Meet your glue - friend or foe?

Please take a look at the chart below, these are the most common wood glues available from Titebond, the manufacturer selected for glue used in the Woodshop. As you can see there are quite a few. Each with a different characteristic. Many moons ago the decision was made that Titebond II Premium was to be the glue of choice. As you can see there are characteristics that make this NOT suitable for specific uses, you should be cognizant of these, lest your fine woodworking project unexpectedly disassemble itself.

PRODUCTS	TYPE	STRENGTH +	CHALK TEMP	SHELF LIFE	DRIED FILM	CLEANUP	VOC	OPEN/CLOSED ASSEMBLY TIME
Titebond III Ultimate	Proprietary Polymer	4,000 psi	47°F	2 years	Light Brown	$	5.6 g/L	10/15 minutes
Titebond II Premium	Cross-linking PVA	3,750 psi	55°F	2 years	Yellow	$	5.5 g/L	5/10 minutes
Titebond Original	Aliphatic Resin	3,650 psi	50°F	2 years	Yellow	$	10.7 g/L	5/10 minutes
Titebond II Dark	Cross-linking PVA	3,750 psi	55°F	2 years	Brown	$	5.5 g/L	5/10 minutes
Titebond Polyurethane	Polyurethane	3,510 psi	n/a	1 year	Tan	#	0 g/L	25 minutes total
Titebond Translucent	PVA	3,550 psi	50°F	2 years	Translucent	$	10.7 g/L	5/10 minutes
Titebond No-Run, No-Drip	Thixotropic PVA	3,000 psi	55°F	2 years	Clear	$	9.8 g/L	5/10 minutes
Titebond Liquid Hide	Natural Protein Emulsion	3,590 psi	n/a	1 year	Transparent Amber	@	0 g/L	10/20 minutes

+ Maple to Maple (ASTM D-905) Bond Strength at 70°F $ Water when wet, sand when dry. @ Water when wet or dry. # Mineral spirits when wet, sand or scrape when dry.

Not everyone uses this product, as a matter of fact Mike Thomas uses Gorilla, and Randy Spitzer uses Titebond Transparent.

As you have noticed most projects are NOT assembled using mechanical fasteners, we rely on glue. Not necessarily by choice but by design. So it's important we are all aware of the characteristics of the glue we use.
In a simplified explanation Glue adheres by either molecular or by mechanical means. Not being a chemical engineer I'll try to explain it in not technical terms:

A Molecular bond is a chemical bond formed between atoms by the sharing of electrons which is facilitated by the boding agent which is the glue. The strength of chemical bonds varies considerably; there are "strong bonds" such as covalent or ionic bonds and "weak bonds". The atoms of each substrate interlink using the glue as the catalyst.

The mechanical bond found in mechanically-interlocked molecular architectures. Unlike classical molecular structures, interlocked molecules consist of two or more separate components which are NOT connected by chemical bonds. Basically the substrate has microscopic fissures, think nooks and crannies, the glue cures in that shape thereby interlocking the 2 materials being glued. The strength of a mechanical bond is a "weak bond".

Basically there are 2 types of glue failures.
The most common is an adhesive failure where there is a failure between the glue and the substrate. The least common is failure is a cohesive failure wherein the glue itself fails.

The prime cause of a cohesive failure is improper mating of surfaces and/or clamping.
1 The surface aren't even resulting in an inconsistent mating of surfaces causing excess glue. Dry fit to verify surface are prepared evenly.
2 Improper clamping pressure. Either too much or to little. Tighten clamps enough to bring joints tightly together (generally, 100-150 psi for softwoods, 125-175 psi for medium woods and 175-250 psi for hardwoods).
3 Since Titebond II is water resistant NOT water proof, submersion can ultimate cause a cohesive failure.

The prime cause of a mechanical bond rather than chemical bond and/or adhesive failure is a poorly, improperly prepared substrates. The most common examples and remedies are:
1 A surface contaminated with dust and/or sawdust. Don't just blow the dust away, use a brush. Don't let your clean surface lay in wait after machining, clean and use ASAP.

2 Many exotic woods are oily in nature. If you glue immediately after machining you're in good shape. If you let your material wait the oils will migrate to the surface. Reminiscent of the plastic steering wheel of yesteryears cars. Most times there will be a delay between machining and gluing. If this occurs use acetone to clean the surface immediately prior to gluing.

3 Applying glue and waiting to long to join materials. Basically past the open assembly time. For Titebond is II open assembly time is 5 minutes and closed assembly time is 10 minutes. Have clamps ready, dry fit and when all is good apply glue and clamp.

4 Applying glue and waiting to long to join materials then wiping glue off. Wait for the glue to dry then start all over by re-machining the surface.

5 Insufficient application of glue. Glue spread should be approximately 6 mils or 250 square feet per gallon. OK, so what does that really mean to me. Forget the gallon coverage. For reference a dollar bill is 4.3 mils thick and a standard playing card is 10.5 mils.

6 Improper clamping pressure. To paraphrase Olivia Newton John, "Let's get technical". Enough to bring joints tightly together (generally, 100-150 psi for softwoods, 125-175 psi for medium woods and 175-250 psi for hardwoods). OK so you can't easily measure clamping pressure. So for reference I tested one of our standard press clamps. Due to my sophisticated measuring equipment limitations, consisting of a bathroom scale and Ron Hyslop's engineering refresher, I couldn't get about 350 lbs.

100 lbs on a 100 sq in (10" x 10") surface equates to 1 lb/sq in or 1 psi. So to get 100 psi you need 10,000 lbs hence the use of screw clamping devices which are force multipliers. Using this same formula to achieve a clamping pressure of 100 psi on a segmented bowl ring 1 1/2" x 8" od requires 2178 lbs.

Back to the press clamp and the testing. 1 turn represented approximately 350lb of weight or clamping pressure. As the increase is geometric rather than arithmetic. By extrapolation one could deduce 3 turns might get to maybe 800lbs of clamping pressure. Just enough to deform the clamp and really foul the joint.

7 Improper mating surfaces. Poor preparation creates uneven mating surfaces. Don't rely on a saw for a glue ready surface, make sure to joint or plane.

Some tips:

Titebond II is water soluble, so it's easy to clean. I am not a proponent of wiping excess glue off surfaces with a wet rag as the water dilutes the glue and forces this thinned glue in the grain. We've found through experience that about 10-20 minutes after application the glue begins to set or cure at which time the excess squeeze out looses adhesion to the substrate and can easily be scraped off with a sharp scraper. It almost peels off like a piece of tape.

Apply glue evenly using any number of applicators: putty knife, brush, roller, squeeze bottle, and the ubiquitous finger (doesn't make a difference which finger).

For easy cleanup tape clamps to easily remove excess glue, cover work area with kraft paper or wax paper.

Before gluing have clamps ready and have a paper towel at the ready.

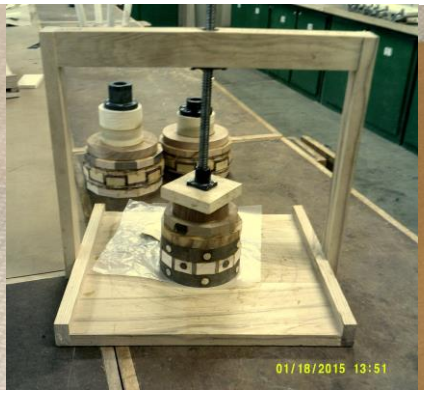
Before using the squeeze bottle make sure the top is snug. Make sure to recap the squeeze bottle ASAP after using.

Use the stomper for alignment and glue up thru open assembly time, then apply proper clamping.

If you leave your work overnight after gluing make sure to mark it with your name and when it was glued.

Visit http://www.titebond.com/woodworking_glues.aspx

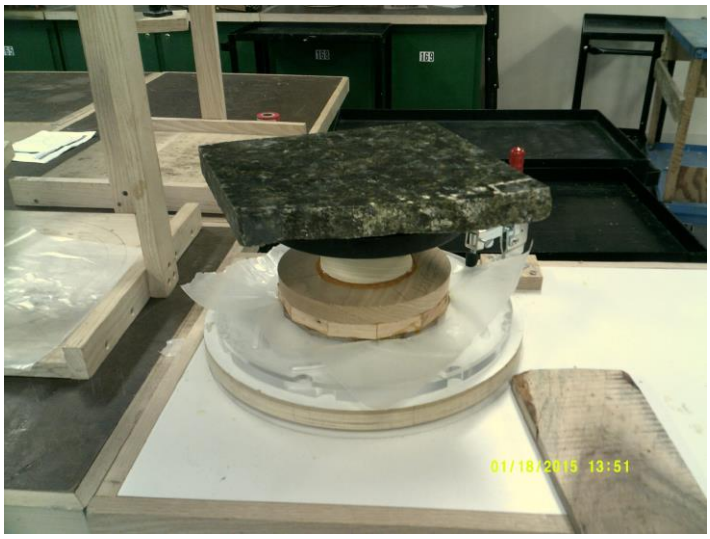
Adhesive Failure



Press clamp in use

Residue after acetone wipe

Creative clamping to achieve proper pressure



Stomper during alignment & glue up