

## Cyanoacrylate Adhesive, (CA glue)

Cyanoacrylate is a simple polar linear molecule that polymerizes rapidly when exposed to moisture. The first commercial CA adhesive, Eastman 910, was introduced in 1958. During the Vietnam war it was used for emergency wound repairs and other medical applications.

Ethyl cyanoacrylate formulations are used for general purpose bonding including wood, paper, and plastic materials. Methyl formulations are used in industrial applications for bonding metals.

CA is an appealing glue, because it is relatively non-toxic, very fast-acting, extremely strong, and needs no other mixer or catalyst. There is no need for ovens or clamps. Lightweight construction often utilizes CA since very little glue is required to create a strong joint.

CA differs from conventional adhesives in that it does not set by the evaporation of a solvent, and yet is still a one-part adhesive. Moisture is required to make it set. Normally a thin layer of water is naturally present on the parts to be glued, and this is the catalyst that makes CA set. CA acts like a pressure sensitive adhesive because of this, and this fact also explains why a good fitting joint results in stronger bonds. Smooth surfaces that have close contact are more readily bonded, and setting or "polymerization" will take place almost instantaneously. A thickening agent must be used when the parts to be bonded do not mate, or have rough surfaces or voids up to 0.25 mm (0.010 in.). Setting can take up to a minute, but usually occurs with 5 to 25 seconds. However the adhesive will not reach its ultimate tensile strength until aged for 24 to 48 hrs at room temperature.

Typical hobby shop varieties of CA glues are ethyl formulations and are available in three viscosities: thin, medium, and thick. When shopping for CA, remember that higher purity formulations work better. (USA Gold is one recommended brand.)

### Advantages to CA glues:

- One-part system.
- Solvent free.
- Rapid room temperature cure reduces need for fixturing.
- Excellent adhesion to many substrates.
- Wide range of viscosities.
- Excellent bond strength in shear and tensile mode.
- Primers available for polyolefins and engineering plastics.

### Disadvantages:

- Bonds to skin instantly, posing safety risks.
- Fumes are unpleasant and may present a health risk. (Produces Cyanide gas when heated)

- Eats plastic foam instantly.
- Poor peel strength.
- Poor resistance to impact loads.
- Subject to age embrittlement.
- Limited gap cure.
- Poor durability on glass.
- Low temperature resistance (loses strength at about 185 deg. F)
- Poor solvent resistance.
- May stress crack some sensitive plastics, such as polystyrene, polycarbonate and acrylics.
- Tends to "fog", or discolor some plastics.

### Rules of Thumb for CA's:

- The better the parts fit, the stronger the glue joint.
- The strongest CA glues are water thin.
- CA glue is relatively heavy. CA glue piled up on exterior surfaces does not add strength to the joint.
- The better the glue penetrates the substrate, the better the glue joint.
- The thicker the CA glue, the less penetration and the weaker the joint.
- 24 to 48 hours cure time is required to achieve full bond strength.
- The more catalyst you use, the weaker the joint. Many times it is better to use micro-balloons or baking soda as an accelerator.
- Good CA glue has a shelf life of 3 to 6 months at room temperature. It is best stored refrigerated or frozen.
- CA glues can be modified to extend the shelf life, to increase viscosity, or to increase flexibility. All such modifications will decrease the strength. A typical, thick, CA with 2-3 year shelf life has only about 20% of highly refined CA strength.
- When gluing non-porous surfaces such as glass, mylar, plastics, or metal you must increase the bonding area of the substrate.
- CA glues will not bond to anything with a waxy surface. Oil or grease on the surface prevents glue penetration and results in poor glue joints.
- When CA starts to thicken in the bottle, it's time to dispose of it.
- CA glues all have temperature limitations. Generally about 185 Degrees F.
- Solvents for CA include Nitromethane, MEK, and acetone.
- Don't store CA next to accelerator.
- The best way to remove CA glue from your fingers is by soaking in hot soapy water or by peeling the hardened glue off.
- The most difficult wood to glue is very thin plywood (1/64" to 1/32"). This material is very tight grained and oily.
- Don't move parts before the CA has set. Premature movement will weaken the bond.
- Using too much CA may introduce problems such as slow setting time or blooming.

- Curing speed depends on the moisture of the bonding surface. The best results are achieved when the relative humidity in the assembly environment is 40 to 60 percent at room temperature.
- High relative humidity levels make CA more reactive, resulting in faster curing rates.
- Low humidity environments cause CA products to cure slowly. This is a frequent complaint in winter.
- If surfaces are excessively dry or acidic, curing will be much slower or may not occur at all.
- Cyanoacrylates can produce a white powder resin when applied in very humid conditions or when the bonded materials are immediately placed in a closed space.

### Health Concerns:

Use CA only in a well ventilated area and avoid skin contact.

Uncured CA vapors cause eye and respiratory irritation. Repeated and/or prolonged use of CA adhesives may result in sensitization. Re-exposure symptoms include wheezing, coughing, sneezing, and respiratory distress. There are also reports of allergic skin reaction to CA.