Steel

stabolit® insulation coatings for non grain oriented electrical steel

Product information

thyssenkrupp

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stabolit® is the name given to the various powercore® insulation coatings that also meet global standards such as IEC 60404-1-1, DIN EN 10341 and ASTM A976. Six different stabolit® insulation coatings are available to meet a range of customer requirements. They feature both inorganic and organic varnishes.

stabolit® insulation coatings give powercore® NGO electrical steel the required surface resistivity

The primary objective of stabolit® insulation is to guarantee a defined surface resistivity for our powercore® non grain oriented (NGO) electrical steel so as to avoid short circuits between the individual laminations when used in stacks. Depending on coating type, the varnishes also have additional properties such as improved punchability, weldability and defined temperature resistance in air.

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stabolit® 10

stabolit® is a phenolic resin-based insulation coating and offers high surface insulation resistivity, making it ideal for small and medium-size machines as well as small transformers with cores that are assembled by clamping, riveting, or similar. Significantly improved punchability – up to three-times longer die life compared with uncoated dry-punched electrical steel.

Isolation description

Characteristics	Testing method / standard	Valuation
Isolation basis		Organic
Coated sides		Both sides
Coating thickness per side		0.5 – 1.5 µm 2.5 – 4.5 µm 3.0 – 5.0 µm
Color[1)]		Yellow-green
Surface insulation resistivity at room temperature	ASTM A717	> 5 Ω cm² / lamination (0.5 – 1.5 µm coating thickness) > 20 Ω cm² / lamination (2.5 – 4.5 µm coating thickness) > 50 Ω cm² / lamination (3.0 – 5.0 µm coating thickness)
Temperature resistance	DIN IEC 60404-12	180 °C permanently in air
Improvement in punchability		Very good in comparison to uncoated material
Corrosion resistance	DIN EN ISO 6270-2 AHT[2)]	Good
Degree of rusting	DIN EN ISO 4628-3	Ri 0
Classification according to international standards	DIN EN 10342, IEC 60404-1-1 ASTM A976	EC-3 C-3

[1)] Color deviations are possible without affecting the properties.
[2)] AHT = condensation atmosphere with alternating humidity and air temperature.

stabolit® 20

stabolit® 20 has high elevated-temperature strength and very good weldability and is ideal for small and medium-size machines as well as miniature transformers, also with welded cores.

It provides significantly improved punchability and adequate insulation resistivity despite its low coating thickness.

Isolation description

Characteristics	Testing method / standard	Valuation
Isolation basis		Inorganic with organic components
Coated sides		Both sides
Coating thickness per side		max. 1.0 µm 0.5 – 1.5 µm 1.5 – 2.5 µm
Color[1)]		Colorless
Surface insulation resistivity at room temperature	ASTM A717	> 2 Ω cm² / lamination (max. 1.0 µm coating thickness) > 5 Ω cm² / lamination (0.5 – 1.5 µm coating thickness) > 50 Ω cm² / lamination (1.5 – 2.5 µm coating thickness)
Temperature resistance – permanently in air – short time in air	DIN IEC 60404-12	 210 °C permanently in air 30 min at 600 °C
Improvement in punchability		Very good in comparison to uncoated material
Corrosion resistance	DIN EN ISO 6270-2 AHT[2)]	Satisfactory
Degree of rusting[3)]	DIN EN ISO 4628-3	Ri 3
Weldability (TIG)	SEP[4)] 1210	Up to 1,000 mm/min at 125 A
Suitability for the annealing of laminations	DIN EN 10341	Yes
Classification according to international standards	DIN EN 10342, IEC 60404-1-1 ASTM A976	EC-5-P chrome-free C-5

[1)] Color deviations are possible without affecting the properties.
[2)] AHT = condensation atmosphere with alternating humidity and air temperature.
[3)] To avoid premature corrosion the oil content of water-dilutable lubrication must be higher than 5 % (time in stock for lamination max. five days).
[4)] SEP = Stahl-Eisen-Prüfblatt (steel-iron-testing sheet).

stabolit® 30

stabolit® 30 is a classic anti-stick coating based on phosphates. Its high elevated-temperature strength and very good weldability make it ideal for small and medium-size motors as well as miniature transformers, also with welded cores.

It provides adequate insulation resistivity despite its low coating thickness. This insulation is therefore ideal for processing operations in which the material is exposed to thermal stresses, e. g., aluminium die casting or stress relief annealing.

Isolation description

Characteristics	Testing method / standard	Valuation
Isolation basis		Inorganic insulation based on phosphates with 5 % organic additives for adhesion
Coated sides		Both sides
Coating thickness per side		0.5 – 1.0 µm
Color[1]		Light gray
Surface insulation resistivity at room temperature	ASTM A717	> 5 Ω cm² / lamination
Temperature resistance – permanently in air – short time in air	DIN IEC 60404-12	 300 °C permanently in air Resistant to annealing according to DIN EN 10126
Improvement in punchability		Good in comparison to uncoated material
Corrosion resistance	DIN EN ISO 6270-2 AHT[2]	Satisfactory
Degree of rusting[3]	DIN EN ISO 4628-3	Ri 0 to Ri 3
Weldability (TIG)	SEP[4] 1210	> 1,000 mm/min
Suitability for the annealing of laminations	DIN EN 10341	Yes
Classification according to international standards	DIN EN 10342, IEC 60404-1-1 ASTM A976	EC-4 C-4 resp. C-4-AS

[1] Color deviations are possible without affecting the properties.
[2] AHT = condensation atmosphere with alternating humidity and air temperature.
[3] Depending on steel surface and coating thickness.
[4] SEP = Depending on steel surface and coating thickness.

stabolit® 60

stabolit® 60 is a phosphate-based insulation coating with organic components containing inorganic pigments. It displays very good weldability and punchability at low coating thicknesses. Other outstanding properties are corrosion protection and high elevated-temperature strength. This insulation is therefore ideal for processing operations in which the material is exposed to thermal stresses, e. g., welding, die casting or stress relief annealing. The insulation is also suitable as an anti-stick coating. Additionally it meets very high standards of surface resistivity.

Isolation description

Characteristics	Testing method / standard	Valuation
Isolation basis		Pigmented inorganic varnish with organic components
Coated sides		One side and both sides
Coating thickness per side		1.0 – 3.0 µm
Color[1]		Gray
Surface insulation resistivity at room temperature	ASTM A717	> 15 Ω cm² / lamination
Weldability (TIG)	SEP[2] 1210	Up to 1,000 mm / min. (at 1.5 µm thickness)
Temperature resistance – permanently in air – short time in air	DIN IEC 60404-12	 270 °C permanently in air 2,500 h at 300 °C or 30 min. at 600 °C
Improvement in punchability		Good in comparison to uncoated material
Corrosion resistance	DIN EN ISO 6270-2 AHT[3]	Satisfactory
Degree of rusting[4]	DIN EN ISO 4628-3	Ri 0 to Ri 3
Suitability for the annealing of laminations	DIN EN 10341	Yes
Classification according to international standards	DIN EN 10342, IEC 60404-1-1 ASTM A976	EC-5 C-5

[1] Color deviations are possible without affecting the properties.
[2] SEP = Stahl-Eisen-Prüfblatt (steel-iron-testing sheet).
[3] AHT = condensation atmosphere with alternating humidity and air temperature.
[4] Depending on steel surface and coating thickness.

Bonding varnish stabolit® 70

Bonding varnish based on a heat-curing synthetic resin can be used for bonding electrical steel laminations into stacks as an alternative to riveting or welding. An electrical steel coating has been developed under the name stabolit® 70 which acts as an adhesive and therefore as a bonding element between the laminations in the stack. In addition to optimum bonding properties, an improvement in punchability has also been observed. stabolit® 70 is a colorless varnish coating, which is applied to one or both sides of the strip in a thickness of approximately 5 µm. In the as-delivered condition, the varnish coating is completely dry and non-adherent, which allows the sheets to be stacked and the coils to be tightly wound, even at higher weights, without any bonding at normal storage temperatures, even after an extended period. In this state the bonding varnish is not resistant to solvents. Strip coated with stabolit® 70 can be used to produce laminations in the usual manner. By applying pressure and temperature, the laminations are then bonded together into the stack. In this process the previously dry varnish softens, bonds the laminations and then hardens again. Experiences in the field of electrical engineering have shown that the use of the bonding varnish coating is not restricted to the production of small motors. In many applications the use of stabolit® 70 enables considerable time and cost savings.

Information on processing

Bonding conditions

a) Temperature

Both induction and convection furnaces are suitable for heating the laminated stacks. When bonding smaller stacks, which can be rapidly heated through to the core, care must be taken to ensure that the temperature does not exceed 230°C for more than a few minutes at any position within the stack. A short holding time is sufficient in this case, e. g., 2 minutes at 200 °C. For larger stacks, we recommend a lower temperature and correspondingly longer soaking time, e. g., 1 hour at 180 °C or 2 hours at 140 °C. The exact temperature profile naturally depends on the stack geometry and heating method must be tested in each individual case. The above temperature figures refer the core temperature of the stack, not the furnace temperature. Holding time is the period from reaching the core temperature to removal from the furnace, during which there is no significant increase in core temperature

b) Pressure

A pressure of 150 to 300 N/cm² has proven successful in a wide range of applications. Hydraulic pressing devices and clamping devices with spring washers are suitable. Pressure must be applied from the start of heating and maintained for as long as possible during the cooling process. Under the stated conditions, shrinkage per lamination and side is 2.5 to 3.5 µm.

Temperature properties

The bonded cores can withstand temperatures up to 150 °C during continuous operation. Temperatures up to 200 °C over a short period of time will not cause any damage. It should be noted that in principle the bonding is softer at temperatures above 100 °C. As a result, its strength is reduced as a function of temperature, and the roller peel values in the following refer to temperatures below 100 °C.

Adhesive strength of the bonding

The results of shear tests on two bonded laminations show that when perfectly bonded, separation is generally triggered by material flow in the yield range, meaning that bonding strength depends on the grade and thickness of the electrical steel. As a function of the silicon content and based on laminations coated on both sides with stabolit® 70, the roller peel values are as follows:

- M270-50A with 1.5 N/mm,
- M400-50A with 4 N/mm,
- M800-50A with 6 N/mm.

The roller-peel values are guideline values. Peeling resistance is measured in accordance with DIN EN 1464.

Resistance against corrosive liquids

stabolit® 70 is resistant against normal grades of oil. The unbonded coating is not solvent-resistant. In the bondedcondition, a slight softening should be allowed for with some solvents.

Surface condition

The coated surface must be free of grease. Options for cleaning any contamination must be examined in each case.

Insulation resistance

Depending on the pressure applied, some direct contact between the laminations may occur during bonding.

Health and safety

During the bonding procedure, around 3% of the bonding varnish volume is released as volatile matter. This corresponds to approx. 0.4 g/m² of bonded electrical steel with a coating of 5 µm per side on both sides. Therefore good ventilation must be provided at high throughput.

Storage life of the coated electrical steel materials

At temperatures below 40 °C and in dry conditions, storage life is at least 6 months. The material must be protected from exposure to sunlight and ultraviolet radiation, and the temperature must not fall below the dew point.

stabosol®

stabosol® denominates a special highly reactive adhesive and insulating varnish for the coating of electrical steel intended for the manufacture of rotor and stator packets in large-scale electric motor production. The product has the ability to stably bond the full surface of laminations punched for stack assembly in a short and energetically advantageous series production process. In contrast to the processes commonly used in large-scale production, such as interlocking and welding, the material properties of the electrical steel strip are optimally maintained for the final motor product. With stabosol®, the disadvantageous effects of joining the laminations in the form of material damage and short circuits are avoided. In this way, eddy current losses and disturbances in the magnetic flux can be minimized, and thus electric motors with significantly higher efficiency and power density can be built. In contrast to other established bonding solutions, e.g. with baking varnishes, stack assembly with the highly reactive stabosol® bonding system is also characterized by a particularly short cycle time suitable for large-scale production as well as for a continuous process that is not interrupted by oven storage.

For further information, please refer to the current product information stabosol®.

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