Blokset MB301M

Low Voltage Equipment

Quality inspection guide V5

Schneider Electric

Foreword

On the strength of its experience, the Groupe Schneider has always sought to produce quality equipment.

But what exactly do we mean by Quality?

The standard defines the Quality as:
"the set of properties and characteristics of a product or service which make it suitable to satisfy implicit or explicit needs".

Although final inspection is in some respects a statement of failure (as we have not been able to control the necessary quality throughout the assembly process) it is nevertheless a vital stage in equipment production.

This stage must be performed with care and rigour, both with respect to customer specifications (explicit needs), and proper operating procedures (implicit needs), in order to satisfy the customer.

The quality is also the willingness of all the staff, from the manager to the worker to satisfy the customer. This guide is a good means to help you in this way and to reach the excellence.

Thank you for your contribution.

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Quality inspection: means and procedures

Procedure
"Set of organisational rules of an administrative nature in order to achieve a certain result" (see Petit Robert dictionary)
"Specified way of accomplishing an activity" (see ISO 9001)

1 Justification of quality inspection

The complexity of LV equipment and the large number of human interventions and thus risk of errors, are the main reasons for its implementation.

It is also stipulated in the standards (see IEC 61439-1/2) which defines three routine tests (or individual tests) to complete the type tests:

- giving the equipment the TTA label (Type Tested Assembly),
- and which are binding on the panel builder's responsibility.

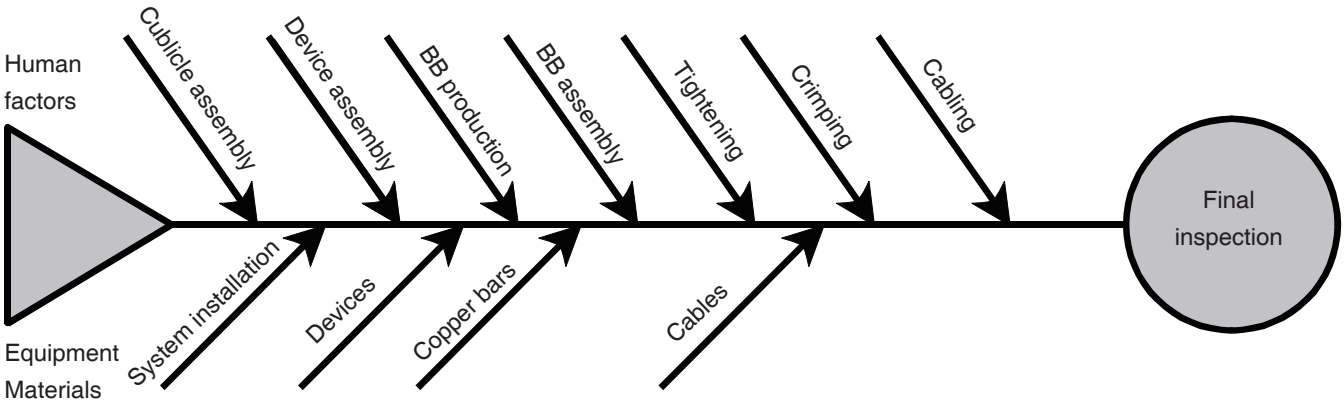
These three individual tests are:

- Electrical operation,
- Dielectric tests and/or measurement of insulation resistance,
- Checking of the electrical continuity of the protective circuit.

Quality inspection has several aims:

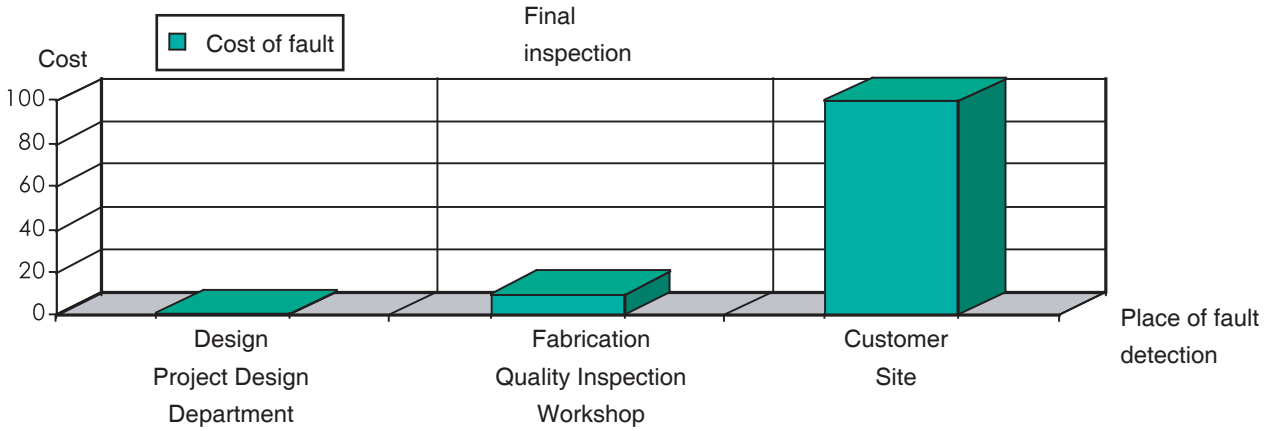
- Error detection.

The electrical equipment design and assembly includes a very important human intervention. This is also the main source of mistakes in our field, where each job must be checked.



- Cost reduction.

A study shows that a fault can cost one hundred to one thousand times more than if it had been detected during the switchboard design phase (see graph below).



The Quality inspection therefore contributes:

- to the guarantee of quality of Schneider equipment:
  - by preserving the company's brand image,
  - by guiding training according to the anomalies observed.
- to the safety of people and equipment,
- to the economic results of the company.

2 Quality inspection

2.1 Quality inspection function

- Perform the inspection with respect to:
  - the project file and the customer document,
  - Schneider rules and products,
  - IEC standards.
- Carry out acceptance tests in the customers' presence.
- Perform quality follow-up and corrective actions.

2.2 Quality inspection responsibility

Quality inspection:

- is directly attached to management and independent from manufacture,
- can delay delivery of a project and require reworking to ensure conformity,
- performs the corrective actions,
- in event of a dispute, informs the unit manager who alone has the power to decide,
- is responsible for the safety of all people working in the quality inspection zone.

2.3 Quality inspector's profile

- Electrotechnical training (B.T.S. or equivalent: higher technician's certificate),
- Versatile,
- Sound knowledge of Schneider equipment,
- Authorised to work near electrical current:
  - Knowledge of the hazards of electrical current,
  - Authorisation by approved training course,
  - Basic notions of first-aid.

2.4 Quality inspection zone

- is independent from production,
- must be physically separated from the other departments:
  - for reasons linked to the hazards of electrical current,
  - for protection of people and equipment,
- is clearly marked out (tapes, partitions, etc.)
- is clearly indicated (warning beacon, flashing light, etc.)

2.5 Necessary document

To carry out the various checks, the quality inspector must possess a complete, updated file of the project and the customer technical specifications.

2.6 Dedicated material means

The quality inspector must:

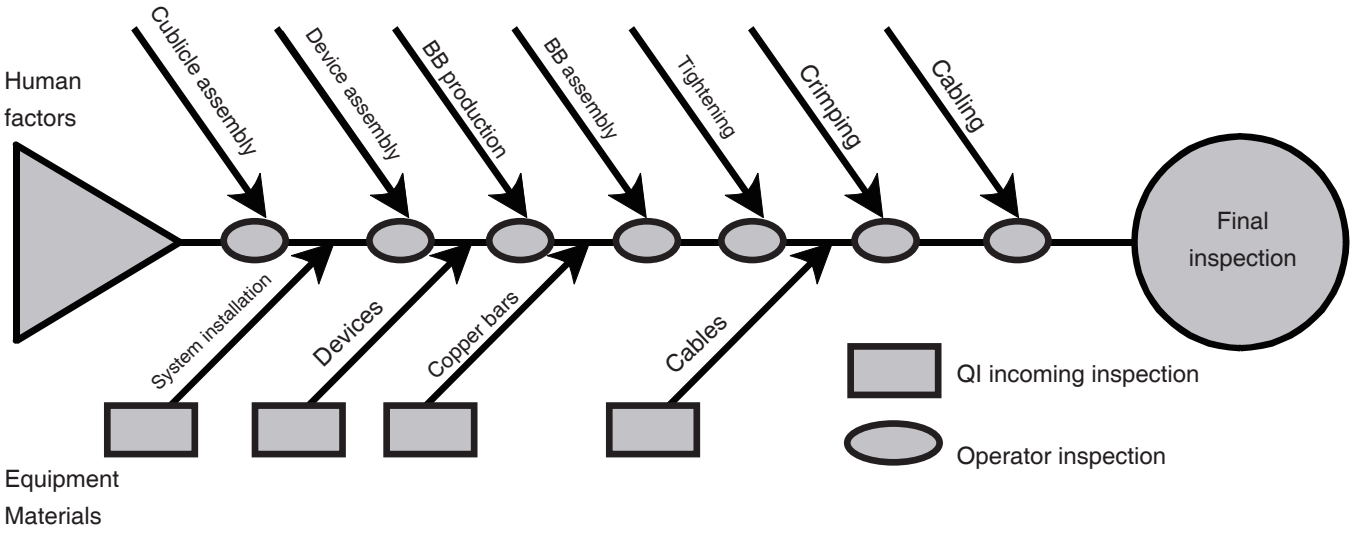
- Have the necessary inspection means (mechanical and electrical):
  - Test desk, variable current and voltage sources,
  - Inspector, peak demand,
  - Dielectrometer, insulation monitor,
  - Tools,
  - Mounting plates,
  - Associated documents.
- Ensure periodical calibration of his equipment

2.7 Necessary human resources

In the Group equipment units, the quality inspectors account for approximately 10% of workforce, i.e. 1 quality inspector for 8 to 10 cablers/fitters.

3 Continuous inspection

- Continuous inspection consists of carrying out checks throughout manufacture in the form of:
  - Operator checks which make each operator responsible for the quality of his work. The instructions provided at each manufacturing stage enable these checks to be formally defined (see ISO 9000).
  - Systematic inspection or sampling which is part of quality inspection and takes place during manufacture.
- A follow-up sheet must be used to log the status of the inspections performed.
- The various inspections can be modelled by the diagram below:
- This diagram represents the operations on which in-process inspections are carried out. The many phases in which operator inspections and incoming quality inspection are performed are clearly marked.



NB:
Despite the operator checks performed for each operation, final inspection is always necessary. It can be reduced but never completely removed, particularly as it is stipulated by standard IEC 60439.1.

4 Final inspection

Final inspection guarantees operation and conformity of products with respect to applicable drawings and standards. It is performed by the unit's Q.I. department.

A document per project formulating the customer's requirements and transcribing the specification is used for the checking phases during assembly and for final inspection. It forms the first reference document (project file).

The final inspection takes place as follows:

- Carry out the conformity check,
- Conduct the tests,
- Modify the Project Design file by adding any necessary annotations (throughout testing),
- List all the nonconformities:
  - by drafting a list of missing parts,
  - by noting all the faults observed.
- Draft the report,
- Ensure reworking for conformity,
- If customer acceptance is scheduled, receive the customer and his representative in the quality inspection zone. Carry out the tests and ask him to sign the report at the end of customer acceptance,
- Point out any areas of dispute between customer and supplier,
- Ensure that the Project Design documents have been properly updated, by checking final version status and dating the versions,
- Sign the documents and in particular the report,
- Archive the final inspection documents.

List of the various final inspection tests:

a. conformity checks：

- Enclosure,
  - Appearance,
  - Composition,
- Framework,
- Devices,
- Busbars,
- PE and (or) PEN protection busbars,
- Cables,
- Connections.

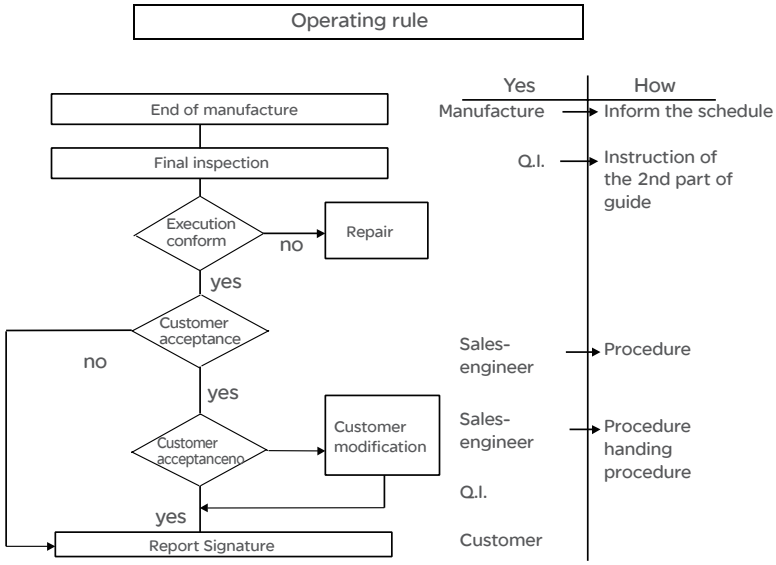
b. mechanical checks:

These checks consist of testing proper operation of the mechanisms and manual controls, the sturdiness of the switchgear, the proper location of the polarising devices as per their code, etc.

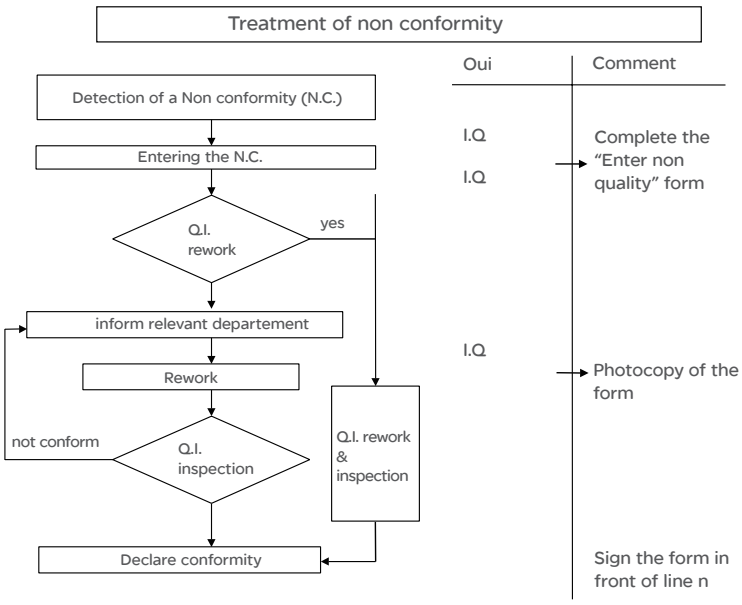
c. electrical checks:

- Operating tests,
- Dielectric withstand,
- Electricity continuity of protection circuits,
- Insulation resistance.

The operating rules can be modelled using the following diagram:



The following diagram describes the various possible cases of treatment of nonconformity.



During the final inspection operations, any errors detected must be marked on an "enter non quality" list, and all nonconformities corrected. This table is a standard table that can be modified as required.

Non-quality record board											
Quality inspector:	Manufacturing:	Project name:							Date:		
Product:	Quantity:	Job number:									
Number of faulty column:		Client:									
Number of drawer:									Repair action		
A: minor fault	B: major fault	C: critical fault	A	B	C	A	B	C	Repaired		Checked by
		Location and type of fault	Design / tendering			Manufactu-ring			By:	Duration	Q.I.

(reference: quality indicator chart file)

The following table gives you an idea of the average time required to perform a final inspection according to the type of switchboard to be inspected. The following information is given in hours per cubicle.

Distribution cubicle	Motor control cubicle		
Standard project	Simple project	Semi-complex	Complex
4	8	12	16

On completion of final inspection, a label declaring conformity of equipment is placed inside a cubicle (label example).

Schneider Electric

Manufacture
Performed by:

Date: …./…./….
Project no: . . . .
Switchboard: . . . .
Number of columns: . . . . . .
Checking index: . . . . . .

Quality inspection
Checked by:
Date: …./…./….

Only fully inspected cubicles can be dispatched.
A label, resembling the one below, is used to identify them.

Final inspection sheet OK for dispatch		
Customer:		Customer order no.:
Project:		Factory order no.:
Report number:		Of the:
Quality Inspection	Date:	
Name:		
Signature:		

5 Summarising operations after final inspection

After final inspection and according to contract clauses, the Quality inspector may run a check on the project accompanied by a sales engineer and the customer. This is known as customer acceptance, in the course of which the customer ensures that the specification has been respected.

Note:
The following information is taken from procedures for the Merlin Gerin Alpes, Pontcharra (France) regional workshop.

After final inspection, the following are required:

- Check that all the boxes of the "ITP" (Inspection and Test Programme) have been filled in,
- Check any reworks noted on the "enter non quality" sheet and sign in the relevant boxes,
- Record and draft a report (final inspection report),
- Ask the quality manager to validate the report,
- Note the report number on the ITP.

Quality inspection: instructions

Instruction (dictionary definition)
"Verbal or written explanation intended for the person responsible for the carrying out of a specific mission."

6 Performing in-process inspection

6.1 Reminder

The purpose of in-process inspection is to ensure product conformity after each manufacturing operation.

6.2 Composition

- One assembly follow-up sheet is completed for each cubicle
- It is used from the first assembly phase through to final inspection.
- After each stage, the operator checks and declares product conformity by signing this sheet and noting any observations.
- On completion of the inspections, a copy of this sheet is archived (see sheet example in the appendix).

7 Performing the final inspection

The Quality Inspector must:

- Take delivery of the switchboards to be inspected in the dedicated zone.
- Examine the Project Design file
- Check the observations and information given in the assembly follow-up sheet,
- Perform the final inspection by following the list of tests to be carried out.

7.1 Conformity check

7.1.1 Enclosure

Appearance

- Colour and reference of paint:

Use the colour palette to ensure that the reference of the paint given in the project file matches the colour of the cubicle.

- Homogeneity:

Perform a visual inspection to check the homogeneity of the colours of the various switchboard components (doors, panels, etc.).

○ Front face:
Visually check that the front face of the cubicle matches that shown in the drawing of the project design file

○ Finish:
Check external appearance by an essentially visual inspection: no scratches, deformation, etc.

Composition

○ Number and order of cubicles:
Use the drawing of the front face of the project to ensure that the number and order of cubicles is respected.。

○ Dimensions:
Check the cubicle dimensions (height, width, length and depth) by measuring and comparing them with those stated in the project design file.

○ Type of form:
Check the type of form against that defined in the project design file.

○ Mimic diagram:：
Check conformity of the mimic diagram compared with the power diagram.

○ Project identification label:
– Check that the label is present and in the right position (normally it is placed at the top of the switchboard).
– Check that the information marked on the label matches that in the project file

○ Cubicle identification markers:
– Check the presence of an identification marker on each switchboard cubicle. This is normally shown in the form of a selfadhesive label.
– Ensure that this label contains the registration number, signature, switchboard number and update version.
– On completion of final inspection, the Quality Inspector must place his registration number or signature and indicate the date when the inspection was performed.

7.1.2 Framework

- Ground fixing:

Use the project design drawing to check the location of the ground fixing points and the layout of the various cubicles in the project.

- Cable routing area:

Check the special facilities provided for cable (top or bottom) routing or busbar trunkings.

- Fixing of mounting plates, protection screens and partitioning or cowling parts:

Check that all screws (and picot washers) for fixing these components are present, and check that screws are properly tightened.

- Auxiliary screws:

Check the presence of the screws required for joining the cubicles and for mounting fishplates and roofs.

- "Danger" and "downstream live" warning plates：

Ensure they are fitted if required by the product or customer.

- Equipment:
  - Use the project design file to ensure that the cubicle equipment is complete and has been installed properly (seal covers, base plates, cableways, awnings, etc.)
  - Panelling：

Ensure the presence and proper fitting of:

–the front, rear and end panels,

– the roofs and bottom plates (steel, aluminium, etc.),

– the doors (plain, transparent, etc.).

- Conformity of cutouts in the plates

Using the drawing check the presence of any cutouts in the roofs and separation plates allowing fishplating of transfer busbars (mainly for MB 200), etc.

  - Checking the locks:

Check matching of the lock references and the key numbers with the references given in the project design file.

  - Checking the degree of protection (IP)：

–This check is performed by checking the presence of the components guaranteeing the IP level stated in the project design file. Needs vary according to the required IP degree: awning, seal, front plate, etc. (information given in the product catalogues or guides).

– If a seal is used, ensure it is properly positioned and continuous.

7.1.3 Switchgear

- Location / identification:

Use the layout diagrams in the project design file to ensure that the devices are properly placed and identified (QF1, QF2, etc.). At the same time, the nature of the labels associated with the devices and the content of the text can be checked using the project design file drawing.

- Fixing the switchgear:

Check the fixing of the devices on the mounting plates, doors, auxiliary compartment doors or front plates (checking that they are correctly fitted and that all the necessary screws are present).

- Accessories:

Visual checking of the presence of these accessories:

- Crank handles for circuit-breaker extraction,
- Locking of doors,
- Clamps for fuse extraction,
- Pins for fixing certain relays,
- etc.

- Technical data:
- For circuit-breakers:

– Check the type, rating, breaking capacity and number of poles. Also check presence and technical data of their associated devices (vigi, SD switch, trip unit, etc.).

– Check or carry out the settings for switchgear such as thermal and magnetic releases, time delays, etc.

- Check the supply voltages for:

– coils (contactors, relays, impulse relays, undervoltage or shunt coils of the Compact, Masterpact and Multi 9),

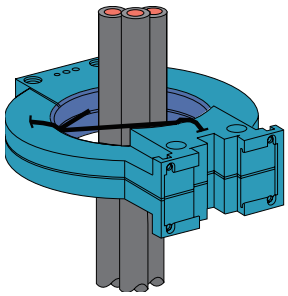
– switchgear motor mechanisms,

– indicator lights,

– all the electronic devices.

All these checks must be made with respect to the project design file.

Quality inspection: instructions



○ Toroids:
Check the technical data of each toroid against the project design file and the customer connection cables. Also ensure the correct mounting direction: the arrow shows current direction.

○ Current transformer (CT):
– Check the technical data of the current transformers against the project design file, together with the supply direction.
For example: some manufacturers propose transformers where current must enter via P1 and leave via P2.
– Check the correspondence between the current transformer and the associated device (ammeter, meter, etc.), ensuring that the current delivered by its secondary circuit is compatible with the device.
– Check the clearances of the fixing screws and the connecting screws of the current transformer and particularly those near the live conductors or metal parts.
○ Shunt:
Check the connection between the shunt and the measuring instrument.
○ Position of the indicators after a fault trip: trip the device, then examine the position of the indicators.

○ Plug-in protection flaps:
Check the presence of the plug-in sealing flap.

○ Insulation screen / phase separator:
Check they are fitted if required.

○ Accessibility:
Check accessibility of the devices, settings, HPC fuses for replacement, coils.

○ Safety perimeters:
– Check the circuit-breaker safety perimeters referring to their installation guides,
– Check if necessary, the various accessories necessary for proper operation.
○ Pre-tripping of the devices during plug-in and plug-out:
Check operation of the mechanical systems for pre-tripping the plugout devices on base or frame.

7.1.4 Busbars

- Type:

Check correspondence of the busbar type (Linergy, flat busbars) with the one shown on the project design file drawing.

- Cross-section:

According to nominal current (In), short-circuit current (Isc) and circuit-breaker breaking time, check that the cross-section corresponds to that shown in the switchboard technical guide.

- Coating:

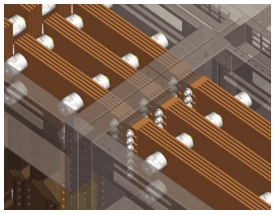
Check the type of coating of the busbars (bare copper, tin-coated copper, sheathed busbars, epoxy paint, silver-plating, etc.).

- Layout:
  - Check their position (horizontal, vertical) using the project design file layout drawing.
  - Check that the layout or arrangement of the busbars does not obstruct routing of cable connection cables.
  - Ensure the extension possibilities of the busbars according to specific features.
- Marking:
  - Check correspondence of the type of labelling against the project design file.
  - Check that marking order (phases 1, 2, 3, neutral and PE) is respected according to the layout drawing. Phase order will be checked at a later stage.
- Type of supports:

Check their type referring to the switchboard technical guide.

- Clearances / creepage distances:

Check using the switchboard technical guide.



- Spacing and number of busbar supports:

Check using the technical guide, the distance between supports (according to busbar cross-section and Isc).

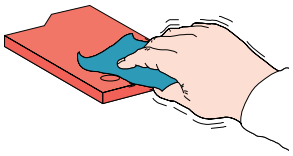
- Busbar fishplating:

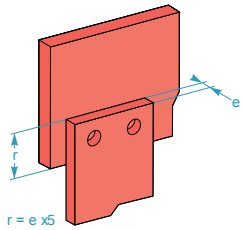
Check using the technical guide:

  - fishplate cross-section (same as busbars),
  - number and sufficient length.

- Incomers and outgoers:

Check the direction of the incomers and outgoers against those in the file.





- For Linergy type busbars:

Check positioning and accessibility of the connection screws.

- Connection quality

Check:

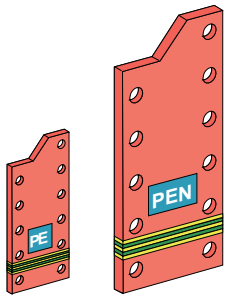
  - The number and length of bolts compared with busbar dimensions,
  - Screw quality (class 8.8),
  - Quality of drillings and surface finish (no burr, no oil stains, etc.).
  - The overlapping surfaces: R = e x 5

As a rule, an overlapping height equal to 5 times the thickness of the derived busbar must be counted in order to obtain the suitable overlapping surface.

- Radius of curvature: A minimum bending radius of curvature must be respected that is equal to r = 1.5 x e.

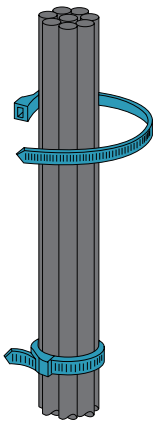
It is considered satisfactory if we have: r ≥ 1.5 x e.

If the copper is of excellent quality (CuETP), we accept: e



7.1.5 PE and/or PEN protection busbars

- Cross-section: Check using the technical guide.
- Presence and cross-section of the fishplates between the cubicles: Check that fishplate cross-section is at least equal to the cross-section of the busbar to be connected (see technical guide).
- Check the presence of the PE connection.
- Two-colour green/yellow marking: Check presence of the green/ yellow markings and PE lozenges on the conductors.
- Earthing fishplate: Check presence and cross-section of fishplate.



7.1.6 Cables

- Cross-section of power, auxiliary and protection conductors:

Check cross-section referring to the switchboard technical guide

- Protection of cables:

Check that the cables do not run near sharp edges, moving parts or exposed live parts.

- Radius of curvature:

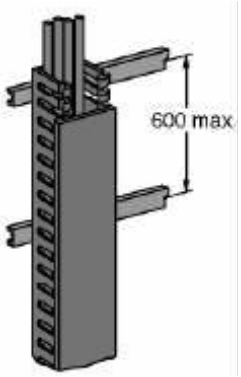
Ensure that the cable radius of curvature is roughly 6 to 8 times cable diameter.

- Number of cables per strand:

Refer to the switchboard implementation guide.

- Separating the strands:

Check that the power and control strands are separated as well as the strands receiving an auxiliary voltage of more than 500V AC-DC.



- Separating the strands:

Check that the power and control strands are separated as well as the strands receiving an auxiliary voltage of more than 500V AC-DC.

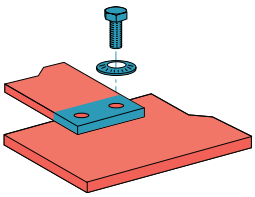
- Wiring trunking:

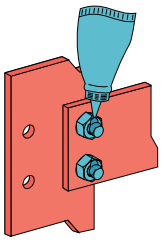
Ensure that the reserve in the trunkings is approximately 20% and that their fasteners are made of insulating accessories (e.g. polycarbonate screws).

- The maximum centre distance between two trunking fasteners must not exceed 600mm.
- No cables must be inserted between the power bars.

- Cable fixing:

Use the technical guide to ensure that the number of cable tie-bars, the quality of fastening according to Isc and the type of binding used are correct.





7.1.7. Connections

- Three types of inspection are performed according to theconnections:

  - Visual inspection (A):
  - Of the crimping recess (quality, pressure, etc.),
  - Of proper cable insertion,
  - Of the position of the conductor core in the lug shaft,
  - Of cable cross-section compared with lug cross-section
  - Mechanical inspection (B) by manual traction (performed by random sampling).
  - Visual inspection (C) of presence and direction of contactwashers (flat washers + "contact" washers on oblong holes), and presence of varnish certifying tightening to the right torque (on visible connections).

Quality inspection: instructions

In event of doubt (number of threads protruding from the nut, for connections of the same type, differs on screws of the same length, contact washers excessively crushed or moving), carry out a sampling check. If a number of faults are detected, ask the person responsible for assembling it to repair the LV switchboard.

The following table gives the inspections to be performed according to the type of connection used:

Connections	Power	Othercircuits
Lugs	A+C	B+C
Clips	B	B
Cable connectors	A	B
Terminals	B+C	B
Nuts-washers contacts	C	C

Where A, B, C stand for the various inspection types.
A = visual inspection
B = mechanical inspection
C = checking presence and positioning.

- Accessibility of power connection points and terminal blocks:

Check accessibility of the connection points so that the customer can connect according to the radius of curvature of the cables.

- Possibility of connecting cables on pads or terminals:

Refer to the technical guide and the project design file.

- Check that the number of holes matches the number of cables with which the customer connects.
- Check that the cross-section and number of cables ensure compliance with clearances.

7.2. Mechanical checks

● Operation of doors, mechanical accessories and drawers:
Check their operation by manoeuvring them.

● Manual controls of mechanisms:
Manoeuvre the manual control devices to ensure their proper operation.

● Resetting after fault trip:
Check that the circuit-breaker is reset after an electrical fault trip or after pressing the tripping test button.

● Locking systems:
a. interlockings:
Check that closing of one circuit-breaker prevents closing of the other(s).

○ Locking by rods:
Check their mechanical fasteners.

○ Locking by cables:
Check its radius of curvature using the installation guide and ensure that they are not fixed near exposed live parts.

○ Locking by key-locks, check:
– the type and references of the key-locks.
– that the key-lock prevents the device from operating.

b. Plug-in / Plug-out:

○ Check that operation is impossible when the device is closed.
○ Check pre-tripping of the devices on plug-in and plug-out.
○ Check the clamp penetration in the busbars, on live and load side, using the suitable tool (Mw).

c. ensure sturdiness of the various locking systems:

○ Polarisation:
Check that the position of the polarising slots matches the specification (MCC drawers).
With respect to switchgear, check their polarising code referring to the device polarisation manual.

○ Interchangeability between drawers and circuit-breakers:
Check the possibility of interchangeability of circuit-breakers and drawers of the same type.

○ Check the working of the bolting by padlock in the 3 holes (Mw).

7.3. Electrical checks

7.3.1. Operating tests

- Checking the powercircuits:

  - Check preparation:

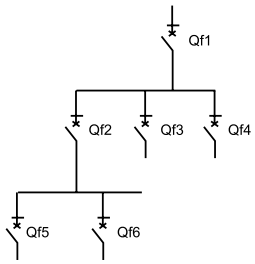
– Supply the busbar with the controldesk, ensuring that phase rotation direction is respected.
– Also connect the neutral and the earth.
– Before energising, open the auxiliary circuit protection circuit breakers (relays, measuring instruments, coils, etc.).

  - Carrying out the operations:

Check the order of the phasesusing the tester built into the control desk. Testing is always performed downstream of the circuit breakers in order to check its poles at the same time. However a different method or device can be used.

– Open all the circuit - breakers.
– Test the bus bar conduct or by applying the pin tip on them (L1, L2, L3) and check corresp ondence of their marking.
– Check the correspondence of the phases at each circuit- breaker by closing them one by one from line side to load side (see example below).

Example
When the incomer of some circuit-breakers is connected to the terminals, perform the tests on the terminals.



- Checking the control circuits:

Check the power supply of the auxiliary circuts by examining phase order at their as sociated protection circuit - breakers.

- Remote / local operating mechanisms:

Check their operation. If necessary use accessories (pin tip, small box equipped with push buttons, indicator lights, etc.).

- Supply circuits:

Systematically check the electronic switchgear supply circuits and the DC circuits using a tester (voltmeter).

- Electrical indications:
  - Check the presence of the power on indicator lights.
  - Check the function of these indicator lights.
  - Ensure their correspondence with the associated devices ("on" indicator light for "on" position, etc.).
- Information supplied on the connection terminals:
  - Check contact status (open or closed on make or break according to required operation).
  - Check the remaining information (voltage, current, etc.) by measuring it using a suitable device.
- Motor mechanisms (contactors, relays, etc.):
  - Close the protection devices to be checked.
  - Activate the operating mechanism of these devices using pushbuttons or relays.
- Electrical lockings:

Check that it is impossible to close a device equipped with a locking contact.

- Metering circuits:

Example of carrying out the operations:

– Select the supply voltage,

– Adjust the maximum value of the current to be injected in the secondary circuit,

– Inject the current in one of the circuits or in all three at once to check cabling.

- Checking the test function:

Circuit-breaker operation is checked by a variety of tests according to device type:

  - Earth leakage module test (Multi 9 range, NS range):

– Close the circuit-breaker.

– Press the test button of the Vigilohm part. This test is used to regularly check device tripping by simulating an earth fault.

○ Trip unit test (NS and Masterpact range):

This test is performed using an external electronic tripping box.

– Close the circuit-breaker.

– Make it trip using the box by connecting its cord to the specially provided socket on the front face of the trip unit part.

– For increased dependability, repeat this operation.

○ Testing the mechanical part:

– Press the test button (normally red).

– Check circuit-breaker tripping.

○ If the circuit-breaker opens for each test, the device operates correctly.

● Voltage relays, time delay relays, fault tracking devices:

○ For the voltage relays, check that the contacts are in the status

○ For the time delay relays, check correct operation of the time delays.

○ For the fault tracking devices, create a fault and check that the device detects and indicates its presence.

Pre-set the value of the resistance required to create a fault according to toroid characteristics.

Make the resistance vary by reducing its value. When you fall below the pre-set value, the device must indicate the fault.

● Time delay settings:

Check that these settings comply with the project design file.

7.3.2. Dielectric withstand

(Standard IEC 61439-1/2 paragraph 8.3.2)

● Preparation:

○ The dielectric test is always performed before the insulation test.

○ Do not forget to remove the covers from the Vigi modules of the Compact NS.

- Before performing the test, make sure that you disconnect:

- the surge absorbers (if any),
- the electrical control motors,
- the Vigilohm,
- and any other device not withstanding the applied voltage (electronic switchgear, contactor coils, indicator lights, miniature relays, horn, measuring instruments, etc.).

To do this open the circuit-breaker(s) supplying the auxiliary circuits.

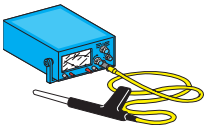
- The interference suppression capacitors installed between the live parts and the frames must not be disconnected, but be able to withstand the test voltage.
- There are no tests to perform on an auxiliary circuit not connected to the main busbar if it:

- is protected by a device of rating < 16 A,
- has undergone the operating tests.

NB:

Check, for certain auxiliaries, that no unprotected connections are left. Otherwise, disconnect these connections.

For example: remove the neutral connection wire for the PIM.



- Operating mode:
- Perform this test using a dielectrometer (or dielectrimeter) designed to deliver a variable voltage 0-5000V AC.
- Apply voltage in turn on each phase and on the other phases which are inter-connected and brought back to the switchboard frame.
- The standard stipulates that this voltage must be maintained for one second. However, it is customary to maintain it for one minute.
- Record the test result.

Voltage to be applied:

Ui	Test U
690V	2500V
1000V	3500V
Ui < 60V	500V
Ui > 60V	(2Ui + 1000)Vwith 1500V min.

Ui = Switchboard rated insulation voltage

- Note:

If, for any reason, the dielectric test must be repeated with, it will be done with voltage lowered to 85% of the previous value.

- Carrying out the operations:

Example of the neutral test for a 4P equipment:

- Close all the circuit-breakers,
- Connect the phases to one another and to the switchboard frame,
- Interconnect all the switchboard frames and earth them,
- Connect the measuring instrument earthing wire to the switchboard frame,
- Place the pin tip in contact with the circuit to be monitored and gradually increase voltage up to the required value,
- Maintain this voltage for one minute,
- Gradually reduce voltage before disconnecting,
- Record the result and note it on the measuring sheet,
- Once this check is complete, repeat it for the other conductors.
- Result:

The tests are satisfactory if there is no bypass, deterioration of the insulators or perforation.

7.3.3. Insulation resistance

- Check preparation:

Disconnect:

- The circuit-breaker electrical control motors and Vigilohms together with any other device not withstanding the applied voltage.
- Some devices, so as not to create connections between the live conductors (such as coils, relays, indicator lights, contactor electromagnets, etc.) and the loads such as measuring instruments.
- Operating mode:

Using an insulation measuring instrument (megohmmeter), measure insulation at a voltage of 500 V DC. This measurement is taken between each live conductor and the two or three other conductors connected to the switchboard frame.

- Carrying out the operations: The procedure is the same as the one used for testing dielectric withstand.
- Result:

The test is correct if insulation resistance between the circuits and the frame is at least 1000 Ohms/Vwith respect to the voltage of this circuit (NB: for our LV switchboards, the usual).

7.3.4. Electrical continuity of the protection circuits

(standard IEC 61439-1/2 paragraph 8.3.3)

The inspection is either visual or electrical as required by the customer.

- Visual inspection:

This inspection is performed by checking the presence of componentparts such as picot washers, earthing braids, etc.

  - For earthing braids, check the presence and direction of the picot washers (see electrical switchboard implementation guide) as well as their withstand by exerting a slight pressure on their connections.

- Electrical inspection:

NB:

There is no device enabling this continuity to be checked. The method given is only for information.

  - Operating mode:

A DC source is used, with an electromotive force of less than 6 V. A 2 A current is injected between the inlet of the earth busbar and the parts to be inspected (doors, front face, frame, etc.).

Measured resistance: R = U / I

- Result:

The inspection is satisfactory if the measured resistance is less than0.1 Ohm.

8. Quality indicator chart

8.1. Purpose

The purpose of this chart is to measure quality performance and perform the necessary corrective actions to progress.

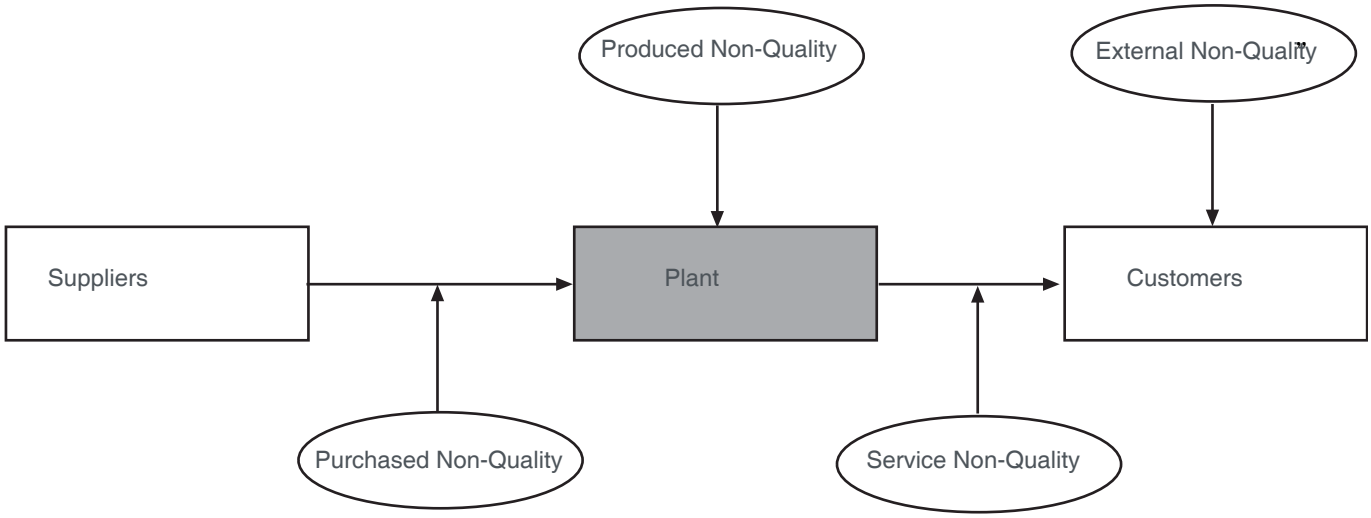
8.2. Principles

The quality assurance manager issues a monthly quality report entitled "Quality indicator chart". This document is intended for the unit manager,the site department managers and the quality assurance managers of the activity in the division.

8.3. Scope

Performance is evaluated in the Groupe Schneider according to the four indicators below:

- PNQ: purchased non quality.
- PNQ: produced non quality.
- SNQ: service non quality.
- ENQ: customer complaints.



- The non quality index:
  - is an indicator used to measure changes in non quality,
  - defines the target aims,
  - reveals the weaknesses of the various operations and allows the relevant action to be taken.
- These non quality indices can be calculated using specific formulas that are found in the quality indicator chart form. With respect to quality inspection, the index directly associated with the final inspection is produced non quality.

- Purchased non quality is monitored by means of 3 indicators:
  - global ratio,
  - ratio outside the group,
  - Schneider ratio.

- External non quality:

Taking customer complaints into account (intermediate or end).

8.4. Produced non quality

- This index is calculated during the final inspection by the quality inspector.
- It is calculated using this formula:

Non quality index = Sum of weighted faults
Total nbr of cubicles*

- The faults revealed by the quality inspection are assigned according to their origin to production, the project design department or the subcontractors.
- The faults are classed in 3 categories:
  - Critical:

A fault which, according to judgement and experience, is likely to result in a lack of safety or risk of accidents for the user. It presents a real danger for persons and equipment.

  - Major:

A fault risking a considerable reduction in switchboard operation.

  - Minor:

A fault corresponding to a nonconformity.

- Weighting:

The weighting applied to these three types of faults is:

  - critical fault = 10
  - major fault = 3
  - minor fault = 1

Produced non quality is monitored by means of indicators for each type of product and a global indicator.

* Remarks:
Note 1: in the distribution switchboards (PCC), the number of cubicles indicated corresponds to the number of cubicles produced.
Note 2: in the motor control panel (MCC), the rules are as follows:
– Framework = 0.2 cubicle,
– Drawers ≤ 125 A = 0.1 cubicle,
– Drawers >125 A = 0.2 cubicle.

- Example of a MCC cubicle made up of:

1 framework	(1X0.2)	= 0.2
2 drawers >125 A	(2X0.2)	= 0.4
8 drawers ≤ 125 A	(8X0.1)	= 0.8
	Total	=1.4

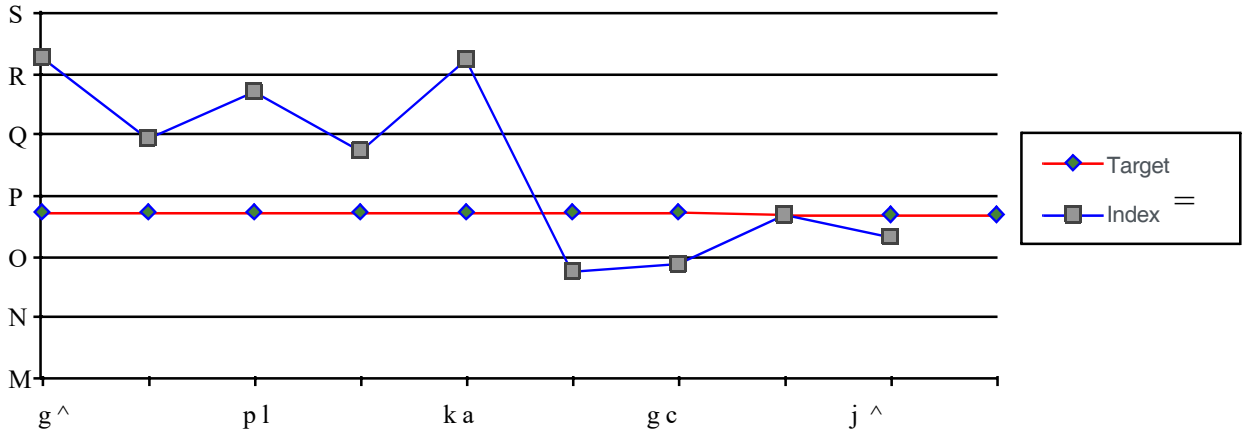
In the cubicle equivalent = 1.4

8.5. Example of a Produced Non Quality index switchboard.

Product	Number	Non conform		Faults				Responsibilities			Weighting version
		Nbr	%	A	B	C	Weight. total	Prod.	Project design dept.	Ext.	
equip. 1	12.0	3	25	5	2	0	11	4	2	1	0.92
equip. 2	5.0	4	80	3	3	1	22	3	1	3	4.44
equip. 3	8.0	4	50	4	0	1	14	4	0	1	1.75
Total	25	11	44	12	5	2	4	11	3	5	1.88

A: Minor = 1.
B: Major = 3.
C: Critical = 10.

8.6. Example of a graph showing the non quality index



- The peaks shown on the graph of the previous page may be dueto:
  - the number of projects handled,
  - the complexity of certain projects (complicated operating sequence),
  - insufficient personnel training,
  - insufficient sensitivity of personnel,
  - poor control of supplies,
  - poor quality of the project design file.

9 Control of inspection means

9.1 Purpose

The purpose of this section is to control the inspection and production means used in the unit.

9.2 Reminders of basic principles

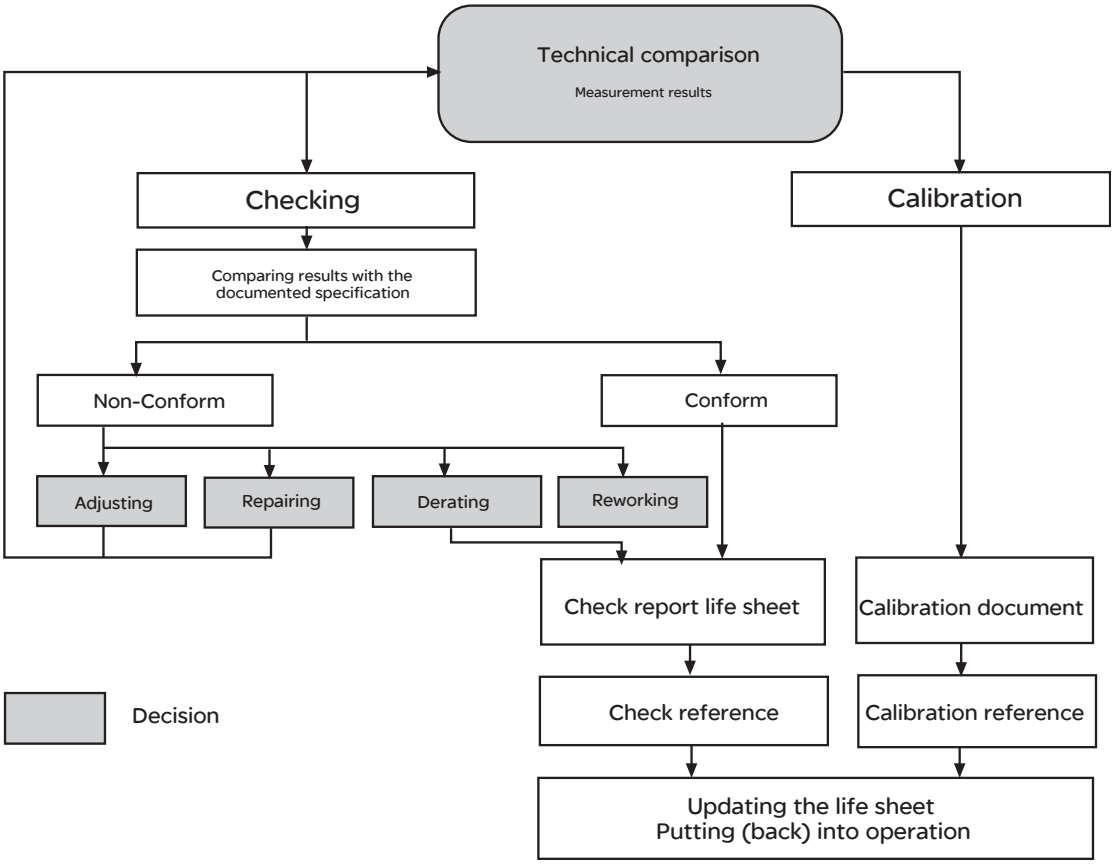
- Inspection means
  - List and identify the inspection means,
  - Have them checked at specific intervals, according to the accuracy of the measurements to take, by an approved international or national organisation. (For example, the organisation for France is the B.N.M. – National Metrology Office),
  - Identify by a label "not followed up in calibration", the devices not assigned to measurement (e.g. power on detection devices),
  - Store, use and transport these means in conditions guaranteeing their proper operation and level of accuracy,
  - Rule on the project equipment delivered and inspected using nonconform measuring instruments.
- Production means
  - Torque wrenches.
  - Crimping means.

9.3 Responsibility

The inspection and production means manager appointed by the quality manager is responsible for:

- listing and identifying these means,
- implementing and monitoring the checks,
- decision-making after checking,
- archiving the documents.

9.4 General diagram of operations



9.5 Application rules

9.5.1. Choice of means

Inspection means are chosen according to:

- the type of measurement,
- the theoretical values to be measured,
- the required accuracy.

9.5.2. Classification of means

- For checking follow-up:

All the inspection means identified and monitored during checking that are used for inspection.

- The items of equipment identified by a label "not followed up in calibration" and listed on the associated document are used as indicators.

NB: the electrical test desks are qualified by the QI manager.

9.5.3. Checking frequency

- Inspection means

The normal frequencies chosen are:

  - 1 check once a year for normally used inspection means (type: dielectrometer, etc.),
  - 1 check once every 2 years for seldom used inspection means(e.g. oscilloscope, etc.).

- Production means
  - Torque wrenches:

Must be calibrated once a year at least.

  - Crimping means:

Must be checked once a year.

9.5.4. Listing and monitoring the inspection means

- A list of inspection means plus a checking schedule are updated by the manager.
- Each inspection means has a life sheet, which is opened for each acquisition and completed after each check by the manager.
- A label is placed on each inspection means by an authorised organisation, such as BNM for France. It gives the check date and the date of the next check to be carried out.
- The checking reports, measurement readings and nonconformity sheets transmitted by the organisation are filed with the life sheet.

9.5.5. Occasional checks

These checks must be performed after:

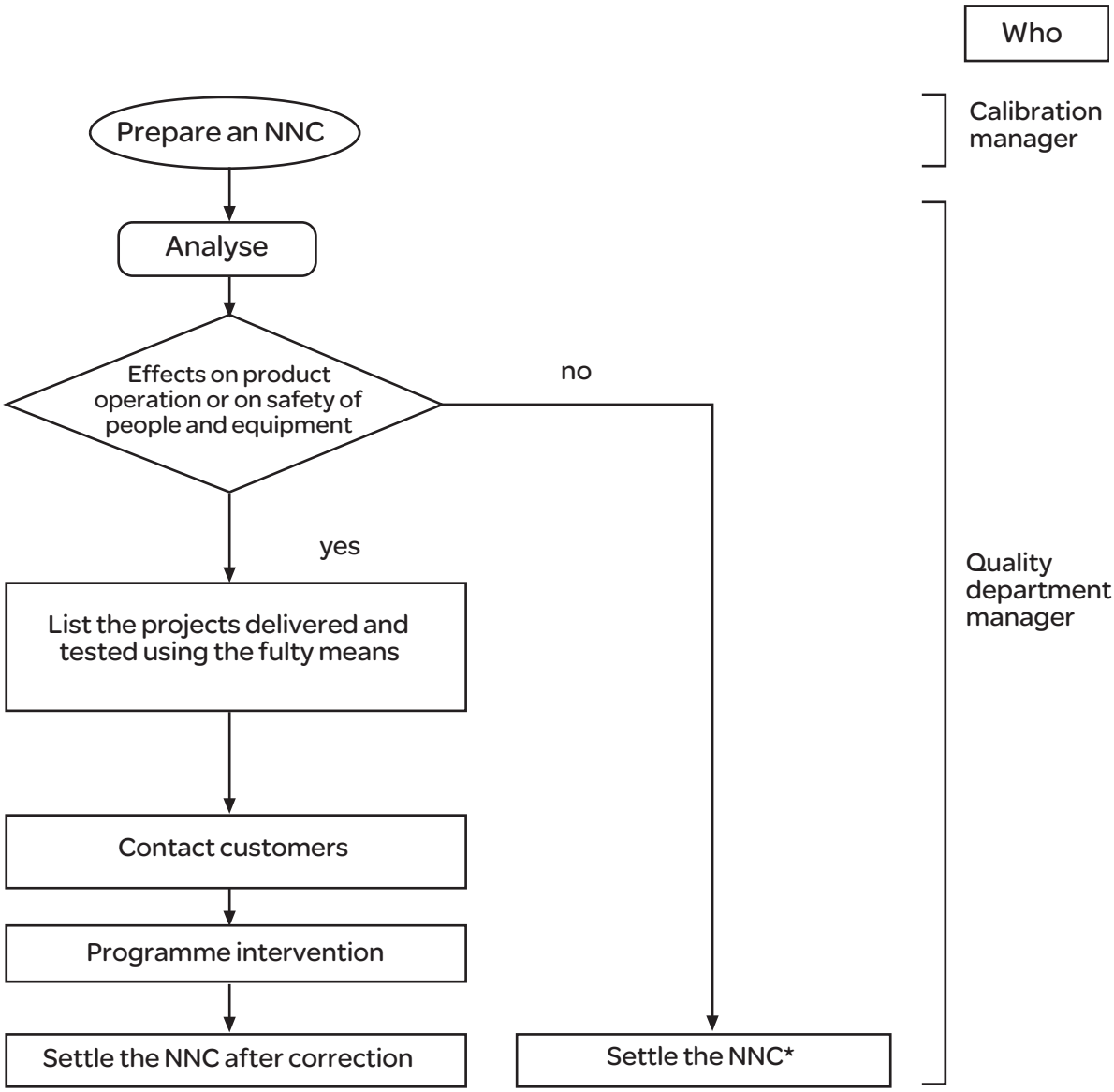
- Acquisition of a new inspection means (without verification or conformity certificate),
- An impact,
- A repair,
- A loan,
- A long period of inactivity.

9.5.6. Devices outside the accuracy class

Should the calibration organisation declare the inspection means to fall outside the accuracy class, it is up to the manager to isolate it and implement one of the decisions listed below:

- Repair,
- Derating to an inspection means not assigned to measurement,
- Scrapping.

He must also decide whether to initiate a Notification of NonConformity (NNC) used to rule on project equipment delivered which is inspected using the device in question as follows:



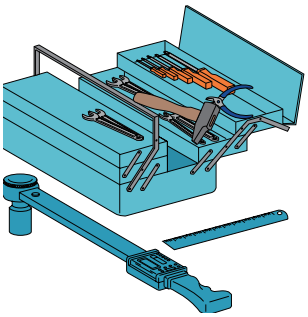
* See the example of Notification of NonConformity.

10. List of equipment

10.1. The Quality Inspector's tools

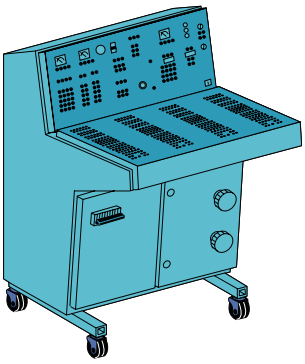
These are the switchboard fitter's tools (screwdriver, wrenches, etc.)with in addition:

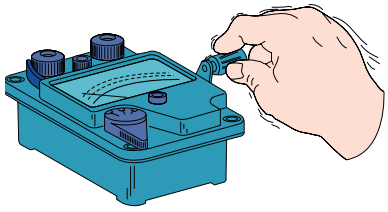
- A small rule to check clearances,
- A lamp,
- An articulated mirror.

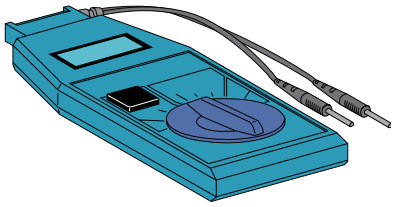


10.2. Switchgear common to the Quality Inspection

- Control desk,
- Dielectrometer or dielectrimeter,
- Megohmmeter,
- Peak demand, phase order tester,
- The Quality Inspector should have at his disposal: mounting plate, test cords and a variety of plugs, supply cords and other connection systems,
- Some devices are seldom used and act only as an indicator (e.g. oscilloscope, cubicle scales, etc.).







11. Example of measuring means accuracy

Type of measurement	Example of the type device to be used	Required accuracy	Device accuracy
Voltage measurement: – ac: 0-650V – dc: 0-250V	■ Peak demand ❑ MX522 (Metrix).		❑ 0.5%
	❑ MX570 (Metrix).	5%	❑ Digital 0.1% ❑ Anal. 1.5%
Current measurement 0-10A 0-50A	■ Kit DHF MTM 3US2 ■ Peak demand ❑ MX522 (Metrix). ❑ MX570 (Metrix).	5%	❑ 1% ❑ 0.5%
Resistance measurement	■ Kit DHF MTM 3US2. ■ Peak demand ❑ MX522 (Metrix).	5%	❑ 1% ❑ 0.5%
Insulation measurement	❑ MX570 (Metrix). ■ Megger BM6. ■ Chauvin Arnoux Isoca. ■ ELK VH 27. ■ Bouchet A 509. ■ Sefelec MG50.		❑ Digital 0.1% ❑ Anal. 1.5%
Temperature measurement	Metrix HA 1159.	5%	❑ 2° from 0 to 70 ❑ 3° from 70 to 120°
Length measurement	■ Sliding caliper: ❑ Mittutoyo CD 15D	0.1mm (Dimension measurement up to 200m)	❑ 0.02mm
Coating thickness measurement on ferrous and non-ferrous metals:	❑ Storm. Elcometer 345-022322	■ Paint on steel sheet: 10 microns ■ Nickel and Zinc on steel: 2 microns	0.01mm 3% of value read
Signal readings:	Metrix Oscilloscope		
Circuit-breaker tripping test:	Merlin Gerin		
Dielectric withstand:	Bouchet A507 (or A884) Chauvin Arnoux MC5B.		

12. Example of control check-list

12.1. List of checking procedures

This list contains all the tests to be carried out. It can be of use to you if you complete it when you have to carry out the checking operations in the final inspection.

Customer reference:
... ...

Document:
... ...

Project identification:
... ...

Checked:
... ...

Date:
... ...

Signature:
... ...

IEC 60439-1 reference standards
Degree of protection
... ...

1. Composition

- Number of cubicles
- Order of cubicles
- Cubicle identification
- Handling device
- Switchboard and cubicle identification markers
- "Man struck by lightning" plates for U660 V or form door

2. Appearance

Paint

- MG paint colour and reference
- Finish - Homogeneity
- No scratches or deformation

3. Framework

- Dimensional inspection – Switchboard – Length – Width – Height – Depth – Fixing points
- Operation of doors and mechanical accessories
- Inspecting key-locks and key numbers
- Operation of drawers
- Checking the degree of protection

4. Conformity of the devices installed

Checking

- Conformity of the devices installed (circuit-breakers – contactors – thermal relays - etc.)
- Their type and rating
- Device breaking capacities
- Safety perimeters
- Manual controls of mechanisms
- Interlockings
- Plug-in protection flaps
- Fault trip indicators
- Compacts NS motor mechanisms

5. Checking the electrical connections

Busbars

- ● Checking the busbars:
- ○ Spacing and number of BB supports for electrodynamicwithstand
- ○ Type of supports (conformity with product technical file)
- ○ Busbar fishplating

- ● Checking:
- ○ Phase rotation
- ○ Effective continuity of the earthing circuit (take care with EMC compatibility
- ○ Presence of the earthing fishplate
- ○ Cross-section of the protection conductor

Cables

- ● Checking:
- ○ Power conductor cross-section
- ○ Auxiliary conductor cross-section
- ○ Type of cables (insulation 1000 V - 105°C, self-extinguishing)
- ○ Connection stresses
- ○ Protection of sockets on busbars

Protection of cables

- ○ against sharp edges
- ○ against moving parts
- ○ separation of strands for auxiliary U ≥ 500 V DC-AC
- ○ wiring trunking (reserve in trunking: 20%)

Checking crimping

- ○ Power cables
- ○ Control cables

6.Conformity of screw tightening and assemblies

Checking

- ○ Tightening
- ○ Busbar overlapping
- ○ Class of screws

7.Connections

- ○ Possibility of connecting cables to pads or terminals
- ○ Power incomers and outgoers with respect to cross-section

– from the top

– from the bottom

- ○ Auxiliary incomers
- ○ Cable fixing

– Number of cable supports

– Quality of fixing taking the short-circuit current into account

8.Clearances

Inspection

MB301M:

- Clearance: 20 mm
- Creepage distances: 25mm

MB401M:

- Clearance: 14 mm
- Creepage distances: 16mm

9.Protection of persons

- During normal operation
- During safety operations
- Presence of flaps sealing or partitioning the cable head outlet pads (as per Specification)
- Rigidity of plates, protection grids
- Presence of door earthing braids
- IP of the measuring instruments

10.Accessibility

- Functional units or devices
- Terminal blocks manually or using a screwdriver

11.Interchangeability of drawers

- Polarisation
- Electrical interchangeability between drawers and circuit-breakers

12.Checking switchgear locking

- Pre-tripping of devices on plug-in and plug-out operations
- Correct resetting of devices after a fault trip (circuit-breaker,relay, etc.)

13.Checking drawers locking

- Impossibility of plugging in a drawer when the device is closed
- Impossibility of plugging out a drawer when the device is closed
- Of the working correct of locking by padlock of diameter 5 mms in the 3 holes of boltings by locks by padlock
- Operating safety (jamming - safety margin)

14. Checking mechanical settings

Check

- Limit travel contacts: circuit-breaker - drawer - etc.

– Plug-in position - test

– Plug-out position - free

- Contactor pretripping
- Tripping on fuse blowing
- Cubicle back micros
- Circuit-breaker rod assemblies (Normal/Standby Source Changeover switches – switches)
- Power plug-in penetrations
- Freedom of the power clamp fingers – of contact pressure

15. Checking serviced devices

- Fitting or removing the arc chutes (contactors, circuit-breakers,etc.)
- Access to HPC fuses for replacement
- Ease of fitting or removing covers, front plates, etc.

16. Operating inspection

Check

- CT inlets and outlets
- Winding direction
- Wiring and the various operating sequences
- Local and remote controls
- Mechanical electrical indications
- Electrical controls and mechanisms
- Electrical locking
- Protection and metering circuits
- Time delay setting

17. Measuring dielectric withstand

Circuit tested	φ1	φ2	φ3	N	Aux
Nominal voltage					
Circuit tested					
Leakage current					
Result					

18. Insulation resistance measurement

Circuit tested	j1	j2	j3	N	Aux
Nominal voltage					
Circuit tested					
Leakage current					
Result					

19. Monitoring protection circuits

- ○ Visual
- ○ By tests

20. Inspection prior to dispatch

Check

- ○ Roofs, seal covers and fixing screws
- ○ End panels and fixing screws
- ○ Sealing flaps (+ screws), openings for access to the cubicle anchoring points
- ○ Cubicle coupling screws
- ○ Conformity of cutouts in the separation plates for insertion of the transfer busbars (or cables)
- ○ Seals according to the IP (those mounted after installation)
- ○ Fishplates (nature) and associated screws
- ○ Circuit-breaker extraction crank handles: - Masterpact - C 1250,etc
- ○ Device lifting handles
- ○ Extraction clamps for L fuses
- ○ Accessories for protecting wires between cubicles
- ○ Separate equipment
- ○ Cubicle anchoring bolting (if stipulated in Specification)
- ○ Devices dismantled for transportation
- ○ Door handle keys: key-locking
- ○ The list of equipment not delivered (missing)

12.2. Example of Quality Inspection documents

- ● Final inspection report.
- ● Leaf of follow-up of assembly.
- ● List of components not dispatched with the project.
- ● Follow-up of missing components at end of project.
- ○ Missing components at end of assembly.
- ○ Missing components at end of inspection.
- ○ Sales department notification.
- ● Request for corrective action.
- ● Project design file.

Final inspection record

Customer : .....
Projet : .....
Switchboard identification : ..... .
..... .
Product : .....
Qty : ..... .
DRWG Nr : .....

Certif Nr : .....
Customer ref : .....
.....
Job ref : .....

Index : Exped

Checking program

1. conformit checkin g
   - Enclosures .....
   - Switchgear .....
   - Conductors .....
2. mechanical checking
3. Exposed conductive parts electrical continuit y — Visual / Electrical
   meter ref.
   Value
4. diel edielectric test — meter ref.

Circuit		Auxiliaries	Power
nominal volt	V		
injection volt	V		

5. insulatin g test — mesure ref.

Circuit		Auxiliaries	Power
Applied voltage	V		
Insulation value	V		

6. performances electric test
   .....

comment :

Customer représentative	Quality inspector	Quality manager
Visa	Visa	

MB301M

PRODUCTION AUTO CONTROL FOLLOW-UP

Job N° : _____ MB301M Type : _____

Customer : _____ Drawings N°: _____

Column N°: _____ Revision index : _____

	Operator	Remarques
Column assembly		
frame assembly		
column modularity		
painting aspect (no scratches)		
door and covers locking devices		
form locking devices		
doors assembly and operation, ground connections		
IP conformity		
diagramics		
LOGO assembly		
assembly of accesssories for internal arc (see doc. 7041xxx.pdf , chap. 2.5)		
assembly of accessories for earthquakes withstand (see doc. 704 1xxx.pdf chap. 7)		
Mw column assembly		
column modularity		
dimension of reset axe is good to operate and avoid mechanical interference		
drawers operation (rack-in, test, draw-out position)		
drawers locking (padlock)		
power finger penetration on V BB		
Column equipment		
assembly and arrangement of the devices		
devices location		
CT assembly		
Busbars		
H BB assembly		
H BB supports		
V BB assembly		
V BB supports		
insulating distance on Mw V BB		
derivation BB assembly		
bolts tightening and marking		
fish plates		
Cabling		
power cabling (1000V, 105°C, crimping, securness)		
auxiliary cabling (1000V, 105°C, crimping, securness)		
voltage pick-up wire cabling (separated way of cabling, protec tion devices)		
sharped angle protection		
trunking capacity		

1.Missing parts list

Project NR:

Item	Designation	Qty

Quality control:

Date:

2. Follow-up of missing parts at end of project

Date received by customer of factory

Project no.

1	Missing at end of assembly

Issued by: Mcenu->I.m.->Supply->I.m
Date: (copy)->Q.I.

Items	Projectco-ordinator Reference	Quantities	Supplies Lead timeannounced

2	Missing parts at end of in spection/customer acceptance

Issued: Q.I.->I.M.->Supply->I.M.->S.E.->I.M.->S.E.
Date: (COPY) -> Q.I.
(COPY) ->Warehouse

Items	Quality inspector Reference	Quantities	Supplies Lead time announced	

3	Sales department notification

Can the project be dispatched with missing parts? Yes ☐ No ☐

Must the missing parts be partially dispatched? Yes ☐ No ☐

Which ones? _____

_____

Missing parts _____

dispatch address: _____

Project site delivery date: ☐ _____

CORRECTIVE ACTIONS REQUEST

A. R. of _____

Date: _____

From: _____ To: _____

Copy to: _____

Non conformity detected by customer detected internally

Product in question: _____ Project no: _____

Issued by: _____ Date: _____ Customer: _____

Description of the non conformity

Any suggestions:

Answer

Corrective actions	Performed by	Date

RCA settled Date _____ Q.A. signature _____