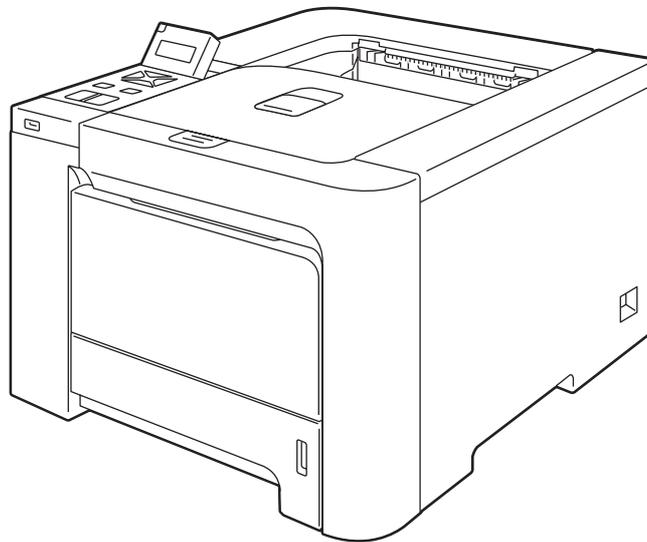**brother**®

Brother Color Laser Printer
SERVICE REFERENCE MANUAL

MODEL:
HL-4040CN/4040CDN/
4050CDN/4070CDW

Read this manual thoroughly before maintenance work.

Keep this manual in a convenient place for quick and easy reference at all times.

PREFACE

This service reference manual contains basic information required for after-sales service of the laser printer (hereinafter referred to as "the machine"). This information is vital to the service personnel to maintain the high printing quality and performance of the machine.

This service reference manual covers the **HL-4040CN/4040CDN/4050CDN/4070CDW machines**.

This manual consists of the following chapters:

REFERENCE 1: SPECIFICATIONS

Provides specifications of each model, which enables you to make a comparison of the different models.

REFERENCE 2: THEORY OF OPERATION

Gives an overview of the printing mechanisms as well as the sensors, actuators, and control electronics. It aids in understanding the basic principles of operations as well as locating defects for troubleshooting.

APPENDIX 1: TONER CARTRIDGE WEIGHT INFORMATION

APPENDIX 2: REFERENCES

APPENDIX 3: GLOSSARY

Information in this manual is subject to change due to improvement or redesign of the product. All relevant information in such cases will be supplied in service information bulletins (Technical Information).

A thorough understanding of this machine, based on information in this service reference manual and service information bulletins, is required for maintaining the print quality performance and for improving the practical ability to find the cause of any problems.

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REFERENCE 1   SPECIFICATIONS

1.   COMPONENTS

The equipment consists of the following major components:

Fig. Ref1-1

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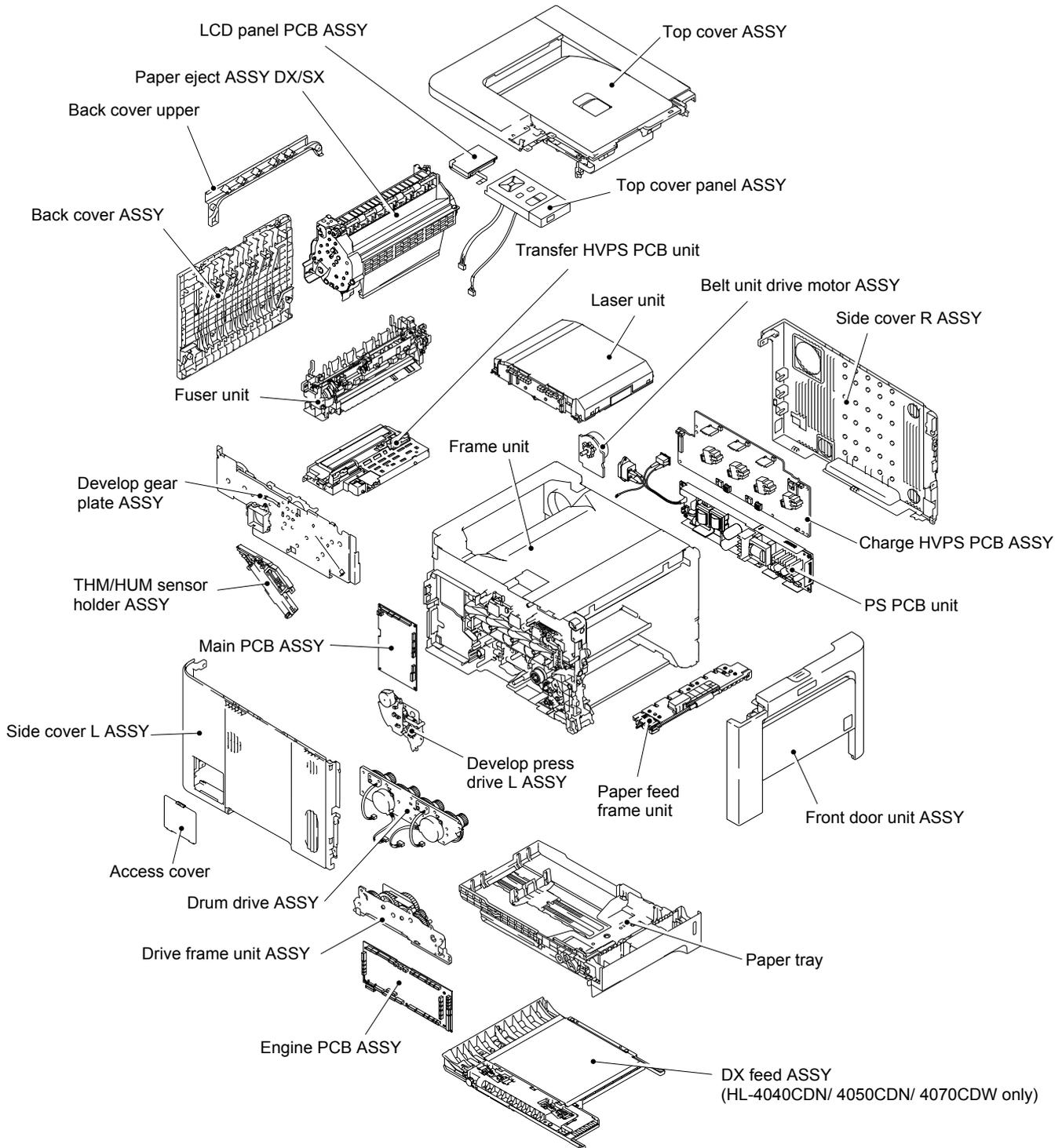
2. SPECIFICATIONS LIST

2.1 Printing

Model		HL-4040CN	HL-4040CDN	HL-4050CDN	HL-4070CDW
Print method		Electrophotography by semiconductor laser beam scanning			
Laser		Method: 1 polygon motor, 4 laser beams Wavelength: 780nm~800nm Output: 30mW (Max)			
Resolution	2400dpi (2400x600) quality	Windows® 2000/XP/ XP Professional x64 Edition, Windows Vista®, Windows Server® 2003/ Windows Server® 2003 x64 Edition, Mac OS® X 10.2.4 or greater			
	600 x 600dpi	Windows® 2000/XP/ XP Professional x64 Edition, Windows Vista®, Windows Server® 2003/ Windows Server® 2003 x64 Edition, Mac OS® X 10.2.4 or greater, DOS, Linux			
Print mode		Normal printing mode Economy printing mode (Toner saving mode)			
Print Speed	Standard	Monochrome/ Full Color: Up to 20/20 ppm (A4 size), Up to 21/21 ppm (Letter size) * when loading A4 or Letter-size paper from the standard paper tray, or the optional lower tray			
	Auto Duplex	N/A	Monochrome/ Full Color: Up to 7/7 sides per minute (3.5 sheets per minute)		
Warm-up time *1		From Sleep Mode : less than 33 seconds From Power OFF→ON : less than 37 seconds * with standard 64MB RAM, 23°C (73.4°F)			
First print time *1		Monochrome: Less than 16seconds Full Color: Less than 17seconds			
Consumables	Toner cartridge	Life expectancy: Black Standard: 2,500pages/ cartridge Black High-capacity: 5,000pages/ cartridge Cyan, Magenta, Yellow Standard: 1,500pages/ cartridge Cyan, Magenta, Yellow High-capacity: 4,000pages/ cartridge * when printing A4/ Letter-size paper at 5% print coverage. Shelf life: 2years (6months after opening)			
	Drum unit	Life expectancy: 17,000pages/ drum unit Life expectancy will vary depending on number of continuous printing pages. (Refer to "Life of Drum Unit" in Chapter 5, "2.3 Printout of Printer Settings" of the Service Manual.) * when printing A4/ Letter-size paper. Shelf life: 2years			

*1 The time may change if the machine is calibrating or registering itself.

Model		HL-4040CN	HL-4040CDN	HL-4050CDN	HL-4070CDW
Consumables	Belt unit	Life expectancy: 50,000pages/ belt unit Life expectancy will vary depending on number of continuous printing pages. (Refer to "Life of Belt Unit" in Chapter 5, "2.3 Printout of Printer Settings" of the Service Manual.) * when printing A4/ Letter-size paper.			
	Waste toner box	Life expectancy: 20,000pages/ waste toner box * when printing A4/ Letter-size paper at 5% print coverage.			
		The shelf life of toner cartridge and drum unit is guaranteed under the normal condition as below; (Temperature) Normal condition: 0 to 40°C * Storage condition at the temperature of 40 to 50°C: Up to 5days * Storage condition at the temperature of -20 to 0°C: Up to 5days (Humidity) Normal condition: 35 to 85% * Storage condition at the humidity of 85 to 95%: Up to 5days * Storage condition at the humidity of 10 to 35%: Up to 5days			

Note:

Print speed varies depending on the paper size or media type. For details, refer to " 2.8 Print Speeds with Various Settings" in this chapter.

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2.2 Functions

<Controller>

Model		HL-4040CN	HL-4040CDN	HL-4050CDN	HL-4070CDW
CPU		300MHz			
Memory	Standard	64MB			
	Option	1 DIMM slot; expandable up to 576MB			
Interface		Hi-Speed USB 2.0, 10BASE-T/100BASE-TX Ethernet		Hi-Speed USB 2.0, IEEE 1284 Parallel, 10BASE-T/100BASE-TX Ethernet	Hi-Speed USB 2.0, IEEE 1284 Parallel, 10BASE-T/100BASE-TX Ethernet, Wireless LAN IEEE 802.11b/g
Emulation		PCL6		PCL6, BR-Script 3 (PostScript$^®$ 3™)	
Network Connectivity	Protocols	TCP/IP (Standard 10/100BASE-TX Ethernet)			
	Management tool	BRAdmin Light, BRAdmin Professional, Web BRAdmin, Web Based Management			
Resident fonts	PCL	66 scalable fonts, 12 bitmap fonts, 13 bar codes			
	PostScript$^®$ 3™	N/A		66 fonts	

<Software>

Model		HL-4040CN	HL-4040CDN	HL-4050CDN	HL-4070CDW
Printer driver	Windows$^®$	Host-Based Driver for Windows$^®$ 2000/XP/XP Professional x64 Edition, Windows Vista$^®$, Windows Server$^®$ 2003/Windows Server$^®$ 2003 x64 Edition			
		N/A		BR-Script 3 (PPD file) for Windows$^®$ 2000/XP/XP Professional x64 Edition, Windows Vista$^®$, Windows Server$^®$ 2003/Windows Server$^®$ 2003 x64 Edition	
	Macintosh$^®$	Macintosh Printer Driver for Mac OS$^®$ X 10.2.4 or greater			
		N/A		BR-Script 3 (PPD file) for Mac OS$^®$ X 10.2.4 or greater	
	Linux	Linux driver for CUPS printing system (x86, x64 environment)			
		Linux driver for LPD/ LPRng printing system (x86, x64 environment)			
Utilities		Interactive Help Driver Deployment Wizard			

\<Direct Print feature\>

Model	HL-4040CN	HL-4040CDN	HL-4050CDN	HL-4070CDW
Direct Print	PDF version1.6[*1], JPEG, Exif+JPEG, PRN (created by HL-4040CN or HL-4040CDN or HL-4050CDN or HL-4070CDW printer driver[*2]), TIFF (scanned by all Brother MFC or DCP models)		PDF version1.6[*1], JPEG, Exif+JPEG, PRN (created by HL-4040CN or HL-4040CDN or HL-4050CDN or HL-4070CDW printer driver), TIFF (scanned by all Brother MFC or DCP models), PostScript® 3™(created by HL-4050CDN or HL-4070CDW BRScript3 printer driver)	

[*1] The data including JBIG2 image file, JPEG2000 image file and layered files are not supported.

[*2] HL-4040CN cannot print PRN files of duplex printing which are created by HL-4040CDN, HL-4050CDN or HL-4070CDW printer driver.

\<System requirements\>

Computer Platform & Operating System Version		Processor Speed	Minimum RAM	Recom-mended RAM	Available Hard Disk Space
Windows®	Windows® 2000 Professional	Intel®Pentium® or equivalent	64MB	128MB	50MB
	Windows® XP Home Edition		128MB	256MB	50MB
	Windows® XP Professional				
	Windows® XP Professional x64 Edition	AMDOpteron™ AMDAthlon™64 Intel® Xeon® with Intel® EM64T Intel® Pentium® 4 with Intel® EM64T or equivalent	256MB	384MB	50MB
	Windows Vista®	Intel® Pentium® 4 or equivalent 64-bit supported CPU	512MB	1GB	50MB
	Windows Server® 2003	Intel® Pentium® III or equivalent	256MB	512MB	50MB
	Windows Server® 2003 x64 Edition	AMD Opteron™ AMD Athlon™ 64 Intel® Xeon™ with Intel® EM64T Intel® Pentium® 4 with Intel® EM64T or equivalent	256MB	512MB	50MB
Apple® Macintosh®	Mac OS® X 10.2.4 or greater	PowerPC G4/G5, Intel® Core™ Solo/Duo, PowerPC G3 350MHz	128MB	160MB	50MB

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2.3 Electronics and Mechanics

Model		HL-4040CN	HL-4040CDN	HL-4050CDN	HL-4070CDW
Power consumption	Printing	Average 510W at 25°C (77°F)			
	Standby	Average 85W at 25°C (77°F)			
	Sleep	Average 20W at 25°C (77°F)			Average 23W at 25°C (77°F)
Noise level	Sound Pressure	Printing: 54dB(A) Standby: 30dB(A)			
	Sound power	Monochrome printing: LWAd = 6.6Bell(A) Monochrome standby: LWAd = 4.8Bell(A) Color printing: LWAd = 6.6Bell(A) Color standby: LWAd = 4.8Bell(A)			
Temperature		Operating: 10 to 32.5°C (50 to 90.5°F) Non operating: 0 to 40°C (38 to 104°F) Storage: -20 to 40°C (-4 to 104°F)			
Humidity		Operating: 20 to 80% (non condensing) Storage: 10 to 85% (non condensing)			
Dimensions (W × D × H)		419 × 475 × 317mm (16.5 × 18.7 × 12.5in.)			
Weights		Approx. 29.1kg (64.2lb) including the drum unit and toner cartridge.			

2.4 Network Connectivity

\<Wired network\>

Network node type	NC-6500h	
Operating system support	Windows® 2000/XP, Windows® XP Professional x64 Edition, Windows Vista®, Windows Server® 2003, 2003 x64 Edition, Mac OS® X 10.2.4 or greater	
Protocol support	TCP/IP: IPv4	ARP, RARP, BOOTP, DHCP, APIPA (Auto IP), WINS, NetBIOS name resolution, DNS Resolver, mDNS, LPR/LPD, Custom Raw Port/Port9100, SMB Print, IPP, IPPS, FTP Server, SSL/TLS, POP before SMTP, SMTP-AUTH, TELNET, SNMPv1, HTTP/HTTPS server, TFTP client and server, SMTP Client, APOP, LLTD responder
	TCP/IP: IPv6 [1]	NDP, RA, DNS, mDNS, LPR/LPD, Custom Raw Port/Port9100, IPP, IPPS, FTP Server, SSL/TLS, POP before SMTP, SMTP-AUTH, TELNET, SNMPv1, HTTP/HTTPS server, TFTP client and server, SMTP Client, APOP, LLTD responder
Network type	10/100BASE-TX Ethernet network	
Network printing	Windows® 2000/XP, Windows Vista® and Windows Server® 2003 TCP/IP printing Mac OS® X 10.2.4 or greater printing	
Computer requirements (for drivers, BRAdmin Light and Peer-to-Peer software)	Minimum Processor	Intel® Pentium® or equivalent for Windows® 2000 Intel® Pentium® or equivalent for Windows® XP AMD Opteron™ AMD Athlon™ 64, Intel® Xeron® with Intel® EM64T, Intel® Pentium® 4 with Intel® EM64T or equivalent, for Windows® XP Professional x64 Edition and Windows Server® 2003 x64 Edition Intel® Pentium® III or equivalent for Windows Server® 2003
	Minimum RAM	64 MB for Windows® 2000, 128 MB for Windows® XP, 256 MB for Windows® XP Professional x64 Edition, 256 MB for Windows Server® 2003 and Windows Server® 2003 x64 Edition
	Recommended RAM	128 MB or greater for Windows® 2000, 256 MB or greater for Windows® XP, 384 MB or greater for Windows® XP Professional x64 Edition, 512 MB for Windows Server® 2003 and Windows Server® 2003 x64 Edition
Macintosh connection	Computer	Ethernet ready Power Macintosh®
	Minimum Processor	PowerPC G4/G5, Intel® Core™ Solo/Duo, Processor PowerPC G3 350MHz
	Minimum RAM	128MB
	Recommended RAM	160MB
	Operating system	Mac OS® X 10.2.4 or greater

[1] If you want to use the IPv6 protocol, visit http://solutions.brother.com for more information.

Management utilities	BRAdmin Light	Windows® 2000/XP/XP Professional x64 Edition, Windows Vista®, Windows Server® 2003/2003 x64 Edition
		Mac OS® X 10.2.4 or greater
	BRAdmin Professional [*2]	Windows® 95/98/Me, Windows NT® 4.0, Windows® 2000/XP/XP Professional x64 Edition, Windows Vista®, Windows Server® 2003/2003 x64 Edition
	Web BRAdmin [*2]	Windows NT® 4.0, Windows® 2000 Professional / Server / Advanced Server, Windows® XP Professional/XP Professional x64 Edition, Windows Vista®, Windows Server® 2003/2003 x64 Edition

[*2] BRAdmin Professional and Web BRAdmin are available as a download from http://solutions.brother.com

<Wireless network>

Network node type	NC-7300w	
Operating system support	Windows® 2000/XP, Windows® XP Professional x64 Edition [*1], Windows Vista®, Windows Server® 2003, 2003 x64 Edition [*1], Mac OS® X 10.2.4 or greater	
Protocol support	TCP/IP: IPv4	ARP, RARP, BOOTP, DHCP, APIPA (Auto IP), WINS, NetBIOS name resolution, DNS Resolver, mDNS, LPR/LPD, Custom Raw Port/Port9100, SMB Print, IPP, IPPS, FTP Server, SSL/TLS, POP before SMTP, SMTP-AUTH, TELNET, SNMPv1, HTTP/HTTPS server, TFTP client and server, SMTP Client, APOP, LLTD responder
	TCP/IP: IPv6 [*2]	NDP, RA, DNS, mDNS, LPR/LPD, Custom Raw Port/Port9100, IPP, IPPS, FTP Server, SSL/TLS, POP before SMTP, SMTP-AUTH, TELNET, SNMPv1, HTTP/HTTPS server, TFTP client and server, SMTP Client, APOP, LLTD responder
Network type	IEEE 802.11b/g wireless	
Frequency	2412-2472 MHz	
RF channels	US/Canada	1-11
	Europe/Oceania	1-13
	Japan	802.11b: 1-14, 802.11g: 1-13
Communication mode	Infrastructure, Ad-hoc (802.11b only)	
Data rates	802.11b	11/5.5/2/1 Mbps
	802.11g	54/48/36/24/18/12/11/9/6/5.5/2/1 Mbps

[*1] A wireless network connection is supported only between the Brother printer and an access point for PC's running Windows® XP Professional x64 Edition and Windows Server® 2003 x64 Edition.

[*2] If you want to use the IPv6 protocol, visit http://solutions.brother.com for more information.

Link distance	70m (233ft.) at lowest data rate (The distance rate will vary upon environment and other equipment location.)
Network security	SSID/ESSID, 128 (104) / 64 (40) bit WEP, WPA/WPA2-PSK (TKIP/AES), LEAP (CKIP)
Network printing	Windows® 2000/XP, Windows Vista® and Windows Server® 2003 TCP/IP printing Mac OS® X 10.2.4 or greater printing

Computer requirements (for drivers, BRAdmin Light and Peer-to-Peer software)	Minimum Processor	Intel® Pentium® or equivalent for Windows® 2000 Intel® Pentium® or equivalent for Windows® XP AMD Opteron™ AMD Athlon™ 64, Intel® Xeron® with Intel® EM64T, Intel® Pentium® 4 with Intel® EM64T or equivalent, for Windows® XP Professional x64 Edition and Windows Server® 2003 x64 Edition Intel® Pentium® III or equivalent for Windows Server® 2003
	Minimum RAM	64 MB for Windows® 2000, 128 MB for Windows® XP, 256 MB for Windows® XP Professional x64 Edition, 256 MB for Windows Server® 2003 and Windows Server® 2003 x64 Edition
	Recommended RAM	128 MB or greater for Windows® 2000, 256 MB or greater for Windows® XP, 384 MB or greater for Windows® XP Professional x64 Edition, 512 MB for Windows Server® 2003 and Windows Server® 2003 x64 Edition
Macintosh connection	Computer	Ethernet ready Power Macintosh®
	Minimum Processor	PowerPC G4/G5, Intel® Core™ Solo/Duo, Processor PowerPC G3 350MHz
	Minimum RAM	128MB
	Recommended RAM	160MB
	Operating system	Mac OS® X 10.2.4 or greater
Management utilities	BRAdmin Light	Windows® 2000/XP/XP Professional x64 Edition, Windows Vista®, Windows Server® 2003/2003 x64 Edition
		Mac OS® X 10.2.4 or greater
	BRAdmin Professional [*3]	Windows® 95/98/Me, Windows NT® 4.0, Windows® 2000/XP/XP Professional x64 Edition, Windows Vista®, Windows Server® 2003/2003 x64 Edition
	Web BRAdmin [*3]	Windows NT® 4.0, Windows® 2000 Professional / Server / Advanced Server, Windows® XP Professional/XP Professional x64 Edition, Windows Vista®, Windows Server® 2003/2003 x64 Edition

[*3] BRAdmin Professional and Web BRAdmin are available as a download from http://solutions.brother.com

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2.5 Service Information

These are key service information to maintain the product.

Machine life: 200,000pages or 5years

MTBF (Meantime between failure): Up to 4,000hours

MTTR (Meantime to repair): Average 30minutes

Monthly volume: 35,000pages

Periodical replacement parts:

Parts	Approximate Life
Fuser unit & Toner filter frame ASSY	80,000pages
Laser unit	100,000pages
Paper feeding kit	100,000pages
MP paper feeding kit	50,000pages

* As for periodical replacement parts, refer to Chapter 2 in the Service Manual.

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2.6 Paper

2.6.1 Paper handling

Model		HL-4040CN	HL-4040CDN	HL-4050CDN	HL-4070CDW
Paper Input	Multi-purpose tray	50sheets			
	Paper tray (T1)	250sheets			
	Lower tray (LT)	N/A		500sheets	
Paper Output *	Face-down	150sheets			
Duplex	Manual Duplex	Yes			
	Automatic Duplex	N/A	Yes		

* Calculated with 80g/m^2 (20lb) paper

2.6.2 Media specifications

Model		HL-4040CN	HL-4040CDN	HL-4050CDN	HL-4070CDW
Media types	Multi-purpose tray	Plain paper, Bond paper, Recycled paper, Envelopes, Label, Thin paper, Thick paper, Post card			
	Paper tray (T1)	Plain paper, Recycled paper, Thin paper			
	Lower tray (LT)	N/A		Plain paper, Recycled paper, Thin paper	
	Automatic duplex printing	N/A	Plain paper, Recycled paper, Thin paper		
Media weights	Multi-purpose tray	60 to 163g/m^2 (16 to 43lb)			
	Paper tray (T1)	60 to 105g/m^2 (16 to 28lb)			
	Lower tray (LT)	N/A		60 to 105g/m^2 (16 to 28lb)	
	Automatic duplex printing	N/A	60 to 105g/m^2 (16 to 28lb)		
Media sizes	Multi-purpose tray	Width: 69.8 to 216mm (2.75 to 8.5in.) Length: 116 to 406.4mm (4.57 to 16in.)			
	Paper tray (T1)	A4, Letter, Legal*, B5 (ISO), Executive, A5, A6, B6 (ISO), Folio			
	Lower tray (LT)	N/A		A4, Letter, Legal*, B5 (ISO), Executive, A5, B6 (ISO), Folio	
	Automatic duplex printing	N/A	Letter, Legal*		

* Legal size paper is not available in some regions outside the USA and Canada.

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2.6.3 Type and size of paper

The printer loads paper from the installed paper tray or the multi-purpose tray. The names for the paper trays in the printer driver as follows;

Paper tray (T1)	Tray 1
Multi-purpose tray (MP)	MP Tray
Optional lower tray unit (LT) (for HL-4050CDN/4070CDW)	Tray 2
Duplex unit for automatic duplex printing (for HL-4040CDN/4050CDN/4070CDW)	DX

<Media type>

	Tray 1	**Tray 2** (HL-4050CDN/ 4070CDW)	**MP Tray**	**DX** (HL-4040CDN/ 4050CDN/ 4070CDW)	**Choose the media type from the printer driver**
Plain paper 75 to 105g/m^2 (20 to 28lb)	Yes	Yes	Yes	Yes	**Plain paper**
Recycled paper	Yes	Yes	Yes	Yes	**Recycled paper**
Bond paper Rough paper- 60 to 163g/m^2 (16 to 43lb)	N/A	N/A	Yes 60 to 161g/m^2 (16 to 43lb.)	N/A	**Bond paper**
Thin paper 60 to 75g/m^2 (16 to 20lb)	Yes	Yes	Yes	Yes	**Thin paper**
Thick paper 105 to 163g/m^2 (28 to 43lb)	N/A	N/A	Yes	N/A	**Thick Paper or Thicker Paper**
Label	N/A	N/A	Yes A4 or Letter	N/A	**Thicker Paper**
Envelopes	N/A	N/A	Yes	N/A	**Envelopes, Env. Thin, Env. Thick**

Memo:

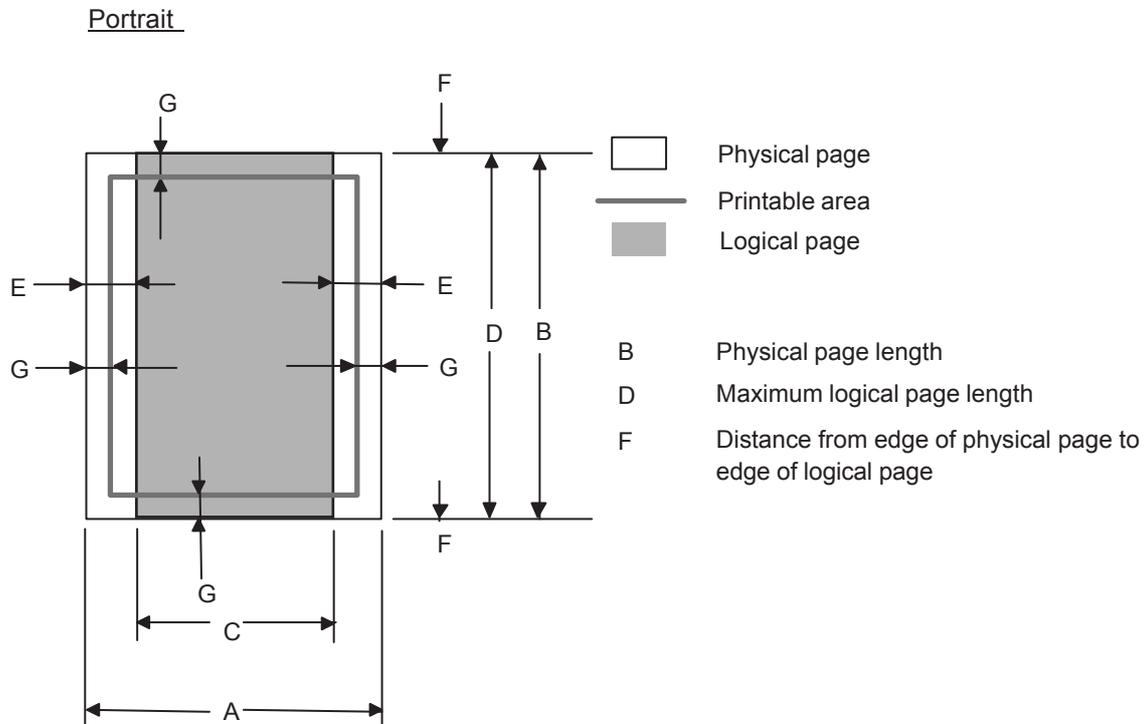- Use paper that is made for plain-paper copying.

- Use papers that is 75 to 90g/m^2 (20 to 24lb).

- Use neutral paper. Do not use acidic or alkaline paper.

- Use long-grain paper.

- Use paper with a moisture content of approximately 5%.

- This printer can use recycled paper that meets DIN 19309 specifications.

- DO NOT use ink jet paper because it may cause a paper jam or damage your printer.

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2.7 Printable Area

2.7.1 PCL5e emulation

When using PCL emulation, the edges of the paper that cannot be printed on are shown below.

Portrait

	Physical page
	Printable area
	Logical page

B	Physical page length
D	Maximum logical page length
F	Distance from edge of physical page to edge of logical page

Note:

- "Logical page" shows the printable area for a PCL driver.

- "Printable area" shows mechanical printable area of the machine.

- Therefore, the machine can only print within the shaded area when you use a PCL driver.
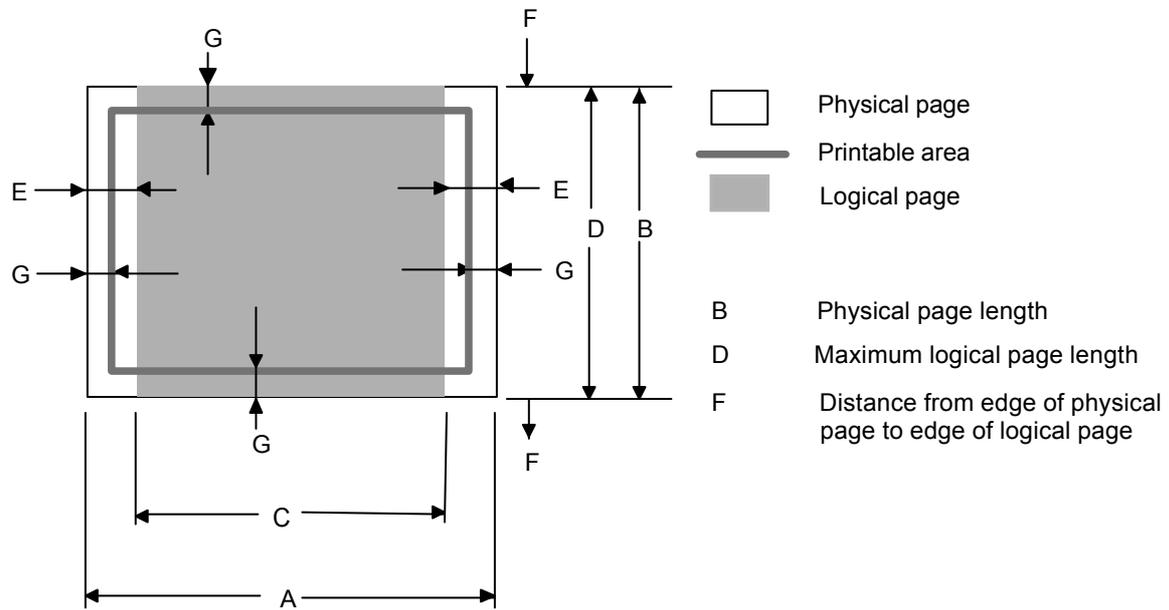
The table below shows the printable areas when printing on Portrait for each paper size.

Size	A	B	C	D	E	F	G
Letter	215.9mm 8.5" (2,550dots)	279.4mm 11.0" (3,300dots)	203.2mm 8.0" (2,400dots)	279.4mm 11.0" (3,300dots)	6.35mm 0.25" (75dots)	0mm	4.2mm 0.16" (50dots)
Legal	215.9mm 8.5" (2,550dots)	355.6mm 14.0" (4,200dots)	203.2mm 8.0" (2,400dots)	355.6mm 14.0" (4,200dots)	↑	0mm	4.2mm 0.16" (50dots)
Folio	215.9mm 8.5" (2,550dots)	330.2mm 13.0" (3,900dots)	203.2mm 8.0" (2,400dots)	330.2mm 13.0" (3,900dots)	↑	0mm	4.2mm 0.16" (50dots)
Executive	184.15mm 7.25" (2,175dots)	266.7mm 10.5" (3,150dots)	175.7mm 6.92" (2,025dots)	266.7mm 10.5" (3,150 dots)	6.35mm 0.25" (75dots)	0mm	4.2mm 0.16" (50dots)
A4	210.0mm 8.27" (2,480dots)	297.0mm 11.69" (3,507dots)	198.0mm 7.79" (2,338dots)	297.0mm 11.69" (3,507dots)	6.01mm 0.24" (71dots)	0mm	4.2mm 0.16" (50dots)
A5	148.5mm 5.85" (1,754dots)	210.0mm 8.27" (2,480dots)	136.5mm 5.37" (1,612dots)	210.0mm 8.27" (2,480dots)	↑	0mm	4.2mm 0.16" (50dots)
A6	105.0mm 4.13" (1,240dots)	148.5mm 5.85" (1,754dots)	93.0mm 3.66" (1,098dots)	148.5mm 5.85" (1,754dots)	↑	0mm	4.2mm 0.16" (50dots)
B5 (JIS)	182.0mm 7.1" (2,130dots)	257.0mm 10.11" (3,033dots)	170.0mm 6.69" (2,007dots)	257.0mm 10.11" (3,033dots)	↑	0mm	4.2mm 0.16" (50dots)
B5 (ISO)	176.0mm 6.93" (2,078dots)	250.0mm 9.84" (2,952dots)	164.0mm 6.46" (1,936dots)	250.0mm 9.84" (2,952dots)	↑	0mm	4.2mm 0.16" (50dots)
B6 (ISO)	125.0mm 4.92" (1,476dots)	176.0mm 6.93" (2,078dots)	164.0mm 4.44" (1,334dots)	176.0mm 6.93" (2.078dots)	↑	0mm	4.2mm 0.16" (50dots)
Envelope Monarch	98.43mm 3.875" (1,162dots)	190.5mm 7.5" (2,250dots)	85.7mm 3.37" (1,012dots)	190.5mm 7.5" (2,250dots)	↑	0mm	4.2mm 0.16" (50dots)
Envelope Com-10	104.7mm 4.12" (1,237dots)	241.3mm 9.5" (2,850dots)	92.0mm 3.62" (1,087dots)	241.3mm 9.5" (2,850dots)	6.35mm 0.25" (75dots)	0mm	4.2mm 0.16" (50dots)
Envelope DL	111.0mm 4.33" (1,299dots)	220.0mm 8.66" (2,598dots)	98.0mm 3.86" (1,157dots)	220.0mm 8.66" (2,598dots)	↑	0mm	4.2mm 0.16" (50dots)
Envelope C5	162.0mm 6.38" (1,913dots)	229.0mm 9.01" (2,704dots)	150.0mm 5.9" (1,771dots)	229.0mm 9.01" (2,704dots)	6.01mm 0.24" (71dots)	0mm	4.2mm 0.16" (50dots)
Post Card	100.0mm 3.94" (1,181dots)	148.0mm 5.83" (1,748dots)	88.0mm 3.46" (1,039dots)	148.0mm 5.83" (1,748dots)	6.01mm 0.24" (71dots)	0mm	4.2mm 0.16" (50dots)
A4 Long	210.0mm 8.27" (2,480dots)	405.0mm 15.94" (4,783dots)	198.0mm 7,79" (2,338dots)	405.0mm 15.94" (4,783dots)	6.01mm 0.24" (71dots)	0mm	4.2mm 0.16" (50dots)
DL Long Edge	220.0mm 8.66" (2,598dots)	110.0mm 4.33" (1,299dots)	207.0mm 8.17" (2,450dots)	110.0mm 4.33" (1,299dots)	6.26mm 0.25" (74dots)	0mm	4.2mm 0.16" (50dots)
3X5	76.2mm 3.00" (900dots)	127.0mm 5.00" (1,500dots)	63.5mm 2.50" (750dots)	127.0mm 5.00" (1,500dots)	6.35mm 0.25" (75dots)	0mm	4.2mm 0.16" (50dots)
Organizer J	69.9mm 2.75" (825dots)	127.0mm 5.00" (1,500dots)	57.2mm 2.25" (675dots)	127.0mm 5.00" (1,500dots)	6.35mm 0.25" (75dots)	0mm	4.2mm 0.16" (50dots)
Organizer K	95.3mm 3.75" (1,125dots)	171.5mm 6.75" (2,025dots)	82.6mm 3.25" (975dots)	171.5mm 6.75" (2,025dots)	6.35mm 0.25" (75dots)	0mm	4.2mm 0.16" (50dots)
Organizer L	139.7mm 5.50" (1,650dots)	215.9mm 8.50" (2,550dots)	127.0mm 5.00" (1,500dots)	215.9mm 8.50" (2,550dots)	6.35mm 0.25" (75dots)	0mm	4.2mm 0.16" (50dots)
Organizer M	215.9mm 8.50" (2,550dots)	279.4mm 11.0" (3,300dots)	203.2mm 8.00" (2,400dots)	279.4mm 11.0" (3,300dots)	6.35mm 0.25" (75dots)	0mm	4.2mm 0.16" (50dots)

Note:
- The paper sizes indicated here should confirm to the nominal dimensions specified by JIS except B5 (ISO), B6 (ISO).

- The dot size is based on 300dpi resolution.

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Landscape

	Physical page
	Printable area
	Logical page

B	Physical page length
D	Maximum logical page length
F	Distance from edge of physical page to edge of logical page

Note:

- "Logical page" shows the printable area for a PCL driver.

- "Printable area" shows mechanical printable area of the machine.

- Therefore, the machine can only print within the shaded area when you use a PCL driver.

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The table below shows the printable areas when printing on Landscape for each paper size.

Size	A	B	C	D	E	F	G
Letter	279.4mm 11.0" (3,300dots)	215.9mm 8.5" (2,550dots)	269.3mm 10.6" (3,180dots)	215.9mm 8.5" (2,550dots)	5.0mm 0.2" (60dots)	0mm	4.2mm 0.16" (50dots)
Legal	355.6mm 14.0" (4,200dots)	215.9mm 8.5" (2,550dots)	345.5mm 13.6" (4,080dots)	215.9mm 8.5" (2,550dots)	↑	0mm	4.2mm 0.16" (50 dots)
Folio	330.2mm 13.0" (3,900 dots)	215.9mm 8.5" (2,550dots)	320.0mm 12.6" (3,780dots)	215.9mm 8.5" (2,550dots)	↑	0mm	4.2mm 0.16" (50dots)
Executive	266.7mm 10.5" (3,150dots)	184.15mm 7.25" (2,175dots)	256.6mm 10.1" (3,030dots)	184.15mm 7.25" (2,175dots)	5.0mm 0.2" (60dots)	0mm	4.2mm 0.16" (50dots)
A4	297.0mm 11.69" (3,507dots)	210.0mm 8.27" (2,480dots)	287.0mm 11.2" (3,389dots)	210.0mm 8.27" (2,480dots)	4.8mm 0.19" (59dots)	0mm	4.2mm 0.16" (50dots)
A5	210.0mm 8.27" (2,480dots)	148.5mm 5.85" (1,754dots)	200.0mm 7.87" (2,362dots)	148.5mm 5.85" (1,754dots)	↑	0mm	4.2mm 0.16" (50dots)
A6	148.5mm 5.85" (1,754dots)	105.0mm 4.13" (1,240dots)	138.5mm 5.45" (1,636dots)	105.0mm 4.13" (1,240dots)	↑	0mm	4.2mm 0.16" (50dots)
B5 (JIS)	257.0mm 10.11" (3,033dots)	182.0mm 7.1" (2,130dots)	247.0mm 9.72" (2,916dots)	182.0mm 7.1" (2,130dots)	↑	0mm	4.2mm 0.16" (50dots)
B5 (ISO)	250.0mm 9.84" (2,952dots)	176.0mm 6.93" (2,078dots)	240.0mm 9.44" (2,834dots)	176.0mm 6.93" (2,078dots)	↑	0mm	4.2mm 0.16" (50dots)
B6 (ISO)	176.0mm 6.93" (2,078dots)	125.0mm 4.92" (1,476dots)	166.4mm 6.55" (1,960dots)	125.0mm 4.92" (1,476dots)	↑	0mm	4.2mm 0.16" (50dots)
Envelope Monarch	190.5mm 7.5" (2,250dots)	98.43mm 3.875" (1,162dots)	180.4mm 7.1" (2,130dots)	98.43mm 3.875" (1,162dots)	↑	0mm	4.2mm 0.16" (50dots)
Envelope Com-10	241.3mm 9.50" (2,850dots)	104.7mm 4.12" (1,237dots)	231.1mm 9.10" (2,730dots)	104.7mm 4.12" (1,237dots)	5.0mm 0.20" (60dots)	0mm	4.2mm 0.16" (50dots)
Envelope DL	220mm 8.66" (2,598dots)	110mm 4.33" (1,299dots)	210.0mm 8.26" (2,480dots)	110mm 4.33" (1,299dots)	↑	0mm	4.2mm 0.16" (50dots)
Envelope C5	229mm 9.01" (2,704dots)	162mm 6.38" (1,913dots)	219.0mm 8.62" (2,586dots)	162mm 6.38" (1,913dots)	4.8mm 0.19" (59dots)	0mm	4.2mm 0.16" (50dots)
Post Card	148mm 5.83" (1,748dots)	100mm 3.94" (1,181dots)	138mm 5.43" (1,630dots)	100mm 3.94" (1,181dots)	4.8mm 0.19" (59dots)	0mm	4.2mm 0.16" (50dots)
A4 Long	405mm 15.94" (4,783dots)	210mm 8.27" (2,480dots)	395mm 15.55" (4,665dots)	210mm 8.27" (2,480dots)	4.8mm 0.19" (59dots)	0mm	4.2mm 0.16" (50dots)
DL Long Edge	110mm 4.33" (1,299dots)	220mm 8.66" (2,598dots)	102mm 4.00" (1,199dots)	220mm 8.66" (2,598dots)	4.0mm 0.16" (50dots)	0mm	4.2mm 0.16" (50dots)
3X5	127mm 5.00" (1,500dots)	76.2mm 3.00" (900dots)	116.8mm 4.60" (1,380dots)	76.2mm 3.00" (900dots)	5.0mm 0.20" (60dots)	0mm	4.2mm 0.16" (50dots)
Organizer J	127mm 5.00" (1,500dots)	69.9mm 2.75" (825dots)	116.8mm 4.60" (1,380dots)	69.9mm 2.75" (825dots)	5.0mm 0.20" (60dots)	0mm	4.2mm 0.16" (50dots)
Organizer K	171.5mm 6.75" (2,025dots)	95.3mm 3.75" (1,125dots)	161.3mm 6.35" (1,905dots)	95.3mm 3.75" (1,125dots)	5.0mm 0.20" (60dots)	0mm	4.2mm 0.16" (50dots)
Organizer L	215.9mm 8.50" (2,550dots)	139.7mm 5.50" (1,650dots)	205.7mm 8.10" (2,430dots)	139.7mm 5.50" (1,650dots)	5.0mm 0.20" (60dots)	0mm	4.2mm 0.16" (50dots)
Organizer M	279.4mm 11.00" (3,300dots)	215.9mm 8.50" (2,550dots)	269.2mm 10.6" (3,180dots)	215.9mm 8.50" (2,550dots)	5.0mm 0.20" (60dots)	0mm	4.2mm 0.16" (50dots)

Note:
- The paper sizes indicated here should confirm to the nominal dimensions specified by JIS except B5 (ISO), B6 (ISO).
- The dot size is based on 300dpi resolution.

2.7.2 PCL6 emulation

You cannot print within 4.2mm (50dots in 300dpi mode) on all four sides of the paper.

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2.8 Print Speeds with Various Settings

Print speed is up to 20ppm for A4 size and 21ppm for Letter size when loading A4 or Letter size paper from the paper tray in the plain paper mode.

Actual print speed varies depending on the media type or paper size as shown in the tables below;

<A4/Letter size>

Media type setting	All models
Plain Paper, Recycled Paper	20/21ppm
Plain Paper Thick	20/21ppm
Thick Paper, Envelopes, Envelopes Thin, Label	10ppm
Thicker Paper, Bond Paper, Envelopes Thick	4ppm

<Smaller size than A4 or Letter>

Media type setting	All models
Plain Paper	20/21ppm
Plain Paper Thick, Recycled Paper	60 sec 20/21ppm → 8ppm
Thick Paper, Envelopes, Envelopes Thin, Label	30 sec 10ppm → 8ppm
Thicker Paper, Bond Paper, Envelopes Thick	4ppm
Post Card	30 sec 10ppm → 8ppm

Note:

- The print speed may vary according to conditions, such as paper size and paper tray.

- When a smaller size paper than A4 or Letter is printed, the temperature on both edges of the fuser unit is much higher than the temperature on the center of the unit where the paper is fed depending on the setting or model. Therefore, the print speed is slowed in order to decrease the temperature on the edges after the specified time, it is maximum print speed when you first start printing.

- The actual print speed varies depending on the paper size.

REFERENCE 2   THEORY OF OPERATION
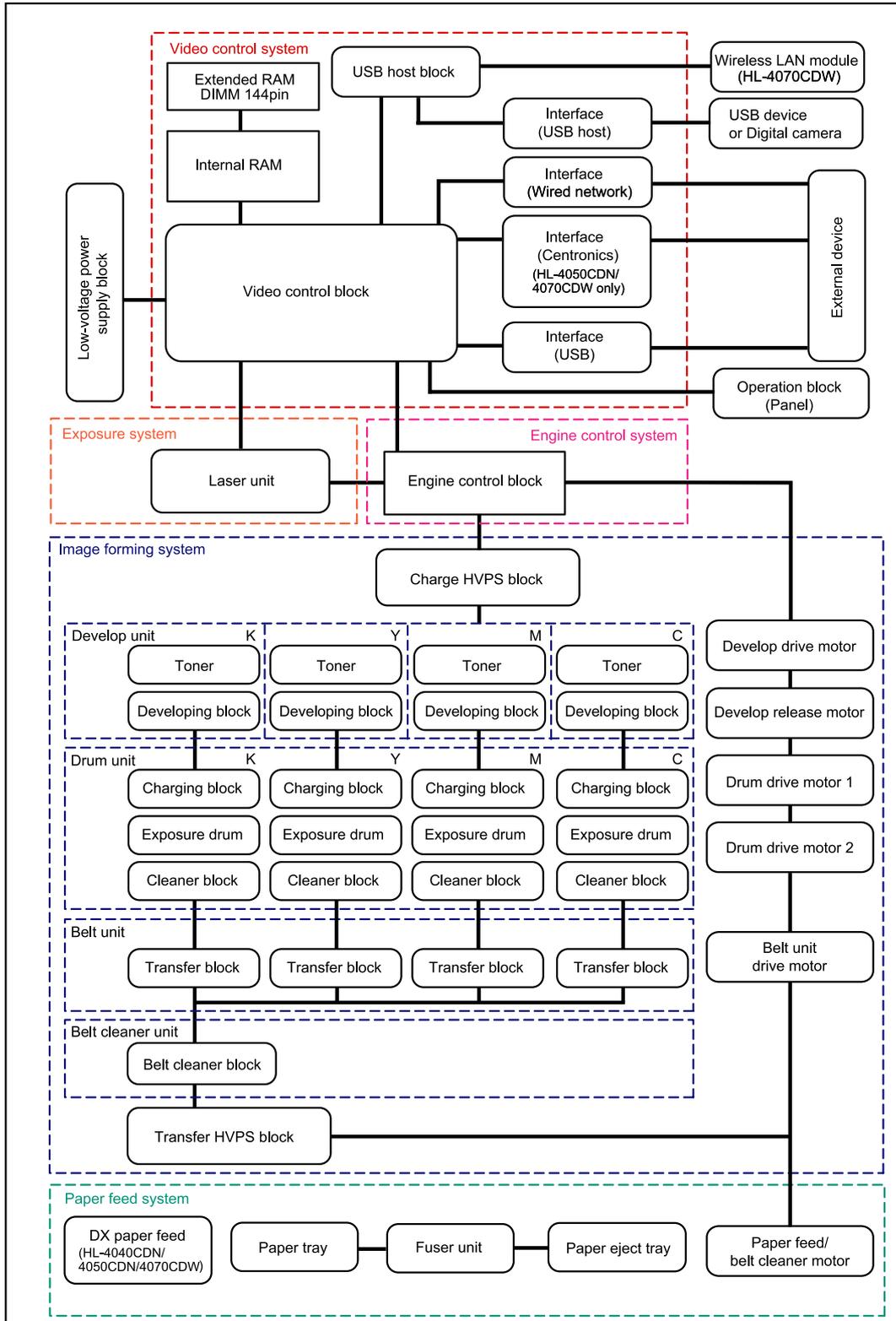
1.   GENERAL BLOCK DIAGRAM

Fig. Ref2-1
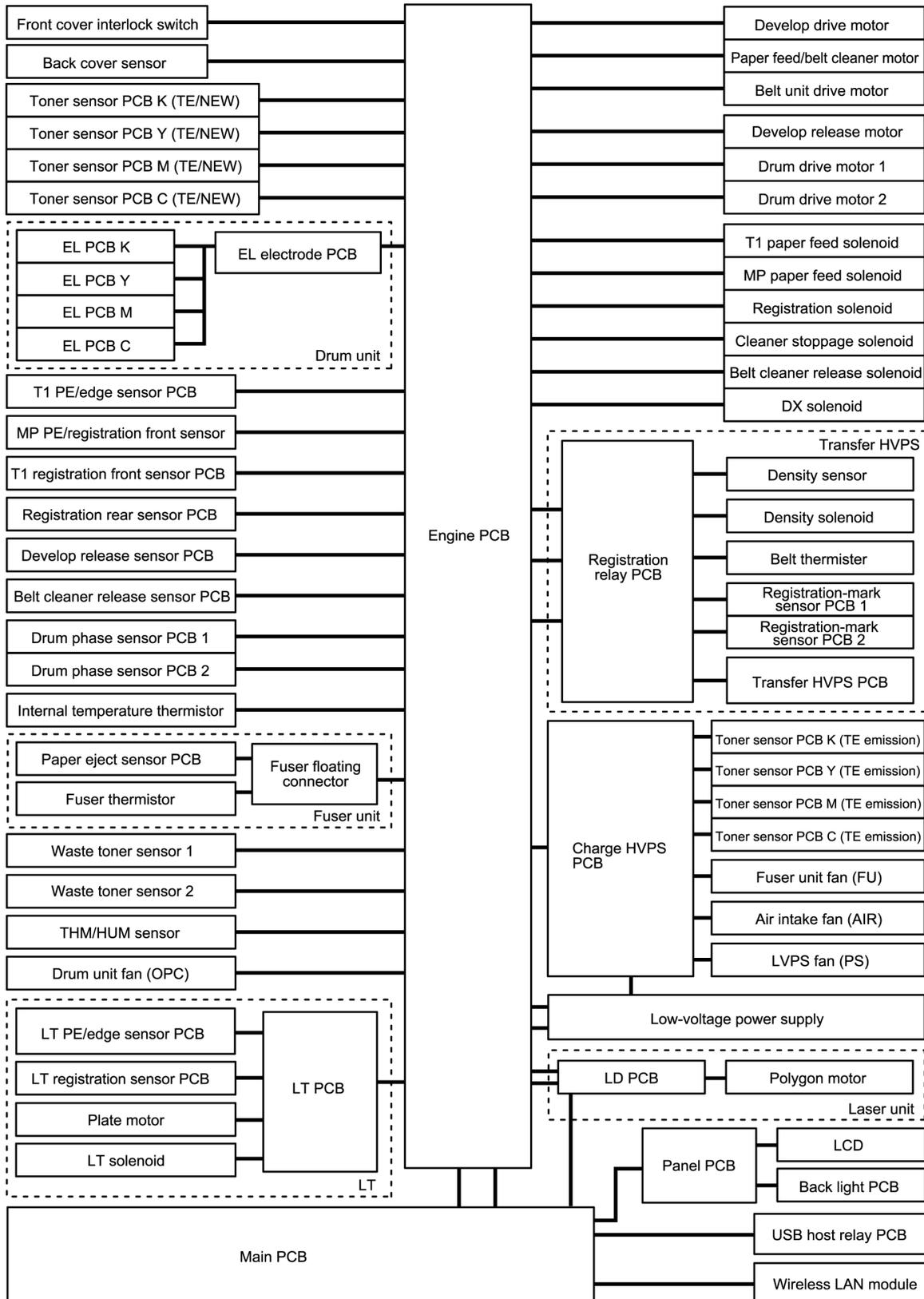
2. ELECTRONICS GENERAL BLOCK DIAGRAM

Front cover interlock switch		Develop drive motor
Back cover sensor		Paper feed/belt cleaner motor
Toner sensor PCB K (TE/NEW)		Belt unit drive motor
Toner sensor PCB Y (TE/NEW)		Develop release motor
Toner sensor PCB M (TE/NEW)		Drum drive motor 1
Toner sensor PCB C (TE/NEW)		Drum drive motor 2

Drum unit
- EL PCB K
- EL PCB Y
- EL PCB M
- EL PCB C
- EL electrode PCB

T1 paper feed solenoid
MP paper feed solenoid
Registration solenoid
Cleaner stoppage solenoid
Belt cleaner release solenoid
DX solenoid

Engine PCB

T1 PE/edge sensor PCB
MP PE/registration front sensor
T1 registration front sensor PCB
Registration rear sensor PCB
Develop release sensor PCB
Belt cleaner release sensor PCB
Drum phase sensor PCB 1
Drum phase sensor PCB 2
Internal temperature thermistor

Transfer HVPS

Registration relay PCB
- Density sensor
- Density solenoid
- Belt thermister
- Registration-mark sensor PCB 1
- Registration-mark sensor PCB 2
- Transfer HVPS PCB

Fuser unit
- Paper eject sensor PCB
- Fuser thermistor
- Fuser floating connector

Charge HVPS PCB
- Toner sensor PCB K (TE emission)
- Toner sensor PCB Y (TE emission)
- Toner sensor PCB M (TE emission)
- Toner sensor PCB C (TE emission)
- Fuser unit fan (FU)
- Air intake fan (AIR)
- LVPS fan (PS)

Waste toner sensor 1
Waste toner sensor 2
THM/HUM sensor
Drum unit fan (OPC)

Low-voltage power supply

LT
- LT PE/edge sensor PCB
- LT registration sensor PCB
- Plate motor
- LT solenoid
- LT PCB

Laser unit
- LD PCB
- Polygon motor

Panel PCB
- LCD
- Back light PCB

Main PCB
- USB host relay PCB
- Wireless LAN module

Fig. Ref2-2

3. MECHANICS

3.1 Cross-section Drawing

Exposure drum (K)
Exposure drum (Y)
Exposure drum (M)
Exposure drum (C)
Paper eject roller shaft ASSY

Supply roller
Develop roller
Registration rear actuator
Registration roller
MP registration front actuator
MP paper feed roller
MP PE actuator
MP separation roller
T1 registration front actuator
T1 PE actuator
T1 edge actuator
T1 separation roller
T1 separation pad
T1 paper feed roller
LT edge actuator
LT separation roller
LT separation pad

Outer chute
Thermistor
Heat roller
Paper eject actuator
Pressure roller ASSY
Back cover
Belt unit

LT paper feed roller
LT PE actuator
Feed roller
Waste toner box
Feed roller

Fig. Ref2-3

3.2 Paper Feeding

The following figure shows the paper feeding paths.

MP path

Paper tray path

LT path

DX path

Fig. Ref2-4

3.2.1 Plate-up Function of the Paper Tray

The plate of the paper tray is pushed up by the force exerted by the motor not by springs so as to keep paper-feeding performance constant irrespective of the quantity of papers remaining in the tray. This paragraph provides an overview of this function.

At the time of inserting the paper tray into the main body of the product, the plate is kept lowered. When the paper feed/belt cleaner motor is operated under such condition, a driving force is transmitted to the lift gear Z42M75 by way of several gears. The force is also transmitted to the plate-up plate to push up the plate.
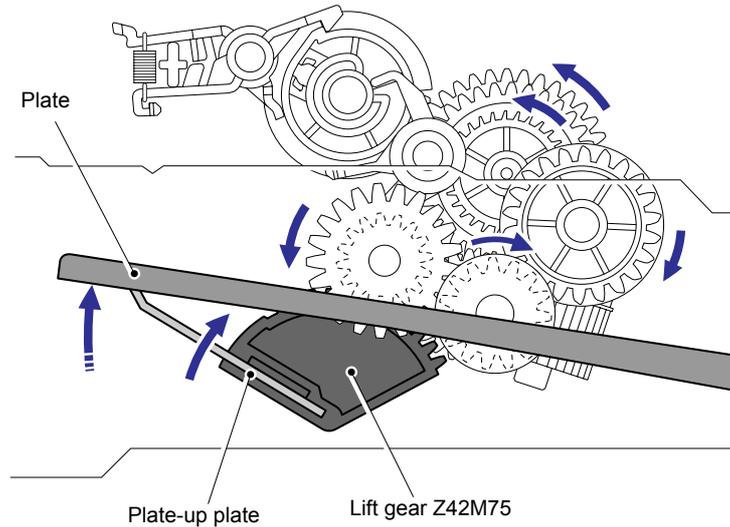
Fig. Ref2-5

When the plate is pushed up, the T1 lift arm goes down and the hook B is released. The PP gear clutch cam off the hook B rotates to push down the rib of the hook A. Subsequently, the ratchet of the hook A for the clutch gear deviates from the gear and the plate-up plate stops its push-up function.
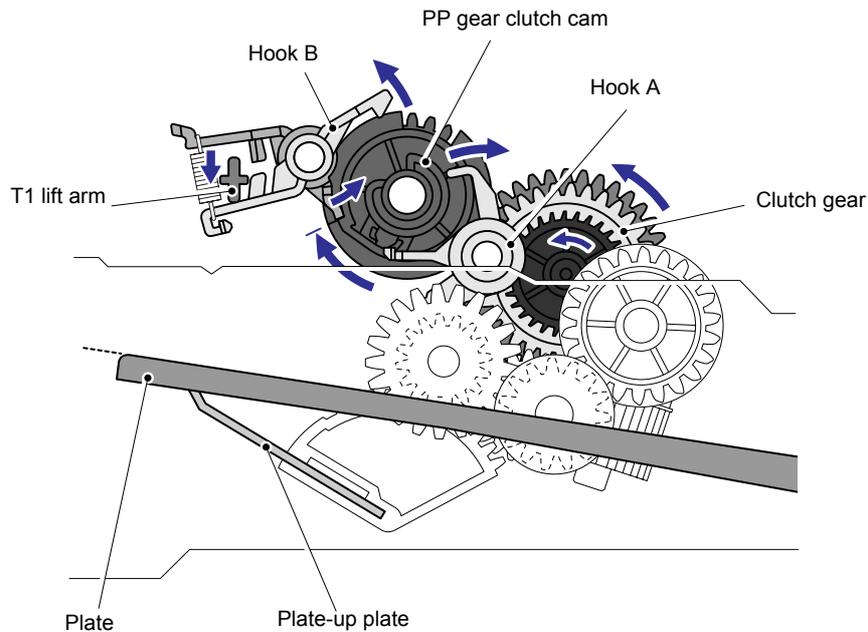
Fig. Ref2-6

3.2.2 Paper Supply

The T1 paper feed roller picks up a few sheets or one sheet of paper from the paper tray every time it is rotated and feeds it to the T1 separation roller. Subsequently, stacks of paper are caught between the T1 separation roller and T1 separation pad, they are then separated into single sheets.
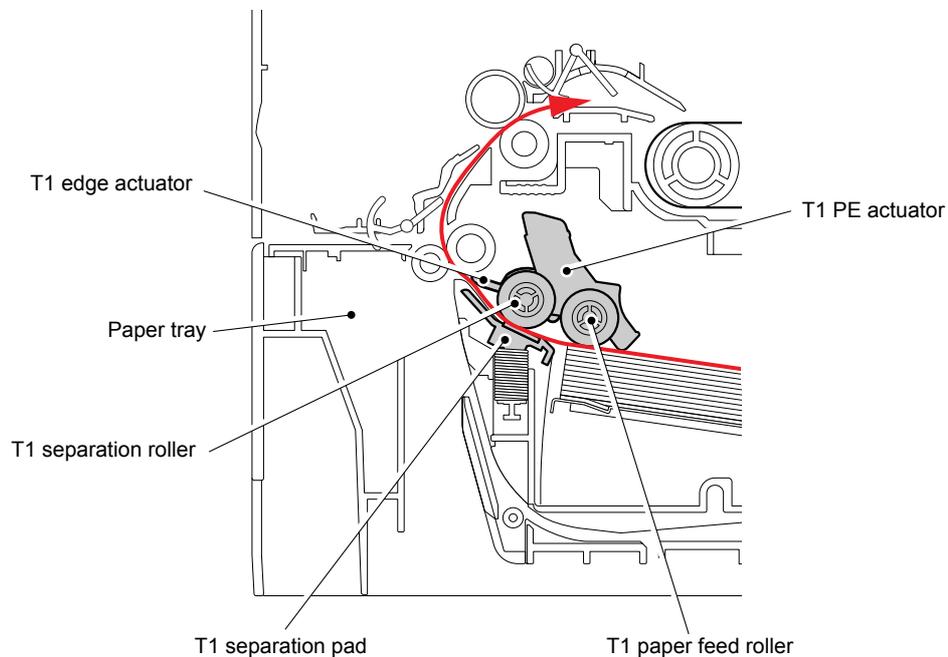
Fig. Ref2-7

<Operation of Actuators>

- The T1 PE actuator detects the presence or absence of paper.
- The T1 edge actuator detects the presence or absence of paper trays and the rear edge of paper.

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3.2.3 Paper Registration

The front-edge position of a sheet of paper after separation by the separation roller is detected by the T1 registration front actuator. Then, the paper is fed further for a certain time, and its front edge hits the stopped registration roller so that the paper skew is corrected. After such correction, the registration roller is rotated in the normal direction and the paper is carried to the belt unit.
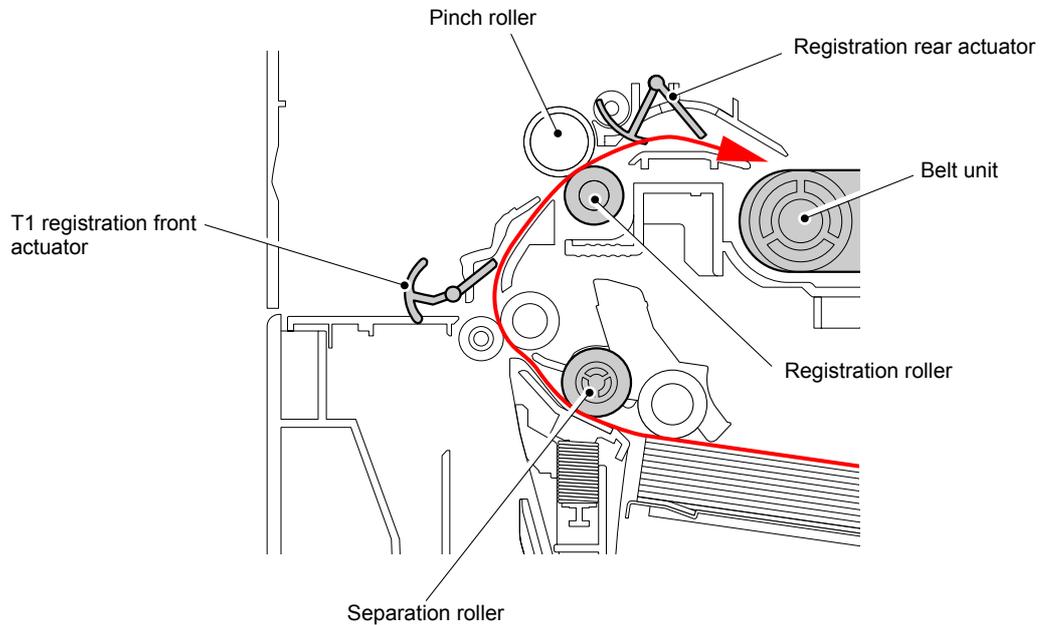
Fig. Ref2-8

<Operation of Actuators>

- The T1 registration front actuator detects the passage of paper.
- The registration rear actuator adjusts the starting position for writing on a sheet of paper.

3.2.4 Paper Eject

Toner on paper is fused by the heat roller and pressure roller ASSY of the fuser unit. Paper moves along the outer chute and is ejected into the face-down output tray from the paper eject roller shaft ASSY with its print side down.
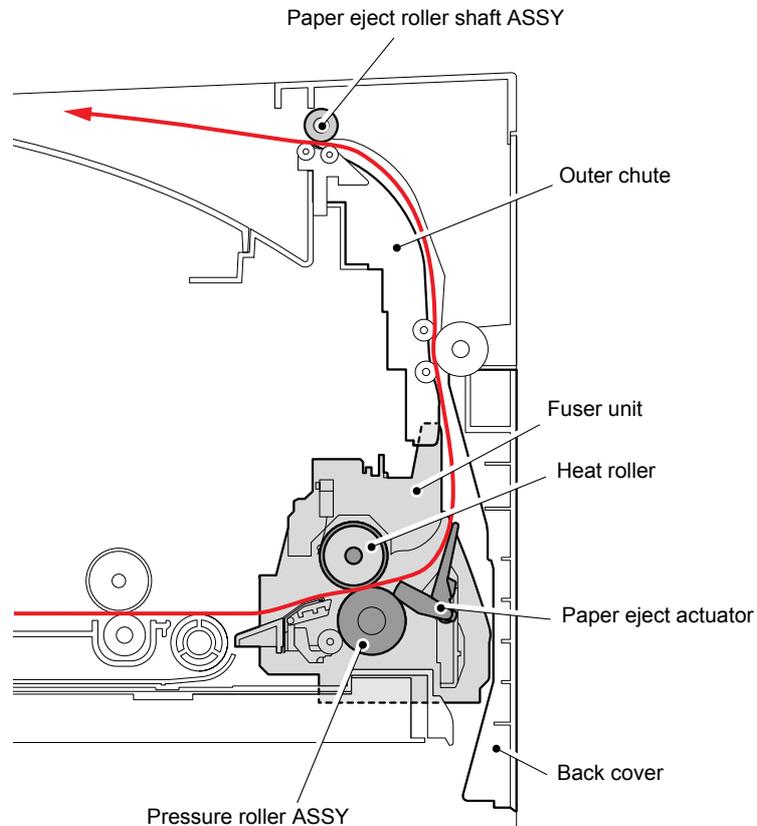
Fig. Ref2-9

Memo:

When a paper jam is detected near the paper eject actuator, the paper feed/belt cleaner motor is revolved in the reverse direction to move the gears out of engagement. The paper eject gears become free, allowing any paper jam to be cleared.

<Operation of Actuators>

The paper eject actuator detects whether or not paper is ejected from the fuser unit.

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3.2.5 Paper Feeding for Duplex Printing (DX) (HL-4040CDN/ 4050CDN/ 4070CDW only)

After the paper eject actuator detects the edge of the paper and a certain volume of paper is sent from the paper eject roller shaft ASSY, it rotates against the normal direction of rotation, thereby enabling the paper to be pulled in and pass between the outer chute and the back cover. The paper is subsequently sent to the back of the paper tray, and to the belt unit again by way of the feed roller. Printing is done on the back side of the paper.

Here, "the back side of paper" refers to the paper side which is printed for the second time. In actual duplex printing, an even page is printed as the first print side after being turned upside down 180 degrees, and then an odd page is printed as the second print side.
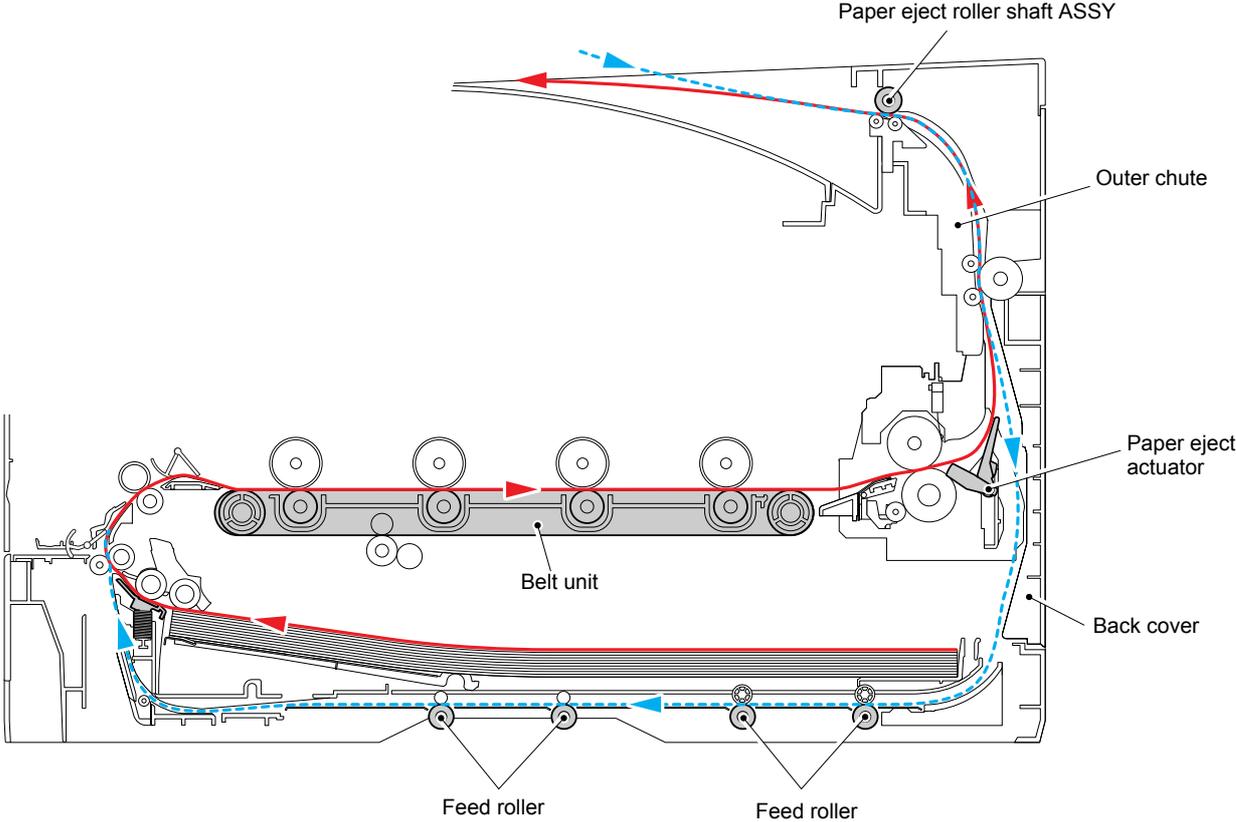
Fig. Ref2-10

3.2.6 Paper Feeding from the MP Tray (MP)

When the MP paper feed roller making contact with paper is driven, the paper is drawn out of the MP tray. The drawn paper is separated into individual sheets by the MP separation roller.
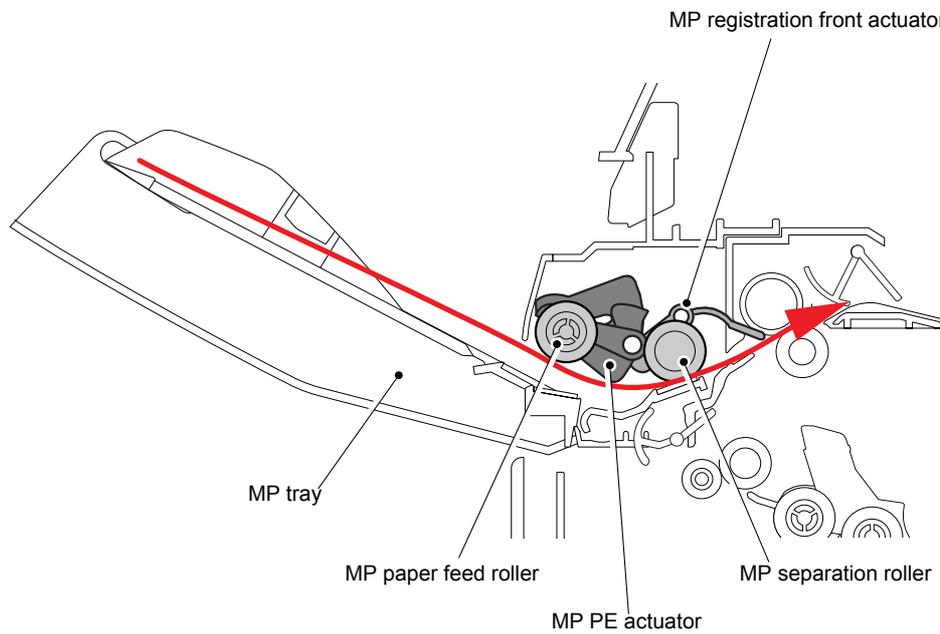
Fig. Ref2-11

<Operation of Actuators>

- The MP registration front actuator detects the passage of paper.
- The MP PE actuator detects the presence or absence of paper.

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3.2.7 Paper Feeding from the Tray 2 (LT) (HL-4050CDN/ 4070CDW only)

The driving force from the paper feed/belt cleaner motor is transmitted to the gear of tray 2 (LT) to rotate the LT paper feed roller so that the paper is fed. The paper is separated into individual sheets by the LT separation roller and fed to the machine.
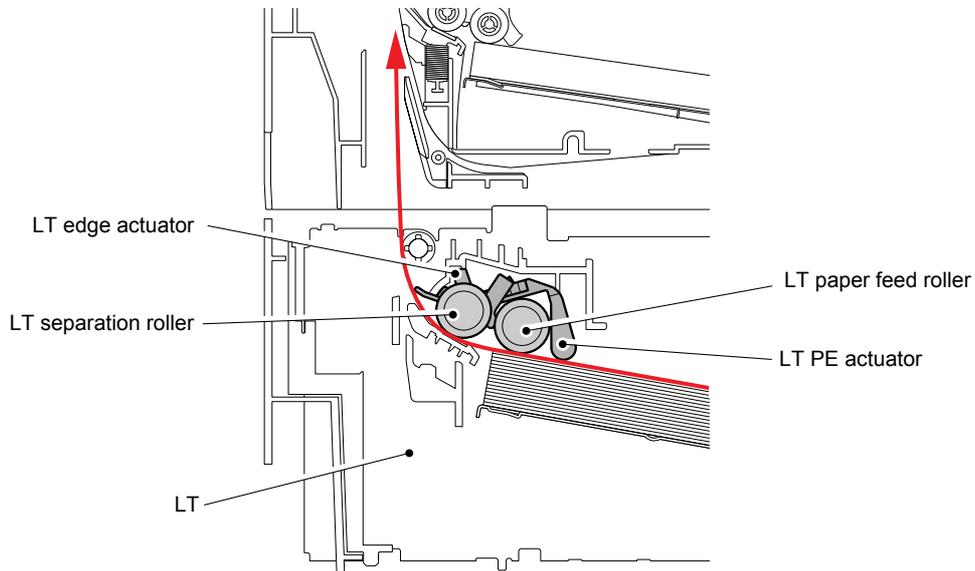
Fig. Ref2-12

<Operation of Actuators>

- The LT PE actuator detects the presence or absence of paper.
- The LT edge actuator detects the rear edge of the paper.

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3.3 Toner Cartridge

3.3.1 Methods for Detecting and Counting Toner Life

"Toner Life End" is displayed through the following two ways. First, such indication is displayed when detection is performed by the toner sensor; second, it is displayed at the time when a rotation rate of the develop roller reaches its upper limit.

(1) Detection by the toner sensor

The amount of toner remaining can be detected by checking the imperviousness to light of the toner in the cartridge by means of the transmissive photosensor.

(2) Detection by means of rotation rates of the develop roller reached its upper limit

The upper limit of such rotation rates can be detected before the develop roller becomes unusable due to wear.

<When a new toner cartridge is inserted after "Toner Life End" is displayed>

Corresponding counter, Setting value	Operation
Counter of toner cartridge changes	+1
Page counter for each toner cartridge	Reset (0)
Coverage for each toner cartridge	Reset (0)
Developing bias voltage	Reset (Initial setting)

<When a toner cartridge in use is inserted after "Toner Life End" is displayed by toner sensor detection [1]>

A count value before changes is continuously indicated as a rotation rate of the develop roller. Irrespective of the amount of toner, printing becomes disabled when the rotation rate reaches the upper limit.

Corresponding counter, Setting value	Operation
Counter of toner cartridge changes	No count up
Page counter for each toner cartridge	Continued
Coverage for each toner cartridge	Continued
Developing bias voltage	Reset (Initial setting)[2]

[1] Excluding a toner cartridge in use in which there is a little toner remained.

[2] The developing bias voltage is reset to the initial setting once when a toner cartridge in use is inserted. After resetting, the developing bias voltage correction is performed so that the developing bias voltage is corrected according to the amount of toner.

Note:

The descriptions in the above tables apply to all the four colors.

3.3.2 Toner Life End

A new toner cartridge can print with standard toner approximately 2,500 (black), 1,500 (yellow, magenta, cyan), with high capacity toner, approximately 5,000 (black), 4,000 (yellow, magenta, cyan) in the case of A4 or Letter size single-sided pages at 5% coverage.

If printing A4 paper at 5% print coverage or less, the "Toner Life End" message is displayed before the machine runs out of toner, and the printing operations are inhibited, in order to avoid the problem due to wear on the surface of the developing roller, deterioration of the toner seals or the like. The upper limit of the rotation rate of the develop roller is 55,500 rotations (3,000 pages x 18.5 rotations) for standard black toner; 33,300 rotations (1,800 pages x 18.5 rotations) for standard toners of yellow, magenta and cyan. In addition, the limit is 111,000 rotations (6,000 pages x 18.5 rotations) for high-capacity black toner; 92,500 rotations (5,000 pages x 18.5 rotations) for the high-capacity toners of yellow, magenta and cyan.

The following graph shows the number of printable pages in the case of A4 printing.

Memo:

The number of rotation of the developer roller per page is as follows.
  - One printed page only or the first page of continuous printing = 18.5 rotations
  - After 2 pages for continuous printing = 5.6 rotations

Number of idling rotation when the printer is turned ON = 12 rotations

■ Standard toner cartridge (Black) * Approximately 2500 pages

Page/job	1	2	3	4	5	6	7	8	9	10	11	12
Cartridge life	3,000	4,606	5,606	6,289	6,785	7,161	7,457	7,695	7,891	8,055	8,195	8,315
Cartridge life+ON/OFF	1,820	3,075	3,993	4,693	5,246	5,692	6,061	6,370	6,633	6,860	7,058	7,231
Toner empty (5% Coverage)	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Toner empty (4% Coverage)	3,125	3,125	3,125	3,125	3,125	3,125	3,125	3,125	3,125	3,125	3,125	3,125
Toner empty (3% Coverage)	4,167	4,167	4,167	4,167	4,167	4,167	4,167	4,167	4,167	4,167	4,167	4,167
Toner empty (2% Coverage)	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250
Toner empty (1% Coverage)	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500

Cartridge life = 18.5a x 3000 / (5.6 x (a - 1) + 18.5)   a : Page / job

Cartridge life+ON/OFF = (18.5a x 3000) / (5.6 x (a - 1) + 18.5 + 12)

Cartridge life (Mechanical limit) :   3000   (1page / job)
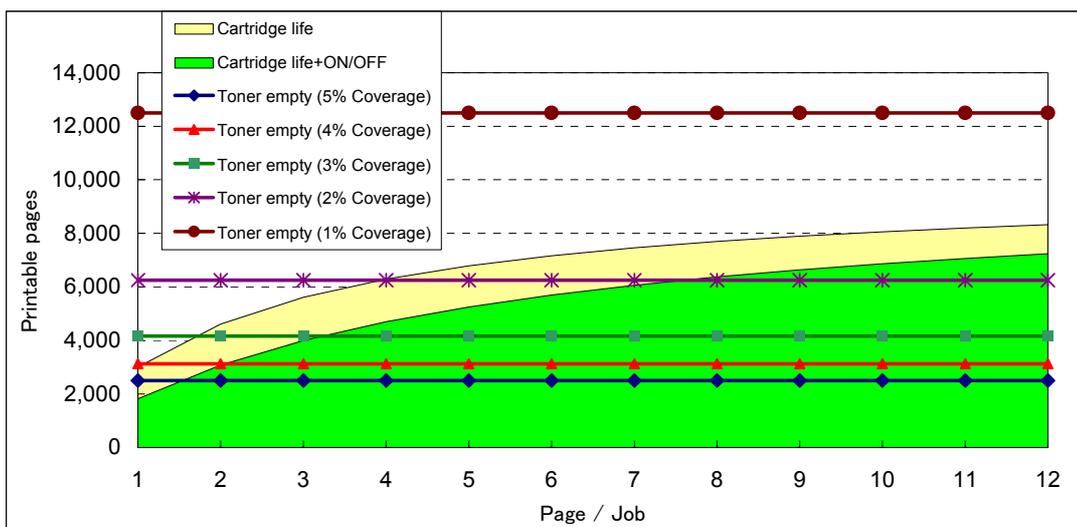
## ■ Standard toner cartridge (Yellow, Magenta, Cyan) * Approximately 1500 pages

Page/job	1	2	3	4	5	6	7	8	9	10	11	12
Cartridge life	1,800	2,763	3,364	3,773	4,071	4,297	4,474	4,617	4,735	4,833	4,917	4,989
Cartridge life+ON/OFF	1,092	1,845	2,396	2,816	3,147	3,415	3,637	3,822	3,980	4,116	4,235	4,339
Toner empty (5% Coverage)	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Toner empty (4% Coverage)	1,875	1,875	1,875	1,875	1,875	1,875	1,875	1,875	1,875	1,875	1,875	1,875
Toner empty (3% Coverage)	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Toner empty (2% Coverage)	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750
Toner empty (1% Coverage)	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500

Cartridge life = 18.5a x 1800 / (5.6 x (a - 1) + 18.5)   a : Page / job

Cartridge life+ON/OFF = (18.5a x 1800) / (5.6 x (a - 1) + 18.5 + 12)

Cartridge life (Mechanical limit) :   1800   (1page / job)
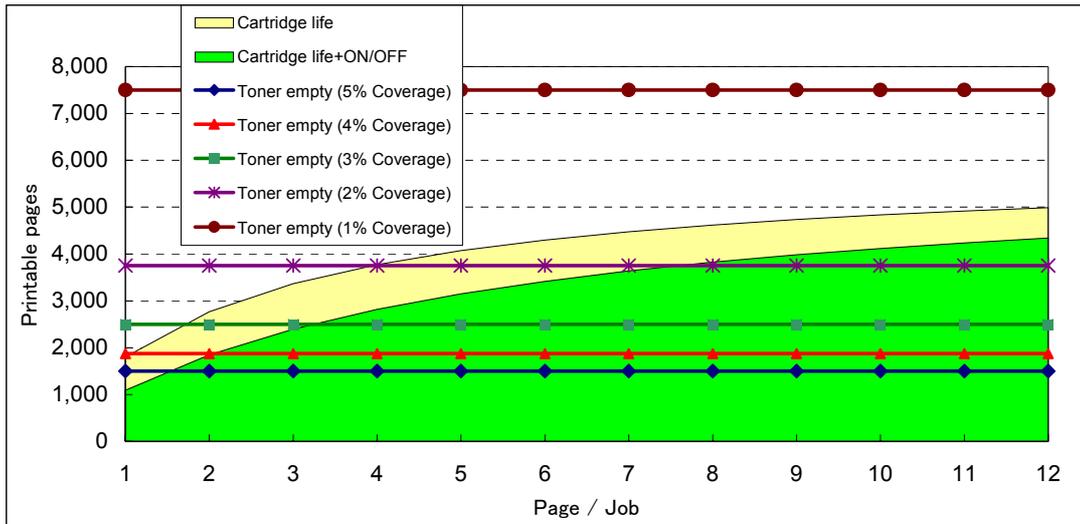
■ High-capacity toner cartridge (Black) * Approximately 5000 pages

Page/job	1	2	3	4	5	6	7	8	9	10	11	12
Cartridge life	6,000	9,212	11,212	12,578	13,570	14,323	14,914	15,390	15,782	16,110	16,389	16,629
Cartridge life+ON/OFF	3,639	6,150	7,986	9,387	10,491	11,385	12,122	12,740	13,267	13,721	14,116	14,463
Toner empty (5% Coverage)	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Toner empty (4% Coverage)	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250
Toner empty (3% Coverage)	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333
Toner empty (2% Coverage)	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500
Toner empty (1% Coverage)	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000

Cartridge life = 18.5a x 6000 / (5.6 x (a - 1) + 18.5)   a : Page / job

Cartridge life+ON/OFF = (18.5a x 6000) / (5.6 x (a - 1) + 18.5 + 12)

Cartridge life（Mechanical limit）:   6000 (1page / job)
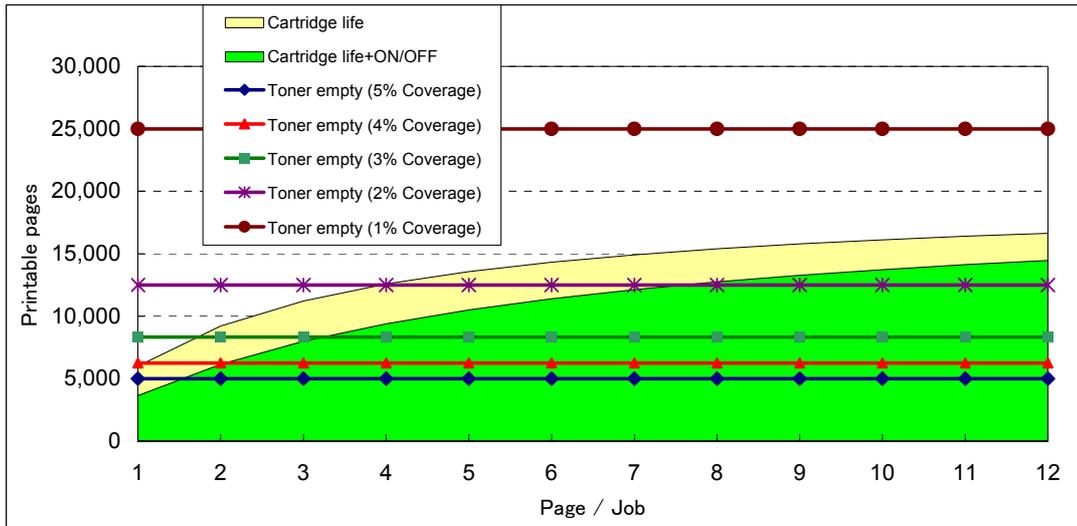
■ High-capacity toner cartridge (Yellow, Magenta, Cyan) * Approximately 4000 pages

Page/job	1	2	3	4	5	6	7	8	9	10	11	12
Cartridge life	5,000	7,676	9,343	10,482	11,308	11,935	12,428	12,825	13,152	13,425	13,658	13,858
Cartridge life+ON/OFF	3,033	5,125	6,655	7,822	8,743	9,487	10,101	10,617	11,056	11,434	11,763	12,052
Toner empty (5% Coverage)	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
Toner empty (4% Coverage)	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Toner empty (3% Coverage)	6,667	6,667	6,667	6,667	6,667	6,667	6,667	6,667	6,667	6,667	6,667	6,667
Toner empty (2% Coverage)	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Toner empty (1% Coverage)	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000

Cartridge life = 18.5a x 5000 / (5.6 x (a - 1) + 18.5)   a : Page / job

Cartridge life+ON/OFF = (18.5a x 5000) / (5.6 x (a - 1) + 18.5 + 12)

Cartridge life (Mechanical limit) :   5000   (1page / job)
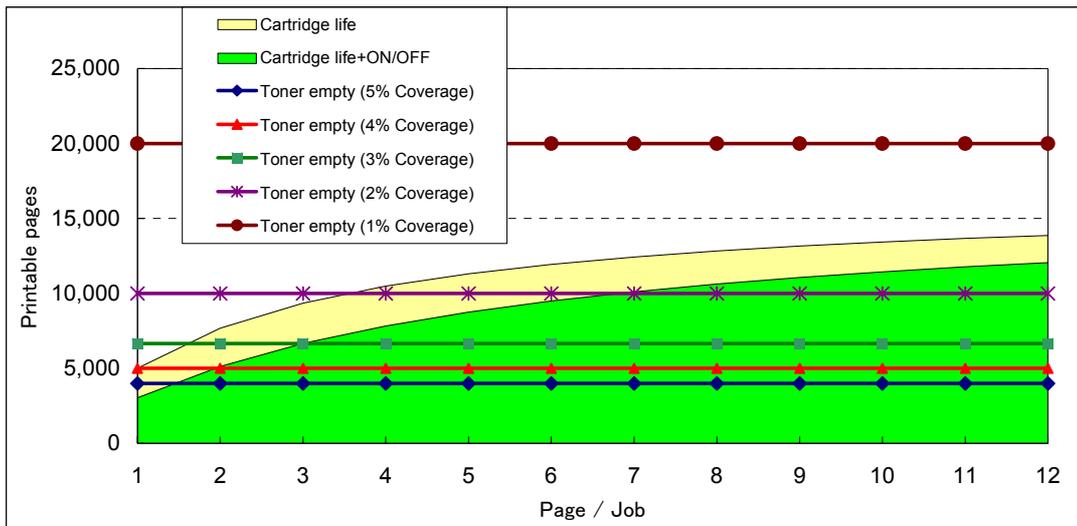
3.3.3 New Toner Detection

When a toner cartridge is changed, discrimination between new and secondhand toner cartridges is performed by means of the new toner detection mechanism shown below.

<New Toner Detection Mechanism>

The rotation of the gear (1) of the toner cartridge is transmitted to the reset gear, and the rib of the gear pushes down the reset upper lever attached to the drum unit.

By pushing down the reset upper lever, the linked reset lever turns and pushes up the new toner actuator with its lever fitted on the main body. The detection mechanism detects that new toner is provided.

- For high-capacity toner cartridges

  The reset gear has two ribs. The new toner actuator is pushed up twice by these ribs, allowing the presence of a high-capacity toner cartridge to be detected.

- For standard toner cartridges

  The reset gear has one rib. The new toner actuator is pushed up once by this rib, allowing the presence of a standard toner cartridge to be detected.
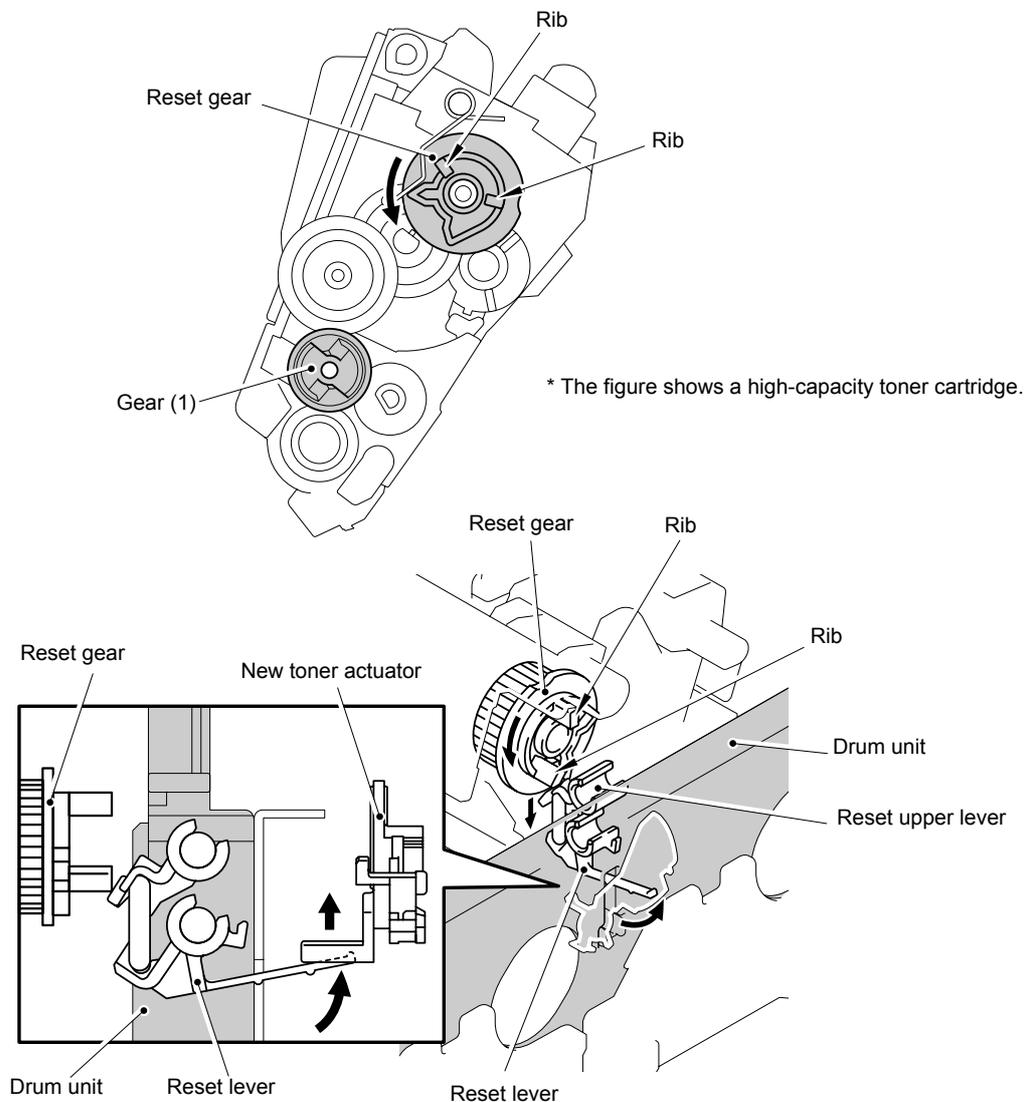
Fig. Ref2-13

<Developing Bias Voltage>

When the new toner detection mechanism detects the change to a new toner cartridge, the developing bias voltage is reset. Toner in use tends to have a low printing density at the time of first use, but the density gradually becomes higher after a certain period of use.

The properties of the toner is controlled by means of the developing bias voltage. The values are varied according to counts of the amount of toner used immediately after a toner cartridge is changed so that excellent print quality of even contrast can be obtained constantly from the printing start time to the stop time. In addition, the developing bias voltage of all the toner cartridges are periodically corrected so as to eliminate variation in the density of the four colors.
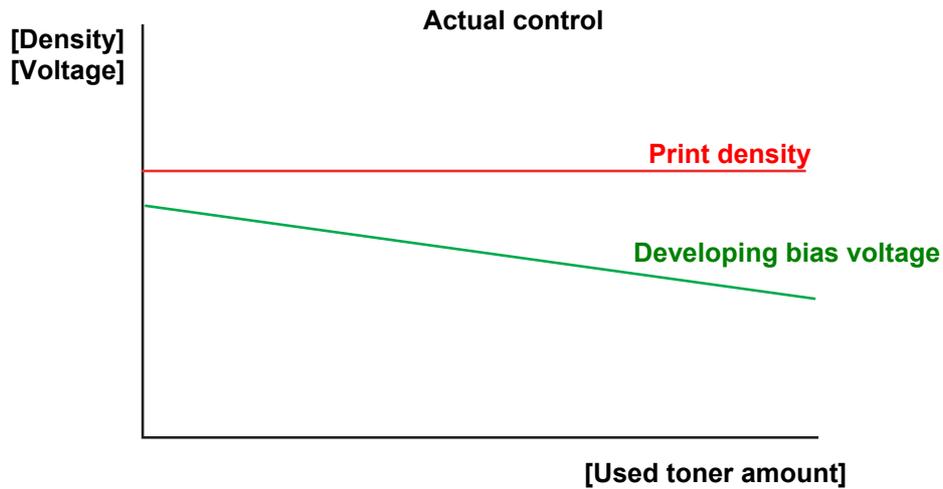
Fig. Ref2-14

Memo:

If a toner cartridge in use is changed to a cartridge which has previously been in use, the developing bias voltage will become incorrect to the change color density. Toner cartridges being used must not be replaced with other ones. As this will cause print defects.

3.4 Print

3.4.1 Principle of Color Overlapping

The human eye distinguishes one color from others by receiving light's three primary colors (Red, Green, Blue). When monochrome lights are received, each color can be sensed. However, when two-color lights, red (R) and green (G), are received, they are recognized as "yellow"; when three-color lights, red (R), green (G) and blue (B), are received, they are recognized as "white." The fineness of coloration is perceived according to the nature of light.
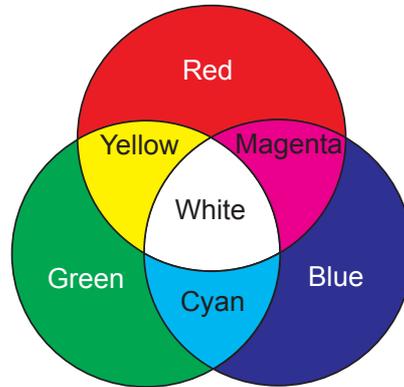
Fig. Ref2-15

For printed colors, the human eye can perceive them as various colors by distinguishing each color light reflected off the surface of a sheet of paper.

(1) For "cyan," since the print absorbs red (R) light of the three colors, only green (G) light and blue (B) light are reflected, the color on the print side is recognized as a cyan color. (See the following figure (1).)

(2) "Magenta" absorbs green (G) light and reflects red (R) light and blue (B) light. (See the following figure (2).)

(3) If cyan and magenta are mixed, cyan absorbs red (R) light and magenta absorbs green (G) light, and only blue (B) light is reflected. The light is identified as "blue." (See the following figure (3).)

Theoretically, if cyan, magenta and yellow are mixed, all the colors are not reflected and black can be shown. However, a black mix is difficult to produce, and black is shown using black-color paint for practical purposes. Using such a principle, color-absorbing paints are mixed to allow many colors to be shown on the surface of a sheet of paper.
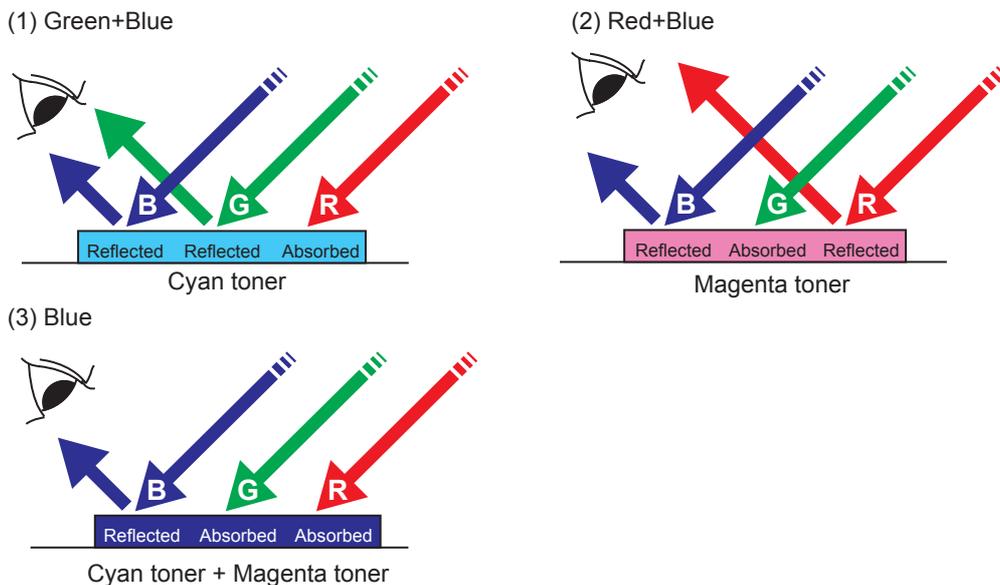

Fig. Ref2-16

3.4.2 Basic Printing Principle

The printing process consists broadly of 6 processes: Charging, Exposure, Development, Transfer, Fusing and Cleaning.

1. Charging: The surface of the drum is electrically charged (Primary Charge).
2. Exposure: A printed image is formed on the surface of the drum by applying laser beam (Electrostatic Latent Image).
3. Development: Toner is adhered to the surface of the drum (Visible Image).
4. Transfer: The toner on the surface of the exposure drum is transferred to the paper.
5. Fusing: The transferred toner is fused on to the paper.
6. Cleaning: Toner remaining on the exposure drum and belt unit is removed for recovery.

After these processes, the image is printed on the paper.

Fig. Ref2-17

Ref. 2-20
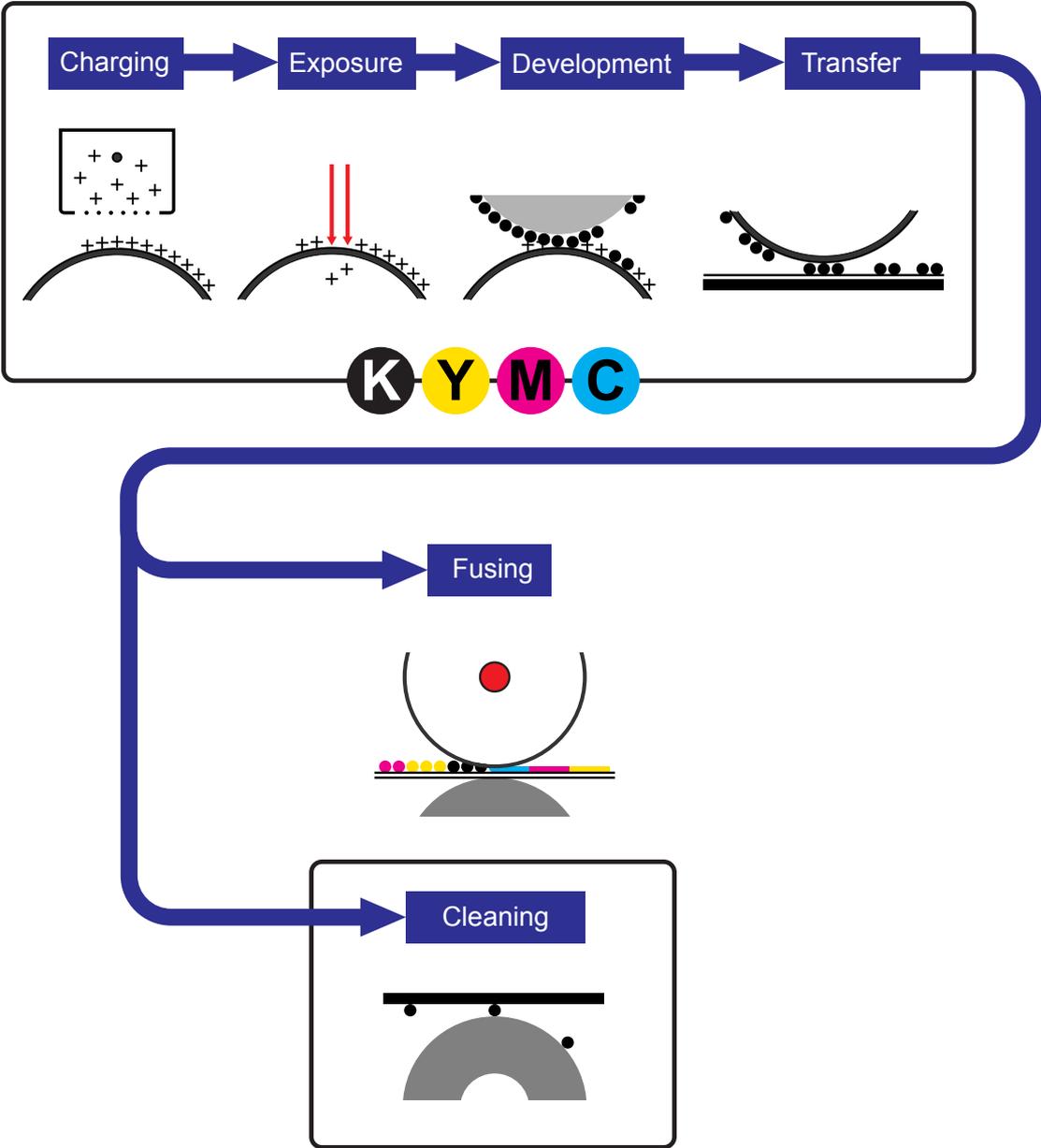
3.4.3 Print Process

1. Charging

The flow of the ion charge is controlled by the constant voltage of the grid 870 V to ensure it is distributed evenly on the drum surface. In order to coat toner on the exposure drum, the drum needs to be evenly electrified. Ions are produced by supplying high-voltage power to the corona wire.
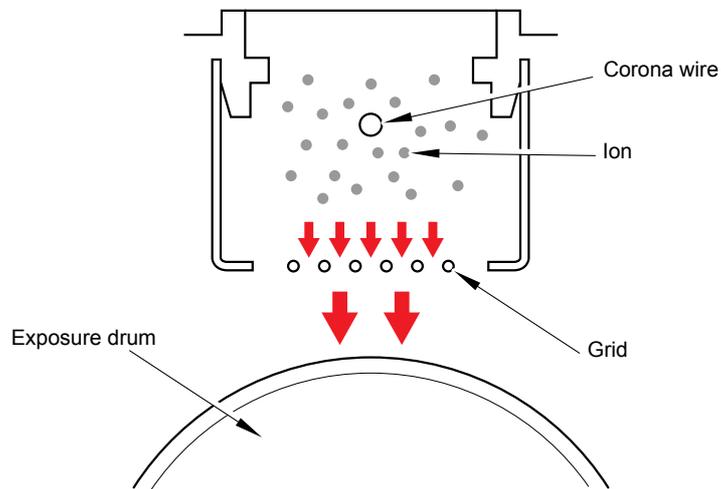
Fig. Ref2-18

Memo:

The level of ozone expelled from the printer is less than 3.0 mg/h therefore not harmful to the human body. Applicable safety standards have been complied with.

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2. Exposure

Four laser beams radiated from a laser diode inside the laser unit are concentrated into a constant width by a slit in the CO lens cell and then reflected by a polygon mirror rotating at high speed. The evenly charged exposure drum is irradiated with reflected light and exposed. Surface potential is lowered by such exposure and an Electrostatic latent image is formed.
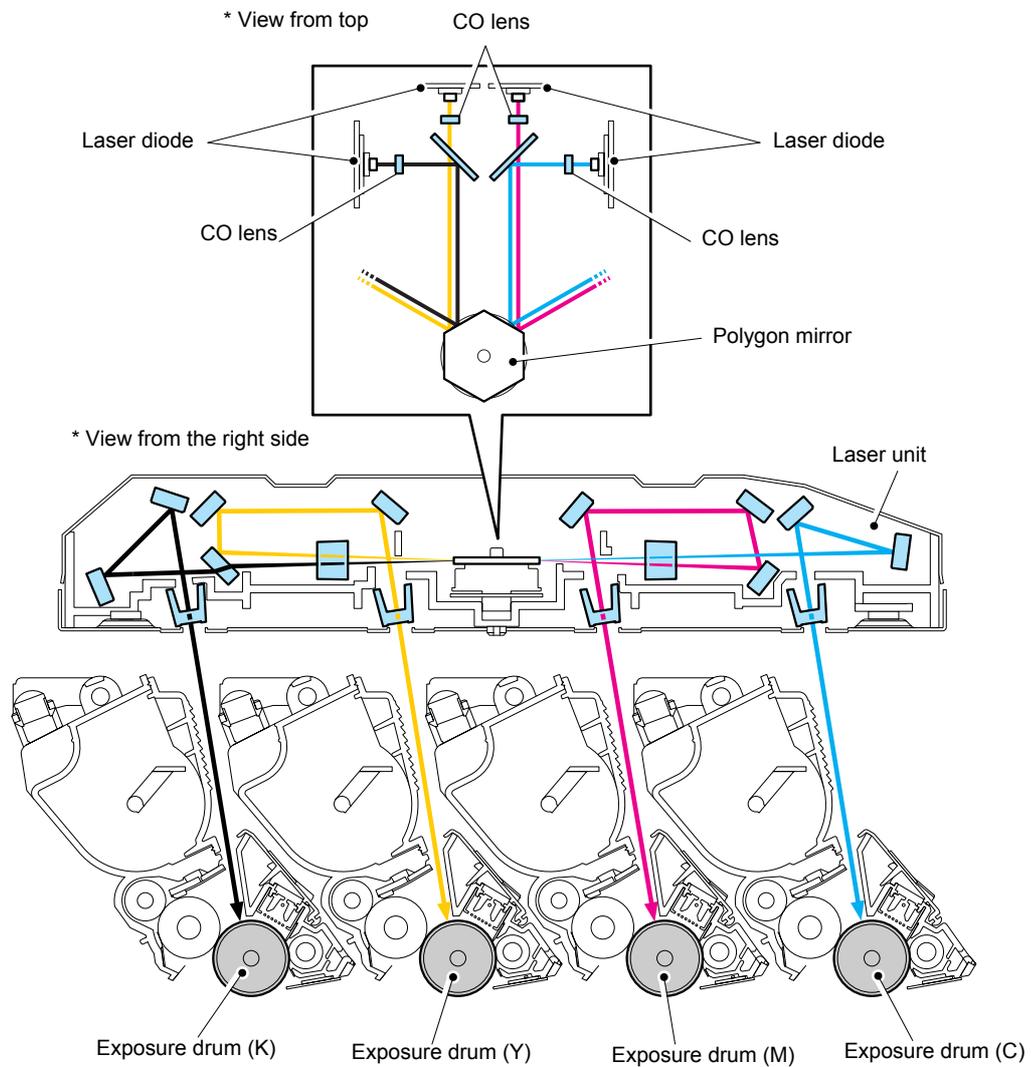

Fig. Ref2-19

3. Development

Toner is attracted to the latent-image area on the exposure drum where surface potential is lowered due to exposure.

By controlling the developing bias voltage supplied to the develop roller, the amount of toner taken to the drum is adjusted to keep printing density constant.
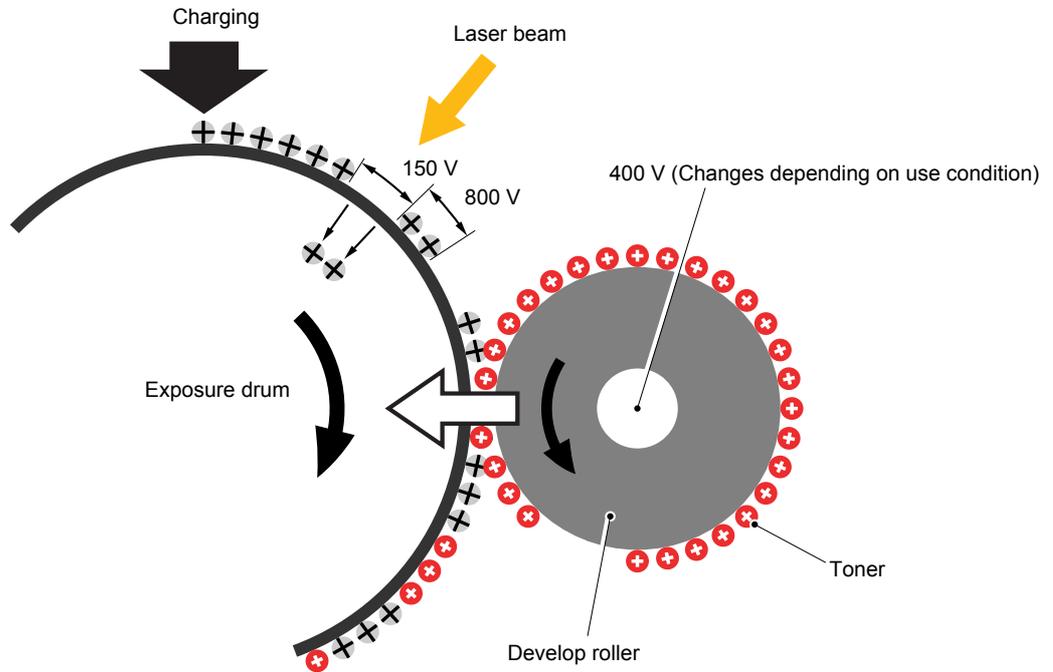

Fig. Ref2-20

<Flow up of toner to the development process>

Toner adheres to the charged develop roller. Such adhered toner is adjusted to an even thickness, and is attracted to an exposed area on the exposure drum.
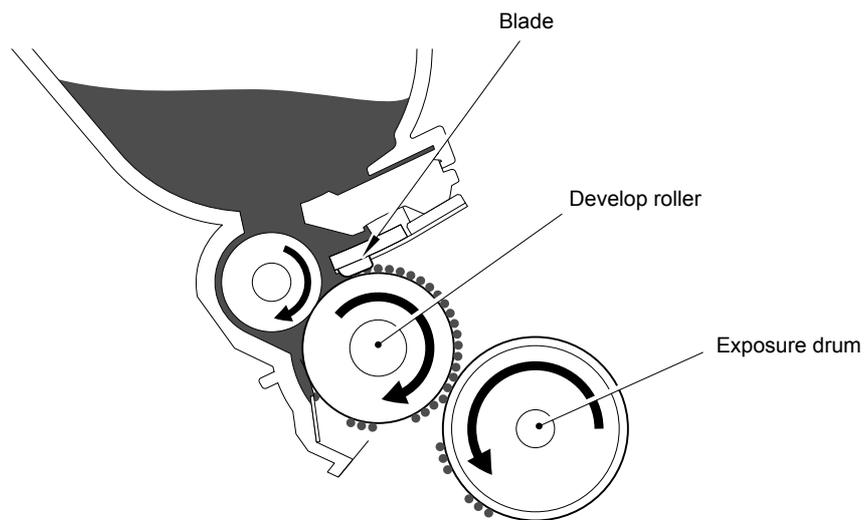

Fig. Ref2-21

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4. Transfer

By applying a minus charge to the belt unit, the toner adhered to the exposure drum is transferred to paper.
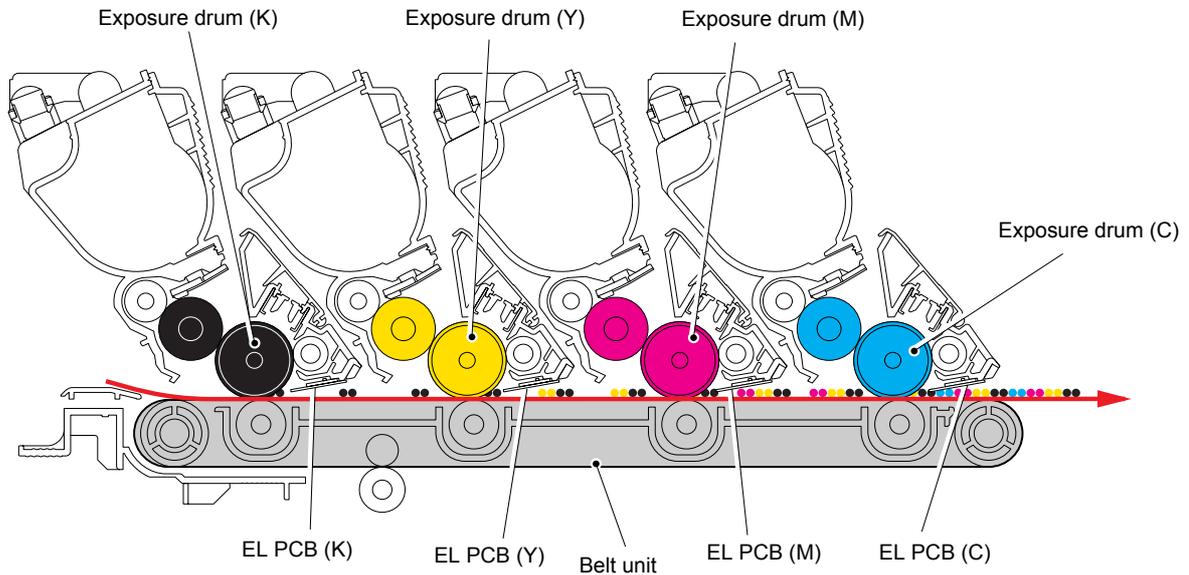

Fig. Ref2-22

Memo:

The four colors of toner are coated in turn on the paper to form a color: First comes black (K), then yellow (Y), then magenta (M), and then cyan (C).
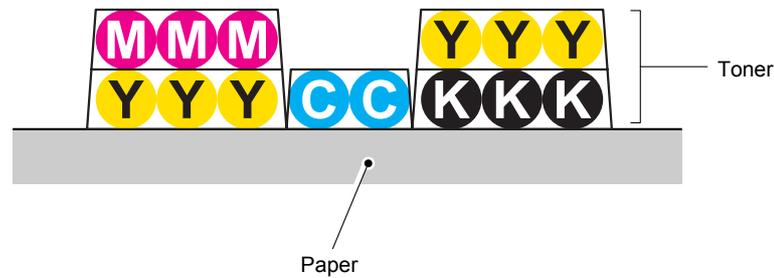

Fig. Ref2-23

<Function of EL PCBs>

After toner is transferred, a surface potential difference occurs between the exposed areas and non-exposed areas on the exposure drum. The lamp (LED) of each EL PCB evenly irradiates the surface of the exposure drum to keep the surface potential constant, preventing an image failure caused by a potential difference (appearance of a ghost image).

5. Fusing

The toner transferred on to the paper passes between the heat roller and the pressure roller ASSY in the fuser unit and are fused by heat and pressure. The thermistor detects surface temperature of the heat roller and turns ON/OFF the halogen heater lamp to keep the temperature constant.
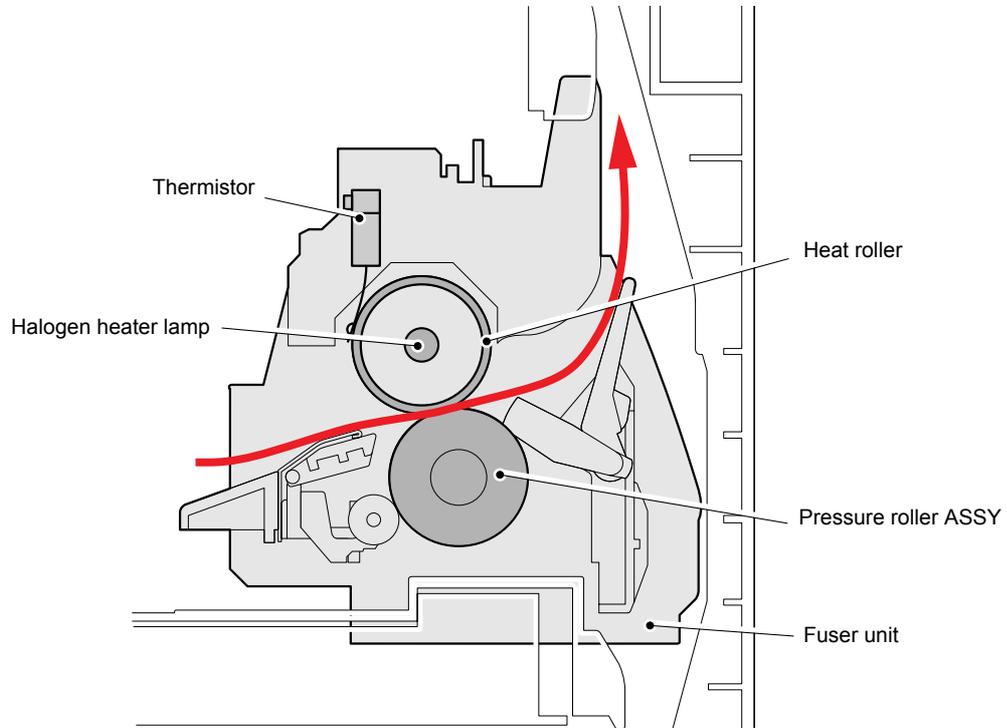

Fig. Ref2-24

Memo:

Control of fusing temperature

The fuser unit adjusts such temperature according to types and sizes of paper so as to keep excellent image quality.

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6. Toner cleaning

(1) Toner remaining on the exposure drum which has not completely been transferred on to the paper is pulled onto the cleaning roller with a lower potential and the drum is cleaned.

(2) After the above step, the potential of the roller is raised during printing, and such attracted toner is returned to the drum again. The returned toner is attracted to the belt unit by lowering the potential of the transfer roller.

(3) The toner attracted to the belt unit is collected by the belt cleaner below the unit, and stored in the waste toner box.

Memo:

When the toner returns to the exposure drum from the cleaning roller, the develop roller is separated from the drum to prevent color mixture.
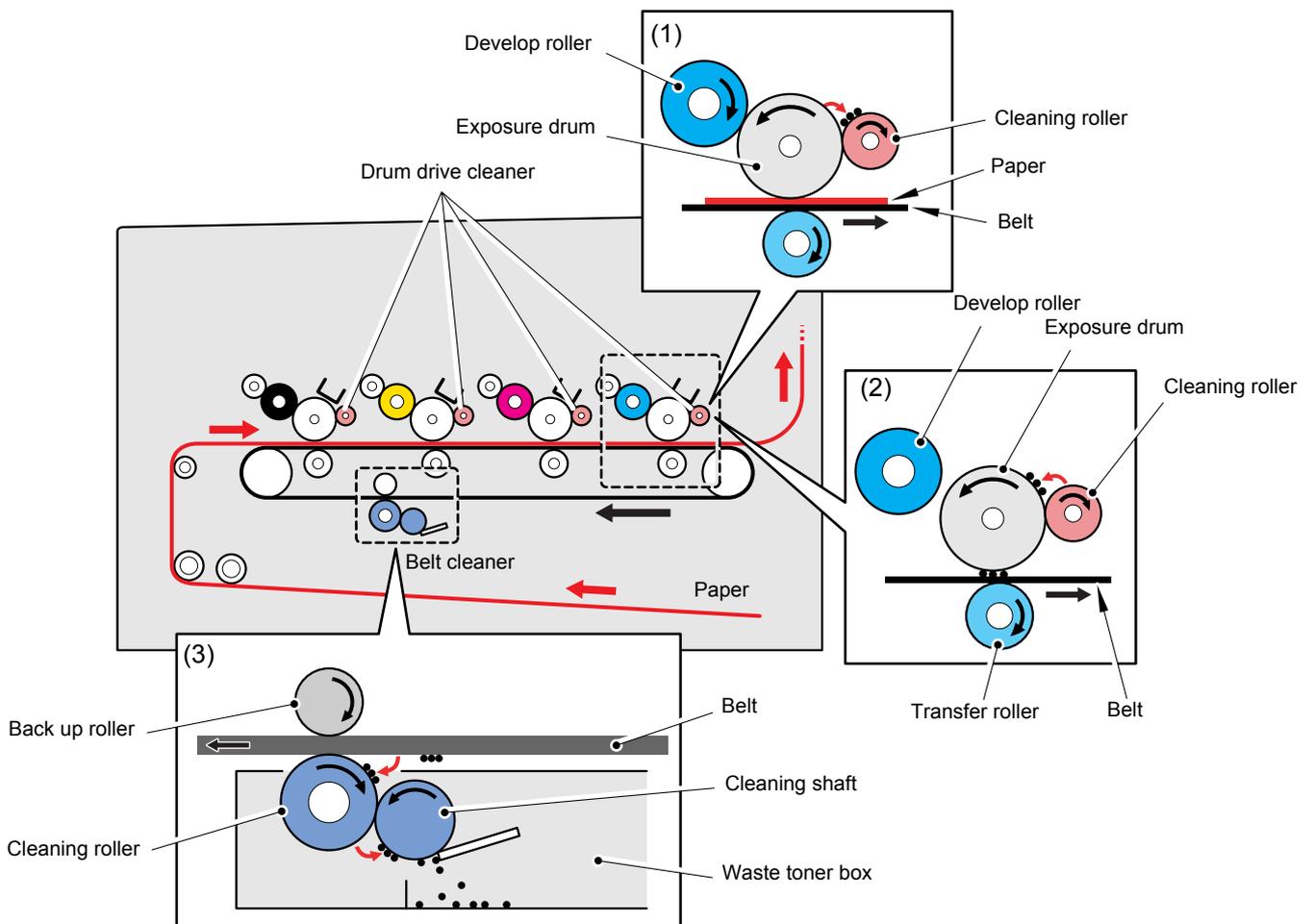
Fig. Ref2-25

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3.4.4 Switch between Color Print Mode and Monochrome Print Mode

By switching the mode between color print and monochrome print to avoid unnecessary load on the toner cartridges and keep the specified product life, the rotation and press/release operations of the develop roller are controlled, and the print operation is executed.

<Rotation of the develop roller>

The gear is driven by the develop drive motor through the clockwise or counterclockwise rotation, and all four develop rollers for four colors (K, Y, M, C) rotate in the color print mode, and the one develop roller for the black color (K) only rotates in the monochrome print mode.

<Press/release operations of the develop roller>

By rotation of the develop release motor, all four develop rollers for four colors (K, Y, M, C) press corresponding exposure drums respectively in the color print mode, and the one develop roller for the black color (K) only presses the corresponding exposure drum and the remaining three develop rollers for three colors (Y, M, C) are kept separated from the exposure drums in the monochrome print mode.

APPENDIX 1   TONER CARTRIDGE WEIGHT INFORMATION

> **Note:**
> **This information shows approximate weight of the toner cartridge.**
> **Toner weight is subject to change due to redesign of the machine.**

Depending on the serial number of toner cartridge, the weight of toner cartridge will be different. Refer to the table shown below for details.

Cartridge type	Color	Serial No.	Factory No.	Refer to
High-capacity toner cartridge (TN-115, TN-135, TN-155)	Black	No difference upon serial number	P	Table 2
		Before TKCG8JB006956CLR0923	J	Table 1
		After TKCG8JH006957CLR0923		Table 2
	Yellow	Before TYCG8PF138401FLR0922	P	Table 1
		Before TYCG8JF002890DLR0922	J	
		After TYCG8PJ138402FLR0922	P	Table 2
		After TYCG8JJ002891DLR0922	J	
	Magenta	Before TMCH8PD148340GCR1429	P	Table 1
		Before TMCG8JD999999BLR1951	J	
		After TMCH8PK148341GCR1429	P	Table 2
		After TMCH8JK000001BLR1951	J	
	Cyan	No difference upon serial number		Table 2
Standard toner cartridge (TN-110, TN-130, TN-150)		No difference upon serial number		Table 3

Table 1

High-capacity toner cartridge (TN-115, TN-135, TN-155)	BK (5K)	Y (4K)	M, C (4K)
Brand New Toner Cartridge Weight	695g (±10g)	675g (±10g)	670g (±10g)
Toner Weight at "Brand New Toner Cartridge"	160g	140g	135g
Toner Cartridge Weight at "Toner Near Empty"	615g (±10g)	615g (±10g)	615g (±10g)
Remaining Toner Weight at "Toner Near Empty"	80g	80g	80g
Toner Cartridge Weight at "Toner Life End"	595g (±10g)	595g (±10g)	595g (±10g)
Remaining Toner Weight at "Toner Life End"	60g	60g	60g

Table 2

High-capacity toner cartridge (TN-115, TN-135, TN-155)	BK (5K)	Y (4K)	M (4K)	C (4K)
Brand New Toner Cartridge Weight	685g (±10g)	681g (±10g)	653g (±10g)	670g (±10g)
Toner Weight at "Brand New Toner Cartridge"	150g	146g	118g	135g
Toner Cartridge Weight at "Toner Near Empty"	615g (±10g)	615g (±10g)	615g (±10g)	615g (±10g)
Remaining Toner Weight at "Toner Near Empty"	80g	80g	80g	80g
Toner Cartridge Weight at "Toner Life End"	595g (±10g)	595g (±10g)	595g (±10g)	595g (±10g)
Remaining Toner Weight at "Toner Life End"	60g	60g	60g	60g

Table 3

Standard toner cartridge (TN-110, TN-130, TN-150)	BK (2.5K)	Y (1.5K)	M, C (1.5K)
Brand New Toner Cartridge Weight	645g (±10g)	630g (±10g)	625g (±10g)
Toner Weight at "Brand New Toner Cartridge"	110g	95g	90g
Toner Cartridge Weight at "Toner Near Empty"	615g (±10g)	615g (±10g)	615g (±10g)
Remaining Toner Weight at "Toner Near Empty"	80g	80g	80g
Toner Cartridge Weight at "Toner Life End"	595g (±10g)	595g (±10g)	595g (±10g)
Remaining Toner Weight at "Toner Life End"	60g	60g	60g

Note:

- You can print about 500 pages with 10g toner. (A4 size, 5% coverage, continuous printing)

- Toner cartridge weight is without the package and the protective cover.

- Toner weight may vary ± 1g.

- The molding is different on each model so that the container weight is different.

APPENDIX 2   REFERENCES

This page provides reference information. It is possible to get the full instructions of the subjects by just clicking on the links below.

1. Error codes

(Refer to "2.1 Error Indication", Chapter 1 of the Service Manual.)

2. Error message

(Refer to "2.2 Error Cause and Remedy", Chapter 1 of the Service Manual.)

3. Diameter of rollers

(Refer to "4.2 Diameter of Rollers", Chapter 1 of the Service Manual.)

4. Periodical replacement parts

(Refer to "2.1 Periodical Replacement Parts", Chapter 2 of the Service Manual.)

5. Reset parts life

(Refer to "2.3 Parts Life Reset Function", Chapter 2 of the Service Manual.)

6. Machine specification

(Refer to "2. SPECIFICATIONS LIST", Reference 1 of the Service Reference Manual.)

7. Paper specification

(Refer to "2.6 Paper", Reference 1 of the Service Reference Manual.)

8. Toner cartridge weight information

(Refer to "APPENDIX 1 TONER CARTRIDGE WEIGHT INFORMATION" of the Service Reference Manual.)

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APPENDIX 3 GLOSSARY

ACRONYMS AND TECHNICAL TERMS

In this manual and the Service Manual, the manual specific acronyms and technical terms are used in addition to the generally used ones. The table below contains typical acronyms and technical terms that are used throughout these manuals.

APIPA	Automatic Private IP Addressing	LCD	Liquid Crystal Display
ASIC	Application Specific Integrated Circuit	LD	Laser Diode
		LED	Light Emitting Diode
ASSY	Assembly	LM hook	Lift-up Motion hook
C	Cyan (Color)	LT	Lower Tray
CN	Connector	LV	Low Voltage
CPU	Central Processing Unit	LVPS	Low Voltage Power Supply
CR	Cleaner Release	M	Magenta (Color)
dB	decibel	MP	Multi-Purpose
DEV	Development	N/A	Not Applicable
DIMM	Dual Inline Memory Module	NC*	Network Circuit
dpi	dots per inch	NVRAM	Nonvolatile Random Access Memory
DX	Duplex		
EEPROM	Electronically Erasable and Programmable Read Only Memory	OPC	Organic Photo Conductor
		PF	Paper Feed
		PP gear	Pressure Plate gear
EL	Erase Lamp	ppm	pages per minute
FR	Feed Roller	PU	Pick-Up roller
FU	Fuser	RAM	Random Access Memory
HEX	Hexadecimal	REGI	Registration
HUM	Humidity	SOL	Solenoid
HV	High Voltage	SP	Spare Parts
HVPS	High Voltage Power Supply	SX	Simplex
IEEE 1284	Institute of Electrical and Electronic Engineers 1284	T1	Tray 1
		TE	Toner Empty
IF	Interface	THM	Thermal
IPv4	Internet Protocol Version 4	TN	Toner
IPv6	Internet Protocol Version 6	TR	Transfer
K	Black (Color)	Y	Yellow (Color)
LB	Left Bottom		

* Excluding the acronym shown on the wiring diagram or circuit diagram.