AIAG

Automotive Industry Action Group

B-13

2-D Symbology White Paper

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FOREWORD

The original 2D Symbology White Paper, published in 1995, was the culmination of two years of effort by the Symbology Work Group of the AIAG Automatic Identification Project Team. It contained recommendations for the newest (at the time) automatic identification technology: two-dimensional (2D) symbols. Linear bar codes served the industry well for over ten years. A major drawback of linear bar codes, such as the automotive industry standard Code 39, is the limitation in the amount of data they can carry efficiently. As times and business processes change, many processes need to capture more data, often in smaller spaces. Linear bar code systems will not suffice.

2D symbologies have the potential to meet various data collection requirements. They are based on the same concept as linear bar codes, except they provide data capability in two dimensions instead of one. Not only do they provide the ability to capture more data, they are sophisticated enough to provide error correction. And, due to their ability to provide data in a very small space, they present the opportunity to mark directly on parts. This opens a whole new world for marking small parts such as electronic components. The need to track parts throughout their life cycle to aid processes such as warranty, quality, safety, etc. has increased as our processes and products become more complicated.

In March 1993, the AIAG Symbology Work Group began a project to determine the best 2D symbology(s) for applications in the North American Automotive Industry. The original B-13 white paper was the result of that effort and was intended as an informational guide only. The AIAG Automatic Identification Project Team has developed several application-specific guidelines for functions/operations such as parts marking and shipping labels as well as symbol quality and data structure.

In August 1998, the Symbology Work Group was assigned a Work Request from DENSO International America, Inc., sponsor for the 2D symbology QR Code, asking the committee to consider a revision of the selections made in 1995 by selecting QR Code as a second 2D symbology for the Part Marking category.

This document update will help you understand the choice of two-dimensional symbologies for the North American Automotive Industry. The Symbology Recommendations are spelled out in Section 3.0, followed by separate historical records in Sections 4.0 and 5.0 outlining the decision-making processes for both the 1993 and the1998 Symbology Work Groups.

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1.0 INTRODUCTION

For more than 20 years, business and government have successfully used linear bar code symbols. The adoption of Code 39 by the AIAG in 1984 fostered quantum improvements in intercompany communication and has provided a reliable and effective vehicle for an ever-increasing range of applications within member companies.

Recently, some AIAG member companies have increased the range of applications to which they wish to apply automatic identification. They have pushed the reasonable limits of conventional linear bar code technology. Many of these applications require either higher data capacity or smaller symbol size — needs that can be addressed by two-dimensional (2D) symbols.

Two-dimensional symbols work similarly to conventional bar code symbols in that data are encoded as a set of machine-readable elements. Unlike linear bar code symbols, which encode information only as bar and space width variations along a single axis of the symbol, 2D symbols encode data using both dimensions of the printed symbol. There are two distinct methods for accomplishing this: stacked symbols and matrix symbols.

Stacked symbols work in a manner similar to linear bar code symbols except that the data are divided into relatively short segments stacked one above the other. 2D stacked symbols offer high data capacity and moderately small symbol size. To aid the 2D reader in reconstructing the proper order of the data, additional characters are appended to each segment, often in the form of row identifiers added to the beginning and end of each row. Error correction characters allow the data to be recovered, even in the event of damage to the symbol.

Matrix symbols encode data as individual bit values across a two-dimensional region of the label. 2D matrix symbols offer high data capacity and the smallest possible symbol size. To visualize how this works, imagine a checkerboard. The value of a particular bit is then encoded by filling in the square (or element) corresponding to that bit with either black or white. The entire symbol is then constructed by combining this matrix of data bits, some additional symbol locating and orientation features, and some error correction bits. By reading the bit values in the proper order, a binary message can be decoded from the printed symbol.

Both stacked and matrix symbols offer improvements over conventional linear bar code symbols with respect to data capacity, symbol size and damage tolerance. Stacked symbols permit readability over the widest range of reading technologies (both laser and image based systems), while matrix symbols allow for a smaller symbol size.

In 1993 and again in 1998, the AIAG Symbology Work Group was charged with examining and evaluating this technology for use in the North American Automotive Industry.