March 27, 1998

DC-80

VARIABLE FLEXIBILITY, THIXOTROPIC EPOXY ADHESIVE

Description:

Lord DC-80 is a paste consistency, epoxy adhesive which may be used in varying proportions of resin to hardener to provide optimum properties for particular applications. Higher levels of hardener produce cured products of increased flexibility. Lord DC-80 will provide improved tensile shear and peel strength in the bonding of flexible substrates.

Lord DC-80 resin is white and the hardener is black. These colors assist as an indicator of a thorough mix when the catalyzed system becomes gray without streaks.

Use:

The following list of suggested mix ratios (resin:hardener) gives the application and typical cured properties of each:

Rigid Bond: 2:1 by weight or 1.7:1 by volume. Bonds metals, glass, ceramics, and most plastics. Best chemical resistance. Can be used in some applications to temperatures of 250°F.

Semi-Rigid Bond: 1:1 by weight or 1:1.2 by volume. Improved impact and thermal shock resistance. Higher tensile shear strength than rigid bond.

Flexible Bond: 1:2 by weight or 1:2.4 by volume. For bonding hard rubber, teflon and treated polyethylene. Better peel strength than rigid or semi-rigid bond.

Within the range of mix ratios from 1:2 to 2:1 (resin to hardener by weight) cured properties can be effected as follows:

	Increasing the Proportion of DC-80 Hardener	**Decreasing the Proportion of DC-80 Hardener**
Flexibility	Increases	Decreases
% Elongation	Increases	Decreases
Water Resistance	Decreases	Increases
Heat Resistance	Decreases	Increases
Acid Resistance	Decreases	Increases

Typical Properties:

The values listed below are averages and they are not intended for specification purposes. Contact Lord when establishing specifications. In the interest of achieving optimum properties in a minimal amount of time, the cured physical properties were developed by using a cure schedule of sixteen hours at 25°C plus one hour at 100°C. The choice of cure schedule will vary with the application and users must establish their own optimum cure schedules.

Handling Properties:

Mix Ratio	Variable (See text)
Mixed Viscosity @ 25°C	Thixotropic Paste
Working Life @ 25°C (1 lb) (minutes)	60

Typical Cure Schedule of Thin Bond Lines

	Initial	Full
@ 25°C	24 hours	7days
@ 66°C	2 hours	3 hours
@ 93°C	30 minutes	80 minutes
@ 121°C	5 minutes	45 minutes
@ 150°C	- - -	20 mins

Measured after system reaches temperature

Physical Properties:

Color	
Resin	White
Hardener	Black
Mixed	Gray

Hardness (Shore D) vs Mix Ratio

@ 2:1	resin to hardener by weight	
@ 1:1	" " " " "	82
@ 1:1.5	" " " " "	60
@ 1:1.75	" " " " "	40
@ 1:2	" " " " "	20

STM 5 (ASTM D 2240)

Tensile Shear Strength (psi) (Al to Al)

@ 2:1	mix ratio by weight	3,300
@ 1:1	" " " "	4,750
@ 1:2	" " " "	840

(ASTM D 1002)

Physical Properties (cont'd):

Compressive Yield (mixed @ 100:50 by weight) ASTM D 695	12,000 psi
Tensile Strength (mixed @ 100:50 by weight) ASTM D 638	7,600 psi
Percent Elongation (mixed @ 100:50 by weight) ASTM D 638	12%
Flexural Modulus (mixed @ 100:50 by weight) ASTM D 790	3.0 x 10^5 psi
Tensile Shear Strength (steel to steel) Mixed @ 1:1 by weight and cured @ 149°C (ASTM D 1002)	4,920 psi
Maximum Heat Distortion Temperature (ºF) Mixed @ 100:33 by weight STM D 648	232

To insure thorough mixing, periodic scraping of the sides and In most cases, STM (Lord Standard Test Methods) correspond with standard ASTM tests. Copies are available upon request.

Proportioning and Mixing:

Lord DC-80 can be proportioned by weight or volume. Automated meter-mix dispensing equipment may be used for high volume production. (A list of dispensing equipment manufacturers is available from Lord.)

When mixing small amounts of DC-80, it is best to use a balance and disposable containers. The containers should be large enough to hold both resin and hardener and still have ample room for mixing. After allowing for the weight of the container, the correct amount of resin is added to the container. The scale is then set for the total weight of both resin and hardener. The hardener is added slowly until the total weight is reached bottom of the container is necessary. Even small amounts of improperly mixed material can cause soft spots or irregular curing.

Clean-Up:

It is recommended that customers use disposable containers and utensils when working with epoxies. However, when disposable materials are impractical, uncured epoxy can be removed by cleaning equipment with solvent. Observe appropriate precautions when using flammable solvents. Solvent-cleaned utensils should be thoroughly dried before reuse. Any remaining solvent can contaminate the next mixture.

Shelf Life and Storage:

Lord DC-80 resin has a shelf life of six months and DC-80 hardener has an approximate shelf life of twelve months at room temperature (25°C) in closed containers.

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 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.

<u>PLASTICS</u>- 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.

<u>METALS</u> - 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

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

<u>CERAMICS</u> -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.