DRAFT

GROCERY INDUSTRY UPC SYMBOL

SYMBOL SPECIFICATION

RCA II SYMBOL

3/23/73

#7

KEY FEATURES OF RCA II UNIVERSAL PRODUCT CODE SYMBOL

Increased Printing Tolerances	Using this new symbol tolerance, ranges of from ± .001" to ± .010" will be permitted based upon the size of the printed symbol.
Size Variations	This symbol permits variations in physical size of the symbol by allowing single-bit variations between .009" and .030". This variable-sized symbol will, therefore, be adaptable to the wide range of printing capabilities available to the industry.
Light Pen Capability	Use of the RCA II symbol will permit scanning by simple light-pen type systems.
UPC Expandability	The RCA II UPC symbol has the inherent capability of representing from one to as many as thirty decimal digits. This will provide ample allowance for accomodation with numeric product codes adopted by other retailing industries.
Most Efficient Code	Because the coding system for the RCA II symbol requires the use of only 70 bits of information to perform its function, it is the most efficient code available to the committee.
In-Store Labeling	The code structure of the new symbol can be adapted to the elimination of leading and trailing zeroes. The abbreviated three-digit versions of the UPC which would result from this could be used to identify up to 999 high velocity items in each store. Small three-digit symbols could be applied to these high volume items by means of high-speed, hand-held, label guns at store level to provide a low cost symbol application method to bridge the gap between initial scanner system installations and cost-effective levels of source symbol marking.

Truncated Symbol	Where space is limited and where there is an obvious natural orientation of the product to the scanner, a truncated version of the symbol, representing a radius of the symbol including its center, may be used.
Bar-type Version	Bar-type versions of the RCA II symbol can also be used to adjust to product space limitations, as in the case of the truncated symbol version described above.
Error Detection	The new symbol incorporates a check digit utilizing the Module 10 error detection method which provides accurate error detection.
Improved Space Utilization	Use of a half bullseye provides more efficient utilization of packaging real estate.
Omnidirectionality	Because the symbol remains curvilinear, it retains its capability for omnidirectional scanning.

1.0 INTRODUCTION

The purpose of this document is to provide the members of the grocery industry with the general and technical information necessary to evaluate the RCA II Universal Product Code symbol proposed by RCA Corporation for use by the industry in the implementation of supermarket front-end automation.

The symbol design and printing specifications included herein are designed to meet the guidelines established by the Grocery Industry Ad Hoc Committee on the Universal Product Code, and those established by the Symbol Standardization Subcommittee.

The RCA symbol is the result of more than seven years of research and development in the area of supermarket fron-end automation. This R & D effort has been conducted with the assistance and cooperation of a great number of companies and individuals in all areas of the grocery industry. RCA would like to take this opportunity to thank all those who have given so generously of their time and knowledge in this effort.

The materials that follow are broken down into sections covering the major elements to be considered in choosing an industry symbol. They are:

* Symbol Description
* Dimensional Requirements
* Optical Requirements
* Code Descriptions

* Printing Considerations
* Symbol Location
* Application Methods
* Quality Control Methods

2.0 SYMBOL DESCRIPTION

2.1 General

The RCA II Universal Product Code symbol being proposed by RCA consists of a "machine-readable" pattern of binarily encoded concentric half-bands and a "human-readable" 10 digit number. (Figure 1) This half-bullseye pattern is a binary equivalent of the 10 digit number and can be read by either a fixed-slot scanner or a hand-held light pen.

The intent of the symbol is to accurately and easily encode grocery merchandise, permitting the use of an automated checkout system in which the current price of the commodity and other information are retrieved from a storage file and transmitted to the checkstand. (See Figure 2).

The symbol is essentially an omni-directional bar code, i.e., it can be read in any orientation from the outside to inside or inside to outside. It has the inherent advantage of accuracy since internal checks verify the correctness of the code. Omnidirectionality and scanning accuracy of a UPC symbol are directly related to increased savings at the supermarket front end.

A major advantage of the symbol is that an infinite number of uniform size variations are permitted between the smallest size and 3.3 times

FIGURE 1

the smallest size. Since the allowable printing tolerance increases substantially with size, virtually any printing process can be used to generate the symbol without taking special precautions. We feel that this is a major advantage for the printing industry since tolerance has been their major concern.

Since only one scan of the symbol is required to read and verify the encoded data, the merchandise can be moved across a fixed-slot scanner at speeds up to 80 inches per second or can be read by a wand at speeds from 5 to 50 inches per second. Display of the retrieved price and printing of the price and other retrieved information on the sales slip at the checkstand is accomplished in as little as 1/3 of a second.

FIGURE 1 (equivalent of Figure 2) FIGURE 2 (equivalent of Figure 1)*

2.2 Variations (Composition)

In order to meet industry symbol requirements for differentiation between the various types of merchandise and transactions that are found in the supermarket environment, such as standard measure items, variable measure items, coupons, and items that could require long term compatibility with other commodity codes, the RCA symbol has been designed so that the basic symbol structure for each number can be modified four ways to permit this differentiation. As example of such a variation in symbol composition is provided in Figure 2.

FIGURE 2 (equivalent of Figure 3)

* The figure numbers in parentheses refer to the figures in the RCA I Specification.

2.3 Variations (Number Locations)

The 10-digit number represented by the symbol is normally located outside, and underneath the half-bullseye. However, it is possible to locate the numbers above, or above and below the symbol. (Illustrated in Figure 3). It is also possible to superimpose the number on the half-bullseye. If the number is superimposed it is necessary to print the number with an ink that is PMS Standard "Warm Red Transparent", or equivalent.

FIGURE 3 (equivalent of Figure 4)

2.4 Variations (Shape)

Although the preferred use of the symbol is in its full omni-directional half-bullseye form, there are, obviously, some products whose size and shape prohibit the use of the full symbol. In addition, there are other products that have dimensions that would require an obvious special orientation to the scanner in order to be read. Fortunately, since the RCA bullseye is essentially a bar-coded symbol, such products can use one of two partial symbol configurations, as described and illustrated below. However, it is recommended that these partial configurations be used after every effort has been made to utilize the full symbol. Note that any variation can be varied in size also, as was alluded to in section 2.1.

2.4.1 Truncated Version

One modification of the basic symbol which can be successfully used (if space is a problem and directional scanning is not) is depicted in Figures 4 and 5 below.

FIGURE 4 (equivalent to Figure 5) FIGURE 5 (equivalent to Figure 6)

The angle θ can assume any value up to 180°. Naturally, as θ increases, less orientation of the package is required.

2.4.2 Bar Symbol Version

A second modified version of the basic symbol is the parallel bar equivalent of the bullseye, as illustrated in Figure 6. This version has been designed for use in situations where it may prove to be economically or physically unfeasible to apply the symbol to the natural bottom, or top, of the product. As illustrated, when using this version, the length (perpendicular to the bars) of the symbol is the same as the symbol height. The width (parallel to the bars) may be any convenient dimension between 0.1" and 0.5".

This version of the symbol is particularily recommended for cans and bottles where side marking is highly desirable. An example of the use of this version of the symbol is shown in Figure 7.

FIGURE 6 (equivalent of Figure 7) FIGURE 7 (equivalent of Figure 8)

3.0 DIMENSIONAL REQUIREMENTS

3.1 Symbol Dimensions

The half-bullseye is summarized in Figure 8 and Chart I. The symbol consists of 70 concentric bands which extend slightly below the geometric center. As explained in 5.0, most of the bands may be either light or dark. Note that every dimension on the symbol is an integral multiple of the "basic" or smallest band width W. W can assume any

value from .009" ± .001" to .030" ± .010" inclusive. The RCA coding (see 5.0) is such that only the multiples shown in Figure 8 will appear on any given symbol. Note the overall dimensions of the symbol: 73W high x 140W wide.

The portion of the bands which lie below the diameter by an amount equal to 3W may be either curved or straight. Areas shown in Chart I presuppose that the bands are straight and are therefore maximum values.

Dimensions and tolerances for intermediate bandwidths may be obtained by interpolating between two adjacent points in Chart I.

The particular font style and location of the human-readable code is a function of the maximum area allocated to the symbol (half-bullseye plus digits) and the chosen size of the basic band width. Both may be adjusted accordingly, keeping in mind that the human-readable code must be easily discernable at arm's length.

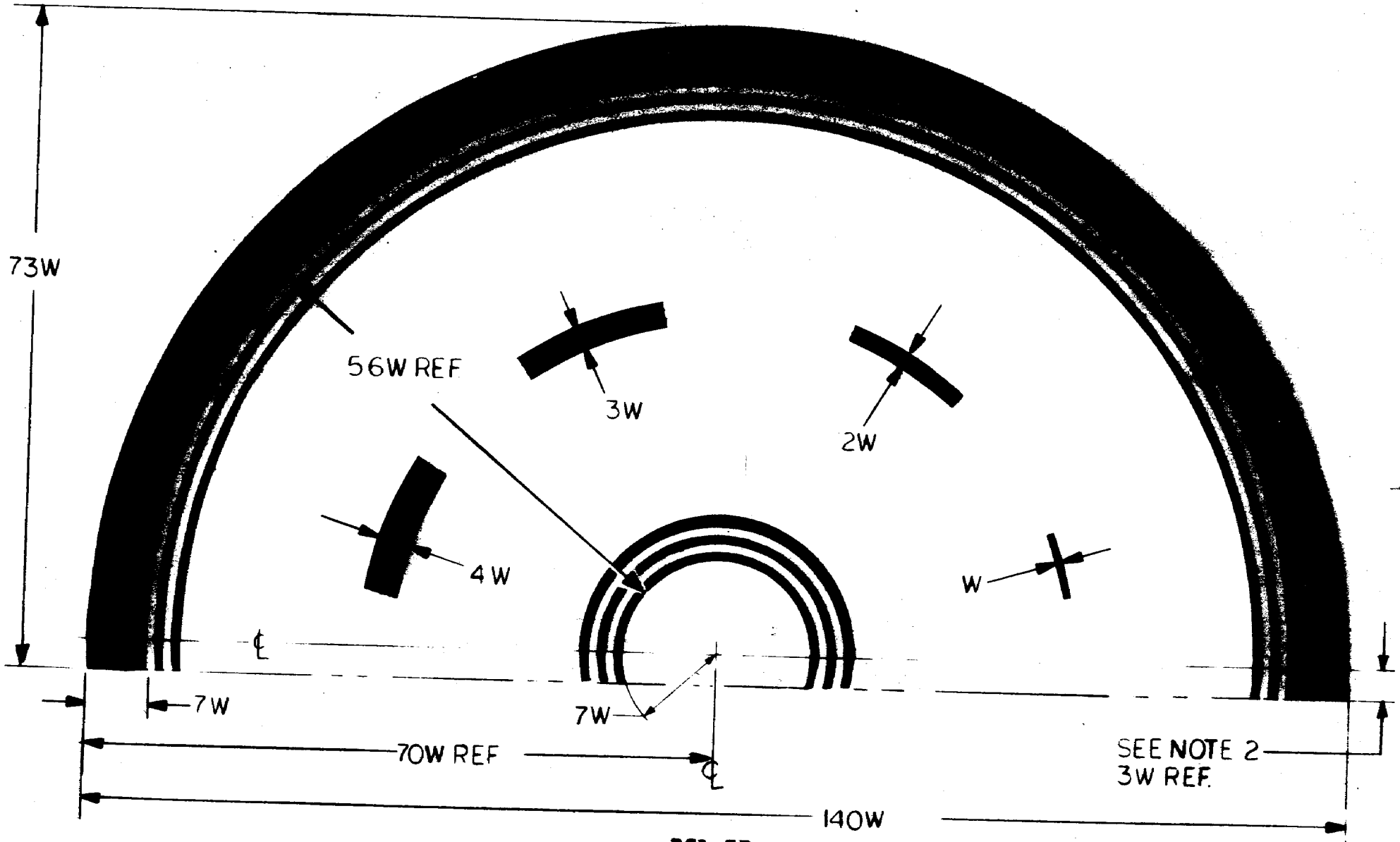
FIGURE 8 CHART I (equivalent to Figures 9 and 10)

3.2 Printing Quality Requirements

Print quality requirements are described by the factors below. Unless otherwise specified, all requirements pertain to any variation of the symbol. (size, composition, number, location, and shape)

3.2.1 Voids

Maximum dimension in any direction should not exceed .003". Within a dark band, no more than one void of the above size can be tolerated for each .005" of arc length.



RCA II
SYMBOL STRUCTURE

NOTES: 1) SEE CHART I FOR DIMENSIONS AND TOLERANCES.
2) BANDS IN THIS AREA MAY BE EITHER CURVED OR STRAIGHT.

FIGURE 8

RCA II - CHART I

SYMBOL DIMENSIONS AND TOLERANCES

I Basic Band Width (W)	II Double Band (2W)	III Triple Band (3W)	IV Quadruple Band (4W)	V Outer Band or Center Radius (7W)	VI Tolerance (columns I-IV)	VII Symbol Height (73W)	VIII Symbol Width (140W)	IX Symbol Area (in^2)
.009	.018	.027	.036	.063	±.001	.657	1.260	.657
.010	.020	.030	.040	.070	±.002	.730	1.400	.812
.011	.022	.033	.044	.077	±.003	.803	1.540	.982
.012	.024	.036	.048	.084	±.004	.876	1.680	1.168
.013	.026	.039	.052	.091	±.004	.949	1.820	1.372
.014	.028	.042	.056	.098	±.005	1.022	1.960	1.591
.015	.030	.045	.060	.105	±.005	1.095	2.100	1.826
.016	.032	.048	.064	.112	±.006	1.168	2.240	2.078
.017	.034	.051	.068	.119	±.006	1.241	2.380	2.345
.018	.036	.054	.072	.126	±.007	1.314	2.520	2.630
.019	.038	.057	.076	.133	±.007	1.387	2.660	2.931
.020	.040	.060	.080	.140	±.007	1.460	2.800	3.247
.021	.042	.063	.084	.147	±.008	1.533	2.940	3.579
.022	.044	.066	.088	.154	±.008	1.606	3.080	3.928
.023	.046	.069	.092	.161	±.008	1.679	3.220	4.294
.024	.048	.072	.096	.168	±.008	1.752	3.360	4.676
.025	.050	.075	.100	.175	±.009	1.825	3.500	5.073
.026	.052	.078	.104	.182	±.009	1.898	3.640	5.487
.027	.054	.081	.108	.189	±.009	1.971	3.780	5.917
.028	.056	.084	.112	.196	±.009	2.044	3.920	6.363
.029	.058	.087	.116	.203	±.010	2.117	4.060	6.826
.030	.060	.090	.120	.210	±.010	2.190	4.200	7.305

Note: 1) All dimensions are in inches
2) Tolerances for columns VII-IX are code dependant

3.2.2 Edge Roughness

Edge roughness can be specified by the peak-to-peak amplitude and minimum arc length of adjacent peaks and valleys. These specifications vary as the symbol changes size as summarized below:

Basic Band Width (nominal)	Maximum Peak-to-peak Amplitude	Maximum Arc length
.009 - .010	to be supplied	to be supplied
.011	.002	.005
.012 - .030	to be supplied	to be supplied

3.2.3 Edge Accuity

Any point from which a band width measurement is made should have a reflectance value which is at least 50% of the average reflectance for that band.

3.2.4 Ink and Dirt Spots

Maximum dimension in any direction should not exceed .003". Within a given band, no more than one ink or dirt spot of the above size can be tolerated for each .005" arc length. In addition, the human-readable number must be easily discernible.

3.2.5 Ink Film Uniformity

No restrictions, as long as optical requirements (see 4.0) are met.

3.2.6 Inclusions

Maximum dimension in any direction should not exceed .003". Within a

light band, no more than one inclusion of the above size can be tolerated for each .005" of arc length.

3.2.7 Show-Through

No restrictions, as long as optical requirements (see 4.0) are met.

3.2.8 Scuff and Scratch Resistance

The type of ink used, selection of substrate, symbol location, use of protective barrier, etc., should be such that, under normal handling (from printing level to store level), all optical and dimensional requirements of the symbol are maintained.

3.3 Other Physical Requirements

3.3.1 Symbol Embossment

Since the symbol is optically read on a fixed surface, the degree to which the printed image is depressed below, or raised above, the surface of the package is inconsequential, as long as all other requirements are met.

3.3.2 Symbol Surface Curvature

For the symbol to be read omnidirectionally, the radius of curvature of the surface at the half-bullseye portion of the symbol shall be greater than or equal to the value shown below. This radius applies to any section of symbol area and may be either cylindrical or spherical, concave or convex.

Basic Band Width (nominal)	Minimum Radius of Curvature
.009 - .010	to be supplied
$.012^{.011}$ - .030	$\frac{1.0}{\text{to be supplied}}$

3.3.3 Symbol Vertical Displacement

The maximum height of any portion of the symbol being scanned, above the counter surface, and the angle between the plane of the symbol and the plane of the scanner surface (tilt) when measured in the direction of the scanner slot shall not exceed the values listed below.

Basic Band Width (nominal)	Maximum Displacement	Maximum Tilt
.009" - .010"	to be supplied ---	
.011"	0.5"	15°
.012" - .030"	to be supplied ---	

4.0 OPTICAL REQUIREMENTS

4.1 Reflectivity

Contrast is defined as the difference between the diffuse reflectance of the light bands and the diffuse reflectance of the dark bands. Minimum value is 30%. Measurements should be made in accordance with section 9.0. Note that the background or light area may be the substrate as well as the light bands.

4.2 Substrate Reflectance

Optical properties of the substrate are important only if used as the background or "light" portion of the symbol. If this is the case, optical requirements are as listed above. By virtue of the design of the scanner optics, diffuse, rather than specular, reflectance must be controlled.

4.3 Barrier Restrictions

Any barrier such as a transparent film or a frost, stain or moisture

film is permitted, providing all symbol optical requirements are met.

4.4 Color Variations

4.4.1 General

The preferred colors for the dark and light bands are black and white, respectively, although almost any color combination that meets the required optical contrast may be used. (see Section 4.1)

Some typical background colors are whites, reds, and yellows; while some typical image colors are blacks, browns, greens and blues.

4.4.2 Special Properties of Red

Since the scanner employs a red light source most reds are recognized by the scanner as white. For this reason they should be avoided for the image bands. However, the special properties of reds can be advantageously used for overprinting the UPC number of the sumbol in situations where space does not permit printing the number below or above the bullseye, or its variations. In addition, these properties also make possible the use of red as a background color. An additional use of red could be as a deterrent to photocopy counterfeiting - for instance, by printing the center zone of the symbol red, or by using red for overprinting the UPC number, as noted above.

5.0 CODE DESCRIPTION

5.1 Code Objectives

The coding of the proposed RCA Universal Product Code symbol was specifically designed with the following goals in mind:

* To permit reading with either a fixed-slot or a light pen-type of scanner
* To be cost effective in terms of label making and scanning equipment requirements
* To provide immediate and completely effective error detection
* To provide an infinite number of uniform size variations between 1X and 3.3 X (approximately)
* To facilitate automated artwork generation
* To permit simple manual decoding of the symbol ring structures
* To facilitate etching of printing plates
* To provide compatibility with any length code by expanding the number of bands in modular fashion (see below).

5.2 Coding

The coding is best understood by breaking up the 70 semi-circular bands into discreet sections and describing each one. (Figure 9). All bands are numbered from the center to the outside. (Dark = 0 and Light = 1).

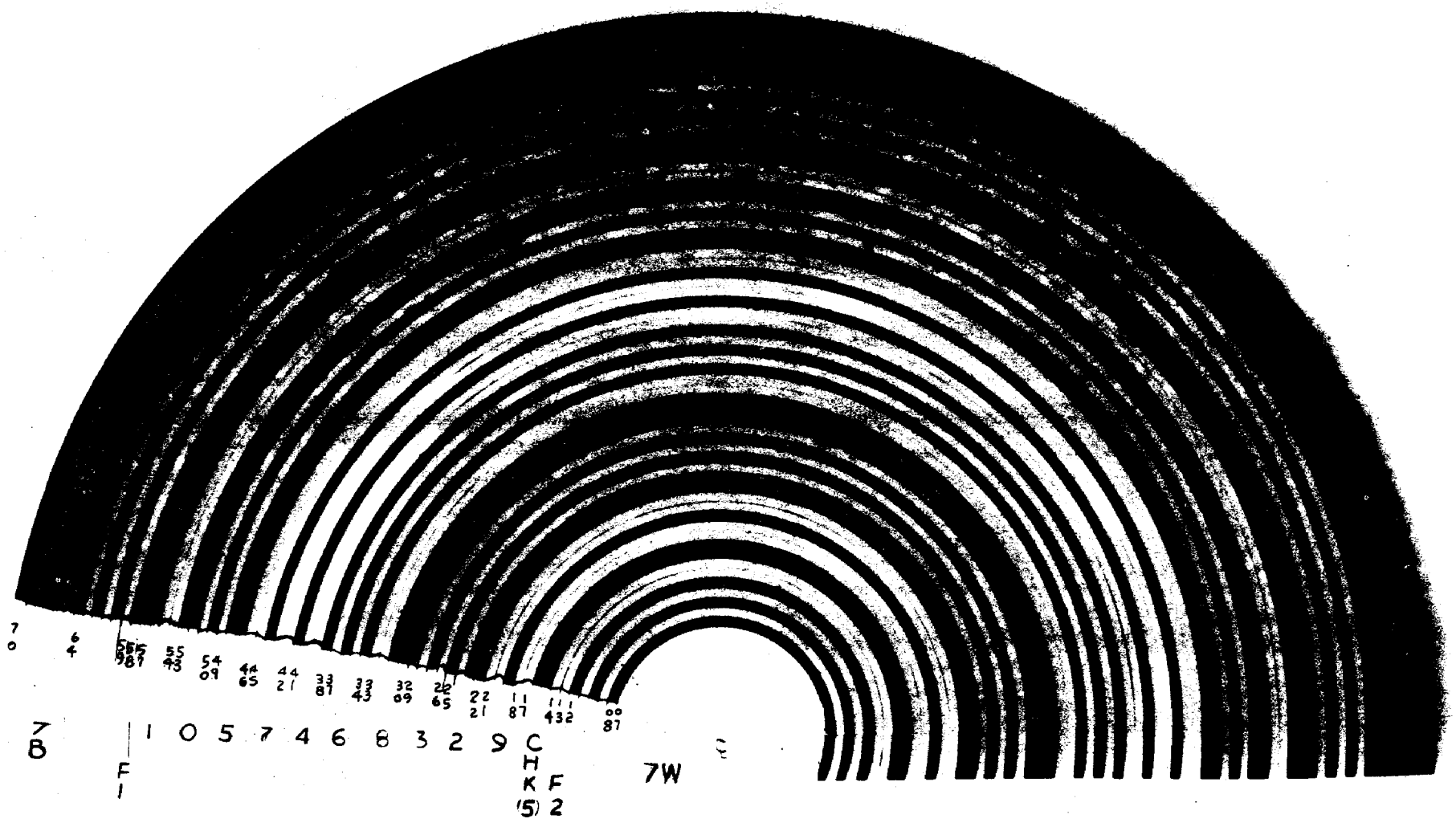
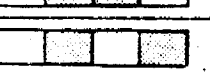


FIGURE 9

Bands	Shading (L = light, D = dark)	Function
# 1 - # 7	all L	These bands serve 3 functions
# 8 - # 12	DLDLD	o indicate direction of scanning (outside to inside or inside to outside) o serve as a start or stop code depending on scanning direction o identify the size of the basic band width
# 13	L or D	#2 flag band - provides 2 of 4 concurrent numbering systems
#14 - #17	see table below	"Modulo 10" check digit serves to check coding accuracy
#18 - #57	see table below	10 digits of the UPC
#58	L or D	#1 flag band - provides 2 more of the 4 concurrent numbering systems
#59 - #63	LDLDL	Same as bands #1 - #12
#64 - #70	DDDDDDD	

The shading for bands #14 - #57 (10 UPC digits plus 1 check digit) is indicated in the table below:

DECIMAL DIGIT	BINARY CODE (READING TOWARDS CENTER) (BLACK = 0 & WHITE = 1)	
	BITS	BAND COLORS
1	0011	
2	0100	
3	0101	
4	0110	
5	1001	
6	1010	
7	1011	
8	1100	
9	1101	
0	0010	

The assignment for the shading of the flag bands is optional. A suggested scheme follows:

Shading		Numbering System
Flag # 1	Flag #2	
L	L	Standard UPC
L	D	Variable measure
D	D	Code Compatibility (e.g. drugs)
D	L	Other (e.g. coupons)

5.3 Code Length Variations

The coding structure for the RCA II Symbol has been designed so that codes of virtually any length can be represented by the half-bullseye symbol. This concept applies to any variation (truncated, bar or expanded size) of the basic UPC symbol and for any combination of flag bands. It is important to note that any variation from a 10 digit code length must be accompanied by a corresponding hardware change.

In addition, it provides for complete compatibility with retail merchant coding requirements and permits the use of a store assigned code of any length.

5.3.1 Expanded Code Lengths (Greater than 10 Digits)

Any number of additional 4 bit units (using the same coding scheme) may be added between the check digit bands and the #2 flag band for each additional digit required. All other bands would remain the same.

5.3.2 Reduced Code Lengths (Less than 10 Digits)

Any number of 4 bit units may be removed from the area between the bands of the least significant digit and the #2 flag band if fewer digits are required, providing at least one unit remains. All other bands would remain the same.

5.3.3 Code Suppression (any number of digits)

A third option of the RCA Symbol permits the same size symbol to be used with codes of various lengths. If the first N-1 digits or the last N-2 digits of a code of length N are all zeroes, it is possible for the scanning logic to suppress them. For example, two codes, one 10 digits long and the other 3 digits long could be represented by the same size half bullseye if 7 zeroes were added either before or after the 3 digits.

Adding zeroes to the beginning of a code (justify right) requires no additional character.

Adding zeroes to the end of a code (justify left) requires the addition of a special 4 bit character such as LLLD or DDDL.

6.0 PRINTING CONSIDERATIONS

6.1 General

Virtually all package printing processes can be used to print the RCA Universal Product Code bullseye symbol. RCA has been working with a number of packagers and printers over the past few years to assure the feasibility of printing its symbol. To date, extensive studies have

been conducted of four basic printing processes: letterpress, rotogravure, lithography and flexography. Other processes (old and new) are presently being studied.

6.2 Printing Experience

The basic printing processes, and the items on which a similar RCA symbol has been successfully printed are included in the following list. Also included are the names of some of the equipment or printing suppliers with whom RCA has worked to date in connection with its feasibility studies:

* Letterpress - Tompkins Label Service (TOLAS) - preprinted labels
* Rotogravure - American Can Company - Preprinted labels
* Lithography - American Can Company - Preprinted frozen food packages
  - Avery Label Company - Preprinted labels
  - Michigan Carton Company - Preprinted cereal boxes
* Flexography - American Can Company - Samples
  - Dairy-Pak - Milk carton samples
  - Sentinel Printing, Inc. - Bun bag samples
  - St. Regis Company - Preprinted bread, vegetable and french fries bags

6.3 Key Symbol Printing Considerations

Based upon experience to date, the following factors seem to be key considerations in the successful printing of the RCA symbol:

6.3.1 General

- Pre-press photography - Care must be exercised, as in process color printing, to maintain correct image size, particularly with regard

to the bands which encode the UPC digits, throughout all photographic steps.

- Engraving - In processes using the engraving system, care should be exercised in using adequate "patented" etching solutions in order to maintain line width without undercutting. Plate inspection and measurement are highly recommended.

6.3.2 Specific Processes

- Letterpress - Plate cleanliness is extremely important, as is monitoring of make-ready thickness.
- Rotogravure - The screen used should be 133 or 150 lines per inch or greater. Coarser screens will produce images with rough edges.
- Lithography - Wash plate at start of and during the run, depending on pickup from the substrate.
- Flexography - Excess impression on a worn plate can cause wide (over tolerance) and distorted printing.

7.0 SYMBOL LOCATION

7.1 General

Since the RCA symbol, in its full form, is omni-directional, its placement is independent of package boundaries, and symbol alignment and skew are not relevant. Since both the truncated and parallel bar versions of the symbol are not omni-directional, placement on the package should take into consideration package boundaries, alignment and skew. (Figures 11 and 12)

FIGURE 11 (equivalent of Figure 11) FIGURE 12 (equivalent of Figure 12)

7.2 Preferred Location

The preferred location of the symbol is a central position on the package surface which is normally considered the natural bottom of the package when placed on the checkout counter. (Figures 14-18). Studies indicate that this location minimizes checkout time. For cans and bottles, however, a side location, opposite the manufacturer's logo, is recommended. Studies indicate that this placement has a negligible effect on checkout time, particularly if the bar version of the symbol is utilized. (See Figure 13; equivalent to Figure 21)

FIGURES 14-18 (equivalent to Figures 13-17)

7.3 Alternate Locations

Variations in location are permissible where necessary to cover the following situations:

* Packages with no discernible natural bottom (Figure 19)
* Packages with a natural bottom unsuitable for symbol placement because of area, curvature or vertical displacement (Figure 20).

FIGURE 19 (equivalent to Figure 18)

FIGURE 20 (equivalent to Figure 19)

* Packages where placement on a surface other than the center of the natural bottom, or even the natural bottom, would facilitate source symbol marking (either by printing on the package, or by labeling). Examples are cans and bottles which, as mentioned above, might utilize the parallel bar version of the symbol (Figure 21).

FIGURE 21 (equivalent to Figure 20)

8.0 APPLICATION METHODS

8.1 General

RCA has, for many years, conducted studies in conjunction with packagers, printers and equipment manufacturers with a view towards identifying the most economical symbol application method for every packaging situation. These studies are continuing today. While most of the work has been done with a full bullseye symbol, the results are applicable to the present half-bullseye version.

There are essentially three ways to apply the RCA Universal Product Code symbol to a commodity: (a) incorporation of the symbol in the package, or label, printing process; (b) automatic application of labels; and (c) manual application of labels. The choice of method depends upon many variables, such as the volume of packages sold, the size and shape of the package, the printing process used, the packaging process used, the level of the distribution chain at which the symbol is applied, and others. For the purpose of this document, all levels of marking prior to the store level are termed "Source Symbol Marking," or SSM.

8.2 Printing on Packages, Containers or Product Labels

Obviously the most economical means of applying the symbol to packages and containers, both from the manufacturer's and supermarket operator's point of view, is to incorporate the symbol into the product's current printing and/or labeling processes. Analysis has shown that most items currently sold in supermarkets or other grocery outlets can be source symbol marked with the RCA symbol through the use of present printing processes. (See Section 6.0 Printing Considerations)

8.3 Automatic Labeling (SSM)

In cases where it is not practical to incorporate the symbol into current printing processes, the next best SSM process would be one which can be incorporated into the existing processing, filling or labeling line, such as CSI, thermal or electrostatic imaging. American Can Company, for instance, has developed an automatic labeling system to mark three types of Kroger coffee cans. In this method, pre-printed labels with a heatseal adhesive are applied at speeds up to 100 per minute using a modified Doboy Mark IV Labeler in line with the filling operation. Studies indicate that virtually any commercially available automatic labeler (such as the Dennison System 900 or a Fasson labeling system) could be used to automatically apply the RCA symbol in label form.

8.4 Automatic Labeling (In-Store)

Since a certain percentage of the items sold in supermarkets, such as meats and unpackaged produce, will have the symbol marked in the store for some years to come, RCA has developed an in-store symbol labelmaker which is attached to an electronic weighing scale and a transport mechanism. The RCA in-store labelmaker has been operation at the Kroger test store in Cincinnati since early July, 1972, in conjunction with a Hobart unit, and is used for applying labels to variable measure items such as meat, produce and dairy products.

8.5 Manual Labeling

The manual application of preprinted labels can be an efficient labeling method if done systematically. It can be done either with a hand-held labeler, or by hand, using pressure sensitive labels.

9.0 QUALITY CONTROL METHODS

9.1 Symbol Optical Quality Control

All reflectance measurements can be made with a good quality standard reflection densitometer. If a test spot of the ink in question is available, measurements can be made with a so-called macro-densitometer such as the Welsh Densichron Reflectometer Model #1 (with a #3832A reflection head) or the MacBeth RD-517 densitometer. In either case, when measuring the reflectances of color combinations other than black and white, a #29 Wratten gelatin filter must be placed in front of the reflection head.

The following conditions apply to the MacBeth instrument:

9.1.1	Light Source	Tungsten filament bulb
9.1.2	Angle of Incidence	90° from plane of symbol
9.1.3	Angle of Measurement	45° from plane of symbol
9.1.4	Minimum test spot size	0.125" diameter
9.1.5	Standard White	Barium Sulphate (100% reflectance)

If a test spot is not available, a so-called micro-densitometer such as the Kidder 082 Optical Character Tester equipped with an .008" diameter aperature and a Wratten #29 filter (or, if possible a Baird-Atomic interference filter #35-88-6) is highly recommended. The reflectance of the bands can be measured directly without resorting to a test spot.

9.2 Symbol Dimensional Quality Control

All dimensional measurements should be made with a tool makers microscope (30X minimum) equipped with an X-Y table; or a Nikon Model #6C Comparator set at 50X; or the equivalent of either device.

If a Kidder 082 tester is available, it may be used to measure bands (as well as reflectance) if equipped with an X-Y stage.

9.3 Printing Quality Control

Standard statistical "QC" methods, similar to those used in industry today for process color printing, can be used to insure adequate symbol print quality.

For roll-to-roll operation sample measurements (both dimensional and optical) can be made on each roll. Sheet operations would require similar sample measuring of a sheet from each skid.

An automatic electronic scanning system which will continuously monitor printing quality by comparative means is presently being evaluated by RCA. Such a system would eliminate tedious measuring with comparators, microscopes and densitometers.

RCA has developed a lab type "diagnostic" scanner which can completely check a symbol electronically. Items such as contrast, band width, edge accuity, voids, etc. are sampled in seconds on a go-no go basis. A device similar to this could be made available to the industry at a reasonable cost, and would make dimensional or optical measurements unnecessary.

RCA is presently evaluating a "gaging Technique" which could be used by any printer to visually check his printing accuracy without resorting to measuring or scanning equipment. A small pattern of parallel

bars (similar to a resolution pattern) would be printed with the symbol, either on package or on label stock. The visibly discernible "fill-in" between the printed bars would be an indicator of printing accuracy. The patterns would be oriented in the web and cross-web directions.