

**All of this information has come from the "What Works for Me" school of research and development, and represents my experiences from using a lot of glue for a lot of years.**

## **CA Glues**

In this age of instant gratification, we have universally accepted Cyanoacrylate (CA) glue for one single characteristic - *Instant Cure*. We willingly overlook its many failings for this one convenience. CA glue is not a good structural adhesive for wood and it is not a good "crack filler". Yet, these are the most common uses for CA glues by the woodturner. Our best use for CA may be as a wood hardener and a finish.

### **As a structural glue**

CA glue is fast and easy to use, but there are many problems:

- CA cures to a brittle material that is easily fractured and shattered.
- Because it is brittle, the glue-line can easily fracture from shock, fatigue, vibration, and wood shrinkage or movement.
- Its "full strength" is developed only in a 100% contact joint. There is a considerable sacrifice in the strength in any joint that has anything less than "full contact".
- We use the "Thick" CA for its "gap filling" ability when our joints are not as good a fit as we would like them to be, but its brittle nature will allow the greater thickness of the glue line to fail faster.
- CA is difficult to use with dry wood because it requires some moisture in the wood for it to cure, but....
- CA glue loses its bond with the wood very rapidly in the presence of excess moisture.
- The "thin" varieties can penetrate so rapidly into the wood that there is nothing left in the joint to create a bond.

Most of the time we can get away with using CA glues because we are staying below the limits of its strength and durability, and any elasticity in the joint is from the wood itself, not the glue. When these limits are exceeded, the bond will fail, and these failures are what will get us into trouble.

Our biggest concern for using CA as a structural adhesive would be when holding a waste-block to a piece of wood. We always risk a failure of the brittle glue-line from fatigue caused by the cyclic stress reversals of the rotating weight or from vibration in the joint. Small pieces may not present a problem, but we should be using a stronger more durable adhesive such as Titebond or Polyurethane for heavy and/or unbalanced pieces of wood.

If we insist on using CA for attaching a waste-block, the strongest CA joints that I have seen use both the "Thin" and "Thick" types at the same time. The adjoining surfaces are made as close to flat as we can get them by using the

lathe, a hand-plane, or other means. "Thick" CA is spread on one surface, and a similar coat of "Thin" CA is spread on the other. The waste-block is then quickly put together with the wood and moved around to mix the two adhesives and spread it into a thin layer. It is then clamped or weighted in place and allowed sit for about 10-minutes before mounting the piece in the lathe. It isn't "instant" but it is a stronger and safer joint than one that is. I use this method for attaching a disc of ¼" plywood to the bottom of plates and small platters for use as a chucking spigot.

### **As a "crack filler"**

CA is fast, and easy to use, but it may not be the best thing to use for filling voids and cracks in a piece of wood.

- We are all familiar with the most common problem - the CA penetrates into the wood and leaves a large hardened stained area around wherever it is used. And, there is no way to remove or cover this stain, other than turning or sanding down through it.
- A large piece of CA filler is like a "rock" stuck in the wood. It does not move with the wood. Over time, any wood movement or shrinkage will either cause the CA glue to crack and separate from the wood, or fracture the wood at the bond with the filler. I have seen them fall out.

And, if that isn't enough,

- It will not easily bond to oily or resinous wood.
- It shrinks as it ages.
- Some CA glues will turn a nasty looking dark orange color as it ages.

A better alternative is an epoxy or Titebond glue with colorants and/or wood dust added to fill the cracks and voids.

An alternative for filling smaller voids is one of the commercial wood fillers, such as "Famowood" or "Wood Patch". These products dry to a hardness that is somewhat softer than the surrounding wood, are easily sanded, and they are compatible with almost any finishing product that we want to use.

### **CA with Inlaid and other decorative materials**

We are using more materials such as "Inlaid", brass powders and filings, stone, etc. as a decorative addition to our woodturnings, and CA glue is usually the recommended adhesive. But, for all of the reasons that I have listed, CA may not be the best adhesive for holding these materials in place. CA glue is fast, easy to use, and it will look good now, but come back in 5-years after it has started to discolor, shrink, or separate from the wood, and tell me that using it was the right thing to do. An epoxy resin is a far more durable adhesive for this purpose, but it isn't as fast.

## **CA as a finish**

CA glue leaves a hard durable surface film, that would seem to make it a good finish. The reality is that it has no advantage over the other finishes that we can use, and there are several problems with its application and use.

- CA is a very expensive finishing material when compared to the other products that we can use.
- It is difficult to apply because of its fast drying. Unless we are able to give the entire piece a single wet coat, there will be discoloration problems with heavy and light areas and overlap lines where the wet edge has cured.
- Discoloration from the staining and differences in grain penetration can cause a worse "blotching" of the wood surface than an oil finish.
- CA glue is the most brittle finish that we can put on a piece of wood, and as such, it can develop hair-line cracks and/or separate from the surface as the wood adjusts to its final shape after turning or moves with seasonal changes.
- The cured CA glue is a plastic material, it must be sanded and polished as such, it wears like plastic, and it looks more like plastic than anything else we can apply to a piece of wood, including Polyurethane (my opinion).

As a finish, CA should be applied with one uniform wet coat on the entire piece. This is best done with a slow curing CA, but there will still be a limit on how large an area can be covered in the short time that is available. The use of CA as a finish or a wood filler is described in my Finishing Secrets, "Chapter 4 - Pens, Watches, and Small Personal Items". These same techniques that are described can be expanded to larger items.

A different technique for using CA as a wood finish is described in an article by Bill Haskell, "An Amazing Finish", American Woodturner, Winter 2002 issue, page 47.

## **CA as a wood hardener and stabilizer**

If we can live with its staining and other faults, CA glue is an effective "hardener" for soft and spalted woods, and it can be used as a grain-filler for open grained woods when it is mixed with fine wood-dust. In either case it should be sanded after application so that all of the remaining CA is "In" the wood rather than "On" it. This application is described in more detail in my earlier article, ["Finishing Secrets: Chapter 4 - Pens, Watches, and Small Personal Items."](#)

## **Accelerators for CA glue**

There are two (2) problems that can result from using an accelerator, whether it is one of the commercial products, water, or whatever else may be used.

- The accelerator will enhance the brittleness of the cured glue.
- When applied too quickly to a thick film of CA, the glue will foam up into a white substance that has the appearance of a hard styrofoam, and has

- about the same strength.
- The accelerator can seal a pocket of uncured liquid under a thick application.

These problems can be reduced by always applying the glue in thin layers, waiting 1-minute before subjecting any CA glue to an accelerator, and eliminated altogether by not using one at all.

## **Parting thoughts on CA glue**

Not all CA glues are created equal. Some can be more suitable than others for use as a wood glue, and how suitable seems to be directly proportional to its price. The first commercial CA was "Crazy Glue" in the consumer market, and "Hot Stuff" in the hobby market in the mid-60's. These two products are still with us, and have been joined by other name-brands, and a host of generic products.

Although I have used nearly every brand that has been available since the first "Hot Stuff", I have always had better results with the "Zap" brand than any other. "Better results" is a subjective definition that comes from years of using a product and becoming familiar with it. "Zap" is made by Pacer Technologies, and it isn't available from any of our normal woodworking/woodturning suppliers. I purchase it from Tower Hobbies at [www.towerhobbies.com](http://www.towerhobbies.com)

In case anyone is wondering, yes, I do use CA glues, but I also recognize their limitations, and don't try using them at the exclusion of all other adhesives. I use them for such things as hardening wood under the chuck jaws, to hold temporary alignment blocks for gluing segmented assemblies, attaching waste-blocks where it is appropriate, stiffening and permanently attaching the bark on a natural edge bowl, as a wood-filler and hardener for pen barrels, and similar tasks for which it is well suited. And, I use CA glue to fill small cracks because it is fast.

## **PVA (White) Glue**

Polyvinyl acetate glue (PVA), also known as "White Glue", has been around since the late 40's. "Elmer's" is the most common brand name. While this glue will bond any porous materials that are free of moisture and oil, it has several characteristics that make it less suitable for use in our woodturning shop.

- PVA glues stay relatively soft and plastic, and structural joints made with them will move over time. This isn't a problem in most furniture construction where some features of the joint other than the glue (mortises, tenons, dowels, screws, nails, etc.) are used to carry the load. If you want an illustration of what we call "glue creep", put a "segmented" bowl together with Elmer's.
- It has no moisture resistance, making it unsuitable for exposure to the moisture in a salad bowl.
- We would think that it should be possible to get an invisible glue-line with a glue that dries "clear", but I have found the opposite to be true. The soft glue does not sand well, and sanding dust and grit particles get imbedded in it, which then absorb the finish. The result is a dark glue-line.

I keep a bottle of Elmer's around because it is useful for gluing various pads, paper, cloth, box liners, sanding discs, and temporary bonds.

### **Aliphatic Resin Glues (Titebond, Pro-Bond, etc.)**

The first commercially available Titebond glue was made by Franklin and sold under the Sears Roebuck label in the early 60's. It was several years before Franklin started marketing the product nationwide under their own "Titebond" brand name. Titebond-II is a more recent development.

Titebond-II is good for almost anything we want to do with an adhesive.

- It is water-resistant (not waterproof) enough that it can be used to assemble bowls that are used for food service.
- It has good "gap filling" strength.
- It is sandable.
- It has good fatigue and shock resistance.
- The color of the glue-line will be nearly invisible even in light colored wood.
- It can be used to join small pieces of wood with little to no clamping pressure. When the pieces to be joined are rubbed together under hand pressure to remove the excess glue, and then held for a minute, the pieces can then be left undisturbed and unclamped until the glue is cured. The joint can be handled in 15-minutes, but I would leave it overnight before using it to turn a piece of wood in the lathe.

Titebond-II has a reasonable shelf life, usually be about two (2) hot/cold weather cycles, equivalent to 2-years in most parts of the country, but longer in climates that are relatively warm all of the time. As it nears the end of its useful life, it will become "stringy" and difficult to spread.

If there is any problem with Titebond-II, it is a relatively short working time of less than 5-minutes, during which time the parts can be shifted into position. After that, they will have to be pried apart. Cooling it in the refrigerator can extend the assembly time of Titebond-II. Decant it into a small container because the repeated temperature changes will shorten its useful life. For some reason, this technique doesn't work as well with the original Titebond.

Titebond-II is an excellent adhesive for attaching waste-blocks. If the wood is still moist, the two wood surfaces can be dried with a hair dryer or heat gun. This will dry the wood sufficiently for a good glue bond, and it will be cured enough to be "water resistant" by the time the moisture has migrated back into the joint area. The joint will not hold together forever in the presence of the wood moisture, but it will last several days, long enough to turn a piece in the lathe.

The original Titebond has similar properties to those of the Titebond-II except that it is not water-resistant. To its benefit, it has a longer working time approaching 10-minutes, and it dries to a lighter color. These two properties can make it the preferred adhesive for segmented work that will never be subjected to the moisture of food service.

## **Titebond (Extend)**

Titebond-II (Extend) has an advertised working time of approximately 15-minutes, but 10 to 12-minutes is a more realistic number. This is particularly useful for making complex assemblies. Don't throw away the other Titebond glues, because the (Extend) also takes 3-times longer to dry, and the "rubbing" technique for making unclamped joints doesn't work as well.

## **Polyurethanes**

Like their finishing counterpart (polyurethane varnishes), these glues are a product of modern chemistry that may have created more problems than they solved. Polyurethane glue will do several things better than most other adhesives.

- 100% waterproof
- Impervious to strong solvents, acids, caustics, and other chemical compounds
- Good gap filling ability because of its foaming property
- High strength

However, these same properties cause most of its problems.

- Difficult clean-up. Even Acetone does little after it has started to cure. Vinyl gloves are the best solution.
- Very short shelf life after the bottle has been opened.
- Clamping is an absolute requirement. Its foaming will float a joint apart when it is not clamped.
- It will fill a large gap in the joint, but the cured glue has very little strength when it is allowed to foam.
- Polyurethane and waterborne finishes do not adhere well. If one of these finishes is applied over a wide glue-joint, the finish will start to separate at that point over time.
- Its rate of expansion with changes in temperature and humidity is greater than that of the wood. This will give the appearance that the glue in the thicker glue-lines (bad joints) has started to foam again with an increase in temperature and humidity.
- It will stain through white paint, either latex or oil.

I could work around all of these problems except the last two. The expansion of the glue-line makes it unsuitable for segmented bowls and similar assemblies, and the staining prevents it from being used for making glue-ups for outdoor architectural turnings.

Many cures for the short shelf life have been suggested, from BLOxygen to moving to a dryer climate, but I prefer to buy the glue in small quantities and throw it away when it has formed a crust in the bottle and is no longer useable.

If we can live with the clean-up problem and short shelf life, there are two places in our woodturning shop where a poly-glue is superior.

- It is excellent for holding the brass tubes in pen blanks. A 1/32" oversized hole (a 9/32" drill for a 7mm tube) will leave some space for the glue to

foam. The porous glue-line will have sufficient strength to hold the tube in place, and enough flexibility to prevent the wood from cracking with changes in humidity. The only caution is that the foaming can float the tubes out of the wood, and they may have to be pushed back into the wood before the glue cures.

- Sometimes a Poly-glue is the only way that we can join two pieces of hard oily wood, such as Cocobolo or Bocote. Wiping both wood surfaces with Acetone will insure a reliable bond.

It can be used for gluing other woods and attaching waste-blocks to our turning wood, but it offers no advantages over using Titebond-II, requires clamping and for a longer time, and we cannot rely on its gap-filling ability.

## **Epoxies**

I have used many different epoxy resins over the years because they offer many advantages.

- Within reasonable limits, the strength of the glue line is not dependent on its thickness. A thick glue-line will have the same strength as a thin one.
- Their strength and gap-filling ability makes them an ideal candidate for holding a waste-block to a problem piece of wood.
- Their gap-filling ability and flexibility makes them excellent for filling cracks and holes in the surface of the wood.
- They are useful for filling recesses in the wood with augmenting materials such as brass powders, crushed stone, and Inlace.
- Application of heat (hair dryer) has the effect of a thinner on the glue, but can also reduce its cure time.
- They are very water-resistant.

If there is any problem with an epoxy resin, it is that we usually ask too much of it, and we are disappointed when it didn't reach our expectations. Using better quality resins can solve most problems. I would not consider using most of the epoxy resins that are available in the two-part packages from Home Depot and similar stores as being suitable for use in woodturning. While these home center and hobby shop epoxies are easy to use and mix, two lines on a flat surface IS NOT sufficient control to get consistent results from a glue that is labeled as having a 5-minute and 10-minute cure time. Mixing larger quantities of the 30-minute epoxies is a better alternative if we want to use these products.

I have had good and consistent results from the resins that are available from West Systems and System-3, and these are preferred over anything else that is commercially available.

## **Problems with Epoxies**

All epoxy resins have the potential for several problems, and the degree to which they are a problem seems to increase as their cure time becomes faster.

- The expansion/contraction rate of the glue with changes in temperature and

moisture can be different from that of the wood. When the two rates don't match, a repair made with an epoxy will either be raised above the wood surface, or be a depression below it. This characteristic must be considered before using an epoxy resin for a segmented assembly, gluing pen tubes, or other places where differential movement could present a problem. Using up to 50% wood dust in a filler mixture will reduce the expansion problem.

- Epoxy cures with an exothermic (It gets hot) reaction. Large masses can get very hot and become filled with bubbles. Again, using up to 50% filler material will reduce these effects.
- Epoxies are water-resistant and some are even waterproof, but none of them are vapor-proof. On a scale of 1 to 10, the absorption of water vapor from the air into bare wood will be a "10" and through an epoxy coating as a "1". The wood will still change from seasonal changes in moisture content, but it will just be much slower. There is a high probability that the expansion of the wood will make hairline cracks in an epoxy coating. After that there is nothing to keep out the water, and nothing looks worse than an epoxy coating that is coming off of a piece of wood.
- There is always a concern for whether any finish is "food safe". An oily film forms on the surface of many epoxy glues, and a drinking vessel that is assembled or coated with the resin will have the rainbow colors of an "oil slick" on the still surface of Coca-Cola. And, in the old-days that was a test for whether the liquor was fit for drinking. These oils may not be harmful, but they can cause intestinal distress. Cleaning the inside surface with Isopropyl Alcohol will temporarily eliminate the oil film. It is a good idea to make a test before using the vessel, and wipe the surfaces with alcohol before every use.
- Epoxy resins must be mixed for each use.
- Clean-up can be messy, but a good amount of Isopropyl Alcohol will make that an easier task.

For all of its faults, epoxy resins are better for filling cracks and voids in wood than a CA glue. It just takes longer.

## **Lock-Tite**

It may seem odd that we are mentioning these anaerobic (cure in the absence of air) epoxy resins that are sold for locking screw threads and mounting bearings. It is available as a "blue" formula that can be broken loose with force after it is cured, and as a "red" formula that will require heat. In addition to their intended uses for setting loose screws and bearings, the "Blue" formula makes an excellent bedding compound under the scraper type tips that we use on boring bars. The resin makes a firmer contact between the tip and the tool. The "Red" formula is useful for securing pen parts that don't fit as tightly as they should, and the excess is easily removed with Isopropyl Alcohol that will not harm a finish.



## **Plastic Resin Glue (Weldwood)**

Plastic Resin glue, a urea-formaldehyde that is now made by Dap, has been around longer than any of the other glues that are discussed. For most things, it is still as good as or better than many of its newer rivals. It is in powder form and mixed with water to use.

- It has a reasonable working time of about 10-minutes.
- Long shelf-life in its powdered form when it is stored in a cool and dry place.
- Stronger than Titebond-II.
- Very High water resistance, bordering on being "waterproof".
- Easily sanded.
- Excellent where fatigue or vibration are factors.
- Excellent stability in the glue joint.
- It will not stain through white paint.

Its only negatives are:

- A very visible glue-line.
- Overnight wait before the wood can be used or worked.
- Clamping is required.
- It has to be mixed before each use.

All of its positive properties make it my choice for any outdoor furniture or a glue-up for architectural turnings that will be painted. It could also be argued that this would be the best glue for segmented bowl assemblies. While that may be true, I prefer Titebond and similar glues because of they are a lighter color, they can be assembled without clamping, and they are premixed and ready to use.

## **Hide Glue**

I have found very little use for Hide Glue in the woodturning shop. It has excellent strength and a reasonable gap-filling ability. Light clamping is required to hold the pieces in place, and it will take overnight to cure. However, it is not at all water resistant.

Hide Glue is not well suited for any construction of a segmented assembly because there is no guarantee that a finished bowl will not be used where contact with water and other liquids that would soften the glue.

I have used liquid Titebond (in the brown bottle) to attach the purchased decorative strips to bowls. It has the advantage that the strip can be moved around after the glue has cured with the application of heat to soften the glue. It is less sandable than Titebond, but better than Elmer's. When totally dry, it is stable, and "creep" in the glue-line is not a problem. It has a longer "working time" than most other bottled glues, and this could be a benefit for a complex assembly.

## Hot Melt Glue

This glue has reasonable shear strength but very little tensile strength. It has the advantage of a good gap-filling ability up to about 1/16". This makes it very useful for attaching wood to a waste block for faceplate turning, and the piece is ready to turn as soon as the glue has cooled. However, its use is limited to holding a work piece that is neither too heavy nor too long. Each of us will have to determine the limits of weight and length. It is excellent for attaching platters, plates and shallow bowls, but I would stay away from tall vases or large bowls that have a large overhung weight.

The most common problem with using a hot-melt glue is in getting it spread on the wood surface, and then getting the pieces together and held in place before the glue starts to cool. The result is too often a very thick layer of the glue that is not attached to either wood surface very well. A very hot glue gun is a necessity, and that is one that is hot enough for the glue to be dripping from the tip and starting to smell like something that is burning. That is about 30-minutes after the glue has softened enough to flow freely. Even then, it is helpful to heat the surface of the wood with a hair dryer until it is hot to the touch, before applying the glue.

A better solution would be dipping the wood surface into a bath of hot glue. That way the entire surface is covered at one time, and there is a better chance of getting the pieces together before the glue starts to cool. An electric frying pan makes a good pot for heating the hot-melt for this purpose.

Some hot-melt glues can be used on wet wood if the wood is heated and dried on the surface with a hair dryer. The piece should be turned immediately because the moisture will migrate back to the surface of the glue joint and break the bond. The user of this method will have to experiment to determine the limits.

## Carpet Tape

These adhesive tapes can be very effective for attaching a piece of wood to a waste-block of a faceplate when we remember that it has good shear strength, very poor tensile strength, and that it will creep and come apart over time when a load is applied. This means that we should not use it for holding a piece that is either heavy or long, and we probably shouldn't leave it hanging in the lathe for overnight. I offer the following recommendations for using carpet tape.

- Use the fabric tape. This is usually a fiberglass. There are better tapes available, but those sold at Home Depot or Lowe's are fine for our use.
- Do not use the thin plastic film tape. It is totally useless.
- Both surfaces should be reasonably flat and dry.
- Total coverage of the joint area is recommended for the first time usage. We will know how much less tape is needed for subsequent use after we have broken the joint apart.
- Both surfaces should be dry, smooth, reasonably flat, and CLEAN.
- Clamp the pieces together for a few minutes after assembly. This can be as simple as holding them together between the head and tailstocks of the

lathe or in a drill press. The adhesives on the tape will develop a stronger bond with time in a good joint.

- Turn the piece as quickly as possible after attaching it to the faceplate.
- Always try to break the joint with pressure. A cheap chef's knife makes a good prying tool.
- Squirt some Acetone into the joint if the bond cannot be broken with pressure. Allow it to soak for a few minutes, and I guarantee that the joint will come apart and that it will be a mess to clean up.

In spite of the clean-up problem, carpet tape is still the best way to hold some things in the lathe. I use it for holding plates, small platters, segmented rings and similar relatively flat turnings to a large MDF face plate. As an example, I make a lot of plates, both polychromatic and solid wood, that have a segmented rim. I attach a segmented ring to the MDF faceplate with 6 pieces of 1" square carpet tape, fit the plate into the ring, and then turn and finish sand the entire bottom before removing it. The thinness of the rim and the time involved for curing the other glue joints insures that I will have to soak the tape with Acetone to remove it without destroying the joints in the rim.

## **Sanding Pad Adhesive**

This is a contact type adhesive that is useful when we make our own sanding disc pads, or recycle the commercial pads. The only requirement for their use is that both surfaces must be smooth, and the glue on both surfaces must be dry when they are brought together.

"Barge's" brand adhesive, available from a shoe repair shop or supply catalog, is the best available for attaching sanding discs in mandrel. This is a strong contact adhesive that is fairly heat tolerant. Following the directions on the label will insure success with it.

The Titebond "Sanding Disc Adhesive" and similar glues are effective, but they are not at all tolerant of heat. Sanding must be at a very slow speed to prevent it from melting. Once it has softened, the bond is destroyed, and it will not reattach itself after it has cooled.

## **Conclusion**

And that represents everything I know about using the adhesives that are available to us. Other adhesives could find limited use in our shop. Things like contact cements, nitrocellulose glues, various paper adhesives, rubber cement, plastic model cement, and the list goes on. They have not been discussed because I rarely use them and then only peripheral to any woodturning.

A useful site for solving most of our unusual gluing problems may be found at: <http://www.thisisthat.com>. This site is easy to use, type in the two surfaces to be bonded, and it will give the recommended adhesive, several alternatives, and notification of any safety hazards.

## **Polyurethane glues- the foam is not for filling gaps**

I've seen quite a few people say that they like using polyurethane glues because the foam fills gaps. The foam does fill gaps but it has very low strength because it is mostly air bubbles. Manufacturer's used to say so on their websites but seem to have taken it off all the ones I checked tonight. Maybe because they found out that the foam sells glue. I did find this info:

"Gap Filling - Polyurethane glues will fill small gaps of 1 to 2mm. For larger gaps, the air bubbles in the expanded glue create a weaker bond which will fail, so they are not advised for areas where strong bonds across gaps are required." That quote came from this website: [How to Use Polyurethane Glues for Miniatures and Models](#)

Polyurethane is recommended for tight fitting joints. The foaming action does promote stronger bonds in tight fitting joints by forcing the glue into the wood fiber creating a stronger bond than PVA (polyvinyl acetate) glues.

If you have a loose fitting joint that needs filling you should use a gap filling epoxy or a PVA glue with high solids content like Lee Valley's 202GF (the GF stands for gap filling). Gap filling glues shouldn't be used in tight fitting joints. I've split joints using 202GF because it was too thick and I got a hydraulic lock in the bottom of the joint and the excess glue couldn't squeeze out. There is no one glue that satisfies every situation you'll come up against sometimes even in just one build.