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Castable Epoxy Resin Applications

Castable two part epoxy resins are an economic way to mount high volumes of specimens, as well as for mounting specimens that are pressure sensitive. Epoxy resins are available in a number of varieties for metallographic specimen preparation, including low viscosity or fast curing resins. Low viscosity resins are useful for backing filling voids and because of their low viscosity have a tendency to better wet and

adhere to the specimen surface. Fast curing resins allow for quicker mounting but may result in higher resin exotherms and greater resin shrinkage.

Epoxy resins are tough and rigid polymers which have good wetting and adhesion characteristics to most surfaces. Epoxy resins are also very resistant to water, acids and bases and most organic solvents.



Low viscosity resin for filling in cracks and for edge retention.

Characteristic	ULTRATHIN™	QUICKMOUNT™	EPOCAST™
Primary characteristic	Low viscosity	Fast cure	General purpose
Color	Water clear	Semi-clear	Semi-clear
Viscosity (resin)	500 cps	1000 cps	1000 cps
Viscosity (mixed)	250 cps	350 cps	350 cps
Specific gravity (mixed)	1.09	1.10	1.10
Pot Life	12-20 minutes	2-3 minutes	2 hours
Cut time to 75-80 Shore D*	4-6 hours	30-45 minutes	6-8 hours
Full Hardness (Shore D)	85	84	85
Tensile Elongation	5%	4%	6%
Tensile strength	8000 psi	8000 psi	8500 psi
Dielectric strength	410 v/mil	410 v/mil	410 v/mil
Cost	Moderate	Moderate	Low

Viscosity and Resin Penetration

Low viscosity resins are very useful for filling in void, porosity, cracks and other microstructural details. To enhance these features a dye is sometimes added to the epoxy. In addition, lower viscosity resins mix easier and cure more consistently than higher viscosity resins, which are more difficult to mix. Another feature of low viscosity resins is that they generally have fewer

entrapped air bubbles and thus are clearer. Abrasive contamination carry is also reduced by eliminating the air bubbles.

The ULTRATHIN™ Epoxy is a low viscosity resin system. The resin has a viscosity of 500 cps and the hardener has a viscosity of 250 cps. After mixing the total viscosity is 250 cps. The

ULTRATHIN™ also cures water clear and reaches a polishing Shore D hardness of around 80 within 4-6 hours*.

In addition, the ULTRATHIN™ epoxy has very good wetting and adhesion characteristics and produces excellent edge retention around metallographic specimens including pipe and other difficult to mount samples.

* Cure times are dependent upon volume of casting and mass of specimen being mounted.

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Considerations for Castable Epoxy Resin Mounting

- Viscosity and resin penetration
- Clarity
- Curing time
- Shrinkage
- Cost

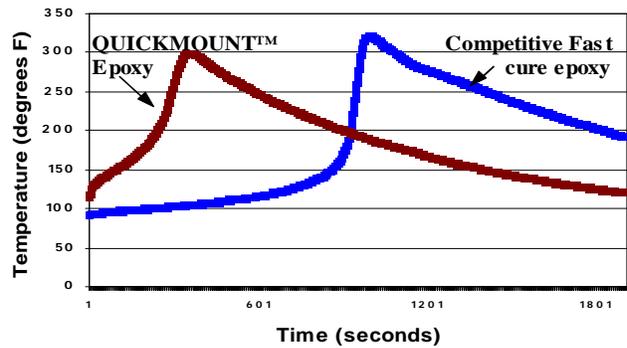
Fast Curing Resins

Fast curing epoxies are useful for metallographic specimen preparation because you do not need to wait until the next day to do your grinding and polishing. A key characteristic of fast curing epoxies is the peak exotherm temperature. All epoxy systems can be made to cure faster with the addition of heat, however excessive heat causes increased shrinkage and yellowing of the mount.

Ideal quick curing epoxy resin begins to react and cure immediately, but do not create an uncontrollable exotherm. An example of an ideal fast curing resin is shown in the

adjacent figure for the QUICKMOUNT™ epoxy system. Almost immediately after mixing the resin begins to generate heat for curing. It reaches its peak exotherm at approximately 5 minutes and begins to cool down. Total curing time for the QUICKMOUNT™ epoxy system is about 45 minutes*. This time can be reduced further by heating the specimen mount after the resin reaches its maximum exotherm. For example, heating the mount to 65 Celcius after an initial room temperature cure for 5 minutes decreases the total curing time to 15 minutes.

Exotherm Profile for Fast Curing Resins



Vacuum /Pressure Impregnation

For porous samples such as powder metallurgy samples, or specimens with cracks or other features which need to be filled with an epoxy, either a vacuum impregnation set-up or a pressure curing chamber can be used to increase the resin penetration into the voids.

For vacuum impregnation, the proper technique is to place the specimens and epoxy into a chamber before pouring the resin. A vacuum is then pulled on both the sample and the resin to reduce the air pressure within the voids or cracks. Prior to the air degassing from the resin, it must be poured over the sample (while under vacuum).

Immediately after pouring the vacuum must be discontinued and the resin must be cured at room pressure or at a higher pressure. The resin should **never** be poured onto the sample before pulling a vacuum, this will only cause the air dissolved in the resin to degas (just like opening a bottle of carbonated water or soda). It does nothing to help fill in voids.

To increase resin penetration, the resin can also be cured at higher pressure. In fact, the best resin penetration can be obtained by pouring the resin under vacuum and then curing the resin to full hardness at a higher pressure.

Curing at higher pressures also produces clearer mounts because the fine bubbles in the resin will dissolve into the resin.



Vacuum Impregnation system for improved resin penetration.

Shrinkage Issues (pre-heat the specimen)

Shrinkage away from the specimen edge can be a very significant problem for metallographic specimen preparation with castable resins. This shrinkage can result in edge rounding during polishing, as well as act as a reservoir for abrasive and liquid etchant contamination. The abrasive contamination can result in scratching and damage during finer grinding operations. This gap can also trap liquids

from the polishing or etching stage and when viewed under a metallographic microscope the intensity and heat from the microscope light can boil out this liquid and stain (corrode) the sample.

To eliminate this shrinkage and to improve the resin wetting, either a low viscosity resin can be used or the specimen can be preheated to

85-100 F prior to mounting. The result is that the sample will drive the epoxy reaction near the sample/resin surface and thus cause the resin to start curing at the interface and shrink towards the specimen. Note if the sample is not preheated, the sample will act as a heat sink and thus the resin will first cure at the outside edge of the mount and shrink away from the specimen edge.

“Pre-heating the specimen can significantly improve the resin adhesion to the specimen surface”



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PACE Technologies offers metallographic testing consumables and equipment, including: abrasive blades, diamond wafering blades, compression and castable mounting compounds, grinding abrasives, polishing pads, diamond abrasives, final polishing alumina and colloidal silica abrasives.

As leaders in the field, we seek to provide technical information and innovations to the metallographer. Our Arizona research facility focuses primarily on the development of new products and processes for both the metallographic and industrial precision surface finishing markets.

Our web page offers the most complete metallographic web site for specimen preparation procedures and specimen preparation training, as well as links to other useful web sites. We have also just completed a technical and etchant database. Featuring thousands of etchants, this easy-to-use database is the most comprehensive etchant database available on CD.

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