# PRODUCT INFORMATION

# DIFFERENT INSULATION SYSTEMS IN CONDENSER BUSHINGS

**Introduction**

There exist three main types of insulation in high voltage condenser bushings. This paper is intended to briefly explain the main differences between today's Resin-impregnated Paper (RIP) bushings and the old Resin-bonded Paper (RBP) bushings. The third type, Oil-impregnated Paper (OIP) bushings is today's main technology with more than 80 % of the market and considered to be well know and therefore not detailed. It shall also be emphasised that all three types utilise the same type of electric field control by floating screens, the differences are in the way of insulating the paper core.

**Definitions**

IEC 137 gives a straightforward definition of the different types of insulation systems:

**Resin-impregnated paper bushing (RIP)**
Bushing in which the major insulation consists of a core wound from untreated paper and subsequently impregnated with a curable resin.

**Resin-bonded Paper bushing (RBP)**
Bushing, in which the major insulation consists of a core wound from resin-coated paper. During the winding process, each paper layer is bonded to the previous layer by its resin coating and the bonding achieved by curing the resin.

**The RIP technology used in our GSA line of bushings**

By incorporating state-of-the-art production technology, ABB Components re-introduced dry insulated condenser bushings as an alternative to OIP bushings in 1996.

RIP condenser cores are wound from crêpe paper, followed by impregnation by epoxy resin. The principle is similar to producing OIP bushings.

Oil impregnation under vacuum is a relatively straightforward and forgiving process, impregnation with epoxy resin however requires a much more controlled ambient, including continuous monitoring of the curing process in a hermetically sealed environment.

This production technology developed by ABB, resulting in the GSA line of dry insulated condenser bushings through 245 kV system voltage. The bushings are void-free, keeping the partial discharge levels as well as tan $\delta$ within the stipulated limits of IEC 137.

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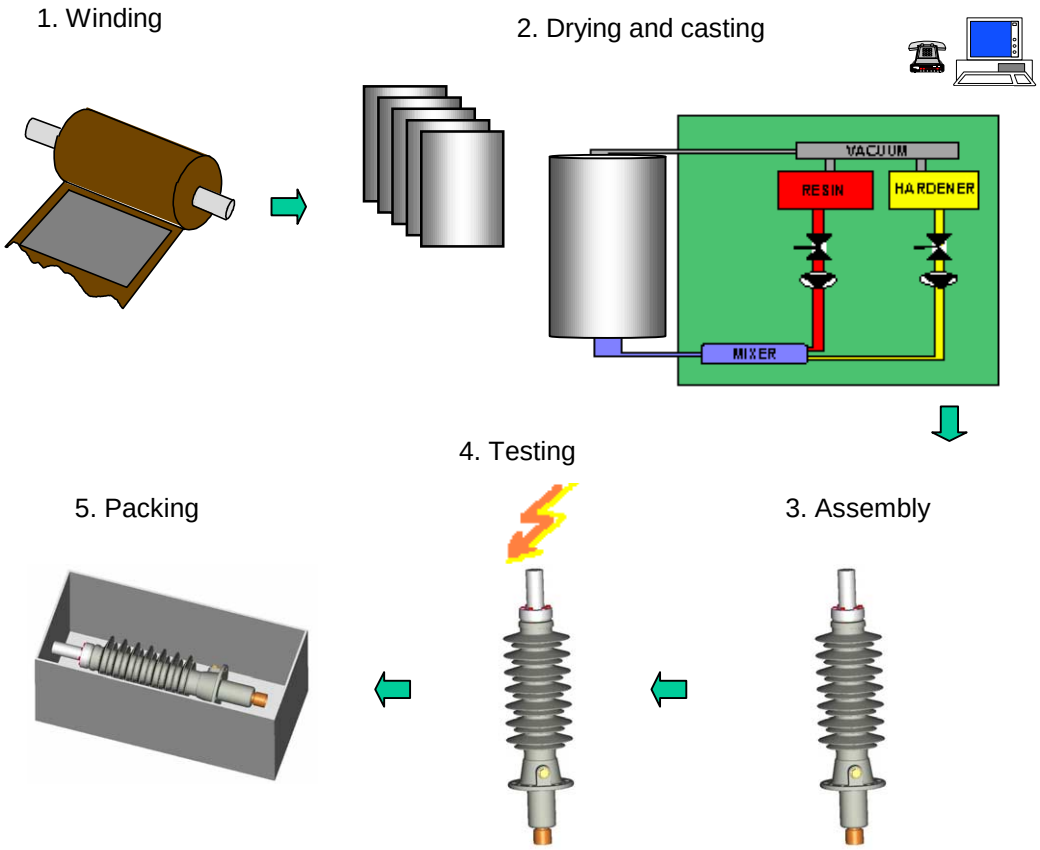
The production process is illustrated in the schematic procedure as detailed below.




**Technical implications of using RBP**

Since RBP bushings are produced from resin coated paper and wound in an uncontrolled workshop ambient during the heating process air is trapped inside the core forming voids after curing. RBP bushings are subsequently not free from partial discharges and difficult to produce with low dissipation factors (tan δ).

Partial discharge causes erosion of material. High tan δ causes capacity losses and hence thermal problems.

Both phenomenon increase with voltage, which was one reason for ABB to abandon this technology when reaching 220 kV system voltages in the early fifties. There have also been continuous reductions of limit values allowed by international standard.

Those are the main reasons why ABB Components discontinued using the RBP technology, in favour of OIP and recently also RIP insulation technology, which allows low level of partial discharges and tan δ provided that the production process is of a high quality.