

TEMPERATURE LIMITATIONS FOR INSULATION MATERIALS BETWEEN OUTER CORE PACKETS AND TIE PLATES

IEEE Transformer Committee
Insulation Life Subcommittee
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Metallic part temperature limitations (inside liquid filled power transformers) are published in various IEEE, CSA and IEC standards referenced below.

The specific location in the assembly that is of concern is where low density pressboard insulation is used between the outer core packet and the tie plates to prevent an unintentional ground on the core, which can lead to circulating currents and gas generation at the point of contact. In such cases, the extra core ground has to be dealt with in the field or, under the worse case scenario, the transformer may have to taken out of service for repairs.

Low density cellulosic pressboard is not available in a thermally upgraded form and will deteriorate if heated for long periods at or above a temperature of approximately 100 to 110C. If this were TUP ("thermally upgraded insulation material"), the safe operating limit would be 120C per IEEE C57 (80C rise over a 40C maximum ambient during a 24 hour cycle).

CSA (Canadian Standards Association) limits the temperature of metallic parts in contact with "electrically stressed insulation" to the same limits prescribed for winding hot spots. It is not clear if the insulation between the tie bar and core packet was intended to fall in this category. But as previously mentioned, if this insulation fails, repairs or modifications to the transformer may be required.

CSA C88-M90 – Aug 1990

9.2 Limits of temperature rise for continuous operation.

c) Metallic parts in contact with or adjacent to conductor insulation or other electrically stressed insulation shall not attain a temperature in excess of that allowed for the hottest spot of the winding adjacent to that insulation.

d) Internal metallic parts other than those covered in item (c) above that are immersed in transformer oil shall not attain a temperature rise in excess of 100C.

IEC limits the temperature to 120C for large power units - similar to the limit for conductor insulation- see **IEC 600354 Table 1.**

Large power transformers

Normal cyclic loading

Current (p.u.) 1,5 1,5 1,3

*Hot-spot temperature and metallic parts in contact with insulating material (°C) **120***

C57.12.00 is rather vague on this matter, stating: "... shall not attain excessive temperature rises at max rated load".

5.1 1.1.3 Rises of metallic parts other than windings

Metallic parts in contact with current-carrying conductor insulation shall not attain a temperature rise in excess of the winding hottest-spot temperature rise.

*Metallic parts other than those described above shall not **attain excessive temperature rises** at maximum rated load.*

C57.91-1995, Table 8 seems to specifically lump metal in contact with insulation with metal not in contact with insulation to 140C for "normal life expectancy loading".

Other metallic hot-spot temperature

(in contact and not in contact with insulation), C

140

Many transformer manufacturers split the outermost packet of core laminations when required to limit the stray flux heating to 120C or less.

Question 1 - Is IEEE C57.12.91, Table 8, correct when it states that being in contact with insulation does not matter?

Question 2 - Would it not be better for IEEE to clearly specify temperature limits for metallic surfaces for various types of insulation (Class A pressboard, TUP, or class H materials (such as Nomex) which they are in contact?

Technically speaking, the continuous operating temperature of the class A pressboard located between the tie plates and the outer core packet should not exceed 65 or 70C rise, but it is common practice to allow 80C rise (just as for TUP) or even higher. It is not known if this practice has been justified.

Respectfully,

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