

Don Lancaster's

RESOURCE BIN

number fifty

Injection molding & plastic prototyping.

Our usual reminder here that the *Resource Bin* is now a two-way column. You can get tech help, consultant referrals and off-the-wall networking on nearly any electronic, *tinaja* questing, personal publishing, money machine, or computer topic by calling me at (520) 428-4073 weekdays 8-5 Mountain Standard Time.

I'm now in the process of setting up my new *Guru's Lair* web site you will find at (where else?) www.tinaja.com

This is the place you go for instant tech answers. Among the many files in our library, you will find complete reprint sets for all of the *Resource Bin* and other columns.

You will get the best results if you have both *Netscape Gold* and *Acrobat Reader 3.0* installed.

Plastics and Polymers

I sure do get a lot of helpline calls that concern plastics in one way or another. Maybe as a custom part for a project. Or for fancier cases. Or to create unique packaging or effective presentations. Or to explore several new desktop publishing options.

Nearly all of the plastics industry does appear to be snotty and inbred. You will often find steep minimums, arrogant resellers, unanswered calls, and insanely high setup charges. Even finding suppliers can be a real bear.

The reasons for these hassles are simple: Plastics form a high volume industry. Onesie-twosies can end up more trouble than they are worth.

The term "custom" means different things to different outfits. One blow molder I tried working with defined "custom" as "On our regulation one gallon milk container, do you want a green or a blue cap?" Their minimum order was two million units.

When I tried to sort all my plastics resources out, I was utterly amazed at how big the pile ended up. Let's see if we can't rearrange it...

The Usual Suspects

There's zillions of different plastic options out there today. These vary in cost, strength, and flexibility. Picking the wrong plastic for any ap is bound to cause you grief. Here's some of the more popular candidates...

ABS is a durable family of plastics used for everything from water pipes to ads. Foam core expanded versions make light and rigid displays. The typical brands are *Sintra* and *Kydex*. A solid textured version is *Royalite*.

Acrylic is a low cost and somewhat brittle plastic that can offer extreme clarity. *Plexiglass* is one trade name for the thicker sheets. It's available in many colors and patterns. Plexiglass is easily cut by scoring and snapping. It is also easily heat formable.

Butyrate is a clear and modestly flexible plastic. It is mainly used for mailing tubes and point-of-purchase parts containers. These cut easily with plain old scissors.

Delrin is one brand name for acetal, a versatile engineering and structural plastic. It often outperforms nylon at a modest cost premium. This can be turned, milled, or otherwise cut up by using normal shop tools.

NEXT MONTH: Don takes a second look at some solar energy winners and losers.

Fiberglass is a misnomer. Instead, You really have an epoxy or polyester plastic resin that has been *reinforced* using glass fiber mats. Boats, flexible antennas, and printed circuit boards are three important uses.

Mylar is one name for a polyester plastic. It is very dimensionally stable

and extremely strong in thin films. An older use is recording tape. The Mylar sheets have good temp resistance and may safely be sent on through a laser printer. Mylar also mirrorizes quite well. For decorative or solar apps.

Nomex is a stable plastic with very high temperature capabilities. It even gets used for fire suits. Although its typical electrical properties are very good, above a critical high temp, it chars and can become a conductor. *Kapton* is a related brand name.

Nylon is a common and a highly useful engineering thermoplastic. It is easy to machine, quite stable, and can make excellent bearings. It injection molds beautifully. This one is often your best all around choice for many mechanical and support parts.

Phenolic is an older, quite brittle thermosetting plastic. Your available colors are brown, brown, and brown. It has real good electrical properties and reasonable temp performance. It cracks fairly easily.

Polycarbonate is a very tough and clear replacement for acrylic. Lexan is one brand. "Bulletproof" windows are one use. The standard sizes used for windows are often cheapest.

Polypropylene is just a variation on polyethylene that offers incredible flexibility. "Living hinge" applications are found on everything from car gas pedals to file card holders. It is very difficult to bond.

Polyethylene is a very flexible and slippery low cost plastic. It gets used for lots of items from food bowls to adhesives. Ziploc shipping bags and construction films are two of the high volume uses. Linear polyethylene is an improved and stronger product.

Polystyrene is an improved form of styrene. It can be very clear and has

quite good high frequency electrical properties. But it is brittle and has a very low melting point. Do beware of using soldering irons or solvents near polystyrene capacitors!

PVC is short for *poly vinyl chloride*. You'll see some members as the thick gray slabs in printed circuit etchers, as thin films in vinyl page protectors, or as a plain old black plastic sewer pipe. It has good resistance to most chemicals and heat forms beautifully. PVC can also be welded with a heat gun and a PVC rod.

Styrene is an economic but brittle plastic. It is also made in light foams or expandable beads. When you heat these, they will expand into a mold to create your classic beer cooler or such. A hot wire cutter is one easy way to work with these materials. Make your own by smashing a power resistor to get some nichrome wire.

Teflon is but one tradename for a fluorinated hydrocarbon. Featuring extreme surface slip and outstanding chemical resistance. Although a lot cheaper than before, teflon is still very expensive for most apps. It is normally reserved for "Uh, compared to what?" uses. And then only sparingly.

Tyvec Whoever invented this one should get chopped up and fed to the cows. The "paper" replacement made from ground up polypropylene fibers, it makes for totally impossible to open packages; envelopes that forcibly eject themselves from bicycle carriers and dump your mail all over the road; and mailers that instantly destroy electric letter openers.

UHMW is a specialized variant of polyethylene which has an ultra high molecular weight. It is very slippery and has extreme cut resistance. "Self healing" cutting blocks and conveyor rails are two important uses. UHMW impact resistance is unbeatable.

Urethane is that incredibly durable rubber-like plastic. Its durometer can be adjusted all the way from rigid to ultra flexible. It is also an outstanding low temperature casting resin.

Getting Started

One source for engineering plastics in very small quantities is *Small Parts*. They also custom cut sheets and rods of nylon, delrin, teflon, and a few of the other engineering plastics.

Real bargains in plastic items can often be found at *American Science &*

Surplus. Since these are left over from some other use, it's strictly catch as catch can. And WYGIWYG - what you get is what you get.

One traditional plastics distributor that I've found to be fairly reasonable is *U.S. Plastics*. A competitor is *Ain Plastics*. Free catalogs from both.

The classic old line name brand big distributor is *Cadillac Plastics*.

But the best sources I've found for price and delivery are the outfits who aim at the school markets. Especially those that advertise in *School Shop* and similar magazines.

Let's See. *Iasco* is short for *Industrial Arts Supply Company*. They have now got everything from a liquid plastisol for use in fish lures to acrylic powder casting to real injection molding and vacuum forming machines. A useful second source is *Delvies Plastics*. Who also offer lots of books and patterns.

Model and hobby sources are also useful. See the ads in *Model Railroader* and similar mags. One leader here for styrene parts is *Evergreen*. They offer a free *Styrene Handbook*. Subtitled *Tips and Basic Techniques on Working With Styrene Plastic*.

Be sure to get this one.

Injection Molding

It sure is infuriating to go down to your hobby store and look in a cheap kit and see bunches of highly detailed injection molded parts. But have the molders laugh in your face when you want to get anything injection molded on your own.

The problem is that most injection molded parts can be extremely cheap. But only when ordered in humongous quantities. There are major front end charges involved in making the molds and in machine setup.

Because of the steep front end costs *injection molding is totally unsuitable for most low volume uses*.

Surprisingly, there are several low cost injection molding machines for do-it-yourself users. The cheapest is that *Quick Shooter* sold by *Haygean Machine* at \$560 list. This one uses a drill press to create the injection force. Shots up to 1/3 ounce are possible at a 100 shot per hour rate.

Higher performance machines are offered by *Morgan Press*. They offer a \$20 book called *Cutting Costs in Short Run Plastics Injection Molding*.

Alternates include the *Tri-Tron 303*, the *X-Tron 300A*, an *Alumi-Tron 66M*, and others distributed by *Iasco*. A *Plasticor PLA-63* is offered by *Delvies*.

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PLASTICS RESOURCES

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American Science & Surplus 3605 Howard St Skokie IL 60076 (708) 982-0870	Converting 301 Gibraltar Dr Morris Plains NJ 07950 (201) 292-5100	Film & Video 8455 Beverly Blvd #508 Los Angeles CA 90048 (213) 653-8053	Master Bond 154 Hobart St Hackensack NJ 07601 (201) 343-8983	P-O-P & Sign Design 7400 Skokie Blvd Skokie IL 60077 (708) 675-7400	Stephens Products 128 N Park Street E Orange NJ 07017 (201) 672-2140
Associated Bag Co 400 W Boden St Milwaukee WI 53207 (800) 926-6100	Delvies Plastics 133 W Haven Ave Salt Lake City UT 84165 (800) 533-5843	Garden Fresh Replicas PO Box 208 Neosho MO 64850 (800) 545-7304	Model Railroader 21027 Crossroads Cir Waukesha WI 53187 (414) 796-8776	Rogers 5750 E McKellins Road Mesa AZ 85205 (602) 830-3370	Stratasy 14950 Martin Dr Eden Prairie MN 55344 (612) 937-3000
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Caplugs 2150 Elmwood Ave Buffalo NY 14207 (716) 876-9855	Devcon 30 Endicott St Danvers MA 01923 (508) 777-1100	Haygean Machine 2225 S 170th St New Berlin WI 53151 (414) 797-7520	Morgan Industries 3311 E 59th Street Long Beach CA 90805 (800) 222-6929	School Shop Box 8623 Ann Arbor MI 48107 (313) 769-1211	3D Systems 26081 Ave Hall Valencia CA 91355 (805) 295-5600
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My Glue Gun Trick

There's one ultra-cheap alternative to injection molding that I sometimes use. Yeah, this one is crude, slow, and produces rather wimpy products. But the cost is nearly zero. You simply use polyethylene rods in a glue gun!

Squirted into any cavity, you can build up a solid and reasonably useful plastic part. This stunt is particularly handy to build up oddball connectors. Just find some mating pins and plug them into the connector to be fit. Then polyglop them. For extra strength and a better final appearance, you can coat everything with epoxy.

At one time, many larger glue gun suppliers did stock the polyethylene rods. Sadly, these are unlikely to be available at your hardware store. *Ain* has them at twenty cents a foot.

Vacuum Forming

A low cost and sometimes alternate to injection molding is called *vacuum forming*. In which you lay a thin sheet of plastic on a form, heat it, and then suck it down onto the surface. Zillions of tiny holes in the form are routed to a vacuum pump. Vacuum forming is

often used for larger size signs.

Again, vacuum forming machines are stocked by both *Iasco* and *Delvies*. Another school-shop oriented supplier is *Pitsco*. They also resell rotational molders and blow molders.

These are not at all that expensive. And it is possible to build your own.

One superb resource for all sorts of books involving do-it-yourself home machinery is *Lindsay Publications*. One of their hundreds of titles is *How to Cast Small Metal and Rubber Parts*.

Rigid Vinyl

What is the cheapest sheet plastic you can get? Often it is a variation on PVC known as *rigid vinyl*. This one is the standard plastic used for interior signs and advertising displays. Prices start at fifty cents per square foot.

Lots of colors and textures.

You can cut this using any simple Plexiglass scoring tool. It heat forms and bends easily. This bonds just fine using superglue or model cements. I have used it for custom dials.

Ain is one source. Others advertise in normal trade resources—*POP* and *Sign Design*, *Signcraft*, and in the *Sign Business* magazines.

Special Effects

One little known resource for many types of highly useful plastics in small quantities is the movie *special effects* industry. All the folks that create the movie magic. While some of this info appears in *Film and Video*, the leading top secret insider pub is *Cinefex*.

Two suppliers here include *Polytek* and *Special Effects Supply*.

A listing of dozens of other special effects resources is in HACK72.PDF.

Santa Claus Machines

Well, that's what the science fiction folks call them. Replication machines that, on software command, can make a copy of anything for you. Roast beef sandwich, a new girlfriend, hundred dollar bill, you name it.

Surprisingly, these devices *do* exist today. But the roast beef sandwiches, while low in calories and fat free, do leave a distinctly acrylic aftertaste.

These also go by the names of *rapid prototyping machines*. In which plastic or metal parts get built up by several processes. Such as selective hardening of a photopolymer, sintering of some powder, extruding some sticky string,

injection of a binder, or cutting of a gasket-like layer. Three leaders here are *3-D Systems*, *DTM* and *Stratsys*.

While Santa Claus machines remain rather expensive (a house and two cars), It should be possible to build a crude version up yourself for \$200 or so. Such as adding X-Y movement to a polyethylene loaded glue gun to make house letters or whatever.

More on Santa Claus machines is found in HACK01.PDF, HACK36.PDF, in HACK40.PDF, HACK54.PDF, and in HACK77.PDF.

Random Stuff

A fine collection of glues, sealants, bonding agents, and casting plastics gets distributed by *Ellsworth*.

Two manufacturers include *Devcon* and *Master Bond*. Who also sells epoxy stripping chemicals.

Plastic sheets for printing and new desktop aps appear in *Paper, Film, and Foil Converter*, or *Converting*. *Catalina Plastics* sells printing mylar.

Stevens is one source for electronic and structural fiberglass items.

Decorative holographic, prismatic, and diffraction grated plastics sheets are manufactured by *Coburn*. Sources for poly shipping bags include *Ipac*, and *Associated Bag*.

One leading supplier for epoxy and fiberglass casting resins and such is *West Systems*. Free tech manuals.

That ordinary deeper red plexiglass makes an acceptable infrared filter for IR remotes. But *Rohm and Haas* has special opaque plexiglass sheets that are optimized for IR uses.

They have an *Infrared Transmittance of Opaque Plexiglas Colors* ap note. The 2711 "color" costs only a few cents per square inch.

Adhesives and Sealants Industry is a trade journal that really knows how to stick to their subjects.

Lots of photopolymer resources are reviewed in HACK66.PDF.

Silicon rubber and sealants are now made by *Dow Corning*. They've got a freebie *Solutions* newsletter. There are lots of plastics industry insider trade mags. Such as *Modern Plastics*.

The leading source of plastic caps, protectors, and coverings is *Caplugs*.

Free sample pacs on request.

Plastic cases and enclosures did get reviewed in NUTS15.PDF on my www.tinaja.com. This one is also available in my *Resource Bin* book.

The premium printed circuit plastic is G-10 fiberglass. But more economic FR-4 variants are available. These use

fewer glass layers with more plastic. Ultra-cheapo high volume consumer aps still stick with brittle phenolic.

Kepro is a good supplier for all of these materials in smaller quantities. The higher frequency materials get sold by *Rogers*. *Circuits Manufacturing* is a typical trade journal.

Plastic Grecian urns are offered by *Outwater Plastics*. Who carry scads of other goodies from store fixture clips on up to architectural columns.

Plastic Gargoyles are created by the *Design Toscano* folks.

Vinyls suitable for cut lettering are available from *Gerber*. *Struhl* has *static cling vinyls*. They all stick to windows without using any glue.

A plastic synthetic kale is available from *Garden Fresh Products*. For 100% authenticity they do use real powdered kale as a filler.

I sure sleep better at night knowing that there are those of you out there who have dedicated your lives to the perfection of synthetic kale.

This Month's Contests

For our contest this month, just tell me about any plastics resource I don't already know about. Or tell me about the oddest thing you have ever done with a glue gun. Best of all, find me a new use for synthetic kale.

There will be a largish pile of my new *Incredible Secret Money Machine II* books going to the dozen or so better entries, plus an all-expense-paid (FOB Thatcher, AZ) *tinaja quest* for two that will go to the very best of all.

Send all your *written* entries to me here at *Synergetics*, rather than to *Nuts & Volts* editorial.

Let's hear from you. ♦

Microcomputer pioneer and guru Don Lancaster is the author of 33 books and countless tech articles. Don maintains his no-charge US tech helpline found at (520) 428-4073, besides offering all of his own books, reprints, and consulting services. Don also has two free catalogs full of his resource secrets waiting for you. Your best calling times are 8-5 on weekdays, Mountain Standard Time.

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