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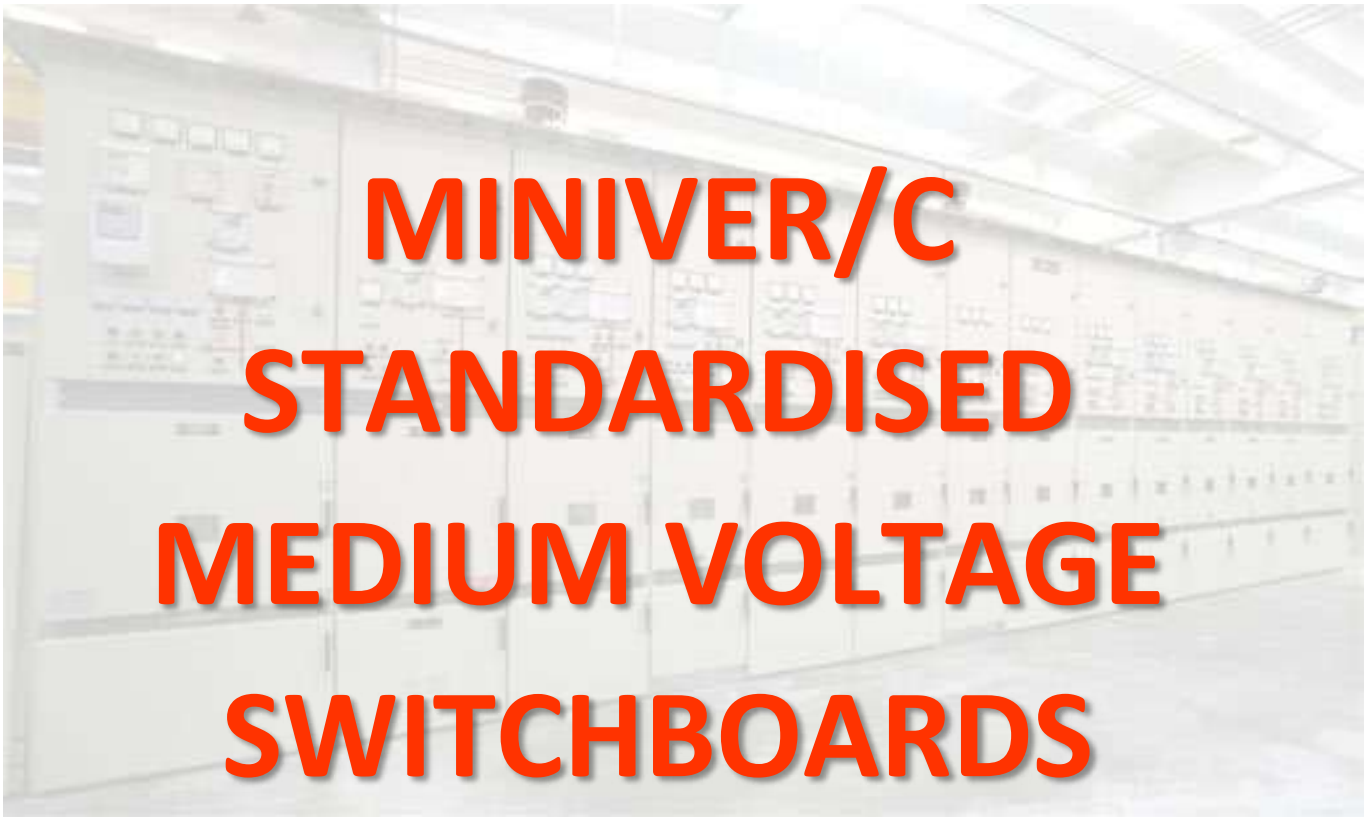

MINIVER/C STANDARDISED MEDIUM VOLTAGE SWITCHBOARDS

INTRODUCTION

It is important to always refer, in addition to this manual, also to the technical documentation issued by IMESA for the specific project supply (general arrangement drawings, single-line electrical diagrams, schematic diagrams, etc.).

WARNING

IMESA disclaims all liability in the following cases:

- ✓ **inadequate maintenance and non-compliance with the instructions contained in this manual;**
- ✓ **Interventions by inadequately trained and instructed personnel;**
- ✓ **failure to comply with the safety provisions**;

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1. TRANSPORTATION

To transport properly the product, it must be strictly followed all the safety rules. To prevent damaging it it's mandatory to follow all the rules included in this document, about handling, lifting, storing and unpacking.
For the proper transportation of the electrical panel, it must be securely fastened to the transport vehicle used. It is allowed to secure it to a base using slings, provided that protective materials or shock absorbers are used for the parts in contact with the panel. These materials must be selected to prevent scratches, impacts, or deformation during transportation, ensuring the safety and integrity of the electrical panel.
An example for protecting the edge of the cubicles (protective materials must be applied where the slings get in contact with the edges.):

2. CHECKS ON RECEIPT

When required to facilitate transportation, the switchboard is split into shipping sub-sections, consisting of one or more standard vertical units; generally, of a total width not exceeding 3,000 mm.
Each section is packaged according to the shipping and storage instructions communicated by the Customer.
In general, the switchboards are shipped complete with removable parts (MV circuit breakers, MV contactors, voltage transformers) inserted in the respective cells, unless otherwise agreed with the Customer. On the panels the earthing switches are in closed position, while the MV circuit breakers are in open and disconnected position.
Upon receipt, it is necessary to unpack and check compartments and accessories, as indicated in the technical documents provided before delivery of the switchboard.
If there are damages or faults detected on the switchboard or on the internal equipment, once the material is unpacked, immediately inform our logistic dept. (directly or through your agent).
Claims regarding defects, shall include the serial number and the year of manufacturing, indicated on the nameplate of the switchboard.

3. STORAGE

If the switchboard is to be temporarily stored, our workshop (upon request) will provide suitable packaging for the specified storage conditions.
Upon receipt, the panel shall be in any case unpacked and thoroughly subjected to visual inspection, as indicated at par. 1, and then repacked using the packaging material originally provided.
The switchboard must be stored in a dry, non-dusty and non-corrosive environment, as well as not subjected to extreme temperature fluctuations.
When the switchboard is not immediately installed at receipt, to store it in a well-ventilated environment, covering the same with a tarpaulin or with waterproof sheets (such as polyethylene). Anti-condensation heaters are to be and regularly used to avoid build-up of humidity.
It is also recommended to place at least one bag of desiccant salts in each compartment; to be replaced every six months.
Further details on the storage recommendations may be conveyed upon request.

4. LIFTING THE SWITCHBOARD

Each unit is generally attached to a wooden platform. For handling, it is recommended to use an overhead travelling crane or a mobile crane. Alternatively, use rollers or forklift trucks. The weight and dimensions of the various sections are indicated in the shipping documents and on the system drawings.

SAFETY PRECAUTIONS

- **While handling the panels, it is recommended to pay extreme caution**
- **To handle the single panel modules or the shipping sections of the switchboard, it is essential to use the appropriate lifting eyebolts or the flanges at the baseframe, in the case of lifting from the bottom, as advised in the General Arrangement drawings.**

4.1. Handling of wood packaging with overhead or mobile crane

To lift using a crane, use circular harnesses (fig. 1). The harnesses must be inserted at the lifting symbols shown on the crate. When selecting the circular harnesses, take into account the weight to be lifted and the lifting opening angle.

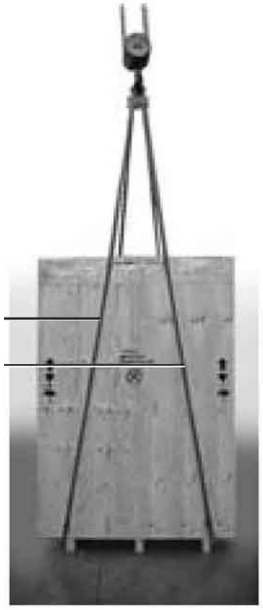

fig. 1 – Wood packaging

4.2. Handling with rollers

The floor on which the rollers slide must be levelled. Move the module avoiding shocks that could tip it over.
Lift the unit by means of an overhead travelling crane, a mobile crane or jacks (fig. 1). Remove the wooden platform by loosening the screws that secure it to the base of the switchboard. Place a sturdy sheet metal plate between the rollers and the base of the units and place the unit on the sliding rollers (fig. 2).

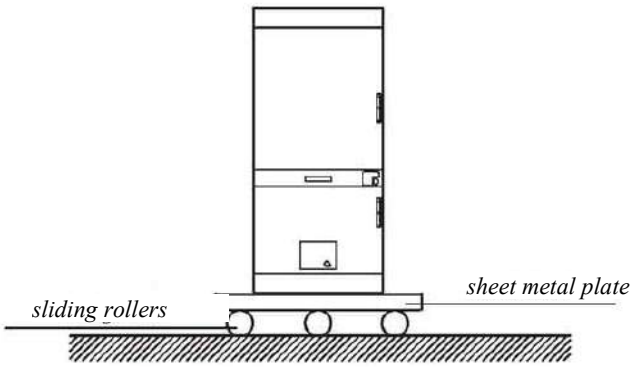

fig. 2 – Handling with rollers

4.3. Handling with pallet trucks or forklift trucks

The floor on which the pallet trucks or forklift trucks run must be levelled. Move the unit avoiding shocks that could tip it over.
To obtain greater stability, lift the unit only enough to allow it to be moved. Also check the flatness of the forks (fig. 3).

fig. 3 – Handling with pallet trucks

4.4. Unpacking

Remove any nails and the lid and the sides of the crate (if present).
Open the door of the units and loosen the screws that secure the module to the support platform (if present).
Lift the module by means of the appropriate method, among those described in the following paragraphs.
Remove the support platform from below the unit.

N.B. : to be exclusively employed a lifting system with spreader beam (not included in the supply) of the type shown in Figures 5 and 6.

4.5. METHOD A – Lifting of a single panel section (fig. 4)

Four lifting eyebolts are provided, as shown and highlighted in the figure below.

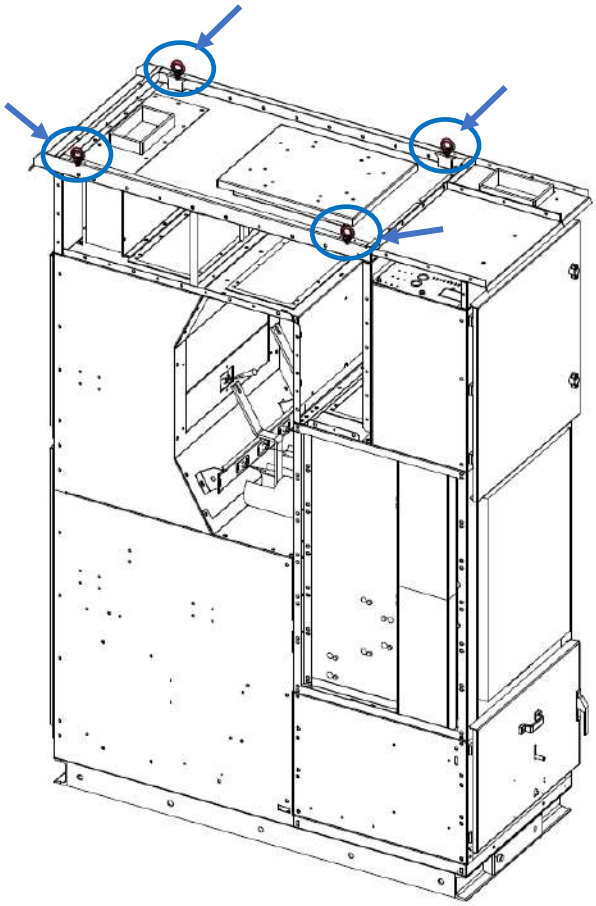

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fig. 4 – Lifting eyebolts for lifting the single panel section

On the aforementioned eyebolts, use four certified lifting shackles, each with a capacity of at least 500 kg. Attach the rope carabiners to the shackles and lift the compartment, strictly following the safety procedures.

4.6. METHODO B – Lifting of a shipping section, assembling more panel sections

Secure the lifting ropes to the spreader beam at the designated attachment points (A in fig. 5). These points must be selected so that the ropes do not compress the cells and that the cells remain levelled once lifted. Secure the other ends of the ropes to the lower attachment points (B in fig. 5). Lifting must be carried out as shown in Figure 6.

fig.5

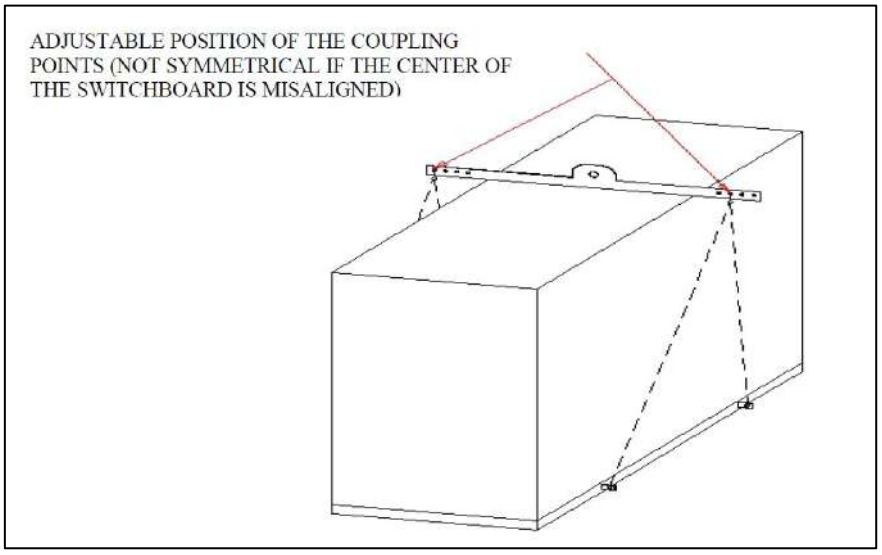


fig.6

5. DESCRIPTION

5.1. Layout and characteristics of the single panel units

Normal operations at Miniver-C switchboard are carried out from the front of the units with all the doors closed.

Only maintenance and the replacement of faulty parts do require opening of doors and panels.

Miniver-C switchboards units can be provided both in execution for wall mounting, as well as the version with accessibility to power connection compartment and busbars compartment from the rear side.

Each vertical panel is composed of the following segregated compartments:

- Instrument unit (A)
- Switch unit (B)
- Line unit (C)
- Distribution busbars unit (D)
- Voltage transformer unit (E)

Switch compartment details

1 Voltage presence indicating device
2 MV circuit breaker / MV contactor
3 Shutters to segregate the switch unit from main poles terminations
4 Lower and upper isolating blocks of the main poles
5 Earthing switch
6 Compartment door

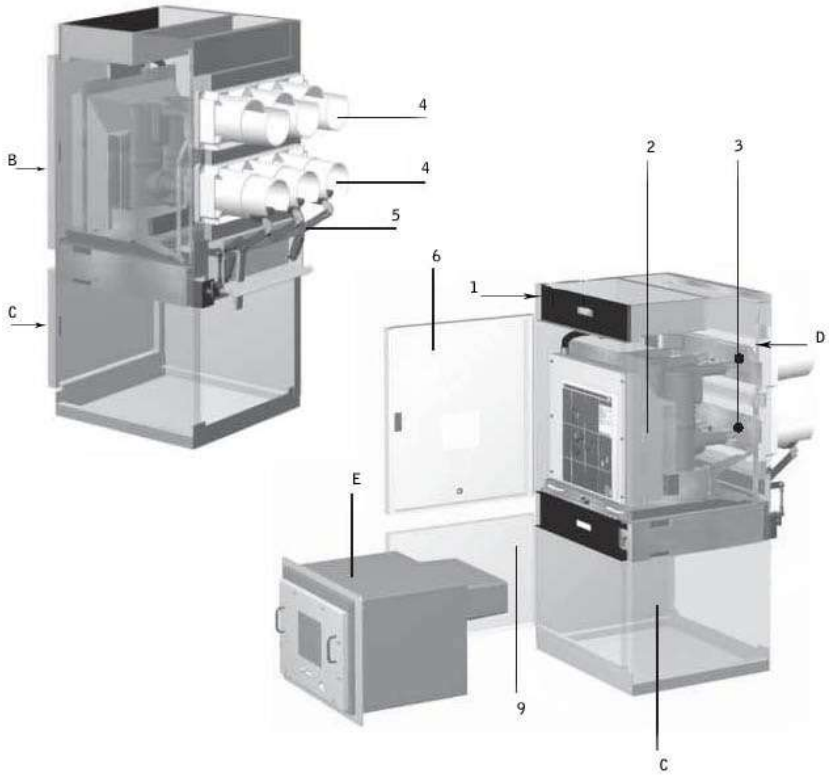


fig. 7 – Typical section

fig. 8 – Front of the switchboard

5.2. Main compartments and appliances

5.2.1. Switching and interrupting devices

The Miniver-C units can be equipped with the following switching and interrupting devices:

- MV SF_6 circuit breakers
- MV vacuum circuit breakers
- MV vacuum contactors
- Trolleys for voltage transformers.

The above appliances, typically in withdrawable and removable execution, are fitted on a specific truck that allows for the following operating conditions of the equipment, with regard to the position into the compartment:

RACKED-IN: main and auxiliary circuits connected

RACKED-OUT:

- partially disconnected, with main circuits disconnected and auxiliary circuits connected (connecting plug inserted)
- totally disconnected, with main and auxiliary circuits disconnected (connector plug racked out)

REMOVED: main and auxiliary circuits disconnected and appliance removed from the panel.

In the racked-in and racked-out condition, the appliances remain in the compartment while the door is closed. The appliances are visible through the inspection window of the door.
The main appliances are equipped with key locks, located at the front crossbar. Those key locks allow for the safety interlocks design for the specific application of the unit.
At the front door of the switch unit, it is provided the slot for racking-in/racking-out manoeuvres, by means of the dedicated crank (operations allowed with front door closed). A mechanical interlock prevents the breaker trolley from moving forward/backward in the compartment, in case the main breaker/contactor or the earthing switch is closed. Viceversa, in case the breaker trolley is in an intermediate position, between racked-out and racked-in status, the mechanical interlock prevents the switch from closing. Also a locking magnet is fitted on the trolley, which, if de-energised, prevents the trolley from manoeuvring (electrical interlock). The connecting plug, provided for the connection of the auxiliary circuits of the main switching device (breaker or contactor) comes out from the front protection of the appliance.
The upper part of the switch unit is fitted with the lever mechanisms for activation of the auxiliary contacts of the main appliance, for indication of its relevant position (racked-in/racked-out).
The slides for operating the MV poles segregating shutters are fixed to the sides of the appliances. Please, refer to the instruction manuals of that equipment for further details.

5.2.2. Earthing switch

The earthing switch is located at the rear of the unit (fig. 9, item 1); while the manoeuvring mechanism and relevant key locks are located at the front side (fig. 10).
The safe position of the earthing switch is indicated by means of the graphic symbols at the operating position (fig. 10, item 2). The actual corresponding position of the earthing switch is indicated by the yellow arrow marked on the manoeuvring shaft (fig. 10, item 5). In most of the arrangements it is also allowed to check once more the actual position of the earthing blades by means of the relevant visual indicator (fig. 9, item 3), which is located inside the power cable connection compartment and visible through the inspection window provided at the front side (fig. 11, item 1).

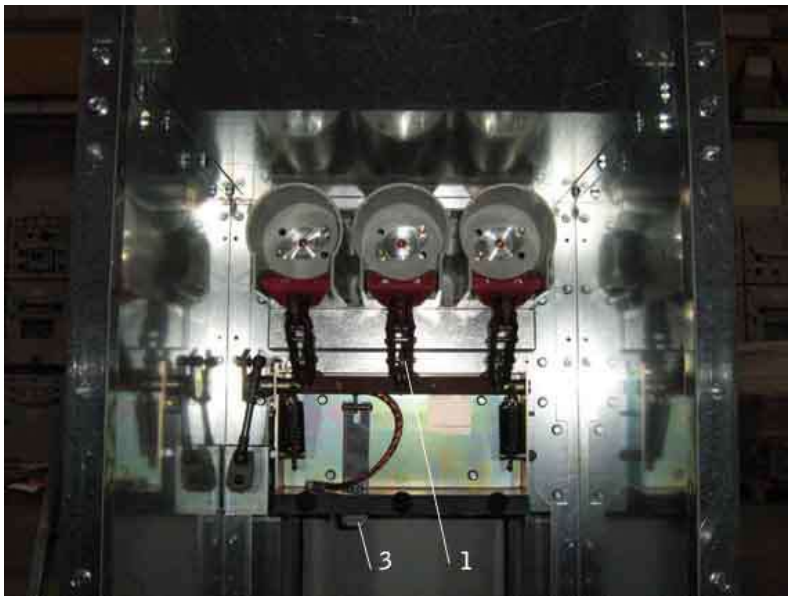


fig.9 – Earthing switch (unit rear side)

fig.10 – Manoeuvring and key locking set of the earthing switch (unit front side)

5.2.3. Unit compartments

MV Circuit breaker / MV fused-Contactor compartment

The metallic structure is equipped with a front door and has external manoeuvring and control devices on the front side (fig. 11). Racking-in / racking-out operations of the appliances must be carried out with doors closed only.

In the lower area of the front side, it is located the earthing switch manoeuvring set, which includes (fig. 12):

- the slot for the manoeuvring lever of the earthing switch (item 12);
- the actuator (9) to lift the covering shutter (item 13) of the earthing switch manoeuvre slot;
- key lock at open earthing switch (item 8);
- key lock at closed earthing switch (item 12);

In the upper part of the compartment, voltage presence indicating lamps (fig.11, item 4) are provided.
In some cases, those are located at the door of the upper LV compartment.

The door is fitted with (fig. 11):

- closing-opening handle (item 5);
- inspection window to check the position of the main appliance (item 3);
- slot for the crank to rack-in/rack-out the main appliance, while the front door remains closed (item 2).

The following parts are instead housed into the compartment itself (fig. 13):

- guiding rails for the main appliance trolley (item 15);
- shutters for segregation of the main poles (item 18) and moving mechanisms of the shutters (item 16);
- socket for the main appliance aux. circuits' plug connector (item 22);
- mechanical block to prevent removal of the auxiliary circuits plug connector, when the main appliance is in closed position (item 23);
- mechanisms with limit-switches, indicating the main appliance's complete racked-in position (item 21);
- mechanisms with limit-switches, indicating the main appliance's complete racked-out position (item 24);
- mechanical block that prevents the main appliance from being racked-in, if the earthing switch is closed; as well as preventing the earthing switch from being closed, if the main appliance is racked-in (item 27);
- space heater location (item 25), in case requested;
- location for the key lock to prevent racking-in of earthing trolley with upper loops (item 19), when requested;
- location for the key lock to prevent racking-in of earthing trolley with lower loops (item 20), when requested;
- interlock to prevent insertion of main appliances of wrong size (item 22; included in the socket).

At the back side of the compartment are provided the insulating blocks for the power connections to the main poles (fig. 14, item 14).

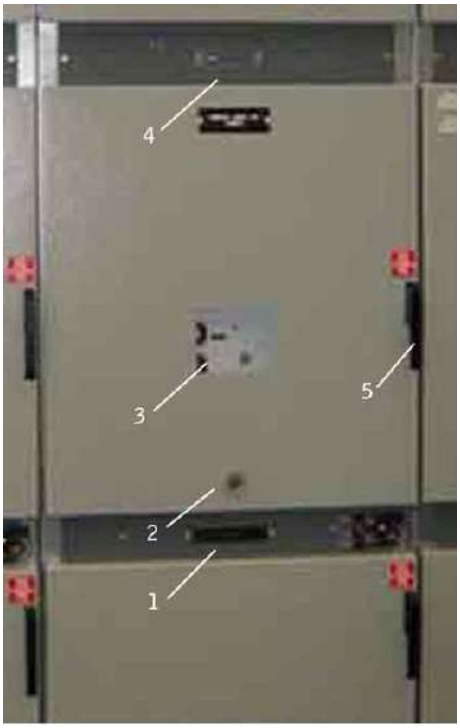


fig. 11 – Front of the switchboard (detail)

fig. 12 – Manoeuvring and key locking set of the earthing switch (unit front side)

fig. 13 – Switch unit interior view (detail)

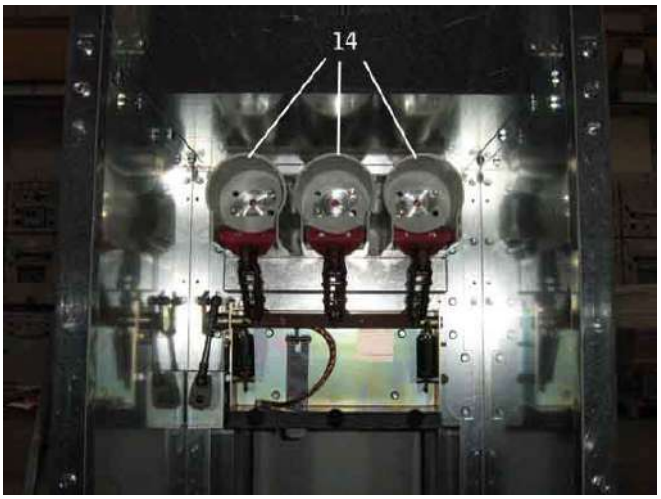


fig. 14 – Switch unit rear view (main poles isolating blocks)

Line compartment

From the line compartment it is possible to reach the earthing switch auxiliary contacts.
It also allows access to the power cable connection area from the front, on wall mounted execution of the switchboard.
In that case, opening of the line compartment front door is interlocked to the earthing switch closed position (door opening allowed only when the earthing switch is closed). Viceversa, opening of the earthing switch is allowed only when the front door is closed.

Before accessing to the terminations of the power cables, make sure that the earthing switch position indicator (fig. 9, item 3), visible through the inspection window (fig. 11, item 1), as well as the shaft indication, visible from the manoeuvring set of the earthing switch (fig. 10, item 5), is confirming successful closure.

Voltage transformers compartment and withdrawable trolley

The voltage transformers compartment (fig. 15 and fig. 17) consists of a casing (fig. 16) containing a withdrawable trolley (fig. 18), where are installed the voltage measuring transformers (fig. 18, item 53) and the relevant protective fuses at the primary circuit (within the VT resin block itself).
The withdrawable trolley (fig. 18) is completely removable from the compartment, which allows for safe replacement of the primary circuit fuses. A dedicated metal damper (fig. 16, item 57) prevents direct contact to the medium voltage terminals, when the trolley is removed from the compartment.

The main features of the voltage measuring compartment are:

- voltage transformers are mounted on a trolley, that can be positioned in fully disconnected position, while remaining within the inside compartment space (complete operation with front door closed);
- voltage transformers with built-in fuses are being disconnected by means of the control handle, located at the front door of the compartment;
- once disconnected the main circuit of the voltage transformers, the relevant auxiliary circuits are also disconnected, at the same time;
- the metal shutter, segregating the compartment from the MV circuits of the switchboard, is automatically activated by the relevant movement of the transformers trolley;
- the primary circuit fuses can be replaced once removed the VTs trolley from the compartment, after opening the front door and having already disconnected the transformer trolley;
- the transformers can be replaced only when the trolley is removed from the compartment;
- the electrical aux. contacts, signalling VTs racked-in and racked-out position, can be supplied on request.

The voltage transformers trolley can take the following positions, with relation to the compartment:

RACKED-IN: main and auxiliary circuits of the transformers are connected;

RACKED-OUT: main and auxiliary circuits of the transformers are disconnected; the transformer trolley remains inside the compartment.

REMOVED: main and auxiliary circuits of the transformers are disconnected; the transformer trolley is removed from the compartment.

The resin insulated Voltage transformers, provided for measurement to the instrumentation and protections relays, have the performance and accuracy class required by the calculations carried out in the engineering phase. The auxiliary circuits of the transformers are connected by sliding contacts (58) (fig. 14).
The power cable connecting compartment, in case of wall mounted execution switchboards, can be reached by pulling out the entire VT measurement compartment.

The following components are fitted in the transformer compartment:

Voltage transformer compartment:

- Door (41) (fig. 15);
- manoeuvring sequence plate indication (42) (fig. 15);
- manoeuvring seat for insertion of the lever to rack-in/rack-out the transformer trolley (43) (fig. 15);
- trolley guides (55) (fig. 16);
- metal damper (57) for segregation of the sectioning contacts inside the monoblocks and activation mechanisms of the shutters (56) (fig. 16);
- sliding contacts of the transformer auxiliary circuits (58) (fig. 16);
- inserted transformer trolley signalling contacts (60) (fig. 16);
- disconnected transformer trolley signalling contacts (61) (fig. 16).

Voltage transformer trolley:

- Door closing latch actuator (45) (fig. 17); manoeuvre seat of the insertion/disconnection lever (46) (fig. 17);
- door closing latch release pin (47) (fig. 17);
- door locking screws (48) (fig. 17);
- voltage transformers (53) (fig. 18);
- additional right and left guides (52) (fig. 18).

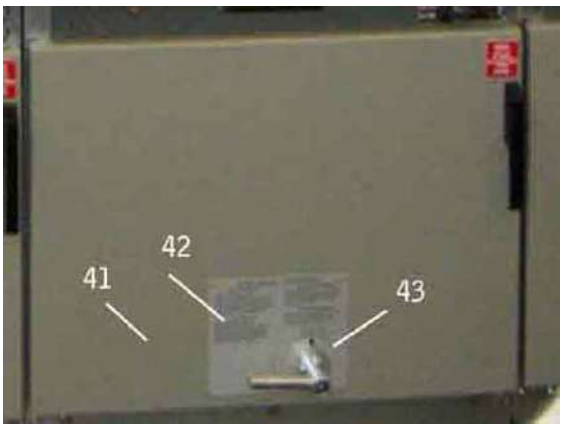


fig.15 – Voltage transformer compartment (front door closed and withdrawing lever)

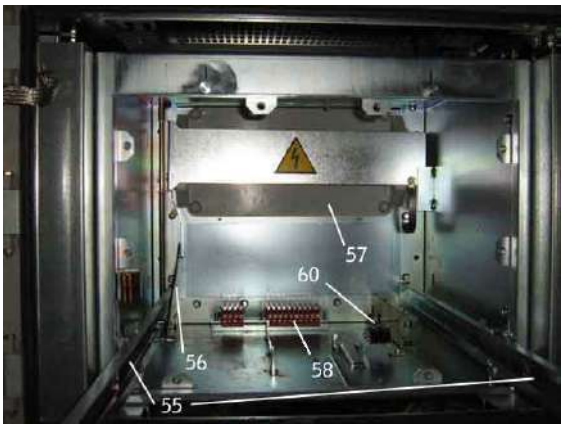


fig. 16 – voltage transformers compartment (internal view)

fig.17 – Voltage transformer compartment (front door open)

fig.18 – Voltage transformers on the withdrawable trolley

LV compartment

The LV compartment, positioned above the C.B. compartment, can contain all the low voltage components (see fig. 19).

In particular, the LV compartment unit houses:

- the terminal block and the cables (inserted in specific ducts) for the connections between the compartments and for connection of the auxiliary cables
- the field control cables terminal blocks
- switch and compartment auxiliary accessories (measuring instruments, protection relays, control and signalling devices, fuses, low voltage switches, etc.)
- the auxiliary switch position contacts (on/off) (on request)

The unit is partitioned by a plate with the relative cable glands for accessing to the upper duct.

fig.19 – Low voltage compartment

Distribution busbar unit

The distribution busbars unit (see fig.20) houses the main busbars system, fitted on the through-terminals of the MV switch unit.
Segregation with respect to the line unit is ensured by removable sheet metal plates.

fig.20 – Distribution busbar compartment

5.3. Ducts for gas venting due to overpressure caused by internal arcs

The electric arc that can spread inside a panel represents a danger for users who access, transit or stop near the switchboard.
The possibilities of developing an internal arc are extremely remote; however, if this happens, all configurations of the MINIVER/C panels have been designed with appropriate technical solutions.
The hot gases and overpressure generated by the arc fault are conveyed towards the top, into the internal exhaust duct and finally released outside, preventing direct impact and injuries to the operators.

When required, a dedicated duct can be provided for routing the exhaust gas outside the room.

5.4. Interlocks

The manoeuvres must be carried out with the normal operating force (not exceeding 200 N) using only the appropriate levers. If the manoeuvres are prevented, do not force the mechanical interlocks and check the correctness of the manoeuvres themselves.
The blocks can be operated with a maximum force of 400 N, using the appropriate manoeuvring tools.

The locks used in Miniver-C units are mechanical and electrical, with microswitches that give continuity or interrupt the circuits. The mechanical locks are divided into:

- force locks;
- impediment locks;
- electromechanical locks;
- safety locks (padlocks/keys).

The locks provided for Miniver-C modules are those indicated in the following table:

Description of the blocks	Appliances	Appliances compartment
Electrical lock that prevents the devices from closing when the trolley is not in the inserted and disconnected positions.	Yes	
Mechanical lock that, in the closed position, prevents insertion and extraction of the devices.	Yes	
Mechanical lock that prevents the devices from closing when the trolley is not in the inserted and disconnected positions.	Yes	
A block that prevents the insertion of an appliance into a compartment designed for an appliance of a different type or size. The lock is located in the connector.	Yes (fig. 21 - det. 4)	Yes (fig. 21 - det. 4)
Locking electromagnet on the trolley of the appliances which, in the absence of voltage, prevents insertion or extraction.	Yes (fig. 29a - det. 43)	
Electromechanical lock that prevents the door from opening if the appliances are not in the disconnected position.		On request (fig. 23 - det. 8)
Mechanical lock that prevents insertion of the appliances if the door is open.	On request	On request (fig. 29 - det. 17)
Mechanical interlock with earthing switch: when the earthing switch is closed, the appliances cannot be inserted; with devices inserted or in the intermediate positions between inserted and disconnected, it is not possible to close the earthing switch.	Yes (fig. 28 - det. 14) Yes (fig. 28 - det. 60) (fig. 29a – det. 12)	Yes Yes
Mechanical lock that prevents manual opening of the dampers if the appliances are removed. (Fail-Safe).	On request (fig. 22 - det. 3)	On request (fig. 28 - det. 3)
Key lock with earthing switch open. It can only be operated with the earthing switch open. The key can only be pulled out when the block is active.		On request (fig. 24 - det. 33)
Key lock with earthing switch closed. It can only be operated when the appliances are disconnected and the earthing switch is closed. The key can only be pulled out when the block is active.		On request (fig. 24 - det. 34)
Lock that blocks the dampers in the closed position.		On request (fig. 25 - det. 52)
Mechanical lock that prevents extraction of the connector of the auxiliary circuits when the devices are inserted and during insertion and extraction.		Yes (fig. 21 - det. 5)
Electromechanical lock for earthing switch, which, with the coil de-energised (BED), prevents opening and closing of the earthing switch.		On request (fig. 26 - det. 53)
Door lock with earthing switch open.		

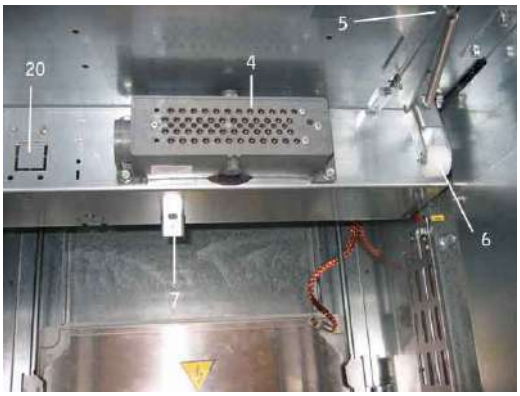


fig. 21 – Internal view

fig. 22 – Internal view

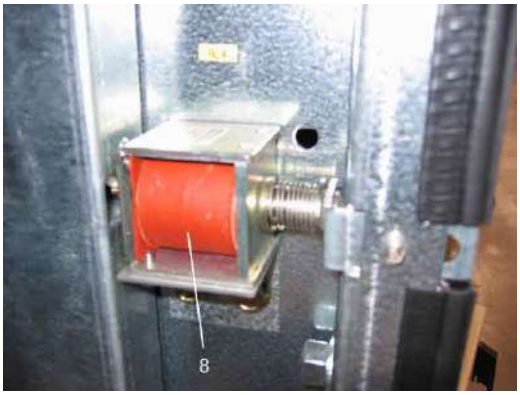


fig. 23 – Internal view

fig. 24 – Front view

fig. 25 – Internal view

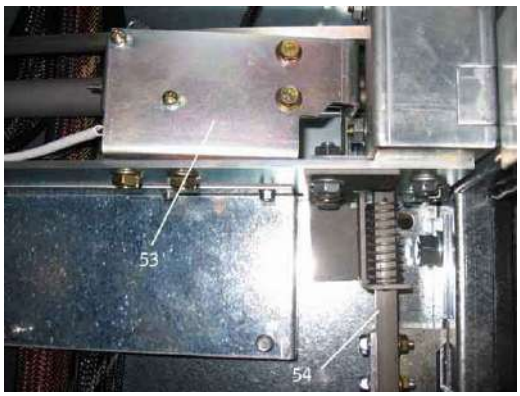


fig. 26 – Internal view

fig. 27 – Internal view

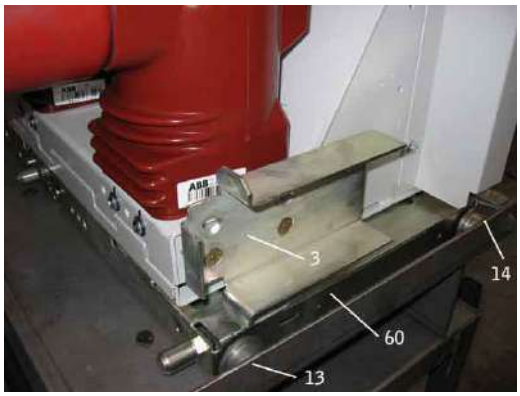


fig. 28 – Internal view

fig. 29 – Front view with door open

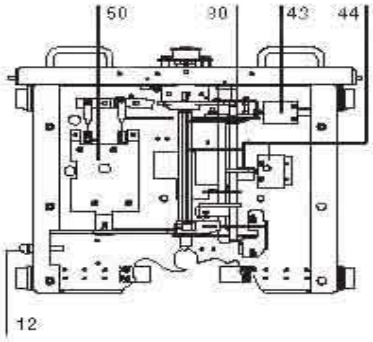


fig. 29a – Internal view

5.5. Reference standards

IEC 62271-1	for MV general appliances
IEC 62271-200	for MV switchboards
IEC 62271-102	for earthing switches
IEC 60071-2	for insulation coordination
IEC 62271-100	for MV circuit breakers
IEC 62271-106	for MV contactors
IEC 60271-103	for MV switches and switch-disconnectors
IEC EN 60529	protection degrees classification of casings

6. INSTALLATION

Correct installation is paramount. The manufacturer's instructions must be carefully studied and followed. The final drawings are provided shortly before shipment of the panel to allow appropriate preparation of the installation site. The drawings include overviews, front and sectional views, layout of the holes on the slab and the fixing points of the panel, operational drawings and, if necessary, the topographical drawing.

6.1. Installation conditions

The panels are intended to be used under operating conditions of temperature and humidity considered normal in accordance with the provisions of sect.2.1 of IEC 62271-200.
Any special operating conditions are managed at the request of the Customer.

6.2. Place of installation

When positioning the switchboard, leave a minimum clearance on the front (at least 1500 mm) and on the back (at least 1100 mm; 10 mm for the panels intended for wall mounting) and on the sides of the switchboard with respect to the walls of the room and other obstacles. Please, refer to the General Arrangement Drawings, for better details.
The space on the front of the panel must be sufficient to allow opening of the doors, removal and insertion of the circuit breakers and their transfer to other compartments or away from the room.
The use of dedicated lifting and handling devices is to be considered, when calculating the necessary clearance on each side.

SAFETY PRECAUTIONS

The safety provisions provided for in the Emergency and Evacuation Plan must be respected to allow free passage to the emergency exits.

6.3. Foundations and fixing plan

The floor or foundation must be strong enough to withstand the weight of the module without bending.
The foundation must be well prepared before installation, in accordance with the instructions of the project documents. Considering that permissible tolerances and corrections are minimal, the panel must be installed on a perfectly smooth and horizontal surface.

The switchboard or the different sections that compose it can be supplied with base rods, shipped together with the switchboard or before delivery, to allow preparation of the foundation in accordance with the drawings provided.

PRECAUTIONS

- **clean the area provided for the installation of the fixing surface**
- **visibly trace on the slab the perimeter of all the compartments constituting the panel, taking into account the minimum distances from the walls and from any obstacles present in the room**

The compartments can be fixed directly to the floor or to steel surfaces, in particular:

1. fixed on masonry flooring without base rods
2. fixed on masonry flooring with base rods
3. fixed on a steel surface with a base frame

1. This fixing technique must comply with the following rules:
   - Level the floor longitudinally and transversely with a tolerance of ± 1mm over a length of 1 m;
   - Drill the floor at the fixing points by means of an impact drill with tip diameter and depth appropriate to the expansion plugs;
   - Insert the expansion plugs into the holes
   - Cause expansion of the plugs in the floor by pushing with a hammer and drill of adequate diameter
2. In this case it is necessary to:
   - Install the base rods, which can be supplied by the manufacturer at the request of the Customer, in the slab before finishing the floor.
   - place and align the rods on the floor so that they are parallel and adequately spaced from each other as required by the construction drawings (foundation drawing)
   - Level the floor longitudinally and transversely with a tolerance of ± 1mm over a length of 1 m;
   - secure the base rods in this position by means of the expansion plugs using the appropriate holes provided in the rods themselves.
   - complete the flooring so that the base rods protrude by 5 mm with respect to the finished surface of the floor
3. This mode must follow these points:
   - position and align the base frame on the floor;
   - secure the base frame to the floor by means of welding beads with a length of 8-10 cm, which must be carried out with a step of approximately 20-25 cm along the entire perimeter of the frame, respecting the sequence shown in the annexed drawing (ann.1)

The panel or the various sections that compose it, can be provided, on request, with base rods supplied with the panel itself or supplied in advance to allow prior preparation of the support surface according to the drawings sent.

6.4. Installing the compartments

To ensure that the panel has been installed correctly, check that:

- the compartments are firmly fixed to the floor and correctly aligned
- the front of the panel is perfectly vertical
- the sections (and/or compartments) of the panel have been coupled and all the ground busbars and auxiliary connections have been completed
- the ground busbar of the panel has been connected to the earthing system.
- the power connections with the utilities and the auxiliary connections of the control circuits have been made.

To properly align the panel, draw a line on the floor, several cm away from the front and parallel to the final installation position of the panel. When positioning and fixing the panel to the floor, make sure that the distance of the panel from this line is the same.

After positioning the first compartment section, align the next sections as described above.
The compartments must be fixed to the floor starting from the centre of the switchboard and gradually adding the side compartments.
The table below indicates the tightening torques to be applied to the nuts and screws to fix and connect the compartments and the distribution busbar.

Screw Type	Tightening Torque (Nm)		
	Minimum	Nominal	Maximum
M 5	4.5	**5**	5.5
M 6	8	**9**	10
M 8	19	**22**	25
M 10	40	**45**	50
M 12	68	**75**	83
M 14	100	**115**	130
M 16	160	**185**	200

In the case of hardware other than that mentioned above, apply a tightening torque corresponding to the strength class of the fixing device in question.

6.4.1. Positioning the compartments

- Lift the compartment units and deposit them on the line drawn on the floor
- Secure the central compartment to the floor
- Make sure that the side compartments are positioned correctly, joining them to the central compartment and securing them to the floor

6.4.2. Securing the compartments to the floor

Using expansion plugs: install the plates on the slots using screws and washers (flat and glover)
With base rods or a subframe:

- insert the blocks into the base rods passing through the slots
- install the plates on the slots using screws and washers (flat and glover)

6.4.3. Joining the compartments

Secure the outer sheet metal plates at the appropriate points by means of nuts and screws (to determine the exact position of the fixing points, refer to the position of the screws of the joint compartments from our workshop).

6.4.4. Connecting the main distribution busbars

The distribution busbars are connected between the compartments by means of standardised elements; all the necessary components are contained in the supplied hardware bag.
It may be necessary to remove the unit segregation plates to reach the connection points.
Before assembling the main distribution busbars, thoroughly clean the contact area with a clean cloth soaked in alcohol or in a suitable solvent. Rub with neutral grease.
The tightening torque of the nuts and screws is indicated in the table in para. 6.4.

IMPORTANT! If the surfaces are silver plated, it may stain under certain environmental conditions, without however damaging the resistance of the contacts. Never use any type of file (as it may damage the silver coating of the bar couplings). If it is necessary to use similar tools, remember to restore the silver coating of the bars.

6.4.5. Connecting the earthing busbar

Usually, all the compartments of the panel are equipped with a 250 mm2bare ground busbar.
The ground busbar must be connected to the coupling joints of the panel compartment units, after having removed any traces of oxidation from the contact area of the distribution busbars with an emery cloth.
Secure the ground busbar using the screws, the flat washers, the spring washers and the corresponding nuts.

6.4.6. Connecting the auxiliary circuits

After fixing and coupling the electrical cabinet compartments, couple the auxiliary connections.
The wires of the auxiliary connections, equipped with terminals and detached from the terminal board of the compartment to which they must be connected, are curled up and positioned near the compartment.
To ensure correct identification of the terminals to which they are connected, the wires are generally provided with a numbered ring.
Follow the instructions on the drawings.

6.5. Installing the compartments – external connections

6.5.1. External connections - earthed

The ground busbar extends longitudinally in the lower section at the back of the panel.
The holes at its ends are provided for connection to the system earthing system.
Screws and bolts must be tight at the specified torque to prevent loosening due to vibrations during operation.
The location of the connection to the earthing network of the system is illustrated in the project drawings and must be carried out at the two ends of the switchboard. This connection must be as short as possible and must not be inserted into metal pipes. The ground conductor must be sized to withstand the specified maximum ground fault current. In general, the conductor section must not be less than that of the ground busbar of the switchboard.

6.5.2. External connections - power circuit connections

The output terminations of the line unit are silver-plated and arranged for connection by means of a lug.
Pay particular attention to the correct position and direction of the cycle of the phases and to all the connections to ensure parallelism of the two systems, as well as the correct direction of rotation of the motors supplied, in order to ensure the regular insertion of the measuring and protection instruments.
If the terminations are installed inside the panel, take appropriate precautions to avoid sudden changes in direction, angles and sharp edges that could damage or destroy the insulation.
Pay particular attention also to the radius of curvature of the cable.
Provide adequate mechanical and electrical distances between the cables, the live busbars and the sheet metal plate. The input cables of the different units must be fixed in such a way as to prevent tugging or stress on the terminals.

The cable supports must be arranged and fixed on the structure of the panel in order to resist the electrodynamic stresses due to the short circuits.
The connection of each cable must be fixed separately, to facilitate maintenance or replacement of the cables.
The surface coating of the connections depends on the type of conductor used and the environment, as indicated in the table below.

ENVIRONMENT INSTALLATION	SURFACE COATING OF CONNECTIONS	
	COPPER	ALUMINIUM
NORMAL	NONE	RUB WITH NEUTRAL GREASE
POLLUTED	LEAD OR SILVER	SILVER PLATED
AMBIENT TEMPERATURE ABOVE 40 °C	SILVER PLATED	SILVER PLATED

6.5.3. External connections - auxiliary circuit connections

To connect the auxiliary circuits, refer to the diagram of each compartment.
Each compartment is arranged, through a suitable output terminal board, to receive connection wires coming from the outside.
These terminal blocks are usually equipped with screw terminals suitable for connecting wires without terminals.

The panel can be equipped with an upper or lower cable entry, with a conduit for the auxiliary cables.

6.6. Protection from pollutants

If the panel is installed in a polluted environment, silicone spray grease must be applied to the live parts.
During the installation phase, this operation can only be necessary if the grease applied in the factory has been removed during the operations.
The grease application points are indicated in the maintenance chapter.

6.7. Painting

Any damage to the external painting of the panel, scratches or peeling caused during installation operations, can be repaired as indicated in the chapter on maintenance.

7. ACCESS TO THE CABLE CONNECTION AREA

7.1. Access from the front

Rack-out the MV circuit breaker or contactor and then close the earthing switch
Attention! In case of units with forced ventilation, disconnect the fan power supply.

Procedure

- check, from the front inspection window (fig. 11, item 1) whether the earthing switch blades are really in closed position;
- check that the front indicator of the earthing switch status (fig. 12, item 11) is in position ⏚ , which represents the closed status;
- loosen the retaining screws of the front panel (fig. 30);
- loosen the two retaining screws (right side) of the MV switch compartment panel;
- loosen the two retaining screws (left side) of the MV switch compartment panel;
- lift and remove the MV switch compartment panel (fig. 31);
- access the cable connection area of the unit (fig. 32)

fig.30 – Disassembly procedure

fig.31 – Disassembly procedure

Fig.32 – Disassembly procedure

7.2. Front access through the voltage transformer unit

- Remove the voltage transformer trolley
- Disassembly of the voltage transformer compartment (fig. 33)
- Loosen the retaining screws (right and left side) of the voltage transformer unit (fig. 34)
- Move the guides (right and left) against the walls of the panel
- Loosen the retaining screws of the panel at the base of the panel (fig. 35)
- Loosen the retaining screws of the transformer unit base (fig. 36-37)
- Remove the transformer unit as shown in fig. 38 and 38a

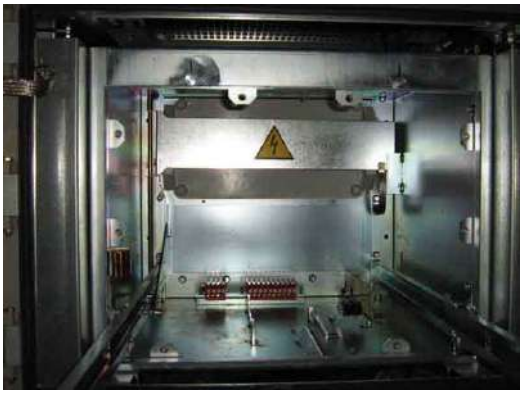


fig.33 – Voltage transformer compartment - Internal view

fig.34 – Disassembly procedure

fig.35 – Disassembly procedure

fig.36 – Disassembly procedure

fig.37 – Disassembly procedure

fig.38 – Disassembly procedure

fig.38a – Disassembly procedure

7.3. Access from the back

Rack-out the MV circuit breaker or contactor and then close the earthing switch
Attention! In case of units with forced ventilation, disconnect the fan power supply.

Procedure

- check, from the rear inspection window (fig. 39, item 61) whether the earthing switch blades are really in closed position;
- check that the front indicator of the earthing switch status (fig. 12, item 11) is in position ⏚ , which represents the closed status;
- loosen the retaining screws at the perimeter of the rear panel (fig. 39, item 62) and remove the panel;
- access to the MV cable connection compartment of the unit (fig. 40).

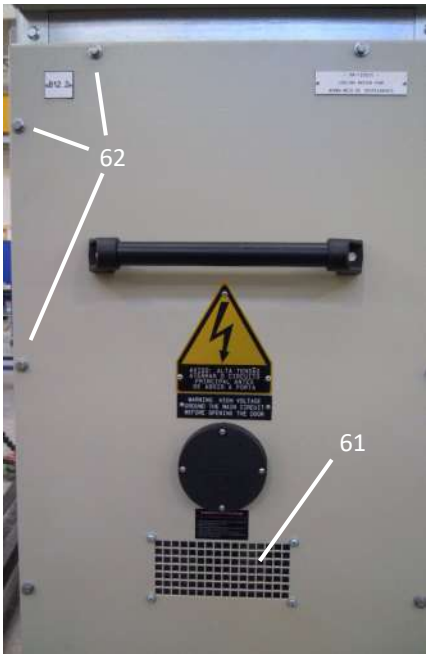


fig.39 – Rear side of the switchboard (closing panel at the cable compartment)

fig.40 – MV cable compartment

8. COMMISSIONING

8.1. General notes

Operations related to the commissioning of IMESA panels must be carried out by qualified personnel who have a detailed knowledge of the equipment and of the system.

- If the manoeuvres are prevented, do not force the mechanical interlocks; check the correct sequence of the manoeuvres being carried out.
- Before opening the front door of each compartment, always check the correct position of the earthing switch (closed) through the external mechanical signalling and the position of the blades through the inspection window.
- Only power the panel with the appliances open and the doors closed.
- Before commissioning the panel, carry out the following checks; at the end of the operations, check that everything is restored to its original condition.
- In case of negative verification, do not put the panel into service and if necessary, contact IMESA.

Before commissioning the panel, carry out the checks shown in the following table.

Object of the check	Operation and Controls	Notes
Compartments	Visually inspect the inside and outside, ensuring there is no obvious damage: remove any foreign bodies (such as tools or test connections that may have been forgotten during installation). Carefully clean the insulating parts, removing any traces of moisture. Remove dust or dirt from air intake grilles and vent ducts	
Main circuit connections	Check that bolted connections of the MV and earthing circuits (at busbars, CBs poles, CTs, VTs, etc.) are suitably tighten. No misalignment is allowed at the marks provided over the bolt, during torque wrench tightening at the factory. In case found, to torque wrench again the connection (see par. 6.4). Torque wrench all the bolted joints of the shipping sections, which have been coupled at site, according to the values indicated at par. 6.4. After tightening, each bolt is to be marked to indicate its relative position against the fixed part (as already done for the torque wrench tightening provided at the factory).	

Object of the check	Operation and Controls	Notes
Grounding bars and relevant branch connections	Check that bolted connections of the earthing circuits are suitably tighten. In case found loose connections, to torque wrench it again (see par. 6.4).	Check the efficiency of the earthing according to the accident-prevention regulations.
Insulation	Measure the insulation resistance of the power circuits (phase to ground) by 2500 V or 5000 V d.c. and the insulation resistance of the auxiliary circuits by 500 V d.c. by means of Megger testing device. The measured value must be >1000 MΩ for power circuits and >2 MΩ for auxiliary circuits.	The insulation resistance value may be affected by environmental conditions. The panel must not be put into service if the insulation resistance is very low, for example less than 50 MΩ. If the low value of the insulation resistance is attributable to the humidity of the environment, use temporary heaters to resolve the problem.
Switches and contactors	Perform on each appliance the operations prescribed by the relevant instructions before commissioning. Check the presence of the manoeuvring devices and accessories provided for normal operation. Insert the appliances into the relevant units and connect the plugs of the auxiliary circuits. Close the doors of the units and bring the appliances to the "inserted" position.	The spare keys of each safety lock must be stored in a place not accessible to the personnel assigned for the operations. The operations are indicated in the instructions of each switch
Auxiliary circuits	According to the schematic diagram of the panel, check the functionality and the service sequence of the automation and of all the auxiliary relays.	Before performing this check, verify the calibrations of all the relays installed in the panel.

In case of particular system configurations, it is possible that the tests shown in the table must be integrated with others to be established by the system technical manager.
Check that the secondary winding of the current transformers is grounded and connected to the relative amperometric circuit of protection and/or measurement; then, remove all the short-circuit connections at the testing terminal blocks (if provided).

If the secondary winding of the voltage transformers is to be connected to any external equipment, the following conditions must be verified, to avoid overloads or short circuits of the voltage transformers:

- Check that the total self-consumption of the powered equipment does not exceed the performance of the voltage transformer.
- Check that there are not incorrect connections in the measuring circuit (possibly even temporary) and, in any case, not in accordance with the schematic diagram of the panel and of other system units (power supply panel, sub-distribution panels, control or manoeuvring benches, etc.).

- Check that only one of the secondary windings of the voltage transformers is earthed. This verification is particularly important on the power supply side of the devices that can be connected to each other by means of a connector. The system configuration described above is in fact used in cases where it is necessary to place in parallel several power supply circuits.

At the end of the preliminary tests, perform the following operations:

- Open and disconnect all the trolleys (MV switches and contactors).
- Remove any test connection and restore the temporarily disconnected circuits, at the testing terminal blocks of the protection relays.

RECOMMENDATIONS

It is advisable to manually load all the closing springs of the switches before powering the auxiliary circuits, to avoid excessive current absorption as a result of the simultaneous starting of the gearmotors.

Also, remember to:

- Ensure that the internal metal segregations have been properly installed.
- Verify that the various mechanical and electrical interlocks (possibly switched off to carry out the commissioning tests, with dead panel) have been restored.
- Close all the doors and the panels of the switchboard.
- Power on the auxiliary circuits and the power circuit.
- Close the MV switches and contactors, by following the operating sequence of the system and making sure that each relative function regularly takes place as envisaged.
- Check the correct operation of the measuring instruments.

8.2. Instructions for operation of the devices and sequence for operations of the units

The operations must be executed with all the doors and panels of the switchboard closed.
Given the type of accessibility of the internal arc resistance requirement (type A), the operator must keep a safety distance of at least 30 cm from the switchgear.
The manoeuvres must be carried out with the normal operating force (not exceeding 200 N) using only the appropriate levers (see fig. 41). If they are prevented, check the correct manoeuvring sequence.

Manoeuvring accessories and devices:

fig.41 – Manoeuvring accessories

Legend
1. Earthing switch manoeuvring lever
2. MV Circuit breaker spring loading crank
3. MV Circuit breaker / Contactor racking-in/racking-out lever
4. Voltage transformer trolley racking-in/racking-out lever
5-6. Additional guides for racking-in/racking-out of the voltage transformer trolley

8.2.1. Racking-in/racking-out/removal of the MV appliances

If manoeuvres are carried out with the appliance removed from the panel, pay the utmost attention to the moving parts. The appliance must only be inserted into the unit in the open position. Insertion and extraction must be gradual to avoid impacts that can deform the mechanical interlocks.

8.2.1.1. MV Circuit breakers and Contactors

a) Racking-in (with MV circuit breaker or contactor open)

(1) Switching from the “removed from the panel” position to the "racked-out" position

- lift the appliance device (2) (fig. 42) and place it on the handling trolley (1);
- open the door of the circuit breaker compartment;
- align the trolley (1) (fig. 42) with the panel;
- insert the coupling bracket (4) and lock the wheels (fig. 43);

- release the circuit breaker trolley by simultaneously moving the two handles (5) (fig. 44) towards the median axis of the switch and, at the same time, progressively push the handles of the switch towards the bottom of the module, until the circuit breaker unit locks with the handles (5) (fig. 45) that click sideways, sliding into the slots (6) (fig. 43);
- unlock the wheels, lift the coupling bracket (4) (fig. 43) and move the handling trolley away from the panel.

Make sure the handles are clicked sideways (horizontal trolley locks inserted in the frame of the case)

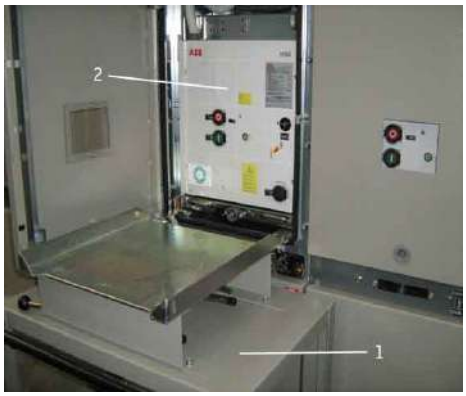


fig.42 – Insertion

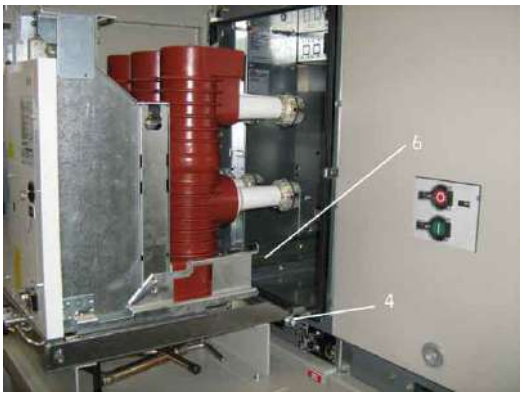


fig.43 – Insertion

fig.44 – Insertion

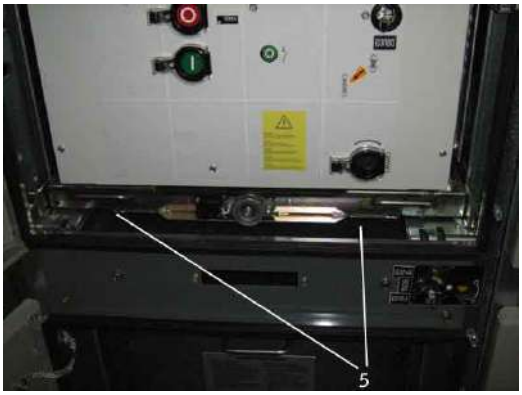


fig.45 – Insertion

(2) Switching from the "racked-out" position to the "test" position (connection of the auxiliary circuits).

- Insert and attach the mobile connector (fig. 46) into the fixed socket of the casing (fig. 47).

Make sure that the lever (3) (fig. 47) is fully pressed against the connector (1) (fig. 47)

fig.46 – Connecting the auxiliary circuits

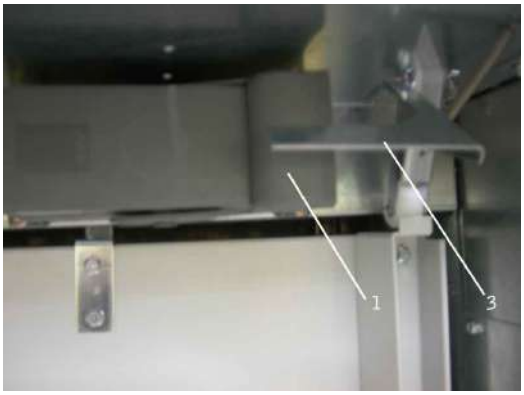
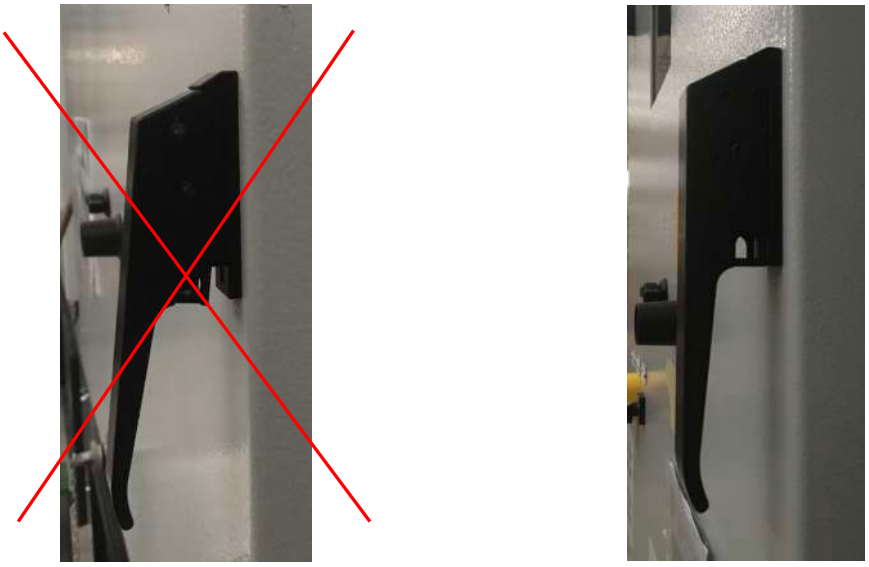


fig.47 – Connecting the auxiliary circuits

(3) Switching from the "test" position to the "racked-in" position (with the earthing switch closed) (fig. 49).

- Close the MV circuit breaker compartment (1) (fig. 49) and pushdown the door handle;
- press the push-button on the LV compartment door, which releases the locking magnet of the door handle, at the MV circuit breaker compartment door;
- close the MV circuit-breaker compartment door (1) (fig. 49), pushing down completely the handle and checking the door is definitely closed and secured (see fig. 48.a, 48.b);



b. not completely closed position

a. completely closed position

fig.48 – Circuit breaker compartment door handle

WARNING: the door handle shall be pushed down to its complete close position, represented in the right hand picture (fig. 48.b).
If the handle is not in its complete close position, the door is not yet really closed and the functionality of the interlocks is not guaranteed.

- close the line compartment door (2) (fig. 49) and push down the handle;
- ensure that the earthing switch locking magnet (if provided) is properly powered on;
- ensure that the key locks (7-8) (fig. 49) are deactivated, if provided;
- insert the manoeuvre lever (13) (fig. 49) in the seat of the earthing switch, making the projection (12) line up with one of the two slots (11) (fig. 49);
- open the earthing switch by turning the manoeuvre lever (13) anti-clockwise;
- remove the manoeuvre lever (13) from the earthing switch seat;
- check on the manoeuvre seat (11 - fig. 49) and, in versions without forced ventilation, through the inspection window (6), that the earthing switch is open (indicator in position "O");
- In the case of switchboards having front access only, to the MV cable compartment => Check that the line compartment door (2) (fig. 49) is locked.
- close the cover of the earthing switch manoeuvre seat, turning the actuator (10) (fig. 49) clockwise; this operation releases the racking-in manouevre of the MV circuit breaker or contactor and activates a lock that prevents insertion of the manoeuvring lever in the earthing switch;

- check that the locking magnet on the trolley of MV circuit breaker or contactor (if provided), is powered on and check that the key lock that prevents racking-in operation (if provided) is deactivated;
- fully insert the trolley racking-in/racking-out lever (3) (fig. 41) into the corresponding coupling (5) (fig. 49) and turn it clockwise until the MV circuit breaker or contactor is fully racked-in;
- check that the MV circuit breaker or contactor is actually racked-in, through the inspection window (4) (fig. 49).

fig.49 – Handling for the earthing switch

b) Racking-out (with MV circuit breaker or contactor open)

(1) Switch from the "racked-in" position to the "test" position

- check that the locking magnet on the trolley of MV circuit breaker or contactor (if provided), is powered on
- fully insert the trolley racking-in/racking-out lever (3) (fig. 41) into the corresponding coupling (5) (fig. 49) and turn it anti-clockwise until the MV circuit breaker or contactor stops;
- check that the MV circuit breaker or contactor is actually racked-out, through the inspection window (4) (fig. 49).

(2) Switching from the "test" position to the "racked-out" position (disconnection of the auxiliary circuits)

- open the door of the MV switch compartment (1) (fig. 49), by pulling the handle upwards;
- release the mobile connector and remove it from the fixed socket of the casing (fig. 46, 47).

(3) Switching from the "racked-out" position to the "removed from the panel" position

- bring the trolley close to the panel (fig. 42);
- insert the coupling bracket (4) (fig. 43) and lock the wheels;
- simultaneously move the two handles (5) (fig. 44) towards the median axis of the MV switch and at the same time progressively pull the handles of the switch outwards towards the handling trolley;
- release the handles and continue to withdraw until the MV switch trolley is locked, by clicking the handles sideways;
- release the wheels, lift the coupling bracket (4) (fig. 43) and move the trolley away from the panel.

c) Disabling the door lock of the MV switch (circuit breaker or contactor) compartment

Operation only to be carried out in the event of an emergency, by personnel who have an adequate knowledge of the equipment and the system; since the safety interlocks are being bypassed.

If the door lock of the MV switch compartment is present and it is necessary to force unlocking and opening of the door, bypassing the safety interlock that allow opening of the door only when the MV circuit breaker or contactor is in the test or racked-out position, loosen the screw (1), push the lever (2) and open the door by pulling the handle upwards (fig. 50).

fig.50 – Front door

8.2.1.2. Voltage transformer trolley (VT)

a) Positioning the VT trolley into the compartment

- open the door of the unit by pulling the handle (15) upwards;
- insert the additional left and right guides into the side slots as in (52) (fig. 55);
- lift the front of the voltage transformer trolley and insert the front wheels into the additional guides (fig. 51);
- push the trolley towards the bottom, lift the rear and insert the rear wheels into the slots of the additional guides (fig. 51);
- push the trolley towards the bottom until it locks;
- remove the additional left and right guides (fig. 52);
- attach the front door (fig. 53), insert the earthing connection of the door, rotate clockwise the handle (45) (fig. 54) and push the door forward;
- fix the position of the front door by rotating anti-clockwise the handle (45) (fig. 54);
- tighten the door retaining screws (48) (fig. 54);
- move the pin (47) (fig. 54) to the left, freeing the hatch (46) (fig. 54) which enables insertion of the manoeuvring lever (4) (fig. 41);
- close the compartment door by pushing the handle (fig. 15) downwards.

b) Removing the VT trolley from its compartment

- open the door of the unit by pulling the handle (15) upwards;
- move the pin (47) (fig. 54) to the right, to close the hatch (46) (fig. 54) which prevents insertion of the manoeuvring lever (4) (fig. 41);
- turn clockwise the handle (45) (fig. 54);
- loosen the door retaining screws (48) (fig. 54);

- remove the front door;
- insert the additional left and right guides in the slots (52) (fig. 55) – (Fig. 52);
- pull the trolley outwards until it locks;
- lift the rear of the trolley and remove the rear wheels from the additional guides (fig. 51);
- pull the trolley outwards until it locks;
- lift the front of the voltage transformer trolley and remove the front wheels from the additional guides (fig. 51);
- remove the additional left and right guides (52) (fig. 55);
- close the compartment door by pushing the handle (fig. 15) downwards.

fig.51 – Placing/Removal of the voltage transformers

fig.52 – Placing/Removal of the additional guides for the VT trolley

fig.53 – Placing/Removal of the voltage transformers

fig.54 – Voltage transformer compartment

fig.55 – Voltage transformers removed from the VT compartment

c) Putting in service the VT trolley

The operation of putting in service the voltage transformer trolley must be carried out with the front door closed.

- Insert the manoeuvring lever (fig. 56 – the protrusion on the lever shall be lined up with the slot in the manoeuvring seat);
- rotate the lever clockwise and push hard until it is fully engaged;
- from the racked-in position, turn the lever anti-clockwise, until the indexes line up and the manoeuvring lever remains engaged (fig. 57);
- check that, by pulling the handle upwards, the front door does not open.

d) Putting out of service the VT trolley

- turn the lever clockwise (fig. 57) and pull it outwards, until it reaches the position of VT trolley completely racked-out;
- remove the manoeuvring lever from the seat, aligning the projection of the lever with the slot;
- open the front door by pushing the handle upwards. In this condition, the voltage transformers trolley is racked-out and grounded and the auxiliary circuits of the transformers are disconnected.

fig-56 – Putting in service / out of service the VT trolley

fig-57 – Putting in service / out of service the VT trolley

8.2.2. Manoeuvring the earthing switch

Check that the key locks on the earthing switch (if present) are deactivated and the electromechanical lock of the earthing switch (if present) is properly powered on. The earthing switch can only be operated with the MV circuit breaker or contactor in the test, racked-out or removed position. Once started, the manoeuvres must be carried out until completion.

8.2.2.1. Closing the earthing switch

- Check that the MV switch is in the test, racked-out or removed position;
- open the cover of the earthing switch manoeuvre seat, by turning the actuator (10) (fig. 58) anti-clockwise; the earthing switch manoeuvre seat is then released;
- insert the manoeuvre lever (13) (fig. 49) in the seat of the earthing switch manoeuvre by matching the projection (12) with one of the two slots (11) (fig. 58);
- close the earthing switch by turning clockwise the manoeuvring lever (13) (fig. 49);
- remove the manoeuvring lever;
- check on the manoeuvre seat (58) and, in the versions without forced ventilation, through the inspection window (fig. 9-1), that the earthing switch is closed (indicator in the position " ⏚ ").

8.2.2.2. Opening the earthing switch

Insert the manoeuvring lever (13) (fig. 49) in the manoeuvre seat of the earthing switch matching the projection (12) line up with one of the two slots (11) (fig. 58);

- open the earthing switch by turning the manoeuvring lever (13) (fig. 49) anti-clockwise;
- remove the manoeuvring lever (13) (fig. 49) from the earthing switch manoeuvre seat;
- check on the manoeuvre seat (fig. 58) and, in versions without forced ventilation, through the inspection window (fig. 9-1), that the earthing switch is open (indicator in the position "O").
- close the cover of the earthing switch manoeuvre seat, by turning the actuator (10) (fig. 58) clockwise; this operation releases the MV switch racking-in operation and activates a lock that prevents insertion of the earthing switch manoeuvring lever in the earthing switch manoeuvre seat.

fig.58 – Manoeuvre seat for the earthing switch

8.2.3. Replacement of voltage transformer fuses

Check that the rated current of the fuses to be installed corresponds to the value indicated on the switchboard's schematic diagrams and bill of materials.

- Put out of service the VT trolley, following the procedure provided at par. 8.2.1.2.d and, then, the procedure for removing the VT trolley from the compartment, provided at par. 8.2.1.2.b;
- turn clockwise the fuse contact ring nut (fig. 59) and remove it;
- remove the fuse and replace it;
- insert the contact ring nut and rotate it anti-clockwise;
- place the VT trolley in its compartment, following the procedure provided at par. 8.2.1.2.a and, then, the procedure for putting in service the VT trolley, provided at par. 8.2.1.2.c.

fig-59 – Replacement of voltage transformers fuses

9. MAINTENANCE

Safety precautions

Before carrying out any maintenance on the panel or on the installed equipment, it is necessary to:

- ✓ **remove voltage**
- ✓ **earth the main circuits**

Use equipment and apparatus that complies with the current safety regulations
The personnel performing maintenance must be adequately trained and instructed
Use voltage detectors
Use barriers and hazard warning signs

9.1. General Information

Electrical equipment is sensitive to environmental conditions and can be easily damaged by abnormal operating conditions.
Water, dust, heat, low temperatures, humidity, corrosive atmosphere, chemical residues, fumes, vibrations and other conditions can affect the performance and durability of electrical equipment.
Such conditions, if neglected, will result in premature system faults.

Repair costs can be avoided by observing the manufacturer's recommendations for application and maintenance. The most important rules to follow are:

- keep clean
- keep dry
- tighten bolts and connections
- prevent excessive friction of the mechanical parts.

Any defects must be removed immediately.
In the event of danger to persons, property or to the environment,
defective equipment must be taken out of service to prevent its use.

The following paragraphs provides instructions for the maintenance of the various parts of the switchboard; not including the electrical appliances, for which reference is made to the relative product instruction manuals.

a) Metallic structure

For metallic structure it is intended the set of components of the load-bearing construction, complete with removable panels, vertical and horizontal segregation metal sheets, hinges, doors and locks. These parts are generally coated by epoxy resin based paint or galvanised or chrome-plated with electrolytic process.

- **Cleaning painted parts**

Clean the painted parts with a solution of soap and water or, in the most difficult cases, with a common thinner for paints. In this case, it is in any case advisable to carry out a test on a surface that is not visible and check that the thinner does not remove the paint layer.

- **Retouching painted parts**

Obtain the material necessary for any retouching that may be necessary after installation, following the instructions of the paint manufacturer. If they are not available, proceed as follows:

- clean the part to be retouched with damp abrasive paper and smooth the edges of the damaged area;
- prepare the quantity of paint needed for the repair, adding 30% by weight of catalyst to the paint;
- perform a test retouch on a piece of sheet metal. Any scratches of the brush can be reduced by making the paint more fluid with the addition of solvent. The product prepared by this method can be stored in a normal refrigerator for approximately 24 hours, after which it will solidify.

- **Cleaning galvanised components**

Clean the galvanised and passivated parts (iridescent yellow coloured parts) with a dry cloth.
Any oil or grease can be removed with an alcohol damp cloth. To restore shine to the surface, repeat the previous operation, with a dry cloth.

- **Retouching galvanised components**

All parts are protected with a minimum zinc thickness of 12 microns; however, in the presence of reagents such as sea moisture, the metal could rust on corners, holes and edges, where the coating is thinner.
If this happens, remove the rust with abrasive paper or a metal brush, rub the residues of oil or grease, clean thoroughly and apply a galvanising product to the area.

- **Hinges**

They are lubricated at our workshops during assembly. If necessary, lubricate them again.

- **Locks**

The type of lock used depends on the degree and type of protection required.
The locks are of the knob type, with or without a key.
The moving parts do not require lubrication.

b) Mechanical drives

Mechanical drives are all the mechanical components of a compartment suitable for carrying out manoeuvres, locks and to act as safety devices. Force locks, stop locks and safety locks are considered mechanical drives. These devices are normally galvanised with an electrolytic process.
The moving parts are lubricated and tested during assembly of the panel.

PRECAUTIONS

- Mechanical locks should not be ignored but correctly used in order to avoid creating dangerous situations.
- Knowledge of the blocking process is essential, before using any mechanical block, so that all situations can be verified.
- When operation is prevented, before forcing the mechanical lock, test the mechanical operation sequence.

The mechanical interlocks must be placed in the final locked or unlocked positions without stopping in the intermediate positions. To achieve this, check the distances and adjustments by precisely following the instructions.
The mechanical interlocks must be tested several times to ensure that their movement is free, also checking the pressure necessary to carry out the operations.
Check the correspondence of the position of the mechanical interlock with the position of the controlled component and with the blocked equipment.
If excessive effort is observed in the device's operation, it means that the device is prevented in its movement by the presence of dust or by a modification of the adjustment of the mechanism itself.
To test the device, proceed as follows:

- remove the moving part, clean it and, if necessary, lubricate all parts subjected to movement or friction;
- test the efficiency of the operating device and, if necessary, clean and lubricate the parts subjected to movement or friction;
- test the efficiency of all the devices that compose the drive: pins, levers, pins, screws, nuts and washers, etc., and if necessary clean and lubricate;
- adjust the device, checking the force required for movement.

If during these tests an altered component has been noticed and it is not possible to change it, report the observation on the maintenance sheet and in the service book, indicate the anomaly with a sign on the compartment and inform the operating personnel.

- **Blocks**

For the force, stop and safety locks of the MV circuit breakers trolleys, MV contactor trolleys, special MV trolleys and MV circuit breakers or contactors fixed parts, refer to the relevant installation, operation and maintenance product instructions.

- Force blocks

They are all those devices whose action is based on the actuating force and which may be damaged by the application of a force exceeding normal resistance.
These devices are mechanical locks and control manoeuvres.

- Stop blocks

These are all devices whose action is based on interference that prevents the manoeuvre device from entering the control part seat and therefore from being controlled.
Application of excessive force will bring to the mechanical fracture of the stop block device.

- Safety blocks

They are all those devices that prevent access to a unit or compartment, if a certain operation, that allows the operator to reach the affected area without danger, has not been performed in advance.
These blocks are, for example, the door locking devices that prevent opening of the door of the MV cable termination compartment, if the earthing switch is not closed.

9.2. Maintenance schedule

The maintenance activity can be divided into two categories:

- **preventive maintenance**
- **extraordinary maintenance**

PREVENTIVE MAINTENANCE: activity aimed at preventing faults/interruptions, at limiting degradation and at maintaining optimal operating conditions of the switchboard.

EXTRAORDINARY MAINTENANCE: activity carried out following occurrence of a fault or for an intervention not included in the preventive maintenance.

9.2.1. Preventive maintenance and functional checks

Essentially, the frequency of preventive maintenance depends on the service conditions in which the switchboard operates; in fact, the performance and duration of electrical equipment can be influenced by operating and environmental conditions.

The maintenance intervals shall be reduced, when the plant or the appliance is installed in the presence of particular operating conditions (defined by the IEC EN 62271-200 Standard), in order to avoid that early faults can occur.

At present, no technical standard regulates the preventive maintenance of electrical equipment and, in principle, reference is made to the condition of defectiveness and therefore of danger to the safety.

Maintenance schedule

PART SUBJECT TO INSPECTION	FREQUENCY	ACTIVITY TO BE PERFORMED	SOLUTION
Metallic structure	12 months	Presence of dirt or scratches	Cleaning and retouching
Painted or galvanised parts	24 months	Presence of dirt, grease and/or rust	Clean and/or remove rust
Hinges, locks		Presence of dirt	Cleaning
Mechanical drives	12 months	Presence of dust or rust	Clean and remove rust
Force blocks		Additional pressure required for manoeuvring	Check the blocking sequence
Stop blocks		Incorrect adjustment	Adjust the tie rods
Safety blocks			
Disconnecting contacts	12 months	Silver coating blackening	Wipe with a cloth soaked in alcohol and protect the areas with petroleum jelly
Fixed contacts	24 months	Blackening of silver surfaces in environments with the presence of H_2S, SO_2 and salt environment	Wipe with a cloth soaked in alcohol and protect the areas with silicone grease spray
Switch trolley Contactor trolley Special trolley	12 months	See the relevant installation, operation and maintenance instructions	Perform the recommended maintenance
Earthing connection components Connections to the earthing system	12 months	Traces of discharges or presence of black smoke	Clean with thinner Rub the oxidation traces with emery cloth Tighten the screws
Auxiliary circuits connections	12 months	Loose screws	Tighten the screws
External connections Power circuits	12 months	Traces of discharges or presence of black smoke	Clean with thinner Remove the oxidation traces with emery cloth
External connections Power circuits	12 months	Check that bolted connections of the MV and earthing circuits (at busbars, CBs poles, CTs, VTs, etc.) are suitably tighten.	No misalignment is expected at the marks provided over the bolt, during torque wrench tightening at the factory. In case found, to torque wrench again the connection (see par. 6.4).
Check the insulation resistance Power circuits Auxiliary circuits	12 months	Insufficient insulation resistance (see comments)	Identify the point of failure

Comments

Measure the insulation resistance with the same methods indicated for commissioning. The measured values must not be very different from those measured at the time of commissioning. If the insulation level is very low, perform a power frequency voltage test. It is advisable to measure the insulation resistance before and after the voltage test, to facilitate identification of the failure point, in the event of a decrease in the insulation resistance

Functional checks

PART SUBJECT TO INSPECTION	FREQUENCY	PROBLEM	SOLUTION
Command and control circuit Power supplies Local controls Remote controls	12 months	Absence of power supply Contactors missed opening or closing	Check the power supply circuit. Check with the functional diagram the efficiency of the control devices (push-buttons, consent contacts, fuses or protection switches, auxiliary relay contacts, terminals, cables, etc.).
Automatisms	12 months	Work sequence of one or more functions does not take place	Check the circuit with the functional diagram and intervene accordingly
Indicators	12 months	Failure to power on	Check the power supply circuit. Check the signalling lamps and replace them if necessary
Measuring devices	12 months	Irregular or absent indications	Check the efficiency of the measuring circuit including current and/or voltage transformers and any measuring transducers. Check the functionality of the measuring instruments with test instruments.
Protections	12 months	Irregular or absent indications	Check the efficiency of the measuring circuit including current and/or voltage transformers. Check the functionality of the protection relays with test instruments.
Service circuits Sockets	12 months	Absent or delayed intervention	Check the power supply circuit. Check the power supply and trip circuits of the protection relays
Mechanical interlocking devices	12 months	Malfunction of the mechanical locking devices	Check the adjustments

9.2.2. Extraordinary maintenance

If scheduled maintenance is carried out periodically and according to the procedures described above, no functional faults should occur (except in the case of electrical or mechanical wear and tear of the equipment), as declared by the manufacturer.

ANOMALY	CAUSES	SOLUTION
Noise in metal structures	Incorrect fixing of: - segregation plates - external panels	Check the fixing of metal sheets and panels
Unit overheating	Insufficient ventilation caused by: - obstructed ducts - obstructed slots	Eliminate the obstructions
	High ambient temperature	Reduce the ambient temperature
	Incorrect tightening torque: - joints of the distribution busbars - shunts - connections of power circuits	Check the tightening torque of joints, shunts and terminals
	Disconnecting contacts	Check the pressure of the disconnection contacts, clean and lubricate
	User overload	Reduce the user load
Condensation	Insufficient ventilation	Restore the correct ventilation. To activate the space heaters to development of moisture
Non-functioning or malfunction of the equipment: - circuit breakers - various equipment - automatisms - signallings	Power supply out of the admitted tolerance values. Interrupted connections at the auxiliary circuits Faulty auxiliary components	Analyse the installation, operation and maintenance instructions. Search for possible causes by consulting the schematic diagram of the switchboard. Replace the faulty components and restore the correct power supply, with rated values within the tolerances.
Untimely opening of circuit breakers or contactors	- Intervention of the power fuse - Intervention of the voltage transformer fuse - No auxiliary power supply - Overheating - Incorrect coordination of the protections - Faulty protection relays	Identify the cause and replace the fuses Restore the auxiliary power supply. Check the pressure of the disconnecting contacts, clean and lubricate. Check the calibration of the protections based on the selectivity diagrams. Replace or repair the protection relays.

10. DISPOSAL

The switchboard must be disposed in accordance with the legal provisions for environmental protection, of the Country of installation of the switchboard.

The following materials may be used in the switchboard:

Metals:

- Steel sheet metal (stainless steel, galvanised, painted, etc.)
- bare copper, silver plated copper, tin plated copper
- aluminium

Plastic:

- PVC (insulation of cables, insulation of busbars, cable ducts, ...)
- Polycarbonate

Rubber materials

- gaskets

The components of the switchboard’s units are recyclable as mixed metal scrap.

For the installed equipment, follow the instructions in the relevant manufacturer's instruction manuals

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