IEC 61439: The Mystery of the Temperature Rise Limits

- **Was your low voltage switchgear approved in the temperature rise test?**
- **Is this written in the test report or you have a "quality system" weak point?**
- **An alert to low-voltage switchgear buyers**

http://www.cognitor.com.br/TemperatureRise_IEC61439Mistery.pdf

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1. AN ALERT TO LOW-VOLTAGE SWITCHGEAR BUYERS

From 2016 I have been writing articles about a clear, old and strange deficiency in IEC 61439 standard that impact the worldwide market of low-voltage switchgear. I will not repeat here, the contents of these articles but you may read them freely in the links:

- http://www.cognitor.com.br/TemperatureRise_IEC61439_2019.pdf
- http://www.cognitor.com.br/TempRise_IEC61439_07112018.pdf
- More information: http://www.cognitor.com.br/downloads1.html

The facts motivating this, and previous articles are:

a) Low-voltage switchgear (LV) (IEC 61439) is a piece of equipment basically equal to medium voltage switchgear **(MV)** (IEC 62271-1 , IEC 62271-200 and IEC 62271-307). Both are metallic boxes enclosing electrical conductors and insulators, made of the same materials. They have the same basic operational functions and so, it is reasonable to expect that both would have the same life expectancy.

b) The only difference between LV and MV switchgear is the rated voltage, which is not relevant for temperature rise tests. You may do the tests at any convenient (low) voltage for both medium and low voltage switchgear.

c) To attend the temperature rise requirements specified in the IEC standard is the predominating aspect that defines the design and cost of such equipment. Other things like electrodynamic forces, mechanical and electrical endurance and supportability to internal arcs are important but at a lower level.

d) For MV switchgear, the temperature rise test limits are clear and well defined (see table 1 below). If a testing laboratory does a test, it is easy for the testing teams to state in the test report if the equipment passed or failed in the test. In my opinion, if they do not include these statements (approved or not) they are being

omitted in their neutral laboratory role. The omission is because they are leaving to the user, the task of interpreting well the IEC standards, when it seems they are not skilled enough to do it.

e) For LV switchgear, the temperature rise test limits of connections and contacts are not defined in a clear table to be used by the testing lab. So, most of the testing laboratories simply present the test results but do not state if the equipment passed or not. Labs also do not usually include in the test reports the alerts to the reader already mentioned. Not passing, in the sense of the text of this article, means that the temperature was above table 1. For values higher than table 1 there will be accelerated aging in daily life the greater are the differences to the values of table 1 as explained in the previous articles.

f) In my 40+ years of experience as a testing lab expert and a designer of switchgear for companies all over the world the majority of the testing lab reports of low-voltage switchgear do not present (approved or not) statements and the temperature rise values presented for the connections like busbar to circuit breaker are higher than the ones in Table 1. This means that by MV standards parameters they did not pass in the test.

Table 1 – Values extracted from Table 14 of IEC 62271-1 (2017)) for temperature rise limits of MV switchgear

Nature of the part, of the material and of the dielectric	Maximum value	
	Temperature °C	Temperature rise at ambient temperature not exceeding 40°C K
Contacts		
Bare-copper or bare-copper alloy		
- in OG	75	35
- in NOG	115	75
- in Oil	80	40
Silver-coated or nickel-coated		
- in OG	115	75
- in NOG	15	75
- in Oil	90	50
Tin-coated		
- in OG	90	50
- in NOG	90	50
- in Oil	90	50
Connections, bolted or the equivalent		
Bare-copper or bare-copper alloy or bare-aluminium alloy		
- in OG	100	60
- in NOG	115	75
- in Oil	100	60
Silver-coated or nickel-coated		
- in OG	115	75
- in NOG	115	75
- in Oil	100	60
Tin-coated		
- in OG	105	65
- in NOG	105	65
- in Oil	100	60
Terminals for the connection to external conductors by screws or bolts (refer to points 8 and 14)		
- bare	100	60
- silver or nickel coated	115	75
- tin-coated	105	65
Accessible surfaces		
Surfaces of manual control components to be touched in normal operation:		
- Uncoated metal	55	15
- Coated metal	55	15
- Non metal	65	25
Other surfaces to be touched in normal operation but not to be held continuously in the hand:		
- Uncoated metal	65	25
- Coated metal	70	30
- Non metal	80	40
Surfaces not to be touched in normal operation:		
- Uncoated metal	80	40
- Coated metal	80	40
- Non metal	90	50

2. THE MARKET ISSUE CAUSED BY NOT HAVING THE LIMITS CLEARLY DEFINED IN THE IEC 61439 STANDARDS

IEC technical standards are powerful documents providing directions for specifications, tests, and types of equipment which will be commercialized in the Worldwide market. What is written in IEC standards will influence what will happen all over the world in developed and developing countries.

What is written in the IEC standards is seen around the world as unquestionable and the vast majority of buyers, manufacturers and testing labs follow it fully.

If the temperature rise limits define a considerable part of the project and its cost, there will be a big difference between someone designing the equipment considering the values in Table 1 or considering values far higher since IEC 61439 doesn't define them as it should.

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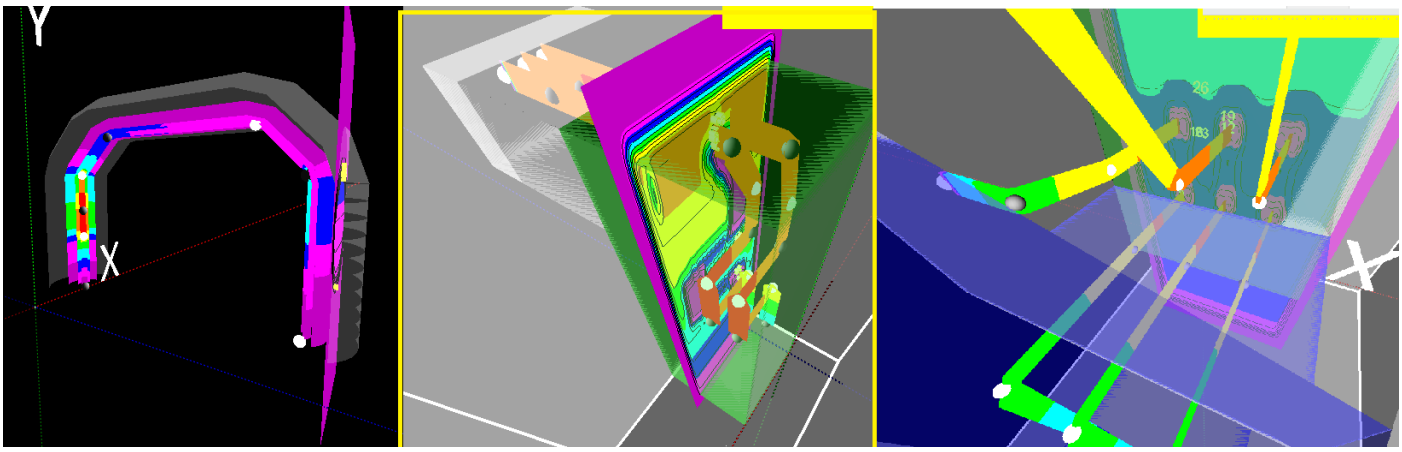
This creates unfair competition in the market as LV manufacturers aiming to meet Table 1 will possibly have a design of higher cost. They will be penalized for trying to do what is technically correct.

As a suggestion to the IEC committee preparing the IEC 61439 series, I suggest including in the next revision the phrase "Temperature Elevation Limits are shown in IEC 62271-1". Doing this the problem is solved.



The author of this paper is Mr. Sergio Feitoza Costa. Sergio is an electrical engineer, M. Sc in Power Systems and director of COGNITOR. Sergio has 35+ years of experience in design, operation and management of high power, high voltage and other testing laboratories. After leaving the activities in testing labs Sergio acquired considerable experience in the use of testing simulations to support manufacturers and certification companies.

Sergio is the author of the simulation software SwitchgearDesign and provides consultancy services for the development of innovative equipment

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- **Sergio Feitoza provides consultancy studies for extrapolation of test results, to verify, based on the test report of an already tested equipment, whether or not another untested equipment would be approved in the same tests. More and more companies are accepting these studies to avoid expensive high-power tests.**
- **Sergio helps to develop innovative substation equipment designs.**