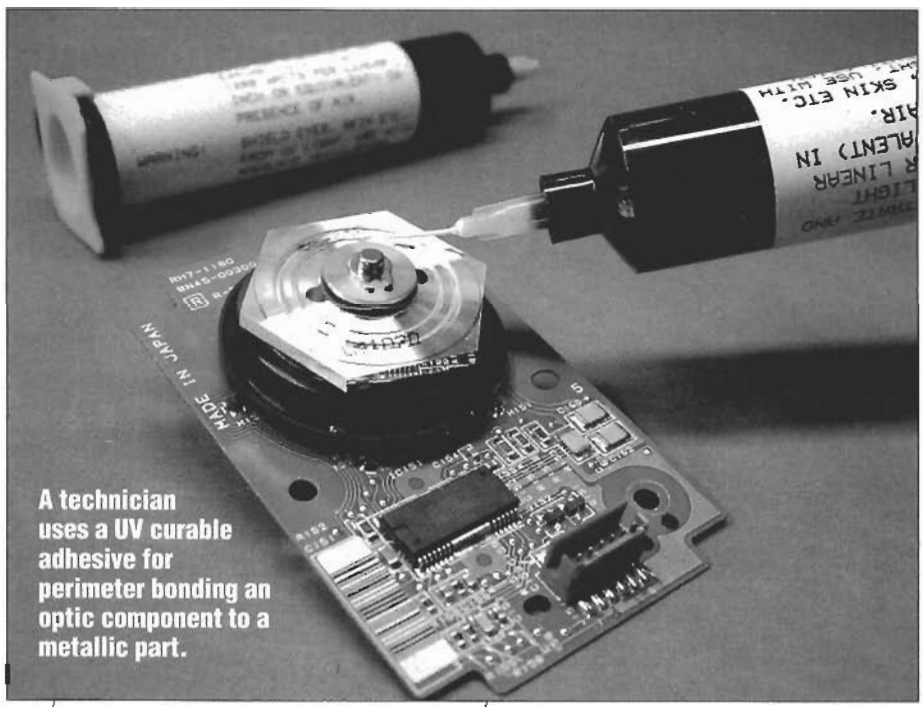
UV-cure adhesives 101

UV-curing adhesives can help get manufacturers out of sticky situations.

Walter Brenner
Technical Director
Master Bond Inc.
Hackensack, N.J.



A technician uses a UV curable adhesive for perimeter bonding an optic component to a metallic part.

Organic adhesives usually contain solvents and various diluents or are composed of two components which must be carefully weighed and mixed prior to use. After these adhesives are applied, it takes heat to drive off solvents and other volatiles and speed the cure or hardening, especially for two-component mixtures. This thermal curing puts as many as 6 gallons of solvent into the air for every gallon of solid adhesive left. Such pollution is regulated by the EPA and companies are often forced to buy expensive recovery systems with afterburners.

UV-curing adhesives and compounds, on the other hand, avoid most of these problems while providing top-notch bonding and performance. For example, UV adhesives use only one component, so there's no weighing or mixing before use. This simplifies production schedules by eliminating pot-life problems. UV adhesives are also 100% reactive, so there are no volatile losses during curing and the process is nonpolluting.

UV adhesives remain stable and usable — even after storage at ambient temperatures for six months — until activated by UV light. Activation occurs only when exposed to UV light of 250 to 350 nm, and then the materials cure on demand, letting companies get rid of lengthy ambient-temperature cures or ovens needed for elevated temperature cures.

Edited by Stephen J. Mraz

HOW THEY WORK

UV adhesives absorb radiant energy from a UV light source and convert it to chemical energy so quickly that curing is practically instantaneous. So quick, in fact, that substrates experience only a brief, superficial temperature change. This lets companies use UV adhesives on heat-sensitive materials including plastic films, moldings, and synthetic fibers, as well as elastomers and paper products.

The lack of heat is particularly valuable in electrical and electronic industries where transient thermal changes can degrade a component's performance. In addition, the low heat reduces substrate shrinkage and warpage, and permits additional on-line processing and off-line handling. This eliminates having to move parts to cooling racks before they go down the line, along with the space and labor requirements.

Completely reactive UV adhesives are not oxygen-inhibited and have fast curing rates at ambient temperatures and atmospheres, though curing is faster if heat is applied. This eliminates the need for atmospheric control

UV ADHESIVES

Grade	Viscosity RT (cps)	Color	Hardness (Shore D)	Temperature range (°F)	Application
UV10	300 to 400	Light amber/clear	60 to 65	–60 to 250	Low-viscosity, general-purpose adhesive, sealant, coating, and encapsulant. Cures rigid and up to 0.125-in. deep
UV10FL	600 to 700	Light amber/clear	45 to 50	–60 to 250	Flexible version of UV10. Resists shock and vibration. Good thermal cycling properties
UV10LV	150	Light amber/clear	75	–60 to 250	Ultralow viscosity. Good electrical properties. Ideal for conformal coatings
UV10MED	1,200 to 1,500	Light amber/clear	60 to 65	–60 to 250	Medical version of UV10. USP Class IV approved. Resists sterilants.
UV10PSA	16,000 & 18,000	Transparent	N/A	–60 to 250	Strong, fast-tacking pressure-sensitive adhesive. Available in two viscosities for flexible application.
UV10TK	30,000 to 40,000	Light amber/clear	70 to 75	–60 to 300	Higher viscosity version of UV10. Enhanced chemical and temperature resistance. Good dimensional stability, low shrinkage
UV14-3	8,000	Transparent	30	–60 to 250	Flexible adhesive. Removes easily with conventional solvents. Low refraction index (1.477)
UV14X-2TK	Thixotropic	Transparent	60	–60 to 250	Semiflexible adhesive. Durable. Good electrical properties and low shrinkage.
UV15	120 to 150	Slight amber/clear	Below 75	–60 to 300	Very-low viscosity, good temperature stability, resists chemicals and shrinkage.
UV15-42C	Paste	Translucent	Below 50	–60 to 250	Fast curing, good dimensional stability, and little shrinkage.
UV15-7	1,400 to 1,800	Transparent	70	–60 to 300	Good adhesion and nonyellowing.
UV15-7DC	1,500 to 2,500	Transparent	below 70	–60 to 300	Dual-cure version of UV15-7. Cures in shadowed out areas by adding heat (250°).
UV15-LRI	6,000 to 10,000	Transparent	50	–60 to 250	Low refraction index (1.481)
UV15-7SP4	800 to 1,500	Transparent	35	–80 to 250	Flexible version of UV15-7
UV15-7SP4DC	800 to 1,500	Transparent	35	–80 to 250	Dual-cure version of UV15-7SP4
UV15-7TK1A	Paste	Translucent	65	–60 to 300	Paste version of UV15-7
UV15FL	200 to 300	Light amber/clear	60	–60 to 250	Flexible version of UV15. Improved peel strength
UV15TK	8,000 to 10,000	Slight/amber	Below 75	–60 to 350	High viscosity version of UV15
UV15X-2	6,000 to 8,000	transparent	65	–80 to 250	Semiflexible adhesive
UV15X-2GT	Paste	Translucent	65	–80 to 250	Resists heat and moisture
UV15X-5	120,000	Transparent	35 to 40	–80 to 250	Flexible with good peel strength and abrasion resistance
UV15X-6 MED	24,000	Transparent	25 to 30	–80 to 250	Medical grade of UV15X-5. USP Class IV approved.
UV16	120 to 150	Slight amber/clear	Below 75	–60 to 300	Resists temperature and chemicals. Little shrinkage.
UV18 MED	1,800 to 2,000	Transparent	55 to 60	–60 to 250	Class VI medical adhesive. Resists sterilants
UV18S	1,800 to 2,000	Slight amber/clear	55 to 60	–60 to 250	Resists acids, bases, and solvents.
UV19	300	Transparent	15 (Shore A)	–60 to 250	Ultraflexible and soft curing.
UV21	32,000 to 36,000	Transparent	20 to 25	–60 to 250	Flexible and adheres to acrylics, glass, polycarbonates, and other optical-type substrates
UV22	4,000	Transparent below 85	–60 to 300		Nanoparticle-reinforced for strength and low shrinkage

The table lists various properties of UV-curing adhesives from Master Bond. Those with n/a under hardness are so listed because Shore-D hardness cannot be measured on these formulations.

— a nitrogen atmosphere, for example — to get tack-free cures. Equally important, cure continues in the dark after UV exposure until all UV reacting species are consumed, thus making economical use of UV energy.

UV compounds can cure despite cross-section thicknesses up to 0.5 in. and more for specific formulations. Maximum dimensional accuracy is assured because the compounds cure with minimum shrinkage.

UV-cured bonds remain intact over temperatures ranging from –80 to 350°F. The bonds also stay intact for a long time because they resist most chemicals even in the presence of moisture and heat.

For best adhesion, substrates must be carefully cleaned of oils, greases, release agents, dirt, and other contaminants. In many cases, such as with metals and other inorganics, a simple test determines if the surface is clean. The test involves spreading a few drops of cool water on the surface. If water spreads over the area with a continuous film, parts are clean enough. But if water beads or stays in puddles, degrease the surface with an EPA-acceptable solvents such as IPA or acetone. Repeat the water test before applying UV-cure adhesives. Polyolefins, such as polyethylene and polypropylene, as well as fluorocarbon polymers such as polytetrafluoroethylene and various chlorinated fluorocarbon resins, require special surface treatments for adequate adhesion. **MD**