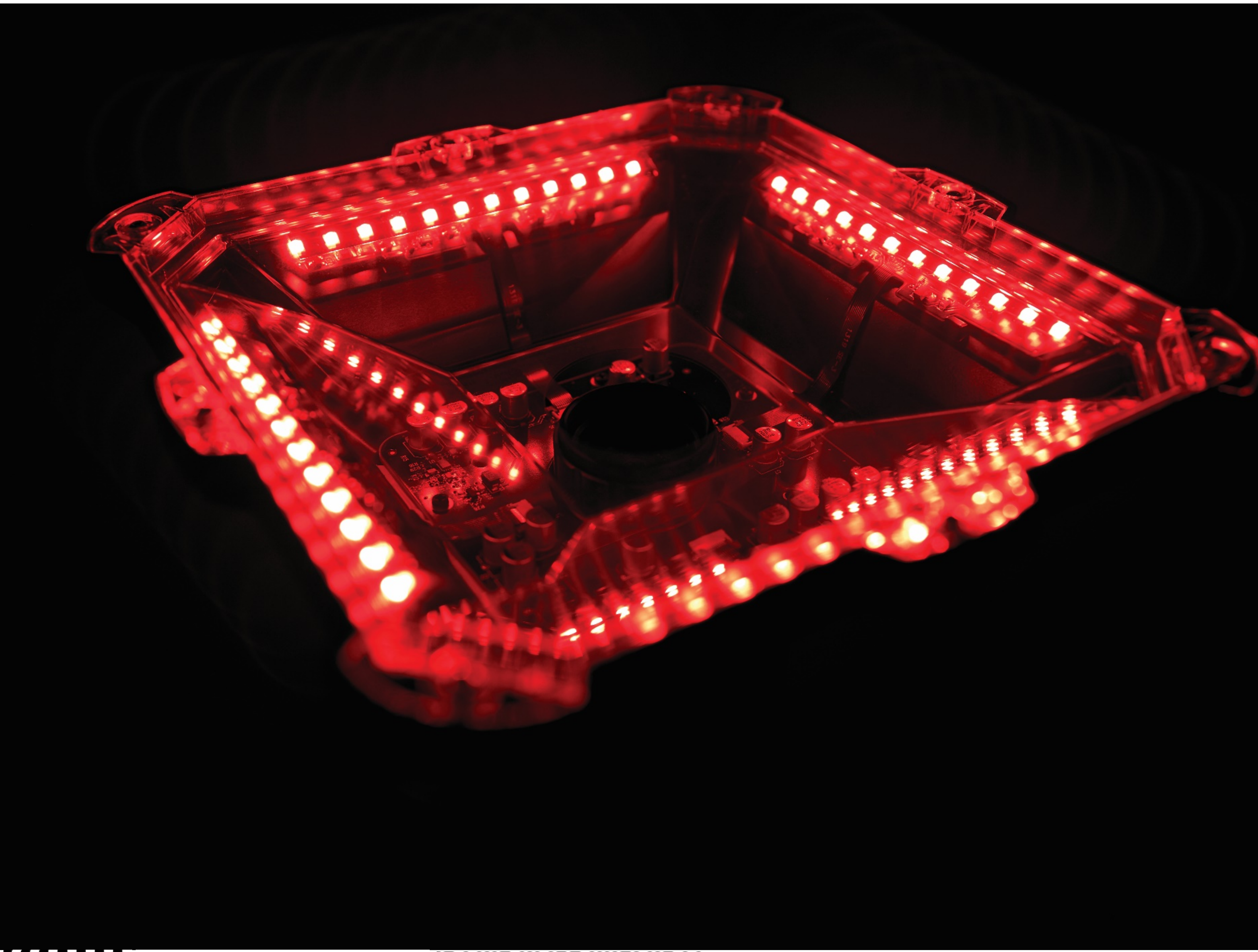
COGNEX



BARCODE VERIFICATION

A COMPLETE GUIDE TO CODE QUALITY

CONTENTS

Rev. H

WHAT IS VERIFICATION?

- Barcode verification is the process of grading the quality of barcodes.
- During that process, an image of the code is captured and analyzed according to ISO standards, a report is generated, and diagnostic information is displayed.
- A certified verifier must meet the rigorous ISO 15426-1 and 15426-2 standards for both hardware and software. Tolerances specified in these standards for all measured values ensure that calibration, lighting, and algorithms are implemented correctly.

BENEFITS

- Reduce product returns and packaging waste
- Save time by avoiding costly reprints and/or re-shipments
- Pinpoint exactly what the errors are in your code so the appropriate corrections can be made
- Guarantee compliance with contract and industry requirements

BARCODE READER VS BARCODE VERIFIER

BARCODE READER

- Designed to read barcodes and output data very quickly

BARCODE VERIFIER

- Captures a reproducible image of a code in accordance with ISO standards
- Analyzes an image of the barcode and assigns a quality grade
- Generates reports certifying that codes meet industry standards
- Confirms that your barcodes can be read by all scanners
- Pinpoints the reason(s) why the barcode gets a low grade
- Ensures that your data is formatted correctly

WHY VERIFICATION PRODUCTS FROM COGNEX?

- Cognex certifies that our verification solutions are fully ISO-compliant in accordance to ISO 15426-1 and 15426-2.
- Reliable verification algorithms are combined with Cognex's fast finding algorithms and integrated into rugged Cognex hardware .
- Cognex engineers participate in the ISO committees that develop the grading standards.

BENEFITS

- Detailed reporting and export options
- Easy-to-use software interface with a variety of diagnostic tools
- Accurate and repeatable results
- Large product range to meet various application needs including 1D, 2D, and DPM
- Free support

COGNEX IS THE TECHNOLOGY LEADER IN BARCODE READING AND VERIFICATION, MANUFACTURING THE HIGHEST QUALITY, MOST ACCURATE, AND EASY-TO-USE VERIFIERS ON THE MARKET.

WHO NEEDS VERIFICATION?

Any company that produces barcodes will benefit from having a barcode verifier on hand. However, unless the company is in an industry that requires verification, chances are most do not realize the difference between ISO-compliant verification and code quality software.

Due to a lack of regulation and consistency, code quality software tends to have a lot of variation between each set-up, making repeatable results difficult and leaving users with less confidence of the grading accuracy, whereas verifiers must meet the requirements of the ISO Standard 15426-1 and 15426-2. Verifier ISO-compliant requirements include a calibration process, use of the applicable reference decode algorithm, etc.

Verification offers more than just a dependable quality grade assessment; it also provides detailed diagnostic information needed to maintain or improve code quality. It is ideal for companies that want to be able to prove the quality of barcodes when they were printed or received.

ISO STANDARD SUMMARIES

- **1D BARCODES USE ISO/IEC 15416**
- **2D BARCODES PRINTED ON A LABEL USE ISO/IEC 15415**
- **2D DPM BARCODES USE ISO/IEC TR 29158**

A barcode verifier is the only device that can assign an objective quality grade to a code and generate an official quality report. A series of quality parameters are used to determine a barcode's overall quality grade. The individual grades from each of those parameters determines the overall grade of the code.

While there are many standards from the International Organization for Standardization that pertain to barcodes, most describe how the barcode is constructed. However, there are only three ISO standards that specify how to determine the print or marking quality of a barcode.

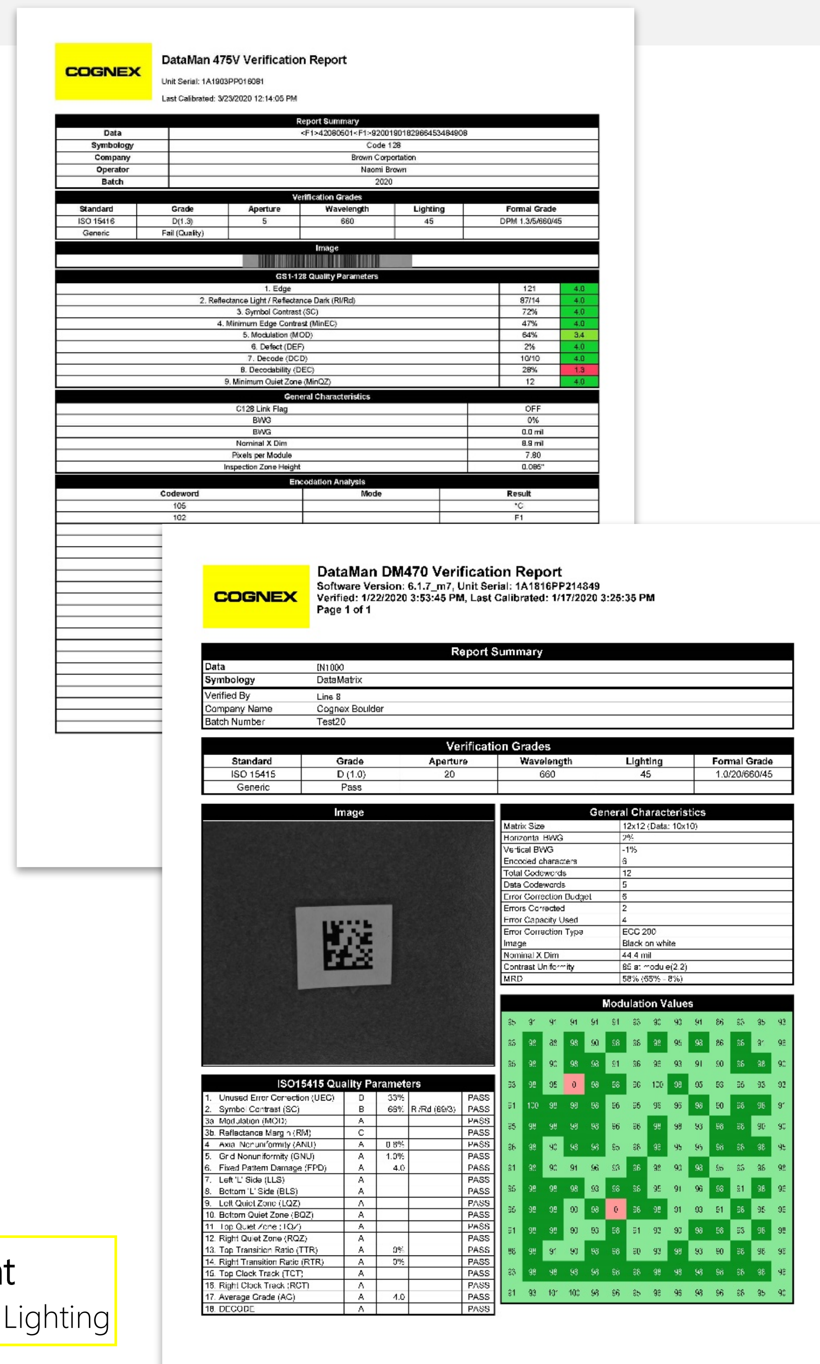
GRADE REPORTING FORMAT

- The formal grade is written in a single line starting with the overall grade value followed by the aperture size, light wavelength, and lighting angle used.
- The verification grade is shown as a letter grade. The letter grade is based off a calculated numerical value that works just like a GPA, a 4.0 is an "A", 3.0 is a "B" and 2.0 is a "C".
- The information listed is to make sure the required settings were used for the code type. This is especially helpful when comparing two verification reports for the same barcode. Using a different aperture size or lighting angle can give drastically different results.

3.0/10/660/45

Formal Grade Reporting Format

Overall Grade/ Aperture Size/ Light Wavelength/ Lighting



COGNEX

DataMan 475V Verification Report

Unit Serial: 1A1903PP016061

Last Calibrated: 3/23/2020 12:14:05 PM

Report Summary	
Data	<F1>42060601<F1>9200190182966453484908
Symbology	Code 128
Company	Brown Corportation
Operator	Naomi Brown
Batch	2020

Standard	Grade	Aperture	Wavelength	Lighting	Formal Grade
ISO 15416	D(1.3)	5	660	45	DPM 1.3/5/660/45
Generic	Fail (Quality)				

GS1-128 Quality Parameters		
1. Edge	121	4.0
2. Reflectance Light / Reflectance Dark (Rl/Rd)	87/14	4.0
3. Symbol Contrast (SC)	72%	4.0
4. Minimum Edge Contrast (MinEC)	47%	4.0
5. Modulation (MOD)	64%	3.4
6. Defect (DEF)	2%	4.0
7. Decode (DCD)	10/10	4.0
8. Decodability (DEC)	28%	1.3
9. Minimum Quiet Zone (MinQZ)	12	4.0

General Characteristics	
C128 Link Flag	OFF
BWG	0%
BWG	0.0 mil
Nominal X Dim	8.9 mil
Pixels per Module	7.80
Inspection Zone Height	0.085"

Codeword	Mode	Result
105		*C
102		F1

COGNEX

DataMan DM470 Verification Report

Software Version: 6.1.7_m7, Unit Serial: 1A1816PP214849

Verified: 1/22/2020 3:53:45 PM, Last Calibrated: 1/17/2020 3:25:35 PM

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Report Summary	
Data	IN1000
Symbology	DataMatrix
Verified By	Line 8
Company Name	Cognex Boulder
Batch Number	Test20

Standard	Grade	Aperture	Wavelength	Lighting	Formal Grade
ISO 15415	D (1.0)	20	660	45	1.0/20/660/45
Generic	Pass				

General Characteristics	
Matrix Size	12x12 (Data: 10x10)
Horizontal BWG	2%
Vertical BWG	-1%
Encoded characters	6
Total Codewords	12
Data Codewords	5
Error Correction Budget	5
Errors Corrected	2
Error Capacity Used	4
Error Correction Type	ECC 200
Image	Black on white
Nominal X Dim	44.4 mil
Contrast Uniformity	86 at module(2,2)
MRD	58% (65% - 8%)

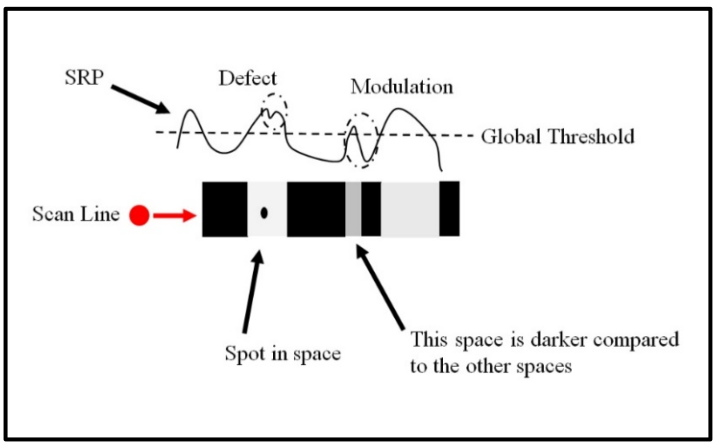
ISO15415 Quality Parameters				
1. Unused Error Correction (UEC)	D	33%		PASS
2. Symbol Contrast (SC)	B	66%	Rl/Rd (69/3)	PASS
3a. Modulation (MOD)	A			PASS
3b. Reflectance Margin (RM)	C			PASS
4. Axial Nonuniformity (ANU)	A	0.8%		PASS
5. Grid Nonuniformity (GNU)	A	1.0%		PASS
6. Fixed Pattern Damage (FPD)	A	4.0		PASS
7. Left 'L' Side (LLS)	A			PASS
8. Bottom 'L' Side (BLS)	A			PASS
9. Left Quiet Zone (LQZ)	A			PASS
10. Bottom Quiet Zone (BQZ)	A			PASS
11. Top Quiet Zone (TQZ)	A			PASS
12. Right Quiet Zone (RQZ)	A			PASS
13. Top Transition Ratio (TTR)	A	0%		PASS
14. Right Transition Ratio (RTR)	A	0%		PASS
15. Top Clock Track (TCT)	A			PASS
16. Right Clock Track (RCT)	A			PASS
17. Average Grade (AG)	A	4.0		PASS
18. DECODE	A			PASS

Modulation Values

HOW THE DECODE PROCESS WORKS WITH 1D LINEAR BARCODES

A 1D barcode is made of a sequence of bar and space elements that create a set of data based on the pattern of their widths. Each individual bar or space is referred to as an element. Groups of bars and spaces that form a specific pattern are called characters. Each symbology has a different set of patterns that translate into characters.

To be decoded, a scan line crosses the width of the code measuring reflectivity levels to determine the size and pattern of the bar and spaces. As the scan line moves across the code, light is reflected as it crosses over space modules and is absorbed by the bar modules and this creates a scan reflectance profile or SRP. As the scan line crosses the dark bars, it will cause the SRP to drop below the global threshold and then it will rise again above the global threshold as it crosses over the spaces. The dotted line in the image represents the global threshold, which is what defines the gray scale value that divides between light and dark.

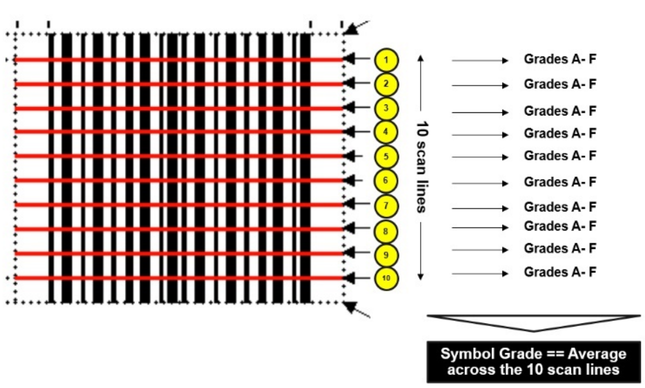


Every graded parameter is based off the scan reflectance profile or SRP. Ideally the SRP represents the bars and spaces just as they were intended when printed. The code in this image shows an example of a code with defect and modulation issues. When the scan line goes across the defect spot the light path begins to drop, interrupting the smooth curve with a dip. There is also a space that is not as bright as the other spaces, so the reflectance profile does not reach the same height as other space elements, revealing an issue with modulation.

ISO STANDARD 15416

GRADING PROCESS (1D BARCODES)

1D barcodes are graded by averaging the results of 10 scan lines. Each scan line is graded against nine different parameters. The lowest graded parameter becomes the scan grade for the scan line. All the scan grades are then averaged to compute the overall grade.



1D APERTURE SIZE

The scan reflectance profile consists of samples across the length of the code. The diameter of the sampled area is the aperture size. Apertures are referred to in mils which is equivalent to a 1000th of an inch. Aperture size is specified by the application standard in use. If aperture is set at auto and an application standard is selected, the software will automatically set the aperture recommended in that application standard.

If you do not have an application standard to reference, generic rules on aperture size given in ISO 15415, are shown in the following chart:

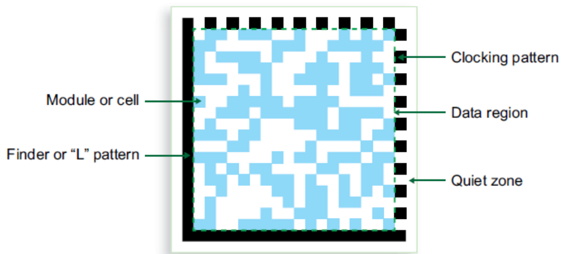
Barcode X-Dimension	Aperture Size
4-7 mil	3 mil
7-13 mil	5 mil
13-25 mil	10 mil
25 mil +	20 mil

ISO 15416 1D QUALITY PARAMETER EXPLANATIONS AND COMMON SOLUTIONS

Edge Count (EDGE)	Pass or fail parameter that is counting the number of edges in the code.	▪ A no decode could mean that the barcode does not have the proper edge count, it could be incomplete. ▪ The bar space edges are not crossing the global threshold. ▪ Try a smaller aperture size to see if the code can decode. ▪ Double check that the code is not inverted in color.
Minimum Reflectance (Rl/Rd)	Graded as A or F, the reflectance value for at least one bar must be less than half the highest reflectance value for a space.	▪ To improve your minimum reflectance grade, the bars need to be darker or less reflective and the substrate or spaces need to be brighter or more reflective.
Symbol Contrast (SC)	A graded value that measures the difference between the maximum reflectivity in the lightest space and the minimum reflectivity in the darkest bar.	▪ To improve contrast, make the bars darker and the spaces lighter or less shiny.
Minimum Edge Contrast (MinEC)	A pass or fail parameter checking the level of contrast between adjacent spaces and bars is at least 15%.	▪ Try using a lighter substrate and darker ink or increasing the x-dimension. ▪ Be sure to use an appropriate aperture based on the application spec.
Modulation (MOD)	The minimum edge contrast as a fraction of overall symbol contrast, i.e. MinEC divided by SC.	▪ Try making narrow spaces slighting wider than narrow bars this may increase the modulation grade (i.e. bar width reduction). ▪ Alternatively, try using a smaller aperture.
Defect (Def)	A graded value that refers to a spot in a space or a void in a bar. The formula for defect is element reflectance non uniformity max divided by symbol contrast.	▪ Defects can be caused by dirty print heads, fusers, improper media match, low heat on thermal printers, worn printer plates, or texture of the material that the code is marked on. ▪ Make sure the proper aperture size is selected according to the application spec.
Decode (DCD)	A pass or fail parameter looking to see if the code can be decoded using the standard reference decode algorithm with the selected aperture.	▪ Try using less ink or a different kind of ink. ▪ Change paper or substrate. ▪ Adjust artwork to accommodate known growth. ▪ Clean print head. ▪ Reduce thermal or laser heat.
Decodability (DEC)	A measure of how closely the element widths match their nominal sizes and are identified with margin-for-error by the reference decode algorithm.	▪ To improve decodability, ensure element widths are correct. ▪ Barcode generation software must account for printer resolution (dots-per-inch or dots-per-mm). The printed x-dimension must be an integer multiple of the printer's raster pitch.
Quiet Zone (MinQZ)	Checks that there is enough open space to the left and the right of the barcode.	▪ Double check artwork. ▪ Change placement of barcode. ▪ Increase label size.

HOW THE DECODE PROCESS WORKS FOR DATA MATRIX BARCODES

The best barcodes have a high contrast between the black and white modules with crisp edges and ideal proportions. Even the slightest imperfection can cause problems with the code. A barcode verifier will compare barcodes to a perfect version of the code and identify areas with issues. To fully understand why even the slightest variance matters, it is necessary to understand how verification software decodes barcodes.



The Data Matrix symbology is probably the most common 2D code. It allows for the highest density of data per module, especially for small symbols, so grading quality is essential. The finder pattern consists of solid left and bottom sides, which form an “L” pattern and a horizontal and vertical clock track on opposite sides of the “L”. The clock track tells the number of modules in the matrix and is used to decode the grid on which the modules are placed. All the information about the symbol size, encoding, and error correction is determined from the size of the matrix.

DECODE PROCESS STEPS

There are multiple steps that must happen to decode the data within a data matrix barcode. Codes must be decoded before they can be verified. The quality parameters accessed during verification are based on items that are needed for each of the decode steps. Understanding this process will make deciphering verification results easier.

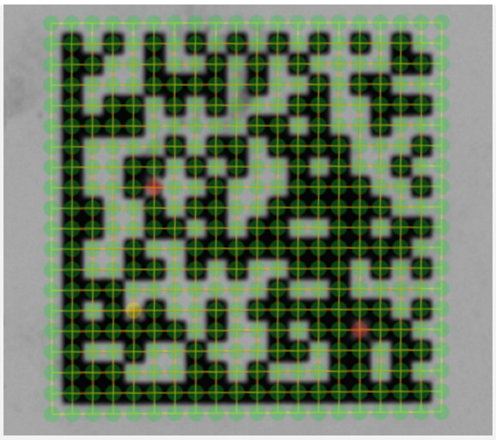
The steps proceed in the following order:

1. The verifier captures the image.
2. The software adds a blur to the image to remove noise or texture in the background.
3. Global threshold is calculated using the blurred image. The global threshold is the set value to determine if a cell’s gray value is closer to white or black.
4. The software converts image to a black and white, or “binary” image. To binarize the image, software takes the blurred image that has grey values and then converts every pixel to either black or white.
5. Software traces lines to find the L pattern and looks for a clock track pattern opposite each L side. Essentially it is locating the finder pattern.
6. Based on the spacing of the clock teeth, the reference decode grid is generated.
7. At each grid intersection, a circle is drawn (the aperture), and the pixels within this circle are sampled to determine the color, or reflectance, of the module. This color is compared to the threshold for each module, creating a sequence of binary data based on the color of the cell called a bit stream.
8. The bit stream (data sequence) is corrected using Reed-Solomon error correction.
9. The corrected bit stream is converted to ASCII values revealing the data within the code.

ORIGINAL IMAGE BLURRED IMAGE BINARY (B&W) IMAGE

2D APERTURE SIZE

For 2D codes, aperture refers to the circular sample that is captured at grid intersections. Each of those sample circles are what the software will use to determine whether a cell is dark or light. The size of the aperture can greatly affect the result. Any time the sample circle captures both dark and light cells within it, it will result in a shade of gray. Ideally, you want your aperture to be perfectly centered in the middle of a cell that is the correct color. Cells that start off without a crisp edge or have other cell colors bleeding into them will most certainly result in a gray color. The decode process will convert the image to binary, so anything that was grey will have to be converted into either black or white. Any cell that is gray leaves room for error. Too big or too little aperture will cause your grade to be less accurate.



In the ISO standard 15415 for 2D barcodes printed on a label, you must set the aperture size in accordance with your application standard. It is typical that an application standard will set the aperture size to be 80% of the smallest module size allowed within the application. For instance, a typical GS1 application allows a range of X-dimensions from 10 MIL to 20 MIL and specifies an aperture size of 8 MIL.

With the ISO/IEC TR 29158 (AIM DPM) standard, the software will change the size of the aperture until the symbol is decoded, and then the grading is repeated with two different aperture sizes (50% and 80% of the symbol's X-dimension). The better of the two grades is reported as the final grade. When the reference decode algorithm fails to decode a symbol with both 50% and 80% aperture, the DECODE grade will be "F", even if the symbol is recognized and decoded with a different aperture size in an earlier phase of the grading procedure.

ISO STANDARD 15415 GRADING PROCESS (2D BARCODES PRINTED ON A LABEL)

ONCE A BARCODE PASSES DECODE, IT WILL THEN BE ASSESSED BY THE FOLLOWING PARAMETERS:

- SYMBOL CONTRAST OR CELL CONTRAST (FOR DPM)
- MODULATION OR CELL MOD
- REFLECTANCE MARGIN
- FIXED PATTERN DAMAGE
- AXIAL NON-UNIFORMITY
- GRID NON-UNIFORMITY
- UNUSED ERROR CORRECTION

During the decode process, several additional steps must occur to complete the grading process. The first step is to determine whether the code can be decoded by the standard reference decode algorithm. This is essentially a very basic algorithm that runs through the decode process discussed previously. All verifiers use the standard reference decode algorithm for each symbology type as their first step in the verification process. This is a way to essentially guarantee that even the most rudimentary barcode readers can decode the symbol.

If a code cannot be decoded, the verifier will show an "F" grade and state "NO DECODE." This is different from how a failing code that has been decoded would be displayed. A code that receives an "F" grade but passed the decode process would show a grade for each of the quality parameters.

If the verification process is complete and a formal grade has been generated that is not acceptable, the next step is to see what parameter(s) is causing the grade to be lowered. Once the lowest scoring parameters have been identified, a closer look at the code itself will identify exactly what modules are causing the quality to be reduced.

ISO 15415 2D QUALITY PARAMETERS EXPLANATIONS AND COMMON SOLUTIONS

Unused Error Correction (UEC)	This is the percentage of error correction capability that is available for further incorrect modules.	▪ Modify artwork by changing the module colors that are failing to the opposite color ▪ Check for physical damage to the code ▪ Look for bar width growth or print growth
Symbol Contrast (SC)	The difference in reflectivity between the brightest module and the darkest module.	▪ Change the paper type ▪ Change ink color or amount ▪ Add a light-colored background behind the code ▪ Change the lighting angle
Modulation and Reflectance Margin (MOD) and (RM)	This is a grade based on the amount of variability in reflectivity of the modules. A multi-step process is used to get the modulation grade. MOD and RM are often the same, differing only when some modules are determined to be the wrong color and error correction is used.	▪ Reduce BWG by adjusting the amount of ink used ▪ Change the speed or temperature of the marking process ▪ Adjust the scale of the artwork ▪ Look for defects in the print ▪ Is there show through with the paper choice?

Axial Non-Uniformity (ANU)	Tests for uneven scaling of the symbol, which would make readability more difficult at some non-normal viewing angles.
	
	In other words, a measure of the overall aspect ratio of the symbol.
		▪ Can be caused by:
		    ▪ Improper printing
		    ▪ Marking speed or speed mismatch
		    ▪ Printing software errors

Grid Non-Uniformity (GNU)	Measures and grades the largest vector deviation for the grid intersections from their ideal calculated position.
	
	In other words when module grid alignment is not centered based on the calculated grid.
		▪ Can be caused by:
		    ▪ Inconsistent print or marking speeds, vibration, or slippage interference
		    ▪ Odd shaped parts and incorrect print distance, angle, or speed
		    ▪ Poorly managed artwork or pixel round off

Decode (DEC)	Report whether the 2D Symbol was decoded in accordance with the reference decode algorithm with the specified aperture. *Note that when Auto Aperture or Auto 80% is selected for Aperture, it is possible for decoded results to be reported but for a failure to occur when decoding using the selected aperture. In this case, the DECODE grade will be F and a message will be reported in the grade section of the report.*	▪ Are you using the correct aperture? ▪ Are you using the right ISO Standard? ▪ Are you using the right lighting angle? ▪ Is the symbology enabled? ▪ Is the symbol “mirrored”? ▪ Is the camera in focus? ▪ Is the code in the center of the FOV? ▪ Do the cell sizes look proportionate to one another? ▪ Are the edges of the cells crisp? ▪ Are all the components of the finder pattern present? ▪ Is the inkjet nozzle blocked? ▪ Is the thermal element faulty?
Fixed Pattern Damage (FPD)	Overall grade for all the fixed pattern components. This grade is equal to the lowest grade of the finder pattern components.	▪ Issues with printer nozzle, needle, laser, or thermal element ▪ Physical damage to the code ▪ Are there gaps in the L, or dirt in the quiet zone?

MODULATION

Modulation is one of the most common causes for a reduction in barcode quality. Modulation refers to localized issues with contrast, meaning that certain areas within a code do not have consistent contrast. This is different from symbol contrast, where the entire code suffers from low contrast. A high-quality barcode has well-defined dark and light cells throughout the code. During the decode process, cells that are labeled as a shade of grey will be converted to either a black or white module based on the software's calculation when the image is changed to a binary image. This leaves room for error as cells can be mislabeled, causing the need for error correction to be applied.

Verification software will highlight which cells have issues with modulation, but what is causing the modulation will need to be identified. First check how much bar width growth (also known as print growth) is found within the code. Bar width growth is not a graded parameter but often the source of modulation or decodability issues for 1D, 2D, and DPM barcodes. A positive bar width growth value indicates growth or spread within the bars of the symbol; a negative bar width growth value indicates a loss or reduction in bar width size. Growth or loss can be caused by using too much or too little ink, the type of paper, laser speed, heat levels, or focus.

A quick way to identify growth is to look at the proportion of the dark cells to the light cells. They should be the same size. If one is much larger than the other, there is a growth problem.

The software will provide you with an exact growth percentage for both horizontal and vertical directions reported as a percentage of the code x-dimension and as a mil size. Those figures can be used to adjust artwork, ink flow, laser settings, etc.

If bar width growth is not the cause of the modulation issues, the modulation value table will provide more information to locate the source of the issues. The modulation value table quantifies the distance between the global threshold and the reflectance of each module.

	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
-1	100	90	96	91	98	91	97	91	94	90	76	85	96	91	91	83	89	94	102	91	96	79
0	92	87	67	91	73	91	73	92	76	87	63	89	71	90	82	89	86	87	78	91	80	77
1	85	95	92	67	84	93	84	72	84	65	93	60	91	66	84	75	83	79	91	95	87	73
2	82	95	69	82	77	93	75	75	95	93	95	84	67	76	85	77	84	79	90	75	75	75
3	83	93	64	93	91	71	95	85	97	75	70	77	91	82	76	78	73	90	75	75	87	77
4	86	97	93	95	67	75	64	95	63	72	92	73	55	75	93	96	93	80	90	89	67	78
5	82	95	59	68	69	95	93	59	98	90	70	79	82	79	97	96	96	84	84	66	90	71
6	84	95	79	93	81	96	69	76	97	92	72	95	71	64	95	52	93	84	75	90	73	70
7	80	95	71	64	92	58	92	82	64	59	67	96	96	95	58	92	97	62	96	98	91	76
8	82	93	67	90	64	90	66	76	60	93	95	73	69	98	96	96	84	55	95	95	67	80
9	78	96	0	88	80	96	96	96	93	73	82	79	83	64	95	66	96	95	97	98	90	75
10	80	91	72	86	70	96	67	93	69	78	72	91	72	92	92	72	93	83	71	95	77	79
11	78	92	98	90	92	72	83	72	60	90	73	93	69	93	73	78	91	90	84	93	83	78
12	72	100	98	95	93	78	70	95	93	65	61	93	72	93	79	80	82	85	84	72	78	77
13	88	83	90	54	90	93	92	59	93	97	97	95	66	93	79	91	69	91	96	95	91	78
14	89	36	97	87	93	97	98	75	55	96	98	100	89	55	96	92	93	95	95	93	78	79
15	79	97	92	70	75	65	92	52	90	66	65	92	63	95	93	59	83	66	91	72	85	72
16	69	96	92	61	91	73	96	93	51	93	40	70	87	61	93	91	96	89	87	85	80	75
17	71	96	85	67	89	79	67	97	95	96	92	77	78	84	73	65	89	61	80	82	89	73
18	66	87	75	80	69	26	69	57	96	72	70	71	89	66	92	92	97	81	72	68	79	75
19	69	91	86	75	73	44	0	95	96	87	93	93	95	90	95	93	95	93	87	93	87	75
20	96	80	83	85	83	90	90	88	88	86	84	86	85	86	89	85	88	83	88	86	88	84

The cells with modulation values that are marked in yellow or red should be examined to see if they need to be made darker or lighter to be more consistent with their like modules. If a cell value within the data and not the finder pattern lands directly on or on the wrong side of the global threshold, it will have a zero-value listed, meaning the software needs to use Reed-Solomon error correction to determine whether the cell should be labeled as dark or light.

Other causes for issues with modulation could be the substrate used or even the size of the aperture. Typically, there is a specific aperture size called out in each industry application standard. It is important to use the recommended size or results can be skewed.

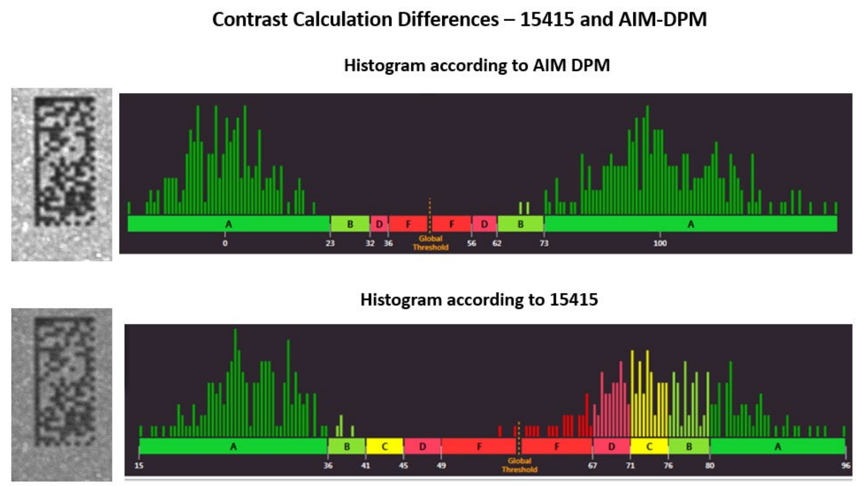
MODULATION IS ONE OF THE MOST COMMON CAUSES FOR A REDUCTION IN BARCODE QUALITY. MODULATION REFERS TO LOCALIZED ISSUES WITH CONTRAST, MEANING THAT CERTAIN AREAS WITHIN A CODE DO NOT HAVE CONSISTENT CONTRAST.

ISO/IEC TR 29158 (DPM GRADING STANDARD)

The ISO/IEC TR 29158 method of grading Data Matrix symbols modifies the process of ISO/IEC 15415 and is more appropriate for direct part marking (DPM) code applications. This standard was developed to accommodate the variety of different substrates and marking types used in direct part mark symbols.

In this method, the image brightness is automatically adjusted to produce an image of the symbol that is easier to see. Additionally, a more optimal global threshold is calculated using an algorithm commonly known as “Otsu’s Algorithm”. The outcome is a more ideal threshold that will result in higher values of Modulation.

The global threshold for the 15415 standard is done in a simple way, calculating the median between the highest and lowest reflectivity values. Thus, the measurements calculated by ISO/IEC TR 29158 differ from those of ISO/IEC 15415 significantly.

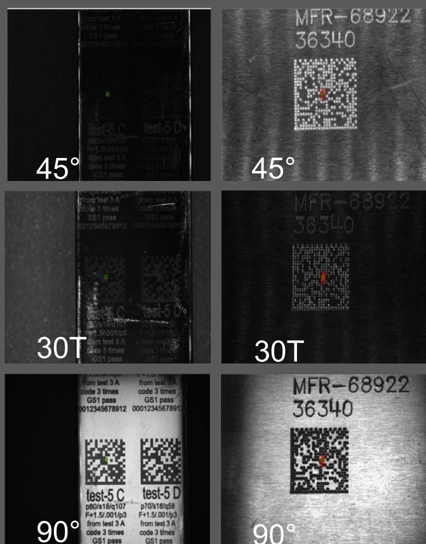


Some of the parameters reported in ISO/IEC 15415 are changed so drastically that to remove the possibility of confusion between these two methods, the parameters have been renamed.

ISO TR 29158 Parameter Name	ISO 15415 Parameter Name	Summary of Change(s)
CC (Cell Contrast)	SC (Symbol Contrast)	The relative contrast value between bars and spaces. (CC=(Lmean-Dmean)/Lmean))
CM (Cell Modulation)	MOD (Modulation)	Threshold calculated from statistics rather than the maximum and minimum reflectance. Grading scale range is set to mean of distribution, rather than maximum and minimum reflectance.
DD (Distributed Damage)	AG (Average Grade)	Modulation overlay uses only A, B, and F levels instead of A, B, C, D, and F.
MR (Minimum Reflectance)	Not necessary since SC is measured on an absolute scale	The ISO/IEC TR 29158 standard automatically brightens an image before conducting the verification process. If the symbol had lower than 5% brightness before the adjustment, it will fail. (An absolute limit on SC of 5% has been added to temper the relative nature of CC.)

All the Fixed Pattern Damage grading (other than AG shown above) are not renamed but are functionally different since the global threshold and modulation grading scale are different. In general, symbols will obtain a significantly higher grade according to ISO TR 29158 than ISO 15415, and is intended to represent readability only with suitable DPM enabled barcode readers. Therefore, grading according to ISO TR 29158 is appropriate only when called for in an application specification.

LIGHTING AND APERTURE SIZE FOR DPM CODES



Another significant difference between the DPM standard and 15415 is the allowance for a variety of illumination options. Four-sided 45˚ light that is the default for ISO 15415 is permitted. In addition to 45˚, the lighting angles allowed are: 30˚ lighting from four sides, 30˚ from two sides (which can be either north/south or east/west), 30˚ from only one side, and 90˚ diffuse on-axis lighting. The light source that is used is reported using a notation that includes the angle and a letter (Q for 4, T for 2, S for 1).

ISO TR 29158 also varies the size of the aperture until the symbol is decoded, and then the grading is repeated with two different aperture sizes (50% and 80%) and the better of the two grades is reported as the final grade. Note that when the reference decode algorithm fails to decode a symbol with both 50% and 80% aperture, the DECODE grade will be “F” and a note will be printed on the grade section of the report, even if the symbol was recognized and decoded with a different aperture size in an earlier phase of the grading procedure.

ISO 29158 DPM QUALITY PARAMETER EXPLANATIONS AND COMMON SOLUTIONS

Cell Contrast (CC)	Essentially the same as Symbol Contrast but made relative to light background.	▪ Modify the substrate to incorporate more contrast between the light and dark modules ▪ Add a light-colored background behind the code ▪ Change the lighting angle
Cell Modulation (CM)	A measure of the consistency of brightness, with the grading scale range from Global Threshold to Mean of distributions, rather than maximum and minimum reflectance. The DPM version of modulation.	▪ Reduce BWG by adjusting the amount of ink used ▪ Change the speed or temperature of the marking process ▪ Change pin size or replace with new pin
Distributed Damage (DD)	Similar to AG in ISO 15415, this parameter takes into account the effect of multiple segments of the fixed pattern having imperfections. Where multiple segments have a low grade, the effect of this “distributed damage” is reflected in a lower grade for DDG than the lowest of the individual segments. All the Fixed Pattern Damage grading are not renamed but are functionally different since the global threshold and modulation grading scale are different.	▪ In general, symbols will obtain a significantly higher grade according to AIM-DPM than ISO 15415. Therefore, grading according to AIM-DPM is appropriate only when called for in an application specification. ▪ Modulation overlay uses only A, B, and F levels instead of A, B, C, D, and F.
Minimum Reflectance (MR)	Checks that the brightness of the light elements is sufficient so that the exposure adjustment is not too extreme. Strictly speaking, the mean of the light elements must be at least 5% on an absolute calibrated scale of diffuse reflection. If this requirement is met, the grade will be A, otherwise it will be F.	▪ If the symbol has less than 5% contrast before the auto adjustment to the image ISO/IEC TR 29158 makes, it will fail. ▪ Increasing brightness of the light elements could be done by pre-conditioning the substrate. ▪ Try different lighting options. ▪ MR is not graded, and given a pass automatically, when using 90˚ light.

APPLICATION STANDARDS

Rules set by industries that define guidelines on what an acceptable/ideal barcode is for that specific application. Application Standards rely upon ISO 15415, ISO 15416, or ISO TR 29158 and add the appropriate parameters required in order to properly apply these standards to that particular industry.

Application Standards dictate:

- Aperture size
- Allowed x-dimension range
- Symbologies
- Minimum Passing Grade
- Condition of verification, such as lighting
- Data content and format rules


APPLICATION EXAMPLES

GS1 RETAIL POS AND DISTRIBUTION	UID	UDI	PHARMACEUTICAL
• Minimum passing grade usually "C" (1.5) • Data encoding using AI's • Select GS1 "Auto" or "Always"	• MIL-STD 130 • Can use ISO 15415 or 29158 or AS9132 • Minimum passing grade "B" on ISO 15415 (with some exceptions) and "C" on 29158	• Encode "PI" (production identification) and "DI" (device identification) data According to rules of "Issuing Agency" which are: • GS1 • HIBCC • ICCBBA	• US FDA Unit Dose Labeling Rule • GS1 or HIBCC criteria • Must encode NDC number in a linear barcode • GS1 DataBar or GS1-128 are typically used

PHARMACEUTICAL AND MEDICAL DEVICE MANUFACTURER VALIDATION PROGRAM

Cognex offers a thorough validation protocol for every verification model. A validation protocol exercises virtually all the functions of the barcode verifier and its settings and options (IQ, OQ, PQ). Hundreds of test barcodes, each designed to test specific operational characteristics of the verifier, are included with the protocol.

The Cognex validation protocol was designed for pharmaceutical and medical device manufacturers with FDA regulations and guidance to help ensure the highest quality standards are being met. This validation protocol is expected to be used in combination with the customer's own quality systems to assure themselves and FDA inspectors that their manufacturing practices meet quality and health standards.

A data matrix calibration conformance test card (such as DMV-DMCC) is required to complete the protocol.

HOW TO SELECT THE RIGHT VERIFIER

AUTOMATED INLINE OR OPERATOR OFFLINE

Barcode verifiers are available for both offline and inline operation. Most verifier models available today are offline, meaning they are handheld, or desktop models used outside of a production line. To keep pace with production, most producers will only verify a sample of codes in any batch. The sampling standard is determined by the producers' quality control statistical requirements and sometimes customer specifications. However, with random sampling barcode quality issues are often not caught in real time.

Offline verifiers have the benefit of being less expensive and do not require a labor-intensive setup process. Additionally, they are easy to use when working with an odd-sized part or marking on a difficult substrate because there are many different verifier models on the market made specifically for certain barcode sizes and marking processes.

Inline verifiers, or verifiers installed in a fixed position on a production line, have traditionally been too slow to handle most line speeds since the verification process takes much longer than simply reading a code. Until recently, inline verifiers have also been limited to verifying only 1D linear barcodes. Developing an inline verifier is no small task, but a few companies have developed products that can now verify codes, including 2D codes, at much faster speeds.

For an inline verifier to be compliant with ISO standards, the lighting must conform to the specific angle required. The verifier also needs to be calibrated. This can make setup more complex than an offline verifier depending on the verifier model, barcode procedure, and the intricacy of the production line.

Inline verification may cost more than offline verification, but it is valued because it can provide quality grades and reports for every single barcode produced. That means less liability and less potential problems with code quality and read rates. It also provides a notification as soon as code quality begins to drop, taking away the guesswork of things like when to change the ink or marking needles.

WHAT ARE THE LARGEST AND SMALLEST SIZE BARCODES PRINTED?

This will determine the field of view needed and the minimum X-dimension required. The term "field of view" is referring to the largest area that a verifier can read. It is commonly listed in millimeters and often abbreviated as FOV. The minimum X-dimension is determined by measuring the smallest sized bar or module used in the code. It is important to select a verifier with a high enough resolution that can capture sharp enough images and is specified to meet your required minimum X-dimension.

F.O.V. AND RESOLUTION BALANCE

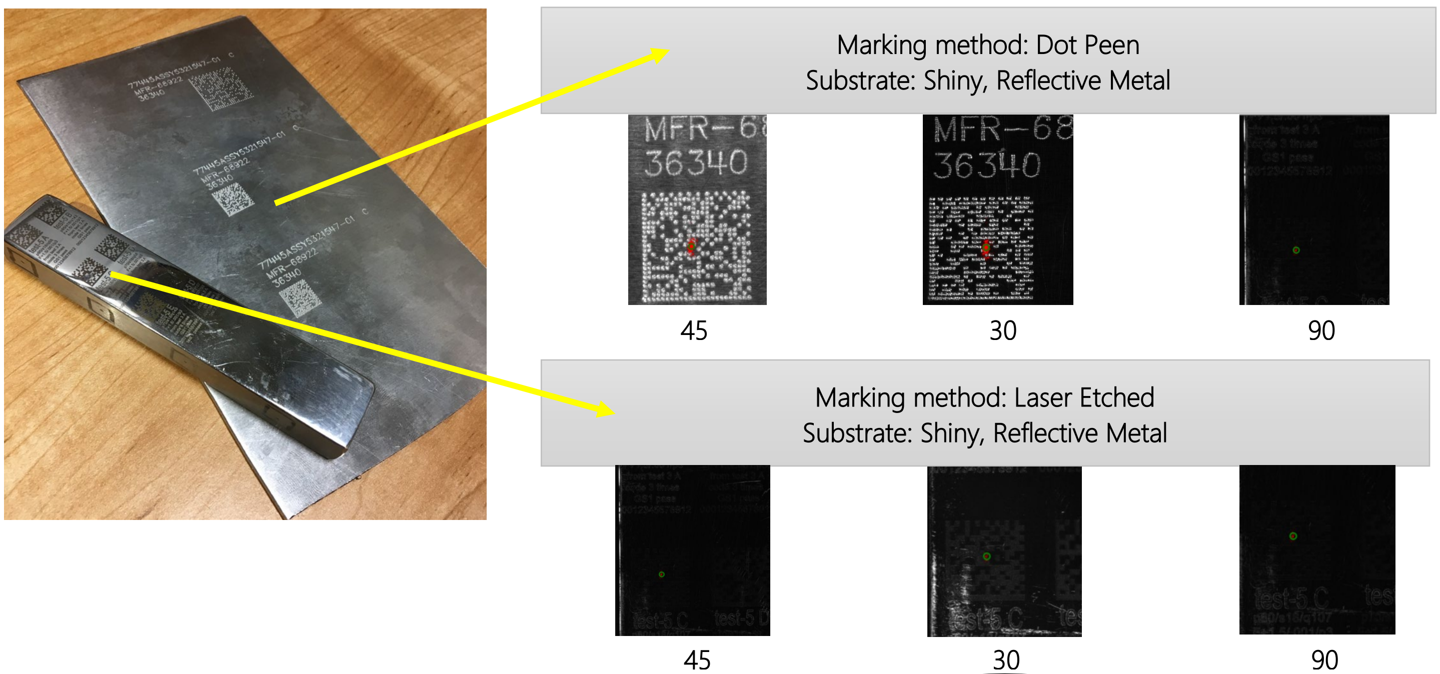
Most verifiers have several versions available (i.e., standard, wide angle and high resolution). The reason for this is to provide the right balance between field of view and resolution for most applications. There is a tradeoff between resolution and field of view. Verifiers with a smaller field of view usually offer higher resolution. Unless equipped with a camera with more pixels, a larger field of view cannot be achieved without limiting resolution.

WHAT MATERIAL ARE THE CODES PRINTED ON?

This determines what types of lighting options are needed to get the most accurate results.

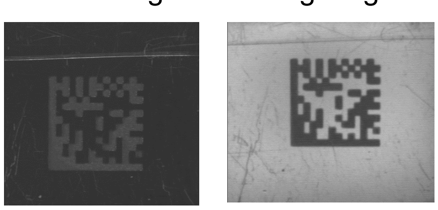
- If printing using red ink, a verifier with white LEDs is needed. This is not common and not standard practice in most industries.
- If printing directly onto the surface of the part, printing on a shiny surface, or printing on a curved surface, a verifier with 30° and 90° or dome lighting is usually needed. Most DPM verifiers feature some or all of these lighting options for this reason.

HOW TO SELECT THE RIGHT LIGHTING ANGLE



A 45-degree angle is the most common lighting angle, as it is the required angle for all flat label printed codes according to the ISO 15415 and 15416 standards. However, due to the variety of surfaces DPM barcodes can be printed on, 45-degree lighting alone cannot properly illuminate every code, which is why verifiers designed to grade DPM codes need several different lighting angle options. With DPM, the lighting angle that produces the most contrast is the best choice.

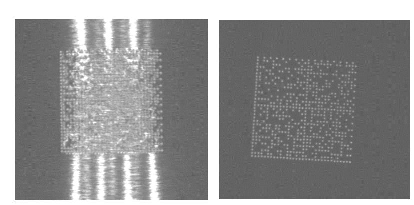
Additional lighting options of 30, 90-degree, and dome lighting make illuminating symbols on other surfaces possible. Here is an example of how the same barcode looks completely different when viewed using different lighting.



On the left, using 45-degree lighting, the background is dark because the shiny surface reflects the incoming light away and not up towards the camera. The marked area is not shiny and is scattering some light, some of which does go up into the camera. On the right, the 90-degree light, which is coming straight down, is reflected up into the camera; therefore, the shiny background appears light. However, the marked area of the code is not very reflective and therefore looks dark. This example demonstrates why different lighting angle options are needed in order to form a high contrast image dependent upon the characteristics of a particular part.

When working with codes that are directly printed onto a curved surface, the addition of 30-degree lighting makes a big difference. The DPM verifier series offers 30Q, 30T, 30S, and 90 in addition to 45-degree lighting options. 30Q refers to all four sides illuminated by lights at a 30-degree angle. 30T is lighting from two sides and has two options: it can be light from the top and bottom or light from the left and right. 30S is light from a single side, and as you can imagine, there are four different lighting options.

Two-sided light, or 30T, is ideal for certain curved (cylindrical) and/or textured surfaces. Below is an example. The image on the left shows light shone from the left and the right. On the left, we see the effect of a brushed surface, which reflects some of the light from the



left and right lights from “tangential” points on the brush strokes. The image on the right shows light from the top and the bottom. To get the best image, the lighting should be oriented parallel to the brush stroke. When it is parallel, the light reflects away, as it does on a shiny flat surface. A Dome verifier illuminates from all angles at the same time and is most ideal for many highly curved parts.

DM8072V

30, 45 and 90-degree lighting options built in
This is the smallest verifier on the market to offer most of the lighting options called out in the ISO 29158 standard. Having many lighting options gives the best chance of illuminating codes on the most challenging surfaces, even some curved and highly reflective surfaces.

Standard: 27x20mm FOV and 6.0 mil min x-dimension
HD: 17x13mm FOV and 3.5 mil min x-dimension
Compared to the existing DataMan 8600V, the 8072V has a larger field-of-view and a smaller minimum x-dimension capability. It allows even more versatility, since the 8072V can verify larger and smaller codes than the 8600V.

Webscan TruCheck verification algorithms integrated into the DataMan Setup Tool
DataMan high-speed locate and decode capabilities combined with the robust grading algorithms make verification faster and more accurate. The software screens provide detailed results presented in a way that is easy to decipher.

Compliant with ISO/IEC 15415, 15426-2, TR-29158 (AIM DPM), GS1, HIBCC, UDI, and UID (MIL-STD-130)
Meets ISO standards for 2D barcodes and DPM barcodes. The software can also be set to grade against application standards like GS1 or MIL-STD-130.

FOV: 27mm x 20mm

Minimum X-dim: 6.0mil

Illumination Options: 30, 45, and 90-degree lighting

Symbologies: Data Matrix, QR Code

Grading Standards: AIM DPM and ISO-15415

Application Standards:

- **GS1**
- **MIL STD 130**
- **UDI/HIBCC**

Communication Options:

- **USB 2.0**
- **Ethernet**

Optional stand accessory makes grading odd-shaped parts even easier.

DM475V

Compliant verification results for every code
No more sample checking

Advanced code diagnostics
Clear visuals for every code – powered by Cognex TruCheck software – highlight problematic cells so you can resolve issues more quickly

Easily access the verification data
Export results to PLC, Database, or FTP Server, as CSV, HTML PDF, or Custom format

FOV: 80mm x 60mm

Minimum X-dim: 6.0mil

Working Distance: 60mm +/- 3mm

Illumination: 45-degree 660NM 4-sided lighting

Symbologies: 1D: UPC/EAN, Code 128, ITF-14, PDF 417, I25, Code 39, Code 93, Codabar
2D: Data Matrix (ECC 200), QR Code, Micro QR Code

Grading Standards: ISO-15416, ISO-15415, ISO TR 29158

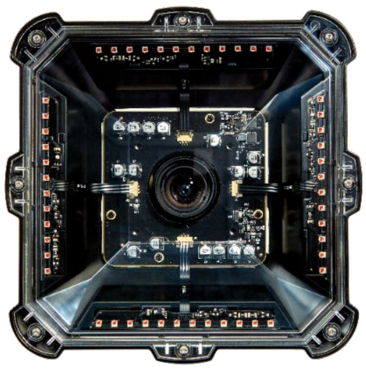
Application Standards: GS1, MIL-STD 130 UID, UDI, HIBCC, ISO 15434, Russian Crypto-Code, Custom Application

20 1D codes per second

10 2D codes per second

3.6 ft per second

1.1 m per second



The DataMan 475V four-quadrant, 45-degree lighting attachment is compliant with the International Organization for Standardization (ISO) requirements for grading 1D and 2D label-based barcodes. The included calibration card and robust grading algorithms ensure that the DataMan 475V conforms to ISO and application standards while providing accurate and repeatable results.

STANDARDS-BASED GRADING

There are many ISO standards pertaining to barcodes. Some dictate how a barcode should be created and how data should be encoded and decoded, such as ISO 16022 (Data Matrix) and 18004 (QR Code) for example. Three ISO standards describe how to grade a barcode's quality (ISO 15415, 15416, and TR 29158). There are even ISO standards that spell out the requirements of a barcode verifier ISO 15426-1 and ISO 15426-2. The standardization makes verification results from verifier to verifier more consistent. However, it can also put limitations on the type and placement of barcodes that can be verified. Standards-Based Grading is a way to get the reliability of ISO-compliant verification without the limitations.

Standards-Based Grading, or SBG, is a feature key add-on that can be activated for qualifying DataMan fixed-mount readers. SBG uses the same verification algorithms and software user interface as the rest of our verifier product line, with one key difference: lighting. Both ISO 15426-1 and ISO 15426-2, the standards that define verification manufacturing, have lighting angle requirements that also define an allowable working distance and presentation angle. By removing the lighting attachment component, users can create a custom lighting set up, often with off the shelf lights, that works for their specific application needs. Another benefit is that a liquid lens can be used, expanding the field of view and depth of focus capabilities and in addition to adding personalized lighting for your application.

WITH SBG, YOU CAN ACCESS THE SAME ROBUST SOFTWARE ALGORITHMS AND USER INTERFACE AS VERIFICATION BUT WITHOUT THE LIGHTING AND FIXED FOCAL DISTANCE RESTRICTIONS.

Removing the lighting attachment does take away the ability to claim ISO compliant verification and is shown by a slight alteration in the grade report format. To avoid confusion, parameters that are not conforming, such as lighting and aperture, are not reported. Setting up the lighting as closely as practically possible to a standard verifier setup, will increase correlation between compliant verification results and SBG results.

A key component to stable verification results is ensuring that the unit is calibrated, and the software is using the appropriate standard reference decode algorithms for the symbology type. This is a crucial way that verification differs from basic code quality software. However, since Standards-Based Grading is essentially the same dependable verification software Cognex is known for, these two vital features are included, making the results correlate closely to true verification. Additionally, users will also have access to the same detailed diagnostic information and reporting features.

COGNEX	Reader	PCM	SBG	Verification
Reads Codes	Y	Y	Y	Y
Validates Data	Y	Y	Y	Y
Code Quality Feedback		Y	Y	Y
ISO Parameter Grades		Some	Y	Y
Calibrated			Y	Y
Advanced Code Diagnostics			Y	Y
Uses ISO Standard Decode Algorithm			Y	Y
Fixed Angle Lighting				Y
Fully ISO Compliant				Y

- **NEXT BEST THING TO TRUE VERIFICATION**
- **SACRIFICES FIXED-ANGLE LIGHTING REQUIRED TO BE CONSIDERED ISO COMPLIANT**
- **GAINS MOUNTING FLEXIBILITY**
- **RETAINS DIAGNOSTICS, REPEATABILITY, AND RELIABLE CODE QUALITY GRADING**

WEBSCAN LEGACY VERIFIER PRODUCT OVERVIEW

TRUCHECK OPTIMA™

- Verifies 1D and 2D symbols with a large field of view in a hand-held unit

Versions	Product ID	Lighting	Field of View	Min X Dim
+Plus	DMV-TC829-OPP-01	45°	74mm x 55mm	8.0 mil

TRUCHECK ROVER™

- Portable, battery powered
- Verifies 1D and 2D symbols without being connected to a PC
- Reports are stored and can be printed or exported using USB connectivity

Versions	Product ID	Lighting	Field of View	Min X-Dim
Standard	DMV-TC501-R-01	45°	51mm x 38mm	8.0 mil
Wide Angle	DMV-TC504-RWA-01	45°	76mm x 57mm	8.0 mil

TRUCHECK OMNI™

- Handles both 1D and 2D verification with an extra-large field of view, up to 150mm wide
- Verify multiple codes on a label at once and produce a summary report for a whole label

Versions	Product ID	Lighting	Field of View	Min X Dim
XD	DMV-TC840-OXD-01	45°	80mm x 60mm	6.0 mil
XL	DMV-TC836-OXL-01	45°	150mm x 112mm	14.0 mil
Wide Angle	DMV-TC833-OWA-01	45°	150mm x 115mm	7.0 mil

TRUCHECK 2D USB UV™

- Verifies 2D symbols printed in invisible ink

Versions	Product ID	Lighting	Field of View	Min X Dim
(435nm)	DMV-TC826-2DUV-01	45°	17mm x 12.5mm	5.0 mil
(500nm)	DMV-TC819-UV-01	45°	17mm x 12.5mm	5.0 mil

TRUCHECK FLEXHITE DPM™

- Adjustable height for parts up to 6 inches tall with laser focus indicator

Versions	Product ID	Lighting	Field of View	Min X Dim
Standard	DMV-TC850-FDPM-01	30°/45°/90°	34mm x 25.5mm	6.0 mil
High Resolution	DMV-TC853-FDPHR-01	30°/45°/90°	20mm x 15mm	3.75 mil
Dome	DMV-TC863-FD-01	Dome/90°	25mm x 18mm	6.0 mil
Dome HD	DMV-TC861-FDHD-01	Dome/90°	19mm x 14mm	3.75 mil

TRUCHECK DPM TOWER™

- The adjustable height of this system makes it perfect for verifying barcodes on physical items, when they are recessed, or otherwise hard to reach (12-inch max vertical adjustment)
- Focus adjustment is guided by our proprietary laser indicator

Versions	Product ID	Lighting	Field of View	Min X Dim
Standard	DMV-TC825-2DDPT-01	30°/45°/90°	60mm x 45mm	7.5 mil

CALIBRATION CARD FAQ

What do calibration cards do? Calibration is the process of mapping a cameras measurement to actual reflectance levels. To be ISO compliant, a verifier must have a calibration process.

How often do you need to calibrate? Every company has their own policy on how often to calibrate, we recommend every 30 days.

How often do you need to purchase a new calibration card? Calibration cards expire after 2 years from the in-use date. Cards should be safely stored away from dust and direct sunlight when not in use.

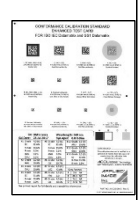
What does conformance calibration card mean? The card contains “Conformance Test Symbols” with intentional imperfections. When you verify these symbols, you can check the reporting capabilities of the verifier and confirm that the verifier conforms to industry standards such as ISO/IEC 15415, ISO/IEC 15426-2. Since these cards can be used as a quick way to double check that the verifier is working properly, some companies have written requirements to use them in their quality processes. Certain industries also require the use of a card with conformance test symbols, those industries list the requirement in their application standards.

Does it matter what kind of symbology is used when calibrating? Calibration is not specific to the symbology and once the verifier is calibrated using either type of calibration target, the verifier is calibrated for both 1D and 2D barcodes.

Can we do Conformance test when grading against ISO/IEC TR 29158? There are no DPM-specific calibration cards to challenge the ISO TR 29158 standard. A data matrix conformance test card can be used, but the contrast values will never perfectly match the value on the card because of the image adjustment used in the ISO TR 29158 standard. It is recommended that the verifier also be tested using the ISO 15415 standard. Testing with the ISO TR 29158 grading standard can be done to check for correct operation, but will yield results that are different than those shown on the conformance card.

Where can we check calibration results? Check to see that the verifier is returning the correct Rmin/Rmax values (sometimes labeled RL and RD) by verifying the test symbol as you would normally verify a code. The values are found next to the Symbol Contrast grade in the Quality Detail section of the report and on the user interface. These values should match those shown on the card with allowance for a small amount of tolerance.

Other parameter values can likewise be checked and compared to the expected values on the conformance test card.

Product ID	Description	List Price
DMV-AICC	Applied Image #AI-CCS-UPC/EAN 6 mil UPC/EAN Calibrated Conformance Standard Test Card. (This is most similar to discontinued item #1556 (GS1 EAN/UPC Calibration Card)). 	**$439.00**
DMV-DMCC	Applied Image Data Matrix Calibration and Conformance Symbol 	**$600.00**
DMV-CCC	Cognex Calibration Card contains Master Grade 1D and 2D symbols. For calibration only, does not contain any ISO/IEC 15426 conformance test symbol. 	**$149.00**

VERIFICATION TERMS TO KNOW

Validation: Confirms that the format of the barcode data is correct in accordance to application requirements so that a computer system that receives the barcode data can correctly interpret the meaning of that data.

Verification: Refers to the print quality and readability of the barcode by a test instrument.

X-Dimension: Size of the narrowest bar in any barcode; normally referenced in mils.

Field of View: The overall image size a particular camera supports.

Mil: One thousandth of an inch. (.001” not a mm which is 39.6 mils.)

Element: An individual bar or space within a linear barcode.

Characters: The encoded data in a barcode.

Quiet Zone: This refers to specified uncluttered space on the left and right of a linear barcode or the area on all four sides of a 2D barcode. Individual barcode specifications define the amount of quiet zone.

Aperture: Refers to the size of the area of reflectance tested in the bars and spaces to determine the transition between bars or modules and spaces when verifying a barcode. Aperture size can be dictated by the application specification, quality specification, or a combination thereof. When there is a lack of a specification, the general rule is that codes with x-dimensions between 4 mil and 7 mil should be verified with a 3 mil test aperture. Codes 8 mil to 13 mil use a 6 mil test aperture, and codes 14 mil to 25 mil use a 10 mil test aperture. Codes larger than 25 mil use a 20 mil test aperture.

Bar Width Growth: The amount a bar or element size deviates from the ideal size.

Cell Contrast: The term used to refer to the measurement of separation between light and dark elements in a 2D symbol when verified in accordance with the AIM DPM methodology.

Symbol Contrast: Measurement of the contrast between the brightest space and the darkest bar. The result is assigned a letter grade of A, B, C, D, or F, with A being the highest contrast.

Decodability: The 1D barcode quality formula used for Decode is further analyzed to see how accurate the bar and space widths are. A perfectly accurate barcode will have 100 percent decodability, but decodability as low as 25 percent is often acceptable. This measure helps track degradation in printing plates and gives early warning while there is still plenty of room for more degradation.

Error Correction: An encoding method that adds extra data that is mathematically computed to enable missing or incorrect data to be recalculated later if necessary.

30Q: 30-degree lighting on all four sides.

30T: 30-degree lighting from two sides; either from top and bottom or from left and right.

30S: 30-degree lighting from a single side.

DPM: Stands for direct part marking: barcodes that are permanently placed on an object.

Global Threshold: The gray scale value that divides between light and dark.

SUPPORT

FOR TECHNICAL QUESTIONS, HARDWARE OR SOFTWARE ISSUES, OR SOFTWARE UPDATES, CONTACT:

Technical Support
ts.global@cognex.com

For additional information including software settings and features, please refer to the Reference Manual found in the Setup Tool.