

# MV Air Insulated Switchgear, Model Unisafe

Power<sup>IT</sup>

1VDU29001-YN



Industrial<sup>IT</sup>  
enabled™

**ABB**

## **Introduction**

This publication contains the information required for installation, putting into service, operation and maintenance of Unisafe Switchboards.

For correct usage of the product, please read this manual carefully.

As with all the switchboards which we manufacture, the Unisafe switchboards are also designed for a large number of standardized installation layouts.

They do, however, allow for further technical-constructional variations (at the Customer's request) to adapt to special installation requirements.

For this reason, the information given in this manual will not always contain instructions regarding special layouts.

It is therefore always necessary to consult both this manual and the latest technical documentation (circuit diagram, wiring diagrams, assembly and installation drawings, any studies of protection co-ordination etc.), especially in the case of any variations of standardized layouts requested.

In any case, it is always advisable to use this manual for all operations regarding installation, putting into service, operation and maintenance of the switchboard to be carried out by specialized personnel.

The switchgear cubicle is designed to accommodate 12 kV vacuum circuit breakers type Vd4 / VD4E of ABB make.

## Index

1.	Control on receipt	...	1
2.	Storage	...	1
3.	Lifting	...	1
4.	Description	...	2
4.1	Cubicles	...	2
4.2	Circuit Breakers	...	4
4.3	Degrees of protection	...	5
5.	Installation	...	5
5.1	General	...	5
5.2	Normal installation conditions	...	5
5.3	Installation room	...	5
5.4	Foundations and fixing surface	...	5
5.5	Installation of the switchboard sections	...	7
6.	Putting into service	...	9
7.	Instructions for use	...	12
7.1	Mechanical operations	...	12
7.2	Potential Transformer Compartment	...	13
8.	Maintenance	...	14
8.1	Safety regulations	...	15
8.2	General	...	15
8.3	Maintenance operations	...	16

8.4	Maintenance program	...	18
9.	Intervention of any operating anomalies	...	21
10.	Accessories and spare parts	...	23
10.1	Normal completion accessories	...	23
10.2	Optional accessories and completion items	...	23
10.3	Spare parts	...	23

## **1. Control on receipt**

The switchgear cubicles are normally shipped complete with trucks (circuit breakers, potential transformers) inserted in the relative compartments. Accessories, Earthing Trucks (if any), Breaker transport trolleys are packed separately.

On receipt, the cubicle and accessories must be unpacked and checked according to the instructions in the relative order acknowledgment and with reference to the most up-to-date technical documentation sent prior to shipment.

Should any damage or irregularity in the supply be noted on unpacking (including switchboard and equipment), inform our commercial offices (either directly or through the consultant) as soon as possible.

Notification of any irregularities, even at times after receipt, must contain the year of construction of the switchboard and the relative number of the order acknowledgment.

## **2. Storage**

When immediate installation is not possible and the cubicle does not have special packing, store in a dry, dust-free non corrosive place without notable changes in temperature. Should this not be possible, cover it with tarpaulins or sheets of waterproof material (eg. Polyethylene) and supply the anti condensation heaters to prevent condensation.

It is also advisable to place suitable hygroscopic substances inside the packing, with at least one standard bag for each circuit breaker compartment.  
The bags must be replaced about every six months.

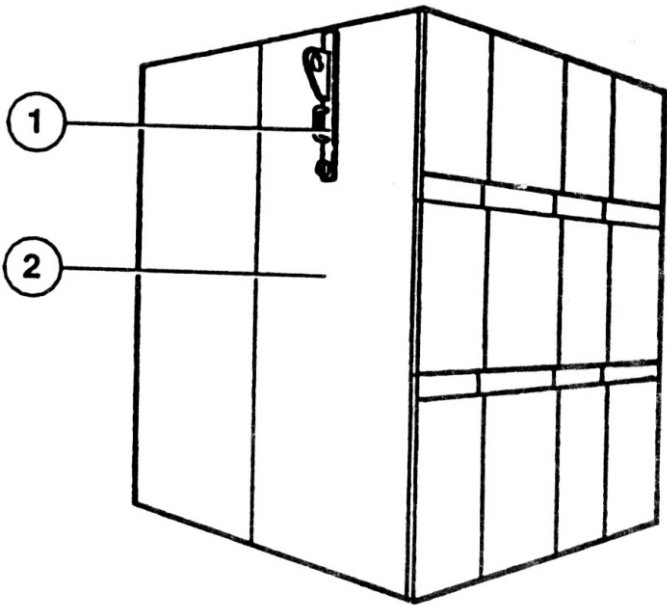
## **3. Lifting**

The cubicle should be lifted, preferably by using a bridge crane or mobile crane of suitable capacity. If necessary, the sets of cubicles may be handled by means of rollers. In this case, put a strong sheet plate between the rollers and the cubicle base.

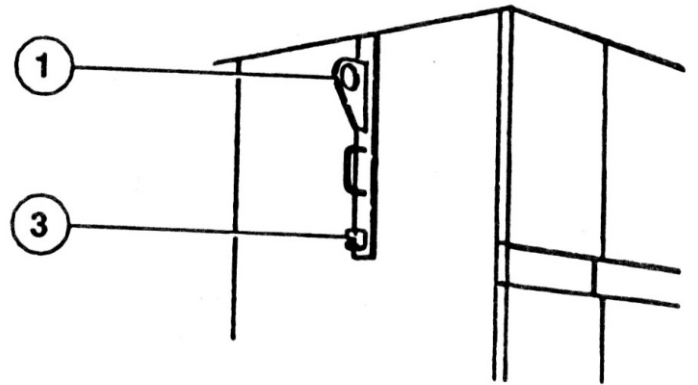
Follow the sequence for lifting very carefully (Fig 1);

- unpack the cubicles
- insert the special lifting bolts (1) in the slots
- make sure the lifting bolts can not come out by keeping them pushed upwards and screwing up the positioning screw (3) fully.
- using the special spring catches, hook the ropes to the lifting bolts
- after installation, remove the lifting bolts by working in reverse order to the one described

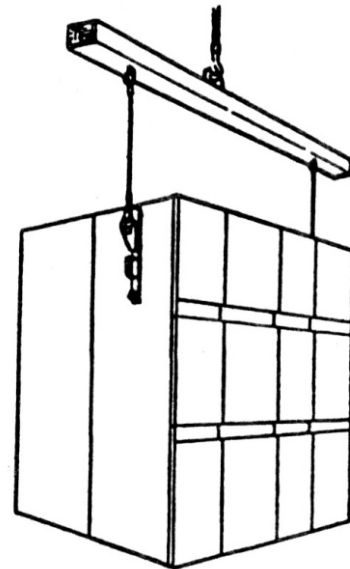
A lifting system like the one shown in Figure 1 to be used. Instead of 4 cubicles as shown, only one cubicle to be lifted.



Positioning the lifting bolts



Fixing the lifting bolts



Lifting a switchboard section

Fig. 1

## **4. Description**

### **4.1 Cubicles**

The Unisafe switchboards are constructed by placing standardized prefabricated cubicles side by side. The cross-section of the cubicle is shown in Fig. 2. Each cubicle is subdivided internally into the following compartments which are segregated from each other with provision for internal wiring.

- Metering box
- Circuit breaker compartment
- Cable compartment
- Busbar compartment
- PT compartment

The cubicle version, and therefore the switchboard constructed, is of the single-level type, with a single busbar system, a circuit breaker compartment per cubicle.

Unisafe switchboards are the internal arc-proof version.

The cubicles are completely cabled in the factory: installation on site only requires the external power and auxiliary connections and those between the various transportation sections. All normal operating operations are carried out from the switchboard front with closed doors; only maintenance and replacement operations require the opening of doors on the front and back.

#### **4.1.1 Cross section of the cubicle**

##### **a. Metering box**

All the low voltage apparatus normally used is housed in this box which is provided above the circuit breaker compartment. In particular;

- terminal boards and cables for interconnection of cubicles and for connection of the auxiliary cables;
- measuring instruments, protection relays, control and signaling devices, fuses, low voltage miniature circuit breakers etc.
- circuit breaker position contacts (connected - isolated)
- provision for inter panel wiring

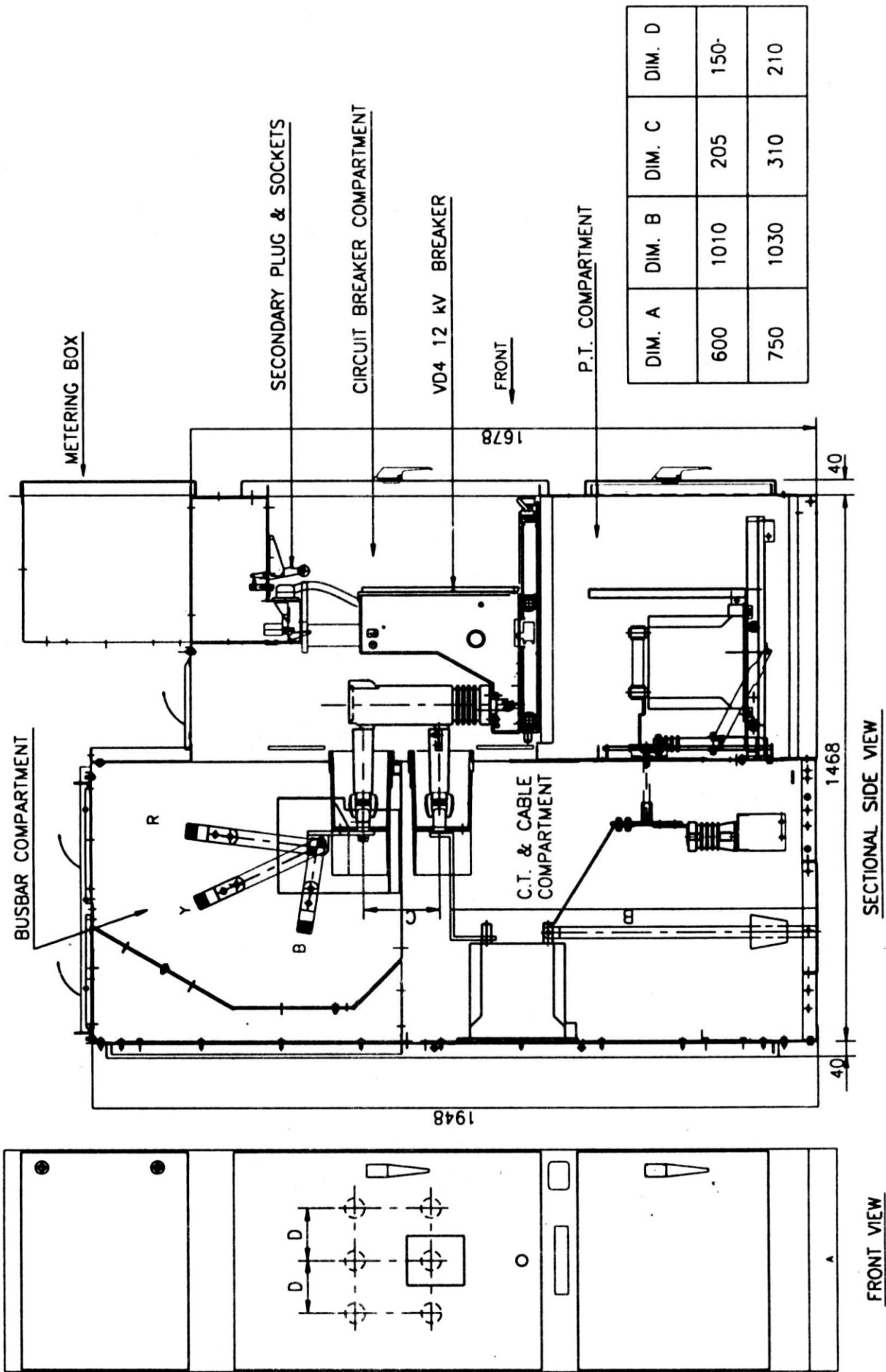


Fig. 2



## b. Circuit Breaker Compartment

The compartment is preset to hold the withdrawable circuit breaker, with its truck, and includes all the accessories required for its operation. Circuit breaker isolation is carried out with the door closed.

The following components are mounted in the compartment -

- Insulating monoblocks ie. the insulator bushings which contain the power connections between the circuit breaker compartment, the feeder compartment and the busbar compartment. The insulator bushings have isolating contacts;
- automatic segregation shutters of the medium voltage circuit;
- mechanical arrangement for operating the limit switches at connected / isolated positions of the circuit breaker
- locking device between circuit breaker and earthing switch
- metal wiring ducts for passage of auxiliary circuit cables.
- manual secondary plug and metering box socket arrangement provided

## c. Feeder compartment

The feeder compartment is accessible from the front and back of the cubicle. For switchboards installed against the wall, to reach the cable area from the front more easily, the removable bottom of the circuit breaker compartment can be taken out.

The feeder compartment can contain the following components -

- earthing switch and relative auxiliary contacts
- current transformers
- toroidal current transformers on cable
- cable terminals

There is an opening in the base of the compartment for passage of the power cables.

## d. Busbar Compartment

The busbar compartment houses the main busbar system mounted on the terminals connected to the upper fixed contacts of the monoblock.

#### e. PT Compartment

The potential transformers and relative fuses are mounted in the compartment, and are in the withdrawable version to facilitate their replacement in safety.

The main characteristics of the PT compartment are as follows -

- PT can be withdrawn from the connected position and fuses can be replaced.
- Manual secondary plug and socket arrangement provided
- PT mounted on a withdrawable truck
- Activation of the insulating shutter is automatically obtained with transverse of the PT truck.

### **4.2 Circuit Breakers**

The circuit breakers, which are always the withdrawable version, are mounted on a truck which makes the following positions possible in relation to the fixed part of the compartment.

CONNECTED: main and auxiliary circuits connected

ISOLATED: main circuits disconnected and auxiliary circuits connected  
(TEST POSITION) or disconnected (FULLY ISOLATED)

WITHDRAWN: main and auxiliary circuits completely disconnected

In the CONNECTED and ISOLATED positions, the circuit breaker remains inside the compartment with the door closed.

The withdrawable circuit breaker is fitted with the following locks:

- mechanical lock which prevents withdrawal of the circuit breaker when it is closed from connected position to isolated position
- mechanical lock which does not allow manual or electrical closing of the circuit breaker in the intermediate positions between connected and isolated.
- mechanical lock which prevents connection of the circuit breaker when the relative earthing switch is closed and the earthing switch closing with circuit breaker connected
- mechanical lock which prevents the movement of closed circuit breaker from isolated position to connected position

### **4.3 Degrees of Protection**

The Unisafe switchboard is designed with the following degrees of standard protection -

- IP4X on the outside
- IP2X inside the switchboard

## **5. Installation**

### **5.1 General**

Correct installation is of great importance. The manufacturers' instructions must be studied and followed carefully. The final drawing are sent some time prior to shipment of the switchboard to allow suitable preparation of the installation rooms. The drawings include overall views, front and cross sectional views, drilling in floor slabs and switchboard fixing and wiring diagrams.

### **5.2 Normal Installation Conditions**

Maximum ambient air temperature:	+40°C
Minimum ambient air temperature:	-5°C
Maximum relative humidity:	95%

For other conditions, please consult our technical department.

### **5.3 Installation room**

The switchboard must be situated in the room of height 3 Mtrs. A minimum clearance of 1.5 Mtrs. to be provided from the front and clearance of 1Mtr. to be provided at the back of the cubicle.

If any switchboards are installed in such a way as to communicate through the floor, the openings between the interior of the switchboard and the area underneath it must be filled in.

### **5.4 Foundations and Fixing surface**

The floor of foundations must be strong enough to support the weight of the switchboard (complete with all equipment) without fixture.

The foundations must be made in good time before the installation date, following the instructions given in the design documents.

Since the tolerances and adjustments permitted are reduced to a minimum, the switchboard must be installed on a smooth and level surface.

All the switchboard cubicles have six holes in the base for welding on to the foundation frame.

Normal operations for preparing the fixing surface are as follows -

- clean the installation area
- on the floor slab, visibly trace the perimeter of all the cubicles which make up the switchboard, taking the minimum clearances from the walls and obstacles into consideration.

a) Checking of foundation (Refer Fig. 3)

Check the foundation w. R. T. The foundation drawing supplied. The foundation frames on which the cubicles are to be installed must be properly leveled. The level differences more than 2 mm is not permitted. Refer Fig. 3 for details. Level is to be checked using water level.

b) Mounting of first cubicle on the foundation frame

Start installation of cubicle from anyone side. The cubicle when despatched from the factory is pallet mounted. It should unloaded from the pallet as close as possible to the foundation frame position so that less movement is required after the cubicle is on the ground. Once the cubicle with pallet is on the ground, the same is to be pushed manually on the foundation frame. If use of crowbar is unavoidable, the crowbar is to be inserted either on sides or on rear of the cubicle. Do not insert crowbar in the front side of the cubicle. Please ensure that the cubicle, when mounted on the frame, is vertical. If necessary, use shims to make the cubicle vertical.

c) Mounting of second, third... cubicles on the frame

Follow the procedure described under item 5.4. When the second cubicle is placed on the foundation, it must be pushed as close as possible to the first cubicle so that two cubicles touch each other from top to bottom.

Do not weld other cubicles on frame till all cubicles are erected and busbars are coupled.



## 5.5 Installation of the Switchboard Sections

### 5.5.1 General

A correctly installed switchboard must satisfy the following conditions -

- cubicles are correctly aligned
- switchboard is securely fixed to the floor
- front panels form a straight line
- cubicles are coupled and all the main and earthing busbars and the auxiliary interconnections are completed
- the switchboard earthing busbar is connected to the earthing plant.
- the power connections to the users and the auxiliary connections of the control circuits are made

To obtain correct alignment of the sections, trace a basic line on the floor, a few centimeters from the front, parallel to the final position of the switchboard. When positioning and fixing to the floor, make sure that the distance of the switchboard from this line is constant.

Fixing the various sections to the floor must be carried out starting from the central section or from the central cubicles of the switchboard and then proceeding towards the side cubicles. To facilitate moving, lifting, floor fixing and coupling operations, it is advisable to withdraw the circuit breakers, contactors and voltage transformers from the trucks.

The tightening torque of the screws and nuts for fixing and for coupling the switchboards and busbars are those shown in this table:

Tolerance - 0% +20%

Screw	M6	M8	M10	M12	M14	M16
Tightening torque (Nm)	7.5	19	33	62	98	150

### 5.5.2 Cubicle Coupling (Fig. 4)

Bolt the external sheets at the points marked with (\*) by means of screws (1) and nuts (2).

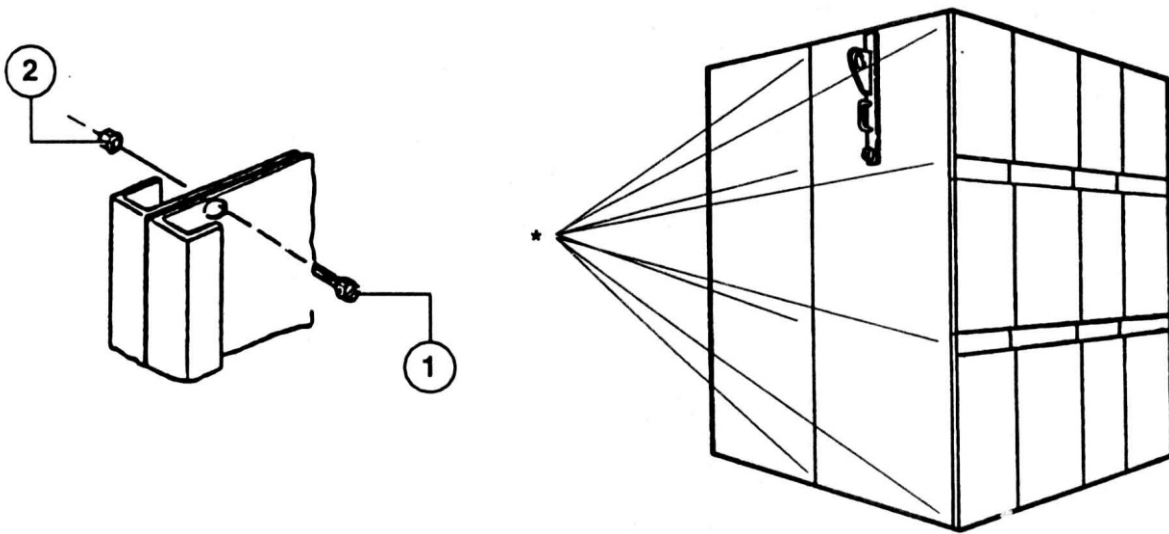


Fig. 4 Cubicle coupling

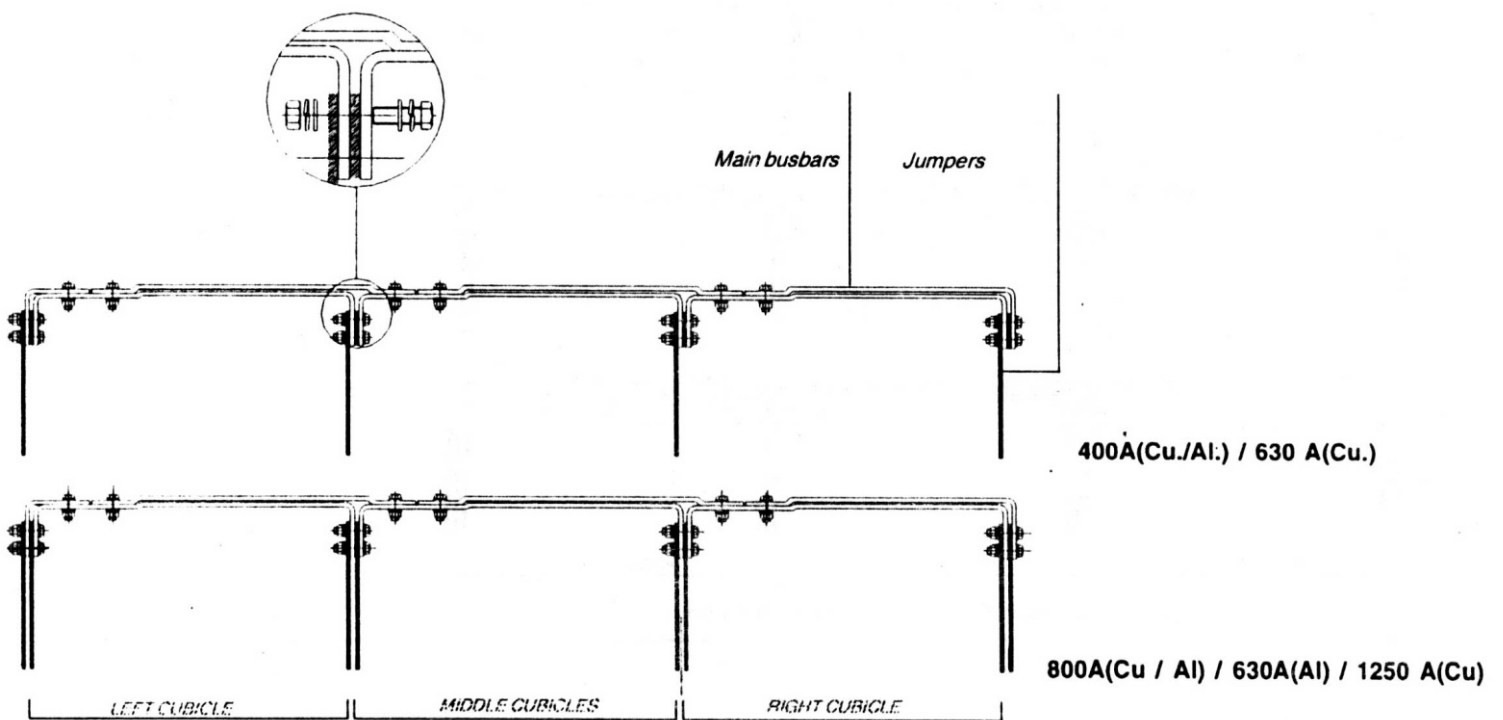


Fig. 5a 630A(Al) / 800A (Cu / Al) / 1250A (Cu) main busbars coupling (viewed from front)

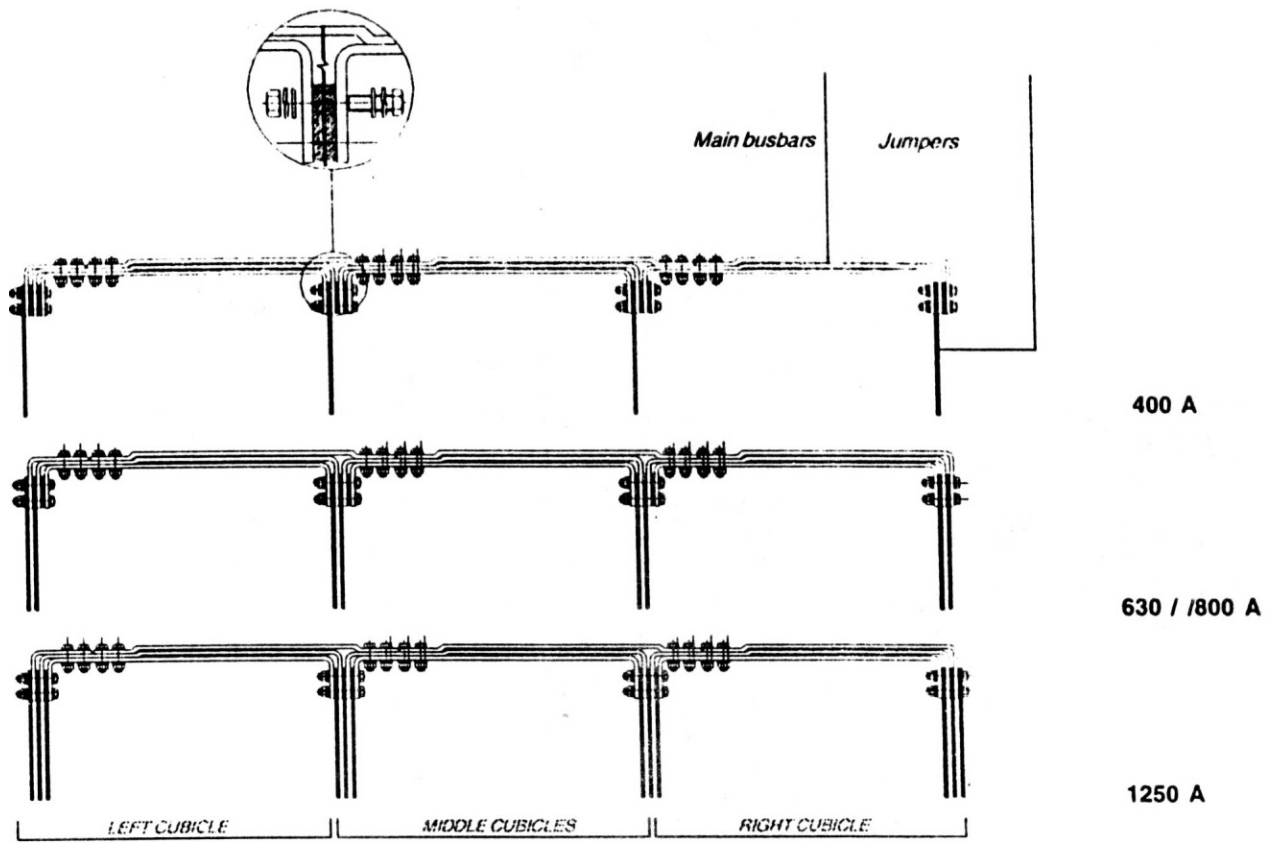


Fig. 5b 1250A (Al) main busbars coupling (viewed from front)

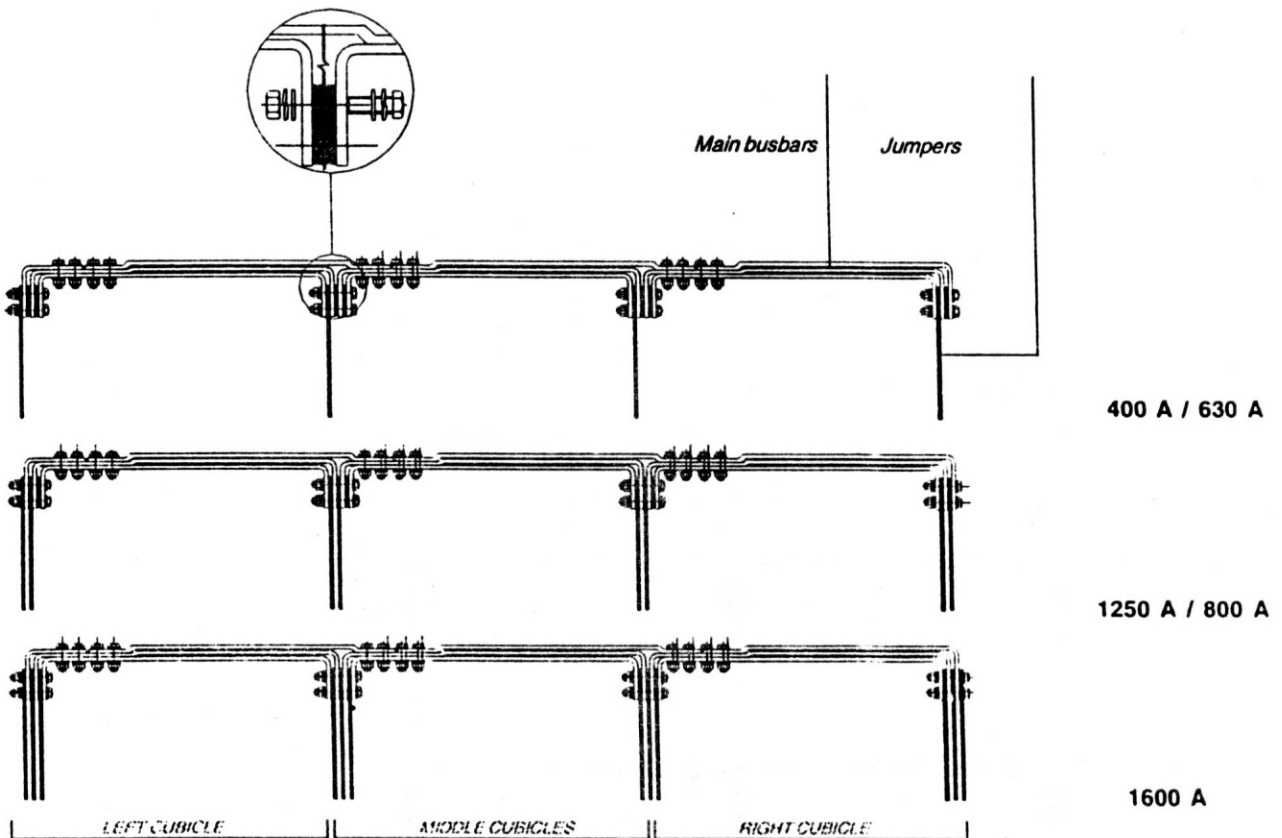


Fig. 5c 1600A (Cu) main busbars coupling (viewed from front)



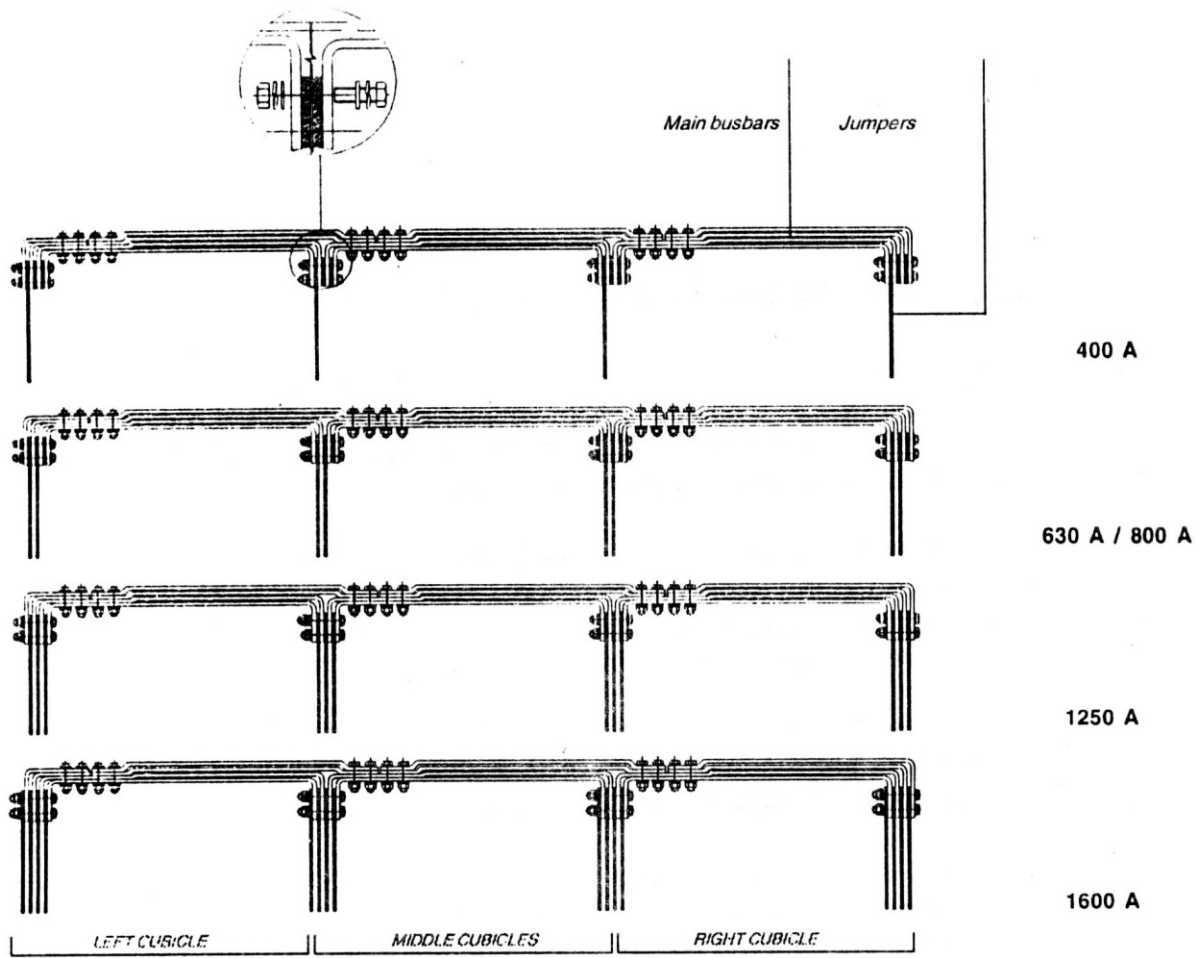


Fig. 5d 1600A (Al) main busbars coupling (viewed from front)

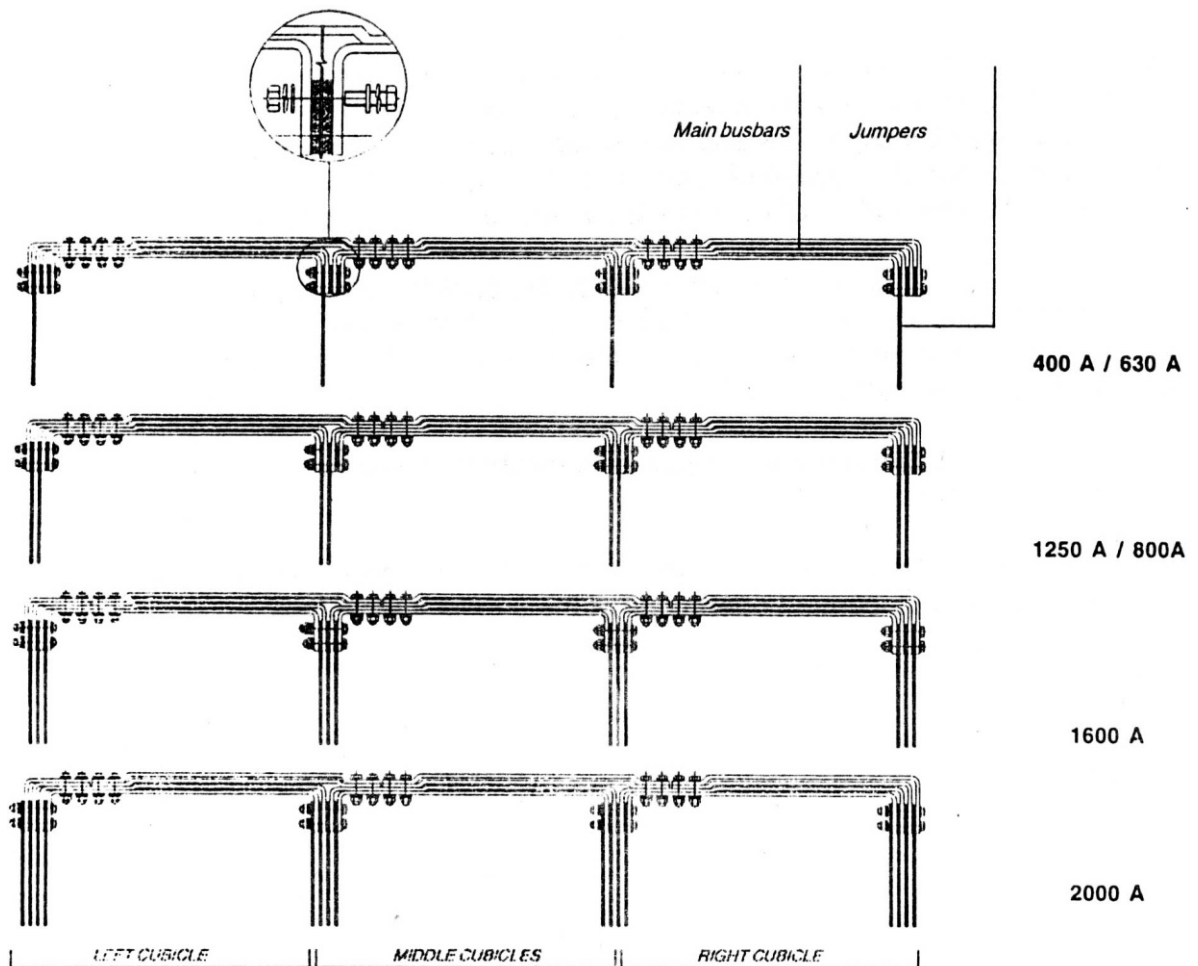


Fig. 5e 2000A (Cu) main busbars coupling (viewed from front)

### **5.5.3 Busbar Coupling ( Ref Fig. 5)**

Start mounting of busbars from one end. Aluminium busbars are delivered, mounted on the top of the cubicle. Copper busbars are supplied separately, packed in a box. All the joints are to be properly cleaned using a stainless steel wire brush and conducting grease must be applied on the joints.

Fasteners required for the busbar assembly, are supplied loose and can be found in a plastic bag in the cable compartment. Remove these bolts and insert busbars at the required location as shown in drawing. The busbars for all the cubicles should be mounted first and after proper alignment, the fasteners should be tightened.

Normally the busbars are mounted using M12, high tensile bolts and these bolts are to be tightened with 50/60 Nm torque.

Earthing busbar of adequate dimension is provided in the bottom of the cubicle and the bar required for jointing. The cubicle earth busbar of two cubicles is to be connected to join the earthing busbar using a connecting piece provided in the cubicle.

### **5.5.4 Power Circuit Connections**

The outgoing terminals of the feeder compartment are provided for connection with a cable terminal. Special attention must be given regarding the position and cyclic direction of the phases and all the connections to ensure any parallel of two systems, correct direction of rotation of the motors supplied and, in any case, to ensure correct insertion of the measuring and protection instruments.

When the cable terminals are made within the switchboard, suitable measures must be taken to prevent unexpected changes of direction, angles and sharp edges which might damage or destroy the insulation. Also pay attention to the radius of curvature of the cable.

There must be adequate mechanical and electrical distances between cables, busbars and sheets.

Each cable connection must be anchored separately to facilitate any maintenance or replacement operations of the cables themselves.

## Procedure

- Remove the rear covers for access to the cable compartment.
- Check that the contact surface is flat and clean the terminals.
- If necessary, eliminate any burrs, dents and traces of oxidation with emery cloth.
- Remove traces of grease with a clean, dry cloth soaked in solvent before making the connections.
- Remove the cable entry cover plates and prepare the holes in these for cable passage. Insert the cable, making it pass through the toroidal current transformer if provided.
- Prepare the cable terminal by following the manufacturers' instructions for the cable and terminals.
- Connect the cable terminal to the terminal of the cable using proper screws and washers.
- Complete insulation using insulating tape
- Close the cable entry by the cover plate.

### 5.5.5 Control Cable Connections

Cubicle is designed for bottom control cable entry and control cable can be directly terminated in the metering box. The cables are to be routed through the metal duct provided in the circuit breaker compartment.

## 6. Putting into Service

ITEM TO BE CHECKED	OPERATIONS	NOTES
Cubicles	<ul style="list-style-type: none"><li>- Visually check the inside and outside, making sure there is no evident damage; remove any foreign bodies (such as tools or test connections, which might have been forgotten during installation)</li><li>- Carefully clean the insulating parts, removing any traces of humidity.</li><li>- Remove rust or dirt.</li></ul>	

Power circuit connections	Check circuit tightness and continuity.	See table para 5.5.1
Earthing busbar and relative connections	Check tightness and continuity.	Check earthing efficiency according to the accident prevention standards.
Insulation	<p>With a 2500V or 5000V Megger, measure the power circuit insulation resistance (phase-phase and phase-earth) and with a 1000V Megger, measure the insulation resistance of the auxiliary circuits; the value obtained must be at least a few tenths of M<math>\Omega</math> for the auxiliary circuits.</p> <p>The insulation resistance must remain constant in time even after any voltage tests.</p>	<ul style="list-style-type: none"> <li>- The insulation resistance value can be influenced by ambient conditions.</li> <li>- The switchboard must not be put into service if the insulation resistance is very low. For example below 5 M<math>\Omega</math>.</li> <li>- If the low value of the insulation resistance is due to ambient humidity, use temporary heaters.</li> </ul>
Circuit Breakers	<ul style="list-style-type: none"> <li>- Carry out the operations prescribed in the relative instructions before putting into service.</li> <li>- Check that the operating mechanism devices and accessories foreseen for normal operations are present.</li> <li>- Insert the equipment in the relative compartment and connect the secondary plug and socket manually.</li> <li>- Close the compartment doors and rack the equipment to the "connected" position.</li> </ul>	The spare key (if any) to each lock must be put in a place which is Inaccessible to the operating personnel.

Service and control auxiliary circuits	According to the switchboard key diagram, check functionality and service sequence of the automatism and of all the auxiliary relays.	Before carrying out this control, check the settings of all the various relays installed in the switchboard.
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- For special installation layouts, the tests given in the table can be integrated with others to be established by the technician responsible for the installation.
- Check that the secondary winding of the current transformers is earthed and connected to the relative amperometer protection circuit and/or measuring circuit, then eliminate (provided) any short circuit connections.
- In case the secondary winding of the voltage transformer has to be connected to equipment outside the switchboard, the following conditions must be ascertained to prevent over loads or short-circuits of the potential transformers themselves.
  - 1) Check the total self-consumption so the equipment to be supplied is not above the performances of the voltage transformers.
  - 2) Check that only one phase of the secondary winding of the potential transformer is earthed.

This check is particularly important on the supply side of the equipment interconnected by means of a bus-tie. (the installation layout described above is, in fact, used in cases where it is necessary to put several supply circuit in parallel).

On completion of the preliminary tests, carry out the following operations -

- Open and isolate all the circuit breaker trucks
- Eliminate any test connections

### **Note**

It is advisable to charge all the circuit breaker closing springs manually before supplying the auxiliary circuits to avoid any excessive current absorption due to contemporary start-up of the geared motors.

- Close all the circuit breaker and metering box doors
- Make sure that the internal metal partitions (when provided) and the external closing panels are in place.

- Check that the various mechanical and electrical interlocks (which may have been disconnected to carry out the putting into service tests with the switchboard switched off) are reconnected.
- Supply the auxiliary circuits and the power circuit.
- Close the circuit breakers (compatibility with installation requirements) making sure that each relative function is carried out correctly.
- Check correct operation of the measuring instruments.

## 7. Instructions for use

### 7.1 Mechanical operations

#### 7.1.1 Circuit breaker transport trolley (Ref. Fig. 6)

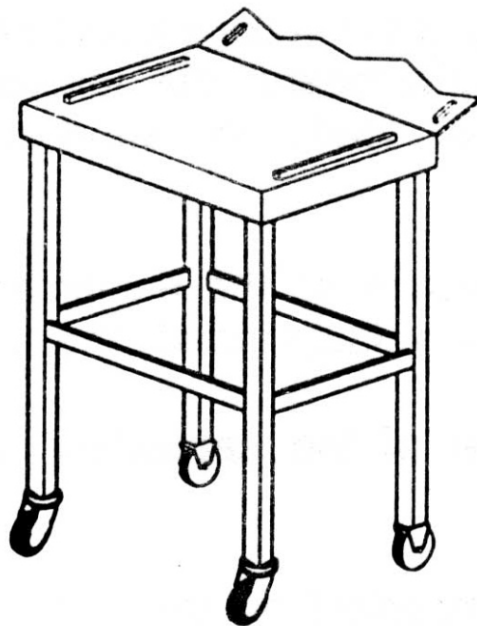


Fig. 6 Truck for circuit breaker racking in / racking out

A special transport trolley is available to transfer the circuit breakers.

This trolley is also used for racking the circuit breaker in and out of the compartment.

The procedure below refers to this trolley -

#### a) Loading the circuit breaker on to the trolley

- Lift the circuit breaker manually or using a special hoist
- Place it on the trolley and hook it on to the appropriate guides

#### b) Insertion of the circuit breaker in the compartment

- Bring the trolley with the circuit breaker close to the compartment
- Open the circuit breaker compartment door.

- Lower the shelf (1), hooking its front ends into the special slots provided for this in the circuit breaker compartment
- Release the circuit breaker truck and push it into the relative enclosure till the truck gets engaged into the slot of the cubicle.
- Refer to the circuit breaker instruction booklet for the remaining isolation and connection procedure.

#### c) Withdrawal of the circuit breaker from the relative compartment

Put the circuit breaker trolley into the withdrawn position as shown in the relative instruction booklet. Then proceed in reverse order to the indications given in points (a) and (b).

#### 7.1.2 Earthing switch

The feeder compartments are fitted (on request) with a medium voltage circuit earthing switch.

With the earthing switch closed, the circuit breaker movement to the connected position is prevented.

#### 7.1.3 Testing and mechanical locks

The standardized equipment provided on the switchboard makes wide use of a standardized mechanical interlock produced by us.

The mechanical operations must be carried out using normal strength, without forcing the interlocks, and thereby preventing permanent alterations or breakages.

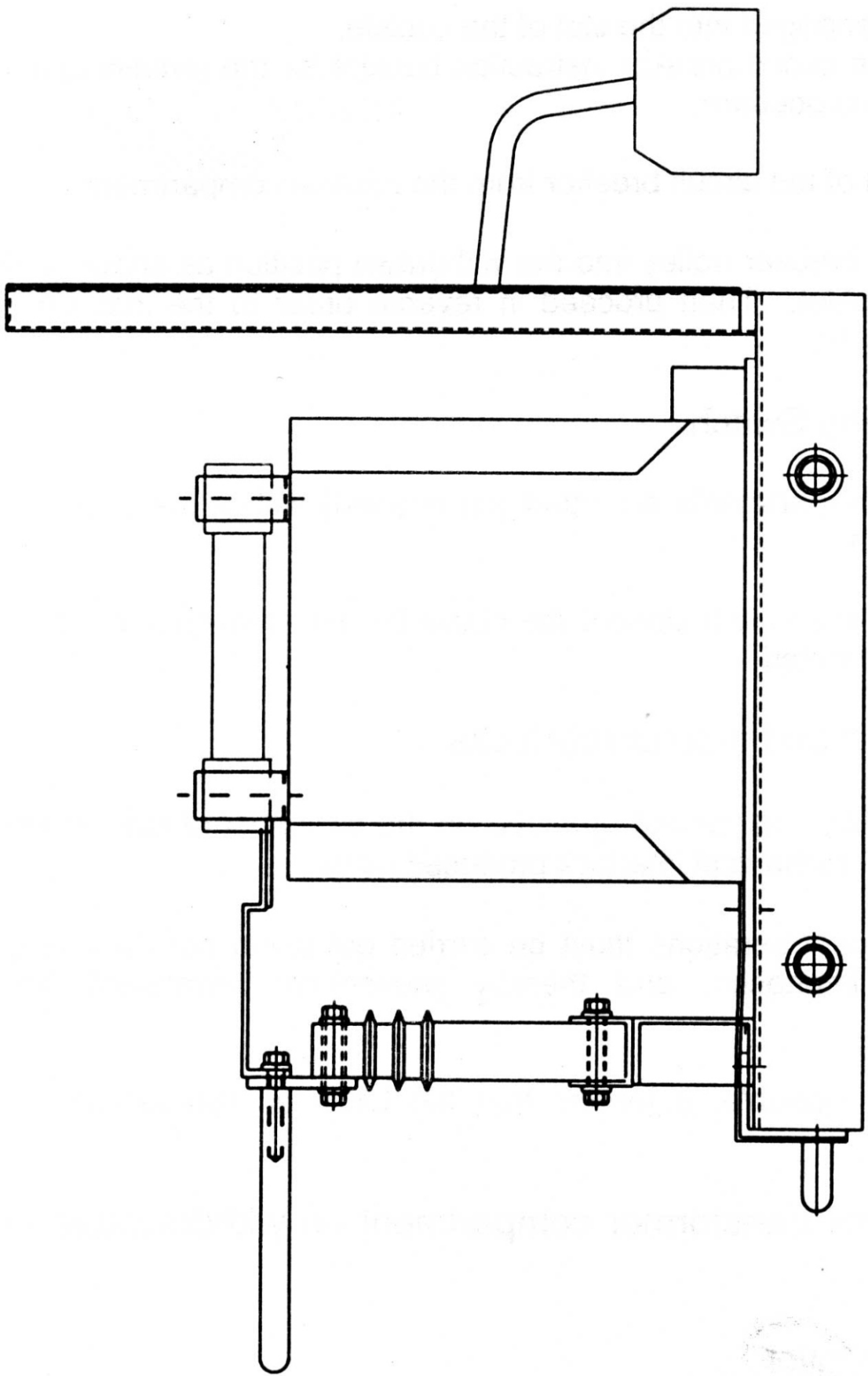
If this is not possible, it means that the locks are prevented or functioning incorrectly.

### 7.2 Potential transformer compartment on withdrawable truck (Ref. Fig. 7)

#### 7.2.1 Description

The potential transformer compartment consists of a withdrawable trolley inserted with the transformers and relative protection fuses mounted on it.

The withdrawable trolley can be completely removed from the cubicle.



P. T. Trolley

Fig. 7



A special insulating shutter prevents contact with the medium voltage terminals when the trolley is withdrawn (Ref. Fig. 2)

### 7.2.2 Mechanical tests

All the mechanical devices are normally checked and controlled in the workshop but for transport or other reasons they may undergo alterations and it is therefore advisable to carry out a careful check before putting them into service.

### 7.2.3 Electrical tests

#### 7.2.3.1 Insulation resistance

Carry out measurement between the phase and earth using a Megger, both on the main and secondary circuits to check that the insulation resistance (Megger voltage) is 2500V for the main circuit and 500V for the secondary circuits.

#### 7.2.3.2 Operation

Carry out tests on the secondary circuits to check remote operation of the signals, protections and of all the other circuits connected to the VT compartments.

### 7.2.4 Maintenance

#### 7.2.4.1 Inspection frequency

To prevent deterioration of the insulation to dangerous levels, it is advisable to inspect it 6 months after putting into service, in order to define the maintenance programme card and the best maintenance intervals, taking into account the single components as well as the compartment itself.

#### 7.2.4.2 Maintenance Operations

- a) Remove any dust from the insulating parts using clean dry rags
- b) Check correct operation of the levels and if necessary, grease moving parts
- c) Inspect the isolating and earthing contacts, eliminating any blackness on the contact surfaces with alcohol, and then protect them again with a layer of Vaseline grease.

## 8. Maintenance

The maintenance operations indicated in this chapter must only be intended as normal maintenance operations to eliminate any wear on the apparatus due to usage.

The normal maintenance operations must be carried out by the expert and qualified personnel and the original safety and operations of the apparatus must be guaranteed.

The owner of the installation is responsible for the maintenance operations.

It is good practice to keep a maintenance sheets and service book to record all the operations carried out in detail together with the date, description of the anomaly, reference to the data required to identify the apparatus.

In case of necessity and for further details, please refer to what is stipulated in art. 10 of the IEC 694 standard.

In any case, should any problems arise, please do not hesitate to contact us.

### 8.1 Safety regulations

Before carrying out any maintenance operations on the switchboard or on the equipment installed, it is compulsory to -

- turn the power supply off
- carry out earthing for work

These operations must refer to the cubicle or section of switchboard involves and regard the power circuit and the auxiliary circuits. Only in case of dire necessity can some parts of the cubicle or switchboard section be kept in service.

In any case, do not remove any partition or panel before checking that in the relative cubicle area, the power supply has been turned off. Always carry out earthing for work to be done.

- Use safe, well-insulated tools and equipment with low voltage operation
- Use voltage detectors
- Use barriers and monitors for signalling danger
- Maintenance work must always be carried out in the presence of at least two people.

### 8.2 General

The electrical equipment is sensitive to ambient conditions and is easily damaged by abnormal operating conditions.

Dust, heat, cold, humidity, a corrosive atmosphere, chemical residues, fumes, vibrations and other conditions can affect performances and life of the electrical equipment.

These conditions, especially when combined, are bound to cause premature faults. Repair costs can be avoided by following the recommendations of the manufacturer for application and maintenance. The most important rules to respect are the following-

Keep clean

- Keep dry
- Tighten bolts and connections
- Prevent excessive friction of mechanical parts

Instructions regarding maintenance of the various switchboard parts, excluding the equipment which is referred to in the relative instruction booklets, are given below, complete with tables regarding the maintenance programme, operation checks and remedies for operating anomalies.

### 8.3 Maintenance Operations

#### 8.3.1 Metal structure

By saying metal structure, the overall structure is intended, including removable panels, vertical and horizontal segregation sheets, hinges, doors and locks. These are painted.

##### Painted parts

The switchboard doors are painted with epoxy resins based paint with a minimum thickness of more than 40 - 60  $\mu$ m.

##### Hinges

These are lubricated in our workshops during assembly. If necessary lubricate periodically.

##### Locks

The locks are of the type with a handle with or without a key. The moving parts must never be lubricated.

#### 8.3.2 Mechanical movements

By mechanical movements, all the mechanical parts of the cubicle for operations, locks and safety are intended. The forced locks, the prevention locks and the safety locks are considered mechanical movements.

The moving parts are lubricated and tested during switchboard assembly.

For any applications to switchboard already installed, ask for intervention by one of our technicians.

### **Caution**

- The mechanical interlocks must not be ignored, but use correctly to prevent arising dangerous situations.
- Knowledge of the interlocking procedure is indispensable before causing any mechanical interlocks, so that all situations can be completely checked.
- When operation is prevented, before forcing the mechanical interlock, test the mechanical operation sequence.

The mechanical interlocks must be positioned in the final locked and unlocked positions without stopping in the intermediate positions.

The mechanical interlocks must be tested several times to ensure that their movement is free, also checking the force required to carry out the operations.

In all cases, correspondence of the mechanical interlock position with the operated part and with interlocked equipment must be checked. If excessive force is needed it means that the device is prevented from moving by alteration of the adjustment of the mechanism itself. To test the device, proceed as follows -

- When provided, remove the moving part, clean it and, if necessary, lubricate all the parts subject to movement or friction.
- Test efficiency of the device which carries out the action and, if necessary, clean and lubricate the parts subject to movement or friction.
- Test efficiency of all the devices which make up the mechanism, pins, levers, plugs, screws, nuts and washers etc and if necessary, clean and lubricate them.
- Adjust the device, checking the force required for movement. If an altered component is noticed during these tests and it is not possible to replace it, note this down on the maintenance sheet and in the service book, indicate the anomaly with a tag on the cubicle and inform the operating personnel.

For forced, prevention and safety locks of circuit breaker trucks see the relative installation, service and maintenance instructions.

## 8.4 Maintenance program

The time interval shown in the table in paragraph 8.4.1 refers to normal ambient conditions (atmosphere, vibrations..) and is the minimum thought necessary for good operation and good preservation of the materials and equipment.

For more severe conditions (which must, however be declared at the time of order and foreseen during the construction stage), these time intervals must be at least halved. The operations to be carried out are those shown below, checking the operating conditions of all the equipment following the indications of the relative instruction manuals.

During the initial period of operations, it is, however, always necessary to make more frequent checks to establish a correct preventive maintenance program.

### 8.4.1 General Inspection

<b>Part subject to Inspection</b>	<b>Time Interval</b>	<b>Check points</b>	<b>Remedies</b>
Metal structure	12 months	Presence of dirt or scratches	Clean or touch up
Painted parts	12 months	Presence of dirt, grease or rust	Clean or remove the rust
Hinges	24 months	Presence of dirt	Clean
Locks	24 months	Presence of dirt	Clean
Mechanical activating elements	12 months	Presence of dirt or rust	Clean and remove the rust
Prevention locks	12 months	Alteration to adjustments	Adjust the tie locks
Isolating contacts	12 months	Blackening of silver plated surfaces	Clean with alcohol and protect the surfaces with Vaseline grease

Fixed contacts	24 months	Blackening of silver plated surfaces in ambient with H <sub>2</sub> S or SO <sub>2</sub> present and saline ambient.	Clean with alcohol and protect the surfaces with silicone spray grease.
Circuit breaker trucks, special trucks	12 months	See relative installation, service and maintenance instructions	Carry out the recommended maintenance
Busbars Main busbar and Jumper connections	12 months	Presence of oxidation or discharge marks  Loose screws	Clean with solvent  Tighten the screws
Earthing Earthing bus-ties Component earthing connections Connections to Earthing network	12 months	Presence of oxidation or discharge marks  Loose screws	Clean with solvent. Remove any traces of oxidation with an emery cloth  Tighten the screws.
External connections Power circuits Auxiliary circuits	12 months	Traces of discharges of presence of lampblack.	Clean with solvent. Remove any traces of oxidation with an emery cloth.
Prevention locks	12 months	Alteration to adjustments	Adjust the tie locks
Insulation resistance check Power circuits Auxiliary circuits	12 months	Insufficient insulation resistance (see note)	Look for the weak point.

NOTE: Measure the insulation resistance using the same methods given for putting into service. The values obtained must not differ greatly from those taken at the time of putting into service. Should the insulation have notably decreased, carry out the voltage tests, it is advisable to measure the insulation resistance before and after the voltage tests to facilitate localization of the fault if the insulation resistance drops.

#### 8.4.2 Operational checks

Item to be checked	Time Interval	Fault found	Remedies
Control circuit Power supplies Local controls Remote controls	12 months	- No power supply - No contactor opening or closing	- Check the power supply circuit - Using the key diagram, check efficiency of the control devices (push buttons, contacts, fuses or protective circuit breakers, auxiliary relay contacts, terminals, cables etc)
Automatisms	12 months	- No working sequence of one or more of the foreseen functions	- Using the key diagram, check the circuit and intervene as necessary
Signaling devices		- Do not light up	- Check the power supply circuit - Check the lamps are working and if necessary replace them.
Measuring devices	12 months	- Irregular or missing indications	- Check the measuring circuit efficiency including current and/or voltage transformers and an measuring transducers. -Check efficiency of the measuring instruments using testing equipment.

Protections	24 months	- Unwarranted or no intervention	- Check efficiency of the measuring circuit including current and voltage transformers. - Check the protection relay function and relative setting with testing equipment. - Check the power supply relays and protection relay tripping circuits.
Service circuits sockets	12 months	- Not working	- Check the power supply circuit - Check socket Functionality.
Mechanics interlocking devices	12 months	- Incorrect operation of the mechanical interlocking devices	- Check adjustments

#### 9. Intervention for any operating anomalies

Intervention for operating anomalies should not be necessary except in cases of electrical or mechanical parts wearing out (eg. signaling lamps): If programmed maintenance is efficient and installation is correct (ie. with application of the equipment within the limits specified by the manufacturer).

In general, the most frequent intervention regards signaling lamps.



Anomaly	Probable cause	Remedies
<p>Metal structure buzz</p> <p>Compartment heating</p>	<p>Incorrect tightening of:</p> <ul style="list-style-type: none"> <li>- segregation sheets</li> <li>- external closing panels</li> </ul> <p>Incorrect tightening of:</p> <ul style="list-style-type: none"> <li>- Bus-ties</li> <li>- Branches</li> <li>- Power circuit connections</li> <li>- Isolating contacts</li> </ul>	<ul style="list-style-type: none"> <li>- Check the sheet and closing panel fixing</li> <li>- Check bus-tie branch and terminal tightness (see para 5.5.1)</li> <li>- Check isolating contact pressure, cleanliness and lubrication</li> <li>- Reduce user overload.</li> </ul>
<p>Incorrect or no operation of the equipment</p>	<ul style="list-style-type: none"> <li>- Circuit Breakers</li> <li>- Various components</li> <li>- Signaling devices</li> </ul> <p>- No auxiliary supply</p>	<ul style="list-style-type: none"> <li>- See the relative service, installation and maintenance instructions</li> <li>- Look for possible causes, consulting the key diagram of the switchboard</li> <li>- Auxiliary supply beyond the permitted tolerance limits</li> <li>- Replace the faulty part or reset supply conditions.</li> <li>- Put back the auxiliary supply.</li> </ul>

Unwanted tripping of circuit breakers	<ul style="list-style-type: none"> <li>- Overheating</li>   <li>- Incorrect co-ordination of the protections</li>   <li>- Fault in protections</li> </ul>	<ul style="list-style-type: none"> <li>- Check the isolating contact pressure cleanliness and Lubrication.</li>   <li>- On the basis of the installation selectivity diagrams, check the setting of the relative protections.</li>   <li>- Replace or repair the protection.</li> </ul>
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## 10. Accessories and spare parts

### 10.1 Normal completion accessories

The switchboard is normally supplied complete with:

- Foundation Frame
- Lifting Bolts
- Handle for any earthing switches
- Trolley for withdrawing the circuit breaker outside the switchboard
- Handle for circuit breaker movement
- Design diagrams and drawings
- Installation, service and maintenance instructions

### 10.2 Optional accessories and completion items

The switchboard can be completed with supply of the following accessories -

- Earthing truck
- Earthing switch

### 10.3 Spare parts

For circuit breakers see the relative installation, service and maintenance instructions.

For other equipment the quantity to be kept in stock must be evaluated each time -

- Protection relays
- Auxiliary relays
- Control knobs
- Position indicators
- Flag relays
- Auxiliary switches
- Sockets

For consumable goods, such as signaling lamps, fuses and terminals for terminal boxes, a sufficient stock is indispensable.

#### Caution

When ordering spare parts, always specify the order number of switchboard on which the spare parts are to be installed. For current transformers, indicate the transformation ratio. The spare parts normally supplied are shown in the following table -

<b>Description of spare part</b>	<b>Assembly by the customer</b>
Earthing switch	NO
Auxiliary contacts for limit switch inserted	YES
Auxiliary contacts for limit switch isolated	YES



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