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**Bar Code Scanner Implementation
of *ISBT 128* Concatenation**

Bar Code Scanner Implementation of *ISBT 128* Concatenation

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**This technical bulletin discusses the characteristics of scanners and
their setup and use in concatenation as described in the
*ISBT 128 Application Specification***

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Introduction

It is not the role of the ICCBBA, Inc Technical Advisory Groups to recommend specific scanning technologies for bar codes. Users have the responsibility to determine the best type(s) of scanners to utilize with their own applications. It is, however, within the purview of the Technical Advisory Groups to provide suppliers of scanning hardware (as well as other devices) with guidance regarding general application requirements to enhance the usefulness of their offerings and the ease with which *ISBT 128* can be implemented. The purpose of this document is to discuss the concatenation function as outlined in the *ISBT 128 Application Specification* and its impact on the three major type of scanning devices: contact scanners (“wands,” “pens”), near-contact scanners (CCDs), and non-contact scanners (lasers, “guns” and non-contact CCDs).

Concatenation Basics

According to Version 1.0.0 of the *ISBT 128 Application Specification*, the second Technical Objective was to “develop a concatenation capability for *ISBT 128* that performs the same function as the use of Start and Stop code “D” in *ABC Codabar* (also known as pause code “D”) to provide time and/or spatially-dependent restricted concatenation of two bar codes, the Donation Identification Number and ABO/Rh(D) Blood Groups. This pair, together with the Product Code and Expiration Date [(and Time)], will be the most commonly concatenated symbols using the new standard.” If blood containers are labeled according to *ISBT 128* guidelines, these pairs of symbols are placed adjacent to one another. Regardless of the scanning technology used, they can be decoded in a single pass.

How will this concatenation actually be performed using the most common scanning technologies? Each alternative is explored briefly below.

Contact [Wands — Pens]. The original *ABC Codabar* specification and its concatenation feature were based on the use of handheld contact scanners—virtually the only scanning technology used in blood banks at that time. In Section V of the 1989 *Guidelines for the Uniform Labeling of Blood and Blood Components*, concatenation is prescribed as follows:

“When ‘D’ is encountered as a stop character. . .the decoding system is to decide within about 30 milliseconds that this is a ‘stop’ code unless a ‘D’ start character has subsequently been encoded. The 30 milliseconds is roughly the time it takes the reader to pass across the distance of approximately 0.3 inch and decode the second ‘D.’ Further, the direction of the decoded ‘D’s must be the same, and the pair of ‘D’s must be removed from the message before it is transmitted to the host computer. . . Messages will be

transmitted to the host computer as if they had been read from left to right.”

Host software prompts the user to either concatenate or not concatenate as appropriate to the situation. If concatenation is required, the user of the handheld wand simply draws an imaginary line through the two adjacent symbols in a single pass. If concatenation is not required, the operator scans the single symbol.

Two error scenarios are possible with concatenation. The first occurs when concatenation is required and only a single symbol is scanned. In that case, host software will prompt the user to re-scan. The second error scenario is the opposite of the first: Concatenation is not desired, yet two symbols are scanned simultaneously. Again, the host software is expecting a message of a specific length, and the longer message will be disallowed; a re-scan is required.

Thus, trained operators of contact scanners should have no trouble using the concatenation feature of *ISBT 128*: they will use their wands just like they have with *ABC Codabar*. The decoder will be “customized” with the concatenatable pairs outlined in the *Application Specification*, and only allow combining of approved messages. The concatenation feature will be enabled for any scanner that might be used when concatenation is desirable. Scanners used at workstations that never require concatenation may have that feature disabled if the decoder is user-programmable.

Contact and Near-Contact [CCDs]. The CCD (charge-coupled device) scanner requires the user to “touch” (or come within an inch or two of) the bar code symbol for reading to occur. Housing geometry (*ie*, how wide the scanner head is) determines the longest symbol or symbol pair that can be scanned with that particular model. A 3” [76.2 mm] width, for example, is required for successful concatenation of the *ISBT 128* Donation Number and its adjacent ABO/Rh symbol. If concatenation is not desired, that same scanner can be placed over only the symbol the user desires to read. Only complete bar code symbols can be decoded; if scanner placement is imprecise, no partial reads will occur. Similar to wands, the concatenation feature will be enabled for any scanner that might require it. In those situations, of course, it will be necessary for the user to place the scanner over both symbols, just as the pen (wand) must be “drawn” across both symbols in a single pass.

Non-Contact [Lasers]. Because the laser is a non-contact device, it presents special concerns with regard to concatenation. When trying to read two symbols simultaneously, improperly positioned laser scanners may read only one of the two symbols presented to the scanner because it is difficult to guarantee that the laser will be aligned on both symbols when the trigger is pulled. The person using the reader will generally start with the beam somewhat off the symbol, then re-position the beam to cover both symbols. The problem is that one of the symbols will come completely into view before the other is detected. At that point, the scanner declares a decode and transmits only one of the two symbols, never detecting a second symbol. Training the operator of a laser scanner to scan two horizontal symbols at the

same time is not difficult. (Readers interested in a more complete discussion of options available to prevent erroneous concatenation events with a laser scanner are referred to the appendix to this document).

Position of the Technical Advisory Groups [NATAG and ETAG]

Scanning in a blood center or hospital transfusion service has always been assumed to occur in a closed-loop host-driven environment. Specific end-user requirements are best handled by host software as opposed to being resident in the scanner. The more intelligence that must be built into the scanner to accommodate *ISBT 128*, the fewer scanner companies will elect to provide for it in their product offerings. Prices are likely to reflect that scarcity.

Outlined below are the only two possible conditions that will be encountered in a blood center or transfusion service with respect to concatenation. The assumption in both is that the scanner has been “customized” with *ISBT 128* concatenation capabilities, and that the feature is enabled within the unit.

Concatenation prohibited: Host software will prompt the user to scan, for example, the Donation Identification Number. It will thus look for the appropriate Data Identifier, and ignore scanned bar codes that do not contain those unique initial characters and the expected character count. In this situation, if two codes are scanned and concatenated, host software can be programmed to do one of two things:

- a) Using the Data Identifier and the expected message length, the correct message will be selected by the host. In other words, because the host “knows” the appropriate Data Identifier and the expected length of the ensuing message, it can “choose” which of the two decoded message segments it accepts.
- b) Alternatively, the host may simply disallow any message that does not conform to a specific length, and require a re-scan. The TAGs defer to the wishes of individual end-users in selecting the best approach for their systems.

Concatenation required: If the user is prompted to scan **both** the Donation Identification Number **and** the ABO/Rh Blood Groups symbols as a single scan, but only scans one or the other, the scanner transmits the data from the single bar code scanned to the host. The host rejects the scan and requires a re-scan because, again, it knows the Data Identifiers that should be present as well as the correct message length.

Here is a summary of what the scanner and host software would be expected to do in two common scanning scenarios. Assume in each case that the concatenation feature is enabled in the scanner and that the host is expecting a concatenated message.

Scanner decodes two symbols within time required.

- a) Scanner confirms that the two data identifiers are a concatenatable pair.
- b) Scanner combines the two messages in the appropriate order [*eg*, the Donation Identification Number on the left and the ABO/Rh Blood Groups on the right, or the Product Code on the left and the Expiration Date (and Time) on the right].
- c) Host receives single message from scanner; may double-check to verify it was created from a concatenatable pair.
- d) No characters are inserted between the end of one message and the beginning of the next for transmission to the host.

Scanner decodes only one symbol.

- a) Scanner passes through the message it decoded.
- b) Host rejects message because it is not the required length.
- c) Host prompts user to re-scan the symbol.

This overall approach to concatenation has a number of advantages:

- ' it does not require any revision to the current *ISBT 128 Application Specification*;
- ' it can be supported by current scanning technology, and
- ' it simplifies the scanning process.

Users may elect to use the scanning technology most appropriate to their needs. It is the intent of the TAGs to encourage proliferation of the standard by simplifying the scanner customization required to accommodate those needs.

Appendix A Moving-Beam Scanner Operations

The following section is meant to provide insight into non-contact scanner operation and how the Concatenation List may be used to assist in this operation.

From the standpoint of the non-contact scanner user, there are two types of concatenation scenarios within the blood center:

- | | |
|------------------------------|--|
| Static Concatenation | Each blood processing station at a site is set-up to either always or never concatenate, but not both. |
| Dynamic Concatenation | Each blood processing station will, through some automated means, determine if concatenation is desired (or not). |

In the **Static Concatenation** case there is no ambiguity as to the concatenation mode. At stations where concatenation is “disabled,” each bar code is separately scanned and transmitted to the host application. At stations where concatenation is “enabled,” the Concatenation List (referred to as the “C-List” in the *ISBT 128 Application Specification*) in the scanner can be used to determine if a scanned bar code has a “mate.” If a “mate” bar code is not required, then the bar code data is transmitted to the host application. However, if a “mate” bar code is required, the scanner can postpone transmission until the “mate” bar code is also scanned.

In the **Dynamic Concatenation** case the scanner is not immediately aware whether concatenation is required. If a bar code is scanned and found to exist in the C-List, the operator may have intended to concatenate it to a “mate” bar code but, then again, may not. This type of scenario can occur when the container labeling steps outlined in Table 1 (Page 1-2) are performed.

Steps 1 and 3 may be indistinguishable to the laser scanner because the two bar codes in Step 3 could be mis-scanned as shown in Figure 1 (Page A-2).

Figure 1 (Page A-2) illustrates how it is possible to have the scanner fail to concatenate two bar codes when concatenation is actually intended and is denoted a “*missed concatenation event*.” Such an event can lead to inefficient operation by requiring a re-scan of the bar code pair and, possibly, additional interaction with the host application.

There are several methods to deal with a missed concatenation event. Note that the alternatives presented below only apply to the case where **Dynamic Concatenation** is being used.

Table 1 Dynamic Concatenation Scenario

		Concatenate?
Step 1	Identify the blood container to the host application by scanning the Donation Identification Number bar code.	No
Step 2	Affix to the blood container the ABO/Rh Blood Groups label indicated by the host application.	Not a scan operation
Step 3	Scan the Donation Identification Number and ABO/Rh Blood Groups bar codes together to verify that the correct label was affixed.	Yes

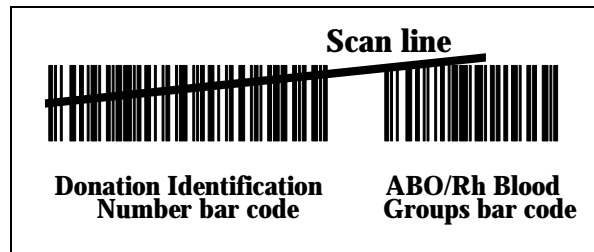


Figure 1 A Missed Concatenation Event. Scanner misses ABO/Rh Blood Groups bar code

Method 1. Have the operator re-scan the bar code pair in an attempt to concatenate them. In a situation where the operator using the scanning equipment is well-trained, this solution may be viable because a missed concatenation event would be infrequent. Such an approach would also simplify the overall system design.

Method 2. Have the host application transmit a command to the scanner to either “enable” or “disable” concatenation, depending on the processing step being performed. Returning to the scenario in Table 1 (Page A-2), the host application would command the scanner to “disable” concatenation at Step 1. With concatenation “disabled” the scanner would read and transmit a single bar code. At Step 3, the host application would command the scanner to “enable” concatenation. The scanner would, in turn, only transmit data when both bar codes of a concatenatable pair are read. Communication from the host to the scanner is not precluded by the *Application Specification*. If used, such a method would ensure that the host application and

scanner are “in-sync” and would eliminate the missed concatenation event. The downside of this method is that a communication protocol from the host application to the scanner would have to be developed.

Method 3. Incorporate an automated decision process in the scanner to decide when concatenation is desired. This method would use the entries of the C-List to determine if the scanned bar code is a candidate for concatenation. If the scanned bar code is not present in the C-List, it would be transmitted to the host application. If, however, the scanned bar code *is* in the C-List, it is termed a *candidate bar code*, eligible for concatenation. In this case, the scanner would perform two additional checks:

- ' Determine if a second, partial bar code is present in the scan line which meets the spatial-temporal relationship of concatenated bar codes described in the *Application Specification* (Subsection 4.6). If a partial bar code is present, then concatenation would be assumed and the scanner would wait for the “mate” bar code to be read.
- ' Provide a programmable delay count requiring that the *candidate bar code* be scanned, without seeing a second bar code, a specified number of times. If a second bar code is not sensed during this “wait-and-see” period, then the *candidate bar code* would be transmitted to the host without a “mate.”

Method 3 has the advantage that the host application would not need to communicate with the scanner as in *Method 2*, thus yielding a simpler system design. The disadvantages of *Method 3* are that it further complicates scanner design and does not guarantee that the missed concatenation event will be eliminated. However, testing of this method has shown it to be quite effective at eliminating such missed concatenation events.

Finally, note that none of the above methods are needed in an environment where a **Static Concatenation** policy is enforced, due to the unchanging concatenation set-up of the scanner. This knowledge can be used by the scanner to prevent a missed concatenation event by disallowing transmission of bar codes found to reside in the C-List in the absence of their “mate” bar code.

Scanner Setup Verification

It is crucial that the programming setup of the scanner be verified to ensure proper system operation. Because many scanners do not provide a display readout, some other means of displaying this set-up to the operator must be devised. This can be accomplished by having the scanner transmit its set-up parameters, in ASCII format, to the host application for display. This would require cooperation on the part of the scanner and host application supplier on a way of

conveying and displaying this information to the operator. The transmitted information would include items such as the C-List, the concatenation status (“enabled” or “disabled”) and other control parameters deemed necessary to properly set-up the scanner. A special bar code read by the scanner or a command from the host application would cause the set-up data to be transmitted from the scanner to the host application for viewing by the operator.