Clean Start™ PRINTHEAD CLEANER

Performance Report

Introduction

Thermal transfer printers need regular care to maintain their performance just like a car needs its oil changed. Typically, printer OEMs recommend cleaning the printhead after every ribbon. This assures print quality does not degrade over time and the head does not prematurely fail. Yet, research shows less than 20% of people follow the manufacturer's printhead cleaning recommendations. A primary reason people don't clean the printhead is it is inconvenient and messy. Cleaning supplies are not always readily available at the printers, and traditional cleaning methods are time consuming - slowing down the printing process.

Importance of Printhead Cleaning

Printhead buildup is a normal occurrence in thermal transfer printing. Dirt and residue from the ribbon, stock, and environment are deposited on the printhead during the printing process. If the printhead is not cleaned regularly, the residue eventually becomes permanent and will create a barrier between the printhead element (dot) and the label. Blocked elements cause print quality problems such as lighter print, voiding and streaking, as well as shortened printhead life.

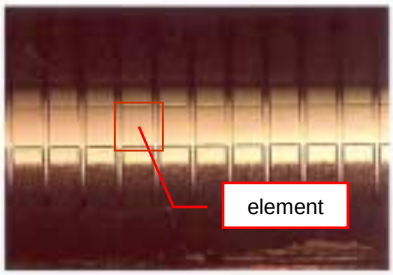


Figure 1 Clean Printhead

Buildup and related problems can be prevented by regularly cleaning the printhead. Cleaning removes dirt and debris before it bakes onto the printhead elements. *Figure 1* represents a magnified photograph of a clean printhead. The rows of squares in the center of the photo are printhead elements or dots. Commonly, there are 203 dots per inch.

Factors that Affect Buildup

Complex label format, faster print speeds, high heat settings, and high volume printing are some extremely aggressive conditions in thermal transfer printing that accelerate printhead buildup. The type of printer and ribbon are other variables that affect the level and severity of buildup. All thermal transfer ribbons have a "backcoat" that serves as a protective layer between the printhead and ribbon's base film, allowing the ribbon to slide smoothly under the printhead. Because all backcoats leave some residue on the printhead, it is necessary to clean the printhead regularly to avoid buildup.

Figure 2 below demonstrates how quickly buildup occurs when a printhead is not cleaned. The photographs represent buildup induced by aggressively printing with three leading ribbon brands and NOT CLEANING at each ribbon load. This amount of buildup was generated after 5 ribbons, and has no impact on print quality. However, the rate of buildup will progress in a similar fashion if the printhead is not cleaned. Over time, print quality will suffer and the printhead elements will burnout prematurely, requiring the printhead to be replaced.

Brand A *Brand B* *Brand C*

Figure 2 - Printhead Buildup when Not Regularly Cleaned (three leading ribbon brands)

A New Innovation - Clean Start™ Built-in Printhead Cleaner

Clean Start was invented to encourage printhead cleaning and make it easy. Clean Start is a printhead cleaner that is built into the beginning of the thermal transfer ribbon. Clean Start is a thin, white film coated with a mild cleanser that gets pulled through the locked printhead at the start of each ribbon load to remove residue before it builds up.

Clean Start was introduced in February 2004 on a wax thermal transfer ribbon. Based on strong demand, Clean Start was expanded to wax/resin and resin ribbons in late 2004.

This Performance Report provides details on a series of tests performed to confirm the effectiveness of Clean Start and meets the following objectives:

1. Ensure Clean Start does not, in any way, damage the printhead.

2. Compare the buildup on a printhead when using Clean Start as a routine cleaning method versus not cleaning the printhead at all.

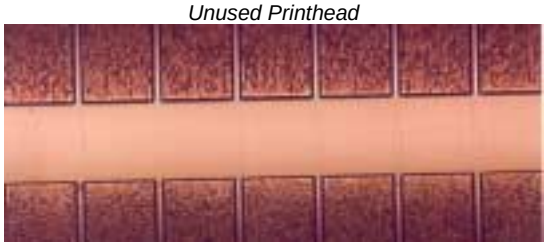
3. Compare the effects of using Isopropyl Alcohol (IPA) vs. Clean Start to clean the thermal printhead.

Test One - Clean Start Does Not Damage the Printhead

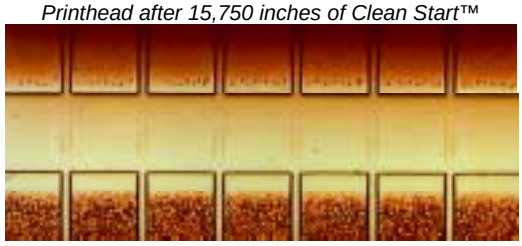
The objective of Test One was to ensure Clean Start does not, in any way, damage the printhead. A new printhead was placed in a Zebra 140xi printer and 15,750 inches of Clean Start material was pulled through the printer per the operating instructions for Clean Start. In an actual application, approximately seven inches of Clean Start is pulled through at the start of each ribbon. This is equivalent to using Clean Start with 2,250 ribbons. Assuming a ribbon length of 1,476 ft, this translates to 39.9 million linear inches of ribbon.

Once this test was done, the printhead was evaluated to see if any change had taken place. The printhead elements were not worn or scratched and performance remained flawless as the test images below demonstrate.

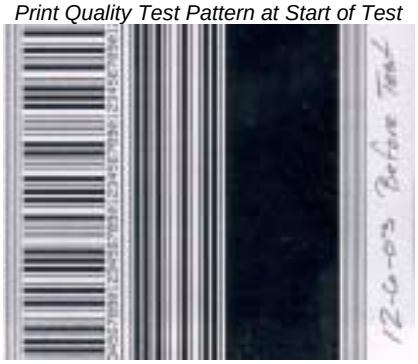
Unused Printhead



Printhead after 15,750 inches of Clean Start™



Print Quality Test Pattern at Start of Test



Print Quality Test Pattern after 15,750”

Figure 3 - Before and After Pulling 15,750" of Clean Start over a Locked Printhead - No Abrasion Occurred

Test One Conclusion - Clean Start Does Not Damage the Printhead

This test was conclusive. Prolonged use of Clean Start will not damage the printhead in any way. Using Clean Start every time a new ribbon is loaded is a safe way to keep printheads clear of residue and debris.

Test Two - Clean Start vs. Not Cleaning at All

Test Two was developed and performed to compare the buildup on a printhead when using Clean Start as a routine cleaning method versus not cleaning the printhead at all.

Test Printer: Zebra 140xiII
Test Image: Low density rotated bar code, small text, 80% solid bar
Test Speed : 8 ips
Print Energy: Various wax and wax/resin ribbons
Example of test image (*Figure 4*)

Figure 4 Test Image

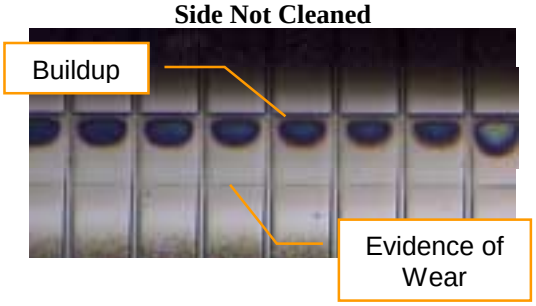
To eliminate any variability from the printhead, one printhead was used to print two identical images side by side. At the beginning of every new ribbon, one side of the head was cleaned with Clean Start while the other side was not cleaned.

A Zebra 140xiII printer was used to print low density rotated bar codes, small text and bars 80% of the format length. Various wax and wax/resin ribbons were used in the test on a typical variety of coated and uncoated papers. Print speed was set at 8 ips and print energy was adjusted according to the ribbon type for an optimal image. The first half of the test was random with the exception of cleaning method. Wax and wax/resin ribbons with different energy requirements were selected for differences in backcoatings as well. This was intended to represent variability in the end use applications. The 80% duty bar, 8 ips print speed and higher energy setting typically accelerate the test.

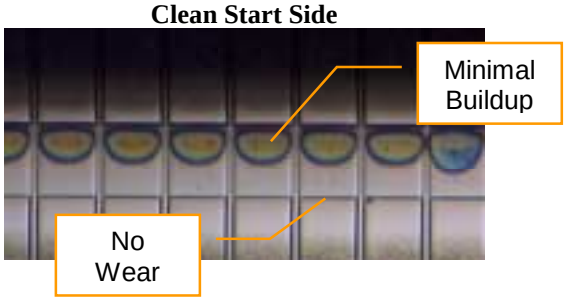
Approximately 1 million linear inches were printed and showed no significance in print quality change from side to side. However, photomicrographs of the printhead elements show less wear and buildup on the side that was cleaned with Clean Start. This was true in areas of high duty (heavy printing) and in normal duty areas of the head.

The following are photomicrographs of the printhead elements on comparable areas of the print format's 80% duty area. Although the printed image remained acceptable, the printhead shows evidence of wear on the side that was not cleaned. The darker marks on the elements suggest buildup. On the Clean Start side, the elements are much lighter and the elements are well defined indicating less printhead wear.

Heavy Print Area
Side Not Cleaned

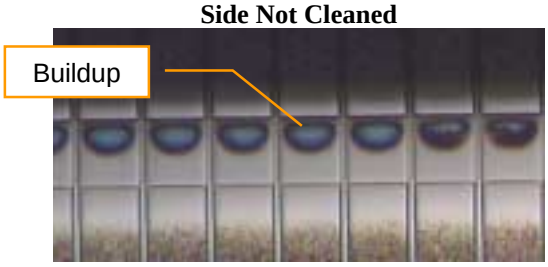


Heavy Print Area
Clean Start Side

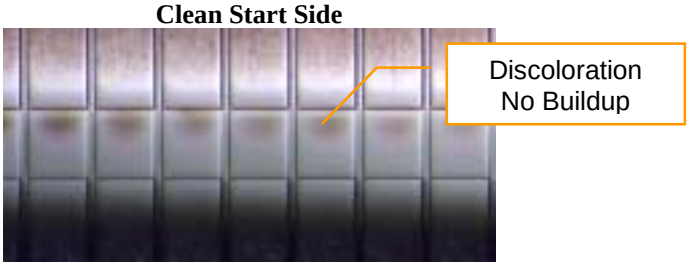


The following photographs show different elements on the same printhead in a less severe printing area on the format and the difference is obvious. The Clean Start side has no buildup. The non-clean side shows signs of buildup.

Moderate Print Area
Side Not Cleaned



Moderate Print Area
Clean Start Side



Buildup is a condition that will eventually result in poor print quality and premature printhead failure. As print quality degrades, users typically will increase heat (if possible) or replace the printhead. Increasing the heat accelerates the printhead's ultimate failure to perform.

Debris left on the printhead is abrasive, causes premature wear, and even scratches through the elements.

Routine cleaning ensures that the printhead's life is extended beyond what is normally achieved in cases where no cleaning method is used.

Test Two Conclusion - Clean Start Minimizes Printhead Buildup When Compared to Not Cleaning
The conclusion from this test is that using Clean Start regularly to clean the printhead prevents and minimizes buildup when compared to not cleaning at all. Additionally, Clean Start also minimizes printhead wear compared to not cleaning at all.

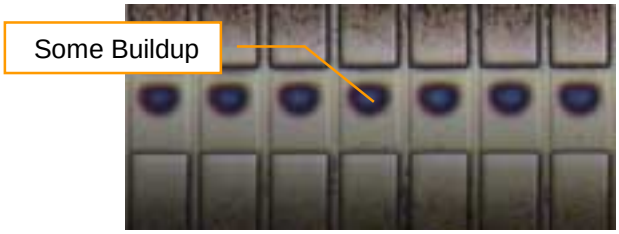
Test Three - Clean Start vs. Isopropyl Alcohol (IPA)

Test Three was developed and performed to compare the effects of using Isopropyl Alcohol (IPA) vs. Clean Start for cleaning the printhead.

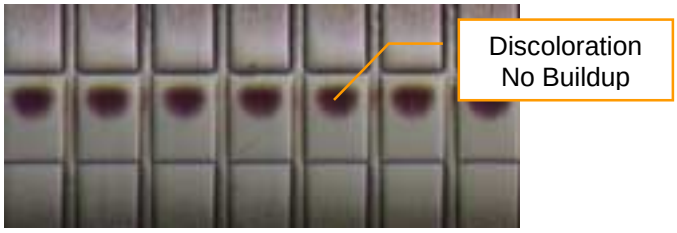
In this test, two printers were used. Both were 300 dpi resolution (Zebra 170 xiII and Sato 8450). The test image used was the same as in previous tests. Energy settings were selected to provide the best image. In both cases, 10 ribbons were printed (450M for the Zebra & 360M for the Sato). Before each new ribbon was loaded, half of the printhead was cleaned with a typical printhead cleaning pad containing IPA, and the opposite half was cleaned with a strip of Clean Start material.

Zebra Printer - On the Zebra printer, there was no evidence of print quality differences related to buildup between the two cleaning methods. However, the printhead elements cleaned with IPA did show early signs of buildup. These photographs of the printhead show less buildup on the Clean Start side and slightly more buildup on the IPA side.

Zebra 170xiII Printhead
Side Cleaned with IPA

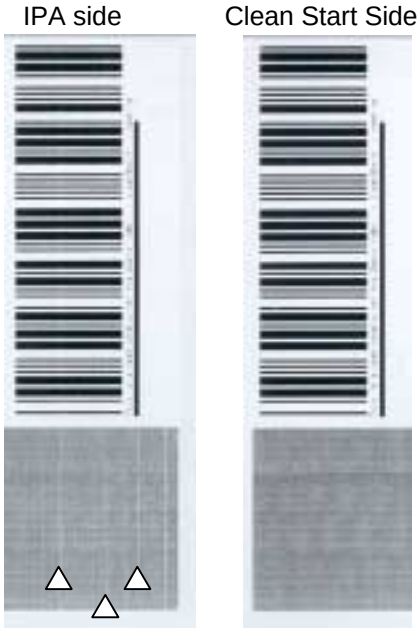


Zebra 170xiII Printhead
Clean Start Side



Test Printer: Zebra 170xiII • Test Print: Heavy Duty Image • Test Speed: 7 ips • Energy: 14

Sato Printer - On the Sato 8450 printer, buildup was more extensive on the side that was cleaned with IPA, which is evidenced by lines running through the solid test print (see image, right). The Clean Start side exhibited no signs of buildup.



Test Three Conclusion - Clean Start is More Effective than IPA when Cleaning the Printhead
This test proves that Clean Start is more effective than IPA for cleaning the printhead when used after every ribbon per the manufacturer instructions.

Given the evidence produced in this short test, it is believed that IPA cleaning wouldn't perform as well as the Clean Start process of cleaning over an extended period of time.

There is also a time factor involved with IPA. When cleaning with IPA wipes, the printhead must be allowed to dry before the ribbon is rewebbed. If not, the IPA solvent breaks down the ribbon's backcoat, defeating the purpose of cleaning the printhead. Clean Start used in the webbing process adds little time with no additional drying time needed as is with IPA.

The following is a chart that shows actual ribbon loading times:

Cleaning method	**Time to Load Ribbon**
No Cleaning	19 seconds
Clean w/Clean Start	25 seconds (6 Seconds longer than 'No Cleaning')
Clean w/IPA Wipe/Pen/Swab	51 seconds (32 Seconds longer than 'No Cleaning')

Overall Conclusion

Using Clean Start is beneficial to thermal transfer printing. It is an efficient and cost effective way of maintaining good print quality while extending the life of the printhead. When compared to IPA cleaning, Clean Start is at least comparable and arguably superior. When compared to no cleaning at all, Clean Start is significantly better for printhead maintenance as well as maintaining good print quality.

Clean Start is available on a full line of thermal transfer ribbons. More information on Clean Start is available at www.ThermalTransferRibbons.com.