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Composite Bond Prep 101

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Introduction

Surface preparation for adhesive bonding is the process of creating roughened surfaces for joining to optimize load transfer from one part to another. These surfaces are called Faying or Joining surfaces. The bond preparation is typically dependent on the substrate (type of material) to be bonded and the type of adhesive used. The enclosed set of processes is targeted at bond preparation of thermoset Epoxy composite laminates. We touch on initial cleaning prior to prep, abrasion and verification of bond prep final cleaning and preparation prior to application of the adhesive. The set of processes herein do not necessarily reflect the processes required for the bonding of thermoplastic materials, metal, ceramics or wood materials.

Pre-cleaning surfaces prior to abrasive surface prep

Generally, when bonding to a composite laminate or tube, like those supplied by Rock West Composites, it will be important to clean the piece to be prepared prior to the abrasion process. This is done to remove any oils or foreign contaminants that could be spread over the bond areas during the abrasion process, assuming that the surfaces are dirty.

- 1. Wash the composite surfaces to be bonded with detergent and water
 - a. A small amount of Alconox, Tide or Dish Washer Detergent but not soap*
 - b. Rinse well and dry**
- 2. Wipe the surface with Acetone followed by Alcohol using a clean cotton rag, tex-wipe or other lint-free wipe.*

Pre-fitting

Dry-fit your assembly into its final configuration to ensure that everything fits together as required before applying adhesive. This will allow you to better understand the fixturing, the bond areas you need to prepare and any bond-line thickness control that may be required to ensure that your final assembly meets your expectations. Dry-fitting your assembly before pre-cleaning and bond prep ensures that the bond areas are not contaminated after they have been prepped and cleaned for bonding.

Generally, adhesive thicknesses should be between 0.007" and 0.025" thick, though thinner and thicker bond-lines are often used with reductions in some properties. Bond-lines on tubular fittings may need to use bond-line control to center the fitting with the axis of a tube. This is achieved through the incorporation of bond beads (tiny spheres) into the adhesive while mixing the adhesive components together.

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Once the pre-assembly is complete, mark the areas to be bonded by lightly scribing lines into the surface, marking with a pencil or masking off the area with masking tape. A good practice is to bond prep about 1/8" beyond the part contact areas, so that any area that adhesive is applied is adequately prepared (Note: The highest stress in a bonded joint is at its edge, so fillets and edge surface prep ensures a good bond).

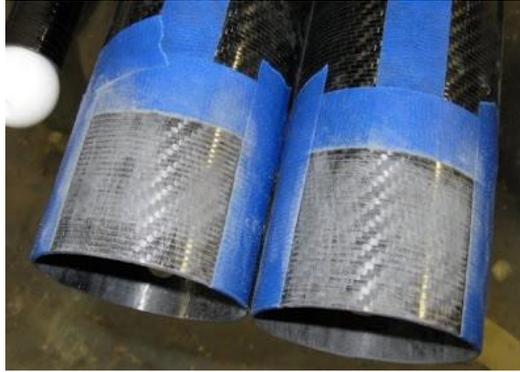


Fig. 1; Tape off the area to be abraded

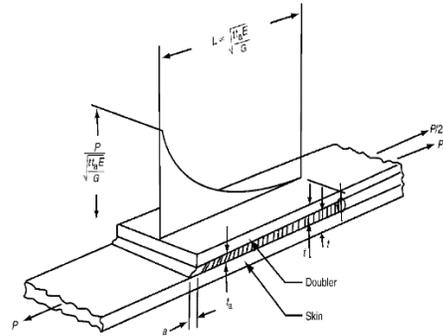


Fig. 2; Stress peaks at the edge of the bond

Abrading the Bonding Surfaces

Many abrasion techniques can be used to roughen and prepare the bond areas on composite surfaces. This document discusses abrasion by hand with Scotch-Brite, sandpaper and Grit-Blasting.

1. Scotch-Brite Prep

Abrasion using Scotch-Brite Pads will leave a superior bondable surface if done correctly. A fine (grey) or medium (red) grit pad is generally preferred as it is able to scuff smooth tool-side surfaces as well as non-uniform or rough surfaces without sanding through the fibers next to the surface. When abrading with Scotch-Brite, scuff 100% of the surface. Do not leave any shiny spots on the surfaces to be bonded. Once the surfaces are completely scuffed, wipe them with acetone to verify that no sheen remains on the surface. If you can see the reflection of lights, continue scuffing until no reflection or shiny spots remain. Un-sanded areas will appear darker than sanded areas.

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2. Sandpaper Prep

Start the surface prep with sandpaper at the highest grit that will not damage the composite (will not abrade through the outer ply). Start with 150 grit sandpaper and finish with 220 to 320 grit to reach all areas of the surface. Sandpaper will not generally conform to rougher, non-tooled surfaces and will end up cutting into the first ply to eliminate the shiny surfaces.



3. Grit-Blasting Surface Prep

Abrasion by Grit-Blasting can be an effective way to prep surfaces for bonding. Variations with the type of grit media, pressure and grit nozzle will affect the prepared surfaces and should be understood before proceeding. Some guidelines to consider for Grit-Blasting as a bond prep are:

- a. Use new, clean blast media to ensure a sharp grit without contaminants
- b. Keep the blast pressure at or below 40psi
- c. Do not use blast media that "eats" away the composite. Baking soda is a commonly used blast media for composite materials and will not cause damage to the composite.

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- d. *Always wash grit-blasted parts with clean water and detergent followed by a clean water rinse and alcohol wipe.*



Cleaning after Abrasion

If dirt and/or oil is not cleaned, your bond will only be as strong as the forces that hold the dirt and oil to the surface of the part. Follow these steps to thoroughly clean dirt and oil off the surface:

1. *Scrub the abraded surface with a brush using a mild detergent and clean water to remove all of the dust and grit created during abrasion.*



2. *Dry the part with a hair dryer or in a warm oven at 100°F for 15 min.*
3. *Solvent wipe the surface with a clean cotton rag, Tex-Wipe or other lint-free wipe and acetone followed by Isopropyl Alcohol. The alcohol is used to clean acetone from the surface, which can break down the resin in the part if left on the surface too long. Using Q-tips to clean smaller areas can be very effective. The bonding surfaces should be cleaned until no debris is removed during the solvent wipe. (ie. Little to no black should come off a carbon epoxy laminate when cleaned).*

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4. *Make sure that any cut edges in the bond area are also cleaned.*

Verification of surface cleanliness.

On surfaces where maximum adhesive bond strength is required, a simple verification test can be done to evaluate the cleanliness of the surface.

A water break test is often used to verify surface cleanliness for bonding. This test will require that you have distilled water in either a squirt bottle or a small pitcher to pour over the prepared surface. To perform this process:

1. *Place the part over a pan or water collection device*
2. *Pour or squirt the distilled water slowly over the areas to be validated*
3. *Watch as the water flows over the surface to see if the flow stream is smooth or breaks into beads, leaving a non-wetted area.*
4. *If the area has a break or multiple breaks the surface prep should be repeated until no breaks are seen during this test (see illustration below).*



Left side is properly cleaned. Right side needs further cleaning.

Indemnity

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