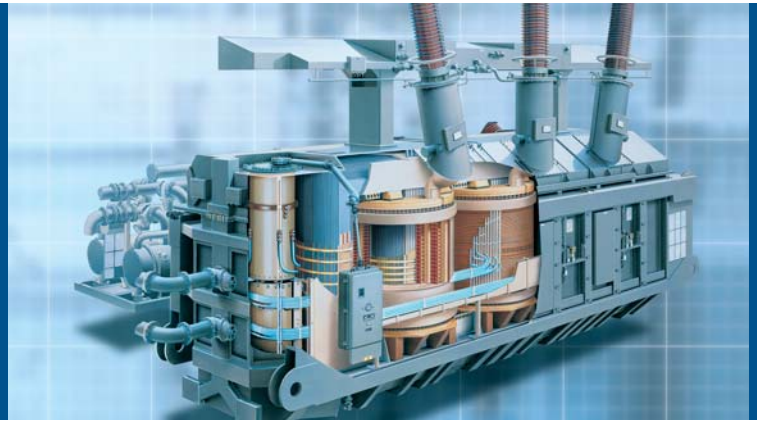


Grain oriented electrical steel is used to build magnetic cores. It should be noted that the best magnetic properties are found only in the rolling direction. If the magnetization is outside the rolling direction, core loss will increase substantially e.g. at 90° to the rolling direction, the loss increases by a factor of more than three and at 60° it increases by a factor of more than four. It is therefore essential that the steel is magnetized as precisely as possible along the rolling direction in the whole magnetic circuit.

Mechanical stress

Mechanical stress has a highly negative effect on the magnetic properties of grain oriented electrical steel. The strips can become exposed to this type of stress for a variety of reasons:

– external forces (external stresses)

– plastic deformation (internal stresses)

External stress is caused by excessive or uneven compression forcing the magnetic core laminations into a wavy or curved shape. Internal stress is generated along the cut edges during each slitting operation or as a result of bending the sheet or subjecting it to tension beyond the yield point.

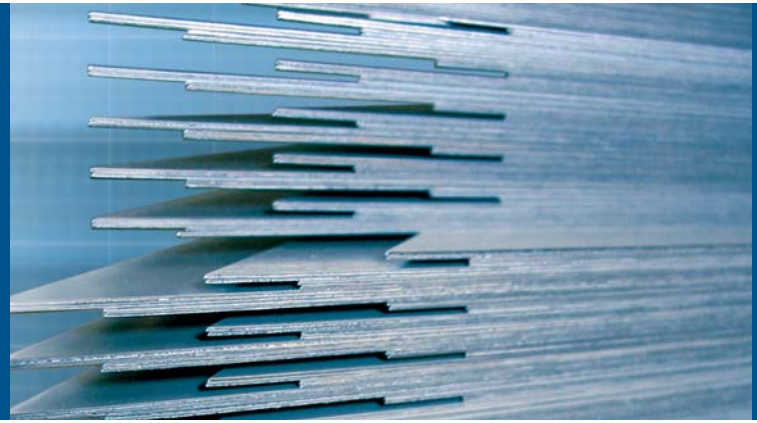
This sometimes unavoidable stress can be almost completely eliminated by stress relief annealing. Material can be annealed in a continuous annealing line under air (short-time annealing) or in a box annealing line under a nitrogen atmosphere (long-time annealing). Whether or not the material is stress relief annealed depends on the conditions at the customer´s place of installation.

Annealing by the customer

Short-time annealing

Laminations are usually subjected to short-time annealing in a roller furnace. This process takes a few minutes and requires a soaking time of 1 to 2 minutes at a maximum temperature of 860 °C. Since the laminations are annealed under an air atmosphere, the cut edges oxidize, thus creating an insulating coating. Any grease or oil from earlier processing stages is burnt off and is generally harmless in small quantities.

PowerCore® grain oriented electrical steel
Further processing information



Long-time annealing

Wound cores and stacking transformers undergo long-time annealing in a box-type furnace. Long-time annealing should be carried out under the following conditions:

– Soaking temperature: min. 820 °C, max. 840 °C to 850 °C

– Soaking time: 2 hours (the coolest part of the material must be at least 800 °C)

– Cooling: Preferably within the furnace to about 200 °C to 300 °C

– Protective atmosphere: Preferably 100 % nitrogen. The addition of hydrogen is not recommended.

The heating, soaking and cooling times are largely determined by the type and size of furnace and the amount of annealing material. The annealing cycle must be adapted to the above parameters. As a general rule, heating the material too quickly may result in local overheating, especially in the outer cores. This risk can be reduced by controlling the temperature with a thermocouple near the heating conductors. The soaking time must be long enough to ensure that the annealing material reaches the soaking temperature (minimum 800 °C) throughout.

If the material cools down too quickly, the cores may warp or distort. If is further recommended that the soaking temperature is controlled by thermocouples positioned at the hottest and the coolest points of the annealing material. The cores should be allowed to cool down in the furnace to a temperature between 200 °C to 300 °C to avoid quenching effects during unloading. The annealing material must be free from grease, oil and other organic substances to prevent carburization.

Domain refined material

Stress relief annealing of laser-irradiated **PowerCore® H** reverses the reduction in core loss produced by the laser treatment. The special design of our laser beam ensures that the excellent adhesive properties and the high resistance value of the insulation are preserved in our laser-irradiated **PowerCore® H** grades. As a result, laser-irradiated **PowerCore® H** grades show the same favourable noise behaviour in the finished transformers as **PowerCore® H** grades that have not been laser treated.