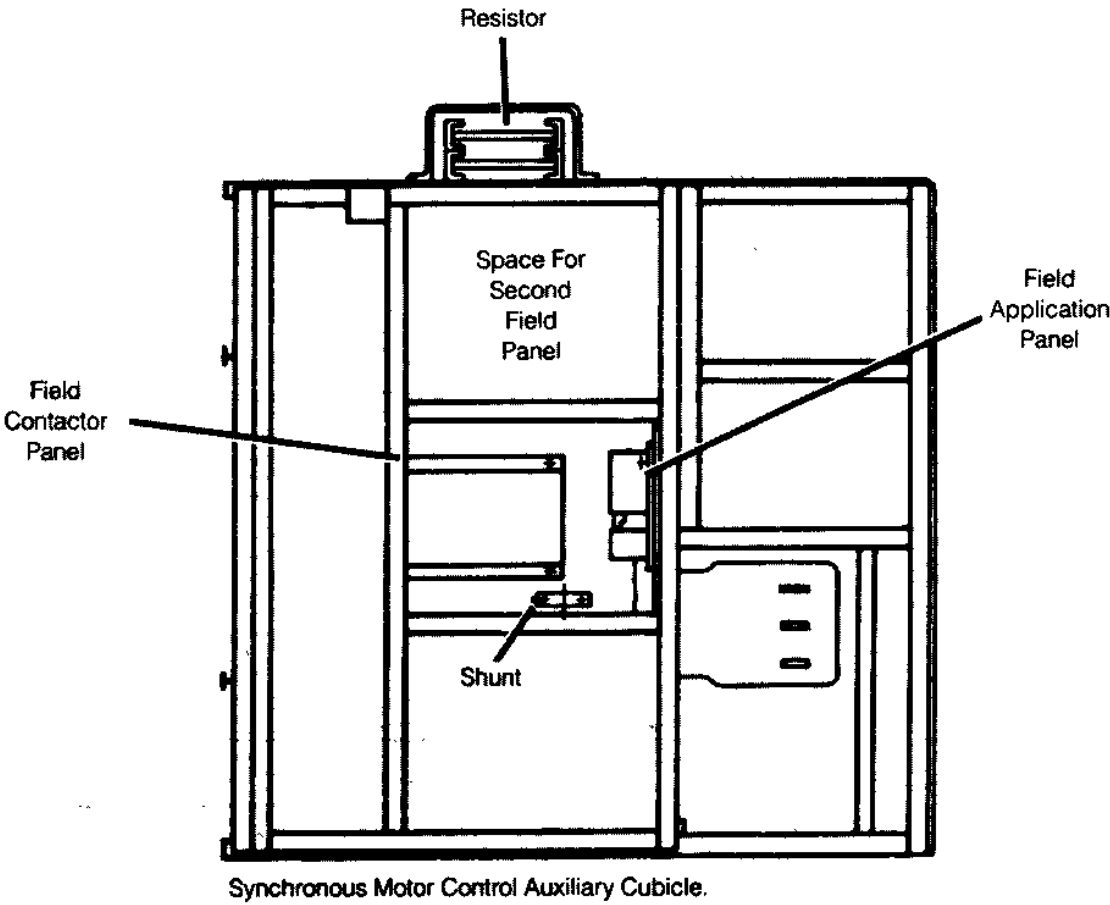
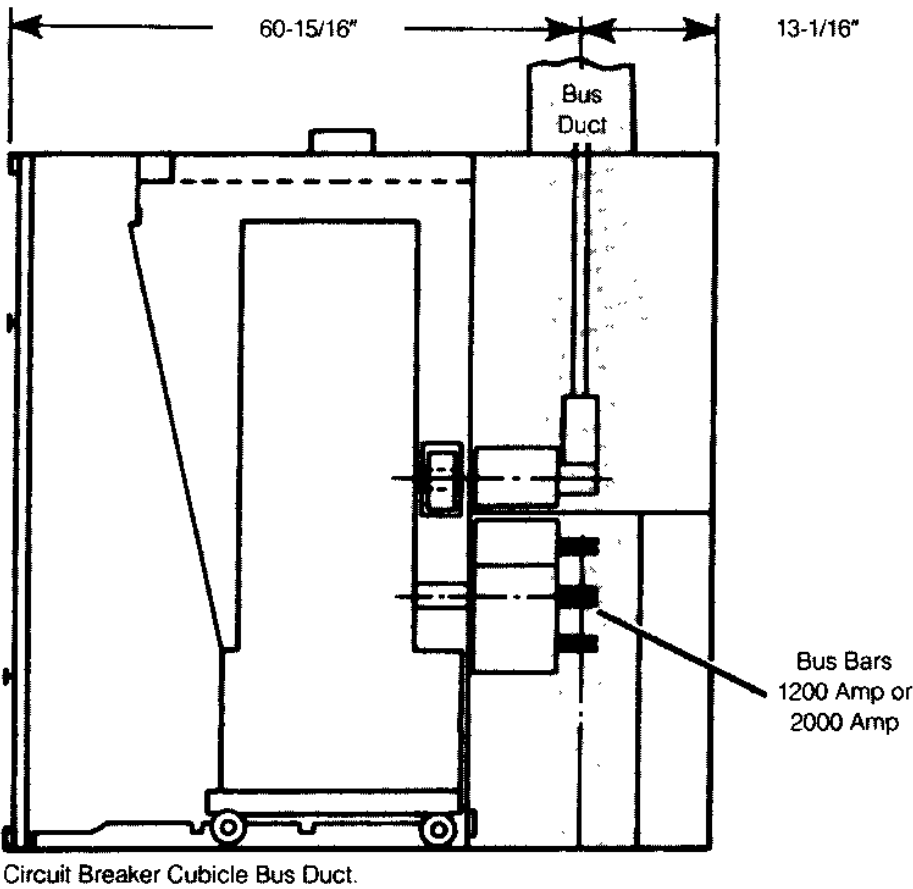
Switchgear Division

General Arrangements 5 kV Indoor	Dimensions
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General Arrangements
5 kV Indoor

Dimensions



Type D&F
Metal-Clad Switchgear

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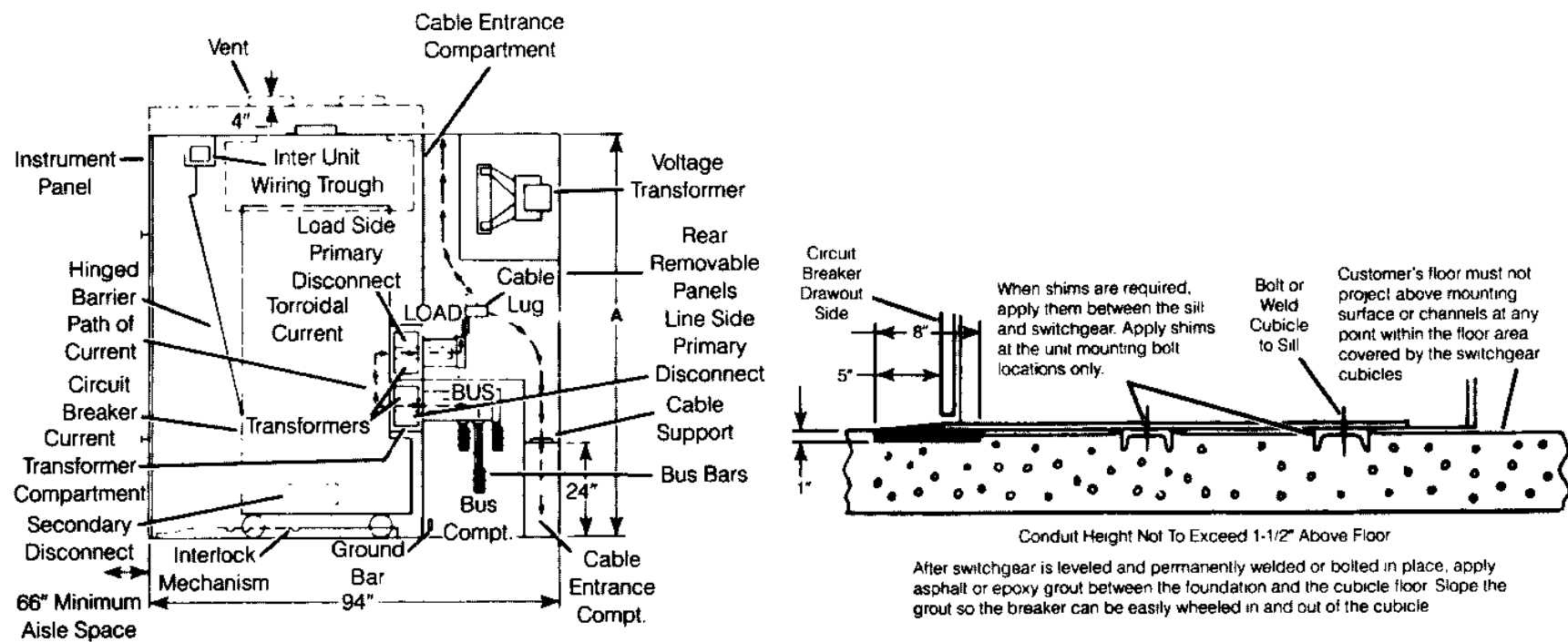
Switchgear Division

Dimensions and Installation Data 7.2 and 15 kV Indoor	Dimensions
----------------------------------------------------------	------------

Dimensions and Installation Data
7.2 and 15 kV Indoor

Breaker Ratings		Air Magnetic		Vacuum		Structural Data			
Rated kV	Cont. Current (Amps)	Type	Weight (lbs.)	Type	Weight (lbs.)	Type	A = Height (In.)		Common Information
							Air Magnetic	Vacuum	
7.2	1200	FB-500	1780	7-FSV-500	860	FO	92	92	All units 36" W X 94" D All units 66" Drawout Aisle
7.2	2000	FB-500	1900	7-FSV-500	860	FO	92	92	
7.2	3000	FB-500	2185	7-FSV-500	900	FO	92	92	
13.8	1200	FC-500	1275	15-FSV-500	860	FO	92	92	All units 1800 lbs weight
13.8	2000	FC-500	1375	15-FSV-500	860	FO	92	92	
13.8	1200	FC-750	1780	15-FSV-750	860	FQ	92	92	Side Views and Floor Plans are located on Pages 40 thru 43
13.8	2000	FC-750	1900	15-FSV-750	860	FQ	92	92	
13.8	3000		2185	15-FSV-750	900	FQ	92	92	
13.8	1200		2200	15-FSV-1000	1200	FR	100	92	
13.8	2000		2320	15-FSV-1000	1200	FR	100	92	
13.8	3000		2360	15-FSV-1000	1200	FR	100	92	

Maximum shipping group . . . 5 units. Additional weight for impact loading is equal to the sum of the weights of the breaker involved.



Typical Side View

Carefully check that switchgear not furnished with supporting beams is in firm contact with the sills. DO NOT FORCE CUBICLE INTO FIRM CONTACT BY DRAWING DOWN MOUNTING BOLTS. THIS MAY DISTORT CUBICLE. Place 4" x 4" shims, if necessary, in the area of the mounting bolts to get firm contact. Sill channels and anchor bolts are normally furnished by the purchaser.

SIEMENS

Type D&F Metal-Clad Switchgear

SG 3011

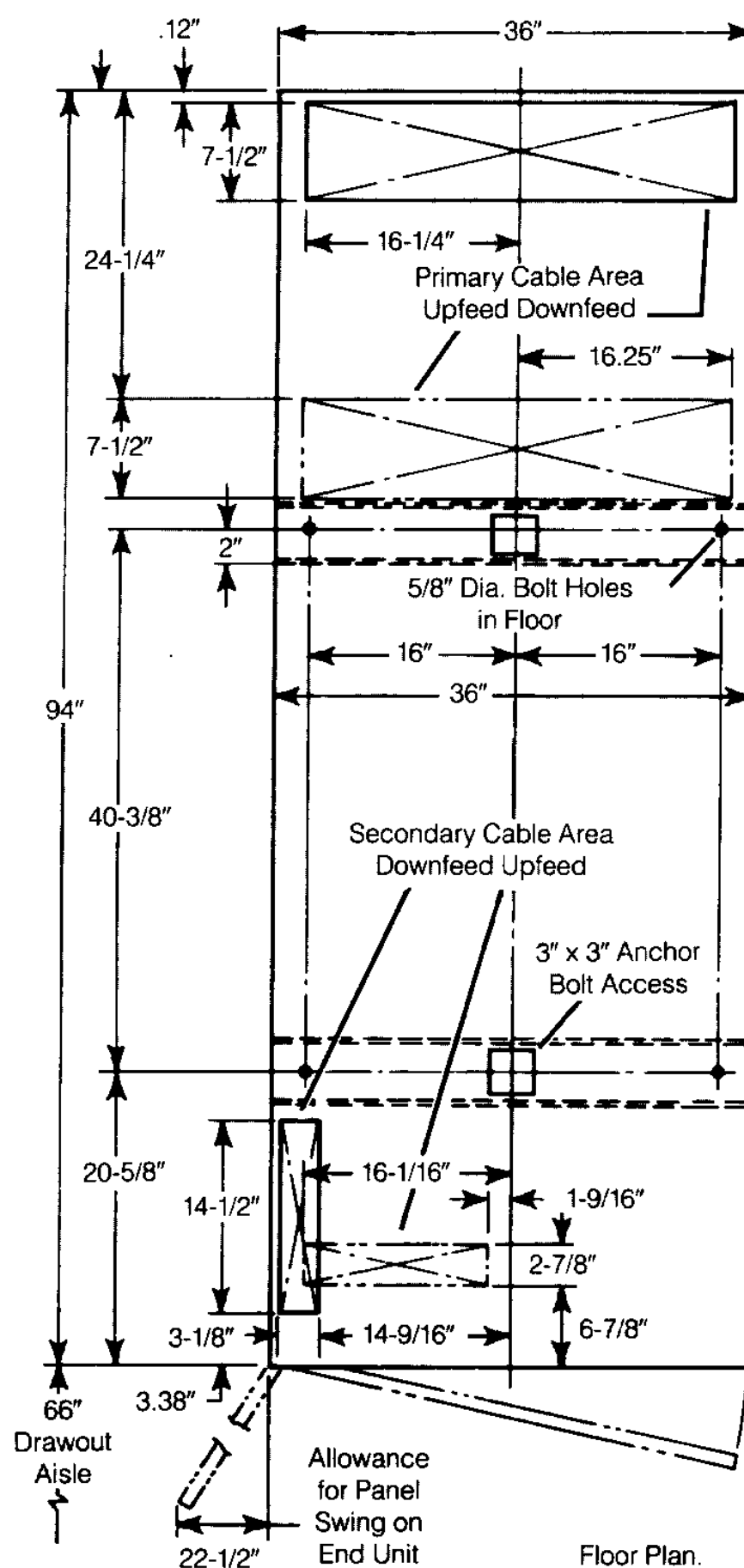
Switchgear Division

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Dimensions And Installation Data

7.2 & 15 kV Indoor

Dimensions

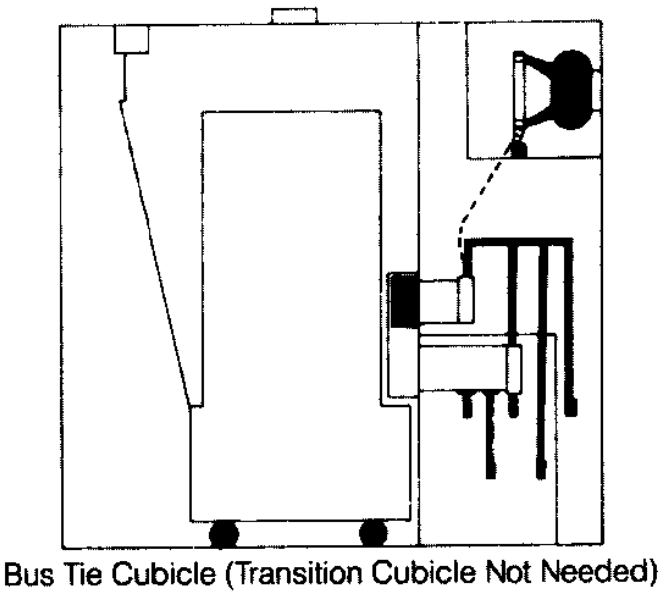
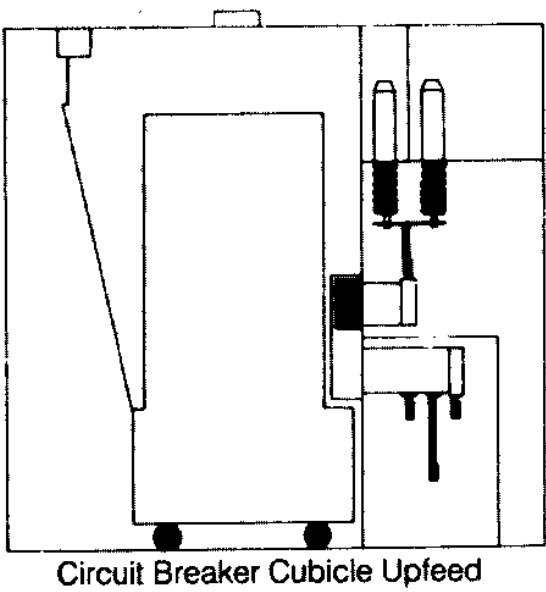
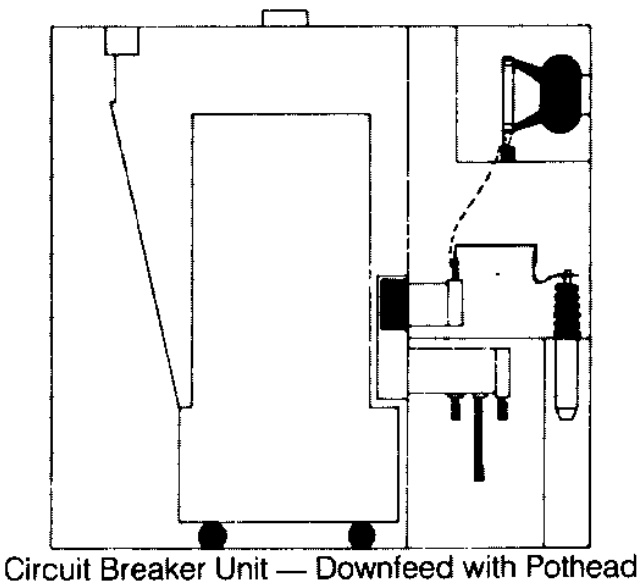
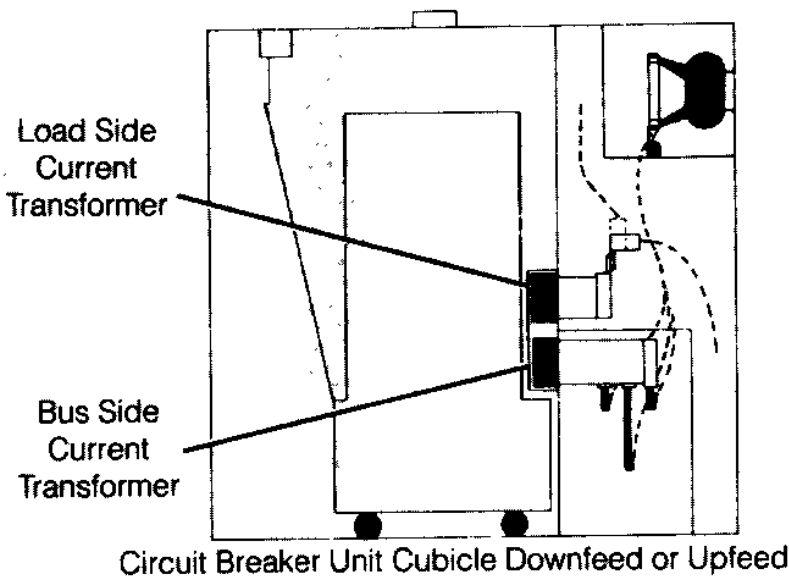


**Type D&F
Metal-Clad Switchgear**

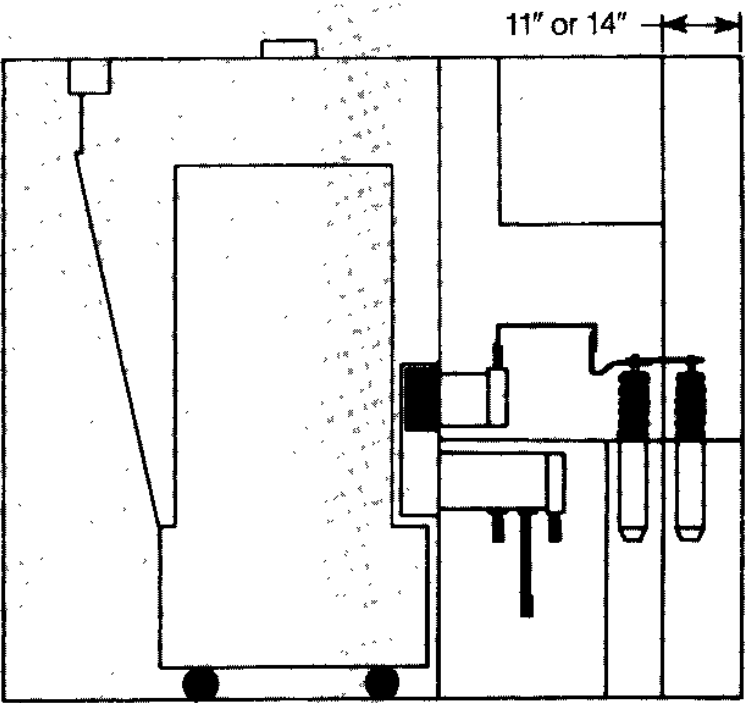
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Switchgear Division

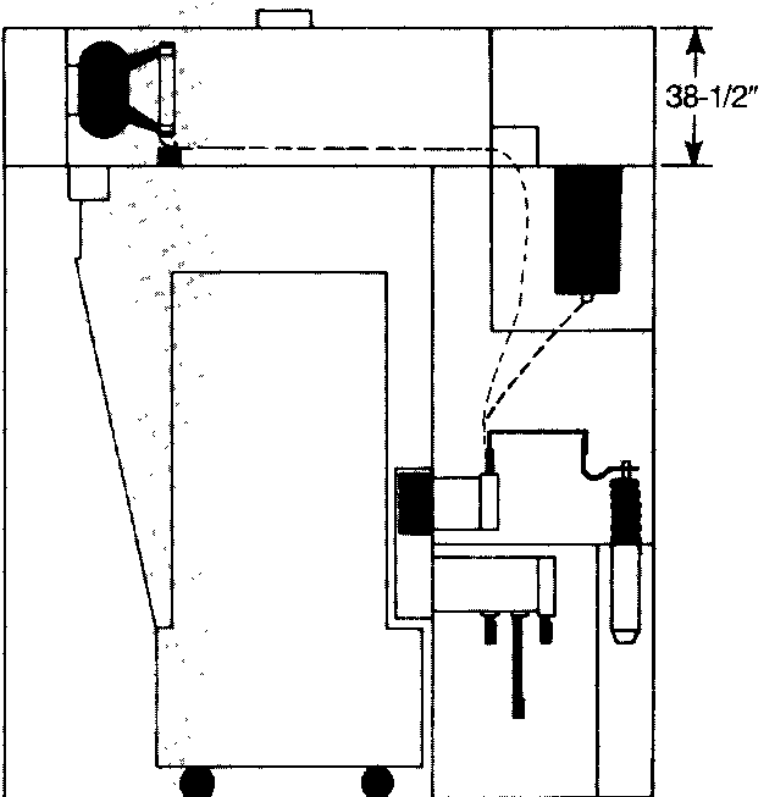
General Arrangements 7.2 & 15 kV Indoor	Dimensions
--------------------------------------------	------------



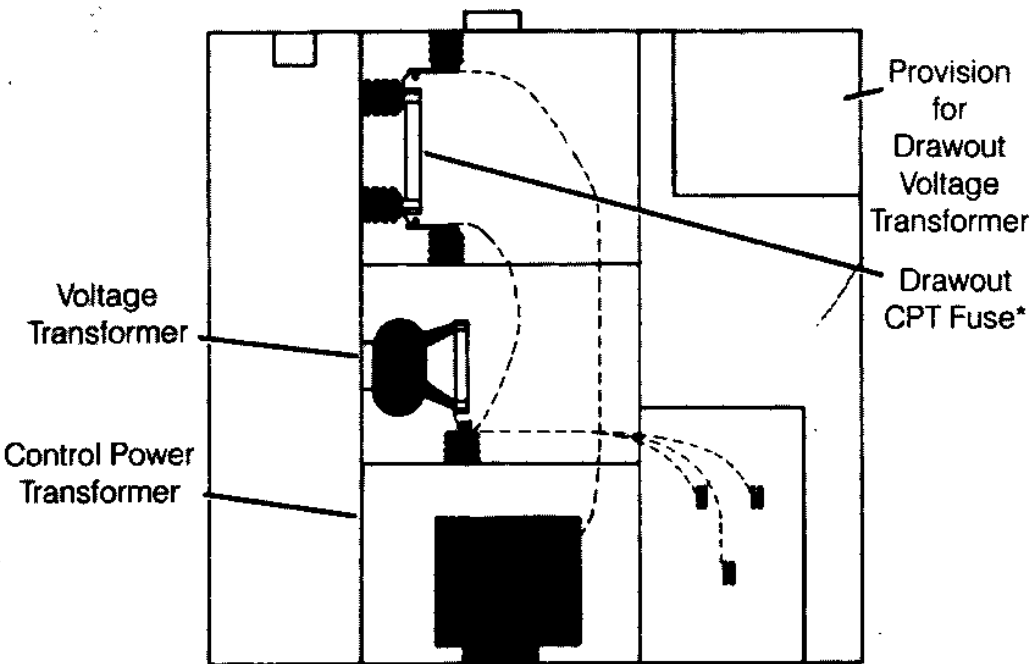
General Arrangements 7.2 & 15 kV Indoor	Dimensions
--------------------------------------------	------------



Circuit Breaker Cubicle with Extension to Accommodate Multiple Potheads



Circuit Breaker Cubicle (with Superstructure)



Typical Auxiliary Cubicle

*The top front compartment of an auxiliary unit can also be used for a trunnion mounted CPT (up to 15 kVA single phase)

Type D&F Metal-Clad Switchgear

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Switchgear Division

Dimensions And Installation Data 5 kV Outdoor Single Aisle Shelter-Clad™ Housings	Dimensions
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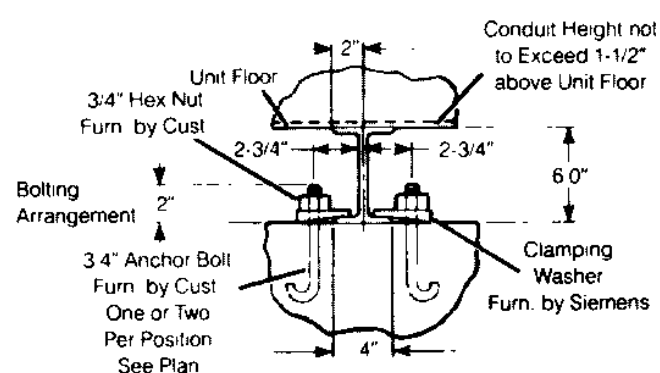
Breaker Type		Unit Designation	Structural Dimensions (Inches)							
Air Magnetic	Vacuum		A Width *	B Depth	C Factory Assembled Equipment	D	E	F	H	Weight (Including Aisle) Lbs.
MA-250	5-MSV-250	SDM	26	150**	79-5/8	71-7/8	19	2-7/8	11-1/4	1900
MA-350	—	SDN	26	150	79-5/8	71-7/8	19	2-7/8	11-1/4	1900
—	5-FSV-350	SFN	Refer to Page 43							

*Minimum Group Width—52 inches

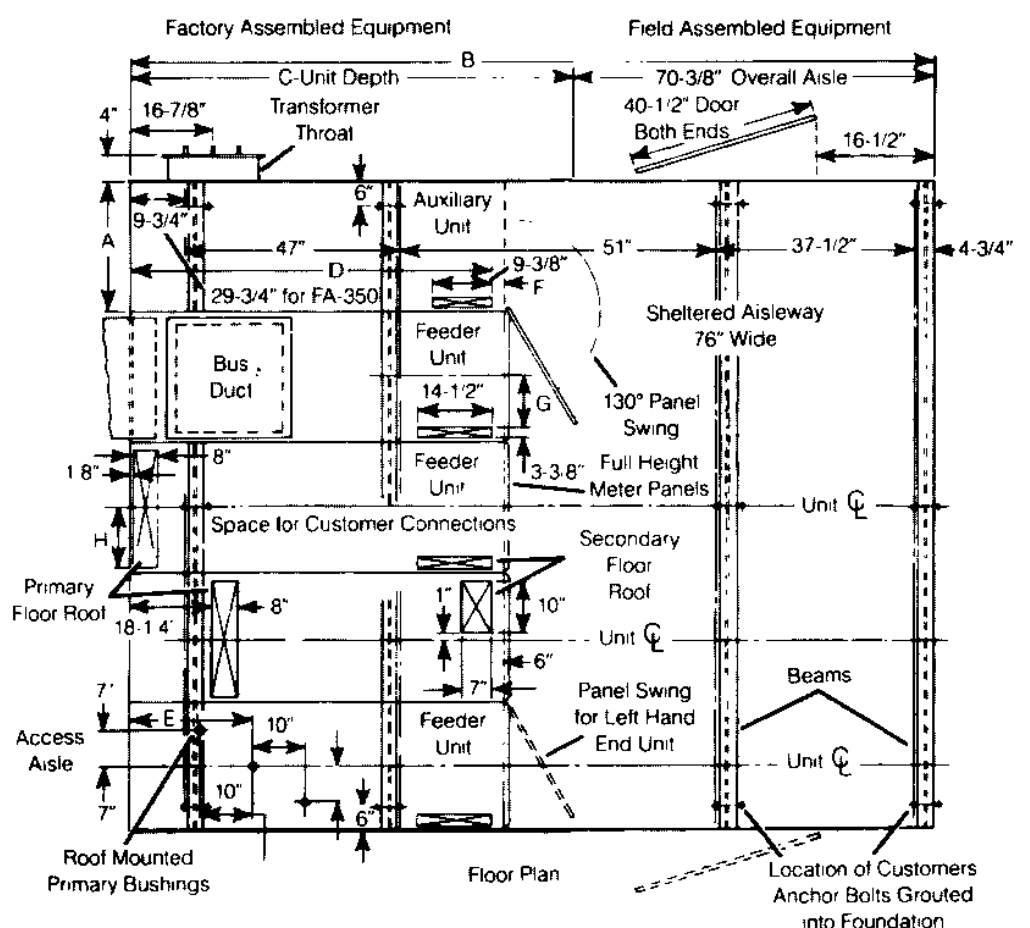
**With 3000 amp bus, this unit is 152 inches deep Maximum shipping group is 15'-2" (7-26" units)

Note: Additional weight for impact loading is equal to the sum of the weights of the breakers involved.

Refer to page 1 for breaker weights

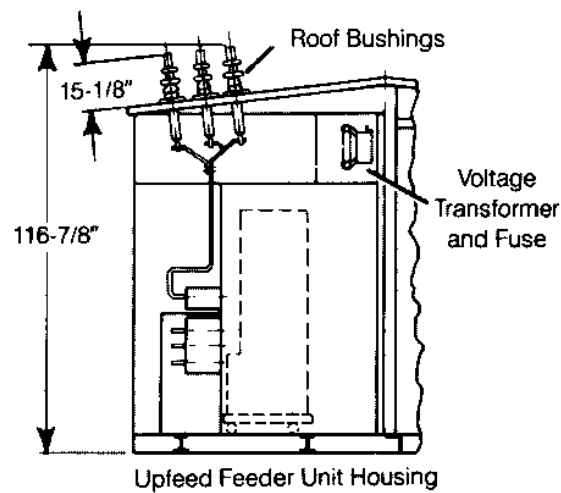
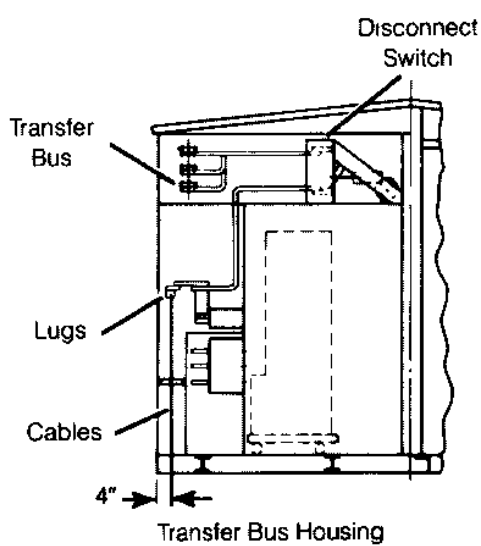
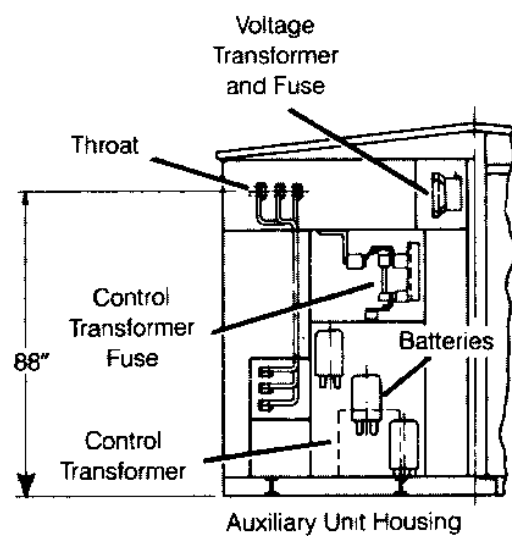
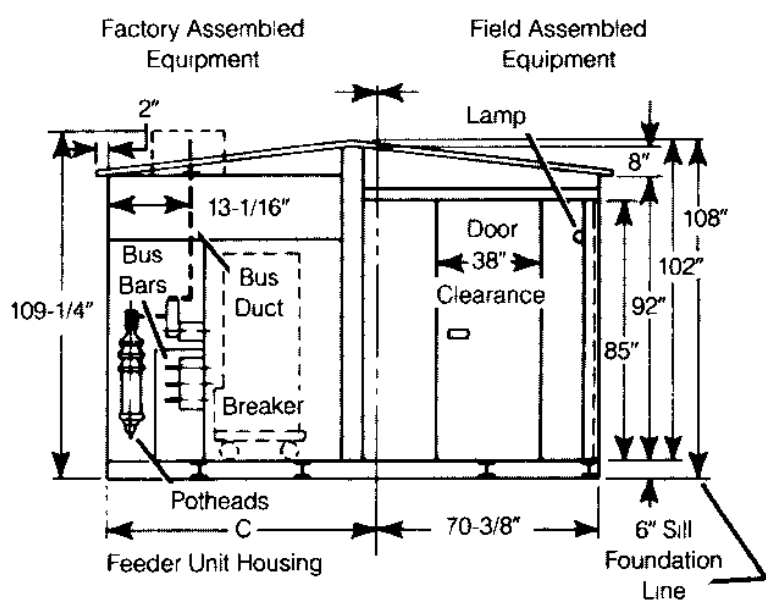


The maximum span for units with 1000 mva air magnetic breakers is six feet. The diameter of pilings must not be less than 12 inches for maximum contact with the beams. Supports must be located at shipping splits.



Dimensions And Installation Data 5 kV Outdoor
Single Aisle Shelter-Clad™ Housings

Dimensions



Foundation Requirements—15 and 15 kV Outdoor Single
Aisle Shelter-Clad Housings

Supporting concrete pads, piers or pilings must be constructed with true surfaces and in the same plane to within 1/16 inch. On groups supported on 4 x 6—12 lbs./ft. beams, the maximum span between supports must not exceed nine feet.

Type D&F
Metal-Clad Switchgear

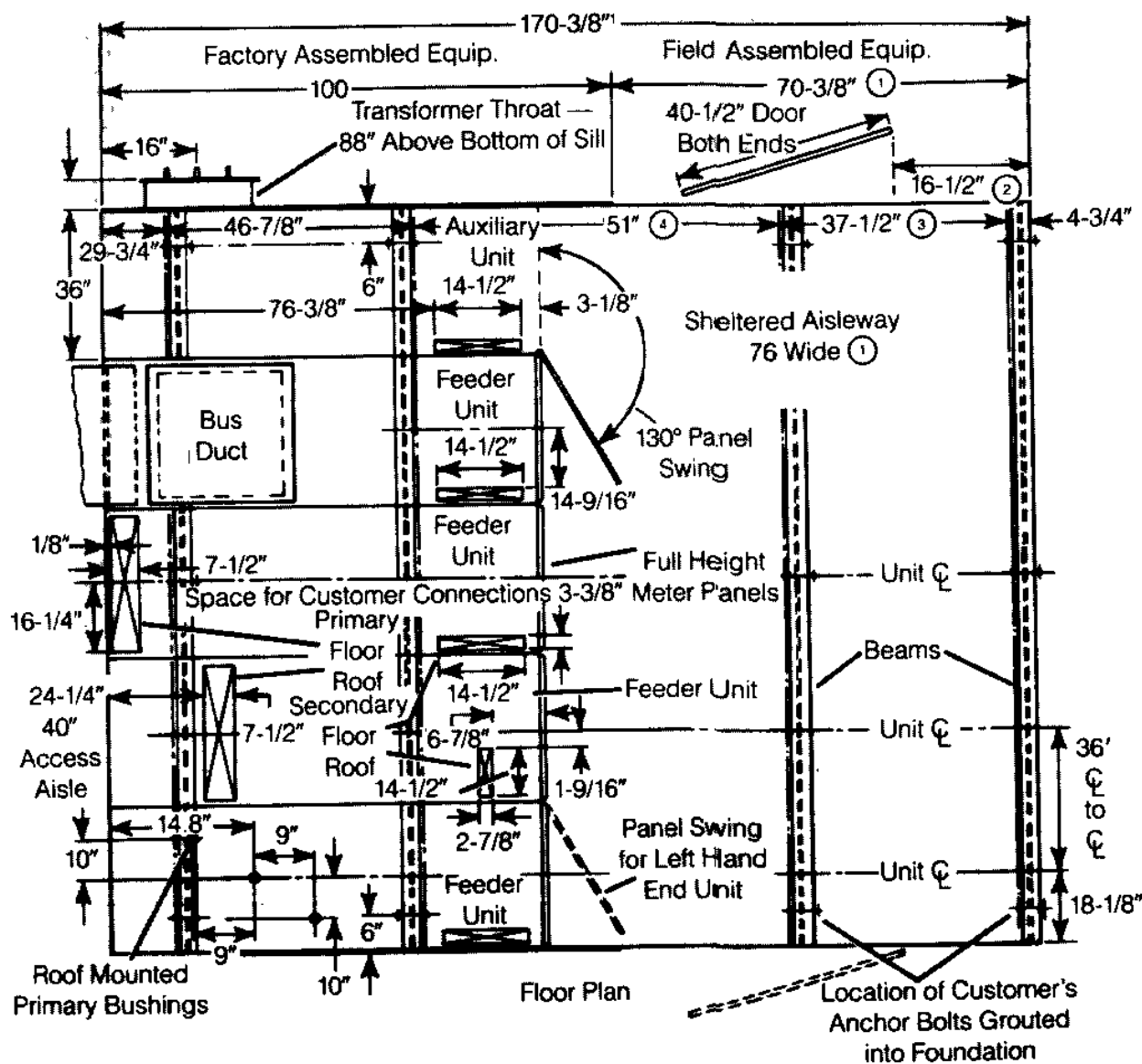
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Switchgear Division

Dimensions And Installation Data 5 kV Outdoor Single Aisle Shelter-Clad™ Housings	Dimensions
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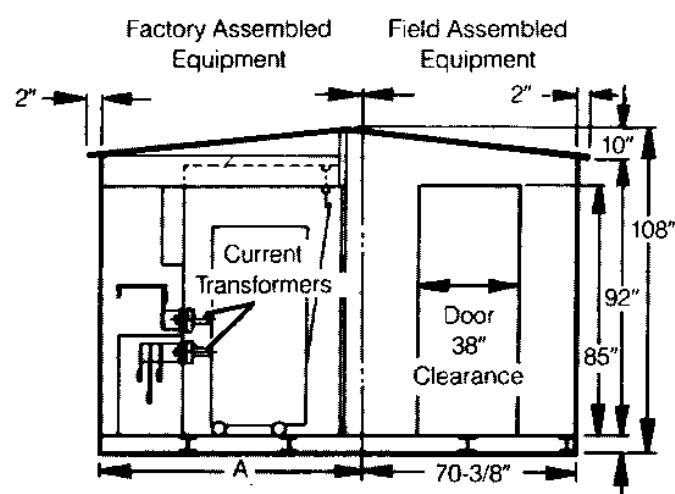
Breaker Type		Unit Designation	Structural Dimensions (inches)		
Air Magnetic	Vacuum		Width*	Depth	Weight (including aisle) lbs.
—	5-FSV-350	SFN	36	170-3/8①	2800
FB-500	7-FSV-500	SFO	36	170-3/8①	2800
FC-500	15-FSV-500	SFO	36	170-3/8①	2800
FC-750	15-FSV-750	SFQ	36	170-3/8①	2800
—	15-FSV-1000	SFR	36	170-3/8①	2800

*Minimum group width - 72 inches
Maximum shipping group is 5 units
Refer to pages 1 or 3 for breaker weights
Additional weight for impact loading is equal to the sum of the weights of the breakers involved.
See page 7 for foundation requirements.
① Add 10"
② Add 5"
③ Add 4 1/8"
④ Add 6 3/8" } With superstructure, top entry bus duct, roof bushings, or rear drawout voltage transformers

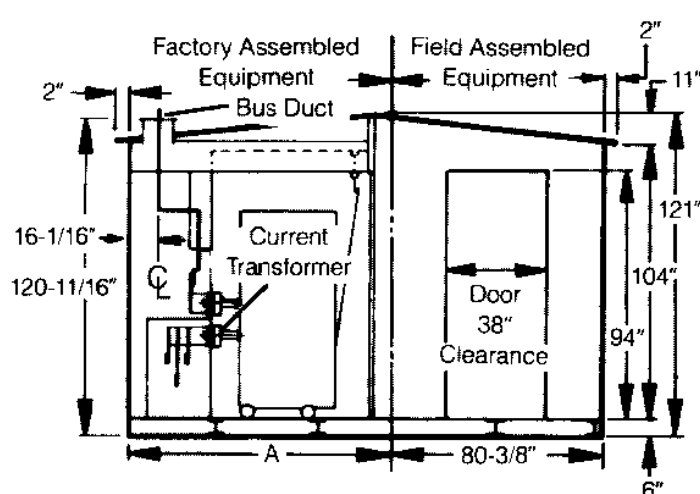


Dimensions And Installation Data 7.2 And 15 kV Outdoor
Single Aisle Shelter-Clad™ Housings

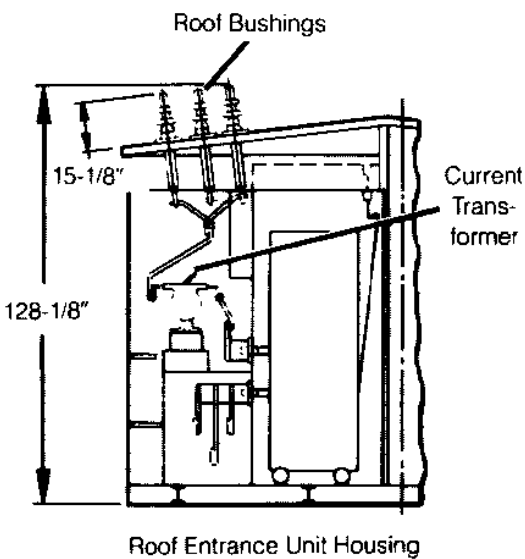
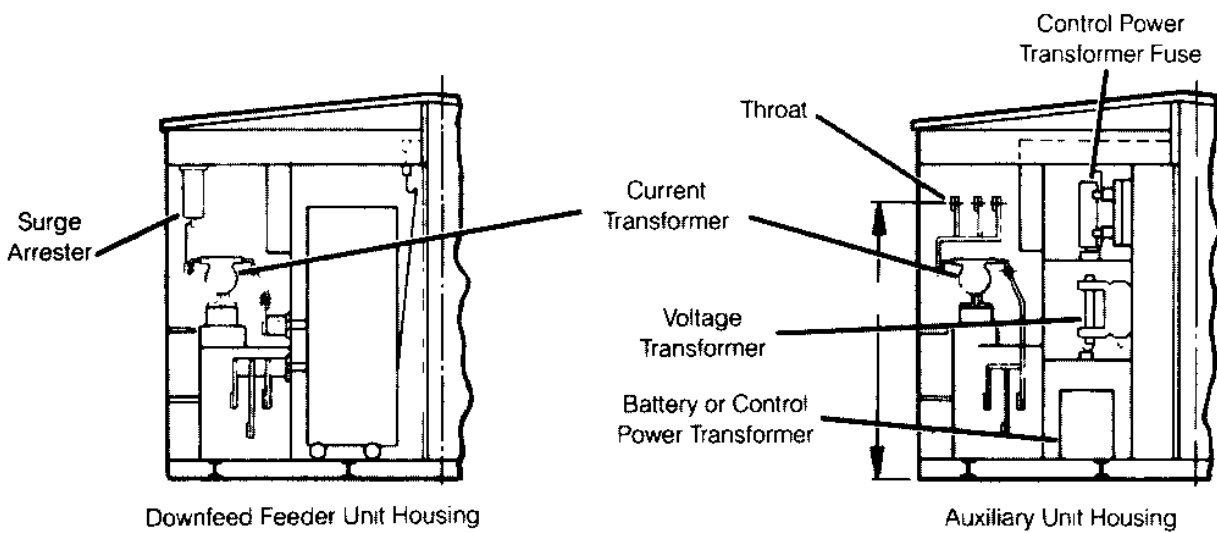
Dimensions



Low Silhouette
Feeder Unit Housing
Applies to units with top entry bus duct, roof
bushings, rear drawout voltage transformers.
*Height with Superstructure—137-9/16"



High Silhouette
Feeder Unit Housing
Applies to units with top entry bus duct, roof
bushings, rear drawout voltage transformers.
*Height with Superstructure—137-9/16"

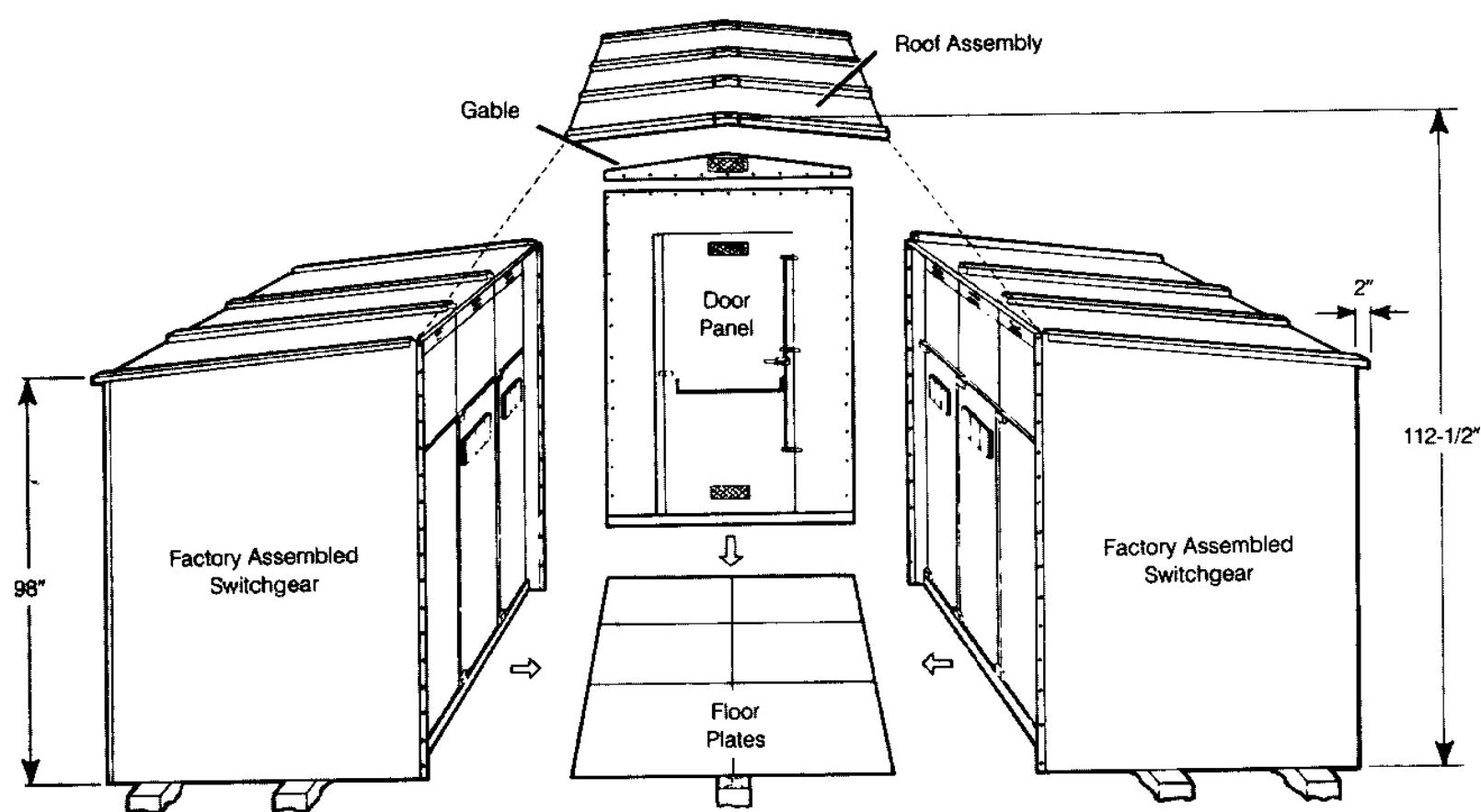


**Type D&F
Metal-Clad Switchgear**

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Switchgear Division

Dimensions And Installation Data 5 kV Outdoor Common Aisle Shelter-Clad Housings	Dimensions
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See page 36 for dimensions of units
with 5-FSV-350 vacuum circuit breakers.

Foundation Requirements

Supporting concrete pads, piers or pilings must be constructed with true surfaces and in the same place to within 1/16 inch. On groups supported on 4 x 6—12 lbs./ft beams, the maximum span between supports must not exceed nine feet. The diameter of pilings must not be less than 12 inches for maximum contact with the beams. Supports must be located at shipping splits.

SIEMENS

Type D&F Metal-Clad Switchgear

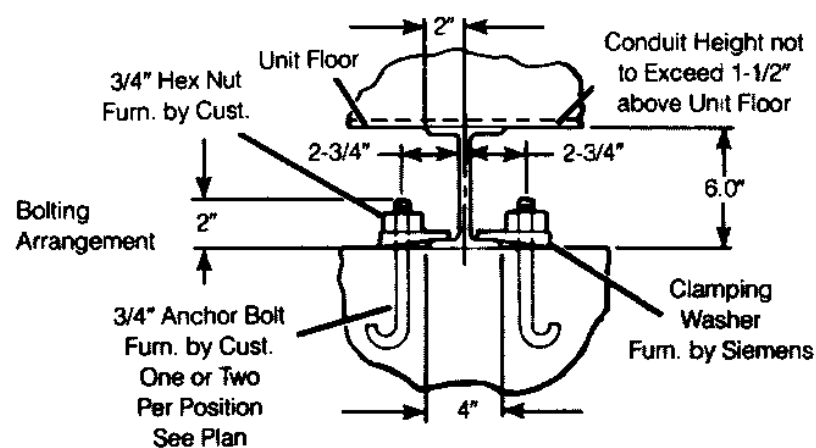
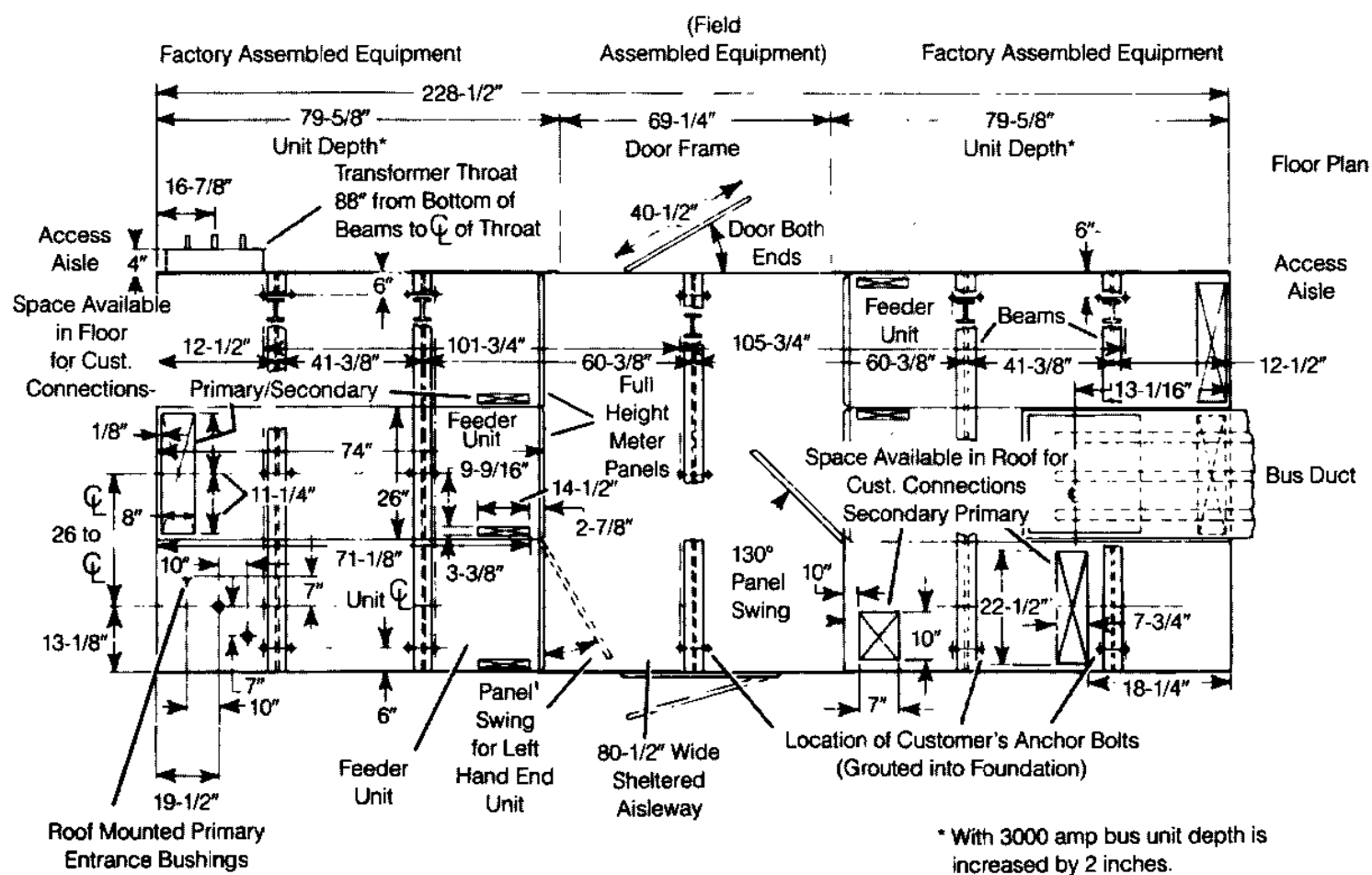
SG 3011

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Dimensions And Installation Data 5 kV Outdoor Common Aisle Shelter-Clad Housings

Dimensions

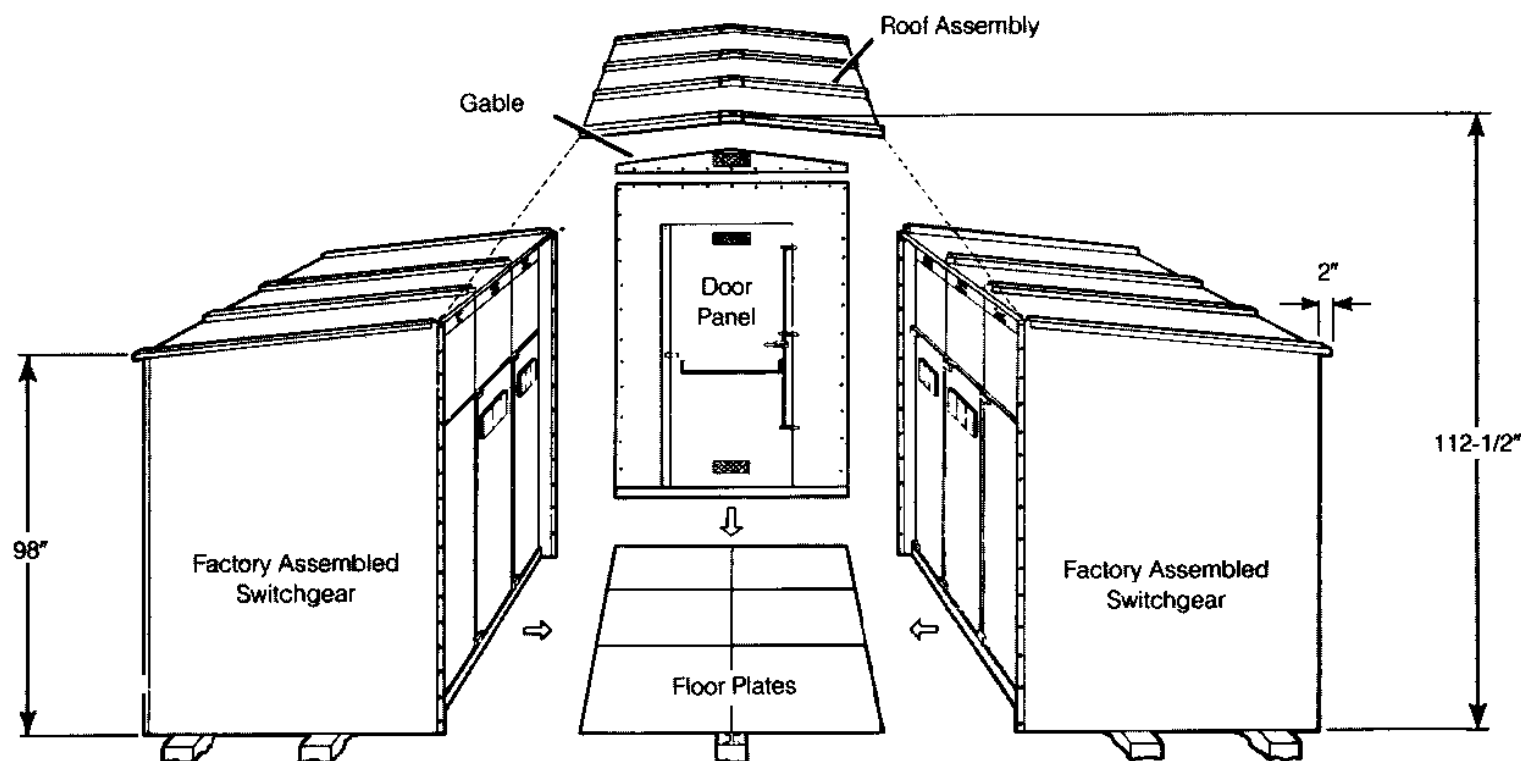


Type D&F
Metal-Clad Switchgear

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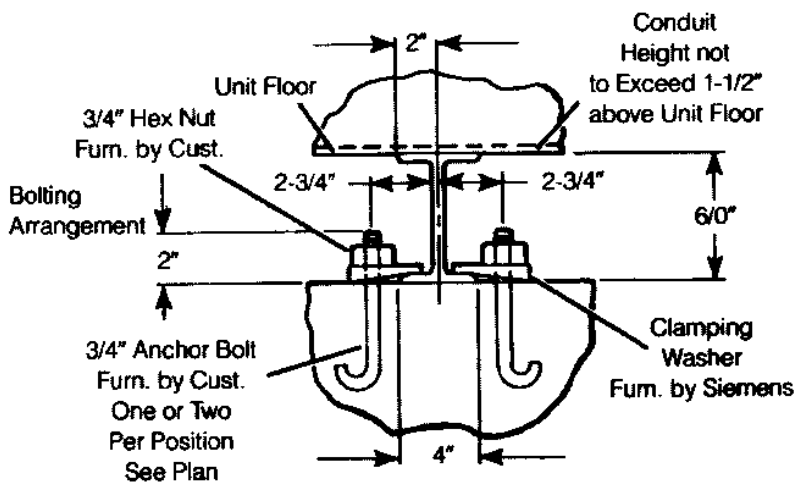
Switchgear Division

Dimensions and Installation Data — 7.2 and 15 kV Outdoor Common Aisle Shelter-Clad Housings	Dimensions
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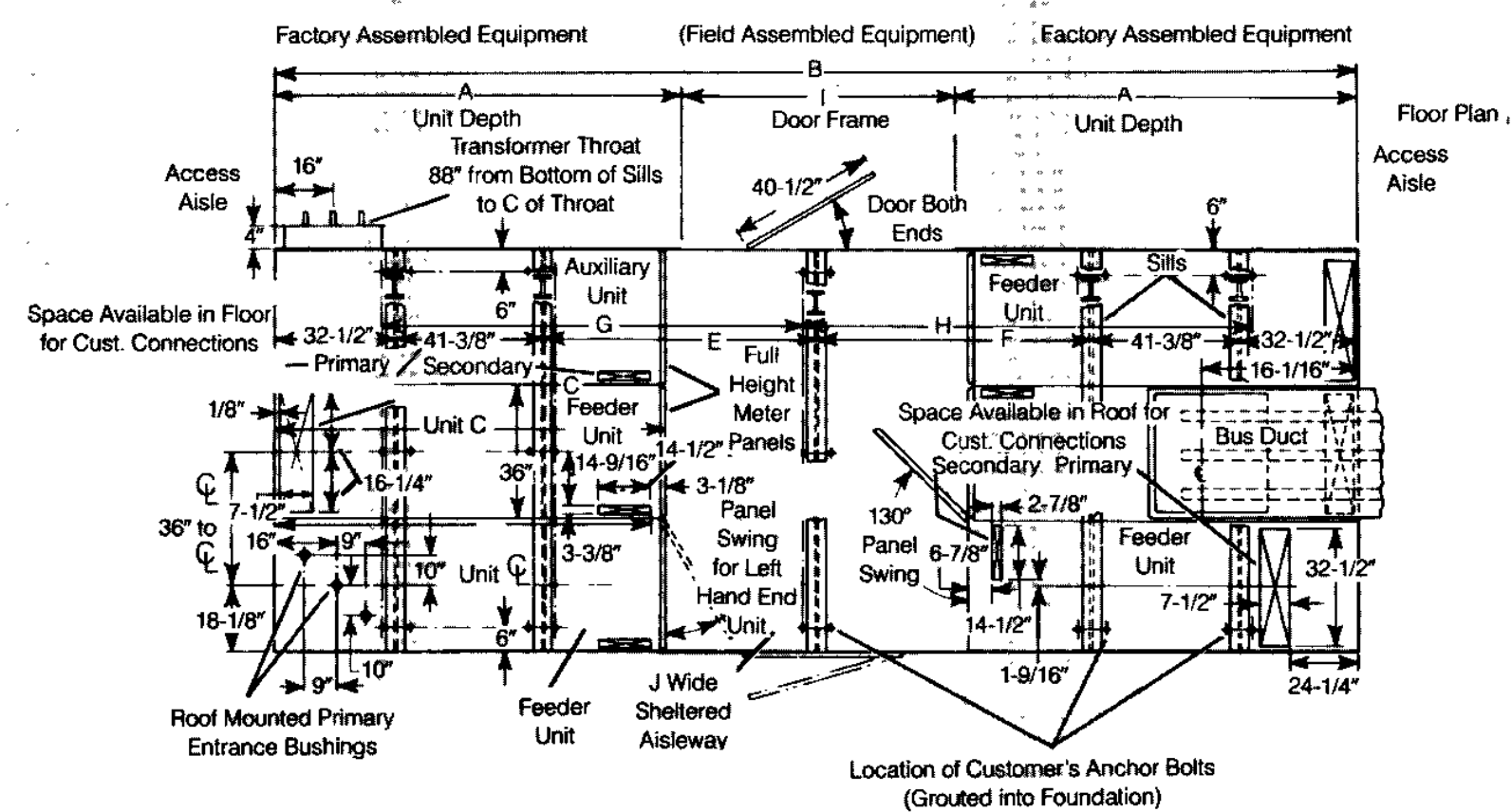
Foundation Requirements

Supporting concrete pads, piers or pilings must be constructed with true surfaces and in the same place to within 1/16 inch. On groups supported on 4 x 6—12 lbs./ft beams, the maximum span between supports must not exceed nine feet. The diameter of pilings must not be less than 12 inches for maximum contact with the beams. Supports must be located at shipping splits.



Dimensions And Installation Data 7.2 And 15 kV Outdoor
Common Aisle Shelter-Clad Housings

Dimensions



Dimensions (Inches)	
Breaker Type	FB-500 FC-500 FC-750 5-FSV-350 7-FSV-500 15-FSV-500 15-FSV-750 15-FSV-1000
A	100
B	268-1/2
C	94
D	90-7/8
E	60-3/8
F	60-3/8
G	101-3/4
H	107-1/4
I	69-1/4
J	80-1/2

Type D&F
Metal-Clad Switchgear

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Switchgear Division

Typical Metal-Clad Switchgear	Specifications
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Information set with a check box and fill-in data is to be supplied by purchaser and denotes alternates, options and specific information.

General Description Of Switchgear— Units And Rating

The equipment outlined in this specification will consist of ☐ indoor, ☐ Shelter-Clad (walk-in) Metal-Clad switchgear with horizontal drawout air magnetic, vacuum circuit breakers. General construction features will be of a coordinated design so that shipping groups are easily connected together in the field into a continuous line-up. Necessary standard connecting materials will be furnished. Shipping groups ordinarily will not exceed 15' in length.

The general arrangement and single line diagram of the equipment will be as indicated on Sketch No. _____ dated _____.

Codes And Standards

The equipment covered in this specification, except as noted, will be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

- ANSI — American National Standards Institute
- ASTM — American Society for Testing and Materials
- IEEE — Institute of Electrical and Electronic Engineers
- NEC — National Electric Code
- NEMA— National Electrical Manufacturers Association

Service

The switchgear sections will be rated ☐ 5, ☐ 7.2, ☐ 15 kV, with a maximum design voltage of _____ kV. This equipment will operate on a service voltage of _____volts, _____ phase, _____ wire, _____ hertz.

Insulation Levels

The assembled switchgear structures will be designed for the following insulation levels:

- Insulation Test, (60 Hertz) _____☐ 19, ☐ 36 kV
- Full-wave Impulse Test _____☐ 60, ☐ 95 kV BIL

Dimensions

Approximate dimensions of the switchgear are shown on the sketch included with this specification. The circuit breakers will be removable from, opposite from the control panel side. An aisle space of _____ inches is recommended or available to permit withdrawal of the circuit breaker element.

Circuit Breakers

The air magnetic, vacuum circuit breakers will be:

- Siemens Type _____
- Nominal Voltage Class—kV, RMS _____
- Nominal 3 Phase MVA Class _____
- Rated Maximum Voltage—kV, RMS _____
- Rated Continuous Current at 60 Hz—Amp, RMS _____
- Rated Short Circuit Current at Rated
Maximum Voltage (Symmetrical—kA, RMS) _____
- Rated Interrupting Time in Cycles _____
- Maximum Symmetrical Interrupting
Capability—kA, RMS _____
- Short-Time (3 Sec.) Current Carrying
Capability—kA, RMS _____
- Closing and Latching Capability—
kA, RMS Std. _____

The circuit breakers will be three pole, single throw, mechanically and electrically trip free, with position indicator, operation counter, auxiliary switches, primary and secondary disconnecting devices, and a mechanical interlock to prevent making or breaking load current on the primary disconnects.

The circuit breakers will be equipped with a stored energy operator.

The control voltages will be:

- Spring Charging Motor: ☐ 48, ☐ 125 ☐ 250 volt dc, ☐ 120, ☐ 240 volt ac]
- Spring Release (Close) Coil: ☐ 48, ☐ 125, ☐ 250 volt dc, ☐ 120, ☐ 240 volt ac]
- Trip Coil: ☐ 24, ☐ 48, ☐ 125, ☐ 250 volt dc, ☐ 120, ☐ 240 volt ac capacitor trip]

The source of control power will be ☐ a battery provided in the switchgear, ☐ a control power transformer in the switchgear, ☐ a separate supply provided by the Purchaser, a battery located in the vicinity of the switchgear.

Meters And Relays

All instruments, meters and relays are standard switchboard type for mounting on the steel panels. All meters and relays, if provided as standard, are of the drawout type with built-in test devices.

Indicating and recording instruments, meters and relays are of the rectangular type, semiflush mounted.

Control And Instrument Switches

All switches furnished will be switchboard type and are of rotary-type construction, with two contacts per stage.

Typical Metal-Clad Switchgear

Specifications

Basic Structure

Each circuit breaker compartment will contain a manually operated drawout mechanism with automatic shutters and safety interlocks, and will also include the following:

- a. Hinged front panel.
- b. Primary and secondary disconnecting devices.
- c. Control circuit cutout device.
- d. A set of _____ ampere, ☐ copper (silver-plated at connection points), ☐ aluminum (tin-plated at connection points) 3 phase, 3 wire insulated main bus and connections.
- e. Ground bus of ☐ copper, ☐ aluminum.
- f. Necessary terminal blocks, small wiring and control buses, where required.
- g. Cable supports, where required.
- h. Engraved nameplate, as required.

Each auxiliary compartment will include the following:

- a. Hinged front panel.
- b. A set of _____ ampere, ☐ copper (silver-plated at connection points), ☐ aluminum (tin-plated at connection points) 3 phase, 3 wire insulated main bus and connections.
- c. Ground bus of ☐ copper, ☐ aluminum.
- d. Necessary terminal blocks, small wiring and control buses, where required.
- e. Cable supports, where required.
- f. Engraved nameplate, as required.

High Durability Finish

The framework and the panels will be chemically cleaned, hot phosphate treated, and rinsed, and given a coat of ANSI No. 61 indoor vinyl paint. After complete assembly, all exterior surfaces of outdoor units are given an additional coat of vinyl paint.

Production Tests

All products are tested and inspected as part of the regular manufacturing procedure and are in accordance with ANSI C37.20 paragraph 5.3 for Switchgear Assemblies and ANSI C37.09-1979 paragraph 5 for AC high-voltage circuit breakers.

Weatherproof Housing

Shelter-Clad Housing—Single Aisle

The *Shelter-Clad* Switchgear will consist of indoor type circuit breakers and auxiliary units located in a weatherproof steel

housing having an operating aisle space of sufficient size to permit withdrawal of the circuit breakers for inspection, test or maintenance. An access door will be located at each end of the aisle, with provision for padlocking on the outside, but also arranged so that the door can be opened from the inside regardless of whether or not it has been padlocked on the outside. The aisle space will have adequate incandescent lighting which will be controlled by means of a three-way switch at each access door.

Included in the switchgear will be the following:

- a. One (1) space heater, 500 watts, 240 volts A.C. in each Unit.
- b. Two (2) utility duplex receptacles with integral ground fault protection, one at each access door, for electrical tools, extension cords, etc.

The complete assembly will rest on four (4)—6 inch high "I" beams running parallel to the length of the switchgear. Steel plates will be supplied for covering the space between the ends of the "I" beams to prevent entrance of debris. The underside of the enclosure and "I" beams will be undercoated with asphaltic material.

The switchgear will be shipped in convenient groups for erection in the field, and shipping groups ordinarily will not exceed fifteen (15) feet in length.

The weatherproof enclosure for the aisleway will be shipped in sections for ready erection in the field. Necessary erection hardware will be furnished.

Shelter-Clad Housing—Common Aisle

The *Shelter-Clad* Switchgear will consist of two (2) line-ups of indoor type circuit breakers and auxiliary units located in a weatherproof steel housing having a common operating aisle space of sufficient size to permit withdrawal of the circuit breakers for inspection, test, or maintenance. An access door will be located at each end of the aisle, with provision for padlocking on the outside, but also arranged so that the door can be opened from the inside regardless of whether or not it has been padlocked on the outside. The aisle space will have adequate incandescent lighting which will be controlled by means of a three-way switch at each access door.

Included in the switchgear will be the following items:

- a. One (1) space heater, 500 watts, 240 volts, A.C. in each unit.
- b. Two (2) utility duplex receptacles with integral ground fault protection, one at each access door, for electric tools, extension cords, etc.

**Type D&F
Metal-Clad Switchgear**

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Typical Metal-Clad Switchgear	Specifications
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The complete assembly will rest on five (5)—6 inch high "I" beams running parallel to the length of the switchgear. Steel plates will be supplied for covering the space between the ends of the "I" beams to prevent entrance of debris. The underside of the enclosure and "I" beams will be undercoated with asphaltic material.

The switchgear will be shipped in convenient groups for erection in the field, and shipping groups ordinarily will not exceed fifteen (15) feet in length

The weatherproof enclosure for the aisleway will be shipped in sections for ready erection in the field. Necessary erection hardware will be furnished.

Detailed Specifications

The group of indoor, outdoor switchgear, will include:

- 1—_____ ampere, 3 phase, main bus.
- 1—Ground bus.

The circuit breaker units and auxiliary units will be as specified on the following sheets.

Incoming Line Unit(s) Or Feeder Unit(s) Or Future Feeder Unit(s)

Unit(s) Number _____

☐ Each, ☐ This unit will contain the following:

☐ Air, ☐ vacuum circuit breaker, rated _____ amperes, type _____ .

☐ Provision for future circuit breaker, rated _____ amperes, type _____

_____ Cubicle mounted mechanism operated (MOC) auxiliary switch mounted on the left side of the cubicle.

_____ Cubicle mounted truck operated (TOC) cell switch mounted at the rear of the cubicle.

_____ Current transformer(s) _____/5 ampere ratio, with a ☐ single, ☐ double, ☐ multiratio primary.

_____ Current transformer, zero sequence. _____/5 ampere ratio.

_____ Voltage transformer(s), trunnion mounted _____ -120 volt ratio, complete with primary current limiting fuses.

_____ Surge arresters, _____ type, _____ kV.

_____ Surge capacitors, _____ volts.

_____ Pothead, _____ conductor _____ kV, for _____ (type) cable _____ (wire size), for ☐ top, ☐ bottom entry.

_____ Cable lugs, ☐ set screw compression, ☐ crimp compression type _____ per phase, for (type cable) _____ (wire size) _____ kV for ☐ top, ☐ bottom entry.

_____ Provision for connection to a bus duct rated _____ amperes, _____ kV, at the ☐ top, ☐ bottom, ☐ side of the unit.

_____ Provision for connection to the throat of a _____ kVA transformer.

_____ Cable lugs per phase.

_____ Cable terminations, _____ conductor, _____ kV, for _____ (type) cable _____ (wire size), for ☐ top, ☐ bottom entry.

_____ Roof bushings, rated _____ amperes, _____ kV.

_____ Heater.

_____ Thermostat.

Typical Metal-Clad Switchgear Specifications

Mounted on hinged front panel:

- _____ Circuit breaker control switch, complete with one red and one green indicating light.
- _____ Indicating light ☐ amber, ☐ white, ☐ blue.
- _____ Voltmeter, single phase, ☐ indicating, ☐ recording 0- _____ volt scale.
- _____ Voltmeter transfer switch, 3 phase.
- _____ Ammeter, single phase, ☐ indicating, ☐ recording 0- _____ ampere scale.
- _____ Ammeter transfer switch, 3 phase.
- _____ Wattmeter, ☐ indicating, ☐ recording _____ MW scale.
- _____ Watthour meter, _____-element, with ☐ 15, ☐ 30 minute demand attachment.
- _____ Varmeter.
- _____ Power factor meter.
- _____ Overcurrent relay(s) time and/or instantaneous, device No. ☐ 50, ☐ 51, ☐ 50/51.
- _____ Ground relay time and/or instantaneous, Device No. ☐ 50N, ☐ 51N, ☐ 50/51N, ☐ 50G, ☐ 51G.
- _____ Directional relay(s), ☐ overcurrent, ☐ time, Device No. ☐ 67, ☐ 67N.
- _____ Thermal overload relay(s), Device No. 49.
- _____ Current balance relay, Device No. 46.
- _____ Undervoltage and Phase sequence relay(s), Device No. 47.
- _____ Undervoltage relay(s), Device No. 27.
- _____ Overvoltage relay(s), Device No. 59.
- _____ Differential relay(s), Device No. 87.
- _____ Lockout relay, Device No. 86.
- _____ Pilot wire relay, equipment, 3 phase, Device No. 87.
- _____ Pilot wire monitoring relay, Device No. 85.
- _____ Underfrequency relay, Device No. 81.
- _____ Auxiliary relay, Device No. _____.
- _____ Reclosing relay, with ☐ one, ☐ three reclosure(s), ☐ automatic, ☐ hand reset, Device No. 79.
- _____ Reclosing relay cutout switch.
- _____ Test Block.
- _____ Transducer, ☐ current, ☐ voltage, ☐ watt, ☐ var.

Bus Tie Unit

Unit Number _____

- ☐ Each, ☐ This unit will contain the following:
- ☐ Air, ☐ vacuum circuit breaker, rated _____ amperes, type _____.
- _____ Cubicle mounted mechanism operated (MOC) auxiliary switch mounted on the left side of the cubicle.

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Switchgear Division

Typical Metal-Clad Switchgear	Specifications
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- _____ Cubicle mounted truck operated (TOC) cell switch mounted at the rear of the cubicle.
- _____ Current transformer(s) _____ /5 ampere ratio, with a ☐ single, ☐ double, ☐ multiratio primary.
- _____ Provision for connection to a tie bus duct rated _____ amperes, _____ kV, at the ☐ top, ☐ bottom, ☐ side of the unit.
- _____ Automatic transfer equipment for transferring secondary control.
- _____ Heater.
- _____ Thermostat.

Mounted on hinged front panel:

- _____ Circuit breaker control switch, complete with one red and one green indicating light.
- _____ Indicating light ☐ amber, ☐ white, ☐ blue.
- _____ Voltmeter, single phase, ☐ indicating, ☐ recording 0-_____ volt scale.
- _____ Voltmeter transfer switch, 3 phase.
- _____ Ammeter, single phase, ☐ indicating, ☐ recording 0-_____ ampere scale.
- _____ Ammeter transfer switch, 3 phase.
- _____ Overcurrent relay(s) time and/or instantaneous, device No. ☐ 50, ☐ 51, ☐ 50/51.
- _____ Undervoltage relay(s), Device No. 27.
- _____ Lockout relay, Device No. 86.
- _____ Auxiliary relay, Device No. _____.
- _____ Synchronism check relay, Device No. 25.
- _____ Test Block.

Auxiliary Unit(s)

Unit(s) Number _____

☐ Each, ☐ This unit will contain:

- _____ Current transformer(s) _____/5 ampere ratio, with a ☐ single, ☐ double, ☐ multiratio primary.
- _____ Voltage transformer(s), trunnion mounted _____-120 volt ratio complete with primary current limiting fuses.
- _____ Control power transformer, stationary, _____ kVA, _____ phase, 60 Hertz, _____ type, _____ volt ratio, complete with trunnion mounted primary current limiting fuses, and a secondary molded case circuit breaker interlocked with the primary fuse carriage.
- _____ Control power transformer, trunnion mounted, _____ kVA, _____ phase, 60 Hertz _____ type, _____ volt ratio, complete with trunnion mounted primary current limiting fuses. (This option available only for 7.2 kV or 15 kV class equipment with 15 kVA maximum transformer size)
- _____ Surge arresters, _____ class, _____ kV.
- _____ Surge capacitors, _____ volts.
- _____ Battery, _____ volt, _____ type, _____ cells with a maximum discharge rate of _____ amperes down to _____ volts per cell, complete with rack and standard accessories.
- _____ Battery charger, ☐ static type, ☐ with voltage regulation, complete with ☐ ammeter, ☐ voltmeter, and ☐ rheostat, suitable for use with the above battery.

Typical Metal-Clad Switchgear Specifications

- ____ Pothead, ____ conductor ____ kV, for ____ (type) cable ____ (wire size) ____ kV for ☐ top, ☐ bottom, entry.
- ____ Cable lugs, ☐ set screw compression or ☐ crimp compression type ____ per phase, for (type cable) ____ (wire size) kV for ☐ top, ☐ bottom entry.
- ____ Provision for connection to a bus duct rated ____ amperes, ____ kV, at the ☐ top, ☐ bottom of the unit.
- ____ Provision for connection to the throat of a ____ kVA transformer.
- ____ Cable lugs per phase.
- ____ Cable terminations, ____ conductor ____ kV, for ____ (type cable) ____ (wire size) ____ kV for ☐ top, ☐ bottom entry.
- ____ Roof bushings, rated ____ amperes, ____ kV.
- ____ Heater.
- ____ Thermostat.

Mounted on hinged front panel:

- ____ Voltmeter, single phase, ☐ indicating, ☐ recording 0-____ volt scale.
- ____ Voltmeter transfer switch, 3 phase.
- ____ Ammeter, single phase, ☐ indicating, ☐ recording 0-____ ampere scale.
- ____ Ammeter transfer switch, 3 phase.
- ____ Wattmeter, ☐ indicating, ☐ recording ____ MW scale.
- ____ Watthour meter, ____-element, with ☐ 15, ☐ 30 minute demand attachment.
- ____ Overcurrent relay(s) time and/or instantaneous, Device No. ☐ 50, ☐ 51, ☐ 50/51
- ____ Ground relay time and/or instantaneous, Device No. ☐ 50N, ☐ 51N, ☐ 50/51N, ☐ 50G, ☐ 51G.
- ____ Test Block.

Accessories

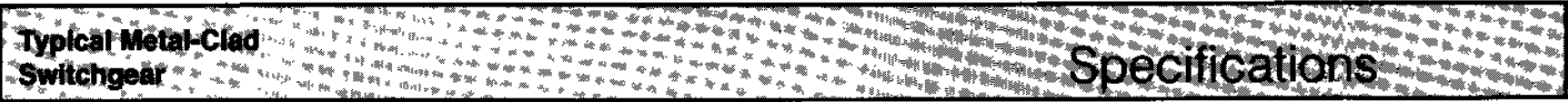
The following accessories will be supplied, but not housed:

- 1 — Lever for use in racking breakers to and from the connected position.
- 1 — Crank for use in manually slow-closing breakers and for manually charging the closing springs if the normal control power supply is not available.
- 1 — Maintenance slow closing device (for air circuit breaker only).
- 1 — Fifth wheel for use in moving breakers while outside the unit.
- 1 — Floor plate rack extension (Type F—indoor only).
- 1 — Transfer truck (Conventional non walk-in outdoor only).
- 1 — Arc chute support stand (air circuit breaker only)
- ____ Arc chute lifting device. (For type FC-1000 breakers only)

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Special Accessories (Optional)

- _____ Test plug, less cable, for drawout relays and watthour meters.
- _____ Test device consisting of plugging units and cable, for testing breaker and control circuits while breaker is outside and adjacent to unit.
- _____ Inspection and test cabinet, indoor type, with necessary control switch.
- _____ Ground and test device, ☐ manually, ☐ electrically operated type.
- _____ Spare Circuit Breaker(s), type _____, rated _____ amperes, _____ kV.

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