Bonded electrical sheet stacks? Contact us!

The technologies for the bonding (Backlack) of electrical sheet are various. The properties of the bonded stator and rotor stacks too.

Each manufacturer of bonded (Backlack) electrical sheet stacks has its own technology and processes to do the bonding/curing of the coated electrical sheet material. Backlack basically is an epoxy resin which is cured with pressure, temperature and time and results in chemical hardening. Thus, the electrical sheet are glued together full surface strongly. The manufacturers of the bonding varnish (Backlack) provide a curing chart, based on temperature and time. The higher the temperature, the shorter the hardening time of the bonding varnish (Backlack). Provided, enough pressure is applied to ensure the bonding varnish coatings flow together and tie up strongly.

Batch oven

The well-known technology is the curing in a traditional oven. The electrical sheets are stacked up in bonding tools and pressurised with springs. The bonding tools are then put into the oven at 200°C for 2 hours to cure the bonding varnish (Backlack). Afterwards, the tools are cooled down for approx. 30 minutes to room temperature. Then, the springs are unloaded and the bonded stator and rotor stacks are taken out of the tool. This process is well established and traceable. The process is not suitable for large series productions due to the long **cycle time of 3h** or even more when needing heavy tools due to large parts.

Improvement to continuous furnace

A continuous furnace is an improvement of the batch oven above. The tools are the same. The continuous furnace consists of a heating part and a cooling part and a transportation system to move the bonding tools continuously trough the furnace. By increasing the speed of the air flow and installing special air jets, the heating can be accelerated and the cycle time be reduced. By doing so, the electrical sheet stacks are getting warm faster on the outer side than on the inner side, which leads to an asymmetric temperature distribution inside the stator and rotor stacks. This results in different curing times within the stack and leads to a variation of the stiffness and can induce tensions with a negative impact on the flatness or rectangularity of the parts. Additionally, the effect of the temperature difference between outer side and inner side is even increased by the geometry of the lamination stack (e.g. a rotor lamination with magnet pockets is a temperature barrier which prevents the temperature to flow). Although the continuous furnace enables faster cycle times (approx. 1.5h), the **quality is heavily affected by the geometry of the laminations and the process parameters** which need to be adapted in many dimensions.

Bonding in the punching tool

Another technology is the bonding in the punching tool directly. For this purpose, a heating unit is installed below the punching die. The lamination sheets are guided from the punching die trough this heating unit, are heating up and are pressurised by a counter punch. After a certain amount of laminations, either a separation layer is applied or the laminations are ejected, thus, separated stator and rotor stacks are the result. This procedure induces several conflicts:

- A high punching speed (high output) reduces the curing time in the heating unit (less equal and stiff bonding)
- Das The punching tool should be held constantly at room temperature to keep the punching clearance and position of punches and dies tight. In contrast, the heating unit should be as warm as 200°C for a fast and stiff bonding
- The heating unit holds and heats the lamination sheet mainly from the outer side. The same issues arise as with the continuous furnace

These conflicts are solved by compromises. The result are stator and rotor stacks with a **low stiffness, more stacking errors, and high shape tolerances (rectangularity and parallelity)**. Additionally, constraints on a second sight arise as: **lower stacking factor, setting of the parts at assembly and over temperature cycles**, which can lead to a reduction of the OD and ID of segmented stators!

Bonding as separated process

The SWD Technologies BPS® (for segments) and EPS® (for large stators and rotors) are based on a complete separation of the punching process and the bonding/curing process. Thus, each process can be implemented on the best technical base and no compromises are required. The processes are interconnected by automation and handling units.

This setup enables highest punching speeds and precision and shortest bonding/curing cycles due to higher temperature and higher pressure. Today, our processes are well developed and the cycle time for small parts and segments is reduced **to 3-4 minutes** and by applying a dynamic bonding process, **highest stiffness and small tolerances for rectangularity and flatness are achieved**. Our technology allows the highest precision in the alignment of the single sheets which almost eliminates any stacking errors and therefore allows narrowest tolerances. Additionally, the segments **do not show any setting behaviour, neither during assembly nor over temperature cycles of the motor** because the bonding varnish is completely cured, and the stacking error is almost eliminated.

For large stators and rotors, we optimise the bonding/curing process continuously, too. The core of our technology is the equal and fast heating up of the electrical sheet, independent on the individual geometry. Paired with the dynamic bonding process from above, we can improve the stator and rotor properties in many dimensions and produce the best-in-class lamination stacks. As an additional feature, the dynamic bonding/curing process can be **adapted easily to different raw material and coating suppliers in no time**, thus enabling a free choice of the suppliers.

SWD AG – Your partner

SWD AG Stator- und Rotortechnik is your partner for your next generation of electric motors. We make your motors better and support you from your idea to the efficient serial production and produce the stacks in each phase.

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