

**SIEMENS**

# Explanations on the Concept of IEC61439

Fit for the Future with SIVACON!



# Explanations on the Concept of IEC61439

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# Explanations on the Concept of IEC61439

## Milestones in the development of the switchgear and controlgear standards:

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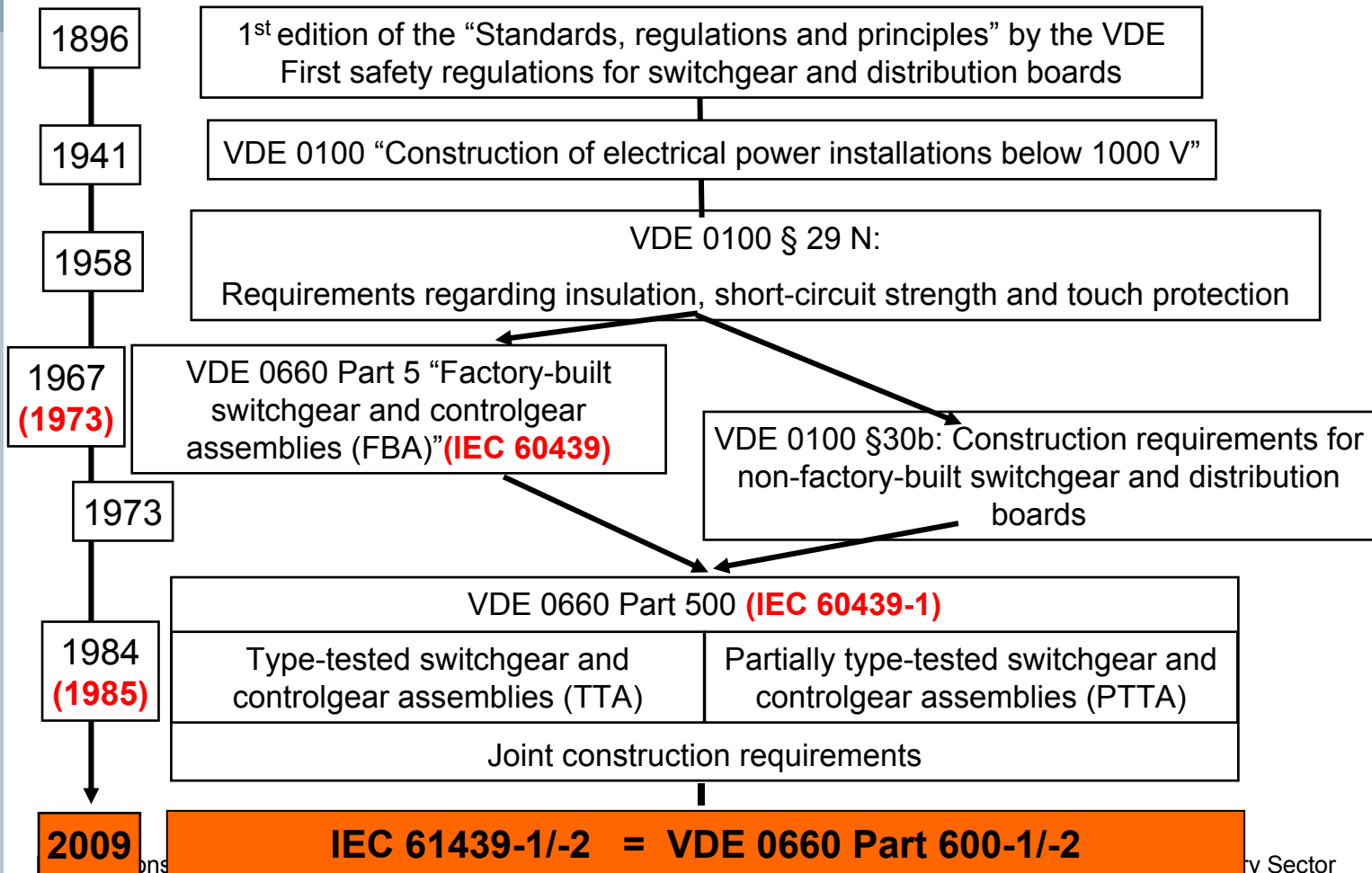
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## Reasons for the radical revision and restructuring:

### Criticism on the standards series IEC 60439

1998: New work item proposal 17D/205/NP by the British National Committee: "Radical restructuring and revision of the IEC 60439 series of standards"

- The standards are difficult to understand and apply
  - Gray areas allow for subjective interpretations
  - Poorly structured contents
- TTA/PTTA dilemma:
  - Misinterpretation of categories
  - Limited applicability
  - Classification does not bear any benefits for end customers
- IEC 60439 Part 1 assumes a double function:
  - Product standard &
  - General requirements for all other standards of the series
- The standards are not complied with by some manufacturers and in certain market segments

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## Changes:



- Division of the IEC 60439-1 into a general part and product standards
- Abolition of the categories “TTA” and “PTTA”
- Alternative, but equivalent verification methods for switchgear and controlgear assemblies
- Introduction of the “black box” concept for interface definition
- Product responsibility – divided verification responsibilities
- Interface characteristics – terms, definitions
- Construction and behavior requirements
- Design verification

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## Overview of the standards series IEC61439

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<i>New standard</i>	Replaced standard	Year of publication
▪ IEC 61439-1: General Rules	IEC60439-1	01/2009
▪ IEC 61439-2: Power switchgear & controlgear assemblies	IEC60439-1	01/2009
▪ IEC 61439-3: Distribution boards	IEC60439-3	ca.12/2010
▪ IEC 61439-4: Assemblies for construction sites	IEC60439-4	ca. 2012?
▪ IEC 61439-5: Assemblies for power distribution	IEC60439-5	ca. 05/2011
▪ IEC 61439-6: Busbar trunking systems	IEC60439-2	ca. 07/2011
▪ IEC/TR 61439-0: Requirements manual for low-voltage switchgear and controlgear assemblies ("Specifier's Guide")	None	ca. 2010

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## IEC 61439-1 Ed.1: Low-voltage switchgear and controlgear assemblies Part 1: General rules

VDE 0660-600-1: Low-voltage switchgear and controlgear assemblies  
Part 1: General rules



- Collection of general requirements
- Without reference to a specific product group
- The requirements laid down in Part 1 are only applicable if they are referred to in the respective product standard
- The applicable product standard for switchgear previously constructed in accordance with IEC 60439-1 is now IEC 61439-2

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The concept, classification and the terms TTA and PTTA were abolished in favor of “design-verified switchgear and controlgear assemblies”.



**Design-verified switchgear and controlgear assemblies**

**For customers, only the verification of the product's suitability for its intended application is important.  
No further classification is required.**

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The manufacturer is responsible for selecting the approved alternatives for verifying compliance with the standard.

**Design verification through:**

(replaces and extends “type test”)

**Test**

**Calculation**

**Verification of compliance  
with design rules**

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**Required proof for verifying the suitability of switchgear and controlgear assemblies in accordance with IEC61439**

**Before: IEC 60439-1  
TTA  
+  
routine test**



**SIVACON**

**New: IEC 61439-1  
design verification  
+  
routine verification**



**SIVACON**

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## Product responsibility – divided verification responsibilities

Terms:

### “Original manufacturer”

- Company which developed a switchgear system
  - “The organization that has carried out the original design and the associated verification of an ASSEMBLY in accordance with the relevant ASSEMBLY standard”

### “Assembly manufacturer”

- Manufacturer using the switchgear system, e.g. user of a KIT-system, franchise partner, etc.
  - “The organization taking the responsibility for the completed ASSEMBLY”
  - The manufacturer of the switchgear and controlgear assembly is always responsible for the routine verification!

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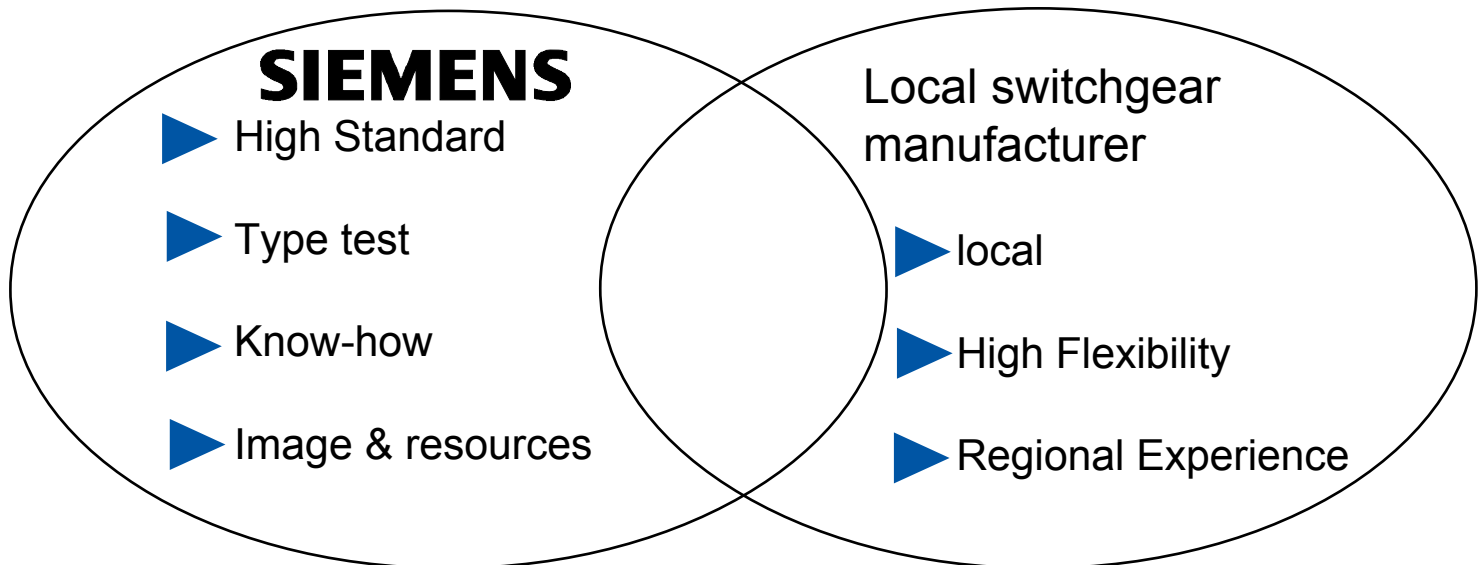
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## Example SIVACON:

“Original manufacturer”



“assembly manufacturer”



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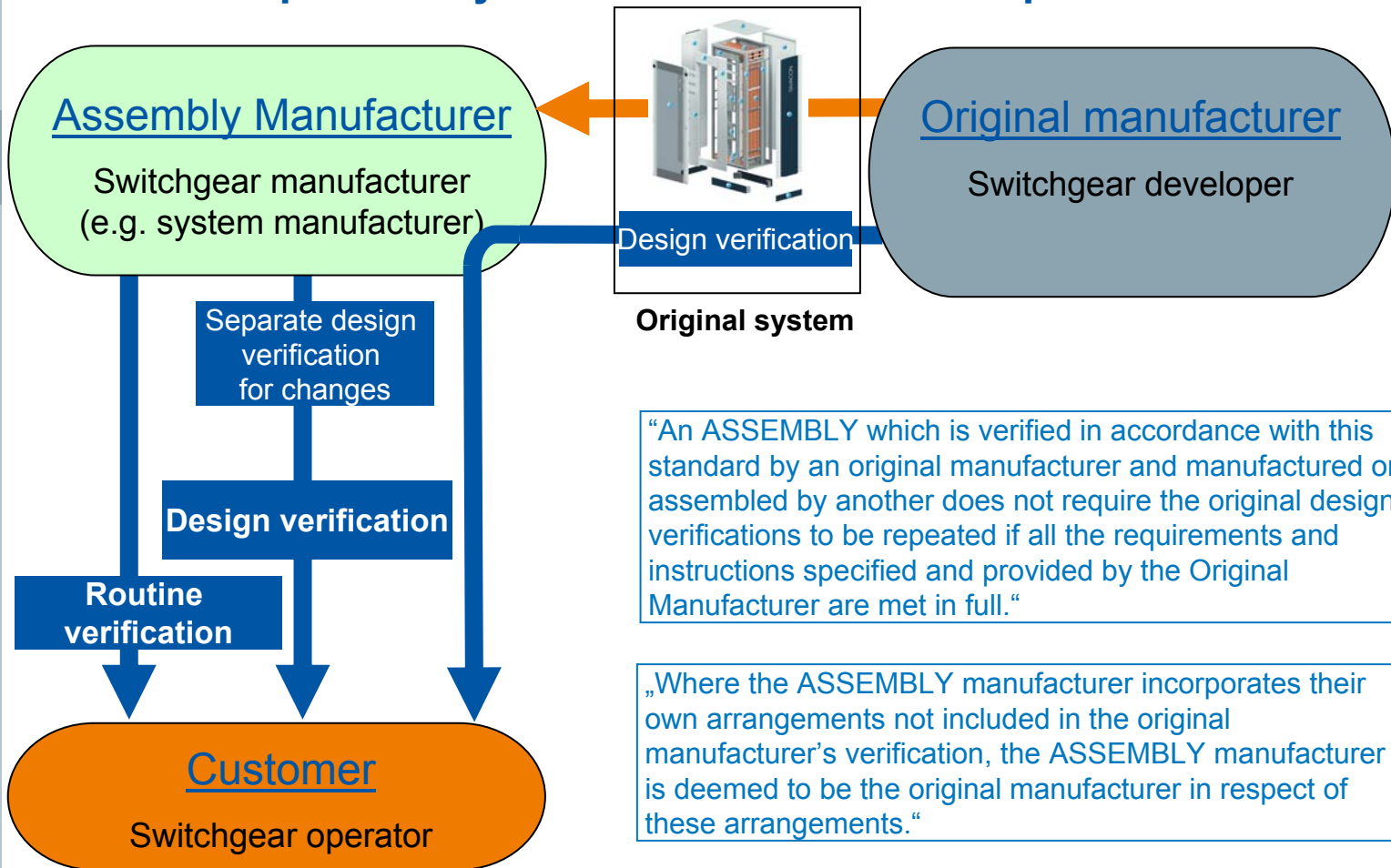
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## Product responsibility – divided verification responsibilities



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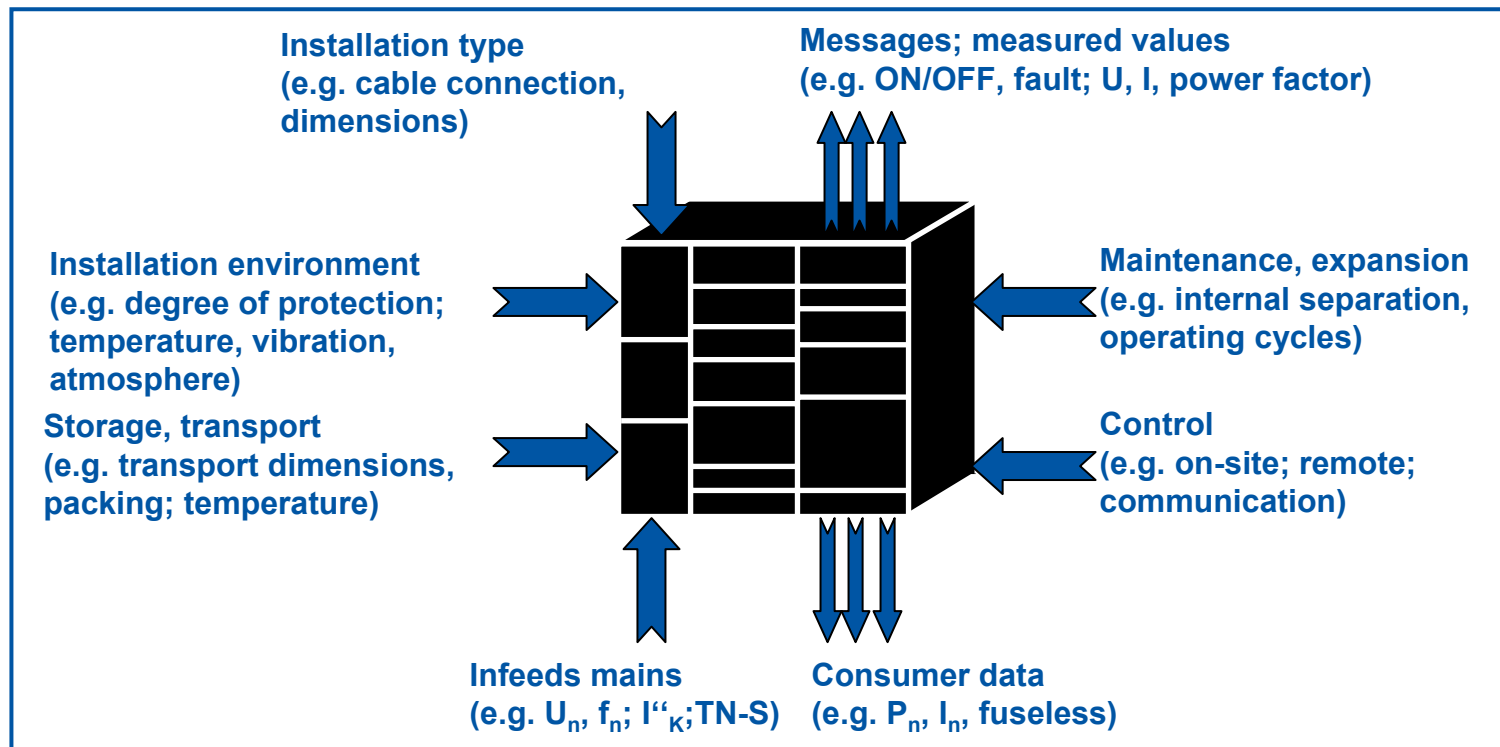
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## Introduction of the “black box” concept for interface definition

- The customer is to specify the “system characteristics” important for the application
- The manufacturer is responsible for the solution’s design



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## Introduction of the “black box” concept for interface definition

- The concept is supported by the “Specifier’s Guide” (IEC/TR 61439-0)
- [Table from Part 1, Annex C](#)

Table C.1 – Items subject to agreement between the ASSEMBLY manufacturer and the user

User defined functions and characteristics	Reference clause or subclause	Standard arrangement b)	User requirement a)
<b>Electrical system</b>			
Earthing system	5.5, 8.4.3.2.3, 8.6.2, 10.5, 11.4		
Rated voltage $U_n$ (volts)	3.8.8.1, 5.2.1, 8.5.3		
Overtoltage category	5.2.4, 8.5.3, 9.1, Annex G		
Unusual voltage transients, voltage stresses, temporary overvoltages	9.1	No	
Rated frequency $f_n$ (Hz)	3.8.11, 5.4, 8.5.3, 10.10.2.3, 10.11.5.4		
Additional on site testing requirements: wiring, operational performance and function	11.10		
<b>Short circuit withstand capability</b>			
Prospective short-circuit current at supply terminals $I_{cp}$ (kA)	3.8.6		
Prospective short-circuit current in the neutral	10.11.5.3.5	60 % of phase values	
Prospective short-circuit current in the protective circuit	10.11.5.6	60 % of phase values	
SCPD in the incoming functional unit	9.3.2		
Co-ordination of short-circuit protective devices including external short-circuit protective device	9.3.4		

Data Acquisition Sheet			
<b>Project Data</b>			
Customer		Processed by	
Project		Phone	
Order no.		Fax	
Delivery date		Date	
Penalty			
<b>Standards and Specifications</b>			
<input checked="" type="checkbox"/> IEC 60439-1 / EN 60439-1	<input type="checkbox"/> IEC 61641/VE 0660 Part 500 Suppl. 2	<input type="checkbox"/> Arc barriers for limiting the arc to one section	
<input type="checkbox"/> VDE 0660 Part 500	<input type="checkbox"/> Arc resist. (standard 440V, 50kA, 100ms)		
<b>Environmental Conditions</b>			
Environmental class (acc. IEC 60721-3-3)		<input type="checkbox"/> Interior room climate 3k4	
Ambient temperature (24-hour average)		<input type="checkbox"/> 20 °C <input type="checkbox"/> 25 °C <input type="checkbox"/> 30 °C <input type="checkbox"/> 35 °C <input type="checkbox"/> 40 °C <input type="checkbox"/> 45 °C <input type="checkbox"/> 50 °C	
Installation altitude above MSL		<input type="checkbox"/> ≤ 2000 m <input type="checkbox"/> Other	
<b>IP degree of protection</b>			
towards the interior	<input type="checkbox"/> IP 30 <input type="checkbox"/> IP 31 <input type="checkbox"/> IP 40 <input type="checkbox"/> IP 41 <input type="checkbox"/> IP 54		
section ventilated			
section unventilated (not OFFP, PFC)			
towards the cable floor	<input type="checkbox"/> IP 00 <input type="checkbox"/> IP 30 <input type="checkbox"/> IP 40 <input type="checkbox"/> IP 54		
at the works			
on site			
<b>Aggravated operating conditions</b>			
<input type="checkbox"/> None <input type="checkbox"/> Earthquake-resistant <input type="checkbox"/> Chemical emissions			
<b>Control cabinet heating</b>			
<input type="checkbox"/> No <input type="checkbox"/> Yes			
<b>Network Data / Supply Data</b>			
Type of network:	<input type="checkbox"/> TN-C <input type="checkbox"/> TN-S <input type="checkbox"/> TN-C-S <input type="checkbox"/> IT <input type="checkbox"/> TT		
Version of external connection	<input type="checkbox"/> L1, L2, L3, PEN <input type="checkbox"/> L1, L2, L3, PE + N <input type="checkbox"/> Other: _____		
	<input type="checkbox"/> CEP (PEN+PE)		
Rated transformer power $S_n$	_____ kVA	Rated short-circuit voltage $u_k$	_____ %
Rated operation voltage $U_L$	_____ V	Frequency $f$	_____ Hz

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## Interface characteristics – new terms, definitions:

- Rated current of the switchgear and controlgear assembly  $I_{nA}$ 
  - Describes the total current which can be distributed by a switchgear and controlgear assembly, limited by main busbars or incoming circuits (in parallel)
  
- Rated current of a circuit  $I_{nC}$ 
  - Current which can be carried by a circuit within a switchgear and controlgear assembly without overheating if only this circuit is loaded
  
- Definition of rated demand factor **RDF**
  - No longer describes the assumed load of circuits, but their (verified) capacity of simultaneously carrying a percentage of their rated current
  - The rated current of a circuit, multiplied by the RDF, has to be higher than or equal to the load on the circuit to be expected
  - The RDF applies to the operation of the switchgear and controlgear assembly with its rated current (i.e. with maximally permissible load)

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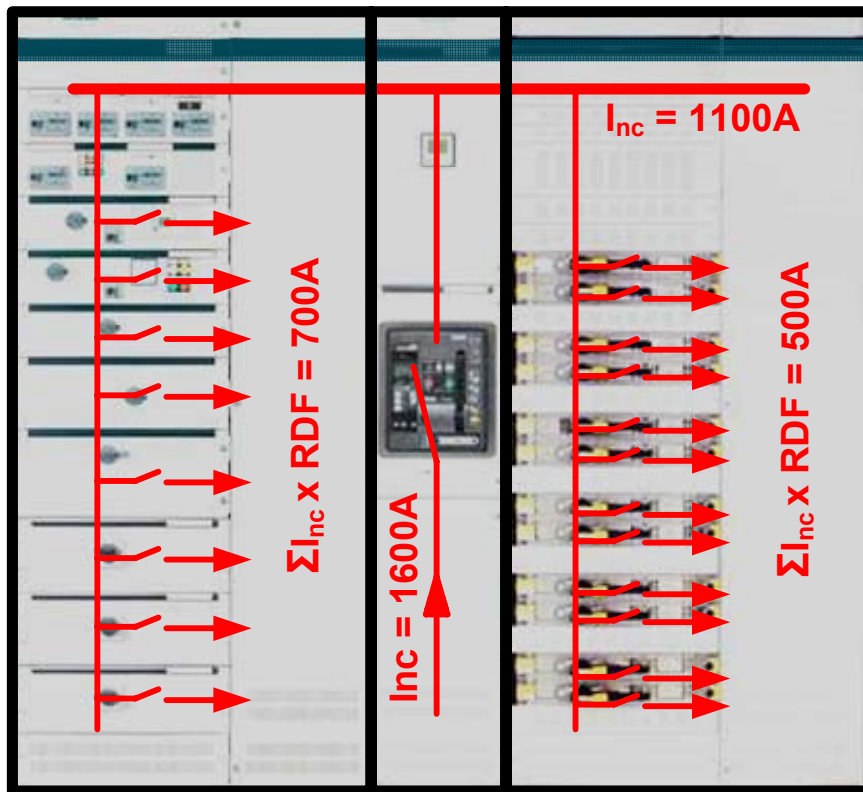
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## Interface characteristics – new terms, definitions:



$I_{nA} = 1600A$

Example:

- The rated current of the switchgear and controlgear assembly ( $I_{nA}$ ) is limited by the incoming
- With central incoming, the rated current of the main busbar may be lower than  $I_{nA}$
- Feeders can be retrofitted up to  $\Sigma I_{nc} \times RDF = I_{nA}$

(Observe rated current of the main busbar!)

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## Interface characteristics – new terms, definitions:

- Rated short-time withstand current
  - The standard no longer defines a standard value for the current flow duration (previously in IEC 60439-1: 1 sec)

$I_{cw}$

Technical Data			
Rated insulation voltage ( $U_i$ )	Main circuit		up to 1000 V
Rated operating voltage ( $U_e$ )	Main circuit		up to 690 V
Clearances and creepage distances	Rated impulse withstand voltage $U_{imp}$		8 / 12 kV
	Overvoltage category		III / IV
	Pollution degree		3
Busbars (3-pole and 4-pole)	Main busbars horizontal	Rated current Rated peak withstand current ( $I_{pk}$ ) Rated short-time withstand current ( $I_{cw}$ )	up to 7010 A up to 330 kA up to 150 kA, 1s
	Vertical busbars for circuit breaker design	Rated current Rated peak withstand current ( $I_{pk}$ ) Rated short-time withstand current ( $I_{cw}$ )	up to 6300 A up to 220 kA up to 100 kA, 1s
	Vertical busbars for universal mounting and fixed-mounted design	Rated current Rated peak withstand current ( $I_{pk}$ ) Rated short-time withstand current ( $I_{cw}$ )	up to 1600 A up to 143 kA up to 65 kA *, 1s
	Vertical busbars for 3NJ4 in-line design (fixed-mounted)	Rated current Rated conditional short-circuit current ( $I_{cc}$ )	up to 1600 A up to 50 kA
	Vertical busbars for 3NJ6 in-line design (plug-in)	Rated current Rated peak withstand current ( $I_{pk}$ ) Rated short-time withstand current ( $I_{cw}$ )	up to 2100 A up to 110 kA up to 50 kA *, 1s

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## Changes regarding construction and performance requirements

**Previous chapter “7. Construction requirements” divided into:**

- 8. Constructional requirements (design)
- 9. Performance requirements

**Contents restructured, e.g.**

- Requirements affecting the same subjects are compiled in the same section
- Changed sequence of the sections

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## Changes regarding construction and performance requirements

### ■ Changes regarding protection against electric shock

- The new terminology of the basic safety standards was adopted and the requirements were adjusted
- Changes: The terms “protection against direct touch” and “protection against indirect touch” were replaced by the new terms “basic protection” “fault protection”



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## Changes regarding construction and performance requirements

### ■ 8.6.1 Main circuits

- Minimum cross-section for N-conductors: 50% of phase conductors (but not smaller than 16 mm<sup>2</sup>)

### ■ 9.3.4 Coordination of protective equipment

- If back-up protection is employed, a warning note has to be included on a label attached to the system or in the operating instructions which prohibits the replacement of any short-circuit equipment by a device of a different type.

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## Changes regarding design verification

Design verification has to include the following:

### Constriction:

- 10.2 Strength of materials and parts
- 10.3 Degree of protection of ASSEMBLIES
- 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 circuits and connections
- 10.8 Terminals for external conductors

### Behavior:

- 10.9 Dielectric properties
- 10.10 Verification of temperature rise
- 10.11 Short-circuit withstand strength
- 10.12 Electromagnetic compatibility (EMC)
- 10.13 Mechanical operation

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## Changes regarding design verification

### 10.2 Strength of materials and parts

Verification based on tests were adopted from the standard for empty enclosures VDE 0660-511 (IEC 62208) in chapter 10.2:

- Corrosion resistance
- Resistance of insulating material to normal heat
- Resistance of molded-plastic casing parts for outdoor installation to UV radiation
- Raising of switchgear and controlgear assemblies
- Impact test (IK code)
- Inscriptions

Prüflaboratorium Böhlitz-Ehrenberg, Siemens AG	
<b>Typprüfbescheinigung</b>	
TPB B0449d	Rev. 00
<b>Prüfobjekt:</b>	Typgeprüfte Niederspannungs-Schaltgerätekombination SIVACON S, Feld mit typischen Umhüllungsteilen, Schutzart IP40, Tür, Seitenwand, Rückwand
<b>Auftraggeber:</b>	Siemens AG, A&D CD DM Südstraße 74 –D-04178 Leipzig
<b>Angewandte Prüfbestimmungen:</b>	VDE 0660 Teil 511: 2005-04, Abschnitt 9.6 DIN EN 62208: 2005-04, Abschnitt 9.6
<b>Durchgeführte Prüfungen:</b>	Typprüfung zum Nachweis des Schutzgrades gegen mechanische Beanspruchung
<b>Prüfergebnis:</b>	Die Anforderungen für einen Schutzgrad gegen mechanische Beanspruchungen IK10 werden eingehalten. Die Schutzart IP40 bleibt nach der Prüfung erhalten.

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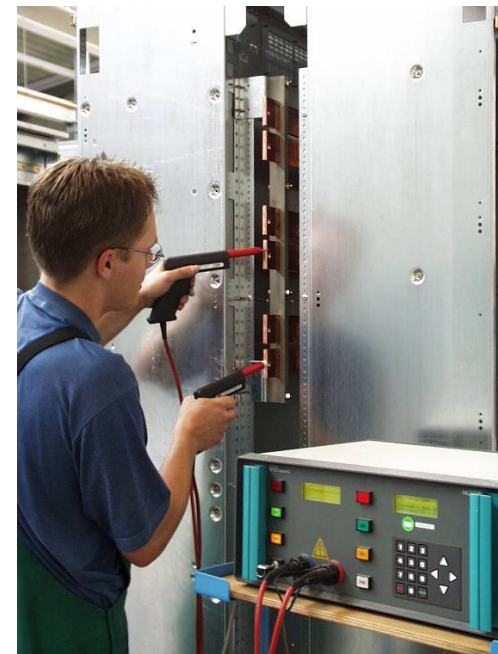
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## Changes regarding design verification

### 10.9 Dielectric properties

- Power frequency- and impulse withstand tests are required
- The impulse withstand test can be replaced by measurement of the clearances, given they are at least 1.5 times longer than the minimum distances for inhomogeneous sections (construction rule)
- The test voltages for Power frequency withstand tests were reduced (adjustment to basic device and safety standards)



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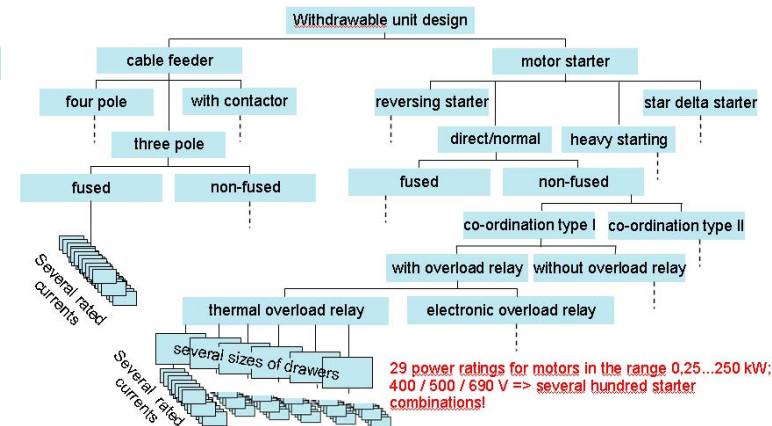
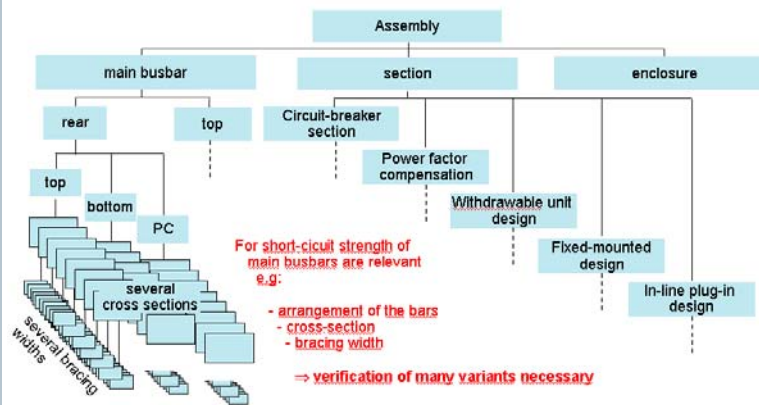
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## Changes regarding design verification

### 10.10 Heating verification

- Verification based on tests
  - For all switchgear and controlgear assemblies  **$I_{nA} > 1600 \text{ A}$**
  - Rules for the selection of the test specimens (worst-case test)
  - Rules for the testing of complete switchgear and controlgear assemblies
  - Rules for the separate testing of main busbars, distribution busbars and functional units



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## Changes regarding design verification

### 10.10 Test specimen selection

#### Testing of main busbars

- Most unfavorable versions under worst-case conditions
- Irrespective of the section type, but valid for all sections



Sections with one functional unit

#### Testing of section types

- Most unfavorable versions under worst-case conditions
- Valid for all versions of the section type



#### Testing of section distribution busbars

- Most unfavorable versions under worst-case conditions
- Irrespective of versions and arrangement of functional units, but valid for all versions



#### Testing of functional units

- Most unfavorable versions under worst-case conditions
- Valid for all versions of functional units



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## Changes regarding design verification

### 10.10 Heating verification

- Verification based on calculation (no consideration of hot spots)
  - The rated current of the switchgear and controlgear assembly's circuits must not exceed 80 % of the conventional thermal rated currents of the switching devices and electrical operating equipment in free air in the circuit.
  - Switchgear and controlgear assemblies with a compartment,  $I_{nA} \leq 630 \text{ A}$  through comparison of the generated power loss which can be dissipated
  - Calculation on the basis of power loss and radiation via the enclosure in accordance with IEC 60890 for switchgear and controlgear assemblies  $I_{nA} > 630 \text{ A to } 1600 \text{ A}$  (maximally 3 internal separations)

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## Changes regarding design verification

### 10.10 Heating verification

- Functional units – device replacement
  - A device may be replaced by a similar device of a different range than the one used for original verification, given the power loss and heating values of the device's connections are proven to be lower or equal by a test in accordance with the applicable product standard. In addition, the physical requirements in the functional unit and the rating of the functional unit have to be maintained.

### 10.11 Short-circuit strength verification

- The testing rules have been specified in more detail, but no requirements were changed
- Derivation of tested arrangements based on calculation (IEC 61117) integrated (with additional restrictions)
- Derivation of tested arrangements based on construction rules ([checklist](#)) newly introduced

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## IEC 61439-2 Ed.1: Low-voltage switchgear and controlgear assemblies Part 2: Power switchgear and controlgear assemblies

VDE 0660-600-2 Low-voltage switchgear and controlgear assemblies  
Part 2: Power switchgear and controlgear assemblies



- Part 2 contains all requirements of the old standard IEC60439-1 with regard to:
  - Gangways within switchgear and controlgear assemblies
  - Withdrawable design
  - Internal separation
- It does not contain any significant changes regarding the requirements.

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## New terms, definitions:

- Power switchgear and controlgear assembly
  - Low-voltage switchgear and controlgear ASSEMBLY used to distribute and control energy for all types of loads, intended for industrial, commercial and similar applications where operation by ordinary persons is not intended.



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## Conclusion:

- As is the rule with other products, switchgear and controlgear assemblies will in the future – **only be classified in accordance with their application area.**

The type of verification is irrelevant for the customer.

- Clearer than before : **Identical technical requirements for all applications / products!**

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## Conclusion:

Testing on the basis of arbitrary examples is not sufficient – **systematic coverage of the entire spectrum is required!**

- **The verification always also includes the devices!**

The verification of device X does not automatically apply to a replacement device Y from a different device range by the same or a different manufacturer.

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## Conclusion:

# Fit for the Future with SIVACON!



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## Transition

*This new series of completely revised and restructured standards for switchgear and controlgear assemblies will ultimately replace the previous parts of the IEC 60439 series, which will then be outdated. However, application of some parts of the IEC 60439 series (covering certain designs of switchgear and controlgear assemblies), which have not yet been incorporated in the new IEC 61439 series, should be continued for a transition period together with IEC 60439-1 as the contents of IEC 61439-1 do not harmonize with the parts of IEC 60439.*

<i>New standard</i>	Replaced standard	Year of publication
▪ IEC 61439-3: Distribution boards	IEC60439-3	ca. 12/2010
▪ IEC 61439-4: Assemblies for construction sites	IEC60439-4	ca. 2012?
▪ IEC 61439-5: Assemblies for power distribution in public networks	IEC60439-5	ca. 05/2011
▪ IEC 61439-6: Busbar trunking systems	IEC60439-2	ca. 07/2011

Explanations on the Concept of IEC61439

Industry Sector

# Explanations on the Concept of IEC61439

History &  
Origination

Overview

Part 1 General  
Rules

Part 2 Product  
Standard

Summary

Transition /  
Validity of the  
Standard

The publication as EN 61439-1 / -2, listing under low-voltage directive and EMC directive, forms a prerequisite for the declaration of conformity on the basis of the new standard:

**Not before mid-2009 (parallel voting + ratification)**

As VDE 0660 -600-1 / -2:

**As of mid-2009 (translation in progress)**

# Explanations on the Concept of IEC61439

## History & Origination

## Overview

## Part 1 General Rules

## Part 2 Product Standard

## Summary

## Transition / Validity of the Standard

The new standard contains the following statement on the validity of type test certifications in accordance with IEC60439-1:

10 Design verification

10.1 General

...

*Where tests on the ASSEMBLY have been conducted in accordance with the IEC 60439 series, prior to the publication of the relevant product standard in the IEC 61439 series, and the test results fulfill the requirements of the relevant part of IEC 61439, the verification of these requirements need not be repeated. ...*

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