GSMP:

# General Specifications Change Notification (GSCN)

| GSCN # | GSCN Name | Submission Date | Status |
|---|---|---|---|
| **WR15-259** | **Film Master Production** | May 2016 | Ratified |

## Associated Work Request (WR) Number:

15-259

## Background:

- The explanations of barcode production section 5.5.3.2 and quality assessment section 5.5.3.3 (the use of barcode verifiers) are outdated, and would be better if they reflected present practices.
- To ensure that these explanations of barcode production and quality assessment explain briefly and accurately the methods to be followed.
- Updates to the film master production within the GS1 General Specifications sections 5.5.3.2 Barcode master Image Production and 5.5.3.3. Quality Assessment.

## GS1 General Specification Change:

The recommended changes are highlighted in the attached excerpt from the GS1 General Specifications, v16.

### 5.5.3.2 Barcode master image Film master production

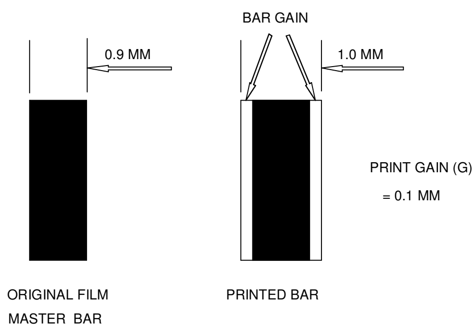
Commented [CJ7]: WR15-259 – several changes

#### 5.5.3.2.1 Introduction

For symbols in the EAN/UPC symbology family, the biggest usage of verification has always been in conjunction with printing and production of packaging and labels by means of the conventional or "wet ink" printing processes, such as offset lithography, flexography, and photogravure. . A barcode master image is required as part of the production of printing plates for these processes. These printing processes use a film master as the initial artwork of the symbol, although some form of electronic origination of the symbol is increasingly replacing this high-precision article.

The first point at which one might use verification is the a printability test stage prior to before actual production of the "real-life" symbols, where a printing run of including a test symbol is carried out under normal conditions. The test barcode is then verified and measured in order to characterise the printing process for a particular press and printing substrate. It is necessary to assess how much bar gain (or loss) has occurred and over what range of variation, to decide how much bar width adjustment (BWA) is required. Bar gain will mean that the printed bars are wider than those of the master image, so the master image will need to be adjusted to compensate for this. BWA can be in the form of bar width reduction (BWR), where there is bar gain, or the less common bar width increase (BWI). The required BWA is associated with the X-dimension used. These details are required in order to specify the film master image correctly, or as input parameters for the barcode origination software.

**Figure 5.5.3.2.1-1.** Example of bar width adjustment




Verifying the film master on receipt confirms that the correct BWA has been applied and that it is otherwise as specified. Note that a special type of verifier using traditional measurement and capable of more precise measurement is necessary at this point, since film master requirements are specified in terms of element widths and are subject to tolerances of only plus or minus five microns for EAN/UPC symbols. In addition, the verifier needs to be capable of measuring the intensity of light transmitted through, rather than that reflected by, the film material. Also, film masters may be either photographic positives or negatives, and in the latter case, the light and dark characteristics of the background and bars are reversed. In the absence of such a verifier, reliance may be placed on the verification report normally provided by the film master supplier with the master.

If a proof of the print job is produced, the barcode should be verified as part of the approval process. Note, however, that since proofing presses are not the same as production printing presses, there may be a slight difference in the quality of the proof and the production job.

While the presses are being made ready, a check of bar widths on the first few printed sheets can help to ensure that the press is correctly set to produce near-ideal bar widths. Once the presses have started to roll, periodic sampling should be carried out, at intervals based on experience or dictated by the company's quality control procedures, to monitor both bar widths and other aspects of symbol quality (in particular symbol contrast), since these are the attributes most easily adjusted during the run.

Finally, a further sample should be verified following completion of the print job. The Scan Reflectance Profile (SRP) analysis SHALL be used as the basis for decision making, to ensure that the job has achieved at least the minimum quality grade specified by the customer or based on the application.

The following items are recommended to appear on or with a film master image file:

- X-dimension (magnification factor).
- Selected bar (line) width reduction.
- Product identification, including company name.
- A test square (outside the symbol area) for emulsion studies (this should be incorporated in the film, not affixed on a separate label).
- Printing process for which the film master image is intended.
- Identification of the film master image supplier.
- Date of film master image manufacture.

#### 5.5.3.2.2 Terms and definitions

Definitions for the following terms are found in *ISO/IEC 15421*, section 4:

- Achieved bar width difference.
- Bar edge.
- Bar edge conformance.
- Bar edge contour.
- Bar edge gradient.
- Bar width adjustment (BWA).
- Bar width increase (BWI).
- Bar width reduction (BWR).
- Bar width tolerance.
- Base density.
- Negative image.
- Nominal bar width (EAN/UPC Family).
- Optical density profile.
- Polarity.
- Positive image.
- Specified bar width.
- Target element width.

#### 5.5.3.2.35.5.3.2.2 Master imagePhysical requirements

The master image must be produced at an appropriate resolution for the hardware device which will produce the physical image of the barcode on paper, photographic film, printing plate or other substrate. The associated software which converts the input data (the master image) into digital instructions to drive the hardware device is equally important. The general principles and requirements that should be followed are explained in ISO/IEC 15419 Information Technology, Automatic Identification and Data Capture Techniques, Bar Code Digital Imaging and Printing Performance. This international standard sets out general principles governing the barcode image generation function in each component, supplemented by more specific details applicable to certain major categories of software and hardware.

The physical requirements for a film master are found in section 6 of ISO/IEC 15421 Information technology -- Automatic identification and data capture techniques -- Bar code master test specifications.

~~Physical requirements consisting of the following topics are found in section 6 of *ISO/IEC 15421 Information Technology, Automatic Identification and Data Capture Techniques, Bar Code Master Test Specifications*:~~

- ~~Material:~~
  - ~~Dimensional stability.~~
  - ~~Archival properties.~~
- ~~Physical requirements controlled by the manufacturing process:~~
  - ~~Target bar width.~~
  - ~~Bar width adjustment (BWA).~~
- ~~Tolerances:~~
  - ~~Tolerance A – all symbologies.~~
  - ~~Tolerance B – two-width symbologies.~~
  - ~~Tolerance C – (n,k) symbologies.~~
  - ~~Tolerance D – all symbologies.~~
- ~~Bar edge characteristics:~~
  - ~~Bar edge conformance.~~
  - ~~Bar edge gradient.~~
- ~~Defects.~~
- ~~Quiet Zones.~~
- ~~Corner marks.~~
- ~~Optical densities (including table "Reference Density Values," and, from informative reference Annex A of *ISO/IEC 15421 Optical Density Profiles*, the following figures: Minimum and Maximum Values of Optical Density, Measurement of Slope, Threshold Point for Bar Edge Determination, Measurements for Ratio-Based Symbologies, Measurements for (n,k) Symbologies, and Symbol Character Pitch Measurement):~~
  - ~~Minimum density ($D_{min}$).~~
  - ~~Maximum density ($D_{max}$).~~
- ~~Orientation.~~
- ~~Polarity.~~
- ~~Encodation.~~
- ~~Human readable interpretation.~~
- ~~Test Methods:~~
  - ~~Bar and space width measurement.~~
  - ~~Conditions for dimensional measurements.~~
  - ~~Calculation of the achieved BWA.~~
  - ~~Test report and traceability.~~

### 5.5.3.3 Quality assessment

#### 5.5.3.3.1 Verification

Commented [CJ8]: WR15-259 – several changes

Verification is the technical process by which a barcode is measured to determine its conformance with the specification for that symbol. Verification is not intended to be used alone as a method for downstream rejection. For example, GS1's advice is to use the *ISO/IEC 15416* or *ISO/IEC 15415* methodologiesy as a toolthe basis to improve overall scanning performance. An ISO/IEC-based verifier is of enormous assistance in diagnosing the problem and providing a standard means of reporting among printing companies and their trading partners.

It is also important to note the difference between a scanner and a verifier. A verifier is a measuring tool by which one can make certain determinations concerning the ability of the symbol to do its job, namely, to carry and deliver data on demand. ~~Because traditional verification measurement is typically made in a single scan across the symbol, it is uncertain whether this "snapshot" is truly representative of the symbol's characteristics throughout the symbol.~~

When interpreting the results from verification it is also important to remember that:

- Most verifiers do not measure symbol height.
- Without additional software linking the decoded data to a database, the quality and accuracy of the data content of a symbol cannot be confirmed.
- ~~The verifier cannot confirm that the symbol dimensions are those intended and are as indicated in symbol specification tables (SSTs). For example, many of the simpler verifiers cannot measure in dimensional terms (X-dimension), though they can be remarkably accurate in measuring the relationships of element widths to each other. The amount that bar widths differ from nominal width on average in a symbol is called the average bar error. This number is expressed as a fraction of X-dimension. A positive value indicates average bar growth and a negative value indicates bar shrinkage.~~
- The verifier does not check that the human readable interpretation matches the barcode data (and it is necessary to check that the two correspond, particularly where the barcode generating software does not include human readable interpretation data).
- Because only a sample of the symbols produced are actually verified, the quality of all the symbols in a production batch cannot be guaranteed beyond the statistical confidence limits associated with the sampling rate used.
- Even a perfect symbol at the time of production can be damaged or otherwise affected in its passage through the supply chain (e.g., scratched, frozen, dampened).
- Operator error can cause inconsistent results. Operators should be properly trained and visual checks should be made to confirm verifier results (e.g., where the barcode is expected to get a good result and fails the verifier test, recheck the operation of using the verifier).
- The correct barcode has been printed for the scanning environment of the item (e.g., an ITF-14 symbol SHALL NOT be used on an item intended for retail point-of-sale).

##### 5.5.3.3.1.1 Traditional verification (informative)

Traditional verification methods were introduced in the early to mid-1970s and were based on the measurement of two symbol parameters: print contrast signal (PCS) and the bar width deviation. If the bar (or space) widths were within a defined (but somewhat arbitrary) tolerance, and if PCS was above a defined minimum value, the symbol was regarded as being "in spec."

Initially, none of these measurements were automated, and human factors affected the accuracy and consistency of measurements. Also, checking that the symbol was correctly encoded was a laborious task. However, within a few years, instruments were developed that performed these measurements automatically. These were the first true verifiers that enabled the printer to take steps to produce the symbols as nearly perfectly as this process allowed.

Traditional verification does not necessarily give results that correlate very closely with the actual scanning performance of the symbols. One reason is that the assessment of the symbol gives only a single threshold for acceptability: "Pass" or "Fail." In addition if the assessment is based on a single scan across the symbol, which might be through an exceptionally good or bad section of the symbol, it cannot be guaranteed to be truly representative of its condition.

Measurements of bar gain or loss are less meaningful in the case of certain symbologies, like the EAN/UPC symbology and the GS1-~~-~~128 barcode, where decoding relies primarily on edge-to-similar-edge distances, which are relatively immune to even substantial amounts of consistent gain or loss across the symbol. These distances are measured from the leading edge of one bar to the leading edge of the next (or from one trailing edge to the next), which tends to move in the same direction if there is bar gain or loss. A more subtle factor is that the method is not standardised, either as to where the dark and light reflectance (or density) measurements are made for the calculation of PCS, or as to how the exact position of an element edge is defined, so that some models of verifier could assess a given symbol as "Pass" whereas others could "Fail" it – a source of potential and, indeed, actual disagreements among suppliers and customers.

#### 5.5.3.3.1.2 ISO/IEC verification

During the 1980s~~, two factors led to attempts to improve the traditional verification technique. One was the disparity between traditional verification results and the real life performance of symbols, and the other was the increasing number of product rejections by customers based on differing verification results between the supplier's instrument and his customer's.~~

~~A wide-ranging programme by~~ a group of experts from barcode and user industries working on all types of scanning systems determined the factors that most directly affect symbol-scanning performance and resulted in the analysis of the Scan Reflectance Profile (SRP). This methodology was originally known as ANSI verification because it was first described in the United States' standard ANSI X3.182, published in 1990 under the title *Bar Code Print Quality Guidelines*. The method was then defined in a European standard (*EN 1635*), published in 1995, and an international standard (*ISO/IEC 15416*), published in 2000. *ISO/IEC 15416* is the definitive international specification of the ISO/IEC linear barcode verification methodology, and the numeric grading system is used.

The method, as described in the *ISO/IEC 15416* standard, is technically fully compatible with the ANSI X3.182 and *EN 1635* method, so verifiers based on these standards are not obsolete. ~~Additionally, *ISO/IEC 15415* standard achieves comparable results to the linear barcode symbol quality standard *ISO/IEC 15416*, with the modifications in terms of parameters and methodologies that are applicable to two dimensional symbols.~~

*ISO/IEC 15415* is the equivalent definitive international standard for two-dimensional barcode symbols, with one methodology applicable to multi-row barcodes and the other to two-dimensional matrix symbols. In addition *ISO/IEC TR 29158 Direct Part Mark (DPM) Quality Guideline* is relevant when assessing the quality of symbols marked directly to the surface of an item.

In simple terms, an ISO/IEC verifier looks at the symbol in exactly the same way a scanner sees it. The ISO/IEC verifier reports its assessment of the symbol quality not as a single "~~p~~Pass" or "~~f~~Fail" decision, but as one of a range of four passing grades (from 4 to 1, in order of decreasing quality) or one failing grade (0). This enables an application to set the most appropriate minimum grade for acceptability. It may be noted that the ANSI standard uses the alphabetic scale A to D for passing grades and F for failing symbols, but the grade thresholds are identical.

The relationship between symbol grades measured in this way and the way the symbols behaved when they were scanned was so close that users rapidly came to accept the SRP assessment method for verifying symbols received from their trading partners. Users knew that as long as a symbol achieved grade 1.5 or better it would give them acceptable performance when they had to scan it to capture the encoded data.

**Note**: The GS1 system requires that the Quiet Zone be a measured parameter for EAN/UPC Symbology, GS1-128 symbols, and ITF-14 symbols per the values expressed in *ISO/IEC 15416*, section 5. For GS1 DataMatrix it is equal to one X-dimension expressed in *ISO/IEC 16022* section 7 and for GS1 QR Code it is equal to ~~the~~ four times the X-dimension expressed in *ISO/IEC 18004* section 5.

#### 5.5.3.3.1.3 Types of verifiers

The *ISO/IEC 15426* standard, which is in two parts, defines the test methods and minimum accuracy criteria for verifiers using the methodologies of *ISO/IEC 15416* (for linear barcodes) and

*ISO/IEC 15415* (for multi-row barcodes and two-dimensional matrix symbols). *ISO/IEC 15426-1* relates to linear barcode verifiers, and *ISO/IEC 15426-2* to two-dimensional barcode verifiers.

There are many types of verifier that meet the requirements of *ISO/IEC 15426*, some that are used in conjunction with a personal computer with special verification software for the symbol analysis and display/printing of results, while others are integrated stand-alone units. In addition, some verifiers may have interchangeable measuring apertures and light sources to enable measurement of symbols with a wide range of X-dimensions and to meet the illumination needs of differing application standards.

~~There are many types of verifiers and almost as many ways of classifying them, but for practical purposes, it is convenient to group them into two classes related to where they are used and the extent to which all their possible functions are required. This grouping corresponds reasonably closely to the Class A and Class B classification respectively (as used in the European pre-standard ENV 12647).~~

~~The first group (broadly equivalent to the Class A category) contains the full-function type of verifier, which is mainly found in a quality control laboratory. It performs a full range of measuring functions and provides comprehensive analytical reports on the symbol, enabling the cause of problems to be diagnosed. Its use requires a good degree of knowledge of the technology, and the operator must, therefore, be specially trained. Its measurement accuracy may be substantially higher than the average; its cost almost certainly is, and the time taken to perform the necessary scans and output the results may be relatively long; however, in the expected conditions for which such an instrument is purchased, this is not likely to be a problem. This type of verifier may have motorised optical heads to improve the evenness of movement and achieve the multiple scanning requirements, and to enable accurate dimensional measurements. In addition, this verifier may have interchangeable measuring apertures and light sources to enable measurement of symbols with a wide range of X-dimensions and to meet the illumination needs of differing application standards. Some of these instruments are used in conjunction with a personal computer with special verification software for the symbol analysis and display/printing of results, while others are integrated stand-alone units.~~

~~The second group (corresponding to the Class B category) contains all the simpler, easy-to-use devices intended for use in the pressroom or on the receiving dock by relatively less trained operators. At their simplest, these devices are used to rapidly check that symbols are of the desired grade or better and, particularly in the pressroom, to obtain an indication of bar gain or loss and of contrast to help the press operator fine-tune his machine. Typically they have a single light source and measuring aperture, though by using plug-in wands or mice, a degree of interchange functionality may be achieved. Some instruments use laser beam illumination, which facilitates multiple scans of the symbol, though the effective measuring aperture may not be circular in shape, and its size may not be precisely known. They also may be more limited in their reflectance measurements.~~

~~A group of specialised verifiers is designed for mounting on printing equipment. They monitor the barcodes produced by the equipment and provide continuous analysis of key parameters, notably element widths, to enable the operator to control the printing process very quickly. Some are designed for high-speed presses and others for on-demand printers. Some are even able to automatically feedback control instructions to improve symbol quality and reprint defective labels.~~

~~A particular verifier may be hard to fit neatly into either class, as it may resemble the simpler class of unit in its physical construction, but its functions and the amount of information that it can give on the symbol may correspond more closely to those of the laboratory unit. Partly for this reason and partly because the Class A and Class B reporting requirements did not necessarily correspond precisely to what a verifier manufacturer might wish to offer for commercial reasons, the international standard *ISO/IEC 15426* (composed of *ISO/IEC 15426-1* for linear symbols and *ISO/IEC 15426-2* for two dimensional symbols), which replaces *ENV 12647*, has eliminated the classification scheme in favour of a minimum set of reporting requirements for all verifiers, to which manufacturers are at liberty to add in accordance with their view of the market needs.~~

#### 5.5.3.3.2 Measurement methodology

The symbol must be verified in its final configuration wherever possible (e.g., including over-laminate, package material, contents), but if this is not feasible, the following procedure is recommended to allow for the effects of show-through.