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LEECURE B CURING AGENTS FOR SMALL-PART ON-LINE ASSEMBLY

Fast cure coupled with exceptional physical properties distinguishes Leepoxy's LEECURE B reactive series from other epoxy curatives for structural adhesives. Since 1965 these distinctive catalysts have carved a niche for continuous on-line assembly or sub-assembly of product where outstanding strength or heat or chemical resistance is required. The cone and spider-to-voice coil assembly in loudspeakers is one such niche. Others are replacing rivets, spot-welds, solder, and temporary mechanical fasteners subject to high stress. Mass produced metal components requiring assembly on-line can be bonded economically in seconds with adhesives based on LEECURE B reactive epoxy catalysts.

The unique chemistry of this series means high-strength adhesion to a variety of materials as well as superior chemical resistance, electrical properties, and high-temperature performance. These excellent cured properties, however, are not provided at the expense of rapid on-line cure; the reactive LEECURE B series catalysts offer both.

Leepoxy's LEECURE B series curatives attractive for automated on-line bonding consist of four boron trifluoride (BF_3)-amine epoxy formulations. Two cure at room temperature, and two require modestly elevated bondline temperature (150°F minimum.)

LEECURE B-612 and 36-98-2 B are the most reactive and cure tack-free within 90 seconds at 77°F or 25 seconds at 150°F (bondline temperature), assuming at least a 5 mil film for non-metal parts or 10 mil for metal parts. In either case, thinner adhesive films require higher bondline temperatures to initiate polymerization. Their short static mixer work time necessitates dispensing with brief intervals between "shots" through automatic meter-mix equipment.

For automated or semi-automated production assemblies with random interruptions, LEECURE B-614 and B-1310 are preferred because their longer work times translate to fewer static mixer purges or replacements. However, these catalysts need a higher bondline temperature (150°F minimum) for a longer time than either LEECURE B-612 or 36-98-2 B.

The addition latency of LEECURE B-614 and B-1310 allows for more thorough surface wet-out for a given cure schedule. Therefore, they offer better cured physical properties and may be the curatives of choice where surface wet-out and ultimate bond strength are issues.

All four LEECURE B curing agents are liquids and are completely compatible with Bisphenol A, Bisphenol F, flexibilized, novolac, and other multifunctional epoxy resins. They are also compatible with dry, non-alkaline fillers, which may be desirable additives to an epoxy structural adhesive formulation. They contain no solvents and, thus, do not add volatiles to the system. Furthermore, they are each classified as non-hazardous for DOT surface and IATA/ICAO domestic and international air shipping.

As a custom formulator, Leepoxy Plastics has always developed complete solutions for customers desiring a ready-to-use two-component epoxy for their specific application. In addition, it has also modified the reactivity of LEECURE B curatives to meet customers' specific cure requirements. Further, each of the four standard LEECURE B catalysts has been modified to accommodate customer requests for a 4 to 1 by volume mix ratio instead of the standard 10 to 1.

Prolonged exposure to humidity before cure—or contact with other ingredients in the epoxy system that have been contaminated—will adversely affect reactivity, physical properties, and surface cosmetics of the cured adhesive. Surfaces to be bonded must be dry. They also should be mated under pressure as soon as possible after application to prevent moisture contamination.

Determining the proper cure temperature requires understanding the heat sink represented by the parts being bonded. For non-metallic parts, the heat sink effect is usually nominal. With some metal parts, especially larger or poor thermally conductive pieces, the effect can be dramatic. In bonding such parts, it may require heat source temperatures well above the minimum 150^{o}F bondline cure temperature necessary for LEECURE B-614 or B-1310. Induction heat can be an attractive option in these instances.

Cure should be initiated immediately after allowing sufficient surface wet-out. The cure temperature should be low enough to preclude out-gassing, yet high enough for rapid green strength within a practical timeframe. See Table I for reactivity information and performance properties based on the modest, minimum bondline cure cycles listed for each LEECURE B curative. Enhanced performance properties can be attained with cure temperatures higher than those listed in Table I.

In addition to or as an alternative to higher initial cure temperatures, post-curing at temperatures up to 400^{o}F maximizes glass transition temperature (Tg) and other performance properties. Post-curing can be accomplished on-line or off-line. It can be realized in subsequent manufacturing processes involving the assembled product, such as paint or coating bakes, or during in-field operation.

TABLE I TYPICAL PROPERTIES OF LEECURE B HARDENERS				
	B-612	**36-98-2**	**B-614**	**B-1310**
Appearance	Blue-Brown	Brown	Brown	Brown
Viscosity @ 25°C, cps	17,000	3,500	19,000	15,000
Density, lbs./gal.	9.3	9.1	9.5	9.4
The following properties are obtained in conjunction with Bisphenol A Epoxy Resin (EEW=189)				
Mix Ratio, phr	8 – 12	8 – 12	8 – 12	8 – 12
Pot Life @ 25°C, 11 g	75 sec	75 sec	13 min	20 min
Suggested Cure Time in 3/16 inch bead, time/bondline temp	6 min/ 25°C	9 min/ 25°C	2 min/ 65°C	5 min/ 65°C
Typical cured properties according to suggested cure cycle				
Tensile Strength, psi	1,000	340	2,000	4,000
Tensile Modulus, psi	----	----	480,000	480,000
Tensile Elongation, %	----	----	4.0	4.0
Heat Deflection Temperature, °C	75	70	78	78
Dielectric Constant, 1 mHz @ 25°C	----	----	3.9	3.9
Dissipation Factor, 1 mHz @ 25°C	----	----	0.018	0.018
Volume Resistivity @ 25°C, ohm-cm	----	----	10^{15}	10^{15}
Volume Resistivity @ 130°C, ohm-cm	----	----	10^{10}	10^{10}
HDT's increase with an elevated temperature post cure. Post cure can be realized by temperatures generated in use or in operation.				