

Adhesion Testing Procedures

Glue: 3M Scotch-Weld DP-460NS

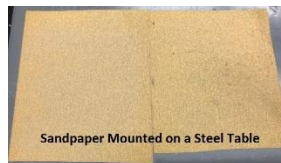


Testing Equipment: DeFelsko PosiTest AT



Dolly Preparation

- For new dollies, soak the dollies for a minimum of 24 hours in MEK or Acetone to remove the tooling oils.
- For used dollies, soak dollies in MEK or Acetone to remove glue/coating. Depending on the type of glue or coating that was on the dolly, removal of the glue/coating may require the use of a tool. A suggested tool for doing this is a chisel. It is important that the chisel doesn't have any imperfections that can cause deep gouges in the dolly.
- Using 80 to 120 grit sandpaper on a flat surface (adhesive backed sandpaper works great), sand any remaining glue/coating from the used dollies. Once clean, sand 5 times in one direction then turn the dolly 90 degrees and sand once to create a cross-hatch profile. Make sure to keep the dolly flat while sanding to avoid rounding the corners of the dolly.

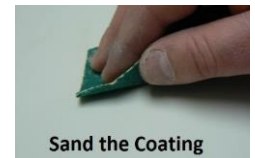


- Press the prepared side of the dolly onto the adhesive side of scotch tape. Leave the dolly on the tape until you are ready to apply the glue to the dolly (this process removes the aluminum dust from the dolly profile and helps keep the dolly clean while waiting for use). **Do not store the dolly on the tape for longer than 1 hour or the tape adhesive may stick to the dolly, resulting in poor glue adhesion to the dolly.**



Coating Preparation

- Using 80 to 120 grit sandpaper, sand the surface of the coating in one direction until all of the gloss is removed from the coating.
- Using a clean rag, wipe the sanded coating surface to remove all of the dust. Continue wiping the surface until there is no longer any visible dust on the rag after wiping with a clean rag.



Glue Mixing: Scotch-Weld DP460 NS

- Use of the EPX Applicator System with EPX mixing nozzle (static mixer) is NOT recommended due to poor mixing and excessive waste when small portions are extruded.
- Hand mixing instructions:
 - Place the duo-pak cartridge into the applicator gun (make sure the applicator has the correct plunger ratio for DP-460NS, which is 2:1).
 - Remove the cap from duo-pak cartridge.
 - Dispense the desired amount of glue onto a clean disposable surface (e.g. coated cardboard).
 - Using a clean utensil (small tongue depressors work well), thoroughly mix the two parts together. The glue should have a uniform color and viscosity when mixing is complete.
- The pot life for mixed DP-460NS is about 60 minutes at 70°F (21°C). The pot life will be shorter at higher temperatures and longer at lower temperatures.

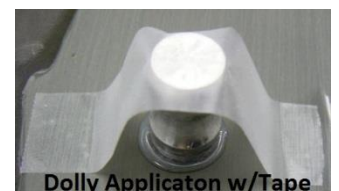


Gluing Dolly

- For applying the dolly to a non-horizontal surface, it is recommended that the dolly be secured to the surface until the glue cures. One option is:
 - Measure out about 4" of scotch tape and orient the tape so the adhesive side is facing up on a flat surface.
 - Set a dolly in the middle of the scotch tape section with the prepared side of the dolly facing up (the top of the dolly should be stuck to the tape).
- Using a clean utensil, apply a liberal amount of the mixed DP-460NS to the prepared side of the dolly and spread the glue uniformly around the surface of the dolly (try not to spread it too thin). Remove any visible air bubbles in the glue.
- Gently press the glue/prepared side of the dolly onto the sanded, clean coating surface until the glue is visible all around the dolly edges.* Do not press too hard. DP-460NS is not activated by pressure like cyanoacrylate glues. Pressing too hard may force too much of the glue out from under the dolly, potentially causing a gap to develop under the edge of the dolly when applying it to a curved surface.
 - Securing with tape (optional): while holding the dolly in place, attach both ends of the scotch tape to the coating surface in such a manner that the dolly is held firmly in place.* Try not to let the dolly move around during this process.



Dolly Application w/o Tape



Dolly Application w/Tape

*Care must be used to ensure that the dolly is applied perpendicular to the test substrate. Dollies pulled at an angle not normal to the substrate may result in artificially low adhesion results due to a peel force applied to the coating.

Adhesive Curing

- Option 1 (preferred method) – ambient curing in temperatures at or above 60°F (16°C): allow glue to cure for a minimum of 24 hours (longer cure times will result in higher glue strength). Glue curing is catalyzed by heat. Ambient temperatures above 60°F (16°C) will result in faster cure times, and vice-versa.
- Option 2 – for time sensitive dolly-pull applications or in cold ambient conditions:
 - For non-horizontal surfaces, make sure dolly is fastened down securely.
 - Using a heat gun on LOW setting, hold the heat gun directly above the dolly so the hot air is impacting the top of the dolly. **Keep the tip of the heat gun at least 4” above the surface of the coating to avoid overheating the coating surface.**
 - Heat the dolly for about 15** seconds, remove the heat for at least 1 minute, then heat again for 15 seconds. Repeat this process until the dolly has been heated for total of 1-2 minutes (four to eight 15 second heat cycles, total), depending on ambient conditions. **Use an infrared thermometer to monitor the coating surface temperature and do not let the coating temperature exceed 180°F.** (**use caution as there is variability between heat gun manufacturers/models)
 - At an ambient temperature of 70°F (21°C), heating the dolly with a heat gun for 1 minute will typically result in a 3 hour cure-to-pull dolly time.
 - For ambient temperatures <50°F (10°C), a total dolly heat time of 2 minutes may be necessary. Allow for a longer cure-to-pull dolly time at colder temperatures (test different cure times to determine the minimum required time for your ambient temperature).

Dolly Pull

- Score dolly
 - Using the properly sized scoring tool, gently score around the dolly to remove excess glue and coating.
 - Try to keep the scoring tool perpendicular to the test site to avoid putting leverage on the dolly as you score around it.
 - While scoring, regularly clean the debris that forms during the scoring process so that it doesn't impact the adjacent test site.
- Pull dolly
 - Record the environmental conditions and any pertinent test information.
 - Turn on the DeFelsko PosiTest AT and make sure it is set for the correct dolly size.
 - For the AT-A model (automatic unit), set the pull rate to the specified rate. Typical pull rates are 100-150 psi/sec. If the dolly size is changed after setting the pull rate, be sure to check the pull rate to make sure it is correct as the pull rate changes when the dolly size is changed.
 - Zero the PosiTest.
 - Attach the detaching assembly to the dolly such that it is perpendicular to the test surface. For test surfaces that are non-horizontal, continuously support the detaching assembly in the perpendicular position from the time it is attached to the dolly until the test is complete. Failure to do so will result in an abnormal force on the dolly that could lead to artificially low adhesion results.

- Start the test. Note: for the AT-M model (manual unit), ensure pressure is applied in a manner that keeps the pull rate at or below the specified rate. Try to keep the pull rate as close to the specified rate as possible. Applying pressure too slowly may result in the test taking longer than the maximum allowable time of 100 seconds.
- Record the test result.
 - For tests that result in termination without dolly removal, record the maximum test pressure and note “Term”.
 - For test that result in dolly removal, record the maximum test pressure and note the percentages of the method of fracture:
 - Adhesion, typically marked with an “A”, is used to indicate the area where the coating fractured clean at the substrate.
 - Cohesive, typically marked with a “C”, is used to indicate the area where the coating internally fractured, meaning coating remains on both the substrate and the dolly.
 - Glue, typically marked with a “G”, is used to indicate the area where the glue fractured, either from itself, at the coating surface or from the dolly surface.
 - Note: it is common for pull-off results to have a combination of two or more of the fracture methods listed above. For example, a result could have 20% A (adhesion), 20% C (cohesion) and 60% G (glue).