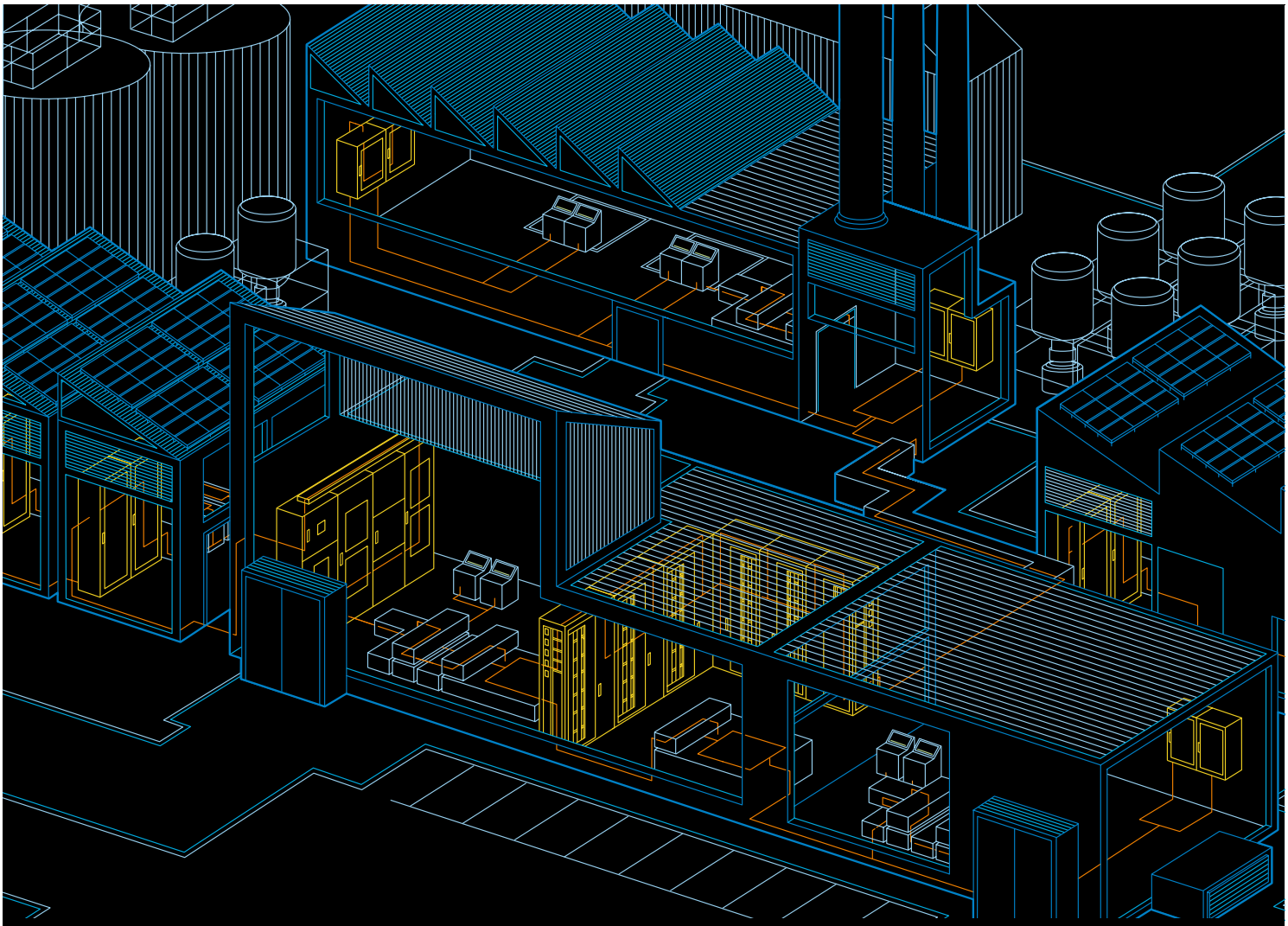

11 | 2010

IEC 61439

The new standard for low-voltage switchgear and controlgear ASSEMBLIES

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Content

Introduction

A low-voltage switchgear and controlgear assembly (ASSEMBLY) is a combination of low-voltage switching devices together with associated equipment (for controlling, measuring, signalling, etc.) complete with all the internal mechanical and electrical interconnections and structural parts. As with every component of an electrical installation, the ASSEMBLY also has to comply with its appropriate standard.

In January 2009 the IEC 61439, the new standard for low-voltage switchgear and controlgear ASSEMBLIES, was published. This was the aim of an international project group which had been working on a task named ”radical restructuring and revision of IEC 60439 series” since 1998. This initiative was introduced by several countries following dissatisfaction with the IEC 60439 series. The purpose was to harmonise and define all general requirements for low-voltage electrical ASSEMBLIES.

Reaching an agreement has proven extremely challenging, but the first parts of the new standards have been published. For each type of electrical ASSEMBLY only two parts of the standard are necessary to determine all requirements:

– the basic standard IEC 61439-1 “General rules”
– the specific ASSEMBLY standard

The aim of this guide is to allow panel builders, electrical installers, planners or purchasers to familiarise themselves with the new standards and to point out the main changes that have been introduced as well as elements that remain unchanged.

The current IEC 60439

The current IEC 60439 standard applies to enclosures for which the rated voltage is under or equal to 1000 V AC (at frequencies not exceeding 1000 Hz) or 1500 V DC. The standard makes a distinction between type-tested assemblies (TTA) and partially type-tested assemblies (PTTA).The following parts are mentioned and have equal weighting. There is not a formal hierarchy. Each part is a complete entity and can be used on an individual basis:

IEC 60439-1
type-tested and partially type-tested assemblies

IEC 60439-2
particular requirements for busbar trunking systems (busways)

IEC 60439-3
particular requirements for low-voltage switchgear and controlgear assemblies which are to be installed in locations where unskilled persons have access for their use.

IEC 60439-4
particular requirements for assemblies for construction sites (ACS)

IEC 60439-5
particular requirements for assemblies intended to be installed outdoors in public places – Cable distribution cabinets (CDCs) for power distribution in networks

The standard remains valid until 2014

The new IEC 61439

The new IEC 61439 standard applies to enclosures for which the rated voltage is under 1000 V AC (at frequencies not exceeding 1000 Hz) or 1500 V DC. The standard defines the design verified ASSEMBLIES and eliminates completely the categories TTA and PTTA. In order to conform to the standard, type tests have been replaced by a design verification which can be carried out by the three following equivalent and alternative methods: testing, calculation/measurement or application of design rules.

The following parts are mentioned and do not have equal weighting. There is a formal hierarchy. Each part can not be used individually:

- IEC 61439-1 “General rules“
- IEC 61439-2 “Power switchgear and controlgear ASSEMBLIES”
- IEC 61439-3 “Distribution boards“
- IEC 61439-4 “ASSEMBLIES for construction sites”
- IEC 61439-5 “ASSEMBLIES for power distribution”
- IEC 61439-6 “Busbar trunking systems”

Part 1 is the general rules part and cannot be used alone to specify an ASSEMBLY.

Part 2 defines the specific requirements of power switchgear and controlgear ASSEMBLIES (PSC ASSEMBLIES) and must be used with Part 1. This is the only part that has a double role, it covers PSC ASSEMBLIES and any ASSEMBLY which is not covered by any other specific parts.

Parts 3-X are still under preparation but are already mentioned in Part 1. These could be more than four, as additional parts may be developed as the need arises.

Summarising: With the currently used IEC 60439, the rule is “one part for each type of ASSEMBLY”. With the new IEC 61439 the rule is “two parts for each type of ASSEMBLY”. The compliance of an ASSEMBLY is declared referring to the specific ASSEMBLY standard (e.g. IEC 61439-2), and the compliance with the general rules (IEC 61439-1) is always implicit. The sentence “TTA switchgear according to IEC 60439-1“ is now replaced by “Power switchgear and controlgear ASSEMBLIES according to IEC 61439-2, design verified ASSEMBLY“.
The validity of the two standards will overlap until 2014 and prior to this date, ASSEMBLIES can be manufactured according to IEC 61439 or IEC 60439.

Relationship between the two standards is as shown in the table below:

IEC 61439-1 +	IEC 61439-2	replaces	IEC 60439-1 (still valid until 2014)
	IEC 61439-6	will replace	IEC 60439-2 (still valid)
	IEC 61439-3	will replace	IEC 60439-3 (still valid)
	IEC 61439-4	will replace	IEC 60439-4 (still valid)
	IEC 61439-5	will replace	IEC 60439-5 (still valid)

Main changes –
More than a single digit change…

The new IEC 61439 includes the following significant technical changes with respect to the last edition of IEC 60439.

Responsibility split:
New terms have been introduced and there is a split in product responsibility between the “Original manufacturer” (e.g. ABB, responsible for carrying out the original design and the associated verification of an ASSEMBLY) and the “ASSEMBLY manufacturer” (e.g panel builder using an ASSEMBLY system from an Original Manufacturer) assuming responsibility for the completed ASSEMBLY.

The Assembly Manufacturer may be a different organisation to the Original Manufacturer. Where the ASSEMBLY Manufacturer introduces changes to the ASSEMBLY configuration tested by the Original Manufacturer, he is deemed to be the Original Manufacturer in respect of these changes and has to carry out the design verification.

Design verification replaces TTA and PTTA categories:
Design verification replaces type tests so the discrimination between type-tested assemblies (TTA) and partially type-tested assemblies (PTTA) is eliminated.

Three different but equivalent types of verification of requirements are introduced:

Verification by testing (test made on a sample of an ASSEMBLY or on parts of ASSEMBLIES to verify that the design meets the appropriate requirements. This method is equivalent to the currently implemented type tests).

Verification by calculation/measurement (calculations applied to a sample of an ASSEMBLY or to parts of ASSEMBLIES to show that the design meets the appropriate requirements).

Verification by application of design rules (specified rule to verify the design of an ASSEMBLY).

The selection of the appropriate verification method has to be made according to annex D, which explains the available verification options for each characteristic which is to be verified, as shown in the table below:

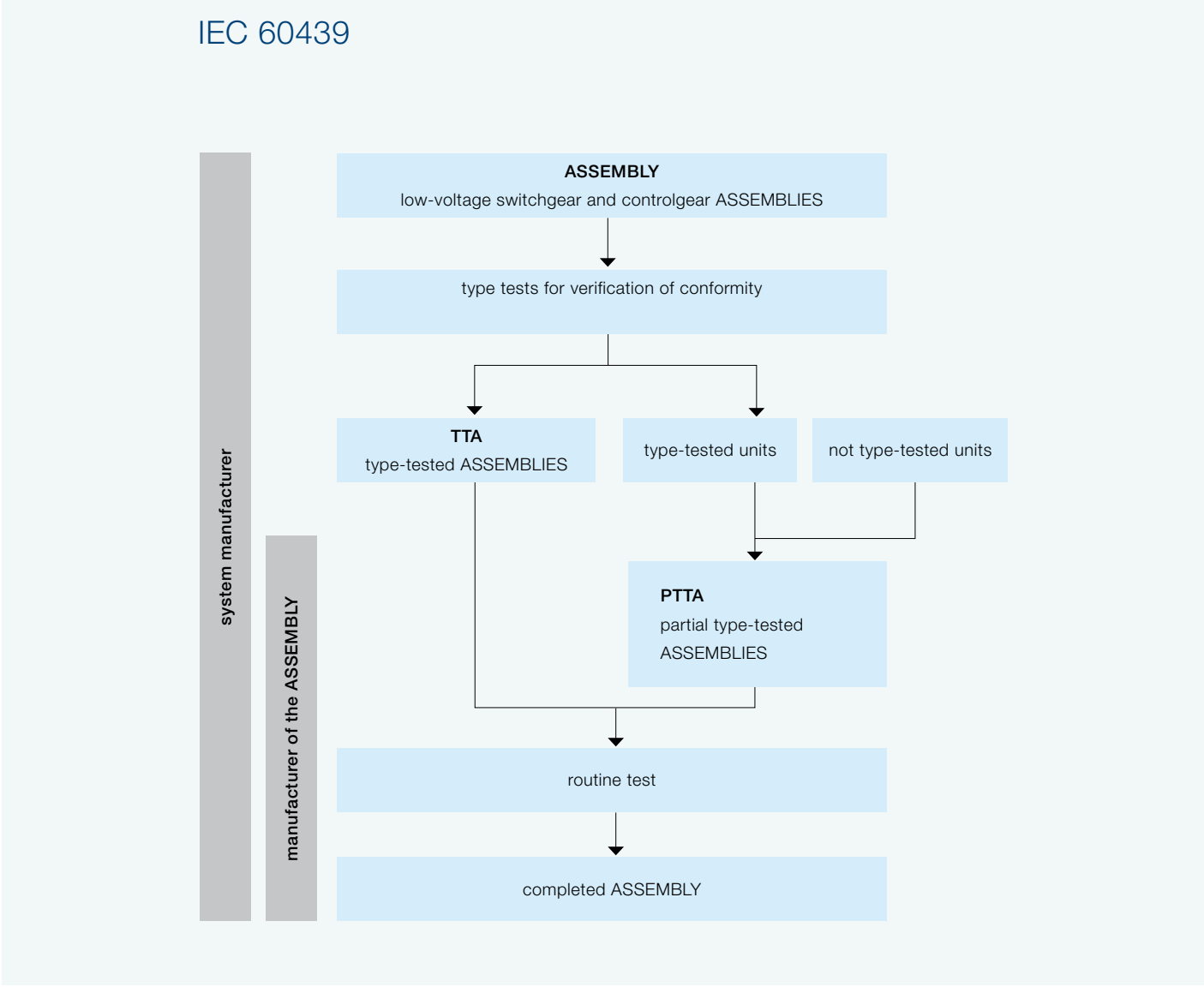
Characteristic to be verified		Verification options available		
		Verification by testing	Verification by calculation	Verification by design rules
10.2	Strength of material and parts	Yes	No	No
10.3	Degree of protection of enclosures	Yes	No	Yes
10.4	Clearances and creepage distances	Yes	Yes	Yes
10.5.2	Effective continuity between parts and PE	Yes	No	No
10.5.3	Effectiveness of the ASSEMBLY for external faults	Yes	Yes	Yes
10.6	Incorporating of apparatus	No	No	Yes
10.7	Internal electrical circuits and connections	No	No	Yes
10.8	Terminals for external conductors	No	No	Yes
10.9.2	Power frequency withstand voltage	Yes	No	No
10.9.3	Impulse withstand voltage	Yes	No	Yes
10.10	Temperature rise limits	Yes	Yes	Yes
10.11	Short-circuit withstand strength	Yes	Yes	Yes
10.12	EMC	Yes	No	Yes
10.13	Mechanical operation	Yes	No	No

Main changes –
More than a single digit change…

Tests that have been made in accordance with IEC 60439 and that fulfil the requirements of the new IEC 61439 need NOT be repeated.

The second stage verification is the routine verification. This is performed to verify that the materials and workmanship are in accordance with the requirements of the standard. Routine verification replaces the current “routine test”. It is more detailed but essentially the new requirements are the same as in the IEC 60439. This verification has to be carried out for each completed ASSEMBLY and it is the responsibility of the ASSEMBLY Manufacturer.

Comparison between the current and the new verification “flow”:

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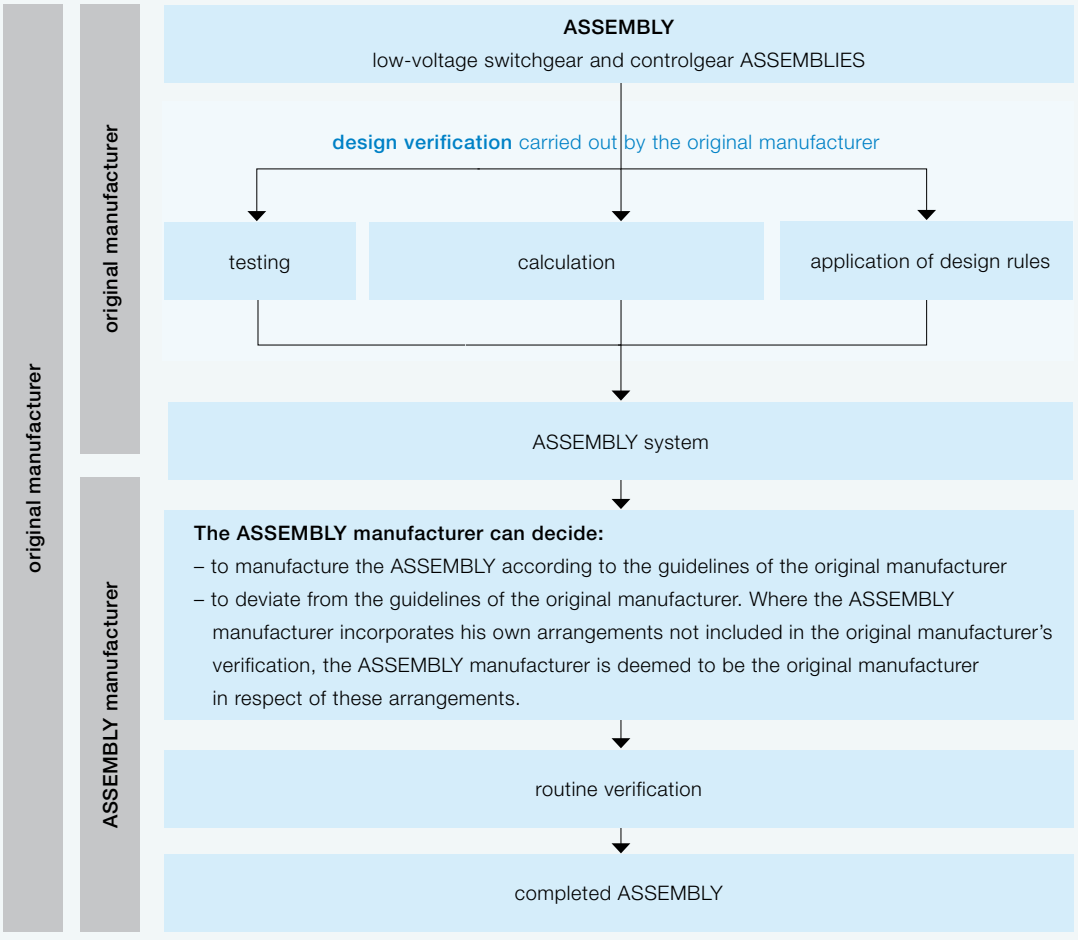

original manufacturer
original manufacturer
ASSEMBLY manufacturer
ASSEMBLY
low-voltage switchgear and controlgear ASSEMBLIES
design verification carried out by the original manufacturer
testing
calculation
application of design rules
ASSEMBLY system
The ASSEMBLY manufacturer can decide:
– to manufacture the ASSEMBLY according to the guidelines of the original manufacturer
– to deviate from the guidelines of the original manufacturer. Where the ASSEMBLY manufacturer incorporates his own arrangements not included in the original manufacturer's verification, the ASSEMBLY manufacturer is deemed to be the original manufacturer in respect of these arrangements.
routine verification
completed ASSEMBLY

Main changes –
More than a single digit change…

Additional verification:

New requirements from the standard IEC 62208 (Empty enclosures for ASSEMBLIES) have been added:

- verification of resistance to UV radiation for outdoor plastic enclosures
- verification of corrosion resistance
- mandatory declaration and confirmation of an impulse rating
- lifting, mechanical impact and marking

Other changes

Temperature rise

Temperature rise requirements have been explained more clearly and have been adapted to the state of the art.
One of the following methods is allowed for verification:

- testing with current
- derivation (from a tested design) of ratings for similar variants
- calculation

(see also "FAQ" chapter)

Tests described in IEC 61439-1 in comparison with the type tests described in IEC 60439

No.	Characteristics to be verified	Clause/Subclause	Comparable type test from 60439-1
1	**Strength of material and parts**	10.2	Not required as "Type test" but as "Design and construction" rules on paragraph 7 or on subsidiary standard
	Resistance to corrosion	10.2.2	
	Properties of insulating materials	10.2.3	
	Thermal stability	10.2.3.1	
	Resistance of insulating materials to normal heat	10.2.3.2	
	Resistance to abnormal heat and fire due to internal electric effects	10.2.3.3	
	Resistance to ultra-violet (UV) radiation	10.2.4	
	Lifting	10.2.5	
	Mechanical impact	10.2.6	
	Marking	10.2.7	
2	**Degree of protection of enclosures**	10.3	8.2.7
3	**Clearances and creepage distances**	10.4	8.2.5
4	**Protection against electric shock and integrity of protective circuits**	10.5	8.2.4
	Effective continuity between the exposed conductive parts of the ASSEMBLY and the protective circuit	10.5.2	
	Effectiveness of the ASSEMBLY for external faults	10.5.3	
5	**Incorporation of switching devices and components**	10.6	Not required as "Type test" but as "Design and construction" rules on paragraph 7 or on subsidiary standard
6	**Internal electrical circuits and connections**	10.7	
7	**Terminals for external conductors**	10.8	
8	**Dielectric properties**	10.9	8.2.2
	Power -frequency withstand voltage	10.9.2	
	Impulse withstand voltage	10.9.3	
9	**Temperature rise limits**	10.10	8.2.1
10	**Short-circuit withstand strength**	10.11	8.2.3
11	**Electromagnetic compatibility (EMC)**	10.12 + Annex J	8.2.8 + Annex H
12	**Mechanical operation**	10.13	8.2.6

RDF

The rated diversity factor is covered in more detail. In practice it is assumed that multiple functional units are not fully loaded simultaneously. **(see also "FAQ" chapter)**

Labels

Labels have to be subjected to testing to verify their legibility. The following information is required on the label:

- ASSEMBLY Manufacturer's name
- Identification number
- Date of manufacture (NEW!)
- IEC 61439-X (the specific part "X" has to be specified) (NEW!)

"Grey" areas

A number of "grey" areas have been clarified:

- neutral conductors will have a current rating equal to 50% of the corresponding phases if not otherwise specified
- agreements between Customer and Manufacturer have been more detailed, extended and listed in annex C
- it is mandatory to specify the rated current of the ASSEMBLY
- a technical report IEC 61439-0 "Guide for specifying ASSEMBLIES" is under development for a better understanding of the new standard
- questions regarding the internal form of separation have been clarified
  (e.g. a moulded case circuit breaker's casing provides separation from other functional units)

Summary table with the main changes

IEC 60439	IEC 61439
IEC 60439-1 Type-tested and partially type-tested assemblies	**IEC 61439-2** Design verified ASSEMBLIES
Mix of different rules and demands in each part	Clear structure: **IEC 61439-1** "General rules" **IEC 61439-2 … -6** "Subsidiary parts" (product standard)
Each part is a complete entity and can be used on an individual basis	**Each "subsidiary part"** is based on the "general rules" (Part 1) and includes only the specific additional rules for the specific product
Testing each type of ASSEMBLY: Partially type-tested or type-tested	**Three alternative methods for verification:** Test, calculation/measurement, design rules
Annex E: Agreements between Customer and Manufacturer	**Annex C:** Agreements between Customer and Manufacturer are more detailed and extended
	Shared responsibility: Original Manufacturer vs. ASSEMBLY Manufacturer
	Technical changes and clarifications: Diversity factor, verification of temperature rise, mechanical characteristics, neutral conductor 50%, additional verification (from IEC 62208)

Responsibilities

With regard to responsibilities, the general and obvious rule is: the manufacturer of the ASSEMBLY is responsible for the ASSEMBLY!

For a better explanation of this concept we can say: the Original Manufacturer usually makes design verifications and assumes responsibility for the proper functionality of prototype ASSEMBLIES. He provides a portfolio of verified ASSEMBLIES and each “actor” in the electrical market, who becomes the ASSEMBLY Manufacturer, can manufacture a design verified ASSEMBLY by following the instructions supplied in the Original Manufacturer´s instruction manual or catalogue; the ASSEMBLY Manufacturer assumes responsibility for the ASSEMBLY, he labels the ASSEMBLY and it is his responsibility to declare that the ASSEMBLY complies with the relevant standards. In practice he has two options:

– he decides to manufacture the ASSEMBLY according to the rules of the Original Manufacturer. In this case, the ASSEMBLY Manufacturer has to perform only the second stage verification, namely routine verification.

– he decides NOT to manufacture the ASSEMBLY according to the rules of the Original Manufacturer. In this case, the ASSEMBLY Manufacturer incorporates his own arrangements, so that he is deemed to be the Original Manufacturer. Regarding these arrangements and he must then carry out both the first and the second stage verification: design verification and routine verification.

Some hypothetical examples:

An Original Manufacturer (e.g. ABB) assembles a complete ASSEMBLY and sells it to a panel builder

– the panel builder is only the ASSEMBLY Manufacturer, if he installs the ASSEMBLY as it is.

– the panel builder is the ASSEMBLY Manufacturer and becomes the Original Manufacturer if he makes some modifications to the ASSEMBLY.

A panel builder assembles a complete ASSEMBLY (according to the rules of the Original manufacturer)

– the panelbuilder is the ASSEMBLY Manufacturer and is responsible for the ASSEMBLY, providing the electrical installer installs the ASSEMBLY without making any alterations.

A panel builder assembles a complete ASSEMBLY (according to the rules of the Original manufacturer) that has been partially assembled by an external supplier

– the panel builder is the ASSEMBLY Manufacturer and is responsible for the ASSEMBLY.

FAQ

Until what point is it possible to manufacture and to install ASSEMBLIES in accordance with IEC 60439?

The validity of the two standards will overlap until 2014 and prior to this date, ASSEMBLIES can be manufactured according to IEC 61439 or IEC 60439.

If tests on the ASSEMBLY have been conducted in accordance with IEC 60439, is it necessary to repeat them in accordance with the new IEC 61439?

No, if the conducted test results fulfil the requirements of the new IEC 61439 it is not necessary to repeat them.
It is necessary to test only the additional verification that has been introduced by the new standard.

Is it possible to manufacture an ASSEMBLY in accordance with the new IEC 61439, with enclosures from ABB, busbars from another manufacturer, circuit breakers from another manufacturer, etc.?

Yes, it is possible but it is not easy and it is expensive. The panel builder that decides to mix different "elements" from different manufacturers is not only the ASSEMBLY Manufacturer, but becomes the Original Manufacturer and has to perform both the first and the second stage verification: design verification and routine verification.

The routine verification is similar to the present routine test and is relatively straightforward. The design verification however includes some characteristics which are easily verified, and others that can only be verified through laboratory testing.

What is the Rated Diversity Factor (RDF)?

The RDF is the per unit value of the rated current, to which outgoing circuits of an ASSEMBLY can be continuously and simultaneously loaded (the mutual thermal influences have to be taken into account). It can be declared for groups of circuits or for the whole ASSEMBLY. The RDF has to be assigned by the ASSEMBLY Manufacturer (if not specified it is assumed to be equal to 1). In practice it is recognised that not all circuits in an ASSEMBLY operate at rated current continuously and this allows efficient use of materials and resources.

Is it possible to substitute a device within an ASSEMBLY? What about temperature rise and short circuit strength?

The new IEC 61439 clearly defines a device substitution in respect of temperature rise and short circuit strength.
Temperature rise: it is possible to substitute a device without repeating the design verification, provided that the new device from the same or another series has identical or better values, regarding power loss and terminal temperature rise, in comparison with those of the original device, as tested in accordance with the product standard.
Short circuit: it is possible to substitute a device without repeating the design verification, provided that the new device is identical. If different, it has to be from the same manufacturer who has to certify that it is equivalent or better with regard to all relevant short circuit characteristics.

Is the verification of the short circuit withstand strength required for all circuits of an ASSEMBLY?

No, it is not required for:

- An ASSEMBLY having a rated short-time withstand current or rated conditional short circuit current not exceeding 10 kA r.m.s.
- An ASSEMBLY protected by current-limiting devices having a cut-off current not exceeding 17 kA at the maximum permitted prospective short-circuit current at the terminals of the incoming circuit of the ASSEMBLY.
- Auxillary circuits of an ASSEMBLY 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 have to be verified.

Does the verification of temperature rise remain unchanged?

Temperature rise requirements have been explained in further detail. Three different methods are now allowed for verification (the Original Manufacturer is responsible for choosing the suitable verification methods):

1) Testing with current:

Three different test methods are permitted and the Original Manufacturer has to determine the best method. When a number of variants of an ASSEMBLY have to be verified, the most onerous configuration has to be tested and the ratings of the less onerous (and similar) variants can be derived without testing.

2) Derivation:

(from a tested design) of ratings for similar variants

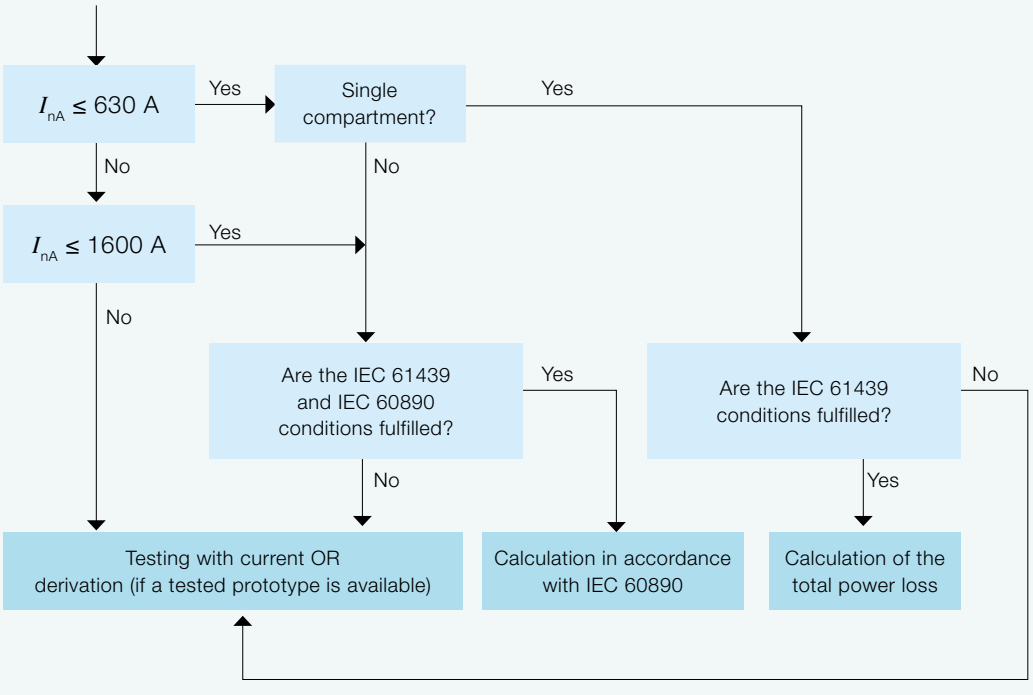
The standard defines a series of sub-clauses that help define, how non-tested variants can be verified by derivation from similar arrangements verified by test.

3) Calculation:

two calculation methods are allowed

- Single compartment ASSEMBLY with rated current not exceeding 630 A (done by calculating the total power loss of the ASSEMBLY if certain conditions are fulfilled).
- Multiple compartment ASSEMBLY with rated current not exceeding 1600 A (done by calculation in accordance with the method of IEC 60890 if certain conditions are fulfilled).

Flow chart to establish how to verify the temperature rise

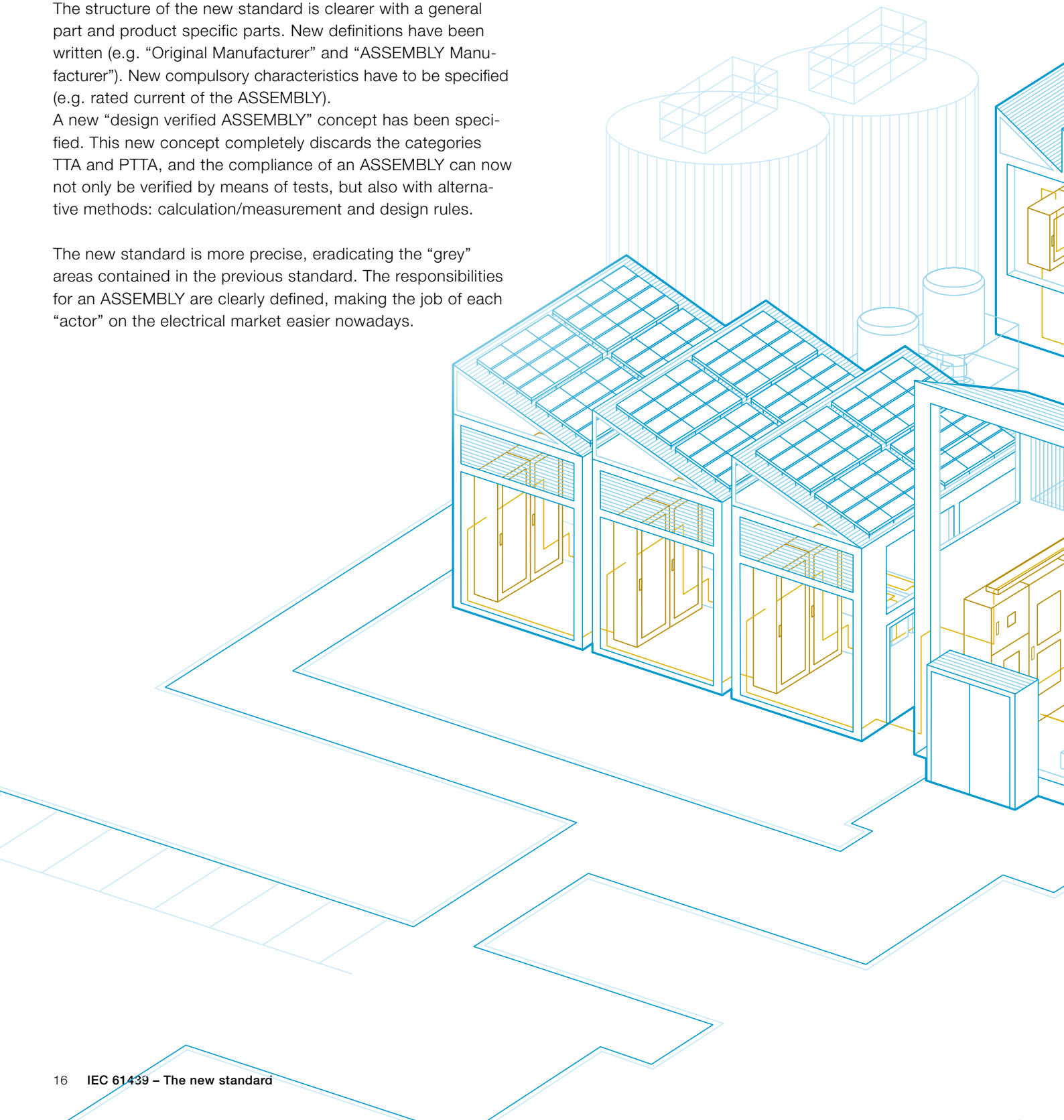


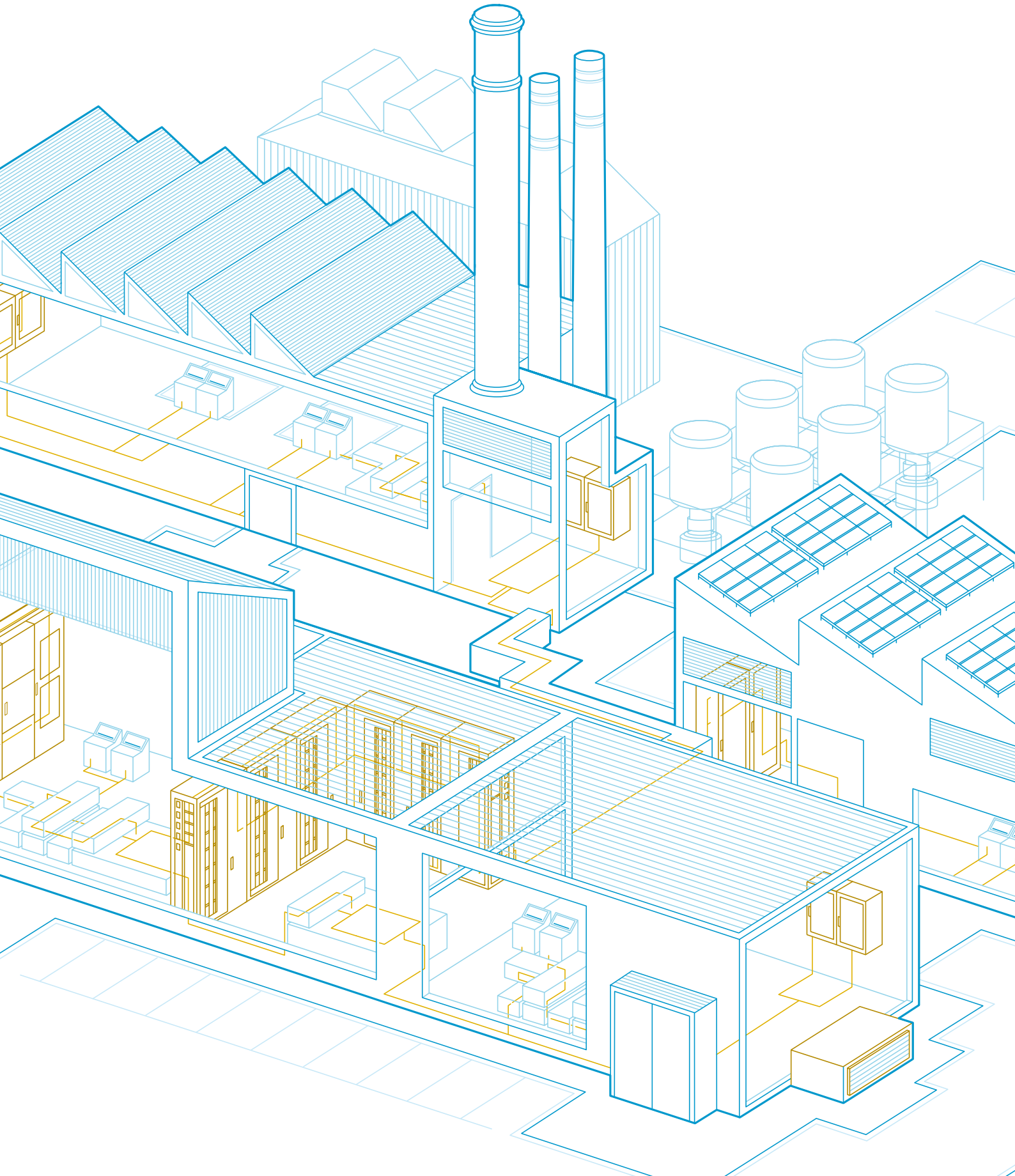
Summary and conclusion

The new standard IEC 61439 introduces important modifications in comparison with the current standard IEC 60439 on low-voltage switchgear and controlgear ASSEMBLIES.

The structure of the new standard is clearer with a general part and product specific parts. New definitions have been written (e.g. “Original Manufacturer” and “ASSEMBLY Manufacturer”). New compulsory characteristics have to be specified (e.g. rated current of the ASSEMBLY).
A new “design verified ASSEMBLY” concept has been specified. This new concept completely discards the categories TTA and PTTA, and the compliance of an ASSEMBLY can now not only be verified by means of tests, but also with alternative methods: calculation/measurement and design rules.

The new standard is more precise, eradicating the “grey” areas contained in the previous standard. The responsibilities for an ASSEMBLY are clearly defined, making the job of each “actor” on the electrical market easier nowadays.





Notes

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