

# THIS MONTH, from the TECH FILES of Liberty Parts Team...

## HP Toner Sensing

Because an adequate supply of toner is essential for proper operation of a laser printer, all printers contain mechanisms for monitoring toner usage and alerting the user when the supply runs low. In this article, we will discuss monitoring methods used by HP and the pros and cons of each. We will also make a case against over-reliance on the graphic toner gauge that some printers display on their test prints.

HP has used three basic methods of tracking toner usage:

1. Electromagnetic toner sensing: The AC bias voltage applied to the developing cylinder produces an electromagnetic field in the toner particles. The strength of this field is proportional to the amount of toner inside the cartridge. The cartridge has an internal antenna that detects the field, and the printer monitors the signal from the antenna. When it gets below a certain level, the printer knows that the toner is getting low. This method is quite accurate, as long as the sensing circuit is properly calibrated, but it only works with magnetic toner, and since most color toners are wax-based, electromagnetic toner sensing is used primarily on monochrome printers.

2. Optical toner sensing: The cartridge has a double-ended "light pipe", and the printer has an optical emitter at one end of the pipe and an optical receiver at the other end. The normal toner-stirring action will alternately block and unblock the light pipe, so that light



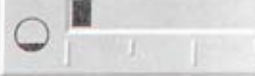
Memory Tag on an aftermarket 4200 toner cartridge

can or can not get through to the receiver. The more toner is present in the cartridge, the more often the light pipe will be blocked. When it is unblocked (i.e., the optical receiver detects light) a high percentage of the time, the printer concludes that toner is low. When it is unblocked all the time, the printer concludes that toner is out. Since this method works equally well for magnetic and non-magnetic toner, it is used in most color printers.

3. Page counts: Toner cartridges are rated to print a certain number of pages at a nominal coverage of 5 percent (meaning that the page is 5 percent toner and 95 percent white space). This takes into account the amount of toner in the cartridge as well as wear and tear on the mechanical components. So the printer can also estimate the remaining life of the cartridge by keeping track of how many pages have been printed with it (this will be more or less accurate, depending on how far the print jobs stray from the nominal 5 percent

### Cartridge Information

#### HP Black Cartridge Gauge



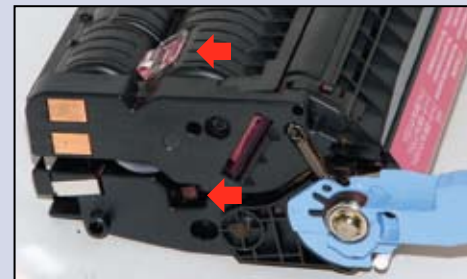
coverage). Color printers usually also keep track of the number of developer and/or drum rotations, as this can differ from the number of pages printed. As with method 2, this works on all types of cartridges. However, because it is an estimate, it tends to be less accurate than methods 1 and 2, both of which more directly measure the actual amount of toner remaining.

Most printers use some combination of the three methods. Newer models incorporate a memory tag or E-label – a nonvolatile (permanent) memory chip in the toner cartridge that stores data collected by the various methods of toner sensing. The chip is also used to identify whether or not the cartridge is a genuine HP cartridge. Non-HP cartridges will generally still work in the printer, but the accuracy of the "toner life remaining" function may be compromised.

The printers have several ways of alerting the user when the toner is running low. The most useful and reliable of these is via the display (which may be just lights on some models). The printer will display "toner low" message when about 15 percent of capacity remains. At this point you should order a new toner cartridge, so that you have one when the next stage is reached – a "toner out" message, after which many printers will not allow you to print until a new cartridge is installed. Since this message can be triggered either by toner levels or by page counts or rotation counts, you may or may not notice a degradation of print quality.

In addition to "toner low" and "toner out" messages, many newer printers also have a "toner gauge", which appears either on the configuration page or the supply status page. This shows the approximate remaining toner life in both graphic and numerical form. While it provides an easy way to estimate toner life at a glance, we have to caution against over-reliance on this gauge. It can be inaccurate at times, for various reasons.

• The printer checks the toner level and resets the



"Light Pipe" on LaserJet 4600 toner cartridge

gauge only at certain times. In particular, some printers do not automatically reset the gauge when a different cartridge is used. The user may be prompted for this information, or he may have to go into a menu and select "New Cartridge = Yes."

• Early in the life of the cartridge, the gauge is based mostly on page counts, which can be inherently inaccurate, particularly if your toner coverage is significantly different than 5 percent. Interestingly, the gauge becomes more accurate as the cartridge nears the end of its life, because the printer relies less on page counts and more on methods 1 and 2 (described earlier).

• Finally, you cannot always trust the gauge when using a non-HP cartridge, because of possible memory tag issues. HP even goes so far as to say that "smart cartridge features (cartridge out/low) are not available" with a non-HP cartridge.

Do not depend on the toner gauge for toner levels, especially with non-HP cartridges. If the printer display indicates "toner low," you need to order a new cartridge. Otherwise, you are probably OK, despite toner gauge indications to the contrary.

—Dennis Kosterman