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Medium Voltage
Metal-clad Switchgear

[ANSI C37.20 and NEMA SG-5]

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

We build a better future!

Medium Voltage Metal-clad

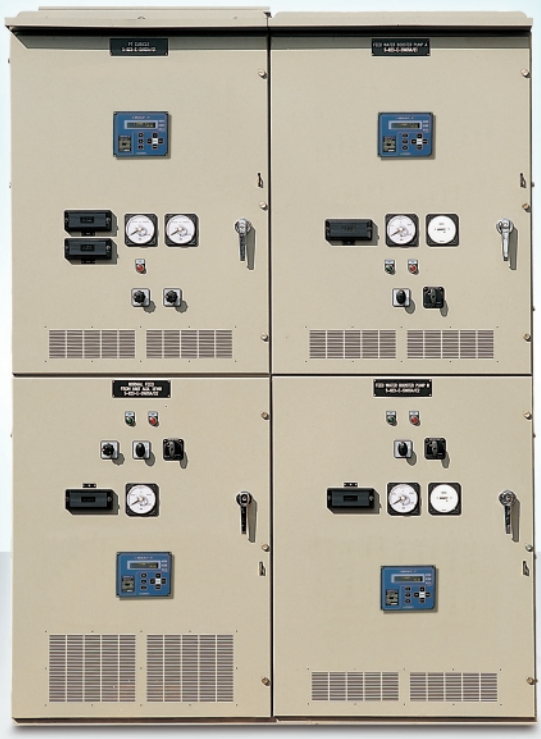
ANSI C37.20 and NEMA SG-5

Safety Convenience

High Ability

Quality Assurance

Environmental Qualification



Switchgear

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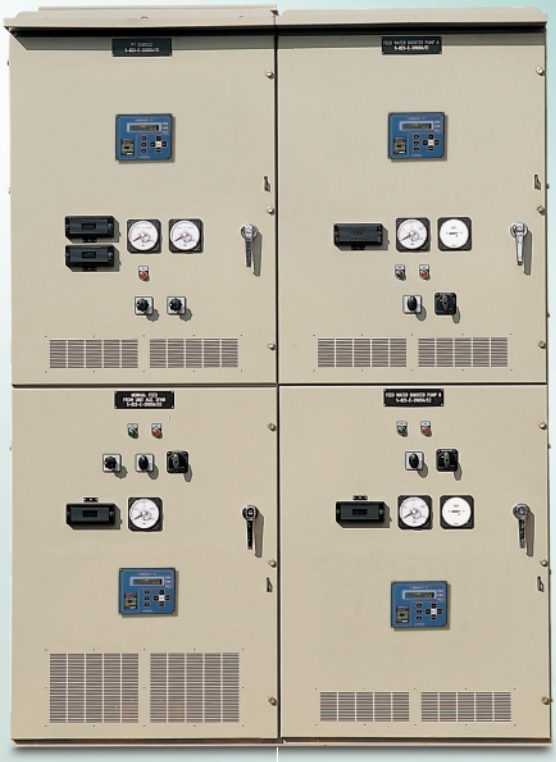
General



Typical
4.76 kV and 15 kV Switchgear

Description and Application

The HMS Vacuum Medium Voltage Metal-clad Switchgear is an integrated set of drawout vacuum circuit breakers, buses, and control devices coordinated electrically and mechanically for medium voltage circuit protection.

Metal-clad integrity provides maximum circuit separation and safety.

Included are isolated and grounded metal compartments and completely insulated conductors ensuring that no live parts will be exposed by the opening of a door.

It is typically used on circuits with feeder circuits, transmission lines, distribution lines and motors.

The HMS Vacuum Medium Voltage Metal-clad Switchgear is available at voltage ratings of 4.76 kV through 15 kV, for indoor or outdoor applications.

The metal-clad switchgear and all components are designed, manufactured, and tested in accordance with the following standards :

- ANSI C37.20.2
- NEMA SG-5
- IEEE

Definition

The Metal-clad Switchgear is a group of units characterized by the following features :

- The main interrupting device is removable and outfitted with a mechanism for moving it manually between connected and disconnected positions. It is equipped with self-aligning and self-coupling primary and secondary disconnecting devices.
- The interrupting devices, buses, voltage transformers, and control power transformers are completely enclosed by grounded metal barriers, which have no intentional openings between compartments. A metal barrier in front of the interrupting device ensures that no live parts are exposed by opening the door in the connected position.
- All live parts are enclosed within grounded metal compartments.
- Automatic shutters cover primary circuit elements when the removable element is in the disconnected, test, or removed position.
- Primary bus conductors and connections are covered throughout with track-resistant insulating material.
- Mechanical interlocks are provided to maintain a proper and safe operating sequence.
- Instruments, meters, relays, secondary control devices, and their wiring are isolated, where necessary, by grounded metal barriers from all primary circuit elements.

Quality Assurance

The HHI Power Distribution Organization Quality Assurance Program has been continuously improved.

It currently employs a total quality approach to provide reliable equipment and satisfy customer needs.

The program conforms to the requirements of ISO 9001.

Environmental Qualification

HMS Vacuum Medium Voltage Metal-clad Switchgear equipment has been evaluated by comprehensive analysis and testing for maintainability and life expectancy.

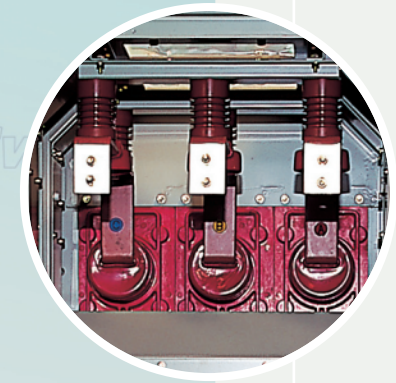
Documentation in accordance with IEEE 323-1983 is available for Class 1E Nuclear applications.

Seismic Capability

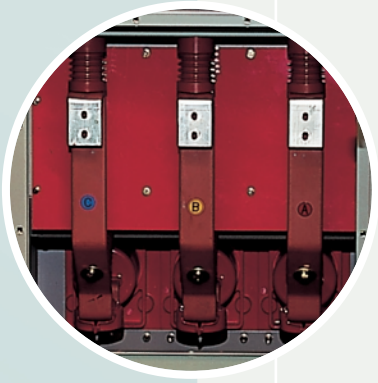
HMS Vacuum Medium Voltage Metal-clad Switchgear equipment is designed and tested to withstand high levels of seismic vibration without service interruption.

Equipment for nuclear plants, qualified per IEEE 344-1987, is availiable with full documentation.

Application Data



HMS Type Switchgear
Rear View Showing Cable Compartments



Applicable Industry Standards

ANSI-American National Standards Institute.
IEEE-Institute of Electrical and Electronic Engineer, Inc.

C37.06 AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis -Preferred Ratings and Related Required Capabilities

C37.09 Test Procedure for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

C37.010 Application Guide for AC High Voltage Circuit Breakers Rated on Symmetrical Current Basis

C37.011 Application Guide for Transient Recovery Voltage for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

C37.012 Application Guide for Capacitance Current Switching for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

C37.20.2 Standard for Metal-clad and Station Type Cubicle Switchgear

C37.54 Conformance Test Procedure for Indoor AC High Voltage Circuit Breaker Applied as Removable Elements in Metal-enclosed Switchgear

C37.55 Conformance Test Procedure for Metal-clad Switchgear Assemblies

NEMA National Electrical Manufacturers Association

SG-5 Power Switchgear Assemblies

Design/Proof Tests

The HMS Vacuum Medium Voltage Metal-clad Switchgear meets applicable ANSI, IEEE and NEMA standards.

The design criteria dictate that performance is demonstrated all test above the requirements of standards.

The basic ANSI test series includes short circuit, BIL, dielectric, continuous current, mechanical life, and thermal and environmental conditions.

Design tests are called type tests at times.

Production Tests

Production tests are used to check the quality and uniformity of workmanship and materials, and to verify during production that the product delivered to the customer meets the design specifications and applicable standards.

Features

HMS Type Switchgear
Bottom Circuit Breaker
Door Opened

Compactness

Space-saving compactness is the most noticeable characteristic of this Hyundai two-high HMS Vacuum Metal-clad Switchgear.

One standard frame size saves and simplifies layout. It also permits the complete allocation of space for future frame additions.

This Hyundai switchgear makes it possible to save space with every installation.

Standard frames are designed to house auxiliary equipment, voltage transformers, lightning arresters and bus tie transitions.

Front Access Port

With the access port opened, the breaker position, contact position and operation counter are easily observed.

With easy access to the racking mechanism, the breaker can be moved from the connected position through the test position to the disconnected position.

Features

Economy and Convenience:

- Completely engineered product.
- Standardized construction.
- Ease of match and line.
- Standardized ratings.
- Complete line of solid state relays.
- Integrally-mounted ground sensors.
- Vacuum interrupters.

Safety and Ease of Maintenance:

- Segregated compartments.
- Pressure relief flaps.
- Drawout voltage transformers in stationary control. Power transformers with drawout primary fuses.
- Positive automatic stops in each position during racking.
- Bus sectionalized through a tie breaker.
- Safe manual closing of stored energy breaker.
- Access port to racking mechanism.

Service Continuity:

- Re-usable interrupting device.
- Self-contained operating mechanism.
- Multiple-shot reclosing
- Automatic transfers for multiple-source systems.
- Limiting of damage to a single compartment.
- Bus differential protection minimizes bus fault downtime.
- Stored-energy breakers permit faster transfer of banks of feeders.
- Three-phase interruption-no single phasing.
- Speed and positive action for bringing a synchronized generator on the system.

Safe compartment-complete accessibility of all components:

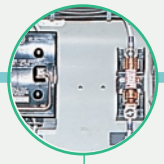
This unit is divided into six completely segregated areas, with front formed doors with concealed hinges.

- Instrument compartment.
- Circuit breaker compartment.
- Current transformer compartment.
- Bus compartment.
- Cable compartment.
- Auxiliary device compartment.

Circuit Breaker Compartment Features

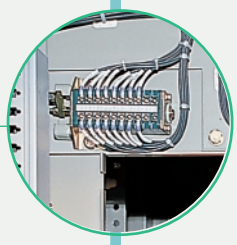
1 Mechanism Operated Cell (MOC) Switches

An eight-contact MOC switch is standardly supplied to provide open-closed status of the vacuum circuit breaker's primary contacts.
MOC switches are optionally available in sixteen and twenty-four contact configurations.
Normally open(a) and normally closed(b) contacts are equally divided.



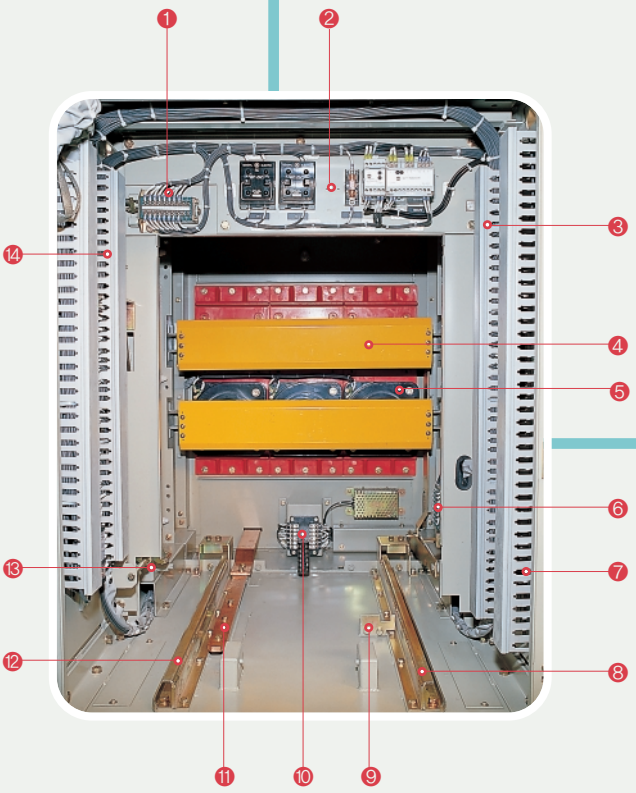
3 Terminal Blocks

Numbered eight point recessed screw type terminal blocks are mounted on stand off removable panels to prevent enclosure penetration by device mounting hardware.
Terminal block points designated for user interconnections have one side of the block reserved for this purpose.



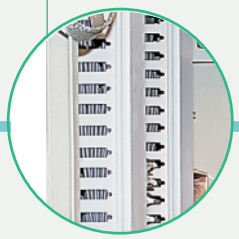
2 Low Voltage Compartment

With the vacuum circuit breaker in the drawout connected position, a segregated grounded metal-enclosed low voltage compartment is formed to provide access to the secondary wiring and devices without personnel exposure to primary voltage.



14 Secondary Wiring and Devices

Secondary wiring and all interconnected door mounted devices, control fuses, MOC and TOC auxiliary switches, terminal, and CT shorting blocks are readily accessible in the low voltage compartment.
Standard secondary wiring is in accordance with related NEC regulations.



13 MOC Switch Actuator

The cell mounted MOC switch actuator interfaces with the vacuum circuit breaker's operating mechanism linkage only in the drawout connected position.

5 Current Transformer (CT) Mounting

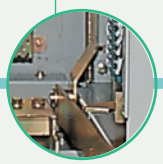
Current transformers are of the toroidal type and can be mounted on both line and load primary bushings behind the shutter.
Each primary bushing will accommodate up to two ANSI standard accuracy class CT's or one special high accuracy class CT.
Adding new CT's or changing CT ratios is easily and quickly performed without disturbing primary buses.

4 Safety Shutter

The stationary primary disconnects are covered by a grounded matal safety shutter whenever the vacuum circuit breaker is out of the drawout connected position.
The safety shutter is driven open as the vacuum circuit breaker moves between drawout test and connected positions to permit mating of the primary disconnects.
As an additional safeguard to the shutter closing springs, cam action assures the complete closing of the safety shutter when the vacuum circuit breaker is removed.
A provision for padlocking the safety shutter in the closed position is standard.

6 Truck Operated Cell (TOC) Switches

An optional eight contact TOC switch is available to provide connected/not connected drawout status of the vacuum circuit breaker.
Movement of the circuit breaker during racking between test and connected drawout positions causes a contact position change in the TOC switch.
Normally open(a) and normally closed(b) contacts are equally divided.

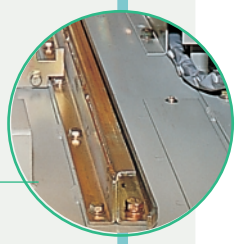


7 User Interconnecting Secondary Wiring

User interconnecting secondary wiring may enter from above or below.
As applicable, an integral wireway is provided for routing user wiring to the low voltage compartment.

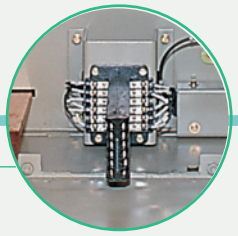
8 Drawout Position Indicator

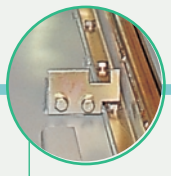
An indicator on the vacuum circuit breaker points to an indicator on the circuit breaker compartment floor to clearly illustrate the drawout position.
This indication can be observed through the access panel or with the circuit breaker compartment door open.



11 Grounding Contact

A copper ground bus rigidly connected to the switchgear ground bus system is engaged by a grounding contact on the drawout element to provide a maintained ground on the uninsulated portion of the drawout element whenever its secondary and/or primary disconnects are mated.





12 Dual Guide Rails

Floor mounted full-length dual guide rails assure positive alignment of the vacuum circuit breaker within its compartment to achieve the proper mating of all primary, secondary and grounding contacts.

10 Stationary Secondary Disconnector

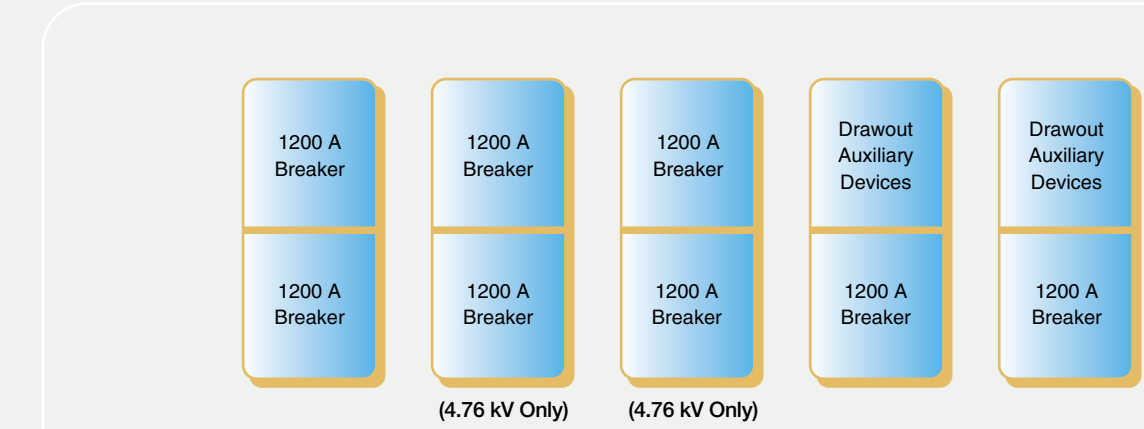
The stationary secondary disconnectors automatically mate with the vacuum circuit breaker's moving secondary disconnectors in the test and connected drawout positions to interconnect circuits for the spring charging motor, close, and trip devices and indicating lights.

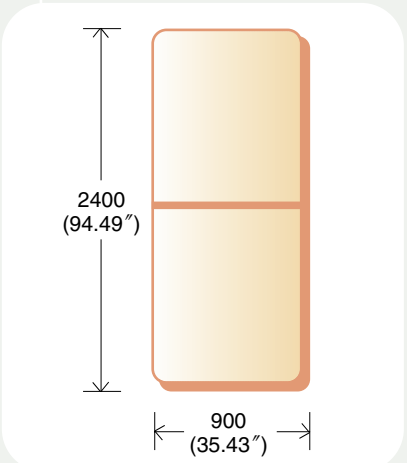
9 Interference Block

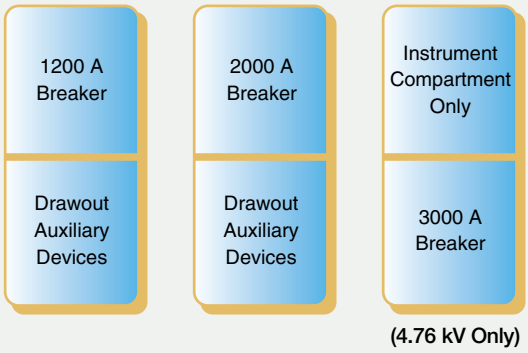
The interference block in the compartment mates with the interference angle on the vacuum circuit breaker to accept insertion of correctly rated drawout elements and to reject insertion of incorrect rated drawout elements.

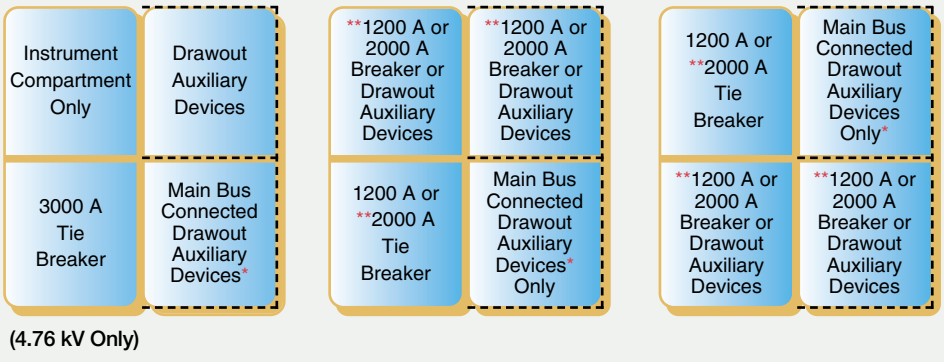
Standard Modules

Typical Arrangements



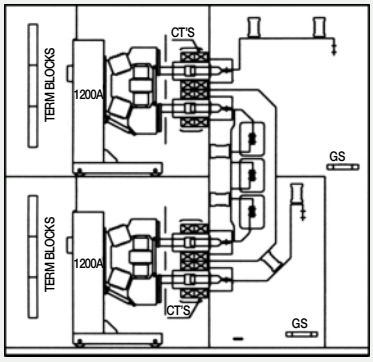




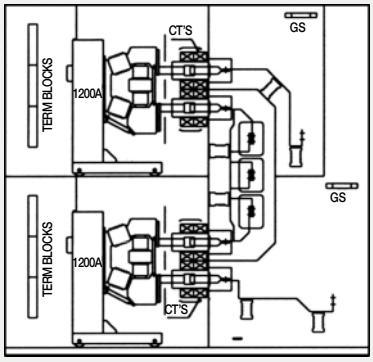


* Auxiliary Compartment Adjacent to Tie Breaker Required.
** Only One 2000 A Breaker in Any Vertical Frame.

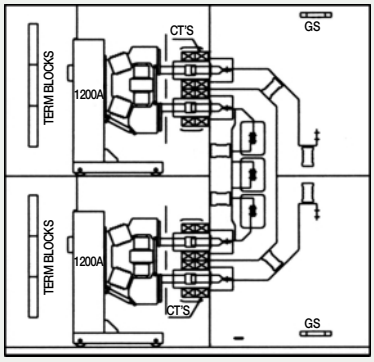
Typical Section Views - Two High Construction



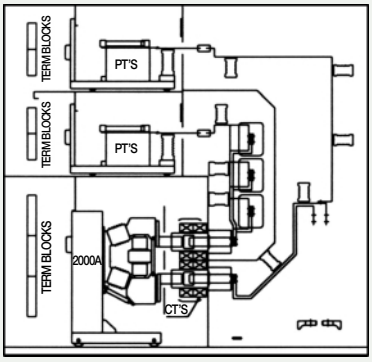
Breaker / Breaker (Bottom Entry)



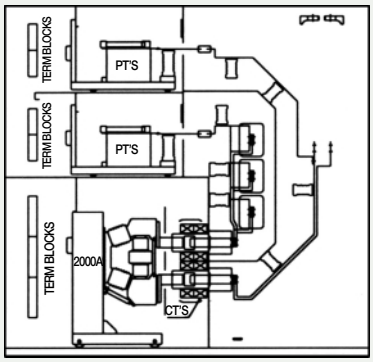
Breaker / Breaker (Top Entry)



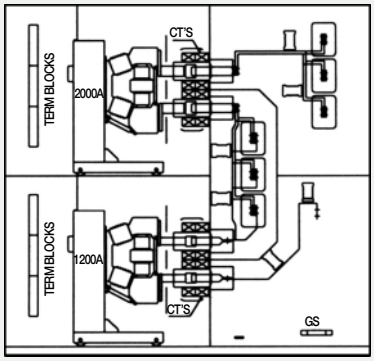
Breaker / Breaker (Top and Bottom Entry)



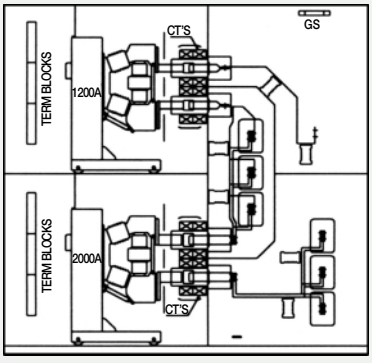
Auxiliary / Breaker (Bottom Entry)



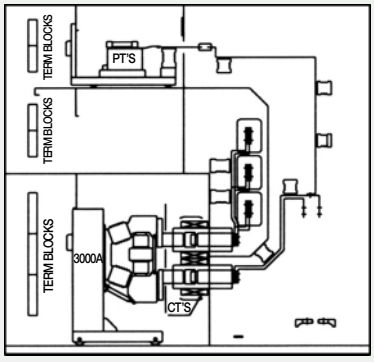
Auxiliary / Breaker (Top Entry)



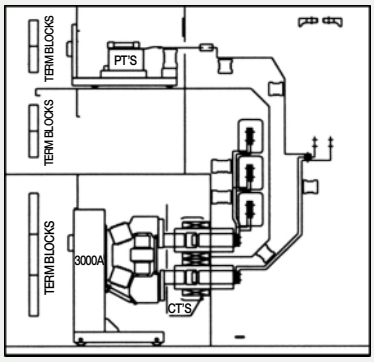
Breaker / Breaker (Top Tie)(Bottom Entry)
*Can be also Suitable for top Entry



Breaker / Breaker (BottomTie)(Tie Entry)
*Can be also Suitable for top Entry



Auxiliary / Breaker (Bottom Entry)
*4.76 kV Only



Auxiliary / Breaker (Top Entry)
*4.76 kV Only

Technical Data

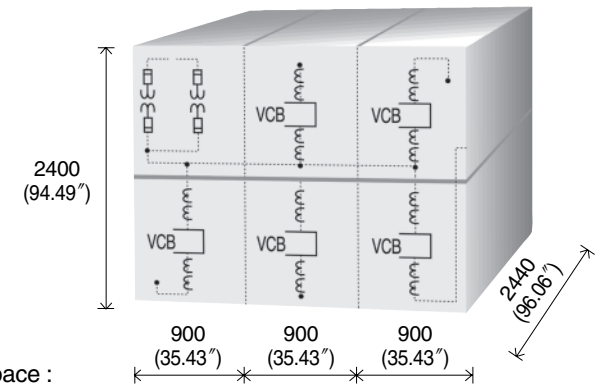
Metal-clad Switchgear
Medium Voltage

4.76 kV/15 kV
Two High Construction

Table 1 - Technical Data

Model Name		HMS	
Rated Maximum Voltage (kV rms)		4.76	15
Rated Insulation Levels (kV)	Normal Frequency Withstand Voltage (rms, 1min)	19	36
	Normal Impulse Withstand Voltage 1.2 / 50μs	60	95
Rated Continuous Current (A)		1200 / 2000 / 3000	1200 / 2000
Rated Short-time Current (2 sec)		50 kA	40 kA
Circuit Breaker		VCB	VCB
Bus-Bar System		Single	Single
Installation		Indoor Outdoor	Indoor Outdoor
Applicable Standard		ANSI C37.20 NEMA SG-5	ANSI C37.20 NEMA SG-5
Dimensions (mm) L×W×H		2440×900×2400 (96.06″×35.43″×94.49″)	2440×900×2400 (96.06″×35.43″×94.49″)
Switchgear Weights (Kg) - Approximately		Indoor : 1,700Kg	Indoor : 1,700Kg

Technical Isometric Arrangment



Recommended breaker withdrawal space :
front 1500 mm, rear 1000 mm of switchgear.

Technical Data

Table 2 - Vacuum Circuit Breakers - Ratings on Symmetrical Basis

Type of Breaker	Nominal Rating		Rated Continuous Current 60 Hz AMPS-RMS	Rated Voltage		Insulation Level Rated Withstand		Interrupting AMPS-Symmetrical	Asymmetrical Rating Factor	Short Time Rating 3sec. AMPS -RMS	Close and Latch Rating AMPS-RMS	Interrupting Time Cycles
	Three Phase MVA	Voltage kV-RMS		Max. Voltage kV-RMS	K-Factor Max. kV Min.kV	Low Frequency kV-RMS	Impulse 12x50MS kV-Crest	Normal kV kV-RMS				
HAF 1072-3	350	4.16	1200	4.76	1.0	19	60	50,000	1.1	50,000	78,000	5
HAF 1074-3	350	4.16	2000	4.76	1.0	19	60	50,000	1.1	50,000	78,000	5
HAF 1077-3	350	4.16	3000	4.76	1.0	19	60	50,000	1.1	50,000	78,000	5
HAF 2362-3	1000	13.8	1200	15.0	1.0	36	95	40,000	1.1	40,000	62,000	5
HAF 2364-3	1000	13.8	2000	15.0	1.0	36	95	40,000	1.1	40,000	62,000	5

※ HAF Vacuum circuit breakers are in accordance with the latest applicable standards of ANSI C37.06(1997), ANSI C37.09(1979), and ANSI C37.09a(1991)

Table 3 - Operating Voltage Range

Nominal Control Voltage	Spring Charge Motor	Closing Coil	Tripping Coil
∗24 V DC	-	-	14-30
△48 V DC	† 35-50	35-50	28-60
125 V DC	90-130	90-130	70-140
250 V DC	180-260	180-260	140-280
115 V AC	95-125	95-125	∓95-125
230 V AC	190-250	190-250	∓190-250

Table 4 - Weight, Kg

Breaker Type	True MVA Symmetrical	Continuous Current AMPS-RMS	Breaker Element (Kg)	Breaker With Truck (Kg)
HAF 1072-3	350	1200	160	260
HAF 1074-3	350	2000	160	280
HAF 1077-3	350	3000	200	350
HAF 2362-3	1000	1200	125	225
HAF 2364-3	1000	2000	125	245

Notes:

- Unless the circuit breaker is located close to the battery and protective relay and adequate electrical connections are provided between the battery and trip coil,

*24 V DC tripping is not recommended.

† 48 V DC spring charging is not recommended.

＋AC tripping is not recommended.

△48 volt tripping or closing functions are not recommended, except when the device is located near the battery or where special effort is made to insure the adequacy of conductors between battery and control terminals.

This brochure dose not cover all details or variations in equipment design.
Should further information be desired or particular applications arise which are not covered sufficiently, please contact our nearest local office or send us an e-mail or fax.

Specification Guide

Specification Guide

Note : Color denotes information to be provided by purchaser regarding either :

1. Alternative choices
2. Addition of optional features
3. Specific information

General

The (indoor-outdoor) metalclad switchgear described in this specification is intended for use on a (4160-13800) volt 3-phase (3-4) wire (grounded ungrounded) 60 Hz system.

The switchgear shall be rated (4160-13800) volts and have horizontal drawout vacuum circuit breakers.

The switchgear and circuit breaker either individually or as a unit shall have an impulse rating of (60-95) kV.

The entire switchgear, including vacuum circuit breakers, meters, relays, etc., shall be completely factory tested, and breakers of like ratings shall be interchangeable.

Applicable Standards

The switchgear equipment covered by these specifications shall be designed, tested, and assembled in accordance with the latest standards of ANSI, IEEE and NEMA.

Stationary Structure

The switchgear shall consist of vacuum circuit breaker units and ( ) auxiliary units assembled to form a rigid self-supporting, completely metal-enclosed structure including two thicknesses of painted steel between units.

Each breaker unit structure shall be segregated by metal-sheets into the following compartments :

(1) Circuit Breaker

(2) Main Bus

(3) Instrument

(4) Current Transformer

(5) Auxiliary

(6) Cable

Circuit Breaker Compartment

Each circuit breaker compartment shall be designed to house a horizontal drawout (4160-13800) volt vacuum circuit breaker.

The stationary primary disconnecting contacts shall be constructed of silver-plated copper.

All movable contact fingers and springs shall be mounted on the circuit breaker where they may easily be inspected.

The entrance to the stationary primary disconnecting devices shall be automatically covered by a shutter when the circuit breaker is withdrawn to the test position or disconnected position or removed from the breaker compartment.

Cable Compartment

The lower primary disconnecting contacts shall be supported by means of flame-retardant polyester bushings which extend into the cable compartment.

(Clamp type cable terminals will be bolted to the out- going bus by means of an adapter.), (potheads suitable for terminating cable will be furnished).

A copper ground bus shall extend through the length of the switchgear.

Bus Compartment

Removable panels shall be provided for access to the bus compartment.

The main bus shall be rated (1200-2000-3000) amperes. (5-15) kV bus bars shall be silver-plated, and bolted connections shall be used.

The conductors shall be insulated by means of flame-retardant, track-resistant epoxy insulation, or heat shrinkable tube and polyester bus supports shall support the insulated bus.

Porcelain is optional. Bus bar joints for power cable connection are covered with completely insulated boots.

Doors and Panels-Outdoor

The relays, meters, instruments, control switches, etc. shall be mounted on a formed hinged panel.

The panel shall be mounted in a compartment located on the same side of the switchgear as the circuit breaker compartment.

All weather-proof exterior doors shall be provided with suitable fasteners.

Cleanable metallic filters shall cover the louvers.

Circuit Breakers

The circuit breakers shall be rated (4160-13800) volts, 60 Hz, having a continuous current rating of (1200-2000-3000) amperes and interrupting rating of (3500-1000) MVA.

All circuit breakers of equal rating shall be completely interchangeable.

The circuit breaker shall operate by means of a stored energy mechanism, which is normally charged by a small universal motor, but which can also be charged by a manual handle for emergency manual closing or test.

The mechanism shall be so arranged that the closing speed of the contacts is independent of both control voltage and the operator.

The circuit breaker shall have three independent vacuum interrupters, one per phase.

The circuit breaker shall be equipped with secondary disconnecting contacts which shall automatically engage in the operating and test position to complete circuits as required.

The contacts shall automatically disengage when the circuit breaker is withdrawn to the disconnect position.

The circuit breaker shall have a means for racking in and out of the compartment and between positions.

It shall furthermore be provided with a means of holding the circuit breaker in the compartment in all positions.

Interlocking shall be provided to make it impossible to rack a closed circuit breaker to or from any position.

An additional inter-lock shall be provided which shall assure automatic discharging of the closing springs upon insertion or removal of the breaker into or out of the compartment.

The circuit breaker control voltage shall be

(48-125-250 DC; 115-230 AC, 60 Hz)

The technical data for VCB is described in Table #2.

Instrument Transformers

Current transformers are safely isolated behind the shutter barrier.

(1 or 2) current transformers may be accommodated on both the line and load sides of the circuit breaker.

Current transformers are front accessible after removal of the shutter barrier.

Voltage Transformers

Voltage transformers shall be of the drawout type, equipped with current limiting fuses.

They shall have an accuracy as required by the details of each switchgear unit.

The ratio shall also be as indicated in each switchgear unit specification.

Control Wiring

The switchgear wire shall be #14 AWG SIS except where larger is specified.

The switchgear shall be provided with terminal blocks for outgoing control connections.

All wiring shall be terminated in looped tongue.

Finish

All parts of the structure shall be phosphate-treated and painted with an oven-baked, corrosion-resistant epoxy polyester resin powder finish.

The color of finish shall be light gray, ANSI #61.

Outdoor construction surfaces shall receive one additional coat of oven-baked corrosion-resistant special polyester resin powder finish.

The color of the finish shall be light gray, ANSI #61.

Accessories:

Racking crank assembly.

Manual charging handle.

Test jack and plug.

Breaker lifting device.

Mechanical key interlock device in three positions (Service, test, disconnected)

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Head Office	1, Jeonha-dong, Dong-gu, Ulsan, Korea Tel. 82-52-202-8101~8	Fax. 82-52-202-8100
Seoul **(Sales & Marketing)**	140-2, Gye-dong, Jongno-gu, Seoul, Korea Tel. 82-2-746-7578, 7542, 7585	Fax. 82-2-746-7648 / **Domestic Sales** Tel. 82-2-746-7610, 7622 Fax. 82-2-746-7607
Orlando	3452 Lake Lynda Drive, Suite 170, Orlando, Florida 32817, U.S.A. Tel. 1-407-249-7350	Fax.1-407-275-4940
London	2nd Floor, The Triangle, 5-17 Hammersmith Grove London, W6 0LG, UK Tel. 44-20-8741-0501	Fax. 44-20-8741-5620
Tokyo	8th Fl., Yurakucho Denki Bldg.1-7-1, Yuraku-cho, Chiyoda-gu, Tokyo 100-0006, Japan Tel. 81-3-3212-2076, 3215-7159	Fax. 81-3-3211-2093
Dubai	Room 6206, Al Bustan Centre Al Qusais P.O.Box 252458 Dubai, U.A.E. Tel. 971-4-263-9071	Fax. 971-4-263-9072
Sofia	1271, Sofia 41, Rojen Blvd. Bulgaria Tel. 359-2-803-3200	Fax. 359-2-803-3203
Yangzhong	Lianzhong Avenue, Xinba Scientific and Technologic Zone, Yangzhong City, Jiangsu 212212, China Tel. 86-511-842-0666, 0500	Fax. 86-511-842-0668, 0231