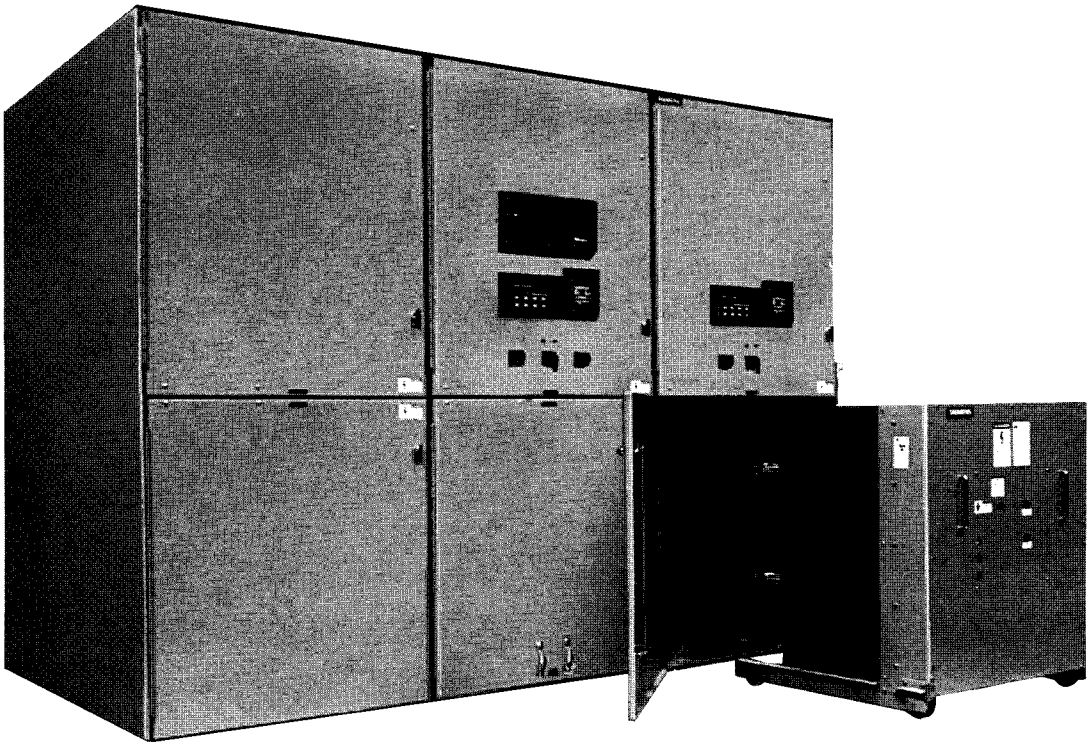
SIEMENS

# 38kV Switchgear

## Selection and Application Guide



**Application**
Siemens 38kV type GM38 metal-clad switchgear is used to control and protect transformers, capacitor banks, distribution lines, and various types of circuits in utility systems, large industrial facilities, pumping stations, refineries, transit systems, or wherever power is used at 16.5-38kV. Indoor and outdoor equipment is available with continuous ratings up to 3000 amperes.

**Features**
GM38 switchgear combines the basic construction concepts used in Siemens 5-15kV GM switchgear, which capitalizes on the repeatability of CNC machinery, along with the proven 3AF vacuum circuit breaker design. Siemens 3AF breaker, first produced in 1976, has over 100,000 units in service. This combination results in switchgear which is easier to install and use.

**Contents**



Bulletin SG-3511 (May 1995)

# Features

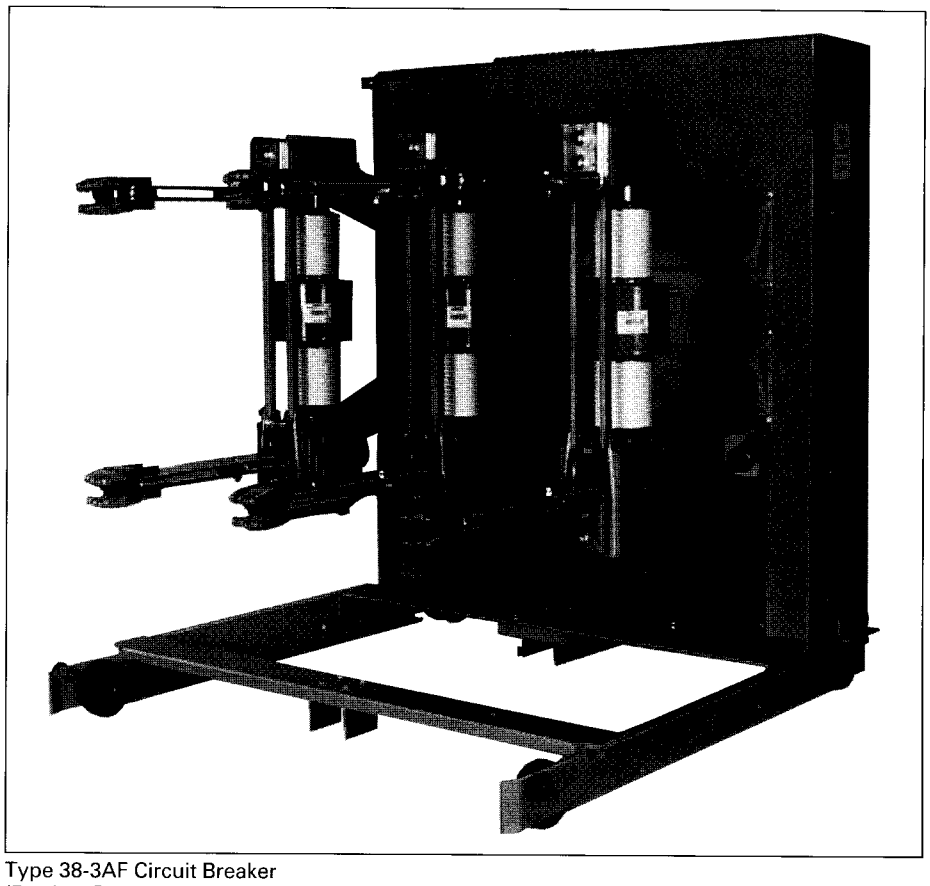
**Floor Rollout**
Floor rollout convenience is standard for circuit breakers used in GM38 switchgear, eliminating the need to use a lift truck to insert or remove circuit breakers in indoor or shelter-clad walk-in outdoor installations.

**Front Accessible Operator**
The 3AF stored energy operator is located at the front of the circuit breaker, so there is no need to tilt or turn over the circuit breaker for normal service.

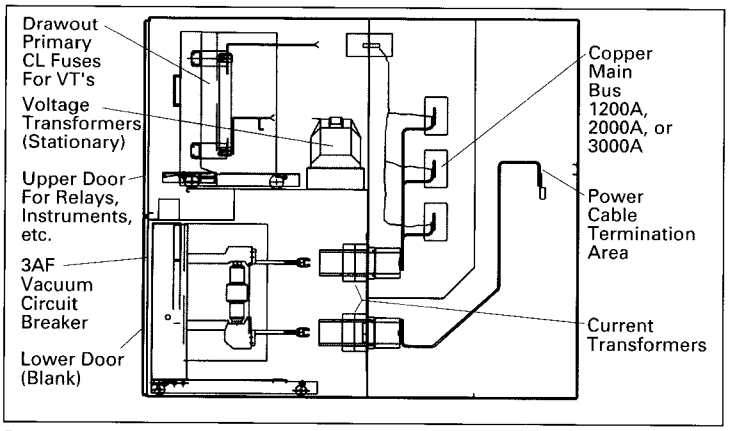
**Proven Vacuum Interrupters**
The 38-3AF vacuum circuit breaker uses reliable Siemens vacuum interrupters, proven in thousands of installations since 1976. The chrome-copper contact design used in these interrupters assures low chopping levels, eliminating the need for surge protection on most circuits.

**VT's Above Breaker**
For the first time in 38kV metal-clad switchgear, voltage transformer auxiliaries can be located in the same section as a circuit breaker. This allows significant space savings and convenience.

**Full ANSI Metal-Clad Construction**
GM38 switchgear incorporates all ANSI C37.20.2 features, including true mechanically trip-free operation, complete drawout safety interlocks, full compartmentation, metal shutters, insulated bus, automatic secondary disconnects, and convenient floor rollout drawout circuit breaker design.



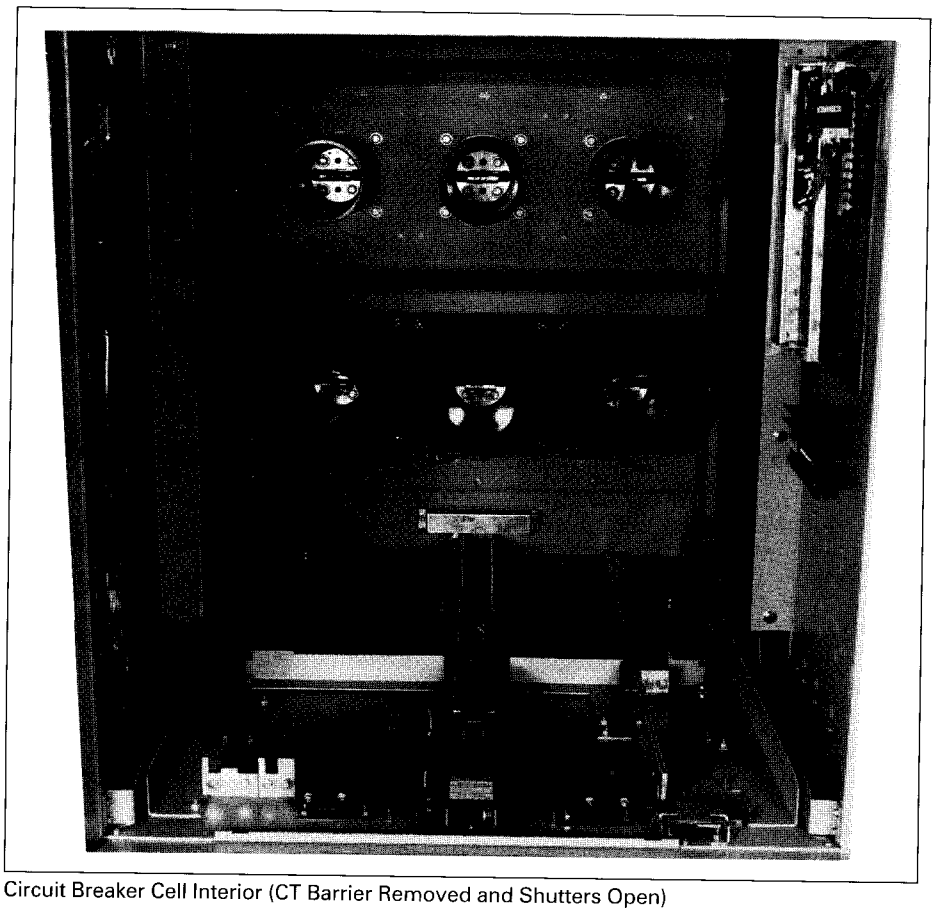
Type 38-3AF Circuit Breaker
(Barriers Removed)




Breaker Cell (1200A or 2000A) with VT Auxiliary

**Full ANSI Testing**
Full design integrity is assured. ANSI C37.20.2 requires design tests on circuit breaker and cubicles together. Since both the cubicles and the circuit breakers are produced in a single facility, Siemens controls the entire product from design concept to production. Records are maintained to document compliance with ANSI standards such as: dielectric (both 60 Hz and impulse), continuous current, short-time current withstand, momentary current, short circuit interruption, and mechanical life tests.

# Construction



Circuit Breaker Cell Interior (CT Barrier Removed and Shutters Open)

**Switchgear Structure**
Siemens GM38 switchgear provides enhanced flexibility in locating the circuit breaker and auxiliary cells within the structure layout. Voltage transformers and their drawout primary fuses may be located in the cell above a 1200 or 2000 ampere circuit breaker. This eliminates separate auxiliary sections required with previous designs.

The upper cell above a 3000 ampere (fan cooled) circuit breaker cell can be used for metering. Bus tie circuit breaker configurations do not require an auxiliary section next to the tie section — the bus transition requires only a small rear extension on the section next to the tie section if the section next to the bus tie has a circuit breaker cell.

**Vacuum Circuit Breaker Cell** — A circuit breaker cell consists of a bolted, reinforced sheet steel enclosure, with provisions for a 38-3AF vacuum circuit breaker. The cell includes a blank hinged front door, inter-compartment and inter-unit barriers, stationary primary and secondary disconnects, drawout guide rails, circuit breaker racking mechanism, and necessary interlocks. Control wiring, terminal blocks, current transformers, and secondary control circuit cutouts are provided as needed for the application. Instruments and relays, as needed, are mounted on the front panel of the upper cell.

**Floor Rollout** — Breakers can be rolled out directly onto the floor in front of the section, without a handling device or lifting device for indoor and shelter-clad installations.

**Closed Door Breaker Racking** — The cell mounted circuit breaker racking mechanism may be operated with the cell door open or closed. For racking, a manual drive crank or an optional electric motor drive may be used. The racking system includes a position indicator which is visible with the cell door open or closed.

**Interlocks** — The racking mechanism is designed to prevent moving a closed circuit breaker in the cell. An interlock prevents engaging the racking screw if the breaker is closed. A second interlock lever holds the circuit breaker mechanically trip-free between positions. Padlock provisions are included a) to prevent unauthorized racking of the circuit breaker, and b) to hold the circuit breaker in the trip-free condition in the cell.

**Automatic Shutters** — Steel shutters are opened by the circuit breaker as it moves toward the connected position, allowing access to the primary disconnects. The shutters close as the breaker is racked away from the connected position. The two shutters are designed to remain closed until they are opened by the presence of the circuit breaker.

**Primary Disconnects** — The cubicle stationary contacts are recessed inside epoxy primary disconnect bushing assemblies, and are located behind grounded steel shutters to prevent accidental contact when the breaker is withdrawn. The primary disconnect finger clusters are mounted on the circuit breaker.

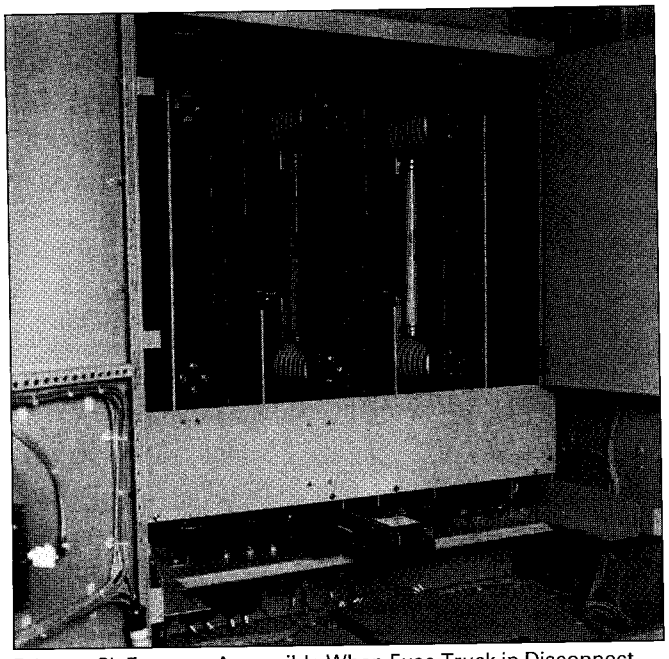
**Current Transformers** — Front-access torroidal current transformers may be mounted in any circuit breaker cell. Up to four current transformers (standard accuracy or optional high accuracy) may be mounted on each phase — two on the bus side and two on the load side, around the primary disconnect bushings.

**Secondary Disconnects** — The cubicle mounted stationary contacts mate with spring loaded secondary contacts on top of the circuit breaker. They automatically engage in both the test and the connected positions.

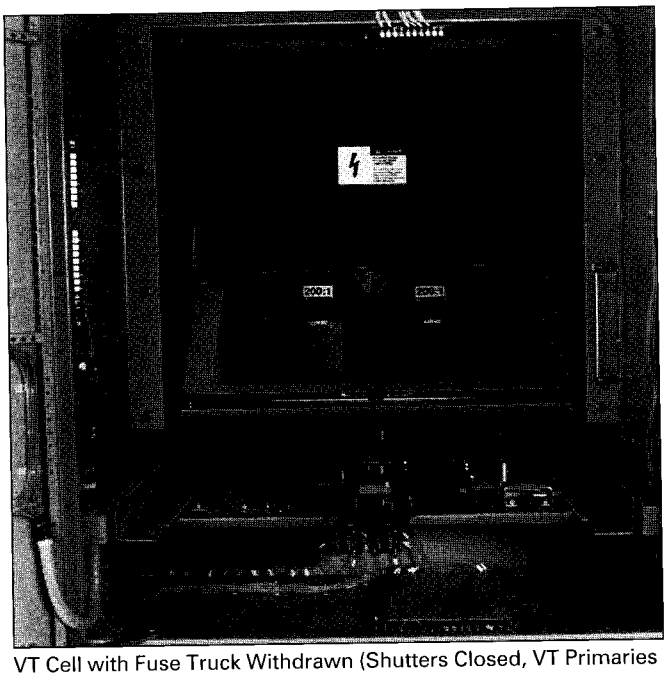
**MOC / TOC Switches** — 6, 12, 18, or 24 stages of MOC (Mechanism Operated Cell) auxiliary switch can be mounted in the circuit breaker cell. This switch is operated by the circuit breaker mechanism.

4, 8, or 12 stages of TOC (Truck Operated Cell) switch can be mounted in the circuit breaker cell. The switch stages change state when the breaker moves into or out of the connected position.

# Construction



Primary CL Fuses — Accessible When Fuse Truck in Disconnect Position



VT Cell with Fuse Truck Withdrawn (Shutters Closed, VT Primaries Grounded)

**Auxiliary Cells**
Auxiliary cells are constructed in the same general manner as the circuit breaker cells except without provisions for a circuit breaker element. Auxiliary cells may be located in the top or bottom of a section.

The front door panels may be used to mount relays or instrumentation. The interior of the cell may be used for mounting devices such as voltage transformers, control power transformers, automatic transfer switches, battery chargers, or batteries.

For ease in operation, primary current limiting fuses for control power transformers and voltage transformers are arranged in a drawout configuration, while the heavy transformers are stationary. This greatly reduces the effort required to isolate transformers for inspection or maintenance. The racking mechanism for the fuse truck is manually operated with the compartment door open, but is otherwise similar to the circuit breaker racking mechanism.

**Voltage Transformers** — Up to three voltage transformers with their drawout mounted current limiting fuses may be mounted in an auxiliary cell. VT's can be accommodated in the upper cell above a circuit breaker, or in either the upper or lower cells of a section which does not have a circuit breaker cell.

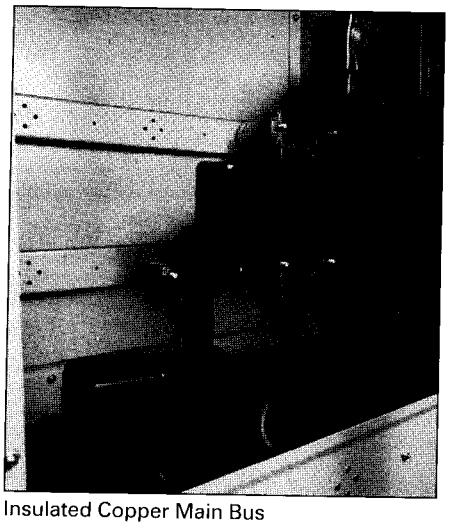
When the drawout fuses are moved to the disconnect position, they are automatically disconnected, and the transformer windings are grounded to remove any static charge. Insulating shutters are provided, arranged to operate before the primary fuses become accessible for inspection or removal.

**Control Power Transformers** — Control power transformers can be accommodated in either of two manners. For single phase and small three-phase transformers, the primary drawout fuses can be located in the upper auxiliary cell of a vertical section, and the fixed mounted control power transformer can be located in the lower front cell of the same vertical section.

Alternatively, the primary drawout fuses can be located in the lower auxiliary cell of a vertical section, and the fixed mounted control power transformer can be located in the rear of the section.

The secondary molded case breaker is interlocked with the drawout fuses so that the secondary breaker must be open before the control power transformer primary can be disconnected or connected. This prevents accidental load current interruption on the main primary contacts. With the secondary breaker open and the latch released, the primary fuse truck can be moved easily to the disconnect position. The operation of the drawout fuse truck and insulating shutters is similar to that for the VT's.

# Construction



Insulated Copper Main Bus

**Primary Entrance / Bus Compartments**

**Primary Termination Compartment —** The primary termination compartment at the rear of the switchgear section is separated from all other compartments by barriers. This space can be used for connecting power cables, bus duct, or for connection to an adjacent power transformer. Surge arrestors may also be provided in this compartment. Bolted rear plates are provided as standard to provide access to the cable area for each unit. Hinged rear doors are available as an option.

**Bus Bar System —** The main bus is available in 1200A, 2000A, or 3000A self-cooled ratings. The main bus bar system is enclosed by grounded metal barriers. Full round-edge copper bus bars with silver plated joints are standard. A .25 in. (6 mm) x 2 in. (51 mm) copper ground bus is provided, accessible at each end of the lineup and in the primary termination area of each section.

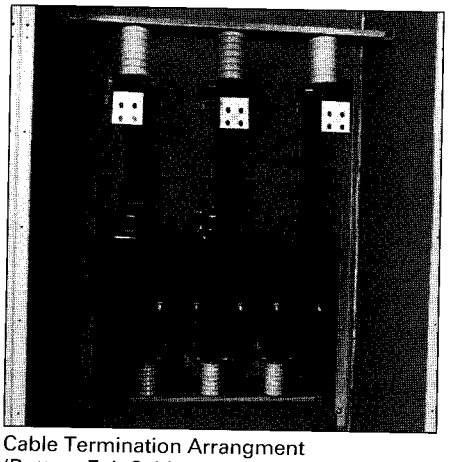
**Insulation —** Bus bars are insulated using heat shrink insulation. Bolted bus joints are insulated by preformed molded boots which are held in place by nylon hardware. For bus configurations where no boot design is available, taped joints are used. The main bus is supported with porcelain inserts where the bus passes from one section to another. Other bus is supported using porcelain standoff insulators. Circuit breaker support insulators and cubicle primary disconnect supports are molded epoxy. Interphase and other barriers are track-resistant, flame retardant glass polyester.

**Wiring**

The secondary and control wiring is connected to terminal blocks which have numbered points for identification. One side of the terminal blocks for all connections leaving the switchgear is reserved for external connections. Secondary and control wire is No. 14 AWG, extra-flexible, stranded type SIS wire, insulated for 600 volts. Insulated barrel, crimp-type locking fork terminals are used for most applications, except where the devices require a different type of terminal. Where they pass through primary compartments, secondary control wires are armored or enclosed in grounded metal wire troughs.

**Instrumentation and Relays**

Instruments, meters, and relays can be traditional switchboard type, or modern electronic type, depending on the requirements of the specification. If traditional electromechanical devices are used, they have semi-flush cases with dull black covers. Protective relays, if available as standard, are of the drawout type with built-in test facilities. Indicating and recording instruments, meters and relays are of the rectangular type, semi-flush mounted. All scales have a suitable range and are designed with black letters on a white background.



Cable Termination Arrangment
(Bottom Exit Cables)

**Control and Instrument Switches**

Switches furnished are rotary, switchboard type and have black handles. Circuit breaker control switches have pistol-grip handles, while instrument transfer switches have round notched handles, and auxiliary or transfer switches have oval handles.

Circuit breaker control switches have a mechanical flag indicator showing a red or green marker to indicate the last manual operation of the switch.

# Construction

**Accessories**
Standard accessories include
- Manual Racking Crank
- Spring Charging Handle
- Contact Lubricant (tube)
- Touch-Up Paint
- Lift Sling (for fuse trucks in upper cell, or breakers if not at floor level)

Optional accessories available include:
- Split Plug Jumper
- Test Cabinet
- Lift Truck (for fuse trucks in upper cell, or breakers if not at floor level)
- Fifth Wheel
- Test Plugs (for drawout relays or watthour meters)
- Electric Circuit Breaker Racking Motor Assembly
- Manual Ground and Test Device
- Electrical Ground and Test Device

Several options are available for testing circuit breakers outside the cubicle. A split plug jumper can be used to bridge the secondary disconnects with a flexible cable, so the circuit breaker can be electrically closed and tripped with the control switch on the instrument panel. Alternatively, a test cabinet can be furnished for closing and tripping the circuit breaker at a location remote from the switchgear.

**Manual Ground and Test Device**
The manual ground and test device is a drawout element that can be inserted into a circuit breaker cell. It opens the shutters, connects to the cell primary disconnecting contacts, and so provides a means to make the primary disconnect stabs available for testing. It is suitable for high potential testing of outgoing circuits or of the switchgear main bus, or for phase sequence checking. It also provides a means to connect temporary grounds to de-energized circuits for maintenance purposes. Either 3 stud or 6 stud devices are available.

**Electrical Ground and Test Device**
An electrical ground and test device includes a power operated grounding switch, arranged to allow grounding of one set of disconnect stabs. The device includes test ports to allow testing for presence of voltage on both the line side and the load side of the cell. The device provides a means of access to the primary circuits for high potential tests or for phase sequence checking. An electrically operated ground and test device is able to close and latch against short circuit currents corresponding to the ratings of the switchgear. Due to the unique requirements frequently involved in such devices, all applications of electrically operated ground and test devices should be referred to Siemens for review.

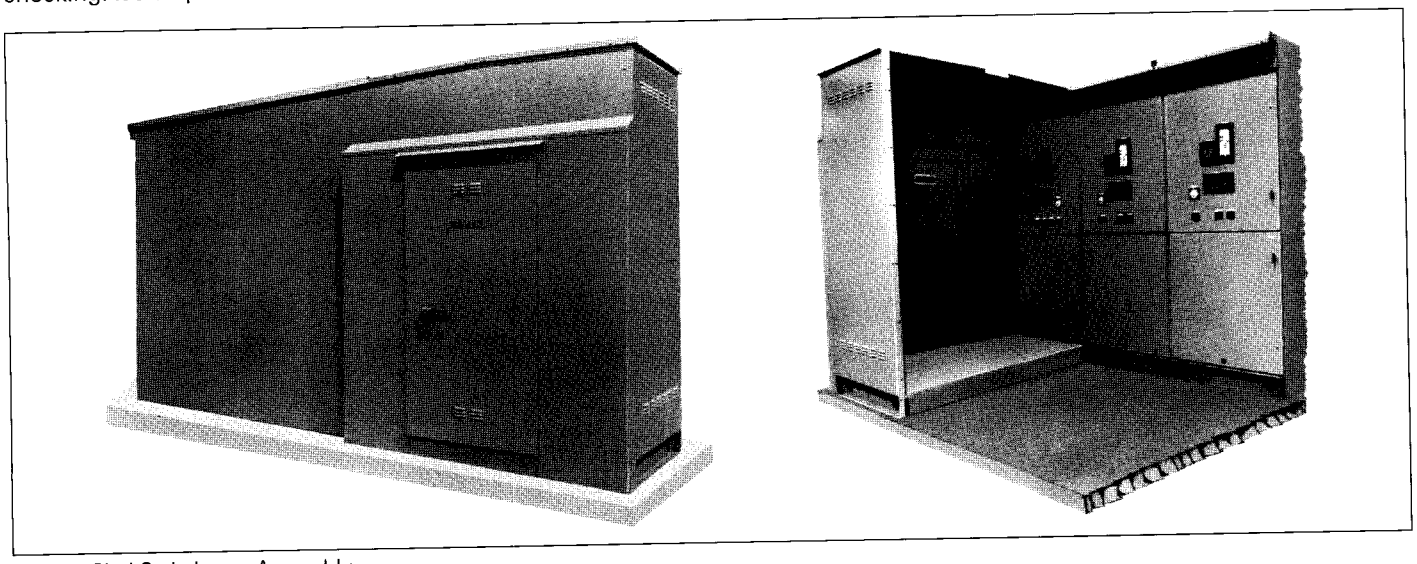
**Outdoor Housings**
Two types of outdoor housing — Non-Walk-In and Shelter-Clad — are available to meet almost any application. For both types the underside of the base is coated with a coal tar emulsion. The switchgear is shipped in convenient groups for erection in the field.

**Non-Walk-In Design**
The non-walk-in switchgear consists of indoor type breaker and auxiliary cubicles located in a steel housing of weatherproof construction. Each vertical section has a full height exterior front door with provision for padlocking. Each cell is also equipped with an inner hinged front door for mounting relays, instrumentation, and control switches. Two removable rear panels are included for cable access to the primary termination area. Each cubicle includes a switched lamp receptacle for proper illumination of the cubicle during maintenance and inspection, a duplex receptacle for use with electric tools, and necessary space heaters. A switch for all space heaters is located in one cubicle.

**Shelter-Clad Design — 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, 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 is provided with incandescent lighting which is controlled by means of a three-way switch at each access door. Each cubicle includes necessary space heaters. Each lineup includes two utility duplex receptacles, one at each aisle access door, for use with electric tools, extension cords, etc.

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

**Shelter-Clad Design — Common Aisle**
The Shelter-Clad-Common Aisle switchgear consists of two 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. Otherwise, the construction is as described for single aisle design.

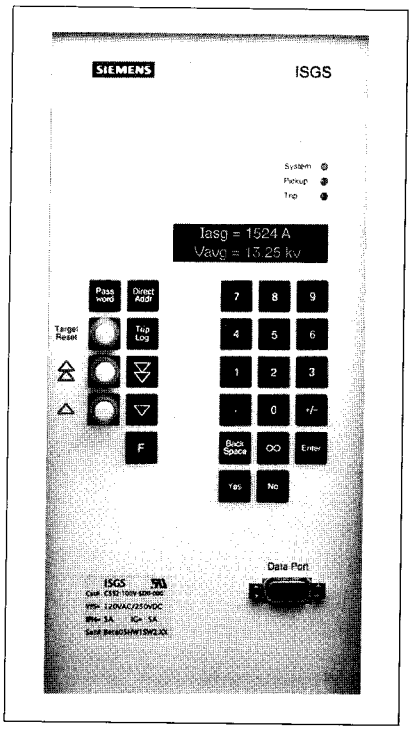


Shelter-Clad Switchgear Assembly

# ISGS™ Intelligent SwitchGear System

**Application**
The ISGS protective relay is used to provide all common protective relay functions, metering, indication and control associated with switchgear circuit breaker installations. The ISGS relay replaces separately mounted and wired components simplifying specification and installation while providing increased reliability and functionality.

**Features**
- Three phase plus ground time and / or instantaneous overcurrent protection, replacing four separate relays.
- 9 selectable time overcurrent curves and 1 custom curve.
- Large 16 character 2-line, back-lit LCD front panel display for easy review of metered data and settings.
- Standard metering functions:
  RMS and average RMS currents
  Ampere demand (per phase & average)
- Optional metering functions
  RMS and average RMS voltages
  Active power (kWatts)
  kW demand
  kW hours
  Apparent power (kVA)
  Volt-amperes reactive (kVAR)
  kVAR hours
  Power factor
  Frequency
- Optional protective functions
  Over and / or under voltage protection (59/27)
  Phase and ground directional overcurrent (67/67N)

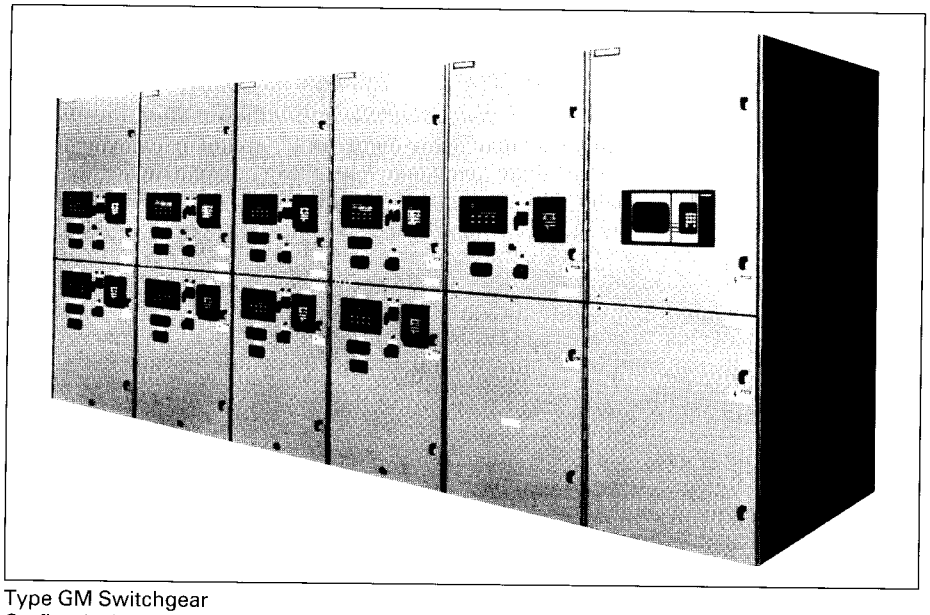



Over and / or under frequency protection (81 O/U)
Negative sequence overcurrent (46)
Negative sequence voltage (47N)
Voltage phase sequence (47)
Four-shot reclosing (79)

- Waveform capture (2 buffers at 1 full second duration each), allowing a review of the fault waveforms and line harmonic conditions on your PC.
- Trip log, recording information on the last eight trip events, including time, date, interrupted amps, time in pickup and other pertinent data to add in quick disturbance analysis.
- Event Log, monitoring relay functions for status changes and recording data available when one occurs.
- Min / Max logs, storing data from metering functions, including current, voltage, power and frequency, all with time stamping.
- Front-mounted RS232 port for local access to all data and settings.
- Direct connection to the Siemens ACCESS™ electrical data system via an optional RS485 port for enhanced communications and control.

**Construction**
The ISGS relay system does away with the costly wiring, drilling and debugging time required to install multiple electromechanical relays. The ISGS unit is housed in a standard M-1 draw-out case and is compatible with commonly used XLA test plugs.

**Mode of Operation**
The ISGS relay system allows the addition of options or configuration changes at any time without discarding the basic hardware. New configuration settings are keyed in directly using the ISGS keypad. The ISGS unit also features a local communications port that allows device configuration and communications with a local PC.



Type GM Switchgear
Outfitted with Siemens ACCESS-Compatible Devices

**Siemens ACCESS System**
Siemens brings the power of communications to medium voltage switchgear. GM38 switchgear can be provided with a variety of ACCESS-compatible devices for protection, instrumentation, or other needs. ACCESS provides real-time critical operating information for electrical distribution systems.

ACCESS™ Compatible

Metering, protection, and event recording are integrated into an easy-to-use package offering:
- Full Metering Capability
- RMS Sensing
- Graphics Display
- Event Recording
- Remote Monitoring

Contact your local Siemens representative for more information on the ACCESS system and ISGS relay.

# Vacuum Circuit Breakers — Type 38-3AF

The 38-3AF circuit breaker utilizes the advantages of arc interruption in a vacuum, and is available in 1200 and 2000 amperes self-cooled, and 3000 amperes fan-cooled continuous current ratings. Horizontal drawout design assures ease of maintenance, and incorporates separate disconnect, test, and operating positions.

**Floor Rollout**
Circuit breakers are arranged to rollout directly on the floor in front of the switchgear. No adapter, hoist, or lift truck is required for indoor or shelter-clad installations.

**Primary Disconnects**
Primary disconnect finger clusters are mounted on the circuit breaker in a convenient position for maintenance or inspection. Cubicle primary disconnect studs have a rounded leading edge which contributes to smooth racking.

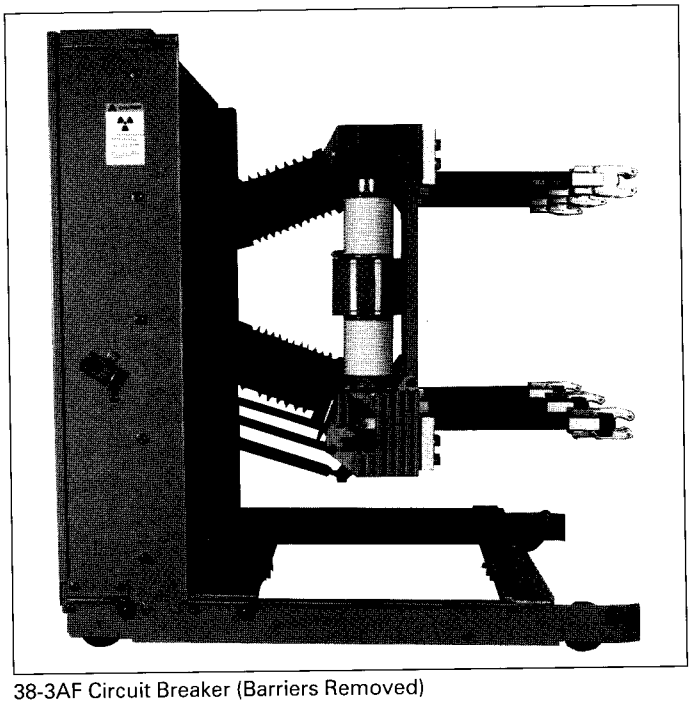
**Secondary Disconnects**
Secondary disconnects are of extremely rugged sliding design, mounted on the top of the circuit breaker for ease of inspection and minimum exposure to inadvertent damage. They are automatically coupled in both the test and connected positions, eliminating the need to manually connect them for testing.

**Non-Sliding Current Transfer**
The vacuum interrupter movable stem is connected to the lower disconnect stud of the circuit breaker by a reliable flexible connector, a method pioneered by Siemens in the 1970's. This provides a low resistance current transfer path, not subject to the wear and contamination problems associated with sliding or rolling joints used in some designs.

**Manual Controls and Indicators**
All breaker manual controls and indicators are conveniently located on the front of the breaker. Standard features include manual close button, manual trip button, open-close indicator, stored energy closing spring charge-discharge indicator, manual spring charging access, and close operation counter.

**Stored Energy Operator**
The operating mechanism stores closing energy in the closing springs. The springs provide sufficient energy not only to close the circuit breaker safely into maximum "close and latch" currents, but also to pre-store the tripping energy necessary to open the circuit breaker. The springs can be manually charged during maintenance or in emergency conditions. They are normally automatically charged electrically after each closing operation.

**True Trip-Free Design**
The mechanism is truly trip-free, both electrically and mechanically. Even if the circuit breaker is in the midst of a closing operation, it can respond to a trip command. Unlike some oil and gas filled circuit breakers, it is not necessary for the circuit breaker contacts to close before the tripping operation can begin.

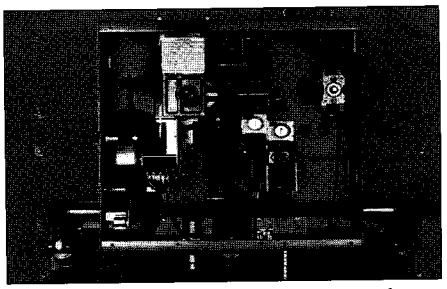


38-3AF Circuit Breaker (Barriers Removed)

**Front-Mounted 3AF Operator**
The 3AF stored energy operator is mounted on the front of the circuit breaker, and is easily accessible through a bolted cover. Tilting or overturning the breaker is not required for maintenance.

**Simple Barriers**
The interphase and outerphase barriers are of very simple design, located on the circuit breaker, allowing the cell to be free of barriers, except the current transformer barrier located in front of the shutters. The barriers on the circuit breaker remove quickly and easily for maintenance. Most maintenance can be done with the barriers in place.

**Siemens Vacuum Interrupters**
The circuit breakers use the Siemens family of vacuum interrupters, proven in over 100,000 circuit breakers produced since 1976. Vacuum interruption occurs in a sealed interrupter, so no toxic interruption by-products are released. Interruption is quiet. The chrome-copper contacts provide low current chopping characteristics. Because there are fewer moving components, reliability is enhanced, leading to long interrupter mechanical and electrical life.



3AF Stored-Energy Operator at Front of Breaker

**Low Maintenance Requirements**
The interrupter is a sealed unit, so the only maintenance necessary is to clean off any contaminants and to check the vacuum integrity. The vacuum interrupters can be disconnected from the stored energy mechanism quickly, without tools, and vacuum integrity inspected by hand; alternatively, a simple hi-pot test can be used.

# Ratings

## Table 1 — Type 38-3AF Circuit Breaker Ratings

| Measured Parameter | | | | | Circuit Breaker Type 38-3AF -1500 ① | Circuit Breaker Type 38-3AF-31 ① |
|---|---|---|---|---|---|---|
| General | Nominal Voltage Class | | | kV | 38.0 | 38.0 |
| | Nominal 3-Phase MVA Class | | | MVA ⑧ | 1500 | — |
| Rated Values | Rated Voltage | Max. ② | | E kV RMS | 38.0 | 38.0 |
| | | Range Factor ③ | | K | 1.65 | 1.0 |
| | Insulation Levels | Rated Withstand Test Voltage | Low Frequency | kV RMS | 80 | 80 |
| | | | Impulse | kV Crest | 150 | 150 |
| | Rated Current | Continuous ④ | | Amperes | 1200<br>2000<br>3000 | 1200<br>2000<br>3000 |
| | | Short circuit (at rated max. kV) ⑤ ⑥ | | I kA RMS | 21 | 31.5 |
| | | Interrupting Time | | Cycles | 5 | 5 |
| | | Permissible Tripping Delay Y | | Sec. | 2 | 2 |
| Related Required Capabilities | Current | Rated Max. Voltage Divided by K | | E/K kV RMS | 23 | 38 |
| | | Max. Sym. Interrupting ⑦ | K Times Rated Short Circuit Current KI | kA RMS | 35 | 31.5 |
| | | 3-Sec. Short Time Current Carrying | | kA RMS | 35 | 31.5 |
| | Closing and Latching (Momentary) ⑨ | 1.6 K Times Rated Short Circuit Current ⑨ | | kA RMS | 56 | 50 |
| | | 2.7 K Times Rated Short Circuit Current | | kA Crest | 95 | 85 |

① Type 38-3AF-1500 ratings are in accord with ANSI C37.06-1987. Type 38-3AF-31 ratings conform to proposed C37.22-19XX and C37.06-19XX ratings.
② Maximum voltage for which the breaker is designed and the upper limit for operation.
③ 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.
④ 3000 ampere ratings are achieved using forced air cooling in the switchgear cubicle.
⑤ 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.

$$\text{Required Symmetrical Interrupting Capacity} \setminus \text{Rated Short Circuit Current} \times \frac{\text{Rated Maximum Voltage}}{\text{Operating Voltage}}$$

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.
⑥ With the limitations stated in 5.10 of ANSI Standard C37.04-1979, all values apply for polyphase and line-to-line faults. For single phase-to-ground faults, the specific conditions stated in 5.10.2.3 of ANSI Standard C37.04-1979 apply.
⑦ Current values in this column are not to be exceeded even for operating voltages below 1/K times rated maximum voltage. For voltages between rated maximum voltage and 1/K times rated maximum voltage, follow 5 above.
⑧ Current values in this column are independent of operating voltage up to and including rated maximum voltage.
⑨ Included for reference only.

## Table 2 — Type 38-3AF Circuit Breaker Control Data

| Control Voltages, ANSI C37.06 Tbl. 10 | | | Coil Amperes ① | | Spring Charging Motor | | |
|---|---|---|---|---|---|---|---|
| | Range | | | | Amperes | | |
| Nominal | Close | Trip | Close | Trip | Run (Avg.) | Inrush (Peak) | Charging Seconds |
| 48 VDC | 38-56 | 28-56 | 2.1 | 20 | 8 | 25 | 10 |
| 125 VDC | 100-140 | 70-140 | 1.0 | 5.4 | 4 | 18 | 10 |
| 250 VDC | 200-280 | 140-280 | 0.5 | 2.1 | 2 | 10 | 10 |
| 120 VAC | 104-127 | — | 0.9 | — | 6 | — | 10 |
| 240 VAC | 208-254 | — | 0.4 | — | 3 | — | 10 |

① Current at nominal voltage.

## Table 3 — Interrupting Capacity Auxiliary Switch Contacts

| Type Switch | Cont. Current Amperes | Circuit Interrupting Capacity in Amperes<br>Control Circuit Voltage<br>120 AC | 240 AC | 48 DC | 125 DC | 250 DC |
|---|---|---|---|---|---|---|
| Non-inductive | | | | | | |
| Breaker | 10 | 10 | 5 | 10 | 9.6 | 4.8 |
| TOC | 15 | 15 | 10 | 0.5 | 0.5 | 0.2 |
| MOC | 20 | 15 | 10 | 10 | 10 | 5 |
| Inductive | | | | | | |
| Breaker | 10 | 6 | 3 | 10 | 6 | 3 |
| TOC | 15 | 15 | 10 | 0.5 | 0.5 | 0.2 |
| MOC | 20 | 15 | 10 | 10 | 10 | 5 |

## Table 4 — Current Transformers①

| Ratio | 60 Hz Metering Accuracy at Burden<br>B0.1 | B0.5 | B1.0 | B2.0 | Relay Class |
|---|---|---|---|---|---|
| Type MD38 Torroidal Standard Accuracy | | | | | |
| 100:5 | 2.4 ② | — | — | — | C 10 |
| 150:5 | 0.6 | 2.4 | — | — | C 20 |
| 200:5 | 0.6 | 1.2 | — | — | C 25 |
| 250:5 | 0.6 | 1.2 | 2.4 | — | C 35 |
| 300:5 | 0.6 | 1.2 | 1.2 | 2.4 | C 40 |
| 400:5 | 0.3 | 0.6 | 1.2 | 1.2 | C 60 |
| 500:5 | 0.3 | 0.3 | 0.6 | 1.2 | C 75 |
| 600:5 | 0.3 | 0.3 | 0.6 | 1.2 | C100 |
| 800:5 | 0.3 | 0.3 | 0.6 | 0.6 | C130 |
| 1000:5 | 0.3 | 0.3 | 0.3 | 0.3 | C170 |
| 1200:5 | 0.3 | 0.3 | 0.3 | 0.3 | C200 |
| 1500:5 | 0.3 | 0.3 | 0.3 | 0.3 | C180 |
| 2000:5 | 0.3 | 0.3 | 0.3 | 0.3 | C210 |
| 2500:5 | 0.3 | 0.3 | 0.3 | 0.3 | C300 |
| 3000:5 | 0.3 | 0.3 | 0.3 | 0.3 | C300 |
| Type MDD38 High Accuracy | | | | | |
| 75:.5 | 2.4 ② | 4.8 | — | — | C 15 |
| 100:5 | 2.4 ② | 4.8 | — | — | C 20 |
| 150:5 | 1.2 | 2.4 | 4.8 | 4.8 | C 35 |
| 200:5 | 0.6 | 1.2 | 2.4 | 4.8 | C 50 |
| 250:5 | 0.6 | 1.2 | 1.2 | 2.4 | C 70 |
| 300:5 | 0.3 | 0.6 | 1.2 | 2.4 | C 90 |
| 400:5 | 0.3 | 0.6 | 0.6 | 1.2 | C120 |
| 500:5 | 0.3 | 0.3 | 0.6 | 0.6 | C150 |
| 600:5 | 0.3 | 0.3 | 0.6 | 0.6 | C200 |
| 800:5 | 0.3 | 0.3 | 0.3 | 0.3 | C250 |
| 1000:5 | 0.3 | 0.3 | 0.3 | 0.3 | C300 |
| 1200:5 | 0.3 | 0.3 | 0.3 | 0.3 | C400 |
| 1500:5 | 0.3 | 0.3 | 0.3 | 0.3 | C440 |
| 2000:5 | 0.3 | 0.3 | 0.3 | 0.3 | C450 |
| 2500:5 | 0.3 | 0.3 | 0.3 | 0.3 | C550 |
| 3000:5 | 0.3 | 0.3 | 0.3 | 0.3 | C700 |

① 1-second through-current and momentary current are equal to the ratings of the associated circuit breakers.
② Exceeds ANSI C37.20.2 Accuracy Limit.

## Table 5 — Voltage Transformers

| Voltage Class | Ratio | Accuracy Class at 120V<br>W,X,Y,Z | ZZ | VA Thermal Rating (55–C Amb) |
|---|---|---|---|---|
| 38kV<br>1 Bushing | 20125:115 | 0.3 | 1.2 | 1000 |
| 38kV<br>2 Bushing | 24000:120<br>27600:115<br>34500:115 | 0.3 | 1.2 | 1000 |

# Enclosure Dimensions

**Table 6 — Cubicle Dimensions-Per Vertical Section**

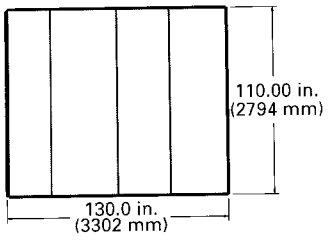
| Type | | Weight in lbs. (kg) | Dimensions in inches (mm) | | | |
|---|---|---|---|---|---|---|
| | | | Width | Depth | Height | Drawout Aisle |
| Indoor | GM38 | 5000 (2273) | 48 (1219) | 130 (3302) | 110 (2794) | 96 (2438) Recommended |
| Shelter-Clad Single-Aisle | SGM38 | 6400 (2909) | 48 (1219) ① | 229 (5817) | 132.5 (3366) | 96 (2438) Included |
| Shelter-Clad Common-Aisle | SGM38 | 11700 (5318) | 48 (1219) ① | 356 (9042) | 132.5 (3366) | 96 (2438) Included |
| Aisle-Less Non-Walk-In | OGM38 | 5800 (2636) | 48 (1219) | 128.6 (3266) | 130.5 (3315) | 96 (2438) Recommended |

① Add 6 in. (152 mm) to each end of lineup for aisle extension (12 in. (305 mm) total.

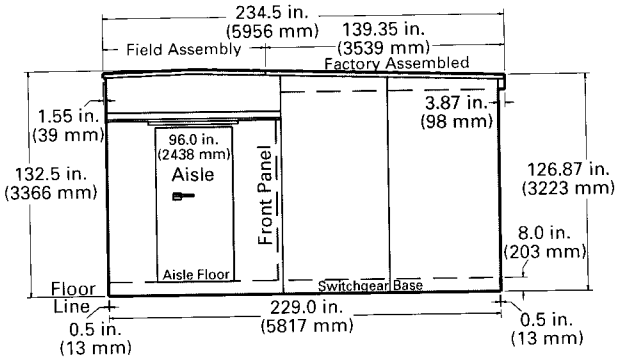
| Add for roof overhang | Non-Walk-in | Shelter-Clad |
|---|---|---|
| Rear (Cable Side) | 3.875 in. (98 mm) | 3.875 in. (98 mm) |
| Front | 6.875 in. (175 mm) | 1.5 in. (38 mm) |

**Table 7 — 38-3AF Circuit Breaker Weights in lbs. (kg)**

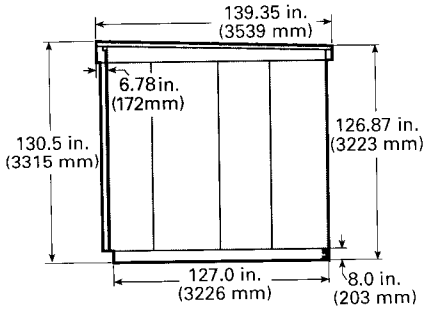
| Cont. Current Amps | Circuit Breaker Type | |
|---|---|---|
| | 38-3AF-1500 | 38-3AF-31 |
| 1200 | 800 (364) | 800 (364) |
| 2000 | 900 (409) | 900 (409) |
| 3000 | 1000 (455) | 1000 (455) |



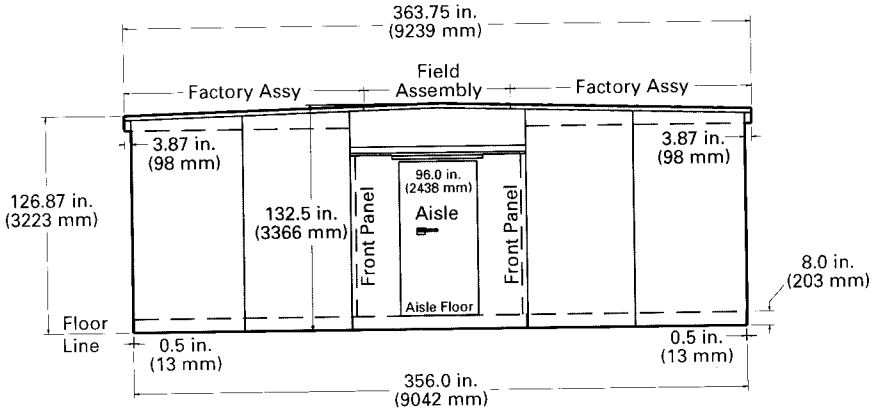

**End View of Indoor Switchgear**
Type GM38




**End View of Single Aisle Switchgear**
Type SGM38

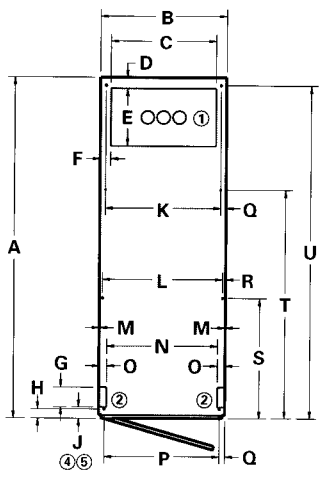



**End View of Aisle-Less Outdoor Switchgear**
(Non Walk-In)
Type OGM38

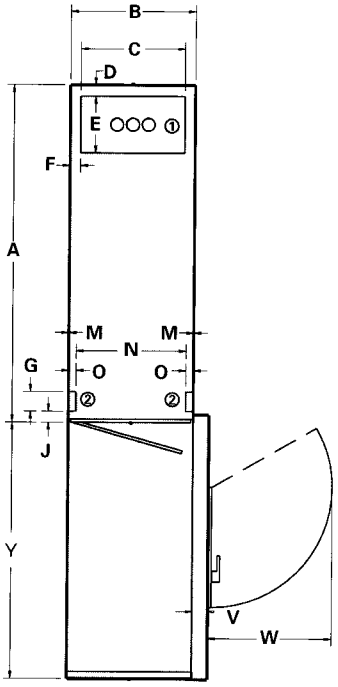



**End View of Common Aisle Switchgear**
Type SGM38

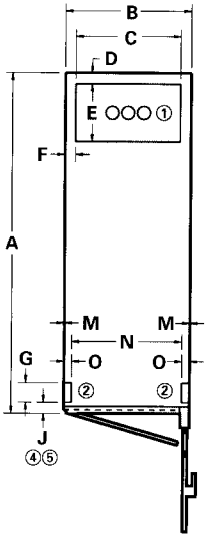
# Floor Plans




**Indoor GM38 Switchgear**

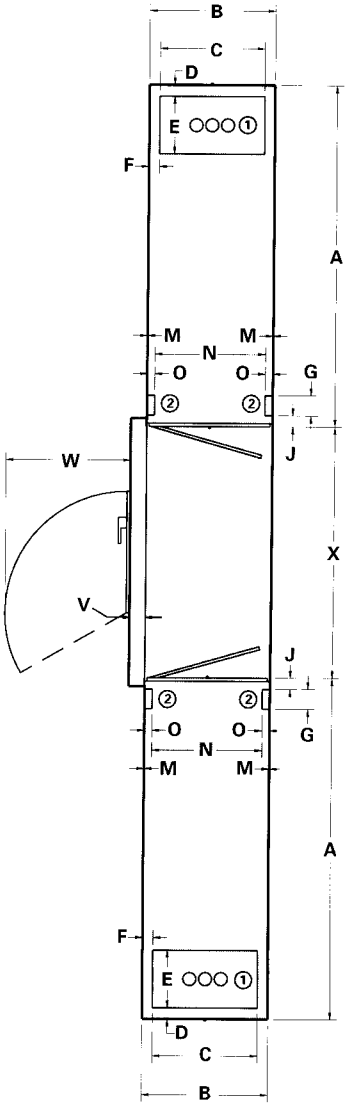



**Outdoor SGM38 Shelter-Clad Walk-In Single Aisle Switchgear**




**Outdoor OGM38 Non Walk-In Switchgear**

① Recommended location of conduits for power cables, top or bottom.
② Recommended location of secondary leads, top or bottom.
③ Customer conduit not to extend more than 1 in. (25 mm) above floor line.
④ Allow 6 in. (152 mm) clearance for lift truck on each end.
⑤ Floor must be level 80 in. (2032 mm) in front of switchgear to allow proper operation of lift truck.

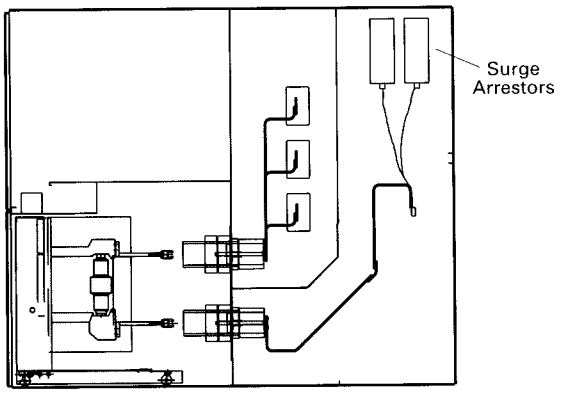



**Outdoor SGM38 Shelter-Clad Walk-In Common-Aisle Switchgear**

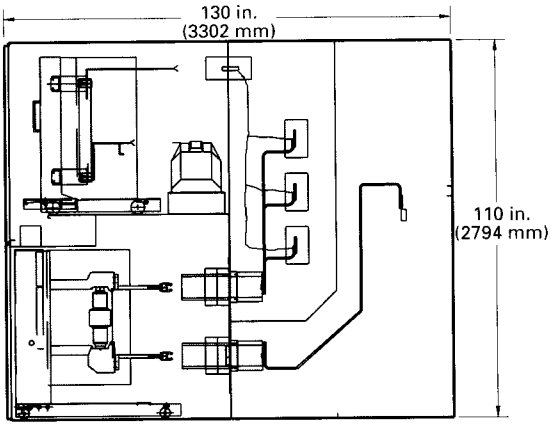
**Table 8 — 38kV Switchgear Floor Plan Detail**
**Dimensions in inches (mm)**

| A | B | C | D | E | F | G | H | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 130.0 (3302) | 48.0 (1219) | 40.0 (1016) | 4.25 (108) | 22.0 (559) | 4.0 (102) | 7.5 (191) | 3.5 (89) | 4.25 (108) | 43.75 (1111) | 45.88 (1165) | 0.12 (3) | 43.12 (1095) | 2.82 (72) | 43.75 (1111) | 2.13 (54) | 1.16 (29) | 45.84 (1164) | 87.06 (2211) | 126.91 (3224) | 6.0 (152) | 47.5 (1207) | 96.0 (2438) | 99.0 (2515) |

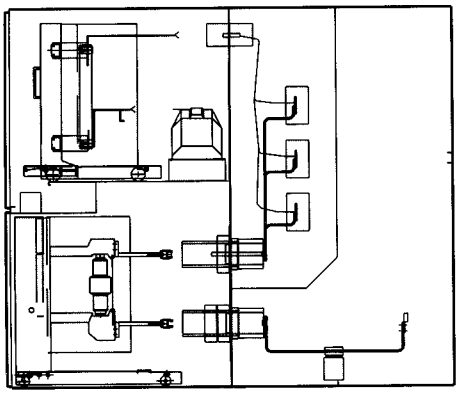
# Side Views — 1200, 2000, 3000A Breakers / Auxiliary



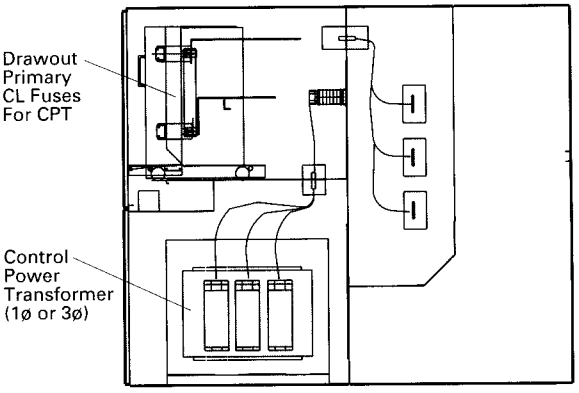

**Auxiliary / 1200A-3000A Breaker**
(No drawout auxiliaries in upper cell for 3000A breaker)



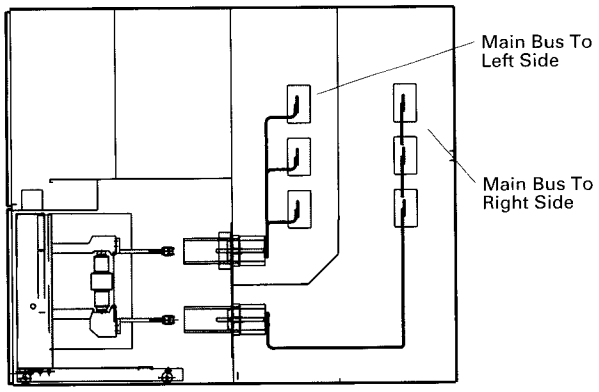

**VT Auxiliary / 1200A or 2000A Breaker**
(Downfeed Cables)



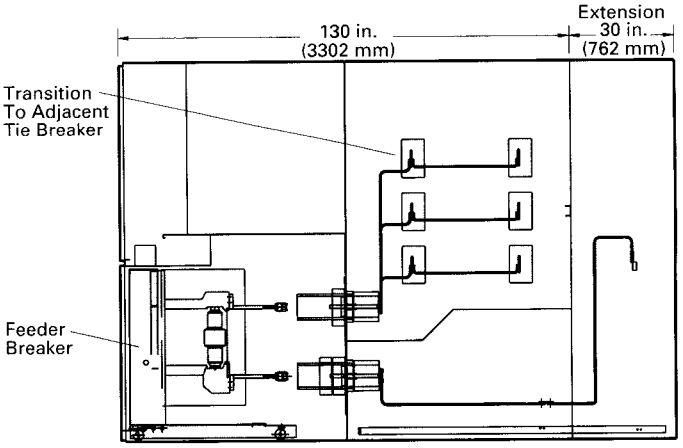
**Auxiliary / 1200A or 2000A Breaker**
(Upfeed Cables)




**CPT Fuse Truck / Stationary 3Ø CPT**




**Auxiliary / Bus Tie Breaker**




**Auxiliary / Feeder Breaker**
(Adjacent to right side of tie breaker section)

# Guide Form Specifications

**Typical Metal-Clad Switchgear Specification**

Note: This specification form requires information to be supplied by the purchaser. Those items preceded by ☐ check box are alternates or are optional. These items preceded by a ___ require a quantity or data to be added.

**General Description of Switchgear — Sections and Rating**

The equipment outlined in this specification shall consist of ☐ indoor ☐ non-walk-in outdoor ☐ Shelter-Clad Single-Aisle ☐ Shelter-Clad Common Aisle outdoor Metal-Clad switchgear with horizontal drawout, vacuum circuit breakers. General construction features shall be of a coordinated design so that shipping groups are easily connected together in the field into a continuous lineup. Necessary standard connecting materials shall be furnished. Shipping groups ordinarily will not exceed 16 ft. (4870 mm) in length.

The general arrangement and single diagram of the equipment shall be as indicated on Sketch Number ___ dated ___.

**Codes and Standards**

The equipment covered in this specification, except a noted, shall 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 Electric Manufacturers Association |

**Service**

The switchgear sections shall be 38kV class, with a maximum design voltage of 38kV. This equipment shall operate on a service voltage of ___ volts, 3 phase, 3 wire, 60 hertz.

**Insulation Levels**

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

| | |
|---|---|
| Maximum Design Voltage | 38kV |
| Insulation Test, (60 Hertz) | 80kV |
| Full-wave Impulse Test (BIL) | 150kV |

**Dimensions**

Approximate dimensions of the switchgear shall be as shown on the sketch included with this specification. The circuit breakers shall be removable from the control panel side. An aisle space of 96 in. (2438 mm) is recommended to permit withdrawal of the circuit breaker element.

**Circuit Breakers**

The vacuum circuit breakers shall be:

| | |
|---|---|
| Nominal Voltage class | 38kV |
| Rated Maximum Voltage | 38kV |
| Rated Continuous Current | ___A |
| Rated Short Circuit Current at Maximum Voltage | ___ |
| Rated Interrupting Time | 5 cycles |
| Maximum Symmetrical Interrupting Capability | ___ |
| Short-Time (3 Sec.) Current Carrying Capability | ___ |
| Closing and Latching Capability (Peak) | ___kA___ |

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

Circuit breakers shall be able to be racked from one position to another with the compartment door closed. There shall be three distinct positions, connected, test, and disconnect.

The circuit breakers shall be equipped with a stored energy operator. The control voltages shall be:

Spring Charging Motor:
☐48 ☐125 ☐250 volts DC
☐120 ☐240 volts AC
Spring Release (Close) Coil:
☐48 ☐125 ☐250 volts DC
☐120 ☐240 volts AC
Trip Coil:
☐48 ☐125 ☐250 volts DC
☐120 ☐240 volts AC capacitor trip

The source of control power shall 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 shall be standard switchboard type for mounting on the steel panels. All meters and relays, if provided as standard, shall be of the drawout type with built-in test devices. Indicating and recording instruments, meters and relays shall be of the rectangular type, semi-flush mounted.

**Control and Instrument Switches**

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

**Basic Structure**

The switchgear assembly shall consist of one or more vertical sections, each of which shall have a main bus compartment and two vertically stacked equipment cells. The cells shall be arranged for circuit breakers or auxiliary devices or shall be blank as indicated in the detailed specification. It shall be possible to locate voltage transformers with their associated fuses in the same section as a circuit breaker.

Each main bus compartment shall contain a set of ☐1200 ☐2000 ☐3000 ampere copper (silver plated at electrical connection points), 3 wire insulated main bus and connections.

Each circuit breaker cell shall contain a manually operated screw type drawout racking mechanism, circuit breaker operated automatic shutters and safety interlocks and shall also include:

a. Hinged front panel (blank).
b. Primary and secondary disconnecting devices.
c. Control circuit cutout device.
d. Necessary terminal blocks, small wiring and control buses, where required.
e. Engraved nameplate, as required.

Each auxiliary cell shall include:

a. Hinged front panel, suitable for relays and instruments.
b. Necessary terminal blocks, small wiring and control buses, where required.
c. Engraved nameplate, as required.

**High Durability Finish**

The framework and the panels shall be chemically cleaned, hot phosphate treated, and rinsed, and shall be given an electrostatically applied coat of ANSI No. 61 polyester urethane paint.

# Guide Form Specifications

**Production Tests**
All switchgear assemblies and circuit breakers shall be inspected and tested as part of the regular manufacturing procedure. The tests and inspections shall conform to ANSI C37.20.2-1987 clause 5.3 for Metal-Clad Switchgear Assemblies and ANSI C37.09-1979, clause 5 for AC High-Voltage Circuit Breakers.

**Weatherproof Housing** (Select one weatherproof enclosure design):

- Shelter-Clad Single Aisle Design
- Shelter-Clad Common Aisle Design
- Non-Walk-In Outdoor Design.

**Shelter-Clad Design—Single Aisle**
The Shelter-Clad Single Aisle Switchgear shall consist of indoor type circuit breaker and auxiliary cells 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 shall 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 shall have adequate incandescent lighting receptacles which shall be controlled by means of a three-way switch at each access door.

Included in the switchgear shall be the following:

a. One (1) space heater, 240 volts AC in each cell and cable compartment.
b. Two (2) utility duplex receptacles with integral ground fault protection, one at each aisle access door, for electric tools, extension cords, etc.

The switchgear shall be shipped in convenient groups for erection in the field, and shipping groups ordinarily shall not exceed sixteen (16) feet (4870 mm) in length.

The weatherproof enclosure for the aisleway shall be shipped in sections for erection in the field. The front wall of the aisle shall be shipped attached to the front of the cubicle assembly for ease of handling. Necessary erection hardware will be furnished.

**Shelter-Clad Design — Common Aisle**
The Shelter-Clad Common Aisle Switchgear shall consist of two (2) lineups of indoor type circuit breaker and auxiliary sections 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 shall 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 shall have adequate incandescent lighting receptacles which will be controlled by means of a three-way switch at each access door.

Included in the switchgear shall be the following items:

a. One (1) space heater, 240 volts AC in each cell and cable compartment.
b. Two (2) utility duplex receptacles with integral ground fault protection, one at each aisle access door, for electric tools, extension cords, etc.

The switchgear shall be shipped in convenient groups for erection in the field, and shipping groups ordinarily shall not exceed sixteen (16) feet (4870 mm) in length.

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

**Non-Walk-in Outdoor Design**
The Non-Walk-in Switchgear shall consist of indoor circuit breaker and auxiliary sections located in a steel housing of non-walk-in weatherproof construction. Each section shall be equipped with a hinged front door with provision for padlocking. Each auxiliary cell is also equipped with an inner hinged front door for mounting relays and instruments.

The following equipment shall be furnished within each section:

a. One (1) lamp receptacle with on-off switch for interior illumination.
b. One (1) utility duplex receptacle with integral ground fault protection, for electric tools, etc.
c. One (1) space heater, 240 volts AC in each cell and cable compartment.

A switch for all the space heaters is located in one cell.

The switchgear shall be shipped in convenient groups for erection in the field, and shipping groups will not exceed sixteen (16) feet (4870 mm) in length. Necessary erection hardware will be furnished.

## Detailed Specifications

The group of ☐ indoor ☐ outdoor switchgear shall include:

1 Set ___ ampere, 3 phase, main bus.
1 Ground bus.

The circuit breaker cells and auxiliary cells shall be as specified in the following paragraphs:

☐ **Incoming Line** ☐ Feeder ☐ Future Feeder Circuit Breaker Cell(s)
___ Section(s) Number ☐. Each ☐ this cell shall contain the following:

1 ☐ Provision only for future vacuum circuit breaker ☐ vacuum circuit breaker, rated ___ amperes, type ___.
1 Mechanism operated cell (MOC) auxiliary switch, ☐ 6 ☐ 12 ☐ 18 ☐ 24 stage.
1 Truck operated cell (TOC) switch, ☐ 4 ☐ 8 ☐ 12 stage.
___ Current transformer(s) single secondary, ___:5 ampere ratio, with ☐ single ratio ☐ multi-ratio primary.
___ Space heater, 240 volts AC.
___ Thermostat.

**Mounted in the cable termination area:**

___ Current transformer, zero sequence, 50:5 ampere ratio.
___ Set zinc-oxide surge arresters, ☐ station ☐ intermediate ☐ distribution type, ___ kV.
___ Set cable lugs, ___ per phase, ☐ crimp ☐ compression type, for ___ type cable, ___ size, ___kV for ☐ top ☐ bottom entry.
___ Set potheads, single conductor, for ___ type cable, ___ size, ___ kV, for ☐ top ☐ bottom entry.
___ Set of 3 roof bushings, rated ___ amperes, ___ kV.
___ Provision for connection to a bar type bus duct rated ___ amperes, ___ kV, at the top of the section.
___ Space heater, 240 volts AC.

# Guide Form Specifications

## Detailed Specifications, cont'd

**Mounted on the hinged front panel of the upper cell:**

___ Circuit breaker control switch, complete with one red and one green indicating light.
___ Indicating light, ☐amber ☐white ☐blue.
___ Digital instrument, multifunction, type 4300.
___ 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.
___ Transducer, ☐current ☐voltage ☐watt ☐var, ☐single ☐three phase.
___ Overcurrent relay(s) ☐time, device 51 ☐instantaneous, device 50 ☐time and instantaneous, device 50/51.
___ Ground overcurrent relay ☐time, device 51N ☐instantaneous, device 50N.
___ Directional relay(s), phase overcurrent, time, device 67.
___ Directional relay, ground overcurrent, time, device 67N.
___ Undervoltage and Phase sequence relay, device 47.
___ Undervoltage relay(s), device 27.
___ Overvoltage relay(s), device 59.
___ Differential relay(s), device 87.
___ Lockout relay, device 86.
___ Auxiliary relay, device No. ___.
___ Reclosing relay, with ☐one ☐three reclosure(s), ☐automatic ☐hand reset, device 79.
___ Reclosing relay cutout switch, device 79CO.
___ Test Block, ☐Current 6 pole ☐Potential 4 pole.

**Bus Sectionalizing / Tie Circuit Breaker Cell(s)**

_ Section(s) Number ___. ☐Each ☐this cell shall contain the following:

1 ☐Provision only for future vacuum circuit breaker ☐vacuum circuit breaker, rated ___ amperes, type ___.
1 Mechanism operated cell (MOC) auxiliary switch, ☐6 ☐12 ☐18 ☐24 stage.
1 Truck operated cell (TOC) switch, ☐4 ☐8 ☐12 stage.
___ Current transformer(s) single secondary, ___:5 ampere ratio, with ☐single ratio ☐multi-ratio primary.
___ Space heater, 240 volts AC.
___ Thermostat.
___ Set automatic transfer equipment for transferring secondary control (may be located in adjacent cell).

**Mounted in the cable termination area:**

1 Set of sectionalizing bus work for connection to each main bus. (If the adjacent section includes a circuit breaker, the adjacent section will have a 30 in. (762 mm) deep rear extension for cable terminations. This rear extension is shipped loose for field installation).
___ Set tie bus work for connection to a bar type bus duct rated ___ amperes, ___kV, at the top of the section.
___ Set tie cable lugs, ☐ per phase, crimp compression type, for type cable, ☐size, ☐kV for ☐top ☐bottom entry.
___ Space heater, 240 volts AC.

**Mounted on the hinged front panel of the upper cell:**

___ Circuit breaker control switch, complete with one red and one green indicating light.
___ Indicating light, ☐amber ☐white ☐blue.
___ Ammeter, single phase, ☐indicating ☐recording 0-___ ampere scale.
___ Ammeter transfer switch, 3 phase.
___ Overcurrent relay(s) ☐time, device 51 ☐instantaneous, device 50 ☐time and instantaneous, device 50/51.
___ Ground overcurrent relay ☐time, device 51N ☐instantaneous, device 50N.
___ Bus differential relays, device 87B.
___ Lockout relay, device 86.

**Auxiliary Cell(s)**

☐ Section(s) Number ___. ☐Each ☐this cell shall contain the following:

___ Voltage transformer(s), stationary mounted, ___ volt ratio, complete with drawout mounted primary current limiting fuses. (May be located in upper or lower cell).
___ Control power transformer, stationary mounted, ___ kVA, single phase 60 Hertz, dry type, -120/240 volt ratio, complete with drawout mounted primary current limiting fuses. (Drawout primary fuses may be located in the upper cell of a vertical section, with the stationary mounted control power transformer located in the lower front cell of the same vertical section. Alternatively, the drawout primary fuses may be located in the lower front cell, with the stationary mounted control power transformer located in the rear of the vertical section.)
___ Control power transformer, stationary mounted, ___ kVA, three phase 60 Hertz, dry type, ___ -120/208 volt ratio, complete with drawout mounted primary current limiting fuses. (Drawout primary fuses may be located in the upper cell of a vertical section, with the stationary mounted control power transformer located in the lower front cell of the same vertical section. Alternatively, the drawout primary fuses may be located in the lower front cell, with the stationary mounted control power transformer located in the rear of the vertical section.)
___ Battery, ___ volt, ☐lead acid ☐nickel-cadmium type, ___ cells, with a maximum discharge rate of ___ amperes for one minute to ___ volts per cell, complete with rack and standard accessories. (May be located only in lower cell).
___ Battery charger, static type, ☐with ☐without, voltage regulation, complete with ammeter, voltmeter, and/or rheostat, suitable for use with the above battery. (Requires an auxiliary cell which does not have VT's, CPT, or drawout fuses).
___ Space heater, 240 volts AC.
___ Thermostat.

**Accessories:**

The following accessories shall be supplied, but not housed:

1 Manual breaker and fuse truck racking crank
1 Lift sling (for fuse trucks in upper cell, or breakers if not at floor level)
1 Manual spring charging lever
1 Tube contact lubricant
1 Container touch-up paint

The following optional accessories shall also be supplied.

1 Split plug jumper
1 Test cabinet
1 Test plug, for drawout relays and watthour meters
1 Lift truck (for fuse trucks in upper cell, or breakers if not at floor level)
1 Fifth wheel
1 Maintenance slow close lever
1 Electric circuit breaker racking motor assembly
1 Spare Circuit Breaker(s) type 38-3AF-___ , rated ___ amperes
1 Ground and test device, manually operated
1 Ground and test device, electrically operated

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