15. What constitutes an EPA Energy Star Transformer and is it important when supplying non-linear loads?

The Energy Star program is sponsored by the US Environmental Protection Agency (EPA) and is designed to encourage the use of energy efficient products. The Energy Star logo is found on many household appliances and other products identifying that they've been designed to specific energy efficiency standards.

For transformers, the Energy Star program is based upon the NEMA TP-1 'Guide for Determining Energy Efficiency for Distribution Transformers'. NEMA TP-1 defines minimum efficiency levels for transformers with linear loads at 35% loading. This criteria was chosen based on surveys which indicated that the average loading on distribution transformers in North America is about 35%. The efficiency limits vary by transformer size but are generally in the 98% range. In choosing 35% loading, NEMA TP-1 puts extra emphasis on no-load (core) losses rather than load (copper) losses. Because of its emphasis on no-load losses, NEMA TP-1 specifically exempts transformers which service non-linear loads. The following are taken from its exemption list:

c. Drives transformers, both AC and DC
d. All rectifier transformers and transformers designed for high harmonics
g. Special impedance, regulation and harmonic transformers

The reason that transformers designed for high harmonics are exempted is that harmonics will dramatically increase load losses (I^2R and eddy current) and have very little effect on no-load losses. Therefore, NEMA TP-1's emphasis on no-load losses can be counter productive when supplying non-linear loads. To meet the efficiency limits, a manufacturer must optimize for lower no-load losses, sometimes at the expense of higher load losses. For example, one common way of reducing no-load losses is to add more steel to the transformer's core. With a larger core, each turn of the transformer's windings must cover a larger circumference. The extra length of copper winding adds resistance which increases I^2R load losses. This can significantly INCREASE losses and REDUCE efficiencies when supplying non-linear loads at load levels above 50%.

For an optimal HMT energy efficiency design, Mirus' Harmony-1E™ HMT not only meets NEMA TP-1 minimum efficiencies at 35% load but also in the entire operating range from 35% to 65%. In this manner, we can assure energy savings not only at lightly loaded conditions but also at more heavily loaded conditions when harmonics have their most significant influence on losses. (See Figures 14-1 and 14-2 in Question 14 for comparison of energy savings).

