# Inductance versus Turns

MAGNETICS inductance standards are measured in a Kelsall Permeameter Cup. Actual wound inductance measured outside a Kelsall Cup is greater than the calculated value due to leakage flux and flux developed by the current in the winding. The difference depends on many variables — core size, permeability, core finish thickness, wire size, and number of turns, in addition to the way in which the windings are put on the core. This difference is negligible for permeabilities above 125 and turns greater than 500. However, the lower the permeability and/or number of turns, the more pronounced this deviation becomes.

The following table is presented as a guide to the differences that may be experienced with various numbers of turns on a 1-inch O.D. 125μ core:

| Number of Turns | Actual Inductance |
|---|---|
| 1000 | +0.0% |
| 500 | +0.5% |
| 300 | +1.0% |
| 100 | +3.0% |
| 50 | +5.0% |
| 25 | +8.5% |

The following formula can be used to approximate the leakage flux to add to the expected inductance. This formula was developed from historical data of cores tested at MAGNETICS. Be aware that this will only give an approximation based on evenly spaced windings. You may expect as much as a ±50% deviation from this result.

$$L_{LK} = \frac{292\ N^{1.065} A_e}{l_e \times 10^5}$$

where : $L_{LK}$ = leakage inductance (mH)
$N$ = number of turns
$A_e$ = core cross-section ($cm^2$)
$l_e$ = core magnetic path length (cm)

# $A_L$ and Inductance Considerations

The inductance of a wound core can be calculated from the core geometry by using the following equation:

$$L = \frac{.4\ \pi \mu N^2 A_e}{l_e \times 10^8}$$

where : $L$ = inductance (Henries)
$\mu$ = core permeability
$N$ = number of turns
$A_e$ = core cross section ($cm^2$)
$l_e$ = core magnetic path length (cm)

The inductance for a given number of turns is related to the nominal inductance (as listed in the catalog as mH/1000 turns) by the following:

$$L_n = \frac{L_{1000} N^2}{10^6}$$

where : $L_n$ = inductance for N turns (mH)
$L_{1000}$ = nominal inductance (mH/1000 turns)