

**PRODUCT BULLETIN 12****TAP Premium Marine Grade Epoxy System**

- **A two component laminating and repair system**
- **100% solids** no solvents/no VOCs
- **Excellent wet out and high strength**
- **Consists of Resin 314 and Three Hardeners: Fast 102 • Medium 109 • Slow 143**

Why Use Epoxy?

The vast majority of watercraft are made with polyester resin, which is excellent for initial construction but has drawbacks in repair work. Epoxy is a better adhesive than polyester and forms a better bond to cured polyester and fiberglass. Polyester shrinks during cure, creating stress at the point of repair; while epoxy has no significant shrinkage during cure and has a better water/chemical resistance. For these reasons, epoxy repairs are more durable, have better bond strength, and are longer lasting than are polyester repairs.

Why Use TAP Marine Grade Epoxy?

1. Superior moisture barrier.
2. Simple, easy-to-use mix ratios.
3. Virtually no exudation or amine blush (see definitions), no need to water wipe and sand surfaces between coats.
4. Faster through-cure than other types (faster demold, easier sanding).
5. Low toxicity, DOT noncorrosive, lower odor, lower skin irritation potential, and no VOCs.
6. Superior mechanical bond to a broad range of materials.
7. Ability to cure in cold weather • Fast 102 and Slow 143.
8. One system for all weather conditions • Slow 143.

Properties

314 Resin is a clear, low viscosity epoxy designed for superior wood penetration and sealing, and extremely fast, efficient fiberglass wet-out. In combination with TAP Hardeners, it can be applied in a wide range of weather conditions with excellent strength, rigidity, and moisture resistance. 314 Resin has excellent thin film cure (through cure) which allows for sanding or removal from a mold in a minimum amount of time.

102 Hardener provides a fast cure for bonding, re-coating, laminating, and fairing. It is mixed in a 4 to 1 ratio with the 314 Resin. 102 Hardener has excellent chemical resistance to most solvents, the highest rigidity, and is recommended for low temperature applications (40°F minimum).

109 Hardener: Medium cure, 5 to 5.5 hours. 20 to 30 minute pot-life. Clearest of the hardeners for a transparent finish. The mix ratio is 4 to 1. Use for adhesive, laminating, clear finishes. This hardener is the most sensitive to temperature. Ideal cure temperature is 80°-85°F. Lower temperatures will produce blushing and potential incomplete cure.

143 Hardener provides a slow cure and is the best all weather hardener. It has the lowest viscosity and therefore is best for penetration. It is also the most flexible, has the best chemical resistance to acids, solvents and fuels. It has the best adhesive (bonding) properties. The words all purpose best describe this hardener.

Liquid Properties:	Fast	Medium	Slow
Resin/Hardener	314/102	314/109	314/143
Mix Ratio...			
...Resin to Hardener (volume)	4:1	4:1	2:1
Viscosity, cps mixed	550	500-700	450
Pot Life (77° F, 25° C)	12-15	20-30	25-30
Re-coat Time, hours	2	4	5
Recommend min. use temp.	40°F	75-80°F	40°F
Suggested Uses	F L A	L A	F L A

• **F** - Fairing • **L** - Laminating • **A** - Adhesive

Which Do I Use?

TAP Marine Epoxy System has a variety of applications.

Fiberglass Laminating • Glass, Carbon/Graphite, Kevlar
 Fast: 314/102 Good speed, through cure, physical properties
 Med: 314/109 Summer use, longer pot-life
 Slow: 314/143 Long pot-life, good penetration and adhesion

Wood to Wood Adhesive • Fast: 314/102 Slow: 314/143
Wood Penetrant/Restoration • Slow: 314/143
Sealing Wood, 'Hot Coating' • Fast: 314/102
Electrical Potting: Med: 314/109
 Dielectric Constant 4.1
 Dielectric Strength 400 watts/mil
 Volume Resistivity 77 x 10¹⁴

**Gel Coat Blister Repairs:**

Small areas/cold weather Fast: 314/102
 Smaller areas in hot weather Med: 314/109
 Larger areas in all weather Slow: 314/143

Fairing or Filleting Compounds: made by mixing epoxy with Cab-O-Sil and Microspheres

Fast curing, small batches, cold weather Fast: 314/102
 Hot weather and small batches Med: 314/109
 Larger batches in all weather Slow: 314/143
 Bonding to metal Slow: 314/143

Comparison With Others?

- Lower toxicity, DOT noncorrosive, lower odor, lower skin irritation potential
- Virtually no exudation or amine blush, 102 and 143; very low exudation, 109 (no need for water wipe and sanding surfaces prior to re-coating)
- Faster through-cure (faster demold times, easier sanding)
- Better release of air bubbles for fewer surface imperfections and void-free laminates
- Ability to cure in cold weather (102, 143)
- One system for all weather conditions
- Better chemical resistance
- More economical (TAP Hardeners are full measure!)

Brand Comparisons

West System® 105/205 (fast) use TAP 314/102
 West System® 105/206 (slow) use TAP 314/109
 System 3® use TAP 314/143 (all weather system)

Surface Preparation

Thoroughly prepare the surface to be worked on. The type of preparation required depends on the surface. Most surfaces, wood, fiberglass, metal, etc., will require a thorough sanding and removal of any wax, paint, or other foreign substances which might impair epoxy adhesion to the surface.

Concrete should be more than 90 days old and it should be acid etched, bead blasted, or sand blasted (bead blasting is preferred). Dust and other particles should be vacuumed. Concrete should be dry.

Suitability and adhesion to other surfaces should be determined by experimentation.

Tools and Supplies

Have all required tools and supplies ready before you start mixing. The following tools are recommended and available at your local TAP store:

- Mixing cups with measure increments
- Stir sticks
- Gloves
- Squeegees
- Safety glasses
- Wipe-Alls
- Sand paper
- Sanding block
- Fillers
- Disposable brushes
- Replacetone
- Fiberglass fabric (Mat, Roving, Tape)
- Knytex
- Carbon Fiber or Kevlar Fiber Fabrics
- Dispensing pumps

(TAP pumps provide accurate and easy measuring)

Mixing

Combine the proper proportions of resin and hardener in a straight sided mixing container (don't use coffee cans, mayonnaise jars, etc.). Measure resin/hardener ratios accurately according to instructions. Improper ratios will produce inferior results and guarantee failure. Mix only small batches until you are familiar with pot-life and coverage requirements of epoxy.

To find Pot-Life expectancies, see Liquid Properties on the other side of this bulletin. Pot-life refers to the approximate amount of time the mixed resin remains a usable liquid while in a mass in the mixing container at a given temperature.

Mix the resin and hardener for 2 minutes, stirring thoroughly with a mixing stick, scraping the sides, bottom, and corners of the container. Any resin or hardener that remains unmixed will never cure and can cause surface tackiness which cannot be removed.

Thoroughly stir in any pigments or fillers desired. If pot-life is short, this should be done before blending the resin and hardener together.

Begin working immediately. As epoxy cures, it generates heat (exothermic). Depending on the mass, air temperature, temperature of the resin and hardener, and the hardener used, the curing temperature can reach over 300°F. If the resin gels and gets hot, move container outdoors to avoid the fumes. Never dispose of epoxy that is not fully cured and cooled.

Heat generated by epoxy as it cures can be dissipated by pouring the mixture into a container with greater surface area, like a paint roller pan. The sooner the mixture is transferred, the longer the pot-life will be.

Never add solvents to epoxy—while they appear to reduce viscosity, they ultimately degrade the finished cure—they should be avoided. Select the hardener with the viscosity that best matches your job requirements. Remember, cold temperatures will thicken all the hardeners and resin, warm temperatures will thin them.

Application

See Product Bulletin 3 for specific fiberglass instructions. When using epoxy as a surface sealer, it can be brushed or rolled. It does not self-level as well as paints, etc., making careful brushing important as well as sanding after cure. Note: Never use pigmented epoxy as a substitute for paint.

When using epoxy as a surface sealer, the first coat will penetrate and may be absorbed by the substrate (material being sealed). Watch for this by observing the first coat for dry spots that form as the surface absorbs the epoxy. A minimum of two to three coats are recommended for a complete seal. For extremely porous surfaces, add layers until you see a continuous smooth film surface indicating a complete seal. For boat hull applications, a 20 mil coating is common, requiring up to 5 or 6 coats.

Cure/Re-coat Time

When fiberglassing, successive layers of cloth and resin are best applied one right after the other before the resin starts to cure. For the final finish, each layer of epoxy should be applied after the prior layer has firmed up enough to support the next. This interval between coats is the 're-coat time'. Re-coat times are listed on the other side of this bulletin under the heading Properties. Re-coating should be done within 24 hours, in order to form a good chemical bond between layers. TAP Marine Grade Epoxies are formulated to minimize oily exudation, however, if exudation (amine blush) forms, remove it with water and a scrub pad. After 48 hours, the surface should be sanded to provide better adhesion for the next coat. Seven days are required for full cure.

Exterior Surface Protection

Unprotected epoxy will degrade when exposed to direct sunlight, so it is not intended as a final finish in exterior applications. Both ultraviolet and heat contribute to the breakdown of epoxy. Pigments help slow down surface degradation. For the best protection, use a light colored opaque marine paint. Polyurethane based paints bond extremely well to epoxy and provide a durable finish. Since light colors reflect more heat, they are recommended to maintain a cooler surface temperature.

While clear finishes require more maintenance, they have the obvious advantage of showing off the natural beauty of the wood. Clear polyurethane based marine coating can be used. Even though this coating can be applied directly to the wood, it does not provide nearly the durability and waterproof protection of an epoxy base coat.

Epoxy must be thoroughly cured before a finish coat can be applied. When the epoxy is cured, sand smooth—start with 80 grit paper and proceed to a grit fine enough to meet your painting needs. When sanding is complete, wash with clean water and allow to dry thoroughly. Then apply a finish coat.

Cold Weather Tips

The optimum temperature for working with epoxy is 70° to 80°F. Lower temperatures can have detrimental effects on epoxy and the finished project. When epoxy is cold, its viscosity increases dramatically (similar to cold honey). Thick resin can result in an incomplete mix with the hardener. Second, thick resin does not penetrate or wet out very well, resulting in inferior bonding strength. Third, epoxy generates and requires heat to fully cure.

When heat never develops, the resin does not fully cure (though it may seem hard to the touch), again resulting in inferior bond strength.

There are, however, some steps you can take to counter cold temperature effects and produce satisfactory results:

- Store resin and hardener in a warm location, 70°F is best. Move it to a cold work area when you are ready to use it.
- Use the 102 Fast Hardener. It is specifically suited for complete cure in cold settings.
- Where possible, warm the surface to which epoxy will be applied. The warm temperature will support better penetration and a more complete cure.
- Stir the epoxy/hardener mixture thoroughly. Due to the possible thickening effect cold temperatures have on resin and hardener, the temptation is to stir less due to fatigue. In fact, the need to stir is even greater than in warm weather because of the resistance of the two viscous liquids to mixing readily. Incomplete mixing will guarantee poor results.
- If the project is not too large, leave the resin/hardener mixture in the mixing container for a few minutes to allow the chemical reaction to get under way before applying to the work surface. This method can be risky because it will cut down on your working time (pot-life).
- Avoid condensation on the work surface, due to cold temperatures, both prior to and after applying resin. Should condensation form on the uncured resin, a white amine blush will result. If this happens, allow the resin to cure (applying heat if possible) and then wash the blush off with soap and water and allow to dry thoroughly before applying the next coat.

Definitions

Amine Blush (also called exudation): A wax-like film that can form on cured epoxy surfaces. It is a normal by-product of the epoxy curing process. If is not removed, it will inhibit adhesion of subsequent layers if they are applied after the prescribed re-coat time. It is water soluble and removed with water and a scrub pad after full cure. TAP Marine Epoxy produces very little amine blush.

Crystallization: A normal condition of epoxy, especially in cold temperatures. It is similar to the effect of crystallized honey. The condition can be completely reversed by setting the can of resin (open the lid to prevent pressure buildup) in a pan of warm water, 120° to 130°F. Stir the resin, then the crystals will dissolve and the resin will return to normal. Crystals around the opening of the can be removed by tightening the lid and inverting the can of warmed resin to dissolve the crystals.

Elongation: Associated with tensile strength because it is the increase in original length at fracture and is expressed as a percentage. Paper has a small elongation whereas taffy has a large elongation.

Flexural and Tensile Modulus: Most easily described as a measure of the stiffness of a material. The higher the number, the stiffer the material.

Flexural Strength: The amount of bending stress placed on a bar of material before it breaks or 'fails'.

HDT (Heat Deflection Temperature): Used to compare various materials. In an actual test it is the temperature at which a sample bends a given number of mils under a given load.

Pot-Life: The time (in minutes) it takes resin, mixed in the 'pot', to gel and become unusable. The test is done with a prescribed quantity of resin (usually 100 grams) at a prescribed temperature (usually 72° or 77°F). The best measure of pot-life is for the actual user to test a small sample under existing working conditions. Increased temperature will reduce pot-life.

Tensile Strength: The amount of pulling or stretching stress placed on a bar of material before it breaks or 'fails'.

Thorough Cure: Just as it sounds, the time required to fully cure through the entire layer of material. Most epoxies have a difficult time curing in very thin films. They remain gummy for a long time, preventing sanding and demolding. TAP Marine Grade Epoxies are formulated to provide excellent, fast, thin film through cure so that sanding can be done in a minimum of time.

Viscosity: Refers to a liquid's ability to flow, or more simply, its 'thickness'. Viscosity is measured in centipoise (cps), for example, water has a viscosity of 1 cps). The higher the viscosity, the 'thicker' the liquid. The lower

the viscosity of a resin mix, the easier it is to mix and the better its ability to penetrate and wet out a laminate and improve adhesion. Temperature dramatically affects the viscosity of epoxy. A low temperature increases viscosity and makes working with the resin difficult. High temperatures do the opposite, but shorten pot-life.

Fillers and Pigments

TAP provides a wide variety of fillers and pigments that can give special properties to epoxy. TAP's pigments are all compatible with our epoxy system. Fillers can be added to epoxy to produce a desired consistency. Experiment to produce the results you desire. Below is a brief description of the properties of various fillers:

Chopped Strand is cut fiberglass strands approximately 1/4" long. It adds structural and impact strength.

Milled Fibers are used to produce a jellylike paste with maximum strength.

Microspheres are synthetic, inorganic, hollow glass spheres. This white filler adds particles of air to resin, creating a light filler with excellent spreading and sanding characteristics. Good for fairing.

Cab-O-Sil is a very light white powder that adds thixotropic properties to resin. When added in a small quantity, resin viscosity remains unchanged—but resin becomes non-sagging on a vertical surface. When used in greater quantity it can turn into the consistency of petroleum jelly. Cab-O-Sil imparts great hardness and abrasion resistance to cured resin. Good for adhesion and strength.

Safety Notes

TAP Epoxy is not FDA approved for contact with food or potable water. However, it can be safely used in aquariums and ponds without harm to fish, provided it has cured at least 7 days and any amine blush has been thoroughly removed.

Gloves should always be worn when working with epoxies. TAP Marine Grade Epoxy has extremely low toxicity and is not corrosive. However, safe work habits are appropriate with all chemicals. TAP Marine Grade Epoxy is not a significant skin sensitizer, however some people may already have a sensitivity, so skin contact should be avoided.

Avoid breathing fumes emitted by the curing exothermal epoxy. Avoid breathing dust when sanding. Always wear a particle mask and eye protection when sanding.

Never use acetone, MEK, or other solvents to remove epoxy from your skin. Solvents may dissolve chemicals and carry them into the blood system. Clean skin, brushed, tools, etc. with Replacetone, soap and water.

Need More Information?

Your TAP store has a wide variety of books which address all aspects of marine construction and repair. Ask your TAP Salesperson for more information.

Visit our website: tapplastics.com

View all of TAP's how-to videos on plastic, fiberglass, mold-making, window films, and more at:
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