

HARDWARE PRINTER ENDURANCE TEST



Two Million Pages

Not good for the environment: Most printers leave behind a great deal of waste (from left to right Kyocera, Xerox, Lexmark, Hewlett-Packard and Brother).

During its life cycle a laser printer can run up costs of between three and seven times the purchase price. Kyocera proves in this *PCpro* test that it can be cheaper.

by Anja Schmolli-Trautmann and Eckhart Traber

After printing two million pages over a period of six months, we are ready to present the results of the most extensive test *PC Professionell* has ever conducted with laser printers.

During the test five printers with engines capable of printing between 16 and 18 pages per minute, ran up total costs of DEM80,000 (including the purchase price and the paper).

Each printer incurred costs of between DEM12,000 and DEM20,000.

The DEM8,000 difference was mainly due to the varying toner consumption and the repair requirements of each individual machine tested.

A complete breakdown of the costs for various print volumes and running times is shown in the table on page 142.

Some of the massive volume of waste paper produced in our test went to local nursery schools to be used as scrap, the rest was sent straight to the recycling plant.

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Kyocera challenges the competition

In April the test was launched with Brother's HL-1660e, HP's Laserjet 4000TN, Kyocera's FS-3700+, Lexmark's Optra S1650, and the Docuprint 4517 from Xerox. All models are in the same category, 16ppm is the norm with the exception of Kyocera's printer, which is rated at 18ppm.

Hewlett-Packard, Lexmark, Brother and Xerox have one thing in common - depending on the model opted for, the entire print unit (toner and drum) has to be changed after between 14,000 and 25,000 prints. Kyocera, however, is equipped with an Ecosys print drum, designed to print 300,000 pages before being replaced. Only the toner has to be replenished after 40,000 pages.

The daily printing routine

Kyocera turned out to be extremely robust. During the entire test not a single repair was necessary. Only the loading mechanism had to be cleaned and the developing unit changed after 400,000 pages, to maintain the high quality in graphics (see print samples on page 134). Brother's HL-1660e was different. This printer's performance was disappointing. There were too many paper jams and other significant mal-

functions requiring more attention than any other machine. Brother's technical staff were the most frequent visitors to our lab. A complete list of the repairs for each printer is outlined in the table below.

We focused on long-term reliability and quality performance. The results of the print quality tests conducted at the start and after completion of the print run are also included in the table on page 144. Kyocera's printer had the best engine speed and was the fastest in printing pure text, followed by Brother, HP and Lexmark. When printing graphics the speed for a page ranged between 22 seconds (Kyocera) and 39 seconds (HP). As far as print quality was concerned HP and Lexmark provided the best results, although every printer performed well.

Only three were convincing

Those who require under 25,000 pages per year will face very few serious problems. If however you expect to print between 10,000 and 65,000 pages per month the resulting costs must be considered at the time of purchase. Another important element to consider is the reduction in the manufacturer's warranty incurred when printing such large volumes. In this case

EDITOR'S CHOICE



Kyocera FS-3700+

If you want reliability and high-quality printouts as well as a cost-saving and environmentally friendly printer then the Kyocera FS-3700+ is the right choice. The company's cartridge-free system features an amorphous silicon print drum with a long-life fuser and developer, rated for 300,000 pages. The quality only began to deteriorate slightly after 400,000 prints requiring repairs costing DEM608.

Kyocera's FS-3700+ has earned our »Editor's Choice« by a wide margin over the rest.

all manufacturers will set a limit of between six months and a year. The price of the toner is also very important. There is an alarming difference between the cost of DEM1,377 for toner for the Kyocera printer and DEM8,000+ paid for toner for the Brother or Xerox, to print the same amount of pages.

Conclusion: For low service and maintenance, Kyocera's printer comes in at the head of the field followed by Lexmark and HP. The Xerox and Brother are both designed to deliver the same print volume as the rest, but proved during the test to be prone to breakdowns which ran up expensive repairs. AS

SERVICING

Regular visits from the technicians...

Kyocera's FS-3700+ didn't start having problems until the 400,000th page. The service personnel from the other manufacturers however were frequent visitors to our labs.

The results printed on the right show the total maintenance and costs for each printer that arose specifically during this test. Depending on the content of the individual service contracts provided, for the normal purchaser these costs can vary. Taking the printer from Brother as an example the total yearly costs after carrying out the recommended servicing would come to DEM7,175 - 780 marks more than during the test. The recommended exchange of the maintenance kit for the Kyocera printer after 300,000 pages would have pushed up the cost by DEM790, but wasn't necessary. AS

Product	Pages	Repairs	Price	Total servicing during the test
Brother	136,500	Separation pad replaced and new paper roll for paper tray	DEM214.30	DEM1562.48
	262,500	Fixer unit replaced	DEM627.37	
	330,000	Fixer unit replaced; cleaning	guarantee	
	350,000	Cleaning and inspection	DEM168.20	
	364,000	Fixer unit replaced; cleaning	DEM168.20	
	380,000	Separation pad and paper feed roll replaced	free of charge	
HP	395,000	New transfer unit, feed roll, and separation pad	DEM384.41	DEM2,198.06
	155,814	Paper jam: front paper path dismantled, paper removed	DEM402.52	
	256,500	Radiator replaced (guarantee 200,000 pages or 12 months)	DEM964.24	
Kyocera	339,500	Radiator replaced; rubber rolls replaced	DEM831.27	DEM607.84
	400,000	Cleaning of the loading mechanism; new developer unit	DEM187.00 DEM1520.84	
Lexmark	161,000	Oiling of the paper feed clip	DEM452.40	DEM904.80
	241,350	Oiling and grinding down of the paper feed clip	free of charge	
	280,000	Transfer roll replaced	DEM452.40	
Xerox	375,000	Cleaning of corona earth wire	free of charge	DEM2,959.39
	135,157	Display modul replaced	DEM357.28	
	199,300	Fixer unit and motherboard replaced	DEM1703.77	
	287,000	Firmware update	free of charge	
	330,000	Cleaning of printer; Fixer unit replaced	DEM898.34	

LAB RESULTS

How we tested

The manufacturer guarantees a monthly print volume of up to 65,000 pages. The *PC Professionell* laboratory tested the five laser printers for almost six months, printing about 3,500 pages per day.

The lab team checked each printer before the start and at the end of each marathon print-run and carried out the standard *PCpro* lab test. This included printing off ten sides of the standard German test page with a black coverage of five per cent and the printing of the *PCpro* CorelDraw page at a resolution of 300 and 600dpi. The factory setting of the printers was not changed either before or during the test phase.

We selected the paper format DIN A4, set the sleep mode to a maximum of 15 minutes and activated the additional paper-feed mechanism.

Within the framework of these standard tests the printout quality, print speed and the power consumption in warm-up phase, in the

print phase and the sleep mode were assessed.

Each candidate printed the German test page 400,000 times and the quality of the printouts is indicated in the test samples below.

Every printer, with the exception of the Kyocera, is designed in such a way that the toner cartridge can be changed at the same time as the print drum. The quality thus remained constant throughout the entire 400,000 printed pages.

The Kyocera was the only machine equipped with a 300,000 page print drum/developing unit and surprised us because only after 400,000 pages a slightly pale effect became evident in printing graphics. The quality of the text however, remained constant.

Ergonomics

Each printer's paper feed mechanism is different. For example, the paper for the Lexmark and Brother machines is simply placed in the half-open tray. The problem with the printer from Hewlett-Packard is that you have to pull the tray completely out of the mounting, to see how much of paper can be placed under the

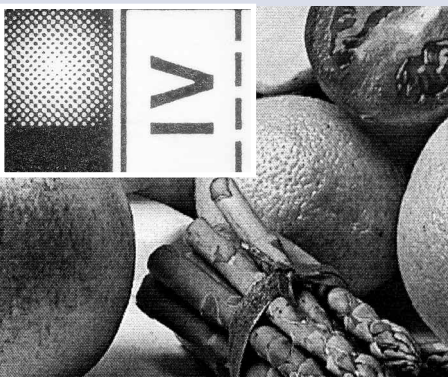


On the Kyocera FS-3700+ every component is easy to reach. Paper jams are simple to clear.

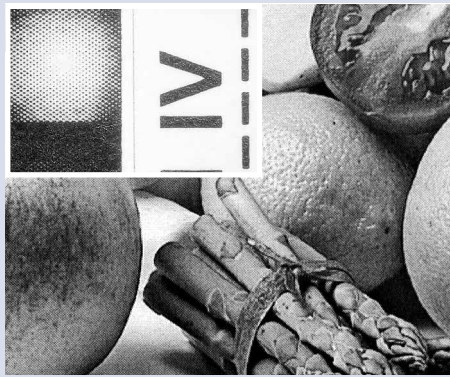
clips at the opposite end of the tray.

Kyocera and Xerox provide metal clips mounted at the front of the paper tray under which the paper has to be slotted.

With the exception of Xerox all of the test machines fed the paper smoothly into the printer even if the paper had not been separated first. With Xerox however, great care had to be taken loading and separating new paper or



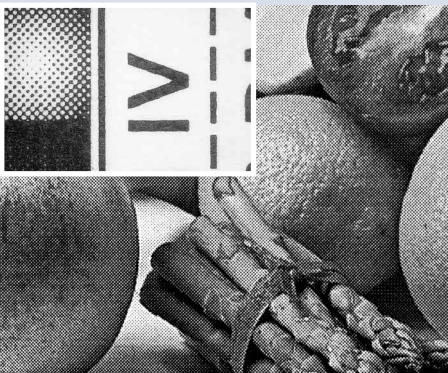
Brother HL 1660e: Faint horizontal stripes can be seen in the dark areas.



Hewlett-Packard Laserjet 4000: Sharp and convincing contrasts.



Lexmark Optra S1650: Needle sharp prints and perfect detail.



Xerox Docuprint 4517: Sound detail work but the printer leaves fine stripes behind.



Kyocera: After almost 400,000 pages the perfect quality is reduced. Replacing the developing unit and cleaning the loading mesh improved the quality.

LAB RESULTS

the penalty was a paper jam within 20 pages (even with the use of high quality Neusiedler Triotec TCF, chlorine free, 3 ply).

The Lexmark and Kyocera printers deliver the printouts smoothly. Printed pages are placed exactly on top of one another and can be bound or punched straight away. The Brother and HP printers performed almost as well. Only the machine from the inventor of photocopying, Xerox, can't place one page on top of another. The pages have to be collated afterwards by hand.

Brother was the only manufacturer to incorporate an awkward and possibly costly construction saving. There is no built-in paper cut-off mechanism, so should more than 370 printed pages be sitting in the copier, the rest of them spill over the printer and land on the floor. The competition saw things differently and built in a warning tone, to alert that the print tray is full.

Lexmark should change the position of the paper-feed stop sensor. After the effect of oiling the mechanism had worn off, the printout came to a halt after 50 pages because the lever had stuck again. Regular oiling solved the problem.

Repairs

Visits from technicians to the test lab for particular machines, especially towards the end of the test, were the rule.

After 300,000 pages the Brother was fading under the strain. At the end of the test all that was left of the original printer was the plastic shell and the metal chassis. Every other part had to be replaced by the technician during the course of the test. The black edge, printed on the left-hand side of the paper however, remained to the end.

The machines from Lexmark and HP had to have a new loading mechanism, fixer or heating element built in from time to time. The Xerox Docuprint 4517 had to have the electronic components checked and finally completely replaced. The reason being the error message in the display which the manufacturer himself apparently did not recognise.

The HP Laserjet 4000TN had difficulties after printing 250,000 pages, a HP technician commented, curiously, that the problem was caused perhaps by the printer's base plate being bent. After exchanging the paper-feed roll the problems disappeared.

In conclusion every manufacturer deserves a

great compliment for the extreme reliability of their printers under the hardest climatic conditions. Every test candidate coped with the summer heat wave of over 35 degrees Celsius in the test room easily, whereas the PCs repeatedly didn't.

ET/AS



The Cost

Model	Price in DEM	Price per page
Kyocera	4,866	0.012
HP	8,624	0.022
Lexmark	10,043	0.025
Brother	10,714	0.027
Xerox	11,267	0.028
<i>(400,000 pages in six months not including paper and repairs)</i>		
Kyocera	10,664	0.027
HP	16,013	0.040
Lexmark	16,139	0.040
Brother	17,467	0.043
Xerox	19,417	0.049
<i>(400,000 pages in six months including paper and repairs)</i>		

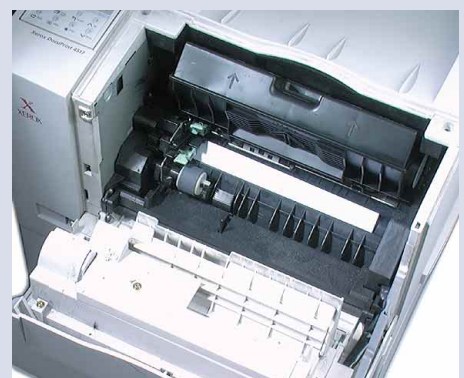


Lexmark Optra S offers a smooth delivery system. Paper is simply placed loose into the tray.

Print Quality

HP Laserjet 4000	████████
Lexmark Optra S1650	████████
Kyocera FS-3700+	███████
Brother HL-1660e	███████
Xerox Docuprint 4517	███████

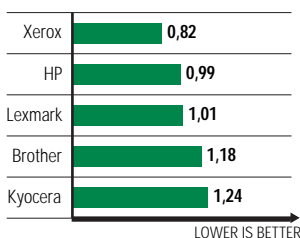
HP and Lexmark show consistently good results. Kyocera only fades slightly after 350,000 pages.



The Xerox 4517 is almost inaccessible. Dealing with paper jams can present real problems.

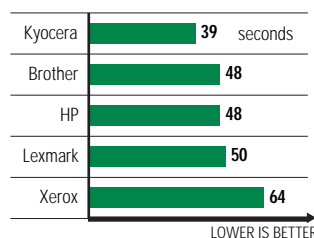
Power Consumption

Cost per day in DEM (400,000 pages in 6 months)



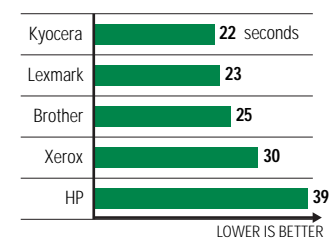
Print Speed

Text with 5% coverage, 10 printouts at 600 dpi



Print Speed

CorelDraw test page, 1 printout at 600 dpi





BROTHER

HL-1660e

The Brother HL-1660e is equipped with a 8MB base RAM, which can be upgraded using PS/2 SIMMs to a capacity of 72MB. The highest physical resolution is 600 x 1200dpi and the print engine is capable of delivering a steady 16 pages per minute. The Brother has a price tag of DEM2,499, which for a printer of this class is very reasonable.

In addition to parallel and serial interfaces, an AppleTalk connector is included as standard - a feature only provided at extra cost by the competition.

Brother's HL-1660e can print documents of up to a weight of 135 grams per square metre and was therefore only able to deliver an average overall performance.

Drivers are included for Windows 3.x, 95/98 and Windows NT 4.0, but OS/2 Warp drivers are not provided. This printer has several deficiencies in terms of ease of use. The most significant being the lack of any paper feed shut-off mechanism when the print tray is full.

The quality and speed in printing both text and graphics is however most satisfactory. The Brother HL-1660e began having problems after 136,000 pages. The paper feed mechanism was not working correctly and required attention from a technician. Streaks on the print-out, caused by the roller, began to appear after 262,000 pages. Neither of these problems could be fully resolved until the completion of the test.

Excluding repairs, the cost of printing 400,000 pages came to DEM15,900 (including paper). If the cost of servicing is included - which depends on the terms of each individual service contract - the cost can rise to a figure of DEM17,500. This printer incurred the highest costs of all of the machines tested.



HEWLETT-PACKARD

Laserjet 4000(TN)

The printer we tested was the Laserjet 4000TN network version, not the basic model (Laserjet 4000). The network version is equipped with a different paper feed mechanism, an 8MB RAM, as opposed to 4MB, and costs DEM3,900. The Laserjet 4000 is priced at DEM2,898, but Hewlett-Packard were not able to provide this version. In order to give them a fair chance we based our calculations on the purchase price of the standard model.

The printer has a Canon engine, is equipped with a 100MHz RISC processor and can deliver 16 pages per minute. The memory capacity is upgradable using DIMMs to a maximum value of 100MB.

Printing speed for both text and graphics was average. The quality however is very good due to the high physical resolution of 1200 x 1200dpi. HP's machine had no problems printing documents of up to 199 grams per square meter. It can operate with Windows 3.x, 95/98, NT 4.0, and OS/2, is simple to install and user-friendly. Several useful details are included in the design, for example with the touch of a button any job can be cancelled directly at the printer.

HP's Laserjet didn't require much servicing, but the price for the repairs were high. The heating coil had to be replaced twice, the first time after 250,000 pages and then again after 340,000 pages. Replacing the coil is included in the guarantee but only for a period of six months. The guarantee expires completely after one year or 200,000 pages. HP's printer ran up costs of DEM13,815, excluding repairs, which placed it in the middle of the field.



KYOCERA

FS-3700+

In terms of speed, the FS-3700+ capable of printing 18 pages per minute is always going to have the advantage over the competition. This printer incurred the highest electricity costs which proved however to be negligible in the final analysis.

Kyocera prints at a resolution of 600 x 600dpi, which is enough to provide a very acceptable print quality, and has a basic memory capacity of 8MB that can be upgraded to 68MB. The FS-3700+, which only weighs 14 kilograms, is equipped with a parallel and a serial interface.

Options are provided for infrared, AppleTalk, Ethernet and Token Ring. Kyocera's printer offers driver support for Windows 3.x, 95/98, NT 4.0 and OS/2 Warp.

Over the entire test this printer gave the best performance. The Ecosys drum, designed for 300,000 printed pages, delivered 400,000 without any problems. Only after the 400,000 mark had been passed, the developing unit needed to be replaced as the graphics began to deteriorate.

The extremely conservative use of toner was also remarkable. One toner cartridge, at a price of DEM153, was enough to print 40,000 pages.

At the end of the test Kyocera's printer had run up the lowest costs by a wide margin, a total of DEM10,057 (excluding repairs) and DEM10,664 including the replacement of the developing unit. The higher purchase cost was in this case fully justified.

The printer is economical, easy to use, delivers high quality prints and can be easily upgraded. Kyocera's FS-3700+ has earned our »Editor's Choice« by a wide margin.



LEXMARK

Optra S1650

The standard version of the Optra S1650 comes equipped with a memory of 4MB, which can be expanded up to an impressive maximum value of 136MB. For the basic set-up only the parallel and serial interface are important, although the options for infrared, AppleTalk, Ethernet and Token Ring are also available. The Lexmark printer is compatible with Windows 3.x, 95, NT 4.0, and OS/2 Warp 4.0.

When printing graphics, the high memory capacity Optra is capable of turning out a page in 23 seconds and is one of the quickest printers in this test. This machine was also the only one tested capable of managing documents of up to 216 grams per m². The Lexmark is simple to operate, performs smoothly and has many carefully thought out design details. The paper is simply placed in the compartment and doesn't have to be slid under a complicated array of metal clips and brackets. An additional clever detail is that if too much paper is been placed in the tray, after closing the draw the excess is simply ejected out at the top.

Throughout the print endurance test very few repairs were required. Only the paper-feed lever provided several difficulties at the start but problem was solved by simply grinding-down and oiling the lever. After printing 400,000 pages the reliable Lexmark was in comparison to the other printers one of the most economical. Excluding repairs, during the entire test the printer incurred costs of only DEM15,234, with service costs of only DEM16,139.

Meanwhile, the new Optra S1655 model is already on the market, however the only difference between the two is the faster 133MHz processor instead of the 66MHz in the previous model.



XEROX

Docuprint 4517

Xerox's Docuprint 4517 with a 50MHz RISC processor and an engine speed capable of delivering 16 pages per minute, is in comparison to the competition pretty frugally equipped. In addition to the integrated parallel interface, only the options to connect up to AppleTalk, Ethernet and Token-Ring are provided.

The printer can only handle documents of a maximum weight of up to 105 grams per square metre, but the Xerox can still be employed in conjunction with Windows 3.x, 95/98, NT 4.0 and OS/2.

In the endurance test this model had problems right from the start. After printing 135,000 pages the display module had to be changed and 60,000 pages later the fixer unit and the motherboard had to be replaced. On reaching 330,000 pages the newly replaced fixer unit gave up the ghost again.

Paper jams were awkward to clear because the cartridge had to be removed first, but the instructions housed in the printer omitted to point this out.

The high total costs run up by the Xerox model were mainly due to the extremely high proportion of toner required (23 cartridges at a total cost of DEM361 each) a total of over 8000 marks! Xerox's Docuprint 4517 proved to be the most expensive printer of all of those tested. The total costs incurred, excluding repairs, came in at DEM16,457 with service costs of DEM19,000.

The very acceptable print-quality cannot however mask the fact that the Docuprint's print rate places it towards the back of the field. All things considered, at the end of the test, the Docuprint 4517 had made the weakest impression.

ANALYSIS OF COST

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How expensive a laser printer really is depends on the level of use, the price of the consumables and the cost of repairs and maintenance.

The more you print the cheaper the page price will be. The cost of the toner however is the important factor. Over a period of four years and 400,000 pages, these costs can vary by up to DEM8,000.

Standard pages (A4), can cost as little as 1 pfennig, or as much as 9 pfennigs depending on how much is printed, how robust the printer is over a long period of time and the price of the additional materials. If under 50,000 pages are printed in four years, the purchase price can be up to 75 percent of the total costs incurred. The outlay for toner however only adds up to 22 percent. Repair costs, with this quantity of prints are not significant. The price of a page is then between 8 and 9 pfennigs.

If the quantity printed in this period however climbs to 400,000 pages than the cost of each page reduces to between 1.2 and 2.8 pfennigs (without considering paper and repairs). The purchase price is now no longer significant, but the repairs can be up to 15 percent of the total. Depending on the particular service agreements made with the service partner, these costs have an influence on the price of each page.

Decisive however is the toner. To print 400,000 pages Brother's machine ran up toner costs of DEM8,084. With the Kyocera printer, for the same number of pages, the outlay was a modest DEM1,377. (\$766.57 US dollars)

In the following table the costs are listed for 50,000, 100,000 and 200,000 printed pages over four years. For a print quantity of 400,000 pages several varying time periods have been considered.

To calculate the total costs incurred for each of the five printers the following data was employed and incorporated in the table on page 142:

Run-time per day: 12 hours
Run-time per year: 222 working days
Price per kilowatt hour: 33.05 pfennigs
Cost of paper: 1.12 pfennigs per page

AS

ANALYSIS OF COST

Toner pushes up the cost

At a low level of use the costs incurred by the printers tested did not vary a great deal. At maximum levels of output significant differences were evident primarily due to toner consumption.

Model	Paper output	50,000	100,000	200,000	400,000	400,000	400,000	400,000	400,000
	Paper output per day	57	112,5	225	3600	1800	900	450	3600
	Period	48 months	48 months	48 months	6 months	12 months	24 months	48 months	6 months ¹⁾
Brother	Total electricity cost	303.70	316.13	340.10	131.20	167.83	241.09	387.17	131.20
	Total toner cost	1023.96	2020.98	4041.95	8083.91	8083.91	8083.91	8083.91	8083.91
	Total paper cost	657.50	1297.70	2595.40	5190.80	5190.80	5190.80	5190.80	5190.80
	Acquisition price	2499.00	2499.00	2499.00	2499.00	2499.00	2499.00	2499.00	2499.00
	Repairs								1562.48
	Total cost including paper	4484.16	6133.81	9476.46	15904.91	15941.54	16014.80	16160.88	17467.39
	Print cost per page in DEM	0.090	0.061	0.047	0.040	0.040	0.040	0.040	0.043
	Total cost excluding paper	3826.66	4836.11	6881.06	10714.11	10750.74	10824.00	10970.08	12276.59 (\$6834.37)
	Print cost per page in DEM	0.077	0.048	0.034	0.027	0.027	0.027	0.027	0.031 (1.7 CENTS)
	HP	Total electricity cost	164.28	176.71	198.91	109.78	128.98	167.83	244.20
Total toner cost		711.37	1404.02	2808.04	5616.08	5616.08	5616.08	5616.08	5616.08
Total paper cost		657.50	1297.70	2595.40	5190.80	5190.80	5190.80	5190.80	5190.80
Acquisition price		2898.00	2898.00	2898.00	2898.00	2898.00	2898.00	2898.00	2898.00
Repairs									2198.06
Total cost including paper		4431.15	5776.43	8500.35	13814.66	13833.86	13872.71	13949.08	16012.72
Print cost per page in DEM		0.089	0.058	0.043	0.035	0.035	0.035	0.035	0.040
Total cost excluding paper		3773.65	4478.73	5904.95	8623.86	8643.06	8681.91	8758.28	10821.92 (\$6024.56)
Print cost per page in DEM		0.075	0.045	0.030	0.022	0.022	0.022	0.022	0.027 (1.5 CENTS)
Kyocera		Total electricity cost	313.46	326.78	351.65	137.20	174.94	250.86	401.38
	Total toner cost	174.38	344.18	688.35	1376.70	1376.70	1376.70	1376.70	1376.70
	Total paper cost	657.50	1297.70	2595.40	5190.80	5190.80	5190.80	5190.80	5190.80
	Acquisition price	3352.00	3352.00	3352.00	3352.00	3352.00	3352.00	3352.00	3352.00
	Repairs								607.84
	Total cost including paper	4497.35	5320.66	6987.40	10056.70	10094.44	10170.37	10320.88	10664.55
	Print cost per page in DEM	0.090	0.053	0.035	0.025	0.025	0.025	0.026	0.027
	Total cost excluding paper	3839.85	4022.96	4392.00	4865.90	4903.64	4979.56	5130.08	5473.74 (\$3047.23)
	Print cost per page in DEM	0.077	0.040	0.022	0.012	0.012	0.012	0.013	0.014 (0.7 CENT)
	Lexmark	Total electricity cost	217.56	229.10	250.42	112.33	138.31	190.48	293.93
Total toner cost		803.88	1607.76	3215.52	6431.04	6431.04	6431.04	6431.04	6431.04
Total paper cost		657.50	1297.70	2595.40	5190.80	5190.80	5190.80	5190.80	5190.80
Acquisition price		3500.00	3500.00	3500.00	3500.00	3500.00	3500.00	3500.00	3500.00
Repairs									904.80
Total cost including paper		5178.94	6634.57	9561.34	15234.18	15260.15	15312.32	15415.77	16138.97
Print cost per page in DEM		0.104	0.066	0.048	0.038	0.038	0.038	0.039	0.040
Total cost excluding paper		4521.44	5336.86	6965.94	10943.37	10069.35	10121.52	10224.97	10948.17 (\$6094.29)
Print cost per page in DEM		0.090	0.053	0.035	0.025	0.025	0.025	0.026	0.027 (1.52 CENTS)
Xerox		Total electricity cost	252.19	260.18	275.28	90.91	121.43	182.93	305.47
	Total toner cost	1049.82	2072.01	4144.02	8288.03	8288.03	8288.03	8288.03	8288.03
	Total paper cost	657.50	1297.70	2595.40	5190.80	5190.80	5190.80	5190.80	5190.80
	Acquisition price	2888.00	2888.00	2888.00	2888.00	2888.00	2888.00	2888.00	2888.00
	Repairs								2959.39
	Total cost including paper	4847.51	6517.89	9902.70	16457.75	16488.27	16549.77	16672.31	19417.14
	Print cost per page in DEM	0.097	0.065	0.050	0.041	0.041	0.041	0.042	0.049
	Total cost excluding paper	4190.01	5220.19	7307.30	11266.94	11297.47	11358.96	11481.51	14226.33 (\$7919.79)
	Print cost per page in DEM	0.084	0.052	0.037	0.028	0.028	0.028	0.029	0.036 (1.97 CENTS)

¹⁾ Total cost including repairs.



summary of features

Manufacturer Product	Brother HL-1660e	Hewlett-Packard Laser 4000 TN	Kyocera FS-3700+	Lexmark Optra S1650*	Xerox Docuprint 4517
Overall verdict	satisfactory	satisfactory	very good	good	adequate
Total cost/page price					
Repair requirements					
Print quality					
Speed					
Info	(061 60) 80 52 33	(018 05) 32 62 22	(021 59) 91 83 13	(08 00) 539 62 75	(01 30) 82 83 83
Price	DEM2,499	DEM2,898/3,999 (4000/TN)	DEM3,352	DEM3,350 (w/ memory)	DEM2,888
Specifications					
Print system	laser	laser	laser	laser	laser
Print engine manufacturer	Brother	Canon	Kyocera	Lexmark	Fuji/Xerox
Max. claimed print speed (plain A4.ppm)	16	16	18	16	16
Max. physical resolution	600 x 1200dpi	1200 x 1200dpi	600 x 600dpi (physical), 2400 x 2400 (interpolated)	1200 x 1200dpi	600 x 1200dpi
Processor, clock frequency	Fujitsu SparcLite, 100MHz	RISC processor, 100MHz	Power PC 603e, 100MHz	NEC processor, 133MHz (reviewed with Intel, 66MHz)	RISC processor, 50MHz
Memory type	PS/2 SIMM	DIMM	PS/2 SIMM	EDO-RAM	PS/2 SIMM
Memory installed as supplied	8MB	8MB	8MB	4MB standard + 32MB extension	4MB basic + 8MB extension
Maximum memory supported	72MB	100MB	68MB	132MB	64MB
Emulations and languages supported	PCL5e, BR-Script, HP-GL, Epson FX-850, IBM ProprinterXL	PCL5e, PCL6, PS-Level-2-Emulation	PCL5e, Diabolo 630, IBM Proprinter X24e, Epson LQ-850, Kyocera PS-Level-2	PLC5e, PCL6, PS-Level-2-Emulation	PCL5e, Adobe Postscript Level 2 (optional)
Interfaces					
Parallel/serial	● / ●	● / ○	● / ●	● / ●	● / ○
Infrared	○	●	optional	optional	○
AppleTalk	●	●	optional	optional	optional
Ethernet	optional	●	optional	optional	optional
TokenRing	optional	●	optional	optional	optional
Automatic emulation sensing	●	●	●	●	●
Paper					
Paper sizes supported	A4, A5, B5, Legal, Letter, envelopes	A4, A5, B5, Legal, Letter, envelopes	A4, A5, B5, Legal, Letter, envelopes	A4, A5, B5, Legal, Letter, envelopes	A4, A5, B5, Legal, Letter, envelopes
Maximum paper weight (gsm)	135 g/m ²	199 g/m ²	200 g/m ²	216 g/m ²	105 g/m ²
Capacity first paper tray (DIN A4)	500 pages	600 pages	250 pages	250 pages	250 pages
Capacity output paper tray (DIN A4)	250 pages	300 pages	250 pages	250 pages	250 pages
Duplexer	optional	optional	optional	optional	optional
Weight/dimensions					
Weight	16kg	22kg	14kg	19.1kg	18.6kg
Dimensions (H x W x D)	340 x 395 x 397mm	390 x 385 x 426mm	310 x 373 x 383mm	335 x 405 x 495mm	294 x 442 x 418mm
Printer drivers					
Windows 3.x	●	●	●	●	●
Windows 95	●	●	●	●	●
Windows 98	●	●	●	●	●
Windows NT 4.0	●	●	●	●	●
OS/2 Warp 4.0	○	●	●	●	●
Extras					
Toner	●	●	●	●	●
Interface cable	○	○	○	○	○
Power cable	●	●	●	●	●
Manual	German	German	German	German	German
Service					
Standard warranty duration	1 year	1 year	1 year	1 year	1 year
Hotline	(061 01) 80 52 00	(018 05) 32 62 22	(01 30) 18 71 87	(018 05) 51 25 11	(018 05) 12 31 18
Internet	www.brother.de	www.hewlett-packard.de	www.kyocera.de	www.lexmark.de	www.xerox.de
Service	○	○	3 years up to 300,000 pages warranty for developer unit	○	on-site, swap service

* replaced by Optra S1855



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Example 12,000 DEM = \$6,680.40

After removing the price of the printers, at 400,000 pages the cost of supplies for the printers were:

Kyocera FS-3700+\$842.00
HP 4000 \$3187.66
The Lexmark Optra S1650	..\$3725.99

The Kyocera also had the least amount of repairs and the lowest cost of service.

Update:

Since this test the FS-3700+ has been replaced with the new FS-3750. It uses the same engine and toner as the FS-3700 but now is a 1200DPI printer. This higher resolution produces outstanding output. The new FS-3750 also has more memory, now with 16MB standard, and a faster 166MHz processor. The FS-3750 has the same low total cost of operation as the FS-3700 at about 1/3 of 1 cent per page.

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