





**YIELD COMPARISON:**

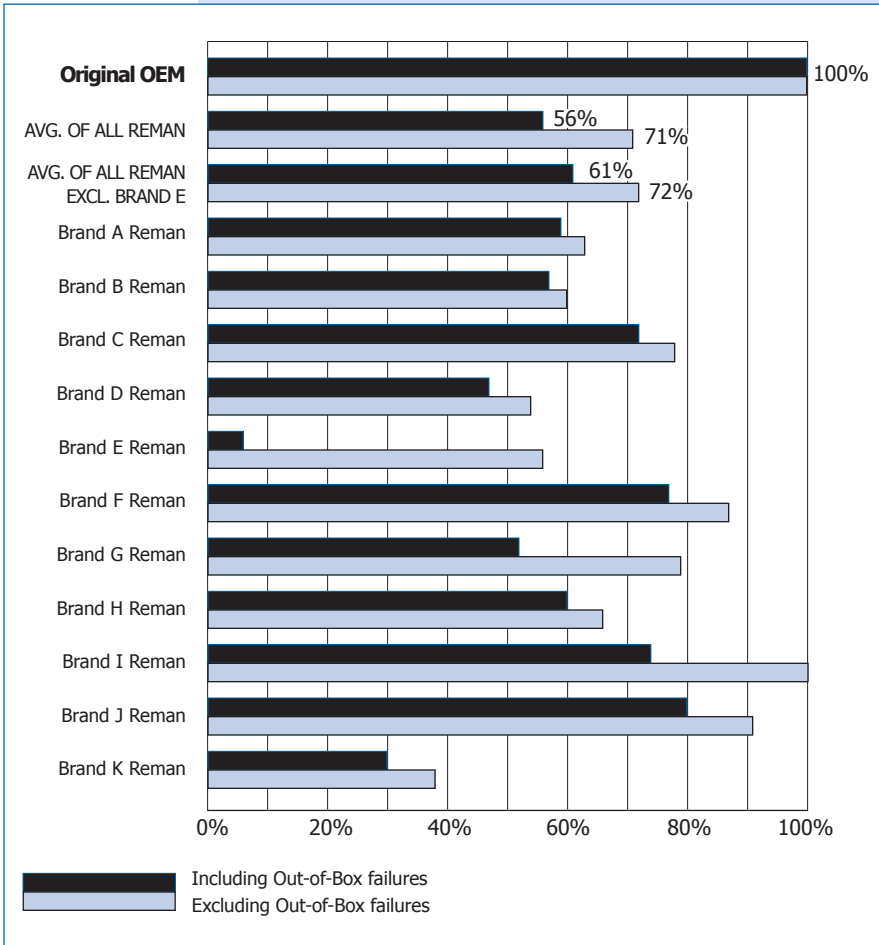
Pages printed by brand were compared to OEM performance. In the case in which a competitive brand claimed to achieve double the yield of the OEM, it was measured to that criterion. OEM pages printed, on average, using the three-page test suite, was used as the benchmark for comparison (Graph 1). Results show that the 688 remanufactured brand cartridges tested produced only 56%, on average, of the pages expected. When excluding out-of-box (OOB) failures from the calculations, the remanufactured brand cartridges averaged only 71% of the pages expected, compared to the original OEM cartridge performance. All of the remanufactured cartridge brands fell short of expected performance, printing fewer pages, on average, than the original OEM cartridges, including extremely poor performance by Brand E. Pages-printed performance of the 10 remanufactured cartridge brands, excluding Brand E, still only averaged 61% of the pages expected, and 72% when excluding OOB failures (Graph 1). This shortfall in performance occurred on all four printer types (Table 1).

**CARTRIDGE RELIABILITY AND PRINT QUALITY PERFORMANCE:**

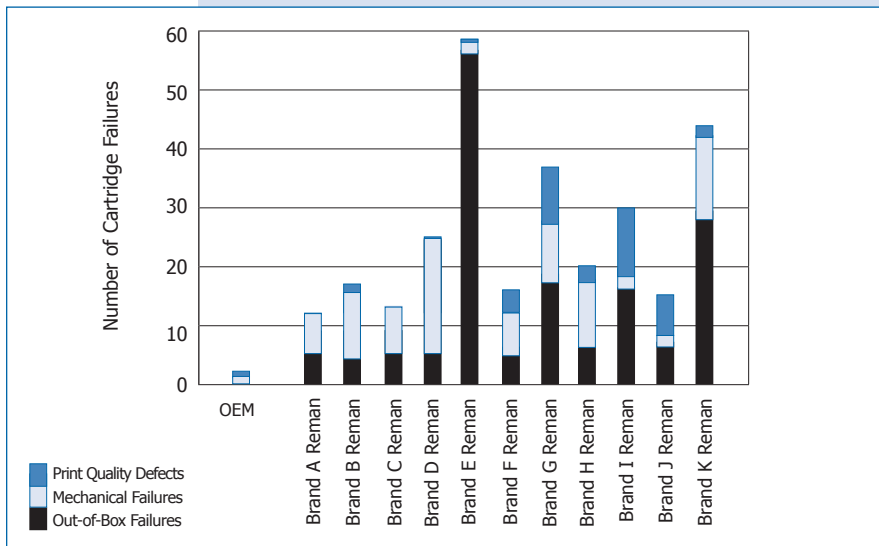
Performance problems were encountered with a significant number of the 688 remanufactured brand cartridges tested (Graph 2). In fact, 154 (22%) failed out-of-box, meaning they were damaged and unusable when removed from their packaging or they produced 20 or fewer acceptable pages before failure. Many of the OOB failures were due to leaking toner or defective drums (Photo 1). In addition, 134 (19%) of the 688 remanufactured cartridges evaluated experienced cartridge reliability failures during life, such as excessive toner leakage, cartridge component failures and broken or missing parts, as well as print-quality problems that ranged from toner leaking on pages, background on images, extraneous lines, spots and blotches on images to image voids. By comparison, none of the original OEM cartridges experienced out-of-box failures and all but two (3%) had excellent reliability performance (one in which background on images developed at approximately 70% through life, and another in which a printer error light illuminated, also at about 70% of its life).

**TABLE 1**

Printer	Average Reman Brand as % of Expected Pages
Model 1	68%
Model 2	69%
Model 3	43%
Model 4	54%



**GRAPH 1: Comparison of average pages printed by brand**



**GRAPH 2: Cartridge Reliability Failures by Brand**



### PRINTER FUSER DAMAGE:

Print problems requiring premature fuser maintenance kit replacement were experienced with every remanufactured cartridge brand tested, resulting in replacement of the fuser, charge roller and transfer roller. In fact, of the 688 remanufactured brand cartridges tested, 141 caused printer fuser problems that resulted in premature fuser maintenance kit replacement (Graph 3). In other words, for every five remanufactured cartridges tested, an unexpected fuser damage and replacement event occurred. The primary cause of fuser failures was toner buildup on the fuser roller (Photo 2), causing print quality problems (Photo 3), which are commonly a result of improperly fused toner or toner leaks in the printer.

*(Note: To prevent contamination from competitive cartridges from negatively impacting performance, each printer received a new fuser, charge roller and transfer roller as part of the printer maintenance prior to beginning the testing of each cartridge brand. This is not included in the failure count.)*



PHOTO 1: Cartridge failed OOB due to toner leak



PHOTO 2: Toner buildup on printer fuser back-up roller

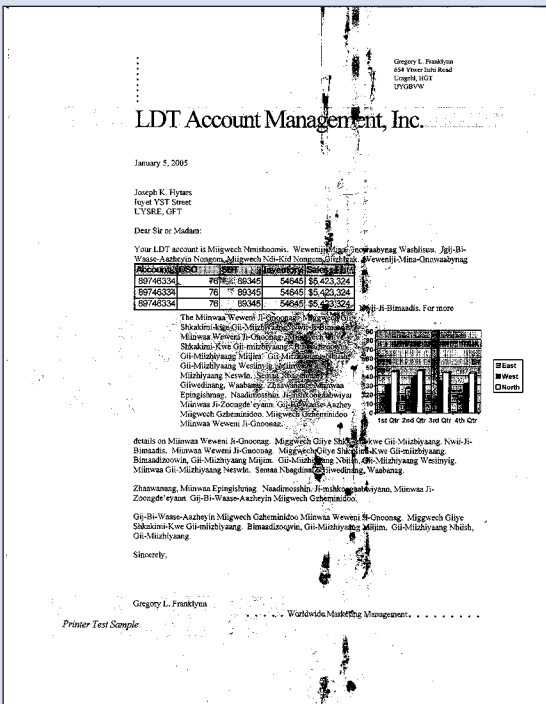
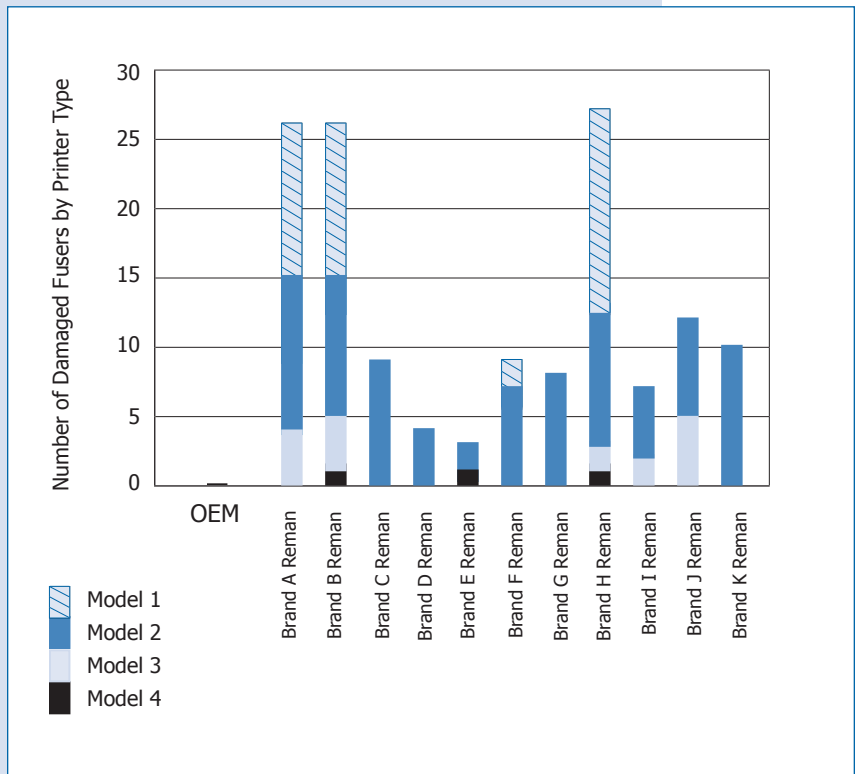


PHOTO 3: Print quality defect caused by toner buildup on fuser hot roller



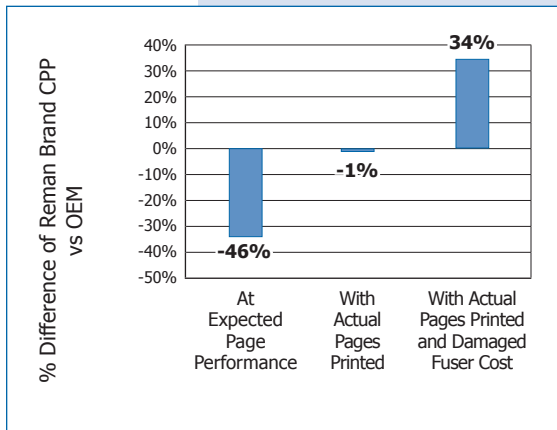
GRAPH 3: Printer Fuser Damage by Brand by Printer Type



**OVERALL VALUE:**

When considering cartridge purchase price, and assuming that the cartridges will achieve expected page yields, the average purchase price of the remanufactured brand cartridges in this test was 46% lower than the average price of the original OEM cartridges. But when considering actual yield performance in testing (with the 688 remanufactured brand cartridges producing only 56%, on average, of the expected pages), the savings from the reman brand cartridges was reduced to only 1% less than the original OEM cartridges. However, when the pro-rated cost of the 141 damaged fusers was factored into the equation, the true cost differential was reversed, with the remanufactured brand cartridges being **34% more expensive** than the original OEM cartridges. It is also important to note that this assessment does not capture the additional business expenses that would be incurred supporting the performance shortfalls of the remanufactured brand cartridges, which could include the added costs of incremental help-desk support, printer downtime, cost of duplicate prints, handling of faulty cartridges and service call expense, to name a few.

As is clearly evident from the test data (contrary to buyers' expectations), purchasing remanufactured cartridges at prices that are below the OEM's does not ensure savings or value, and in fact may actually result in greater cost to the customer in terms of overall dollars lost due to lower page yields and performance problems.



**GRAPH 4: Cost-Per-Page Comparison of Reman Brand vs OEM**

**SUMMARY:**

BLI believes this was one of the most thorough and complete evaluations of toner cartridge yield and reliability performance ever conducted for publication, and that the results undoubtedly show significant variations in the remanufactured cartridge performance vs. the OEM brand. The tests also clearly revealed that there was no consistency in performance across remanufactured brands, and that even when considering a single brand, the remanufactured cartridge performance was not consistent across printer types. Based upon the results of this extensive test, Buyers Lab strongly recommends that buyers considering the use of remanufactured cartridges exercise caution, look well beyond purchase price and thoroughly review unbiased performance data before investing their hard-earned dollars on products intended to replace those offered by the OEM.

**DATA TABLES:**

Data Table 1: Average Cost-per-Page (CPP) Comparison For All Cartridges Tested													
Brand	Purchase Cost For All Cartridges Tested				Expected CPP by Brand based on Mfr's Claim	Expected CPP by Brand as % of OEM CPP	Actual Average Pages Printed for All Four Printer Models	Actual CPP by Brand based on average pages printed. (Excludes Damaged Fuser Maintenance Kit Cost)	Actual CPP by Brand as % of OEM CPP	Damaged Fuser Maintenance Kit Cost. <sup>1</sup>	CPP \$ of Damaged Fuser Maintenance Kit Cost	Actual CPP by Brand based on average pages printed and Damaged Fuser Maintenance Kit Cost.	Actual CPP for average pages printed and Damaged Fuser Maintenance Kit Costs as % of OEM
	Model 1	Model 2	Model 3	Model 4									
Original OEM	\$134.00	\$325.00	\$364.00	\$330.00	\$0.0309		9,332	\$0.0309		\$0.00	\$0.00	\$0.00	
Brand A Reman	\$66.00	\$98.00	\$101.00	\$129.00	\$0.0106	-66%	5474	\$0.0190	-42%	\$119.49	\$0.022	\$0.040	29%
Brand B Reman	\$115.00	\$165.00	\$188.00	\$208.00	\$0.0181	-41%	5293	\$0.0319	3%	\$116.50	\$0.022	\$0.054	75%
Brand C Reman	\$85.50	\$115.00	\$123.50	\$149.00	\$0.0127	-59%	6688	\$0.0177	-43%	\$43.37	\$0.006	\$0.024	-22%
Brand D Reman	\$211.00	\$475.00	\$495.00	\$495.00	\$0.0224	-27%	8864	\$0.0473	53%	\$19.27	\$0.002	\$0.049	60%
Brand E Reman	\$73.31	\$108.69	\$108.69	\$117.82	\$0.0109	-65%	569	\$0.1829	492%	\$11.47	\$0.021	\$0.203	558%
Brand F Reman	\$91.00	\$144.00	\$158.00	\$189.00	\$0.0156	-50%	7211	\$0.0202	-35%	\$42.29	\$0.006	\$0.026	-16%
Brand G Reman	\$99.00	\$169.00	\$172.00	\$172.00	\$0.0164	-47%	4858	\$0.0315	2%	\$38.55	\$0.008	\$0.039	28%
Brand H Reman	\$120.00	\$186.25	\$174.90	\$211.25	\$0.0185	-40%	5578	\$0.0310	0%	\$119.65	\$0.021	\$0.052	70%
Brand I Reman	\$129.00	\$189.00	\$245.00	\$299.00	\$0.0231	-25%	6940	\$0.0311	1%	\$33.79	\$0.005	\$0.036	16%
Brand J Reman	\$127.50	\$199.00	\$205.00	N/A	\$0.0198	-36%	7129	\$0.0249	-20%	\$77.30	\$0.011	\$0.036	16%
Brand K Reman	\$76.09	\$88.39	\$97.61	\$103.76	\$0.0098	-68%	2784	\$0.0329	6%	\$48.19	\$0.017	\$0.050	62%
<b>Average of Reman Cartridges:</b>	<b>\$108.49</b>	<b>\$176.12</b>	<b>\$188.06</b>	<b>\$207.38</b>	<b>\$0.0166</b>	<b>-46%</b>	<b>5,580</b>	<b>\$0.0305</b>	<b>-1%</b>	<b>\$60.52</b>	<b>\$0.0108</b>	<b>\$0.0414</b>	<b>34%</b>
<b>Average of Reman Cartridges Excluding Brand E:</b>	<b>\$112.01</b>	<b>\$182.86</b>	<b>\$196.00</b>	<b>\$217.33</b>	<b>\$0.0172</b>	<b>-46%</b>	<b>6,082</b>	<b>\$0.0291</b>	<b>-6%</b>	<b>\$65.55</b>	<b>\$0.0108</b>	<b>\$0.0398</b>	<b>29%</b>

1. Damaged fuser maintenance kit replacement cost is weighted average based on failures by printer type by brand. See Data Table 5. Total maintenance kit cost is spread over total cartridges purchased for testing.

# Toner Cartridges for Laser Printers

## Test Report BUYERS LABORATORY INC.



Data Table 2: Average Pages Printed Including Out-of-Box Failures

Brand	# of Total Cartridges	Expected Pages Printed based on Mfr's Claim	Actual Average Pages Printed For All Cartridges Tested				Actual Average Pages Printed for All Four Printer Models	% of OEM Pages Printed by Brand	% of Expected Pages Printed by Brand	% of Expected Pages Printed by Brand by Printer For All Cartridges Tested			
			Model 1	Model 2	Model 3	Model 4				Model 1	Model 2	Model 3	Model 4
			Original OEM	64		3,060				9,991	13,727	10,550	9,332
Brand A Reman	64	Equals OEM	2,266	8,899	5,813	4,916	5474	59%	59%	74%	89%	42%	47%
Brand B Reman	64	Equals OEM	1,710	7,738	4,754	6,970	5293	57%	57%	56%	77%	35%	66%
Brand C Reman	64	Equals OEM	2,597	7,231	7,915	9,008	6688	72%	72%	85%	72%	58%	85%
Brand D Reman	64	Double OEM	4,628	11,298	8,559	10,970	8864	95%	47%	76%	57%	31%	52%
Brand E Reman	64	Equals OEM	516	295	634	789	559	6%	6%	17%	3%	5%	7%
Brand F Reman	64	Equals OEM	3,452	8,353	9,567	7,472	7211	77%	77%	113%	84%	70%	71%
Brand G Reman	64	Equals OEM	2,319	6,111	4,478	6,524	4858	52%	52%	76%	61%	33%	62%
Brand H Reman	64	Equals OEM	2,810	9,661	4,055	5,785	5578	60%	60%	92%	97%	30%	55%
Brand I Reman	64	Equals OEM	2,041	7,086	8,637	9,996	6940	74%	74%	67%	71%	63%	95%
Brand J Reman	48	Equals OEM	2,098	9,976	9,312	N/A	7129	80%	80%	69%	100%	68%	N/A
Brand K Reman	64	Equals OEM	709	4,751	5,656	20	2784	30%	30%	23%	48%	41%	0%
Total Reman Cartridges:	688	Average Reman Pages Printed:	2,286	7,400	6,307	6,245	5,580	60%	56%	68%	69%	43%	54%
		Average Reman Pages Printed excluding Brand E:	2,463	8,110	6,875	6,851	6,082	66%	61%	73%	76%	47%	59%

Data Table 3: Average Pages Printed Excluding Out-of-Box Failures

Brand	# of Total Cartridges	Expected Pages Printed based on Mfr's Claim	Actual Average Pages Printed For Cartridges Tested Excluding Out-of-Box Failures				Actual Average Pages Printed for All Four Printer Models	% of OEM Pages Printed by Brand	% of Expected Pages Printed by Brand	% of Expected Pages Printed by Brand by Printer Excluding Out-of-Box Failures			
			Model 1	Model 2	Model 3	Model 4				Model 1	Model 2	Model 3	Model 4
			Original OEM	64		3,060				9,991	13,727	10,550	9,332
Brand A Reman	64	Equals OEM	2,589	9,492	6,643	4,916	5910	63%	63%	85%	95%	48%	47%
Brand B Reman	64	Equals OEM	1,824	7,738	5,848	6,970	5595	60%	60%	60%	77%	43%	66%
Brand C Reman	64	Equals OEM	2,770	8,264	9,046	9,008	7272	78%	78%	91%	83%	66%	85%
Brand D Reman	64	Double OEM	4,628	11,298	8,559	15,956	10110	108%	54%	76%	57%	31%	76%
Brand E Reman	64	Equals OEM	2,054	4,707	5,071	12,601	6108	65%	65%	67%	47%	37%	119%
Brand F Reman	64	Equals OEM	3,452	8,909	10,933	9,195	8122	87%	87%	113%	89%	80%	87%
Brand G Reman	64	Equals OEM	2,474	7,519	6,512	13,047	7388	79%	79%	81%	75%	47%	124%
Brand H Reman	64	Equals OEM	2,810	9,661	5,892	6,169	6133	66%	66%	92%	97%	43%	58%
Brand I Reman	64	Equals OEM	2,968	7,558	11,515	15,994	9509	102%	102%	97%	76%	84%	152%
Brand J Reman	48	Equals OEM	2,398	10,640	11,458	N/A	8165	91%	91%	78%	106%	83%	N/A
Brand K Reman	64	Equals OEM	1,256	5,847	6,960	291	3589	38%	38%	41%	59%	51%	3%
Total Reman Cartridges:	688	Average Reman Pages Printed:	2,657	8,330	8,040	9,415	7,082	76%	71%	80%	78%	56%	82%
		Average Reman Pages Printed excluding Brand E:	2,717	8,693	8,337	9,061	7,179	77%	72%	81%	81%	58%	77%

Data Table 4: Cartridge Failures by Brand

Brand	# of Total Cartridges	Out-of-Box Failures	Print Quality Failures	Cartridge Reliability Failures	Total Failures
Original OEM	64	0	1	1	2
Brand A Reman	64	5	7	0	12
Brand B Reman	64	4	8	5	17
Brand C Reman	64	5	8	0	13
Brand D Reman	64	5	7	13	25
Brand E Reman	64	56	2	1	59
Brand F Reman	64	6	6	4	16
Brand G Reman	64	17	10	10	37
Brand H Reman	64	6	11	3	20
Brand I Reman	64	16	2	12	30
Brand J Reman	48	6	2	7	15
Brand K Reman	64	28	14	2	44
Total Reman Cartridges:	688	154	77	57	288

Data Table 5: Damaged Fusers by Brand by Printer

Brand	# of Total Cartridges	Model 1	Model 2	Model 3	Model 4	Total Damaged Fusers	Damaged Fusers % of All Cartridges
Original OEM	64	0	0	0	0	0	0%
Brand A Reman	64	0	4	11	11	26	41%
Brand B Reman	64	1	4	10	11	26	41%
Brand C Reman	64	0	0	9	0	9	14%
Brand D Reman	64	0	0	4	0	4	6%
Brand E Reman	64	1	0	2	0	3	5%
Brand F Reman	64	0	0	7	2	9	14%
Brand G Reman	64	0	0	8	0	8	13%
Brand H Reman	64	1	2	10	14	27	42%
Brand I Reman	64	0	2	5	0	7	11%
Brand J Reman	48	0	5	7	0	12	25%
Brand K Reman	64	0	0	10	0	10	16%
Total Reman Cartridges:	688	3	17	83	38	141	20%

Average Damaged Fuser % by Printer Type	2%	10%	47%	24%
Average Fuser Maintenance Kit Street Price	\$117.03	\$310.31	\$308.39	\$274.01



### TEST METHODOLOGY OVERVIEW:

BLI ran eight each of four different OEM laser printer models (Models 1, 2, 3 and 4) in default mode. Sixteen high-yield cartridges per brand were tested in groups of four printers, with four cartridges tested in each printer. To measure pages printed (page yield), 16 original OEM high-yield cartridges were run to end of life on each printer model using a three-page test suite comprised of one page with approximately 24% coverage, one with approximately 7% coverage and one with approximately 4% coverage; and page yields and performance results were recorded. Each remanufactured brand was then tested and the "pages-printed" performance was compared to the yields obtained from the OEM cartridges. In the case in which a remanufactured brand claimed to achieve double the yield of the OEM, it was measured to that criterion. The results of average pages-printed performance was calculated in two ways: 1) based on the performance of all cartridges tested, including all out-of-box failures and print quality and reliability failures that occurred; and 2) excluding the cartridges for which OBB failures occurred. All cartridge malfunctions, such as out-of-box failures, operation failure, toner leakage, drum flaws and background on printed pages, as well as printer malfunctions caused by cartridges, such as fuser damage due to toner caking, were recorded.

In evaluating image quality, the three pages of the test suite, plus a 50% gray-scale page, were collected from each toner cartridge at the beginning of testing. Additional sets of print samples were taken at approximate mid-life and at first "toner low," and these sample pages were visually compared to the initial four pages printed at the beginning of each test and were checked for crispness of characters as well as image voids, toner spray, background, smearing, smudging, serif fill or any other image quality defects. Each toner cartridge was considered depleted upon the first "fade" occurrence after the second "toner low" warning was displayed on the printer LCD. At that time testing was halted and a page count was recorded. If image quality prematurely degraded to an unacceptable level or reliability problems were encountered, the test was halted at that time and a page count recorded. At the first and second "toner low" warning, the cartridges were

removed from the printers, shaken and reinstalled in the printers, and printing was resumed until end of life. Due to the absence of a "toner low" indicator, the end-of-life procedure for the Model 1 was as follows: run to text fade, shake cartridge, run to second text fade, shake cartridge, run to third text fade and declare end of life.

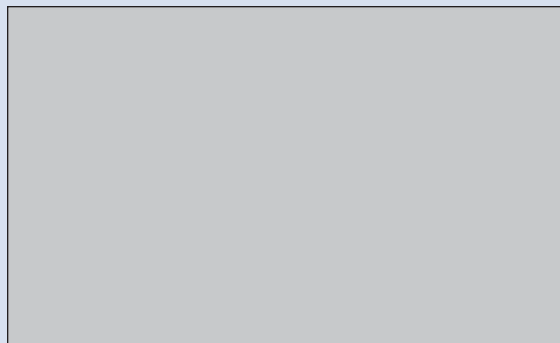
BLI test technicians conducted maintenance on all printers after completion of testing of each brand to prevent brand-to-brand contamination, and whenever printer fusers were damaged. At such time, each printer was vacuumed and the fuser, transfer roller and charge roller were replaced, as well as the paper roller, as needed. BLI procured all toner cartridges and paper through customary retail suppliers consistent with open market purchases. Nine of each printer model was randomly selected from OEM inventory, with an extra of each stocked as a back-up. All parts required for printer rebuilds, including fusers, transfer rollers and charge rollers, were provided by the OEM through standard channels.

### ABOUT BUYERS LABORATORY INC.

For nearly 45 years, Buyers Lab ([www.buyerslab.com](http://www.buyerslab.com)) has been the leading independent test lab and business consumer advocate for the office document imaging industry and buyers of office products. BLI is completely independent in all of its testing processes and subsequent reporting, and performs its extensive product evaluations in its 10,000-square-foot test facility located in Hackensack, NJ.

Each year, BLI's teams of highly experienced lab test technicians and product analysts, who have an average of 10 to 15 years of industry expertise, evaluate and report on hundreds of new document imaging devices, consumables and imaging media of all types. With over four decades of leading the product testing field, and a reputation for quality testing and unbiased reporting, BLI is the recognized expert in the industry. And the company's comprehensive array of products and services provide its clients with the most credible source of critical intelligence—allowing them to make informed and profitable business decisions.

BLI's products include comprehensive field and laboratory test reports, specification data and news coverage on copiers, printers, facsimile machines and multifunctional (MFP) document imaging devices, in addition to consulting services that assist buyers in the office equipment acquisition process, from RFP creation to vendor award. Buyers Lab also provides specialized confidential custom testing services for Original Equipment Manufacturers (OEMs) and business consumers that includes private testing of imaging devices, imaging media and consumables for quality assurance, product development, competitive comparison and acquisition purposes.



OEM printers in BLI's test laboratory