

UNDERSTANDING VERIFICATION RESULTS

A deeper look at what the software is telling you.

2019

WHY AM I GETTING A NO DECODE WHEN THE CODE CAN BE READ USING ONE OF OUR READERS?



ADDITIONAL REASONS FOR A NO DECODE

- 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 camera in focus?
- Is the code in the center of the FOV?
- Is the code close to perpendicular?
- Do the cell sizes look proportionate to one another?
- Are the edges of the cells crisp?
- Are all the components the finder pattern present?



WHY WOULD MY GRADE FLUCTUATE FROM ONE LETTER TO ANOTHER?

ISO/IEC 15415 GRADING PARAMETERS

1. **UEC (Unused Error Correction):** This is the percentage of error correction capability that is available for further incorrect modules. The assignment of grade is according to the following table:

UEC %	Grade
> 62	A
> 50 (but less than 62)	B
> 37 (but less than 50)	C
> 25 (but less than 37)	D
< 25	F

2. **SC (Symbol Contrast):** This is the difference in reflectivity between the brightest module and the darkest module. The assignment of grade is according to the following table:

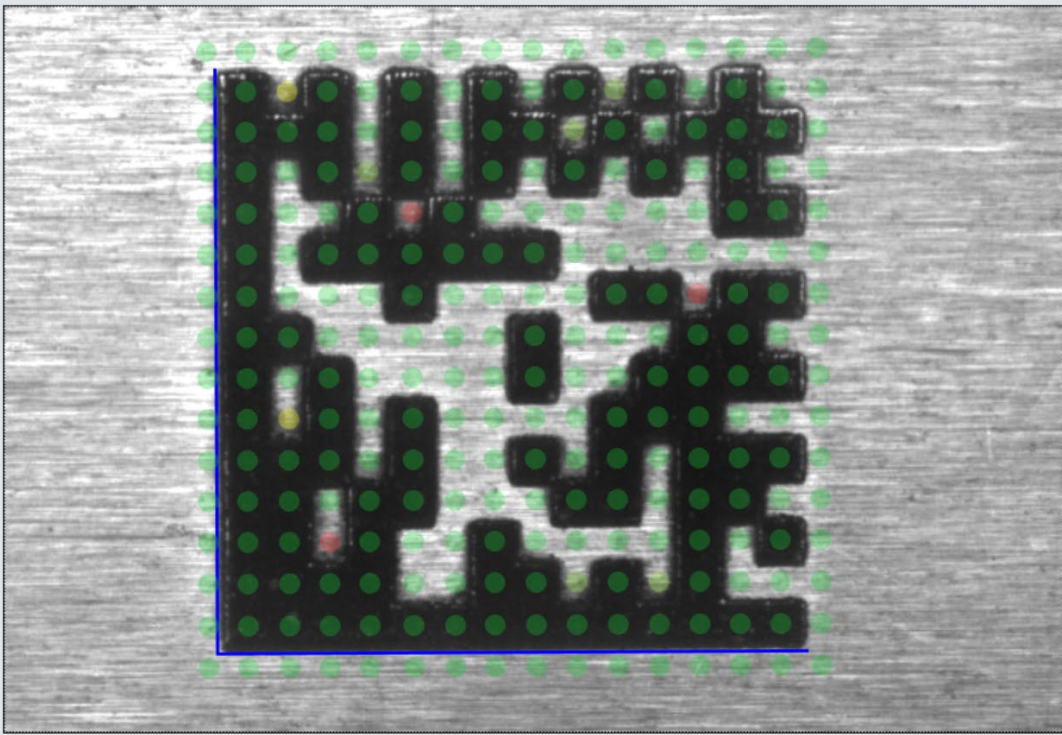
SC %	Grade
> 70	A
> 55 (but less than 70)	B
> 40 (but less than 55)	C
> 20 (but less than 40)	D
< 20	F

WHY AM I GETTING AN F?

TruCheck Verification - DM8072-5CC770

45 30 30 30 30 90

Main | General Characteristic | Data Detail | Quality Detail | Advanced Detail | Histogram | Report



Overall ISO29158 Grade
F (0.0)
DPM 0.0/11/660/90

Symbology
DataMatrix

Grade Parameters

Unused Error Correction (UEC)	40% C
Cell Contrast (CC)	80% A
Cell Modulation (CMOD)	C
Reflectance Margin (RM)	F
Axial Nonuniformity (ANU)	0.5% A
Grid Nonuniformity (GNU)	7.6% A
Fixed Pattern Damage (FPD)	3.0 B
Left 'L' Side (LLS)	A
Bottom 'L' Side (BLS)	A
Left Quiet Zone (LQZ)	A
Bottom Quiet Zone (BQZ)	A
Top Quiet Zone (TQZ)	A
Right Quiet Zone (RQZ)	A
Top Transition Ratio (TTR)	0% A
Right Transition Ratio (RTR)	0% A
Top Clock Track (TCT)	B
Right Clock Track (RCT)	A
Distributed Damage Grade (DDG)	4.0 A
DECODE	A
Minimum Reflectance (MR)	100% A

Generic Acceptance Criteria
Fail (Quality)







Data
TELESIS1

Go Live

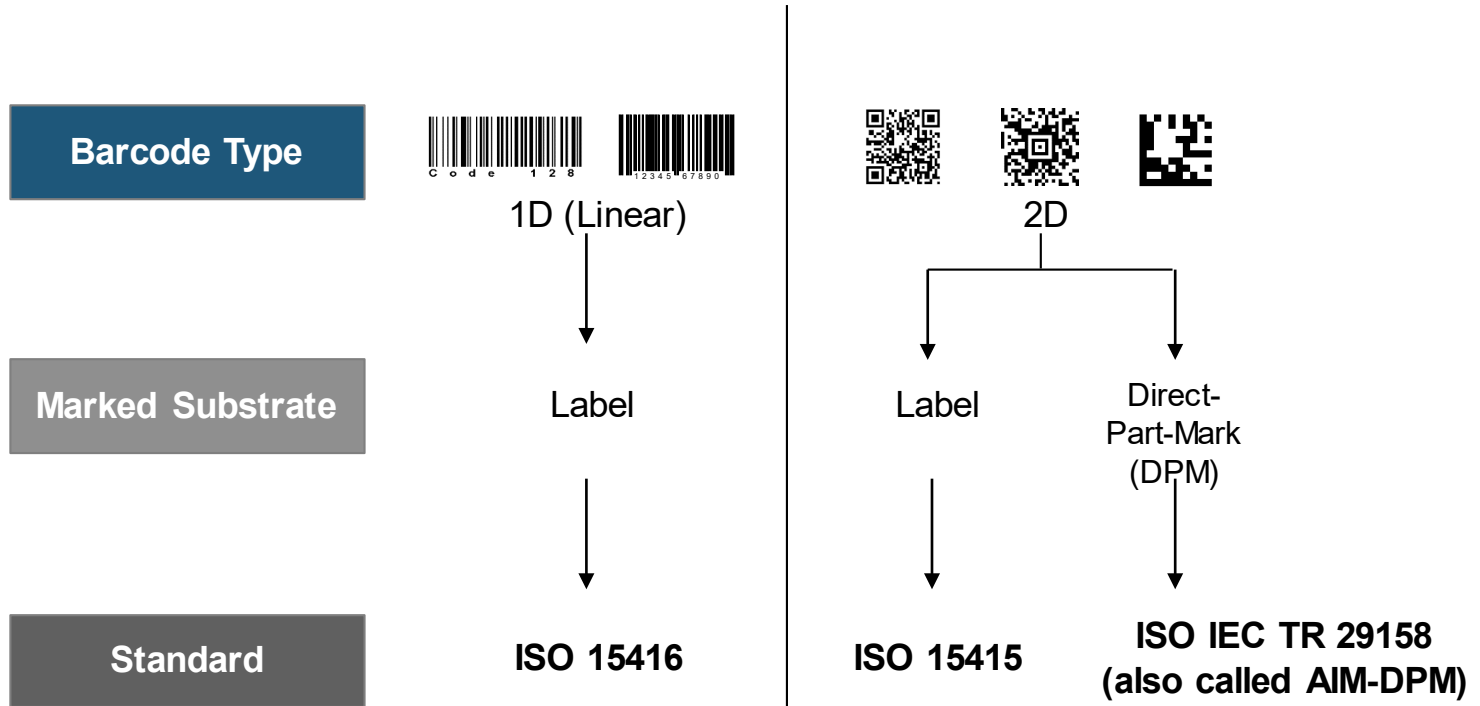
ISO STANDARD OVERVIEW

BARCODE ISO STANDARDS

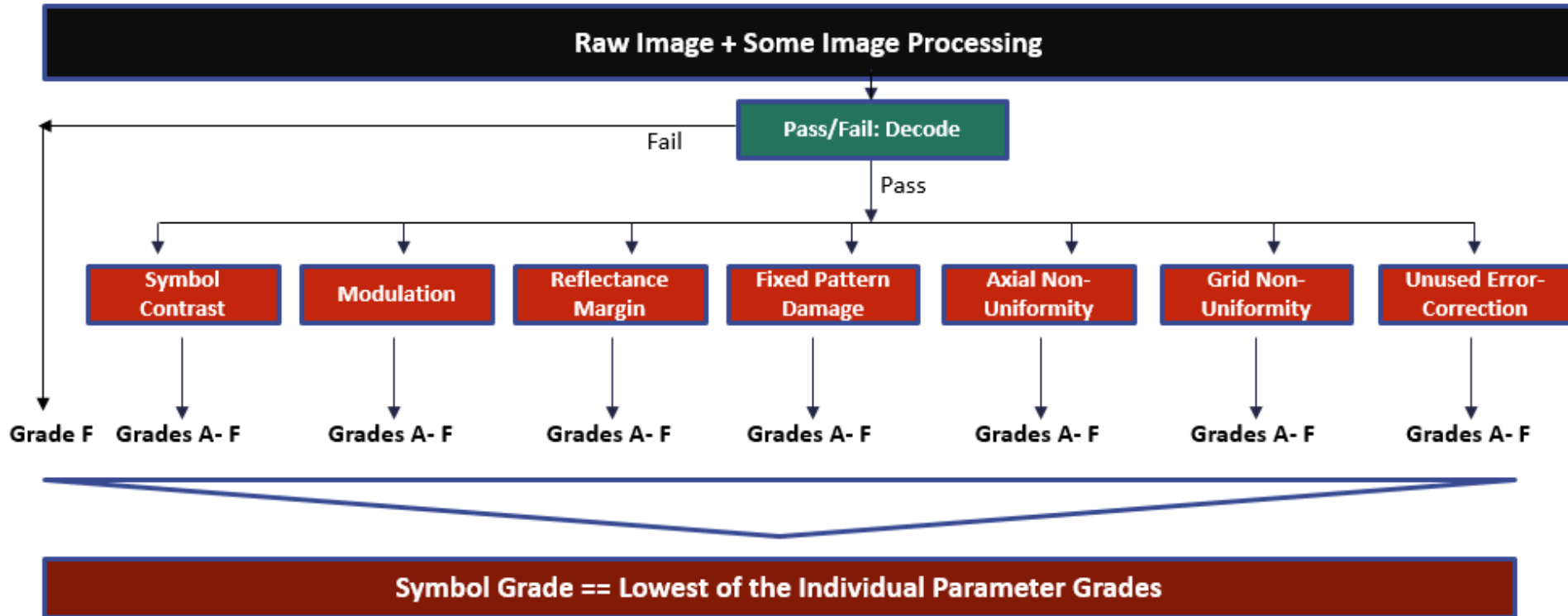
These standards spell out the guidelines for creating, decoding, error correction, encodation, etc.

	BARCODE TYPE	ISO STANDARD
	DATA MATRIX	ISO/IEC 16022
	QR CODES	ISO/IEC 18004
	AZTEC	ISO/IEC 24778
 7 53182 43612 8	UPC/EAN	ISO/IEC 15420
 C o d e 1 2 8	CODE 128	ISO/IEC 15417
 C O D E 3 9	CODE 39	ISO/IEC 16388
	PDF 417	ISO/IEC 15438

BARCODE QUALITY GRADING ISO STANDARDS



ISO/IEC 15415 (2D printed on flat labels)



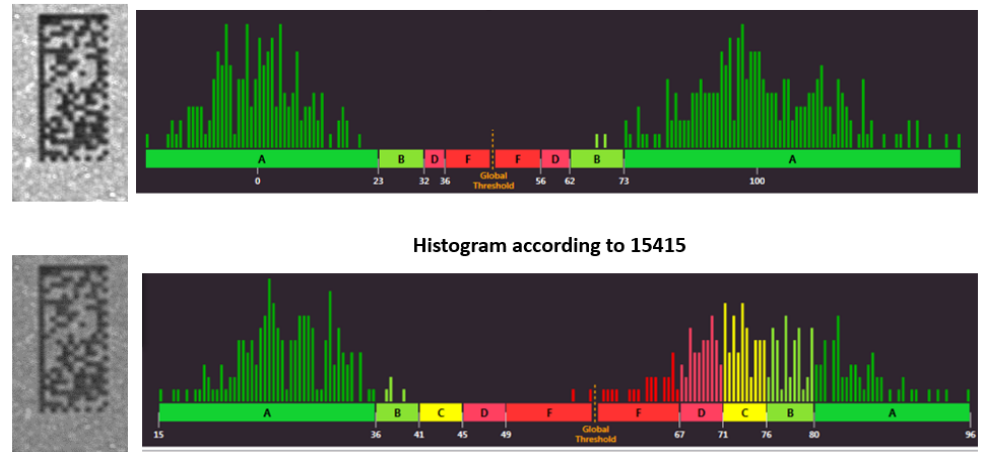
*Other Data Matrix code related parameters – Clock Track Regularity, L1 and L2, Quiet Zones

*Other QR code related parameters – Upper left pattern, Upper right pattern, Lower left pattern, Lower right pattern, Horizontal and vertical clock track, Version information, Format information block

29158 vs 15415?

- **Global threshold calculation:** Calculated differently so image appears brighter.
- **Modulation grading levels:** Modulation is calculated differently to accommodate for the variety of different surfaces codes are printed on.

Contrast Calculation Differences – 15415 and AIM-DPM



- **Allowed lighting angles:** 30-degree, 45-degree, 90-degree and dome
 - 15415 (Labels) allow only 45-degree light.

APPLICATION STANDARDS

– Industry guidelines to be used along with ISO standards

Tip – a useful way to think about Application Standards: specification of type of barcode to use (DataMatrix etc.) and format of the data, and how to implement the ISO grading standard.

	Defense	Medical Devices	Retail/ Pharma
Application Standard	<ul style="list-style-type: none">• UID	<ul style="list-style-type: none">• UDI (Unique Device Identification)	<ul style="list-style-type: none">• GS1
Symbology	<ul style="list-style-type: none">• DataMatrix	<ul style="list-style-type: none">• Linear or DataMatrix issued by GS1 or HIBCC	<ul style="list-style-type: none">• Linear or DataMatrix issued by GS1
Format of Data	<ul style="list-style-type: none">• MIL-STD-130	<ul style="list-style-type: none">• Device Identifier (DI) and a Production Identifier (PI)	<ul style="list-style-type: none">• GS1 Application Format
Cheat Sheet	<ul style="list-style-type: none">• Starts with []>• Uses <GS> as a group separator• Ends with <EO>	<ul style="list-style-type: none">• DI starts with (01)• PIs relate to batch information and usually contain (10) or (17)	<ul style="list-style-type: none">• Starts with GS1 header <F1>• Contains Application Identifiers for GTIN, Lot, Batch, expiry etc.• Contains a Check Digit

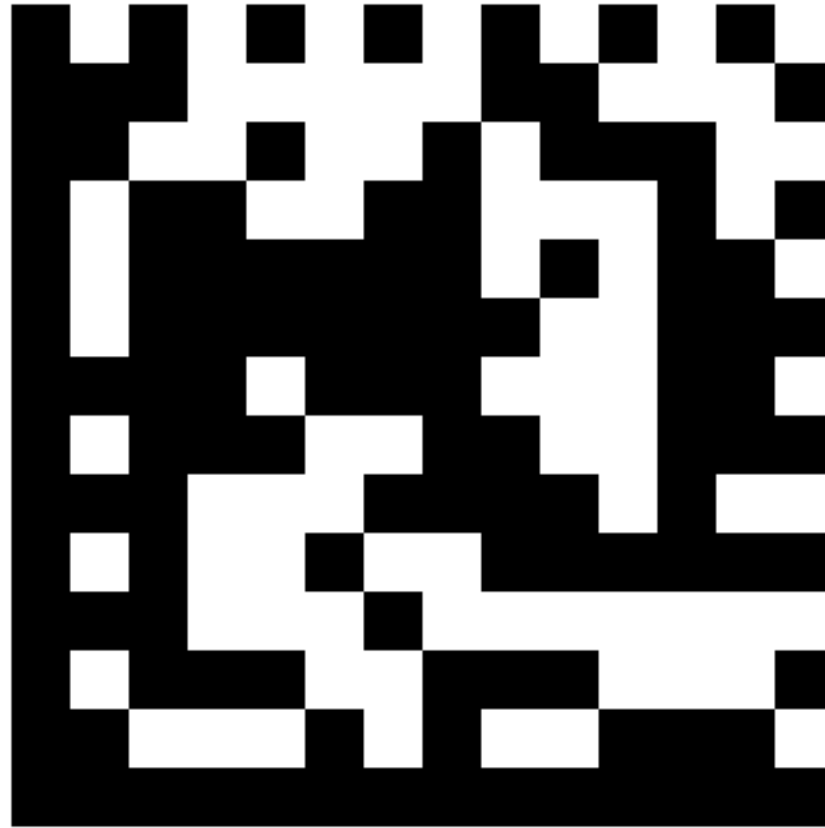
HOW IS A DATA MATRIX DECODED?

REFERENCE DECODE ALGORITHM PROCESS

1. Blur image
2. Calculate Global Threshold
3. Convert to binary black and white image
4. Trace lines to find L pattern
5. Search for clock tracks
6. Calculate grid spacing
7. Sample at grid intersections for average reflectivity within each aperture
8. Apply Reed-Solomon error correction



ORIGINAL IMAGE



BLURRED IMAGE



BINARY (B&W) IMAGE

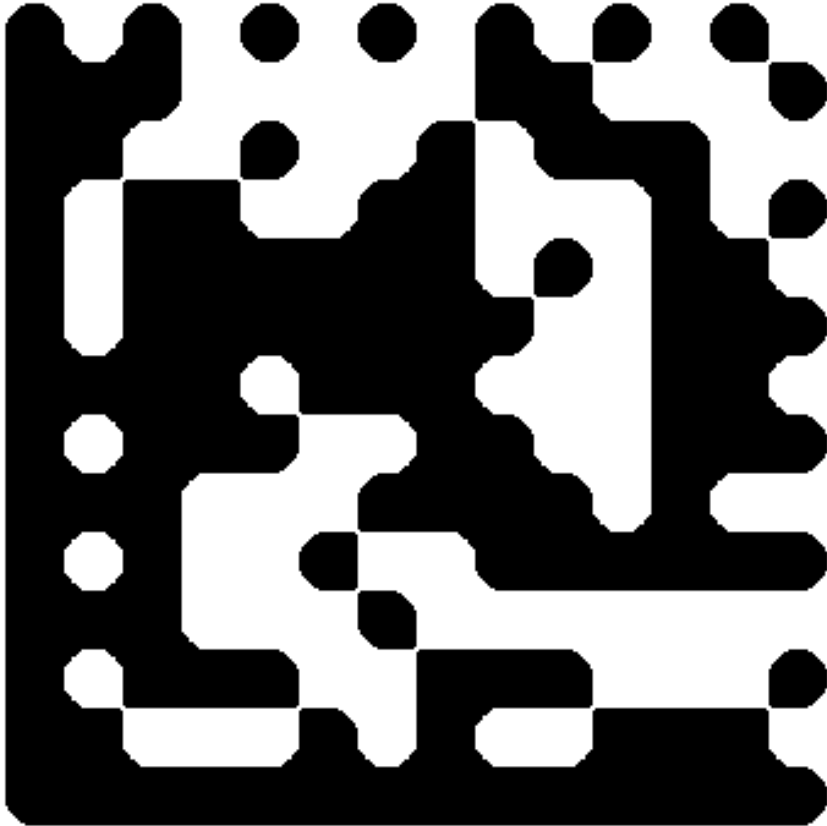
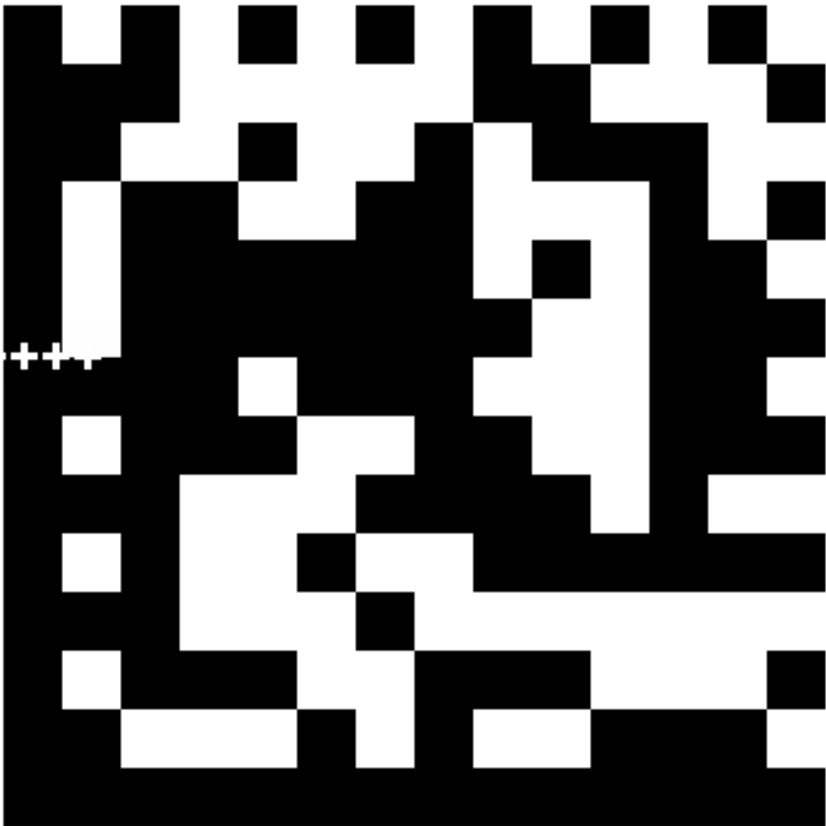


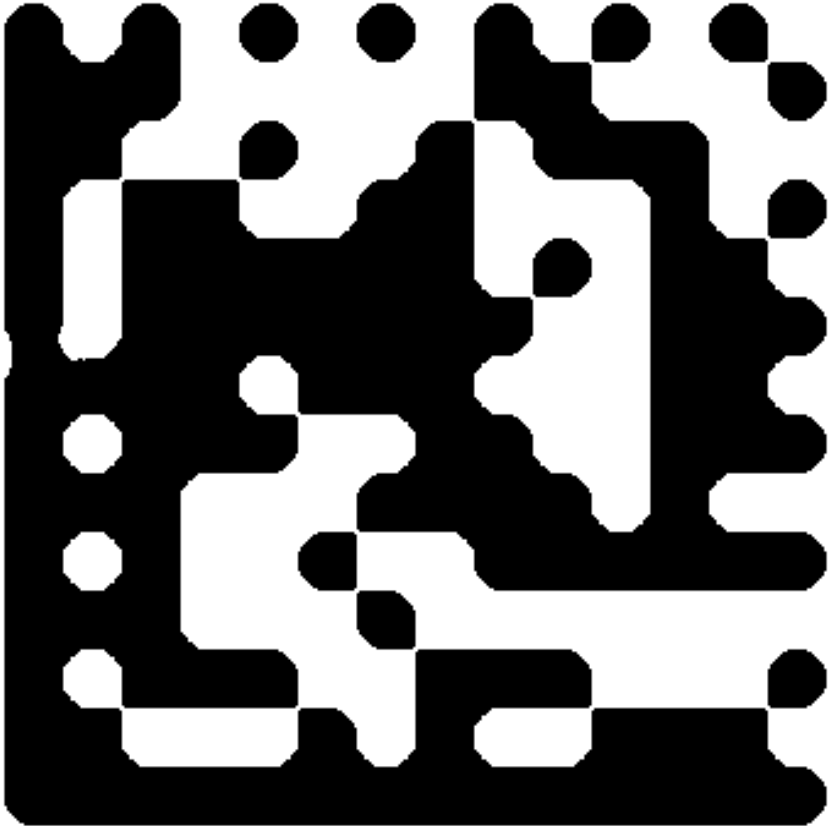
IMAGE WITH DEFECTS



BLURRED IMAGE

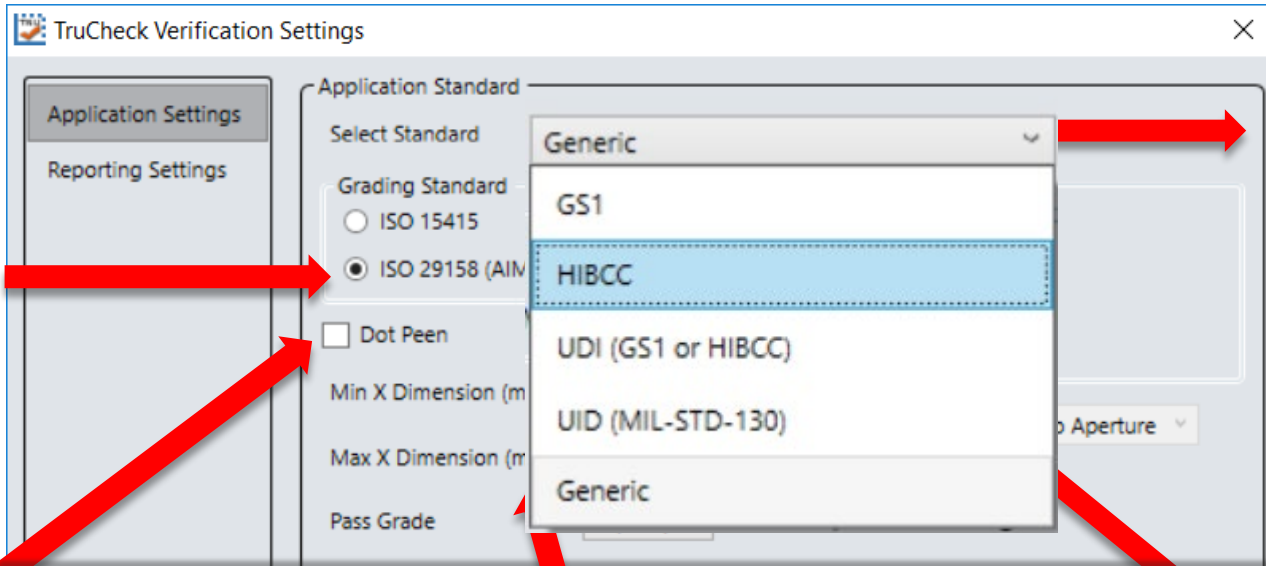


BINARY (B&W) IMAGE



VERIFIER SET UP FOR YOUR APPLICATION

SETTING SELECTIONS



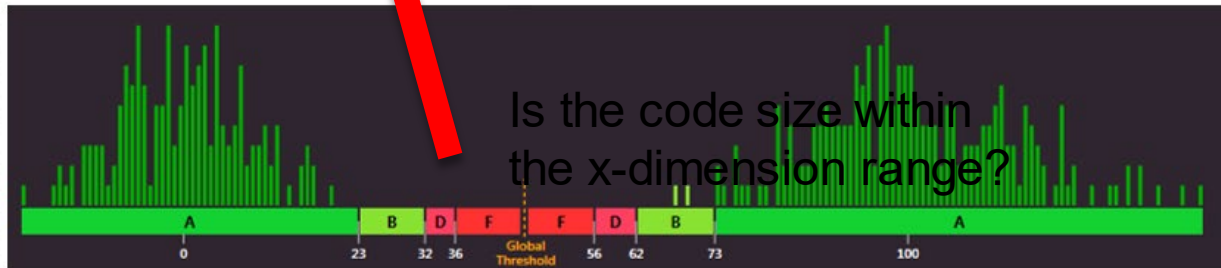
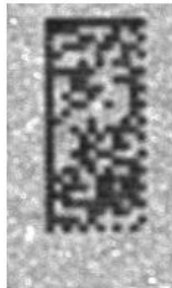
Is the correct application standard selected?

Is the correct ISO standard selected?

Is Dot Peen selected?

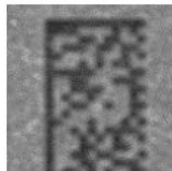
Contrast Calculation Differences – 15415 and AIM-DPM

Histogram according to AIM DPM



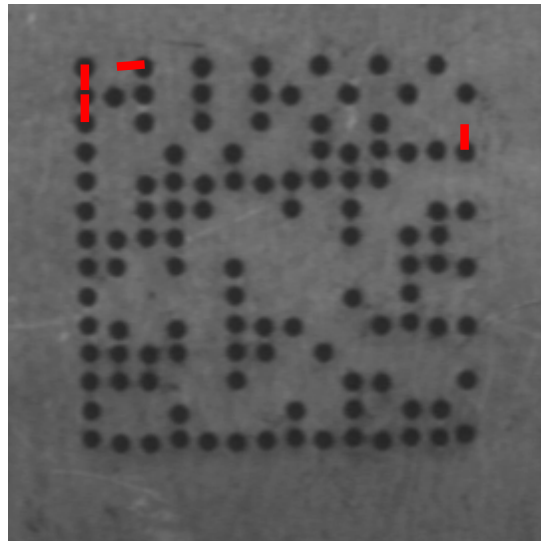
Is the correct...
...re...
...ed?

Histogram according to 15415

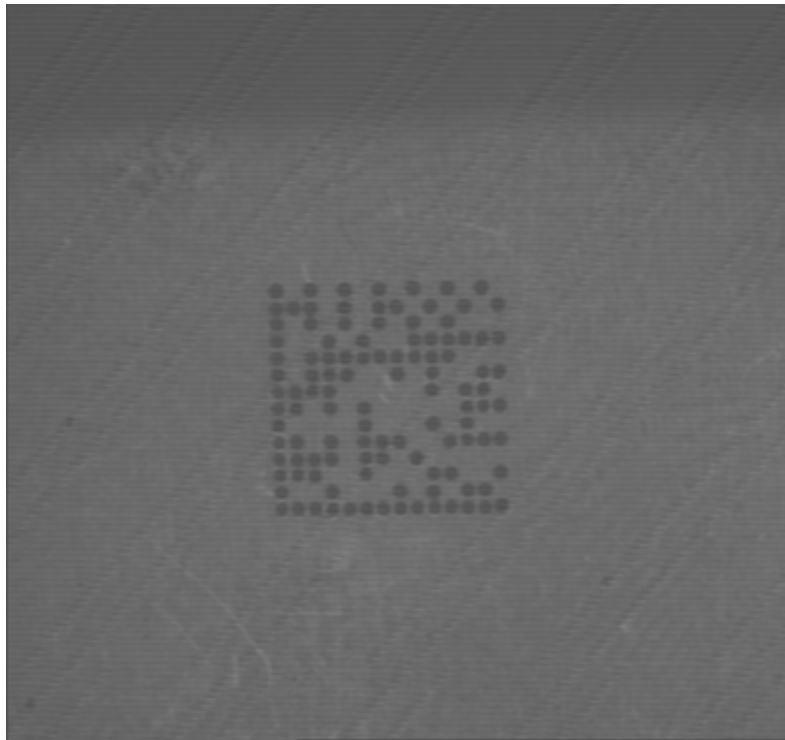


“STICK ALGORITHM”

- Dot Peen symbols do not contain continuous edges
- Consequently the decode algorithm for Data Matrix fails on dot peen symbols
- Rather than change the symbology specification, change the image by “connecting the dots”
- Fill in the “stick” whenever both ends are on color

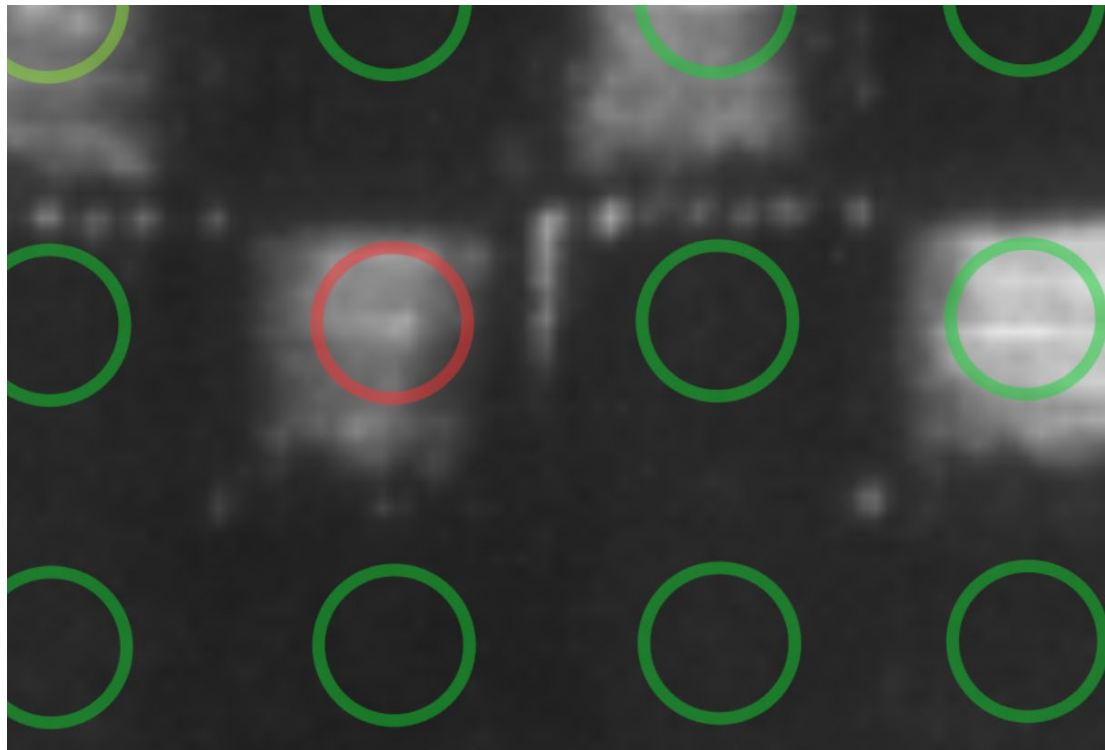


ALGORITHM TO CONNECT DOTS

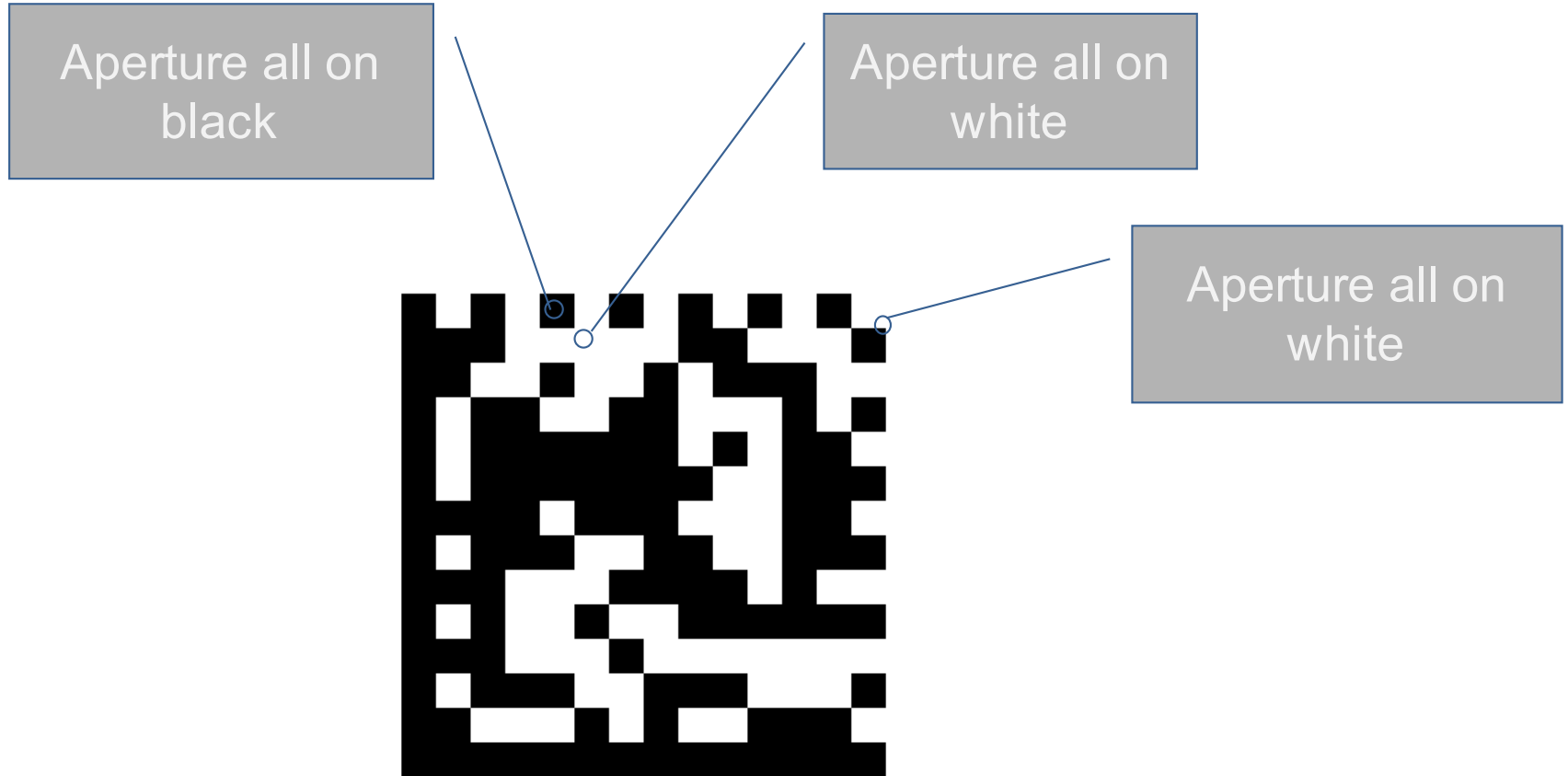


APERTURE

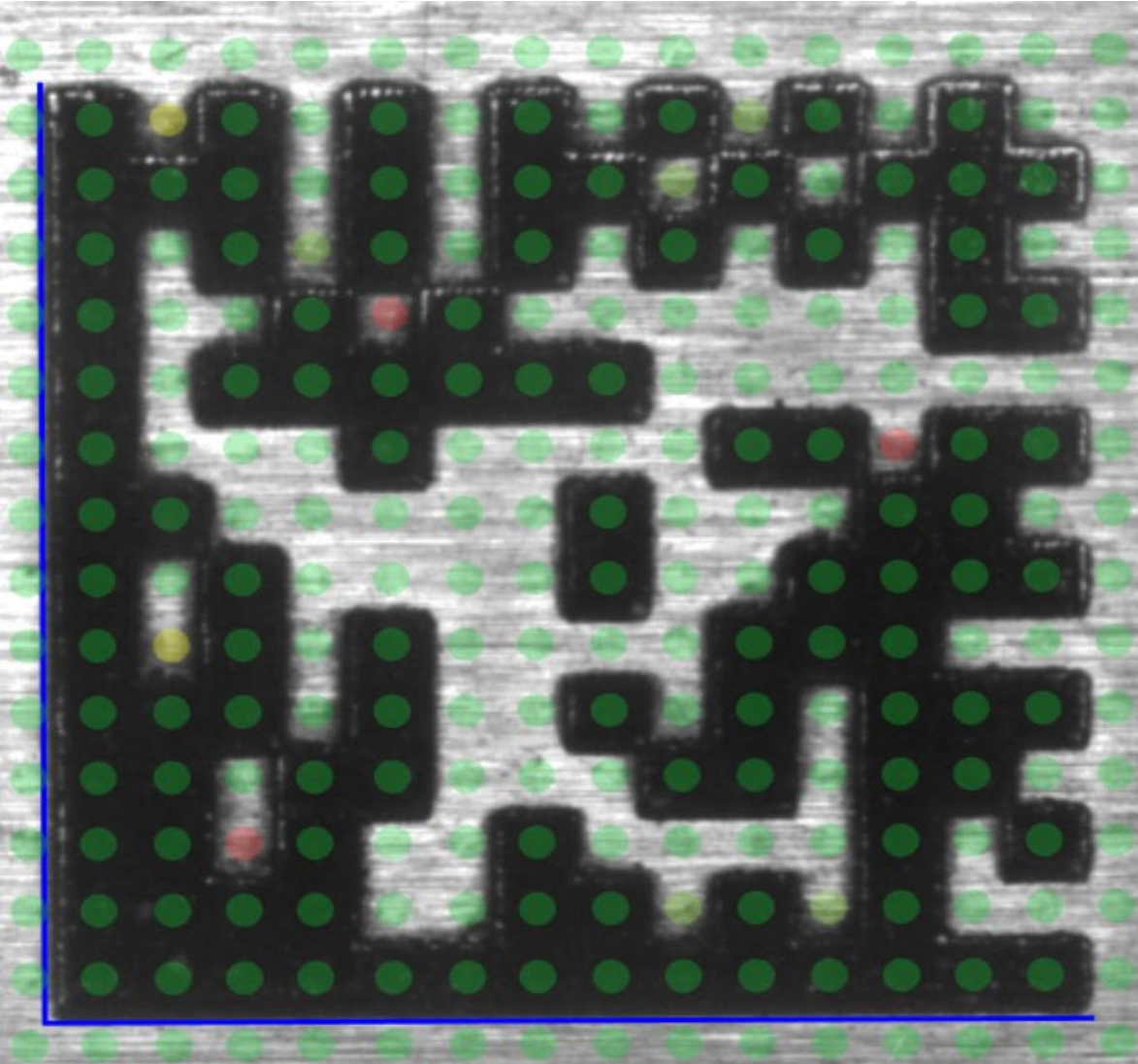
- A circular group of pixels is averaged together
- A blur is applied to “smooth” the image
- The blur also removes “texture”, dirt, printing imperfections
- The blur also limits resolution



APERTURE EFFECT



APERTURE SIZE



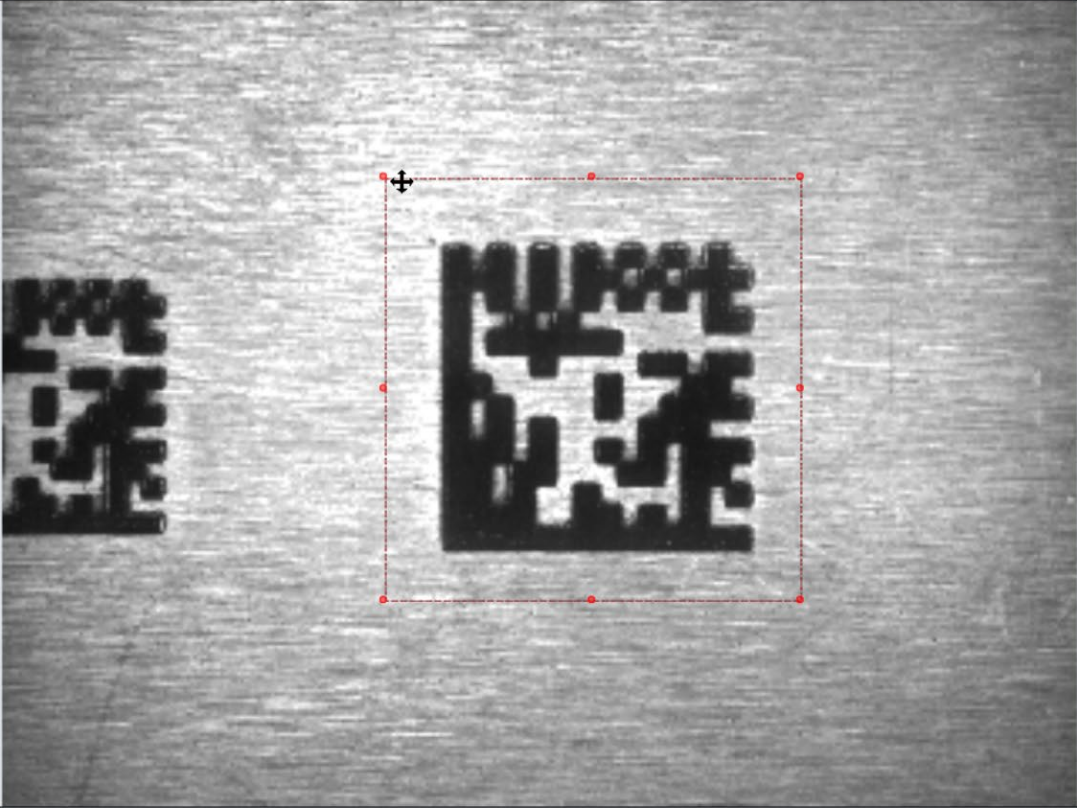
EXAMPLE VERIFICATION PROCESS

PLACE THE CODE IN THE CENTER OF THE FOV

TruCheck Verification - DM8072-5CC770

45 30 30 30 90

Main General Characteristic Data Detail Quality Detail Advanced Detail Histogram Report



Overall Grade

Grade Parameters

Format Grade

Symbology

Cancel Live Mode

Verify

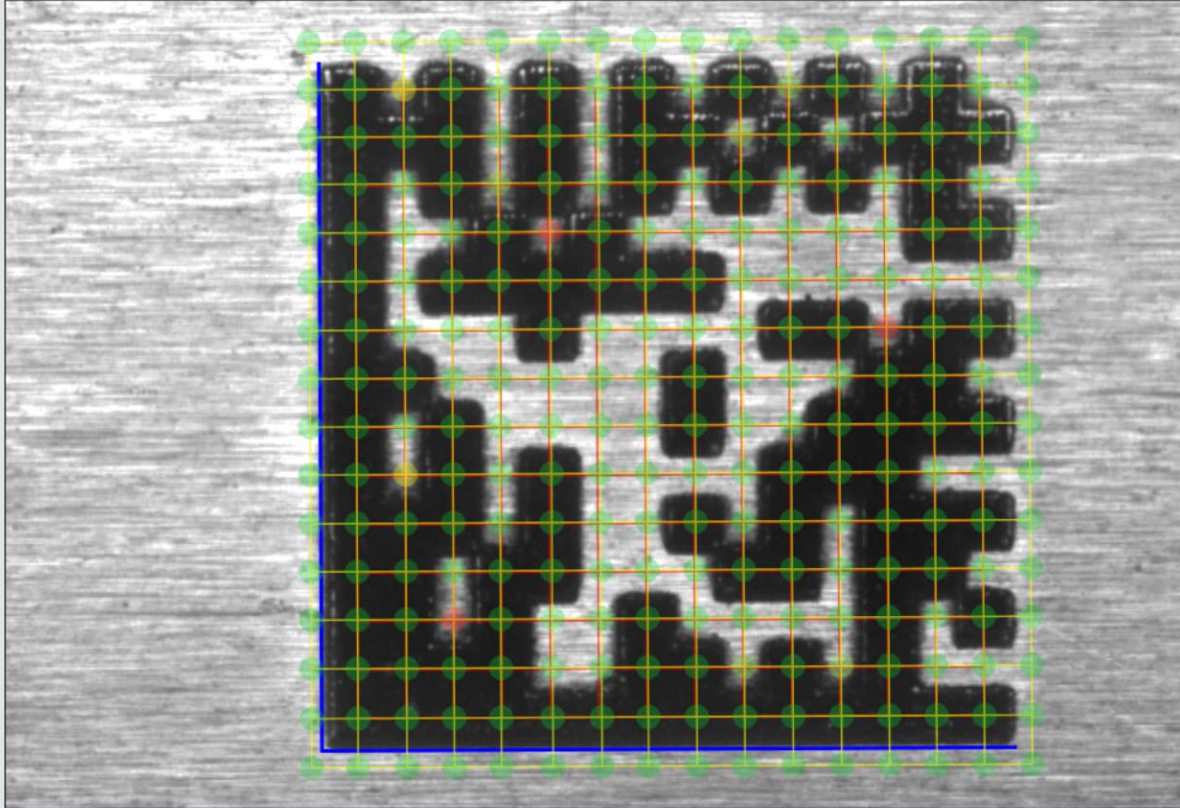
Acceptance Criteria

Data

RESULTS AT FIRST GLANCE

TruCheck Verification - DM8072-5CC770

Main | General Characteristic | Data Detail | Quality Detail | Advanced Detail | Histogram | Report



Overall ISO29158 Grade
F (0.0)
DPM 0.0/11/660/90

Grade Parameters

Unused Error Correction (UEC)	40% C
Cell Contrast (CC)	80% A
Cell Modulation (CMOD)	C
Reflectance Margin (RM)	F
Axial Nonuniformity (ANU)	0.5% A
Grid Nonuniformity (GNU)	7.6% A
Fixed Pattern Damage (FPD)	3.0 B
Left 'L' Side (LLS)	A
Bottom 'L' Side (BLS)	A
Left Quiet Zone (LQZ)	A
Bottom Quiet Zone (BQZ)	A
Top Quiet Zone (TQZ)	A
Right Quiet Zone (RQZ)	A
Top Transition Ratio (TTR)	0% A
Right Transition Ratio (RTR)	0% A
Top Clock Track (TCT)	B
Right Clock Track (RCT)	A
Distributed Damage Grade (DDG)	4.0 A
DECODE	A
Minimum Reflectance (MR)	100% A

Symbology
DataMatrix

Generic Acceptance Criteria
Fail (Quality)

Data
12345678

Go Live

WHAT ARE THE DOTS SAYING?

The screenshot displays the TruCheck Verification interface for a specific part (DM8072-5CC770). The main window shows a grid of colored dots (green, yellow, red) overlaid on a grayscale image of a component. The dots are arranged in a 4x4 grid, with a central dot that is red. The interface includes a top toolbar with various icons and a menu bar with options like 'Main', 'General Characteristic', 'Data Detail', 'Quality Detail', 'Advanced Detail', 'Histogram', and 'Report'. On the right side, there is a 'Grade Parameters' table and a 'Go Live' button. At the bottom, there is a 'Generic Acceptance Criteria' section showing a 'Fail (Quality)' status and a 'Data' field with the value '12345678'.

Overall ISO29158 Grade
F (0.0)
DPM 0.0/11/660/90

Grade Parameter	Grade
Unused Error Correction (UEC)	40% C
Cell Contrast (CC)	80% A
Cell Modulation (CMOD)	C
Reflectance Margin (RM)	F
Axial Nonuniformity (ANU)	0.5% A
Grid Nonuniformity (GNU)	7.6% A
Fixed Pattern Damage (FPD)	3.0 B
Left 'L' Side (LLS)	A
Bottom 'L' Side (BLS)	A
Left Quiet Zone (LQZ)	A
Bottom Quiet Zone (BQZ)	A
Top Quiet Zone (TQZ)	A
Right Quiet Zone (RQZ)	A
Top Transition Ratio (TTR)	0% A
Right Transition Ratio (RTR)	0% A
Top Clock Track (TCT)	B
Right Clock Track (RCT)	A
Distributed Damage Grade (DDG)	4.0 A
DECODE	A
Minimum Reflectance (MR)	100% A

Generic Acceptance Criteria
Fail (Quality)
Data
12345678

Go Live

THE CELL IS IN THE GRAY AREA

TruCheck Verification - DM8072-5CC770

Main | General Characteristic | Data Detail | Quality Detail | Advanced Detail | Histogram | Report



Overall ISO29158 Grade
F (0.0)
DPM 0.0/11/660/90

Grade Parameters

Unused Error Correction (UEC)	40% C
Cell Contrast (CC)	80% A
Cell Modulation (CMOD)	C
Reflectance Margin (RM)	F
Axial Nonuniformity (ANU)	0.5% A
Grid Nonuniformity (GNU)	7.6% A
Fixed Pattern Damage (FPD)	3.0 B
Left 'L' Side (LLS)	A
Bottom 'L' Side (BLS)	A
Left Quiet Zone (LQZ)	A
Bottom Quiet Zone (BQZ)	A
Top Quiet Zone (TQZ)	A
Right Quiet Zone (RQZ)	A
Top Transition Ratio (TTR)	0% A
Right Transition Ratio (RTR)	0% A
Top Clock Track (TCT)	B
Right Clock Track (RCT)	A
Distributed Damage Grade (DDG)	4.0 A
DECODE	A
Minimum Reflectance (MR)	100% A

Symbology
DataMatrix

Generic Acceptance Criteria
Fail (Quality)

Data
12345678

Go Live

MODULATION

TruCheck Verification - DM8072-5CC770

⚙️ Ⓞ 📄 🖼️ 🔍 45 30 30 30 90

Main | General Characteristic | Data Detail | Quality Detail | Advanced Detail | Histogram | Report

Overall ISO29158 Grade
F (0.0)
DPM 0.0/11/660/90

Grade Parameters

Unused Error Correction (UEC)	40% C
Cell Contrast (CC)	80% A
Cell Modulation (CMOD)	C
Reflectance Margin (RM)	F
Axial Nonuniformity (ANU)	0.5% A
Grid Nonuniformity (GNU)	7.6% A
Fixed Pattern Damage (FPD)	3.0 B
Left 'L' Side (LLS)	A
Bottom 'L' Side (BLS)	A
Left Quiet Zone (LQZ)	A
Bottom Quiet Zone (BQZ)	A
Top Quiet Zone (TQZ)	A
Right Quiet Zone (RQZ)	A
Top Transition Ratio (TTR)	0% A
Right Transition Ratio (RTR)	0% A
Top Clock Track (TCT)	B
Right Clock Track (RCT)	A
Distributed Damage Grade (DDG)	4.0 A
DECODE	A
Minimum Reflectance (MR)	100% A

Symbology
DataMatrix

Go Live

Generic Acceptance Criteria

Fail (Quality)

Data

12345678

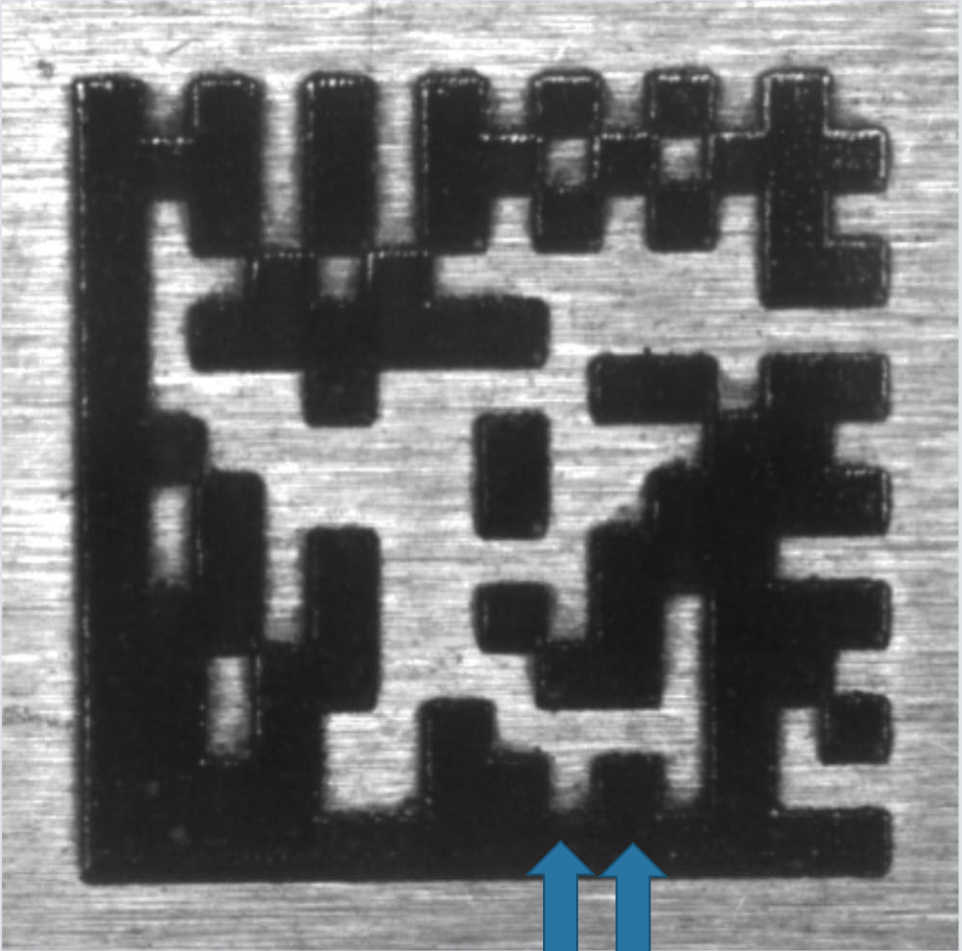
GENERAL CHARACTERISTICS TAB

TruCheck Verification - DM8072-5CC770

Settings: [45] [30] [30] [30] [90]

General Characteristic | Data Detail | Quality Detail | Advanced Detail | Histogram | Report

General Characteristics	
Matrix Size	14x14 (Data: 12x12)
Horizontal BWG	57%
Vertical BWG	31%
Encoded characters	8
Total Codewords	18
Data Codewords	8
Error Correction Budget	10
Errors Corrected	3
Error Capacity Used	6
Error Correction Type	ECC 200
Image	Black on white
Nominal X Dim	21.5 mil
Contrast Uniformity	30 at module(3,4)
MRD	34% (10% - 44%)



QUALITY DETAIL TAB

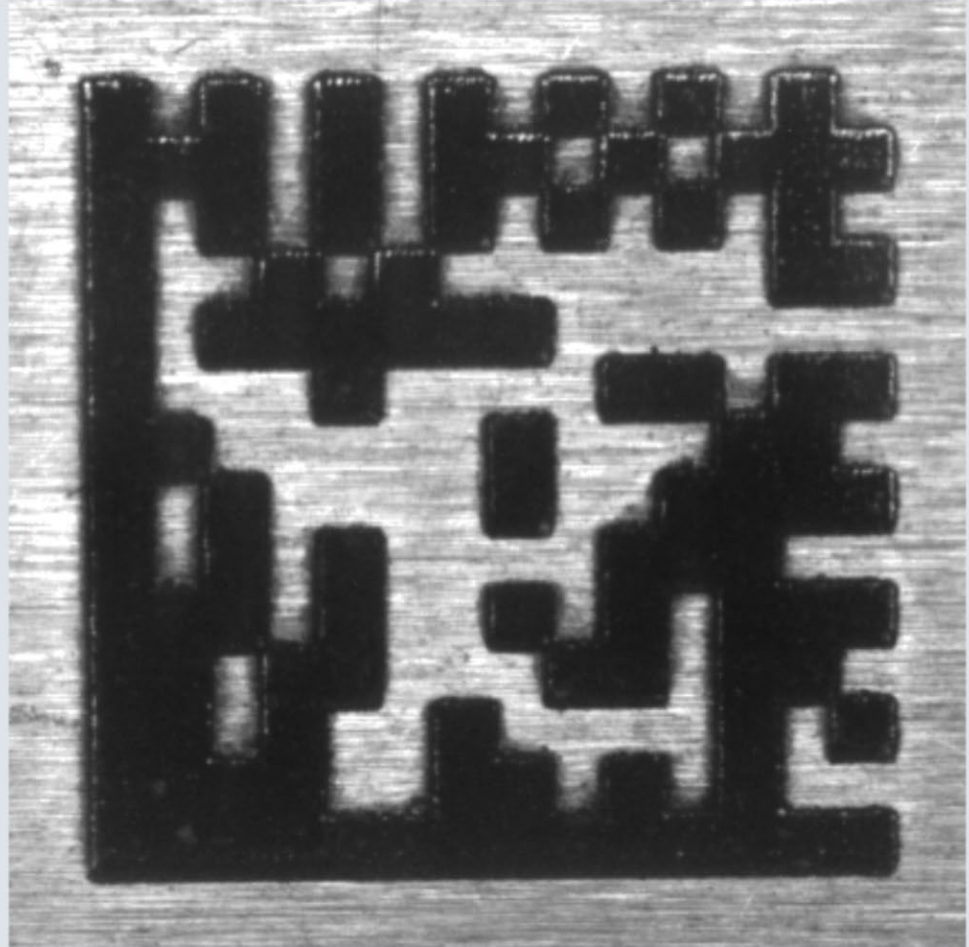
TruCheck Verification - DM8072-5CC770



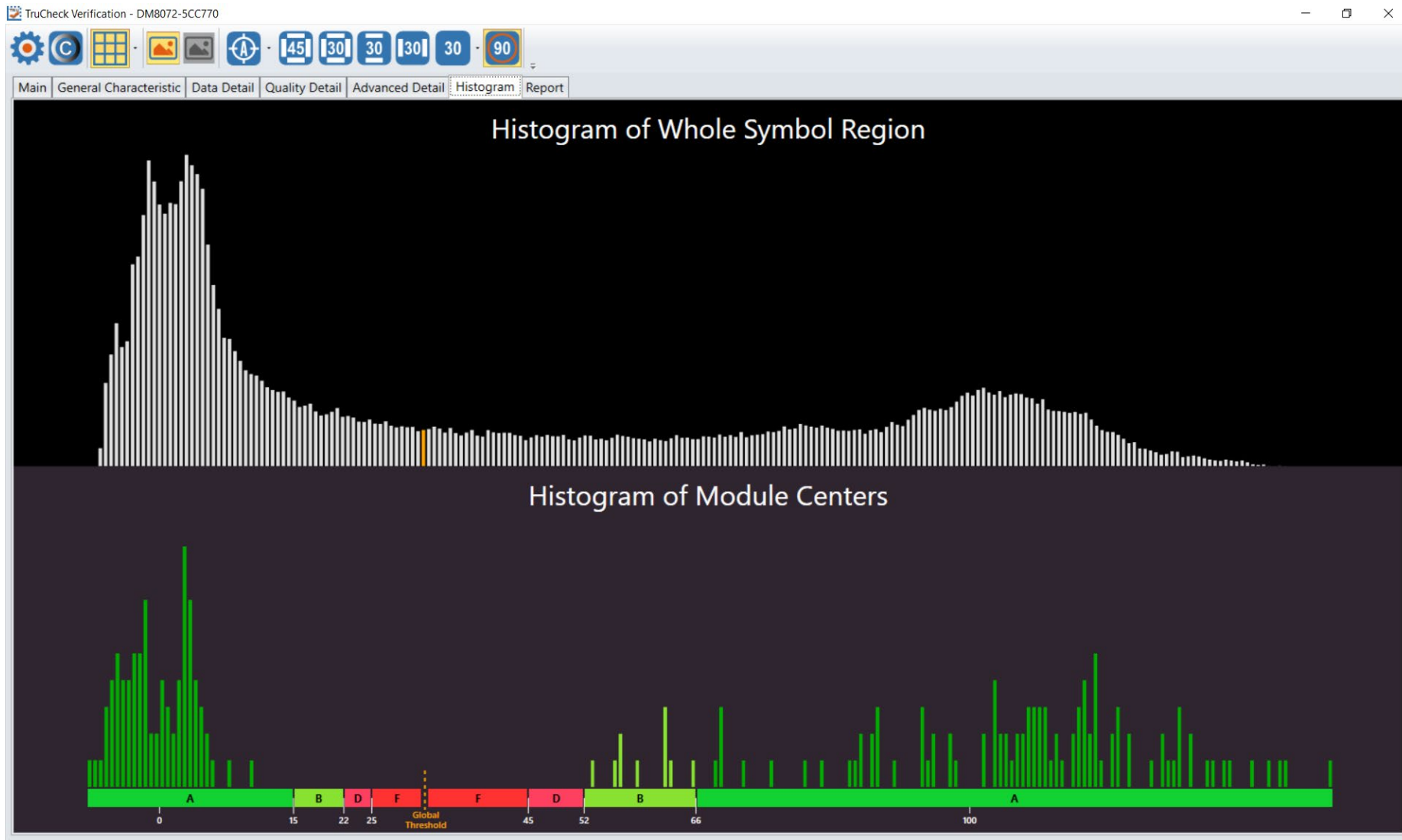
Main | General Characteristic | Data Detail | **Quality Detail** | Advanced Detail | Histogram | Report

ISO15415 Grade				
Overall	Aperture	Wavelength	Lighting	Formal
F (0.0)	11	660	90	DPM 0.0/11/660/90

ISO29518 Quality Parameters				
1. Unused Error Correction (UEC)	C	40%		PASS
2. Cell Contrast (CC)	A	80%	R/Rd (36/20)	PASS
3a. Cell Modulation (CMOD)	C			PASS
3b. Reflectance Margin (RM)	F			PASS
4. Axial Nonuniformity (ANU)	A	0.5%		PASS
5. Grid Nonuniformity (GNU)	A	7.6%		PASS
6. Fixed Pattern Damage (FPD)	B	3.0		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)	B			PASS
16. Right Clock Track (RCT)	A			PASS
17. Distributed Damage Grade (DDG)	A	4.0		PASS
18. DECODE	A			PASS
19. Minimum Reflectance (MR)	A	100%		PASS



HISTOGRAM TAB



REPORT VIEW

TruCheck Verification Settings



Application Settings

Reporting Settings

Report Preview



Report Sections

- Traditional Parameters
- Image of Symbol
- ASCII Values
- Unicode Data
- Encodation Analysis
- Quality Parameters
- Mod Values
- Codewords
- ECC Details

Save Report

Browse

OK

EXPLANATION OF QUALITY PARAMETERS

UNUSED ERROR CORRECTION

ISO 29158 Parameters

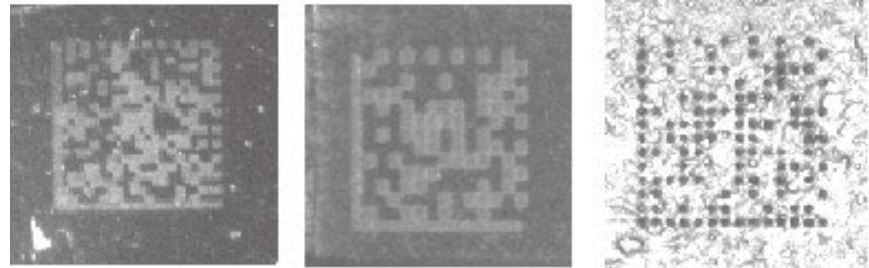
Unused Error Correction	100	A
Cell Contrast	61	A
Modulation		A
Reflectance Margin		A
Axial Nonuniformity	1	A
Grid Nonuniformity	14	A
Fixed Pattern Damage	4	A
Left 'L' Side		A
Bottom 'L' Side		A
Left Quiet Zone		A
Bottom Quiet Zone		A
Top Quiet Zone		A
Right Quiet Zone		A
Top Transition Ratio	0	A
Right Transition Ratio	0	A
Top Clock Track		A
Right Clock Track		A
Distributed Damage Grade	40	A
Decode		A
Minimum Reflectance	44	A

- Any grades showing the use of error correction indicate that the code needs work.
- It is an indication that there are module(s) that are calculated as being the wrong color.
- Review the advanced detail tab and look for modules listed as a zero value and evaluate why they are the wrong color.

Percentage of Unused Error Correction	Grade
≥ 62	A
≥ 50	B
≥ 37	C
≥ 25	D
> 25	F

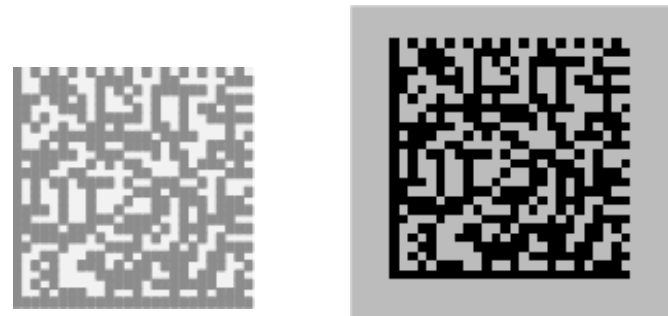
CELL CONTRAST (ISO/IEC TR 29158 AIM DPM)

- The relative contrast value between bars and spaces, taken from the means of the light and dark element.
($CC=(Lmean-Dmean)/Lmean$)



SYMBOL CONTRAST (ISO/IEC 15415)

- This is a measure of overall contrast between the brightest module and the darkest module.



ISO 29158 Parameters

Unused Error Correction	100	A
Cell Contrast	61	A
Modulation		A
Reflectance Margin		A
Axial Nonuniformity	1	A
Grid Nonuniformity	14	A
Fixed Pattern Damage	4	A
Left 'L' Side		A
Bottom 'L' Side		A
Left Quiet Zone		A
Bottom Quiet Zone		A
Top Quiet Zone		A
Right Quiet Zone		A
Top Transition Ratio	0	A
Right Transition Ratio	0	A
Top Clock Track		A
Right Clock Track		A
Distributed Damage Grade	40	A
Decode		A
Minimum Reflectance	44	A

MODULATION & REFLECTANCE MARGIN

ISO 29158 Parameters

Unused Error Correction	100	A
Cell Contrast	61	A
Modulation	A	
Reflectance Margin	A	
Axial Nonuniformity	1	A
Grid Nonuniformity	14	A
Fixed Pattern Damage	4	A
Left 'L' Side	A	
Bottom 'L' Side	A	
Left Quiet Zone	A	
Bottom Quiet Zone	A	
Top Quiet Zone	A	
Right Quiet Zone	A	
Top Transition Ratio	0	A
Right Transition Ratio	0	A
Top Clock Track	A	
Right Clock Track	A	
Distributed Damage Grade	40	A
Decode	A	
Minimum Reflectance	44	A

- Modulation is a measure of localized contrast issues
- Can be caused by textures or imperfections in the substrate, defects in the mark or bar width growth (BWG)
- To reduce BWG you can adjust the amount of ink used, the speed or temperature of the marking process or adjust the scale of the artwork.
- Reflectance Margin is exactly the same as modulation unless error correction is used. Then reflectance margin will always be lower or equal to the error correction grade.



ANU & GNU

ISO 29158 Parameters

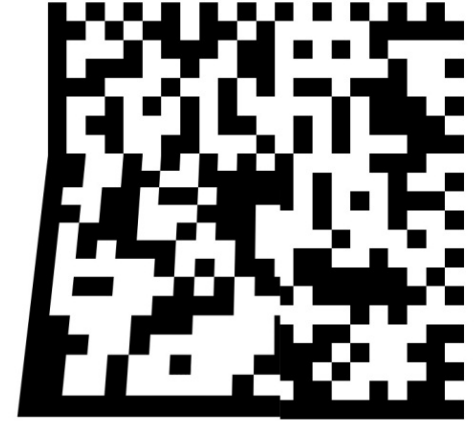
Unused Error Correction	100	A
Cell Contrast	61	A
Modulation		A
Reflectance Margin		A
Axial Nonuniformity	1	A
Grid Nonuniformity	14	A
Fixed Pattern Damage	4	A
Left 'L' Side		A
Bottom 'L' Side		A
Left Quiet Zone		A
Bottom Quiet Zone		A
Top Quiet Zone		A
Right Quiet Zone		A
Top Transition Ratio	0	A
Right Transition Ratio	0	A
Top Clock Track		A
Right Clock Track		A
Distributed Damage Grade	40	A
Decode		A
Minimum Reflectance	44	A

AXIAL NON-UNIFORMITY (ANU)



- The amount of “out of square” a symbol is or in other words a measure of the overall aspect ratio of the symbol.
- This can be caused by improper printing or marking speed.

GRID NON-UNIFORMITY (GNU)



- When module grid alignment is not centered based on the calculated grid
- The grade is determined by the worst case distance between the calculated center of a module and the ideal location of the module.
- Can be caused by inconsistent print or marking speeds, odd shaped parts, poorly managed artwork or pixel round off.

FIXED PATTERN DAMAGE

ISO 29158 Parameters

Unused Error Correction	100	A
Cell Contrast	61	A
Modulation	A	
Reflectance Margin	A	
Axial Nonuniformity	1	A
Grid Nonuniformity	14	A
Fixed Pattern Damage	4	A
Left 'L' Side	A	
Bottom 'L' Side	A	
Left Quiet Zone	A	
Bottom Quiet Zone	A	
Top Quiet Zone	A	
Right Quiet Zone	A	
Top Transition Ratio	0	A
Right Transition Ratio	0	A
Top Clock Track	A	
Right Clock Track	A	
Distributed Damage Grade	40	A
Decode	A	
Minimum Reflectance	44	A

Caused by modulation or wrong colored modules in the finder pattern.

Fixed Pattern



- L Pattern
- Clock teeth
- Quiet Zone



DECODE

ISO 29158 Parameters

Unused Error Correction	100	A
Cell Contrast	61	A
Modulation		A
Reflectance Margin		A
Axial Nonuniformity	1	A
Grid Nonuniformity	14	A
Fixed Pattern Damage	4	A
Left 'L' Side		A
Bottom 'L' Side		A
Left Quiet Zone		A
Bottom Quiet Zone		A
Top Quiet Zone		A
Right Quiet Zone		A
Top Transition Ratio	0	A
Right Transition Ratio	0	A
Top Clock Track		A
Right Clock Track		A
Distributed Damage Grade	40	A
Decode		A
Minimum Reflectance	44	A

Can it be decoded using the selected aperture applied with the standard reference decode algorithm?



Yes



No



MINIMUM REFLECTANCE

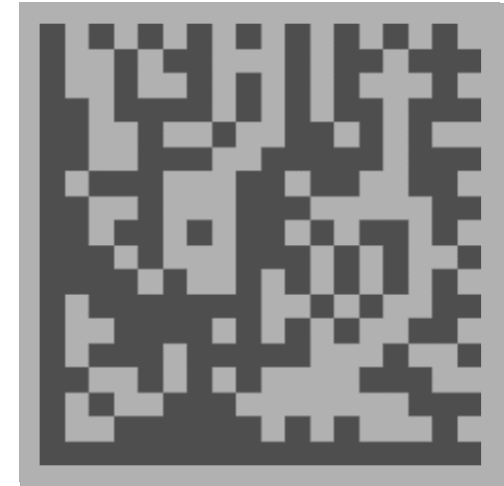
ISO 29158 Parameters

Unused Error Correction	100	A
Cell Contrast	61	A
Modulation		A
Reflectance Margin		A
Axial Nonuniformity	1	A
Grid Nonuniformity	14	A
Fixed Pattern Damage	4	A
Left 'L' Side		A
Bottom 'L' Side		A
Left Quiet Zone		A
Bottom Quiet Zone		A
Top Quiet Zone		A
Right Quiet Zone		A
Top Transition Ratio	0	A
Right Transition Ratio	0	A
Top Clock Track		A
Right Clock Track		A
Distributed Damage Grade	40	A
Decode		A
Minimum Reflectance	44	A

Good



Bad



- The measure of how light or dark the part is before it is lightened by the image adjustment of AIM DPM
- If the brightness level is less than 5% before the AIM DPM image adjustment takes place it will fail.

CONCLUSION

- Try not to get overwhelmed trying to learn everything about verification. Take it one step at a time and remember the basics.
- It's all about having crisp definition between dark and light modules and a clean finder pattern.
- If the code looks blurry, has poor contrast or is missing modules it's going to require some work to get a good grade or even to be verified in the first place.

**For more information on barcode
verification visit www.cognex.com**