

Overview on the IEC61439-1/2 (IS EN61439-1/2):

Power Switchgear and Control Assemblies

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Technical Overview CPD series:

- L.V switchgear and panel selection
- L.V selectivity and discrimination
- IEC61439 part 1 and 2 L.V switchgear & Control assemblies.

Technical support and training

Technical & Design Promotion Manager

Paul Hyland Electrical Engineer (Electrician)

29 +1 years LV switchgear and Control Assemblies

6 years ABB technical Support and product design

Degree in Electrical Service Design BEng

Honours Degree Electrical Service and Energy

Management BSc

SACE Level 3 service engineer

Participating member of the ETC TC4 NSAI group for LV SWG

Member of Engineers Ireland

Participating member of the SC 121B IEC International Electrotechnical Commission, MT2 Maintenance team for the IEC 61439 part 0, part 1 and part 2. for LV switchgear



ABB provide all Technical support as one ABB team.

April/ May 2022

CPD Presentations – timetable

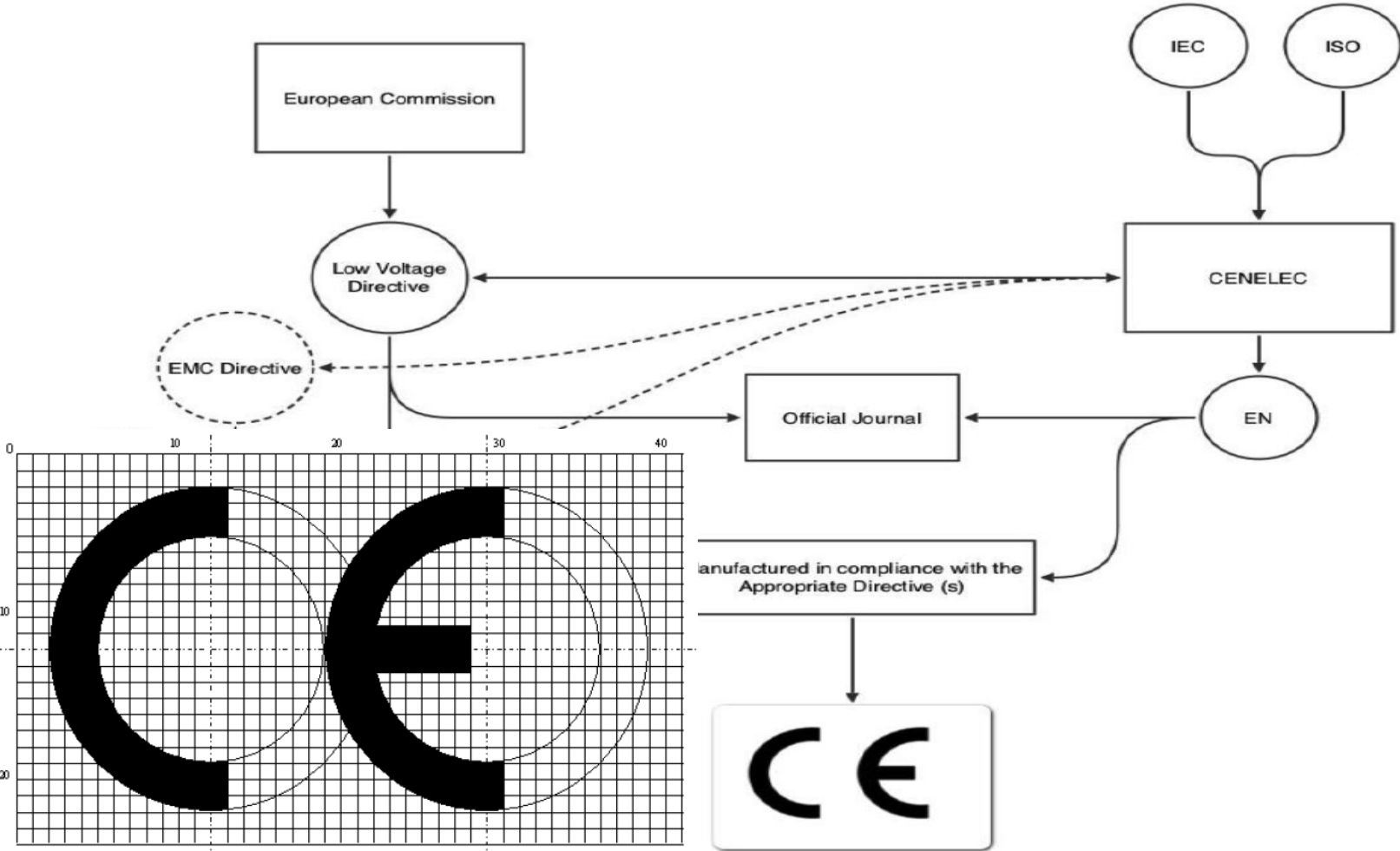
Monday	Tuesday	Wednesday	Thursday	Friday
	26th April Technical overview of LV Switchgear and Panel Selection. Paul Hyland	27th April Building Automation- KNX universal protocol & DALI Pierre Badenhorst	28th April The Fundamentals & Principles of Building Energy Management Systems Seamus MacLughadha	
	3rd May	4th May IIoT for Electrical installations Paul Minnagh	5th May Building Services Integration BACnet and other options Seamus MacLughadha	
	10th May LV Selectivity / Discrimination Paul Hyland	11th May Introduction to MV Switchgear David Supple	12th May IE5 Synchronous Reluctance Drive and Motor Package Tero Helpio	
	17th May IEC61439 overview of Standard for Low Voltage Switchgear & Assemblies Paul Hyland	18th May Electric Vehicle Charging Infrastructure James Kelly	19th May	
	24th May Arc Fault Detection Devices (New MCBs & RCBOs) Paul Hyland	25th May Harmonics, VSDs and mitigation technologies Liam Blackshaw		

The main agenda for this presentation is to give an overview and introduction in to the IEC61439 standard for Power Switchgear and Control Assemblies

- LVD, CENELEC and CE MARKING
- EUROPEAN DIRECTIVES (LVD)
- PURPOSE OF THE IEC61439
- IEC61439 SERIES
- I.S. EN 61439-2
- HOW TO COMPLY WITH THE STANDARD
- THE RATING OF A CIRCUIT (Inc)
- FORMS OF SEPERATION
- WHAT IS AN ASSEMBLY
- DESIGN VERIFICATIONS
- ROUTINE VERIFICATION
- DEVICE SUBSTITUTION



Relation of the LVD, CENELEC & CE Mark



ec.europa.eu/growth/single-market/ce-marking/manufacturers/index_en.htm

European Directive – Low Voltage Directive

29.3.2014

EN

Official Journal of the European Union

L 96/357

DIRECTIVE 2014/35/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 26 February 2014

on the harmonisation of the laws of the Member States relating to the making available on the
market of electrical equipment designed for use within certain voltage limits

(recast)

(Text with EEA relevance)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE
EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European
Union, and in particular Article 114 thereof,

Having regard to the proposal from the European Commission,

After transmission of the draft legislative act to the national
parliaments,

Having regard to the opinion of the European Economic and
Social Committee⁽¹⁾,

Acting in accordance with the ordinary legislative procedure⁽²⁾,

Whereas:

(1) A number of amendments are to be made to Directive
2006/95/EC of the European Parliament and of the
Council of 12 December 2006 on the harmonisation
of the laws of Member States relating to electrical
equipment designed for use within certain voltage
limits⁽³⁾. In the interests of clarity, that Directive
should be recast.

(2) Regulation (EC) No 765/2008 of the European
Parliament and of the Council of 9 July 2008 setting
out the requirements for accreditation and market
surveillance relating to the marketing of products⁽⁴⁾
lays down rules on the accreditation of conformity
assessment bodies, provides a framework for the
market surveillance of products and for controls on
products from third countries, and lays down the
general principles of the CE marking.

(3) Decision No 768/2008/EC of the European Parliament
and of the Council of 9 July 2008 on a common

⁽¹⁾ OJ C 181, 21.6.2012, p. 105.

⁽²⁾ Position of the European Parliament of 5 February 2014 (not yet
published in the Official Journal) and decision of the Council of
20 February 2014.

⁽³⁾ OJ L 374, 27.12.2006, p. 10. Directive 2004/95/EC is the codi-
fication of Council Directive 73/23/EEC of 19 February 1973 on the
harmonization of the laws of Member States relating to electrical
equipment designed for use within certain voltage limits (OJ L 77,
28.3.1973, p. 29).

⁽⁴⁾ OJ L 218, 13.8.2008, p. 30.

framework for the marketing of products⁽⁵⁾ lays down
common principles and reference provisions intended to
apply across sectoral legislation in order to provide a
coherent basis for revision or recasts of that legislation.
Directive 2006/95/EC should therefore be adapted to
that Decision.

LVD Responsibility, Article 9:

(9) The manufacturer, having detailed knowledge of the design and production process, is best placed to carry out the conformity assessment procedure. Conformity assessment should therefore remain solely the obligation of the manufacturer. There is no conformity assessment procedure in this Directive which requires the intervention of a notified body.

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⁽⁵⁾ OJ L 218, 13.8.2008, p. 82.

The Purpose of 61439

IEC61439 compliance with focus on part 1 and part 2

Abstract

The aim of this research is to explore the challenges in the industry for Original Equipment Manufacturers (OEM) and Panel Builders (an Assembler) to ensure compliance within the International Electrotechnical Commission IEC61439 standard for Low-voltage switchgear and controlgear assemblies. In this paper the researcher will refer to the IEC standard however the European Standard EN will be explored and defined. The research will try clear up several areas, which among several of the experienced participants interviewed on this topic has become labelled as the “Grey” areas. Some such grey areas are: Forms of separation, Verification testing, the different responsibilities between OEM and an Assembler and can an Assembler make changes to an original design? All these areas will be addressed within this paper. The researcher believes after reading the code of lighting article by Raynham that the same concept lies in the underbelly of the L.V switchgear industry, L.V switchgear and Controlgear Assemblies (CGA) in Ireland are at an extremely high level of quality and engineering design and like the lighting code there lies a question as to whether we need the standards at all,

“as with BS EN 12464-I, there will perhaps be detractors who think the code and standards generally, don't go far enough. Or that lighting specialists don't need them, and we should do away with them altogether. The point, argues Raynham, is that they are aimed not at the lighting professional but at the non-specialist in the hope of avoiding the worst excesses of the inept and 'to make sure that clients have some vague ideas of what they might be letting themselves in for'. He adds: when we think of the role of the code and the standards it is actually to stop bad lighting rather than promote good lighting” (Raynham, 2011)

so why do we need the IEC61439?

to make sure that clients have some vague ideas of what they might be letting themselves in for'. He adds: when we think of the role of the code and the standards it is actually to stop bad lighting rather than promote good lighting” (Raynham, 2011)

The Purpose of 61439

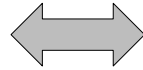
Why do we have IEC61439 (IS EN 61439)?



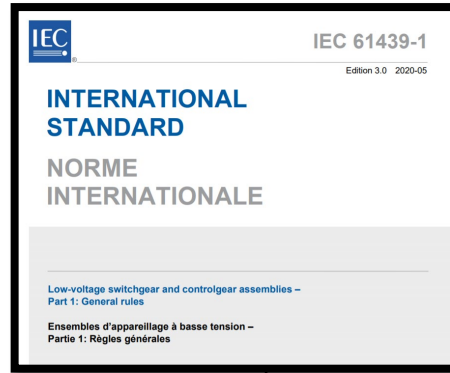
61439 provides a method of confirming that the equipment manufactured meets a level suitability. It is the responsibility of the manufacturer to meet The Standards.

IEC61439 Series

Structure



IEC SC121B MT2 Maintenance committee



Part 0: Guidance to specifying assemblies (technical report) Edition 2.0 2013-04

Part 1: General rules Edition 3.0 2020-05

Part 2: Power Switchgear and Control-gear assemblies (PSC) Edition 3.0 2020-07

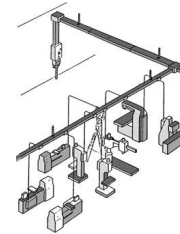
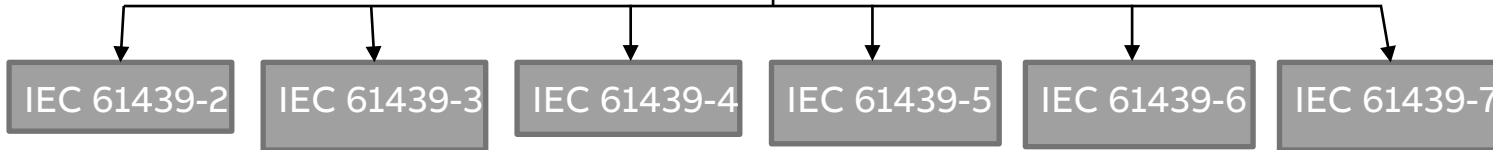
Part 3: Distribution Boards intended to be operated by Ordinary persons (DBO) Edition 1.0 2012-02

Part 4: Particular requirements for Assemblies for Construction Sites (ACS) Edition 1.0 2012-11

Part 5: Assemblies for power distribution in public networks Edition 1.0 2010-11

Part 6: Busbar trunking systems (busways) Edition 1.0 2012-05

Part 7: Assemblies for specific applications such as marinas, camping sites, market squares, electric vehicles charging stations Edition 1.0 2014-02



IEC SC121B MT2 Maintenance Committee



The IEC TC121B MT2 committee meeting at the VDE Verband der Elektrotechnik Elektronik Informationstechnik e.V. Berlin Germany July 2019

I.S EN 61439-2

Ireland NSAI has a “P” membership to the IEC committee however the IEC61439 series is equal to the I.S EN 61439 (I.S means Ireland)

The Scope:

– 12 – 61439-1 © IEC:2011

**LOW-VOLTAGE SWITCHGEAR
AND CONTROLGEAR ASSEMBLIES –**

Part 1: General rules

1 Scope

NOTE 1 Throughout this standard, the term ASSEMBLY (see 3.1.1) is used for a low-voltage switchgear and controlgear assembly.

This part of the IEC 61439 series lays down the definitions and states the service conditions, construction requirements, technical characteristics and verification requirements for low-voltage switchgear and controlgear assemblies.

This standard cannot be used alone to specify an ASSEMBLY or used for a purpose of determining conformity. ASSEMBLIES shall comply with the relevant part of the IEC 61439 series; Parts 2 onwards.

This standard applies to low-voltage switchgear and controlgear assemblies (ASSEMBLIES) only when required by the relevant ASSEMBLY standard as follows:

- ASSEMBLIES for which the rated voltage does not exceed 1 000 V in case of a.c. or 1 500 V in case of d.c.;
- stationary or movable ASSEMBLIES with or without enclosure;
- ASSEMBLIES intended for use in connection with the generation, transmission, distribution and conversion of electric energy, and for the control of electric energy consuming equipment;
- ASSEMBLIES designed for use under special service conditions, for example in ships and in rail vehicles provided that the other relevant specific requirements are complied with;

NOTE 2 Supplementary requirements for ASSEMBLIES in ships are covered by IEC 60092-302.

- ASSEMBLIES designed for electrical equipment of machines provided that the other relevant specific requirements are complied with.

NOTE 3 Supplementary requirements for ASSEMBLIES forming part of a machine are covered by the IEC 60204 series.

This standard applies to all ASSEMBLIES whether they are designed, manufactured and verified on a one-off basis or fully standardised and manufactured in quantity.

The manufacture and/or assembly may be carried out other than by the original manufacturer (see 3.10.1).

This standard does not apply to individual devices and self-contained components, such as motor starters, fuse switches, electronic equipment, etc. which will comply with the relevant product standards.

61439-2 © IEC:2011 – 5 –

**LOW-VOLTAGE SWITCHGEAR AND
CONTROLGEAR ASSEMBLIES –**

Part 2: Power switchgear and controlgear assemblies

1 Scope

NOTE 1 Throughout this part, the abbreviation PSC-ASSEMBLY (see 3.1.101) is used for a power switchgear and controlgear ASSEMBLY.

This part of IEC 61439 defines the specific requirements of power switchgear and controlgear assemblies (PSC-ASSEMBLIES) as follows:

- ASSEMBLIES for which the rated voltage does not exceed 1 000 V in case of a.c. or 1 500 V in case of d.c.;
- stationary or movable ASSEMBLIES with or without enclosure;
- ASSEMBLIES intended for use in connection with the generation, transmission, distribution and conversion of electric energy, and for the control of electric energy consuming equipment;
- ASSEMBLIES designed for use under special service conditions, for example in ships and in rail vehicles provided that the other relevant specific requirements are complied with;

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The manufacture and/or assembly may be carried out other than by the original manufacturer (see 3.10.1).

This standard does not apply to individual devices and self-contained components, such as motor starters, fuse switches, electronic equipment, etc. which will comply with the relevant product standards. This standard does not apply to the specific types of ASSEMBLIES covered by other parts of IEC 61439. For ASSEMBLIES not covered by other parts this part applies.

How do we check conformity?

Concept & Definitions

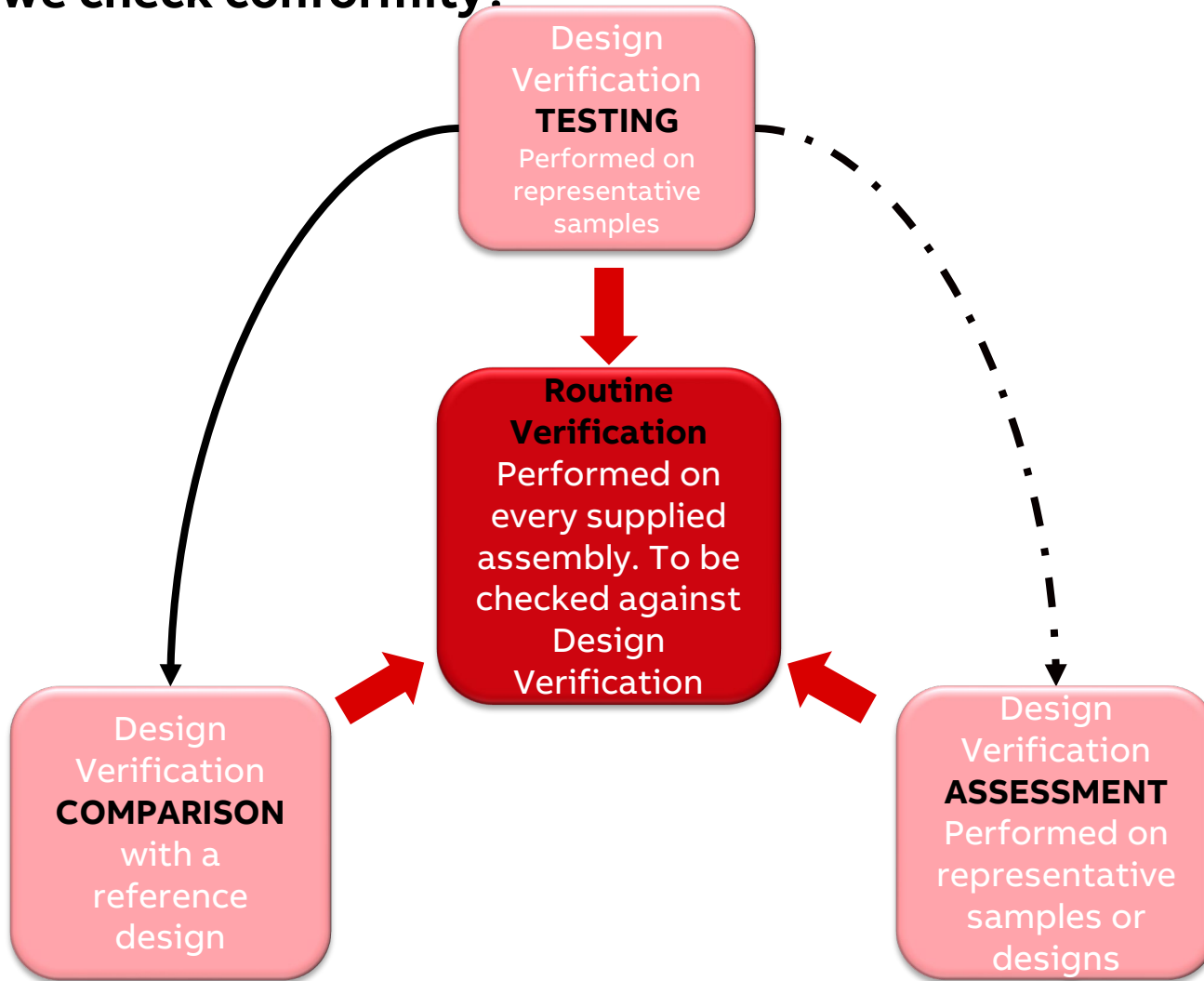
The conformity with the new standard of an ASSEMBLY shall be achieved by the application of one or more of the following equivalent and alternative methods as appropriate, called ***“design verification”***

-verification by testing (3.9.1.1 made on samples in specific laboratories)

-verification by comparison (3.9.1.2 comparison done with a tested design or physical measurements, for the design as an alternative to a test)

-verification by assessment (3.9.1.3 design verification, with calculations, of strict design rules on samples instead of the tests)

How do we check conformity?



Design Verification

IEC 61439-1:2020 © IEC 2020

Section 10.1 Design verification shall comprise the following:	
Construction:	
10.2	Strength of materials and parts
10.3	Degree of protection of enclosures
10.4	Clearances and creepage distances
10.5	Protection against electric shock and integrity of protective circuits
10.6	Incorporation of switching devices and components
10.7	Internal electrical circuit and connections
10.8	Terminals for external conductors
Performance:	
10.9	Dielectric Properties
10.10	Verification of temperature rise
10.11	Short-circuit withstand strength
10.12	Electromagnetic compatibility
10.13	Mechanical operation

How to comply with the standards

Design Verification by Testing:



How to comply with the standards

Routine Verification Tests Certs

The ASSEMBLY manufacturer carries out routine verifications. They are intended to detect defects in workmanship and or materials and are designed to guarantee proper functioning of ASSEMBLIES prior to being introduced to the market

Routine verification protocol (routine check)

Power Switchgear Combinations pursuant to IEC 61439-2

Sub-distribution boards pursuant to IEC 61439-3 (DNO Type)

Manufacturer of the ASSEMBLY:

Customer:

Order number:

Project:

Type:

Verifications:

Serial number	Type of inspection V = visual inspection I = Inspection using mech. or electr. test devices	Criterion
1	S	Degree of protection of cabinets / enclosures
2	V/I	Clearances and creepage distances
3	V/I	Protection against electric shock and continuity of the protective circuits
4	S	Incorporation of equipment
5	V/I	Internal electric circuits and connections
6	S	Terminals for external conductors
7	V	mech. Function (actuation elements, interlocks)
8	V	Dielectric properties
9	V	Wiring, operating behaviour and function

Test voltage value

The power-frequency withstand voltage is to be tested on all circuits for 1 minute at 100% of the test voltage (100% U_{ic} at a rated insulation voltage values of other rated insulation voltages, see Table 8 of the IEC 61439-3.

For ASSEMBLIES up to 30kV with an incoming protective device the insulation measurement using an insulation measurement device at a voltage of not less than 100V DC. This test will be passed successfully when the insulation resistance is at least 500 Ω/V.

Check performed by:

Place / Date: _____ Name and signature of the performer

Place / Date: _____ Name and signature of the tester

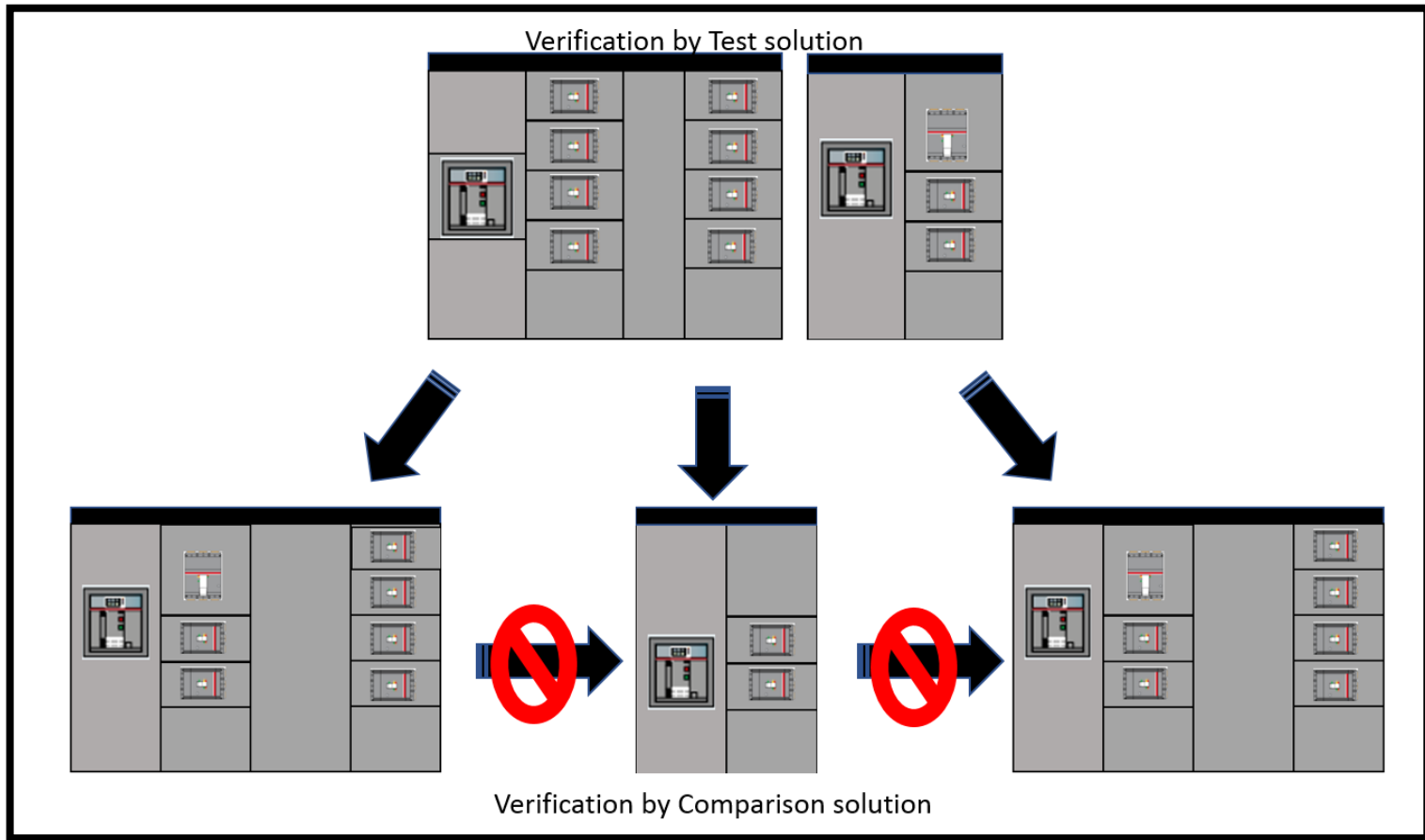
ABB Routine verification protocol - IEC 61439-2, IEC 61439-3 (DNO Type) Copyright © 2017 ABB LTD (UK), a Swiss entity. All rights reserved.

Verifications:					
Serial number	Type of inspection V = visual inspection I = Inspection using mech. or electr. test devices	Criterion	IEC 61439-1 Section	Result	Examiner
1	S	Degree of protection of cabinets / enclosures	11.2		
2	V/I	Clearances and creepage distances	11.3		
3	V/I	Protection against electric shock and continuity of the protective circuits	11.4		
4	S	Incorporation of equipment	11.5		
5	V/I	Internal electric circuits and connections	11.6		
6	S	Terminals for external conductors	11.7		
7	V	mech. Function (actuation elements, interlocks)	11.8		
8	V	Dielectric properties	11.9		
9	V	Wiring, operating behaviour and function	11.10		

Serial number	Criterion	Result	Examiner
1	Degree of protection of cabinets / enclosures		
2	Clearances and creepage distances		
3	Protection against electric shock and continuity of the protective circuits		
4	Incorporation of equipment		
5	Internal electric circuits and connections		
6	Terminals for external conductors		
7	mech. Function (actuation elements, interlocks)		
8	Dielectric properties		
9	Wiring, operating behaviour and function		

Verification by Comparison

Comparison verification can only be to a tested solution.



Ratings declared by Manufacturer and derating factors

Current carrying capability	13			
Rated current of the ASSEMBLY I_{nA} (A)	13.2	Manufacturer's standard, according to application	None	
Rated current of circuits I_{nC} (A)	13.3	Manufacturer's standard, according to application	None	
Rated diversity factor	13.4	As defined within the standard	RDF for groups of circuits / RDF for whole ASSEMBLY	
Ratio of cross section of the neutral	13.5.2	100%	None	

One of the fundamental ratings, IEC61439 requires the original manufacturer to verify I_{nc} is the I_{nc} rating.

This is not the I_n rating of the devices as declared by the device manufacturer.

Ratings declared by Manufacturer and derating factors

5.3 Current ratings

5.3.1 Rated current of the ASSEMBLY (I_{nA})

The rated current of the ASSEMBLY is the smaller of:

- the sum of the rated currents of the incoming circuits within the ASSEMBLY operated in parallel;
- the total current which the main busbar is capable of distributing in the particular ASSEMBLY arrangement.

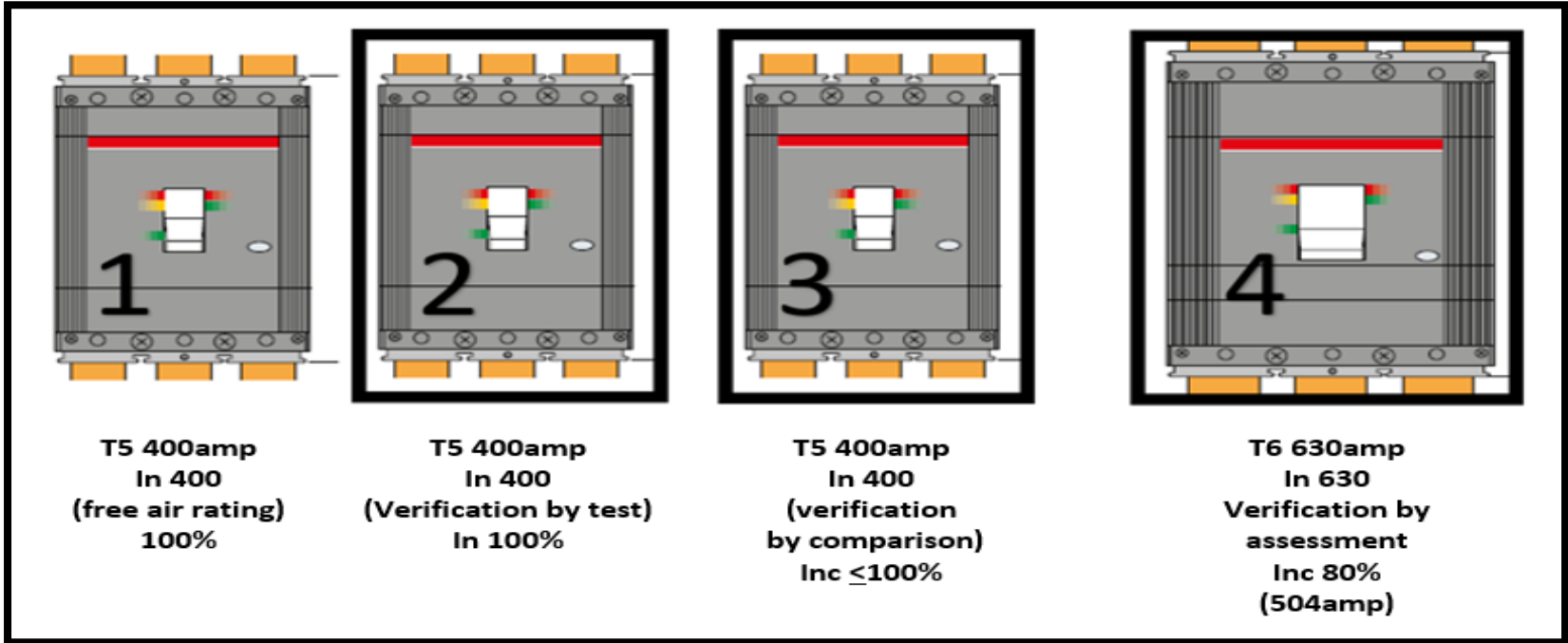
This current shall be carried without the temperature rise of the individual parts exceeding the limits specified in 9.2.

Table 101 – Values of assumed loading

Type of load	Assumed loading factor
Distribution – 2 and 3 circuits	0,9
Distribution – 4 and 5 circuits	0,8
Distribution – 6 to 9 circuits	0,7
Distribution – 10 or more circuits	0,6
Electric actuator	0,2
Motors \leq 100 kW	0,8
Motors $>$ 100 kW	1,0

Verification by assessment

Assessment verification must be de-rated 80%.



How to comply with the standards

Exemption to Verification by Testing

Short Circuit – Clause 10.11

10.11.2 Circuits of ASSEMBLIES which are exempted from the verification of the short-circuit withstand strength

A verification of the short-circuit withstand strength is not required for the following:

- a) ASSEMBLIES having a rated short-time withstand current (see 5.3.4) or rated conditional short-circuit current (see 5.3.5) not exceeding 10 kA r.m.s;
- b) ASSEMBLIES, or circuits of ASSEMBLIES, protected by current-limiting devices having a cut-off current not exceeding 17 kA with the maximum allowable prospective short-circuit current at the terminals of the incoming circuit of the ASSEMBLY;
- c) Auxiliary circuits of ASSEMBLIES intended to be connected to transformers whose rated power does not exceed 10 kVA for a rated secondary voltage of not less than 110 V, or 1,6 kVA for a rated secondary voltage less than 110 V, and whose short-circuit impedance is not less than 4 %.

All other circuits shall be verified.

How to comply with the standards

Exemption to Verification by Testing

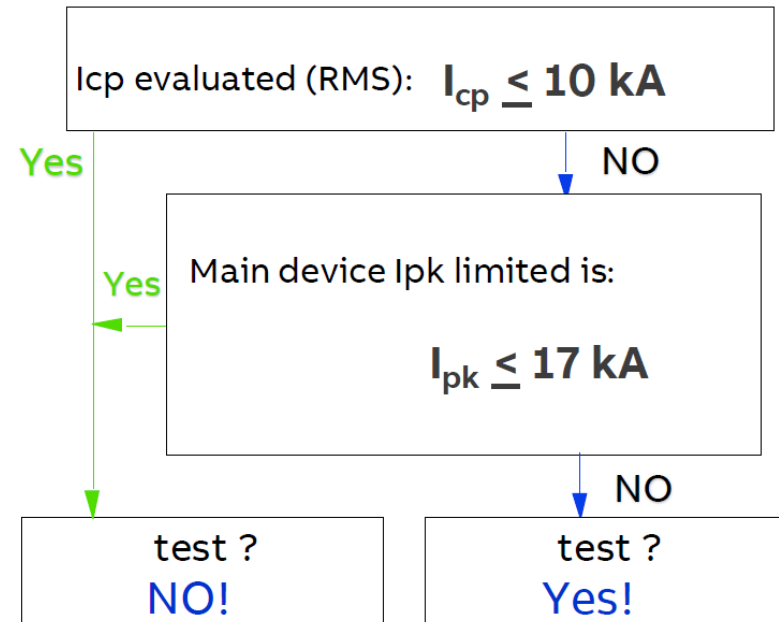
Short Circuit - Clause 10.11

Short circuit test is **NOT** required if

$I_{cp} \leq 10 \text{ kA}$
(short circuit RMS)

or

$I_{pk} \leq 17 \text{ kA}$
(peak current limited by circuit breaker or fuse)



How to comply with the standards

Exemption to Verification by Testing

Temperature Rise – Clause 10.10

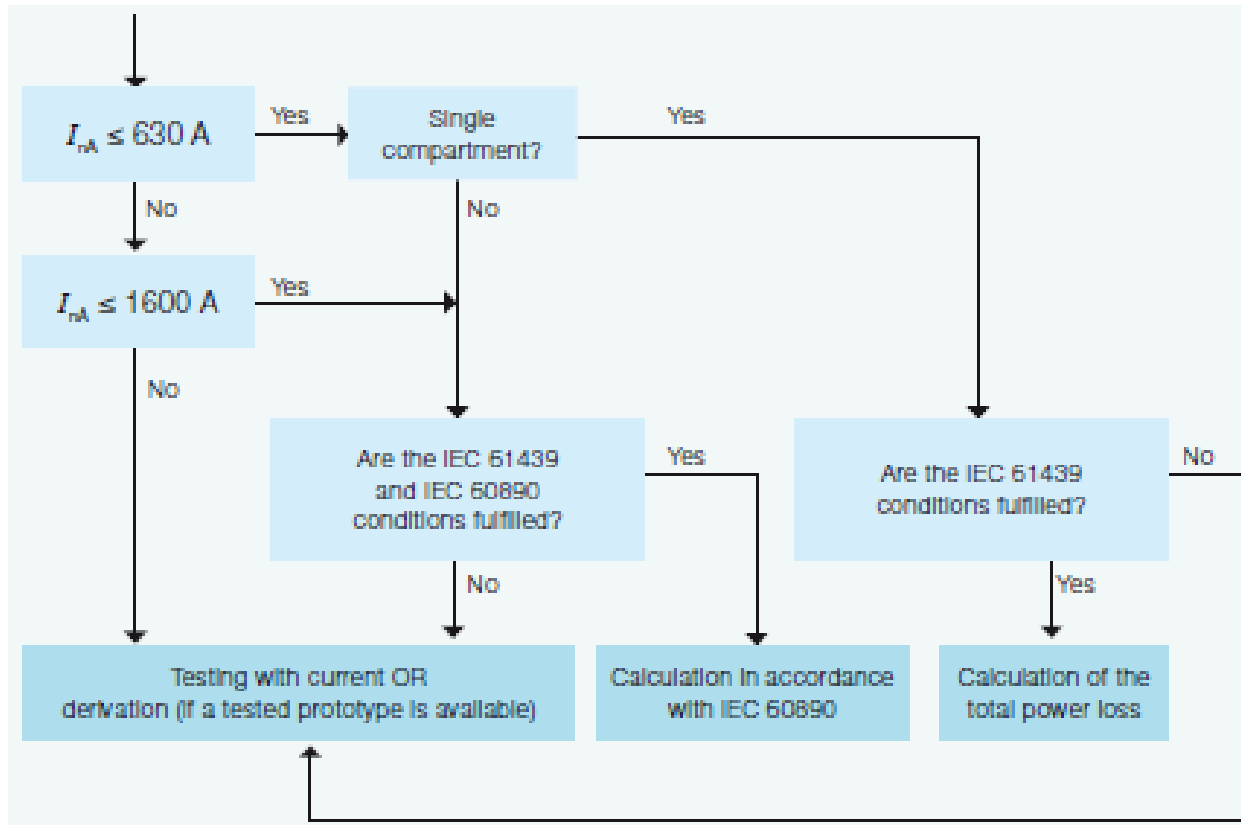
Verification shall be made by one or more of the following methods (see Annex O for guidance):

- a) testing (10.10.2);
- b) derivation (from a tested design) of ratings for similar variants (10.10.3);
- c) calculation for a single compartment ASSEMBLY not exceeding 630 A according to 10.10.4.2 or for ASSEMBLIES not exceeding 1600 A according to 10.10.4.3.

How to comply with the standards

Exemption to Verification by Testing

Temperature Rise – Clause 10.10



What is an Assembly

Enclosure

Earth Bar (protective conductor)

Incoming Devices

- Air Circuit Breakers (ACB)
- Moulded Case Circuit Breakers (MCCB)
- Isolator

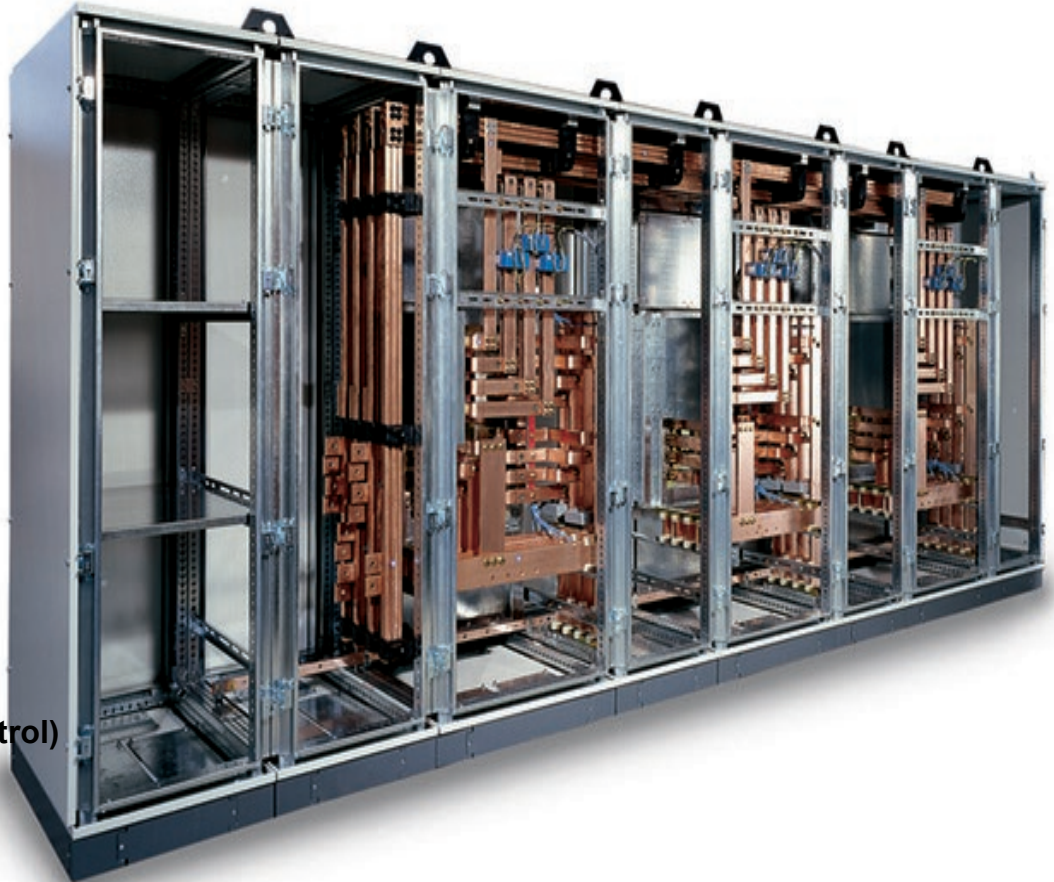
Busbars

- Main
- Distribution

Outgoing Devices

- Fused Isolators
- Moulded Case Circuit Breakers (MCCB)
- Miniature Circuit Breakers
- Additional Power Circuits (for motor control)

Auxiliary circuits (controls)



Types of Assembly

Main Boards *Logstrup System*



Types of Assembly

Main Boards *MNS- System*



Types of Assembly

Main Boards *EI-Steel System*



Construction

Strength of materials and parts

All of the characteristic require verification by test:

- Resistance to corrosion
- Resistance to ultra violet radiation
- Lifting
- Marking
- Properties of insulating materials



IK impact (IEC 62262:2002)

Construction

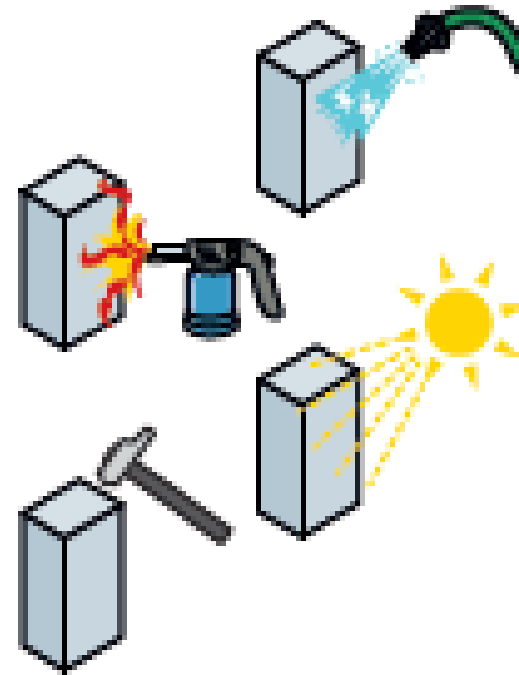
Degree of protection of enclosures IEC60529

The Ingress Protection (IP) is broken in to two elements:

- IP **XX**- Protection against solid objects
- IP **XX**- Protection against water ingress

Default arrangement minimum:

- Indoor IP2X
- Outdoor IP23



Element	Numerals or letters	Meaning for the protection of equipment	Meaning for the protection of persons	Ref.
Code letters	IP	-	-	-
First characteristic numeral	0 1 2 3 4 5 6	Against ingress of solid foreign objects (non-protected) ≥ 50 mm diameter ≥ 12,5 mm diameter ≥ 2,5 mm diameter ≥ 1,0 mm diameter dust-protected dust-tight	Against access to hazardous parts with (non-protected) back of hand finger tool wire wire	Cl. 5
Second characteristic numeral	0 1 2 3 4 5 6 7 8 9	Against ingress of water with harmful effects (non-protected) vertically dripping dripping (15° tilted) spraying splashing jetting powerful jetting temporary immersion continuous immersion High pressure and temperature water jet	-	Cl. 6
Additional letter (optional)	A B C D	-	Against access to hazardous parts with: back of hand finger tool wire	Cl. 7

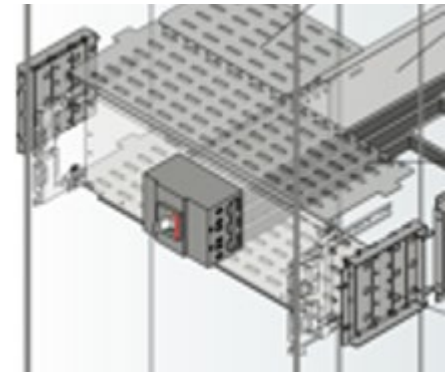
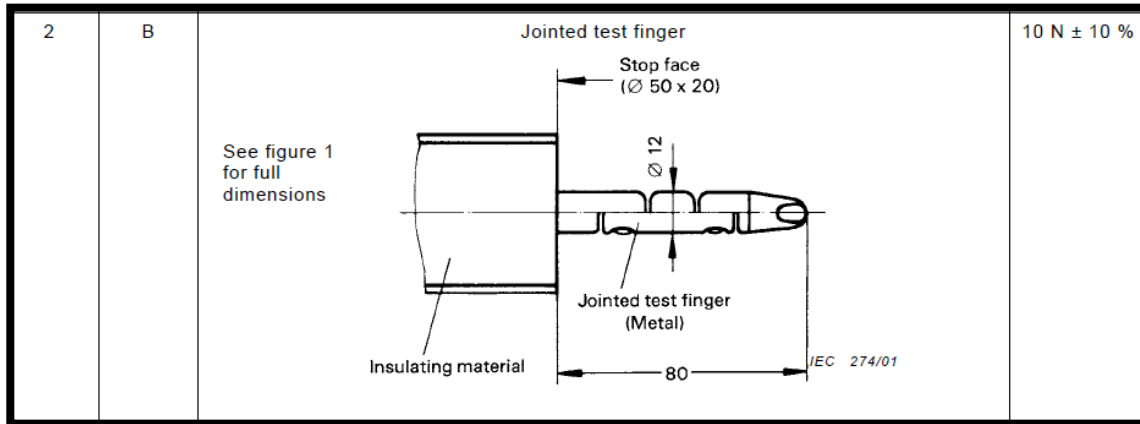
Construction

Internal Separation of PSC- Assemblies

The IEC61439 clarifies that there is a difference between constructional requirements and internal separation.

The degree of protection IP 2X covers the degree of protection IP XXB. Separation may be achieved by means of partitions or barriers (metallic or non-metallic), insulation of live parts or the integral housing of a device.

e.g. a moulded case circuit breaker. (IEC61439-2, 2020 8.101 note 2)



Forms of Separation

Low Voltage Switchgear and Control Assemblies to BS EN 61439-2 (ref; B

Fundamental Objectives

The principal reason for separating an assembly whilst other parts may remain together is that separation does not improve the electrical safety.

- Protection against contact with live parts of adjacent units,
- Protection against the passage of short-circuit currents to an adjacent unit.

The Law

Regulation 14

“No person shall be engaged in any work activity on or near

any live conductor (other than one suitably covered with

insulating material so as to prevent danger) that danger may

arise unless:-

(a) it is unreasonable in all the circumstances for it to be

dead; and

(b) it is reasonable in all the circumstances for a person to be at work on or near it while it is live; and

(c) suitable precautions (including where necessary the

provision of suitable protective equipment) are taken to

prevent injury”

Forms of Separation

The legal obligations

The Health and Safety Authority HSA Regulation 86: Precautions for work on electrical equipment states:

(1) An employer shall ensure that;

- Work activity, including the operation, use and maintenance of electrical equipment or electrical installations, is carried out in a manner that prevents danger.
- Before work is carried out on live electrical equipment the equipment is, where appropriate, made dead so as to prevent danger.
- adequate precautions are taken to prevent danger arising from—
 - (i) electrical equipment which has been made dead becoming live while work is carried out on or near that equipment, and
 - (ii) any electrical equipment inadvertently becoming live,
- where it is necessary for work to be carried out on or near any live part, other than one suitably covered with insulating material so as to prevent danger, of electrical equipment, a person is not engaged in work activity unless—
 - (i) it is unreasonable in the circumstances for it to be dead,
 - (ii) it is reasonable in the circumstances for such person to be at work on or near it while it is live, and

Forms of Separation

Main considerations

BS EN 61439-2 identifies four categories of separation. Step users should refer to the assembly. There are four categories of separation:

Isolation available for all internal operations (except changing fuse links)

Adjust setting and carry out limited maintenance

in functional units, as applicable whilst adjacent circuits are live. Connect and disconnect cables. Adjust setting and carry out limited maintenance in functional units, as applicable whilst adjacent circuits are live.

Isolation available for all internal operations (except changing fuse links)

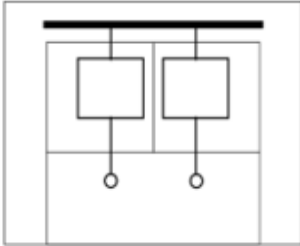
Adjust setting and carry out limited maintenance in functional units, as applicable whilst adjacent circuits are live.

FORM 1 OR 2

FORM 3

FORM 4

Forms of Separation

IEC61439-2 (IEC, 2011)	BS EN 6
 <p data-bbox="115 835 531 878">Form 3b: Terminals and external conductors separated from busbars</p>	<p data-bbox="608 806 685 863">Sepa</p> <p data-bbox="598 1099 685 1135">Form 3b</p>

- 30 -

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Form 3

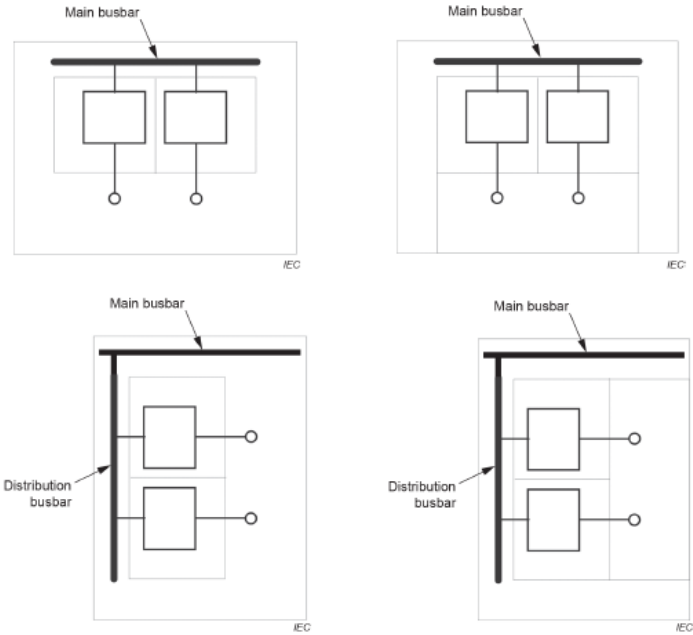
Separation of busbars from all functional units

+

Separation of all functional units from one another

+

Separation of terminals for external conductors and external conductors from the functional units, but not from the terminals of other functional units



Main busbar

Main busbar

Main busbar

Main busbar

Distribution busbar

Distribution busbar

IEC

IEC

IEC

IEC

Form 3a – Terminals for external conductors not separated from busbars

Form 3b – Terminals for external conductors and external conductors separated from busbars

Figure BB.3 – Form 3

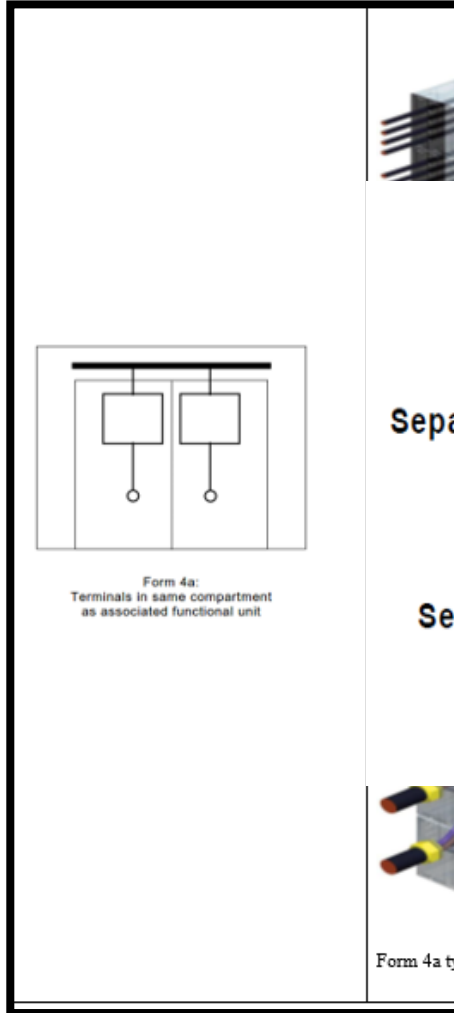
bits

other

conductors from the

nctional units

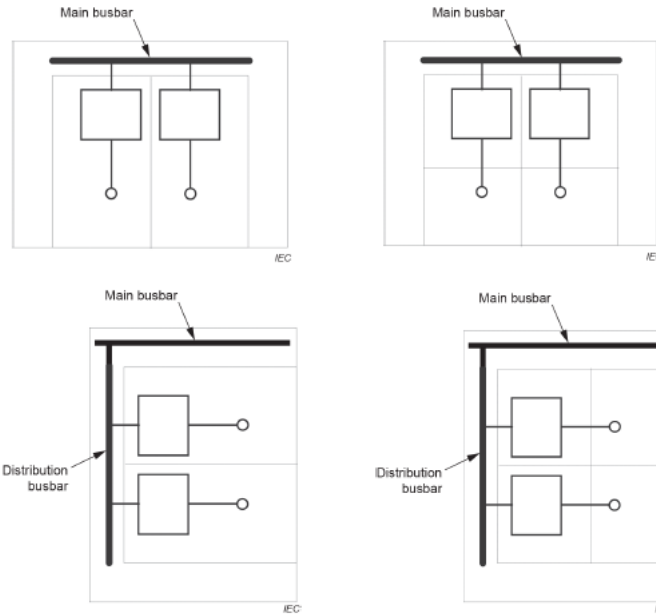
Forms of Separation



Form 4

- Separation of busbars from all functional units
- +
- Separation of all functional units from one another
- +
- Separation of terminals for external conductors associated with a functional unit from the terminals of any other functional unit and the busbars
- +
- Separation of the external conductors from the busbars
- +
- Separation of the external conductors associated with a functional unit from other functional units and their terminals

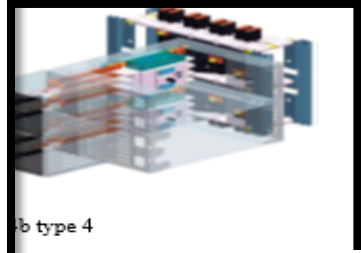
External conductors need not be separated from each other



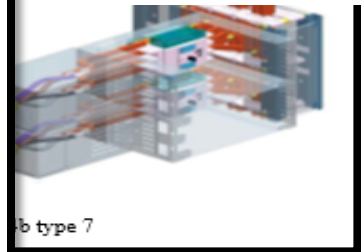
Form 4a – Terminals for external conductors in same compartment as associated functional unit

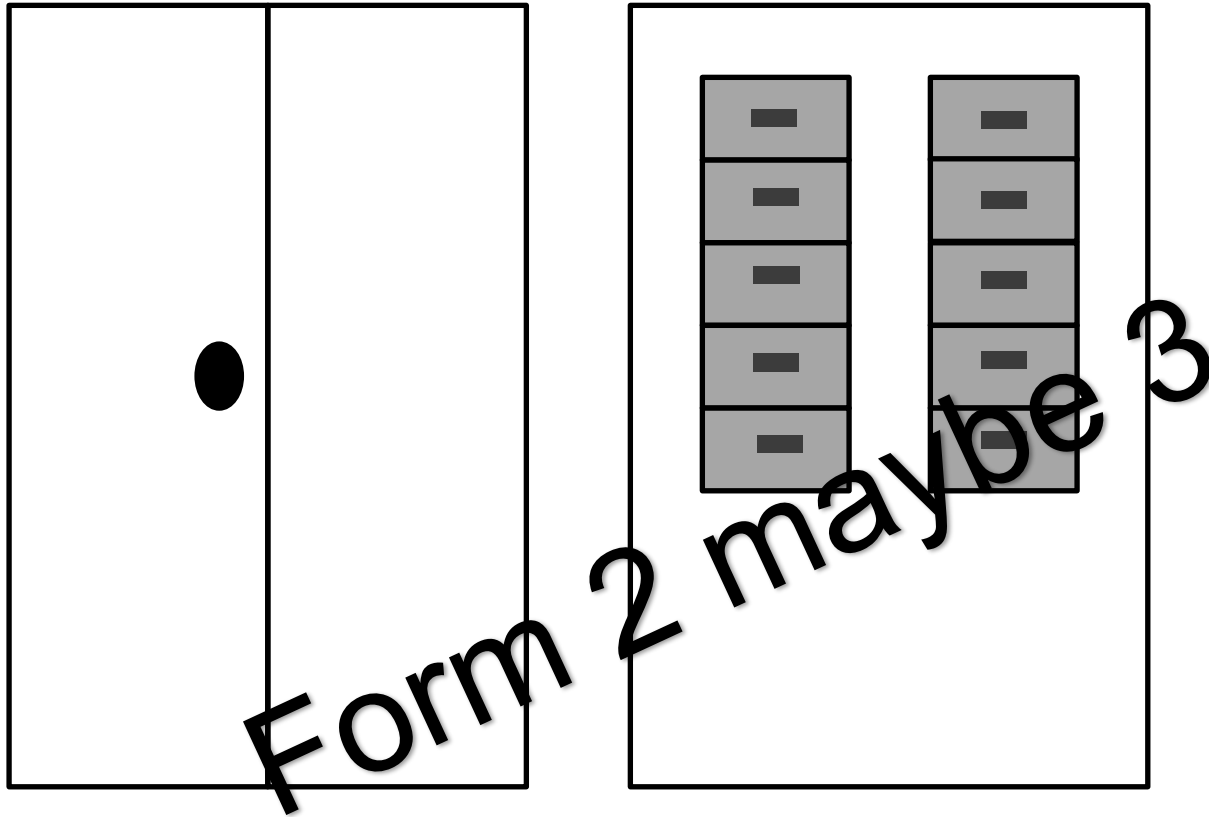
Form 4b – Terminals for external conductors not in the same compartment as the associated functional unit, but in individual, separate, enclosed protected spaces or compartments

Figure BB.4 – Form 4



al units
e another
with a functional unit from
the busbars
the busbars
functional unit from other
ls
om each other





3.1.8

functional unit

part of an assembly comprising all the electrical and mechanical elements including switching devices that contribute to the fulfilment of the same function

Form 4

•		•	
•		•	
•	■	•	■
•		•	
•		•	

Forms of Separation



Form 4

Separation of busbars from all functional units

+

Separation of all functional units from one another

+

Separation of terminals for external conductors associated with a functional unit from the terminals of any other functional unit and the busbars

+

Separation of the external conductors from the busbars

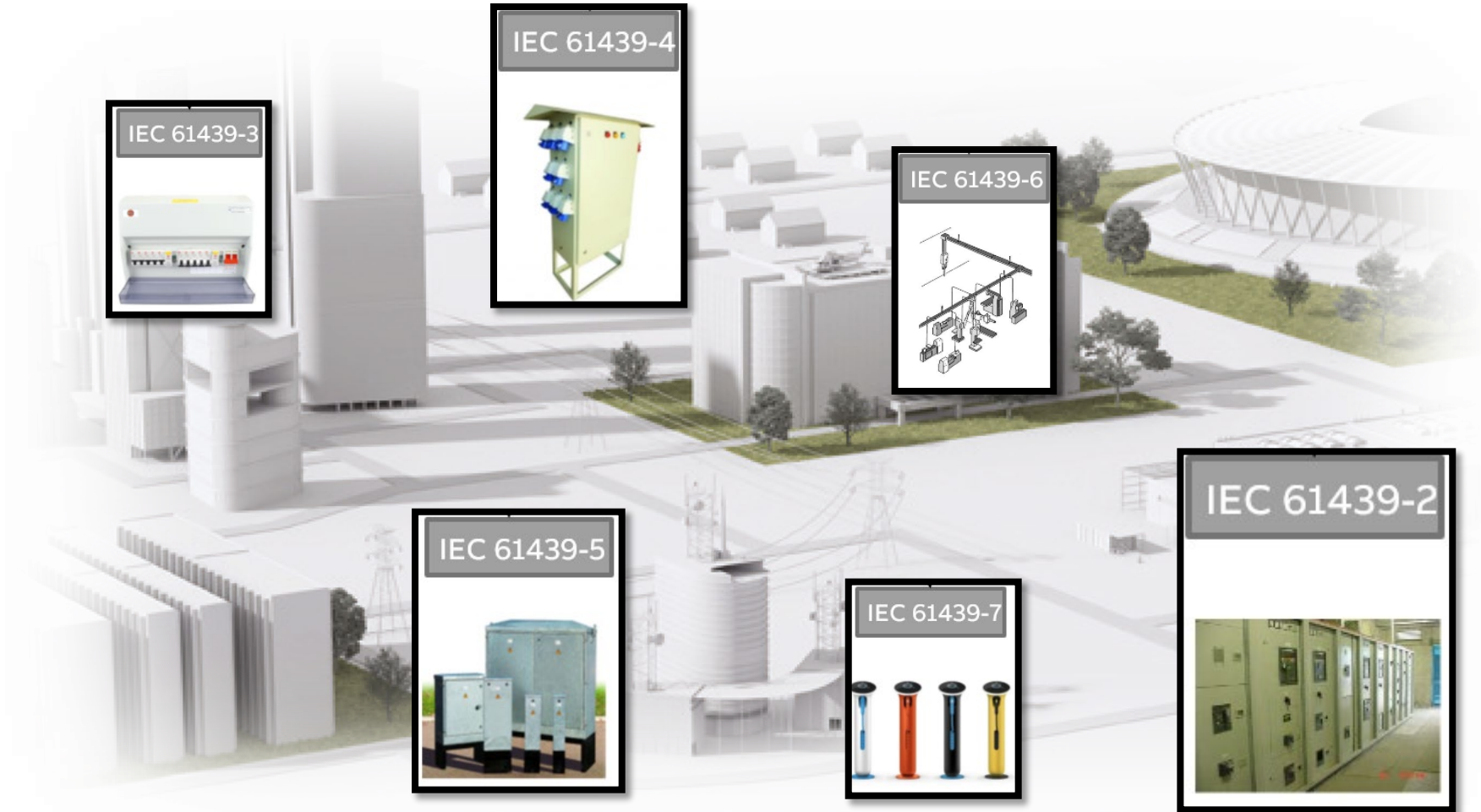
+

Separation of the external conductors associated with a functional unit from other functional units and their terminals

+

External conductors need not be separated from each other

IEC61439 to ensure a safe and reliable electrical industry



IEC 61439-1 General Rules

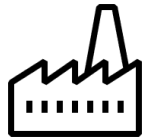
ABB in Ireland

At a glance



180

People work for ABB in Ireland



5

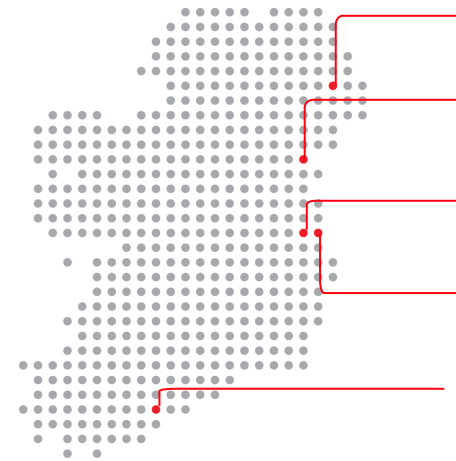
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