

Whatdunnit? Diagnosing Image Defects in the HP LaserJet 5000

Colonel Mustard in the dining room with a candlestick ... Mrs. Peacock in the conservatory with a knife ...

Okay, so image defects aren't the most dramatic of mysteries. Yet, given the numerous components of a laser printer and the many factors that contribute to image defects, technicians must play the role of detective when a printer fails to consistently produce clean, flawless output.

We're responsible for identifying the source of black lines, dropouts, faded or light print, loose or smeared toner,

and other nuances. Although laser printers share a common infrastructure, there are slight differences among models. Thus, this article applies to the HP LaserJet 5000 series only.

Tracing the source of an image defect requires some detective work. Let's begin with how images transfer to a page. See Figure 1. This process involves six stages, four of which take place inside the toner cartridge. See Figure 2.

- 1) Cleaning. See Figure 3.
- 2) Conditioning. See Figure 4.

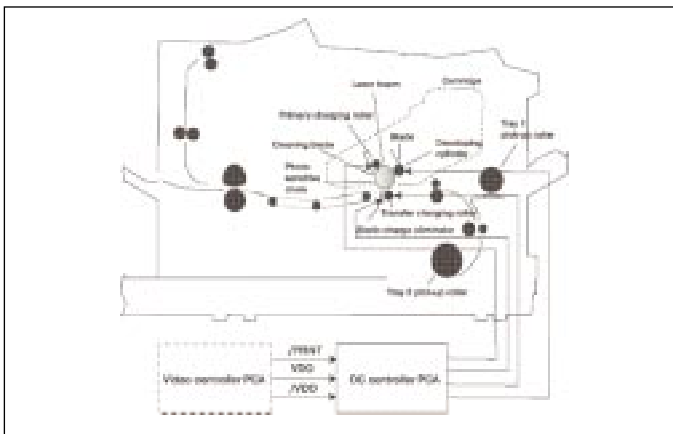


Figure 1

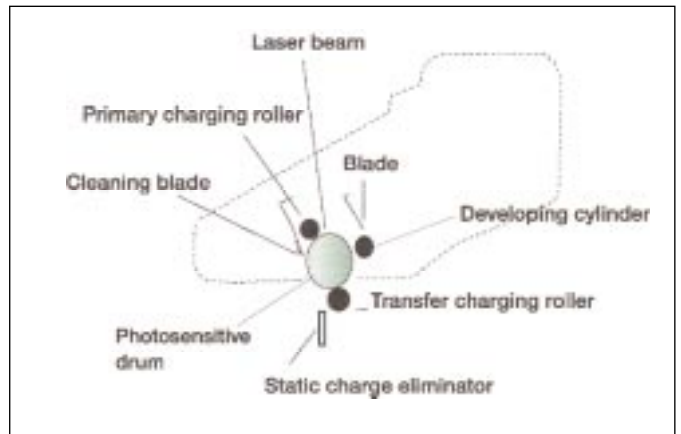


Figure 2

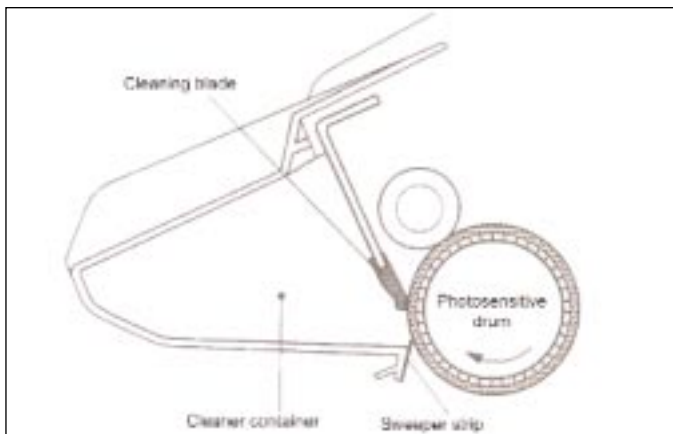


Figure 3

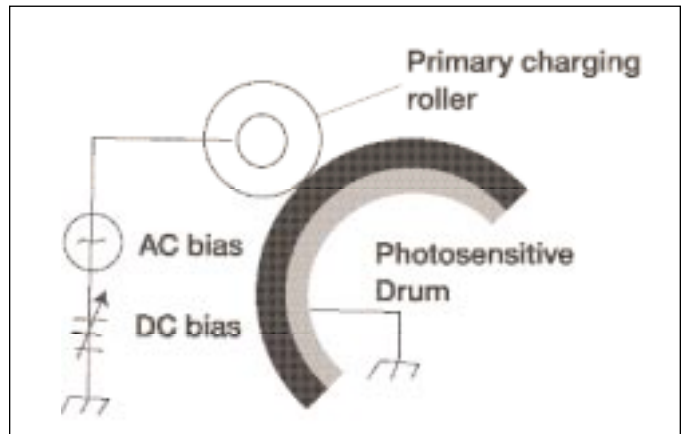


Figure 4

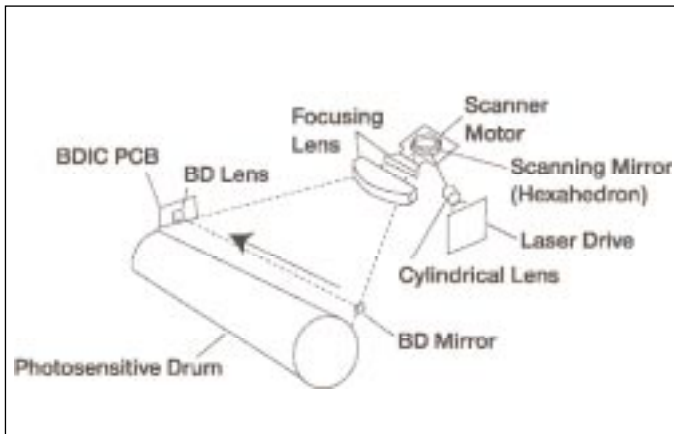


Figure 5

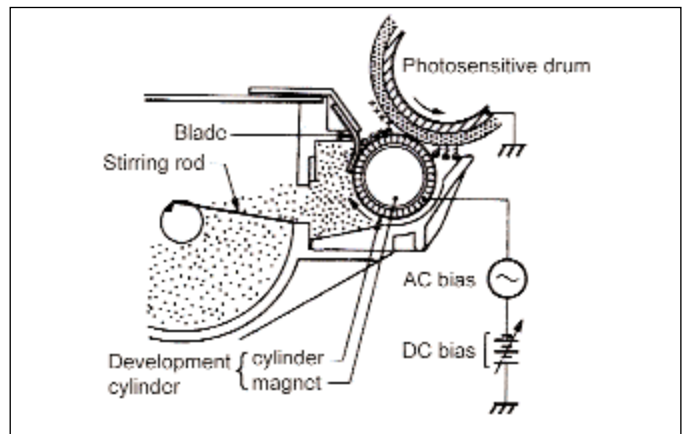


Figure 6

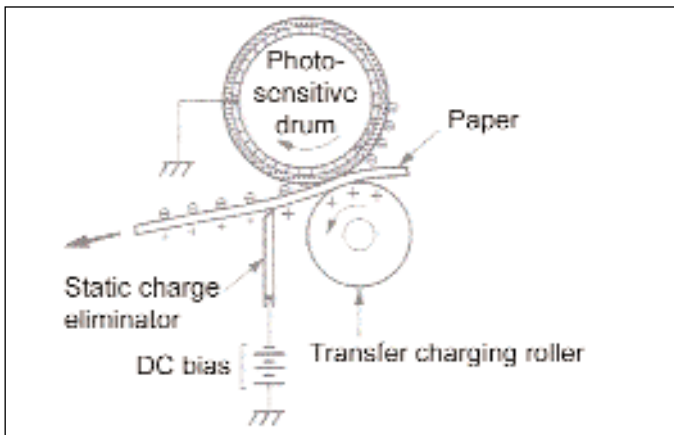


Figure 7

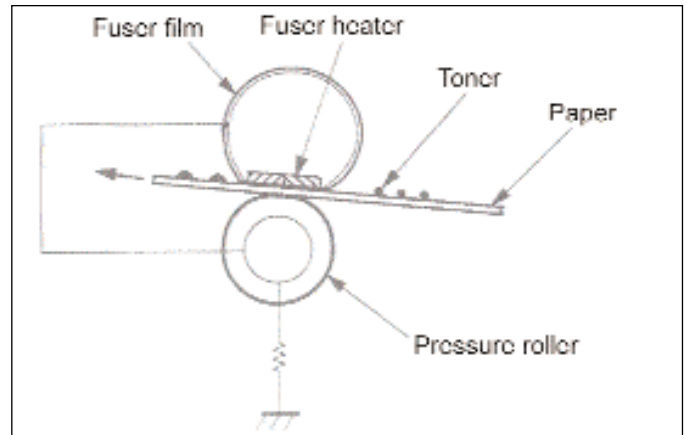


Figure 8

- 3) Writing. See Figure 5.
- 4) Developing. See Figure 6.
- 5) Transferring. See Figure 7.
- 6) Fusing. See Figure 8.

The process begins when the formatter board sends a signal to the DC controller, which drives the main motor. The main motor rotates the toner cartridge, which contains the primary charging roller, photosensitive drum, developing cylinder and transfer-charging roller.

Next, the primary charging roller places a negative charge on the surface of the photosensitive drum. This charge sparks the scanner's laser to form a latent image on the photosensitive drum. The toner, located in the developing cylinder, is responsible for developing the latent image into a visual image. Once this image is formed, the transfer charging roller creates a positive

charge that attracts the toner to the paper. Last, the fuser deploys heat and pressure to fuse the images to the paper.

Suspect Number One: The Toner Cartridge

When images go awry, most end users suspect the toner cartridge. All offices have at least one person who claims to know exactly how to fix the latest snafu. This fearless user isn't afraid to yank open the printer's cover, jimmy the cartridge out of its seat and shake it until more damage is caused from improper handling.

Suspecting the toner cartridge is a smart move. The cartridge houses four of the six processes needed for image formation, so it should not be a surprise that it causes the majority of image defects. Before determining that the toner cartridge should be retired or sent back to its manufacturer, however, it's crucial to check other factors, specifically those involving human error:

1) Is the cartridge properly seated in the printer? Misalignment shifts toner and causes wavy pages.

2) Is the cartridge leaking? Check all seals.

3) Is the photosensitive drum damaged or scratched? Do not touch the drum, as you may contaminate the photosensitive surface.

Other Suspects, a.k.a. Secondary Suspects:

- Defective engine controller board.
- Defective DC controller.
- Defective or insufficient power supply.
- Faulty scanner.
- Adverse environmental conditions, e.g., temperature and debris.

Image Defects: the Innocent Victims

Distorted images are often misdiagnosed as fuser failure. However, the fuser is only responsible for fusing the images to the paper. As discussed earlier, the image is already formed as a latent, hidden image before the fuser enters the scene. The distorted images are more likely caused by a defective DC controller or scanner, or print media such as paper envelopes and transparencies.

Black pages are exactly what they sound like. This problem can often be traced to the toner cartridge. However, if you determine that your toner cartridge is not the culprit, then try examining the contact springs, power supply, charging roller, scanner and controller. Check the connection between the DC controller and the scanner, as a loose cable could be your culprit. Also, look for missing or open top or side covers — light or debris could have entered the printer and altered the developing process.

Black horizontal lines are often indicative of leaking seals in the toner cartridge or a defective photosensitive drum. Check for scratches or debris on the fuser rollers and for defective or dirty static eliminator teeth.

A defective toner cartridge or one that is not properly installed often causes black vertical lines. If the defect consistently appears on the same areas of the page, refer to the Repetitive Defect Ruler. See Figure 9.

A few culprits, including low toner, a defective toner cartridge, dirty scanner lens, or a defective fuser or scanner can cause horizontal white lines.

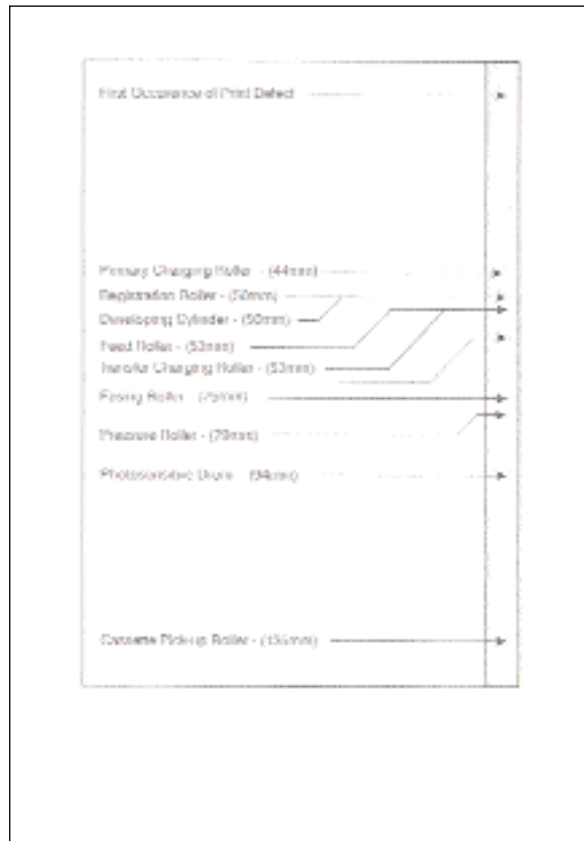


Figure 9

Toner bands on the photosensitive drum (see Figures 10 and 11) are often misdiagnosed as transfer roller failure. This is flawed logic, as the transfer roller never actually contacts the drum. More likely, toner bands are caused by a defective or leaking toner cartridge, a scratched or defective drum, dirt on the toner cartridge, or defective/dirty static eliminator teeth.

Using Diagnostic Tests to Isolate Image Defects

The “Repetitive Defect Ruler” is an effective tool for diagnosing and isolating the source of repetitive image defects. Simply obtain a defective print sample and align the first occurrence of the defect with the top of the ruler. Then, measure the space to

the next defect. This will determine which roller is causing the defect.

The “Half Self-Test Functional Check” helps determine which of the six image formation stages is causing the defect.

1) Print a configuration page from the printer’s control panel.


2) Open the top cover once the paper has advanced halfway through the printer. This occurs approximately five to six seconds after the main motor begins to rotate. The front edge of the paper should now be past the toner cartridge.

3) Remove the toner cartridge.

4) Finally, open the drum shield to view its surface. If you see a distinct toner image on the drum’s surface, then you can assume that the first four stages of the imaging process (cleaning, conditioning, writing and developing) are working efficiently. With four of the six suspects out of the picture, you can focus your troubleshooting efforts on transferring and fusing — the last two stages of the image formation process.

The “Drum Rotation Functional Test” determines if the printer’s photosensitive drum is properly rotating. This is an extremely important test. Check the seals for leakage and the drive gears for wear. The main drive gear drives the

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photosensitive drum, so the drum must rotate properly for the imaging process to work.

1) Open the cover and remove the toner cartridge. Mark the drive gear and record the location of the mark.

2) Reinstall the cartridge. The start-up sequence should rotate the drum and subsequently move the mark. If the mark does not move, then the drum did not rotate.

3) Inspect the main drive assembly to determine if it is aligned with the toner cartridge's gears. If the drive gears move and the drum does not turn, then the toner cartridge must be replaced.


Are We There Yet?

The time it takes to properly diagnose and isolate an image defect depends on the technician. That old cliché of experience being the best teacher applies here. Those with more experience in the field might isolate a defect in seconds and treat it in less than 20 minutes. A less-experienced technician might take longer to assess the problem and identify the source of the image

defect. Keep in mind that proper maintenance is always the best way to prevent image defects.

In conclusion, it is important for manufacturers to encourage the end users to keep their printers clean and in an environment that is not too cold or too humid. Until technology delivers flawless output, technicians will still punch their cards and look through their magnifying glasses to solve the mysteries of image defects. By pooling our strategies and working together to solve printing snafus, we can free up more time for solving the real mysteries of life, like whose chocolate fingerprint is on the paper feeder and are there any doughnuts with sprinkles left?

Bibliography

HP LaserJet 5000, 5000N, and 5000GN Printers Service Manual (C4110-91033). 

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