The Comparison between Circular and Rectangular Transformer Designs:

This technical note brings out the comparison between Round and the Rectangular wound coils and their reliability under short circuit conditions. The through-fault capability of a transformer refers to its ability to withstand, without damage, the fault currents generated in the event of a short circuit.

Radial forces due to short circuit faults act on a transformer winding around the common central axis of the coil. A round winding continues to remain circular, since these forces react equally in all directions. Thus the short circuit forces do not result in any change of shape (see Figure 1).

A rectangular winding tends to assume a more rounded configuration because the radial forces generated under the short circuit condition (see Figure 2).

The forces generated in a transformer subject to short circuit conditions are magnified many times more compared to those under normal operating conditions. This is due to the large currents produced by the short circuit. These radial forces cause the inner winding of the transformer to be crushed inwardly against the core and the outer winding to be expanded outwardly (in opposition to the inner winding).

A transformer must be designed and constructed so that the inner winding is adequately supported from inside and will not be allowed to buckle inward.

The outer winding is designed to withstand the radially outward force (hoop stress) by proper selection of the mechanical strength of the conductor (a function of the material and the cross sectional area).

The short circuit forces on a rectangular winding react the same way as on a round winding. Such short circuit forces tend to force the rectangular coil into a round one. Even if the rectangular coil is "braced" (i.e. prevented from expanding by using a restraining devices, whereby outer winding is prevented from bulging outward), the forces of repulsion between the primary and the secondary windings act more severely on the inner winding. When such large forces act on the inner winding, it frequently results in corrugation (or displacement towards the corners) of the inner winding.

From the above explanation, it will be clear that circular coils are superior to the rectangular coils.

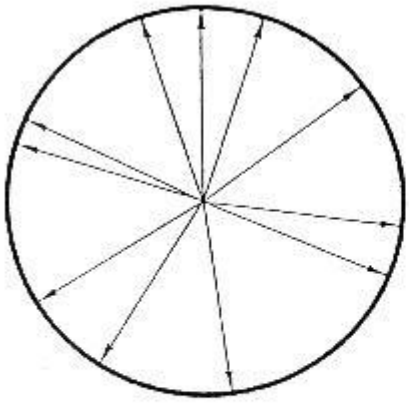

Figure 1 - Forces in a round winding react around the vectorial or physical center axis of the coil. A perfectly round winding tends to stay round.

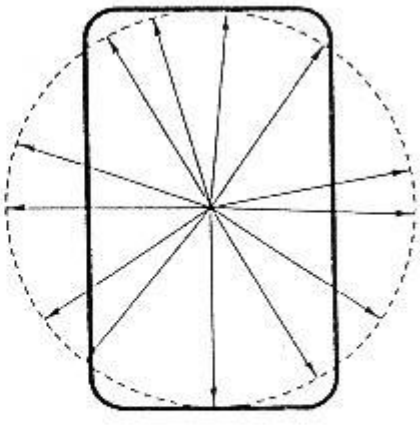

Figure 2 - Forces on a rectangular winding react the same as on a round winding. A rectangular wound coil tends to approach a rounded configuration.