

Inspector 4000™

Operator's Guide

Manual P/N 002-5564
Revision: D
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Reference RJS P/N 002-5564 Revision D
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1.0 Preface

1.1 Proprietary Statement

The RJS Inspector 4000 Operator's Guide contains proprietary information of RJS. It is intended solely for the use of parties operating and maintaining the equipment described herein. This information may not be used, reproduced, or disclosed to any other parties for any other purpose without the express written permission of RJS.

1.2 Statement of FCC Compliance: USA

The equipment described in this manual has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide a reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this operator's manual, may cause harmful interference to radio communications. Operating this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the problem at his own expense.

1.3 Statement of FCC Compliance: Canada

This Class A digital apparatus meets all requirements of the Canadian interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

1.4 CE:

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this operator's manual, may cause harmful interference to radio communications. Operating this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the problem at his own expense.

1.5 Documentation Updates

RJS strives to provide the best possible documentation. This manual, or any of our manuals, may be updated without notice.

1.6 Copyrights

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1.7 Unpacking and Inspection

Carefully unpack the components and save the container. If the container is crushed, punctured or water damaged you can use the container to prove a claim against the carrier. RJS is not responsible for transportation damage.

Your Inspector 4000 is packaged in a custom made container. After removing the unit from the shipping box make sure you have:

- Main display unit
- Auto-optic scan head and cable
- Four size AA batteries
- Operator's manual
- Bar-code "test" symbol sheet

1.8 Installing Batteries

Slide open the plastic cover on the back of the unit. Position the cloth battery "pull strip" down then insert 4 (included) batteries according to the positive/negative markings.

Note: If all 4 batteries are inadvertently installed backwards, the inspector unit will be damaged.

Remove batteries when the unit will not be used for a period of weeks. Also, remove batteries when storing the unit.

Note: NiCad batteries and charger are available as options.

Warning: When using the optional charger, DO NOT charge alkaline batteries—this will damage to the unit.

1.9 Technical Support

Please read the manual and try to understand it, first.

If you need assistance over the phone, please have the following information ready:

- Model and serial number of your unit
- Do you have a maintenance contract in effect
- Have a test print available if applicable
- Detailed explanation of the problem or question
- Your company's phone

RJS

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2.0 Warranty

2.1 General Warranty

Warranty information: (763) 746-8034

RJS warrants your Inspector 4000 to be free from defects in material and workmanship for a period of 1 year from the date of shipment from RJS' factory location.

The liability of RJS under this warranty is limited to repairing or replacing the defective part and/or unit. RJS may optionally choose to issue credit for any unit returned during the warranty period.

You must promptly notify RJS of any defect in order to receive the full protection of this warranty.

2.2 Warranty Limitations

The warranty set forth above is exclusive and no other warranty, whether written or oral is expressed or implied. RJS specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

Some states or provinces do not allow limitation on how long an implied warranty lasts, so the above limitation or exclusion may not apply to you. However, any implied warranty of merchantability or fitness is limited to the one year duration of this written warranty.

RJS shall in no event be liable for any indirect, incidental, or consequential damages, including but not limited to damages which may arise from loss of anticipated profits or production delivery delays, spoilage of material, increased costs of operation of business or otherwise.

2.3 Service During The Warranty Period

If your Inspector 4000 should fail during the warranty period, contact RJS or its authorized representative immediately upon discovery of the defect. A Return Authorization Number (RMA number) may be obtained by visiting our website address: http://www.rjsl.com/request_rma.php

You will be asked to ship the product in its original packing, freight prepaid, with the RMA number visibly written on the outside of the carton to RJS' factory location.

Be sure to include any samples or printouts or other information that will help us to understand the problem. Your repair will be given priority treatment, or your unit may be replaced at RJS' option. The repaired item will be returned UPS/RPS ground, freight prepaid.

At your request we will ship express or overnight if you need premium service and agree to pay the additional cost.

2.4 Trademarks

The following are trademarks of RJS:

- RJS
- RJS Systems International
- Inspector 4000

3.0 Introduction

3.1 Inspector 4000 Description and Features

The Inspector 4000 is an advanced technology bar-code verifier that makes it easy to decode bar-code symbols and to evaluate symbol compliance with industry standards. See *Figure 4-A (Inspector 4000)*.

Features

- Four aperture sizes selectable from setup menu
- Two light wavelengths selectable from setup menu
- Provides scan head light color and aperture size (display/print)
- Auto-discriminates between many different symbologies
- Auto-print mode
- Bi-directional scanning
- Calculate and display print contrast signals (PCS)
- Low battery indicator
- Multiple scan averaging
- Power-down is automatic after short period of disuse
- Programmable, multi-scan analysis
- Specially designed wand ensures accurate scanning angle
- Store and print capabilities
- Visual and audible signals

3.2 Maintenance

To ensure the best possible scanning conditions, keep the display window clean. Use a soft, damp, lint-free cloth to clean the window.

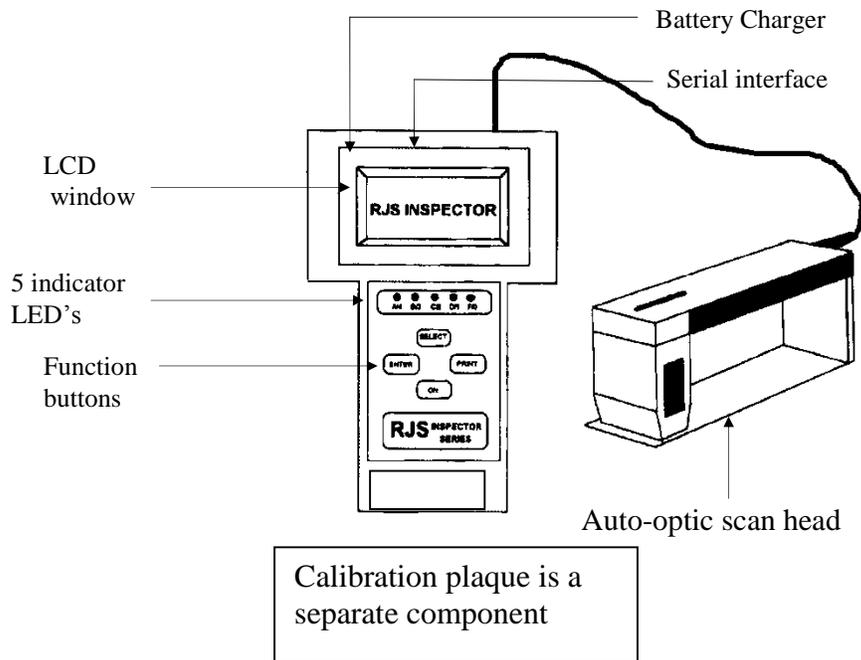
Do not use solvents on the unit or on any of the components. You may use alcohol to clean the unit.

3.3 Temperature Specs

Do not operate or store your unit or components in temperatures outside the range of 50° - 105°. Do not operate or store your unit in conditions of high humidity—over 80%.

4.0 The Inspector 4000

Figure 4-A (Inspector 4000)



5.0 Main Menu Selections

5.1 Calibration

Power On

When the unit is powered on, the following "Ready Menu" will display after a few seconds:

**Verifier Ready
XXX Aperture: YY**

XXX = indicates the wavelength (color) of the light represented in nanometers

YY = indicates the aperture size in mils

Example: **660 Aperture: 10**

This display indicates that the installed wand uses red light at 660 Nanometer wavelength and a 10 mil diameter aperture size.

Press **Enter** and **Select** at the same time to bring up the Main Menu:

**Scan Calib Setup
Storage Inactive
I4000 Ver.x.xx**

x.xx = Indicates the Software Version.

Press **Select** until the cursor is on **CALIB** and press **Enter**.

**Inspector 4000
Reflectance XX%**

Verifying that Unit is Calibrated

Selecting CALIB sets up the mode to measure reflectance. This also allows you to check the calibration of the unit by placing the wand on a template (white or black field) and verifying that the reflectance value matches the stated values.

Verify that reflectance values are within 5% for white and 2% for black. If the values are not within these tolerances you need to calibrate the unit; otherwise, press **Enter** and **Select** at the same time to navigate back to the Main Menu.

Calibrating the Unit

After selecting Calib from the main menu, the reflectance menu will display.



Inspector 4000
Reflectance XX%

From the reflectance menu press **Enter**, the Calibrate menu will display:



Calibrate

When the “Calibrate” menu is displayed, proceed with the following calibration steps:



Place Optics on
White/Enter Key

Place the wand on the white section of the calibration plaque with the shoe guide flat against the surface. Press **Enter** and hold auto-optic scanner head still until you hear a “chirp” sound.

**Place Optics on
Black/Enter Key**

Place the wand on the black section of the calibration plaque with the shoe guide flat against the surface. Press **Enter** and hold auto-optic scanner head still until you hear a “chirp” sound.

When both light and dark have been calibrated the following screen will display:

**Calibrated
Reflectance XX%**

Verify that the unit is calibrated by again placing the scan head on the light or dark area of the plaque.

The reflectance % value will display. Reflectance values should be within 5% (of the known value of the plaque) for white and 2% (of the known value of the plaque) for black.

If the “Unable to Calibrate” screen displays, repeat the calibration.

**Unable to
Calibrate**

Note: Power drain is greatest in the calibration mode. The automatic shut-off feature is disabled in calibration mode. Once the unit is calibrated, the calibration data will remain in memory; however, you should calibrate the unit at the beginning of each day or each shift for the proper PCS readings.

5.2 Scan

After finishing calibration press **Select** and **Enter** at the same time; the “Ready Menu” will display:

**Scan Calib Setup
Storage Inactive**

In addition to **CALIB**, explained in the previous section, there are 3 additional “selectable” functions: **Scan**, **Setup** and **Storage**:

- Press **Select** to choose an option.
- Press **Enter** to initiate processing for that option.

Select Scan (from the Main Menu) to display the initial Pass/Fail Analysis screen for the previously scanned bar code.

Note: A bar code can be scanned at any time except when the unit is printing.

Note: When calibrating the unit or when scanning any bar-code, the background must be the same color as the bar-code background—in the case of the included test symbol sheet the background should be white.

For example, if your scan is picking up part of a dark table top, slip a white piece of paper under the bar-code to assure a good read.

5.3 Setup

Select Setup (from the Main Menu) to view various system parameters:

Wavelength

This selection allows you to select one of two light wavelengths; toggle the two choices by pressing **Select**.

Wavelength
660nm, Red

Wavelength
925nm, Infra-Red

Press **Enter** to enable the selection.

Aperture Size
.10 in.

After selecting Wavelength and pressing **Enter**, select the Aperture size:

.003 in.
.005 in.
.010 in.
.020 in.

The next selection is "Passing Grade."

Passing Grade
B

Select one of the threshold grades, A, B, C, or D.

(See *Appendix H* for an explanation of Decodability grades.)

The next selection is Graph Resolution:

Graph Resolution

Choose either High or Low:

- Select **High** to print all the data points gathered for a scan reflectance profile.
- Select **Low** to print the same thing but in a more compressed format. This option will save paper.

The next selection is “Auto Print Mode.”

**Auto Print Mode
Analysis Profile**

Three choices are available in Auto Print Mode:

1. **Analysis Only:** (For the LP2042/Companion) Both ANSI and Traditional analysis will be printed automatically after a symbol is scanned.
2. **Analysis Profile:** (For the LP2042.) Scan reflectance profile graph will be added to the analysis only printout.
3. **Off:** You must press the print button to print. See Appendix F (Print Functions).

The next selection is Output Device:

**Output Device
LP2042**

Three output choices are available: When **LP2042** is enabled, the data is output in the format required by a **LP2042** printer (The **LP2042** supports graphics).

1. When Companion is enabled, data output is in the format of analysis only.
2. When **Computer** is enabled, data is output in computer readable format (text and graphics). See *Appendix C, Computer Mode*.

The next selection is:

**Scans/Analysis
Single**

From this screen you may choose the number of scans (from 1 (single) to 10) to be used in the analysis.

The next selection is Decode 3of9 as:

**Decode 3of9 as
ANSI 3of9**

This selection is for choosing the Code 39 sub-specifications for analysis:

**ANSI 3 of 9
3of9 w/43
AIAG B-1
AIAG B-3/4/5
LOGMARS
HIBC 3 of 9**

- Press **Select** to choose an option.
- Press **Enter** to initiate processing for that option.

If either AIAG choice is entered, the Inspector 4000 will automatically perform the scan reflectance profile analysis per the AIAG grading thresholds and display numbers 4, 3, 2, 1 and 0 in place of the letter grades.

The next selection is:

**Decode I 2of 5 as
Interlvd 2of5**

The options are “Case Code” and “Interleaved 2 of 5.”

The next selection allows you to select a range of UPC/EAN symbol magnifications:

**UPC/EAN Tol.
116 - 150% Mag.**

The magnifications are:

80 - 89 % Mag
90 - 115 % Mag
116 - 150 % Mag
151 - 200 % Mag

- Press **Select** to scroll the choices.
- Press **Enter** to initiate processing for that option.
(See *Appendix E* for an explanation of magnifications.)

Note: Units with 10 mil wands do not allow the 80 - 89% option.

When all Setup selections have been made, the Inspector 4000 will navigate back to the Main Menu automatically.

All setup parameters are retained in non-volatile memory and will be saved until changed by you—even if the power is turned off.

5.4 Storage

Storage will display as either **Storage Inactive** or **Storage %** depending on whether Store and Print is enabled or disabled.

- When Store and Print is enabled, a number and a percentage sign 0 to 99% will display.
- When Store and Print is disabled, **Storage Inactive** will display.

The Storage Section (from the Main Menu) refers to Store and Print. The display will show either “Storage Inactive” or “Storage %.”

Scan Calib Setup
Storage Inactive

- “Inactive” displays when **Store** and **Print** is inactive.

Scan Calib Setup
Storage XX%

- A storage “%” displays when **Store** and **Print** is active.
- If a % is displayed, it represents the percentage of the buffer that is filled with scan data.

You may enable or disable Store and Print by pressing **Enter** with the cursor on Storage. (Toggle from one option to the other.)

When Storage is active, press **Select** to move the cursor to the % sign. Press **Enter** on the % sign to clear the Store and Print buffer.

Note: See <i>Appendix F</i> for details about printing the contents of the Store and Print buffer.

6.0 PCS Analysis

PCS Scanning (overview)

This section is an overview of PCS (print contrast signal) analysis.

When a successful scan is made, the “Good Read” LED will illuminate and a crisp chirp or beep sound will be emitted.

Excellent results can be obtained when the auto-optic scan head is used properly. Make sure the bottom clear plastic plate of the scanner is flat against the surface to be scanned. This will assure the proper scanning angle.

In addition to the data analysis screens you will also get a PCS analysis screen:

<p>PCS 87 Req 75 Rmn 03% Rmx 90%</p>

- The top row of the display shows the calculated PCS. “Req” is the minimum PCS required for the particular symbology.
- The bottom row shows the minimum and maximum reflectance of the elements in the symbol.

Rmx = maximum space reflectance (light)

Rmn = minimum bar reflectance (dark)

Note: The PCS is calculated as follows:

$$\text{PCS} = \frac{\text{Rmx} - \text{Rmn}}{\text{Rmx}}$$

7.0 Scanning Symbols

After a bar-code is scanned, the Inspector 4000 will respond with a crisp, chirp (or beep) sound.

Decoded data and symbology type will display:



01928374
01 Scan Remain.

Press **Enter** to navigate to more detailed analysis screens:



Code 3of9
Acceptable

(See *Pass/Fail Analysis Screen* section)

7.1 Scanning Techniques

- Lay the symbol to be scanned on a flat, non-reflective surface.
- For greatest accuracy scan a symbol more than once, in both directions.
- Begin a scan from the “quiet zone” as far from the symbol as possible. See *Appendix I* for details.
- Make sure the scan head is flat against the symbol.
- Move the scan head across the symbol in a smooth motion. A constant speed of 5 to 10 inches per second is ideal. Scanning too fast will cause the LCD display to read “Please Scan Slower.”

8.0 Pass/Fail Analysis Screen

(See 7.0 *Scanning Symbols*)

After the symbol is scanned the Pass/Fail Analysis Screen may be displayed.

An example of an analysis screen for an acceptable symbol is shown below:

```
* RJS INC *  
3of9 Pass AB-CDF
```

The upper row is the decoded data. (If more than 16 characters are present, those characters will wrap to the next row of the display.) Press **Enter** to scroll through the data.

If the symbology code is 128 or 93, only printable characters will be displayed. See *Appendices A and B* for descriptions of how these codes are displayed.

The lower row provides the following:

- Symbology type (if symbol accepted) See Table 7-1.
- Pass/Fail indication
- The selected grades that pass or fail. Grades to the right of the dash fail

Below is a sample of a symbology type and rejected message.

```
UPC-A Reject Narr
```

- Scans remaining in multiple scan mode if the last scan has not been completed.

Table 8-A (Code Identifiers Inspector 4000)

LOGMARS	Code 39 Symbology
AIAG B-1	Code 39 symbology
AIAG B 3/4/5	Code 39 symbology
ANSI 3 of 9	Code 39 symbology
HIBC 3 of 9	Code 39 symbology
ANSI W/43	Code 39 symbology
USS 3 of 9	Code 39 symbology
ANSI I 2 of 5	Interleaved 2 of 5
UPC CASEC	Interleaved 2 of 5
USS CODABR	USS Codabar
ANSI CODAB	ANSI Codabar Variant
USS C93	USS Code 93
ANSI C93	Code 93
USS C128	USS Code 128
ANSI C128	Code 128

X - Y % UPC-A	Uniform Product Code, Ver. A
X - Y % UPCA+2	Uniform Product Code, Ver. A with 2 digit addendum
X - Y % UPCA+5	Uniform Product Code, Ver. A with 5 digit addendum
X - Y % UPC-E	Uniform Product Code, Ver. E
X - Y % UPCE+2	Uniform Product Code, Ver. E with 2 digit addendum
X - Y % UPCE+5	Uniform Product Code, Ver. E with 5 digit addendum
X - Y % EAN-13	European Article Number 13 digit
X - Y % EAN13+2	European Article Number 13 digit with 2 digit addendum
X - Y % EAN13+5	European Article Number 13 digit with 5 digit addendum
X - Y % EAN-8	European Article Number 8 digit
X - Y % EAN8+2	European Article Number 8 digit with 2 digit addendum
X - Y % EAN8+5	European Article Number 8 digit with 5 digit addendum

Note: (Previous Tables)

All ANSI symbologies are traditional specifications using bar width deviation.
 X and Y represent the magnification range selected for UPC/EAN tolerances.

Table 8-B (Code Identifier Descriptions for Pass/Fail Analysis Screen)

Identifier	Symbology Type
U39	USS Code 39
B-1	Code 39; B-1 sub-specification for AIAG
B345	Code 39; B2,3 or 4 sub-specification for AIAG
LOG	Code 39; LOGMARS sub-specification
HIBC	Code 39; HIBC sub-specification
3 OF 9	Code 39; Traditional ANSI sub-specification
39+C	Code 39; with Mod 43
U25	USS I2 of 5
I25	Interleaved 2 of 5
CC	Interleaved 2 of 5 Case Code sub-specification
U128	USS Code 128
C128	Code 128
UPCA	UPC version A
UA+2	UPC version A plus 2 digit addendum
UA+5	UPC version A plus 5 digit addendum
UPCE	UPC version E
UE+2	UPC version E plus 2 digit addendum
UE+5	UPC version E plus 5 digit addendum
EAN8	EAN 8 character
E8+2	EAN 8 plus 2 digit addendum
E8+5	EAN 8 plus 5 digit addendum
EN13	EAN 13 character
13+2	EAN 13 plus 2 digit addendum
13+5	EAN 13 plus 5 digit addendum
U93	USS 93
C93	Code 93
UCBR	USS Codabar
CBRV	Codabar Variant

9.0 Data Analysis Screens

After doing a scan, the Pass/Fail Analysis screen displays. (See *Pass/Fail Analysis*, 8.0)

From the Pass/Fail Analysis screen press **Select** to bring up the Data Analysis Screen.

Press **Select** to bring up the next screen:

PCS 98 Req 75
Rmn 01% eRmx 83%

This is the print contrast (PCS) screen. Light and dark reflectance values are shown. eRmx is greatest reflectance of an element (does not include quiet zone).

On the top row of the display, "Req" designates the minimum PCS required for the particular symbology. UPC and EAN have weighted PCS calculations, while most other symbologies require a minimum value of 75.

Note: PCS is calculated as follows:

$$\frac{L - D}{L}$$

Where:

L = Lightest (highest reflectance)

D = Darkest (lowest reflectance)

Press **Select** to bring up the next screen:

Ratio: 2.9

This screen provides the ratio calculation result on the top row (when applicable) and the decodability calculation and grade on the bottom row. If Ratio is not appropriate (UPC, EAN, Code 93 or Code 128), the Ratio field will be blank.

The following displays are brought up by pressing **Select**. The first screen to display is the Decoded Symbol Data:

1234ABCDEF456
01 Scans Remain.

(“Scans Remain” will display if more than “Single” scan was selected in the Setup.)

The decoded symbol data displays. (If more than 16 characters are present, those characters will wrap to the next row of the display. If more than 32 characters are present, press **Select** to scroll through the remaining data.)

Note: Code 128 is displayed in sixteen columns of two alphanumerics each. Each column represents a decoded Code 128 symbol character. Two 16 column fields are used to represent a 32 character decode. Press **Select** to display the second field. See *Appendix A* for details regarding display of Code 128 on Data Analysis Screens.

Press **Select** to bring up the next screen:

Mod Check is : 5
S/B : 5 Pass

This display indicates (**when applicable**) the Mod check character decoded and the Mod check character that should have been decoded (expected) in the symbol. PASS or FAIL is also indicated.

For Code 128, the Mod check character is displayed as the symbology's character value (a number from 000 to 102). One or two numeric Mod check characters may precede the 3-digit Code 128 Mod check described above. These digits represent the Mod 10 check character(s) that can be included depending on the format.

Code 93 will display 2 Mod check characters. See *Appendix B* for Code 93 character representations.

Press **Select** to bring up the next screen:

Code 3of9
Acceptable

Symbology type is indicated on the top row and the analysis overview on the bottom row.

Press **Select** to bring up the next screen.

Bar width deviations are represented graphically on the display.

-100 % Tol. +100%
-----++RRARR+++++

- “R” letters represent “range.”
- “A” represents the average of all character bar width deviations.

Note: The location of the “A” is indicated with the 5 LEDs also.
See *Table 9-A*.

The closer the “A” is to the center of the display, the better. The following shows the percentage of the scanning tolerance at each position on the display:

-	-	-	-	-	-	-	-	0	+	+	+	+	+	+	+
93	79	65	50	36	22	8	1		8	22	36	50	65	79	93

- Negative numbers to the left indicate bars that are narrower.
- Positive numbers to the right indicate bars that are wider.

The closer the “A” is to the edge, the more likely the Reject.

A symbol is “Acceptable” until any calculated bar width deviation exceeds 100% of the tolerance for the symbology decoded; for example:

Acceptable

-100% Tol. +100%
-----RRRARR+++++

Warning

-100% Tol. +100%
-----RRRAR(R)

Rejected

-100% Tol. +100%
-----RRR(A)

“A” is out of tolerance and off the screen. (Could also be on negative side.)

(See *Table 9-A* for visual display of deviations.)

Table 9-A (LED, Bar-code Width Deviations)

5 LED Display Pattern	Average Bar width deviation as a % of tolerance
	within + or - 21%
	within + 22— +49%
	within + 50— +78%
	within + 79— +99%
	Out of tolerance (wide)
	within -22— -49%
	within -50 — -78%
	within -79 — - 99%
	Out of tolerance (Nar.)

Note: Solid indicators represent LEDs turned on
The 9 possible patterns are displayed

ANSI Analysis Screens

Press **Select** again to display the first technical Data Analysis screen.

Ref Decode A Decodable 78% A

This screen shows the grades for the symbol's reference Decode and Decodability.

Press **Select** to display the next screen:

Sym. Cntr 84% A Rmin/Rmx 01% A

This screen shows the ANSI symbol contrast on the top row and Rmin/Rmax calculation on the bottom row.

Press **Select** to display the next screen:

Ecmin 66% A MODulation 78% A

This screen shows the symbol's ANSI Minimum Edge Contrast value on the top row and the Modulation value on the bottom row.

Press **Select** to display the next screen:

Defects 07% A
Appl. Compl. A

The defects value is displayed on the top row. The application compliance grade is displayed on the bottom row (A or F).

If any symbology parameter such as mod check, ratio, character type or inter-character gap is analyzed and found in error, an “F” grade will be given, and this will affect the overall symbol grade (per the ANSI specification).

Press **Select** to display the next screen:

Grade A/06/660
4.0/06/660

This screen shows:

- The ANSI symbol grade (two formats shown).
- The aperture diameter in mils (6 thousands inch in sample).
- The wavelength in nanometers (660, indicating red, in sample).

10.0 Connect to other Devices

Connection to other Devices

Connect to Computer

Optionally, you may store the analysis ASCII data on a PC, but you must have a terminal emulation program and this is not supplied by RJS.

(Your Inspector 4000 will connect to a computer with a serial interface cable; 9600 BPS, 8 bit, no parity, 1 stop bit.)

Connect to Printer

Your Inspector 4000 will connect to an RJS LP2042 printer with a serial interface cable.

Contact RJS to order a printer:

RJS Technologies

701 Decatur Ave North, Suite 107

Minneapolis, MN 55427

(763) 746-8034 Phone

www.rjs1.com Website

Appendix A (Code 128)

Code 128

Code 128 can encode all the characters currently encodable in the various code formats presently in existence. This includes: All ASCII alphanumeric characters (numbers, letters, special characters, control characters in the 128 character set and the distinction of the 3 subsets, A, B and C).

Code subset A includes the standard alphanumeric (upper case only) keyboard characters plus control and special characters.

Code subset B includes all the standard alphanumeric keyboard characters and special characters (upper and lower case).

Code subset C includes a set of 100 digit pairs from 00 to 99 inclusive, allowing definition of double density numeric digits per symbol, plus special characters.

The last 7 characters in Subsets A and B (96 - 102) and the last 3 characters in Subset C (100 - 102) are special characters that are specific to the scanning device.

The Inspector display can accommodate up to 16 characters. However, in order to display symbols greater than 16 (maximum of 32), press **Select** to display the additional characters.

(See Data Analysis Screens).

Table A-1 shows the encodable code subsets for 128. The Inspector display (in the shaded boxes) is just below the encodable code 128 character sets.

Due to the flexibility and nature of Code 128, it is difficult to display “printable” and “non-printable” control codes side by side without confusion. However, the approach taken here (detailed below) simplifies the displaying of this information.

- As indicated before, each of the 3 subsets have “unique” features:
- **Subset A** allows for encodation of control codes but not lower case characters.
- **Subset B** allows for lower case characters but not control codes.
- **Subset C** allows for only numeric data in a compressed format.

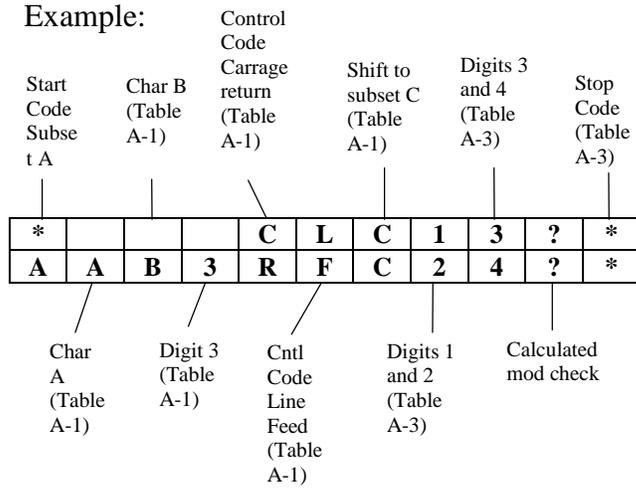
Code 128 also offers the flexibility to “shift” to other subsets in order to combine the “unique” features into one condensed bar-code.

The encoded data occupies 2 rows on the LCD and is encoded in a columnar display with one character above the other.

Display of Code 128 (Rules)

- The first character (column) displays the subset (*A = Subset A).
- The last character is a stop code (**).
- The second from the last is a mod 103 check character.
- Double characters beginning with alphanumeric characters designate non-printable control codes applicable to all subsets.
- Double numeric characters designate the compressed digit mode in subset C only.
- Single characters will always be displayed on the lower row and are applicable to only subsets A and B (normal printable characters.)

Example:



Refer to Code 128 tables (subsets) on the following pages:

Note: Only the first and last alphanumeric of each ASCII character are displayed by the Inspector.
 Shaded boxes are the Inspector's display.

Data
 Display
Table A-1 (Code 128 — Subset A)

SP ! " # \$ % & ' () * + , - . / 0 1 2 3 4 5 6 7 8 9 : ;

! " # \$ % & ' () * + , - . / 0 1 2 3 4 5 6 7 8 9 : ;

< = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W

< = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W

Y Z [\] ^ _ NUL SOH STX ETX EOT ENQ ACK BEL BS HT LF

Y Z [¥] ^ _ N S S E E E A B B H L
 L H X X T Q K L S T F

VT FF CR SO SI DLE DC1 DC2 DC3 DC4 NAK SYN ETB CAN EM SUB

V F C S S D D D D D N S E C E S
 T F R O I E 1 2 3 4 K N B N M B

ESC FS GS RS US FNC3 FNC2 SHIFT CODE-C CODE-B FNC-4 FNC-1

E F G R U F F S C C F F
 C S S S S 3 2 T C B 4 1

START (CODE A) START (CODE B) START (CODE C) STOP

* * * *
 A B C *

Table A-2 (Code 128 — Subset B)

SP ! " # \$ % & ' () * + , - . / 0 1 2 3 4 5 6 7 8 9 : ;

! " # \$ % & ' () * + , - . / 0 1 2 3 4 5 6 7 8 9 : ;

<=> ? @ A B C D E F G H I J K L M N O P Q R S T U V W

<=> ? @ A B C D E F G H I J K L M N O P Q R S T U V W

Y Z [\] ^ _ ` a b c d e f g h I j k l m n o p q r s t

Y Z [¥] ^ _ ` a b c d e f g h i j k l m n o p q r s t

u v w x y z { } ~ DEL FNC-3 FNC-2 SHIFT CODE-C FNC-4

		D	F	F	S	C	F
u	v	w	x	y	z	{	}
->	L	3	2	T	C	4	

CODE—A FNC—1

C	F
A	1

START (CODE A) START (CODE B) START (CODE C) STOP

*	*	*	*
A	B	C	*

Table A-3 (Code 128 — Subset C)

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	
0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	
2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	
40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	
4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	
60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	
6	6	6	6	6	6	6	6	6	6	7	7	7	7	7	7	7	7	7	7	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	
80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	
8	8	8	8	8	8	8	8	8	8	9	9	9	9	9	9	9	9	9	9	
9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	
9																				
CODE-B	CODE-C	FNC-1																		
C	C	F																		
B	A	1																		
START (CODE A)	START (CODE B)	START (CODE C)	STOP																	
*	*	*	*																	
A	B	C	*																	

Note: On the LCD Display the Inspector will show a Yen symbol “¥” instead of a backslash “\” however it will print out as a backslash. On the LCD Display the Inspector will show a right arrow “®” instead of a tilde “~” however it will print out as a tilde.

USS Shipping Container Code (Case Code 128)

When a Code 128 symbol is decoded and the first four characters are:

Start C FNC1 0 0

The symbol is automatically analyzed as a USS Case Code symbol. For details consult the USS specification entitled Application Specification for the USS-128 Serial Shipping Container Code: (with symbol and shipping label guidelines).

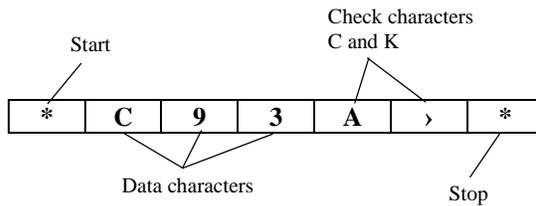
Appendix B (Code 93)

Code 93

Code 93 encodes 43 data characters consisting of 0-9, A-Z, 6 symbols, 4 control characters and a unique start/stop character.

The entire 128 ASCII character set is represented in code 93 using combinations of control characters and basic data characters.

Each symbol includes 2 check characters. The symbols are checked by the Inspector and displayed on the Mod Check Data Analysis screen.



The 2 check characters are referred to in the USS-Code 93 specifications as “C” and “K.” They are displayed in that order on the Data Analysis screen.

The entire Code 93 character set is shown in Table B-1. The Inspector displays the characters shown in the columns labeled Code 93 in the figure. Remember, some ASCII characters require 2 Code 93 symbol characters.

The Start/Stop and control characters cannot be displayed on the LCD as shown in Table B-1. They are displayed as:

- * is substituted for Stop/Start characters
- < is substituted for encircled \$
- > is substituted for encircled %
- ; is substituted for encircled /
- @ is substituted for encircled +

The characters are also transmitted in this form in print and real time communications modes.

See *Table B-1* (Next Page)

Table B-1 (Code 93 Character Set)

ASCII	CODE 93	ASCII	CODE 93	ASCII	CODE 93	ASCII	CODE 93
NUL	% U	SP	Space	@	% V	'	% W
SOH	\$ A	!	/ A	A	A	a	+ A
STX	\$ B	"	/ B	B	B	b	+ B
ETX	\$ C	#	/ C	C	C	c	+ C
EOT	\$ D	\$	\$	D	D	d	+ D
ENQ	\$ E	%	%	E	E	e	+ E
ACK	\$ F	&	/ F	F	F	f	+ F
BEL	\$ G	'	/ G	G	G	g	+ G
BS	\$ H	(	/ H	H	H	h	+ H
HT	\$ I	)	/ I	I	I	i	+ I
LF	\$ J	.	/ J	J	J	j	+ J
VT	\$ K	+	+	K	K	k	+ K
FF	\$ L	,	/ L	L	L	l	+ L
CR	\$ M	—	—	M	M	m	+ M
SO	\$ N	•	•	N	N	n	+ N
SI	\$ O	/	/	O	O	o	+ O
DLE	\$ P	0	0	P	P	p	+ P
DC1	\$ Q	1	1	Q	Q	q	+ Q
DC2	\$ R	2	2	R	R	r	+ R
DC3	\$ S	3	3	S	S	s	+ S
DC4	\$ T	4	4	T	T	t	+ T
NAK	\$ U	5	5	U	U	u	+ U
SYN	\$ V	6	6	V	V	v	+ V
ETB	\$ W	7	7	W	W	w	+ W
CAN	\$ X	8	8	X	X	x	+ X
EM	\$ Y	9	9	Y	Y	y	+ Y
SUB	\$ Z	:	/ Z	Z	Z	z	+ Z
ESC	% A	;	% F	[	% K	{	% P
FS	% B	<	% G	\	% L	;	% Q
GS	% C	=	% H	]	% M	}	% R
RS	% D	>	% I	^	% N	~	% S
US	% E	?	% J	—	% O	DEL	% T

Appendix C (Communication Format)

Computer Mode

When the Computer is enabled during Setup, as an output device, the data is output in a format that a PC can receive.

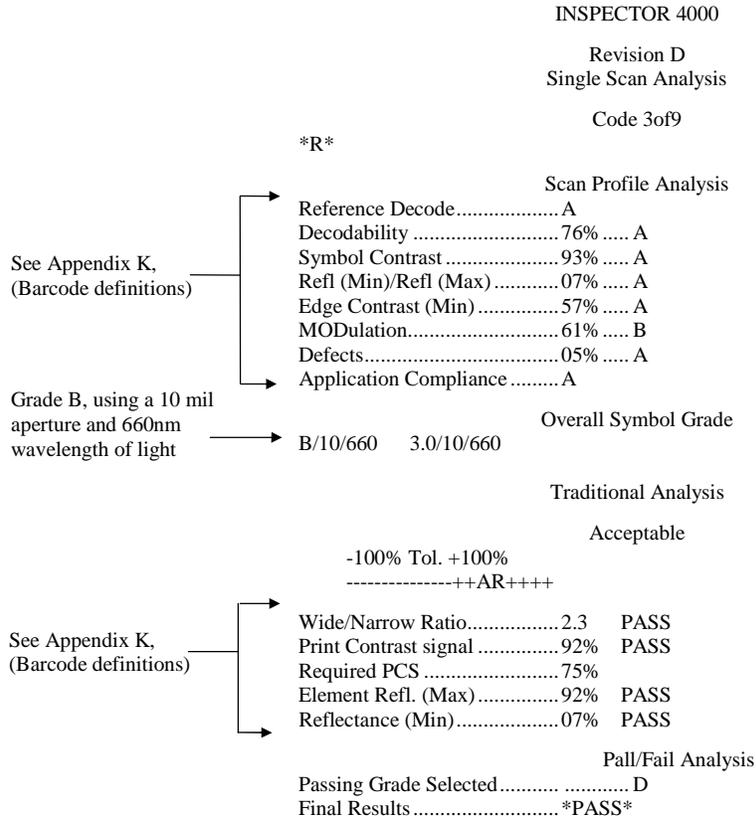
Either analysis data or analysis and profile (graphic) data will be output, depending on your printout selection.

(See *figure C-1*)

Analog Scan Profile

(See *figure F-1*)

Figure C-1



Appendix D (Battery Displays)

Battery Displays

If the “Low Battery” condition displays, there is still power left in the battery to advance to the next screen or even do a scan.

Low Battery

If the “Replace Battery” condition displays, batteries should be replaced immediately. The unit will not operate properly in this condition.

Replace Battery

Note: NICAD batteries and charger are available as options.

Warning: When using the optional charger, **DO NOT** charge alkaline batteries—this will damage the verifier.

Appendix E (Magnifications)

UPC/EAN Magnifications & Bar Width Deviations

UPC and EAN symbols have fixed lengths and formats; therefore, the only way to change their sizes is to magnify them. Specifications relative to bar/space tolerances are published for 80% to 200% magnifications.

While the Inspector 4000 does not measure the bars and spaces to derive a magnification, it does determine the relative sizes of the elements and therefore the bar width deviations.

When UPC and EAN symbols are analyzed, the approximate symbol magnification must be known in order to most accurately determine if the symbol is within tolerance.

For example, if a range of 90 - 115% magnification is selected and a 200% symbol is analyzed, there will be a greater chance of a warning message for the symbol (despite its being within specification) because of the stricter tolerances of a smaller symbol.

Conversely, if a range of 151% - 200% magnification is selected and a 100% symbol is analyzed, there will be a greater chance of an acceptance message for the symbol (despite its possibly not being within specification) because of the more liberal tolerances of a larger symbol.

Note: Magnification choices affect only the traditional bar width deviation analysis.
--

Appendix F (Print Functions)

Print Functions

Scanned data may be printed if the Inspector 4000 is connected to a printer with a serial interface cable.

Press the Print button at any time to display "Printout Type" on the upper row of the display. The lower row will contain one of two options that are scrolled with the **Select** button.

With the selected option chosen, press either **Enter** or Print to start printing. (The choice is saved in non-volatile memory so that printing can be halted by pressing **Select** and **Enter** at the same time, until the Main Menu displays.

Printout Options

Analysis

This option prints the analysis data for the last symbol scanned. This option can also be used to print each individual symbol in the multiple scan mode prior to the last scan being completed. (See the top part of *Figure C-1*.)

Analysis and Profile

This option is the same as Analysis but in addition prints an analog profile. (See *Figure F-1*.)

<p>Note: Inverse text in figure F-1 indicate from where the symbol defects, decodability and Edge Contrast (Min) grades were derived. (The sample is not an actual scan however.)</p>
--

Storage

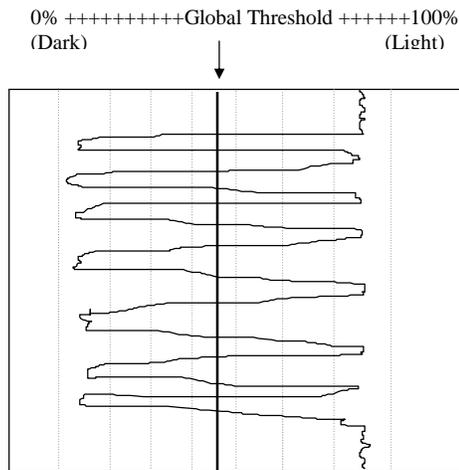
This option prints all analysis data stored in the buffer. The last bar-code that was scanned is printed first.

When printing the buffer in multiple scan mode, don't initiate printing before all scans of the current analysis are complete, otherwise, some completed scans could be lost.

Note: Scan reflectance profiles are not stored in the Store and Print buffer; only analysis data is stored.

Figure F-1 (See Figure C-1 also)

Profile Resolution: High



Analysis and Profile — prints the analysis (Figure C-1) and also prints the profile (above).

Appendix G (Symbology Analysis)

Symbology Analysis Parameters

Table G-1 shows error messages that will be displayed for each parameter type checked by the Inspector 4000.

Table G-1 (Parameter/Error Message)

Parameter	Data Analysis Message
Ratio	Warning Ratio
Inter-Character Gap (ICG)	Invalid Format
Valid Data Character	Invalid format
Mod Check Digits	Bad Mod Check
PCS	Warning PCS
Bar Width Deviation Range	Warning Wide (or narrow)
Bar Width Deviation Ave.	Rejected Wide (or narrow)
Addendum Parity (UPC/EAN)	Invalid Format
ANSI Decodability (if enabled)	Warn D/bility (DCD, in initial Pass/Fail screen)
Object in Quiet Zone	Defects F, 50% or greater typ.

Table G-2 (Parameters Checked for Each Symbology)

Symbology	Ratio	ICG	Data Character	Mod Check	Tolerance
AIAG B-1	2.2-3.2	.5X-8X	STD CODE 39	N/A	((12R-8)/81)X
AIAG B-3 B-4 B-5	2.8-3.2	.5X-8X	\$/+% Not Allowed	N/A	((12R-8)/81)X
LOGMARS	2.2-3.0	.5X-8X	STD CODE 39	N/A	((12R-8)/81)X
CODE 3 OF 9	2.2-3.0	.5X-8X	STD CODE 39	N/A	((12R-8)/81)X
3 OF 9 W/43	2.2-3.0	.5X-8X	STD CODE 39 4 CHARS Min	MOD 43	((12R-8)/81)X
HIBC 3 OF 9	2.2-3.0	.5X-8X	STD CODE 39 Min 2 CHARS 1ST. = "+"	MOD 43	((12R-8)/81)X
INTERLVD 2 OF 5	2.2-3.0	N/A	N/A	N/A	((18R-1)/80)X
CASE CODE	2.3-2.9	N/A	3 Data Chars Min.	MOD 10	((18R-1)/80)X
CODE 128	N/A	N/A	N/A	MOD 103	.35X
CASE CODE 128	N/A	N/A	16 Data Char. Format Check	Mod 10 Mod 102	.35X
UPC/EAN	N/A	N/A	N/A	MOD 10	See Note 1 (bottom of pg.)
CODABAR VARIANT	2.2-3.0	.5X-8X	STD CODABAR	N/A	((5R-8)/20)X
CODE 93	N/A	N/A	STD CODE 93	C&K	.35X

Note 1:

- **X = X dimension**

Tolerance is expressed as a fraction of the X dimension

R = Ratio in the calculations

- **UPC/EAN tolerances:**

80 - 89% = .14X

90 - 115% = .30X

116 - 150% = .34X

151 - 200% = .38X

- See *Appendix I* for Quiet Zone Analysis descriptions.
- UPC-A symbols with a number system character value of 2 and EAN-13 symbols with a prefix of 20 contain a random weight check digit in addition to the normal Mod 10 check digit. This extra digit is automatically analyzed and displayed in the Mod Check Data Analysis screen as shown below:

Modck: 1 5 PASS Expect: 1 5
--

The 1 is the random weight check digit and the 5 is the Mod 10 check digit. The symbology specifications allow the check digit to have a value of zero in cases where it is not used

In cases where the random weight check digit is zero, when another value is expected, a Bad Mod Check Warning will not be issued. The LCD display and corresponding printout will note the discrepancy with a “CHK” message in place of “FAIL” as shown below:

Modck: 0 5 CHK Expect: 1 5

Appendix H (ANSI Decodability)

ANSI Decodability Calculations

There is a specified method for calculating decodability for each symbol. But the method is generally the same for all. Each element width in a bar-code symbol should be consistent across the symbol.

In the case of Code 39, two element widths are needed to produce a symbol.

For optimum scanning, each narrow element, whether a bar or space, should have the same width dimension. And each wide element should have the same width dimension.

Simply stated, the Decodability grade indicates the amount of tolerance remaining in the width of the most deviant element in the symbol. The more tolerance remaining, the higher the grade. Grade "A" is the highest grade and grade "F" is lowest. (Even grade "F" is decodable however.)

The grade is displayed in both its calculated numeric form and in its alphanumerical equivalent (the ANSI specification numbered ANSI X3.182-1990).

In the case of UPC and EAN symbols, the grade is calculated per a proposed guideline draft dated September 4, 1990 issued by the USS.

Decodability Grade Conversions

>= .62 = A
>= .50 = B
>= .37 = C
>= .25 = D
< .25 = F

Appendix I (Quiet Zone Analysis)

Quiet Zone Analysis

The Inspector 4000 trims data gathered during a scan to approximately 10 times the X dimension on each side of a bar-code for all symbologies except UPC and EAN. The areas are assumed to be quiet zones and are included in the symbol analysis. If a low reflectance object is detected in these areas, an Overall Symbol Grade of F will result. The Defects calculation will be the cause of the F grade and typically be a value greater than 50%.

Symbols should be scanned in both directions since the Inspector 4000 is designed to be bi-directional.

Quiet Zone Analysis for UPC and EAN symbols are described in the following tables. In cases where an addendum is included in the bar code, an addendum gap analysis is also performed.

Table I-1 (Acceptable Parameters for Symbols

Without Addendums

Symbology	Leading QZ	Trailing QZ
UPC-A	9X Minimum	9X Minimum
UPC-E	9X Minimum	7X Minimum
EAN-13	11X Minimum	7X Minimum
EAN-8	7X Minimum	7X Minimum

**Table I-1 con...(Acceptable Parameters for Symbols
With Addendums)**

Symbology	Leading QZ	Trailing QZ	GAP Size
UPC-A	9X Minimum	5X Minimum	9 - 12X
UPC-3	9X Minimum	5X Minimum	9 - 12X
EAN-13	11X Minimum	5X Minimum	7 - 10X
EAN-8	7X Minimum	5X Minimum	7 - 10X

Appendix J

Inspector 4000 Analysis Parameters

Reference Decode

This parameter grade can be “A” or “F.”

If the Reference Decode parameter is “F,” then the overall symbol grade is also “F” (regardless of the grade of any other parameter).

If the Reference Decode parameter is “A,” then the overall symbol grade is determined by the lowest of the other parameter grades.

When a symbol contains a global threshold failure (an element does not cross the global threshold), other parameters cannot be analyzed.

- In the case of a global threshold failure symbol contrast calculations are valid, however.
- In the case of a global threshold failure, the Inspector 4000 will force the decodability grade to 00% (an “F” grade).
- Other affected grades will be calculated only for that portion of the symbol which was scanned up to the point of the global threshold failure.

The Inspector 4000 also decodes each symbology with a more aggressive algorithm. This enables many symbols to be scanned and decoded even though the reference decode grade is an “F.”

The overall symbol grade is averaged for the Reference Decode parameter:

For example, if 2 scans are averaged and one passes reference decode and the other fails reference decode, (assuming all other parameters scan "A" or "B"), the average would be a "C" (the average of "A" and "F").

The average grade for the reference decode parameter would be "F" however as a warning that at least one scan failed this parameter.

Decodability

This parameter grade can be "A," "B," "C," "D," or "F."

The decodability grade indicates the amount of error in the width of the most deviant element in the symbol. The lower the deviation, the higher the grade.

Each symbology type has a specified method for calculating decodability but the basic idea is the same for all.

Each element size in a bar-code symbol should be consistent across the symbol. In the case of Code 39 there are 2 element widths needed to produce a symbol.

For optimum scanning, each narrow element (bar or space) should be the same dimension, and each wide element (bar or space) should be the same dimension.

Symbol Contrast

This parameter can also be "A," "B," "C," "D," or "F."

Symbol contrast is the difference in reflectance values of the "lightest" space (including the quiet zone) and the "darkest" bar of the symbol. The greater the difference, the higher the grade.

(Bar-code colors can have a large effect on this parameter.)

Refl (Min)/Refl (Max)

This parameter grade can be “A” or “F.”

The reflectance value of the “lightest” space must be at least twice as great as the reflectance value of the “darkest” bar, otherwise, the grade will be “F.”

Edge Contrast (Min)

This parameter grade can be “A” or “F.”

Edge contrast is the difference of the reflectance values of the dark and light components of an edge.

Each element of a bar-code has two edges which go from dark to light. Therefore, each edge has a dark and light reflectance value component.

The parameter grade is determined by:

1. calculating the edge contrast of every element edge in a symbol
2. finding the lowest value (minimum edge contrast)
3. comparing it to a fixed threshold in the specification (15%)

If the value is at least as great as the threshold, the grade is “A,” otherwise the grade is “F.”

Modulation

This parameter can also be “A,” “B,” “C,” “D,” or “F.”

Modulation grade is based on the relationship between the minimum edge contrast and the symbol contrast.

Ideally, the edge contrast should be equal to symbol contrast, but as an aperture size approaches an element size the amplitude of the signal received will decrease and the edge contrast will decrease.

The greater the difference between minimum edge contrast and symbol contrast, the lower the grade.

(Aperture size has the greatest affect on this parameter. The substrate material can also have a major affect on this parameter.)

Defects

This parameter can also be "A," "B," "C," "D," or "F."

Defects are irregularities in bars, spaces and quiet zones.

For example, a dark spot in a space could cause a low enough reflectance to be mistaken for a bar, and the extra bar would cause a decode error.

The defect grade is determined by a relationship between the largest defect in the symbol and the symbol contrast. The smaller the defect, the better the grade.

(In general, a small aperture used to analyze very wide elements will cause the largest defects.)

The Inspector 4000 incorporates a feature that trims reflectance data gathered during a scan to approximately 10 times the X dimension (5X after a UPC/EAN addendum). These areas, on either side of the bar-code, are assumed to be quiet zones and are included in the analysis.

A graphic object in the quiet zone will produce an "F" grade. This indicates a quiet zone that is too narrow. We recommend that you scan in both directions to make maximum use of this feature.

Traditional Analysis Tolerance Graph

This graph is similar to the ANSI decodability parameter grade previously described except this analysis is based on the average deviations of the bars of each character in a symbol instead of the most deviant element in the symbol.

The width of the graph represents the total deviation from normal reflectance that bars in a symbol can have and still be within dimensional specifications.

The graph provides information about bars being narrow or wide, whereas ANSI decodability does not.

In the graph, "A" indicates the average bar deviation of all characters in the symbol. The "R's (if any) indicate the range of average bar deviations.

The graph is normalized to plus or minus 100% tolerance with no specific dimensions. Higher density symbols such as 80% UPC may indicate larger ranges of deviation than low density symbols such as case code.

Appendix K

Bar-code Definitions

Achieved Width

The calculated element width based on measurements.

Alphanumeric

A character set that contains letters, digits, and other characters such as punctuation marks. Also, a character that is either numeric or alpha.(In programming an alphanumeric cannot be used to do arithmetic.)

ANSI

American National Standards Institute, Inc. 1430 Broadway, New York, New York
10018

Aperture

The effective opening in an optical system that established the field of view.

Application Specification

A set of rules for using bar-code symbols.

Aspect Ratio

The ratio of height to width of a bar-code symbol.

Bar

An element of a bar-code symbol whose reflectance is less than the global threshold. A Bar is the dark (reflective) element of a bar-code. (As opposed to a space which is the light reflective element.)

Bar-code (U.P.C.)

A group of parallel bars and spaces constituting characters that are machine and human readable¹. (See bar-code symbol.)

Bar-code Reader

A device used to identify and decode a bar-code symbol.

Bar-code symbol

An array of rectangular bars and spaces which are arranged in a predetermined pattern following specific rules to represent elements of data that are referred to as characters. A bar-code symbol typically contains a leading quiet zone, start character, data character(s) including a check character (if any), stop character and a trailing quiet zone.

Bar Height

The bar dimension perpendicular to the element width. The measurement of the long dimension of a bar element. (Also called bar length.)

Bar Width

The lateral dimension of a bar; bar thickness.

Bar Width Ratio

The ratio of the widest bar or space to the narrowest.

Bar Reflectance (Rb)

The smallest reflectance value in a bar.

Bi-directional Code

A bar-code that can be read left to right or right to left.

¹ The code numbers while readable must still be interpreted

Bit

The narrowest code element (bar of space) that may contain information.

Character

The smallest group of elements assigned by a symbology to uniquely represent one or more numbers, letters, punctuation marks or other information.

Character Set

The numbers and/or letters and markings included in a bar-code symbol.

Check Character (or Check Digit)

A character included within a bar-code symbol whose value is used for performing a mathematical check of the validity of the decoded data.

Contact Code Reader

A light pen or other scanning device that must come into physical contact with the code medium in order to read the symbol.

Continuous Code

A bar-code or symbol wherein the space between the characters is part of the code.

Decodability

This parameter grade can be "A," "B," "C," "D" or "F." The decodability grade indicates the amount of error in the width of the most deviant element in the symbol. The less deviation, the higher the grade. Decodability is a measure of print accuracy using the symbology reference decode algorithm.

Decode

Determining the information which has been encoded in a bar-code symbol.

Decoder

The portion of a bar-code reading system that performs the decode function.

Defects

This parameter grade can be "A," "B," "C," "D" or "F."

Defects are of two types, voids and spots. Voids are light areas in bars, and spots are dark areas in spaces.

The defect grade is determined by a relationship between the largest defect in the symbol and symbol contrast. The smaller the defect, the better the grade. Aperture size can affect grade; for example, using a small aperture to analyze a very wide element will permit detection of the largest defects.

Defects are usually voids, and these defects can be reduced by increasing the amount of ink (or equivalent).

Diffuse Reflection

Reflected light which emanates uniformly in all directions from the reflecting surface.

Dimensional Deviation (DD)

The measured deviation of bars and/or spaces of a scanned symbol from the specification.

Discrete Code

A bar-code or symbol wherein the spaces between the characters are not part of the data.

Edge Contrast (EC) See Edge Contrast(min)

The difference between the space reflectance (Rs) and adjoining bar reflectance (Rb).

$$EC = R_s - R_b$$

Edge Contrast (min)

This parameter grade can be "A" or "F." Edge contrast is the Reflectance difference between adjoining bars and spaces. The minimum edge contrast is the smallest value of $EC = R_{space} - R_{bar}$ found in the scan.

The grade is determined by calculating the edge contrast of every element in a symbol and then comparing the lowest value to a fixed threshold in the specification (15%).

If the value is equal to or greater than the threshold, the grade is "A." If the value is less than the threshold, the grade is "F."

Element

A generic term used to refer to either a bar or space in a bar-code symbol.

Element Edge

The location where the scan reflectance profile intersects the midpoint between the space reflectance (Rspace) and bar reflectance (Rbar) of adjoining elements. Visual measuring techniques will generally locate the element edge closer to the center of the bar.

Element Reflectance Nonuniformity (ERN)

The reflectance difference between the highest peak and lowest valley within each individual element and quiet zone. When an element consists of a single peak or valley, its element reflectance non-uniformity is zero.

Element Width

The thickness or width of a bar or space as measured from its leading edge to its trailing edge.

Encoded Area

The total linear dimensional space taken by all characters of a code pattern including start/stop and data.

First Read Rate

The percentage of successful "reads" of a bar-code symbol on the first attempt.

Fixed Beam Scanner

A bar-code reading device wherein coded items pass across a stationary incandescent or LED light source.

Flexo Film Master

A measurement standard symbol produced by printing the symbol on clear plastic film using the Flexograph printing process.

Gloss

A phenomenon related to the specular reflection of incident light. The effect of gloss is to reflect more of the incident light in a specular manner, and to scatter less. This effect occurs at all angles of incidence and should not be confused with the grazing angle which is specular reflection often referred to as sheen.

Global Threshold (GT)

The global threshold is drawn through the middle of a profile, to distinguish spaces above the line and bars below. The reflectance value is determined by dividing the symbol contrast (SC) by 2 and adding the minimum reflectance, Rmin.

$$GT = Rmin + (SC/2)$$

Guard Bar

The first and last bars of a bar-code symbol usually having the pattern 101. A guard bar generally follows the leading quiet zone and precedes the trailing quiet zone. This term is used mostly for UPC/EAN symbologies.

Infinite Pad Method

The method for measuring reflectance in which the sample substrate being measured is backed with enough thickness of the same type of substrate so that doubling the number of sheets does not change the measured value of reflectance.

Inspection Band

An area of the bar-code symbol where measurements shall be taken spanning from 10% to 90% of the average bar height.

Inter-character Gap

In discrete barcodes, the space that separates two adjacent characters. When present, inter-character gaps are considered spaces (elements) for purposes of edge determination and reflectance parameter grades.

Interleaved

A bar-code in which characters are paired together using bars to represent the first character and spaces to represent the second.

Ladder Code

A bar-code or symbol printed vertically with the individual bars looking like the rungs of a ladder.

Laminate

See Over-laminate

Laser Scanner

A bar-code reading device that uses a low energy laser light source for illumination.

Magnification Factor

The size of a printed bar-code compared to a standard (nominal) size.

Maximum Element Reflectance Nonuniformity (ERN max)

The largest element reflectance non-uniformity in a scan reflectance profile.

Maximum Reflectance (Rmx)

The greatest reflectance value in a scan reflectance profile including quiet zone. (Note: **eRmx** is the greatest reflectance value of an element, not including quiet zone.)

Minimum Edge Contrast (Ecmn)

The smallest edge contrast in a scan reflectance profile.

Minimum Reflectance (Rmn)

The smallest reflectance value in a scan reflectance profile.

Misread

A condition that occurs when the data output of a reader does not agree with the encoded data.

Modulation (MOD)

(Scanners and verifiers perceive the narrower bars and spaces to have less intensity than wider bars and spaces; the comparison of this diminished intensity of narrow elements to wide elements is called modulation. This condition is affected by aperture size.)

This parameter grade can be "A," "B," "C," "D" or "F."

The modulation grade is based on the relationship between minimum edge contrast (ECmin) and symbol contrast (SC).

$$\text{MOD} = \text{ECmin}/\text{SC}$$

The greater the difference between minimum edge contrast and symbol contrast, the lower the grade.

Since "ink spread" will reduce the width and intensity of single module space within a symbol, this is one thing to check in seeking to correct a low modulation grade.

Module

The narrowest expected bar or space width.

Moving Beam Scanner

A laser device that dynamically searches for a bar-code pattern by sweeping a moving optical beam through a field of view.

N (wide to narrow ratio)

In symbologies with two element widths, the wide to narrow ratio of elements is calculated by summing the average wide bar width and average wide space width and dividing the sum by 2 times Z. Inter-character gaps, if applicable, are not included.

$$N = (\text{avg. wide bar} + \text{avg. wide space}) / (2 * Z)$$

Nanometer (nm)

A unit of measure used to define the wavelength of light, equal to 10⁻⁹ meter.

Nominal

The intended value for a specific parameter. Tolerances are generally specified as positive and negative deviations from this value.

No-Read (Non-read, Non-scan)

The absence of data at the scanner output after an attempted scan because of no code, defective code or operator error.

Nominal Size

The target size for a specific element or group of elements.

Numeric

A character set that contains only numbers.

Omni-directional

The ability to read a bar-code symbol from any angle as long as the bar-code passes across the scanner window.

Opacity

The property of a material that minimizes the show-through of printing from the back side or the next sheet.

Overhead

The number of characters in a symbol required for start, stop and checking.

Over-laminate

A coating or material adhered to the scanning surface of a bar-code symbol.

Parity

A system for encoding characters as “odd” or “even” for self checking of barcodes.

Peak

The graphical pattern on a scan reflectance profile which looks like an upside down “U” or “V.” Within a profile a peak represents a space. One or more peaks could also be found within an element representing a reflectance change within an element.

Plaque

A template used as a reflectance calibration standard (RCS). The known reflectance values are posted on the back of the plaque.

Print Contrast Signal (PCS)

A comparison between the reflectance (brightness difference) of bars and spaces in a symbol. PCS under a given set of illumination conditions is defined as follows:

PCS is calculated as follows:

$$\frac{L - D}{L} \times 100\%$$

Where:

L = Lightest (highest reflectance)

D = Darkest (lowest reflectance)

Profile

See Scan Reflectance Profile

Quiet Zone

The area immediately preceding the start character and following the stop character in a bar-code symbol as specified in a particular application and/or symbology specification.

Reference Decode

Each symbology type specifies a specific decoding method to be used in determining overall symbol grade.

This parameter grade can be “A” or “F.” (“A” is pass and “F” is fail.) If this parameter is “F” the overall symbol grade will also be “F” regardless of any other parameter. If this parameter is “A” the lowest of the other parameter grades determines the overall symbol grade.

Reflectance

A measure of the amount of light reflected from an illuminated surface.

Refl(min) / Refl (max)

This parameter grade can be “A” or “F.” The reflectance value of the “lightest” space in a symbol must be equal to or greater than twice the reflectance value of the “darkest” bar.

Refl(max) = or > Refl(min) x 2 if “yes” “A” else “F”

Reflectance Calibration Standard

(See plaque) A standard or “known” reflectance value, usually printed on the back of a template or plaque. Bar-code readers are calibrated for reflectance using these known values.

Required PCS

This is the minimum PCS percent required for the symbol.

Resolution

The dimension of the smallest code element that can be printed; the higher the resolution the clearer the image.

Scanner

An electronic device that converts printed information into electrical signals.

Scan Reflectance Profile

A record (usually graphically represented) of the reflectance measured using the reference reflectivity method as a function of distance across the entire bar-code symbol.

Segment

Refers to the left and right grouping of modules or elements into segments to designate parity for checking validity of a scan.

Self-checking

A bar-code or symbol that uses a checking algorithm, that can be applied to each character, to guard against undetected errors. (Non-self-checked codes may use a check digit or other redundancy in addition to the data message.)

Show-through

The generally undesirable property of a substrate that allows underlying markings of materials to affect reflectance.

Space

The element of a bar-code symbol whose reflectance is greater than the global threshold. A Space is the light reflective element. (As opposed to a bar which is the dark reflective element.)

Space Reflectance (Rs)

The largest reflectance value in a space or quiet zone.

Specular Reflection

Reflection of light from a surface at an angle equal and opposite to the angle of incidence.

Start and Stop Characters

Characters typically used at the beginning and end of each bar-code symbol.

Substitution Error

This error can be seen in a mis-encodation, mis-read or human operator error where characters that were to be entered were substituted with erroneous information.

Substrate

The material (paper, plastic, metal, etc.) upon which a bar-code symbol is "printed" or reproduced.

Symbol

See Bar-code symbol.

Symbol Contrast (SC)

This parameter grade can be "A," "B," "C," "D" or "F."

Symbol contrast is the difference in reflectance values of the "lightest" space (including the quiet zone) and the "darkest" bar of the symbol. The greater the difference, the higher the grade.

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

Symbol Grade

The simple average of all the overall profile grades using the standard weighing

4.0 = A

3.0 = B

2.0 = C

1.0 = D

0.0 = F

The symbol grade may be stated as a decimal or converted to a letter grade. A measuring aperture number and nominal wavelength are also specified.

Symbology

A set of rules for encoding information in a bar-code symbol.

Symbology Reference Decode Algorithm

A decoding algorithm that may be found in a particular application and/or symbology specification.

TAPPI

Technical Association of Pulp and Paper Industry.
Technology Park/Atlanta, P.O. Box 105113
Atlanta, GA 30348-5115

Threshold (Global Threshold)

see Global Threshold)

Transmission Mode

The mode where light is transmitted through a film master symbol rather than reflected from a printed symbol.

Truncation

Decreasing the length of the bars in a bar-code symbol below the normal specification. Truncation decreases a symbol's omni-directional readability and should be avoided.

Valley

The graphical pattern on a scan reflectance profile which looks like a "U" or "V." Within a profile a valley represents a bar. One or more valleys could also be found within an element representing a reflectance change within an element.

Vertical Redundancy

The availability of more than one scan path through a bar-code symbol.

Visual Measurement

Measurements obtained by using human vision in the determination of characteristics of the bar-code symbol.

Void

White or light reflective area in a bar caused by a printing error that can cause a bar to scan as a space.

Wide/Narrow Ratio

Ratio of narrow to wide elements.

X Dimension

The intended width of the narrow elements dictated by the application and/or symbology specification.

Zero Suppression

Technique used to shorten UPC symbols by omitting zeros from the bar-code.

Z Dimension

The achieved width of the narrow elements. Computation of Z is accomplished using different factors for some symbologies.

