



QualityLogic Reliability/User Experience Test Report

- HP Color LaserJet 4700n Printer vs. Dell 5110cn -

QualityLogic Inc., an independent test firm, recently performed a reliability test comparing the HP Color LaserJet 4700n printer model with the Dell 5110cn. 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 two of the four areas evaluated during this testing, the HP printers performed better than the Dell 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 and Dell printers were easy to setup and had no initial problems. The Dell printers were delayed in delivery though. Print quality was superior and more consistent for the HP printers than the Dell printers. In addition, the overall customer experience was better with HP. Orders for HP products were filled correctly and the only call for technical support was handled promptly. Dell shipped us the wrong material on two orders and expressed reluctance both times to replace the unusable material that they had sent. Persistence on our part was required to obtain the material that we ordered.

| | HP Color LaserJet 4700n | Dell 5110cn |
|---------------------------------|--|---|
| Planned Interventions | ✓ Zero Only need to change toner cartridges | Need to change toner cartridges. Every 35,000 pages requires drum and roller replacement (Dell specification) |
| Failures (including paper jams) | ✓ No setup problems Paper jams - 2 in 300,000 pages One failed toner cartridge replaced under warranty | ✓ No setup problems Paper jams - 2 in 300,000 pages Two print quality issues encountered |
| 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 | Initial shipments delayed ten days Longer time required to resolve issues on the telephone Wrong material sent Limited down time |

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 Dell printers had the same paper capacities in both of the paper

| | HP Color LaserJet 4700n | Dell 5110cn |
|------------------------------|--------------------------------|---|
| Periodic (per 100,000 pages) | ✓ Change toner cartridges | ✓ Change toner cartridges |
| Scheduled parts replacement | ✓ None | Change drums and rollers, 0.7 hours per 100,000 pages. Ordering mistakes made by Dell twice for parts. |

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.

Periodic – Both printers used toner cartridges that required periodic replacement. These are the only items that require periodic interventions on these two printers. The amount of time required between the models for actual replacement of the cartridges was similar. For this test, we used the standard yield Dell cartridges which resulted in the HP printer using fewer cartridges and gave it a slight advantage in replacement time. Had the Dell high yield cartridges been used, the Dell would likely have had a slight advantage requiring fewer cartridge replacements. Overall, the total difference in time to replace cartridges was minimal.

Scheduled parts replacement – The Hewlett-Packard printer did not have any scheduled parts replacement during this test. The Dell printers imaging drum and transfer roller are scheduled to be replaced every 35,000 pages per Dell’s specifications. In testing, the print engine notified the user when these needed to be replaced. Although the two are shipped together it is not required that they be replaced at the same time. Based on this test, the drum lasted an average of 45,000 pages and was replaced twice on each of the printers during the test. The roller lasted an average of 37,600 pages and was also replaced twice on each of the printers during testing. The drums and rollers are not difficult to replace but are more complex than a toner cartridge.

The amount of time required to replace the drum and rollers on the Dell printers was not significant but the amount of time consumed in acquiring these components was. On our second order of toner we attempted to order toner and drums on line. We were not able to find a way to order the drums on line and thus had to call Dell to place the order. The agent that we were working with confirmed the order on the phone incorrectly as 5100 not 5110 drums. We corrected the individual but the order was filled with the 5100 drums which did not work in the 5110. When a second order was called in for the second set of drums the same thing happened again. In both instances when we called back to Dell, they communicated to us that they normally do not take material back unless it is the same kind. We had to be persistent to overcome their reluctance to exchange the material.

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 | Dell 5110cn |
|-----------------------------|---|--|
| Acquisition & Initial setup | ✓ No issues | Delays in equipment arrival |
| Failures during test | ✓ One defective cartridge encountered | ✓ Two print quality issues encountered |
| Printer Jams | ✓ 2 in 300,000 pages Jam rate 1/150,000 Duplex rate 1/7,500 | ✓ 2 in 300,000 pages Jam rate 1/150,000 Duplex jams none |

Initial Setup – During initial setup the HP and Dell printers

encountered no issues. The purchase of the Hewlett-Packard printers was straight forward and they arrived promptly. Acquisition of the Dell printers encountered long delays in equipment arrival after ordering. In addition we encountered miscommunication on the part of Dell in regards to their expected arrival and billing. Initially they informed us that the printers were available and yet they did not ship. This required us to call back in order to determine shipping status. In addition they informed us incorrectly of when billing and invoicing would take place. The Dell printers were delayed in getting to us by ten days.

Failures during test – The HP and Dell printers had similar results in terms of failures in this 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. The Dell printers had two print quality issues during test which required calls to Dell for technical support. The calls to Dell required significantly more time than the single call to HP. We spent less than one hour in total with HP on the phone as opposed to 2.3 hours with Dell.

Jam rates - When comparing the paper jam rates of the two printer models during testing they were equivalent. The HP printers had 2 jams in 300,000 total images both of which occurred during duplex printing. The Dell also had 2 jams in the same 300,000 images.

Print Quality and Consistency

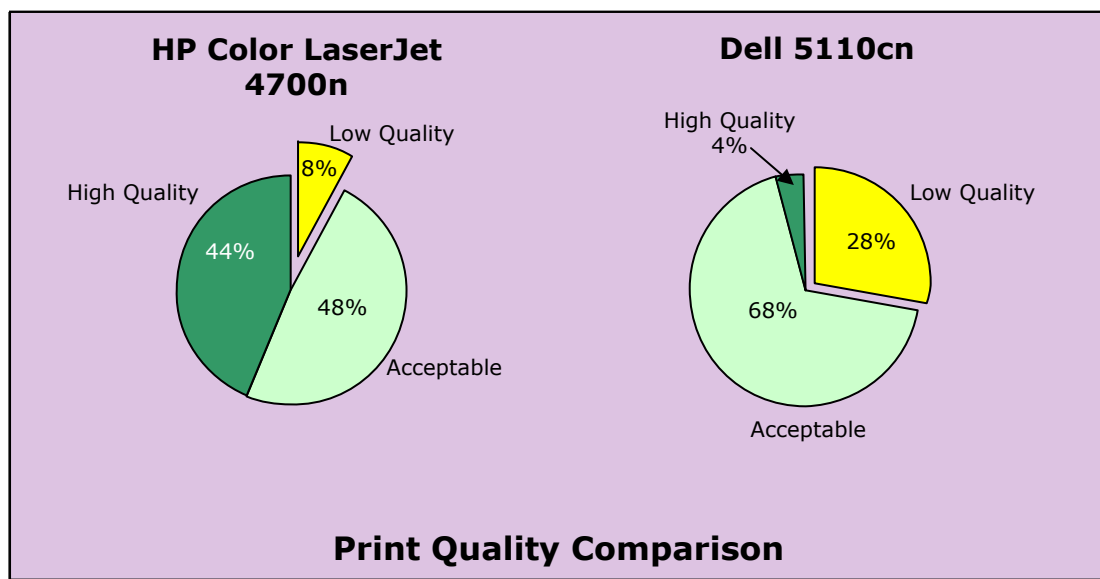
After all testing was completed two separate aspects of print quality were evaluated. The first evaluation compared the output of the HP and Dell printers directly. The second compared output consistency over the test period.

| | HP Color LaserJet 4700n | Dell 5110cn |
|---------------------------|---|--------------------------|
| Print Quality | ✓ Clear winner almost 11X more high quality pages | Graded well below the HP |
| Print Quality Consistency | ✓ High and consistent | Poor |

Print Quality - A direct print quality comparison of output from the Dell 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 Dell printers.

| Quality Level | Print Quality Description | HP Color LaserJet 4700n | Dell 5110cn |
|--|--|-------------------------|-------------|
| 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% | 4% |
| 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% | 68% |
| 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% | 28% |
| 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% | 0% |
| Average (based on 1 worst – 10 best scale) | | 8.2 | 6.4 |

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



The table above shows that the Dell printers received a wider range of grades from the reviewers and a significantly lower average. Dell had 28% of their pages graded as "Low Quality" compared to 8% for HP. HP printed 11 times as many high quality pages as Dell. The HP average of 8.2 (based on a 1 – 10 scale) was significantly higher than the Dell average of 6.4.

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 printers output varied throughout the test. No comparison between models was done during this evaluation only for the given printer being graded.

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 Dell printers were less consistent with overall lower grades that were more spread out. All maintenance procedures were followed during this testing and printing did not exceed monthly recommended duty cycles.

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



Five Page Print Quality test suite

Customer Experience

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.

| | HP Color LaserJet 4700n | Dell 5110cn |
|-----------------------|---|--|
| Equipment Acquisition | ✓ No issues. | Initial delays in receiving printers Wrong drums sent |
| During test | ✓ One call that was resolved to our satisfaction. | Two separate PQ issues required lengthy calls. |
| Downtime | ✓ Limited down time | ✓ Limited down time |

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 Dell printers were easy to order. The Hewlett-Packard printer arrived promptly. The Dell printers were delayed in shipping and required follow up calls to understand the status and billing. The printers did not arrive for ten days.

Subsequent orders of consumables for the Hewlett-Packard printers also went smoothly. On both orders for toner and drums from Dell, the wrong drums were sent. On both occasions we had confirmed our order with an agent on the phone. These mistakes cost extra time and effort on our part to resolve with Dell. In addition Dell expressed reluctance to exchange the incorrect material both times.

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. The Dell printer had two print quality issues. These required time on the phone with Dell technical support to resolve. On one of these occasions we had to explain the complete problem issue to three different support agents before it could be resolved. This one instance took an hour and a half to resolve.

Downtime – The HP printer had very limited downtime during testing due to one failed cartridge. The Dell printers experienced slightly more downtime as the result of the two issues with print quality.

Summary – During this test the HP printers had one problem and the subsequent interaction was positive. The Dell printer had two print quality issues that resulted in lost time on the phone. In addition Dell sent us the wrong material and then expressed their reluctance to exchange it.

Conclusions

The HP Color LaserJet 4700n outperformed the Dell 5110cn in most of tracked reliability metrics. Setup was similar between the two printers. During the test, the HP printer only required cartridge changes with no need for additional scheduled maintenance or parts replacement. The Dell printer would have required fewer cartridge changes overall than the HP printer if we had used the Dell high yield cartridge but did require parts replacement of the drum and roller twice during the test. In the print quality portion of the test, the HP Color LaserJet 4700n had clearly superior print quality with higher consistency. HP had over eleven times as many high quality pages as Dell. Calls to HP revealed that HP support resolved issues quicker with less wasted time than calls to Dell. Orders to Dell for material were filled with incorrect parts requiring extra time to resolve. In this reliability test, the HP Color LaserJet 4700n was the clear winner.

Test Approach

This 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 in 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 $23.0^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and humidity $50\% \pm 10\% \text{RH}$. 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.

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