BAR CODE PROBLEM SOLVER

Bar Code Quality Parameters
- Decodeability
- Quiet Zone
- Print Contrast Signal
- Reflectance
- Edge Contrast
- Modulation
- Defects

Bar Code Trouble Shooting
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BAR CODE QUALITY PARAMETERS: Bar code print quality is not as simple as verifying bar code scan-ability. Most users will not have scanners as sophisticated as the verifiers used in manufacturing plants to validate bar code readability. Also, bar codes verified in-plant are new, unused and presumably in perfect condition. Bar codes in live applications may be damaged, stained, etc. Verifying symbol quality only tells you how well the symbol was printed. It doesn't determine whether the correct symbology or data was printed, whether it was formatted correctly, etc. There are a number of parameters that make up a successful bar code scan. Within the bar code itself, these parameters include:

- Decodability
- Quiet Zone
- Print Contrast Signal
- Reflectance
- Edge Contrast
- Modulation
- Defects

Decodeability: Decodability indicates the amount of tolerance remaining in the width of the most deviant element in the symbol. Bar codes are made up of elements (bars and spaces) of different widths. For example, Code 39 has two element widths…one narrow and one wide. Each element within a bar code symbol should be consistent across the symbol. In other words, all of the narrow elements (bars) should be consistent in width and all the wide elements (bars) should be consistent in width.

The decodability grade indicates the amount of error in the width of the most deviant element in the symbol. The lower the deviation, the higher the grade. Optimally, each element size in a bar code symbol would be consistent across the symbol. A decodability failure means that the width of the bars and/or spaces in one of the elements is so inconsistent that it cannot be evaluated. A decodability failure results in an overall symbol failure regardless of the quality of the other parameters.

NOTE: Bar codes printed in the horizontal orientation (picket fence) will be more consistent that bar codes printed in the vertical orientation (ladder), which tend to have dimensional errors.

Quiet Zone: This is the area immediately preceding the start character and following the stop character in a bar code symbol as specified in a particular application and/or symbology specification. The quiet

zone immediately preceding the start character and following the stop character must each be a minimum of ten times the narrow element for all symbologies except UPC, EAN, and 2-D symbologies. Scanners expect the quiet zone to be free of any low reflectance objects (dark areas). If a low reflectance object is detected in the quiet zone then the scanner may not distinguish the start or stop signal resulting in an unsuccessful scan.

NOTE: Do not print bar codes too close to the edge of the label, tag, or document. Do not print other test or lines too close to the leading edge or trailing edge of the bar code. Quiet zone requirements for 2D (two dimensional) bar codes very with each Symbology, but can be as little as .01 inch. 2D bar codes typically require quiet zones on all four sides of the symbol.

Print Contrast Signal: Symbol contrast is the difference in reflectance values on the "lightest" space (including the quiet zone) and the "darkest" bar of the symbol. The greater the difference between light and dark contrast, the higher the performance of the code (bar code colors and/or background colors can have a large effect on this parameter).

NOTE: Substrates with metallic surfaces will reflect as black and are therefore not recommended for use with bar codes. Scanners read bar codes by distinguishing between the bars and spaces. In order to create the best contrast, the bars should be black and the spaces and background should be white. Other combinations work including different bar colors and different background colors, as long as the contrast between the bars and spaces is distinguishable by the scanner. When the contrast gets too low, the scanner will not distinguish between the bars and spaces and will therefore not see the bar code.

Reflectance: The reflectance value of the "lightest" space must be at least twice as great as the reflectance value of the "darkest bar."

Edge Contrast: Edge contrast is the difference of the reflectance values of the dark and light components of an edge. Each element of a bar code has two edges that go from dark to light. Therefore, each edge has a dark and light reflectance value component.

Modulation: Modulation is based on the relationship between the minimum edge contrast and the symbol contrast. Ideally, the edge contrast should be equal to symbol contrast but as an aperture size approaches an element size the amplitude of the signal received will decrease and the edge contrast will decrease. The greater the difference between minimum edge contrast and symbol contrast, the lower the grade.

NOTE: Aperture size has the greatest affect on this parameter. The substrate material can also have a major affect on this.

Defects: Defects are irregularities in bars, spaces and quiet zones. Defects are measured based upon the relationship between the largest defect in the symbol and the symbol contrast. The smaller the defect, the better the grade. In general, a small aperture used to analyze very wide elements will cause the largest defects.

NOTE: Substrates having recycled content can pose problems. Some recycled content may be darker or protrude slightly from the surface. Such characteristics can create misreads of bar codes. Maintenance; Bar code quality degrades as miscellaneous deposits (paper dust, core, adhesive debris) build up in the

printer and on the print head. Because of the density of bar code printing, it is probable that printer maintenance be required more frequently that outlined in the manufacturer's recommendations. Worn print heads or ribbon creases can result in bar code symbols having missing bars or horizontal white streaks through the bars.
Printed bar codes are denser than standard text. As a result more printer consumables are used and few labels/tags/documents can be printed before maintenance is again required. More frequent maintenance will minimize print defects.

BAR CODE TROUBLE SHOOTING: There are a number of general steps that can be performed to identify or isolate a bar code problem. They include:

1. Inspect the label for obvious damage including tears, dirt, or ink/pencil marks.
2. Determine if there are quiet zones at each end of the bar code. There should be a clear area approximately .25 inch or ten times the narrow bar width at the before and after the bar code. For 2D (two dimensional) bar codes, refer to the symbol specifications provided with your software.
3. If there is no obvious damage and there are quiet zones, you will need to verify that the materials and scanner are compatible. Infrared scanners require substrates that are designed for use with infrared scanners.
4. Verify that the scanner you are using is operating correctly, by scanning another similar bar code symbol. If the second bar code symbol can be scanned, then the scanner is not the problem. If the bar code cannot be scanned, it may be the cable, if your scanner is attached to a decoder via a cable. If you can disconnect the cable from the scanner and the decoder, use a different scanner or a different cable in order to isolate whether the cable and/or scanner is operational.
5. If you're using a scanning terminal or an integrated scanner/decoder and all of the previous steps have failed, make sure the scanner is set to the parameters you need for your application.
    a. Depending on the scanner manufacturer, the dip switches in the scanner may have to be reset. Refer to your scanner manual.
    b. Confirm that the Symbology used to encode the bar code is compatible with scanner and decoder.
    c. Confirm the scanner's optical settings are compatible with the bar code you are trying to scan.

    NOTE: The aperture size of the scanner can be adjusted to read bar codes more accurately. However, there is not a "one size fits" all solution. An aperture setting appropriate for one bar code size will not necessarily result in the successful scan of a different bar code x dimension.
6. If there is no visible problem with the bar code and the scanner is confirmed as operating satisfactorily, you will need to confirm that the scanner and decoder are configured to read that bar code Symbology.
7. If the scanner/decoder is configured to read that Symbology, the next step would be bar code analysis. This will require a bar code verifier.
8. If the verifier cannot decode the bar code, check for print head defects, printer speed variations, toner variations, ribbon defects, and the printer heat settings.
9. Print quality consists of a number of factors and procedures. If the problem remains unsolved, it may be caused by the choice of Symbology, the format (including the x dimension, the ratio, code height, check digit, etc.), the substrate, and even the data file that was encoded. It may be the printing software did not correctly encode the bar code. This may be the result of converting

to new printing software, or utilizing printing software programmed incorrectly. In such cases, a common oversight is the exclusion of start/stop characters.

10. If the bar code is scannable by a verifier, the parameters causing the problem will be identified. A verifier will identify the decodability, print contrast, reflectance, edge contrast, modulation, and defects (see detail above on these subjects).

PRINTER CONSIDERATIONS: Bar code scanning success can be improved by the following:

1. Thermal/Thermal Transfer:
    a. Printer speed: Check speed and heat settings, confirm that the substrate is compatible with the printer, that the ribbons are compatible with the stock.
    b. Print-head temperature: Since thermal transfer printing involves imaging through tiny heated prints contacting a ribbon onto a label, the print head temperature has a dramatic effect on symbol quality. If the heat setting is too high, the bars will print too heavy. Conversely, if the setting is too cool, the bars within a symbol will print too light. The heat setting can be adjusted either as a printer function or through a software setting. Adjustment control will vary between software and printers.
    c. Printer Speed: The rated print or run speed (normally stated in inches per second) of thermal/thermal transfer printers is rarely achieved when printing bar codes. If the print speed is too fast, the heating elements do not have enough dwell time at the substrate surface to fully transfer an image, typically resulting in bars that are too narrow and/or too light.
2. Laser:
   Check the toner and density setting, as well as the minimum x dimension (should not be less than 10 mil).
3. Dot Matrix:
   Check for ribbon/print head spacing to substrate. Spacing needs to be adjusted based upon the thickness of the substrate or document. Bar codes will not be scannable on multiple plies.

The problem solver sections on thermal transfer, thermal, and laser has more specific bar code printing problem solutions as relates specifically to their printing processes.

BAR CODE PROBLEMS:

1. The bar code will not scan.
   Review Bar code Quality Parameters.
   See the Bar code Trouble Shooting Guidelines
   Review Printer Considerations.

2. Go to the printer specific problem solver sections (Thermal Transfer, Thermal, Laser).

3. The bar code scans at a distance, but not up close. This can frequently happen in a warehouse setting where both large and small bar codes are utilized. See depth of field information.

   Potential Cause: Different scanners are built to scan bar codes of different x-dimensions from a certain range of distance (depth of field). The scanner may not set or suited to scan a bar code of that x-dimension from the distance attempted.

Potential Solution: Try scanning a bar code with a smaller x-dimension from the desired distance. If this works, the problem was the size of the bar code x-dimension. (see link to depth of field) See depth of field information.

4. The bar code scans up close, but not at a distance. This can frequently happen in a warehouse setting where both large and small bar codes are utilized.

   Potential Cause: Different scanners are built to scan bar codes of different x-dimensions from a certain range of distance (depth of field). The scanner may not set or suited to scan a bar code of that x-dimension from the distance attempted.

   Potential Solution: Try scanning a bar code with a larger x-dimension from the desired distance. If this works, the problem was the size of the bar code x-dimension. (see link to depth of field)

5. I have relabeled my cartons (new bar code label over old bar code label) and the new codes are not reading correctly now. See depth of field information.

   Potential Cause: The label stock is too transparent. The scanner is reading graphics and/or bar code data off the original label (the label that is covered) as well as bar code data off the new label. The "overlay" of dark symbols from both labels creates a nonreadable field.

   Potential Solution: The new label should be manufactured with a more opaque material and/or a blockout (black or gray tinted adhesive) that will increase opacity and cover the data from the original label.

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