4/23/08 Resin Guidelines

General Principles:

- Always talk to a manager to discuss whether or not your project can be accommodated before bringing in resins and related materials. Generally, small-scale mold making, casting or coating operations using polyester, epoxy and urethane resins can be done in the spray booth and drying room (at the manager's discretion), but similar large-scale projects and projects involving fillers and fiberglass cannot. An alternate worksite may possibly be arranged for these types of projects at the manager's discretion.

- Please remember that none of these projects may be done anywhere but in the spray booth, drying room, or another manager-approved worksite – do not work with resins and related materials in the alternative materials shop, plaster room, model shop, bench room, wood shop, sanding and grinding room, at your desk, or anywhere else in the building.

- Know your materials. Always request MSDSs (Material Safety Data Sheets) and Technical Data Sheets from your vendors and read them carefully before using the material. You must do this to protect your health and that of others, and to get the safest and most efficient results from your materials.

- Do not contaminate surfaces (tables, floors, DOORKNOBS) with resin. Some people are sensitive or allergic to these materials and can unwittingly be exposed.

- Do not throw away un-catalyzed materials. When you mix a two-part material in cups, pour part A into part B (or resin into hardener), mix thoroughly, then pour the catalyzed mixture back into the first cup and mix so that there is no un-catalyzed material left in the first cup. In addition to protecting our landfills from chemical pollution, you will be insuring the best mix and best properties from your material. This goes for the containers the materials came in as well – save some of your catalyzed mixture to kick them off too by pouring it in a swishing it around at minimum. If your are really ecologically conscious, you can cut open plastic containers with a utility knife and metal containers with a hacksaw, and thoroughly brush catalyzed mixture on all surfaces with a chip brush. Your children will thank you.

- If you are caught throwing away un-kicked resin or abandoning only one side of a material, you will be banned from using resins here in the future – We do not want the responsibility (and exposure) of having to kick-off your materials for you.

Common types of resin and what you should know about them at minimum:

Note: To protect your health as well as that of others, and to use any product safely and efficiently, you should ALWAYS read MSDSs (Material Safety Data Sheets) and technical data sheets. This information is not intended to supersede these documents, but rather to supplement them.

Polyesters:

- Polyester resin is most often used for laminating fiberglass but can also be cast solid or used as a coating.
- Polyester resin emits strong-smelling styrene fumes, which are an inhalation hazard. Always wear a respirator with organic vapor cartridges. After curing, polyester sanding dust is also an inhalation hazard best avoided by using a respirator with organic vapor cartridges and particulate pre-filters.
- Do not get polyester resin on your skin – it can cause a rash and is unhealthy to absorb.
- Polyester resins are catalyzed by the addition of MEKP (Methyl Ethyl Ketone Peroxide) catalyst. MEKP WILL BLIND YOU if you get it in your eyes (always wear goggles or safety glasses). The speed at which the resin catalyzes can be controlled by adding more or less MEKP. If you add too little, it might take a long time to cure properly. If you add too much, it might kick off too quickly to work with, and may smoke, crack or even catch on fire in extreme cases. Read your tech sheet for proper catalyst proportions.
- Most polyesters do not surface cure in the presence of oxygen – they will remain tacky and be hard or impossible to sand. To get them to surface cure, you must add surface curing agent (commonly referred to as "wax"). Refer to tech sheet for proper proportions. If you are laminating, wax will impair adhesion between layers, so don't add it until your last layer. Another way to achieve surface cure is to spray your surface with PVA (Polyvinyl Acetate). Ask TAP Plastics about this technique. If you are laminating in a female mold, or casting a solid piece in a closed mold, surface curing will not be an issue since the surface will not be exposed to oxygen anyway.
- Acetone is the solvent for polyester. It can be used for cleaning tools, spills, etc. You should also note that MEKP can react explosively with acetone, so they should always be stored separately.
- Rags with polyester resin on them should be saturated with water before discarding.

Epoxies:

- Epoxy is most often used in composite fabrication and as an adhesive, but some epoxies can also be cast solid or used as coatings.
- Epoxy resin emits amine fumes, which are an inhalation hazard. They don't smell strong like the styrene fumes in polyester resin, but nonetheless require the use of a respirator with organic vapor cartridges. This is a good example of a hazardous material with poor warning properties. The sanding dust is also an inhalation hazard. Use a respirator with organic vapor cartridges and particulate pre-filters.

- Epoxy should be kept off your skin as it is both a skin absorption hazard and a skin sensitizer – it can give you a rash. If you become sensitized to epoxy through repeated exposure, you may experience respiratory and skin symptoms with only minimal exposure in the future.
- Epoxies consist of a resin side and a hardener side. The curing process begins after they are mixed together. Epoxy is more finicky about mixing than polyester – scrape the sides and bottom of your mixing container thoroughly with a stick and mix for a good two minutes plus to avoid incomplete and inconsistent cure.
- Epoxy generates lots of heat during the curing process, especially if left in a large mass (such as a mixing cup), and can smoke and crack and CATCH ON FIRE. Have a bucket of water on hand so you are ready for this if it happens. Large leftover quantities in mixing cups should be quenched with water as a precaution. The epoxy will still kick off under water.
- Rags with epoxy resin on them should also be saturated with water before discarding.
- If you are laminating with epoxy, you should know about amine blush – a waxy film that forms on the surface after curing. If you are adding subsequent layers to your lamination, this blush needs to be removed by sanding and/or acetone before proceeding.
- Acetone is the solvent for epoxy, and can be used for cleanup and spills, etc. There are also solvents designed for use with epoxy that contain fewer VOCs (Volatile Organic Compounds – bad for air quality) than acetone such as TAP Plastics' Replacetone. I have also heard of people using isopropyl alcohol or no solvent at all.

Urethanes:

- Urethanes are most often used for solid castings, but find some applications as coatings, or more seldom in composite fabrication. It is generally not good for lamination (usually kicks too fast).
- Variations of urethanes with no analogues in the polyester and epoxy families include flexible and rigid foams and rubber formulations used for mold making and flexible castings. Urethane is often a good choice for both softer parts and clear castings.
- Urethanes contain chemicals called isocyanates, which are known human carcinogens. You must protect yourself from this serious hazard by wearing a respirator with organic vapor cartridges. Sanding dust is also an inhalation hazard – use a respirator with organic vapor cartridges and particulate pre-filters. Urethane fumes have a sickly- sweet smell to them – a fairly mild warning property to a hazardous material.
- Do not absorb urethane resin through your skin – it is unhealthy to absorb and often causes a rash. It is also a strong sensitizer like epoxy. If you become sensitized to urethane through repeated exposure, you may experience respiratory and skin symptoms with only minimal exposure in the future.
- Most urethanes are extremely sensitive to moisture, and will crystallize if exposed to too much humidity, resulting in poor properties. This problem can be addressed by "burping" the container with dry gas blanket after each time it is opened.

- Clean up rags with urethane resin on them should be coated with catalyzed resin before discarding.

Other members of the polyester, epoxy, and urethane families:

Polyester:

- Bondo and other body fillers are basically polyester resin with filler added to give them body.
- Bondo catalyst is also MEKP with filler added to make a cream.
- The same precautions should be taken with Bondo and cream hardener as with polyester resin and MEKP.

Epoxy:

- Plumber's epoxy and Magic Sculpt are examples of filler added to the resin and hardener sides of an epoxy to give it a clay-like body. It can be sculpted by hand and with tools and smoothed by water, and is machine-able and sand-able after hardening.
- Plumber's epoxy is similar but kicks much faster.
- Magic Smooth is just Magic Sculpt with less filler – it has a viscous glue-like consistency and is an excellent adhesive and coating. It can be smoothed with a gloved hand and water, and is machine-able and sand-able after hardening.
- The same precautions should be taken with these products as with other epoxies, although I have never seen them heat up enough to catch fire.

Urethane:

- The 4, 8, 12, and 20 pound density foam we sell is urethane foam.
- The same precautions should be taken with these materials as with urethane resin.

Fillers:

- Sometimes fillers are called for to change the properties of your resin. Two common ones are glass microspheres or microballoons (trade name Qcel), and fumed silica (trade name Cabosil). Both are used to thicken resin or to increase thixotropy (to give a resin enough body to stick to a vertical surface without running off).
- Both of these products are inhalation hazards that you must protect yourself against by wearing your respirator with particulate pre-filters.
- You may not use either of these products in the spray booth, drying room, or anywhere else in the building. Talk to a shop manager to discuss whether or not your project can be accommodated.

Fiberglass:

- Fiberglass and other materials such as carbon fiber are used in conjunction with polyester and epoxy resins in composite fabrication.

- Fiberglass comes in many forms including woven cloth (E-cloth and S-cloth, S-cloth being the stronger of the two), chop mat (strands are held together by an adhesive binder but oriented randomly – not woven), veil (a lighter weight version of chop mat), etc.
- Higher-end laminates like carbon fiber are also available, but are not suited to inexperienced composite fabricators.
- All of these products are inhalation hazards that require the use of a respirator with particulate pre-filters. You should also protect your skin by wearing a long-sleeve shirt and long pants, as well as a hat if cutting or grinding. Of course, eye protection is also necessary in these cases.
- These materials may not be used in the spray booth, drying room, or anywhere else in the building. Talk to a shop manager to discuss whether or not your project can be accommodated.

Pigments, tints, dyes and other colorants:

- Resins can be colored by the addition of various pigments, tints, dyes and other colorants.
- Generally, pigments (both powdered and liquid) produce more opaque colors, while tints and dyes produce more translucent ones.
- If the resin is white, colorants will produce pastel hues.
- You should check with your materials vendor about colorant compatibility with the resin you are using, as well as proportion limitations – sometimes, adding too much colorant can prevent resin from curing or otherwise adversely affect its properties. Also, be aware that "dry" pigment may contain moisture and may cause problems, especially with urethanes. Cal Tint and other water-based colorants are obviously not a good choice. If you are coloring silicone rubber, solvent-based colorants are problematic.

A note on mold making rubbers:

- Please read your MSDSs and tech sheets before working with mold making rubbers. Silicone mold making rubbers generally do not pose an inhalation hazard, but urethane mold making rubbers do – they are essentially urethane resin with fillers and plasticizers added. Therefore, the same safety precautions must be followed as with urethane resins.
- Do not work with urethane mold making rubbers outside of the spray booth, drying room, or other manager-approved worksite.

Tips and words to the wise:

- Do not re-use resin mixing containers unless you either let the resin harden first and break it out, or clean with solvent and a rag. In the first case, residual catalyzed resin still in the container can actually make subsequent batches kick faster. The drawback to ragging out a container with solvent is the mess (and having to deal with a solvent and resin contaminated rag – saturate with water and

place in flammable container). It is much better to use disposable paper cups for mixing. Let's say you have a two-part urethane resin with a 50/50 volume mix ratio. Follow these steps to mix: Estimate the amount of resin you will need for your pour, then pour half this amount into a paper cup. Cut off one end of a popsicle stick so that it has a square edge. Dip the stick into the cup of resin so that the square edge of the stick is on the bottom of the cup. Notice that that the stick is "marked' by the resin – now you can place the stick (square edge down) into another cup and pour the other side of the resin to the same level. Pour the contents of the first cup into the second and mix thoroughly, scraping the sides and bottom of the cup. Then pour the mixture back into the first cup and repeat the mixing/scraping process. Pour your mold. When the resin in the cups has kicked off, they can be thrown away.

- When working with resins, always have everything you are likely to need close at hand before mixing, so you are not fighting your pot life (the amount of time that the resin remains workable) chasing down necessary items. Consider what you will need first.

- If you are working with a resin with a short pot life (such as quick-cast urethane), consider working with a partner to accomplish your task. For example, one of you can mix, and the other can fill the mold.

- If you are working with a resin with a weight mix ratio, don't forget to figure in the weight of the mixing container or to zero-out or "tare" the scale. If you don't do this, your mix ratio will be off.