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LORD

3135 A/B & 3135/7111

TWO COMPONENT EPOXY ADHESIVE

Description:

Lord 3135 A/B & 3135/7111 is an epoxy-based, room-temperature-curing structural adhesive. Most metals, wood, glass, concrete and masonry, and various synthetic materials can be bonded with this adhesive. It provides high strength bonds, with a degree of flexibility in the bondline.

This polymer adhesive comprises two parts: the 3135 A Resin, and the curing agent, 3135 B (7111). These components should be thoroughly mixed in the recommended proportion just prior to use.

In general, this adhesive is characterized by:

- Long pot life
- Low rate of shrinkage
- Excellent resistance to mechanical impact, and shock
- Good electrical resistance
- Excellent adhesion to a multitude of substrates
- Good machinability.

Lord 3135 A/B & 3135/7111 is an excellent adhesive for bonding "skins" to plastic or metal honey-comb cores, polyurethane foams, and phenolic and epoxy laminates.

This curing agent, 3135 B (7111), has a very low level of toxicity. It is possible to reduce the viscosity of the curing agent by heating to 65°C. However, warming the material will shorten the pot life of the mixed compound. The curing reaction commences as soon as the parts are mixed together.

Typical Properties:

The values listed below are averages and they are not intended for specification purposes. Contact Lord when establishing specifications. The choice of cure schedule will vary with the application and users must establish their own optimum cure schedule.

Physical Properties (Uncured):

Color	Straw Yellow
Viscosity (cps) @ 24°C Brookfield Viscometer, Spindle #5 at 10 rpm	20,000 to 50,000

Mix Ratio by Weight	1:1
Specific Gravity	1.09
Pot Life @25ºC (Working Time - Hours)	1½ to 3
Flash Point	Greater than 225°C

Mechanical Properties (Cured):

Chemical Solvent Resistance	Good to Excellent
Approximate Heat Distortion Point	95°C
Operating Temperature Limit	95°C
Hardness (Shore D)	82
Coefficient of Linear Thermal Expansion in/in/°F	3.2×10^{-5}

The following data was derived from specimens cured for 24 hours at Room Temperature, followed by 1 hour at 65°C, with 10 psi pressure.

Compressive Yield Point (psi) (ASTM D-695)	10,000
Tensile Ultimate (psi) (ASTM D-695)	6,000
Flexural Ultimate (psi) (ASTM D-790)	12,000
T Peel @25°C @-106°C	5 lbs. per in. 1 lb. per in.
Flatwise Tensile @25ºC (psi) @ -73°C (psi)	500 550 psi

NOTE:

1. T Peel Specimens were 0.020-inches 7075 T-6 bare aluminum in 1 X 12-inch strips.
2. Flatwise Tensile Specimens were 2 X 2 inches.
3. Tensile Shear specimens were fabricated from 0.064 inch thick, 2024 T-3 clad aluminum.

All specimens were 1 inch wide, with ½ inch overlap.

TENSILE SHEAR STRENGTH OF LORD 3135 A/B & 3135/7111

(MIL-A-5090 D)

CONDITION	TESTED AT -195°C	-100°C	24°C	70°C
Original	2400 psi	2800 psi	3800 psi	550 psi
30-Day Humidity Exposure	2500 psi	2600 psi	3900 psi	400 psi
30-Day Salt Spray Exposure	2500 psi	3000 psi	3200 psi	600 psi

Humidity Exposure: Conditioned in a counter-flow humidity cabinet for 720 hours at a relative humidity of 100%, and a temperature of 72°C.

Salt Spray Exposure: Conditioned in a salt spray cabinet with saturated salt spray vapor for 30 days, in accordance with MIL-A-00509C, and with Federal Test Method Standard Number 152.

ELECTRICAL PROPERTIES OF LORD 3135 A/B & 3135/7111

PROPERTY	TEST METHOD	RESULTS
Dielectric Constant 60 cycles - R.T. 1000 cycles - R.T.	ASTM -D-159-47T	 3.24 3.21
Volume Resistivity (ohm-cm)	ASTM-D-257-252T	1.25×10^{14}
Arc Resistance (seconds)	ASTM-D-495-48T	78
Power Factor 60 cycles - R.T. 1000 cycles - R.T.	ASTM-D-150-47T	 0.0087 0.0106
Dielectric Strength 60 cycles - R.T.	ASTM-D-149-44	460 v/Mil
Loss Factor 60 cycles - R.T. 1000 cycles - R.T.	ASTM-D-150-47T	 0.0337 0.0341

PROPERTIES OF 3135 A/B & 3135/7111 ADHESIVE - BONDING VARIOUS SUBSTRATES

SUBSTRATE	SURFACE TREATMENT	CURE	TENSILE SHEAR; psi		TEE PEEL; Lbs. Per Inch	
			AT 24°C	AT -195°C	AT 24°C	AT -195°C
Teflon - TFE	NA-Naphthalene	48 hrs. at 24°C	2300	1800	10	5
Teflon - TFE	NA-Naphthalene	1 hr at 121°C	2800	3200	10	5
Teflon - FEP	NA-Naphthalene	48 hrs. at 24°C	-	-	12	4
Teflon - FEP	NA-Naphthalene	1 hr at 121°C	3000	5300	15	15
Kel - F	NA-Naphthalene	1 hr at 121°C	2600	5000	10	17
Tedlar (PUFL)	None	16 days at 24°C	2300	1600	5	2
Nylon FM63	None	48 hrs. at 24°C	1000	700	-	-
Zytel 61	None	48 hrs. at 24°C	1500	700	-	-
Zytel 61	TDI	48 hrs. at 24°C	1200	800	1	-
MD-551 (Chloro-Butyl Rubber)	None	1 hr. at 121°C	320	2300	5	5
Viton A-HV	None	1 hr. at 121°C	1400	4800	19	7
Adiprene C	None	1 hr. at 121°C	2600	3800	15	10
Thiokol FA	None	1 hr. at 121°C	130	1300	7	2
Hypalon 40	None	1 hr. at 121°C	2800	4400	15	4
Copper Foil (2 Mil)	Dilute Nitric Acid	7 days at 24°C	1400	1000	2	5
Lead Foil (4 Mil)	Dilute Nitric Acid	7 days at 24°C	1700	700	5	1
Tin Foil (4 Mil)	None	2 days at 24°C	2400	2200	4	3
Cadmium Foil	None	2 days at 24°C	1500	900	1	1

Mixing Procedure

Just prior to application, stir the constituents vigorously with a glass rod, steel or wood spatula, until a homogeneous paste mixture is achieved. Mixing may be achieved by use of an electric drill fitted with an impeller or automatic mix-metering dispensing equipment. An induction period of 15 minutes is recommended before using.

Application

The mixed 3135 A/B (7111) can be applied with a brush, spatula, putty knife, trowel, or similar instrument. The suggested bondline thickness is 2 to 5 mils for non-porous surfaces or 6 to 10 mils for porous surfaces. A practical guide to usage is 250 square feet at 4 to 5 mils per gallon kit on a non-porous surface.

Cure

The adhesive is cured by a time and temperature pressure relationship. Apply approximately 10 psi pressure, or sufficient contact pressure to ensure that the surfaces are held in intimate contact during the period of cure. At Room Temperature (24°C), the cure is usually accomplished in 24 hours. The cure can be accelerated appreciably by subjecting the bonded parts to an elevated cure cycle of:

30 minutes	@ 150°C
45 minutes	@ 121°C
1 hour	@ 93°C
3 hours	@ 65°C

Shelf Life & Storage

When stored in original unopened container in clean, dry environment shelf life for PMF is 30 days @ -40°C or below, shelf life for 3135 B is two years.

Shipping Criteria

Non-flammable . . . non-corrosive . . . may be shipped via air, land and sea.

Handling Precautions:

The labels on containers of Lord materials contain current information on the hazards associated with each particular product. Most epoxy resins and hardeners are skin and eye irritants. Some may 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, none the less, 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. An example of this is clean, dry, raw wood. Some woods, however, such as Teakwood, possess a high degree of natural oils which make bonding to it difficult to impossible. 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. This is why most woods are easy to bond. The natural porosity inherent in wood allows the adhesive to "wick" into the surface and surround the fibers providing good mechanical strength. Metals, plastics and glass, on the other hand, 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.

WOOD - Insure that the surface is dry and free from contaminants such as grease or oil. A rough sanding will aid adhesion followed by removal of sanding dust.

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.