LEARN-IT: Adhesives

Which adhesive should I use?

	Wood/ Plywood	Metal	Rubber	PVC*	Glass	Plastic*	Fabric, Paper, Leather	Canvas	Fiberglass (FRP)	Poly-carbonate	Plaster	Ceramic/ Brick	Concrete*
REACTIVE	Epoxy	Epoxy	Epoxy	~~Epoxy~~	Epoxy	Epoxy	~~Epoxy~~	~~Epoxy~~	Epoxy	~~Epoxy~~	~~Epoxy~~	Epoxy	Epoxy
	~~Acrylic~~	Acrylic	Acrylic	~~Acrylic~~	Acrylic	Acrylic	~~Acrylic~~	~~Acrylic~~	Acrylic	Acrylic	~~Acrylic~~	Acrylic	~~Acrylic~~
	Urethane	Urethane	Urethane	Urethane	Urethane	Urethane	~~Urethane~~	~~Urethane~~	Urethane	Urethane	~~Urethane~~	~~Urethane~~	~~Urethane~~
	Polyurethane	Polyurethane	Polyurethane	~~Polyurethane~~	~~Polyurethane~~	~~Polyurethane~~	Polyurethane	Polyurethane	~~Polyurethane~~	~~Polyurethane~~	~~Polyurethane~~	~~Polyurethane~~	~~Polyurethane~~
	Cyanoacrylate	Cyanoacrylate	~~Cyanoacrylate~~	~~Cyanoacrylate~~	~~Cyanoacrylate~~	Cyanoacrylate	Cyanoacrylate	Cyanoacrylate	~~Cyanoacrylate~~	~~Cyanoacrylate~~	~~Cyanoacrylate~~	Cyanoacrylate	~~Cyanoacrylate~~
	Silicone	Silicone	Silicone	~~Silicone~~	Silicone	~~Silicone~~	~~Silicone~~	Silicone	Silicone	~~Silicone~~	~~Silicone~~	Silicone	Silicone
NON-REACTIVE	PVA	PVA	PVA	~~PVA~~	~~PVA~~	PVA	PVA	~~PVA~~	~~PVA~~	~~PVA~~	~~PVA~~	PVA	~~PVA~~
	Contact Adhesive	~~Contact Adhesive~~	Contact Adhesive	~~Contact Adhesive~~	~~Contact Adhesive~~	~~Contact Adhesive~~	Contact Adhesive	Contact Adhesive	~~Contact Adhesive~~	~~Contact Adhesive~~	~~Contact Adhesive~~	~~Contact Adhesive~~	~~Contact Adhesive~~
	Hot glue	Hot glue	~~Hot glue~~	~~Hot glue~~	Hot glue	~~Hot glue~~	Hot glue	~~Hot glue~~	Hot glue	~~Hot glue~~	Hot glue	~~Hot glue~~	~~Hot glue~~
	Construction adhesive	Construction adhesive	~~Construction adhesive~~	~~Construction adhesive~~	~~Construction adhesive~~	~~Construction adhesive~~	Construction adhesive	Construction adhesive	~~Construction adhesive~~	~~Construction adhesive~~	~~Construction adhesive~~	Construction adhesive	Construction adhesive

** PVC is best adhered to itself with a solvent-based adhesive that chemically "melts" the PVC together.*

** Most plastic adhesives only work with particular plastics. Confirm that the adhesive will work with your plastic.*

** Concrete itself can act as its adhesive*

"I want to **adhere two different materials!"**

Answer: Find the adhesive that is compatible with both of them

Example: I want to adhere wood to fabric – polyurethane, cyanoacrylate, PVA, contact adhesive, and construction adhesive adhere to wood and fabric. I choose one of these depending on my needs.

Want more specific advice?
Visit This-To-That

Pro Tips

Check the label before you do anything
to make sure it works on your materials in your environment - each adhesive has different variations.

Do you need to use an adhesive?
Would a mechanical fastener like a nail or bolt work better?

Work quickly.
Have all your pieces ready to be adhered before you open the adhesive package/bottle.

Clean all surfaces
before you adhere them to ensure the strongest bond.

Sand metal
and then wipe it clean! Microscopic rust will weaken the bond.

Use in well-ventilated areas.
Don't ever inhale adhesive fumes.

Does your adhesive need to be clamped?

The industry evaluates adhesives based on two things:
shear strength and **peel** strength

Reactive adhesives

bond through a chemical reaction – often used structurally

Epoxy

Two-part curing

Strongest structural adhesive
(vs. urethane and acrylic) – high shear and peel strength

Highest temperature resistance
(vs. urethane and acrylic)

Hardens between **2 – 60 min**
*Gains full strength in **24 hours***

Do NOT clamp
clamping may actually weaken the bond

Cures under a wide range of temperature and humidity
(vs. all other adhesives)

Excellent resistance to solvents, salt water, UV light, impact

Good for **filling spaces** between surfaces

Common brands: **Loctite, Devcon, JB Weld, Titebond , 3M Scotch-Weld**

Acrylic

Two-part curing

High-strength bonding **without the surface preparation** *(vs. urethane and acrylic)*

Bonds to **a wide variety** of materials
Even hard-to-bond plastics and oily metals

Hardens within **3-20 min**
*Gains full strength in **8 to 48 hrs***

No need to clamp

Tolerates moisture and dirty, unprepared surfaces

Good for **filling spaces** between surfaces

Common brands: **3M Scotch-Weld, Loctite, Lord**

Silicone

Cures **with water** on the piece or humidity in the air

Used as a **sealant** – only has enough adhesive capabilities to hold onto the two pieces which it is sealing between

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Hardens in **20 – 40 min**
*Gains full strength in **24 – 72 hours***
(~2mm thickness with moisture in air)

No need to clamp

Excellent resistance to temperature extremes, weather, water, chemicals

Good for **filling and sealing spaces**

Stays very **stretchy** in most conditions

Good for vertical and overhead applications because they don't run

Speed up the curing process by elevating the temperature

Common brands: **Loctite, 3M, Permatex, Dow Corning**

Urethane

Two-part curing

Highly elastic bond
Use when flexibility between dissimilar materials

Hardens in **2 – 120 minutes**
*Gains full strength in **6 hours to 7 days***

No need to clamp

Impact resistant and durable
Use for energy absorption

Lower cost (vs. epoxy and acrylic)

Common brands: **Devcon, Loctite, 3M Scotch-Weld**

Polyurethane

Cures **with water** on the piece or humidity in the air

Swells as it cures

Hardens in **20-30 minutes**
*Gains full strength in **6 hours***

Apply in a **thin layer and clamp**

Good **moisture-resistance**

Sandable and paintable

Works on most **porous and non-porous** surfaces

Common brands: **Gorilla Glue, Titebond**

Cyanoacrylate
(Super glue)

Cures **with water** on the piece or humidity in the air
For the best adhesion, dab the pieces to be glued with a damp cloth before adding the super glue

The reaction is exothermic (it releases heat as it reacts), so be careful when gluing fabrics such as cotton/wool because they could catch fire

Not actually used structurally due to its **brittleness** (low shear strength)

Use for small repairs that are not subject to much stress or movement
Use where the fit must be tight
Capillary action can draw in the glue into where there is little space for a thicker glue

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Hardens in **5 – 30 seconds**
*Gains full strength in **2 hours***

Common superglues **may soak into the surfaces**
...especially with wood – leaving little glue on the surface, reducing the strength of the bond

Strongest when in a **very thin layer and clamped**

Best on **low-porosity materials**
Not recommended to use on glass

Superglue can be used as **a temporary clamp while stronger glue hardens** by adding a small amount to the ends of the pieces being joined.

Added to baking soda, acts as a hard, lightweight filler adhesive

Common brands: **Loc-Tite, Permabond, Eastman, Krazy glue**

Main types of reactive adhesives

Reactive **two-part** adhesives: **base resin + hardener/curing agent** → plastic or rubber
It transforms into a thermoset polymer via a cross-linking process.
The reaction requires mixing.

Reactive **one-part** adhesive: **needs UV light, heat, or moisture**
The one-part adhesive is a pre-mixed two-part adhesive, but the reaction needs UV light, heat, or moisture to begin
These are generally less common.

Non-reactive adhesives

bond through a physical change – often used non-structurally

PVA
polyvinyl acetate
(wood glue and white glue)

Cures by the **evaporation of its solvent**

Used on **porous materials**
Wood, paper, cloth are best

Hardens in **5 – 10 min**
*Gains full strength in **24 hours***

Clamp your pieces together

Most other adhesives do not adhere to PVA after it is cured

Common brands/names: **carpenter's** glue, **yellow** glue (aliphatic resin), school glue, **Elmer's** glue, **Titebond** III

Construction adhesive

Cures by the **evaporation of its solvent**

Begin to **harden quickly** and **remain flexible when dry**

Hardens in **10 – 30 min**
*Gains full strength in **12 – 24 hours***

No need to clamp

A thick mixture of natural or synthetic rubber dispersed in a solvent or water; the mixture varies depending on the application
***e.g.** Liquid Nails Heavy duty construction adhesive: mixture of acrylic adhesive, PVA, limestone, clay*
***e.g.** Liquid Nails Polyurethane construction adhesive: mixture of polyurethane, limestone, quartz*

Excellent for **filling spaces** between surfaces

Common brands: **Liquid Nails**

Hot glue

Cools to cure

Works on most materials, especially porous surfaces

Hardens in **15 – 60 sec**
*Gains full strength in **24 hours***

No need to clamp

No or low volatile organic compounds (VOCs – harsh chemicals for the environment)

Good for **filling spaces** between surfaces

Provide **rigid-to-flexible** low-strength bonds.

They **melt when heated** and solidify when cooled

Require **special dispensing equipment** because they come in rods

Common brands: **Stanley, 3M**

Contact adhesive

Cures by the **evaporation of its solvent**

Hardens in **5 – 30 min**
*Gains full strength in **24 hours***

No need to clamp

Parts harden together **instantly**

Apply on both surfaces to be joined, air dry, and bring together; stick instantly and permanently. Made of a synthetic rubber (usually neoprene) dispersed in a solvent or water.

Adheres nicely to large surfaces such as plastic/wood laminate

Main types of non-reactive adhesives

Emulsion adhesive: adhesive + evaporative solvent → **solvent evaporates** and leaves the adhesive behind
The adhesive is dissolved in solvent (water, other chemicals), so as the solvent evaporates it leaves the adhesive behind.

Hot melt: the **adhesive is melted** and applied

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