The Global Language of Business

GS1 2D Barcode Verification Process Implementation Guideline

developed with the intention of providing a clear explanation on the practical implications of 2D Barcode Verification within the GS1 System.

Release 1.3.21, Ratified, Jul 2015

Document Summary

Document Item	Current Value
Document Name	GS1 2D Barcode Verification Process Implementation Guideline
Document Date	Jul 2015
Document Version	1.3
Document Issue	21
Document Status	Ratified
Document Description	developed with the intention of providing a clear explanation on the practical implications of 2D Barcode Verification within the GS1 System.

Contributors

Name	Organization
Alan Gormley	GS1 Ireland
Alice Mukaru	GS1 Sweden
Andreas Fuessler	GS1 Germany
Andrew Hearn	GS1 Global Office
Anne-Sophie Meurant	GS1 Belgium & Luxembourg
Benjamin Ostman	GS1 Finland
Cedric Houlette	GS1 France
Christine Hanko	GS1 Hungary
Chuck Biss	GS1 Global Office
Daniel Clark	GS1 Canada
Daniel Muller	GS1 Switzerland
Elzbieta Halas	GS1 Poland
Eugen Sehorz	GS1 Austria
Frank Sharkey	GS1 Global Office
Gerald Gruber	GS1 Austria
Glyn Fogell	Shoprite
Greg Rowe	GS1 Global Office
Heinz Graf	GS1 Switzerland
Ilka Machemer	GS1 Germany
Ilteris Oney	GS1 Global Office
James Chronowski	GS1 US
John Lane	GS1 Australia
Karen Moritz	GS1 Australia
Karolin Harsanji	GS1 Sweden
Lionel Willig	GS1 France
Marianna Revallova	GS1 Slovakia
Mark Frey	GS1 Global Office
Matjaz Martini	GS1 Slovenia

Name	Organization
Michel Ottiker	GS1 Switzerland
Naoko Mori	GS1 Japan
Neil Piper	GS1 UK
Nicolas Stuyckens	GS1 Belgium & Luxembourg
Owen Dance	GS1 New Zealand
Pere Rosell	GS1 Spain
Pertti Hakala	GS1 Finland
Peta Scavone	GS1 Australia
Peter Stevens	GS1 New Zealand
Piotr Franckowiak	GS1 Poland
Ray Delnicki	GS1 US
Sabine Kläser	GS1 Germany
Sarina Pielaat	GS1 Netherlands
Scott Gray	GS1 Global Office
Stefan Gathmann	GS1 Ireland
Sue Schmid	GS1 Australia
Sylvia Stein	GS1 Netherlands
Thelma Gonzalez	GS1 Mexico

Log of Changes

Release	Date of Change	Changed By	Summary of Change
1.3.20	24.01.2014	Lutfi Ilteris Oney	Publication
1.3.21	July 2015	Valerie Hoste	Applied new GS1 branding prior to publication

Disclaimer

GS1®, under its IP Policy, seeks to avoid uncertainty regarding intellectual property claims by requiring the participants in the Work Group that developed this **GS1 2D Barcode Verification Process Implementation Guideline** to agree to grant to GS1 members a royalty-free licence or a RAND licence to Necessary Claims, as that term is defined in the GS1 IP Policy. Furthermore, attention is drawn to the possibility that an implementation of one or more features of this Specification may be the subject of a patent or other intellectual property right that does not involve a Necessary Claim. Any such patent or other intellectual property right is not subject to the licencing obligations of GS1. Moreover, the agreement to grant licences provided under the GS1 IP Policy does not include IP rights and any claims of third parties who were not participants in the Work Group.

Accordingly, GS1 recommends that any organisation developing an implementation designed to be in conformance with this Specification should determine whether there are any patents that may encompass a specific implementation that the organisation is developing in compliance with the Specification and whether a licence under a patent or other intellectual property right is needed. Such a determination of a need for licencing should be made in view of the details of the specific system designed by the organisation in consultation with their own patent counsel.

THIS DOCUMENT IS PROVIDED “AS IS” WITH NO WARRANTIES WHATSOEVER, INCLUDING ANY WARRANTY OF MERCHANTABILITY, NONINFRINGMENT, FITNESS FOR PARTICULAR PURPOSE, OR ANY WARRANTY OTHER WISE ARISING OUT OF THIS SPECIFICATION. GS1 disclaims all liability for any damages arising from use or misuse of this Standard, whether special, indirect, consequential, or compensatory damages, and including liability for infringement of any intellectual property rights, relating to use of information in or reliance upon this document.

GS1 retains the right to make changes to this document at any time, without notice. GS1 makes no warranty for the use of this document and assumes no responsibility for any errors which may appear in the document, nor does it make a commitment to update the information contained herein.

Table of Contents

1 Acknowledgements

The development of this guideline would not have been possible without the ISO publications that support the verification of barcodes and understanding of its parameters. GS1 is thankful for the expertise of Lutfi Ilteris Oney and Lionel Willig and all the companies and individuals who contributed during the development, including:

- GS1 France
- GS1 Global Office
- GS1 Barcodes and Conformance Group

2 Foreword

The biggest benefits of verification are, reassurance and confidence that the bar code will perform as intended at all stages of the product's passage through the supply chain, leading to efficient supplier-customer relationships. Additional benefits accrue to the symbol producer, who is able to make use of the measurement information on the symbols. The symbol producer can monitor the production process and adjust one's equipment or procedures in order to correct for any deviations from the optimum quality. Package designers can use feedback from the verification process to ensure that symbol size, position and colour will not result in point-of-use difficulties. The receiver of bar coded products, too, has advantages from the verification process of incoming bar codes, and can assess the likelihood of their causing scanning problems in handling / inventory control systems, or at the point of use.

Today, as the 2D symbols are new to the market, many challenges disappear if the bar code is correctly constructed according to the GS1 Specifications. Also, users need more guidance on the 2D verification process to support the growing implementation of these symbols. With this implementation guideline, all impacted users can confidently move forward with creating the symbols and getting them verified. Verified symbols would support a variety of key business requirements that capture and process GS1 System data automatically at POS and Point of Care.

Additionally, this document aims to facilitate this process by offering detailed information on 2D symbol verification. This document is the result of the consolidation of technical knowledge of many users and solution providers about bar code verification. It aims to be a repository of reference information that can support the implementation of two-dimensional symbols in any sector, industry or country.

Who should use this document?

This document will be helpful to GS1 MO staff who is involved in verifying two-dimensional symbols. Additionally the document provides guidance for the development of two-dimensional symbols in terms of verification so that it will support international usage. Ignoring the advice in this document, or relegating it to a later phase in the development, will only add unnecessary costs and resource issues at a later date.

It is assumed that readers of this document are proficient in developing barcode applications, are able to construct a barcode and understand the basic principles of Automatic Identification and Data Capture. This document limits itself to providing advice related specifically to verification of the bar codes.

How to use this document?

Two-dimensional symbols are primarily intended for implementation in Business to Consumer applications such as extended packaging or healthcare applications such as point of care systems. It is an "open" system (e.g., a system in which the supplier can mark items in the expectation that all trading partners will be able to ‘read’ and correctly interpret the data encoded). In this context, the choice of an agreed system subject to a good quality implementation among the various partners is essential to avoid each partner having to re-label products for different customers and / or at different points of the supply chain.

The basis for this document is GS1 General Specifications and ISO Standards. However, this document is trying to help users with fine details such as parameter guidance, comment resolution,

environment specific options, GS1 standards and printing specifications. . Whilst every effort has been made to ensure that the guidelines to use the GS1 standards contained in the document are correct, the document may need a regular update cycle to correct misalignment with the newest developments. The GS1 System Standards are the norm, and use of this guideline is to understand better the standards related to quality.

GS1 has over 40 years of experience in the definition, maintenance and management of standards for bar code applications. This guideline further assists in making the best practice choices for verification of two-dimensional symbols to deliver the best quality symbol to meet business requirements.

Where to get more Information

This document is published on the GS1 website, *www.gs1.org*

GS1 Global Office

Blue Tower
Avenue Louise, 326
BE 1050 Brussels
Belgium

3 Introduction

Hundreds of thousands of companies globally rely on GS1 standards to conduct business and meet consumers' expectations. If a bar code cannot be properly decoded it's more than just time at the cash register or the warehouse that is lost.

Today, 100% reliable GS1 Bar Codes are a vital part of the supply chain. As a result, users around the world increasingly require assurance that the products they purchase carry a GS1compliant Bar Code, and because it helps to ensure better reading rates, accuracy and efficiency.

Providing a common approach to the delivery of a GS1 Bar Code Verification Process increases consistency, confidence, and establishes credibility and assurance that products are in conformance to GS1 General Specifications.

4 Scope and Purpose

This implementation guideline provides the basic framework for establishing and maintaining a GS1 Bar Code two-dimensional quality verification service. The target audience is GS1 Member Organisation staff involved in GS1 Bar Code Quality and Conformance Verification. It is hoped that the information contained will be of use as a basis for training and/or reference material for [expert] end-users involved in GS1 Bar Code production, print quality control and conformance assessment. The following should be considered when setting up a GS1 2D Bar Code Verification Service:

- Staffing
- Training and education
- General operational
- Creation of procedures / guidelines
- Recommended basic reference documents and guides
- Requirements on equipment such as ISO conformant verification devices and other optional tools, gauges & equipment

Beyond the set up and maintenance of such a service is the actual process of conducting a GS1 Bar Code Verification process. As this process is very technical in its nature, the provision of how to complete an actual GS1 Bar Code Verification is provided within the document GS1 Bar Code Verification Process which can be found on the GS1 Global Office website (http://www.gs1.org/barcodes/support).The GS1 Bar Code Verification Process document includes the details that are needed to create the output of the verification testing as well as the detailed

process on what needs to be done. This guideline does not include guidance on Direct Part Marking (DPM).

A bar code's primary function is that of carrying data from the point at which it is originated to the point at which the data has to be captured. The bar code is therefore a vital link in the data communication chain of any application. The failure of a bar code leads to human intervention that is costly and has been proven to cause errors. These errors are carried through the supply chain and there is a cumulative, increased cost effect of data errors in the long term.

Verification aims to check that the symbol is able to fulfil its function, by:

- Enabling the symbol producer to measure his output, monitor his production processes and to apply feedback in order to correct any quality deviations
- Predicting the scanning performance likely to be achieved by a symbol
- Providing packaging designers with feedback from verification to make sure that symbol size, position and colour will not result in point-of-use difficulties
- Allowing the receiver of bar coded products to assess the likelihood of bar codes causing scanning problems in handling and inventory control systems, or at the point-of-use
- Allowing the party on whose product or item that the bar code is being applied assurance that his customers will accept the symbols

It is important to note that only a sample of symbols in any batch or production run will normally be verified, and 100% sampling is neither expected nor necessary because of the relatively consistent quality levels achieved by the production processes usually used for bar codes. Ideally, the sampling basis will be determined by the statistical procedures used for the organisation's Quality Control programme.

Verification then assists the symbol producer and receiver in setting an agreed quality level for acceptance, allowing them to agree on the acceptability of a given symbol.

Verification carries these tasks out by measuring how close the symbol is to "perfect" in relation to both the symbology specification and certain attributes which are related to the printing or reading of the symbol, and by reporting a quality grade which correlates with the likely scanning performance of the symbol.

4.1 Specific Benefits for Member Organisations

- Here are some benefits for MO's:
- Better member relationship if bar codes are used correctly.
- Better trained staff on bar code testing and use.
- Opportunity to link product description to the company allocated numbers.

4.2 Specific Benefits for Consumers

As barcode scan rates improve, data does not have to be manually entered.
This means:

- reduced chance of delays or waiting time in queue
- accurate product registration and accurate charge of the shopped items
- increased supply chain effectiveness which results in higher service levels to the end consumer

4.3 Specific Benefits for Supply Chain Stakeholders

- Fast and accurate data capture at every point of the supply chain, including goods receiving, warehousing, picking, despatch and Point-of-Sale information
- More efficient supply chain
- Better quality bar codes improving scan rates

- Correct bar codes and therefore correct data in systems
- One test and bar code solution for all manufacturers giving confidence to retailers and other users
- Faster product to market by reducing lead time due to packaging re-printing
- Errors corrected at art work stage, prevents printing of wrong bar code
- Improved customer relationships
- One bar code testing standard accepted globally
- Scannable bar codes facilitate accurate, real time stock management
- No loss of sales due to poor scanning and consequent loss of sales data

5 Process overview

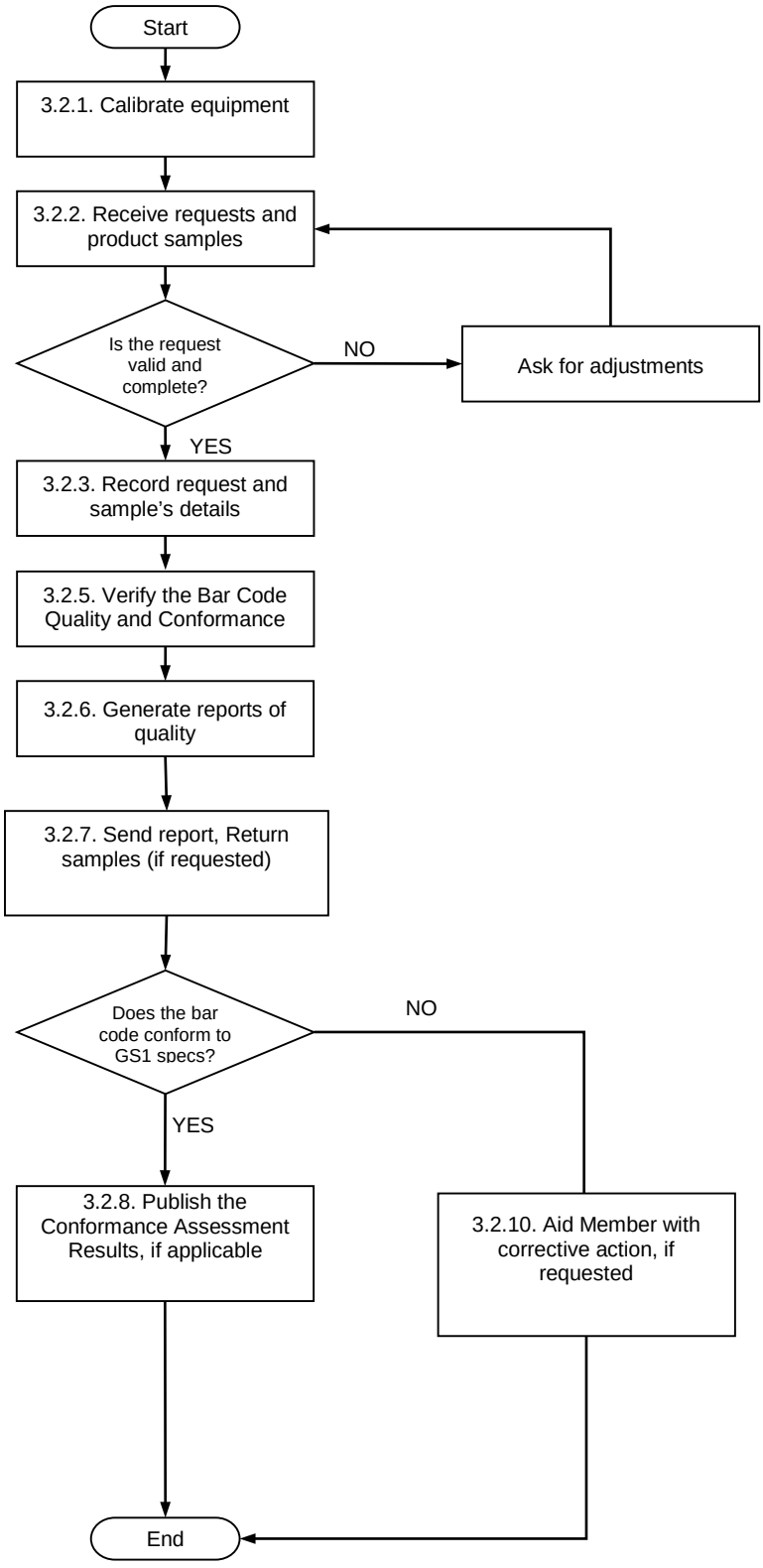
The Bar Code Verification process should comprise of the following high level steps;

- Record of receipt of the sample(s)
- Record of data associated to a bar code (in a database)
- Verify the Bar Code
- Perform the additional tests on the Bar Code
- Create and send Bar Code Verification Report
- Ensure availability of the Verification Report (if available, keep the sample(s) for a minimum of 2 years (suggestion)

In the sections below, the broad requirements for each of these process steps is expanded. However, for services that test many bar codes, it is recommended to create an automated system, supported by a detailed work-flow. This helps to ensure consistency of the testing process and is of particular importance when testing is conducted by multiple staff members.

5.1 Process Workflow

Figure 5-1 Process Work Flow of Verification



6 Procedures / Activities

6.1 Calibrate and Maintain Equipment

The staff member who is conducting the testing (referred to as 'tester' from this point on) shall follow all recommendations provided from the equipment's manufacturer to install, use, maintain, operate and calibrate equipment, especially regarding the extent and frequency of maintenance and calibration.

Regular re-calibration, at least as frequently as recommended by the manufacturer or, if there is no guide, at least once a month, shall be done in order to provide reference values of colour and contrast to the equipment. Typically re-calibration should occur at regular intervals in line with the manufacturer's recommendation, or after a substantial period of inactivity, or whenever there is an environmental change such as lighting conditions. The verifier must always be recalibrated if the scan head, the measuring aperture, or scan width is changed.

A calibration card provided by the verifier manufacturer should be used. It should be traceable and should be replaced periodically, following the manufacturer's recommendation, or earlier if deterioration of the card is noticed. A test of calibration conformance should be done, at least annually. This test can be done using a Calibrated Conformance Standard Test Card, available from *GS1 US* or by the equipment manufacturer. This test confirms that the verifier is responding correctly to its routine calibrations. Results of tests, calibration and maintenance reports of equipment used on the assessment process must be identified and safeguarded for at least two years.

6.2 Receive Requests and Product Samples

The tester shall make clear the conditions and pre-requirements to perform the assessment process (eg.: A Member Organisation may or may not require the submitter to be a Member). The tester shall make clear what/if any fees will be charged to assess conformance and the procedures to provide it.

At least the following information should be provided with the request for a test:

- Company Name
- Contact Details (Name, Position, Address, Telephone Number, e-mail)
- List of products or labels to be assessed.
- Order Number (if applicable)
- Whether the samples are to be returned after testing
- Whether products are confidential (you will need to handle them so that visitors to your office, cleaners etc. will not see them)

- To be assessed, a product (samples) should preferably be submitted full and complete in its final form, which allows extensive testing in terms of colour, contrast, location and quality. Sometimes it is recommended to have bar codes in layout versions, e.g. proofs tested to avoid delays in supply and additional costs.

The verification/assessment body must check if all the requested information about product and submitter was received. If all of the requested information has not been received, the tester will contact the submitter to gather all of the necessary information.

6.3 Example of GS1 Bar Code Verification Request

GS1 Barcode Verification Request Form

Date of Submission:……

Global Location Number or GS1 Company Prefix (if known): ……

Company Name……..……..

Company Address: ……..……..

Contact Name: ……..

Phone Number: ……..……..

Email Address: ……

Urgent Date Required: ……

Total Number of samples submitted: _____

We will be collecting the samples after they have been completed: **Yes / No**

Note: All samples will be disposed of within 7 days of report being issued unless specified. You will be advised when your products are ready for collection. Collection must be within two weeks of this notification.

6.4 Record requests and sample details

Upon receipt, the details required for the testing report should be captured in an appropriate system. As a minimum this shall include all details required for the completion of the GS1 Bar Code Verification Report (i.e. Name and contact details of the submitter, GTIN, date of receipt) and ideally this can be requested on a 'GS1 Bar Code Verification Request Form'.

The tester shall establish systems and procedures for the identification, collection, indexing, accessing, storage, maintenance and disposal of documents and samples provided by the submitter. The procedures shall define the controls needed to prevent the unintended use of obsolete documents. The tester shall guarantee the confidentiality of documents, samples or any information provided. The maximum period to assess conformity of a product should be established and notified to the submitters. The form in which the product is tested should be recorded. The following list indicates the desirability of testing conditions for bar codes:

- Product complete, filled, packaged, ready for market
- Empty package
- Label only
- Model or mock-up of product in authentic colours
- Artwork in authentic colours printed and supplied by user
- Artwork in black and white printed and supplied by user
- Artwork in authentic colours printed by MO from image supplied by user
- Artwork in black and white printed by MO from image supplied by user
- MOs must use policies and processes that aim to have samples sent to them in the highest condition that circumstances and the nature of the product allow.

Where artwork is tested the MO must have protocols to ensure that testers are aware of the actual size at which the bar code involved will be printed. Where only a label is sent, every effort must be made to discover where the bar code will appear on the finished product e.g. artwork, photograph. If location cannot be assessed the report is to indicate "not assessed" for location. The verification/assessment body must check if all the requested information about product and submitter was received.

7 Quality Grading

7.1 Introduction to Quality Grading

The measurement of two-dimensional bar code is designed to yield a quality grade indicating the overall quality of the symbol. It can be used by producers and users of the symbol for diagnostic and process control purposes. It is broadly predictive of the read performance to be expected of the symbol in various environments. The process requires the measurement and grading of defined parameters. The overall symbol grade shall be the lowest of the individual parameter grades.

As a consequence of the use of different types of reading equipment under differing conditions in actual applications, the levels of quality required of two-dimensional bar code to ensure an acceptable level of performance will differ. Application specifications should therefore define the required performance in terms of overall symbol grade.

The sampling method should be based on a statistically valid sample size within the lot or batch being tested. A minimum overall symbol grade for acceptability shall be established prior to quality control inspection. In the absence of internal process, in the formal quality assurance procedures or bilateral agreement, a suitable plan may be based on the recommendations stated in ISO 2859, ISO 3951 or GS1's publication "*Starting and Maintaining a GS1 Bar Code Verification Service*".

7.2 Grading Explanation

Although this ISO/IEC 15415 specifies a numeric basis for expressing quality grades on a descending scale from 4 to 0, with 4 representing the highest quality and 0 is the least quality, individual parameter grades and individual scan grades may also be expressed on an equivalent alphabetic scale from A to CC, with a failing grade of D and F for 2D symbols, in application standards with a historical link to ANSI X3.182.

This table maps the alphabetic and numeric grades to each other.

Table 7-1 Equivalence of numeric and alphabetic quality grade

Numeric Grade	Alphabetic Grade
4	A
3	B
2	C
1	D
0	F

The table below summarises the test parameters and corresponding grade levels; it provides a quick reference for quality parameters of 2D symbols. To see the full table please refer to GS1 General Specifications section 5, GS1 System Symbol Specification tables

Table 7-2 Minimum Quality Grades for 2D Symbols

Symbology	Application or ID Key	ISO (ANSI) Symbol Grade
GS1 DataMatrix	Direct Part Marking,Regulated Healthcare Retail or Non-Retail Consumer Trade Items Extended Packaging	1.5(C)
GS1 QR Code	Extended Packaging limited use to AI (8200) in association with mandatory GTIN-8,GTIN-12, or GTIN-13	1.5(C)

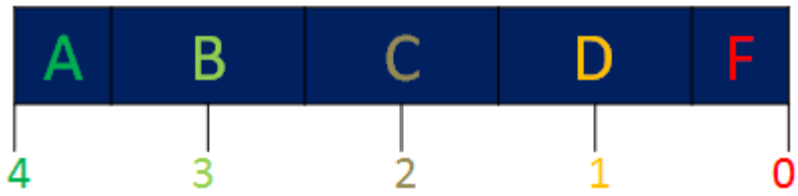
7.3 Overall Symbol Grade

The overall symbol grade shall be expressed to one decimal place on a numeric scale ranging in descending order of quality from 4,0 to 0,0. The overall symbol grade is expressed as a real number to one decimal place in keeping with historical precedent.

The overall symbol grade shall be the lowest of the ISO individual parameter grades. If any of the GS1 parameters fail, the GS1 system grade will be an F.

Where a specification defines overall symbol grades in alphabetic terms the relative mapping of the alphabetic and numeric grades is as illustrated in figure below.

Figure 7-1 Mapping of alphabetic and numeric overall symbol grades



The table below summarises the test parameters and grade levels to achieve minimum symbol quality grade of 2.0 (C).

Table 7-3 Test parameters and grade levels

Parameter / Grade	Decode	Symbol Contrast	Fixed Pattern Damage	Axial Non-uniformity	Grid Non-uniformity	Modulation	Unused Error Correction
4.0(A)	Pass	SC≥0,70	Symbol Spec	AN ≤0,06	GN≤0,38	MOD≥0,50	UEC≥0,62
3.0(B)		SC≥0,55	Symbol Spec	AN ≤0,08	GN≤0,50	MOD≥0,40	UEC≥0,50
2.0(C)		SC≥0,40	Symbol Spec	AN ≤0,10	GN≤0,63	MOD≥0,30	UEC≥0,37
1.0(D)		SC≥0,20	Symbol Spec	AN ≤0,12	GN≤0,75	MOD≥0,20	UEC≥0,25
0.0(F)	Fail	SC<0,20	Symbol Spec	AN >0,12	GN>0,75	MOD<0,20	UEC<0,25

7.4 Reporting the symbol Grade

A symbol grade is only meaningful if it is reported in conjunction with the illumination and aperture used. It should be shown in the format grade/aperture/light/angle, where:

- "grade" is the overall symbol grade
- "aperture" is the aperture reference number from ISO/IEC 15416 for linear scanning techniques, or the diameter in thousandths of an inch (to the nearest thousandth) of the synthetic aperture,
- "light" defines the illumination: a numeric value indicates the peak light wavelength in nanometres (for narrow band illumination); the alphabetic character W indicates that the symbol has been measured with broadband illumination ("white light") the spectral response characteristics of which must imperatively be defined or have their source specification clearly referenced. In GS1 the wavelength of the light is always 670 nm ± 10nm
- "angle" is an additional parameter defining the angle of incidence (relative to the plane of the symbol) of the illumination. It shall be included in the reporting of the overall symbol grade when the angle of incidence is other than 45°. Its absence indicates that the angle of incidence is 45°. In GS1, all two-dimensional symbols should be measured at 45° unless it is a direct part marked item. Direct part marked items can be scanned in different angles and different wavelengths of light so they may need to be verified at the angles / wavelengths at which they will be scanned.

An asterisk following the value for "grade" indicates that the surroundings of the symbol contain extremes of reflectance that may interfere with reading.

See more information on selection of these parameters on section 8.3 reflectance reflectivity measurement.

EXAMPLES

3.00/05/660 would indicate that the minimum grade of the parameters, hence the overall grade , was 3.00 when these were obtained with the use of a 0,125 mm (5 mil) aperture and a 660 nm light source, incident at 45°.

3.00*/10/660 would indicate the grade of a symbol measured using a 0,250 mm (10 mil) aperture, and a 660 nm light source, and indicates the presence of a potentially interfering extreme reflectance value in the surroundings of the symbol.

8 Print Quality Testing Methodology

8.1 Overview of the methodology

According to the ISO/IEC 15415, the measurement methodology is designed to maximise the consistency of both reflectivity and dimensional measurements of symbols on various substrates. The basis of this methodology is the measurement of reflectance from the symbol. This methodology is also intended to correlate with conditions encountered in two-dimensional matrix scanning systems.

There are various actors within the Print Quality Testing Methodology with important roles. Those actors include:

- Operator, the person performing the verification
- User, the person creating the image
- Art designer, the person involved in creation of the symbol and the processing of the image
- Users create the symbol by using barcode software and export the image with correct resolution so that the art designer can process the image

First step is to convert the raw image into a gray scale image. To convert raw image to a grey scale image, art designer removes colour representation of the raw image. Scanners decode images in grey scale. With this step we are ensuring that the evaluation is carried out in the same manner as the scanner systems.

From the reference grey-scale image, the Symbol Contrast, Modulation and Fixed Pattern Damage parameters are measured and graded. This is generally done by a verifier. The verifier decides every module's value (dark or light) by applying the Global Threshold (GT). The global threshold is the average of the dark and the light modules. Any value above the GT will be marked as light and below would be marked as dark. After determining the dark and light modules, the verifier analyses and grades the parameters of Decode, Axial Non-uniformity, Grid Non-uniformity, and Unused Error Correction, together with any additional parameters defined in the symbology or application specification. Print growth is not graded; it is informative only and may indicate process faults or print resolution issues.

The scan grade is the lowest grade achieved for these seven parameters and any others specified for a given symbology or application

8.2 Measurement conditions

Whenever possible, measurements shall be made on the symbol in its final configuration, i.e. the configuration in which it is intended to be scanned. This is required as the production process greatly influences the scanning values of the symbol. If needed, the environment to test the symbol should match as closely as possible to the environment in which the symbol is to be scanned. For verification, a symbol must only be illuminated by the verifier.

For more information please refer to ISO specification, ISO/IEC 15415 Information technology – Automatic identification and data capture techniques – Bar code print quality test specification – two-dimensional symbols. For Direct Part Marking applications, a modified version of the methodology may be more appropriate. The modified methodology is formally defined in ISO/IEC TR 29158.

8.3 Reflectance reflectivity measurement

- Equipment for assessing the quality of symbols in accordance with this clause shall comprise a means of measuring and analysing the variations in the reflectivity of a symbol on its substrate over an inspection area. This shall cover the full height and width of the symbol including all quiet zones. Light source: All GS1 light source wavelength should be selected as 670 nm ± 10 nm
- Effective resolution and measuring aperture: The effective measuring aperture varies based on the application standard and it is referred as in thousands of an inch. The healthcare sector is recommending the GS1 DataMatrix only and the aperture is set to 8. In all other cases the aperture is set to 80% of the X-dimension
- The inspection area: The area within which all measurements are made shall be a rectangular area framing the complete symbol, including quiet zones. The centre of the inspection area shall be as close as practicable to the centre of the field of view

8.4 Number of scans

The overall symbol grade is obtained through **one or more measurements of the whole image vertically and horizontally and processing the measurements to determine the grade**, with the symbol oriented in any rotation with respect to the measuring device, in a plane perpendicular to the optical axis of the imager sensor.

9 Conformance Clauses

9.1 ISO/GS1 Parameters of 2D Verification

9.1.1 Decode

The Decode has only two results. It is either PASS (Grade 4) or FAIL (Grade 0). Every symbol has an ISO specification. ISO specification of a symbol defines how to construct the symbol, how data should be encoded, how the finder patterns, alignment patterns or timing patterns are constructed, how error correction codes shall be used etc. If Decode fails, that means the symbol is not constructed according to its symbol specification.

After capturing the image, if the image could not be decoded following the symbol specification mentioned in ISO, then it shall receive failing grade 0 that is to say FAIL. In all other cases it receives the grade 4 so it is a PASS.

Decode may fail due to a barcoding software error, but mainly insufficient quiet zones. You may also see that the quiet zone parameter fails (see *section 9.2.1.3 Quiet zones).* Please note that GS1 DataMatrix requires 1X quiet zone and GS1 QR Code requires 4X quiet zones. Failing to meet these requirements would cause Decode to fail.

Quiet zones may also fail because the symbol is too close to the edge of the label. In that case, label feed must be adjusted to move the label edge farther from the symbol or the user must use a larger label, or alternatively a smaller X-dimension but not less than the minimum application standards of GS1 General Specifications.

If the Quiet zone parameter is a pass, Decode may fail due to other reasons. Other reasons may include the wrong construction of the data. This can be from check digit calculation or AI structural faults. This also triggers other parameters to fail such as GS1 Data Structure and/or validity.

9.1.2 Symbol Contrast

The symbol contrast is the difference between the lowest and the highest reflectance value of the image. In other words, the difference between the darkest part of the image and the lightest part of the image is called the symbol contrast. The lightest element can exist anywhere in the symbol, such as quiet zones and/or spaces. The darkest element will always be found in the dark square

modules, alignment patterns dark areas or dark cells of finder patterns. The lightest module's reflectance value is called R_{max} and darkest module's reflectance value is called R_{min}.

Symbol Contrast (SC) is calculated by:

$SC = R_{max} - R_{min}$

Symbol Contrast shall be graded as shown in the table:

Table 9-1 Symbol contrast grades

Symbol Contrast	Grade
≥ 70%	4
≥ 55%	3
≥ 40%	2
≥ 20%	1
< 20%	0

The higher the symbol contrast, the more easily dark and light cells can be distinguished. The best values can be obtained through dark images on a light background i.e. white background and black image.

Symbol contrast failure means that the background/substrate is too dark or the print is too light or both. This could be caused by the quality of the ink used, poor ribbon and substrate combination, or a poor worn out print head (in the print process).The image requires a solid, dark bar colour, with a contrasting solid, light background colour.

Failing to choose the right colour combination would also make symbol contrast fail.

Figure 9-1 Mapping of alphabetic and numeric overall symbol grades

9.1.3 Modulation

Modulation is related to Symbol Contrast in the sense that it measures the consistency of the reflectance of dark to light areas throughout the symbol. Uniformity of the symbol is the essence. Misplacement of the cells relative to where they should be or a shift in the printing can create a reduction in absolute value of the difference between the reflectance of a module and the Global Threshold. The Global Threshold is the average of the difference between the highest and the lowest reflectances in the scan so that the scanner can determine if the cell is light or dark. The uneven production of the symbol increases or decreases the global threshold as a consequence it increases the probability of the cell incorrectly identified as dark or light.

The modulation of each code word is calculated by

MOD = 2* (Absolute (R – GT))/SC

Where

MOD = Modulation

R = the reflectance of the module closest to the Global Threshold (GT) in the code word

GT = the Global Threshold

SC = the Symbol Contrast

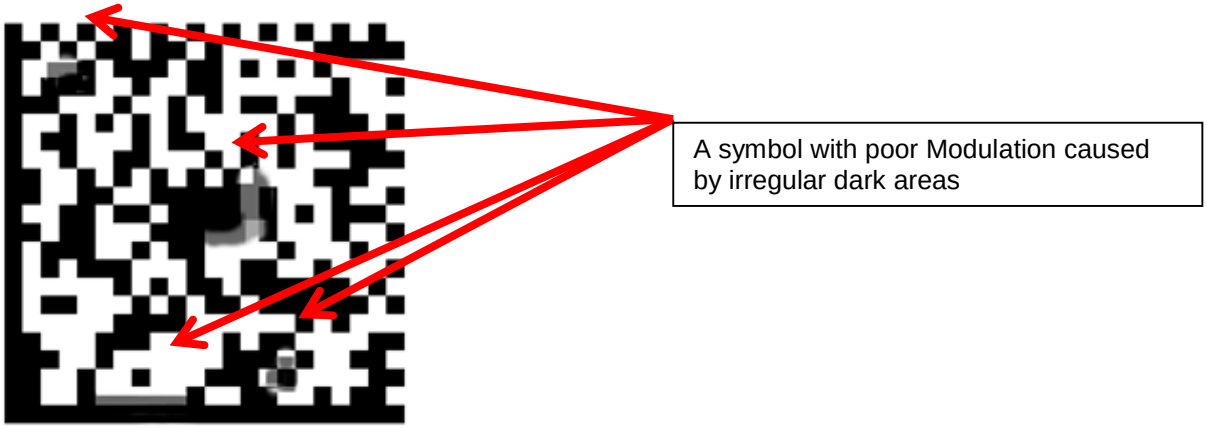
Table 9-2 Modulation grades

MOD	Code word Grade
≥ 0,50	4
≥ 0,40	3
≥ 0,30	2
≥ 0,20	1
< 0,20	0

The use of translucent and reflective substrates will affect the modulation value. Additionally to this, uneven printing, print head shift or paper shift, print growth or loss reduces the grade of the modulation.

Both actual code words and error correction code words are evaluated and the highest is accepted in the modulation grade.

Figure 9-2 GS1 DataMatrix with poor Modulation



9.2 ISO/GS1 2D Only Verification Parameters

9.2.1 Fixed Pattern Damage

Fixed Pattern Damage measures the grades on the 4 to 0 scale. It checks any damage to the finder patterns, quiet zones, clock tracks, timing, navigation and other fixed patterns that scanners use to locate and decode the symbol.

Each of these patterns is evaluated differently, and the lowest is reported. For example one GS1 DataMatrix can have 1X (1 time X-dimension) quiet zones and at the same time 20% damage on the clock track. Despite the damage it meets the minimum size for the quiet zone requirements; fixed pattern damage would be reported based on the clock track damage.

Figure 9-3 GS1 DataMatrix with damaged Clock Track

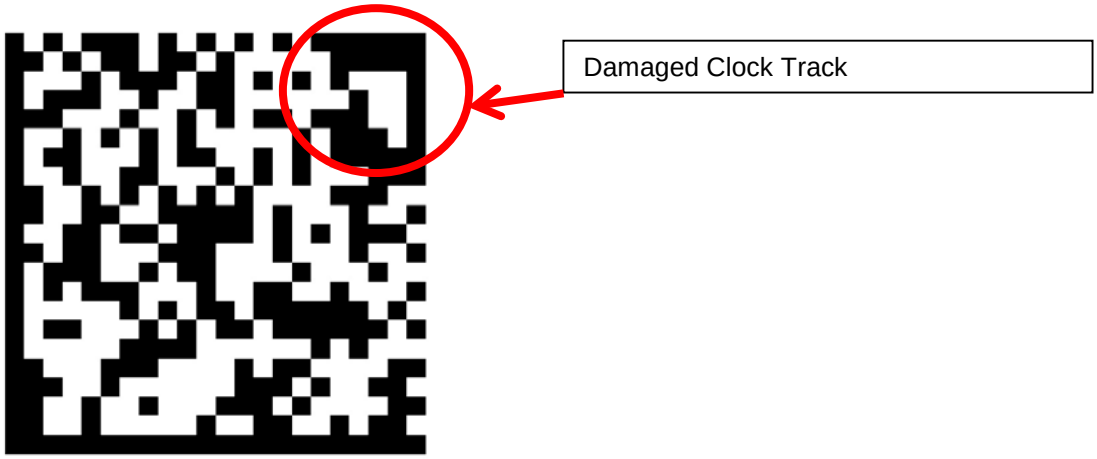
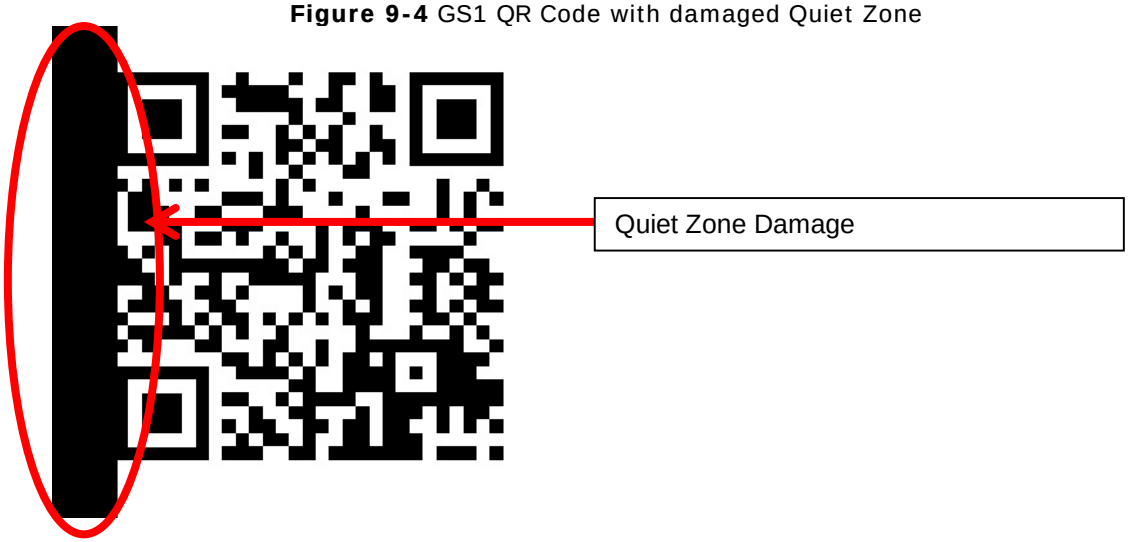


Figure 9-4 GS1 QR Code with damaged Quiet Zone



When fixed pattern fails, users should check to see exactly which fixed pattern fails for a specific symbol. These patterns and their correction recommendations are given in the following sections. Nevertheless, other main reasons for fixed pattern failure can be voids in the printing that can be the result of print head burn out or being worn out, spots of ink or other dark marks on the background.

Because fixed pattern damage also has a grade, this grade is a good indication of the percentage of failure of these patterns. Not all fixed patterns need to be corrected based on the value of the fixed pattern damage.

In the GS1 Verification report, only fixed pattern damage should be reported with associated reason being determined from the parameters of L1, L2, Quiet Zones, and Alignment Patterns etc. Individual parameter reporting would only confuse users and it will be hard for them to make corrective actions on the symbol.

9.2.1.1 Clock Track Regularity

It is a pass/fail test on the elements that make up the clock track. Clock track regularity (CTR) is a feature of a GS1 DataMatrix symbol only. The clock track portion starts with a dark module at the top left corner of the GS1 DataMatrix. The following module should be a light module and the next module should be a dark module again. This sequence continues until the right top corner of the symbol which should finish with the light module. Similarly, the clock track continues vertically with the same sequence but this time it ends at the right bottom corner of the GS1 DataMatrix with a dark module.

Failure to meet the sequence or structure of the clock track leads to a fail in the clock track regularity test. When a user sees a low grade in the fixed pattern damage as well as a low grade in the clock track regularity, this leads to the conclusion that the CTR needs to be corrected.

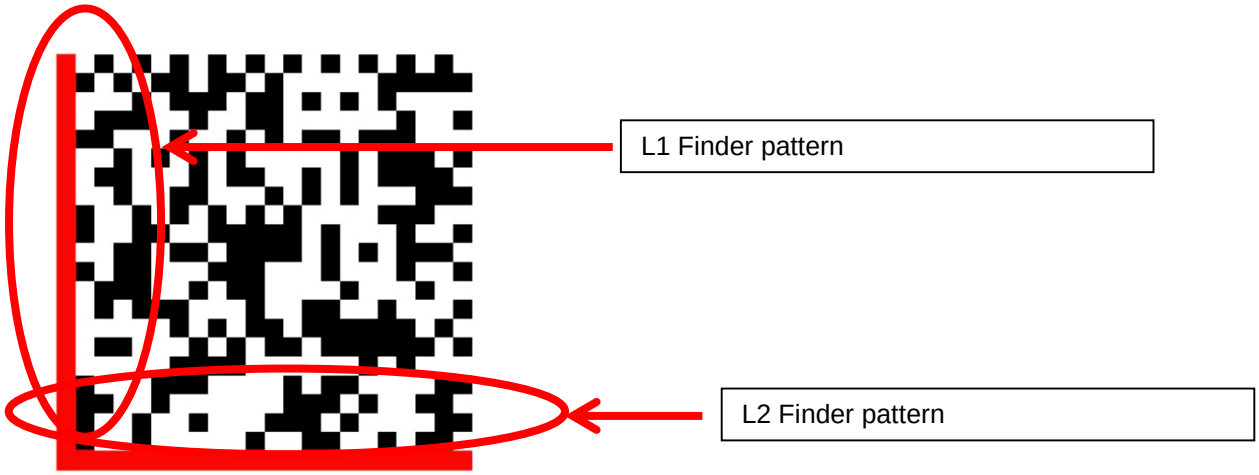
Table 9-3 Clock Track Regularity grades

Incorrect Modules (P)	Grade
P < 10%	4
10 % ≤ P < 15%	3
15% ≤ P < 20%	2
20% ≤ P < 25%	1
P ≥ 25%	0

9.2.1.2 L1 and L2

L1 is the GS1 DataMatrix's finder pattern that is located on the left of the symbol. L2 is the GS1 DataMatrix's finder pattern that is located on the bottom of the symbol. Missing or damaged L1 or L2 leads to difficulty for the scanner to locate the symbol. In that case it is a failure. The L1 pattern should be a sequence of solid dark modules from top left corner to the bottom left corner of the GS1 DataMatrix. The L2 finder pattern is also a solid sequence of modules from left bottom corner until the right bottom corner of the symbol. Please be aware that GS1 QR Code doesn't have L1 or L2 finder patterns. GS1 QR Code uses alignment patterns and timing patterns to locate the symbol.

Figure 9-5 GS1 DataMatrix L1 and L2 Finder Patterns



9.2.1.3 Quiet zones

The quiet zones are clear spaces that are free from any printed elements. Quiet zones surround four sides of the symbol. For GS1 DataMatrix the quiet zone is set to be equal to or greater than the minimum X-dimension for every side. For GS1 QR Code, the quiet zone is set to be equal to or greater than four times the X-dimension for every side. Formerly quiet zones were referred to as a "Clear Area" or a "Light Margin".

Incorrect quiet zones are a frequent source of scanning problems. The consequence of the quiet zone failure is that the scanner may identify the quiet zone area as light modules which can lead to either no decode or, very less likely, a mis-scan.

If the quiet zone fails, there are many reasons for it. It can be only observed by naked eye. It can be caused by interference during printing. There might be a dark spot around the symbol in the clear space and the background has a printed texture or simply that the symbol is too close to the edge of the label. However it can also come from an operator mistake such as selecting too small an inspection area to measure the parameters.

Figure 9-6 GS1 DataMatrix with the minimum quite zone

Figure 9-7 GS1 QR Code with a minimum quiet zone

9.2.2 Axial Non-uniformity (AN)

2D symbol modules must be in a square shape. When they together form a symbol, they lay in a regular square (if GS1 DataMatrix they may also be in rectangular form) grid with even scaling to the finder patterns. Axial non-uniformity tests for uneven scaling of the symbol on a scale of 4 to 0.

$AN = abs (X_{AVG} – Y_{AVG}) / ((X_{AVG}+Y_{AVG})/2)$

X_{AVG} = average spacing to the X axis

Y_{AVG} = average spacing to the Y axis

Axial non-uniformity shall be graded as shown in the table below:

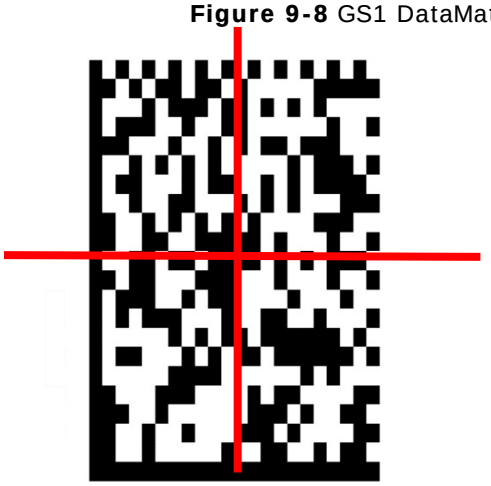
Table 9-4 Axial Non-uniformity grades

Axial Non-uniformity	Grade
≤ 0,06	4
≤ 0,08	3
≤ 0,10	2
≤ 0,12	1
> 0,12	0

Failure of the axial non-uniformity may hinder the readability at some lower angles.

Axial non-uniformity may fail due to mismatch of print speed with symbol dimensions, printing software errors, label stretched in one direction, print head damage or verifier is not perpendicular to the symbol.

Figure 9-8 GS1 DataMatrix with poor Axial Non-uniformity



9.2.3 Grid Non-uniformity

The grid non-uniformity measures and grades on a scale of 4 to 0 the largest vector deviation of the grid intersections. All grid intersections in the data area of the symbol are compared with positions of the ideal gird in a theoretical perfect symbol.

The greatest distance expressed as a fraction of the X-dimension of the symbol is taken as the value to grade the grid non-uniformity.

Figure 9-9 GS1 DataMatrix with poor Grid Non-uniformity

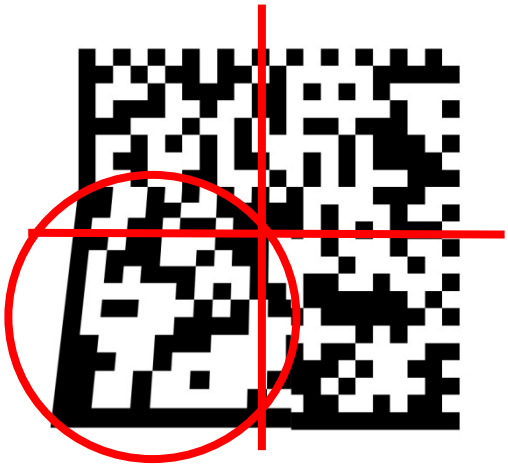


Table 9-5 Grid Non-uniformity grades

Grid Non-uniformity	Grade
≤ 0,38	4
≤ 0,50	3
≤ 0,63	2
≤ 0,75	1
> 0,75	0

9.2.4 Unused Error Correction (UEC)

The unused error correction measures and grades on the 4 to 0 scale the reading safety margin that error correction provides. Unused error correction indicates the amount of available error correction in a symbol.

UEC = 1,0 – ((e + 2t) / ECAP)

e = the number of deletions (erased or rubbed areas)

t = the number of errors

ECAP = The error correction capacity of the symbol, it is selected when you want to construct the symbol.

If no error correction has been applied and the symbol decodes perfectly well UEC = 1, if deletions and double of the number of errors are greater than the error correction capacity, then UEC = 0. UEC is calculated for each block of data and minimum shall be used for grading.

Table 9-6 Unused Error Correction grades

UEC	Grade
≥ 0,62	4
≥ 0,50	3
≥ 0,37	2
≥ 0,25	1
< 0,25	0

If unused error correction is low, it is due to the fact that there may be physical damage of scuffing, tearing or deletions, there may be print defects, excessive print growth, deformation on the symbol, or the modules are simply displaced. Symbols with a low unused error correction would not be scanned.

In the event of physical damage, the symbol may need to be reprinted.

For GS1 QR Code, the users should define the appropriate level of error correction to suit the application requirements. There are four levels of error correction in GS1 QR Code. L, M, Q and H.

Error correction level L is appropriate for high symbol quality and/or the need for the smallest possible symbol for given data. Level M is described as “Standard” level and offers a good compromise between small size and increased reliability. Level Q is a “High reliability” level and suitable for more critical or poor print quality applications while level H offers the maximum achievable reliability.

The error correction level should be determined in relation to:

the expected level of symbol quality: the lower the expected quality grade, the higher the level to be applied;

the importance of a high first read rate;

the opportunity for re-scanning in the event of a read failure;

the space constraints which might reduce the opportunity to use a higher error correction level.

9.2.5 Print Growth

Print growth is not a graded parameter but it is used as an informative measure for the purposes of process control. During the print process, it is inevitable that there will be some growth or shrinkage of the printed dots making up the image. If the growth or shrinkage is too large, then scanning performance will be impacted.

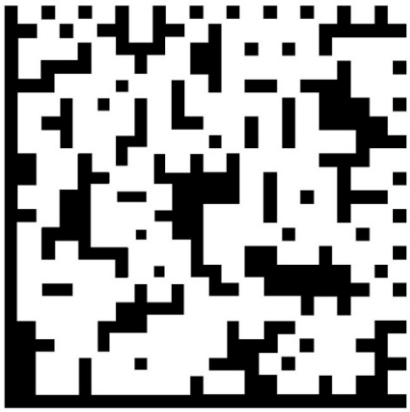
The print growth may be evaluated independently on both the X and Y axis to asses both horizontal and vertical growth.

Print growth is best evaluated by fixed structures or isolated elements such as finder pattern, timing pattern etc. that are the most indicative of element growth or shrinkage in each axis of the symbol.

The two examples below show the effects of print growth / shrinkage:

Figure 9-10 GS1 DataMatrix with print growth

Figure 9-11 GS1 DataMatrix with print shrinkage



9.2.6 Version information

The version information is specific to GS1 QR Code only. It is also only available on GS1 QR Code version 7 or higher. Version 7 represents the size of the GS1 QR Code. GS1 QR Codes start from 21X21 modules (version 1) to 177X177 modules (version 40); GS1 QR Code version 7 has the size of 45X45 modules and it is the first size that carries the version information.

In GS1 QR Code, the version information appears twice in the symbol to secure the correct decoding of the symbol. The version information areas are located above the timing pattern and immediately to the left of the top right finder pattern separator, and also to the left of the timing pattern and immediately above the lower left finder pattern separator.

Figure 9-12 GS1 QR Code with version information

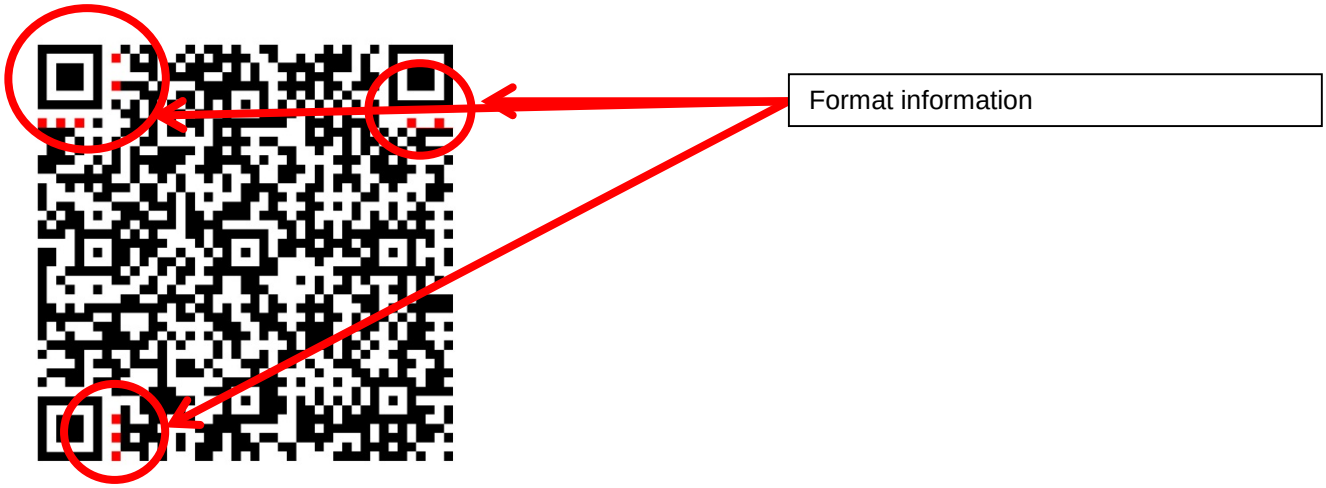
In the event of missing version information for the GS1 QR Codes version 7 or larger, it should be reported as failure both in fixed pattern damage and version information parameters.

9.2.7 Format Information

The format information is also available only on GS1 QR Code. It is the encoded pattern containing information on symbol characteristics essential to enable the remainder of the encoding region to be decoded. Format information appears twice in the symbol similarly to version information to secure the correct encoding and error correction of the symbol.

The format information areas are located immediately below of the top right finder pattern separator, and also immediately to the right of the lower left finder pattern separator.

Figure 9-13 GS1 QR Code with Format Information



In the event of missing format information for the GS1 QR Codes version 7 or higher, it should be reported in fixed pattern damage and version information parameters.

9.3 GS1 Parameters for 2D Verification

9.3.1 X-dimension (Module Size)

X-dimension defines the width of a single module in a 2D symbol. It is also referred as cell size for 2D symbols. The X-dimension of the symbol should be in the allowed range for a specific application table. In order to refer to the correct table please refer to the GS1 General Specifications GS1 Symbology Operational Environment Decision Tree.

A symbol having less than minimum allowed X-dimension or more than the maximum allowed X-dimension would receive a fail.

It is very important that the image should be scaled only with barcoding software. Many users are scaling the image in the design software. This leads to decoding problems as dimensions are not proportionally changed according to the symbol specifications.

9.3.2 Data Structure, Validity

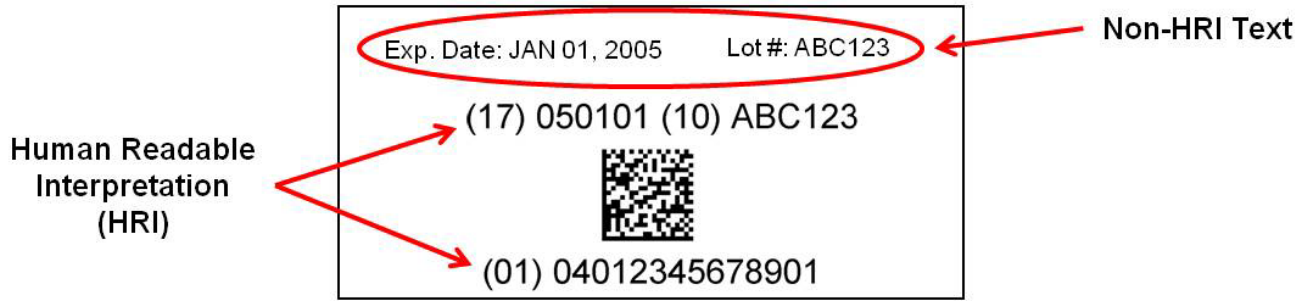
DataMatrix ECC 200 and QR Code 2005 are the only versions of these symbologies that support GS1 Data structures. Their implementation should be done according to approved GS1 Application standards. Data structures are agreed formations of the data and how data would be represented in a symbol.

The operator should check the data structures encoded in the symbols for their conformity to the approved GS1 data structures. Failing to encode a correct data structure such as incorrect check digit, missing digits in GTIN-14 etc. should be mentioned in the educational comments section of the GS1 Verification report.

9.3.3 Human Readable Interpretation for 2D

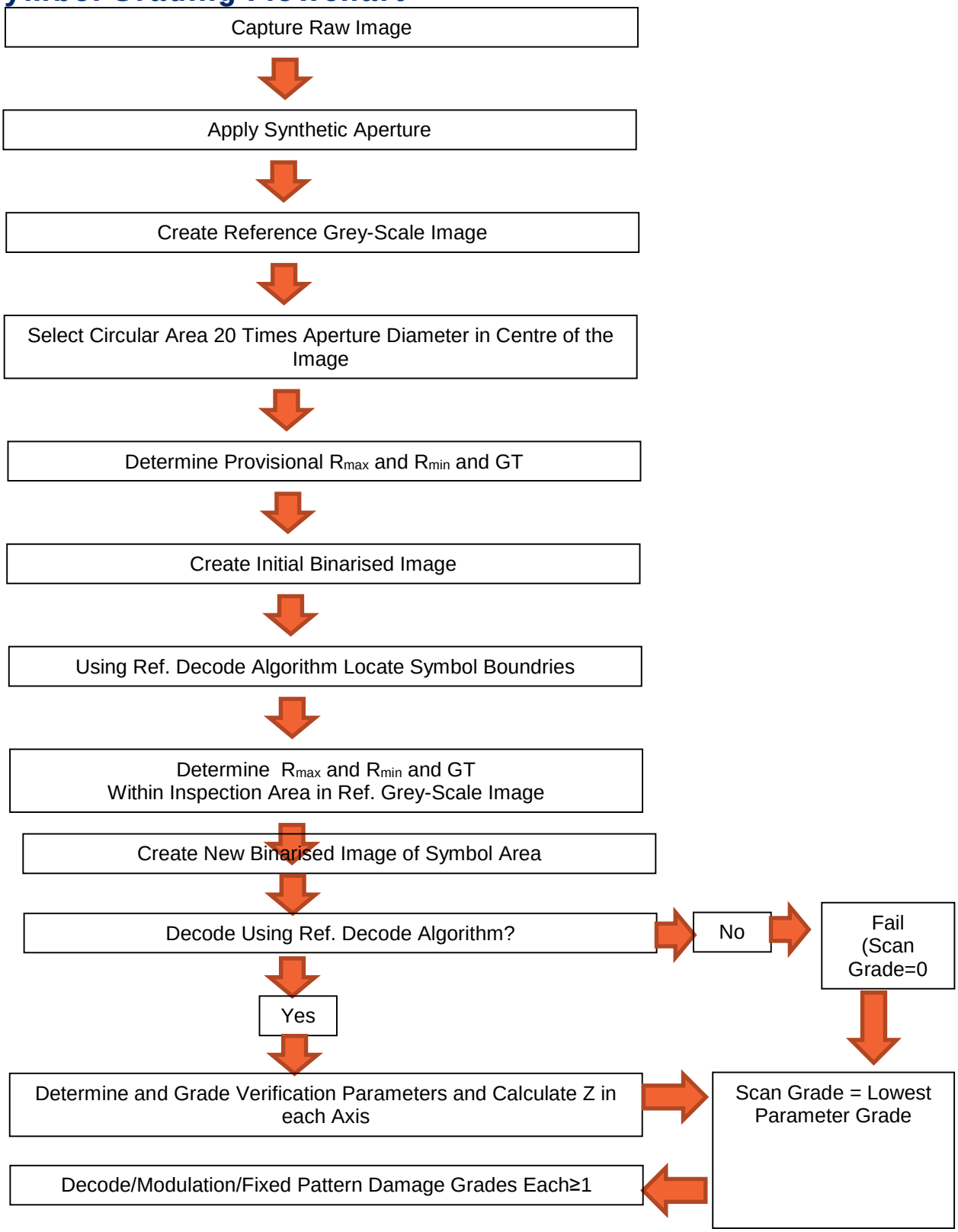
The Human Readable Interpretation (HRI) should be placed below the bar code and grouped together wherever physically possible while maintaining the HRI legibility and minimum bar code height (as specified in the appropriate Symbol Specification Table referenced by the GS1 AIDC Application Standard). The Human Readable Interpretation should not interfere with the symbol itself or the quiet zones.

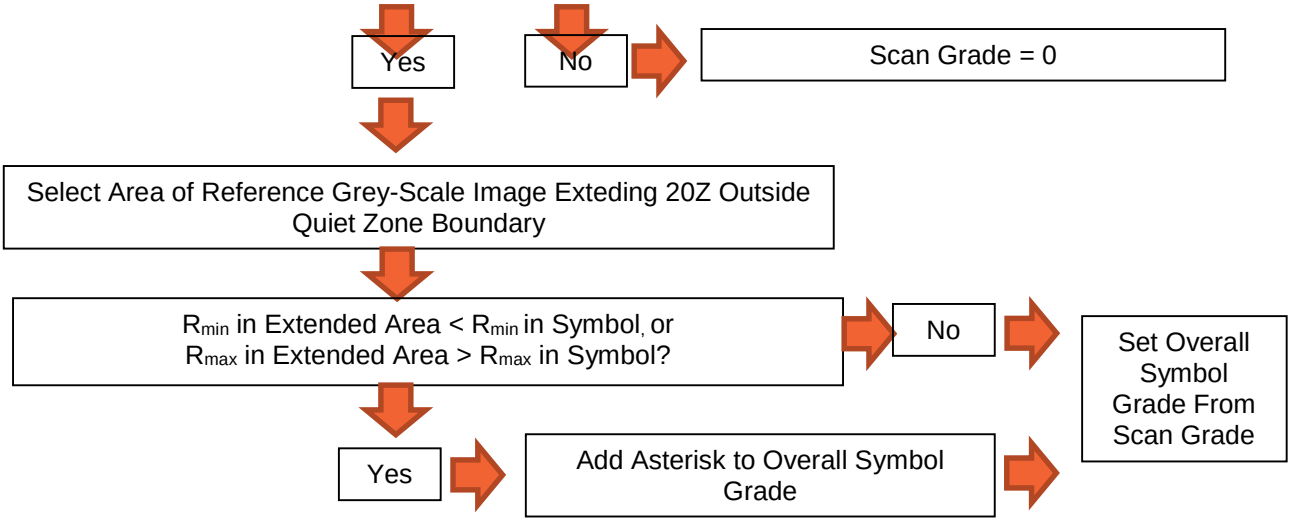
Figure 9-14 Example of HRI and Non-HRI Text



There are exceptions in HRI. All human readable interpretations should follow the rules stated in the GS1 General Specifications section 4.13.

A Symbol Grading Flowchart





B Application Specific Implementations

Check the GS1 General Specifications for the latest application specific implementations.

C Calibrated Conformance Test Cards

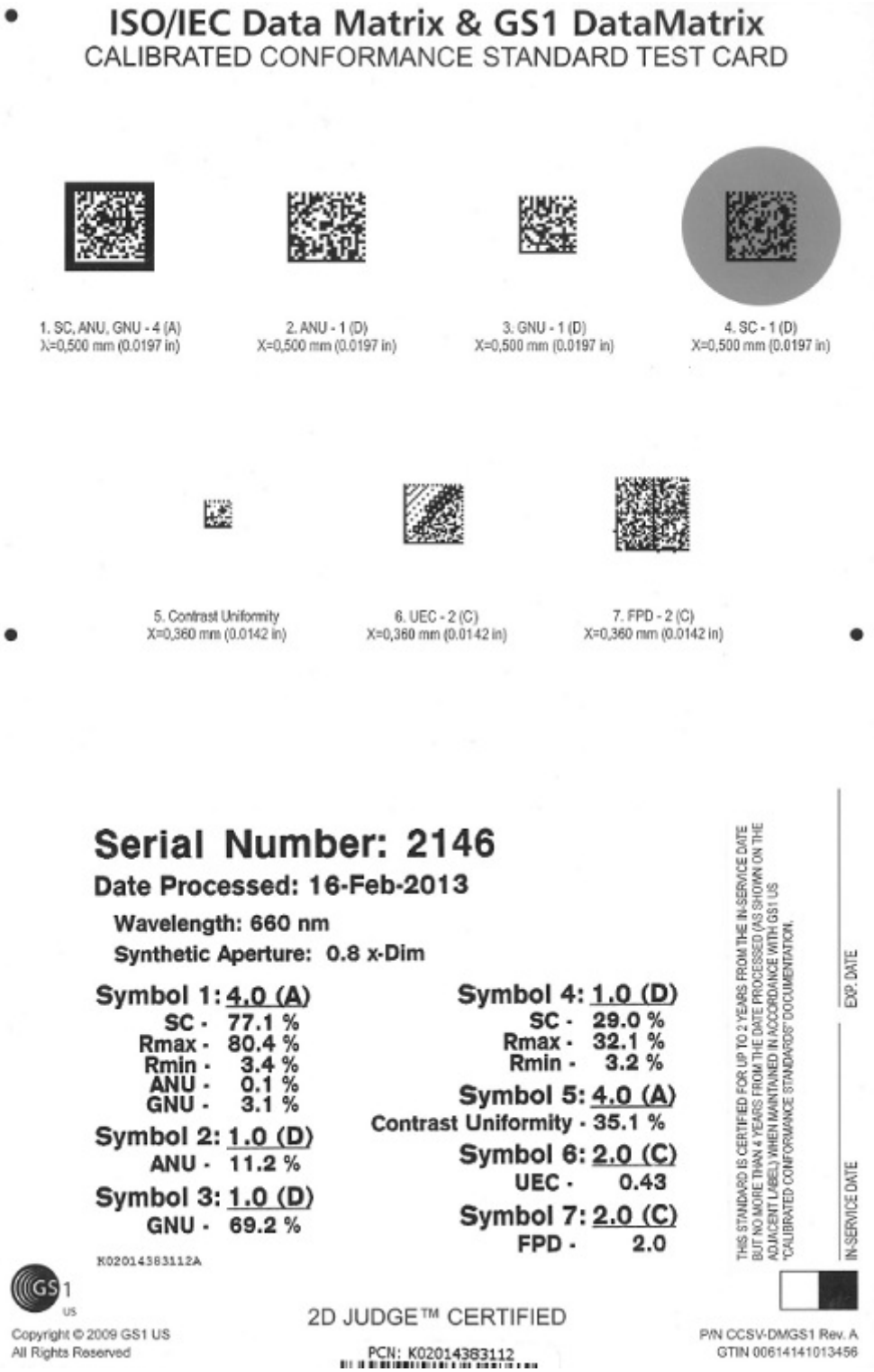
Calibration is appropriate for routine verifier use but periodically a calibration conformance test should be carried out. This will test whether the verifier is responding correctly to routine calibrations and therefore producing accurate results. It will also reveal any deterioration in the calibration materials – cards or tiles – that are used and may indicate any operator faults that affect results. Some verifier manufacturers offer annual calibration conformance testing on their equipment and will take it back to their premises for this purpose. Other verifier users may need to engage their equipment supplier to do the tests or may do the tests themselves.

The decision on how to perform calibration conformance testing and how often should be made in conjunction with the equipment supplier. It is a very important test and should not be overlooked. A verifier that appears to be functioning normally may in fact produce incorrect results if it has not been successfully tested for calibration conformance.

For those choosing to perform the tests themselves, GS1 provides Calibrated Conformance Test cards, produced and measured to a high degree of accuracy, enabling users to check that the readings obtained on their equipment are consistent and accurate

At the time of the writing, there is no available calibrated conformance standard test card for GS1 QR Code.

GS1 DataMatrix Calibrated Conformance Standard Test Card



D GS1 Barcode Verification Template

<NAME>
<Line one address>
<Line two address>
<Town>
<Postcode>

Issue Date<Date of Issue>

Product Description:	<Brand and Name of Product>
Type of barcode:	<Symbol Type>
Data encoded:	< Data Encoded>
Print Method:	<Print Method>
Number of barcodes on product:	<Number of Symbols>

Please Note: **These assessments are based on meeting the minimum GS1 standards.**
To ensure efficient scanning, the barcode should exceed the minimum.

Testing Summary of the Two-Dimensional Symbol

GS1 General Specifications for Two-Dimensional Symbols, environments tested:
PASS or FAIL or Not assessed Healthcare Items (Healthcare Retail Consumer Item or Healthcare Non-Retail Consumer Item or Healthcare Trade Item)
PASS or FAIL or Not assessed Direct Part Marking
PASS or FAIL or Not assessed Extended Packaging

Complies to GS1 Symbol Location Recommendations	In/Out Spec (& comment on business critical issue)
ISO Symbol Grade	ISO <x.x>/06/660 (0.0 – 4.0) PASS/FAIL

Business Critical Comments

Technical Analysis of the Two-Dimensional Symbol

GS1 Parameters	Comment Reference	Values	Within Standard	Required
Symbol Structure			✓	Dependent on symbol encoded
Matrix Size		NN X NN	✓	
X Dimension/Cell Size		in mm / inc	✓	
Data Structure			✓	Dependent on structure encoded
Validity of GS1 Company Prefix			✓	
Human Readable			✓	

ISO/IEC Parameters	Comment Reference	ISO Grade A to F	Within Standard Range?	Required
Overall ISO Grade			✓	
Decode		PASS /FAIL	✓	
Cell Contrast/Symbol Contrast		A-F	✓	
Cell Modulation/ Modulation		A-F	✓	
Axial Non-uniformity		A-F	✓	
Grid Non-uniformity		A-F	✓	
Unused Error Correction (UEC)		A-F	✓	
Print Growth (Horizontal) Informative Only		0%-100%		
Print Growth (Vertical) Informative Only		0%-100%		
Fixed Pattern Damage		A-F	✓	
Clock Track and Solid Area Regularity*		A-F	✓	
QuietQuiet Zones (QZL1, QZL2)*		A-F	✓	
L1 and L2*		A-F	✓	
Format Information**				
Version Information**				

Educational Comments [1]

[1] Educational comments are based on the technical analysis of the symbol. In this comment box the operator comments on what the problem is and how to make the symbol better by explaining the parameter's meanings.

Notes (informative localised)

It is the responsibility of the brand owner to ensure the correct use of the GS1 Company Prefix and the correct allocation of the data content.

Rejection of products should not necessarily be based only on an out of specification results

Barcode verifiers are measuring devices and are tools that can be used for assisting in quality control. The results are not absolute in that they do not necessarily prove or disprove that the barcode will scan.

This report may not be amended after issue. In the event of a dispute over contents the version held at [TESTING AGENCY] will be deemed to be the correct and original version of this report.

* GS1 DataMatrix Only, see *ISO/IEC 15415*

** GS1 QR Code Only, see *ISO/IEC 15415*,

all others are both for GS1 DataMatrix and GS1 QR Code

Important Note (normative localised)

This Verification Report may contain privileged and confidential information intended only for the use of the addressee named above. If you are not the intended recipient of this report you are hereby notified that any use, dissemination, distribution or reproduction of this message is prohibited. If you received this message in error please notify [TESTING AGENCY].

Disclaimer (legal localised)

This report does not constitute evidence for the purpose of any litigation, and [TESTING AGENCY] will not enter into any discussion, or respond to any correspondence in relation to litigation.

Every possible effort has been made to ensure that the information and specifications in the Barcode Verification Reports are correct, however, [TESTING AGENCY] expressly disclaims liability for any errors.

E Normative Reference Documents

The following reference material will be useful to a more sophisticated service:

GS1 General Specifications

GS1 1D Barcode Verification Process Implementation Guide

GS1 DataMatrix an introduction and technical overview of the most advanced GS1 Application Identifiers complaint symbology

ISO/IEC 15415 Information technology – Automatic identification and data capture techniques – Bar code print quality test specification – two-dimensional symbols

ISO/IEC 16022:2006 Information technology – Data matrix bar code symbology specification

ISO/IEC 18004 Information technology – Automatic identification and data capture techniques – QR Code 2005 bar code symbology specification

ISO/IEC 15424 Information technology – Automatic identification and data capture techniques – data carrier identifiers (including symbology identifiers)

GS1 Conformance Calibrated test cards (as needed)

F Glossary of Terms

Term	Definition
2-Dimensional Symbology	Optically readable symbols that must be examined both vertically and horizontally to read the entire message. Two-dimensional symbols may be one of two types: matrix symbols and multi-row symbols. Two-dimensional symbols have error detection and may include error correction features.
alphanumeric (an)	Describes a character set that contains alphabetic characters (letters), numeric digits (numbers), and other characters, such as punctuation marks.
Aperture	A physical opening that is part of the optical path in a device such as a scanner, photometer, or camera. Most apertures are circular, but they may be rectangular or elliptical.
Attribute	An Element String that provides additional information about an entity identified with a GS1 Identification Key, such as Batch Number associated with a Global Trade Item Number (GTIN).
Automatic Identification and Data Capture	A technology used to automatically capture data. AIDC technologies include barcodes, smart cards, biometrics and RFID.
barcode	A symbol that encodes data into a machine readable pattern of adjacent, varying width, parallel, rectangular dark bars and light spaces.
Barcode Verification	The assessment of the printed quality of a barcode based on ISO/IEC standards using ISO/IEC compliant barcode verifiers.
bar gain/loss	The increase/decrease in bar width due to effects of the reproduction and printing processes.
Check Digit	A final digit calculated from the other digits of some GS1 Identification Keys. This digit is used to check that the data has been correctly composed. (See GS1 Check Digit Calculation.)
Cell size	Defines the width and height of a single module in a 2D symbol. See X-dimension.
Company Number	A component of the GS1 Company Prefix.
data character	A letter, digit, or other symbol represented in the data field(s) of an Element String.
Data Matrix	A standalone, two-dimensional matrix symbology that is made up of square modules arranged within a perimeter finder pattern. Data Matrix ISO version ECC 200 is the only version that supports GS1 System identification numbers, including Function 1 Symbol Character. Data Matrix Symbols are read by two-dimensional imaging scanners or vision systems.
data field	A field that contains a GS1 Identification Key, an RCN, or attribute information
data titles	Data titles are the abbreviated descriptions of Element Strings which are used to support manual interpretation of barcodes.
Direct Part Marking	Direct part marking refers to the process of marking a symbol on an item using an intrusive or non-intrusive method.
direct print	A process in which the printing apparatus prints the symbol by making physical contact with a substrate (e.g., flexography, ink jet, dot peening).
Element	A single bar or space of a barcode.
Element String	The combination of a GS1 Application Identifier and GS1 Application Identifier Data Field.
Extended Packaging	An approach to giving consumers access to additional information or services about trade items through their mobile device. It is the ability to retrieve additional information about the trade item through mobile devices or in general between link a trade item with virtual information or services.
Full String	The data transmitted by the barcode reader from reading a data carrier, including the symbology identifier as well as the encoded data.
Function 1 Symbol Character (FNC1)	A symbology character used in some GS1 data carriers for specific purposes.

Term	Definition
General Distribution Scanning	Scanning environments that include barcoded trade items packaged for transport, logistic units, assets, and location tags.
General Retail Consumer Trade Item	A retail consumer trade item identified with a GTIN-13, GTIN-12 or GTIN-8 utilising omnidirectional linear barcodes that can be scanned by high-volume, omnidirectional scanners.
Global Trade Item Number (GTIN)	The GS1 Identification Key used to identify trade items. The key comprises a GS1 Company Prefix, an Item Reference and Check Digit.
GS1 Application Identifier	The field of two or more digits at the beginning of an Element String that uniquely defines its format and meaning.
GS1 Application Identifier data field	The data used in a business application defined by one application identifier.
GS1 B2C Trusted Source of Data (TSD)	A GS1 managed network concept that leverages GTIN (product identification) and GDSN (product information) and would support the communication of authentic product data provided by brand owners to retailers, internet application providers, government, and consumers and shoppers using internet and mobile devices (phones, laptops, etc.).
GS1 Check Digit Calculation	An algorithm used by the GS1 System for the calculation of a Check Digit to verify accuracy of data. (e.g. Modulo 10 check digit, Price check digit).
GS1 DataMatrix	GS1 implementation specification for use of Data Matrix
GS1	Based in Brussels, Belgium, and Princeton, USA, it is the organisation that manages the GS1 System. Its members are GS1 Member Organisations.
GS1 Identification Key	A numeric or alphanumeric data field defined by GS1 to ensure the global, unambiguous uniqueness of the identifier in the open demand or supply chain.
GS1 Identification Keys	A globally managed system of numbering used by all GS1 Business Units to identify trade items, logistic units, locations, legal entities, assets, service relationships, consignment, shipments and more. Any identification number that combines GS1 member company identifiers (GS1 Company Prefix) with standards based rules for allocating reference numbers is a key.
GS1 Member Organisation	A member of GS1 that is responsible for administering the GS1 System in its country (or assigned area). This task includes, but is not restricted to, ensuring brand owners make correct use of the GS1 System, have access to education, training, promotion and implementation support and have access to play an active role in GSMP.
GS1 QR Code	GS1 implementation specification for use of QR Code
GS1 System	The specifications, standards, and guidelines administered by GS1.
Human Readable Interpretation (HRI)	Characters, such as letters and numbers, which can be read by persons and are encoded in GS1 AIDC data carriers confined to a GS1 standard structure and format. The Human Readable Interpretation is a one-to-one illustration of the encoded data. However Start, Stop, shift and function characters, as well as the Symbol Check Character, are not shown in the human readable interpretation.
Identification number	A numeric or alphanumeric field intended to enable the recognition of one entity versus another.
Item Reference	A component of the Global Trade Item Number (GTIN) assigned by the brand owner to create a unique GTIN.
Linear Barcode	Barcode symbology using bars and spaces in one dimension.
Module	The narrowest nominal width unit of measure in a barcode. In certain symbologies, element widths may be specified as multiples of one module. Equivalent to X-dimension.
Non-HRI Text	Characters such as letters and numbers that can be read by persons and may or may not be encoded in GS1 AIDC data carriers and are not confined to a structure and format based on GS1 standards (e.g., a date code expressed in a national format that could be used to encode a date field in a GS1 AIDC data carrier, brand owner name, consumer declarations).

Term	Definition
Point-of-Care (POC)	Dispensing or use of a non-retail, regulated healthcare pharmaceutical or medical device to a patient based on right product, dose, and route of administration
Point-of Sale (POS)	Refers to the retail checkout where omnidirectional barcodes must be used to enable very rapid scanning or low volume checkout where linear or 2D matrix barcodes are used with image-based scanners.
Quiet Zone	A clear space which precedes the Start Character of a barcode and follows the Stop Character. Formerly referred to as “Clear Area” or “Light Margin”.
Quiet Zone Indicator	A greater than (>) or less than (<) character, printed in the human readable field of the barcode, with the tip aligned with the outer edge of the Quiet Zone.
QR Code	A two-dimensional matrix symbology consisting of square modules arranged in a square pattern. The symbology is characterised by a unique finder pattern located at three corners of the symbol. QR Code Version 2005 is the only version that supports GS1 System identification numbers, including Function 1 Symbol Character. QR Code Symbols are read by two-dimensional imaging scanners or vision systems.
Scanner	An electronic device to read barcode and convert them into electrical signals understandable by a computer device.
Separator Character	Function 1 Symbol Character used to separate certain concatenated Element Strings, dependent on their positioning in the GS1 Barcodes.
Serial number	A code, numeric or alphanumeric, assigned to an individual instance of an entity for its lifetime. Example: Microscope model AC-2 with serial number 1234568 and microscope model AC-2 with serial number 1234569. A unique individual item may be identified with the combined Global Trade Item Number (GTIN) and serial number.
Serial Reference	A component of the Serial Shipping Container Code (SSCC) assigned by the brand owner to create a unique SSCC.
Shipment	A grouping of logistics and transport units assembled and identified by the seller (sender) of the goods travelling under one despatch advice and/or Bill of Lading to one customer (recipient).
Special characters	Special characters that are designated by the symbology specification.
Standard trade item grouping	A standard composition of trade item(s) that is not intended for Point-of-Sale scanning. They are identified with a GTIN-14, GTIN-13, or GTIN-12.
Substrate	The material on which a barcode is printed.
Subject of Care	Any person who uses or is a potential user of a health care service, subjects of care may also be referred to as patients or health care consumers
Supplier	The party that produces, provides, or furnishes an item or service.
Symbol	The combination of symbol characters and features required by a particular symbology, including Quiet Zone, Start and Stop Characters, data characters, and other auxiliary patterns, which together form a complete scannable entity; an instance of a symbology and a data structure.
Symbol character	A group of bars and spaces in a symbol that is decoded as a single unit. It may represent an individual digit, letter, punctuation mark, control indicator, or multiple data characters.
Symbol Check Character	A symbol character or set of bar/space patterns included within a GS1-128 or GS1 DataBar Symbol, the value of which is used by the barcode reader for the purpose of performing a mathematical check to ensure the accuracy of the scanned data. It is not shown in Human Readable Interpretation. It is not input to the barcode printer and is not transmitted by the barcode reader.
Symbol Contrast	An ISO/IEC 15416 parameter that measures the difference between the largest and smallest reflectance values in a Scan Reflectance Profile (SRP).
Symbology	A defined method of representing numeric or alphabetic characters in a barcode; a type of barcode.
Symbology element	A character or characters in a barcode used to define the integrity and processing of the symbol itself (e.g., start and stop patterns). These elements are symbology overhead and are not part of the data conveyed by the barcode.

Term	Definition
Symbology identifier	A sequence of characters generated by the decoder (and prefixed to the decoded data transmitted by the decoder) that identifies the symbology from which the data has been decoded.
Trade item	Any item (product or service) upon which there is a need to retrieve pre-defined information and that may be priced, or ordered, or invoiced at any point in any supply chain.
X-dimension (cell size)	The specified width of the narrowest element of a barcode.