BAR CODE
GRAPHICS

Understanding Your Barcode Verification Report

A plain-language guide to ISO/ANSI/EN barcode grading — for both 1D and 2D symbols — covering what each grade means and what to do when a barcode doesn't pass.

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1. What This Guide Covers

Every barcode you send us for verification comes back with a report full of letters, numbers, and terms like "symbol contrast" and "modulation." This guide explains what those terms mean in plain language, so you can read your report and understand exactly what's driving your barcode's grade — and what to do about it if the grade is low.

The grading system described here comes from four aligned standards that all measure barcode print quality the same way:

- **ANSI X3.182** — the original American standard, for linear (1D) barcodes
- **ISO/IEC 15416** — the international standard for linear (1D) barcodes, now the primary reference
- **ISO/IEC 15415** — the international standard for 2D barcodes (Data Matrix, QR Code, PDF417, Aztec, and similar)
- **EN 1635** — the European standard, aligned with ISO

All four use the same A–F grading scale and the same underlying logic, so a barcode graded under one is graded consistently with the others. Sections 2–6 of this guide cover 1D (linear) barcodes; Section 7 covers 2D barcodes.

> **The short version:** a verification device scans your barcode the way a real scanner would, measures how dark the bars are, how light the spaces are, and how consistent everything is, then scores each measurement A through F. The lowest score in the group becomes the barcode's overall grade.

2. How a Barcode Gets Scanned and Graded

A verifier shines light across the barcode and records how much light bounces back at every point along the line — this is called a **scan reflectance profile**. Dark bars reflect very little light; light spaces reflect a lot. Plotted out, it looks like a wave: deep dips for bars, high peaks for spaces.

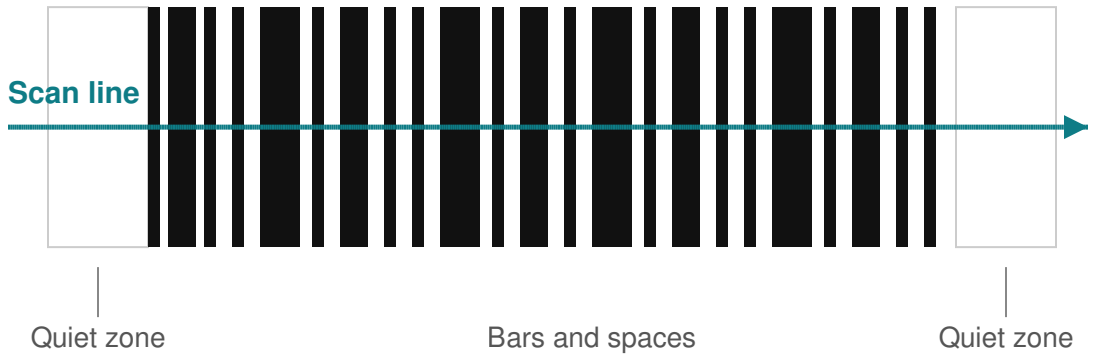


Figure 1 — A verifier reads across the barcode along a scan line, including the blank margins (quiet zones) on either side.

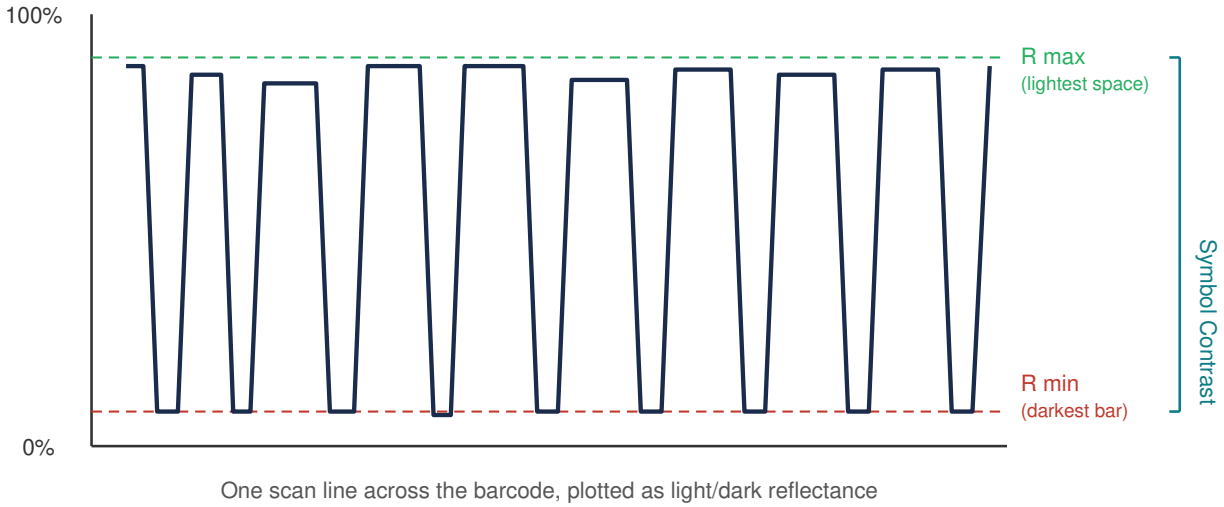


Figure 2 — The resulting reflectance profile. Peaks are spaces, valleys are bars. Several of the grading measurements come directly from this shape.

To get a full picture of the barcode — not just one lucky (or unlucky) slice — the standards call for **10 scans** taken at evenly spaced heights through the symbol. Each scan gets its own grade, and the 10 grades are averaged to produce the **overall symbol grade** that appears on your report. Quality can vary within the height of a single symbol — a smudge near the top, a light streak near the bottom — and averaging keeps one bad (or one lucky) scan from misrepresenting the whole barcode.

Reading the aperture and application spec together

Your report also lists an **aperture size** and **light wavelength** — these describe the "eye" the verifier used to read the code, and they matter because the same barcode can grade very differently depending on which aperture and wavelength were used. Whenever an industry or customer specification (retail, healthcare, automotive, etc.) calls for a specific aperture and wavelength, that requirement overrides the general recommendations in the standards, and it's what we verify against.

Translucent or reflective substrates

For plastic films, bottles, or other see-through materials, the standards call for verifying twice — once with white behind the symbol, once with black — and reporting the lower of the two grades, since real-world scanning conditions vary.

> Not sure which aperture, wavelength, or minimum grade your application requires? Check your customer's or industry's packaging specification — retail, healthcare, and automotive programs each set their own minimums — or ask us directly. We verify against the exact requirement that applies to your product, not just the general guidance in the standards.

3. The Grading Scale

Every measurement on your report — and the overall grade — is expressed both as a letter and a number. A is best, F is a fail. The number is what actually gets averaged; the letter is there for a quick read.

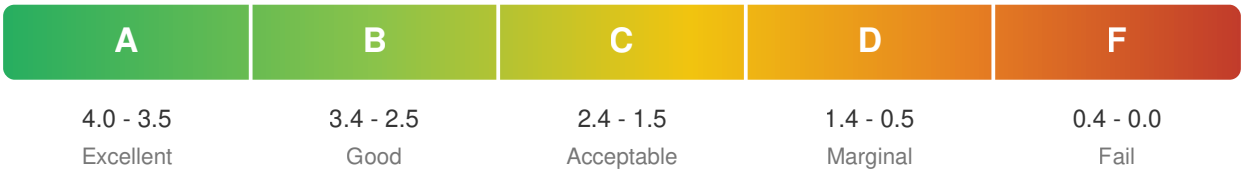


Figure 3 — The grading scale used across ANSI, ISO, and EN reports.

Grade	Numeric range (average)	What it generally means
A	3.5 – 4.0	Excellent. Should read reliably on the first pass, even with a single scan path.
B	2.5 – 3.4	Good. Reads reliably in most single-pass systems; occasional rescans possible.
C	1.5 – 2.4	Acceptable. This is the minimum most retail and GS1 (EAN/UCC) applications require. Benefits from scanners with multiple scan paths.
D	0.5 – 1.4	Marginal. Best read by scanners built for multiple scan paths; some readers may not read it reliably at all.
F	0.0 – 0.4	Fail. Unlikely to read reliably with typical scanning equipment; manual entry is often the fallback.

A grade doesn't equal "broken." A lower grade means a lower first-pass read rate on average hardware — not that the code can never be scanned. Aggressive, modern scanners can often read an F-graded code just fine. What the application requires (retail POS, healthcare, automotive, etc.) sets the minimum acceptable grade, not this guide.

Note on precision: the current revisions of ISO/IEC 15416 (1D, 2016) and ISO/IEC 15415 (2D, 2024) grade most measurements to one decimal place instead of whole numbers, giving a more precise result (for example, 3.7 instead of just rounding to 4). Letter grades are still shown for convenience, but the decimal number is the official value.

4. The 1D Parameters, Explained

Your report grades several distinct things about the barcode. Four are simple pass/fail checks; four are graded A through F. Here's each one in plain language, along with what typically improves it.

Quiet Zones

Pass / Fail

The blank margin of clear space required on both sides of the barcode. Scanners use this space to know where the code starts and ends. If art, text, or another barcode crowds into it, the scanner can misread the edges.

To fix: keep required clear space (typically 10× the width of the narrowest bar) completely free of any printing or graphics.

Minimum Reflectance

Pass / Fail

Checks that at least one bar is dark enough compared to the lightest space. If the bars aren't dark enough relative to the background, the scanner can't tell where a bar starts.

To fix: use darker ink, or increase heat/darkness settings on thermal printers.

Minimum Edge Contrast

Pass / Fail

Looks at every single transition from bar to space (or space to bar) and finds the weakest one — the edge with the least difference in reflectance between the two sides. A hazy or blurry edge anywhere in the code can cause this to fail.

To fix: use a lighter substrate with darker ink, or adjust print settings so the printed bar widths are closer to their intended size.

Decode

Pass / Fail

Confirms the bar code, as printed, can actually be translated back into the correct data using the standard decoding method for that symbology. This is the most basic check: does it decode to the right characters at all?

Symbol Contrast

Graded A–F

The overall difference between the darkest point and the lightest point anywhere in the scan — the bigger the gap, the better the grade. This is the single biggest factor in how "punchy" a barcode looks to a scanner.

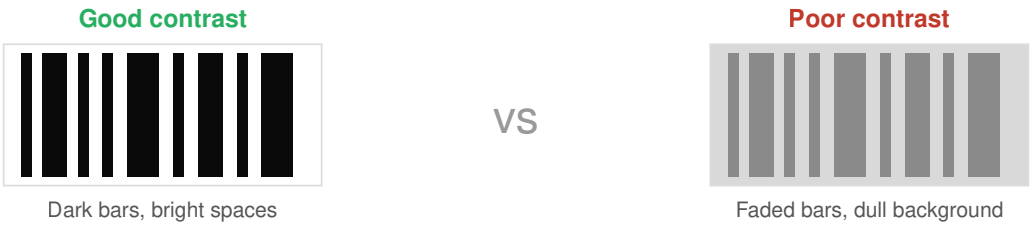


Figure 4 — High contrast (left) grades well; washed-out or shiny materials that don't reflect cleanly (right) grade poorly.

To fix: darken the bars and lighten (or de-gloss) the spaces. Shiny materials — laminates, polished metal, high-gloss coatings — often measure poorly even though they look fine to the eye, because they scatter light away from the verifier instead of reflecting it back.

Modulation

Graded A–F

Checks how consistent the bars and spaces are with each other — specifically, whether the narrow elements are nearly as "deep" (dark or light) as the wide ones. Scanners naturally see narrow elements as less distinct than wide ones, so this measurement rewards symbols where that gap is small.

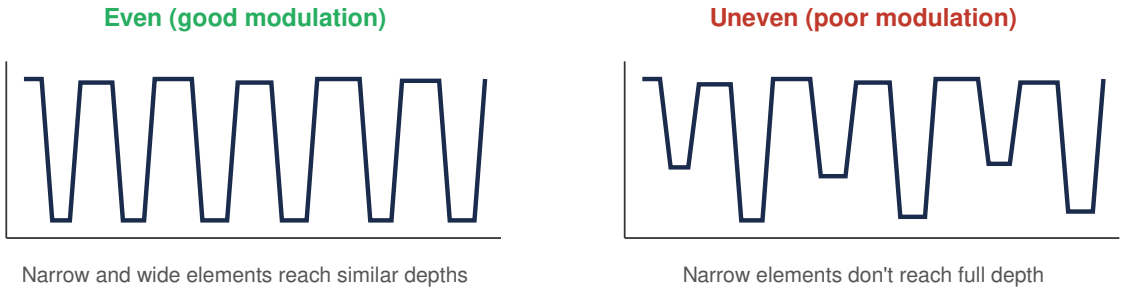


Figure 5 — Even peaks and valleys across all element widths (left) versus narrow elements that never reach full depth (right).

To fix: make narrow spaces very slightly wider relative to narrow bars. In conventional wet-ink printing, apply the correct bar width reduction for gain during printing. In thermal or other on-demand printing, check that ribbon and substrate aren't too glossy.

Defects

Graded A–F

Flags voids (light specks inside a bar) and spots (dark specks inside a space, or in the quiet zones) — local irregularities rather than an overall problem with contrast.

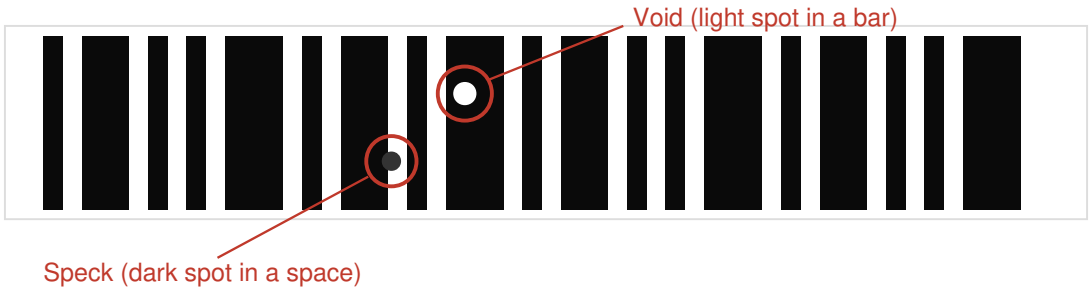


Figure 6 — A void inside a bar and a stray speck inside a space are both scored as defects.

To fix: for on-demand/thermal printing, check for a dirty print head or fuser, wrong media, or low heat. For conventional wet-ink printing, check for worn or dirty plates. Some substrates (like kraft-lined corrugated) simply carry more inherent defects — the substrate itself may need to improve.

Decodability

Graded A–F

Measures how close the printed bar and space widths are to their ideal size for that symbology. Every barcode format has some built-in tolerance for errors in element width; this score shows how much of that margin is left after printing, before a reader would start struggling.

To fix: apply the correct bar width adjustment for wet-ink printing, or verify thermal print head temperature. For barcodes generated in software, make sure element widths round to whole printer pixels — letting software freely resize or stretch a barcode image is a common cause of poor decodability.

5. How the 1D Numbers Roll Up

Your report builds the overall grade in three steps:

1. **Scan Grade** — for each of the 10 scans, every parameter above is measured and the *lowest* of those grades becomes that scan's grade. One weak parameter is enough to pull an entire scan down.
2. **Overall Symbol Grade** — the 10 individual scan grades (as numbers) are averaged together.
3. **Letter conversion** — that average is converted back to a letter using the scale in Section 3.

> **Example:** if nine scans come back grade A (4.0) but one scan crosses a smudge and grades D (1.0), the average is (9×4.0 + 1.0) ÷ 10 = 3.7 — still a strong A. This is what "vertical redundancy" buys you: a single defect doesn't sink the whole result.

6. 1D Quick Reference

If your report shows…	It likely means…	Try…
Low **Symbol Contrast**	Not enough difference between bar and space darkness	Darker ink/toner, less glossy substrate
Low **Modulation**	Narrow bars/spaces are weaker than wide ones	Widen narrow spaces slightly; correct bar width reduction
Low **Defects**	Voids or specks in bars/spaces	Clean print head/plates; check media and heat settings
Low **Decodability**	Element widths drifting from ideal	Correct bar width adjustment; avoid image resizing/stretching
Failed **Quiet Zones**	Artwork crowding the blank margins	Clear required space on both sides completely
Failed **Minimum Reflectance** / **Edge Contrast**	Bars aren't dark enough, or edges are blurry	Darker ink, sharper print, correct print settings
Failed **Decode**	Data can't be reconstructed at all	Check for encoding errors, severe print defects, or wrong symbology settings

7. 2D Barcodes: ISO/IEC 15415

Data Matrix, QR Code, PDF417, Aztec, and other 2D symbols are graded under a companion standard, **ISO/IEC 15415**. It uses the same A–F / 4.0–0.0 scale and the same "lowest parameter wins" logic as 1D grading, but a 2D symbol is a grid of light and dark squares (modules) rather than a line of bars, so several of the measurements are different.

What carries over from 1D grading

- **Symbol Contrast** — the difference between the lightest and darkest modules in the symbol. Same idea as 1D, just measured across a grid instead of a line.
- **Modulation** — how consistently every individual module reaches full light or full dark, now combined with what used to be a separate "reflectance margin" measurement into one grade.
- **Decode** — pass/fail check that the symbol reconstructs the correct data.

What's unique to 2D symbols

Fixed Pattern Damage

Graded A–F

2D symbols rely on built-in reference patterns — finder patterns, timing patterns, and the quiet zone — so a scanner can locate the symbol and orient itself before reading. This measurement grades how intact those patterns are. Damage here is more serious than a stray defect elsewhere, because the scanner may not find the symbol at all.

To fix: keep the finder/locator patterns and quiet zone completely free of print defects, overprinting, or damage — treat them with the same care as the data area.

Axial Non-uniformity

Graded A–F

Checks whether the module grid is stretched more in one direction than the other — for example, slightly wider left-to-right than top-to-bottom. This kind of distortion often comes from the print or marking process rather than the artwork itself.

To fix: check for print process distortion (web tension in flexo, thermal print head drag, laser marking speed) that stretches the symbol unevenly in one axis.

Grid Non-uniformity

Graded A–F

Measures how far individual modules have drifted from their ideal position in the grid — a more general check of grid distortion than axial non-uniformity, which only looks at the two main axes.

To fix: same causes as axial non-uniformity, plus general print registration issues; tightening process control usually improves both together.

Unused Error Correction

Graded A–F

2D symbols carry built-in error-correction data specifically so they can still be read even if part of the symbol is damaged. This measurement reports how much of that safety margin is left unused — in other words, how much damage the symbol could absorb and still decode correctly. A low score means the code is already relying heavily on error correction just to read today.

To fix: reduce whatever is currently forcing the decoder to lean on error correction — usually the same root causes as poor contrast, modulation, or fixed pattern damage.

Print Growth

Graded A–F

New in the 2024 revision of ISO/IEC 15415. Measures whether individual modules printed larger or smaller than their intended size, in both width and height — the same "dot gain" idea familiar from conventional print quality control, applied to barcode modules.

To fix: adjust plate/module sizing to compensate for known gain or loss in your specific print process, the same way you would compensate bar width reduction for a 1D barcode.

Most industries that rely on 2D codes — GS1, Unique Device Identification (UDI) in healthcare, automotive part marking — require a minimum grade of **C (1.5)** under ISO/IEC 15415, measured at the aperture and wavelength called out in the relevant application standard.

8. Quick Reference

If your report shows…	It likely means…	Try…
Low **Symbol Contrast** (1D or 2D)	Not enough difference between dark and light areas	Darker ink/toner, less glossy substrate
Low **Modulation** (1D or 2D)	Narrow elements/modules weaker than the rest	Adjust width/module sizing for print gain; check gloss
Low **Defects** or **Fixed Pattern Damage**	Voids, specks, or damage to finder/locator patterns	Clean print head/plates; protect quiet zone and finder patterns
Low **Decodability** or **Grid/Axial Non-uniformity**	Element or module widths/positions drifting from ideal	Correct width adjustment; check for process-driven distortion
Low **Unused Error Correction**	2D symbol already leaning on its safety margin to decode	Address the underlying contrast/modulation/damage issue
Low **Print Growth**	Modules printing larger or smaller than intended	Adjust module sizing to compensate for print gain
Failed **Quiet Zones**	Artwork crowding the blank margins	Clear required space on both sides completely
Failed **Decode**	Data can't be reconstructed at all	Check for encoding errors, severe print defects, or wrong symbology settings

9. About Bar Code Graphics

Bar Code Graphics specializes in standardized barcode identification, so accurate and compliant data can be efficiently bridged from physical products and shipments to digitized supply chain ecosystems.

Our niche services solve specific deficiencies in barcode identification and compliance encountered by retailers and suppliers.

Our Authority

We are recognized as the expert authority in each of the segments we service. In absence of standardized agency certification, our history, affiliations, and customer base provide a robust validation of our expertise. Our long-standing presence in the barcode industry, coupled with our strategic partnerships with leading technology providers, underscores our capability and reputation.

Barcode Origination

Precise print-ready digital images for packaging, coupons, and labels

Barcode Print Quality Testing

Barcode certification and compliance administration

Identification Services

Programs facilitating ISBNs for self-publishers and GTIN/UPCs for retail suppliers

Barcode Origination

High resolution barcode images are required for package and commercial label printing. CPG and hard good products typically have UPC/EAN barcodes and QR codes integrated within the package and carton artwork. Conversely, on-demand software/hardware companies are used internally by companies to print their own tags and labels.

Standards based SaaS website, www.createbarcodes.com, launched in 2001 and only image creation application to receive UCC/EAN (GS1) certification.

Digital barcode web service licensing enables seamless integration of standards compliant barcodes with database/catalog applications. Eliminates redundant GTIN data entry and only standards certified service to create print-ready images.

Barcode Testing

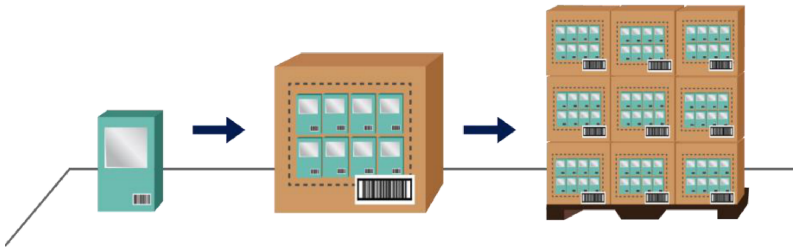
Recognized 3rd party barcode print quality testing authority by retailers, manufacturers, distributors and industry associations. Services include GS1 barcode verification testing, retailer specific certification programs, and barcode compliance administration. Over 14,000 samples evaluated every year.

Bar Code Graphics has earned the reputation as the sole source for unbiased retailer barcode certification. Since 1998, we have established dedicated testing programs for; Sears, JCPenney, Home Depot, Sports Authority, Kohls, Stein Mart, Stage Stores, and True Value. All of these retailers relied on high-speed sortation scanning within their supply chains.

Retailers that utilize our barcode compliance administration services empower us to support compliance offsets and protect their suppliers' interests against inaccurate barcode reporting. Our barcode compliance portals can share data with existing retailer compliance scorecards.

Identification Services

Comprehensive turnkey solutions for self-publishers requiring ISBN identification (www.isbn-us.com) and retail suppliers requiring support with GTIN management & barcodes (www.barcode-us.com).



Through a partnership with the US ISBN Agency, we dynamically provide authentic individual ISBN assignments and barcodes to self-publishers.

Although we are separate from the GS1 US standards organization, we provide support for thousands of companies requiring assistance with UPC barcodes. Through a proprietary portal and personal support, we administer the entire process for compliant UPC and carton barcode implementation.

www.barcode.graphics

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