EcoDesign for Transformers – a progress report

Introduction

The EcoDesign Regulations for Transformers (No 548/2014) have now been in force for two years and many of the early questions such as when transformers were placed on the market are no longer relevant. However, now is a good time to look at some of the questions that have come up since 2015. One of these is quite fundamental. The intention of the EcoDesign Regulations is to ensure customers get more efficient products. But how do you as a customer know the transformer really is more efficient, what do you need to know and what should you look out for?

Rating

What does the rating mean in terms of EcoDesign?

The losses of a transformer vary with load, so any specification of efficiency needs a definition of the rating at which the losses should be measured. Typically, the losses are higher as the load increases. The Regulation simply refer to a "conventional value of apparent power… which defines its rated current". This is further defined in IEC 60076-1 which states "*The transformer shall have an assigned rated power for each winding which shall be marked on the rating plate. The rated power refers to continuous loading. This is a reference value for guarantees and tests concerning load losses and temperature rises.*" The manufacturer will design each transformer to provide long term, reliable operation at the declared rating.

Implications of Fans and Pumps (OF/AF) on the rating

Some transformers are designed so that the rating can be increased compared to the rating with natural air cooling, by providing forced air or pumped fluid cooling. This creates some possible ambiguity over rating and IEC 60076-1 offers further guidance on this "*If different values of apparent power are assigned under different circumstances, for example, with different methods of cooling, the highest of these values is the rated power.*" It follows that, if a transformer is designed for future uprating by the use of fans and/or pumps, its rating for EcoDesign should be the maximum continuous rating with forced cooling in operation, irrespective of whether the fans and/or pumps are delivered with the transformer.

If the cooling has to be in operation for no-load operation (e.g., air-blast OFAF coolers with no ONAN rating), the electrical power consumed by the cooler has to be taken into account when calculating the efficiency.

Exclusions

The Regulations contain a long list of exclusions from the requirements and Cenelec has published a series of standards to provide greater clarity on the interpretation of the Regulations, namely EN 50588-1:2015 and EN 50629:2015. The European

Commission also provides guidance for the interpretation of all EcoDesign measures in their FAQ[1]. The most recent version of the FAQ (Oct 2016E) now refers to the Cenelec standards.

Tier 1 Efficiency Requirements

The most significant loss component of a transformer will vary dependent upon the loading. In the EcoDesign Regulations the losses are measured at no-load and at the transformer's rated power. For small power transformers (power rating > 1kVA, < 5kVA and highest voltage no higher than 1.1 kV), there are no efficiency or loss requirements. However, they are in the scope of the Regulations and must comply with the information requirements.

For liquid immersed transformers with a rating <= 3150 kVA and pole mounted liquid immersed transformers between 25 kVA and 315 kVA, the Regulations set out maximum values of load and no-load losses depending on the power rating. For all other types of transformer covered by the Regulations the transformer must have a Peak Efficiency Index (PEI) above a certain value. The PEI is in turn based on the Load and No-Load Losses, together with any electrical power required by the cooling system for no load operation. For PEI, the manufacturer has some flexibility in their design as they can vary the no-load losses and load losses whilst still achieving the required PEI, to achieve the optimum design.

The Regulations mean that the transformer must meet the efficiency values set out in the Tier 1 tables. However, the manufacturer can exceed this efficiency where justified by higher savings; the purchaser should speak to the manufacturer to understand the options. Software is available from many manufacturers that allows you to work out the whole life costs of various transformer options based on the expected duty.

Information on the manufacturers web site

The Regulations have a requirement for certain information to be in the product documentation, including rated power, load loss and no-load loss and the electrical power of any cooling system required at no-load. Such information should also be included on the manufacturer's free-access website. However, there are many transformers that are not truly a 'catalogue' item as they are bespoke designs. More detailed information will be available from the manufacturer depending on your specific requirements and you should expect to be provided with information on the winding conductor material, the nature of the conductor, the core material and related load and no load losses.

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[1] Frequently Asked Questions (FAQ) on the Ecodesign Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products and its Implementing Regulations - http://ec.europa.eu/DocsRoom/documents/10684/attachments/1/translations/en/renditions/native

Paperwork

On delivery the manufacturer will normally provide an O&M manual containing, at least:

- Serial number
- Date of factory acceptance testing
- Test Standards complied with
- Rated power
- Actual Load loss and no load loss and electrical power of any cooling system required at no-load.
- Information on the weight of all the main components and core material.

along with instructions on how to install, store and operate the transformer.

The documentation will also contain the actual efficiency data for the transformer.

Rating plate

The Regulations set out the minimum information that must be included on the rating plate. As noted earlier, small transformers are covered by these rules even though they don't have to meet any minimum efficiency levels.

The rating plate will show:

- CE mark
- Rated power
- Measured load loss and no load loss and the electrical power of any cooling system required at no-load.
- Information on the weight of all the main components and core material.

If possible, it would be good practice to check a draft of the rating plates of the manufacturer's transformers prior to placing an order to ensure that they are following the regulations.

How is all of this affected if the transformers is imported from outside Europe?

If a transformer is imported into the EU, it is the responsibility of the company importing the transformer to provide all the necessary information. In many cases the importer will receive the information from the manufacturer, and the accuracy of the information is the importer's responsibility. Wherever the Regulation refers to the manufacturer, for a transformer imported into the EU, this denotes the importer.

Market Surveillance

Can you assume that a transformer must be compliant because there is market enforcement? No, not really. Regulatory Delivery (as was NMRO) is responsible for market surveillance and will investigate reports of non-compliance but EcoDesign places responsibility for compliance clearly with the manufacturer or importer.

Conclusions

There are some simple things to look for when you are purchasing and receiving a transformer that complies with the EcoDesign Directive. The losses or PEI should comply with the Directive, and information should be provided in the documentation and on the rating plate to confirm that the measured losses meet the requirements in the Directive. Information about the active materials (conductor and core) used in the transformer construction, and the weights, should also be included and a purchaser should expect to see all of this.