ELECTRIC SHOWERS: FREQUENT FAILURES DUE TO TEMPERATURES OF CONNECTIONS ABOVE LIMITS

Good reading for designers of switchgear IEC 61439 and IEC 62271

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

 As the electric shower has a useful life of, say 10 years, and the (prematurely burned) electrical resistance has a useful life between 1 and 2 years, the most relevant market is not the sale of showers, but rather, the sale of electrical resistances replacement.
 Image: Cognitive consultancy, Research and Training Ltd.



- IEC, IEEE & other standards do not reward designs that use less materials. If weights 10 kg or 1000 kg and passes the test it is OK. The standards do not distinguish. Incentive to over dimensioning.
- It is easy to design efficient+ using less materials, but vision is only on selling old designs.
- DAMAGED PART IS THE CHEAPEST. expensive materials are not damaged. Break in the cheap electrical terminal by working at temperature higher than indicated in IEC 60943 & IEC62271-1.
- LARGE BUYERS of POWER PRODUCTS can help demanding in the BIDs what is not required in standards (good to improve image of OIL & GAS COMPANIES, MINING CEMENT, CHEMICAL FACTORIES, DEFORESTATION INDUSTRY, ELECTRIC POWER UTILITIES. And others that produce severe impacts in environment)

1. INCREASING TIMELIFE SAVES PLANET RESOURCES. It's time to replace beautiful speeches by effective actions.

First, I need to say that several of the concepts I mention here are extensible to low voltage and medium voltage switchgear (IEC62271 and IEC 61439) from the point of view of temperature rise.

We need from World leaders, beyond positive speeches, immediate effective actions. Since Rio 92 Summit, 30 years ago, realized near where I live, I see unfulfilled commitments being postponed year by year and the Planet being destroyed. The Greenhouse Effect ,extinction of animals, destruction of forests in Amazonia are just the most visible aspects of hundreds of issues. The beautiful Guanabara Bay, which was agreed to recover, as successfully made with Thames River, is still completely polluted and improper for use. I live just in front of it and cannot go to the beaches there due to the risk of diseases.

Some causes of the planet's progressive destruction are much less visible. For example, the world-wide used technical standards like IEC, IEEE, etc .. never mention "avoid waste", "improve durability", "reduce the waste of resources". Most of these technical standards are prepared by engineers, only under the view of short-term engineering and business. Nobody told me. I worked in many IEC working groups and was the Chair of IEC Technical Committee in the past.

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Beyond this, the point of view of the common users, as the ones which buy again the damaged shower, is not represented in the commissions that prepare the world-wide technical standards. It should be mandatory, in all IEC standards, to include some kind of statement about using less materials. Could be something like what was done, in the past, regarding electromagnetic compatibility (EMC). Engineers never will propose this. It must come from the top management. However, I think that only a few ear tugs from the G7 leaders would get technical standards associations to move. The group that talks so much about Green Hydrogen could also get involved.

> In this article I show an example of wasting resources with electric showers. I could use many other examples from my books (links at the end). However, my shower resistance failed again yesterday, and the fact is on my mind. I've been writing articles on this topic for decades, but nothing has changed. So, here's one more article.

Now I post my articles on LinkedIn and reach a very large audience. With over 26,000 followers maybe someone will pay attention to the message. LinkedIn is interesting. If I post something like seismic testing, over 85,000 people click on it. But if we write about failures of showers, few people click. Anyway, much more people access them the technical Cigrè brochures that I co-authored. This is life. There are some highly visited posts at the end.

About the issue of the failures in the showers, in the case of Brazil, where I live, it is easy to solve just including a single test detail in technical standard. I explain below

A typical 7500W-220V domestic electric shower cost in Brazil, around 30 American dollars (USD). Maybe are cheaper in other countries which do not have the extorsive and badly used taxes we have here. The reposition electric resistance costs 7 USD per unit, that is, almost ¼ of the price of the shower.

As the electric shower has a useful life of, say 10 years, and the (prematurely burned) electrical resistance has a useful life between 1 and 2 years, <u>the most relevant market</u> is not the sale of showers, but rather, the sale of electrical resistances replacement. This is difficult to notice for the hundreds of millions of lay users.

To have a gross idea of the size of the world-wide market, I did a search on the Web and found a thesis of 2010 authored by Mrs. Denise Druziki (UFPR - Brazil). The title is "Marketing Plan for the Launching of the Shower type ... So, thanks to Denise. The web link is

https://acervodigital.ufpr.br/bitstream/handle/1884/43252/R%20-%20E%20-%20DENISE%20MARIA%20POLETTO%20DRUZIKI.pdf?sequence=1&isAllowed=y or, in my site,

http://www.cognitor.com.br/ThesisDenise2020.pdf

As written in the thesis, according to the "Showers Group of Abinee - Brazilian Association of the Electrical and Electronic Industry", in 2009, the production per year was 11,5 million of units and the market grows 10% per year. So, in 2021, the Brazilian market is something like 35 million of units per year. The resistance of my shower is damaged – at least - each 1 year, even using one of the most traditional brands on the market. As the population of Brazil is around 1/36 of the World population, we can grossly estimate that the worldwide market of showers, per year, is 350 million units and for the electric resistance is the same 350 million of units per year.

So, all over the World, people expend, each year, 350 million x 7 = 2,4 billion USD to replace the damaged electric resistances of showers. With this amount you may give food to a poor population of 2,5 million persons all over 1 year.

2. TECHNICAL STANDARDS REQUIREMENTS FOR THE SHOWERS (THE CAUSE OF THE PROBLEM).

I am skilled in reading and preparing IEC and Brazilian standards being co-author of some of them like IEC 62271-307 (2015) and IEC 60282-2 (1995). Temperature rise in electric equipment is not an easy theme. If you read the article "IEC 61439: The Mystery of the Temperature Rise Limits" you will understand why. The link is in the end of this text.

Technical standards shall be clear when stating the maximum temperature rise permitted in the parts of equipment during laboratory tests prescribed in the technical standards. For example, in IEC61439 the limit values for the connections between busbars and circuit breakers are not explicit. It is bad because the hot spots are usually there, and this cause the market confusions explained in that article.

To investigate why the resistances are damaged so frequently, always in the same connection, my first action was to look for an IEC standard about electric showers. Maybe there is someone, but I could not find any in my searches in the Web. So, I remembered that, when I worked at the electrical energy research centre, we gave support to establishing the Brazilian Labelling Program (PBE) of Inmetro, including electric showers. Inmetro is the national institute of metrology, standardization, and industrial quality.

So, I found in the Web the Inmetro Regulation ("Portaria") 211/2008 of the labelling program. The name is "Regulation of conformity assessment for fixed electric appliances for instantaneous water heating". In the annex of the regulation there is a text that I understood to be part of the Brazilian Technical Standard NBR 12483 (Electric Shower - Standardization) coming from another standard PB-1545. In the Inmetro website I could not find even the 2008 version.

I did not understand why the Regulation is well over 50 pages long but the NBR 12483 (2015) for electric showers has only 4 pages. My first doubt is what is the valid full text of Brazilian Technical Standards applicable to the electric tests on electric showers in Brazil? This should be very easy to identify, for a so popular electric product. When I examined the (old?) text of the Regulation, <u>I</u> did not find any requirement, in the temperature rise test, to measure the temperature rise of the connections. If these values are above the limits corresponding to that material very fast aging will occur as happens to many people (check the Web claims). If the reader want to understand why this is clearly explained in IEC TR 60943. I also explain this in the trainings I apply for switchgear manufacturers. You can easily calculate the loss of life in function of the temperature and materials of the connection showed in the photo above.

So, unless there is a standard somewhere, with values, my understanding is that <u>the reason for the early</u> <u>failures of electric shower resistances is simply that nothing is required, in the Brazilian technical standards</u>, to prevent the fast aging of the electrical connection to the shower resistance. All IEC electric products standards, include in the temperature rise test a verification of the connections.

In the text of the Regulation about the shower test, I only saw requests to measure the temperature rises of the water, the housing, and the external terminals. But not the connection of the internal electric resistances. Check in next section the easy proposal to reduce the enormous number of failures, whose cost goes always to the user.

3. HOW TO REDUCE FAILURES OF ELECTRIC SHOWERS



Table 6 – Typical values of temperature rise and temperature limits*

The only thing to do is to add in the temperature rise test, the measurement of the temperature rises of the connection like in the photo.

To be approved in the test the temperature rise shall remain below the limits for that materials like in this table (from IEC 62271-1 or IEC TR 60943).

As the users are unskilled, the right thing is that the material used in the resistance connections is written in the label, to be possible to know the applicable value by users and testing labs. The labs shall state in the test report if it was approved or not.

REFERENCE :

IEC 61439: The Mystery of the Temperature Rise Limits <u>https://www.cognitor.com.br//Temper</u> atureRise IEC61439Mistery.pdf

Environmental efficiency certificate for electrical products https://www.cognitor.com.br/certificate.html



Points to place thermocouples during temperature rise test of electric shower