

Including Arrhenius Life Plots in the Loading Guide

The current Loading Guide does not have life plots; only 'per unit life' Plot based on life at 110°C hot spot temperature::

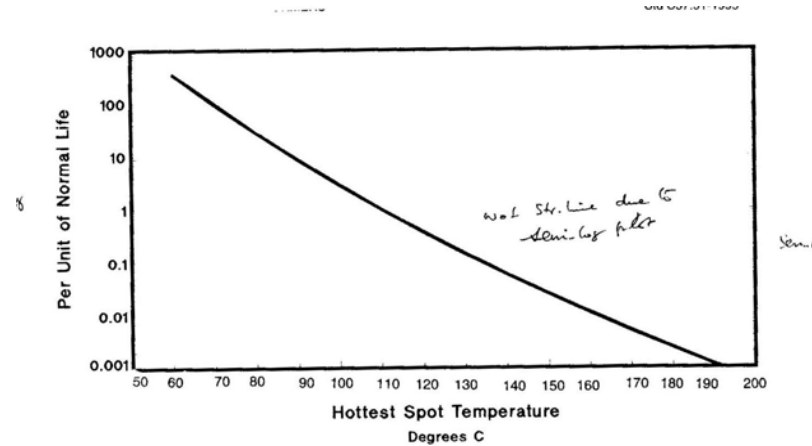
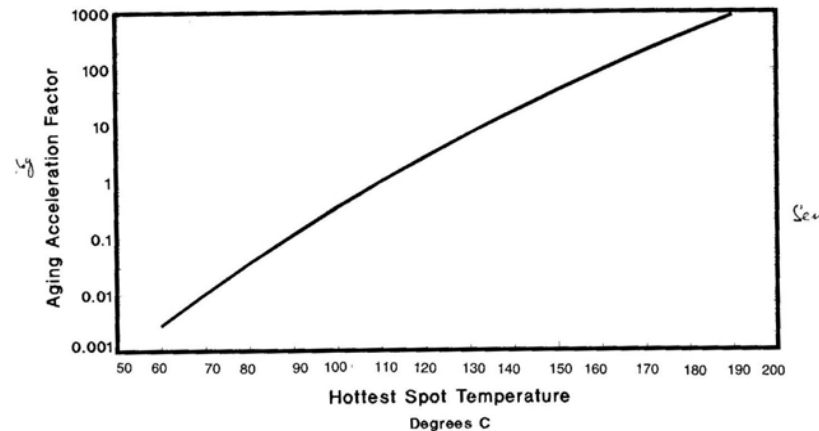
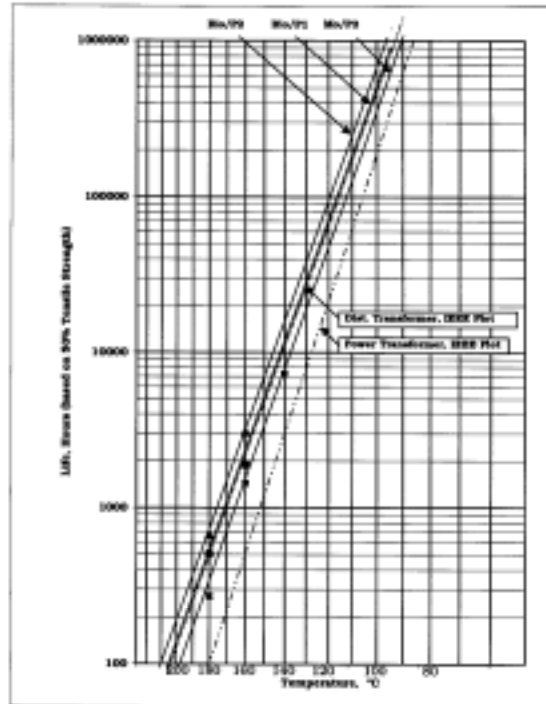


Figure 1—Transformer insulation life



It would be very helpful to have life plots as in the earlier Loading Guides

Problems in Using the Old Life Plots



End point had been defined as retention of 50% tensile strength for power transformers, and short circuit failure during life tests for distribution Transformers (this life was about five times of life of power transformers)

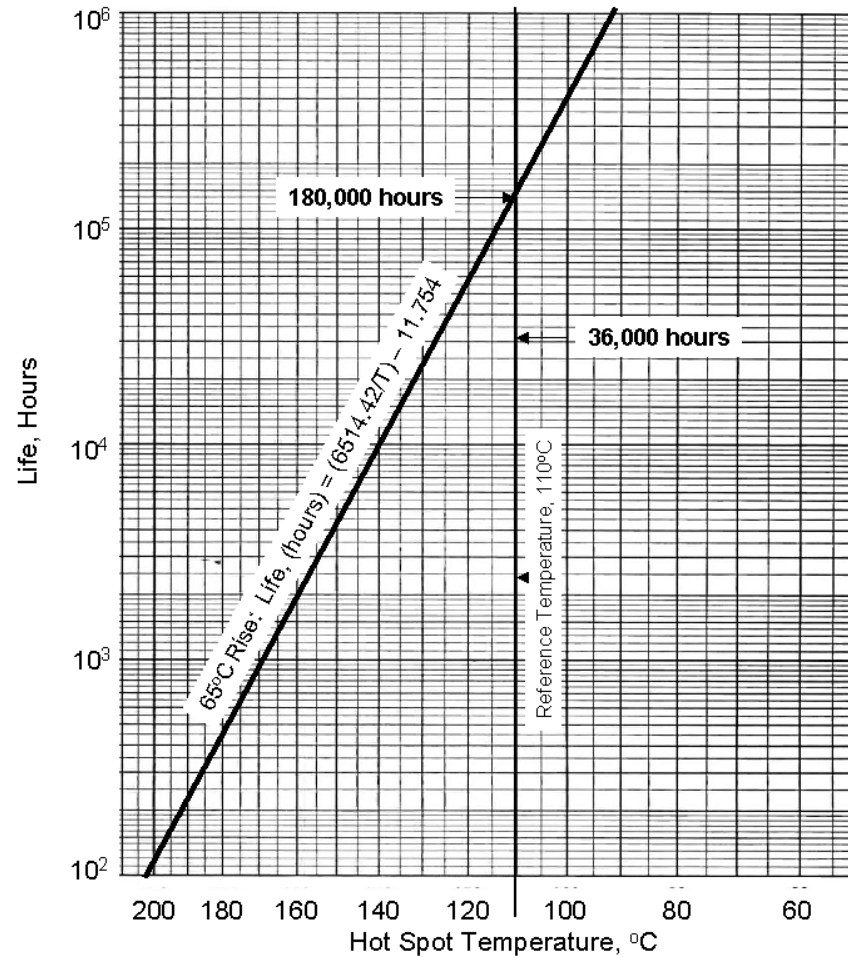
C57.91 – 1995 Revision:

End point was specified on the basis of DP (degree of polymerization). DP of 200 was considered end of life. Based on This the following equation has been stated:

$$\begin{aligned} \text{Life(Hours)} &= \exp[(15,000/T) - 27.064] \\ \text{or } \text{Log}_{10}\text{Life(Hours)} &= (6514.42/T) - 11.754 \end{aligned}$$

This equation would give a life of 180,000 hours at 110°C hot spot temperature (same as for 65°C insulation in distribution transformers above, but at other temperatures .there is some divergence). The equation as such is not shown in the Loading Guide, but may be deduced.

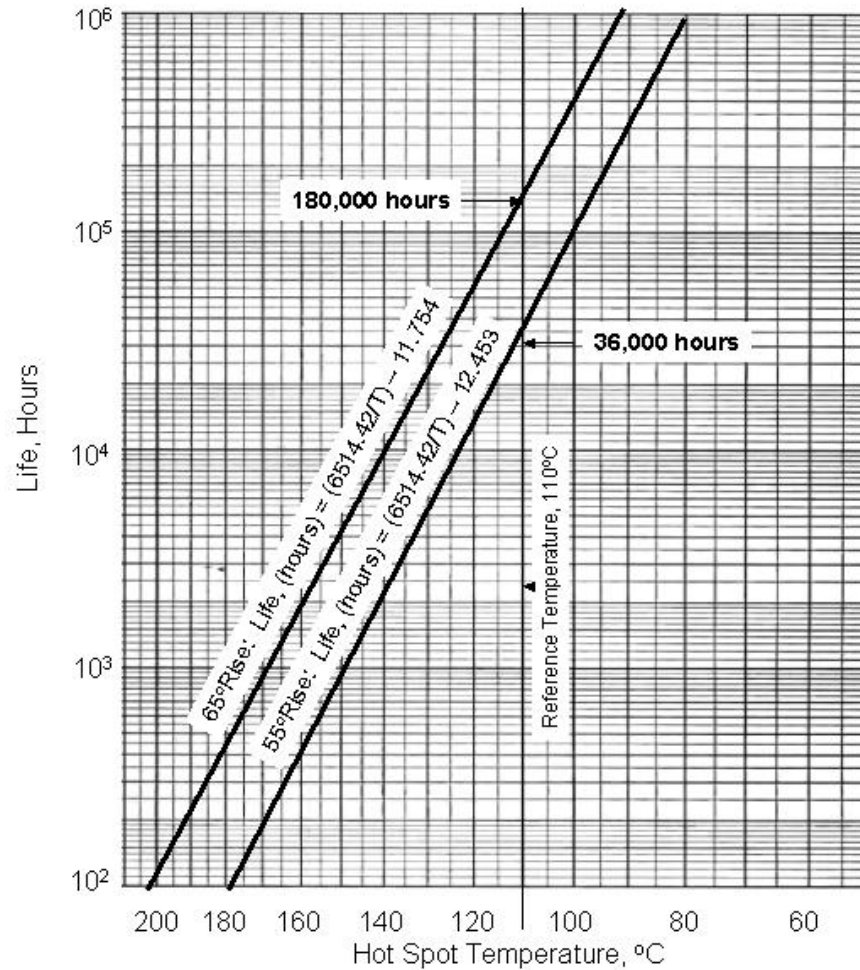
Life plot for power and distribution transformers with Upgraded insulation



Arrhenius Life Plot based on the new equation

What about Transformers with Non-upgraded insulation?

It is possible to develop an Arrhenius life equation and plot assuming that the same divergence would exist on a DP basis as for the life equations and plots for distribution transformers in the older Guides based on life tests. The life predicted for distribution transformers based on the old and the new equations give close enough values for 65°C rise transformers. eg., at 110°C hot spot temp., the life predicted is 180,000 hours. The two equations are not identical, though.



Arrhenius Life Plots for 55°C and 65°C Rise Transformers based on DP end point (proposed)