

# G/flex

**650-8 EPOXY**

**&**

**650-K Repair Pack**



# G/flex

**655-K Repair Pack**



# A guide for handling and using G/flex 650 Epoxy

**Instructions** for handling epoxy and basic techniques. Sample projects include repair to plastic canoes and kayaks, wooden boats, and household and sporting equipment. Also included are tips on gluing to wet surfaces and gluing underwater, joining wood, gluing in fasteners, and blending epoxies.

**G/flex 650 Epoxy** is the result of years of experimentation to develop a toughened epoxy that was simple to use and would adhere tenaciously to a variety of materials under difficult conditions.

G/flex 650 is all that, and more. It is a marine-grade glue that can be accurately mixed in small batches with a simple 1:1 mix ratio. It has the advantage of a long open working time and a relatively short cure time.

G/flex 650 is, first of all, a high-strength epoxy—designed for permanent, waterproof, structural bonding. Furthermore, G/flex has a modulus of elasticity of 1.03 GPa, which gives G/flex the toughness to make structural bonds that can absorb the stresses of expansion, contraction, shock, and vibration.

G/flex adheres tenaciously to difficult-to-glue hardwoods, both tropical and domestic varieties—white oak, Ipe, teak, greenheart, purpleheart and black walnut to name a few. G/flex also has the ability to glue damp woods. It can be used on wet surfaces, even underwater when applied with specific techniques.

G/flex is ideal for bonding a variety of other materials, including dissimilar ones—metals, plastics, glass, masonry, and fibreglass.

We encourage you to read these instructions and then experiment with G/flex. We think you will find many projects for which the particular properties of G/flex are ideally suited. As always, our Technical Staff is available to answer your questions, and we will be eager to hear about your projects and repairs using G/flex Epoxy.



## Handling Epoxy & Basic Techniques

### Safety

- Avoid skin contact with resin, hardener or mixed adhesive. Wear liquid-proof gloves and adequate protective clothing to keep the epoxy off your skin.
- Avoid eye contact with resin, hardener or mixed adhesive. Wear protective glasses. In case of contact with eyes, flush with water for 15 minutes and consult a physician.
- Avoid inhalation of vapours. Provide adequate ventilation. Wear a dust mask when sanding epoxy, especially epoxy that has not fully cured.
- Read and follow safety information on resin and hardener containers.

### Starting out

Remove and discard the red inner seal from both containers. Trim the tip of each spout about 6mm from the end.

Before mixing epoxy, gather all necessary application tools, clamps and equipment. Check all parts for proper fit and be sure all surfaces to be glued are properly prepared.

### Mixing and curing

Dispense equal volumes of G/flex 650 Resin and Hardener into a small mixing cup (1). Use a mixing stick to thoroughly blend the resin and hardener, while scraping the sides and bottom of the mixing cup (2). Small quantities can be mixed on a paper or plastic palette.



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After mixing the resin and hardener, you will have about 45 minutes, at 72°F (22°C), to apply the mixture before it begins to gel

and up to 75 minutes to assemble and clamp parts after it is initially applied. At 72°F (22°C), the adhesive mixture will solidify in 3–4 hours and reach a workable cure in 7-10 hours. The adhesive may be sanded, clamps can be removed, and joints can be moderately loaded. Wait 24 hours before subjecting joints to high loads.

G/flex 650 Epoxy cures faster in warmer temperatures and slower in cooler temperatures. When a quicker cure is desired, apply moderate heat to substantially reduce cure time. Cure time is reduced by half with each 18°F increase in temperature.

G/flex 650 will cure in temperatures as low as 40°F (5°C), but cure very slowly. When using 650 at lower temperatures, it is a good idea to warm resin and hardener to room temperature for easier dispensing and mixing.

Curing epoxy generates heat. Thicker layers of 650 generally cure a little faster than thinner layers, as this heat is concentrated in thicker layers and dissipated in thinner layers.

## Cleanup

Clean uncured epoxy from skin and clothes with the alcohol pad provided, followed by washing with soap and water. Remove excess epoxy from work surfaces with the flat end of a mixing stick or with paper towels. Clean up residue with an alcohol pad, citrus-based cleaner, acetone or lacquer thinner.

## Basic surface preparation

For best adhesion, gluing surfaces should be:

**CLEAN**—Remove loose, chalky or flaky coatings, and contaminants such as grease, oil, wax, and mould release. Clean contaminated surfaces with an appropriate solvent applied with plain white paper towels. Wipe the surface with a clean, dry paper towel before solvent dries. Do not use laundered rags to apply or remove solvent as they may contaminate the surface with fabric softener residue.

**SANDED**—Sand smooth and non-porous surfaces with 80-grit sandpaper to provide good texture for the epoxy to “key” into. Brush away sanding dust.

**DRY**—Although G/flex 650 Epoxy can be used to bond damp and wet surfaces (see *Gluing to wet surfaces and surfaces under water*, on the reverse side), maximum adhesion will be achieved when bonding to dry surfaces.

## Additional surface preparation

### Metals

Sand or grit-blast the surface to expose bright metal.

Clean the area with acetone or lacquer thinner using white paper towels. Allow the surface to dry completely.

**Abrade through wet epoxy**—Apply a thin coat of G/flex 650 Epoxy and immediately scrub metal surfaces through the wet epoxy coating with a fine wire brush or sandpaper.

Adhesion to aluminium can best be improved by treating it with the two-part propriety Aluminium Etch prior to applying the epoxy. Aluminium can be prepared using the “abrade through wet epoxy” method with good results if an aluminium etch kit is not available.

### Plastics

Sand ABS, PVC and polycarbonate plastics with 80-grit sandpaper to provide texture for improved adhesion.

Some plastics like HDPE and LDPE (high-density and low-density polyethylene) benefit from flame treating. First wipe the bonding surface with a solvent to remove contamination and dry with a clean paper towel.

**FLAME TREATING**—Pass the flame of a propane torch across the surface quickly. Allow the flame to touch the surface, but keep it moving—about 30 to 40 cm per second. No obvious change takes place, but the flame oxidizes the surface and dramatically improves adhesion with adhesives and coatings applied over it.

While flame treating will improve adhesion to most plastics, it appears to provide the greatest benefit to polyethylene. If you are unsure of the type of plastic, it doesn't hurt to flame treat.

### Hardwoods, including tropical woods

Bonding to dry wood (between 6 and 12% moisture content) is best for achieving long-term reliable bonds. Sand mating surfaces with 80-grit parallel to the grain. Clean oily woods with a WEST SYSTEM 850 Solvent such. Apply solvent with plain white paper towels. Wipe the surface with a clean, dry paper towel before solvent dries. Do not use laundered rags to apply or remove solvent.

The extent of wood failure in tensile adhesion tests indicate that tensile adhesion achieved using G/flex 650 Epoxy, with proper surface preparation, approached the grain strength of the wood in all of the woods we tested.



Surface preparation for various dry materials		
Material	Basic surface preparation	Additional surface preparation
Fibreglass laminate	As necessary, Remove soft and loose surface material Remove contamination with solvent wipe Sand with medium-grit sandpaper	
Aluminium		Aluminium Etch, two part
Steel		Wire brush through wet epoxy
Steel-galvanized		Wire brush through wet epoxy
Copper		Wire brush through wet epoxy
Bronze		Wire brush through wet epoxy
Lead		Wire brush through wet epoxy
ABS		Flame treat optional
PVC		Flame treat optional
Polycarbonate (Lexan™)		Flame treat optional
HDPE, LDPE plastic		Flame treat
Ipe		70% Isopropyl Alcohol wipe
Teak		Solvent wipe
White oak		
Walnut		
Purpleheart		
Greenheart		

### Bonding

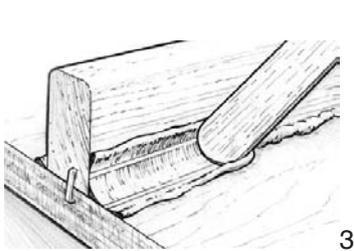
Apply the epoxy mixture to all properly prepared mating surfaces and clamp the components in position before the epoxy begins to gel—about 75 minutes at 72°F (22°C). Use just enough clamping pressure to squeeze a small amount of epoxy out of the joint. Leaving some glue in the joint increases bonding strength. Allow the epoxy to cure thoroughly before stressing the joint.

Thicken the epoxy with WEST SYSTEM 406 Adhesive Filler, included in the kit, as necessary to fill voids when gluing uneven mating surfaces or to bridge gaps in joints.

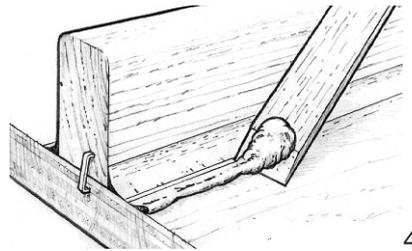
Use a spreader or notched trowel to apply G/flex 650 Epoxy to larger surfaces prior to clamping. Use a pipe cleaner or syringe to apply adhesive to hard to reach areas such as cracks and fastener holes when bonding hardware.

### Making fillets

When parts are joined at or near right angles, fillets can be used to add considerable strength to the joint by increasing the surface area of the bond. Make fillets by applying a bead of G/flex 650 Epoxy, thickened with the filler provided to a mayonnaise consistency, along the inside corner of the joint. Form the epoxy into a cove section using the round end of a mixing stick (3). Clean off the excess epoxy with the bevelled end of the mixing stick before the epoxy gels (4).



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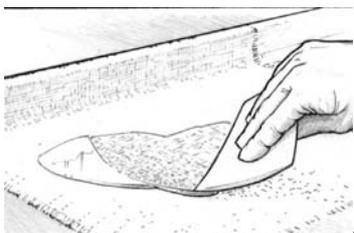


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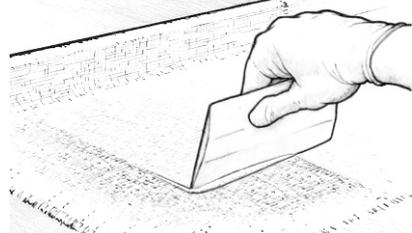
### Fibreglassing

Lightweight fibreglass fabrics and tapes (4–9 oz/sq yd range) can be used with G/flex 650 Epoxy when fibre reinforcement is desired to add stiffness or abrasion resistance, or to patch a damaged area.

Cut the fabric to fit the area. If heavier reinforcing is desired, use multiple thin layers rather than a single thick layer. Properly prepare the surface before applying fabric.



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Coat the substrate with 650. Lay the fabric in position on the wet adhesive. Spread mixed adhesive onto the fabric using a plastic spreader (5). When the fabric and substrate have been saturated, use the spreader to smooth and remove excess epoxy (6). Repeat the process with additional layers.



## Fairing (surface filling)

Use WEST SYSTEM 407 Low-Density Filler to thicken G/flex 650 Epoxy for use as a fairing compound. This mixture also works for light bonding, surface filling, and shaping. The more 407 Filler you add to the epoxy, the easier it will be to carve and sand. Use a mixing stick or spreader to apply and shape the mixture slightly higher than the desired surface contour. Sand it to shape after the epoxy cures. Seal the sanded fairing compound with unthickened epoxy before painting.

## Coating and re-coating

G/flex 650 Epoxy can be used as a moisture barrier coating. It has a mixed viscosity similar to honey, but it has good flow characteristics when brush applied. Use a stiff bristled brush (cut the bristles of a standard paintbrush to half their length) or apply with a flat spreader for best results. On horizontal surfaces, a fine notched trowel can be used to apply a uniform coat. One to two coats are usually enough given the viscosity of G/flex 650 Epoxy.

If you are gluing to or applying more coats of epoxy, apply the next coat while the previous coating is still tacky—usually 2–3 hours after applying at 72°F (22°C). Cured G/flex can be varnished, painted, or recoated or bonded to with epoxy. Wash cured G/flex with water and sand surfaces to a dull finish, providing a texture for good adhesion.

## WEST SYSTEM® Epoxies

G/flex 650 Epoxy is the latest addition to the WEST SYSTEM line of epoxy products. While G/flex offers physical properties and applications that are different than WEST SYSTEM 105 Resin-based epoxies, they share the same high standards for performance and reliability.

For forty years, reliability has been the hallmark of WEST SYSTEM. We adhere to the highest standards of quality assurance in our formulating and manufacturing practices, from raw material qualification to testing and certification of finished resins and hardeners. This means that every properly mixed batch of WEST SYSTEM resin and hardener, including G/flex resin and hardener, will cure as it is supposed to, every time. This commitment to quality has earned certification to the ISO 9001:2008 standard. WEST SYSTEM is your reliable solution.

## Outstanding customer service

WEST SYSTEM provides you with something else as reliable as our epoxy—knowledge. Whether your project is large or small, the WEST SYSTEM Technical Staff and comprehensive instructional publications will help assure the success of your building and repair project. WEST SYSTEM is renowned for its outstanding customer service.

**WEST SYSTEM technical publications** and DVD provide detailed procedures and instructions for specific repair and construction applications.

**The WEST SYSTEM website** provides basic product information, dealer locations and links, project articles and galleries, and safety information. Visit [west-system.co.uk](http://west-system.co.uk).

Further assistance can be obtained by contacting the friendly and knowledgeable Technical Staff. Send e-mail to [Techinfo@wessex-resins.com](mailto:Techinfo@wessex-resins.com) or go to our website [www.wessex-resins.com](http://www.wessex-resins.com).

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# Sample projects

The repairs described on this page are just a sample of the potential uses for G/flex® 650 Epoxy. Products not included in the kit can be found in the *WEST SYSTEM® User Manual & Product Guide* and are available at WEST SYSTEM dealers.

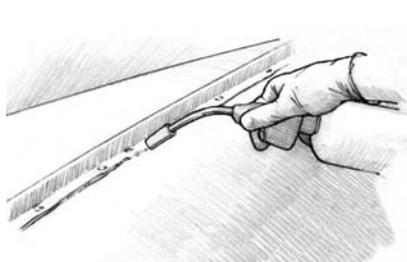
Be sure to read *Handling epoxy* and *Basic techniques* on the reverse side of this guide before beginning these repairs.

## Aluminium boat seam repair

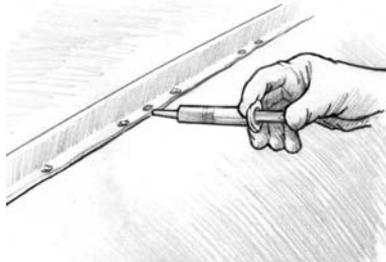
Determine the exact locations of leaks by putting the dry boat in the water or partially filling a small boat with water to see where it leaks.

Pressure wash the leaking area to be sure debris is removed from the rivets and seams. Abrade the area with a wire wheel on a drill motor or a wire brush to further remove debris. Drain and dry the boat.

Mix a small batch of G/flex 650 Epoxy and transfer it to a syringe included in the kit.



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Heat the leaky seams with a heat gun or propane torch. The heat will drive residual moisture from the seams in the form of steam or boiling water, which is a good visual indicator that you are bringing the metal up to temperature (7).

Inject the epoxy with the syringe or apply it with a small brush along the seam while the metal is still warm (8). The epoxy will thin when it touches the warm metal and will flow deep into the crack. Use the heat gun to warm the metal along the seam as you direct the epoxy into it. The heat will help release air in the epoxy and speed the cure.

On very loose and leaky joints, a combination of new rivets and epoxy will work best. If rivets are not available, leaks have been sealed by filling the seam with thickened epoxy.

First warm the metal and apply the liquid epoxy as described above. Then use a putty knife, plastic spreader or syringe to force thickened G/flex into the seam. Thicken the epoxy with 406 Colloidal Silica Adhesive Filler, included in the kit, to a mayonnaise consistency. Try to push the mixture through the seam to the other side of the hull. Thickened G/flex will bridge gaps and stay in the seam until it cures.

420 Aluminium Powder can be added to the thickened epoxy mixture prior to forcing it into the seams to make the repair less obvious and to provide UV protection for the epoxy.

Wipe up excess uncured epoxy from both sides using paper towels and dry cheesecloth. Solvents can be used sparingly if care is taken to avoid washing out the epoxy in the seam or dissolving paint in the area.

Let the epoxy cure overnight before using the boat. You may use a heat gun or heat lamp to shorten the cure time. For every 18°F increase in temperature, G/flex cures in half as much time, but do not heat the curing epoxy over 120°F (49°C).

## Plastic canoe & kayak repairs

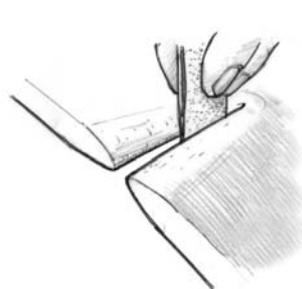
Plastic canoes and kayaks are often made with thermoformed plastics like HDPE (high-density polyethylene), ABS, and occasionally PVC. G/flex adheres to these materials if specific surface preparations are followed. Refer to the *Surface Preparation* chart on the reverse of this page.

### Split and crack repair

Open up cracks and splits with a sabre saw or hacksaw blade to create a slight gap in the break. Bevel the edges of the crack with a sharp scraper like the end of a sharp chisel or with a cabinet scraper to create a  $\frac{3}{8}$ " to  $\frac{1}{2}$ " long bevel on both sides of the split and on both sides of the hull (9). Sand the bevelled surfaces to round the edges and create more taper with 80-grit sandpaper (10).



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Flame treat HDPE and LDPE (high-density and low-density polyethylene) plastic with a propane torch to oxidize the repair surfaces. See *Special surface preparation* on the reverse of this page.

Mix an appropriately sized batch of G/flex 650 Epoxy. Apply a bead of the adhesive to the bevelled joint, overfilling it slightly. Cover the adhesive filled joint with 2" wide cellophane packaging tape while forcing the excess (overfill) epoxy through to the other side of the joint. Avoid using too much force, which could leave the taped side under filled.

Spread out the adhesive on the opposite side to fill in the bevelled seam. Add or remove epoxy to fill the bevel flush.

Allow to cure 7–10 hours before removing tape. Use a scraper or sandpaper to remove high spots and smooth the surface. Paint the area with plastic-compatible paint like Krylon™ Fusion.

### Small hole repair

Canoes and kayaks are often dragged over sand and rocks, resulting in worn off ends and eventual leaks near the bow and stern.

Clean the area being repaired with a mild solvent like rubbing alcohol and paper towels. Sand with 80-grit sandpaper to create a slight taper around the perimeter of the repair. Flame treat the repair surfaces of HDPE and LDPE plastics.

If the worn section has a gap that is too wide to bridge with G/flex 650 Epoxy, say  $\frac{1}{4}$ " to  $\frac{3}{8}$ " across, cover the back of the hole with a temporary backer to support the epoxy while it cures. The backer can be a wad of plastic wrap, piece of polystyrene foam, or any appropriately shaped material covered with plastic wrap. The plastic wrap will allow for easy removal after the epoxy cures.

Mix an appropriately sized batch of G/flex 650 Epoxy.

Apply the adhesive to the area with a mixing stick or plastic spreader. Apply enough epoxy to fill the hole and build up low areas to match the original thickness. Apply additional epoxy, if necessary, while previous applications are still tacky.

Allow to cure 7–10 hours before removing excess cured epoxy and shaping the surface with a cabinet scraper, file, or sandpaper. Paint the area with a plastic-compatible paint like Krylon Fusion™.

### Create skid plates / repair larger holes

Avoid wearing holes on the keels and ends of canoes and kayaks by applying an abrasion resistant fibreglass strip on the wear areas. Fibreglass or Kevlar™ reinforcement can also be used to patch larger holes (over  $\frac{3}{8}$ ").

Clean the surface with a mild solvent like rubbing alcohol and paper towels. Sand the end of the canoe along the bottom and up the sides a few inches with 80-grit (11). This area will define the size of the skid plate. Flame treat HDPE or LDPE plastics. If you are patching a hole, cover the back with a temporary backer as described earlier.



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Cut three or four layers of light fibreglass cloth (4–6 oz fabric) to cover the sanded area. Cut the bottom piece of fibreglass to fit to the sanded/flame-treated boundary. Trim each successive layer an inch or two narrower and shorter than the previous. This tapers the thickness of the fibreglass skid plate/patch toward the edges so it will easily deflect and cling to the hull as it flexes.

Mix enough G/flex 650 Epoxy to wet out and apply one or two layers of fabric.

Apply a coat of epoxy to the sanded/treated area. Lay the largest piece of fibreglass onto the adhesive. Apply more adhesive to wet out the fibreglass cloth. If necessary, a heat gun can be used to warm the epoxy and improve wet out in cooler temperatures. Use a spreader to smooth the fabric and remove excess epoxy (12).

Repeat the fibreglass application with the remaining piece(s). Centre each smaller layer on the one before it. Wet out the fabric, and then use a spreader to smooth the fabric and remove excess epoxy.

Apply a coat of adhesive to fill and smooth the edges of the fabric if desired while the fibreglass application is still tacky.

Allow to cure 7–10 hours before removing any rough edges or excess cured epoxy with a cabinet scraper, file or sandpaper. Paint the area with a plastic compatible paint like Krylon Fusion™.

### Wood construction and repair

G/flex 650 is an excellent adhesive for wood. It is especially good for gluing native hardwoods like white oak and for tropical woods like teak and purpleheart. There are many uses for G/flex Epoxy in building and repairing boats, indoor and outdoor furniture, cabinetry, and trim.

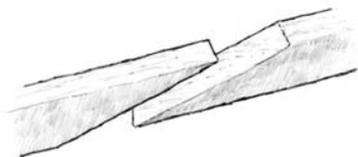
Refer to *Special surface preparation* and *Bonding* on the reverse page for basic gluing information. Here are some additional wood bonding applications that extend the uses of G/flex 650 Epoxy.



## Joining wood

**BUTT JOINTS** are used to edge glue lumber to create wider boards. Edges are typically square cut at 90° and simply butted up to one another when gluing. This joint is used for edge gluing lumber; it is not recommended for end gluing, or lengthening boards parallel to the grain.

**SCARF JOINTS** are used to join two pieces of wood together along their length. The ends of lumber are machined with an 8:1 to 12:1 bevel angle (13). Longer bevels create more gluing surface and potentially stronger joints. Scarf joints are often used to replace damaged sections of frames and ribs in traditionally built wood boats. Use G/flex 650 unthickened if your fits are good or thicken G/flex 650 with the 406 Filler provided to bridge gaps in the joint.

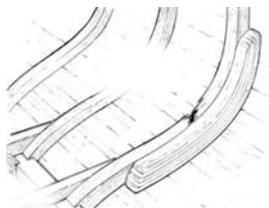


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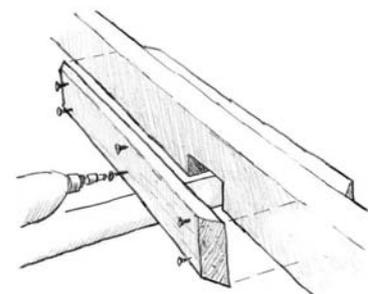
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A **DUTCHMAN** is a wood splice used to repair damaged sections of wood timbers. We recommend creating an 8:1 bevel (14) on each end of the joint to provide adequate gluing area to maintain structural integrity.



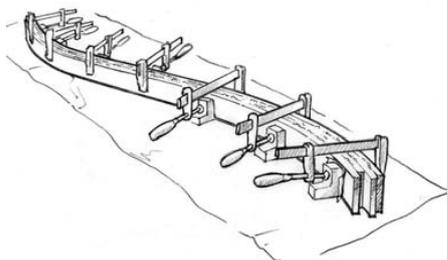
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**SISTER PLANKS** are used to build up the strength of the lumber by gluing additional pieces or sister planks on one or both sides.

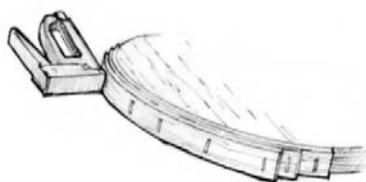


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Bond sister planks where structural members have been damaged by rot (15) or weakened by cut outs for plumbing or drain holes (16). They are useful where weight or appearance is not a factor.



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**LAMINATING** multiple layers of wood strips is a great way to create custom-shaped lumber for frames, sister frames, legs, arches, railings, and trim. Laminated lumber is stronger and more stable than steam bent or sawn lumber. Glue strips using the preparation and bonding techniques on the reverse page. Use a jig or mould to clamp strips to the desired shape (11, 12). Jigs should be strong enough to provide even clamping pressure and prevent spring back until the epoxy cures.

## Repairing splits, cracks and delaminations

Paddles, oars, garden tool handles, and sports equipment made with wood or laminated materials can split or crack under normal use or abuse. Ice hockey sticks, for example, are exposed to bending loads as well as high shock forces from impact with the puck, the ice, and other sticks. Handles and blades often chip and split, as does the equipment from many other sports. G/flex 650 Epoxy's tenacious adhesion and ability to resist shock loads make it a good choice for these kinds of repairs.

Insert a wedge into the crack(s) to expose as much bonding area as possible without increasing the damage. Heat the area to be repaired with a heat gun or hair dryer. This will lower the epoxy's viscosity on contact, allowing it to penetrate deeper into cracks. Fix the item in position so gravity will pull epoxy into the crack.



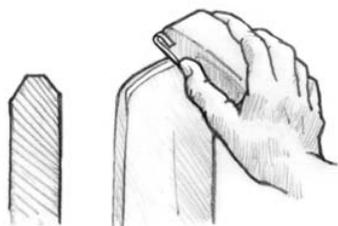
Mix a small batch of G/flex 650 Epoxy. Work epoxy into the crack with the mixing stick or a small brush, or inject epoxy with an 807 Syringe. Use a fine blade or stick to push epoxy as far down into the crack as possible.

Wait a few minutes for absorption to take place before removing wedge and clamping the crack(s) closed. Allow to cure 7–10 hours before removing clamps and sanding away epoxy squeeze-out. Wait 24 hours before using.

Thicken the epoxy as necessary to bridge gaps or fill in missing material. A layer or two of light weight fibreglass fabric (4–6 oz) can be applied for additional reinforcing. Refer to *Fibreglassing* on the reverse page.

### Create durable tips on wood paddles & oars

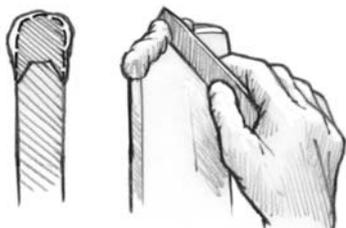
The tips of canoe and kayak paddles take lots of abuse from scraping bottom, pushing off rocks, and fending off debris. Use G/flex 650 Epoxy to produce a durable edge to protect tips from damage.



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Sand varnish or paint from the tip of the paddle to expose fresh wood. Use sandpaper on a hard sanding block to create a slight bevel around the edge of the paddle tip (19).

Apply a generous coating of G/flex 650 Epoxy to the sanded surfaces to wet out the exposed end grain.



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Mix an appropriate amount of G/flex 650 Epoxy thickened with 406 Colloidal Silica Filler to a mayonnaise consistency. Apply a thick bead of the thickened mixture around the edge of the paddle blade (20). Apply additional thickened epoxy to extend the tip, if desired, after the initial application has gelled and will support the additional weight.

Allow to cure 7–10 hours. Wash with water before shaping the tip with a file or sandpaper. Apply paint or varnish if desired. □

### Gluing to wet surfaces and surfaces underwater

While gluing to a dry and properly prepared surface is best for producing reliable long-term bonds, gluing to damp, wet, and even underwater surfaces is possible.

Abrade bonding surfaces with 80-grit sandpaper. Mix an appropriately sized batch of G/flex thickened with 406 Filler to a mayonnaise consistency. Gluing to wet surfaces requires a thickened adhesive that will displace water in the scratches and pores at the bonding surface when it is applied.

Forcefully apply the thickened epoxy onto the bonding surfaces with a plastic spreader or stiff brush.

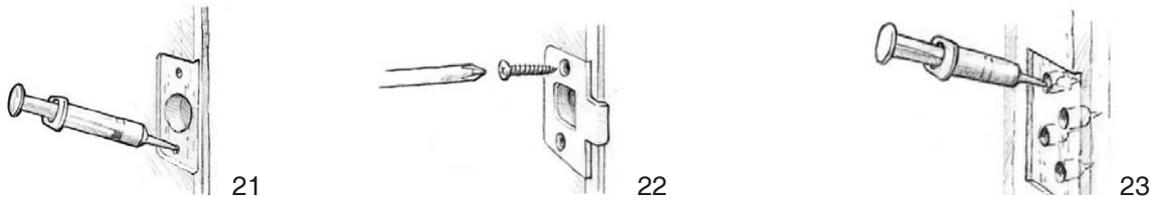
Bring the mating surfaces together and apply just enough clamping pressure to squeeze out excess epoxy and moisture. Allow to cure 7–10 hours before removing clamps and 24 hours before stressing the joint.

### Bonding fasteners

G/flex 650 Epoxy can be used for a variety of household and marine projects and repairs that involve threaded fasteners, especially fasteners subject to shock or vibration. Installing screws and other threaded fasteners with G/flex 650 Epoxy dramatically improves load carrying capacity. Use G/flex 650 Epoxy to install new fasteners and hardware, repair stripped screw holes and replace missing wood around fasteners. When cured, G/flex can be sanded, sawn, nailed and screwed. Small screws, nails, and tacks can be driven into it without pre-drilling. Larger fasteners may require a pilot hole. Experiment for best results.

The easiest method is to simply wet out new pilot holes (or stripped fastener holes) (21) with G/flex 650 Epoxy prior to installing the screws (22). The epoxy will soak into the exposed end grain on the inside of the hole, effectively increasing fastener diameter. This results in more holding power, and seals water out so the wood stays drier. Drier wood is stronger than damp wood.

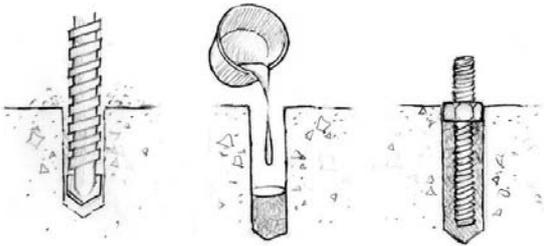




For even greater strength and stability, drill oversized holes 2/3 the depth of the fastener. Wet out the holes and the fastener with epoxy, then fill the hole with thickened epoxy/adhesive filler (23). Use 406 Colloidal Silica Filler to thicken the epoxy to a mayonnaise consistency. Install the fasteners with just enough force to hold the hardware in place until the epoxy cures.

### Bonding anchor bolts

One of epoxy's best uses is to bond anchor bolts into concrete. The principle is the same as for wood. Drill an oversized hole. Wet out the hole with epoxy. Then place the bolt or threaded rod in the hole.



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It's a good idea to put a nut on the threaded rod so that its top is barely above the surface (24). This centres the rod in the hole and will help to reduce the creep load on the epoxy when the hardware item is tightened down. □

### Blending epoxies

Advanced users can blend G/flex 650 Epoxy Adhesive with WEST SYSTEM 105 Resin-based epoxy combinations to modify toughness, flexibility, cure speed, viscosity, strength, and elongation. The epoxy blend will have properties/characteristics derived from both epoxy systems, roughly in proportion to the percentage of each epoxy in the blend.

Blending WEST SYSTEM 105/205 with G/flex 650 will speed up the cure of G/flex, lower its mixed viscosity and increase rigidity of the cured epoxy, compared to using G/flex 650 alone.

To blend G/flex 650 Epoxy Adhesive with 105 Resin-based epoxies, you must meter the appropriate resin to hardener mix ratio of each epoxy prior to blending the two combinations together.

# A guide for handling and using G/flex 655 Epoxy Adhesive

**Instructions** for handling epoxy and basic techniques. Sample projects include repair to plastic canoes and kayaks, wooden boats, and household and sporting equipment. Also included are tips on gluing to wet surfaces and gluing underwater, joining wood, gluing in fasteners, and blending epoxies.

**G/flex 655 Epoxy Adhesive** is the result of years of experimentation to develop a toughened epoxy that was simple to use and would adhere tenaciously to a variety of materials under difficult conditions.

G/flex 655 is, first of all, a high-strength epoxy—designed for permanent, waterproof, structural bonding. Furthermore, G/flex has a modulus of elasticity of 1.03 GPa, which gives G/flex the toughness to make structural bonds that can absorb the stresses of expansion, contraction, shock, and vibration.

G/flex adheres tenaciously to difficult-to-glue hardwoods, both tropical and domestic varieties—white oak, Ipe, teak, greenheart, purpleheart and black walnut to name a few. G/flex also has the ability to glue damp woods. It can be used on wet surfaces, even underwater when applied with specific techniques.

G/flex is ideal for bonding a variety of other materials, including dissimilar ones—metals, plastics, glass, masonry, and fiberglass.

We encourage you to read these instructions and then experiment with G/flex. We think you will find many projects for which the particular properties of G/flex are ideally suited. As always, our Technical Staff is available to answer your questions, and we will be eager to hear about your projects and repairs using G/flex Epoxy.



## Handling Epoxy & Basic Techniques

### Safety

- Avoid skin contact with resin, hardener or mixed adhesive. Wear liquid-proof gloves and adequate protective clothing to keep the epoxy off your skin.
- Avoid eye contact with resin, hardener or mixed adhesive. Wear protective glasses. In case of contact with eyes, flush with water for 15 minutes and consult a physician.
- Avoid inhalation of vapours. Provide adequate ventilation. Wear a dust mask when sanding epoxy, especially epoxy that has not fully cured.
- Read and follow safety information on resin and hardener containers.

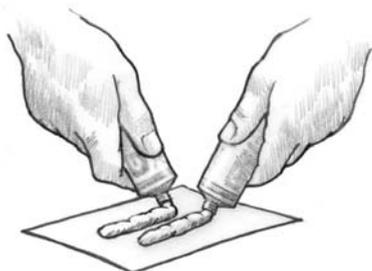
### Starting out

Puncture the seal in each tube with the point in the end of the cap.

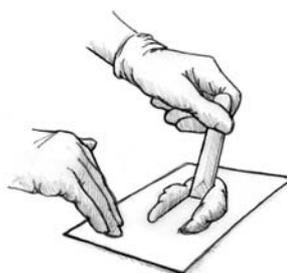
Before mixing epoxy, gather all necessary application tools, clamps and equipment. Check all parts for proper fit and be sure all surfaces to be glued are properly prepared.

### Mixing and curing

Dispense equal volumes of G/flex 655 Resin and Hardener onto a mixing pallet (1). Use the square end of a mixing stick to thoroughly blend the resin and hardener (2).



1



2

After mixing the resin and hardener, you will have about 45 minutes, at 72°F (22°C), to apply the mixture before it begins to gel and up to 75 minutes to assemble and clamp parts after it is initially applied. At 72°F (22°C), the adhesive mixture will solidify in 3–4 hours and reach a workable cure in 7-10 hours. The adhesive may be sanded, clamps can be removed, and joints can be moderately loaded. Wait 24 hours before subjecting joints to high loads.

G/flex 655 Epoxy Adhesive cures faster in warmer temperatures and slower in cooler temperatures. When a quicker cure is desired, apply moderate heat to substantially reduce cure time. Cure time is reduced by half with each 10°C increase in temperature.

G/flex 655 will cure in temperatures as low as 40°F (5°C), but cure very slowly. When using 655 at lower temperatures, it is a good idea to warm resin and hardener to room temperature for easier dispensing and mixing.

Curing epoxy generates heat. Thicker layers of 655 generally cure a little faster than thinner layers, as this heat is concentrated in thicker layers and dissipated in thinner layers.

## Cleanup

Clean uncured epoxy from skin and clothes with the alcohol pad provided, followed by washing with soap and water. Remove excess epoxy from work surfaces with the flat end of a mixing stick or with paper towels. Clean up residue with an alcohol pad, citrus-based cleaner, acetone or lacquer thinner.

## Basic surface preparation

For best adhesion, gluing surfaces should be:

**CLEAN**—Remove loose, chalky or flaky coatings, and contaminants such as grease, oil, wax, and mould release. Clean contaminated surfaces with an appropriate solvent applied with plain white paper towels. Wipe the surface with a clean, dry paper towel before solvent dries. Do not use laundered rags to apply or remove solvent as they may contaminate the surface with fabric softener residue.

**SANDED**—Sand smooth and non-porous surfaces with 80-grit sandpaper to provide good texture for the epoxy to “key” into. Brush away sanding dust.

**DRY**—Although G/flex 655 Epoxy Adhesive can be used to bond damp and wet surfaces (see *Gluing to wet surfaces and surfaces under water*, on the reverse side), maximum adhesion will be achieved when bonding to dry surfaces.

## Additional surface preparation

### Metals

Sand or grit-blast the surface to expose bright metal.

Clean the area with acetone or lacquer thinner using white paper towels. Allow the surface to dry completely.

**Abrade through wet epoxy**—Apply a thin coat of G/flex 655 Epoxy Adhesive and immediately scrub metal surfaces through the wet epoxy coating with a fine wire brush or sandpaper.

Adhesion to aluminium can best be improved by treating it with the two-part propriety Aluminium Etch prior to applying the epoxy. Aluminium can be prepared using the “abrade through wet epoxy” method with good results if an aluminium etch kit is not available.

### Plastics

Sand ABS, PVC and polycarbonate plastics with 80-grit sandpaper to provide texture for improved adhesion.

Some plastics like HDPE and LDPE (high-density and low-density polyethylene) benefit from flame treating. First wipe the bonding surface with a solvent to remove contamination and dry with a clean paper towel.

**FLAME TREATING**—Pass the flame of a propane torch across the surface quickly. Allow the flame to touch the surface, but keep it moving—about 30 to 40 cm per second. No obvious change takes place, but the flame oxidizes the surface and dramatically improves adhesion with adhesives and coatings applied over it.

While flame treating will improve adhesion to most plastics, it appears to provide the greatest benefit to polyethylene. If you are unsure of the type of plastic, it doesn't hurt to flame treat.

### Hardwoods, including tropical woods

Bonding to dry wood (between 6 and 12% moisture content) is best for achieving long-term reliable bonds. Sand mating surfaces with 80-grit parallel to the grain. Clean oily woods with a WEST SYSTEM 850 Solvent such. Apply solvent with plain white paper towels. Wipe the surface with a clean, dry paper towel before solvent dries. Do not use laundered rags to apply or remove solvent.

The extent of wood failure in tensile adhesion tests indicate that tensile adhesion achieved using G/flex 655 Epoxy Adhesive, with proper surface preparation, approached the grain strength of the wood in all of the woods we tested.



Surface preparation for various dry materials		
Material	Basic surface preparation	Additional surface preparation
Fibreglass laminate	As necessary, Remove soft and loose surface material Remove contamination with solvent wipe Sand with medium-grit sandpaper	
Aluminium		Aluminium Etch, two part
Steel		Wire brush through wet epoxy
Steel-galvanized		Wire brush through wet epoxy
Copper		Wire brush through wet epoxy
Bronze		Wire brush through wet epoxy
Lead		Wire brush through wet epoxy
ABS		Flame treat optional
PVC		Flame treat optional
Polycarbonate (Lexan™)		Flame treat optional
HDPE, LDPE plastic		Flame treat
Ipe		70% Isopropyl Alcohol wipe
Teak		Solvent wipe
White oak		
Walnut		
Purpleheart		
Greenheart		

### Bonding

Apply the epoxy mixture to all properly prepared mating surfaces. Apply enough epoxy to fill voids and bridge gaps on uneven mating surfaces.

Clamp the components in position before the epoxy begins to gel—about 75 minutes at 72°F (22°C). Use just enough clamping pressure to squeeze a small amount of epoxy out of the joint. Leaving some glue in the joint increases bonding strength. Allow the epoxy to cure thoroughly before stressing the joint.

Use a spreader or notched trowel to apply G/flex 655 to larger surfaces prior to clamping. Use a pipe cleaner or syringe to apply adhesive to hard to reach areas such as cracks and fastener holes when bonding hardware.

### Bonding to wet surfaces and surfaces underwater

While gluing to a dry and properly prepared surface is best for producing reliable long-term bonds, gluing to damp, wet, and even underwater surfaces is possible.

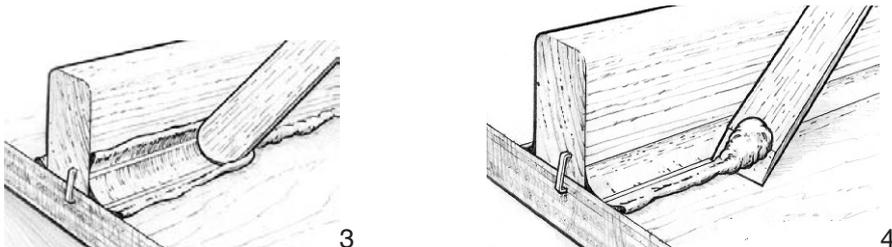
Abrade bonding surfaces with 80-grit sandpaper.

Mix an appropriately sized batch of G/flex 655 Epoxy Adhesive. Forcefully apply the 655 onto the bonding surfaces with a plastic spreader or stiff brush to displace water in the scratches and pores at the bonding surface.

Bring the mating surfaces together and apply just enough clamping pressure to squeeze out excess 655 and moisture. Allow to cure 7–10 hours before removing clamps and 24 hours before stressing the joint.

### Making fillets

When parts are joined at or near right angles, fillets can be used to add considerable strength to the joint by increasing the surface area of the bond. Make fillets by applying a bead of G/flex 655 along the inside corner of the joint. Form the epoxy into a cove section using the round end of a mixing stick (3).



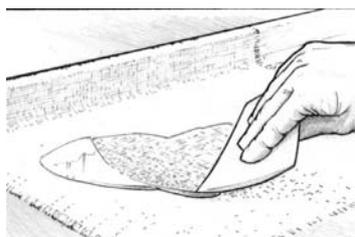
Clean off the excess epoxy with the bevelled end of the mixing stick before the epoxy gels (4).

### Fibreglassing

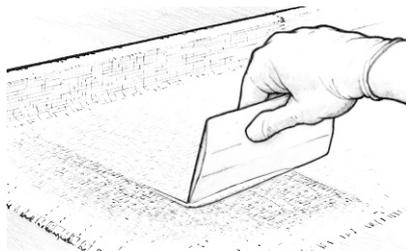
Lightweight fibreglass fabrics and tapes (4–9 oz/sq yd range) can be used with G/flex 655 Epoxy Adhesive when fibre reinforcement is desired to add stiffness or abrasion resistance, or to patch a damaged area.



Cut the fabric to fit the area. If heavier reinforcing is desired, use multiple thin layers rather than a single thick layer. Properly prepare the surface before applying fabric.



5



6

Coat the substrate with 655. Lay the fabric in position on the wet adhesive. Spread mixed adhesive onto the fabric using a plastic spreader (5). When the fabric and substrate have been saturated, use the spreader to smooth and remove excess epoxy (6). Repeat the process with additional layers.

## WEST SYSTEM® Epoxies

G/flex 655 Epoxy Adhesive is the latest addition to the WEST SYSTEM line of epoxy products. While G/flex offers physical properties and applications that are different than WEST SYSTEM 105 Resin-based epoxies, they share the same high standards for performance and reliability.

For forty years, reliability has been the hallmark of WEST SYSTEM. We adhere to the highest standards of quality assurance in our formulating and manufacturing practices, from raw material qualification to testing and certification of finished resins and hardeners. This means that every properly mixed batch of WEST SYSTEM resin and hardener, including G/flex resin and hardener, will cure as it is supposed to, every time. This commitment to quality has earned certification to the ISO 9001:2008 standard. WEST SYSTEM is your reliable solution.

### Outstanding customer service

WEST SYSTEM provides you with something else as reliable as our epoxy—knowledge. Whether your project is large or small, the WEST SYSTEM Technical Staff and comprehensive instructional publications will help assure the success of your building and repair project. WEST SYSTEM is renowned for its outstanding customer service.

**WEST SYSTEM technical publications** and DVD provide detailed procedures and instructions for specific repair and construction applications.

**The WEST SYSTEM website** provides basic product information, dealer locations and links, project articles and galleries, and safety information. Visit [west-system.co.uk](http://west-system.co.uk).

Further assistance can be obtained by contacting the friendly and knowledgeable Technical Staff. Send e-mail to [Techinfo@wessex-resins.com](mailto:Techinfo@wessex-resins.com) or go to our website [www.wessex-resins.com](http://www.wessex-resins.com).

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# Sample projects

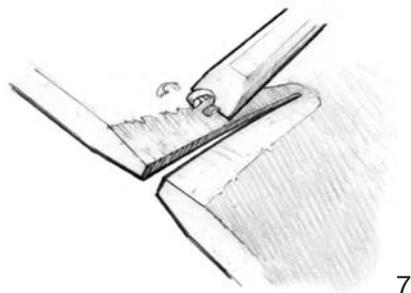
The repairs described on this page are just a sample of the potential uses for G/flex® 655 Epoxy Adhesive. Products not included in the kit can be found in the *WEST SYSTEM® User Manual & Product Guide* and are available at WEST SYSTEM dealers. Be sure to read *Handling epoxy* and *Basic techniques* on the reverse side of this guide before beginning these repairs.

## Plastic canoe & kayak repairs

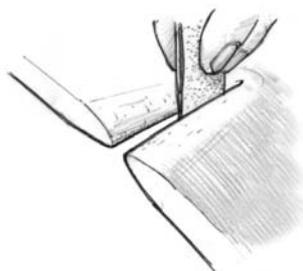
Plastic canoes and kayaks are often made with thermoformed plastics like HDPE (high-density polyethylene), ABS, and occasionally PVC. G/flex adheres to these materials if specific surface preparations are followed. Refer to the *Surface Preparation* chart on the reverse of this page.

### Split and crack repair

Open up cracks and splits with a sabre saw or hacksaw blade to create a slight gap in the break. Bevel the edges of the crack with a sharp scraper like the end of a sharp chisel or with a cabinet scraper to create a  $\frac{3}{8}$ " to  $\frac{1}{2}$ " long bevel on both sides of the split and on both sides of the hull (7). Sand the bevelled surfaces to round the edges and create more taper with 80-grit sandpaper (8).



7



8

Flame treat HDPE and LDPE (high-density and low-density polyethylene) plastic with a propane torch to oxidize the repair surfaces. See *Special surface preparation* on the reverse of this page.

Mix an appropriately sized batch of G/flex 655 Epoxy Adhesive. Apply a bead of the adhesive to the bevelled joint, overfilling it slightly.

Cover the adhesive filled joint with 2" wide cellophane packaging tape while forcing the excess (overfill) epoxy through to the other side of the joint. Avoid using too much force, which could leave the taped side under filled.

Spread out the adhesive on the opposite side to fill in the bevelled seam. Add or remove epoxy to fill the bevel flush.

Allow to cure 7–10 hours before removing tape. Use a scraper or sandpaper to remove high spots and smooth the surface. Paint the area with plastic-compatible paint like Krylon™ Fusion.

### Small hole repair

Canoes and kayaks are often dragged over sand and rocks, resulting in worn off ends and eventual leaks near the bow and stern.

Clean the area being repaired with a mild solvent like rubbing alcohol and paper towels. Sand with 80-grit sandpaper to create a slight taper around the perimeter of the repair. Flame treat the repair surfaces of HDPE and LDPE plastics.

If the worn section has a gap that is too wide to bridge with G/flex 655 Epoxy Adhesive, say  $\frac{1}{4}$ " to  $\frac{3}{8}$ " across, cover the back of the hole with a temporary backer to support the epoxy while it cures. The backer can be a wad of plastic wrap, piece of polystyrene foam, or any appropriately shaped material covered with plastic wrap. The plastic wrap will allow for easy removal after the epoxy cures.

Mix an appropriately sized batch of G/flex 655 Epoxy Adhesive.

Apply the adhesive to the area with a mixing stick or plastic spreader. Apply enough epoxy to fill the hole and build up low areas to match the original thickness. Apply additional epoxy, if necessary, while previous applications are still tacky.

Allow to cure 7–10 hours before removing excess cured epoxy and shaping the surface with a cabinet scraper, file, or sandpaper. Paint the area with a plastic-compatible paint like Krylon Fusion™.

### Create skid plates / repair larger holes

Avoid wearing holes on the keels and ends of canoes and kayaks by applying an abrasion resistant fibreglass strip on the wear areas. Fibreglass or Kevlar™ reinforcement can also be used to patch larger holes (over  $\frac{3}{8}$ ").

Clean the surface with a mild solvent like rubbing alcohol and paper towels. Sand the end of the canoe along the bottom and up the sides a few inches with 80-grit (9). This area will define the size of the skid plate. Flame treat HDPE or LDPE plastics. If you are patching a hole, cover the back with a temporary backer as described earlier.





9



10

Cut three or four layers of light fibreglass cloth (4–6 oz fabric) to cover the sanded area. Cut the bottom piece of fibreglass to fit to the sanded/flame-treated boundary. Trim each successive layer an inch or two narrower and shorter than the previous. This tapers the thickness of the fibreglass skid plate/patch toward the edges so it will easily deflect and cling to the hull as it flexes.

Mix enough G/flex 655 Epoxy Adhesive to wet out and apply one or two layers of fabric.

Apply a coat of epoxy to the sanded/treated area. Lay the largest piece of fibreglass onto the adhesive. Apply more adhesive to wet out the fibreglass cloth. If necessary, a heat gun can be used to warm the epoxy and improve wet out in cooler temperatures. Use a spreader to smooth the fabric and remove excess epoxy (10).

Repeat the fibreglass application with the remaining piece(s). Centre each smaller layer on the one before it. Wet out the fabric, and then use a spreader to smooth the fabric and remove excess epoxy.

Apply a coat of adhesive to fill and smooth the edges of the fabric if desired while the fibreglass application is still tacky.

Allow to cure 7–10 hours before removing any rough edges or excess cured epoxy with a cabinet scraper, file or sandpaper. Paint the area with a plastic compatible paint like Krylon Fusion™.

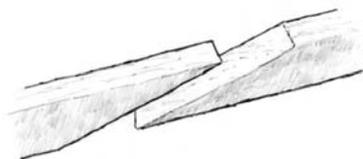
## Wood construction and repair

G/flex 655 is an excellent adhesive for wood. It is especially good for gluing native hardwoods like white oak and for tropical woods like teak and purpleheart. There are many uses for G/flex Epoxy Adhesive in building and repairing boats, indoor and outdoor furniture, cabinetry, and trim.

Refer to *Special surface preparation* and *Bonding* on the reverse page for basic gluing information. Here are some additional wood bonding applications that extend the uses of G/flex 655 Epoxy Adhesive.

### Joining wood

**BUTT JOINTS** are used to edge glue lumber to create wider boards. Edges are typically square cut at 90° and simply butted up to one another when gluing. This joint is used for edge gluing lumber; it is not recommended for end gluing, or lengthening boards parallel to the grain. Avoid excess clamping pressure.



11

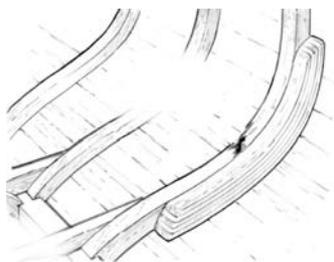
**SCARF JOINTS** are used to join two pieces of wood together along their length. The ends of lumber are machined with an 8:1 to 12:1 bevel angle (11). Longer bevels create more gluing surface and potentially stronger joints. Scarf joints are often used to replace damaged sections of frames and ribs in traditionally built wooden boats.

A **DUTCHMAN** is a wood splice used to repair damaged sections of wood timbers. We recommend creating an 8:1 bevel (12) on each end of the joint to provide adequate gluing area to maintain structural integrity.

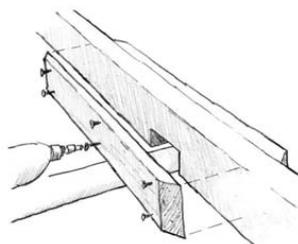


12

**SISTER PLANKS** are used to build up the strength of the lumber by gluing additional pieces or sister planks on one or both sides.



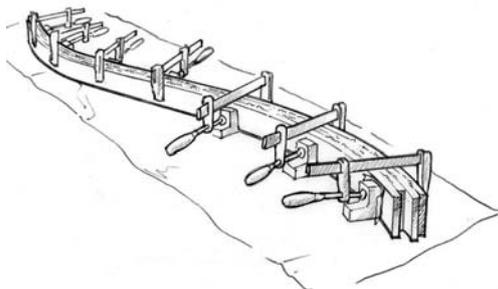
13



14

Bond sister planks where structural members have been damaged by rot (13) or weakened by cut outs for plumbing or drain holes (14). They are useful where weight or appearance is not a factor.

LAMINATING multiple layers of wood strips is a great way to create custom- shaped lumber for frames, sister frames, legs, arches, railings, and trim. Laminated lumber is stronger and more stable than steam bent or sawn lumber. Glue strips using the preparation and bonding techniques on the reverse page.



15

Use a jig or mould to clamp strips to the desired shape (15). Jigs should be strong enough to provide even clamping pressure and prevent springback until the epoxy cures.

## Repairing splits, cracks and delaminations

Paddles, oars, garden tool handles, and sports equipment made with wood or laminated materials can split or crack under normal use or abuse. G/flex 655 Epoxy Adhesive's tenacious adhesion and ability to resist shock loads make it a good choice for these kinds of repairs.

Insert a wedge into the crack(s) to expose as much bonding area as possible without increasing the damage. Mix a small batch of G/flex 655. Work epoxy into the crack with the mixing stick or a small brush, or inject epoxy with an 807 Syringe. Use a fine blade or stick to push epoxy as far down into the crack as possible.

Wait a few minutes for absorption to take place before removing the wedge and clamping the crack(s) closed. Allow to cure 7–10 hours before removing clamps and sanding away epoxy squeeze-out. Wait 24 hours before using.

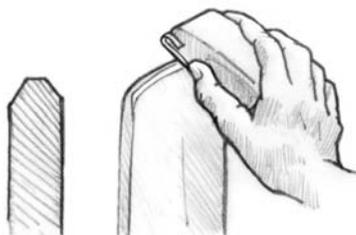
A layer or two of light-weight fibreglass fabric (4–6 oz) can be applied for additional reinforcing. Refer to *Fibreglassing* on the reverse page.

Use G/flex 655 Epoxy Adhesive to fill cracks and voids in masonry and tile. Fill cracks in damp and wet basement walls. Scrape out loose material and force 655 into cracks with a plastic spreader.

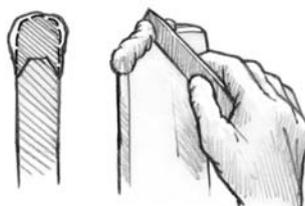
## Create durable tips on wooden paddles and oars

The tips of canoe and kayak paddles take lots of abuse from scraping bottom, pushing off rocks, and fending off debris. Use G/flex 655 Epoxy Adhesive to produce a durable edge to protect tips from damage.

Sand varnish or paint from the tip of the paddle to expose fresh wood. Use sandpaper on a hard sanding block to create a slight bevel around the edge of the paddle tip (16).



16



17

Mix an appropriate amount of G/flex 655. Apply a thick bead of the thickened mixture around the edge of the paddle blade (17). Apply additional 655 to extend the tip, if desired, after the initial application has gelled and will support the additional weight.

Allow to cure 7–10 hours. Wash with water before shaping the tip with a file or sandpaper. Apply paint or varnish if desired.

## Bonding to wet surfaces and surfaces underwater

While gluing to a dry and properly prepared surface is best for producing reliable long-term bonds, gluing to damp, wet, and even underwater surfaces is possible.

Abrade bonding surfaces with 80-grit sandpaper.

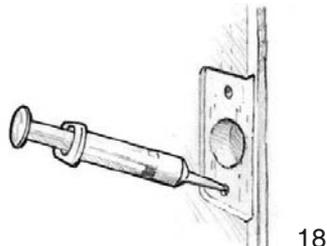
Mix an appropriately sized batch of G/flex 655 Epoxy Adhesive. Forcefully apply the 655 onto the bonding surfaces with a plastic spreader or stiff brush to displace water in the scratches and pores at the bonding surface.

Bring the mating surfaces together and apply just enough clamping pressure to squeeze out excess 655 and moisture. Allow to cure 7–10 hours before removing clamps and 24 hours before stressing the joint.

## Bonding fasteners

Installing screws and other threaded fasteners with G/flex 655 dramatically improves load carrying capacity and is especially useful when fasteners are subject to shock or vibration.

Use G/flex 655 Epoxy Adhesive to install new fasteners and hardware, repair stripped screw holes and replace missing wood around fasteners. When cured, G/flex 655 can be sanded, sawn, nailed and screwed. Small screws, nails, and tacks can be driven into it without pre-drilling. Larger fasteners may require a pilot hole. Experiment for best results.



The easiest method is to fill pilot holes (or stripped fastener holes) (18) with G/flex 655 Epoxy Adhesive prior to installing the screws. The epoxy will bond to the exposed end grain on the inside of the hole, effectively increasing fastener diameter. This results in more holding power, and seals water out so the wood stays drier. Drier wood is stronger than damp wood.

For even greater strength and stability, drill oversized holes 2/3 the depth of the fastener, then fill the hole with G/flex 655. Install the fasteners with just enough force to hold the hardware in place until the epoxy cures.

## Underwater fibreglass patching

Intended for small repairs, fibreglass patches should be small enough for one person to carry and apply underwater, limiting the size to about 12 inches square. The water must be fairly still so the patch is undisturbed during the cure.

Clean the surface to be patched and abrade the area of the patch with sandpaper to remove bottom paint.

Cut multiple layers of fibreglass cloth, with the first layer sized to fit the abraded area and successive layers ½" smaller on each side than the previous one.

Apply G/flex 655 to a piece of sturdy plastic film (like freezer bag plastic), cut larger than the patch. One by one, wet out the fibreglass plies onto the plastic starting with the smallest piece and ending with the largest (19). Compress the patch by squeezing out excess epoxy between layers with a spreader. Spread a uniform 1/16" thick layer of 655 to the compressed fibreglass stack.



19

Position the fibreglass patch over the abraded area underwater, making sure that the plastic covering stays in position on the outside of the patch. (Be sure to wear protective gloves.)

Apply pressure with a plastic spreader starting in the middle of the patch and work toward the edges to squeegee the 655/fibreglass patch against the hull and to displace water at the repair surface. Repeat the process in all directions to displace all of the water under the patch and push excess 655 Adhesive toward the edges of the patch.

Allow 24 hours to cure before removing plastic. Inspect repair at first opportunity (preferably with the hull out of the water) and rework as needed for structural integrity.

## Blending epoxies

Advanced users can blend G/flex 655 Epoxy Adhesive with WEST SYSTEM 105 Resin-based epoxy combinations to modify toughness, flexibility, cure speed, viscosity, strength, and elongation. The epoxy blend will have properties/characteristics derived from both epoxy systems, roughly in proportion to the percentage of each epoxy in the blend.

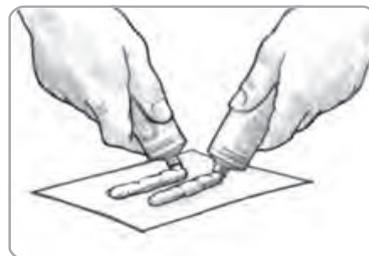
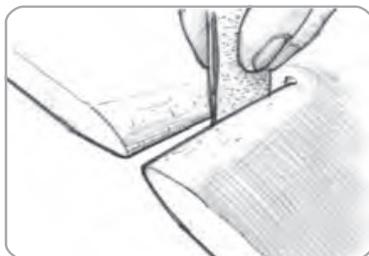
Blending WEST SYSTEM 105/205 with G/flex 655 will speed up the cure of G/flex, lower its mixed viscosity and increase rigidity of the cured epoxy, compared to using G/flex 655 alone.

To blend G/flex 655 Epoxy Adhesive with 105 Resin-based epoxies, you must meter the appropriate resin to hardener mix ratio of each epoxy prior to blending the two combinations together.



655-K

# PLASTIC BOAT Repair Kit



## Repair plastic boats

Step-by-step instructions show you how to use the materials in this kit to repair splits, cracks and small holes in plastic canoes, kayaks and other small boats.

## Tools required

In addition to the materials in this kit, you will need a propane torch, a sabre saw or hack saw, scraper or chisel, clamps, 80-grit sand paper, 2"-wide packaging tape, plastic spreader, paper towels, color matched plastic-compatible paint and laquer thinner or acetone as necessary for cleanup.

## Repairs requiring additional materials

With the addition of 4–6 oz fiberglass or Kevlar™ fabric and a plastic spreader, you can create abrasion resistant surfaces on worn stems and bottoms and repair larger holes. Instructions are included.

## Repairs to inflatable boats

Patch air leaks, re-bond attachment points, repair delaminated transoms and damaged floors. Instructions are included.

## Finishing

G/flex Epoxy is compatible with Krylon® Fusion™ or Rust-oleum® Universal All Surface™ paint to match existing finishes.

## Kit contents

4.5 fl oz G/flex 655-A Resin, 4.5 fl oz G/flex 655-B Hardener (9 fl oz mixed epoxy), 2 reusable mixing stick/applicators, 2 pair disposable neoprene gloves, mixing palettes and complete handling and repair instructions.

**WARNING IRRITANT. POSSIBLE SKIN SENSITIZER.** May cause irritation to eyes and skin. May cause allergic reaction. Avoid skin and eye contact. Do not ingest. Use with adequate ventilation. Use with liquid-proof gloves, eye protection and protective clothing.

**FIRST AID:** SKIN CONTACT—Immediately wash with soap and water. EYE CONTACT—Immediately flush with water for at least 15 minutes. Consult physician. INHALATION—Remove to fresh air. Consult physician if coughing or irritation develops. INGESTION—Do not induce vomiting. If conscious, give 2 glasses of water. Get immediate medical attention. **KEEP OUT OF REACH OF CHILDREN**

**655-A RESIN CONTAINS:** bisphenol-a epoxy resin, bisphenol-f epoxy resin, amorphous silica. **655-B HARDENER CONTAINS:** ATBN polymer, aminoethylpiperazine, tris-2,4,6-(dimethylaminomethyl)phenol, triethylenetetramine, phenol 2,4,6-tris[(dimethylamino)methyl] reaction products with triethylenetetramine, phenalkamine curing agent, cashew nutshell liquid, 1,3-benzenedimethanamine, amorphous silica.



SCAN FOR VIDEO

Manufactured for West System by:



**Gougeon Brothers, Inc.** / Bay City, MI USA  
866-937-8797 / westsystem.com  
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## G/flex 655—a WEST SYSTEM® Epoxy

G/flex 655 Epoxy is the result of years of experimentation to develop a toughened epoxy that was simple to use, viscous enough not to drain out of a joint, and would adhere tenaciously to a variety of materials under difficult conditions.

G/flex 655 is all that, and more. It is a marine-grade glue that can be accurately mixed in small batches with a simple 1:1 mix ratio. It has the advantage of a long open working time and a relatively short cure time.

G/flex 655 is, first of all, a high-strength epoxy—designed for permanent, waterproof, structural bonding. Furthermore, G/flex has a modulus of elasticity of 150,000 psi, giving G/flex the toughness to make structural bonds that can absorb the stresses of expansion, contraction, shock, and vibration.

G/flex adheres tenaciously to difficult-to-glue hardwoods and even has the ability to glue damp woods.

G/flex is ideal for bonding a variety of other materials, including dissimilar ones—metals, plastics, glass, masonry, and fiberglass. It can be used to wet out and bond fiberglass tapes and fabrics.

We encourage you to read these instruction and then experiment with G/flex. We think you will find many projects for which the particular properties of G/flex are ideally suited.

### WEST SYSTEM reliability

G/flex 655 Epoxy is the latest addition to the WEST SYSTEM line of epoxy products. While G/flex offers physical properties and applications that are different than WEST SYSTEM 105 Resin-based epoxies, they share the same high standards for performance and reliability.

WEST SYSTEM is the worlds leading brand of marine epoxy, created by Gougeon Brothers—sailors, boatbuilders, and formulators who literally wrote the book on wood/epoxy boat building. We know the engineering and chemistry required to formulate epoxies for high-performance composite structures. It requires thorough research, rigorous test programs, skillful shop work and direct experience with today's high-performance boats and other engineered structures. This experience and dedication to performance have given



WEST SYSTEM another quality that sets it apart from other brands of epoxy.

For forty years, reliability has been the hallmark of WEST SYSTEM. We adhere to the highest standards of quality assurance in our formulating and manufacturing practices, from raw material qualification to testing and certification of finished resins and hardeners. This means that every properly mixed batch of WEST SYSTEM resin and hardener, including G/flex resin and hardener, will cure as it is supposed to, every time. This commitment to quality has earned certification to the ISO 9001:2008 standard. WEST SYSTEM is your reliable solution.

### Outstanding customer service

WEST SYSTEM provides you with something else as reliable as our epoxy—knowledge. Whether your project is large or small, the WEST SYSTEM Technical Staff and comprehensive instructional publications will help assure the success of your building and repair project. WEST SYSTEM is renowned for its outstanding customer service.

The WEST SYSTEM website provides basic product information, dealer locations and links, project articles and galleries, and safety information. Visit [westsystem.com](http://westsystem.com).

Further assistance can be obtained by contacting the friendly and knowledgeable Technical Staff. Send e-mail to [tech-support@westsystem.com](mailto:tech-support@westsystem.com) or call **866-937-8797** (toll free).

Because West System Inc. cannot control how its products will be used, it makes no warranties, either expressed or implied, including no warranties of merchantability and fitness for purpose intended. West System Inc. will not be liable for incidental or consequential damages.

# 655 Epoxy Adhesive General Use

## Safety

- Avoid skin contact with resin, hardener or mixed adhesive. Wear liquid-proof gloves and adequate protective clothing to keep the epoxy off your skin.
- Avoid eye contact with resin, hardener or mixed adhesive. Wear protective glasses. In case of contact with eyes, flush with water for 15 minutes and consult a physician.
- Avoid inhalation of vapors. Provide adequate ventilation. Wear a dust mask when sanding epoxy, especially epoxy that has not fully cured.
- Read and follow safety information on resin and hardener containers.

## Starting out

Puncture the seal in each tube with the point in the top of the cap. Enlarge the opening as necessary to improve flow.

Before mixing epoxy, gather all necessary application tools, clamps and equipment. Check all parts for proper fit and be sure all surfaces to be glued are properly prepared.

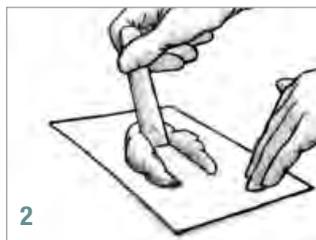
## Mixing and curing

Dispense equal volumes of G/flex 655 Resin and Hardener onto a mixing pallet (1).



1

Use the square end of a mixing stick to thoroughly blend the resin and hardener (2).



2

After mixing the resin and hardener, you will have about 45 minutes, at 72°F (22°C), to apply the mixture before it begins to gel and up to 75

minutes to assemble and clamp parts after it is initially applied. At 72°F (22°C), the adhesive mixture will solidify in 3–4 hours and reach a workable cure in 7–10 hours. The adhesive may be sanded, clamps can be removed, and joints can be moderately loaded. Wait 24 hours before subjecting joints to high loads.

G/flex 655 Epoxy Adhesive cures faster in warmer temperatures and slower in cooler temperatures. When a quicker cure is desired, apply moderate heat to substantially reduce cure time. Cure time is reduced by half with each 18°F increase in temperature.

G/flex 655 will cure in temperatures as low as 40°F (5°C), but cure very slowly. When using 655 at lower temperatures, it is a good idea to warm resin and hardener to room temperature for easier dispensing and mixing.

Curing epoxy generates heat. Thicker layers of 655 generally cure a little faster than thinner layers, as this heat is concentrated in thicker layers and dissipated in thinner layers.

## Cleanup

Clean uncured epoxy from skin and clothes with alcohol, followed by washing with soap and water.

Remove excess epoxy from work surfaces with the flat end of a mixing stick or with paper towels. Clean up residue with alcohol, citrus-based cleaner or a solvent such as lacquer thinner or acetone.

## Basic surface preparation

G/flex 655 Epoxy will bond to many different materials. For best adhesion to most materials, bonding surfaces should be:

**CLEAN**—Remove loose, chalky or flaky coatings, and contaminants such as grease, oil, wax, and mold release. Clean contaminated surfaces with an appropriate solvent applied with plain white paper towels. Wipe the surface with a clean, dry paper towel before solvent dries. Do not use laundered rags to apply or remove solvent as they may contaminate the surface with fabric softener residue.

**SANDED**—Sand non-porous and smooth surfaces with 80-grit aluminum oxide sandpaper to provide good texture for the epoxy to “key” into. Brush away sanding dust. Refer to the chart (*right*) for recommendations.

**DRY**—Although G/flex 655 Epoxy can be used to bond damp and wet surfaces, maximum adhesion will be achieved when bonding to dry surfaces.

## Additional surface preparation

### Metals

Sand or grit-blast the surface to expose bright metal.

Clean the area with acetone or lacquer thinner using white paper towels. Allow the surface to dry completely.

Abrade through wet epoxy—Apply a thin coat of G/flex 655 Epoxy and immediately scrub metal surfaces through the wet epoxy coating with a fine wire brush or sandpaper.

Adhesion to aluminum can best be improved by treating it with the two-part WEST SYSTEM 860 Aluminum Etch prior to applying the epoxy. Aluminum can be prepared using the “abrade through wet epoxy” method with good results if an Aluminum Etch kit is not available.

### Hardwoods, including tropical woods

Bonding to dry wood (between 6 and 12% moisture content) is best for achieving long-term reliable bonds. Sand mating surfaces with 80-grit parallel to the grain. Clean oily woods with a solvent such as isopropyl alcohol or acetone. Apply solvent with plain white paper towels. Wipe the surface with a clean, dry paper towel before solvent dries. Do not use laundered rags to apply or remove solvent.

The extent of wood failure in tensile adhesion tests indicate that tensile adhesion

achieved using G/flex 655 Epoxy, with proper surface preparation, approached or exceeded the grain strength of the wood in all of the woods we tested.

### Plastics

Clean plastics, except for polycarbonate, with isopropyl alcohol to remove contamination. Sand all plastics including polycarbonate with 80-grit sandpaper to provide texture for good adhesion. Flame treat ABS and PVC for additional benefit.

HDPE (high-density polyethylene) and LDPE (low-density polyethylene) must be flame treated for good adhesion.

FLAME TREATING is a method for improving adhesion to plastics by quickly passing the flame of a propane torch across the surface after it is cleaned and sanded. Allow the blue part of the flame to touch the surface. Keep it moving at the rate of 12 inches per second.

No obvious change takes place, but the flame oxidizes the surface and dramatically improves adhesion. Make multiple passes of the torch 3/4" apart to treat wide areas. Be careful not to melt or burn the surface.

While flame treating will improve adhesion to most plastics, it appears to provide the greatest benefit to polyethylene (HDPE and LDPE). If you are unsure of the type of plastic, it doesn't hurt to flame treat. ■

Surface preparation for various dry materials		
Material	Basic surface preparation	Additional surface preparation
Fiberglass laminate	As necessary, Remove soft and loose surface material	860 Aluminum Etch, two part
Aluminum		
Steel	Remove contamination with solvent wipe	Wire brush through wet epoxy
Steel-galvanized		
Copper	Sand with 80-grit sandpaper	Isopropyl Alcohol wipe
Bronze		
Lead		
Ipe	Sand with 80-grit sandpaper parallel to grain	Isopropyl Alcohol wipe
Teak		
White oak		
Walnut		
Purpleheart		
Greenheart	Isopropyl Alcohol wipe	Flame treat
ABS		
PVC	Sand with 80-grit	Flame treat required
HDPE, LDPE plastic		
Polycarbonate (Lexan™)	Sand with 80-grit	

## Bonding

Apply the epoxy mixture to all properly prepared mating surfaces. Apply enough epoxy to fill voids and bridge gaps on uneven mating surfaces.

Clamp the components in position before the epoxy begins to gel—about 75 minutes at 72°F (22°C). Use just enough clamping pressure to squeeze a small amount of epoxy out of the joint. Leaving some glue in the joint increases bonding strength. Allow the epoxy to cure thoroughly before stressing the joint.

Use a spreader or notched trowel to apply G/flex 655 to larger surfaces prior to clamping. Use a pipe cleaner or syringe to apply adhesive to hard to reach areas such as cracks and fastener holes when bonding hardware.

### Bonding to wet surfaces and surfaces underwater

While gluing to a dry and properly prepared surface is best for producing reliable long-term bonds, gluing to damp, wet, and even underwater surfaces is possible.

Abrade bonding surfaces with 80-grit sandpaper.

Mix an appropriately sized batch of G/flex 655 Epoxy Adhesive. Forcefully apply the 655 onto the bonding surfaces with a plastic spreader or stiff brush to displace water in the scratches and pores at the bonding surface.

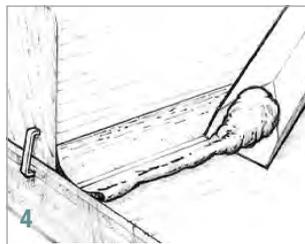
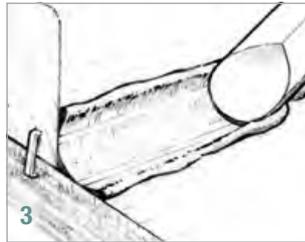
Bring the mating surfaces together and apply just enough clamping pressure to squeeze out excess adhesive and moisture.

If one bonding surface is dry, apply extra adhesive to it, so excess will displace water at the bonding surface. It is important that significant excess adhesive squeezes from the joint for proper bonds to form.

Allow to cure 7–10 hours before removing clamps and 24 hours before applying a load on the joint.

## Making fillets

When parts are joined at or near right angles, fillets can be used to add considerable strength to the joint by increasing the surface area of the bond. Make fillets by applying a bead of G/flex 655 along the inside corner of the joint. Form the epoxy into a cove section using the round end of a mixing stick (3). Clean off the excess



epoxy with the beveled end of the mixing stick before the epoxy gels (4).

## Fiberglassing

Lightweight fiberglass fabrics and tapes (4–9 oz/sq yd range) can be used with G/flex 655 Epoxy Adhesive when fiber reinforcement is desired to add stiffness or abrasion resistance, or to patch a damaged area.

Cut the fabric to fit the area. If heavier reinforcing is desired, use multiple thin layers rather than a single thick layer. Properly prepare the surface before applying fabric.

Coat the substrate with 655. Lay the fabric in position on the wet adhesive. Spread mixed adhesive onto the fabric using a plastic spreader. When the fabric and substrate have been saturated, use the spreader to smooth and remove excess epoxy. Repeat the process with additional layers. ■

### Gluing things to plastic boats

G/flex 655 is a toughened epoxy adhesive designed to bond to many different materials in addition to plastic. Joint strength—the ability to adequately transfer a load from one part, one material, to another—depends on the combined effects of three factors.

**GLUE STRENGTH**—Careful metering and thorough mixing will assure the epoxy adhesive mixture cures to full strength.

**ADHESION**—For the best adhesion, the joint's bonding surfaces must be properly prepared. Refer to the chart at left for the proper surface preparation for the plastic and the material you are gluing to it.

**JOINT AREA**—The bonding area of the joint must be adequate for the load on the joint and materials being joined. Increased overlap, scarf joints, fillets and reinforcing fibers can be used to increase joint bonding area.

# Plastic Boat Repair

Plastic canoes and kayaks are most often made of thermoformed plastics like HDPE (high-density polyethylene), ABS, and occasionally PVC. G/flex Adhesive bonds to these materials and is used to repair damage to products made of these materials. Refer to the safety and general use information on the reverse side of this sheet.

## Repair splits and cracks in plastic boats

The repair procedure will differ depending on whether you will have access to the back side of the repair area. Repairing splits and cracks with this kit and the following items:

- A sabre saw or hack saw.
- A chisel, knife or other sharp scraper.
- 80-grit sandpaper.
- 2"-wide packaging tape.
- A propane torch.
- Matching spray paint (optional).

### Repair with access to both sides

1. Drill a  $\frac{1}{8}$ " diameter hole at the ends of the crack. Open the crack or split with a saber saw or hacksaw blade to create a slight gap in the break.



1

2. Bevel the edges of the crack with a sharp tool to create a  $\frac{3}{8}$ " to  $\frac{1}{2}$ " wide bevel on both sides of the gap and on both sides of the hull including the ends (1).



2

3. Sand the bevels with 80-grit sandpaper to round the edges

and create a smooth taper (2).

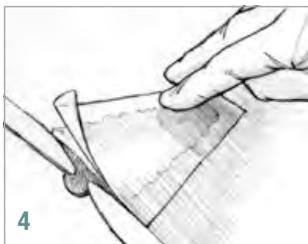
4. Flame Treat the repair area to improve adhesion as described in *Additional Surface Preparation* on the reverse side of this sheet (3).



3

5. Mix an appropriately sized batch of G/flex 655 Adhesive. Refer to *Mixing and Curing* on the reverse side of this sheet.

6. Apply mixed G/flex to one side of the beveled joint, overfilling it slightly.



4

7. Cover the adhesive-filled joint with 2" wide cellophane packaging tape while forcing excess (overfill) epoxy through to the other side of the joint (4). Avoid forcing too much epoxy from the taped side.



5

8. Fill the beveled area on the opposite side of the repair with more G/flex 655. Use the side of the mixing stick to feather the edges flush with the surrounding surface and scrape away excess epoxy (5).

9. Clean uncured epoxy residue with a paper towel and acetone or lacquer thinner. Allow G/flex to cure 7–10 hours before removing packing tape.

10. Remove high spots and smooth the surface with a scraper or sandpaper.

11. Wipe the area with water, dry thoroughly and paint with a plastic-compatible paint like Krylon Fusion™ or Rust-oleum Universal All Surface paint™ if desired. ■

### Repair with access to one side only

1. Drill a  $\frac{1}{8}$ " diameter hole at the ends of the crack.

2. Bevel the edges of the crack with a sharp tool to create  $\frac{3}{4}$ " to 1" wide bevels on both edges of the crack and at each end (6).

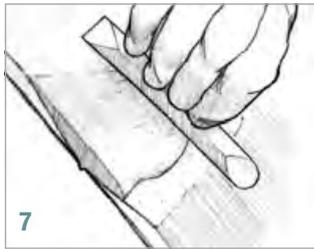


6

3. Flame Treat the repair area to improve adhesion as described in

*Additional Surface Preparation* on the reverse of this sheet.

**4.** Mix an appropriately sized batch of G/flex 655 Adhesive. Refer to *Mixing and Curing* on the reverse side of this sheet.



**5.** Apply adhesive to the beveled joint, overfilling it

slightly. Use the side of the mixing stick or plastic spreader to feather the edges flush with the surrounding surface and scrape away excess epoxy (7). Add more epoxy as needed to fill low areas. Allow to cure 7–10 hours.

**6.** Remove high spots and smooth the surface with a scraper or sandpaper.

**7.** Wipe the area with water, dry thoroughly. Sand with 180-grit sandpaper and paint with a plastic-compatible paint if desired. ■

## Repair holes in plastic boats

Canoes and kayaks can be punctured as a result of impacts with rocks and other sharp objects. Repair holes with G/flex 655 Epoxy and the following items not included in this kit:

- 80-grit sandpaper.
- 2"-wide packaging tape.
- A propane torch.
- Matching spray paint (optional).

Repair techniques can vary depending on hole diameter and accessibility. The goal is to replace the missing material with G/flex 655 Epoxy and providing adequate bonding area.

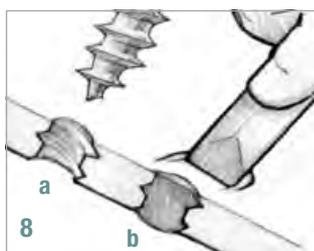
### Repair holes up to ¼" diameter

**1.** Drill out the hole with the smallest diameter bit that bridges the hole.

**2.** Run a slightly larger sheet metal screw into and out of the hole to tap threads on the inside of the hole (8a).

**3.** Apply a piece of packaging tape or duct tape over the back of the hole to prevent epoxy from squeezing through the hole.

**4.** Mix an appropriately sized batch of G/flex 655 Adhesive. Refer to *Mixing and Curing* on the reverse side of this sheet.



**5.** Apply the adhesive to the void, overfilling it slightly (8b). Allow to cure 7–10 hours.

**6.** Remove excess cured epoxy and shape the surface to suit with a cabinet scraper or sandpaper.

**8.** Wipe the area with water, sand for better adhesion and paint with a plastic-compatible paint if desired.

### Repair holes over ¼" diameter



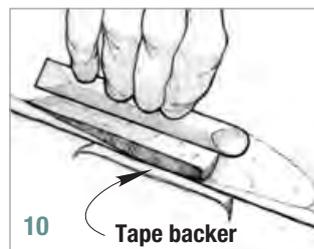
**1.** Sand the area to create a taper around the perimeter of the repair with 80-grit sandpaper (9).

**2.** Flame treat the repair area

to improve adhesion as described in *Additional Surface Preparation* on the reverse side of this sheet.

**3.** Apply a piece of packaging tape over the back of the hole to prevent epoxy from squeezing through the hole. Tape a piece of cardboard or other stiff material to the back of the hole if necessary to maintain the shape of the hull.

**4.** Mix an appropriately sized batch of G/flex 655 Adhesive. Refer to *Mixing and Curing* on the reverse side of this sheet.



**5.** Apply the adhesive to the void, overfilling it slightly. Sculpt the uncured G/flex to match the curve of the hull (10). Allow to

cure 7–10 hours.

**6.** Remove excess cured epoxy and shape the surface to suit with a cabinet scraper, or sandpaper.

**7.** Wipe the area with water, dry thoroughly. Sand with 180-grit sandpaper and paint with a plastic-compatible paint. ■

## Repair worn surfaces / create skid plates

Repair and extend the life of plastic canoes and kayaks by applying reinforcing fabric wear strips along the keel and stems to patch worn holes and provide abrasion resistance. Reinforce and patch worn areas with G/flex 655 epoxy and the following items not included in this kit:

- 80-grit sandpaper.
- A propane torch.
- 4–6 oz fiberglass or Kevlar™ fabric.
- Matching spray paint (optional).
- Plastic spreader



**1.** Sand the ends of the canoe along the bottom and up the sides a few inches with 80-grit sandpaper (11). This

area will define the size of the skid plate.

**2.** Flame Treat the repair area to improve adhesion as described in *Additional Surface Preparation* on the reverse of this sheet.

**3.** Cut three or four layers of lightweight fiberglass or Kevlar fabric to cover the sanded areas. Cut the bottom piece of fabric to fit to the sanded/flame-treated boundary. Trim each successive layer an inch or two narrower and shorter than the previous. This tapers the thickness of the fiberglass skid plate/patch toward the edges so it will easily deflect and cling to the hull as it flexes.

**4.** Place packaging tape or duct tape across the back of large holes if necessary, to support the repair during cure.

**5.** Mix an appropriately sized batch of G/flex 655 Adhesive. Refer to *Mixing and Curing* on the reverse side of this sheet.

**6.** Apply a coat of epoxy to the sanded/flame treated area. Lay the largest piece of fabric onto the adhesive. Apply more adhesive to saturate the fabric. If necessary, warm the epoxy with a heat gun to lower the viscosity and improve wet out in cooler temperatures. Use the side of the mixing stick or a plastic spreader to smooth the fabric and remove excess epoxy.



**7.** Repeat the fabric application with the remaining piece(s). Center each smaller layer on the one before it. Wet

out the fabric, and then use a spreader to smooth the fabric and remove excess epoxy (12).<sup>12</sup>

**8.** Apply a coat of G/flex 655 to fill and smooth the edges of the fabric while the fiberglass application is still tacky (optional). Allow to cure 7–10 hours.

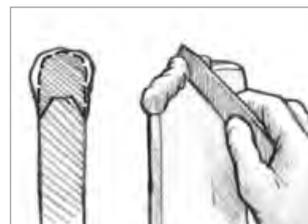
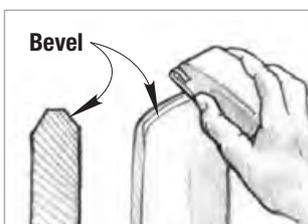
**9.** Remove excess cured epoxy and shape the surface to suit with a scraper, file, or sandpaper.

**10.** Wipe the area with water, sand for adhesion and paint with a plastic-compatible paint if desired. ■

### Paddle tip reinforcement

The tips of wooden canoe and kayak paddles take lots of abuse from scraping bottom and pushing off rocks. Use G/flex 655 Epoxy Adhesive to create durable edges to protect tips from damage.

**1.** Sand the tip of the paddle with 80-grit sandpaper to expose fresh material and create a 45° bevel on both sides of the tip.



**2.** Apply a mixture of G/flex 655 across the paddle tip. Fill any voids and build up

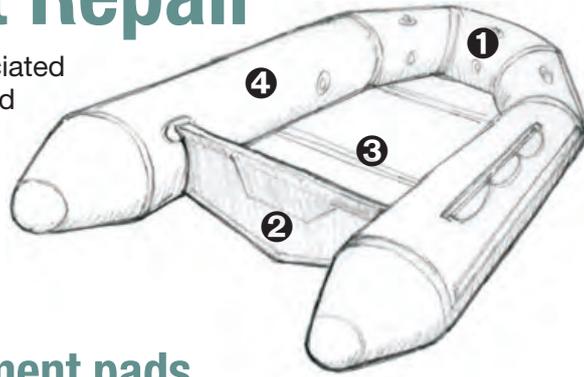
a thick layer that covers the beveled edges and extends the length of the tip. Allow the epoxy to cure.

**3.** Sand the cured epoxy to shape with 80-grit sandpaper. Apply varnish or paint as desired. ■

# Inflatable Boat Repair

There are four common problems associated with inflatable boats that can be resolved with G/flex epoxy:

1. Attach/re-attach accessories
2. Transom damage and de-lamination
3. Stripped fasteners
4. Small air leaks in tube chamber



## Repair accessory attachment pads

Accessory attachments such as oar locks, tow rings and hand holds are mounted to larger flexible base pads which provide a generous bonding area to the inflated tubes. Rub strakes are glued directly to the tubes. They usually begin failure gradually, peeling from one edge and will detach completely if neglected.

Accessory pads and rub strakes can be re-attached and new ones attached with G/flex 655 epoxy and the following items not included in this kit:

- 80-grit sandpaper.
- Masking or packaging tape.
- Acetone solvent.

Inflatable tubes should be filled to the designed pressure. If that is not possible, lay the tube flat so no wrinkles exist.

1. Mark the location where the pad will be re-attached (or attached) and mask off the area outside of the pad to protect adjacent surfaces.

3. Clean the contact areas on the pad and the tube with acetone to remove the previous adhesive.

4. Abrade contact surfaces with 80-grit sandpaper. Hand sand in all directions so surfaces are evenly abraded.

5. Mix an appropriately sized batch of G/flex 655 Adhesive. Refer to *Mixing and Curing* on the reverse side of this sheet.



6. Apply mixed adhesive to the detached pad (or new accessory pad) and the tube contact surfaces (13).

7. Cover pad with plastic (food wrap) film then place a soft cushion-like material such as a sponge over the pad then exert mild force with a weights or wraps of tape to insure full and even contact until epoxy cures. (7–10 hours). ■

## Repair transom damage

Fixed plywood transoms on inflatable boats usually rest in a channel fitted to pads glued to the tubes. Forces exerted from outboard motors often cause de-lamination of the plywood or degradation from rot especially around the motor mount locations. Repairs range from gluing delaminated plywood back together to replacing the transom with new plywood.

### Repair delaminated plywood

1. Open up delaminated plywood with wedges or chisels.
2. Dry the wood thoroughly.
3. Clean debris and loose wood from gaps that would prevent the veneers from closing tight.

4. Mix an appropriately sized batch of G/flex 655 Adhesive. Refer to *Mixing and Curing* on the reverse side of this sheet.



5. Force epoxy into the depth of the separations (14).



5. Force epoxy into the depth of the separations (14).

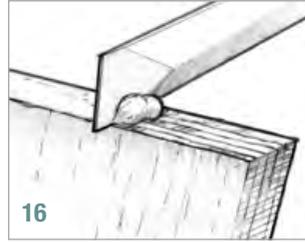
6. Remove wedges and clamp lightly (15). Clean up excess epoxy and allow to cure 7–10 hours before using. ■

## Replace damaged plywood

1. Remove the transom from retaining channel.
2. Clean this channel thoroughly.
3. Locate new plywood of the same type and thickness as used in the original transom.
4. Use the old transom as a pattern. If you can't get plywood thick enough, laminate multiple pieces of thinner plywood and bond together with the epoxy.

5. Mix an appropriately sized batch of G/flex 655 Adhesive. Refer to *Mixing and Curing* on the reverse side of this sheet.

6. Glue layers together and after shaping seal the edges of the plywood with 655 Adhesive to seal end grain (16).



7. Sand smooth, then bond new transom into the channel using G/flex 655. ■

16

## Repair enlarged and stripped fastener holes

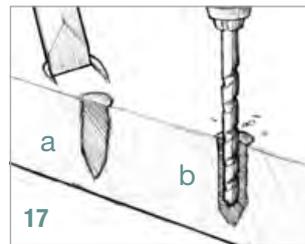
Folding floor boards often have issues with hinge fasteners separating from the boards. Usually, the fasteners are simply stripped.

### Procedure enlarged fastener holes

1. Dry the screw holes.
2. Mix an appropriately sized batch of G/flex 655 Adhesive. Refer to *Mixing and Curing* on the reverse side of this sheet.
3. Fill the holes with G/flex 655 Epoxy.
4. Insert and lightly tighten the fastener. Clamp it if necessary to hold it in place. Allow to cure overnight before applying load.

### Procedure for stripped fastener holes:

1. Dry the stripped screw holes.
2. Mix an appropriately sized batch of G/flex 655 Adhesive. Refer to *Mixing and Curing* on the reverse side of this sheet.



3. Fill the holes with G/flex 655 Epoxy and allow to cure 7–10 hours (17a).

4. Drill a smaller pilot hole and screw the fastener into it (17b). ■

17

## Repairing pinhole leaks

Pinhole leaks in tube chambers typically occur from punctures and abrasion. The repair is similar to reattaching a delaminated accessory pad using the following materials not included in this kit:

- 80-grit sandpaper.
- Masking or packaging tape.

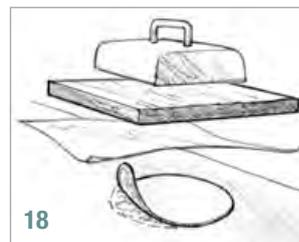
1. Locate exact location while inflated. Apply 50/50 mix of water and liquid soap over the suspected area and observe for bubbles.
2. Mark the location with a pencil where bubbles are created.
3. Dry and clean surface with acetone.
4. Deflate the hull and lay area of the repair flat so no wrinkles exist.
5. Make or buy a patch of the same material as the inflatable tube is made of and of a similar thickness.
6. Cut a 4" diameter round patch. Avoid corners and sharp curves.

7. Trace the patch size with pencil on boat's tube.

8. Abrade tube around leak with 80-grit sandpaper, hand sanding in all directions. Do same to the underside of the patch material.

9. Mix an appropriately sized batch of G/flex 655 Adhesive. Refer to *Mixing and Curing* on the reverse side of this sheet.

10. Apply G/flex 655 to the tube and patch and place patch onto surface.



11. Cover the patch with plastic, then with ½ thick plywood to distribute weight. Place 5–10 lb of weight on

top of the plywood (18).

12. Allow to cure 24 hours before inflating to the recommend pressure. ■

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# Technical Data Sheet

## Specialty Epoxy

# G/flex

## G/flex® Epoxies

### General description

G/flex Epoxies are toughened, resilient two-part epoxies engineered for a superior grip to metals, plastics, glass, masonry, fiberglass, and wet and difficult-to-bond woods. G/flex Epoxies are available in two consistencies. G/flex 650 Epoxy is a liquid epoxy with a honey-like consistency. G/flex 655 Epoxy Adhesive is pre-thickened with a consistency similar to gel toothpaste. Both have an easy-to-use 1:1 mix ratio. G/flex provides a relatively long open working time, yet it cures quickly and can be used in cool temperatures.

G/flex Epoxies are toughened to make them resilient and impact resistant, giving them the ability to make structural bonds that can absorb the stresses of expansion, contraction, shock, and vibration. With a modulus of elasticity of 150,000 psi, G/flex is more flexible and can deflect further before breaking than WEST SYSTEM 105/205, while being much stiffer than typical adhesive sealants.

G/flex adheres tenaciously to difficult-to-glue hardwoods, both tropical and domestic varieties. It can be used to bond metals, plastics, glass, masonry, and fiberglass. G/flex is ideal for repairs to aluminum boats and polyethylene and ABS canoes and kayaks. It can also be used to wet out and bond fiberglass tapes and fabrics. G/flex 650 can be modified with WEST SYSTEM fillers and additives and added to other WEST SYSTEM epoxies to improve their toughness and flexibility.

### Handling characteristics

Mix ratio by volume	1 : 1
by weight	1.2 : 1
Mix viscosity G/flex 650 (at 72°F) ASTM D-2393	15,000 cps
G/flex 655	gel
Pot life (100g at 72°F)	45 minutes
Working time	75 minutes
Initial Cure	3 to 4 hours
Workable cure*	7 to 10 hours
Minimum recommended temperature	40°F (4°C)

\*Wait 24 hours before subjecting to high loads.

### Physical properties of cured epoxy

Specific gravity	1.11
Hardness (Shore D) ASTM D-2240	75
Compression yield ASTM D-695	5,268 psi
Tensile strength ASTM D638	3,440 psi
Tensile elongation ASTM D-638	32.7%
Tensile modulus ASTM D-638	1.44E+05
Flexural strength ASTM D-790	5,192 psi
Flexural modulus ASTM D-790	1.56E+05
Heat deflection temperature ASTM D-648	127°F
Onset of Tg by DSC	138°F
Ultimate Tg	154°F

### Storage/Shelf life

Store at room temperature. Keep containers sealed when not in use to prevent contamination. With proper storage, resin and hardener should remain usable for several years.

Manufactured for  
WEST SYSTEM by:



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 Bay City, MI 48707  
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March, 2013

New product

# WEST SYSTEM<sup>®</sup> launches **G/flex<sup>®</sup> Epoxy**

By Tom Pawlak

**G/flex Epoxy adds a degree of flexibility to the WEST SYSTEM lineup.**

G/flex Epoxy is a toughened, resilient two-part epoxy engineered for a superior grip to metals, plastics, glass, masonry, fiberglass, and wet and difficult-to-bond woods. Introduced in June 2007, G/flex Epoxy is currently available in two consistencies: G/flex 650 Epoxy, a liquid epoxy, and G/flex 655 Epoxy Adhesive, a pre-thickened epoxy. Both have an easy-to-use 1:1 mix ratio.

G/flex Epoxy gives you 46 minute pot life and a long open or working time of 75 minutes at room temperature. It will reach an initial cure in 3-4 hours and a workable cure in 7-10 hours. Wait 24 hours before subjecting joints to high loads.



**G/flex is available in three convenient packages:**

**G/flex 650-8** Includes 4 fl oz-G/flex 650 Resin, 4 fl oz-G/flex 650 Hardener (8 fl oz of mixed epoxy), and handling and repair instructions.

**G/flex 650-K** Kit contains 4 fl oz-G/flex 650 Resin, 4 fl oz-G/flex 650 Hardener (8 fl oz of mixed epoxy), 2 reusable mixing stick/applicators, 2 12 cc syringes, 4 g of adhesive filler, 4 mixing cups, 1 pair of disposable neoprene gloves, 4 alcohol cleaning pads, and complete handling and repair instructions.

**G/flex 655-K** Kit contains 4.5 fl oz-G/flex 655 Resin, 4.5 fl oz-G/flex 655 Hardener (9 fl oz mixed epoxy), 2 reusable mixing stick/applicators, 4 alcohol cleaning pads, 1 pr disposable neoprene gloves, 10 mixing palettes, and complete handling and repair instructions.

Even as we introduce the new G/flex, we want to emphasize that our existing WEST SYSTEM 105 Resin-based epoxies can't be beat for versatility and reliability. WEST SYSTEM 105 Resin mixed with the appropriate hardeners and different additives allows you to create an epoxy for a variety of applications like gluing, sealing, fairing, and sheathing. No other epoxy is more reliable for such a huge spectrum of end uses.

However, as a marine-grade glue that can be accurately mixed in small batches, G/flex Epoxy offers important benefits.

## **Benefits of G/flex Epoxy**

- **Toughness and flexibility** G/flex has been toughened. This gives G/flex the ability to make structural bonds that can absorb the stresses of expansion, contraction, shock, and vibration. G/flex is resilient and impact resistant. With a modulus of elasticity of 150,000 psi (WEST SYSTEM 105 Resin/205 Hardener has a modulus of elasticity of 450,000 psi), G/flex is more flexible and can deflect further before breaking than WEST SYSTEM 105/205, while being *much* stiffer than typical adhesive sealants.
- **Adhesion to wet and damp surfaces** G/flex has the ability to glue damp woods. It can be used on wet surfaces, even underwater when applied with specific techniques.
- **Excellent adhesion to hard-to-bond woods** G/flex adheres tenaciously to difficult-to-glue hardwoods, both tropical and domestic varieties. This is important since many of the exotic and tropical species now being used to replace traditional woods present bonding challenges.

- **Bonds well to a variety of materials**  
G/flex® is ideal for bonding a variety of materials, including dissimilar ones. G/flex has a superior grip so that it can be used to bond to metals, plastics, glass, masonry, and fiberglass. G/flex is ideal for repairs to aluminum boats and polyethylene and ABS canoes and kayaks. It can also be used to wet out and bond fiberglass tapes and fabrics.
- **Ease of use** G/flex is a simple two-part epoxy system. Resin and hardener are mixed in a 1-to-1 mix ratio by volume. G/flex provides a relatively long open working time, yet it cures quickly and can be used in cool temperatures. Because it is simple to mix and use, G/flex is an excellent starting point for customers new to epoxy use.
- **Versatility** G/flex can be modified with WEST SYSTEM® fillers and additives if you need to meet particular bonding needs. Adding G/flex to other WEST SYSTEM epoxies can improve their toughness and flexibility.

### Development of G/flex Epoxy

G/flex is the result of years of experimentation to develop a formula for a toughened epoxy. We wanted something that was simple to use, viscous enough not to drain out of a joint, and adhered tenaciously to a variety of materials under difficult conditions. As explained more fully later (see *Understanding Flexible Properties*, p. 17), material properties of an epoxy form a complicated web. When you formulate for specific end properties (like high elongation), you usually have to give up other properties in order to achieve it. Some of us thought that if you formulate an epoxy with five to six times the tensile elongation of other WEST SYSTEM epoxies, the new product would be poor at dealing with constant or long duration loads. Yet when we tested G/flex under long duration loading with our exclusive Creep Test, it performed admirably—nearly matching the 105 Resin-based epoxy.

We also wondered if an epoxy with this much elongation would perform poorly in heat resistance. Yet ASTM-D648 (Heat Deflection Under Load or HDUL) revealed G/flex performed even better than 105 Resin-based epoxies. (G/flex like all WEST SYSTEM resin/hardener combinations can handle temperatures up to 200°F repeatedly. At this temperature, it will be more flexible and less resistant to heavy durational loads than at room temperature, but it returns to

full strength as it approaches room temperature.) Well, what about through cure? Usually flexible systems take days to achieve the majority of their physical properties. Our testing revealed that G/flex's 24-hour through cure is similar to that of WEST SYSTEM 105 Resin and 205 Fast Hardener.

### Adhesion Testing

How does G/flex adhere to woods and metals? Adhesion testing using the PATTI (Pneumatic Adhesion Tensile Test Instrument) on the same pieces of wood (with the wood sanded parallel to the grain with 80-grit sandpaper but no solvent wash) revealed that G/flex adheres to wood at least as well as any other WEST SYSTEM epoxy. With hardwoods and the often difficult-to-glue species such as white oak, Ipe, teak, greenheart, purpleheart and salangan batu, G/flex performed as much as 30% higher.

Adhesion testing with G/flex Epoxy on metals also yielded excellent results, typically exceeding the adhesion results achieved with 105 Resin-based epoxies (see *Figure 1*).



**G/flex Epoxy has the ability to bond not only to wood and aluminum, but plastics, exotic hardwoods and wet wood.**

**Figure 1—Tensile adhesion results for PATTI test of G/flex and various materials.**

Material	G/flex Epoxy	Surface prep / conditions	Tensile adhesion (psi)
G-10 high-density laminate	650	80-grit sand / dry surface	3459
	655	80-grit sand / wet surface	2473
		80-grit sand / underwater surface	1772
1018 steel	650	80-grit sand / dry surface	3562
	655	80-grit sand / wet surface	1175
Galvanized steel	650	100-grit wet sand	2562
	655	100-grit wet sand	2929
	655	Scotch brite™ pad wet sand	2913
Aluminum 2024 T3	650	80-grit sand, 860 etch / dry surface	2731
	650	Grit blast, 860 etch / dry surface	1856
	655	80-grit sand / wet surface	1503
	655	Grit blast, 860 etch / dry surface	2153
Copper	650	80-grit sand	2334
	655	80-grit sand	2685
Bronze	650	80-grit sand	2782
	650	Scotch brite™ pad sand	2962
	655	80-grit sand	2936
HDPE plastic	655	Alcohol wipe, flame treat	1885
ABS plastic	655	80-grit sand	1535
Lexan™	655	80-grit sand	1870
Ipe	650	60-grit sand	2134
	650	Plane, isopropyl alcohol wipe × 3	2223
Teak, vertical grain	650	80-grit sand parallel to grain	1413
	655	80-grit sand parallel to grain	1381
	655	80-grit sand, alcohol wipe × 2	1503
White oak, vert grain	650	80-grit sand	1935
	655	80-grit sand	1780
	655	Alcohol wipe × 2	2212
Purpleheart	650	60-grit sand parallel to grain	1731

We also found that G/flex® 655 Thickened Epoxy Adhesive adheres to wet and damp surfaces well. Obviously gluing to wet surfaces, especially when dealing with absorbent substrates like wood, is less than ideal because water is taking up the spaces where epoxy otherwise would find its way in; however, G/flex worked surprisingly well. Technique plays an important role in how effective a wet surface adhesion (even underwater repairs) will be. The epoxy must be thick enough to displace the water to ensure a good bond.

Pre-thickened G/flex 655 Adhesive (or G/flex 650 that has been thickened with 406 Colloidal Silica to a mayonnaise consistency) is needed.

G/flex Kit instructions include a number of short “how-to’s” on gluing to damp and wet surfaces, performing underwater repairs, and repairing plastic boats, including crack repairs and making skid plates for worn ends on plastic canoes.

### **Expand the versatility of other WEST SYSTEM® epoxies**

Adding G/flex to WEST SYSTEM 105 Resin-based epoxy improves toughness and tensile elongation. Using it this way expands the utility and ver-

satility of the WEST SYSTEM product line even further. G/flex can also be used with WEST SYSTEM G/5 Five-Minute Adhesive to extend the working time. The more G/flex added to G/5, the slower the cure and the tougher the cure properties become.

### **Do I still need 105 Resin?**

With all the attributes and improved properties of G/flex, you might be asking whether you still need WEST SYSTEM 105 Resin-based epoxy? The answer is that G/flex can't do some things as well as 105 epoxy. Examples include barrier coating and fiberglassing with heavier fabrics. Although G/flex flows nicely when spread out on a surface, it is less than ideal as a coating because of its higher viscosity. WEST SYSTEM 105 epoxy is better for wetting out fiberglass cloth, especially for clear finish projects like wood strip canoes and kayaks. WEST SYSTEM 105 epoxy is also a better base for creating fairing putties because its lower viscosity allows you to add more low-density filler to it. This translates into a fairing putty that sands and carves more easily because of the higher filler loading.

Several articles follow that will help you further understand our new G/flex toughened epoxy and its properties. We encourage you to read these and then experiment with G/flex as we are doing. We think you will find many projects for which the particular properties of G/flex are ideally suited. As always, our Technical Staff is available to answer your questions, and we will be eager to hear about your projects and repairs using the new G/flex Epoxy. ■

### **WEST SYSTEM® products**

This is a good time to clarify that there are now three different epoxy types in the WEST SYSTEM product line. (see page 24.)

1. What we previously referred to as WEST SYSTEM epoxy are the four resin/hardener combinations based on 105 Resin (105 Resin mixed with 205, 206, 207 or 209 Hardener).
2. G/5 Five-Minute Adhesive is a single epoxy resin/hardener combination.
3. We have now added G/flex Epoxy to the WEST SYSTEM product line. G/flex includes 650 (liquid) Epoxy and 655 (thickened) Epoxy Adhesive.