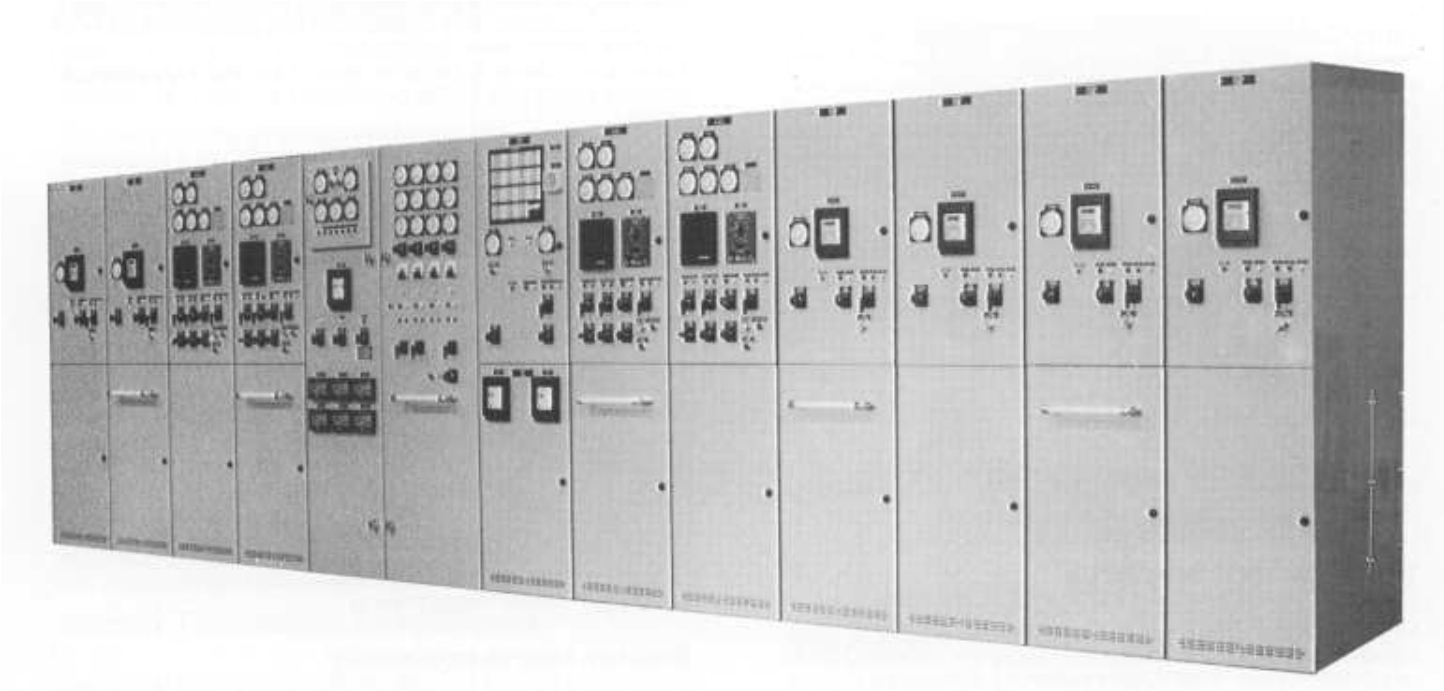
Medium Voltage Metal-Clad Switchgear Type MC

Type MC Metal-Clad Switchgear



Introduction

The increasing use of higher voltages for electrical distribution and application in both industrial and commercial applications places additional requirements on the switchgear which is installed in these facilities. M&I Electric Industries, Inc. offers a wide variety of modern medium voltage metal clad switchgear which has been carefully designed and manufactured to meet the varied requirements of most purchasers and users.

Global changes in the business environment mandate that industrial and commercial facilities become both safer and more reliable than they already are, and that expansions and modifications to the switchgear in these facilities be performed in less time, and on increasingly tight budgets.

To meet all of these requirements, M&I offers type MC switchgear. This modern equipment is available in all industry standard ratings to meet the vast majority of applications. Additionally, a variety of special ratings are available to meet virtually any applications.

In addition to supplying new switchgear for new construction or expansion projects, M&I has the experience and the technical qualifications needed to assist in a variety of switchgear expansion, modernization, extension, and upgrade projects. Whether a particular project requires new switchgear to match and line up with existing apparatus, or simply requires modern circuit breaker elements to replace aging air-magnetic breaker, type MC switchgear is available to meet the project requirements.

M&I is uniquely positioned to design, manufacture, install, test, and maintain a wide variety of electrical apparatus and systems, including medium voltage switchgear and its associated protection, monitoring, and control equipment. M&I can therefore become the ideal partner to organizations which purchase or utilize this type of equipment.

Overview

M&I medium voltage power switchgear is designed to fully incorporate the latest developments in medium voltage circuit breaker technology. Most applications allow two circuit breakers to be stacked in a single vertical section, allowing significant space savings when compared with older switchgear.

M&I type MC switchgear meets or exceeds the latest requirements of ANSI, IEEE, and NEMA standards.

Type MC switchgear can often be constructed to comply with major international standards such as ISO. IEC, and DIN.

Type MC Metal-Clad Switchgear

Contact the M&I factory for further information on compliance with international standards.

Type MC switchgear is ideal for applications in process plants, manufacturing plants, commercial buildings, electric utility systems, cogenerations installations, and other electrical systems. It is suitable for the protection of any medium voltage power circuit, and is commonly used to control and protect transformers, motors, generators, capacitors, buses, and distribution feeder lines.

M&I medium voltage switchgear incorporates features designed to provide personnel and equipment safety, while simplifying maintenance, and minimizing installation cost.

The switchgear cubicle structure and circuit breakers employ an integral design with coordinated dielectric, thermal, and interruption integrity.

Floor rollout convenience is available for circuit breakers located in the lower cell.

Tested to ANSI Standards

M&I switchgear is tested to meet the requirements of ANSI standards. A complete design test program, including short circuit interruption, load current switching, continuous current, mechanical endurance, close and latch current, short time and momentary withstand, impulse withstand, and the other tests required by the standards has been successfully completed. Certified test data can be furnished to customers upon request. These tests encompass the complete equipment design, including both the switchgear structure and the removable circuit breaker element.

Production tests are performed on every group of switchgear and on each circuit breaker, as required by ANSI standards.

Switchgear Structure

M&I compact metal-clad switchgear offers flexibility in locating the various elements of the apparatus, including the circuit breaker, auxiliary, and metering cells, within the structure layout. Circuit breakers may be located in either upper or lower cell positions, up to the maximum main bus self-cooled limit of the equipment (approximately 4,000 Amperes). Bus sectionalizing (tie) circuit breaker cells may be located on the upper or lower level, but must usually be located next to an auxiliary cell on same level to accommodate the transition bus work. All 3000 ampere circuit breakers are located on the bottom level of a cubicle with an upper cell that can be used for metering.

Each vertical section may contain a main bus bar compartment and two cells for auxiliary devices and/or circuit breakers, including primary and secondary disconnects, instrument transformers, instruments and relays, secondary wiring and other components, as necessary. Type MC switchgear is designed so that additional vertical sections may be readily added in the future.

Enclosure Design

The design of M&I type MC switchgear incorporates maximum compartmentation. This means the complete enclosure of all live parts and positive segregation of primary circuits to retard the spread of faults to other sections of the apparatus. Hinged doors or removable plates permit easy access to all compartments.

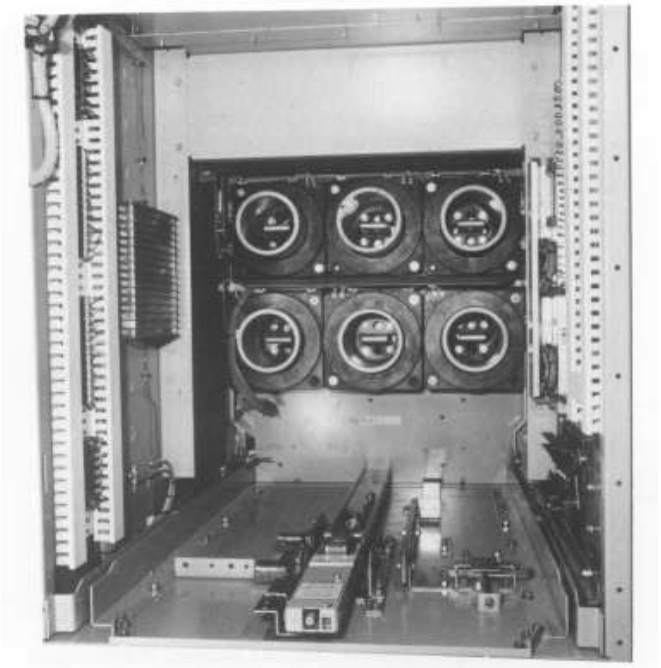
All metal barriers are suitably grounded. Steel barriers extend the full height and depth of each vertical section for isolating adjacent sections. Each cubicle is equipped with a continuous copper ground bus which extends throughout the entire switchgear lineup.

Circuit Breaker Cell

Type MC switchgear employs a reinforced sheet steel cell enclosure with provisions for the appropriate circuit breaker, including (but not limited to); a hinged front door, intercompartment and inter-unit barriers, stationary primary disconnects, circuit breaker racking mechanism, circuit breaker interlocking devices, primary shutter mechanism, drawout guide rails where required, and secondary control circuit connectors. Provisions are provided for instruments and relays, control wiring, terminal blocks, current transformers, and secondary control circuit cutouts.

Breaker Interchangeability

M&I type MC switchgear cubicles and removable circuit breaker elements are built using modern construction aids so



Typical Cell—Note: Shutters and barriers removed

circuit breakers of the same ratings are interchangeable with each other. This use of assembly aids or fixtures assures interchangeability of circuit breakers, even in a cell supplied as "provisions only" several years earlier.

Auxiliary Cell

An auxiliary cell is an enclosure of sheet steel similar to a circuit breaker cell except without provisions for a circuit breaker. Space may be used for voltage and control power transformers and fuses, batteries, chargers, and other auxiliary devices.

Bus Compartment

The main bus compartment is a separate enclosed space for three-phase insulated main power bus bars, supports, and connections to circuit breaker cells.

Cable Entrance Compartment

The cable entrance compartment is an enclosed space for connecting incoming or outgoing power cables, bus duct connections, transformer connections, or surge protection devices.

Primary Termination Compartment

The primary termination compartment is located at the rear of the switchgear and is separated from all other compartments by metal barriers. When two circuit breakers are located in the same vertical section, their primary cables are separated by metal horizontal barriers and by an enclosed vertical cable trough (or chimney) when both sets of cables exit on the same direction. Upper and lower bolted rear access cover plates are standard, and provide separate access to the cable area for each breaker. As an option, hinged rear access doors can be installed in place of the bolted access covers.

Bus Bar System

The main bus bar system is enclosed by grounded metal barriers and can feed both the upper and lower cells in a vertical section.

Full rounded-edge silver-plated copper bus bars are standard. High strength Grade 5 steel hardware assures constant pressure and low resistance connections. Split lock washers are provided as a standard, with spring washers available as an option. A copper ground bus is standard in all cubicles.

Bus bars have flame retardant, track resistant insulation. Bolted bus joints are insulated by performed molded vinyl boots which are held in place by nylon hardware.

Ground Bus

A continuous copper ground bus is incorporated in all cubicles to properly ground the equipment after installation. The ground bus bar extends through the switchgear and is accessible at each end of the lineup and in the primary cable area of each of the cubicles.

Main Bus—Note: Barriers removed for photo

Insulation

Track-resistant, flame retardant glass polyester insulation 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 insulation with high dielectric strength and low moisture absorption characteristics.

Optional Porcelain Insulation

Electrical grade porcelain is an available option on all 5 kV, 7.2 kV and 15 kV switchgear for inserts on main bus bar inter-unit supports and stationary primary disconnects bushings in circuit breaker cells.

Cell Construction Features

Circuit Breaker Element

M&I type MC switchgear employs proven vacuum circuit breaker elements with motor wound spring operated stored energy operating mechanisms, primary and secondary disconnects, auxiliary switches, ground contact, control wiring, and safety interlocks.

Racking Mechanism

The circuit breaker racking mechanism provides for controlled and smooth movement of the circuit breaker from the disconnected position to the test and connected positions within the cell.

Interlocks

The racking mechanism is designed to protect operations personnel from harm and the equipment from possible damage. An interlock prevents moving the breaker from one position to another if the breaker is closed, Additional interlocks maintain the breaker mechanically trip-free between positions, and discharge the stored energy mechanism, as required. Padlock provisions are included to restrict unauthorized movement or operation of the circuit breaker.

Automatic Shutters

Automatically operated grounded steel shutters are included to allow or block access to the stationary primary disconnects. The shutters are opened by the circuit breaker racking mechanism, as the breaker moves toward the connected position. As the circuit breaker is racked away from the connected position, access to the primary disconnects is blocked by the shutters.

Current Transformers

Current transformers may be mounted around both the upper and lower stationary primary disconnect bushings. The actual number of current transformers per phase in each circuit breaker cell is a function of the application, and is dependent upon the ratings and characteristics of the current transformers.

Mechanism Operated Cell (MOC) Switch

When required, a mechanism operated cell switch (MOC) can be mounted in the circuit breaker cell. This device provides control contacts to indicate the position of the circuit breaker within the cell.

Truck Operated Cell (TOC) Switch

When required, a truck operated cell switch (TOC) can be mounted in the circuit breaker cell. This device provides control contacts to indicate the position of the circuit breaker within the cell.

Secondary Control Devices

Each circuit breaker or upper auxiliary cell incorporates its own secondary control devices. The design of type MC switchgear provides space which can accommodate fused knife switches, pullout fuse holders, or molded case circuit breakers to suit the protective practices of the customer, and can also accommodate light duty auxiliary relays or similar control devices.

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 at the top or bottom of a vertical section. The front door panels may be used to mount meters, relays, or other instrumentation. The cubicle portion of the cell may be used for mounting devices such as voltage transformers, control power transformers, automatic transfer switches, battery chargers, and batteries. Rollout trays or trunnion assemblies may also be included for mounting voltage transformers and control power transformers.

Voltage Transformers

Up to three voltage transformers with integrally mounted current limiting fuses may be mounted on each rollout tray or trunnion assembly. The rollout tray or trunnion is moved to the disconnect position, the primary fuses are automatically disconnected and grounded to remove any static charge from the windings.

One single phase control power transformer with its primary current limiting fuses and secondary breaker may be mounted on the rollout tray or trunnion of an auxiliary cell. The secondary molded case breaker is interlocked with the primary rollout tray or trunnion to assure that the secondary breaker must be open before the control power transformer primary can be disconnected or connected, This prevent accidental load current interruption on the main primary contacts. With the secondary breaker open and the latch released, the rollout try or trunnion can be rolled easily to the disconnect position. After the transformer is disconnected from the main bus, and before the rollout tray or trunnion is opened, the primary fuses are automatically grounded to remove any static charge.

Large single phase and all three phase control power transformers are stationary mounted on the cubicle floor or base in the rear of the vertical section. The primary fuses for these large transformers are mounted on a rollout tray or trunnion in the lower portion of the bottom auxiliary cell, and are interlocked with the secondary breaker.

Outdoor Housing

General

Three principal types of outdoor housing (non-walk-in, walk-in, and power house) are available to meet almost any application.

For all types of outdoor construction, the underside of the base is coated with a coal tar emulsion (or equivalent). The switchgear is shipped in convenient groups for erection in the field. Shipping groups normally do not exceed 15 feet in length. All necessary erection hardware is furnished.

Non-Walk-In Design

The non-walk-in switchgear consists on indoor type breaker and auxiliary cubicles located in a steel housing of aisless non-walk-in weatherproof construction. Each vertical section has a full height exterior front door with three point vault type hardware and provisions for padlocking. Each cell is also equipped with an inner hinged front door for mounting relays, instrumentation, and control switches. Two removable rear panels or optional hinged doors 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 the space heaters is located in one cubicle.

Walk-In Design

Single Aisle

M&I single aisle outdoor walk-in switchgear consists of indoor type circuit breaker and auxiliary cubicles located in a weather-proof 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 locked from the outside. The aisle space is provided with 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.

Common Aisle

Common aisle outdoor walk-in switchgear consists of two lineups of indoor type circuit breaker and auxiliary units located in a weather proof 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.

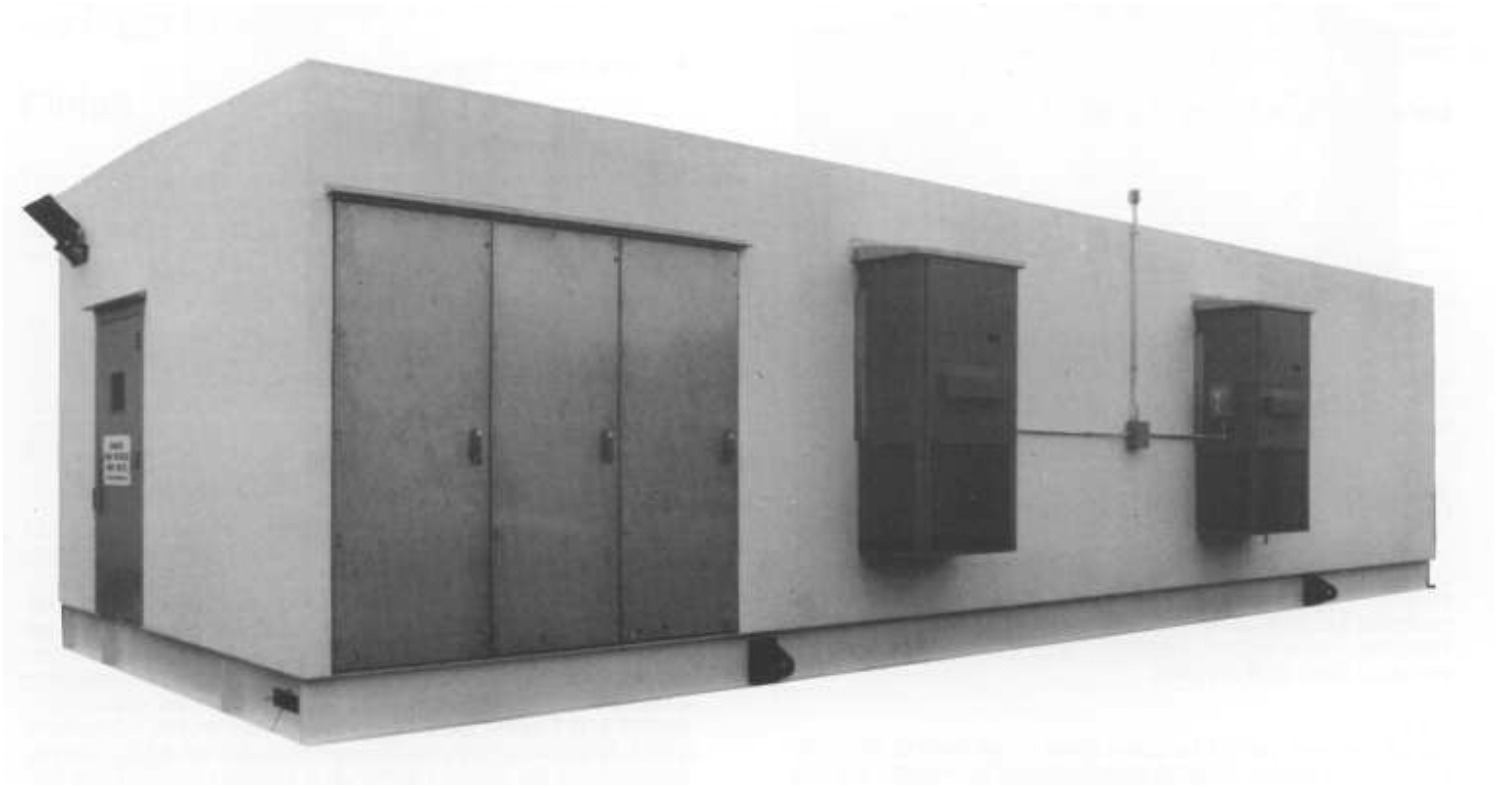
Power Houses

M&I can offer a wide variety of power house designs and construction techniques, each of which is carefully tailored to the customer's application. In addition to type MC metal clad switchgear, all other types of medium and low voltage electrical power distribution apparatus and control equipment can be factory installed, wired, and fully factory tested in a virtually limitless number of schemes and arrangements.

As noted above, M&I power houses can be built using a variety of construction materials and techniques. Houses may be built using interlocking panels fabricated from galvanized steel, aluminum, and even stainless steel. Power houses may also be of the seal-welded type, again using a variety of ferrous or non-ferrous wall skin materials. Finally, power houses may be constructed with non-metallic wall systems, such as fiberglass.

Power houses are typically supplied with fluorescent and/or incandescent lighting systems designed to facilitate equipment operation and maintenance, convenience outlets for maintenance and test procedures, and emergency lighting systems.

M&I power houses are typically supplied with coordinated heating, ventilating, and air conditioning systems which are designed to both extend the life and reliability of the equipment installed in the power house and to provide a comfortable environment for operations and maintenance personnel.



Type MC Metal-Clad Switchgear

A broad selection of special constructions and accessories are available upon request, including pressurization systems to allow power houses to be installed in Class I, Division 2 areas, and CO2 or Halon fire protection systems.

Control System

Wiring

All secondary and control wiring is connected to terminal blocks. One side of the terminal blocks for all connections leaving the switchgear is reserved for external connections. Terminal block numbering strips are provided to identify each point, and several styles of wire tagging systems are also available as options.

Secondary and control wire is No. 14 AWG, extra-flexible, standard wire, insulated for 600 volts, and rated for a minimum of 90 degrees C. Insulated barrel, crimp-type 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.

Current Transformers

Torroidal current transformers are manufactured to ANSI and NEMA standards for mounting at the rear of the circuit breaker cell.

Wound type current transformers may be used in applications where lower ratios are required. They are mounted on the load side in the rear cable compartment.

Metering and Relay Panels

All instruments, meters, and relays are switchboard type for mounting on flanged steel panels. Conventional semi-flush mounted cases with dull black covers are normally used. All meters and protective relays, if available as standard, (and not otherwise specified by the contract) are of the draw-out type with built-in test devices.

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.

Control and Instrument Switches

Control switches are of the switchboard type with rotary construction and have black handles. Circuit breaker control switches have pistol-grip handles, while instrument transfer switches have round handles, and auxiliary or transfer switches have oval handles.

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.

Power Monitor and Control Systems

M&I type MC switchgear can be supplied with a variety of modern electronic power monitoring and/or control systems. These systems allow real-time central monitoring of operating conditions and event recording. Additionally, complete remote control of the switchgear is possible. These systems may be readily incorporated into existing DCS and other computer-based control schemes, or they can form the basis for a central data collection and control system.

Accessories

Standard Accessories:

- Manual racking crank
- Manual spring charging lever
- Drawout extension rails (to facilitate handling of circuit breakers in the upper cell)
- Contact lubricant
- Touch-up paint

Partial list of optional accessories:

- Circuit breaker lift truck
- Secondary control jumper
- Test cabinet
- Test plugs (for drawout relays and watt-hour meters)
- Electric racking motor assembly
- Ground and Test devices

Test Provisions

Test provisions, either a secondary control jumper or a test cabinet, are unavailable for testing the circuit breaker outside of its cell. The secondary control jumper is used to connect the circuit breaker to the secondary disconnects in the cell 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 thus provides a means to access the primary disconnect stabs 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. Both 3 stud and 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. One device allows grounding of the upper set of disconnect stabs, while a second device allows grounding of the lower set of disconnect stabs. Both devices are able to close and latch against short circuit currents corresponding to the ratings of the equipment. Due to the unique requirements frequently involved in such devices, all applications of electrically operated ground test devices should be referred to the factory for review.

DUE TO THE SPECIAL NATURE OF GROUND AND TEST DEVICES, IT IS IMPORTANT THAT EACH USER DEVELOP OPERATING PROCEDURES MANDATING SAFE PRACTICES. ONLY SPECIALLY TRAINED PERSONNEL SHOULD BE ALLOWED TO USE GROUND AND TEST DEVICES.

Finish

The exterior panels and formed structural elements (except extruded structural shapes) of all outdoor equipment are fabricated from zinc plated steel sheets (Galvaneal or equivalent).

All unplated steel parts are degreased and exposed to a phosphate chemical treatment followed by a sealing solution. The phosphate bath effects a chemical conversion of the metallic surface to a non-metallic phosphate coating. Insoluble in water, this coating is effective in retarding corrosion and is an excellent undercoating for paint.

After cleaning and stabilization, primer and polyester urethane paint is applied to each part. Standard finish colors are:

Indoor — Light Gray (ANSI 61)

Outdoor — Dark Gray (ANSI 24) or
Sky Gray (ANSI 70), as specified.

The underside of outdoor equipment is coated with a heavy coal tar emulsion (or equivalent) for added corrosion resistance.

Circuit Breakers

M&I type MC switchgear employs circuit breakers which perform arc interruption in a vacuum. The circuit breakers are available in 250 through 1000 MVA nominal interrupting ratings and 1200 through 3000 amperes self-cooled ratings. Special (forced air cooled) breakers with higher continuous current carrying capability are available for special applications - contact the M&I factory for details.

The horizontal drawout design of M&I type MC switchgear assures ease of maintenance, and incorporates separate disconnect, test, and operating positions.

These circuit breakers use an electric motor charged spring stored energy operator, which is mechanically and electrically trip free. The operator is designed to require minimum maintenance. The front mounted operator is easily accessible through a bolted cover, so that fittings or overturning the breaker is not required for maintenance.

Low Maintenance Requirements

The optimized combination of vacuum interrupters and the simplicity and reliability of the spring actuated stored energy operator results in long life with minimal maintenance. The interrupter is a sealed unit, and the only maintenance neces-

Typical Circuit Breaker

sary is to clean off any contaminants, and check the vacuum integrity.

Primary Disconnects

The primary disconnect finger clusters are mounted on the circuit breaker, where they are readily accessible for maintenance or inspection. The cubicle primary disconnect studs have a rounded leading edge, which contributes to smooth racking of the circuit breaker.

Secondary Disconnects

The secondary disconnects are an extremely rugged design, conveniently mounted for ease of inspection and minimum exposure to damage.

Electrically and Mechanically Trip Free

The operating advantages of a mechanically and electrically trip-free operating mechanism are included on these circuit breakers. This is because the tripping mechanism can trip the circuit breaker even when a normal closing action is applied. The circuit breaker does not have to fully close before it can react to a trip requirement.

Stored Energy Operator

The stored energy operator used on M&I type MC switchgear vacuum circuit breakers has been designed for long life, high reliability, and ease of maintenance.

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 operation counter.

Mechanism Operation

The mechanism is arranged to store closing energy in the closing springs. The closing springs are selected so that they provide sufficient energy not only to close the circuit breaker safely into maximum "close and latch" currents, but also to simultaneously store the energy necessary to trip the circuit breaker. The springs can be manually charged during maintenance or in emergency conditions, but are normally charged automatically after each closing operation by the electrical charging motor.

Interlocks

The racking system is designed to maintain the circuit breaker in a mechanically trip-free condition at any time the circuit breaker is not in either the test or the connected position in the cell. The circuit breaker must be open before the circuit breaker can be moved. These interlocks are in addition to the padlock provisions incorporated for maintenance personnel use. The racking system can be padlocked to prevent unauthorized racking and to maintain the circuit breaker in the trip-free condition. This allows maintenance personnel to positively prohibit racking and/or closing of the circuit breaker.

Surge Limiters

Surge limiters are available for use in distribution systems to protect motors, transformers, and reactors from the effects of voltage surges associated with breaker operations. These limiters are not designed to protect equipment exposed to lightning surges, for which surge arrestors should be applied.

These surge limiters prevent the development of excessive over-voltages which can result from multiple re-ignitions of virtual chopping of the AC waveform. This is primarily of concern during the starting of motors and switching of reactive loads.

In general, if the impulse capability (BIL) of the protected equipment matches that of the switchgear, no protection is needed due to the surges produced by the opening of the vacuum breaker. Since dry type transformers and rotating machines are generally of lower BIL, surge protection may be necessary. Refer to the following table for minimum application recommendations for surge limiters.

Recommended Surge Limiter Application

Equipment (Load) Protected	Recommended Limiter
Liquid Transformers	No
Dry Type Transformers	Yes [1]
Standard BIL	No
5 kV 60 kV BIL	No
7 kV 95 kV BIL	No
15 kV 95 kV BIL	No
Motors	
Locked Rotor Amperes less than 600A	Yes [2]
Locked Rotor Amperes greater than 600A	No
Reactors	Yes
Capacitors	No

Notes: 1. Not required if equipped with surge arrestors or capacitors at transformer terminals

2. Not required if equipped with surge arrestors or capacitors at machine terminals

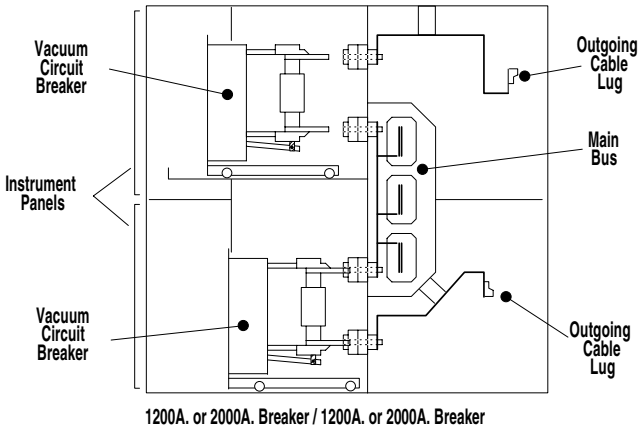
Section Arrangements

1200A Brkr.	1200A Brkr.	Aux.	1200A Brkr.	2000A Brkr.	2000A Brkr.	Aux.	2000A Brkr.	See Note 2	Aux.
1200A Brkr.	Aux.	1200A Brkr.	2000A Brkr.	1200A Brkr.	2000A Brkr.	2000A Brkr.	Aux.	3000A Brkr.	Aux.

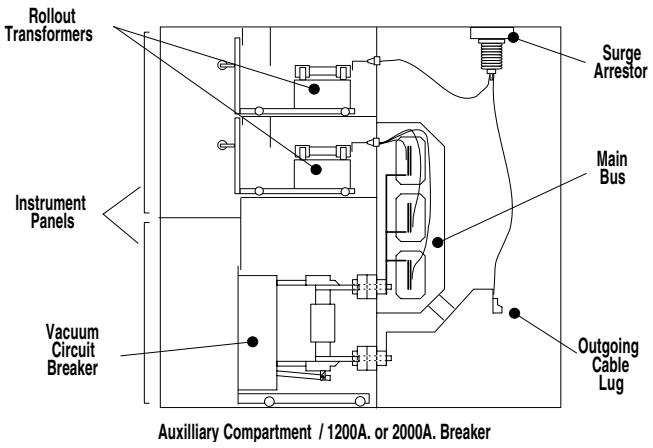
Notes:

1. Main bus sizes 1,200A., 2,000A., 3,000A., or 3,750A.
2. No rollout or trunnion accessories available in same section as 3,000A. Circuit breaker
3. Auxiliary cells may each contain up to two (2) rollout units.
4. Fuse rollout or trunnion for larger (stationary mounted) control power transformers must be located in lowest rollout position in lower auxiliary compartment.
5. Standard circuit breaker and auxiliary compartment arrangements are shown. Total circuit breaker loading in a vertical section can not exceed the main bus rating. Consult the M&I factory for assistance regarding total load limits for each section in a given application.

Cross - Section Arrangements



Dual Breaker Section



Section with Auxiliary Compartment

Type MC Metal-Clad Switchgear

Application Data

Identification		Rated Values								Rated Required Capabilities			
Nominal Voltage Class	Nominal 3-Phase MVA Class	Voltage		Insulation Level		Current				Current Values			
		Rated Max. Voltage [1]	Rated Voltage Range Factor	Rated Withstand Test Voltage		Rated Cont. Current [3]	Rated Short Circuit Current (at rated Max. kV) [4 & 5]	Rated Interrupting Time	Rated Permissible Tripping Delay	Rated Max. Voltage Divided By K	Max. Sym. Interrupting Capability [6]	Short Time (3 sec.) Current Carrying Capability	Close And Latch Capability (Momentary) [7]
				Low Frequency	Impulse						K Times Rated Short-Circuit Current KI		1.6 K Times Rated Short Circuit Current
kV Class	MVA Class	E kV RMS	K	kV RMS	kV Crest	Amperes	I kA RMS	Cycles	Sec.	E/K kV RMS	kA RMS	kA RMS	kA RMS
4.16	250	4.76	1.24	19	60	1,200 2,000 3,000	29	5	2	3.85	35	35	58 78
4.16	350	4.76	1.19	19	60	1,200 2,000 3,000	41	5	2	4.0	49	49	78
7.2	500	8.25	1.25	36	95	1,200 2,000 3,000	33	5	2	6.6	41	41	66
13.8	500	15	1.30	36	95	1,200 2,000 3,000	18	5	2	11.5	23	23	37 58
13.8	750	15	1.30	36	95	1,200 2,000 3,000	28	5	2	11.5	36	36	58 77
13.8	1,000	15	1.30	36	95	1,200 2,000 3,000	37	5	2	11.5	48	48	77

Symmetrical rating basis per ANSI

Notes:

1. Maximum voltage for which breaker is designed and the upper limit for operation.
2. 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.
3. 3,000 Ampere breakers available with fan cooled ratings of 3,750 Amperes.
4. To obtain the required symmetrical interrupting rating 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 Capacity = Rated Short Circuit Current x $\frac{\text{Rated Maximum Voltage}}{\text{Operating Voltage}}$

   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 short circuit current.
5. With the limitation 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.
6. Current values in this column are not to be exceeded even for operating voltage below 1/K times rated voltage. For voltages between rated maximum voltage and 1/K times rated maximum voltage, follow note 4 above.
7. Current values in this column are independent of operating voltage up to and including rated maximum voltage. Higher ratings are for optional non-standard breakers.

Type MC Metal-Clad Switchgear

SAMPLE SPECIFICATION

SCOPE

This specification covers the design, manufacture, testing and delivery of medium voltage metal-clad switchgear. The switchgear will be rated for operation at _____(5/15) kV. The breakers are to be of the draw-out design, and shall utilize vacuum interchangers.

VENDOR RESPONSIBILITIES

In addition to the Vendor's scope of supply specified in other sections, the Vendor shall provide the following:

The Vendor shall furnish and deliver the switchgear and auxiliary equipment F.O.B. destination, in accordance with this specification.

All major equipment specified hereunder shall be manufactured in the United States of America.

The switchgear manufacturer shall have at least ten years previous experience in the design and manufacture of 5/15 kV class metal-clad switchgear to ANSI standards. The circuit breaker ratings shall be in accordance with the latest issue of ANSI Standard C37.06, for indoor, oilless circuit breakers. The switchgear assembly shall be designed and rated in accordance with the latest issue of ANSI Standard C37.20 for metal-clad switchgear.

OWNER'S RESPONSIBILITY

Unloading and installation

Interconnecting control and power field wiring

Relay coordination, relay settings and short circuit study

REFERENCED DOCUMENTS

The metal-clad switchgear shall comply with the following standards:

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA S G 5-1975 Switchgear Assemblies

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI C37.06AC High-Voltage Circuit Breakers
- ANSI C37.20 Switchgear Assemblies
- ANSI C37.20 Metal-clad and Station Cubicle Switchgear

SERVICE CONDITIONS

The equipment shall be suitable for operation in an environment with a temperature range of _____F in winter to _____F in summer. The equipment shall operate in a relative humidity range of _____% to _____% (non condensing).

CONSTRUCTION

Indoor Applications

All equipment shall be constructed for indoor service. The switchgear cubicles shall be fabricated from cold rolled steel and formed steel members, reinforced as required to form a rigid self-supporting structure.

The rear of each circuit breaker enclosure shall include bolted panel(s)/hinged door(s) with padlocking provisions for gaining access to the cable termination area.

Suitable openings shall be provided in each cubicle for owner's power and control cables to enter from the top or bottom of the associated cubicle.

Each cubicle shall have edges formed by appropriate metal fabrication tooling. All exposed welded joints shall be ground smooth after welding.

Outdoor Applications

All equipment shall be constructed for outdoor service. The switchgear cubicles shall be fabricated from zinc coated cold rolled steel and formed steel members, reinforced as required to form a rigid self-supporting structure.

A weatherproof aisle shall be provided for each group of equipment large enough to permit interchange of drawout circuit breaker elements. A weatherproof door with panic hardware at each end of the aisle shall be provided. The aisle and switchgear will be shipped totally assembled in one piece on a common base to a maximum of 14" in depth.

The rear of each circuit breaker enclosure shall include one or more (as required) [select] bolted panels / hinged doors with padlocking provisions for gaining access to the cable termination area.

Suitable openings shall be provided in each cubicle for owner's power and control cables to enter from the bottom of the associated cubicle.

All cubicles shall be provided with electrical space heaters to prevent condensation of moisture within the switchgear.

Each cubicle shall have edges formed by appropriate metal fabrication tooling. All exposed welded joints shall be of the continuous (seal) type, and shall be ground smooth and dye penetrate tested after welding.

The bottom of the switchgear and aisle shall be covered with a coal tar or equivalent undercoating compound to prevent corrosion.

PAINTING

All weld splatter, loose scale, and similar rough spots shall be removed by power tool or abrasive blast cleaning in accordance with SSPC recommendations (Steel Structures Painting Council) to present an acceptable appearance and to provide a surface to promote adhesion and application of primer coat.

The surface shall be free of any foreign materials (grease, oil, tar, etc.). These materials shall be removed by solvent cleaning per SSPC. The surfaces shall then be cleaned by steam or immersion in a cleaning and degreasing solution and shall be treated with an approved phosphating compound containing an etching agent.

After the surface has been properly cleaned and prepared, the work shall be coated with a zinc-rich chromate primer to a minimum thickness of .5 mils.

After the primer coat has been applied and properly dried, the surface shall be sprayed with a combination of primer and polyester urethane top coat for a total finish thickness of 2.0-3.0 mils.

The bottom of the switchgear and aisle shall be covered with a coal or tar equivalent undercoating compound to prevent corrosion.

One quart of the exterior finishing paint per lineup shall be included for field touch up.

CIRCUIT BREAKER COMPARTMENT

Each cubicle containing a circuit breaker shall be provided with a mechanism which will control the movement of the breaker between the operating, test, and disconnected positions. The mechanism shall be self-aligning and the circuit breaker shall be rigidly held in the operating position without the necessity of locking bars or bolts.

The stationary primary disconnecting contacts shall be constructed of silver plated copper. Grounded metal safety shutters shall be provided to isolate all primary connections in the circuit breaker compartment when the breaker is withdrawn from the connected position.

CIRCUIT BREAKERS

The circuit breakers shall be rated at _____ (5/15) kV nominal, _____(1200, 2000, or 3,000) amperes continuous current carrying capacity, and _____ (250, 350, 750, 1,000) MVA interrupting capacity, as indicated on the contract drawings. The vacuum circuit breaker interrupter shall be 3-pole, and shall be mounted on a drawout truck assembly.

The circuit breakers shall be operated by a motor-charged, mechanically and electrically trip-free, stored-energy spring driven operating mechanism. Provisions shall be included for manual charging of the mechanism.

Interlocks shall be provided to prevent moving the breaker to or from the operating position unless the breaker's contacts are in the open position. The operating springs shall be discharged automatically when the breaker is moved from one position to another, to assure operator safety.

The Drawout Breaker shall be furnished with reliable, robust secondary control power contacts or connections.

BUS COMPARTMENT

The main bus shall be rated _____ (1200, 2000, or 3,000) amperes, as indicated on the contract drawings. Bus bars shall be high conductivity copper and shall have a continuous current rating, in accordance with ANSI standards of temperature rise and documented be design tests. Bus work shall be braced to withstand the magnetic stresses developed by currents equal to the main power circuit breaker close, carry and interrupt ratings.

All bus shall be fully silver plated. All bus joints shall be constructed with at least two bolts per joint, and shall be insulated with molded vinyl boots, affixed with nylon hardware. The bus shall be fully insulated throughout its entire length.

GROUND BUS

A continuous copper ground bus shall be furnished and secured to each unit. The ground bus shall extend the entire length of the switchgear and shall be equipped with a mechanical lug suitable for connecting the ground bus to the Owner's ground grid.

INSTRUMENT TRANSFORMERS

Current transformers shall have ratios in accordance with the contract drawings. The current transformers shall have a mechanical rating equal to the momentary rating of the circuit breakers and shall be insulated for the full voltage rating on the Switchgear.

Potential transformers shall meet ANSI standard accuracy ratings and shall include primary and secondary fusing. The potential transformers shall be mounted in a suitable disconnect mounting system, such as a drawout drawer or trunnion.

CONTROL WIRING

All control wiring shall be installed and tested at the factory unless otherwise specified. All electrical conductors shall be Class B stranded copper #14 AWG or larger. All current transformer secondary wiring shall be #12 AWG. Wiring shall have thermosetting insulation rated 600 volts, designed for a conductor temperature of 90 degrees C (minimum).

Terminal blocks shall be provided for conductors requiring connection to circuits external to the specified equipment, for internal circuits crossing shipping splits, and where equipment paints, replacement and maintenance will be facilitated.

All terminal blocks shall be rated 600 volts minimum and shall have terminals which do not damage the individual strands of the control wire.

Shorting type terminal blocks shall be supplied for all current transformer connections.

Not less than 20 percent spare unused terminals shall be provided.

Each terminal block, device, fuse block, and terminal shall be labeled to coincide with the identification shown on the drawings.

Sufficient clearance for field connections shall be provided for all leads. All leads for external circuit wiring shall be connected to grouped terminal blocks.

Splices will not be permitted in switchboard wiring.

DRAWINGS

Vendor drawings shall in sufficient detail to indicate the kind, size, arrangement, and weights of each major component, as well as the breakdown for shipping splits. Drawings shall also indicate the operation of component materials and devices, and the external connections, anchorages, and supports required for the switchgear. The drawings shall also indicate the installation, operating and maintenance clearance dimensions required.

Power diagrams and schematic diagrams shall be furnished in accordance with the functional requirements indicated on the Owner's one-line diagram.

The internal connection diagrams shall be drawn with all devices indicated in their relative physical locations.

EQUIPMENT SUBSTITUTION

The vendor shall indicate in their proposal the equipment (relay, switch, meter, transducer, etc.) included in the proposal.

The equipment being offered in the base bid shall be in strict accordance with the Owner's specification. Any alternate bids shall include a detailed description of the technical merits of the deviation to the specified requirements, and shall identify any cost savings or quality improvements offered to the Owner as a result of the deviation.

EQUIPMENT IDENTIFICATION

Equipment shall be tagged with Owner's tag numbers in accordance with the requirements of this specification. Tag numbers will be supplied to the Vendor by Owner.

TESTS AND INSPECTIONS

The Owner reserves the right to witness all test or to have his authorized representative present for such tests. The Owner shall be notified at least ten (10) working days prior to any test to be performed. In each case, notification shall include contract number, items involved, location of equipment to be tested, and the tests scheduled to be performed at the time.

Vendors shall be responsible for the proper protection of all instruments and devices that may be damaged by any test.

The complete sequence of production tests in accordance with ANSI C37 requirements shall be performed after manufacturing and assembly is completed. After these initial tests, and after all deficiencies and wiring errors have been corrected, the tests required to verify that all of the noted deficiencies have been completed shall be repeated.

Vendor shall provide a qualified service technician or engineer for the length of time required to inspect the switchgear at the factory after completion. This person shall assist in testing each switchgear metering, control, and alarm circuit during checkout by Owner. Any additional costs incurred for this services shall be included as part of the base bid.

An actual breaker of each rating being supplied with this equipment shall be used for testing purposes on this switchgear.

Any bus duct being supplied as part of this contract shall be physically connected to its associated switchgear lineup, to assure the mechanical fit of the sheet-metal flanges and bus bars. This arrangement shall be available for customer inspection.

Certified test reports of the production floor testing shall be supplied to the Owner at time of shipment.

All deficiencies in design, construction or equipment mounting and inadequately designed circuits or wiring error brought out during the testing at the Vendor's plant shall be corrected by the Vendor at no cost to the Owner. The equipment shall meet all requirements stated in this specification.

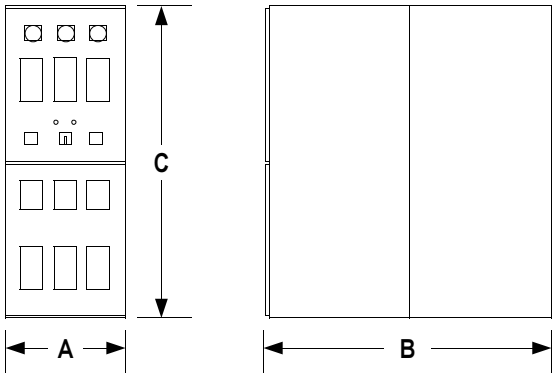
SHIPPING AND HANDLING

The method of preparation and packing shall protect the switchgear and associated equipment against corrosion, breakage, and vibration injury that might reasonably be encountered during transit and handling. If necessary, delicate instruments shall be disconnected, packed and separately shipped to the jobsite for mounting by the Owner. All accessories, mounted devices, instruction books, and parts list shall be packed and shipped with the switchgear.

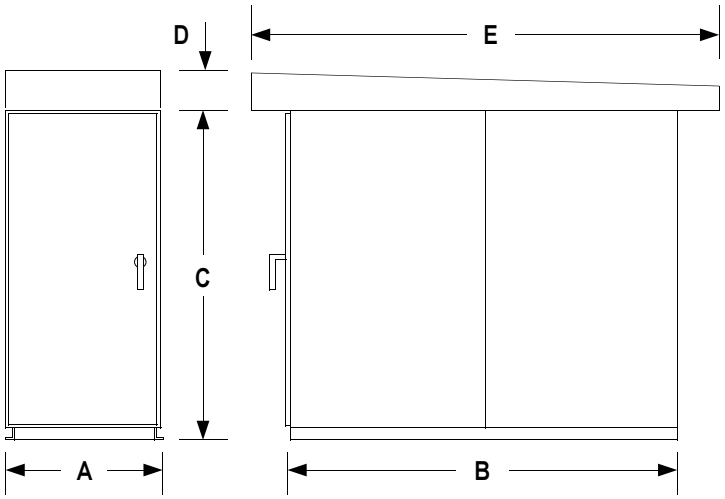
Provisions shall be made for lifting and skidding. All lifting points shall be clearly marked. All temporary bracing shall be bolted to the switchgear so that no cutting torches will be required for installation. Disconnected shipping split wiring shall be properly tagged and supported. The switchgear shall be protected against reasonable environmental and mechanical damage during transit and storage, but the Owner shall be responsible to comply with the Vendor's instructions for handling and storage of the equipment at the destination.

SPECIFIC REQUIREMENTS

Owner or Engineer shall insert special requirements here, as required.



Type MC Indoor Switchgear



Type MCR Outdoor Switchgear

Circuit Breaker Type	A	B	C	D	E	Weight
5 kV / 250 MVA NEMA 1	36”	94”	95.5”			3,300 #
5 kV / 250 MVA NEMA 3R	42”	100”	99”	6”	112”	3,950 #
7.2 kV / 500 MVA NEMA 1	36”	94”	95.5”			3,380 #
7.2 kV / 500 MVA NEMA 3R	42”	100”	99”	6”	112”	4,050 #
15 kV / 750 MVA NEMA 1	36”	94”	95.5”			3,380 #
15 kV / 750 MVA NEMA 3R	42”	100”	99”	6”	112”	4,050 #
15 kV / 1,000 MVA NEMA 1	36”	94”	95.5”			3,410 #
15 kV / 1,000 MVA NEMA 3R	42”	100”	99”	6”	112”	4,100 #

The above dimensions are typical, and are provided for reference only. Actual dimensions depend upon the application. Contact the M&I factory for details.

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