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A New Method to Ensure Bar Code Quality throughout the Distribution Channel

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Developing and maintaining a bar code quality program is essential for ensuring the readability of bar codes throughout the distribution channel. Unreadable bar codes can result in customer charge-backs, and in the most extreme cases, rejection of parts and loss of business. In distribution centers, unreadable bar codes can lead to shipping delays and errors. Bar code quality is equally important when bar codes are used internally for automated sortation, WIP tracking, matching items, packaging and inventory.

Code Qualification vs. Verification

In a perfect world, once a bar code printing program is established, the quality of symbols will be predictable. A statistical sampling program can be established that, along with routine maintenance, can maintain bar code quality.

But this is far from a perfect world. Print head elements can burn out, ink jet nozzles can clog, a new label stock might be less opaque than required, labels can be wrinkled and are typically subjected to abrasion and loss of quality during transport. Identifying these issues before they result in unreadable bar codes is key to a successful bar code quality program. One newer method is to perform bar code “qualification” with camera-based code readers. Unlike verification, qualification is performed **in-line** by monitoring the quality of symbols continually without slowing down a line or requiring worker intervention.

Traditionally, verification is performed as an **off-line** process in which 8 specific parameters are measured and compared to specifications in ISO 15416 (formally ANSI X3.182-1990).

For linear symbologies (e.g., GS1-128, Code 39) and stacked bar codes (e.g., PDF 417), ten

scans are taken of each symbol and an analog signal, a scan reflectance profile, is recorded for each scan. This profile is evaluated for edge determination, minimum reflectance, minimum edge contrast, symbol contrast, modulation, defects and decodability are measured and, finally, the symbol is decoded. The lowest grade of these parameters is taken to be the final symbol quality grade, ranging from A to F (or their numeric equivalent 4 to 0).

Composite symbols (e.g., GS1 Composite) and 2D matrix symbols (e.g., Data Matrix) have somewhat different verification criteria but yield the same type of quality grading.

Verification

Verification requires a special piece of equipment called a verifier. Verifiers measure all of the print quality parameters mentioned above. However, one basic criterion for verification that is sometimes overlooked is that symbols are to be verified in their "final configuration." That means a label should be verified after being applied to the intended substrate because background color or patterns may show through the label stock and result in a lower quality score.

The process for verification can also be more labor intensive. Typically, the bar coded item has to be manually placed in the verifier's field of view for it to analyze bar code quality. Then, the operator must wait for the verifier to assign a grade before it can be manually placed back in-line for the next process step.

There are also direct marking technologies such as laser ablation, high quality ink jet, laser etching, dot peening, laser etch, and so forth. Laser ablation and high quality ink jet may be verified with a standard verifier. The other technologies are typically to permanently mark items with a 2D matrix symbology, Data Matrix. These technologies produce symbols with low or no contrast and require special lighting and camera-based systems to be read, analyzed and graded. ISO 15415, Direct Part Marking Guidelines is the standard for these types of symbols.

Whichever method is used, it is a time-consuming, manual process that typically occurs away from the production line. This off-line process often cannot be done often enough to spot every problem that crops up nor can it identify problems with bar codes after they're printed.

Qualification

With qualification, every symbol is read and analyzed automatically at full line speed by a reader located on a packaging, assembly line, a conveyor, or other location where the symbol is being read for data collection or process-related action. A camera-based system that can effectively measure the bar code parameters that affect print quality, coupled with software that collects and analyzes the data, can perform both the initial task of reading the symbol for its intended use and the collection of quality data for trend analysis.

A key benefit of qualification is trending. The right software can track even minor changes in a bar code's characteristics. Dirty or burned out print head elements, clogged ink jet nozzles, dirt, wrinkles or other defects

might not cause a symbol to be unreadable, but certainly will reduce the symbol's grade and indicate that attention is needed. Some of these problems would be identified during routine verification but others might be the result of a condition down-line from where the symbols are printed and applied after verification has taken place.

For example, a symbol with a "C" grade applied to a part at the beginning of an assembly process might be subjected to abrasion, dirt, grease or other obscuring material during the process. As a result, it may become barely readable by the end of the process. Rather than optimize a reader to cope with these degraded symbols, changing the process or improving the initial quality and durability of the label would result in symbols that customers can easily read. However, without ongoing monitoring of symbol quality throughout the facility, this problem might not be recognized until there's a customer complaint, chargeback or cancelled order.

In addition to identifying immediate problems, collecting quality data over time can reveal operational issues such as lower quality during one particular shift, or from one particular print station. Having this data can improve your overall troubleshooting and maintenance programs, save time over increased manual verification, and prevent hundreds or even thousands of unreadable symbols from being produced between scheduled full verification checks.

Qualification:

- Performed in-line – less downtime
- Automated – not manual
- Grade is output along with bar code data
- Capture trending data – pinpoint operational issues

Application Advantages

Avoid Charge-backs, Shipment Delays

When complying with customer mandates for bar codes -- or even ensuring that carriers can read the relevant bar codes on shipping labels -- ensuring the quality of symbols before they leave your facility is essential to avoid charge-backs, shipment delays or worse. Gathering quality data on your bar codes as you're building a shipment (and possibly creating an ASN 856 Ship Notice from scanned data) can help ensure that they comply with customer mandates for initial symbol quality. Any problems with readability at the customer's site can then be tracked to either handling during transport or at a customer's facility. In either case, you would have the data to prove your symbols were of sufficient quality when they left your shipping dock.

While trending data has clear benefits in ensuring smooth operations when bar codes are used in-house for WIP tracking, item identification, inventory, sortation, etc., it offers equal benefits in gauging the quality of bar codes on incoming shipments and parts.

Save Time during Receiving

Running a full verifier check of all incoming bar codes on all shipments is an impossible and time-wasting process. Yet the quality of incoming bar codes can affect receiving, put-away, and inventory procedures. Automatically checking quality with a camera-based system can not only assess quality but can reveal whether a particular supplier has problems with print quality, whether there is a problem with a particular packaging configuration, or whether shipments with a particular carrier tend to have severely abraded and degraded shipping labels. None of these issues would be identifiable without the ability to automatically collect trending data and over an extended period of time.

Pinpoint Problems during Break Pack and Cross-docking

For distribution centers doing break pack and reshipping or straight cross-docking, unreadable bar codes can slow down the process and even lead to errors. As with the application above, being able to identify shippers, carriers or even routes where unreadable bar codes originate can allow you to pinpoint the problem and resolve it.

Conclusion

While full ANSI/ISO verification of bar codes is necessary for any operations where symbols are printed or applied, collection of quality data over time -- particularly of symbols over which you have no control -- is a valuable tool for ensuring smooth operation of systems that rely on readable bar codes. Some of these problems would be identified during routine verification but others might be the result of a condition down-line from where the symbols are printed and applied after verification has taken place. Qualification provides many advantages. During qualification, users can capture both the initial task of reading the symbol for its intended use and the collection of quality data for trend analysis, reducing downtime and creating a more streamlined process. The ability to monitor trends over time provides many advantages, including revealing potential operational issues and improving troubleshooting.