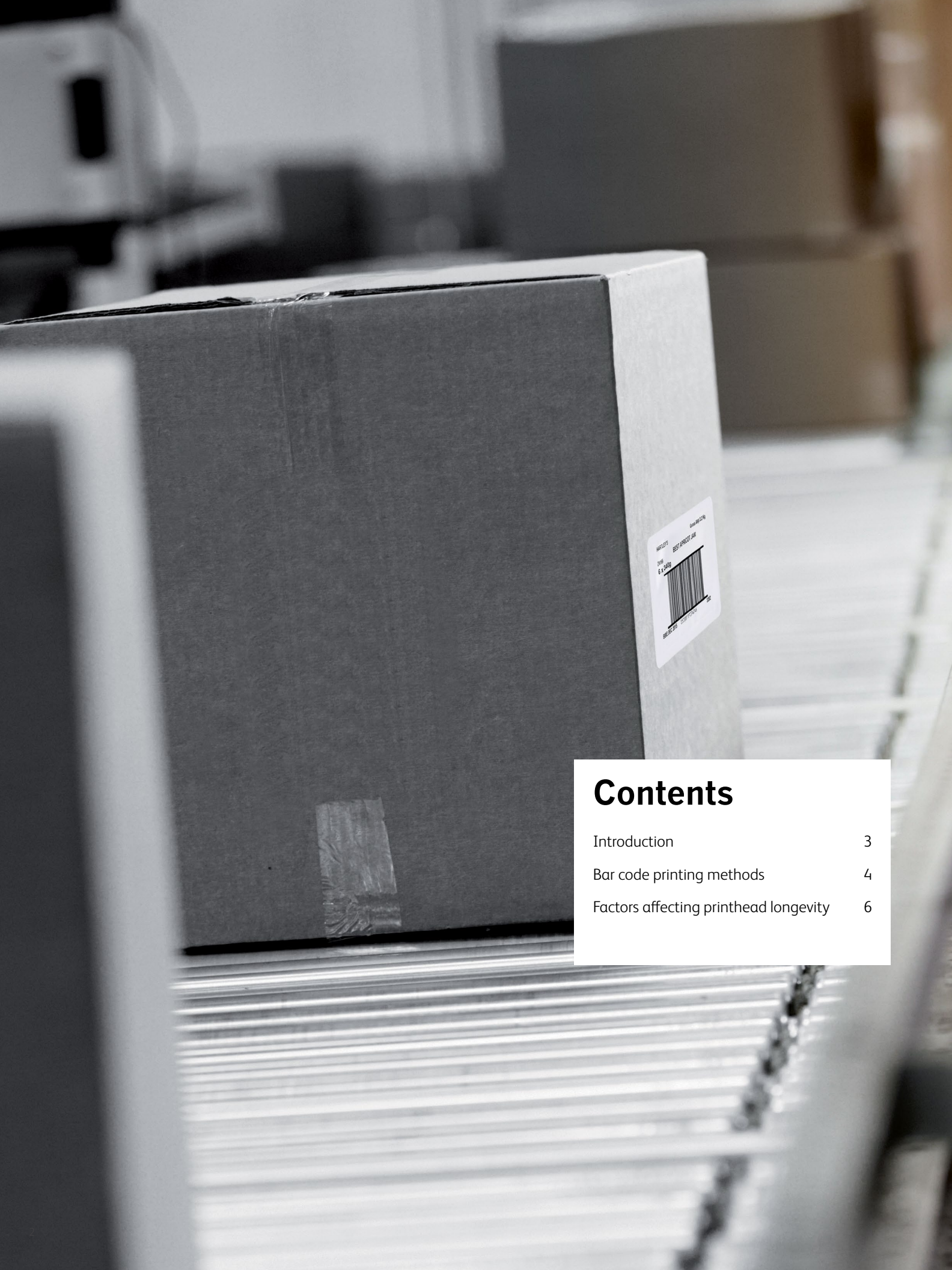
White paper

Improving performance and increasing longevity of thermal printheads

Scenarios to extend printhead life and produce consistent, scannable bar codes on labels.

Due the basic nature of how it operates, the printhead in a label print and apply (LPA) system is a wear part. Changing out the printhead represents potential downtime and expense, so it is desirable to minimize the replacement frequency. Multiple variables can come into play regarding how long a printhead may last in any given application. The purpose of this white paper is to demonstrate how making informed decisions related to the trade-offs associated with these variables, combined with a proper printhead care routine, can provide the optimal combination of performance and printhead life for your particular situation.



Contents

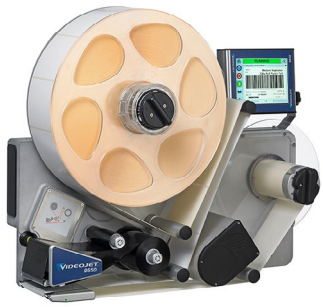
There are steps you can take to extend the life of an LPA printhead and still achieve consistent print quality for high grade bar codes.

The foundation of an LPA is the thermal printhead. This technology works on the basis of a series of heating elements, called "dots", that heat and cool in rapid sequence in order to either melt a ribbon or create a reaction with the print media to form the code image.

The process of actuating and turning off the heating elements, combined with the associated friction involved while transferring the image, will cause the printhead to wear over time. This will at first manifest itself as diminished performance of individual dots (the image begins to look more gray than black) and ultimately lead to the dot going "open circuit" and creating a void in that part of the image. Eventually, the printhead will need to be replaced, and in a typical application this cycle will occur multiple times over the life of the printer.

Exactly how frequently a printhead needs to be replaced is based on a number of variables. It is not unusual for a printhead to last up to a year in an average throughput application*. The degree to which any individual producer utilises a specific LPA unit is the variable with the widest potential range. Therefore, it is useful to think in terms of print distance instead of time in order to make the life expectation applicable to your particular situation.

** Based on a printhead life of 200KM of print travel with a 130mm long message, printing 5000 labels a day, 6 days a week.*



Bar code printing methods

Print quality considerations

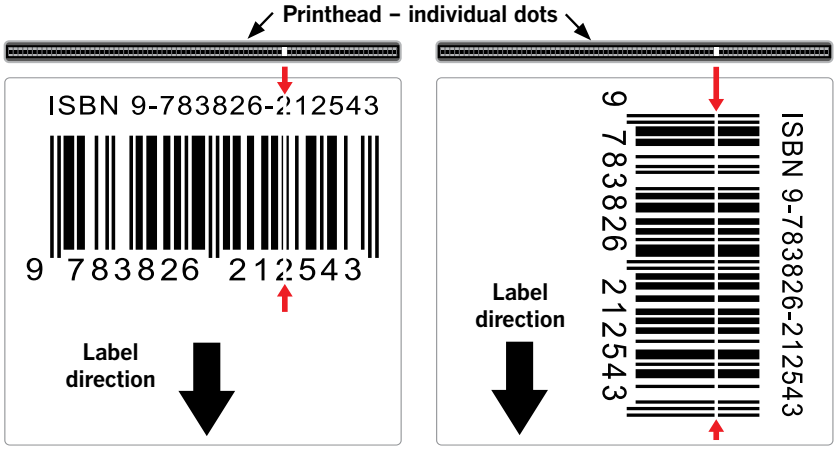
The most critical factor in how long a printhead lasts before it needs to be replaced is your level of print quality requirements. Part of the print area either being lighter or having a void may be acceptable to one person, but not to another. While to a certain degree this threshold is subjective, what you are printing and where the affected dot occurs within the code will make a difference. One or two small lines through a text block may be acceptable as the information would almost certainly still be readable. If the same situation occurred in a printed logo or image, your willingness to accept it may change if you feel it negatively affects your brand image. And if the print defect occurs within a bar code, the decision will likely become totally objective. The minimum requirement for a bar code would be whether or not it can be scanned, but often an LPA is chosen over direct printing on the case because your retail or logistics partners require a grade 'C' or higher bar code, so the standard may be even higher. Your requirements related to bar code quality will have a direct impact on how you configure your system to perform, and if and when a printhead needs to be replaced.

Printing orientation

Whether the bar code is in either a ladder or a picket fence orientation can have trade-offs related to printhead life and acceptable print quality. The concept of ladder and picket fence can be confusing, as the bar code may appear when placed on a case in a different orientation than the manner in which it was printed. For the purposes of this document, we are referring to how it is printed.

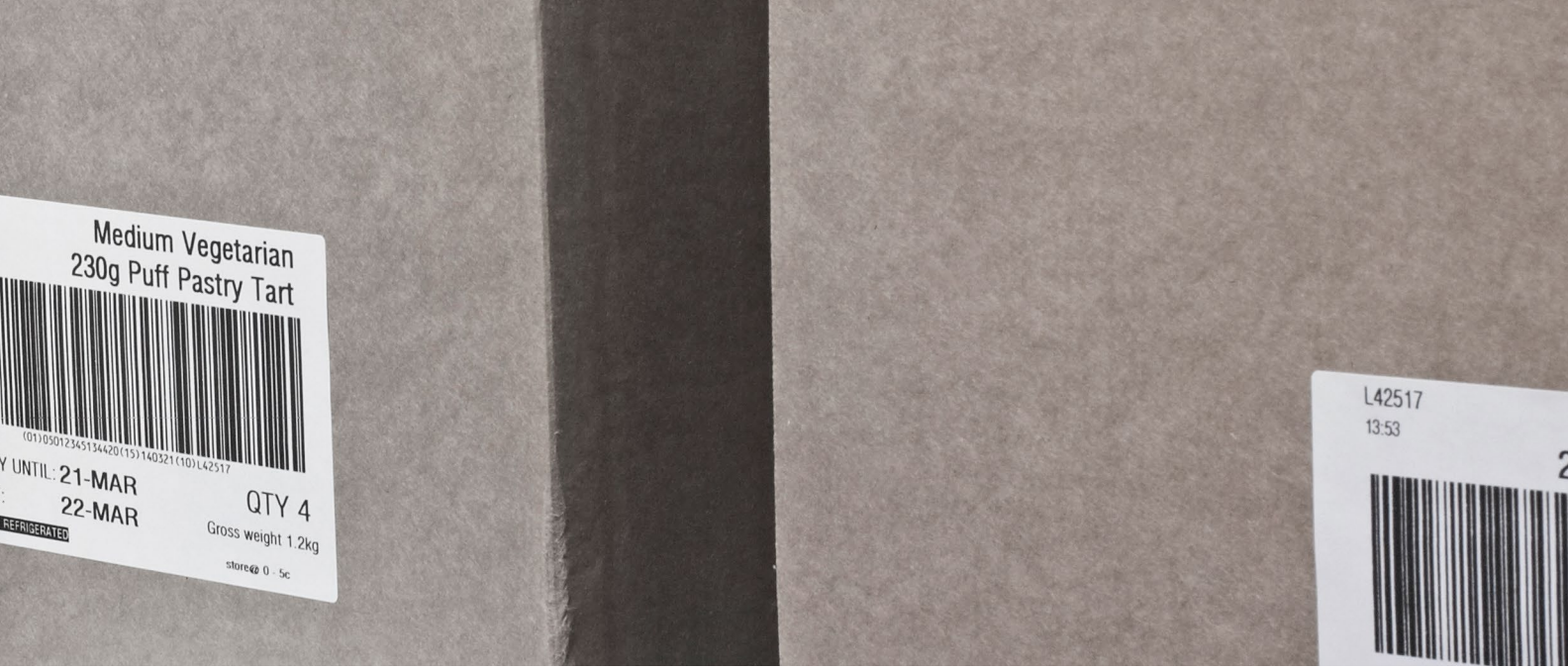
Printing in a picket fence orientation enables a dot to turn on and remain energized during the entire print process of the bar code image. This can lead to a straighter and darker black bar, which can render a higher code grade. However, a single missing dot can change the thickness of a bar enough to make the code unscanable. Although inconvenient, it may be possible to postpone changing out the printhead by making a small adjustment to the position of the bar code on the label, so the affected dot is now in the white area of the bar code.

A bar code printed in ladder orientation is much more tolerant, as a malfunctioning dot will appear as a perpendicular void running across all bars as opposed to altering the characteristic of any one bar. While this void may not look attractive to the naked eye, in all likelihood the bar code will remain scanable.

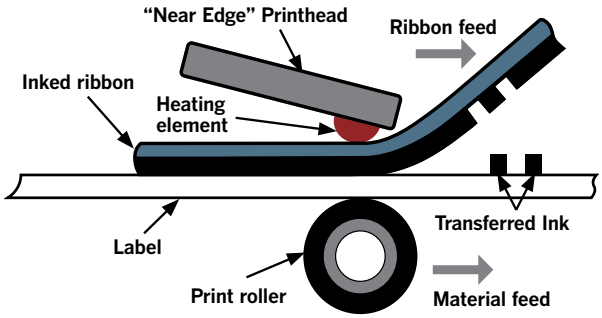


Picket fence orientation with malfunctioning dot

Ladder orientation with malfunctioning dot



With standard printhead technology, the drawback of a bar code printed in ladder orientation is that the dots can't always heat and cool rapidly enough, especially at higher print speeds. This could lead to decreased contrast as well as the bars bleeding into the white space, potentially affecting the code grade. However, this issue is significantly mitigated in the Videojet 9550 LPA, which uses a "near edge" printhead. As opposed to traditional flat head printers, the heating elements in the 9550 are concentrated along the edge of the printhead, which is positioned at an angle relative to the label/ribbon path. This angle helps prevent a continuous temperature rise, and coupled with the Videojet patented Rapid Heat and Cooling (RHC)™ heat dissipation algorithm, allows A and B grade bar codes to be consistently produced, even at print speeds up to 500mm/sec.



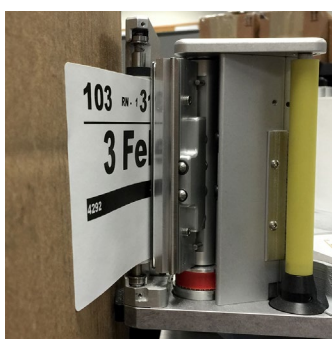
The Videojet 9550 also has software adjustments for the amount of print force (how hard the head presses) and darkness (how much energy is applied). These adjustments can be helpful in calibrating the system to get a consistent A or B grade bar code, but the higher the setting, the more wear the printhead will experience. In order to extended the life of the printhead, we recommend finding the lowest settings which produce an acceptable bar code grade or text print quality. The 9550 LPA utilises Videojet Intelligent Motion™ technology, that by default at any given speed sets the best force and darkness for that speed.

Print modes

The leading cause of a dot having diminished performance or burning out is abrasion. Multiple factors affect the degree of abrasion to which a printhead is subjected, the most impactful of which is the mode in which the printhead is operated.

Thermal printheads can be operated in either Thermal Transfer (TT) or Direct Thermal (DT) mode. In TT mode, the dots contact a wax/resin ribbon to melt the ink in order to transfer it onto the label. In Direct Thermal (DT) mode, the dots contact a heat-sensitive label and the chemical reaction forms the image. Because the printhead directly contracts the label, which is far more abrasive then a lubricated ribbon, a printhead run in DT mode typically lasts 1/3 as long as one run in TT mode.

The obvious advantage of running in DT mode is it eliminates the need to purchase ribbon, which can be one of the most significant running costs of an LPA system. However, the higher costs of the heat-sensitive labels and the more frequent printhead changes often negate the savings from the ribbon. While results may vary based on application specifics, it is typical that the total cost of ownership is similar in both modes, although running in DT mode does still offer the advantage of one less consumable to replenish. You should also take into consideration your needs related to the required life of the label and the critical nature of any information on the label before making a choice. The code on a DT label can be more easily scratched, and can fade in extreme temperatures or due to prolonged exposure to UV light, so their use should be limited to applications where the label will be in the supply chain for a short period of time and confined to controlled environments.



Direct Thermal (DT) mode

Factors affecting printhead longevity

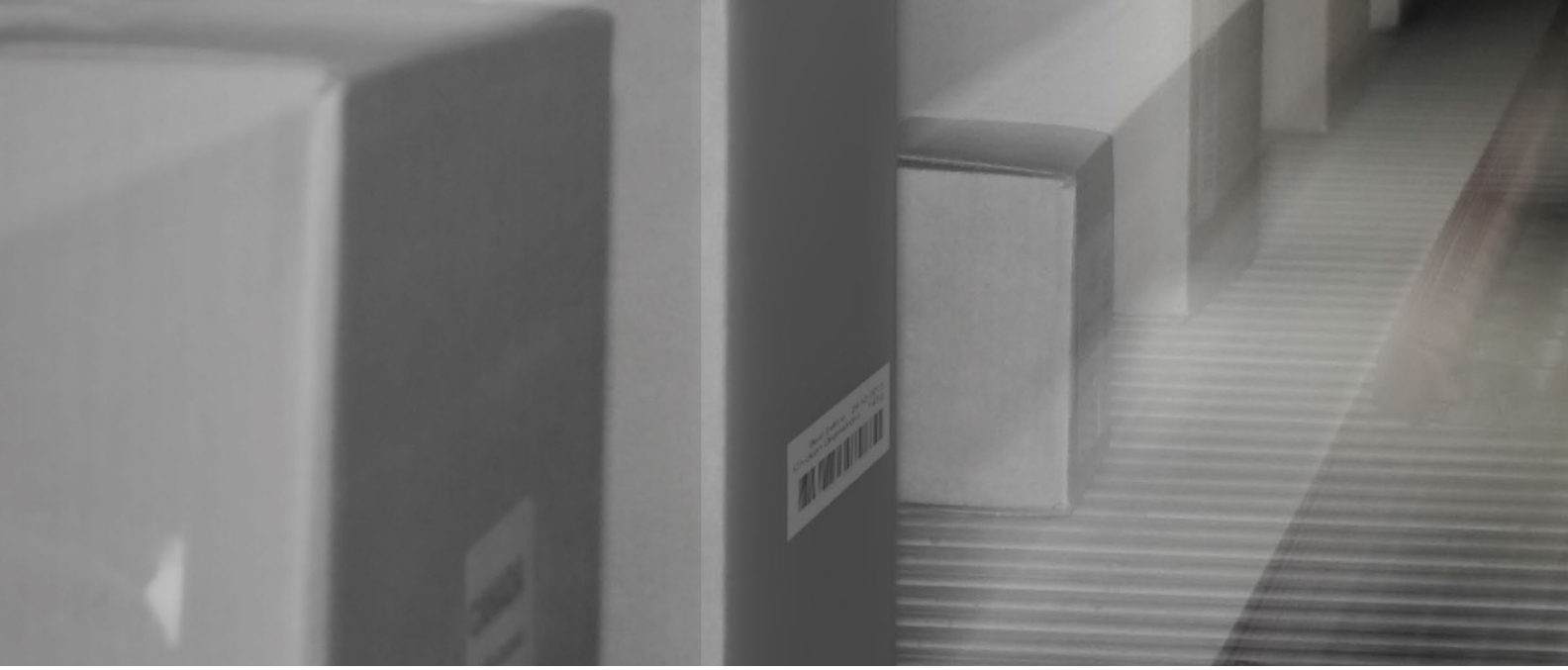
Label and ribbon quality

There are several other considerations that must be taken into account in order to maximise printhead life. The first of which is the quality of the consumables that are used. Lower quality labels tend to have a much more uneven surface, which creates more abrasion and can often throw off particles. These particles can cause a variety of issues, including imbedding in the printhead and falling onto the ribbon and creating a print void in that area. The most important specification for a label in relation to how it will affect the printhead is surface roughness which is often measured via Sheffield or Bensten units, with a lower number being preferable as it represents a more smooth label surface.

The quality off the ribbon can also impact printhead life and system performance. The Videojet 9550 uses near edge printhead technology which concentrates the dots along the edge of the printhead and contacts the ribbon/label at a 26% angle in order to provide greater print speeds than conventional flathead technology. Because the label and ribbon are only in contact for a very short time, it is essential that only ribbons with “quick release” chemistry are used.

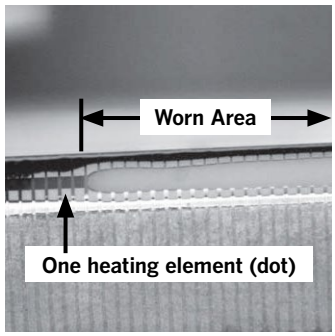
Dust and debris

Environmental contaminants can also imbed themselves against the printhead and over time can cause abrasion that can diminish the resistance levels of the individual dots. While it would be preferable to locate an LPA in an area that is as dust-free as possible, moving corrugated cases by their nature throw off debris, so this is rarely a practical solution. This increases the importance of frequently cleaning dirt and dust off of the printhead. Videojet recommends cleaning the printhead with Isopropyl alcohol whenever the ribbon is changed. Environmental dust can also be minimised by use of a removable cover.



Other sources of abrasion

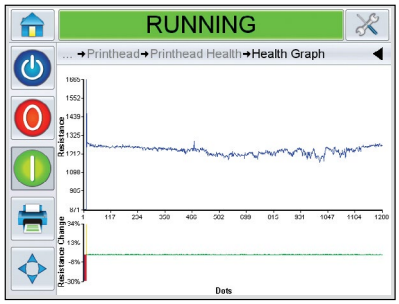
The two other factors which contribute to abrasion are the edges of labels and any direct contact between the printhead and the print roller. Having the print image near (within a few millimetres) of the leading edge of the label will cause the printhead to lower sooner and potentially catch that edge, which will lead to abrasion. Finally, care should be taken that the printhead never directly contacts the print roller. In an application where the same label size is always used, this issue should not arise as it will be straightforward to match the printhead and ribbon width to the label. But if the label sizes vary, it is important not to move to a smaller ribbon that would leave the printhead exposed to the roller, as these dots would quickly wear out and no longer be usable when reverting back to a larger label.



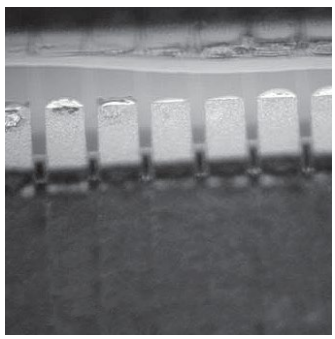
Broken heating elements (dots) caused by abrasion that has removed the protective coating of the printhead

Summary

The Videojet 9550 further assists with printhead monitoring by providing a printhead health graph with dead dot detection. This helps enable users to see which dots are fully malfunctioning, versus those that may be affected by imbedded debris and can be recovered with a targeted cleaning.



Printhead health graph with dead dot detection



Close up of damaged heating elements (dots), causing missing print

Predicting the expected printhead life in a specific application involves too many variables to be done with any degree of certainty. However, carefully considering the trade-offs and following the recommendations in this document can help you minimize the amount of times you will need to change the printhead over the life of your system.

Peace of mind comes as standard

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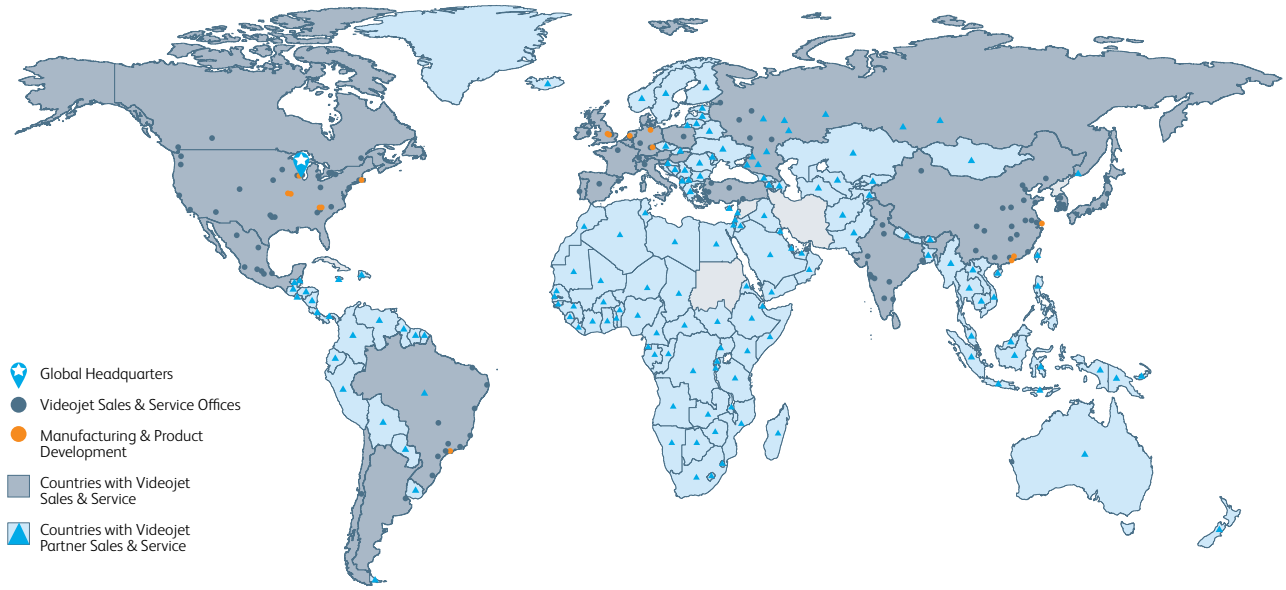

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