Preface

Foreword
On the strength of its experience, Schneider Electric has always sought to produce high-quality equipment, fully complying with IEC 60439-1 and IEC 61439-2 standards.

But what exactly do we mean by Quality?

The ISO 9000 standard defines quality as: the “degree to which a set of inherent characteristics fulfils requirements”.

Although final inspection is in some respects a recognition 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, in compliance both with customer specifications (explicit needs) and with proper operating procedures (implicit needs), in order to satisfy the customer.

Quality is also the determination of all the staff, from the manager to the line worker, to satisfy the customer. This guide is a good means to help you in this and to achieve excellence.

Thank you for your contribution.
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1. Introduction to quality inspection

1.1. Justification for quality inspection

- Implementation of the quality process in the production plant will entail organizing the work station so as to achieve the quality target as imposed by the standard.
- A quality inspection process has always been recommended to all our partners and subsidiaries.
- A part of quality assurance, it is a normative obligation of the IEC 60439-1 and IEC 61439-2 standards which stipulate that three routine tests should be performed under the scope of the quality inspection procedures to complete the type tests:
  - giving the equipment the TTA label (Type Tested Assembly)
  - and which are the panel builder’s responsibility.

These three routine tests are

- inspection of the assembly
- dielectric tests and/or measurement of insulation resistance
- checking of protective measures and of the electrical continuity of the protective circuit.

Human factors

- The specificity and complexity of low voltage equipment, the numerous human operations, and thus risk of errors, are the principal source of mistakes in our field, and hence the main reasons for implementation of the quality inspection process.

Each job must be checked.

Cost reduction

- Manufacturing non-quality entails extra costs in term of time and money due to:
  - product examination,
  - repair,
  - scrapping,
  - impacts on delivery schedule, brand image,
  - etc.

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

- The in-process checking operation and final inspection also ensure good economic management of the switchboard manufacturing process.
1. Introduction to quality inspection

The Quality inspection therefore contributes
- to guaranteed quality of the equipment:
  - by preserving the company’s brand image
  - by guiding staff training according to the anomalies observed.
- to the safety of personnel and equipment
- to the company’s profitability.

1.2. Quality inspection function
- Guarantee the quality of service and protect the brand image.
- Detect and settle internal dysfunctions and thereby increase plant profitability.
- Perform inspection with respect to:
  - the project file and the customer’s documents
  - Schneider and product rules
  - IEC standards
- Carry out acceptance tests in the customer’s presence
- Perform quality follow-up and corrective actions
- Ensure information, preventive action and training for production staff
- Ensure regular calibration of inspection and production facilities.

1.3. Quality inspection responsibility
- Quality inspection department
  - reports directly to management and is independent from manufacturing
  - can postpone the delivery of a project and require reworking to ensure conformity
  - in the event of a dispute, informs the unit manager who alone has the power to decide
  - is responsible for the safety of all people entering the quality inspection zone.

1.4. Quality inspector’s profile
- Graduate as electrical technician (technician’s certificate)
- Versatile
- Good knowledge of Schneider equipment and devices
- Authorised to work near electric currents:
  - knowledge of the risk of electric current
  - authorisation by approved training course
  - basic notions of first-aid.

1.5. Necessary documents
- To carry out the various checks, the quality inspector must possess a complete, updated production file of the project, including the check list, missing parts list, etc.

1.6. Required human resources
- For an accurate and reliable quality process, quality inspectors represent approximately 10% of workforce, i.e. 1 quality inspector for 8 to 10 fitters.
1. Introduction to quality inspection

1.7. Inspection diagram

<table>
<thead>
<tr>
<th>Design</th>
<th>Procurement</th>
<th>Manufacturing stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design office</td>
<td>Receptionist</td>
<td>Operator</td>
</tr>
<tr>
<td>Procurement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procurement order</td>
<td>Basic check list for incoming inspection</td>
<td></td>
</tr>
<tr>
<td>Dimensional inspection report</td>
<td></td>
<td></td>
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<tr>
<td>Commercial contract</td>
<td></td>
<td></td>
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<tr>
<td>Design inspection report</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Framework</th>
<th>Busbar</th>
<th>Device &amp; drawer</th>
<th>Enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assembly plan</td>
<td>Assembly plan</td>
<td>Assembly plan</td>
<td>Assembly plan</td>
</tr>
<tr>
<td>In-process inspection specifications</td>
<td>In-process inspection specifications</td>
<td>In-process inspection specifications</td>
<td>In-process inspection specifications</td>
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<td>In-process inspection report</td>
<td>In-process inspection report</td>
<td>In-process inspection report</td>
<td>In-process inspection report</td>
</tr>
</tbody>
</table>

Example of "In-process inspection specification" delivered with assembly drawing

<table>
<thead>
<tr>
<th>In-process control specification : Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection</td>
</tr>
<tr>
<td>Dimensions of cubicle</td>
</tr>
<tr>
<td>Mechanical assembly</td>
</tr>
<tr>
<td>Framework combination</td>
</tr>
<tr>
<td>Handling system</td>
</tr>
<tr>
<td>Ground fixing &amp; civil engineering</td>
</tr>
<tr>
<td>Bottom plate form 2</td>
</tr>
<tr>
<td>Cleanness</td>
</tr>
</tbody>
</table>
Example of "In-process inspection report"

<table>
<thead>
<tr>
<th>Checking programme: Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index:</td>
</tr>
<tr>
<td>Product type:</td>
</tr>
<tr>
<td>Project No.:</td>
</tr>
<tr>
<td>Drawing No.:</td>
</tr>
<tr>
<td>Cubicle No.:</td>
</tr>
<tr>
<td>Date:</td>
</tr>
<tr>
<td>Checking programme:</td>
</tr>
<tr>
<td>In-process inspection report</td>
</tr>
<tr>
<td>Quality inspection</td>
</tr>
<tr>
<td>Observations:</td>
</tr>
<tr>
<td>Checked by</td>
</tr>
<tr>
<td>Customer</td>
</tr>
<tr>
<td>Remarks</td>
</tr>
<tr>
<td>Dimensions of cubicle</td>
</tr>
<tr>
<td>Material assembly</td>
</tr>
<tr>
<td>Measurements</td>
</tr>
<tr>
<td>Checking during process:</td>
</tr>
<tr>
<td>Final inspection and testing:</td>
</tr>
<tr>
<td>Remarks</td>
</tr>
</tbody>
</table>

Checking during process: tick in the grey box.
Final inspection and testing: tick in the white box.
2. Incoming delivery inspection

- Applicable to external and internal products and assemblies.
- In the case of sub-assemblies and internally manufactured products, an internal procedure could be used to perform a final inspection of one process, combined with incoming inspection of another.

2.1. Justification for incoming inspection

- As a final stage before the assembly process, this quality inspection is a significant part of the final quality of the job and will ensure its profitability.
- The reason for implementing the incoming inspection process is to ensure that the received materials and components comply with:
  - the specifications indicated in the order form (colours, etc.)
  - standard
  - product specifications
  - good practice rules.
Means and process

2. Incoming delivery inspection

2.2. Procedures

Verification

- Quantity and appearance inspection of products could be performed by the receiving officer according to the "Basic checklist for incoming inspection".
- Quality checking should be done by the quality inspector.
- In cases of large product volumes, this operation could be done on a sample.
- If the drawing of the component to be inspected includes a dimensional warning !, the quality inspector shall check the dimensions on 5 samples.

Example

- All incoming items should be received and stored in such conditions that they will not be damaged until their final installation.

Non-conformity processing

- All non-conforming products shall be:
  - confined in a separate location
  - registered as a non-conforming product and clearly identified.
- All precautions should be taken to prevent their repetition.

---

**Basic checklist**

for incoming inspection of sheet metal parts

- The type of material is right
  - [ ] Aluminium
  - [ ] Steel
  - [ ] Stainless Steel
  - [ ] Plastic
  - [ ] Color

- The component looks like the drawing and the 3D view
  - [ ] all shapes and lines exist
  - [ ] the component is bent in the correct side
  - [ ] all cut edges are straight, without stairs or burrs
  - [ ] no deformation due to punching
  - [ ] sub-assembly is consistent with the bill of material

- The coating is well done
  - on visible sides:
    - [ ] no grains
    - [ ] no tears
    - [ ] no cracks
    - [ ] no scratches
    - [ ] adherence
    - [ ] uniformity

- The dimensions identified by ! are measured on 5 samples
  - checking card is written.

---

**Checking programme: manufactured parts checking card**

- Product type:
  - [ ] Drawing No.:
  - Quantity:

**Dimensions to be measured on 5 samples**

<table>
<thead>
<tr>
<th>Dimension to be checked</th>
<th>Location</th>
<th>Parts or lot checked</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

| Date:            | /        |
| Signature:      | /        |
3. In-process inspection

3.1. Inspection during manufacturing

- To ensure the conformity of the product or sub-assembly with the expected needs, the quality assurance programme may recommend the implementation of a specific inspection procedure. Done on parts of an assembly or at the end of various assembly operations.

- The following diagram represents the operations on which in-process inspections are carried out and the main items concerned by incoming quality inspection.

3.2. Justification for inspection during the manufacturing stage

The reasons for performing inspection during the manufacturing process are:

- the complexity of some equipment systems. It could be necessary to perform a quality inspection process during manufacturing to ensure the conformity of parts or assembly stages due to:
  - difficulty of access: current transformer, bar characteristics, connections, installation, etc.;
  - the time (profitability) needed for the final inspector to remove some covers or other parts;
- the will to involve and motivate the staff for the quality of their work;
- the workshop organisation;
- existence of dedicated assembly line for frame, busbars, functional units (withdrawable, disconnectable, plug-in, fixed);
- presence of a device adaptation workstation;
- mass produced manufacturing system.
3. In-process inspection

3.3. Process

Inspection during the manufacturing stage could be described by the following process.

Inspection during the manufacturing stage.
- This operation involves carrying out checks at different stages of the assembly process:
  - inspection done at the end of each key manufacturing step (framework assembly, busbar installation, device & drawer mounting, wiring, enclosure assembly) is part of the operators’ work. Each operator must fill in an "In-process inspection report"
  - quality inspectors have responsibility for overseeing and compiling all "In-process inspection reports".

Continuous inspection
- The assembly operations require constant observance of good practice rules.
- Due to this, this procedure involves carrying out checks throughout manufacturing in the form of operator or project supervisor checks.
- It will make them responsible for the quality of their work.
- These checks should always be validated by the final inspection inspectors.

Notice: The cleaning process is an integral part of the checking operations and should be performed during and at the end of the manufacturing process and registered on the check list. (i.e.: Okken or Blokset busbar compartment).

3.4. Means

- The instructions (In-process inspection specifications) provided with assembly drawings enable these checks to be formally defined on check list reports.
- One check list is commonly dedicated to each manufacturing stage, and located on the cubicle frame.
- The fitter should fill in the check list dedicated to his manufacturing stage to allow the quality inspector to verify that all the points have been checked and that the procedures have been implemented.
- These checklist reports are used to log the status of the inspections performed.
- The same forms are finally validated by the quality inspector during the final inspection stage.

N.B.: Despite the operator checks performed for each operation, final inspection is always necessary, as stipulated by the IEC 60439-1 and IEC 61439-2 standards.
Final inspection guarantees operation and conformity of products in accordance with applicable drawings and standards. It is performed by the unit’s quality inspection department.

One 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 (production 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 as an average % of assembly process.

<table>
<thead>
<tr>
<th>Switchboard</th>
<th>Simple</th>
<th>Complex</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCC</td>
<td>3%</td>
<td>8%</td>
</tr>
<tr>
<td>MCC</td>
<td>4%</td>
<td>10%</td>
</tr>
</tbody>
</table>

### 4. Final inspection process

**Final inspection takes place as follows**

- Carry out the conformity check by compiling the "In-process inspection reports".
- Conduct the final inspection tests.
- Modify the production file by adding any necessary annotations (throughout testing).
- List all the non conformities:
  - by noting all the faults or modifications observed;
  - by drafting a list of missing parts.
- Ensure reworking for conformity.
- Point out any areas of dispute between customer and supplier.
- Ensure that the design documents have been properly corrected, by checking final version status and updating.
- Ensure that all the check lists have been filled in.
- Draft and record the quality control plan.
- Sign the quality control plan and other documents.
- If customer acceptance is scheduled, receive the customer and/or his representative in the quality inspection zone. Sign the "Quality control plan" after customer acceptance.
- Archive the documents.
List of the various final inspection tests:

**Conformity checks**
These checks consist of validating all "In-process inspection reports":
- framework
- busbar
- device and drawer
- enclosure.

**Mechanical checks**
These checks consist of testing proper operation of the mechanisms and manual controls, the sturdiness of the switchgear, etc.

**Electrical checks**
- Operating tests
- Dielectric withstand
- Electrical continuity of protection circuits
- Insulation resistance.

### 4.2. Operating rules
- The operating rules can be modelled using the following diagram.

![Operating rules diagram](image-url)
4.3. Non-conformity treatment process

- The following diagram describes the various possible cases of treatment of non-conformities.

During the final inspection operations, any errors detected must be recorded on a "non-quality record board" and all non-conformities corrected.

E.g.: type of table.

<table>
<thead>
<tr>
<th>Non-quality record board</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location / Type of fault</td>
<td>BB assembly</td>
</tr>
<tr>
<td>Cabling error</td>
<td></td>
</tr>
<tr>
<td>Busbar support missing</td>
<td></td>
</tr>
</tbody>
</table>
4. Final inspection

4.4. Conformity declaration

- On completion of final inspection, the quality inspector’s signature declaring conformity of the equipment should be affixed on the identification label placed on the drawers and cubicles.

Panel builder

Tene
X0 000 ile
Tel : XX XX XX XX XX
Fax : XX XX XX XX XX

“Quality inspection
Checked by:”

Conformity
DATE: ………/……/…… frame □ Conformity □
Job No.: …………………… device □ Mechanical check □
Switchboard: ……………… power □ Electrical test □
Cubicle: …………………… auxiliaries □ Dielectric test □
Equipment No./location: ………………… finishing □ Protective measures check □
Rating: …………………… Insulation test □
Design No.: ………………… Index: ………………

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

Final inspection sheet

Client: …………………………… Purchase order No. ………………
Switchboard designation: ………………… Design file reference ………………
Quality control plan No.: ………………… Issue on: ………………
Quality Inspector
Name: …………………… Date: ………/……/…… Quality Manager
Name: ……………………
Signature: Signature:

On request, and depending on the product’s destination, it is also up to the quality inspection manager to establish a mark declaration of conformity (e.g. CE) which certifies that the industrial product complies with the technical directives and obligations incumbent on the product manufacturer.
5. Summary of tasks after final inspection stage

5.1. Customer acceptance before installation
- After final inspection and according to the contract clauses, the Quality Inspector may perform a check on the project accompanied by a sales engineer and the customer or his representative. During the acceptance procedure, the customer makes sure that the specifications have been complied with.

N.B.: The procedures mentioned in this guide are given as an indication.

- After final inspection, the following are required:
  - Check that all the boxes of the checking programme have been filled in.
  - Check any reworks noted on the "non-quality record board" and sign in the relevant boxes.
  - Draft and record the quality control plan.
  - Note the quality control plan registration number on the checking programme.
  - Ask the quality manager to validate the report (the final inspection should be signed by the customer or his representative after customer acceptance inspection).
  - Draft and record the delivery sheet.

5.2. Installation
- See "Installation guide".

5.3. Commissioning
- Fill in and sign the customer’s acceptance report with the costumer.
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6. Performing in-process inspection

**Reminder**
- The purpose of in-process inspection is to ensure product conformity after each manufacturing operation.
- This process concerns all the manufacturing operations done by the workshop operators.

**Composition**
- One check list sheet for each manufacturing stage is completed for each cubicle and/or functional unit (depending on the manufacturing process).
- These documents are used by both the operators and the quality inspectors (see model check list in appendix).
- These are used from the first manufacturing phase through to final inspection.
- These check lists should mention:
  - the designation of each point to be controlled
  - the operator's identification and the checking period.

**Process**
- After each stage, the operator checks and declares the product in conformity by signing this follow-up check list sheet and noting any observations.
- On completion of the inspections, a copy of this sheet could be archived.
6. Performing in-process inspection

6.1. Design

Switchboard characteristics
- Check the protection index required in the project production file.
- Check that the corrosion resistance required in the project production file is taken in account.
- Check the form partitioning level.
- Check the organisation of spares.
- Make sure that separate equipment delivery is defined.

Cubicle characteristics
- Check that the dimensions, number and layout of cubicles are in accordance with the layout and the civil engineering works specified in the project production file.
- Check that the incoming cable cut-outs comply with the incoming cables’ characteristics (section number, position).

Busbar characteristics
- Check the environmental installation (temperature, humidity) specification required in the project production file.
- Check that the horizontal and vertical busbar cross-sections are in accordance with the short-circuit and/or peak current.
- Check that busbars are in conformity with the corrosion resistance required in the project production file.
- Make sure that the type of busbar coating is defined.

Device and drawer characteristics
- Make sure that device characteristics defined comply with the project production file and derating tables.
- Make sure that the jaw characteristics comply with the corrosion resistance.
- Check that the mismatch coding is defined.

Wiring characteristics
- Validate the single-line diagram.
- Check that BUS architecture rules are complied with (cf. wiring guide)

6.2. Framework

Dimensions of cubicle
- Check the cubic dimensions (height, width, length and depth) by measuring and comparing them with those required in the project production file.

Mechanical assembly
- Check the overall assembly, frame position (top, bottom), the presence and location of the screws required for assembling and joining the cubicles, bottom plate, mounting plate, etc.
- Check that screws are properly tightened.

Cleanliness
- Check the cleanliness of the framework assembly: no grease, no scratch, etc.

6.3. Busbars

Type and characteristics
- Check the bars’ characteristics according to the type of equipment, the project specifications and the project design.

Cross-section
- According to nominal current (In), short-circuit current and/or peak current, IP, circuit-breaker breaking time, etc.
- Check that the cross-section corresponds to that shown in the project production file and product documentation.

Coating
- Check the type of busbar coating (bare copper, tin-coated, sheathed busbars, epoxy paint, silver-plating, nickel, etc.)
6. Performing in-process inspection

**Layout and installation**

**Busbars**
- Check their position (horizontal, vertical, top, etc).
- Check that the layout or arrangement of the busbars does not obstruct the routing of customer cable.
- Ensure the extension possibilities of the busbars according to specific features.

**Supports**
- Check the spacing, fastening, characteristics and number of busbar supports.
- Refer to technical documents, switchboard characteristics, etc.
- Type of supports:
  - Check their type and characteristics (material) referring to the switchboard characteristics.
  - Check the alignment of the support, and presence of deformation due to extra torque applied to the fixing bolt.

**Bending radius and bar alignment**
- Check that the bending radius and angle are in accordance with the drawing. If specified, use the jig to check dimensions.
- Check the perfect alignment of the various bar assemblies:
  - Ensure good positioning in the support;
  - Make insertion of the connection bolt easier.

**Busbar junctions and links**
- Joint cross-sections
- Characteristics and number
- Check positioning and accessibility of the joint screws
- Insulating distances versus frame, form partition, etc.
- Bar overlapping surfaces: H = th. x n.
- For all non-standard bar connections done under supervision of the fitter, an overlapping height equal to 5 times the thickness of the derived busbar must be allowed for order to obtain a suitable connection.

**Contact surfaces**
- Quality of drilling/punching and surface finish (no burr or cutting deformations on the conductors, no oil stains, etc.).
- Correspondence between the hole diameter and bolt.

**Bolt characteristics**
- Check the bolt type (in accordance with the product specifications), quality: class 8/8, stainless steel, etc.

**Installation and tightening torque**
- Bolt insertion method (insulating distance), length of bolt, etc.
- Presence, position and type of washer.
- Tightening torque in accordance with bolt, devices and other part characteristics.
- Consult the product and devices documentation.
- Presence of varnish certifying tightening to correct torque.
- In case 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 the switchboard to verify all its connections.

**Clearances**
- Shortest distance in the air between two live conductors or between live conductors and exposed conductive parts.
  - 14 mm for 12 kV impulse voltage (main Masterpact busbar)
  - 8 mm for 8 kV impulse voltage (Compact)
  - 5.5 mm for 6 kV impulse voltage (Multi 9).
- The IEC 60439-1 and IEC 61439-2 standards stipulate the minimum clearances required to withstand impulse voltage up to 2000 m above sea level.
- Pollution degree 3.
6. Performing in-process inspection

Creepage distances
- Shortest distance along an insulated material surface between two live conductors or between live conductors and exposed conductive parts.
  - 16 mm for rated insulation voltage 1000 V AC and DC (main busbar Masterpact)
  - 12.5 mm for rated insulation voltage 750 V AC and DC (Compact)
  - 8 mm for rated insulation voltage 500 V AC and DC (Multi 9).
- See IEC 60439-1 and IEC 61439-2 table 16.
- Pollution degree 3, Material group 3a.

Marking and phase order
- Check phase labelling type conformity.
- Check that phase order (phases 1, 2, 3, neutral and PE) is complied with according to the product specifications.

Cleanliness
- After busbar installation, ensure that no foreign bodies are lost in the bars compartment.
- In particular in the case of access difficulties.

6.4. Device and drawer

Conformity of devices

Device characteristics
- Type, rating
- Breaking capacity and number of poles
- Masterpact terminal pad characteristics and installation (according to product). Inspection to be performed prior to installation in the cubicle.

Toroids
- Check the technical data of each toroid. Also ensure the correct mounting direction: the arrow shows the current direction.

Current transformer
- Check the technical data of the current transformers together with the installation direction.
- Check the correspondence between the current transformer and the associated device, ammeter, etc. Ensure that the current delivered by its secondary circuit is compatible with the associated device.
- Check compliance with clearances between the fastenings and the secondary connecting screws of the current transformer relative to live conductors or metal parts.
- Check whether the current transformers are well secured on the conductor.

Shunt
- Check the connection between the shunt and the measuring instrument.

Safety perimeters
- Check the circuit-breaker safety perimeters, referring to their installation guides.
- No devices, equipment or bundles should be located in the safety perimeter.

Mounting

Contact surfaces
- Quality of drillings/punching and surface finish (no burr or cutting deformations on the conductors, no oil stains, etc.).
- Correspondence between the hole diameter and bolt.
- Bar overlapping surfaces: H = th. x n.
- For all the non-standard bar connections done under supervision of the fitter, an overlapping height equal to 5 times the thickness of the derived busbar must be allowed for in order to obtain a suitable connection.
- Avoid problems (flexion, torsion, etc.) due to incorrect busbar positioning on devices or terminal pad connections.

Bolt characteristics
- Check the bolt type (in accordance with the product specifications), quality: class 8/8, stainless steel, etc.
6. Performing in-process inspection

Installation and tightening torque
- Bolt insertion method (insulating distance), length of bolt, etc.
- Check the Linergy sliding bolt position.
- Presence, position and type of washer.
- Tightening torque in accordance with bolt, devices and other parts' characteristics. Consult the product and devices documentation.
- Presence of varnish certifying tightening to the correct torque.
- In case 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 the switchboard to verify all the connections.

Clearances
- Shortest distance in the air between two live conductors or between live conductors and exposed conductive parts:
  - 14 mm for 12 kV impulse voltage (main busbar Masterpact)
  - 8 mm for 8 kV impulse voltage (Compact)
- The IEC 60439-1 and IEC 61439-2 standards stipulate the minimum clearances required to withstand impulse voltage up to 2000 m above sea level.
- Pollution degree 3.

Creepage distances
- Shortest distance along an insulated material surface between two live conductors or between live conductors and exposed conductive parts:
  - 16 mm for rated insulation voltage 1000 V AC and DC (main busbar Masterpact)
  - 12.5 mm for rated insulation voltage 750 V AC and DC (Compact)
  - 8 mm for rated insulation voltage 500 V AC and DC (Multi 9).
- See IEC 60439-1 and IEC 61439-2 Table 16.
- Pollution degree 3, Material group 3a.

Wiring
- To be checked according to the device and switchboard characteristics.

Flexible bar characteristics and installation
- Check characteristics and cross-section.
- Radius of curvature of the flexible bars (at least once times bar thickness). Manual bending operations are recommended to avoid damaging the bar insulator.
- In the event of a superimposed flexible bar installation, ensure that insulating spacers are placed between the conductors to provide proper ventilation.

Binding and cable trunking
- Check that the characteristics and number of bindings used match the electro-dynamic force that could affect the assembly in case of short circuit.
- No direct binding on metal parts. If necessary fit an insulating wedge.
- Check connections: presence of thick flat washer and contact washer.
- Maximum cable size 6 mm² in cable trunking.
  - Ensure that the spare space in the cable trunking is approximately 30 %; cable fasteners should preferably be made of insulating accessories (e.g. polycarbonate screws or rivets).
  - The maximum centre-to-centre distance between two trunking fasteners must not exceed 600 mm.

Cable characteristics
- Cross-section of power and auxiliary conductors: check cross-sections with reference to the switchboard specifications and product documentation.
- Type and colours.
- Nature of cables: Schneider recommends use of U 1000 V insulation with an insulation temperature resistance of < 105°C (self-extinguishing).
- Using these cables, we meet class 2 requirements, so these cables may be secured directly on metal supports.

Cables installation
- Protection of cables:
  - Check that the cables do not run near sharp edges, moving parts, against or between exposed live parts, air blast areas, etc.
  - No cables should be inserted in ventilation grille hole or mechanical fixing holes.
- Radius of curvature: Ensure that the cable radius of curvature is roughly 6 to 8 times cable diameter.
6. Performing in-process inspection

- Number of cables per strand:
  Refer to the switchboard assembly and installation 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 500 V AC and the DC circuit and communication network (cf. Communication wiring guide)
- Cable fixing:
  Make sure that the conductors are fastened in accordance with their characteristics, size and network short circuit withstand. Check collar characteristics.
- Non-protected active conductors
  - Ensure that cables not protected by short-circuit devices are installed safely along their entire path.
  - Separated bundle, no risk of mechanical damage, safe connection, etc.

Cable connections
- Three types of inspection are performed according to the connections:
  - Visual inspection (A) of:
    - the crimping recess (quality, pressure, etc.);
    - the correspondence between the lug or terminal and the cable section;
    - the position of the conductor core in the lug shaft, and proper cable insertion;
    - the bolt diameter relative to the lug fixing hole;
    - the quality of the cable insulation and strands (no damage during cable installation or wire stripping operation).
  - Mechanical inspection (B) by manual pulling (performed by random sampling).
  - Verification (C) of:
    - presence and direction of contact washers;
    - presence of varnish certifying tightening to the right torque (on visible connections) or use of torque nuts.
- The following table gives the inspections to be performed according to the type of connection used:

<table>
<thead>
<tr>
<th>Connections</th>
<th>Power</th>
<th>Other circuits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jaws and auxiliaries pins</td>
<td>A + B</td>
<td>A + B</td>
</tr>
<tr>
<td>Lugs</td>
<td>A + C</td>
<td>B + C</td>
</tr>
<tr>
<td>Clips</td>
<td>-</td>
<td>A + B</td>
</tr>
<tr>
<td>Cable connectors</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Terminals</td>
<td>B + C</td>
<td>B</td>
</tr>
<tr>
<td>Screws</td>
<td>C</td>
<td>C</td>
</tr>
</tbody>
</table>

- Connection stresses and fastening:
  - Check that the lugs match with the connector type.
  - Be sure that the cables are properly inserted in the terminal.
  - Reminder: Make sure that the crimping tools are calibrated.

Test
- It is recommended to use the drawer test equipment for mechanical and electrical testing of each drawer (cf. Industrial guide).

Manual operation of equipment
- Manoeuvre the manual mechanisms of the devices, to ensure their proper operation.
- Check the operation of the functional units based on drawers, disconnectable, plug-in on base or chassis version.

Equipment fastening
- Check the fastening of the devices on the drawers, on Polystat (inspection during manufacturing process), on mounting plates, on doors, etc.
- Check that they are correctly fitted and that all the necessary screws or miscellaneous additional items are present.
- Special attention should be paid to:
  - assembly compliance with functional dimension tolerances;
  - jaw installation and validation in the check list.
  - Check that the auxiliary blocks are correctly identified and assembled and that the mechanical assemblies remain free to move.
6. Performing in-process inspection

Mechanical operation
- To be checked:
  - Installation and operations of the position contact, door, drawer position, extended rotary handle, etc.
  - Operation of the limit switch, position of drawers, circuit breakers, contact located on door.
  - Functional units (drawers - plug-in, disconnectable, etc.) operating margin.

Jaws
- Check power jaws plug-in penetrations and installation.
- With Blokset, use the specific jig to check the bars’ position (jaw operation).

Accessibility of functional units or devices
- Check accessibility of the terminal, current transformer, etc.
- Always check the ease of access to pivoting front face locking devices.
- If stipulated in the project specifications, check also check the access facilities for thermography.

6.5. Enclosure

PE and/or PEN protection busbar characteristics
- Cross-section:
  - Check using the technical guide.
- Presence and cross-section of fishplates between cubicles:
  - Check that fishplate cross-section is at least equal to the cross-section of the busbar to be connected (see technical guide).
- Earthing systems:
  - In some configurations (earthing systems: TNC, TNS), check presence of the PEN/PE connection.
  - Two-colour green/yellow marking:
    - Check presence of the green/yellow marking and PE or PEN lozenges on the conductors.
- Earthing fishplate:
  - Check presence and cross-section of fishplate. Then ensure that its cross-section is the same as that of the earth busbar (for PEN).

Wiring (terminal blocks and protection busbar connection)

Bolt characteristics and tightening torque
- Check the bolt type (in accordance with the product specifications), quality: class 8/8, stainless steel, etc.
- Bolt insertion method (insulating distance), length of bolt, etc.
- Check the Linergy sliding bolt position.
- Presence, position and type of washer.
- Presence of varnish certifying tightening to the correct torque.
- Check that all screws, picot washers and earth braids (if required) for fixing these components are present.
- In case of doubt:
  - Number of threads protruding from the nut, for connections of the same type, differing on screws of the same length.
  - Contact washers excessively crushed or loose: carry out a random check. If a number of faults are detected, ask the person responsible for assembling it to verify all the switchboard connections.

Cable characteristics
- Check cross-section of power and auxiliary conductors:
  - Check cross-section with reference to the switchboard specifications and product documentation.
- Type and colours.
- Nature of cables:
  - Schneider recommends use of U 1000 V insulation with an insulation temperature resistance of < 105°C (self-extinguishing).
  - Using these cables, we meet class 2 requirements, so these cables may be secured directly on metal supports.

Cable installation
- Protection of cables:
  - Check that the cables do not run near sharp edges, moving parts, against or between exposed live parts, air blast areas, etc.
  - No cables should be inserted in ventilation grille holes or mechanical fixing holes.
- Radius of curvature:
  - Ensure that the cable radius of curvature is roughly 6 to 8 times cable diameter.
6. Performing in-process inspection

- Number of cables per strand:
  Refer to the switchboard assembly and installation 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 500 V AC and the DC circuit and communication network (cf. Communication wiring guide).
- Cable fixing:
  Make sure that the conductors are fastened in accordance with their characteristics, size and network short circuit withstand. Check collar characteristics.
- Wiring in cable trunking:
  - Maximum cable size 6 mm² in cable trunking.
  - Ensure that the spare space in the cable trunking is approximately 30%.
  - Cable fasteners should preferably be made of insulating accessories (e.g. polycarbonate screws or rivets).
  - The maximum centre-to-centre distance between two trunking fasteners must not exceed 600 mm.
- Non-protected active conductors:
  - Ensure that cables not protected by short-circuit devices are installed safely along their entire path.
  - Separated bundle, no risk of mechanical damage, safe connection, etc.
- Accessibility and client connection facilities:
  - Accessibility of power connection points on devices, and terminal blocks:
    - Compliance with the cable curvature radius and cable routing (entry from the top/bottom).
    - Check the length of pads and number of connecting holes taking into account the size and number of cables (check the devices or product information).
  - Check:
    - that the number and cross-section of cables ensure compliance with clearances (lugs).
  - Reminder: the arrange must ensure safety of the operators (maintenance).
  - the number and sturdiness of cable supports;
  - the ease of connection of client cable on earth or PEN bar nearby the functional unit.

Appearance

Paint colour and reference:
- Use the colour palette to ensure that the reference of the paint given in the project file matches the colour of the cubicule.
- Verification generally carried out at the incoming delivery inspection stage.

Mounting

Panelling:
- Operation of drawers:
  - check the operating safety margin of the drawers and ease of operation; drawer inserting and withdrawal should be performed without damaging the internal components or wiring.
- Operation of doors and mechanical accessories:
  - Check their operation by manoeuvring them.
  - Ensure that the cubicle equipment is complete and has been installed properly.
- Check the presence, characteristics (IP, material, etc.) and proper fitting of:
  - ventilation grille, bottom plate;
  - side and rear cover;
  - roof, blanking plate, etc.
- Conformity of apertures in the plates:
  - Using the drawing, check the presence of any apertures in the roofs, mounting plates and separation plates allowing fish plating, coupling bar installation, interlock cable or rod installation, etc.

Degree of protection
- This check is performed by checking the presence of the components ensuring the IP level stated in the project production file.
- Needs vary according to the required IP degree: awning, seal, front plate, cable glands, etc. (information given in the product catalogues or guides).
- If a seal is used, ensure it is properly positioned and continuous.
- Make sure that the IP degree of the equipment located on the door or the device manoeuvring mode (apertures on doors or presence of specific cover), matches the switchboard requirements.

Safety check:
- Ensure that no foreign body is lost in the bar compartment.
7. Performing final inspection

7.1. First routine test: inspection of the assembly, conformity check

The Quality Inspector must:
- take delivery of the switchboards to be inspected in the dedicated zone
- become acquainted with the product production file;
- check the observations and information given in the assembly follow-up sheet (could be a part of the follow-up check list);
- perform final inspection using the follow-up check list.

In-process checklist validation
- Check and validate the in-process check list fulfilled by operators during at each manufacturing stage.

Composition, dimensions and identification label
- Number and order of cubicles
- Use the drawing of the project front face to ensure that the number and order of cubicles is respected.
- Check that the information marked on the label match with the project file.
- Check the presence of a product identification marker on each cubic. This is normally in the form of a self-adhesive label.
- Ensure that this label contains the registration number, signature, switchboard number and the design update version.
- On completion of final inspection, the Quality Inspector must place his registration number (or signature) and indicate the date at which the inspection was performed.

Homogeneity - Finish
- Perform a visual inspection to check the homogeneity of the colours of the various switchboard components (doors, panels, etc.).
- Check external appearance by a visual inspection: no scratches, deformations, etc.
- Front face and mimic diagram: Visually check that the front face of the switchboard matches that shown in the product drawing.
- Check conformity of the mimic diagram compared with the power diagram and front layout.

Framework ground fixing, handling devices, keys
- Ground fixing: Use the product design drawing to check the location of the ground fixing points.
- Handling devices: Check their fastening and layout according to the documentation.
- Keys: Check matching of lock references and key numbers with the references given in the product production file.
Detailed instructions

7. Performing final inspection

Connection facilities, space and equipment
- Check the special facilities provided for cable routing (top or bottom) and busway connections.
- Fixing of mounting plates, protection screens and partitioning or cowling parts:
  - Check that all the screws for fixing these parts are present, and properly secured;
  - Check the quality of the riveted assembly: type of rivets, direction, pressure.

Conformity of devices
- Location/identification:
  - Use the layout diagrams in the product production file to ensure that the devices are properly located 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.
- Check presence and technical data of circuit breaker’s associated devices (Vigi, fault signal switch, trip unit, etc.).
- Check the supply voltages for:
  - switchgear motor mechanisms;
  - coils (contactors, relays, impulse relays, undervoltage or shunt coils of the Compact, Masterpact and multi 9);
  - indicator lights;
  - all electronic devices;
  - soft starter, capacitor bank, etc.
- Check compatibility of the toroid with the customer connection cables.
- Current transformer:
  - Check the technical data of the current transformers together with the installation direction
  - check the correspondence between the current transformer and the associated device, ammeter, etc. Make sure that the current delivered by its secondary circuit is compatible with the associated device.
  - Check compliance with the clearances between the fastenings and the secondary connecting screws of the current transformer relative to live conductors and metal parts.
  - Check that the current transformer is well secured on the conductor.
- Accessories:
  - Visual checking of the presence of:
    - crank handles for circuit-breaker and/or drawer extraction;
    - door stops, light;
    - clamps for fuse extraction;
    - pins for fixing certain relays;
    - etc.

Mechanical check on safety and locking system.
- All mechanisms making the various operations (possible or impossible) to be checked.
- Functional unit pre-tripping and locking,
  - Check that during plug-in or plug-out operation of the functional units (withdrawable, disconnectable, plug-in on base or chassis version) is impossible when the device is closed (Pre-tripping accessories, mechanical locking and/or micro-switch).
  - Check pre-tripping of the devices, on plug-in and plug-out operations.
  - Devices on chassis, plug on base, drawers, disconnectable on strip, contactors, etc.
  - Check fuse blowing mechanical operation.
- Fault trip and position indicator
  - Position of the mechanical indicators after operation, a fault trip, drawer manoeuvring.
  - Check that the circuit-breaker is reset after an electrical fault trip or after pressing the tripping test button. Check the position of the handle.
  - Make sure of the correct resetting of the devices and drawers after a fault trip or switching operation.
Detailed instructions

7. Performing final inspection

- Safety systems
  Check sturdiness of the various locking and mismatching systems.
  - Interlocking.
  Check that closing of one device prevents closing of the other associated one:
    - Locking by rods: check their mechanical fasteners and adjustment.
    - Locking by cables: check their radius of curvature using the installation guide and ensure that they do not run near exposed live parts.
    - Locking by key-locks: check the type and references of the key-locks and make sure that the key-lock prevents the device from operating.
  - Mismatching:
    Check that the code of the polarising slots matches the specifications (drawers, devices on chassis).
  - Padlocking
    Check padlocking operation (devices, drawers, etc.).

Interchange:
- Check the possibility of interchange of circuit-breakers or drawers of the same type.

Clearances
- Shortest distance in the air between two live conductors or between live conductors and exposed conductive parts:
  - 14 mm for 12 kV impulse voltage (main busbar Masterpact)
  - 8 mm for 8 kV impulse voltage (Compact)
  - 5.5 mm for 6 kV impulse voltage (Multi 9).
- The IEC 60439-1 and IEC 61439-2 standards stipulate the minimum clearances required to withstand impulse voltage up to 2000 m above sea level.
- Pollution degree 3.

Creepage distances
- Shortest distance along an insulated material surface between two live conductors or between live conductors and exposed conductive parts:
  - 16 mm for rated insulation voltage 1000 V AC and DC (main busbar Masterpact)
  - 12.5 mm for rated insulation voltage 750 V AC and DC (Compact)
  - 8 mm for rated insulation voltage 500 V AC and DC (Multi 9).
- See IEC 60439-1 and IEC 61439-2.
- Pollution degree 3, Material group 3a.

Manual equipment of operation
- Operate the devices' manual mechanisms, to ensure their proper operation.
- Check the operation of the functional units based on drawers, disconnectable, plug-in on base or chassis version.
- Check the operating safety margin of the drawers and their ease of operation; inserting and withdrawal of drawers should be performed without damaging the internal component or wiring.
- Mechanical operation:
  - To be checked:
    - installation and operation of the position contact, door, drawer position, extended rotary handle, etc.;
    - operation of the limit switch, drawer position, circuit breakers, contact located on door;
    - functional units (drawers - plug-in, disconnectable, etc.) operating margin.

Installation and maintenance access
- Check accessibility of:
  - joint, cubicle coupling accessories;
  - settings, HPC fuses for replacement, contactor coils, interlocking mechanism, arc chute chamber.
- In some particular cases (e.g. plug-in auxiliary terminal blocks), check the ease of removing these items from their mounting with regard to screw access for modifications and maintenance.
- The associated bundles should be long enough to have access to the screws without difficulties.

Presence of electrical and mechanical grease
- Jaw lubrication.
- Mechanical parts lubrication.
- Consult the technical product documentation.
- Freedom of the power clamp fingers, contact pressure.
  - Make sure that during the functional units' operation, the various types of power and command and control clamps will not be damaged.
  - Check carefully whether the contact pressure seems well distributed.
Detailed instructions

7. Performing final inspection

Electrical operations checks
- Equipment preparation.
  - Connect the equipment circuit and be sure of the earth link between sections.
  - Before energising, open the auxiliary control devices (relays, measuring instruments, coils, etc.).
  - Power the switchboard from the control desk, ensuring that voltage and phase rotation direction is complied with.
- Check power circuits
  - Carry out the operations
    - Open all the devices.
    - Check the order of the phases
    - Check correspondence of circuit and conductor identifications
    - Check correspondence of the phases on each device by closing them one by one from line side to load side (see example on the left).
  - Testing is always performed downstream of the devices in order to check the poles at the same time. However, a different method can be used.
  - When the devices are connected to terminals or pads, perform tests on them.
- Check the control circuits
  - Check the power supply of the auxiliary circuits by examining the phase order on their associated control devices.
  - Reminder: special attention should be paid to non-protected circuits (see IEC 60439-1 and IEC 61439-2).
  - Electrical indicator light and command and control button:
    - Check operation of indicator lights
    - Check correspondence of the command and control button with the associated devices.
  - Remote/local operating mechanisms:
    - Check their operation. If necessary use accessories (pin tip, small box equipped with pushbuttons, indicator lights, etc.).
  - Supply circuits:
    - Systematically check the electronic switchgear supply circuits and the DC circuits using a tester (voltmeter).
  - Check the information supplied on the connection terminals:
    - Contact status
    - Other information (voltage, current, etc.).
- Motor mechanisms
  - Close the relevant protection devices.
  - Activate the devices’ operating mechanisms according to the command and control diagram: local, remote, automatic, etc.
- Electrical locking
  - Check that it is impossible to close a device equipped with a locking contact.
- Metering circuits
  - Check the winding direction, and input and output characteristics of the current transformers.
  - To check the metering circuits, the CT secondary must be powered using a phase shift box (failing this, you can use any other calibrated device offering the same possibilities).
  - Example of operations performance:
    - Select the supply voltage.
    - Adjust the maximum value of the current to be injected into the secondary circuit; inject the current into one of the circuits or into all three at once to check cabling.
  - Check the test function
  Circuit-breaker operation is checked by a variety of tests depending on the 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.
  - If the circuit-breaker opens for each test, the device is operating correctly.
Detailed instructions

7. Performing final inspection

- Voltage relays, time delay relays, fault tracking devices.
  - For voltage relays, check that the contacts are in the status defined in the electric design.
  - For time delay relays, check correct operation of the time delays.
  - If mentioned, check that these settings comply with the product design file.
  - For the fault tracking devices, create a fault and check that the device detects and indicates its presence.
  - In order to create a fault, a resistance box can be supplied:
    - Pre-set the value of the resistance required to create a fault according to fault tracking device characteristic.
    - Make the resistance vary by reducing its value. When the resistance is adjusted below the pre-set value, the device must indicate the fault.

7.2. Second routine test: protective measures & protective circuit

Protective measures and electrical continuity of protection circuits (IEC 60439-1 and IEC 61439-2 standards)

Monitoring protection circuits
- The inspection is either visual and/or electrical as required by the customer.

Mechanical inspection (Visual)
- PE and/or PEN protection bars.
- Check the presence of all the constituent elements of the assembly which ensure the electrical continuity between the metal part and the earth bar (see technical file).
- Cross-section in accordance with electrical characteristics.
- Presence and cross-section of the joints between the cubicles: they should be at least equal to the cross-section of the PE/PEN bar to be connected.
- Depending of earth/neutral connection systems, check presence of the PEN/PE disconnecting link and access.
- Ensure that its cross-section is the same as that of the earth bar.
- Check
  - that the protective conductors are identified by the two colours green/yellow marking plus PE or PEN lozenges;
  - the accessibility of the terminals for external conductors;
  - the contact efficiency between sections or parts of the protective circuit;
  - the presence of only one conductor per connection on the protective bar.
- If, for maintenance reasons, a part of the equipment is removed from the enclosure, the protective circuit of the other parts should not be interrupted.

Electrical inspection

N.B.:
There exist some electrical measuring devices able to perform this test. The above method is given only for information.
- Example of operating mode:
  - A DC source is used, with an electromotive force of less than 6 V / 2 A current is injected between the input of the earth busbar and the parts to be inspected (doors, front face, frame, etc.)
  - Measured resistance: \( R = \frac{U}{I} \)
  - Result: the inspection is satisfactory if the measured resistance between the circuits and exposed conductive parts is below 0.1 Ohm.
  - Register the result on the final inspection record list.

Operator safety, protection of persons
- During normal operations
  - devices adjustment;
  - operating handle access;
  - drawer operation.
- Be sure that persons are protected during the following operations:
  - pre-tripping of devices on plug-in and plug-out operation;
  - operating safety;
  - drawer mechanical locking.
- During maintenance and safety operations (emergency stop, padlocking, etc.)
  - Warning plate:
    - Check the presence of the various warning plates such as “do not step”, “danger”, “danger supply side”, form door, advertising plate for voltage equal or greater than 660 V, etc.
    - No live part near the operating handle, adjustment screw, etc.
Detailed instructions

7. Performing final inspection

- Plug-in protection flaps.
  - Check the presence of the plug-in flap: chassis, etc.
- Insulation screen / phase separator / terminal shield.
  - Check that they are fitted (if required), firmly fixed and connected to earth for the metallic parts.
- Conformity of partitions and form
  - Check the presence of all screens, form partitioning and protection covers of devices located on the door (direct contact).
- Protection against contact
  - This inspection is performed by checking the presence of component parts such as:
    - picot washers
    - earthing braids, doors, device chassis (according to type and installation method);
    - barriers, front plate, etc.
  - For earthing braids, check their strength by exerting a slight pressure on their connections.

7.3. Third routine test: dielectric test

Dielectric withstand (IEC 60439-1 and IEC 61439-2 standards)

- Preparation
  - The dielectric test is always performed before the insulation test.
  - Before performing the test, make sure that you disconnect:
    - the surge absorbers (if any);
    - the covers from the Vigi modules of the Compact NS;
    - the electrical control motors;
    - and any other device not withstanding the applied voltage (electronic switchgear, contactor coils, indicator lights, miniature relays, horn, measuring instruments, etc.).
  - The interference suppression capacitors installed between the live parts and the frames must not be disconnected, but be able to withstand the test voltage.
  - This test does not need to be performed on auxiliary circuits which are connected to the main busbar if it:
    - is protected by a device of rating < 16 A;
    - has previously undergone operating tests (IEC 60439-1 and IEC 61439-2).

N.B.: Check that no unprotected connections are left.

For example: remove the neutral connection wire for permanent insulation measurement.

- Operating mode
  - Perform this test using a dielectrometer (or dielectrimeter) designed to deliver a variable voltage 0-5000 V AC.
  - Voltage to be applied:

<table>
<thead>
<tr>
<th>Circuit</th>
<th>Rated insulation voltage Ui</th>
<th>Dielectric test voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main circuit</td>
<td>300 V &lt; Ui y 690 V</td>
<td>2500 V</td>
</tr>
<tr>
<td></td>
<td>800 V &lt; Ui y 1000 V</td>
<td>3500 V</td>
</tr>
<tr>
<td></td>
<td>Ui y 60 V</td>
<td>1000 V</td>
</tr>
<tr>
<td>Auxiliary circuit</td>
<td>Ui &gt; 60 V</td>
<td>(2 Ui + 1000) V with 1500 V min.</td>
</tr>
</tbody>
</table>

- Apply voltage on each phase in turn and on the other phases which are inter-connected and led back to the switchboard frame.
- The standard stipulates that this test voltage must be maintained for one second.

N.B.: If, for any reason, the dielectric test must be repeated, it will be done with a voltage lowered to 85% of the previous value.
7. Performing final inspection

Detailed instructions

- Carrying out the operations
  - Example of the phase live part test:
    - All switching devices shall be closed-interconnect the exposed conductive parts and earth them.
    - Interconnect the live parts to one another and then to the assembly conductive parts.
    - Connect the measuring instrument earthing wire to the assembly frame.
    - Connect the injection cable to the circuit to be monitored and gradually increase voltage up to the required value.
    - The test voltage should be applied for 1 second.
    - Gradually reduce voltage before disconnecting.
    - Once this check is complete, repeat it for the other live circuits.

- Result
  - The tests are satisfactory if there is no puncture or flashover.
  - Register the result on the final inspection record list.

Insulation resistance

- Preparation
  - Before performing the test, make sure that you disconnect:
    - the surge arrester (if any);
    - the covers from the Vigi modules of the Compact NS;
    - electrical control motors;
    - current consuming devices, so as not to create connections between live conductors and loads such as measuring instruments, coils, relays, indicator lights, contactor electromagnets, etc.).

- Operating procedure
  - Using an insulation measuring instrument (megohmmeter), measure insulation at a voltage of 500 V DC.
  - This measurement is performed between each live part and the other interconnected parts of the assembly.

- Result
  - The test is correct if insulation resistance between the circuits and the frame is at least 1000 W/V with respect to the nominal voltage of this circuit.
  - Register the result on the final inspection record list.

7.4. Pre-dispatching checks

Cleanliness

- Prior to packing, check that the equipment is clean:
  - No dust
  - No foreign body forgotten in the equipment.

Reminder:
See Chapter 3.2 concerning assemblies for which access is difficult at the final inspection stage.

Miscellaneous

- Using a detailed check list established by the design office, perform inspection of:
  - all the equipment to be delivered separately, spare parts, devices dismantled for transport, etc.;
  - roof, coupling screws;
  - busbar joints, etc.

Documentation

- Presence of the name plate and/or the "as built design".
- Make sure that all the documentation relating to the quality inspection procedures are filled in:
  - missing parts list;
  - quality control plan;
  - checking program;
  - corrective action form;
  - non-quality record board;
  - delivery slip;
  - etc.
Detailed instructions

7. Performing final inspection

- Associated documentation delivered with the equipment:
  - device and switchboard technical documentation;
  - maintenance documentation;
  - missing parts list;
  - and on request
  - quality control plan.
- Be sure that all internal devices and other parts are well secured, inserted or locked in the switchboard

Packaging
- Inspection of packaging before delivery according to:
  - the type of product to be carried;
  - the means of transport;
  - the destination;
  - storage conditions;
  - climatic conditions.
8. Quality status chart

8.1. Purpose 38
8.2. Principles 38
8.3. Produced non-quality 38
8.4. Example of a Produced Non-Quality index board 39
8.5. Non-conformity weight example 39
8. Quality status chart

8.1. Purpose
- This status chart allows the measurement of quality performance and reveals the necessary corrective actions to be taken.

8.2. Principles
- The quality assurance manager issues a monthly quality report entitled "Quality indicator report".
- Performance is evaluated according to the four indicators below:
  o purchased non-quality
  o produced non-quality
  o non service quality
  o external non-quality.
- The non-quality index:
  o is an indicator used to measure changes in non-quality
  o defines the target objectives
  o reveals the weaknesses of the various operations and allows the relevant actions to be taken.
- These non-quality indices can be calculated using specific formulas (see chapter 9.3).
- The index which is directly associated with final inspection is "produced non-quality".
- Purchased non-quality can be monitored by different indicators depending on the origin of supplies:
  o Overall ratio
  o Ratio of supplies purchased
  o Internal manufactured supplies ratio.
- External non-quality:
  o Taking customer complaints into account (intermediate or end users).

8.3. Produced non-quality
- This index is calculated after the final inspection process using the "non-quality record board".
- It is calculated using this formula:
  \[
  \text{Non-quality index} = \frac{\text{Sum of weighted faults}}{\text{Total number of cubicles}}
  \]
- The faults revealed by quality inspection are assigned, according to their origin, to Production, the product design department or Sales.
- The faults are classified in 3 categories:
  o minor: a fault corresponding to a non-conformity;
  o major: a fault risking a considerable reduction in the achievement of a function in the switchboard;
  o critical: a fault which, based on 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.

Weighting
- The weighting applied to these three types of faults is:
  o minor fault = 1
  o major fault = 3
  o critical fault = 10
- Produced non-quality is monitored by means of indicators for each type of product and a overall 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 = 0.3 cubicle
  - \(< 12 \text{ m (1) drawers or functional units} = 0.1 \text{ cubicle}
  - \(\geq 12 \text{ m (1) drawers} = 0.2 \text{ cubicle}
  (1) Modules.
- Example of an MCC cubicle made up of:
  1 framework \((1 \times 0.3) = 0.3\)
  2 drawers 250 A - 6 modules \((2 \times 0.1) = 0.2\)
  Total = 0.5
  Cubicle equivalent = 0.5.
8. Quality status chart

8.4. Example of a Produced Non-quality index board

<table>
<thead>
<tr>
<th>Product</th>
<th>Number</th>
<th>Non-conforming</th>
<th>Faults</th>
<th>Responsibilities</th>
<th>Weighting version</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Qty</td>
<td>%</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Equip. 1</td>
<td>12.0</td>
<td>25</td>
<td>5</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Equip. 2</td>
<td>5.0</td>
<td>80</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Equip. 3</td>
<td>8.0</td>
<td>50</td>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

| Total   | 25.0   | 44            | 12     | 5   | 2   | 47            | 11    | 3                  | 5    | 1.88          |

*Equipment 1: Prisma Plus*  
A: Minor = 1.  
*Equipment 2: Prisma Plus*  
B: Major = 3.  
*Equipment 3: Okken*  
C: Critical = 10.

The peaks shown on the graph may be due to:  
- 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 product production file.

8.5. Non-conformity weight example

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Labelling</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Wire marking</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Wiring appearance</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Accessibility of equipment</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Apparatus fastening</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Space for customer connection</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Bad crimping</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>Auxiliary wire section</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>Auxiliary protection rating</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>IP degree</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>Earth connection</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>Phase polarity</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>Electrical sequence operation</td>
<td>3</td>
</tr>
<tr>
<td>14</td>
<td>Auxiliary wire damage</td>
<td>3</td>
</tr>
<tr>
<td>15</td>
<td>Power wire damage</td>
<td>10</td>
</tr>
<tr>
<td>16</td>
<td>Insulating distance</td>
<td>10</td>
</tr>
<tr>
<td>17</td>
<td>Power cable or busbar cross-section</td>
<td>10</td>
</tr>
<tr>
<td>18</td>
<td>Protection devices conformity</td>
<td>10</td>
</tr>
<tr>
<td>19</td>
<td>Number and clearance of busbar supports</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>Interlocking</td>
<td>10</td>
</tr>
</tbody>
</table>

Example of a graph showing the “non-quality index”.
# Facilities and calibration

## 9. Facilities
- 9.1. The Quality Inspector’s individual tools
- 9.2. Common quality inspection facilities
- 9.3. Quality inspection zone
- 9.4. Necessary documents

## 10. Control of inspection facilities
- 10.1. Purpose
- 10.2. Reminders of basic principles
- 10.3. Responsibility
- 10.4. Diagram of operations
- 10.5. Application rules
- 10.6. Listing and monitoring inspection and production facilities
- 10.7. Occasional checks
- 10.8. Devices outside the accuracy class
9. Facilities

9.1. The Quality Inspector’s individual tools
- These are the switchboard fitter’s tools (screwdriver, wrenches, etc.) with, in addition:
  - a small rule or measuring rods to check clearances;
  - a lamp;
  - an articulated mirror;
  - a set of crocodile clips;
  - a bell tester;
  - a set of probe fingers.

9.2. Common quality inspection facilities
- Control desk:
  Enables the main and auxiliary circuits to be energised. Equipped with a voltage regulator and a number of selector switches and indicators, to make the various operating sequences easier.
- Dielectrometer:
  To perform the dielectric testing followed by insulation resistance testing.
- Megohmmeter:
  To perform the insulation resistance testing
- Earth continuity tester
- Phase order tester
- Drawer test equipment
- Test cords and a variety of plugs, supply cords and other connection systems
- Steps, pallet-mover or other transportation facilities.

9.3. Quality inspection zone
- Quality inspection zone:
  - is independent from production
  - must be physically separated from the other departments:
    - for reasons linked to the hazards of electric current
    - for protection of people and equipment
  - is clearly marked out (tapes, partitions, etc.)
  - is clearly indicated (warning beacon, flashing light, sign, etc.).
- This area should be equipped in compliance with applicable legislation and local regulations.

9.4. Necessary documents
- To carry out the various checks, the quality inspector must have:
  - a complete, updated production file of the project, check list;
  - a missing parts list;
  - update procedures and associated document;
  - updated products documentations (devices, equipment system...);
  - standards.
- He must have the necessary inspection facilities (mechanical and electrical):
  - test desk, variable current and voltage sources;
  - measurement devices, multi-meter;
  - bell tester;
  - phase order monitor.
10. Control of inspection facilities

10.1. Purpose
- The purpose of these operations is to check the inspection and production facilities used in the unit for maintenance and calibration.
- To organize inspection facilities tracking to set up possible corrections on delivered equipment.

10.2. Reminders of basic principles

Inspection facilities
- List and identify the inspection facilities.
- Have them checked at specific intervals, according to the accuracy of the measurements to be taken, by an approved international or national organisation. (For example, the organisation for France is the B.N.M. – National Metrology Office).
- Identify by a "not followed up in calibration" label, 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 delivered project equipment inspected using non-conforming measuring instruments.

Production facilities
- Torque wrenches.
- Crimping equipment.

10.3. Responsibility
- The inspection and production facilities supervisor appointed by the quality manager is in charge of:
  o listing and identifying these facilities;
  o implementing and monitoring the checks;
  o decision-making after checking;
  o archiving the documents.

10.4. Diagram of operations
10. Control of inspection facilities

10.5. Application rules

Choice of facilities
- Inspection and production facilities are chosen according to:
  - the type of measurement;
  - the theoretical values to be measured;
  - the required accuracy;
  - the type of process to be performed.

Classification of facilities
- For checking follow-up:
  - All the inspection and production facilities identified and monitored.
  - The items of equipment identified by a "not followed up in calibration" label and listed on the associated document are used as indicators only.

Checking frequency

Inspection facilities
- The normal frequencies chosen are:
  - 1 check once a year for normally used inspection means (e.g. dielectric meter, etc.)
  - 1 check once every 2 years for seldom used inspection means.

Production facilities
- Torque wrenches: must be calibrated at least once a year.
- Crimping means: must be checked once a year.

10.6. Listing and monitoring inspection and production facilities

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

10.7. Occasional checks

- These checks must be performed after:
  - acquisition of a new inspection and production means (without verification or conformity certificate);
  - an impact;
  - a repair;
  - a loan;
  - a long period of inactivity.

10.8. 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;
  - downgraded to an operation means not assigned to measurement (indicator only);
  - scrapping (most common case for production means).
- The calibration manager must also decide whether to initiate a notification of non-conformity (NNC) used to rule on delivered project equipment which was inspected using the defective device in question as on the left:

(*) See the example of a corrective action request in the appendix.
## Appendix

### 11. Model form

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.1.</td>
<td>Follow-up of missing parts</td>
<td>46</td>
</tr>
<tr>
<td>11.2.</td>
<td>Checking programme</td>
<td>47</td>
</tr>
<tr>
<td>11.3.</td>
<td>Checking program: manufactured parts checking card</td>
<td>49</td>
</tr>
<tr>
<td>11.4.</td>
<td>Non-quality record board</td>
<td>55</td>
</tr>
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<td>11.5.</td>
<td>Corrective action request</td>
<td>56</td>
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<td>11.6.</td>
<td>Quality control plan</td>
<td>57</td>
</tr>
<tr>
<td>11.7.</td>
<td>Missing parts list</td>
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</table>

### 12. Glossary

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<thead>
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<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
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<tbody>
<tr>
<td>12.1.</td>
<td>Abbreviations</td>
<td>59</td>
</tr>
<tr>
<td>12.2.</td>
<td>Vocabulary</td>
<td>59</td>
</tr>
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</table>
# Appendix

## 11. Model form

### 11.1. Follow-up of missing parts

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

<table>
<thead>
<tr>
<th></th>
<th>Project no.: ..................................................</th>
<th>Date received by client or factory availability lead time: ..........................................................</th>
</tr>
</thead>
</table>

#### 1 - Missing at end of assembly

<table>
<thead>
<tr>
<th>Items</th>
<th>Project co-ordinator &amp; References</th>
<th>Quantities</th>
<th>Supplies Lead time announced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 2 - Missing parts at end of inspection/customer acceptance

<table>
<thead>
<tr>
<th>Items</th>
<th>Project co-ordinator &amp; References</th>
<th>Quantities</th>
<th>Supplies Lead time announced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 3 - Sales department notification

<table>
<thead>
<tr>
<th>Can the project be dispatched with missing parts?</th>
<th>Yes ☐ No ☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can the missing parts be partially dispatched?</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>Which ones? ..............................................</td>
<td>..................................................</td>
</tr>
<tr>
<td>Missing parts dispatch address:........................</td>
<td>..................................................</td>
</tr>
<tr>
<td>Project site delivery date: ............................</td>
<td>..................................................</td>
</tr>
</tbody>
</table>
## Appendix

### 11. Model form

#### 11.2. Checking programme

Back to Checking programme: Design

<table>
<thead>
<tr>
<th>Product type</th>
<th>Project No.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drawing No.:</td>
<td>Customer:</td>
</tr>
<tr>
<td>Cubicle No.:</td>
<td>Date:</td>
</tr>
</tbody>
</table>

### Checking programme

<table>
<thead>
<tr>
<th>Observations</th>
<th>In-process inspection</th>
<th>Quality inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Checked by</td>
<td>Conformity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Checked by</td>
</tr>
</tbody>
</table>

- Compliance with the project production file

- Switchboard characteristics
- Cubicles characteristics
- Busbars characteristics
- Devices and drawer characteristics
- Wiring characteristics

Checking during process: fill in the grey box

Final inspection and testing: fill in the white box
Basic checklist
for incoming inspection of sheet metal parts

☑ The kind of material is the good one

☐ Aluminium  ☐ Steel  ☐ Stainless  ☐ Plastic  ☐ Color

☑ The component looks like the drawing and the 3D view

☐ all shapes and holes exist
☐ the component is bent in the correct side
☐ all cut edges are straight, without stairs or burs
☐ no deformation due to punching
☐ sub-assembly is consistent with the bill of material

☑ The coating is well done

on visible sides:
☐ no grains
☐ no tears
☐ no craters
☐ no scratch
globally:
☐ adherence
☐ uniformity

☑ The dimensions identified by △ are measured on 5 samples

☐ checking card is written

Goal of the document:
This document lists the basic checks to be performed in order to ensure the quality of the switchboard manufactured parts (see the "Blokset Transfer File" for further details).
11.3. Checking program: manufactured parts checking card

<table>
<thead>
<tr>
<th>Dimension to be measured on 5 samples</th>
<th>Location</th>
<th>Parts or lot checked</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td>Comments</td>
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<td></td>
</tr>
</tbody>
</table>

- Approved [ ]
- Rejected [ ]

Date: / / 
Signature:
### Appendix

#### 11. Model form

**Checking programme: Framework**

<table>
<thead>
<tr>
<th>Index:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product type:</td>
</tr>
<tr>
<td>Drawing No.:</td>
</tr>
<tr>
<td>Cubicle No.:</td>
</tr>
<tr>
<td>Date:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Checking programme</th>
<th>In-process inspection</th>
<th>Quality inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>Checked by</td>
<td>Conformity</td>
</tr>
<tr>
<td>Dimensions of cubicle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical assembly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleanness</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Checking during process: fill in the grey box
Final inspection and testing: fill in the white box
## Appendix

### 11. Model form

#### Checking programme: Busbars

<table>
<thead>
<tr>
<th>Observations</th>
<th>In-process inspection</th>
<th>Quality inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Checked by</td>
<td>Conformity</td>
</tr>
<tr>
<td>Type and characteristics</td>
<td></td>
<td>OK</td>
</tr>
<tr>
<td>Layout and installation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bending radius and bar alignment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Busbar junctions and links</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact surfaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bolt characteristics and tightening torque</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creepage distances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marking and phase order</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleanness</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Checking during process: fill in the grey box

Final inspection and testing: fill in the white box
## Appendix

### 11. Model form

#### Checking programme: Device & Drawer

<table>
<thead>
<tr>
<th>Index:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Product type:</td>
<td></td>
</tr>
<tr>
<td>Drawing No.:</td>
<td></td>
</tr>
<tr>
<td>Cubicle No.:</td>
<td></td>
</tr>
<tr>
<td>Date:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Checking programme</th>
<th>In-process inspection</th>
<th>Quality inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>Checked by</td>
<td>Conformity</td>
</tr>
<tr>
<td>Conformity of devices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type and characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toroid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current transformers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shunt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety perimeters</td>
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<td></td>
</tr>
<tr>
<td>Mounting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact surfaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bolt characteristics and tightening torque</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creepage distances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wiring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexible bars characteristics and installation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cables characteristics and installation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Binding and cable trunking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cable connections</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment manual operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment fixing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mechanical operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jaws characteristics and installation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>accessibility of functional units or devices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleanness</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Checking during process: fill in the grey box

Final inspection and testing: fill in the white box
### Appendix

#### 11. Model form

**Checking program: Enclosure**

<table>
<thead>
<tr>
<th>Checking programme</th>
<th>In-process inspection</th>
<th>Quality inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Checked by</td>
<td>Conformity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td>Repair</td>
<td>Checked by</td>
</tr>
</tbody>
</table>

- PE and/or PEN protection busbars characteristics
- Wiring terminal blocks
- Bolt characteristics and tightening torque
- Cables characteristics
- Cables installation
- Appearance
- Painting color and reference
- Mounting
- Panelling
- Degree of protection
- Safety control

*Checking during process: fill in the grey box*

*Final inspection and testing: fill in the white box*
### Checking programme: Final inspection

<table>
<thead>
<tr>
<th>Checking programme</th>
<th>Quality inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>Checked by</td>
</tr>
<tr>
<td></td>
<td>OK</td>
</tr>
</tbody>
</table>

#### First routine test / inspection of the assembly, conformity check

- In-process checklist validation
- Composition, dimensions and identification label
- Homogeneity - Finishing
- Framework grounding fixing, handling devices, keys
- Connection facilities space and equipment
- Conformity of devices
- Mechanical check of safety and locking system
- Clearances and creepage distances
- Equipment manual operation
- Installation and maintenance access
- Electrical and mechanical grease
- Electrical operations checks

#### Second routine test / protective measures & protective circuit

- Monitoring of the protection circuit
- Mechanical inspection
- Electrical inspection
- Operator safety - protection of persons

#### Third routine test / dielectric test

- Dielectric withstand
- Insulation resistance
- Cleanness

Final inspection and testing: fill in the white box
### 11.4. Non-quality record board

<table>
<thead>
<tr>
<th>Quality inspector:</th>
<th>Manufacturing:</th>
<th>Project name:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product:</td>
<td>Quantity:</td>
<td>Job number:</td>
<td></td>
</tr>
<tr>
<td>Number of faulty column:</td>
<td>Client:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of drawer:</th>
<th>Repair action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Location and type of fault</td>
<td>Design / tendering</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sum of faults:</th>
<th>Page:</th>
</tr>
</thead>
</table>

---

*Details for columns A, B, C (minor, major, critical fault notations)*
11. Model form

11.5. Corrective action request

**Corrective action request**

<table>
<thead>
<tr>
<th>Action request of:</th>
<th>..............................................................</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
<td>..............................................................</td>
</tr>
<tr>
<td>From:</td>
<td>..............................................................</td>
</tr>
<tr>
<td>To:</td>
<td>..............................................................</td>
</tr>
<tr>
<td>Copy to:</td>
<td>..............................................................</td>
</tr>
<tr>
<td>Non-conformity detected by customer</td>
<td>☐</td>
</tr>
<tr>
<td>Concerned product:</td>
<td>..............................................................</td>
</tr>
<tr>
<td>Issued by:</td>
<td>..............................................................</td>
</tr>
<tr>
<td>Description of the non-conformity</td>
<td></td>
</tr>
<tr>
<td>Any suggestions</td>
<td></td>
</tr>
<tr>
<td>Answer</td>
<td></td>
</tr>
<tr>
<td>Corrective actions</td>
<td>Performed by</td>
</tr>
<tr>
<td>Corrective action settled</td>
<td>☐</td>
</tr>
</tbody>
</table>
## 11. Model form

### 11.6. Quality control plan

#### Procès verbal de contrôle final / Quality control plan

<table>
<thead>
<tr>
<th>Client</th>
<th>PV n° / Registration Nr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affaire / Project</td>
<td>N° Cde client / Client ref.</td>
</tr>
<tr>
<td>Nom du tableau / Switchboard identification</td>
<td>N° affaire / Job ref.</td>
</tr>
<tr>
<td>Produit / Product</td>
<td></td>
</tr>
<tr>
<td>Quantité / Qty</td>
<td></td>
</tr>
<tr>
<td>Plan n° / Drawing No.:</td>
<td>Indice / Index:</td>
</tr>
</tbody>
</table>

#### Gamme de contrôle / Checking programme

1. **Contrôle de conformité / Conformity checking**
   - Les enveloppes / Enclosures
   - L’appareillage / Switchgear
   - Les conducteurs / Conductors

2. **Vérifications mécaniques / Mechanical checking**

3. **Essais électriques / Performances electric test**

4. **Continuité électrique des masses mécaniques / Exposed conductive parts electrical continuity**
   - Visuel / Visual
   - Electrique / Electrical

5. **Essais diélectriques / Dielectric test**
   - Réf. Appareil / Measuring device ref.

6. **Essais d’isolement / Insulating test**
   - Réf. Appareil / Measuring device ref.

#### Observation / Comment:

---

<table>
<thead>
<tr>
<th>Inspecteur client / Client représentative</th>
<th>Inspecteur qualité / Quality inspector</th>
<th>Respons. I.Q / Quality manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date ......................................</td>
<td>Date ......................................</td>
<td>Visa ......................................</td>
</tr>
<tr>
<td>Visa ......................................</td>
<td>Visa ......................................</td>
<td></td>
</tr>
</tbody>
</table>
11. Model form

11.7. Missing parts list

Entity
Tel.: 00.00.00.00.00.
Fax: 00.00.00.00.00.

1. Missing parts list / Liste des composants non expédiés avec l'affaire

Project number / N° d’affaire : .................................................

<table>
<thead>
<tr>
<th>Item / Poste</th>
<th>Description / Désignation</th>
<th>Quantity / Quantité</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Quality control / Contrôle qualité
...................................................................................................................................................................................................

Quality inspector /Inspecteur qualité
...................................................................................................................................................................................................

Date ......................................
12. Glossary

12.1. Abbreviations
- L.V.: Low Voltage.
- Dielectrimeter: A device used only to perform dielectric tests.
- Dielectrometer: A device used for withstand testing. It measures dielectric withstand and insulation resistance.
- I.P.: Degree of Protection.
- P.E.: Electrical Protection.
- P.E.N.: Electrical Protection and Neutral.
- C.T.: Current Transformer.
- MCC: Motor Command and Control
- P.C.C: Power Command and Control

12.2. Vocabulary

Main definitions (ISO 9000 standard)

Quality
Degree to which a set of inherent characteristics meets a requirement

Quality audit
Methodical examination of all the measures described in the quality manual and the relevant procedures, in co-operation with the involved parties. This in order to assess whether the real state of the plant is in accordance with the description in the quality manual.

Quality management
Co-ordinated activities dedicated to managing and controlling organisation with regard to quality.
Also includes assessment of the results and the corresponding cost.

Quality manual
Written documents specifying information about the quality management system of an organisation.

Quality plans
Documents describing the quality management system, and specifying which procedures and associated resources shall be applied by whom and when, in order to obtain the quality level of the considered project, product, process or contract. Also called “quality assurance programme”.

Procedures
Specified way of carrying out an activity or process.
Written document describing the organisation and manufacturing method, control, inspection, checking, assessment, corrective actions intended to be strictly applied in order to reach the predefined quality level.

Inspection
Conformity evaluation performed within the scope of the defined process by observation, measurement, testing or gauging.

Non-conformity
Non-fulfilment or deviation of a need or expectation with respect to the specified requirement.

Traceability
Ability, from registered identification, to trace the process history and the location of the product after delivery.