BEACON ADHESIVES CO.
125 MacQuesten Parkway S. • Mount Vernon, NY 10550 USA
Phone 914.699.3400 • Fax 914.699.2783
david@beaconadhesives.com
www.beaconadhesives.com

Rev214dm

Magna-Tac E645 – AQ
Water Based Solution

Product Information Sheet

Epoxy Adhesive

	Viscosity	Color	Base	Wgt/Gal	Solids	Diluant	Shelf Life
	TBD	Light Green	Modified epoxy	TBD	TBD	Water	TBD

Magna-Tac E645 is a one-part, thermosetting, formulated epoxy adhesive for bonding stack laminations used in stators, rotors, gyros, servomechanisms, synchros, transformers and magnetic amplifiers. It can also be used as an insulating varnish for impregnated coils and small electrical equipment. Bonding is achieved by heat. Only sufficient pressure to assure complete contact is needed. Because so little adhesive is needed to accomplish a strong bond which resists shear stress, Magna-Tac E645 – AQ has proved practical as an adhesive/dielectric in the fabrication of magnetic accelerator units such as cyclotrons and cosmotrons.

Magna-Tac E645 - AQ is a strong metal-to-metal adhesive. Because of its excellent mechanical strength plus its resistance to many solvents, water, atmospheric conditions and temperature changes, this adhesive is adaptable to many industrial uses. It is particularly suited to the bonding of large surface areas and mass production processing.

Methods of Stack Lamination

Most companies develop their own techniques to bond stack laminates most efficiently. The three most common are:

1. **Coil or Stack, then Vacuum Impregnate:** Stack cleaned metal in flat sheets separated on a mandrel or in coils. In a pot or kettle, under vacuum, remove all entrapped air. Pressure-force adhesive between layers. Drain. Apply vacuum to remove solvent vapors. Heat cure. Cut to shape if required.

2. Precoat, then stack: Stack parts to shape and clean. Deposit a thin film of adhesive on each surface to be bonded. Dry. Store if necessary. Assemble into stack and heat cure.

3. Coat, Stamp & Stack: Spray or roll coat adhesive onto both sides of flat sheets. Dry. Stamp to shape. Lay up adhesive-coated laminates and heat cure.

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Adhesive Preparation
TBD

Reducing the viscosity of the mixed adhesive
TBD

Applying the adhesive
Mixed Magna-Tac E645 can be applied by brushing, spraying, dipping or roller coating.

For maximum adhesive, all surfaces must be perfectly clean and thoroughly degreased. For improved strength and chemical resistance, sandblast or treat the surfaces chemically. These treatments will vary according to the material, of course.
Operators' hands must be free from grease or oil while handling coated and uncoated parts.

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Cure Time

The adhesive must be thoroughly dried before curing. Drying may be accomplished at room temperature or by forced drying in circulating air ovens. If all of the solvent is not removed before curing, blisters or weakening of the adhesive film will result. Thick or highly diluted films will take longer to dry.

At normal room temperatures, air drying may take 4-8 hours. Drying at elevated temperatures can be best results, force dry at 125F for 60 mins or at 200F for 10 minutes. Do not dry at temperatures above 250F (adhesive will start to cure at that temp).

The adhesive dries to a tack free surface at room temperature. Coated parts may be stored before curing for periods of up to 6 months at room temperature. However, the adhesive film must be clean and dry.

Heat Curing

MagnaTac E645-AQ is reactive above 250F. Normal cure temperatures at the glue line range from 265F to 400F. Curing temperature below 375F are.

Before curing, Magna-Tac E645 is thermoplastic and flows freely as the temperature is raised. This allows the films to fuse to a stronger bond and assures complete "wetting" of the materials being bonded.

For certain specialized applications, however, some users prefer to retard the normal flowout. This can be done by partially curing the adhesive at contact pressure only for about 1/4 to 1/2 the "minimum gel time" shown in figure 1. Any of the normal time and temperature cycles listed may then be used for subsequent curing... but with slightly increased pressure.

Figure 1 Heat Curing Schedule

Glue Line Temperature	Minimum Gel Time	Minimum Cure Time	Maximum Cure Time
266F or 130C	40 min	14 hours	none
284F or 140C	32 min	7 hours	none
302F or 150C	20 min	4 hours	none
320F or 160C	15 min	2 hours	none
338F or 170C	10 min	1.5 hours	none
356F or 180C	8 min	1 hour	none
374F or 190C	6 min	45 min	none
392F or 200C	4 min	30 min	24 hours
428F or 220C	2 min	10 min	60 min

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The figures refer to the temperature of the adhesive film. Allow sufficient time for the stack to attain the correct temperature. The time required for cure depends on the temperature selected, on the mass of metal and on the heat capacity of the metal in the laminate. The temperature chosen depends on the heat sensitivity of the materials being bonded and time limitations in production scheduling. If the maximum cure time is exceeded, over-curing which may cause failures - can result.

Curing Pressure

Pressure is not needed to affect the bond but is essential that the coated surfaces be in complete and intimate contact over the entire area of the materials being bonded. Accordingly, sufficient pressure must be applied to assure such contact. The specific amount of pressure needed will vary, depending upon the flatness of the components, porosity, resiliency, etc.

Supplemental Information

Fungus resistance: MagnaTac E-645 after cured is fungus inert and is not conducive to fungus growth. It is, however, necessary to conduct specific tests under service conditions to determine actual compatibility with end use application.

Compressive strength (approximately)	60,000 psi.
Flash Point	151°F (66°C)
Modulus (approximately)	5.0 x 105 psi.
Linear coefficient of expansion (approx)	65 x 10^{-6} inches/inches/°C.
Thermal Conductivity (approximately)	5000 x 10^{-7} calories/(second)(square cm)(°C)(cm)
Hardness	Shore D 75(ASTM D 2240)
Tg:	114°C
% TML:	0.50 (when cured 1 hr at 100°C in air followed by 4 hrs at 180°C at 10-2 Torr Vacuum. (NASA Outgassing Technical Note TND-8008)

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Typical dielectric properties are as follows:

Dielectric Strength	400 volts per mil
Dielectric Constant	3-4 at 106 cycles per second at 20°C
Loss Factor	0.06 at 20°C

Typical lap shear values obtained when Magna-Tac E645 is used to bond 0.064" etched 2024T3 aluminum alloy to itself in a 1/2 overlap are as follows:

Test Temperature	Av. Lap Shear, psi
-67 F	2800
77F	4000
180F	3000
260F	1000
300F	800
400F	200