QualityLogic Reliability/User Experience Test Report

- HP Color LaserJet 4700n Printer vs. Ricoh SP C411DN -

QualityLogic Inc., an independent test firm, recently performed a reliability test comparing the HP Color LaserJet 4700n printer model with the Ricoh SP C411DN. The test included three printers of each model and involved printing 100,000 images on each printer during the test. During testing, QualityLogic monitored and documented all interactions and issues with the printers. After the test was completed, an analysis of the print quality was implemented on a sample of the output from each printer. This document summarizes the results from the testing and issues that QualityLogic encountered during initial setup of the printers, the actual reliability test and the subsequent print quality evaluation. The information is divided into the following five sections:

1. Executive Summary (which provides an overview of the next four sections)
2. Planned Interventions
3. Failures
4. Print Quality and Consistency
5. Customer Experience

Executive Summary

In all four of the areas evaluated during this testing, the HP printers performed better than the Ricoh printers as summarized in the table to the right. (A check mark in this table indicates that the model with the check did better than the other. If both models have a check mark it indicates that they had the same or very similar performance in that area.) The HP printers were easy to setup and had no initial problems while the Ricoh printers did have setup related failures. Ricoh printers also had more planned interventions than the HP printers. The HP printers had only one failure during testing; a failed print cartridge that was replaced with limited downtime. The Ricoh printers also only had one failure during testing; a failed fuser, but that failure resulted in nine days of downtime for the printer. Print quality was superior and more consistent for the HP printers than the Ricoh printers. In addition, the overall customer experience was much better with HP as we

	HP Color LaserJet 4700n	Ricoh SP C411DN
Planned Interventions	✓ Zero Only need to change toner cartridges	Requires waste bottle changes every 43K pages Black and Color PCU's need to be replaced every 50K pages Maintenance kit & ITU replacement every 100 K pages
Failures (including paper jams)	✓ No setup problems Paper jams - 2 in 300,000 pages One failed toner cartridge replaced under warranty	Two setup issues, one printer was DOA No paper jams One failed fuser
Print Quality	✓ Better print quality with higher consistency	Much lower print quality with lower consistency
Customer Experience	✓ Positive response by HP on all issues Limited down time	Wrong material sent by Ricoh Printers were down waiting for service both before and during testing

experienced limited downtime with the HP printers. The only issue we encountered with HP was a cartridge failure that was resolved promptly and to our satisfaction. The same cannot be said of Ricoh. Ricoh printers were down for lack of parts availability from Ricoh. When parts were sent they were either for a different printer or would not work. Numerous calls were required to Ricoh including follow-up calls to resolve issues.

Planned Interventions

Interventions are divided into two categories; those that occur frequently such as changing of paper and toner cartridges (referred to as Periodic), and those that are infrequent such as changing a drum assembly (referred to as Scheduled parts replacement). The HP and Ricoh printers had the same paper capacities in both of the paper drawers that were used for this test, thus the number of paper changes and the resulting time required to change paper was the same and is not included in this analysis. Note that interventions that resulted from failures during test are not covered in this section but in the next section.

	HP Color LaserJet 4700n	Ricoh SP C411DN
Periodic (per 100,000 pages)	✓ Change toner cartridges	✓ Change toner cartridges
Scheduled parts replacement	✓ None	Waste toner bottles lasted 43K pages Black and Color PCU's replaced every 50 K pages Maintenance kit and ITU replaced at 100 K pages Delays in getting maintenance kits

Periodic – Both printers used toner cartridges that required periodic replacement. The amount of time required between the models for actual replacement of the cartridges was similar. The Ricoh printer has higher capacity cartridges than the HP printer and thus required slightly less time over the life of the test to change.

Scheduled parts replacement - The Hewlett-Packard printer did not have any scheduled parts replacement during this test. The Ricoh printer had several items that required replacement at different intervals during the testing. Ricoh printers have a waste toner bottle system that required replacement twice on each of the printers during the test. Their expected life is 50,000 pages although we found in our testing that they lasted on average 43,100 pages. In addition, the Ricoh printers have separate Black and Color PCU's (Photo Conductor Units), which required replacement every 50,000 pages. The Ricoh printers also have a maintenance kit and ITU/Transfer belt that we had to replace at 100,000 pages. The maintenance kit and ITU are ordered separately. This replacement was required on two of the three printers. The third printer had the same components replaced earlier when its fuser failed and was replaced. The maintenance kit includes a fuser, transfer roller, pickup guides and rollers along with dust filters. We encountered extensive delays in getting the maintenance kits and ITU's. We initially ordered them from the same source we ordered the printers and consumables from but were informed that the parts were on backorder. In addition, in the middle of September we were informed that they would not be available until the end of the month. We checked with other similar providers and received the same information. We then contacted Ricoh directly and they agreed to send us the parts. The parts arrived from Ricoh but were for a different printer and thus not useable. The correct parts were then sent but they would not work in our printers. New parts finally arrived. The two printers involved were down and unusable for eleven working days each.

Failures

There are three areas that are covered under failures; initial issues encountered before testing began (initial set-up), failures during the actual test and paper jam rates for each model.

	HP Color LaserJet 4700n	Ricoh SP C411DN
Acquisition & Initial setup	✓ No issues	One printer was DOA One printer had poor print quality
Failures during test	✓ One defective cartridge encountered	Failed fuser – printer down for a week waiting for parts
Printer Jams	2 in 300,000 pages Jam rate 1/150,000 Duplex rate 1/7,500	✓ No jams in 300,000 pages

Initial Setup – During initial setup, the HP printers encountered no issues. The Ricoh printers had two issues one of which required a service call to resolve. One issue was a faulty printer that would not print after being turned on. A service call was made and the problem was traced to a defective component. We lost three days of usage of this Ricoh printer waiting to resolve the problem and had to make two additional calls to get it serviced. Another printer had extremely poor color registration requiring QualityLogic to perform a color calibration.

Failures during test – The HP printer had one failure involving a toner cartridge. The cartridge began having a print defect about half way through its life. After calling HP support the cartridge was replaced at no cost. One Ricoh printer had a fuser fail halfway through the test. Ricoh agreed to replace the fuser under warranty but commented that they thought we were using the printer too much and if another one failed they would not replace it. They did not ask what our usage rate was before making the comment. It is important to note that we were well under their maximum recommended duty cycle for this printer. Although they agreed to replace the fuser it had not arrived a week later requiring us to call them back. The fuser was then sent overnight and arrived the next business day.

Jam rates - When comparing the paper jam rates of the two printer models during testing, the Ricoh printer did better than the HP. The HP printers had 2 jams in 300,000 total images both of which occurred during duplex printing. The Ricoh had no jams during the test.

Print Quality and Consistency

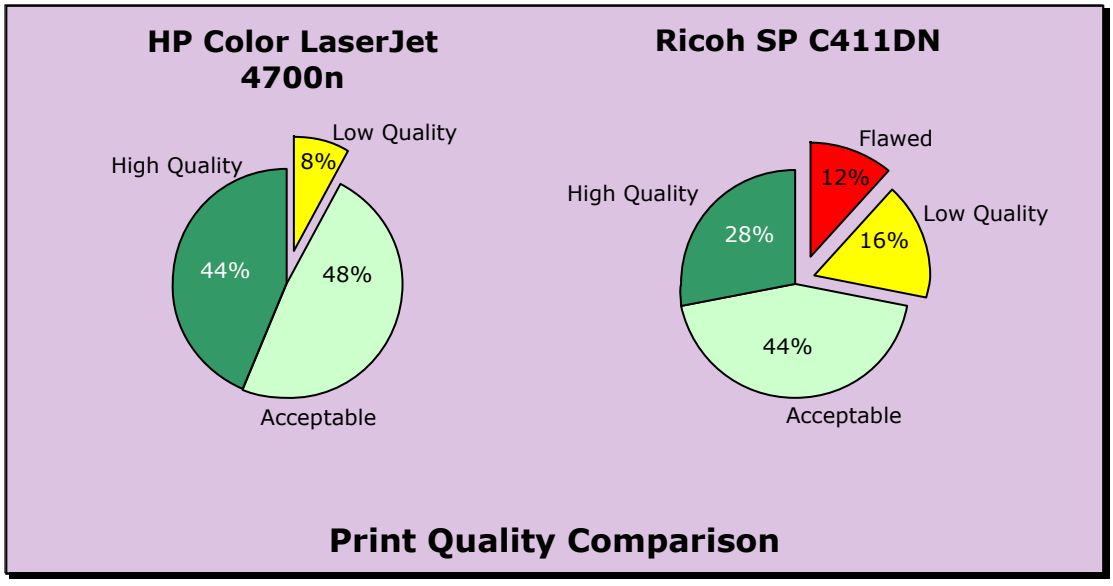
After all testing was completed two separate aspects of print quality were evaluated. The first evaluation compared the output of the HP and Ricoh printers directly. The second compared output consistency over the test period.

		HP Color LaserJet 4700n	Ricoh SP C411DN
Print Quality	✓	Winner almost 1.5X more high quality pages 92% of pages graded acceptable or above	Graded well below the HP Nearly 30% of pages graded "Low Quality" or "Flawed"
Print Quality Consistency	✓	High and consistent	Poor and somewhat declining

Print Quality - A direct print quality comparison of output from the Ricoh and HP printers was performed. A selection of pages from the print quality suites was compared by evaluators and ranked on a scale of 1 to 10 representing pages from "Flawed" to "High Quality". The HP printers showed a clear print quality advantage over the Ricoh printers.

Quality Level	Print Quality Description	HP Color LaserJet 4700n	Ricoh SP C411DN
High Quality	Page has no apparent artifacts and a user would put this page in his or her resume. These pages are defined as "High Quality" pages.	44%	28%
Acceptable	Pages are still acceptable but they have noticeable differences from those above. The average user would still use it in a typical business document.	48%	44%
Low Quality	Page is sufficiently flawed that it would not be circulated to others as a business document and would only be acceptable as a draft page. These pages are defined as "Low Quality" pages.	8%	16%
Flawed	Page has lost some to a significant amount of legibility and is considered severely flawed and would need to be re-printed or corrective action taken.	0%	12%
	Average (based on 1 worst – 10 best scale)	8.2	6.6

The following side by side pie charts compare the above information in a graphic form.



The table above shows that the Ricoh printers received a wider range of grades from the reviewers and a significantly lower average. Ricoh had 16% of their pages graded as "Low Quality" compared to 8% for HP. In addition, Ricoh had 12% of their pages considered to be "Flawed" compared to none for HP. HP printed almost 1.5 times as many high quality pages as Ricoh. The HP average of 8.2 (based on a 1 – 10 scale) was significantly higher than the Ricoh average of 6.6.

Consistency – In addition to the print quality test above, a separate consistency evaluation specific to each individual printer was also completed. This test showed how much each individual printer's output varied throughout the test. No comparison between models was done during this evaluation only for the given printer being graded.

Five Page Print Quality test suite

In the consistency test, similar to the print quality comparison test, the HP printers had higher overall quality grades and printed higher quality pages more consistently. The Ricoh printers were less consistent with overall lower grades that were more spread out. Comparing the grades for the first 50,000 pages versus the last 50,000, the Ricoh's had a downward print quality trend during the test while the HP printers improved slightly. The downward trend seen on the Ricoh printers was the result of one printer having lower print quality scores that were correlated with the replacement of a Black PCU. All maintenance procedures were followed during this testing and printing did not exceed monthly recommended duty cycles.

Summary - In summary the HP printers showed clearly better consistency and print quality compared to the output from the Ricoh printers.

Customer Experience

		HP Color LaserJet 4700n	Ricoh SP C411DN
Equipment Acquisition	✓	No issues.	Bad printer took three days to get fixed
During test	✓	One call that was resolved to our satisfaction.	Maintenance kits were not available through normal channels Ricoh sent wrong maintenance kit Ricoh sent bad transfer roller
Downtime	✓	Limited down time	3 days lost prior to testing 31 days lost during test

There are three areas considered under customer experience; equipment acquisition, testing and downtime. We will cover interactions with the printer vendor or their support infrastructure and how effective those interactions were at resolving any issues that arose. In the first area under equipment acquisition we will cover the initial and subsequent acquisition of printers and consumables along with any initial setup problems. In the second area we will cover any interactions required during the test.

Equipment Acquisition – Both the HP and Ricoh printers were easy to order and arrived promptly. Both the printers and consumables were ordered through a large well known online merchant. As noted earlier, the HP printers did not have any initial setup issues while the Ricoh printers did have issues that were summarized previously. The local service provider for Ricoh did provide service on the issue that we encountered, although it did take three days for them to respond and fix the problem.

During Test – During testing, the HP printer had one issue with a print quality problem that was quickly resolved by HP to our satisfaction. The cartridge was replaced free of charge by HP. As reported earlier the maintenance kits for the Ricoh printer were not readily available as they were on backorder. When Ricoh did send them they were for a different printer. When they replaced these they did not work and required another round of replacement parts.

Downtime – The HP printer had very limited downtime during testing due to one failed cartridge. The Ricoh printers lost nine days due to printer failures and 22 days due to lack of parts during the test in addition to three days prior to testing due to a DOA printer.

Summary – During this test the HP printers had one problem and the subsequent interaction was positive. The Ricoh printer had issues that resulted in lost printing time and extra effort to track and resolve. Ricoh failed to send us replacement components for the failed fuser in a timely manner, had material that was on backorder and shipped us incorrect material or components that did not work.

Conclusions

The HP Color LaserJet 4700n outperformed the Ricoh SP C411DN in almost all tracked reliability metrics. Setup was incident free with the HP printers. Ricoh had two issues, one of which required a service call, before we were able to start testing. During the test, the HP printer only required cartridge changes with no need for additional scheduled maintenance. Ricoh required many additional planned interventions including waste toner bottle, Black and Color PCU, ITU and maintenance kit replacements. In the print quality portion of the test, the HP Color LaserJet 4700n had clearly superior print quality with higher consistency. HP had over 1.5 times as many high quality pages as the Ricoh. More importantly 92% of its pages were rated as "Acceptable" or better while the Ricoh had nearly 30% rated below "Acceptable". The Ricoh printers required on site service and many phone calls during the

test. Components required to maintain the printers were unavailable and when shipped from Ricoh directly were wrong. HP did not require any on site support. Calls to both Ricoh and HP revealed that HP support resolved issues quicker with less wasted time. In this reliability test, the HP Color LaserJet 4700n was the clear winner.

Test Approach

The objective of this reliability study was to identify any reliability and usage issues in a controlled and consistent test environment. The testing was done in a manner that attempted to simulate normal start stop printing usage in a high volume business environment. Another objective of the study was to understand and document the customer experience during the purchase, initial equipment setup and usage of the printers. The test length was set as 100,000 pages per printer with an initial burn in test that extended the test length to 102,000 pages for each printer.

Three printers of each model were purchased and tested in order to have a broad base to compare with and avoid having any single printer predominate. All equipment setup, maintenance (if required) and replacement of parts was done by trained QualityLogic test technicians unless local support was provided by the vendor. All procedures as recommended in supporting documentation provided by the manufacturer were adhered to during testing. The recommended maximum monthly duty cycle by the manufacturer was not exceeded during testing.

Print jobs were 10 pages in length and a pause was inserted between print jobs in order to simulate a work environment in a controlled manner. 90% of the pages were printed on standard 20 lb. laser paper while the remainder was divided between a 20 lb. recycled paper, a heavy 28 lb. laser grade paper and a 32 lb. glossy paper. 10% of the overall pages were printed in duplex using the standard 20 lb laser grade paper. In each group of 100 pages, 95 were using a test suite available from ISO for yield testing while five pages were a print quality grading suite. This suite was developed for this test by QualityLogic from existing QualityLogic files. All printing was done on letter size paper.

All testing was done in an environmentally controlled environment with the average temperature controlled within the range of 23.0ºC ± 2ºC and humidity 50% ± 10% RH. All materials used in testing were acclimated in this environment for at least 8 hours prior to usage.

All printers were configured with similar options. A second bin was added for the standard 20 lb paper while the three special papers were fed from the standard tray. All printers were equipped with their duplex printing options and network connection option (which was used for delivering test files). All printers and consumables were purchased by QualityLogic on the open market. The majority of toner was purchased in one of three lots for each printer. The lots were disbursed over the test period in order to provide randomness in manufacturing lots used for the testing.

All print drivers were installed using the Plug-n-Play method and tested using the default settings. Files were initially printed and captured for later integration into the QualityLogic test environment. The captured files were then sent to the printers during testing. Logs were kept during testing regarding all issues encountered during the test.

After the test was completed, two print quality evaluations were conducted. The first comparison evaluated the consistency of output over the test period for each printer. A single grader was used for the evaluation in order to provide consistency in the process. All three printers from a single manufacturer were evaluated before proceeding to the next model. Every other print quality suite was graded and each page in the sampled suite was evaluated.

For the second portion of the study the grader removed representative samples of the suites from each model. These were graded on a one to ten scale by several evaluators.

This study was commissioned by HP.

About QualityLogic

QualityLogic is a leading Software Quality Services Company offering a variety of testing services and related tools focused on the conformance, performance, and interoperability testing needs, from low level firmware testing, to high level multi-tier application testing. QualityLogic has over 20 years' experience, both in developing specialized test tools and providing comprehensive testing services for top industry manufacturers.

Test results provided by QualityLogic. Tests were performed under laboratory conditions and your results may vary.