

HARDWARE HACKER

More on toner-cartridge reloading and Santa Claus machines, and some VHF and Microwave resources.

DON LANCASTER

Every now and then, it seems a good idea to go back over some of our older *Hardware Hacker* subjects and bring them up to date. Certainly one of the most popular topics ever found on our helpline involves...

Toner cartridge reloading

PostScript and other laser printers are fast becoming a major industry. There are many millions of units now in use. By far the best and the most popular versions use several styles of laser engines made by *Canon*. These engines were originally intended to accept a throwaway plug-in cartridge. Inside the cartridge is a source of toner, a photosensitive drum, and a spent-toner holding tank.

Played according to the rules, you buy these cartridges for \$120, use them for 4000 copies, and end up with a per-page toner cost of three cents.

As we have seen before, you can easily reload these cartridges yourself dozens of times. Today, you can do so in two minutes for a cost of \$6.50 or less, and can easily reduce your per-page toner costs to 0.2 cents per page, a whopping 15:1 cost improvement.

Besides saving big bucks on your own printer, you could also resell recharged cartridges for as much as \$15 or even \$19 each, as part of an ongoing neighborhood service.

There's lots of exciting new things happening in the toner recharging industry, so I thought we might pick up some fundamentals and then bring you up to date on the newest and the best insider secrets.

What is toner? Well, it is a mixture of (usually) black stuff and hot glue. Specifically, toner is a fine powder which has very precisely controlled magnetic, electrostatic, thermal, and visual properties. Most toners are basically a mixture of ferric oxides, polyethylene, and lubricants.

Toner starts out in the cartridge's

fresh toner tank. A magnetized roller then picks up a very uniform layer of toner. Meanwhile, a nearby photosensitive drum gets flooded with light and then electrostatically charged. It next gets selectively discharged by a laser beam, leaving a charge pattern on the drum. As the drum rotates, it passes very near the magnetic roller and the toner selectively jumps onto the drum, sticking by electrostatic forces only where you want an image.

As your drum rotates further, it passes very close to a highly charged piece of paper, and the toner particles then jump onto the paper. Any remaining toner that was left on the drum gets scraped off and routed to a *spent-toner holding tank*. The photosensitive drum then continues on its way for another cycle.

Meanwhile, you now have your image on the paper. But it is only held there by gravity and by rather weak electrostatic forces. It will easily smear if you touch it. The paper then goes on to a *fusion roller* assembly. Heat and pressure will melt the toner and force it into the paper, giving you a fairly durable final hard copy.

One very important part of most fuser assemblies is the *wiper pad*. The wiper pad has a small amount of silicon oil on it that both lubricates and cleans up any remaining toner on the pressure rollers. Wiper pads are usually replaced whenever a cartridge is recharged. Note that just washing a wiper pad is a no-no.

Our first rule: Toners vary from machine to machine. Most *Canon* laser

printers use what is known as a *black write* system, since laser diodes will last much longer this way. On the other hand, all but the newest and most expensive copiers use a *white write* system so that light ends up as white and dark as black.

Thus: *Copier and Laser-Printing toners must NEVER be interchanged or substituted for each other!* There are usually mechanical interlocks that prevent you from plugging a copier cartridge into a laser printer and vice versa. If you attempt to defeat those interlocks, you will end up using the wrong toner. At the very least, that gives you useless copies, and at worst, it can cause serious damage.

Similarly, toner chemistry varies from printer to printer, especially between manufacturers. Our second rule: *The refill toner you use must be pretested in and rated for the exact cartridge you are refilling.*

So where do you get refill toner and the wiper pads? My two favorite sources are *Don Thompson* and *Lazer Products*. There is also one outfit called *Black Lightning* that stocks specialty toners for T-shirt and fabric printing uses.

The toner industry has its own trade journal. It is called *Recharger*, and is chock full of supplier ads and useful industry info. There are also at least a dozen recharging associations who do have lots of seminars and conventions. Details on those usually appear in *Recharger*.

The big news today in toner refilling involves new third-party hard coated drums. For some reason or another, the factory stock drums are made needlessly soft. The third-party drums instead are ultra-hard and can easily be used for dozens of reloads. One leading importer of hard drums is *CopyMate Products*.

Let's look at some specific refilling details. Certainly the most popular cartridges are those used in the *Canon CX, SX, and LX* engines. Figure 1 lists many popular laser printers

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Don Lancaster
Synergetics
Box 809
Thatcher, AZ 85552
(602) 428-4073

Don Thompson and The Printer Works.

Non-PostScript laser printers, of course, are an utterly useless ripoff, so be absolutely certain that your used machine can speak genuine Adobe PostScript.

Before we begin, note that the photosensitive drums must *never* be exposed to strong light, or to *any* light at all over any long period of time. Never get fingerprints on the drum. Cotton gloves are a good idea.

Toner is an ultra fine powder that can end up all over everything. It is sometimes best to work *outside*, possibly wearing a mask. Toner can, in theory, explode a vacuum cleaner, but that rarely will happen. But do be careful.

The general steps in refilling any cartridge are fivefold:

- (1) Remove and discard any waste toner from the spent toner holding tank. Do not reuse the spent toner.
- (2) Refill your fresh-toner supply tank with a new bottle.
- (3) Lubricate the drum with a light dusting of *Pixie Dust* (see below).
- (4) Replace the oiled wiper felt on the fusion assembly elsewhere in the printer.
- (5) Update accurate life and service records on a suitable label.

Figure 2 shows you those CX refilling details. There is really never any

HP MANUAL	HP PRINTER	APPLE PRINTER	QMS PRINTER
02686-90920 (CX Engine)	LaserJet I	LaserWriter LaserWriter Plus	PS800
33449-90906 (SX Engine)	LaserJet II LaserJet III	LaserWriter NT LaserWriter NTX	PS810 & Turbo PS820 & Turbo
33459-90906 (SX Engine)	LaserJet IID LaserJet IIID	----	----
33471-90904 (LX Engine)	LaserJet IIP	Personal LW NT	PS410

FIG. 1—HERE'S A LIST of all the most popular PostScript laser printers, their equivalent service manuals, and the style of toner cartridges they use.

and the specific engine used in each one. Figure 1 also reveals to you the outstanding *Hewlett-Packard* repair and service manuals involved. The manuals, and all major parts, can be had overnight via VISA/800.

For some reason which I simply cannot fathom, *Apple Computer* absolutely insists that you use the HP

service manuals to keep your Apple LaserWriter printers alive. As near as I can tell, this is some sort of a top-secret rebate policy.

At any rate, you can recognize the older CX cartridges by their large three-inch drums, their red-yellow-green end dial, and their obvious lunchbox handle. While the original LaserWriter and all similar printers using them are rather dated, they do remain useful, especially when printing lots of heavier stock. Many used bargains are now cropping up involving these machines. Two sources are

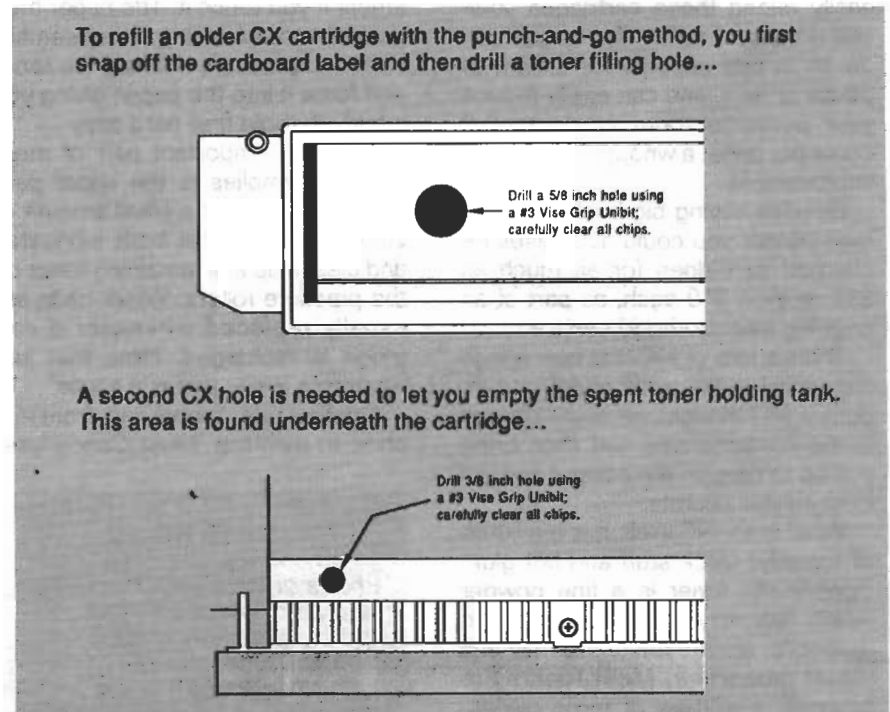


FIG. 2—THE CX CARTRIDGE is easily recognized by its large drum and its obvious "lunchbox" handle. Here are my "punch-and-go" refilling secrets.

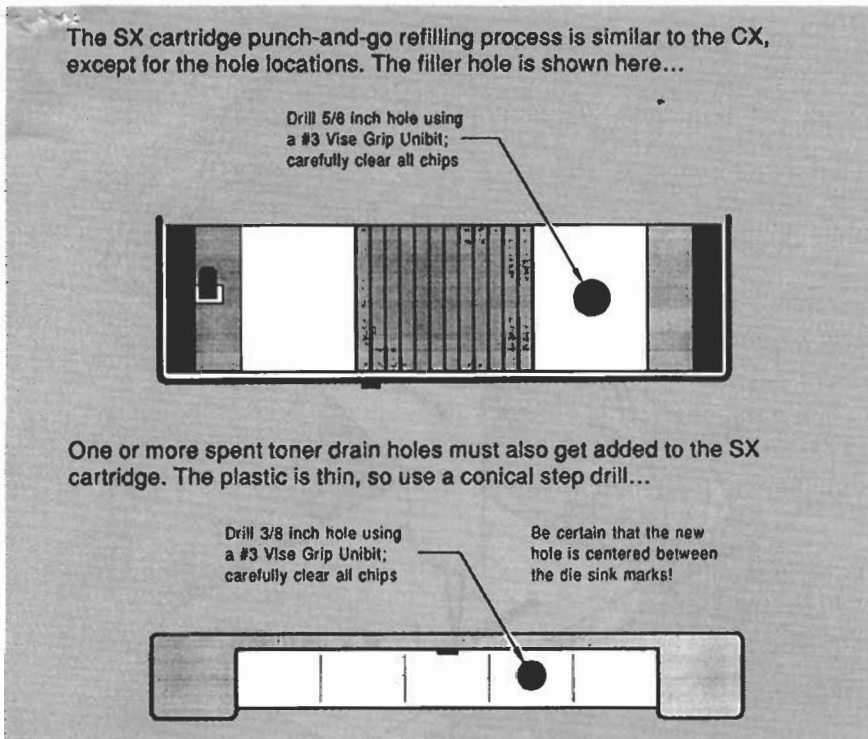


FIG. 3—THE SX CARTRIDGE is wider than it is high, has a small drum, and is the most popular cartridge for the larger 8-PPM PostScript laser printers.

reason to tear down a CX cartridge, except to substitute a hard drum. The original factory drums are big enough that you can often get four or five refills as is. For most people most of the time, a total teardown will cause many more problems than it will solve. Remember that your ultimate goal should be minimizing all of your per-page toner costs, not maximizing the number of recharges for each drum. An extra recharge is pointless if it costs the end user more per page to do so.

If you absolutely have your heart set on taking a CX cartridge apart, you'll need two special tools. One is a special tamperproof *Torx* bit. This is *EVCO* part number #945B700 and is available from *Jensen Tools* as well as most refilling supply houses. The second is a special pin-pulling tool called a *CX Glompenstractor* and available once again through *Don Thompson*.

Should you use my *punch and go* method, you will have to drill two holes in the cartridge on your first reload. That is best done using a rather unusual step-drill called a #3 *Vise Grip Unibit*. They are available from *Jensen Tools* or from any larger electrical contracting supply house. When used with a variable-speed hand drill, the Unibit cleanly cuts a perfectly round hole in brittle plastic,

while producing a single and easily grabbed chip.

After drilling the holes, the spent toner is shaken or vacuumed out. You can reseal the hole with plain old Scotch Tape (be VERY careful to get a secure seal!), or else use a nickel *Caplug*. Your fresh-toner hole is sim-

ilarly used to accept a bottle of new toner and then resealed.

Figure 3 shows you the SX cartridge recharging. The LaserWriter NTX is a typical machine that uses this cartridge. The SX cartridges have a one-inch drum and are rather flat looking, being much wider than thick. Should you decide to tear down the cartridge or upgrade to a hard drum, a different glompenstractor is needed having a narrower snout.

The details of my punch-and-go refill method remain pretty much the same. First time around, you drill a suitable filling and emptying hole. Once again, the #3 *Vise-Grip Unibit* in a variable-speed hand drill is ideal for this. To refill, drain and discard the spent toner and reseal. Then fill the fresh toner tank and reseal.

Figure 4 shows you the newest LX cartridge recharging. The newest personal laser printers, such as the *QMS PS-410*, use this cartridge. The LX cartridge is recognized by its small size, an obvious spring, and its "white trim" gears and bearings.

No holes are required. To access the tank, pull the two pins by using *ChannelLock #357* end pliers. The tank can then be refilled through the existing *Caplug*. To change the drum or drain the spent toner, remove the four *Phillips* screws on those nylon drum bearings and pull the drum.

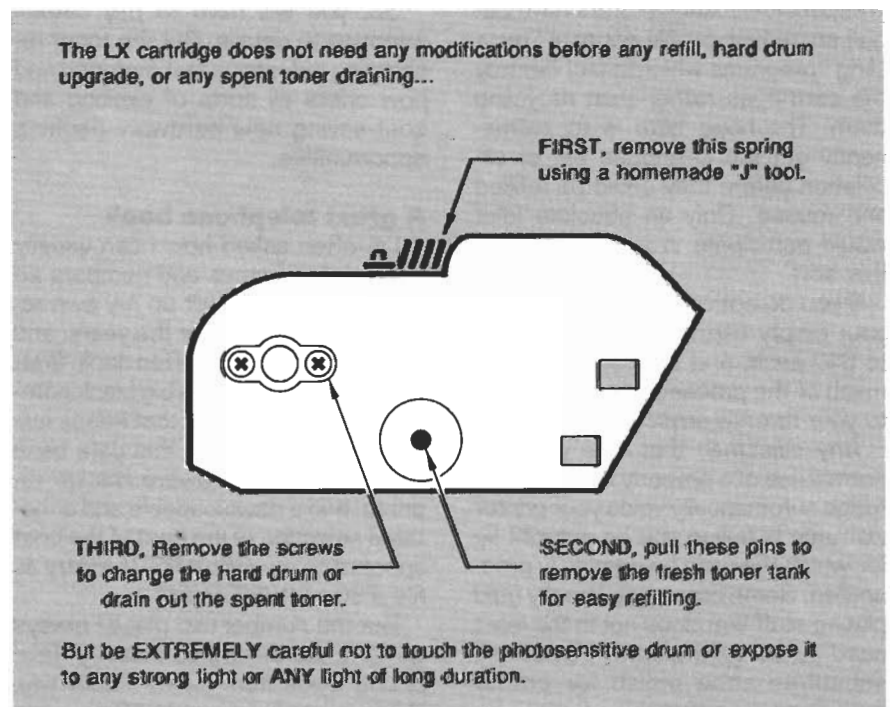


FIG. 4—THE SMALLER LX CARTRIDGE is used in the "personal" 4-PPM printers and is easily spotted by its obvious spring and the "white trim." NEVER use copier toner in a laser printer.

Spent toner can be simply vacuumed or shaken out.

After a recharge, it's a good idea to very *lightly* dust any drum with a suitable lubricant. Many of them are based on plain old zinc stearate. Only don't substitute baby powder since the perfume and oils will do you in. The usual name here is *Pixie Dust*. Pixie dust is available through most recharging supply houses at very low cost. You can make a "duster" from the toe of a child's athletic sock and a rubber band.

Once again, the wiper pad on the fusion assembly should get replaced every time you change the cartridge. You normally keep the old wiper wand and drop a new peel-and-stick oiled nomex felt strip in place.

While you can obtain toner-tank re-sealing strips, travel of any kind is extremely rough on toner cartridges. I do not recommend ever moving a cartridge further than you can gently and personally hand carry it. Nor do I recommend ever swapping your own cartridges for unknown outsiders. I strictly limit my personal recycling service to a six-mile radius. Yours also should be.

Reuse of toner removed from spent-toner holding tanks is not in the least recommended, nor is recycling your own wiper pads.

There does remain plenty of "zoo" aspects to toner recycling. Certain irresponsible manufacturers have begun some high-profile national "recycling" programs which in fact destroy the cartridges rather than recycling them. The hope here is to permanently get the cartridges out of circulation before they could be refilled and reused. Only an absolute idiot would participate in any program of this sort.

If you do nothing else, you can sell your empty cartridges locally for \$5 to \$10 each, and then contribute as much of the proceeds as you care to to your favorite environmental group.

Any salesman that tells you that normal use of a properly recycled cartridge automatically voids your printer warranty is telling you an outright lie for which they can be criminally prosecuted. Some others are literally gold plating stuff that does not in the least need to be gold plated. Yet others substitute shoe polish for proper hard-drum recoating.

Those recharge/repair schools run the gamut from outstanding high-

quality bargains down to outright ripoffs. To tell one from another, ask the school for a list of all previous students in your area. Then call one or two of them.

So, you will have to pay careful attention to details. But the toner recharging industry is fast maturing and now offers all sorts of exciting and cost-saving new hardware-hacking opportunities.

NAMES AND NUMBERS

Anderson Power Products

145 Newton Street
Boston, MA 02135
(617) 787-5880
CIRCLE 301 ON FREE INFORMATION CARD

Black Lightning

RR 1-87 Depot Road
Hartland, VT 05048
(800) BLACK99
CIRCLE 302 ON FREE INFORMATION CARD

Caplug

2150 Elmwood Avenue
Buffalo, NY 14207
(716) 876-9855
CIRCLE 303 ON FREE INFORMATION CARD

CopyMate Products

20F Robert Pitt Drive
Monsey, NY 10952
(800) 457-0074
CIRCLE 304 ON FREE INFORMATION CARD

Cory Laboratories

Box 261, 823 5th Street
Menominee, MI 49858
(906) 863-9336
CIRCLE 305 ON FREE INFORMATION CARD

Crystek

2351/2371 Crystal Drive
Ft Myers, FL 33907
(813) 936-2109
CIRCLE 306 ON FREE INFORMATION CARD

EVCO

PO Box 36339
Birmingham, AL 35236
(205) 822-5381
CIRCLE 307 ON FREE INFORMATION CARD

GEnie

401 North Washington Street
Rockville, MD 20850
(800) 638-9636
CIRCLE 308 ON FREE INFORMATION CARD

Harris Publishing/EITD

2057-2 Aurora Road
Twinsburg, OH 44087
(216) 425-9000
CIRCLE 309 ON FREE INFORMATION CARD

Hewlett-Packard/Manuals

19310 Pruneridge Avenue
Cupertino, CA 94014
(800) 752-0900
CIRCLE 310 ON FREE INFORMATION CARD

Lazer Products

12741 E Caley Avenue #130
Englewood, CO 80155
(303) 792-5277
CIRCLE 311 ON FREE INFORMATION CARD

LSI Logic

1551 McCarthy Blvd
Milpitas, CA 95035
(408) 433-8000
CIRCLE 312 ON FREE INFORMATION CARD

Maxim

120 San Gabriel Drive
Sunnyvale, CA 94086
(408) 737-7600
CIRCLE 313 ON FREE INFORMATION CARD

National Sandblast

4421 Prospect NE
Albuquerque, NM 87110
(505) 883-1151
CIRCLE 314 ON FREE INFORMATION CARD

Printer Works

3431 Arden Road
Hayward, CA 94545
(800) 235-6116
CIRCLE 315 ON FREE INFORMATION CARD

Recharger

3870 La Sierra Avenue S266
Riverside, CA 92505
(714) 359-8570
CIRCLE 316 ON FREE INFORMATION CARD

Rohm

8 Whatney
Irvine, CA 92718
(714) 855-2131
CIRCLE 317 ON FREE INFORMATION CARD

Rotary Flight International

5555 Zuni SE, Ste 281
Albuquerque, NM 87108
(505) 298-9362
CIRCLE 318 ON FREE INFORMATION CARD

Sony Semiconductor

10833 Valley View Street
Cypress, CA 90630
(714) 229-4195
CIRCLE 319 ON FREE INFORMATION CARD

Statek

512 N Main Street
Orange, CA 92668
(714) 639-7810
CIRCLE 320 ON FREE INFORMATION CARD

Stratasys

7411 Washington Avenue S
Minneapolis, MN 55439
(612) 941-5607
CIRCLE 321 ON FREE INFORMATION CARD

Don Thompson

23072 Lake Center Drive #100
El Toro, CA 92630
(714) 855-3838
CIRCLE 322 ON FREE INFORMATION CARD