

The new IEC 61439 series,

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1-1. Market Situation Today

- Grey area between type tested (TTA) and partially type tested assemblies (PTTA);
- In case of PTTA, it is difficult to check compliance with IEC 60439;
- Many PTTA assemblies put on the market that do not comply with the standard;
- Manufacturers who have tested and are complying to the IEC 60439 are unable to compete with these non-complying assemblies;
- Many manufacturers request partial type tests. It seems that many end customers accept this, but is it sufficient?

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1-2. Objectives of the new standard

- Align the structure of the IEC 60439 series with the structure of the IEC 60947 series;
- Delete PTTA and TTA and define clear ways for verification based upon design rules, calculations as well as tests;
- Final objective: limit the extend of assemblies on the market not complying with IEC 61439 by
 - always requiring **full verification of the design of all assemblies**;
 - while permitting **flexibility of whether to actually conduct a test or use another method of verification** as specified in the standard.

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Part 2: The new IEC 61439 standard

1. Short history of restructuring the IEC 60439 standard
2. The new structure
3. Main technical changes
4. Coexistence with IEC 60439 series

2-1. History of restructuring activity

- SC 17D MT11 started more than 10 years ago the restructuring of the IEC 60439 series;
- Several countries have used this opportunity to do a complete review of the IEC 60439 series, bringing in numerous new and country specific demands
- Finally the 3rd CDV (last attempt) was accepted during 2008
- No FDIS (Final Draft International Standard), directly go for IS.
- IEC 61439-1 and -2 published January 2009

2-2. Structure of new IEC 61439 series

- IEC 61439-0: Guide for specifying assemblies
 - A specifier's guide made to improve the usability of the standard for specification purposes
- IEC 61439-1: General rules
- IEC 61439-2: Power switchgear and control gear 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

Chapters of IEC 61439-1

- 1. Scope
- 2. Normative references
- 3. Terms and definitions
- 4. Symbols and abbreviations
- 5. Interface characteristics
- 6. Information
- 7. Service conditions
- 8. Constructional requirements (old: design and construction)
- 9. Performance requirements (old: design and construction)
- 10. Design verification (old: test specifications)
- 11. Routine verification (old: test specifications)

Summary of main changes in the standard

- the discrimination between type-tested assemblies (TTA) and partially type-tested assemblies (PTTA) is eliminated by the verification approach
- three different but equivalent types of verification of requirements are introduced: verification by testing, verification by calculation/measurement, or verification by satisfying design rules.
- the requirements regarding temperature rise have been clarified
- the rated diversity factor (RDF) is covered in more detail, examples
- requirements from the standard for empty enclosures for assemblies (IEC 62208) have been incorporated
- the whole structure of the standard is aligned with its new function as “general rules” standard

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Part 3. Examples of changes

- [Separate constructional and performance requirements](#)
- [Elimination of PTTA and TTA by introduction of equal and alternative methods to type testing for the verification of the design of assemblies.](#)
- Other like:
 - Dielectric test voltage requirements aligned with IEC 60947 series
 -

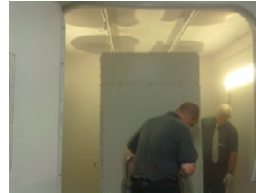
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Structure changes - details

Separate constructional and performance requirements

- Constructional requirements in chapter 8 (aligned with IEC 62208):
 - Strength of materials and parts
 - Degree of protection
 - Clearances and creepage distances
 - Protection against electric shock, etc.

- Performance requirements in chapter 9:
 - Dielectric properties
 - Temperature rise limits
 - Short-circuit protection and short-circuit withstand strength
 - Electromagnetic compatibility (EMC)



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Technical Changes – details on test approach

- Elimination of TTA and PTTA by introduction of equal and alternative methods to type testing for the verification of the design of assemblies
- How to determine if variants of tested systems comply to the standard:
 - 1. Verification test
 - 2. Verification comparison (with a tested reference design)
 - Checklist
 - Calculation
 - 3. Verification assessment
 - Design rule
 - Calculation

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Temperature Rise Testing

- The temperature rise section has changed most compared to the previous standard.



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Temperature Rise Testing

- The standard clarifies that also modifications on type tested panels shall be proven to comply with the standard;
- Future modifications (extensions/ enhancements) on type tested panels can be covered **by including additional power dissipation in the type tests.**



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Verification of temperature rise

Verification of the panel can be done

1. By [derivation](#) (e.g. using design rules wrt a tested design) of ratings for similar variants
2. On the basis of power loss [calculations](#) in accordance with temperature rise data provided by the enclosure manufacturer or by IEC 60890;
3. On the basis of [tests](#) for a specific arrangement of an assembly.

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Derivation from a tested design

- The standard specifies under specified restrictions this can be done:
 - the functional units shall belong to the same group as the functional unit selected for test
 - the same type of construction;
 - the same or increased overall dimensions;
 - the same or increased cooling conditions
 - the same or reduced internal separation
 - the same or reduced power losses in the same section
 - the same or reduced number of outgoing circuits for every section.

Verification of temperature rise

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Calculation method (1/3)

- Determine the approximate air temperature rise inside the enclosure, which is caused by the power losses of all circuits, and compare this temperature with the limits for the installed equipment.
- Because the actual local temperatures of the current-carrying parts cannot be calculated by these methods, some limits and/or safety margins are necessary and are included:
 - the rated current of the circuits of the ASSEMBLY shall not exceed 80 % of the rated conventional free air thermal current (*I*_{th}) of the components in the circuit.
 - conductors shall have a minimum cross section
 - even distribution of power loss

Calculation method (2/3)

- Method 1 (single compartment ASSEMBLY with the total supply current not exceeding 630 A):
The temperature rise within the ASSEMBLY is determined from the total power loss as provided by data from the enclosure manufacturer or by test.
- Method 2 (multiple compartment ASSEMBLY with the total supply current not exceeding 1 600 A):
by calculation in accordance with the method of IEC 60890
- For ASSEMBLIES above 1600 A calculation is not allowed!

Calculation method (3/3)

- The standards states the restrictions under which these methods may be applied.
- The restriction to allow only 80 % of the rated current of the electrical components and switching devices could lead to the situation that manufacturers still test to get better specifications.

Verification of temperature rise

Verification of the panel can be done

1. By [derivation](#) (e.g. using design rules wrt a tested design) of ratings for similar variants
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Real measurements (1/2)

- If the ASSEMBLY to be verified comprises a number of variants, the most onerous arrangements) of the ASSEMBLY shall be selected

- The standard helps you to
 - select the representative arrangement for a modular system type assembly (busbars, functional units etc) that shall be tested
 - Establish the rated current for similar non tested variants by using the derivation rules on the tested variant

Real measurements (2/2)

- The ASSEMBLY shall be verified by one of the following methods,
 - a) considering individual functional units, the main and distribution busbars and the ASSEMBLY collectively
 - b) considering individual functional units separately and the complete ASSEMBLY including the main and distribution busbars
 - c) considering individual functional units and the main and distribution busbars separately as well as the complete ASSEMBLY

Short circuit ratings

- Short circuit ratings can be verified by:
 - Testing
 - Checklist
 - Calculations

- Assessment of the rated short-time withstand current of an ASSEMBLY and its circuits, by calculation and the application of checklist, shall be undertaken by a comparison of the ASSEMBLY to be assessed with an ASSEMBLY already verified by test



Short circuit check list

Table 13 – Short-circuit verification by design rules: check list

Item No.	Requirements to be considered	YES	NO
1	Is the short-circuit withstand rating of each circuit of the ASSEMBLY to be assessed, less than or equal to, that of the reference design?		
2	Is the cross sectional dimensions of the busbars and connections of each circuit of the ASSEMBLY to be assessed, greater than or equal to, those of the reference design?		
3	Is the spacing of the busbars and connections of each circuit of the ASSEMBLY to be assessed, greater than or equal to, those of the reference design?		
4	Are the busbar supports of each circuit of the ASSEMBLY to be assessed of the same type, shape and material and have the same or smaller spacing, along the length of the busbar as the reference design?		
5	Are the materials and the material properties of the conductors of each circuit of the ASSEMBLY to be assessed the same as those of the reference design?		
6	Are the short-circuit protective devices of each circuit of the ASSEMBLY to be assessed equivalent, that is of the same make and series ^{a)} with the same or better limitation characteristics (I_{cu} , I_{cs}) based on the device manufacturer's data, and with the same arrangement as the reference design?		
7	Is the length of unprotected live conductors, in accordance with 8.3.4, of each non-protected circuit of the ASSEMBLY to be assessed less than or equal to those of the reference design?		
8	If the ASSEMBLY to be assessed includes an enclosure, did the reference design include an enclosure when verified by test?		
9	Is the enclosure of the ASSEMBLY to be assessed of the same design, type and have at least the same dimensions to that of the reference design?		
10	Are the compartments of each circuit of the ASSEMBLY to be assessed of the same mechanical design and at least the same dimensions as those of the reference design?		

^{a)} 'YES' to all requirements – no further verification required.
^{b)} 'NO' to any one requirement – further verification is required, see 10.11.1 and 10.11.5.

^{a)} Short-circuit protective devices of the same manufacture but of a different series may be considered equivalent where the device manufacturer declares the performance characteristics to be the same or better in all relevant respects to the series used for verification, e.g. breaking capacity and limitation characteristics (I_{cu} , I_{cs}) and critical distance.

Arcing

- IEC/TR 61641 Technical report on internal arcing
- Will not be included in IEC 61439 series



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Co-existence of IEC 60439 and IEC 61439 series

- IEC 61439-1 and IEC 61439-2 are published today and 2nd edition is expected in 2011
- New standards for Busways, Distribution boards etc. still under development by other MT's to align with new structure:
 - IEC 61439-3: CDV being circulated. Publication expected 2011
 - IEC 61439-4: Publication expected 2012 and aligned with 2nd edition of part 1.
 - IEC 61439-5: Publication expected 2011-05
 - IEC 61439-6: Publication expected in 2011 and aligned with 2nd edition of part 1.
- IEC 60439-1 will still be valid until all IEC 60439 standards are updated.
- IEC 62208 ed 2 (empty enclosures): Publication expected 2011-06

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Part 4: Conclusions

- Conclusions (Pro's)
- Conclusions (Con's)
- Future work

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Conclusions (Pro's)

- New IEC 61439 series with clearer guidelines and verifications for non-tested assemblies can improve the current situation and give a stronger position on the market.
- Overall it will lead to more assemblies complying and improving the overall safety situation



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Conclusions (Con's)

- Full type tests may become costly for large products or product families.
 - Testing individual functional units for temperature rise?
 - Due to the increase in number of tests, will manufacturers and/or end users ask for full type test or only require specific clauses to be tested (economies of scale)?



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Discussions in MT11

- Consequences of device substitution
 - Under which conditions is exchange of components for temperature rise or short circuit allowed?
- Temperature rise issues:
 - Higher environmental temperatures

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Device substitution (general)

- Assembly manufacturers want to replace older devices with new devices because:
 - Older model not available
 - Cost reduction of assembly
 - Create flexibility in use of components
 - Etc.
- Test houses require retesting based upon test experiences (you cannot simply substitute a breaker by another one if the specifications are the same) due to:
 - Different temperature rise characteristics of components
 - Short circuit characteristics are different
 - Breaking characteristics (I_{2t} values, pressure)
 - Constructional differences
- Currently the new standard gives some guidelines, but it still gives not sufficient information under which conditions substitution is allowed.

Device substitution (Current status)

- The current edition of IEC 61439-1 states requirements wrt to device substitution:
 - Temperature rise substitution:
 - Requirements stated in paragraph 10.10.3.5 (similar device from other series with lower power loss and terminal temperature rise)
 - Short circuit substitution:
 - declaration by manufacturer (under conditions of table 13)
- Assembly manufacturers do not want to be dependent upon component manufacturers when choosing substitutes.
- CDV of 2nd edition received many comments wrt device substitution
- Big steps in IEC 61439-1 cannot be taken without involvement of 17B committees, which are responsible for component standards
 - The 61439-1 standard may impose new requirements on the component standards for device substitution
 - New requirements in assembly standard, which are not accepted by component standards, would make assembly standard requirements useless.

- Initiation of joint working group 17B and 17D in 2009
 - Determine how best to address device substitution in SC 17 D assemblies, in particular regarding temperature rise and short-circuit behaviour **for existing and for new assemblies**".
 - 3 meetings took place leading to recommendations for temperature rise
- No changes in 2nd edition of the IEC 61439-1 with respect to device substitution until conclusions are drawn from the JWG

What are the substitution issues for temperature rise?

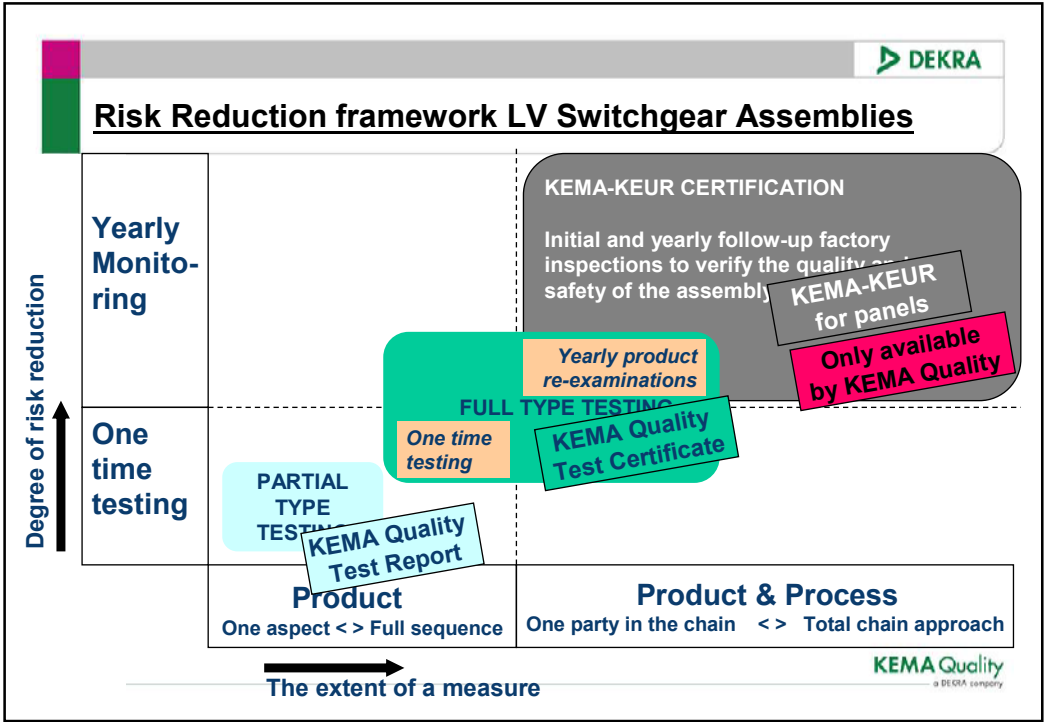
- Power loss of components
 - Currently manufacturers do not commonly provide this info
- Absolute terminal temperature rise
 - Data is not always known
- Design of breakers
- Mounting arrangements shall be the same
- Connection/cross section shall be the same or better

What are the substitution issues for short circuit testing?

- If substitution is allowed for short circuit at least the following issues shall be addressed by requirements:
 - Short circuit ratings shall be equal or better than assembly ratings
 - I^2t and peak current
 - Pressure during breaking operation
 - Coordination between devices
 - Arcing (due to ionized gases, characteristics of assembly etc)
 - Safety spacing

What next?

- Recommendations are made by JWG for temperature rise and are distributed for comments by 17 B and 17D members
- Currently no recommendations available for short circuit behaviour
- Recommendations are not in time for inclusion in 2nd edition of standard
- next meeting of JWG in march 2011
- To summarize, current requirements in edition 1 will not be modified now and may not be sufficient to allow device substitution.



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