ANSI X3.182-1990 Overview

ANSI X3.182-1990 BAR CODE PRINT QUALITY GUIDELINE OVERVIEW

The ANSI Bar Code Print Quality Guideline recommends a method of grading a bar code symbol contingent upon individually calculated and graded parameters. It is necessary to create a Reflectance Profile (SRP) to test these parameters. A Scan Reflectance Profile records and measures a bar code's reflectance values (00% to 100%) along a single line across the entire width of the bar code. The SRP is used to grade each parameter, and each parameter will either Pass, Fail or be graded as *A*, *B*, *C*, *D*, or *F*. The Scan Grade is the lowest grade received in any parameter per SRP. Ten SRP's are required to determine the Overall Symbol Grade. The Overall Symbol Grade is the simple average of ten Scan Grades.

Numeric Grade, Overall Symbol Grade Conversion

A	3.5 to 4.0
B	2.5 to 3.4
C	1.5 to 2.4
D	0.5 to 1.4
F	Less than 0.5

The individual measures considered in a single scan are:

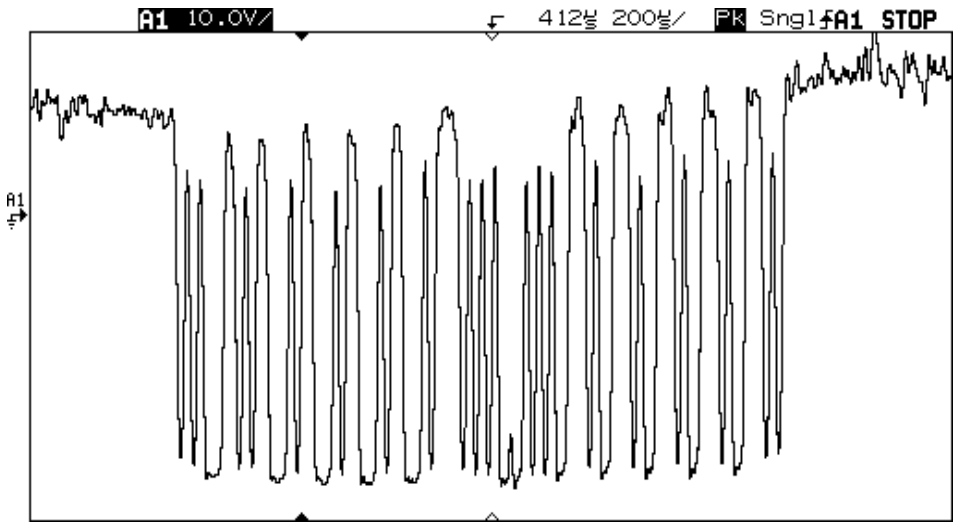
Defects	A, B, C, D, F
Edge Determination	A, F
Minimum Edge Contrast	A, F
Minimum Reflectance	A, F
Modulation	A, B, C, D, F
Symbol Contrast	A, B, C, D, F
Decode	A, F
Decodability	A, B, C, D, F

Note: The X3.182-1990 print quality document evaluates quiet zones as spaces. The size of the quiet zone is not considered. The symbology specifications, however, do generally indicate a size requirement for quiet zone.

To calculate the ANSI Grade, each individual scan translates to a Scan Reflectance Profile. The profile is a graphic depiction of the reflectance at all the points in a scan. See picture below. The ANSI parameters of Defects, Minimum Edge Contrast, Modulation, Minimum Reflectance, and Symbol Contrast all judge how well a bar code reader can find the bar edges. Edge Determination is the idealized number of elements found. (Note: A symbol that fails element determination may still be readable with some scanning devices.) Decode and Decodability (and Quiet Zone for UCC symbols) are uniquely defined for each type of symbology.

Consider Decode as the rule used to convert the bar space pattern into data. Decodability is how close one can be to an “ideal” symbol (100%) or if you just barely made it (1%).

THE SCAN GRADE IS THE LOWEST GRADE RECEIVED FROM EACH OF THE INDIVIDUAL PARAMETERS IN A SINGLE SCAN.



BACKGROUND:
All ANSI reflectance measurements are made on an absolute scale. A defined reflectance is 100%. This is why verifiers’ reading apparatus [light pen or wand] must be held at a specific angle. Unless otherwise specified below, all reflectance measurements are graded with respect to the absolute scale. For example, Minimum Edge Contrast of 15% equals 15% of the absolute scale.

DECODE (Symbol Reference Decode)
Each symbology type has a specific decode algorithm. These are the defined rules used to decode the symbol. If successful, the symbol passes receiving an *A* grade; otherwise it fails receiving an *F* grade. All symbologies include the following rules:

- All data characters are valid.
- Legal start and stop patterns (or characters).
- Correct check character(s) if specified.
- Legal quiet zones.
- Correct number and format of characters as specified.
- Correct "control" and "formatting" patterns (or characters).

Some application standards will place additional checks and/or restrictions on the symbology. Do not confuse these additional requirements with proper decode.

MINIMUM REFLECTANCE

This requirement is that the bars must be sufficiently dark when compared to the spaces. This is a pass, grade *A*, or fail, grade *F*. The measured value is the darkest reflectance value in the scan profile reflectance. It must be less than or equal to half the maximum reflectance. Symbols that fail in this parameter may benefit from darkening the bars.

MINIMUM EDGE CONTRAST

This parameter examines adjacent bars and spaces (including the quiet zones) to determine if there is sufficient contrast. The grade is pass or fail. Each bar and space pair is measured for reflective difference. The absolute value must be greater than or equal to 15%.

EDGE DETERMINATION

This requirement is that the correct number of elements be present. This is a pass, grade *A* or fail, grade *F*. Each bar and space is considered an element. For example, the U.P.C.-A symbol always has 59 elements: 30 bars and 29 intervening spaces. From the Scan Profile Reflectance, one determines the Symbol Contrast and Minimum Reflectance. The global threshold is then calculated:

Global Threshold = Minimum Reflectance + (Symbol Contrast 2)

The elements for Edge Determination are then measured by:

- BAR: Any part of the Scan Reflectance Profile at or below the global threshold.
- SPACE: Any part of the Scan Reflectance Profile above the global threshold.

The Edge Determination fails if the number of elements is invalid for the symbology. Otherwise, Edge Determination passes.

SYMBOL CONTRAST

Symbol Contrast measures the difference between the darkest bar and the lightest space. The grade is based upon the amount of reflective difference. The difference is reported as an absolute percentage. Note the quiet zones are included in this measurement. A low grade indicates the bars may not printed sufficiently black and/or the spaces are not white. Colored bars or spaces as well as shiny materials commonly cause Symbol Contrast grades. Make bars darker and spaces lighter or less shiny if problems exist in this area.

A (4.0)	□ 70%
B (3.0)	□ 55%
C (2.0)	□ 40%
D (1.0)	□ 20%
F (0)	< 20%

MODULATION

This parameter is graded upon the values of Edge Contrast Minimum and Symbol Contrast. The closer Edge Contrast Minimum and Symbol Contrast are the higher the Modulation grade. Modulation relates to how a scanner sees wide bars and spaces in relationship to narrow bars and spaces. Typically, scanners see the narrow spaces as less reflective than the wide spaces. To improve the Modulation grade, make narrow spaces wider than narrow bars.

A (4.0)	□ .70
B (3.0)	□ .60
C (2.0)	□ .50
D (1.0)	□ .40
F (0)	< .40

DEFECTS

This measurement looks for spots (in spaces) and voids (in bars). A scanner may misinterpret these printing imperfections as an additional bar or space if they are sufficiently large. Defects is sensitive to the effective aperture size of the scanning device. Small apertures will "see" more defects than large ones will. Therefore, a 20-mil aperture is recommended for scanning corrugated cardboard material.

The formula for Defects uses a value called ERN_{max}, or Maximum Element Reflectance Non-uniformity. These are the small valleys and peaks that do not cross the global threshold on a SRP. The formula is:

Defects = (ERN_{max} □ SC)

A (4.0)	□ .15
B (3.0)	□ .20
C (2.0)	□ .25
D (1.0)	□ .30
F (0)	> .30

NOTE: Certain readers are unable to read symbols with a Defects grade of *D*.

DECODABILITY

This parameter measures the printed symbol and evaluates how close this symbol comes to an ideal symbol. Each symbology has a specified dimension for each bar and space width. In addition, each bar and space width has certain margins, or tolerances, which allow a small range of sizes to be acceptable. Decodability measures the amount of margin left from the ideal after printing the bar code. One can think of Decodability as how much tolerance has been used in the printing process, allowing the remainder of the tolerance to be used by the reader. The scanability of a bar code increases with its Decodability grade. This parameter is especially important for high first scan read rates. A low Decodability grade is an indication of poor scannability. Many “modern” readers will handle symbols graded D or better without a problem. Sources of low Decodability are related to non-uniform printing such as plate or graphic distortions from the pre-press processes.

The actual measurement is dependent upon the specific symbology and is from the scanners' viewpoint NOT the printer's viewpoint. There are several specific measurements made of each symbol character. The worst of these measurements becomes Decodability. For more specific information, refer to individual symbology specifications.

A (4.0)	□ .62
B (3.0)	□ .50
C (2.0)	□ .37
D (1.0)	□ .25
F (0)	< .25

If you have any questions regarding the information contained in this guideline, please contact:

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