

Module 2– The Four-Color Laser Printing Process

Overview

This module describes how Color LaserWriter printers work. It assumes that you already know how black-and-white LaserWriter printers work. By the end of this module, you should be able to identify and describe the major components of a Color LaserWriter's image formation system and describe the differences between the image formation systems of color and black-and-white LaserWriter printers.

The Skills Checklist (next page) lists the skills you should be able to demonstrate by the end of this module.

Note: This module is designed to teach you the general theory of operations of Color LaserWriter printers. For more detailed descriptions of the workings of individual printer models, such as the Color LaserWriter 12/600 PS, see Service Source and Service Training courses for individual printers.

Equipment Needed

- Recommended: Color monitor set to 16 or more colors (to allow best use of animation referenced in this module), or grayscale monitor set to 16 or more grays.
- Paper and pencil (for exercises)

Skills Checklist

The Skills Checklist (below) lists the skills you should be able to demonstrate by the end of this module; if you think you can already demonstrate the skills, try the Exercises. If you pass the Exercises, you should be able to pass the portion of the course test that covers these skills. (The course test is found on this CD.)

Skill	Where Practiced
Identify the main parts of the color laser printer and the main steps in the four-color laser printing process	Exercise 1
Identify or define the functions of the following parts: <ul style="list-style-type: none">•Toner carousel•Toner cartridge•Photoconductor cartridge•Toner disposal box•Transfer drum•Transfer drum cleaning assembly•Attraction roller•Discharge roller•Separation claw•Separation discharge assembly•Fuser assembly	Exercise 2
Given a description of a printing problem, identify the probable cause.	Exercise 2
Describe the differences between the image formation systems of color and black-and-white LaserWriter printers.	Exercise 3

The Color LaserWriter Printer in Action

Outline

Although Color LaserWriter printers use a number of new parts and technologies, their print process is very similar to traditional black-and-white laser printing:

1. A laser scans the image of a page onto a photosensitive drum.
2. Electrostatic charge attracts toner to the scanned image on the photosensitive drum.
3. The toner image is transferred to the paper by a stronger electrostatic charge.

The main difference is that the Color LaserWriter performs this process four times, once for each color of toner. When all four color layers have been transferred to the paper, the paper is fed to the fuser rollers, which melt the toner into a permanent print.

Running the Print Process Animation

The Color LaserWriter print process is demonstrated in an animation you are about to see. For best results:

- Use the Monitors Control Panel to set your monitor to 16 or more colors.
- Make sure QuickTime is installed in your System folder (in the Extensions folder). QuickTime 2.0 or later (provided on this CD) is recommended, but QuickTime 1.6 is usable. (After you add QuickTime to your System folder, restart your computer.)
- MoviePlayer 1.0 or later (provided on this CD) must be installed on your hard disk.
- Do not resize the animation: Run it at full size.

Here's how to run the animation:

1. Click [here](#) to open the animation. (If you are reading this from printed copy, find the CLW Paper Path icon on the CD-ROM that contains this course, and double-click the icon to open the animation.)
2. For best results, don't use the "play" button () at the lower left corner of the "CLW Paper Path" window; instead, move the cursor over the single-step button () at the lower right corner, and hold down the mouse button to step through the movie. This will ensure that no frames are skipped, and the animation will look smoother.

As you view the animation, note that each frame is numbered in the lower right corner. We will refer to these frame numbers throughout this module.

When you have viewed the animation, leave it open on your computer as you continue reading: We will return to the animation many times in this module.

Refer to Figure 2-1 (next page) for the names of the parts you will see in the animation.

Note: You can move between Acrobat Reader (the application that displays this file) and MoviePlayer (the application that displays the animation) by using the Applications menu at the upper right corner of the Macintosh menu bar.

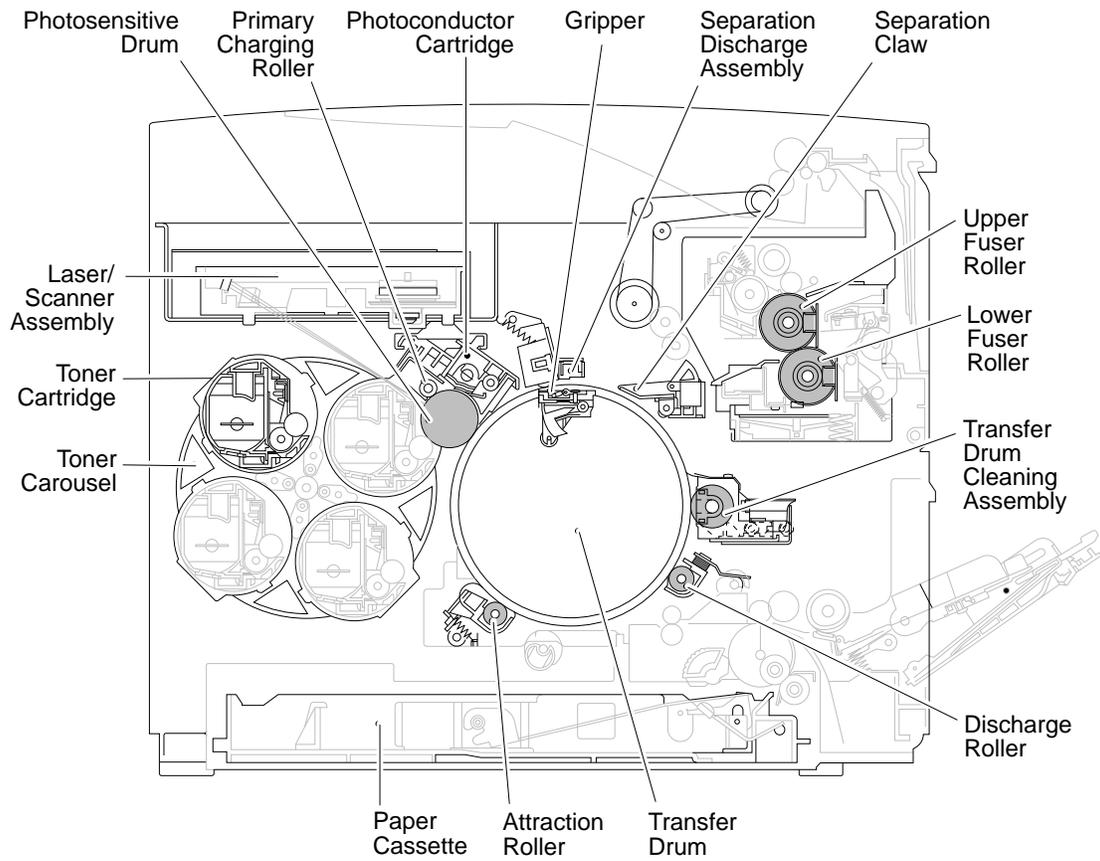


Figure 2-1: Color LaserWriter 12/600 PS

Print Process Overview

The following overview describes the Color LaserWriter print process that you have just watched. Frame numbers given below refer to frames in the animation. Go back to those frames as you read the descriptions.

The main **Differences** from the black-and-white (B/W) LaserWriter print process are pointed out after each step. (For charts comparing the components of the Color LaserWriter 12/600 PS with similar components in black-and-white LaserWriter printers, see the last section of this module.)

Note: Underlined items are important parts of the printer or important terms to be learned. Refer to Figure 2-1 (previous page) for the locations of underlined items.

Page Creation and Conversion

Before printing can take place, the data has to be received and prepared for printing:

1. Data from a computer is received and processed by the printer's I/O board. (Not shown.)
2. A dot-image of a page is constructed in the page buffer RAM of the I/O board. (Not shown.)
3. The page in the page buffer is sent to the laser/scanner assembly.

Difference: In color laser printing, the I/O board processes the data into color separations (or "layers") before sending it to the page buffer and the laser/scanner assembly. The first color layer (magenta) is sent to the page buffer, scanned onto the photosensitive drum, and transferred to the paper before the next layer (cyan) is sent to the page buffer.

Paper Feeding

While the first color separation is being sent to the laser/scanner assembly, the following processes are occurring in the paper feed path:

1. The paper is fed to the registration rollers (frames 1-19), which correct any skew.
2. The registration rollers advance the paper to the leading edge sensor (frames 38-39), where the paper is held until the gripper mechanism on the transfer drum has rotated far enough to accept it.
3. The paper advances (frames 51-53) to meet the gripper mechanism (frame 54), which grips the leading edge of the paper and holds the paper on the transfer drum until the end of the print cycle.

Difference: The transfer drum and the gripper are new parts, not present in B/W LaserWriter printers.

Note: Because the gripper holds the leading edge of the paper, the first 8 mm of the page cannot be printed on.

The Print Cycle

As you read this step-by-step description, bear in mind that many of these processes actually take place at the same time, or overlap each other during a given print cycle.

1. The laser scans each line of the first color layer (magenta) onto the photosensitive drum, creating a pattern of charges called the electrostatic latent image (frames 62-97).
2. The first toner cartridge (magenta) is pressed against the photosensitive drum (frames 57-105). Toner is attracted to the latent image, forming a visible image on the photosensitive drum. (This is called developing the latent image.)

Difference: The Color LaserWriter has four toner cartridges and a separate photoconductor cartridge, which holds the photosensitive drum; in the B/W LaserWriter, the toner and the photosensitive drum are both contained in the “toner cartridge.”

3. The rotating transfer drum carries the paper past the photosensitive drum (frames 72-102). The transfer drum's electrostatic charge attracts the magenta toner image from the photosensitive drum onto the paper and holds it there.
4. The photosensitive drum is cleaned and given a uniform charge to prepare it to receive the next latent image. (Not shown—actually, this cleaning and charging takes place continually during the imaging process.)

Difference: In the B/W LaserWriter, toner cleaned from the photosensitive drum is held inside the toner cartridge; in the Color LaserWriter, it is held in a separate toner disposal box (not shown; discussed later).

5. The toner carousel rotates (frames 107-111) to bring the next color toner cartridge (cyan) into contact with the photosensitive drum, and the latent image of the next color layer is developed and transferred to the paper (frames 116-151).

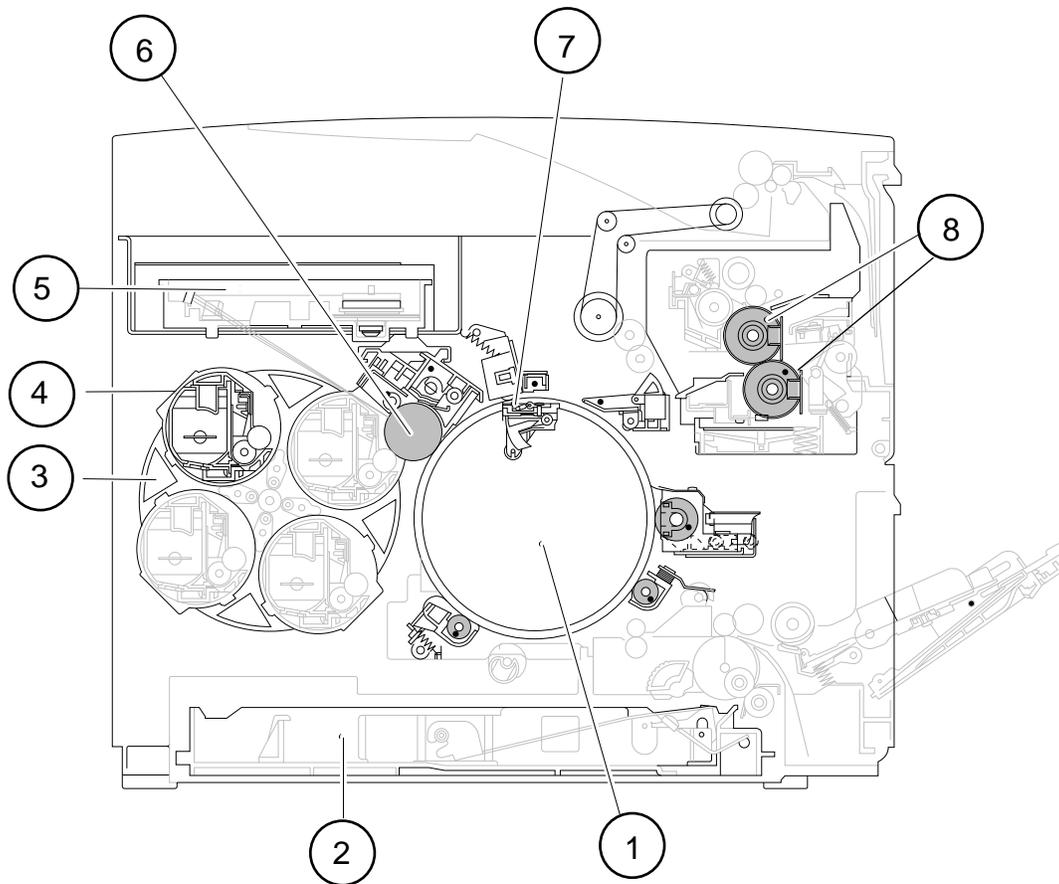
Note: The color layers are always printed in this order: Magenta, cyan, yellow, black.

6. After all four colors have been transferred to the paper, the paper is separated from the transfer drum (starting at frame 233) and fed into the fuser assembly.
Note: If there is only one color on the page—pure Magenta, Cyan, Yellow, or Black—only one pass is needed. The Color LaserWriter 12/600 PS printer can produce 12 pages per minute (ppm) when printing a single color. Four-color pages print at a maximum rate of 3 ppm.
7. The paper passes between the fuser rollers, which melt the toner into a permanent printed image (frames 245-274).

Exercise 1: The Color LaserWriter Print Process

Take a piece of paper and a pencil, and try to answer the following questions from memory. If you need help, refer to the animation you have just viewed, to Figure 2-1, or to the description of the color laser printing process that you have just read. The answers are given at the end of the exercise.

1. Label the parts of the printer pointed out on the following figure.



2. In the Color LaserWriter, the photosensitive drum is part of the
 - A. Photoconductor cartridge
 - B. Toner carousel
 - C. Toner cartridge
 - D. Transfer drum

3. The gripper is part of the
 - A. Laser/scanner assembly
 - B. Photoconductor cartridge
 - C. Photosensitive drum
 - D. Transfer drum

4. What is the sequence of colors in the color laser printing process?
 - A. Cyan, Magenta, Yellow, Black
 - B. Cyan, Yellow, Magenta, Black
 - C. Magenta, Cyan, Yellow, Black
 - D. Magenta, Yellow, Cyan, Black

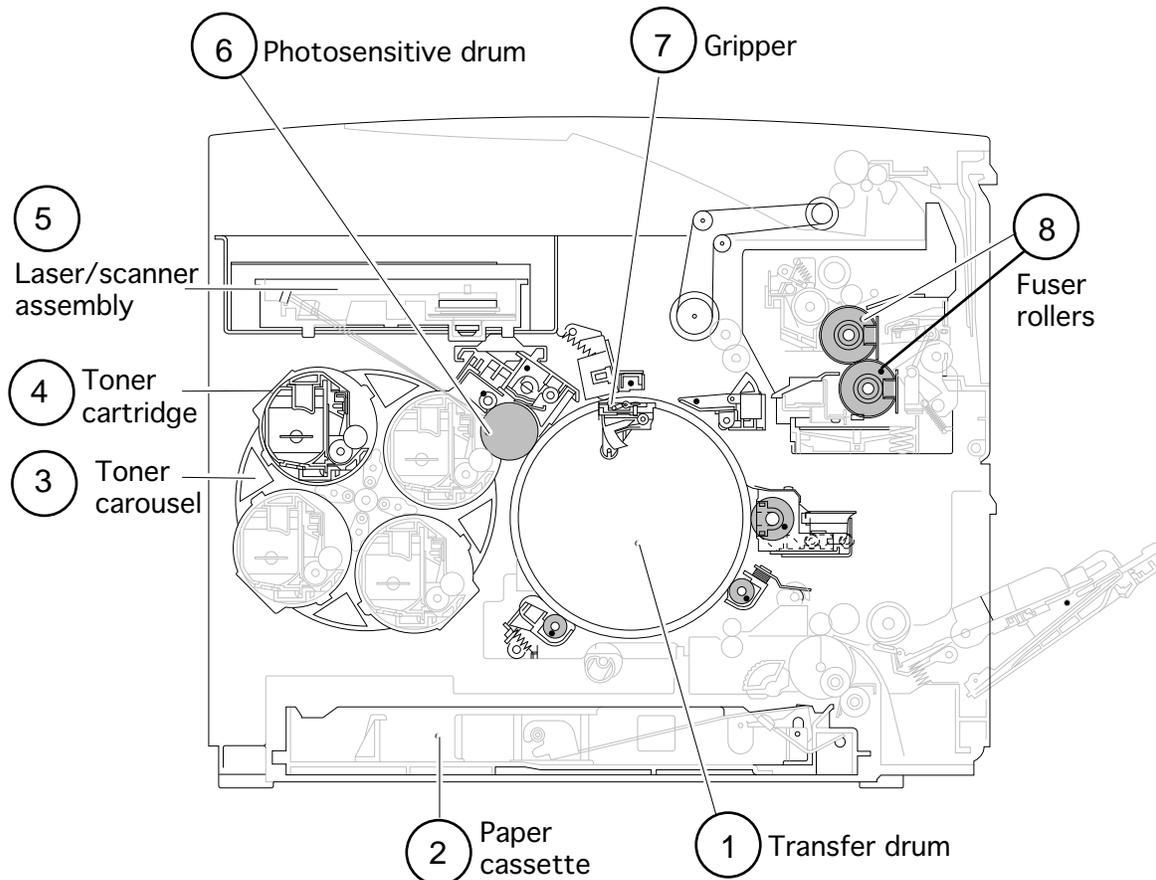
5. Which of the following parts carries the paper and provides the electrostatic charge that attracts toner to the paper?
 - A. Fuser rollers
 - B. Photoconductor cartridge
 - C. Photosensitive drum
 - D. Transfer drum

6. The laser/scanner assembly scans the electrostatic latent image onto the
 - A. Paper
 - B. Photosensitive drum
 - C. Toner cartridge
 - D. Transfer drum

7. The I/O board processes the color data into _____ before sending it to the page buffer and the laser/scanner assembly.
 - A. Color separations
 - B. ColorSync profiles
 - C. JPEG compressed images
 - D. Printer profiles

Answers to Exercise 1

1. The items in the figure are:



2. In the Color LaserWriter, the photosensitive drum is part of the
A. Photoconductor cartridge

Note: This is a difference from the B/W LaserWriter printer, where the photosensitive drum is part of the toner cartridge.

3. The gripper is part of the
D. Transfer drum
4. What is the sequence of colors in the color laser printing process?
C. Magenta, Cyan, Yellow, Black

5. Which of the following parts carries the paper and provides the electrostatic charge that attracts toner to the paper?
D. Transfer drum

6. The laser/scanner assembly scans the electrostatic latent image onto the
B. Photosensitive drum

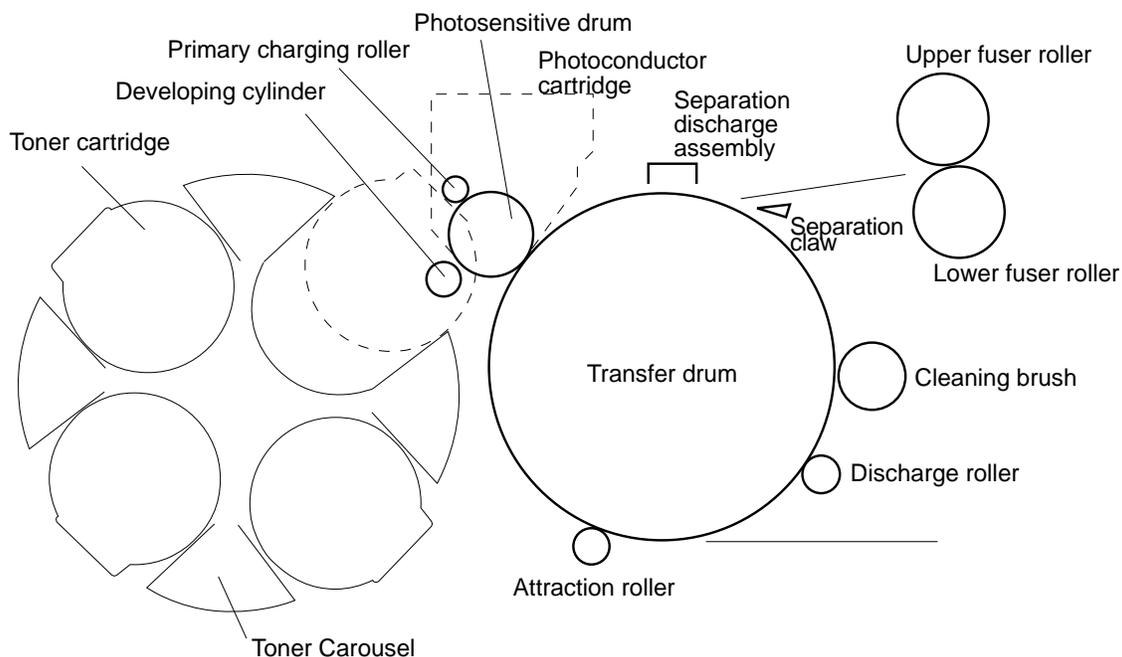
7. The I/O board processes the color data into _____ before sending it to the page buffer and the laser/scanner assembly.
A. Color separations

Image Formation System

The Color LaserWriter image formation system consists of four main parts:

- The toner carousel, containing the four toner cartridges
- The photoconductor cartridge, containing the photosensitive drum, the primary charging roller, and a cleaning unit
- The transfer drum, which holds the paper as it passes next to the photosensitive drum and also provides the charge that attracts the toner particles to the paper
- The fuser assembly, which melts and presses the toner onto the paper

In the following pages, we will describe each part of the image formation system, using the parts of the Color LaserWriter 12/600 PS as examples.



**Figure 2-2: Image Formation System
(Color LaserWriter 12/600 PS)**

The Toner Carousel

Outline

The toner carousel (see Figure 2-2) consists of four cylindrical bays clustered around a central mechanism. The bays hold the four toner cartridges: magenta (M), cyan (C), yellow (Y), and black (K).

Run the animation again and observe how the toner carousel and cartridges move:

- 1- The toner carousel brings a toner cartridge into position next to the photosensitive drum and then stops.
- 2- The toner cartridge is pressed forward toward the photosensitive drum by the press cam assembly in the center of the carousel.
- 3- After the paper has passed by, the toner cartridge moves back into the carousel, and the carousel rotates to bring the next cartridge into position.

(To understand how this movement is accomplished, see “Toner Carousel Control” in the “Basics and Theory” chapter of the Color LaserWriter 12/600 PS manual on [Service Source](#).)

Toner Cartridge Positions

There are three named positions that a toner cartridge can be in:

- Stop position
- Press position
- Fetch position

When the carousel brings a toner cartridge next to the photosensitive drum and then stops, the toner cartridge is said to be in stop position. (The magenta cartridge is in stop position in frames 1-56; the cyan cartridge in frames 111-115; the yellow in frames 161-165; the black in frames 211-215.)

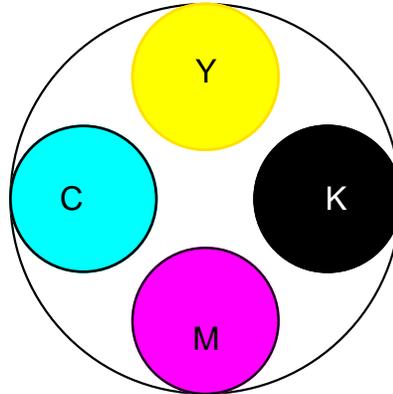
When a cartridge is pressed up against the photosensitive drum, the cartridge is said to be in press position. This is the position in which toner is transferred to the photosensitive drum. (For the magenta cartridge, press position is frames 57-105; for cyan, frames 116-155; for yellow, 166-205; for black, 216-255.)

When a cartridge is centered at the bottom of the carousel, the cartridge is said to be in fetch position. The magenta cartridge is in fetch position at the end of the animation (frames 274-297). A cartridge must be in fetch position to be removed from the printer. The user can manually bring any cartridge to fetch position by using the toner carousel knob.

Toner Carousel Home Position

At the end of every complete print operation, the toner carousel rotates until the magenta cartridge is in fetch

position. **When the magenta cartridge is in fetch position, the toner carousel is said to be in home position.**



**Figure 2-3: Toner Carousel Home Position
(Magenta Fetch Position)**

(When the other toner cartridges are in fetch position, the toner carousel is not in home position.)

Toner Cartridges

Each Color LaserWriter toner cartridge (Figure 2-4) is replaced as a module. Each contains one color of toner and several mechanical parts. Unlike the black-and-white LaserWriter toner cartridge, the Color LaserWriter toner cartridge does not contain a photosensitive drum, nor a receptacle for waste toner cleaned from the photosensitive drum.

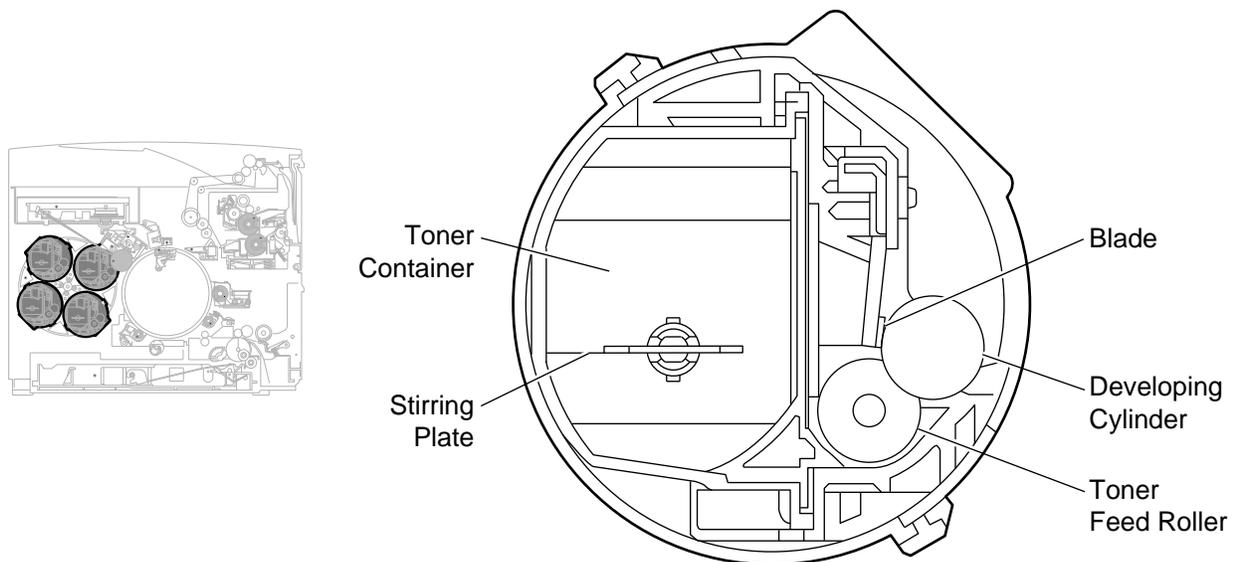


Figure 2-4: A Toner Cartridge

When the toner carousel has brought the cartridge into press position, the developing cylinder is exposed to the photosensitive drum. While the developing cylinder, the stirring plate, and the toner feed roller all rotate,

- The stirring plate stirs the toner and pushes it toward the toner feed roller
- The toner feed roller applies the toner to the developing cylinder
- The developing cylinder brings the toner to the photosensitive drum

The doctoring blade shown next to the developing cylinder ensures that toner is evenly distributed on the developing cylinder.

Toner Projection

When a toner cartridge is brought into press position next to the photosensitive drum, the toner cartridge's developing cylinder (see Figure 2-5) carries toner to the photosensitive drum. The toner is attracted to the latent image on the photosensitive drum by electrostatic charge. This is the same process that is used in traditional black-and-white LaserWriter printers. The only difference is that the toner and the photosensitive drum in the color printer are in separate cartridges.

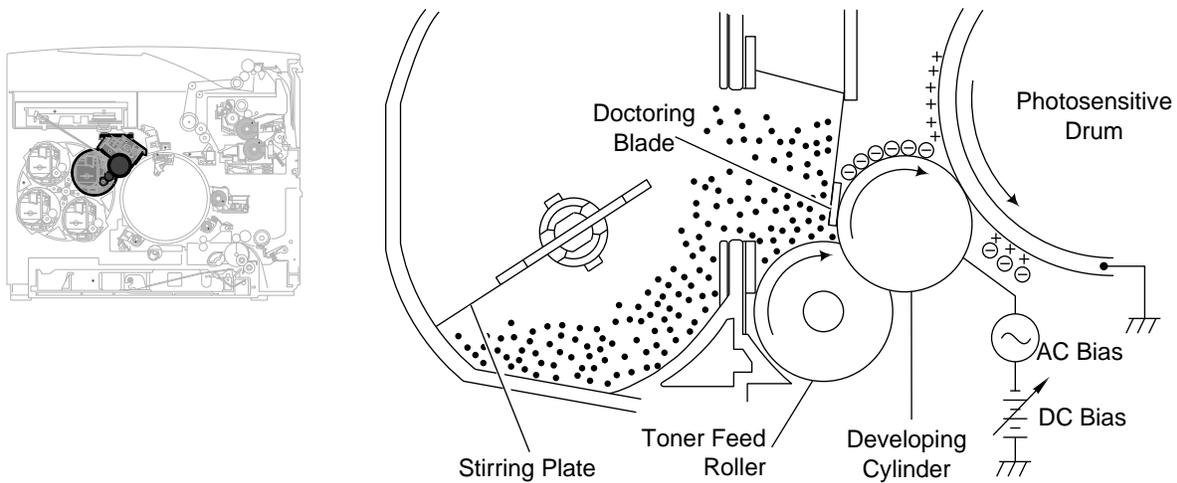


Figure 2-5: Toner Projection

The Photoconductor Cartridge

The photoconductor cartridge (Figure 2-6) contains the primary charging roller, the photosensitive drum, and the cleaner unit. It is a consumable module, replaced by the user.

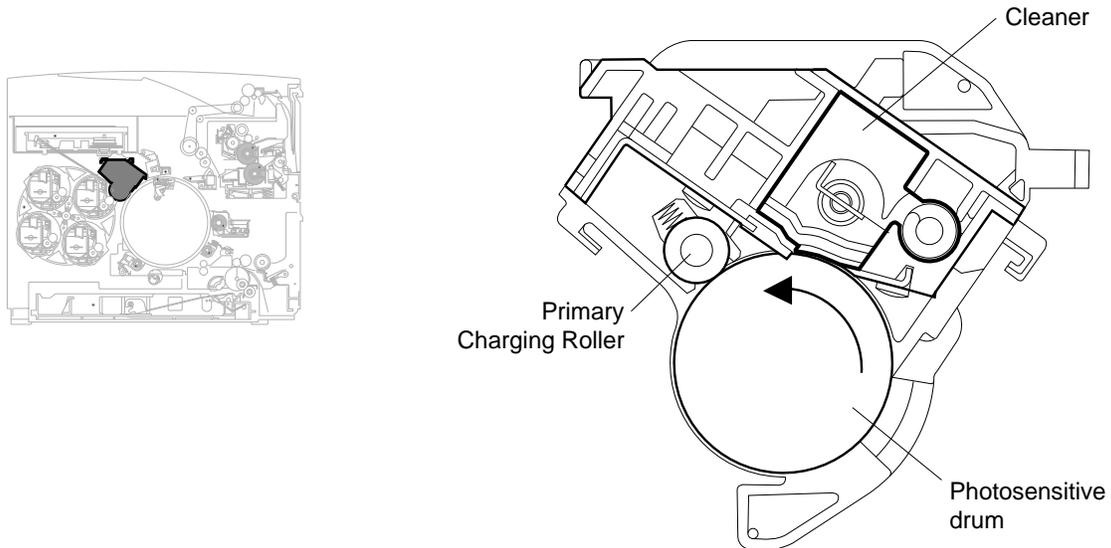


Figure 2-6: The Photoconductor Cartridge

Primary Charging Roller

The primary charging roller (see Figure 2-6) applies a uniform negative charge to the photosensitive drum, preparing it to be exposed to the laser beam.

Photosensitive Drum

The photosensitive drum (see Figure 2-6) is a cylinder coated with an organic photoconductor. After receiving a uniform negative charge from the primary charging roller, the photosensitive drum is exposed to the laser beam, which neutralizes the charge wherever it hits, creating the electrostatic latent image of the page. The neutral areas attract the negatively charged toner from the toner cartridge by their relatively higher potential. Then the photosensitive drum rotates, carrying the toner to the paper on the transfer drum. The higher positive charge provided by the transfer drum causes the toner to jump to the paper (see Figure 2-7).

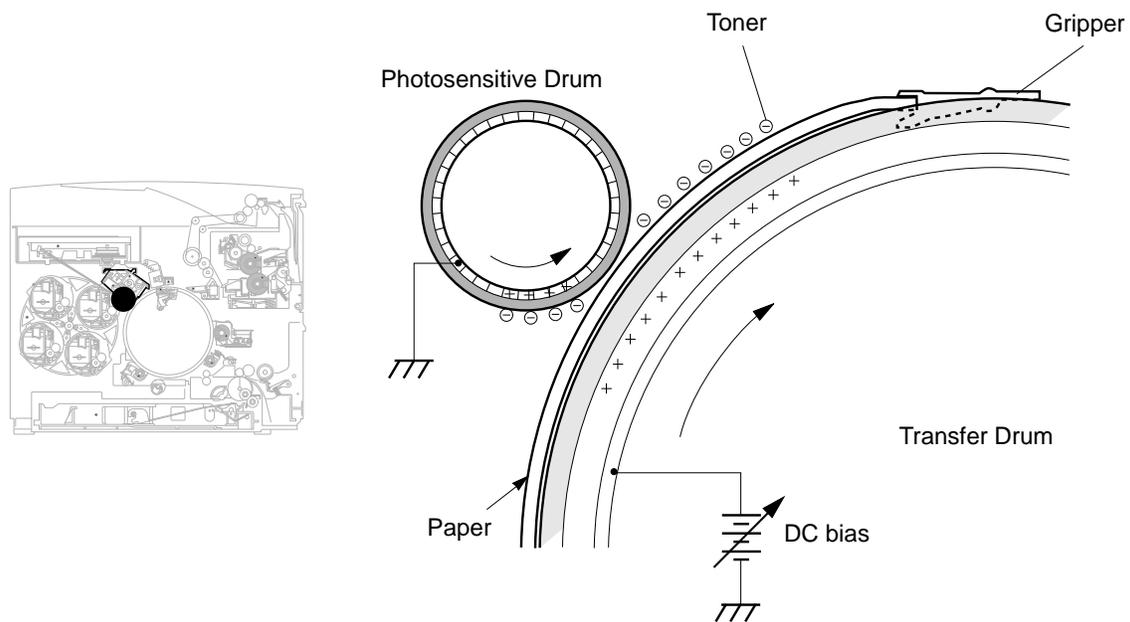


Figure 2-7: Photosensitive Drum

In the Color LaserWriter 12/600 PS, the photosensitive drum is about 5 inches in circumference, so it cannot hold the complete image of a page: It has to rotate two or more times for each color layer. If there is a scratch or defect on the photosensitive drum, a defect will appear at about five-inch intervals on every print.

Photoconductor Cleaner Unit and Toner Disposal Box

As each part of the toner image is transferred to the paper, the cleaner unit inside the photoconductor cartridge (see Figure 2-6) scrapes any residual toner from the photosensitive drum. The scraped-off toner is deposited in a toner disposal box (Figure 2-8). When the toner disposal box is full, the printer signals the user that the box must be replaced.

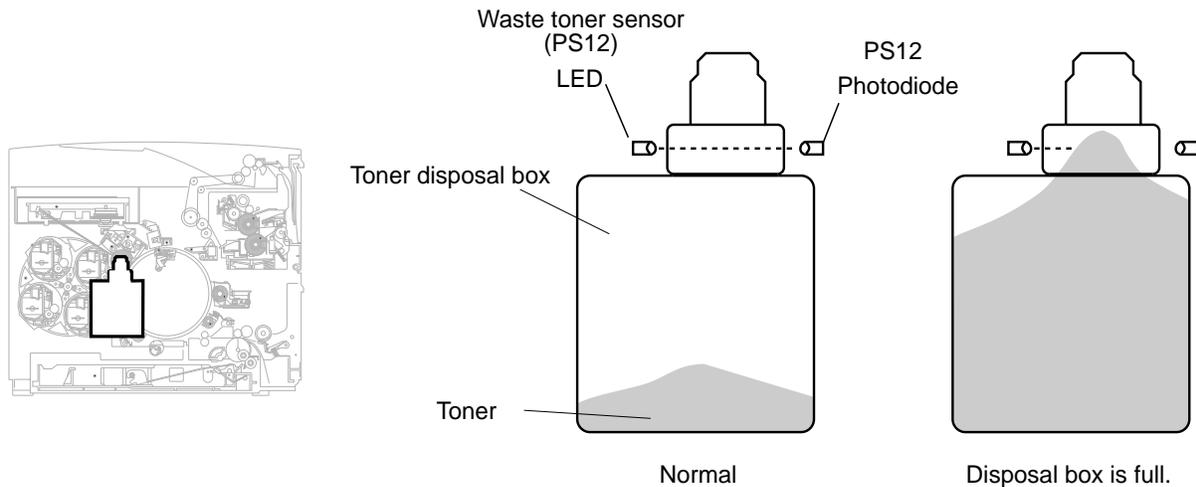


Figure 2-8: Toner Disposal Box

Difference: In the B/W LaserWriter, photoconductor cleaning and waste toner storage are both done within the toner cartridge.

The Transfer Drum

The transfer drum is at the center of the Color LaserWriter printer. It has two main functions:

- **It holds the paper** and carries it past the photoconductor cartridge to receive the toner image of the page. (In B/W LaserWriter printers, this function is performed by feed rollers.)
- **It provides the positive charge that attracts the toner to the paper** (see Figure 2-7). The inner part of the transfer drum is given a positive charge by DC bias from the high voltage power supply. The charge attracts the toner from the photosensitive drum to the paper. (In B/W LaserWriter printers, this function is performed by the transfer corona wire or transfer roller.)

The transfer drum in the Color LaserWriter 12/600 PS holds the paper by two means:

- A mechanical gripper (Figure 2-9), which holds the leading edge of the page. Because of the gripper, the first 8 mm of the leading edge cannot be printed on. The gripper is part of the transfer drum and rotates with it. In figure 2-9, the gripper is shown at the bottom of the transfer drum, in position to pick up a piece of paper.
- Electrostatic charge (see Figure 2-10).

Note: The electrostatic charge on the transfer drum has two purposes: To attract the paper to the drum, and to attract the toner to the paper.

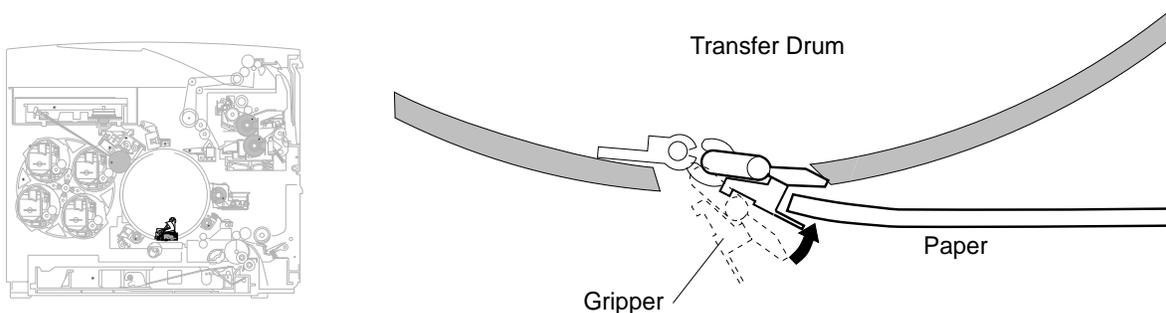


Figure 2-9: The Gripper

Separation Claw

After the complete toner image is on the paper, the leading edge of the paper is released and pushed upwards by the gripper (Figure 2-11a) and then separated from the transfer drum by the separation claw. (See Figure 2-11b.)

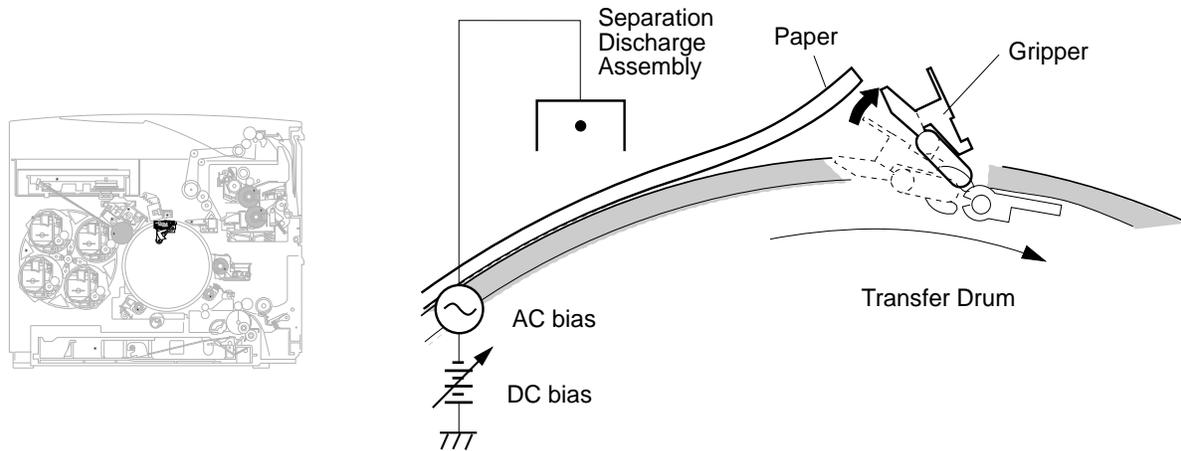


Figure 2-11a: Separating the Paper from the Transfer Drum – First Stage (Gripper)

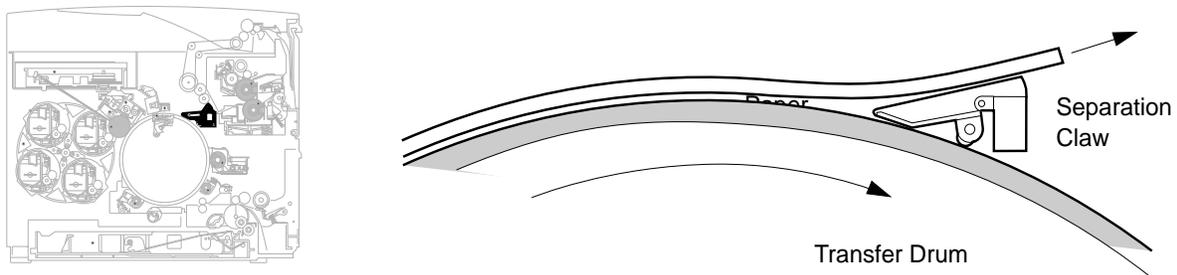


Figure 2-11b: Separating the Paper from the Transfer Drum – Second Stage (Separation Claw)

Review the animation: The separation claw starts functioning in frame 232.

Separation Discharge Assembly

When the printer senses a low temperature/low humidity condition, the separation discharge assembly (Figure 2-12, upper left corner) automatically supplies a slight corona charge above the paper, to help separate the paper from the transfer drum.

Note: If the trailing edge (bottom) of a print shows evidence of smudged or smeared toner, the separation discharge assembly may be supplying too much charge. You can turn off the separation discharge assembly manually (see Service Source for procedures).

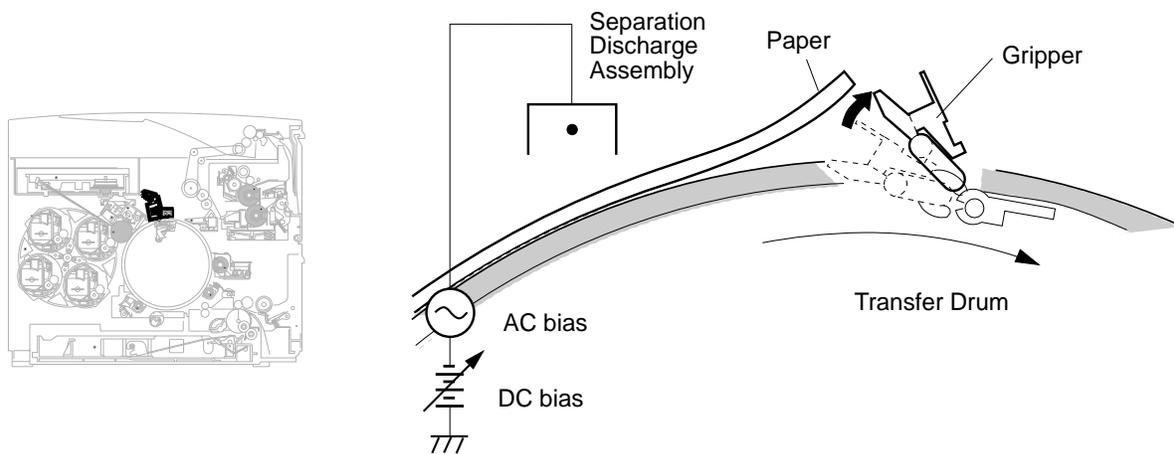


Figure 2-12: Separation Discharge Assembly

Discharge Roller

After a page has been printed and separated, the discharge roller (see Figure 2-13) eliminates unwanted charges from the transfer drum.

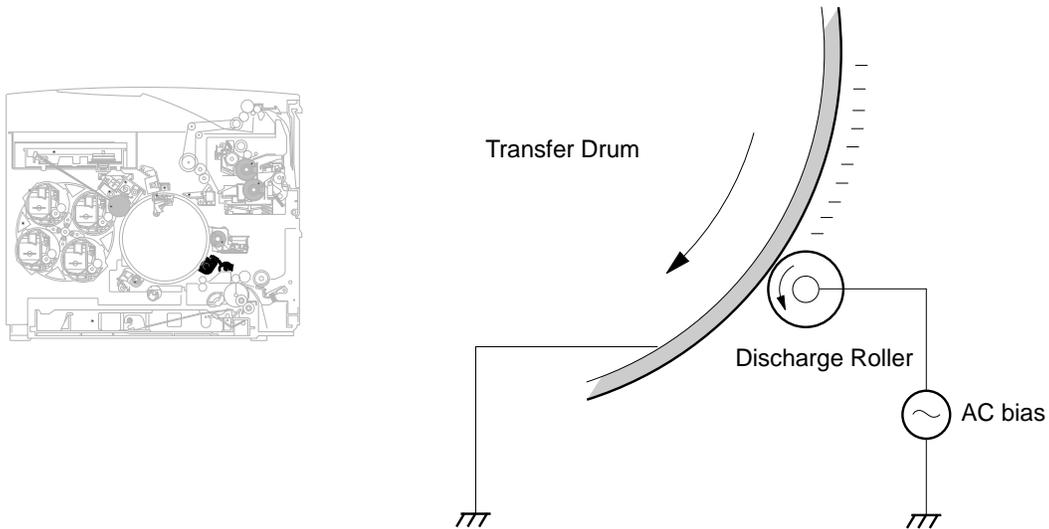


Figure 2-13: Discharge Roller

Review the animation: Notice that the discharge roller is only placed in contact with the transfer drum after printing (frames 228-279). It is never in contact with the paper.

Transfer Drum Cleaning Assembly

Unfused toner can spill onto the transfer drum if a paper jam occurs; it can also accumulate in small quantities in the normal course of printing. Also, toner is deliberately deposited onto the transfer drum as part of the printer's density self-calibration routine. (Upon startup and whenever a toner cartridge is replaced, the printer writes a series of color patches directly onto the transfer drum and then judges their density by means of an internal sensor. Depending on the density sensed, the printer adjusts itself to maintain uniform print density at all times and in all environmental conditions.)

To remove this toner from the transfer drum, the transfer drum cleaning assembly contains a motor-driven cylindrical brush (Figure 2-14), which cleans the transfer drum at the following times:

- After the density pattern has been written and sensed. (In the Color LaserWriter 12/600 PS, this occurs upon power up; whenever the printer senses a sudden change in temperature or humidity; after every 100-140 pages; and whenever a new toner cartridge or photoconductor cartridge is installed.)
- After the front door, fuser door, or pickup block door has been opened and closed (because the printer assumes that a paper jam has occurred).

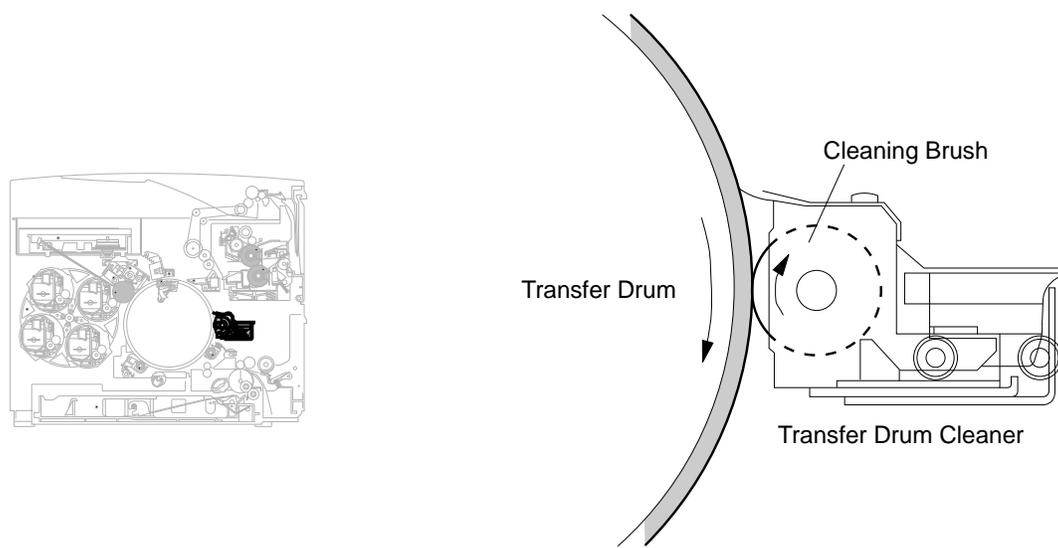


Figure 2-14: Transfer Drum Cleaning Assembly

The toner brushed from the transfer drum is collected in the filter of the transfer drum cleaning assembly. At about 60,000 prints, the transfer drum cleaning assembly should be replaced.

Note: In the Color LaserWriter 12/600 PS, the transfer drum cleaning assembly emits a distinctive whining sound as it operates. You can use this sound to check the operation of the cleaning assembly. Click on the box below to hear the sound.

[CLICK HERE FOR](#)

[CLEANING BRUSH SOUND](#)

Review the animation: The cleaning brush is shown cleaning the transfer drum in frames 223-273. It is important to realize that this cleaning does **not** occur after every print.

The Fuser Assembly

Fuser Rollers

In the Color LaserWriter printer, fusing is performed at 393 degrees Fahrenheit by two fuser rollers. The process is the same as in B/W LaserWriter printers, but the heat is greater and is produced by two heater bulbs (one in each fuser roller) instead of a single heater bulb. (See Figure 2-15.)

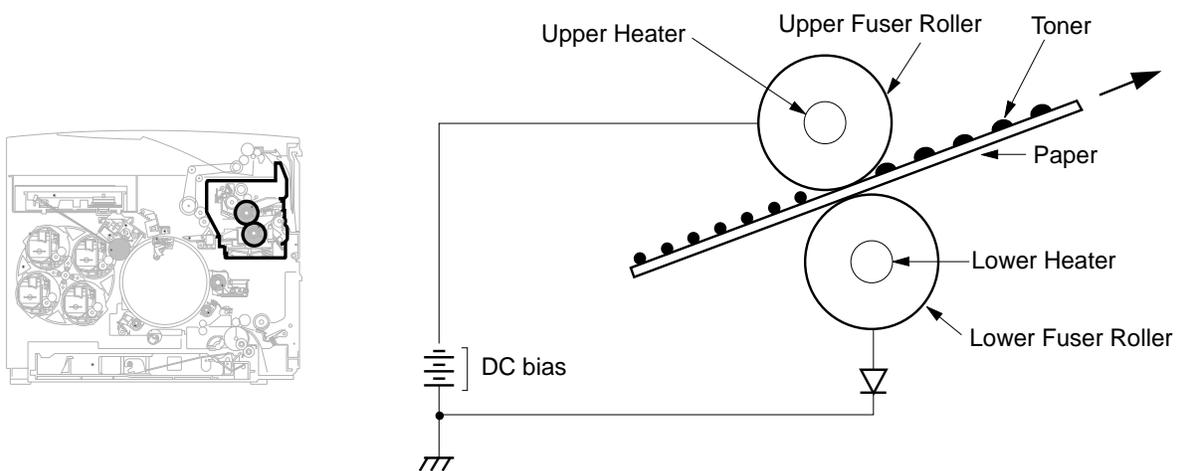


Figure 2-15: Fuser Assembly

Fuser Oil

Because four layers of toner are being fused, the Color LaserWriter 12/600 PS uses an oil circulation system to lubricate the fuser rollers. A silicone-based fuser oil is circulated continuously through the fuser assembly by a pump. The oil ensures proper fusing and prevents toner from adhering to the rollers and appearing as unwanted ghost images on subsequent prints (“image offset”). When the oil is used up (after about 10,000 prints), the user is signalled to replenish it. (See [Service Source](#) or the Color LaserWriter 12/600 PS Service Training Course for details.) Future Color LaserWriter models may or may not include a fuser oil system.

Difference: B/W LaserWriter printers also use silicone oil, but it is simply part of the fuser rollers; they are

impregnated with oil when manufactured. (For more information, see the Service Source manual for Color LaserWriter 12/600 PS.)

Fuser Oil Spotting on Prints

When a Color LaserWriter 12/600 PS is first unboxed and set up, it is not unusual to see some fuser oil spots on the first five or six prints. A printer coming out of a very long standby period may also exhibit some oil spotting on the first couple of pages. Apart from that, spotting should occur very infrequently (once in a thousand pages or so).

If oil spotting occurs more frequently or more severely, one of the following conditions may be the cause:

- Failure to remove the orange spacers from inside the fuser access door. (The spacers are for shipping purposes only.)
- Turning the printer on and off repeatedly over a short period of time (for instance, five times in an hour).
- Using recycled paper. Paper dust from recycled paper can build up in the oil pan and clog the oil circulation system. This can cause long streaks on the back of the paper. The remedy is to clean the fuser oil system.

Special Printing Modes

There are three special printing modes, in which the printing process differs from the process shown on the animation you have viewed:

- “Best” mode
- Transparency mode
- Monochrome mode

Best Mode

In “best” mode, the paper is gripped and pulled through one entire rotation on the transfer drum before any toner is transferred to the paper. This improves plane-to-plane registration by giving the paper an entire rotation to form itself to the shape of the transfer drum before the first color layer is transferred. Altogether, in “best” mode, the transfer drum rotates five times rather than the normal four.

Transparency Mode

In transparency mode, the transfer drum again rotates five times instead of four. In this mode, however, the extra rotation takes place after the four colors have been printed. The purpose of the fifth rotation is to allow the transfer drum to slow down while feeding the transparency to the fuser assembly. When fusing transparencies, the fuser rollers operate at a slower speed than normal, because the toner needs higher temperature to fuse onto a transparency. The transfer drum therefore needs to slow down also, to avoid jamming or deforming the transparency while feeding it to the fuser assembly.

Monochrome Mode

In monochrome mode, the printer prints only one color layer and skips the rotations for the other colors. Thus monochrome printing is four times as fast as four-color printing. Monochrome mode occurs automatically if only one color (cyan, magenta, yellow, or black) is specified in a document.

Exercise 2: Image Formation System

Take a piece of paper and a pencil, and try to answer the following questions from memory. If you need help, refer to the section you have just read. The answers are given at the end of the exercise.

1. The toner disposal box contains toner scraped from the
 - A. Attraction roller
 - B. Photosensitive drum
 - C. Toner cartridge
 - D. Transfer drum

2. The toner cleaned from the transfer drum is contained in the
 - A. Photoconductor cartridge
 - B. Toner cartridge
 - C. Toner disposal box
 - D. Transfer drum cleaning assembly

3. The developing cylinder is part of the
 - A. Developing cartridge
 - B. Photoconductor cartridge
 - C. Toner cartridge
 - D. Transfer drum

4. The primary charging roller is part of the
 - A. Developing cartridge
 - B. Photoconductor cartridge
 - C. Toner cartridge
 - D. Transfer drum

5. Toner is attracted to the paper by the electrostatic charge provided by the
 - A. Attraction roller
 - B. Primary charging roller
 - C. Separation discharge assembly
 - D. Transfer drum

6. In “best” mode, the transfer drum rotates five times in order to
 - A. Avoid stretching the paper while feeding it to the fuser assembly
 - B. Ensure that the paper is flattened before printing
 - C. Prevent image deformation by static electricity
 - D. Slow down to ensure proper fusing

7. In overhead transparency mode, the fuser rollers rotate more slowly in order to
 - A. Heat the toner to a higher temperature
 - B. Heat the toner at a lower temperature for a longer time

8. When black toner is being transferred to the photosensitive drum, the black toner cartridge must be in
 - A. Stop position
 - B. Press position
 - C. Fetch position

9. When you want to remove the cyan toner cartridge, you must bring it to
 - A. Stop position
 - B. Press position
 - C. Fetch position

10. When the toner carousel is in home position, which cartridge is in fetch position?
 - A. Cyan
 - B. Magenta
 - C. Yellow
 - D. Black

11. The Color LaserWriter photosensitive drum is given a uniform charge by the
 - A. Laser/scanner unit
 - B. Developing cylinder
 - C. Primary charging roller
 - D. Primary corona wire

12. What are the two purposes served by the electrostatic charge on the transfer drum? (Choose two answers.)
 - A. Attracting the paper to the gripper
 - B. Attracting the paper to the transfer drum
 - C. Attracting the toner to the photosensitive drum
 - D. Attracting the toner to the paper

13. Because the gripper holds the leading edge of the paper,
 - A. The first 8 mm of the paper cannot be printed on
 - B. Toner smudging may appear at the top of prints in cold weather conditions.
 - C. Oil spotting may occur at the top of prints
 - D. Only special paper may be used.

14. If the trailing edge (bottom) of a print shows evidence of smudged or smeared toner, the _____ may be supplying too much charge.
 - A. Attraction roller
 - B. Discharge roller
 - C. Transfer drum
 - D. Separation discharge assembly

15. Long streaks of fuser oil on printed pages may be caused by
 - A. Excess negative charge on the paper
 - B. A buildup of paper dust from recycled paper
 - C. Low temperature and humidity conditions
 - D. A scratched photosensitive drum

16. A scratch on the photosensitive drum can cause print defects that repeat every _____ inches on printed pages.
- A. 2
 - B. 3
 - C. 5
 - D. 8.5

Answers to Exercise 2

1. The toner disposal box contains toner scraped from the
B. Photosensitive drum
2. The toner cleaned from the transfer drum is contained in the
D. Transfer drum cleaning assembly
3. The developing cylinder is part of the
C. Toner cartridge
4. The primary charging roller is part of the
B. Photoconductor cartridge
5. Toner is attracted to the paper by the electrostatic charge provided by the
D. Transfer drum
6. In “best” mode, the transfer drum rotates five times in order to
B. Ensure that the paper is flattened before printing
7. In overhead transparency mode, the fuser rollers rotate more slowly in order to
A. Heat the toner to a higher temperature
8. When black toner is being transferred to the photosensitive drum, the black toner cartridge must be in
B. Press position
9. When you want to remove the cyan toner cartridge, you must bring it to
C. Fetch position
10. When the toner carousel is in home position, which cartridge is in fetch position?
B. Magenta

11. The Color LaserWriter photosensitive drum is given a uniform charge by the
C. Primary charging roller
12. What are the two purposes served by the electrostatic charge on the transfer drum? (Choose two answers.)
B. Attracting the paper to the transfer drum
D. Attracting the toner to the paper
13. Because the gripper holds the leading edge of the paper,
A. The first 8 mm of the paper cannot be printed on
14. If the trailing edge (bottom) of a print shows evidence of smudged or smeared toner, the _____ may be supplying too much charge.
D. Separation discharge assembly
15. Long streaks of fuser oil on printed pages may be caused by
B. A buildup of paper dust from recycled paper
16. A scratch on the the photosensitive drum can cause print defects that repeat every _____ inches on printed pages.
C. 5

B/W versus Color LaserWriter Printers: Module Differences

The tables on the following pages summarize the differences between the main modules of the Color LaserWriter 12/600 PS and existing black-and-white LaserWriter printers.

Table 2-1: Modules Replaced by Two or More New Modules

Table 2-1 shows B/W LaserWriter modules or components whose functions are split among several new modules or components or replaced by new modules in the Color LaserWriter 12/600 PS.

B/W Module / Component	Color Module / Component	Function
Toner Cartridge	•Toner cartridge	Holds the toner and applies it to the photosensitive drum.
	•Photoconductor cartridge	Contains photosensitive drum, primary charging roller, and cleaning blade. The photosensitive drum is charged by the laser to create the latent image, attracts toner to develop the image, and carries the developed image to the paper.
	•Toner disposal box	Contains toner cleaned from photosensitive drum.
DC Controller board	•DC Controller board	Controls most printer operations.
	•Mechanical Controller board	In response to signals from the DC Controller, the mechanical controller controls most motors, many subsystems. Returns status signals to DC Controller.

Table 2-2: Modules Replaced by One New Module

Table 2-2 shows B/W LaserWriter modules or components whose functions are performed by a single new module or component in the Color LaserWriter 12/600 PS:

B/W Module / Component	Color Module / Component	Function
<ul style="list-style-type: none"> •Preconditioning exposure assembly (early LWs) •Primary charging roller in toner cartridge (later LWs) 	Primary charging roller in photoconductor cartridge	Removes old charges from surface of photosensitive drum
Primary corona wire	Primary charging roller in photoconductor cartridge	Charges surface of photosensitive drum uniformly to prepare for new laser exposure.
Transfer corona wire or transfer roller	Transfer drum	Attracts toner to paper

Table 2-3: New Modules/Components

Table 2-3 shows Color LaserWriter modules or components that have no equivalents in the B/W LaserWriter printers:

New Module / Component	Function
Gripper	Grips leading edge of paper while paper is on transfer drum; releases paper from transfer drum when printing is complete.
Attraction roller	Imparts a charge to the paper so that it adheres to the transfer drum. It does this only during the first rotation— after that it is withdrawn from contact with the transfer drum, so as not to interfere with the toner already on the paper.
Discharge roller	Eliminates charges remaining on the surface of the transfer drum after the separation of the paper. (The discharge roller is only in contact with the transfer drum briefly, before and after the actual transfer operation—before the paper is picked up by the gripper and after the paper is separated from the transfer drum. The rest of the time, the discharge roller is separated from the transfer drum.
Separation discharge assembly	The separation discharge assembly is activated only in low temperature and humidity environments. It provides an AC corona charge to help separate the paper from the transfer drum.
Separation claw	Separates the paper from the transfer drum.

Exercise 3: B/W versus Color LaserWriter Differences

Take a piece of paper and a pencil, and try to answer the following questions from memory. If you need help, refer to the section you have just read. The answers are given at the end of the exercise.

1. The B/W LaserWriter toner cartridge performs the same functions as these parts of the Color LaserWriter printer (choose all that apply):
 - A. Toner cartridge
 - B. Photoconductor cartridge
 - C. Attraction roller
 - D. Toner disposal box
 - E. Transfer corona wire

2. The Color LaserWriter mechanical controller board performs some of the functions performed by the _____ in the B/W LaserWriter printer.
 - A. I/O board
 - B. DC controller board

3. The function of the transfer corona wire in B/W LaserWriter printers is performed by the _____ in the Color LaserWriter printer.
 - A. Photosensitive drum
 - B. Primary charging roller
 - C. Attraction roller
 - D. Transfer drum

Answers to Exercise 3

1. The B/W LaserWriter toner cartridge performs the functions of these parts of the Color LaserWriter printer (choose all that apply):
 - A. Toner cartridge
 - B. Photoconductor cartridge
 - D. Toner disposal box

2. The Color LaserWriter mechanical controller board performs part of the functions performed by the _____ in the B/W LaserWriter printer.
 - B. DC controller board

3. The function of the transfer corona wire in B/W LaserWriter printers is performed by the _____ in the Color LaserWriter printer.
 - D. Transfer drum

[Click here to go to Module 3,
Color Printing Utilities](#)