Instructions for installation, operation and maintenance of low-voltage switchboard
MNS R

Preliminaries 1TTS 900 001 M 02 01

TABLE OF CONTENTS

1. Introduction

This document contains all necessary information for the installation, operation and maintenance of ABB Sace MNS R low-voltage switchboards. Like all the switchboards produced by ABB Sace, also these boards are designed for several system configurations. For this reason, our products can be subjected to technical-constructive variations (Custom-made) according to the system requirements.
Therefore, it is necessary to refer to the most updated ABB Sace technical documentation, especially in case of any possible variation.
Anyway, it is advisable that all the installation, start and service operations are carried out by qualified personnel.

1.1 Consequences in case of non-compliance

ABB declines any responsibility in the following cases:

- Negligent handling of low-voltage switchboards and non-conformity with safety and operation rules.
- Insufficient maintenance, non-compliance with the procedures here described or inadequate repairs carried out by unqualified personnel or with inadequate equipments.
- Any damage suffered during transportation.
- Inappropriate use.
- Modifications to low-voltage switchboards, which have not been carried out by authorized and qualified personnel.

2. Switchboard

The Power Center MNS R switchboard consists of compartments equipped with open-air or moulded-case circuit breakers, in fixed, plug-in, and withdrawable versions, auxiliary and measuring circuits, together with main and distribution busbar systems.

2.1 Technical Data

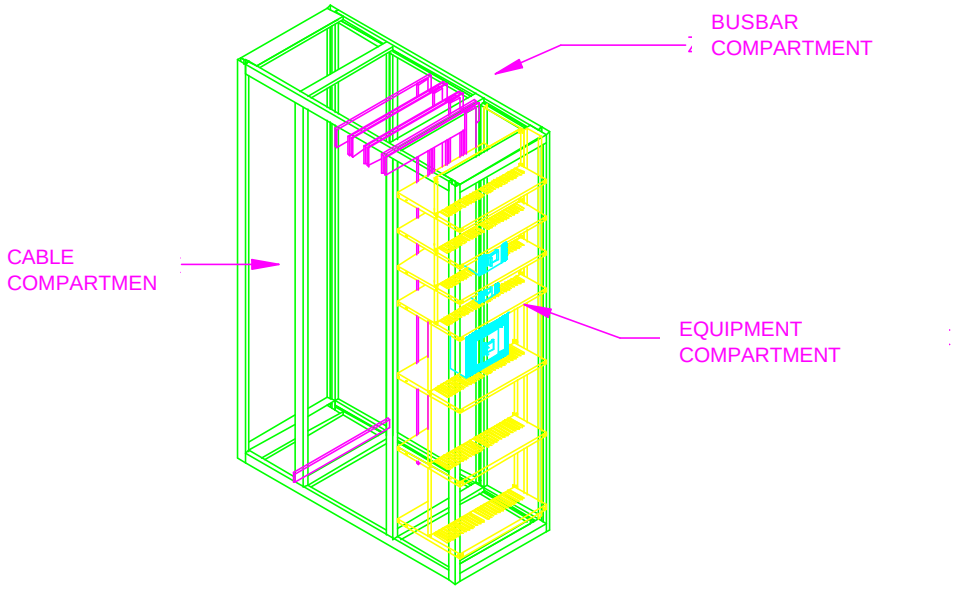
Technical Data			
Standards		MNS R Low Voltage Switchgears, type tested switchgear assemblies (TTA)	CEI 17-13/1, CEI EN 60439-1, IEC 60439-1
Test certificates		ABB SACE and SINAL	
Electrical data	Rated Voltages	Rated insulation voltage Rated operating voltage Rated frequency Rated impulse withstand voltage	1000 V 3 c.a. 800 V c.c. 690 V 3 c.a. 60 Hz max 12 kV
	Rated currents	**Busbars** Rated current Rated peak withstand current Rated short time withstand current (1s) ***Distribution bars*** Rated current Rated peak withstand current Rated short time withstand current (1s)	 Up to 6300 A max Up to 220 kA max Up to 100 kA max 630 ÷ 4000 A 220 kA 100 kA
Mechanical data	Dimensions	Heght Width Depth Basic module (height)	2200 mm 300, 400, 600, 800, 1000, 1200 mm 1025, 1200, 1400, 1600 mm E = 25 mm DIN 43660
	Surface protection	Frame Internal subdivision Transvers section Enclosures	Alu-zinc coated UNI EN 10130 zinc coated UNI ISO 4520 zinc coated Paint RAL 7035
	Degrees of protection (IEC 529)	Open door Closed door	IP 2X IP 30 standard
	Form	1 ÷ 4b	
	Internal subdivision	Cubicle - cubicle Busbar compartment – cable compartment Equipment compartment – Busbar compartment	
	Standard installation condition	Installation Ambient temperature Relative moisture Altitude max. Pollution degree	Internal -5 °C; + 40 °C max 50% a 40 °C ≤ 2000 m ≤ 3
Opzioni extra	Paint	Enclosure	Colour on request
	Busbar system	Busbars	Sheated, treated
	Special request	Ambient temperature > 40°C Protection degree > IP30 Internal arc 75 kA, 0,5 s 690 V	On request On request IEC 61641

2.2 Switchboard Basic Structure

2.2.1 Typical Side Section

The basic structure of the frame (steel C-sections, 2mm thick, with holes at 25 mm intervals), consists of:

- Equipment compartment
- Busbar compartment
- Cable compartment



The equipment compartment consists of:

- Main circuit breakers
- Auxiliary devices
- Terminal boards

The busbar compartment consists of:

- Main busbars
- Distribution bars

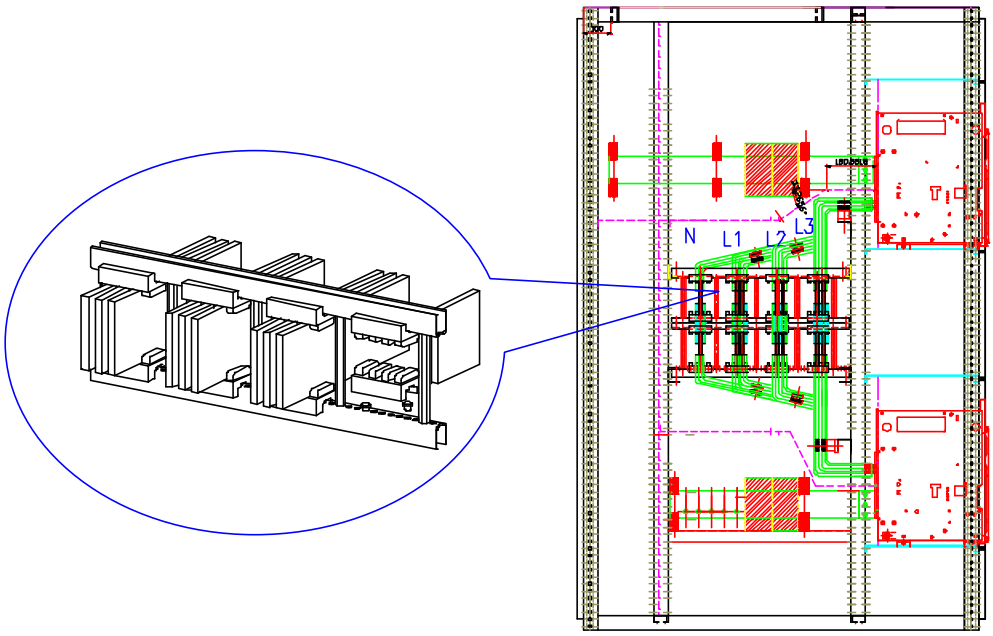
The cable compartment consists of:

- Input and output cables
- Auxiliary accessory (connectors, auxiliary terminal boards, etc.)

2.2.3 Busbars

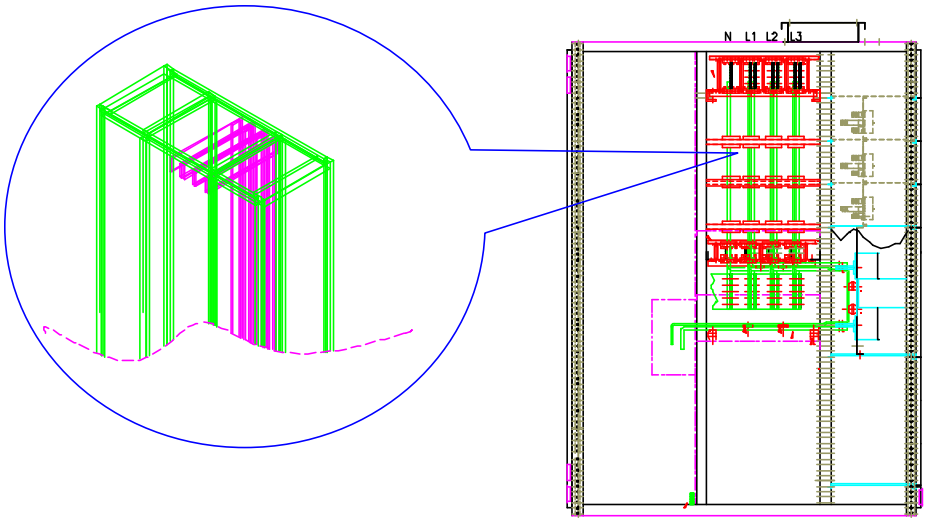
The busbars are in a central position; they consists of a single system or a double system and they can be installed to different levels. It is possible to create a busbar system in 3-pole or 4-pole version.

The busbars are classified according to their length, corresponding to the sizes of the switchboard shipping units.



2.2.4. Distribution bars

The distribution bars are the connection between the busbars ant the outgoing units.



The busbars can be installed in a single section along the whole length of the compartment, or at an appropriate level for particular executions.

3. Packing and Transportation

3.1 General

The MNS R switchboards are delivered either in single cubicles or in shipping units not exceeding 2 meters in lenght, taking also into consideration the type of equipment installed and the available space for handling the switchgear at the erection site.

If no special instruction are given by the customer, the switchboards are delivered with standard packaging, according to ABB internal instructions, and a suitable method of shipping is selected.

3.2 Packing

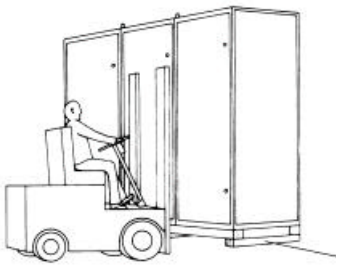
The cubicles are protected by suitable packaging during transport and possible intermediate storage.

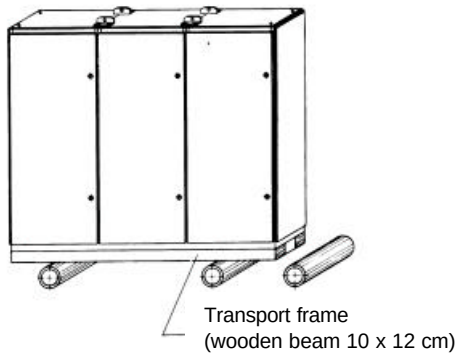
3.3 Delivery and Unloading Operations

The unloading operation must be carried out by means of cranes or lift trucks. The load must be laid down on a level surface.

3.3.1 Unloading

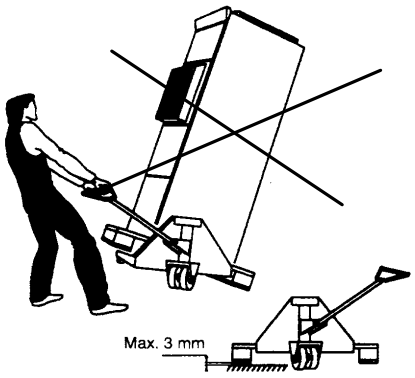
- By means of lift trucks (see Figure).
- By means of lifting and sliding devices (see Figure)





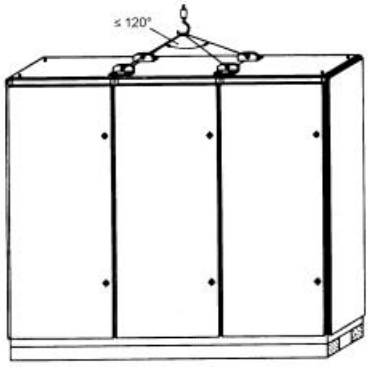
- If necessary, by means of rollers (min. 3 pieces). For roller transport, the wooden crossbeams must be removed (only for cubicles with transverse sections up to 1200 kg) (see Figure).
- The compartments for switchboard must be transported only in vertical position.
- Tilting and canting must be avoided.

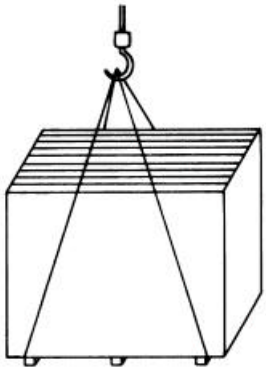
The transportation on manual lift truck is dangerous, the apparatus can overturn. For this reason, the distance between the crossbeams or pallets and the bottom must not exceed 3 mm (see Figure).



3.3.2 Transportation by Means of Crane

- For the transportation by means of a crane, the compartments and the related sending units must be equipped with lifting angles.
- It is not allowed to fix the lifting devices to the frame sections.
- The angle between the lifting cable and the crane hook must not exceed 120° (see Figure).





- The lifting angles can be removed after the apparatus installation has been performed.
- The fastening holes for the lifting angles are to be plugged with plugs GMN 775 502 P18 caps.

Approximate value for acceptable weights lifted by the cable

Cable diameter	Acceptable load for a 4-cable device, angle between the cable and the crane hook		
	Hemp cable DIN 83325	Perlon cable DIN 83330	Steel cable DIN 15060 (160 kg/mm^2)
mm	Kg	Kg	Kg
8	-	-	890
10	180	400	1440
12	280	600	2100
14	350	820	2900
16	470	1060	-
18	580	1340	-
20	720	1660	-
24	1000	2400	-
30	1600	-	-
36	2400	-	-

For a 90° angle, the acceptable load is approximately 40% greater than the values shown in the table.
The sending units, with one or two compartments, are equipped with single eyebolts.

3.3.3 Storage

Storage kind and time depend on the packaging-type.

Standard packaging:

- After the arrival, the goods must be stored in rooms where no condensation can occur.
- Unpack immediately.
- Let the door opened for several hours, to acclimatize the equipment.
- Cover the panels with plastic sheeting in case of any further storage.
- Check for condensation before the installation.

Packaging for marine transportation/export (on request):

- Protection against moisture is only guaranteed if the packaging is undamaged.
- Intermediate outdoor storage is possible.
- 12-month storage is possible, if the goods is wrapped in heat sealed protective sheeting and the packaging is undamaged.
- If the storage period is exceeded, the drying agent must be renewed and the plastic covering must be sealed again.

3.3.4 Spare Module Storage

- In dry rooms.
- Modules must be stored in undamaged original packaging.
- Modules must not suffer sudden changes in temperature.
- Boxes must be stored with the upper side upward.

4 Installation and Start up

4.1 Check on Delivery

After the arrival check that goods is:

- Undamaged in each components.
- Free of damages (otherwise, determine damage entity, cause and possible responsible).

When the damage is detected, proceed as follows:

- Register the visible damage on the delivery note.
- Inform opportunely ABB Sace (directly or by means of the supplier or sales representative).
- For non-visible damages, inform, within a week, the forwarding agent by means of a written document.

Complaints for any damage or for other reasons, following the delivery of the goods, must indicate the year of construction of the switchboard and the number of the order confirmation sent by ABB Sace, which are written on the enclosed supply documents.

In case of loss of supply documents, or failure to make a claim, ABB Sace declines any responsibility.

4.2 Installation

It is necessary to keep the best internal conditions, to guarantee an adequate illumination and free access to switchboards. It is recommended to heat the room to avoid sudden changes in temperature, high humidity and condensate.

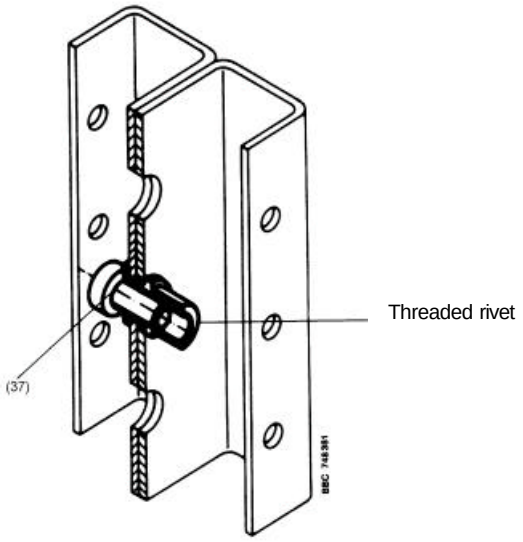
For a correct installation of the switchboard, it is important to prearrange the frame with care. This must be prepared in advance, with respect to the date of installation, according to the design document indications.

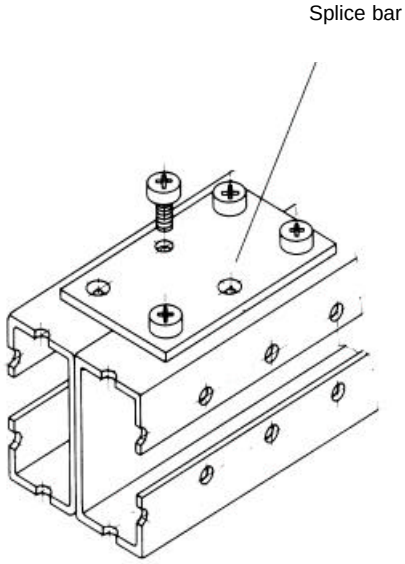
4.2.1 Erection and Connection of the Cubicles

To install the compartments, proceed as follows:

1. Shipping units to be installed must be aligned with care. Check that they are in vertical position. Doors and panels must not be twisted or stressed. Assembly can start from the right or left.
2. Shipping units frames can be screwed together (see Figure). Vertical sections are fixed on the left front and right rear sides, by means of 4 special nuts.

For threaded rivet initial fixing, use an electric or pneumatic screwing device.



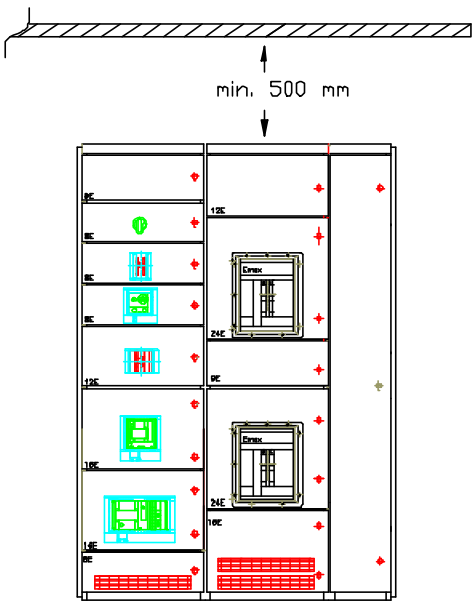


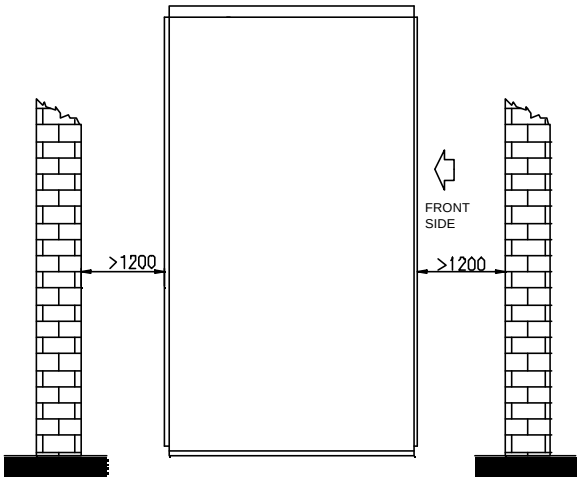
4.2.2 Additional Information for Switchgear Positioning

Minimum distance around the compartments, on the front and rear sides, must be at least 1.200 mm (see Figure).

To install the last compartment (right), the distance between the last compartment and the wall (right) must be 150 mm.

In case of compartments, with doors installed on the left side, the minimum distance between the left wall and the last left compartment must be 150 mm, so the doors can be opened in an angle of more than 90°.
The distance between the upper edge of the highest cubicle end and the ceiling must be min. 500 mm for cubicles which are internal arc proof (see Figure).





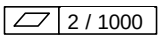
4.2.3 Fastening Methods to Foundation

The installation of switchboards equipped with cables entering form the bottom, requires a foundation with an opening or a cable duct.

Compartments must be installed on a base frame which is:

- Embedded in the concrete floor
- Fixed on supports on a false floor.

To install the base frame, proceed as follows:

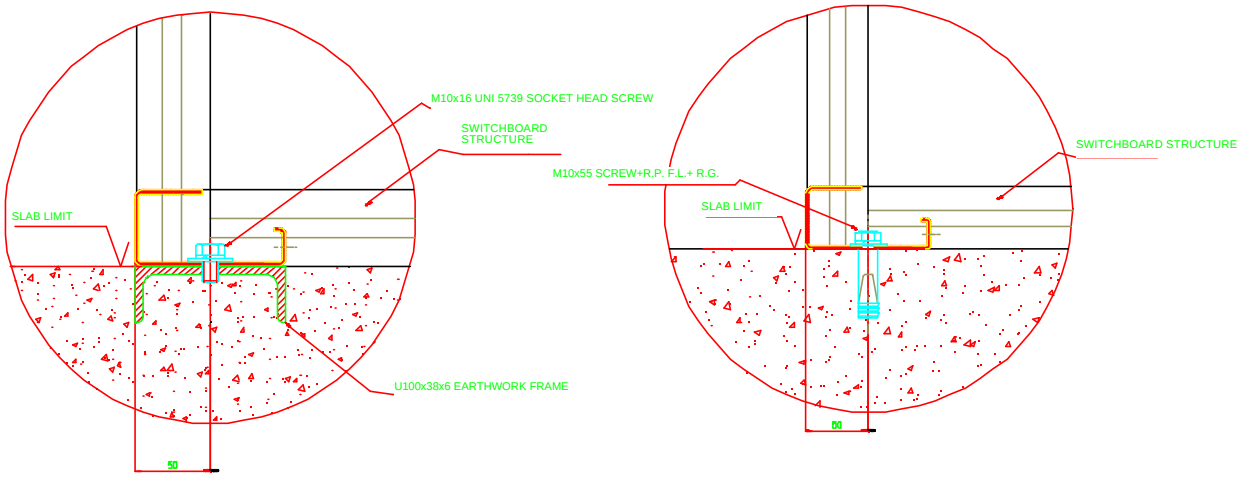
- The base frame should be aligned and checked by an ABB Sace qualified operator (on customer's request).
- The frame must not exceed a horizontal tolerance of ±1 mm on a length of 1 m.
- The frame must not ondulate. 

During the installation, the switchboard is welded or screwed to the base frame (see Figure).

- The welded joint length, on the front and rear sides of each cubicle, should not be less than 20 mm. Each welding should be protected against corrosion by means of an adequate treating (a coat of paint).
- The screwed connection is carried out through the transverse section, using M10 screws. (see Figure).

If the switchboard is installed on false floors, proceed as follows:

- Tolerance is the same as in the case of a base frame.
- The subsoil must be solid, so that the tolerances are not exceeded by settling of the soil (especially when using insulation layers and adhesives).
- The false floor must have a carrying capacity of p=20 kN/m^2 (compression load from the top to the bottom).



4.3 Cable and Bar Connection

For any connections and, in particular for those made with standard elements, it is necessary to conform to the tightening torque indicated by the table in Annexe A.

Circuit breakers and main switching devices are normally connected with cable or busbar. In case of parallel connection:

1. Power and control cables must be fastened to cable mounting rails.
2. Power and control cables are connected to:
   - Terminal boards
   - Connection bars or
   - Outgoing cable connection unit

The terminations of each circuit breaker installed in the switchboard are silver plated. Before the connection, terminations must be cleaned with a cloth and solvent.

- Check that the connection contact surface is flat and clean.
- Remove burrs, dents and oxidation by means of a file or a rough cloth. In case of busbars with special protecting treating, after using the above-mentioned tools, restore the protecting treating.
- Remove any grease with a cloth and solvent.

Busbars Connection

Before assembling, carefully clean the busbar contact area with a cloth soaked in solvent, and lightly grease with vaseline.

- Verify the busbar correct alignment
- Match the coupling elements
- Lock the joints by means of the coupling elements, bolts and nuts on issue.

Busbars, protective and neutral busbars must be screwed up at transportation subdivisions (connecting elements included). Busbars points of connection are accessible from the rear side. If the installation is carried out correctly, the holes match. **Drilling is not permissible, due to the resulting chips.** Contact surfaces do not need any particular treating. As for tightening torque related to busbar connection, see Appendix A.

4.3.1 Protective Conductor Connection

All switchboard compartments are normally equipped with an earth busbar as a protection against any short-circuit current.

The earth busbar is located in the rear side of the switchboard (at the bottom). The earthing busbar joint of each shipping unit must be made according to the following procedures:

- Remove any traces of oxidation from the contact surfaces of the busbars, by means of a file or emery cloth.
- Remove any grease with a cloth and solvent.
- Perform the earth busbar joints by means of screws, washers and nuts on issue.
- Cover the joints with grease.

Switchboard earthing must be performed by means of copper conductor whose cross-sectional area is not inferior to that of the earth busbar.

The doors are earthed by means of yellow-green copper conductors (cross-sectional area 2,5 mm^2). No connexion is necessary, if no energized element is connected to the door (≤ 50 V AC o ≤ 120 V DC).

Anyway, the connections of the protective conductor screwed on the painted surfaces must be fastened by means of lock washers.

4.3.2 Protection Degree

According with the required protection degree, it is necessary to take care to seal the compartments in the place of installation.

- For protection degrees >= IP X2 or >= IP 5X splice bar flanges must be sealed, if they had not yet been sealed. To seal the splice bar flanges, use an adhesive sealant tape of 15 x 2 mm (GSIN100021P0010) and apply it after cleaning the internal part of the flanges. The tape must protrude 3 mm from the edge of the internal part of the flanges.
- For protection degrees >= IP X1 or >= IP 4X it is necessary to put a gasket between the compartments (compartment/compartment) in the shipping division.

4.4 Final Preparations

- Remove the safety devices for the transportation of the heavy components of the apparatus.
- Assemble the equipment, as circuit breakers, fuses, lamps, meters. The various components are opportunely labelled. Follow the enclosed assembly instructions.
- Remove foreign materials, as tools, packaging material and residuals.
- Clean the insulating parts by means of an antistatic cloth. Do not use carbon tetrachloride, trichlorethylene or hydrocarbon solvents.
- Close the doors.

4.5 Check Operations

- Check the busbar connection to the transportation units. Tightening torque, Annexe A.
- Check base frame fastening.
- Check that the required protection degree is achieved, especially concerning the bottom closing.
- General visual inspection: appearance, completeness, labels, foreign materials in the switchboard, and dirt.
- Check that cables connection and wiring connection has been carried out completely and correctly.

4.6 Start

Before starting the switchboard, perform the inspection detailed in the following table.

ITEM	OPERATION	Note
1. Compartment	• Visually inspect internal and external parts for any possible evident damage; remove any foreign material (i.e. test tools left after the assembly) • Carefully clean the insulating parts, remove any trace of damp • Remove dust or dirt from the air-intake grilles	
2. Power circuit connections	Check the tightening and the continuity	
3. Earth busbar and related connections	Check the tightening and the continuity	
4. Insulation	Measure the insulation resistance of the auxiliary power circuits (phase-phase and phase-earth) and of the anticondensate heater The measured value must be at least > 100 Mohm	• The insulation resistance value is strongly influenced by environmental conditions • The switchboard must NOT be put in service if the insulation resistance is too low, for example inferior to 1 Mohm • If the insulation resistance low value is due to humidity, activate the anticondensate heater (after having performed the inspections described in step 8, and possibly taking the thermostat to the higher value); if necessary use also provisional heaters
5. Circuit breakers	• Before putting in service, carry out all necessary operation described in the instructions related to each circuit breaker • Check the necessary devices and the accessories for the operation; in case of key-locked circuit breaker (open or closed), each circuit breaker must be equipped with only one key • Put the circuit breakers into the service position	
6. Protective release device	Check the correct calibration according to the selective diagrams of the plant	
7. Auxiliary circuits	According to the diagram, check the functionality and the operation logic sequences of the auxiliary circuits	Before performing this inspection, check the calibration of each relay of the switchboard
8. Anticondensate heater	• Feed the circuit • Adjust the thermostat to the higher temperature allowed • Check that the heater temperature raises • Adjust the thermostat so that the temperature inside the switchboard is always higher than the outside ambient temperature (approximately 35° C)	

- In case of particular apparatus configuration, it is possible that the previous inspections must be integrated with others suggested by the technician responsible for the apparatus.

- Check that the current transformer secondary winding is connected to the related protective and/or measuring amperometric circuit, then remove any possible short-circuit connections.
- In case the voltage transformer secondary winding must be connected to switchboard external equipment, check for the following conditions, to avoid overloads or short-circuits in the voltage transformers:
  - Check that the total comsumption of the equipment is not superior to the transformer capacities.
  - Check for incorrect connections (also provisional) in the measuring circuit or connections not in accordance with the switchboard connection and other units (supply switchboard, subswitchboards, control or operating desks, etc.).
  - Check that only one phase of the voltage transformer secondary winding is earthed.
- At the end of the preliminary test, carry out the following operations:
  - Open and isolate all the circuit breakers
  - Remove any testing connections
    Close all doors of the circuit breakers and measuring cells
    Check for internal metal segregations (according to the design constructive shape) of the external closing panels
  - Check that the different mechanical and electrical interlocks (possibly deactivated to carry out start test with switchboard not powered) have been restored.
- Feed the control circuit
- Close the circuit breakers (according to system requirements), and ensure that any related function operates regularly
- Check the correct operation of the auxiliary instruments

Respect the general safety rules

5. Maintenance

5.1 General

Before performing any maintenance operation in the switchboard or in the installed equipment it is compulsory to:

- Power the compartment off (if possible), otherwise power off only the relevant section (power and auxiliary circuits)
- Earth the unit involved for work on it.

Only in case of absolute necessity and for switchboards in partially or totally segregated execution, it is possible to keep in service some parts of the compartment. In any case, do not remove any diaphragm or panel which require the use of tools, before having checked that in the related compartment area the voltage has been cut off.
Establish the earth connection.

5.2 Maintenance Intervals

DUTY CONDITIONS	MAINTENANCE	INTERVALS
Normal	Perform the operations described in the program	At least once a year
Installation in dusty or polluted environments	• Perform the operations described in the maintenance program • Check the operation of each apparatus, referring to the related instruction manuals	At least every 6 months
Circuit breaker tripping for short-circuit	• Perform the circuit breaker general inspection (see the related installation, operation and maintenance instructions) • Check the condition of the shorted power cables • Check the circuit breaker terminal connection • Perform the operations described in the maintenance program	Before putting back into service

5.3 Maintenance Program

GENERAL INSPECTIONS		
1. Circuit breakers connections (cables or busbars)	• Contact surfaces blackening • Loosened screws	• Clean with cloth and solvent • Tighten according to the tightening torque indicated in Appendix A.
2. Earth busbar joints and related connections	• Copper oxide	• Remove the oxide by means of a file or an emery cloth • Clean with cloth and solvent
	• Loosened screws	Tighten according to tightening torque
3. Insulating busbar keepers	Dust	Remove the dust by means of a vacuum cleaner
	• Crack • Discharge marks •	Replace the damaged busbar keepers (address to ABB Sace)
4. Ventilation grids	Dust or dirt	Remove by means of a vacuum cleaner
5. Circuit breakers	See the related installation, operation and maintenance instructions	Carry out the suggested maintenance procedures
6. Main power feeding busbars, distribution busbars, connections between busbars and circuit breakers	Discharge or smoke marks	Clean with solvent. If necessary replace the damaged part (address to ABB Sace)
INSULATION RESISTANCE INSPECTION		
Measure the insulation resistance in accordance with the same procedures indicated for the start. Measured values should not be very different from those detected during the start. If the insulation level is notably less, carry out voltage tests. It is better to perform the insulation resistance measurement before the voltage tests, and in case of insulation resistance decrease it is necessary to search the crush point.		

OPERATION INSPECTIONS		
1. Auxiliary circuits	Power supply voltage absent	Check the power circuit according to the related diagram and restore power supply
2. Indicator lamps	Do not turn on	• Check and replace the lamps if necessary • Check the operation of the signalling circuit apparatus by means of the related diagram
3. Anticondensate heater	Heating absent	• Check the thermostat operation • Check the power circuit
4. Automatic controls (if installed)	One or more function not carried out	Search for the possible cause and perform necessary operations. If necessary, ask ABB Sace
5. Devices and circuits for circuit breaker remote control	Circuit breakers do not open or close	Check the operation of the controlgears and of the related circuit (buttons, contacts, fuses, power circuit protective circuit breakers, terminal tightening, relay contacts etc.)If necessary, replace the damaged components
6. Meters	Irregular or absent indications	• Check the operation of the meters with the checking instrument • Check the operation of the voltage and/or current transformer measuring circuit
7. Mechanical and electrical interlock devices	Circuit breaker mechanical locking device failure (key locks, anti-introduction locks, different rated current, etc.)	See the related instruction manual
	• Improper operation of the external accept devices which condition the switchboard circuit breaker operations • Failure of auxiliary contacts used for reciprocal interlocks between the circuit breakers of the same switchboard	Check the operation of the related auxiliary circuits according to the diagram. If necessary, replace possible faulty auxiliary contacts or relays and check the terminal connection of the auxiliary circuit wires

5.4 Repair Operations for Possible Malfunctions

MALFUNCTION	POSSIBLE CAUSE	REMEDY
1. Malfunction of circuit breakers or apparatus installed in the switchboard	See the related installation, operation and maintenance instructions	See the related installation, operation and maintenance instructions
2. Compartment or unit heating abnormalities	Ventilation grids and/or ducts blocked	Clean by means of a vacuum cleaner and check the upper grids
	Connections between busbars, joints and/or terminals not properly tightened	Check the status of the contact surface, then tighten according to the tightening torques indicated in Appendix A
	Improper setting or malfunction of the anticondensate heater thermostat	Set properly the thermostat. If necessary, replace it
3. Condensation formation	Malfunction of the anticondensate heater or of the related power supply circuit	Search the cause; if necessary, replace the anticondensate resistance (ask ABB Sace)
4. Automatic controls do not function	Component malfunction	Search the possible cause by referring to the switchboard operation diagram. If necessary, ask SACE
5. Unwanted trip of circuit breakers	• Improper coordination of the protection • Overheating caused by loosen connections or dirty or oxidated isolating contacts • Failure caused by the overcurrent releases	• According to system selective diagrams, check the correspondence of the maximum current release device setting of the relevant circuit breakers • Clean with solvent the isolating contacts both of fixed parts and circuit breakers, then lubricate with vaseline greese • If the failure is caused by the overcurrent release, check first the temperature inside the circuit breaker compartment. See also the circuit breaker instruction manual •
6. Humming of the metallic structure	Screws loose of the segregation plates (if equipped) or of the external closing panels	General check of the segregation plate fixing or external closing panel

Each maintenance operation must be performed only by qualified personnel, always observing the safety rules.

5.5 Health And Safety

It is necessary to respect the following safety precautions:

- According with the effective rules, all the installation and maintenance operations on the MNS R switchboards must be performed only by qualified personnel.
- For manipulations at low-voltage switchboard components, the component to be manipulated must be **isolated!!!** The power supply to the capacitor by a remote auxiliary power source, if any, must also be isolated.
- When the system has been isolated, discharge the voltage stored in the capacitor by means of discharging resistors by waiting for **one minute**. As further safety measure, it is necessary that all the outgoing capacitor circuits must be tested for discharged condition using an insulated cable.
- Check if the current transformers have been short-circuited before they are isolated or or connected.
- Expecially in case of systems associated with higher risks (e.g.: nuclear plants), the operation and maintenance must be handled very carefully, in order to not exceed the allowed risk limits.
- For more information about the mechanical and electrical life of the electrical apparatuses, refer to the related documentation.
- All the maintenance operations and the operations related to electrical equipment in use must be performed according to the law binding manufacturer instructions.

6 List of the Switchboard Main Equipment

POS.	MANUFACTURER	DESCRIPTION	REFERENCE CATALOGUE

Annexe A

Bolts and Nuts, and Tightening Torque

- **Insulating self-tapping screws**

Screw Part Number	Diameter	Max. tightening torque	
		Thermoplastic/ Duroplastic	
	mm		Nm
GSIN 100073 P ... and GILN 100107 P ...	4,2 5,5 6,3	2,0 4,5 5,5	- 3,5 3,5

- **Metal self-tapping screws**

Screw Part Number	Diameter	Max. tightening torque					
		Steel plate		Aluminium plate		Copper busbar	
		Threading height/		Threading height/		Threading height/	
	Mm	mm	Nm	mm	Nm	mm	Nm
HZN 451307 P ... GILN 100082 P ...	M3 M4 M5 M6 M8	1.5 1.5 1.5 2.0 3.0	1.0 2.0 4.5 5.5 9.5	3 3 3 3 3	1.0 2.0 4.5 5.5 5.5	- - - - 5	- - - - 9.5

- **Busbar (Cu) and system (steel-steel) connecting screws**

Screw type		Diameter	Max. tightening torque
		mm	Nm
DIN 931 hexagonal-head screw DIN 933 hexagonal-head screw DIN 912 cheese-headed screw With or without ESLOK safety, Resistance class 8.8 A2G Hammer-head screw GMN 325 116 P... Screw with SR adapter		M6 M 8 M10 M12 M16	8 20 40 70 140