LORD

Circalok™ 6037

Circalok™ 6037 is an epoxy adhesive formulated for use by the semiconductor industry. An easy-to-spread thixotropic paste, it offers high heat transfer, low shrinkage, and a coefficient of thermal expansion comparable to that of copper and aluminum. Its strong bond to a wide variety of substrates resists severe temperature cycling. This adhesive is principally used to form thermally conductive joints in fabricated heat sinks and between heat sinks and power devices. When used to bond semiconductors to heat sinks, it also serves as an electrical insulator; but the semiconductor's mating surfaces should be precoated with E-343 and allowed to cure to insure the dielectric integrity of the epoxy interface.

Typical Applications: fabricating heat sinks; bonding semiconductors and transistors to heat sinks; general purpose bonding of electronic components.

The values listed below are averages and they are not intended for specification purposes. Contact Lord when establishing specifications.

UNCURED	
Specific Gravity @ 25°C:	2.3 – 2.4
Consistency:	Paste
Color:	Black or Green
Shelf Life (months in closed container):	12
PHYSICAL PROPERTIES*	
Tensile Strength @ 25°C, psi:	10,500
Tensile Elongation, % @ yield:	1.4 – 1.6
Compressive Strength @ 25°C, psi:	29,400
Izod Impact, ft lbs/in of notch:	0.3
Heat Distortion, °C:	155
Water Absorption, 10 days @ 25°C, %:	0.15
Linear Shrinkage, in/in:	0.002
Service Temperature, °C Continuous:	-65 to 155
Service Temperature, °C Intermittent:	-100 to 250
Hardness, Shore D	92-94
Bond Shear Strength	
Aluminum to aluminum, 1" overlap; @ 25°C, psi:	3,840
After 30 days in H_20 @ 25°C, psi:	2,930
Thermal Conductivity,	
Cal/sec/cm^2/°C/cm x 10^{-4}:	33.4
BTU/ft^2/hr/°F/in:	9.7
Thermal Resistance, °C in/Watt:	28
Coefficient of Thermal Expansion, in/in/°C x 10^{-6}:	22

ELECTRICAL PROPERTIES*

Volume Resistivity @ 25°C, ohm-cm:	10^{16}
Dielectric Constant @ 25°C, 100KC:	6.1
Dissipation Factor @ 25°C, 100KC:	0.02
Dielectric Strength, 0.003" thickness, volts/mil:	1000 – 2000

*Typical properties when cured with Hardener E-62S for 3 hours at 100°C (212°F) and 3 hours at 150°C (302°F).

HARDENERS

DESCRIPTION:

Circalok™ 6010B (formerly RT-1)(room temperature cure) Rigid, good properties for ambient temperature cured system, limited working life, fast cure.

Circalok™ 6252 (formerly RT-7)(room temperature cure) Resilient, resistant to thermal shock, very low viscosity, good air release, medium pot life, moderately fast cure.

Lord E-62S (heat cure) Resistant to heat, chemicals, thermal and mechanical shock; good electricals at high humidity; long pot life; noncrystallizing in storage.

Lord HT-75 (heat cure) Good electrical properties at elevated temperature; resistant to heat aging, thermal and mechanical shock; low exotherm; very long pot life.

HANDLING:

Circalok™ 6010B, (formerly RT-1) Circalok™ 6252 (formerly RT-7)(room temperature cure) Moderate heat may be used to accelerate cure.

Lord E-62S (heat cure) To reduce resin viscosity preheat to 65°C (149°F) before adding hardener. Do not preheat when maximum pot life is needed.

Lord HT-75 (heat cure) To make pourable, heat to 65°C (149°F). Circalok™ 6037 may also be preheated to further reduce the viscosity of the system. Minimum hardener ratio favors rigidity at elevated temperature; maximum ratio yields optimum shock resistance.

CURE SCHEDULES:

Hardener	Parts by Weight Per 100 Parts Resin	Pot Life 100 grams @25°C (77°F)	Cure Time 25°C (77°F)	Cure Time 65°C (149°F)	Cure Time 100°C (212°F)	Cure Time 130°C (266°F)
Circalok™ 6010B	3.4	2 hours	24 hours	2 hours	-	-
Circalok™ 6252	7.1	3 hours	24 hours	2 hours	-	-
Lord E-62S	4.9	1-2 hours	-	24 hours	2-6 hours	-
Lord HT-75	17-22	48 hours	-	-	-	4 hours

HANDLING INSTRUCTIONS:

Stir Circalok™ 6037 thoroughly in its shipping container to insure uniform dispersion of the filler. Weigh out the amount needed in a clean container and all the hardener by weight in the proportion specified. Mix thoroughly preferably with power equipment. To insure a void-free glue line evacuate for 5 minutes. Apply the adhesive to both mating surfaces and press together, squeezing out excess resin to obtain a thin glue line. Clamp in position to prevent movement during cure.

HANDLING PRECAUTIONS:

The labels on containers of Lord materials contain current information on the hazards associated with each particular product. Most chemicals are skin and eye irritants, and some may actually be corrosive to the skin and eyes. Other problems, such as skin sensitization or serious health hazards may exist. Further information on each product is contained in the Material Safety Data Sheet, which will be sent upon request.

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SURFACE PREPARATION

Any adhesive, regardless of the type, can only be expected to perform well on a properly prepared surface. Most manufacturers will be quick to point out that such figures as "Tensile Shear Strength" were obtained on specimens tested in accordance with a certain standard. Included in the test will be preparation of the surfaces for bonding, which is usually in accordance with another standard. It would be quite possible to write a complete volume on surface preparation and still not cover every material, application or situation.

Although Lord does not purport to be an expert on all types of surface preparation, we do, nonetheless, feel an obligation to offer some suggestions to aid the user in obtaining good bond strengths.

Some surfaces require little or no preparation and epoxies will cling to them tenaciously. Other materials such as Teflon* or polyethylene are very resistant to bonding even with the best preparation methods known. In the middle of the spectrum, however, are materials, which can be bonded successfully with proper surface treatment. These would include all types of metals, many plastics, glass and ceramics.

In order to properly understand bond strengths, the user should be familiar with the difference between adhesive and cohesive failures. Assume that two pieces of metal are partially overlapped and joined by a thin bond of adhesive. Now the specimen is placed in a machine designed to pull it apart lengthwise. The stress applied is known as "shear". The point at which the specimen breaks across the bond line is known as its "Tensile Shear Strength" and is usually expressed in pounds per square inch. By examining the bond line on the two pieces, we should find that a roughly equal amount of cured adhesive is left on both pieces. This ideal condition is known as a "cohesive break". However, if we find no adhesive left on one of the pieces (or very little adhesive) this is known as an "adhesive break" and is indicative of either poor surface preparation, the wrong adhesive, a non-receptive surface or a combination of these factors. It is important to recognize the major hindrances to adhesion. These are: DUST, DIRT, GREASE, CORROSION, OXIDATION, SCALE

In addition, smooth, nonporous surfaces generally provide poor bonds. Metals, plastics and glass, need to be artificially roughed-up to provide a good bond. Also, materials containing polyolefins or fluorocarbons will require some type of special pre-treatment prior to bonding. For proper bonding, any adhesive must adequately wet the surfaces. Therefore, proper cleaning must also be considered.

In summary, we see that the two most important aspects of surface preparation prior to adhesive bonding are: PROPER CLEANING and PROPER PHYSICAL CONDITIONING. Following is a list of materials commonly encountered in adhesive bonding with a short general description of the preparation methods commonly employed.

PLASTICS- Most plastics to be bonded will have a smooth surface; therefore, particular attention should be paid to roughing or etching the surface in addition to a good solvent cleaning. As pointed out above, some plastics (such as polyethylene) may require special types of treatment. The plastics manufacturer or distributor should be consulted in cases where surface preparation is questionable.

METALS - Two common methods of surface preparation are generally used:

a. degreasing followed by treatment by or grit blasting, grinding, sanding or honing.

b. chemical cleaning by one or a combination of the following methods:

1. degreasing with chlorinated or ketone solvents
2. alkaline cleaning
3. acid etching

GLASS - Solvent wiping and (where possible) sand blasting to improve mechanical bond are the preferred methods.

CERAMICS -Fired, unglazed ceramics generally require no preparation as long as they are clean. Glazed ceramics should be roughed-up by sanding.

The methods listed above are very general in nature and are not intended as specific recommendations by Lord. They are provided solely to focus the user's attention on the importance of proper surface preparation. Lord does not warrant the results of usage of the above methods nor does it assume responsibility for alleged failures of the above methods. Lord suggests that the user thoroughly familiarize himself with all available data for the particular materials he is using as well as conducting his own tests to determine the suitability of an adhesive for his particular application. There is considerable published information available covering surface preparation in detail. For example, the American Society for Testing and Materials publishes recommended practices such as:

ASTM D 2093 Preparation of Surfaces of Plastics Prior to Adhesive Bonding
ASTM D 2651 Preparation of Metal Surfaces for Adhesive Bonding

Complete publications listings are available from ASTM at 1916 Race Street, Philadelphia, PA 19103.

In summary, the possibility of achieving successful adhesive bonding may be increased by following these procedures:

1. Consider the nature of the application and understand the problems associated with adhesive bonding.
2. Conduct thorough suitability testing.
3. Select the proper adhesive.
4. Prepare the surfaces properly.