# Thermoplastic Polyether-Polyurethane Elastomer

## Adhesive Bonding

### Dow Chemical: Pellethane 2363-55D

A study was conducted to test for bond strength on a representative matrix of commonly used plastics and the adhesives best suited to them. For many of the plastics evaluated, the effect of polymer composition on bond strength was evaluated by compounding plastic formulations with each of the most commonly used additives and fillers for that plastic; common grades were used for the remaining resins. The effect of each additive and filler was determined by comparing the bond strength achieved with the specially compounded formulations to that of the neat plastic. In addition, the effect of surface roughening and chemical treatment of the plastic surface on bond strength was examined.

The block-shear (ASTM D 4501) test was chosen as the test method because it places the load on a thicker section of the test specimen that can withstand higher loads before experiencing substrate failure. In addition, the geometry of the test specimens and the block-shear fixture helps minimize peel and cleavage forces in the joint. How well the block-shear test method reflects the stresses that an adhesively bonded joint will experience in real world applications should be considered. Also, limitations on the data due to the variety of additives and fillers used by different companies should not be ignored.

Prism 401, used in conjunction with Prism Primer 770, created bonds which were stronger than the substrate for most of the polyurethane formulations which were evaluated. Typically, the adhesives which achieved the second highest bond strengths were Loctite 3105, a light curing acrylic adhesive, followed by Prism 401 and Super Bonder 414, both cyanoacrylate adhesives, and Depend 330, a two-part no-mix acrylic adhesive. Black Max 380, a rubber toughened cyanoacrylate adhesive, consistently achieved the lowest bond strengths on polyurethane.

*Surface Treatments*
The use of Prism Primer 770, in conjunction with Prism 401, resulted in a large, statistically significant increase in the bond strengths achieved on polyurethane. Surface roughening also resulted in a statistically significant increase in the bond strengths achieved on polyurethane for all the adhesives which were evaluated.

*Other Information*
Polyurethane can be stress cracked by uncured cyanoacrylate adhesives, so any excess adhesive should be removed from the surface immediately. Polyurethane is compatible with acrylic adhesives but can be attacked by their activators before the adhesive has cured. Any excess activator should be removed from the surface immediately. Polyurethane is incompatible with anaerobic adhesives. Recommended surface cleaners are isopropyl alcohol and Loctite ODC Free Cleaner 7070.

**Table 88.1:** Shear strengths of polyurethane (PU) to PU adhesive bonds made using adhesives available from Loctite Corporation. Values are given in psi and (MPa).[a,c]

| Plastic Material Composition (Dow Chemical Pellethane 2363-55D) | | Loctite Adhesive | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Black Max 380** rubber toughened cyanoacrylate (200 cP) | **Prism 401** surface insensitive ethyl cyanoacrylate (100 cP) | **Prism 401/ Prism Primer 770** polyolefin primer for cyanoacrylate | **Super Bonder 414** general purpose cyanoacrylate (110 cP) | **Depend 330** two-part no-mix acrylic | **Loctite 3105** light cure acrylic (300 cP) |
| Unfilled resin (shore D) | 14 rms | 200 (1.4) | 350 (2.4) | 1400 (9.7) | 300 (2.1) | 350 (2.4) | 1150 (7.9) |
| Roughened | 167 rms | 350 (2.4) | 1350 (9.3) | 1950 (13.5) | 1300 (9.0) | 1500 (10.3) | 1700 (11.7) |
| UV stabilizer | 1% Tinuvin 328 | 100 (0.7) | 200 (1.4) | 950 (6.6) | 150 (1.0) | 350 (2.4) | 750 (5.2) |
| Flame retardant | 15% BT-93<br>2% Antimony Oxide | 200 (1.4) | 450 (3.1) | >1850[b] (>12.8)[b] | 600 (4.1) | >1400[b] (>9.7)[b] | >1350[b] (>9.3)[b] |
| Plasticizer | 13% TP-95 | 50 (0.3) | 150 (1.0) | >750[b] (>5.2)[b] | 150 (1.0) | 200 (1.4) | 450 (3.1) |
| Lubricant #1 | 0.5% Mold Wiz INT-33PA | 200 (1.4) | 800 (5.5) | >2150[b] (>14.8)[b] | 700 (4.8) | 900 (6.2) | >1800[b] (>12.4)[b] |
| Lubricant #2 | 0.5% FS1235 Silicone | 450 (3.1) | >2250[b] (>15.5)[b] | >2900[b] (>20.0)[b] | 1250 (8.6) | >2650[b] (>18.3)[b] | >2350[b] (>16.2)[b] |
| Unfilled resin (shore A) | Estane 58630<br>B.F. Goodrich | 200 (1.4) | >850[b] (>5.9)[b] | >1300[b] (>9.0)[b] | 550 (3.8) | 450 (3.1) | 800 (5.5) |

[a] All testing was done according to the block shear method (ASTM D4501).

[b] Due to the severe deformation of the block shear specimens, testing was stopped before the acutal bond strength achieved by the adhesive could be determined (the adhesive bond never failed).

[c] For more information on data presented in this table, contact Loctite Corporation at 800-562-8483 (1-800-LOCTITE). Request the "Design Guide for Bonding Plastics."

**Reference:** *The Loctite Design Guide for Bonding Plastics*, supplier design guide (LT-2197) - Loctite Corporation.